Appendix D
Current Data Collection Analysis Report

(Attachments included on CD)

PORT ANGELES HARBOR

CURRENT DATA COLLECTION AND ANALYSIS

JUNE, 2008

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PORT ANGELES HARBOR
CURRENT DATA COLLECTION AND ANALYSIS

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Port Angeles Harbor
Current Data Collection and Analysis

1.0 Introduction

Evans-Hamilton, Inc. (EHI), under contract to Ecology and Environment, Inc. (E&E), collected lower water column current data and other parameters within Port Angeles Harbor for the Washington State Department of Ecology. To accomplish this, EHI deployed instrument platforms on the bottom at three locations within the harbor in accordance to prioritization set forth by E&E. Figure 1 shows the general work site located on the north shore of Washington State off the Strait of Juan de Fuca with six sites referenced in priority preference for the deployment locations.

Figure 1.Proposed instrument deployment locations within Port Angeles Harbor ranked by priority (importance decreases with increasing number).

2.0 EQUIPMENT AND FIELD PROCEDURES

2.1 Bottom-Mounted Instrumentation

Every effort was made to accommodate the top three priority locations however, it was necessary to move Station 3 northwest of the preferred deployment location due to shipping anchorage within the harbor. Locations of the anchorage positions were provided by the Puget Sound Pilots' Association located on Ediz Hook. Figure 2 shows final deployment locations for each bottom mounts as well as the anchorage positions that were considered in choosing an alternative location for Station 3.

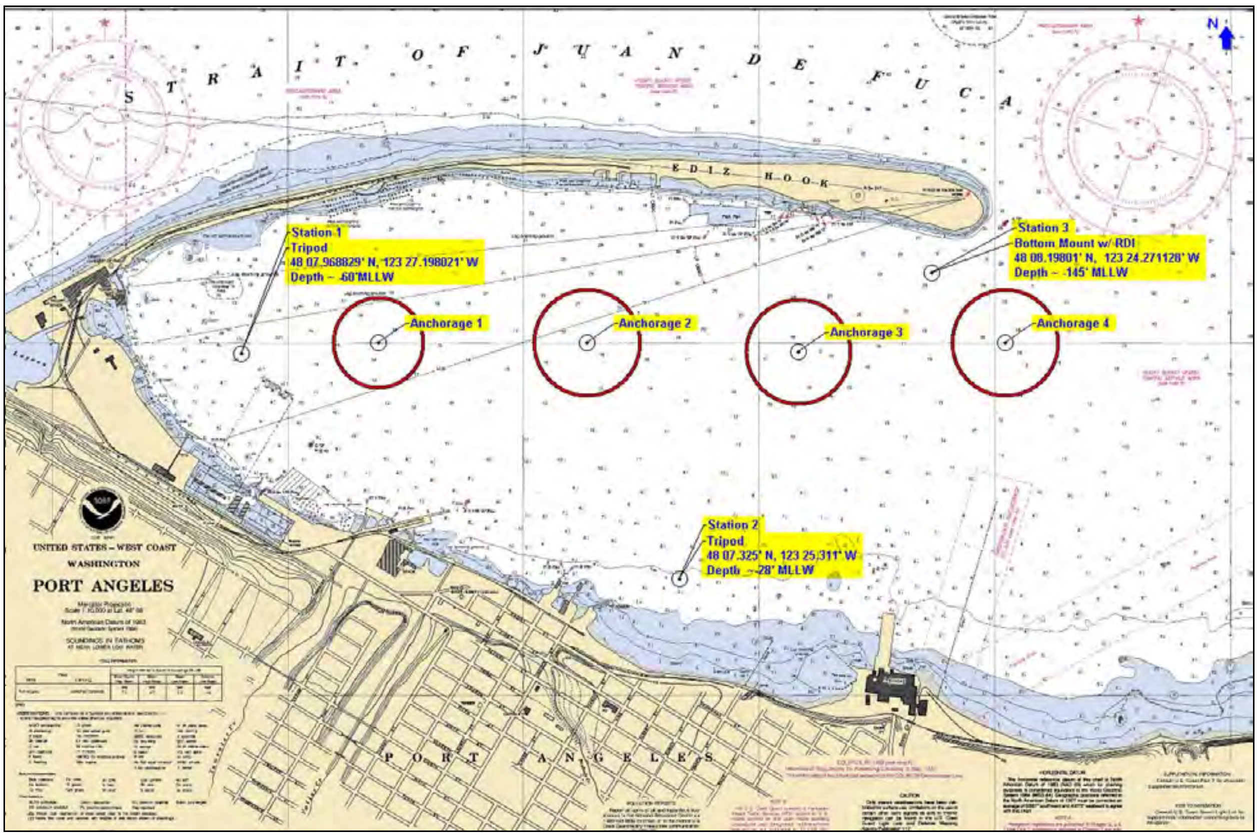

Figure 2. Station locations within the harbor. Large vessel anchor areas (Anchorage 1-4) are denoted by the red circles.

Measurements were collected at the three sites for one-month deployments covering 26 March to 25 April 2008. The dates and locations of each site are listed in Table 1. Upward-looking current profiles and near-bottom single point currents were collected at each location as well as wave, temperature, pressure, and turbidity measurements. The specific instruments used at each location and their respective measured parameters are listed in Table 2.

Table 1. Station dates and locations.

Station Number	Latitude	Longitude	Depth at Deployment	Deployment Date	Recovery Date
Station 1	48 07.969' N	123 27.198' W	-70' MLLW	26-Mar-08	25-Apr-08
Station 2	48 07.325' N	123 25.311' W	-30' MLLW	26-Mar-08	25-Apr-08
Station 3	48 08.198' N	123 24.271' W	-150' MLLW	26-Mar-08	25-Apr-08

Table 2. Deployed instrumentation and measured parameters.

Equipment	Manufacturer	Sample Interval	Frequency	Parameters Measured*
Station 1				
ADP	SONTEK	15 minutes	500 kHz	CP, T, P
ADVo	SONTEK	15 minutes	5 MHz	C, T, P, Dist
HYDRA	SONTEK	N/A	Logger (ADVo, Paros)	
Pressure Sensor	PAROS	N/A	N/A	P
MacroWave	Coastal Leasing	60 minutes	50 psi	T,P,W
OBS-3	D&A	30 minutes	2 Hz	Tb
866-Release	Benthos	N/A	Tx12/Rx 11 kHz	
Tripod	Pacific International Eng.	N/A	N/A	
Station 2				
ADP	SONTEK	15 minutes	1500 kHz	CP, T, P
ADVo	SONTEK	15 minutes	5 MHz	C, T, P, Dist
HYDRA	SONTEK	N/A	Logger (ADVo, Paros)	
Pressure Sensor	PAROS	N/A	N/A	P
MacroWave	Coastal Leasing	60 minutes	50 psi	T,P,W
OBS-3	D&A	30 minutes	2 Hz	Tb
866-Release	Benthos	N/A	Tx12/Rx 14 kHz	
Tripod	Pacific International Eng.	N/A	N/A	
Station 3				
ADCP (waves)	RD- Instruments	currents: 15 minutes waves: 60 minutes	600 kHz	CP, T, P
MacroLite	Coastal Leasing	30 minutes	N/A	T + logger for OBS-3
OBS-3	D&A	30 minutes	2 Hz	Tb
Vector ADV	Nortek	15 minutes	8Hz	C, T, P
MacroDopp	Coastal Leasing	N/A	Logger (ADV)	
866-Release	Benthos	N/A	Tx12/Rx 13.5 kHz	
Open Side Bottom mount	EHI	N/A	NAV	

*CP = Current Profile, C = Currents at one depth, T = Temperature, P = Pressure, Tb = Turbidity, Dist = Distance above Bottom, W = Waves

Instrumentation at Station 1 and Station 2

Sontek Acoustic Doppler Profilers (ADP) were used to measure currents in the water column above the instrument package as well as temperature and pressure (Fig. 3). A Sontek Hydra was used to collect the single point current and temperature data from the Sontek Acoustic Doppler Velocimeter Ocean probe (ADVO), and pressure data from the PAROS pressure sensor. The Hydra is an integrated instrument data logging system that allowed greater data file sizes, and therefore, higher sampling rates and longer deployment times. Wave and temperature data were collected using a Coastal Leasing MacroWave. The MacroWave measures pressure (ICS Strain Gauge or Paroscientific Digiquartz) and temperature (internal YSI thermistor) to record wave height and water level. The D&A OBS®-3 sensor measured suspended solids and turbidity using optical backscatter.

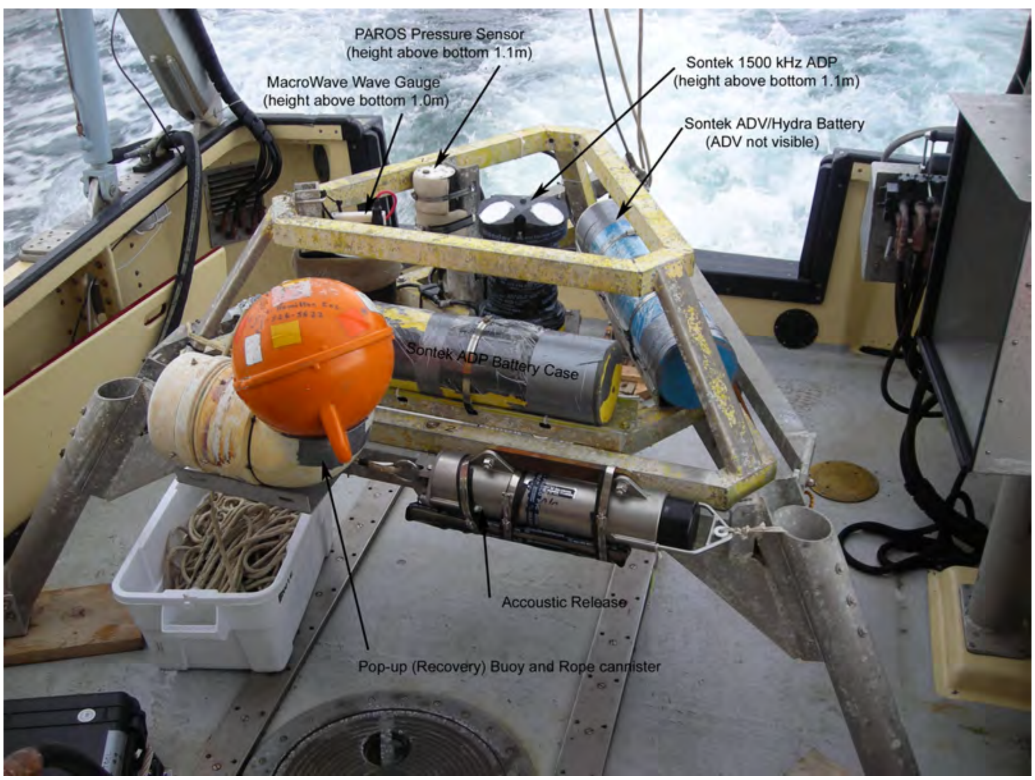

Figure 3. Station 1 and 2 tripod equipment.

Instrumentation at Station 3

A Teledyne-RDInstruments Acoustic Doppler Current Profiler (ADCP) was used to measure currents in the water column above the instrument package as well as temperature and pressure, and waves (Fig. 4). A Coastal Leasing MacroDopp was used to collect the single point current, temperature, and pressure data from the Nortek Vector Acoustic Doppler Velocimeter (Vector ADV). A Coastal Leasing MacroLite measured turbidity with a D&A OBS-3 turbidity monitor and temperature with an internal YSI thermistor.

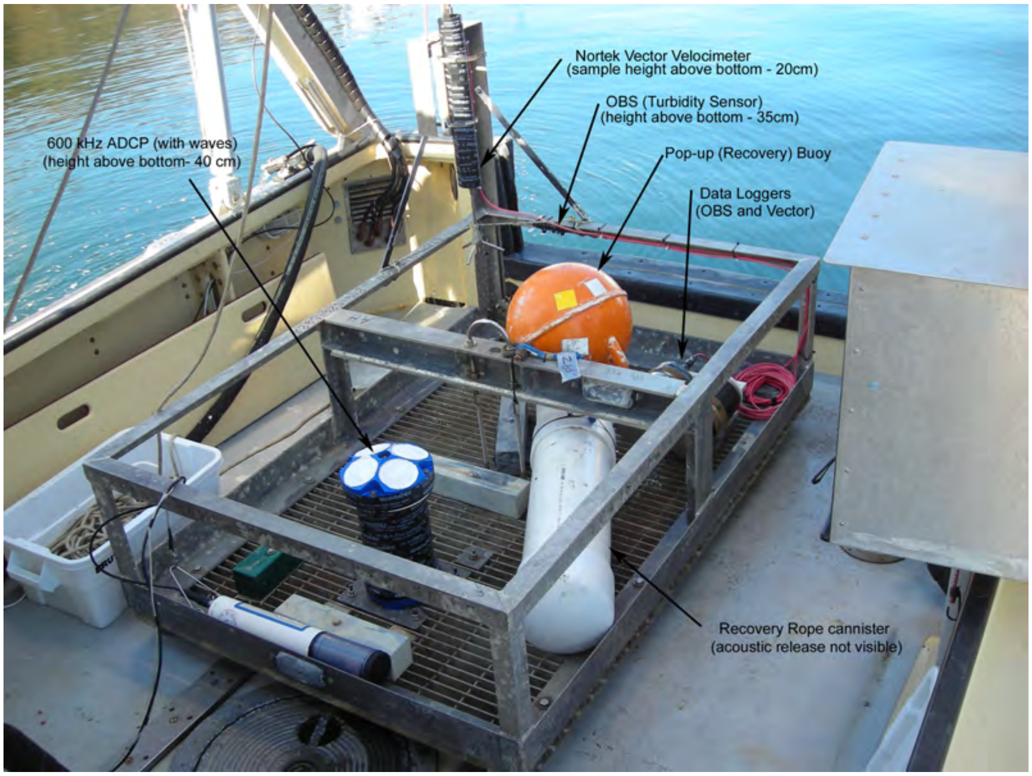

Figure 4. Station 3 equipment arrangement.

2.2 Deployment

Prior to deployment, all equipment was mobilized at the EHI Seattle facility. This included calibrating the current meter compasses and referencing all pressure sensors to zero. All instrument clocks were synced to Coordinated Universal Time (UTC).

The tripods and bottom mounts were transported to Port Angeles Marina by flatbed truck on 26 March 2008 where they were lowered onto the research boat, *BRENDAN D II* using the marina's crane. Since the boat could only accommodate one instrument mount at a time due to limited deck space, trips were made from the marina to deploy each station separately. Station 1 was deployed first since it was furthest from the marina. The bottom mount was lifted over the stern of the boat using the boat's A-frame and winch. When the mount was clear of the back of the boat, it was lowered to the bottom using a slip line. Once on bottom, the deployment position was recorded using DGPS interfaced into Hypack® Survey software and the remaining slip line was recovered from the mount leaving no surface expression. This procedure was repeated at all three stations.

Upon deployment of Station 3, the crew contacted the Puget Sound Pilot house at Ediz Hook to inform them directly of the deployment locations. The field crew was informed that the location of Station 3 lay directly on anchorage location 4 and would surely be destroyed by a ship's anchor or chain within the month. The field crew contacted E&E directly to inform them of this situation and worked to find an alternative deployment location that would still provide E&E with good data regarding the circulation within the harbor and still be within the data collection, depth, limitations of the instrument. Station 3 was recovered, re-set, and re-deployed northwest of preferred location 3 and out of the predicted range of an anchored vessel's watch circle.

A CTD cast was made at each station during the mooring recovery cruise.

2.3 Recovery

All three stations were recovered on 25 April 2008 using the research boat *BRENDAN D II.* The boat was maneuvered to approximately 100-meters from the deployment location using DGPS and Hypack® Survey software (allows referencing an electronic chart with the boats real-time position and relative position to the station). To prevent any damage to the boat from the surfacing buoy, the distance to the station was verified using the transponder within the acoustic release on each bottom mount. Once the target deployment location was verified and the boat was in a safe location, an acoustic signal was sent to the release mechanism allowing the recovery buoy to surface trailing a recovery line to the bottom mount.

The buoy was recovered as the boat maneuvered next to it. The recovery line was removed from the buoy and shackled into the boat's main lifting winch line which passed through a block on the A-frame and allowed a direct lift of the station off the bottom as the boat was brought directly over it. Once the station was lifted out of the water, the A-frame was swung inward bringing the instrument safely onto the back deck of the boat were it was secured and transported back to Port Angeles Marina. Each station was recovered on separate trips and loaded back onto a flatbed truck at the marina.

Station 1

This station was located the furthest east in approximately -60-feet MLLW. Despite large wooden pads on the tripod legs to prevent sinking into soft sediments, it appeared from mud-line on the tripod after recovery that this mount (weighing approximately 200 kg) sunk about 20 cm into the soft mud at this site after deployment. This settling did not appear to interfere with the OBS data or current measurements. Other than a light coating of silt on the entire instrument mount, no algae or bio-fouling was evident on the sensors including the OBS. Data was successfully recovered from all instruments on this station.

Station 2

This station was located near the southern portion of the harbor in approximately -30-feet MLLW. A small amount of bio-fouling on the OBS and other sensors as well as on the entire tripod was noted upon the recovery of this instrument mount. Large pieces of macro-algae were wrapped around the tripod's legs. Data was successfully recovered from all instruments on this station. Upon downloading, it was found that the ADP had multiple files recorded. This is usually the indication of a power problem. Upon further investigation of the ADP batteries, a manufacturing defect was discovered in one of the custom battery packs that could not be detected prior to deployment. This resulted in only 26-days of current data collected at this station.

Station 3

This station was located off the southern tip of Ediz Hook in approximately -150-feet MLLW. Several factors were taken into account when selecting this new site for Station 3. The water depth needed to be shallow enough to allow the ADCP to measure the full water column. The slope of the sea-bottom could not exceed 5º to allow the instrument collect wave data. The deployment location depth was at the maximum limits of the ADCP but did have a flat bottom when compared to other areas investigated by the field crew during deployment. Upon recovery, the instruments were clean and free of any bio-fouling or sedimentation. Data was successfully recovered from all instruments on this station.

3.0 Data Processing and Analysis

The data has undergone processing using EHI standard routines. Data plots have been generated as well as text files of the data. The organization of the data products within the appendices, along with notes concerning each type of data product, is provided below. All times are referenced to UTC.

Text files of the processed data are available via the EHI ftp site. File format and units are provided at the start of each data file. Bad or missing data (typically near the surface bins) are designated with 999.9.

Meteorological data measured during the deployment period was obtained from the Port Angeles, William R. Fairchild International Airport. The met tower is located at 48.11N -123.43W (Elev. 108 ft) approximately 2 miles WSW of the harbor. Figure 5 shows a plot of the wind, precipitation, air temperature, and barometric pressure for the deployment period.

Appendix A—Station 1

Color contours of current speed versus depth and time, and current direction versus depth and time. Current speed is in cm/s. Current direction is in degrees True. Conversion of cm/s to knots: 51.4 cm/s = 1 knot. Conversion of cm/s to feet/s: 30.48 cm/s = 1 ft/s.

Color contours of data quality parameters for each beam of the transducer heads of signal-to-noise ratio (SNR) and signal amplitude versus depth and time. Signal-to-noise is in dB. Amplitude is in counts. Oscillating lines (light blue in SNR and red in amplitude) in graphs indicate the boundary layer or water surface.

Time history plots of water level (pressure sensor in m), temperature (degrees Celsius), pitch and roll of the tilt sensor (degrees True), and heading from the compass (degrees). Water level has no time history line because the ADCP did not have a pressure sensor.

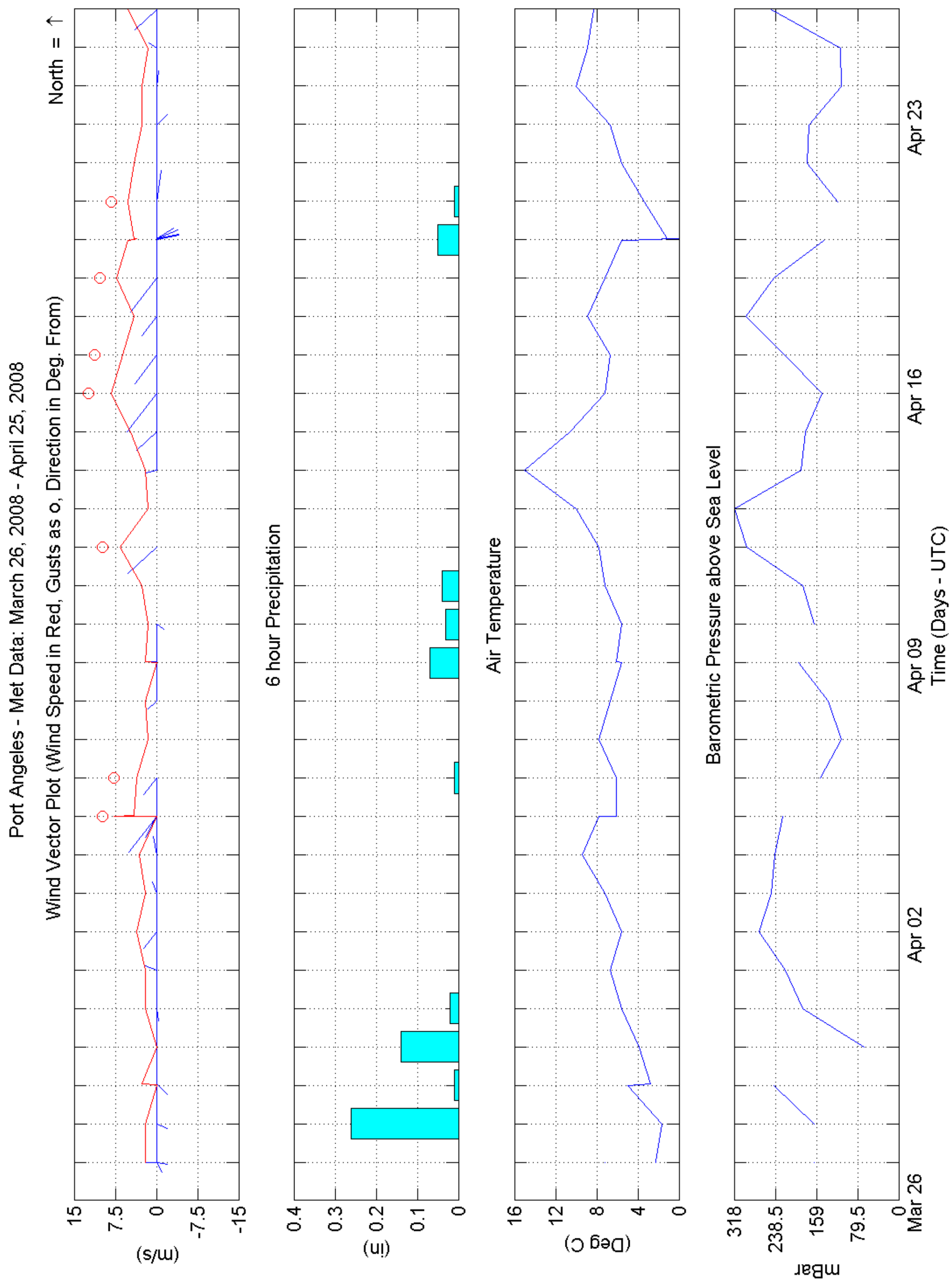

Figure 5. Port Angeles met data for the deployment period. For the wind vector plot (top panel) the wind speed (red line) and wind gusts (red circle) have been supimposed.

Time series vector plots of the measured currents at selected depths referenced to north. For readability, one month of data at six depths (maximum) is plotted per page. For Station 1, data are plotted for every bin up to approximately 9 m above the ADP and then every other bin to near surface (19 m). Data from a total of twelve depths are displayed, resulting in two pages per month. In these plots, the length of the vector is equal to the speed of the current according to the speed scale (in cm/s). The direction of the vector equates to the current direction, with the current moving from the centerline toward the tip of the vector. North is towards the top of the paper, east to the right, south to the bottom, and west to the left. Time series of current magnitude is superimposed on the vector plots.

Time series vector plots of the measured currents at selected depths referenced to east. Vectors have been rotated 45°. This version provides a better perspective of the current intensity. In these plots, east is towards the top of the paper, south to the right, west to the bottom, and north to the left. Time series of current magnitude is superimposed on the vector plots.

Time series vector plot from the ADVO of the measured currents referenced to north. In these plots, the length of the vector is equal to the speed of the current according to the speed scale (in cm/s). The direction of the vector equates to the current direction, with the current moving from the centerline toward the tip of the vector. North is towards the top of the paper, east to the right, south to the bottom, and west to the left. Current magnitude is superimposed over the vectors. Other parameters measured by the ADVO and displayed on the page are water level (pressure sensor in m), temperature (degrees Celsius), distance to seafloor from current measurement (cm), signal correlation for each beam (percent), and signal amplitude for each beam (counts).

Time series vector plot from the ADVO of the measured currents referenced to east. Vectors have been rotated 45°. This version provides a better perspective of the current intensity. In these plots, the east is towards the top of the paper, south to the right, west to the bottom, and north to the left. Current magnitude is plotted over the vectors. Other parameters measured by the ADVO and displayed on the page are equivalent to the prior page.

Deployment record statistics for each depth bin. The first table is record statistics for the ADP. The second page is record statistics for the ADVO.

Percent occurrence tables for each depth bin. Table shows the percent of the measurements within 4 cm/s speed bins, and 24-degree direction bins, is provided. Directions are degrees True.

Current roses of percent occurrence of current speed versus direction for total record. The first page is rose plots for the ADP. The second page is a rose plot for the ADVO.

Histograms of percent occurrence of current speed versus direction for total record. The first page is histogram plots for the ADP. The second page is a histogram plot for the ADVO.

Time history plots of wave height (m), peak period (seconds), number of waves (count), water level (m), temperature (degrees Celsius), and turbidity (NTU) measured by the MacroWave.

Summary table and plots of CTD cast data during mooring recovery. Data includes both down and up cast for turbidity (NTU), dissolved oxygen (mg/l), salinity (ppt), temperature (degrees Celsius), and battery power (voltage).

Appendix B—Station 2

Color contours of current speed versus depth and time, and current direction versus depth and time. Current speed is in cm/s. Current direction is in degrees True. Conversion of cm/s to knots: 51.4 cm/s = 1 knot. Conversion of cm/s to feet/s: 30.48 cm/s = 1 ft/s.

Color contours of data quality parameters for each beam of the transducer heads of signal-to-noise ratio (SNR) and signal amplitude versus depth and time. Signal-to-noise is in dB. Amplitude is in counts. Oscillating lines (light blue in SNR and red in amplitude) in graphs indicate the boundary layer or water surface.

Time history plots of water level (pressure sensor in m), temperature (degrees Celsius), pitch and roll of the tilt sensor (degrees True), and heading from the compass (degrees).

Time series vector plots of the measured currents at selected depths referenced to north. For readability, one month of data at six depths (maximum) is plotted per page. For Station 2, data are plotted for every bin up to approximately 5 m above the ADP and then every other bin to near surface (8 m above bottom) where every bin is again plotted.. Data from a total of twelve depths are displayed, resulting in two pages per month. In these plots, the length of the vector is equal to the speed of the current according to the speed scale (in cm/s). The direction of the vector equates to the current direction, with the current moving from the centerline toward the tip of the vector. North is towards the top of the paper, east to the right, south to the bottom, and west to the left. Time series of current magnitude is superimposed on the vector plots.

Time series vector plots of the measured currents at selected depths referenced to east. Vectors have been rotated 45°. This version provides a better perspective of the current intensity. In these plots, east is towards the top of the paper, south to the right, west to the bottom, and north to the left. Time series of current magnitude is superimposed on the vector plots.

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ADVO and displayed on the page are water level (pressure sensor in m), temperature (degrees Celsius), distance to seafloor from current measurement (cm), signal correlation for each beam (percent), and signal amplitude for each beam (counts).

Time series vector plot from the ADVO of the measured currents referenced to east. Vectors have been rotated 45°. This version provides a better perspective of the current intensity. In these plots, the east is towards the top of the paper, south to the right, west to the bottom, and north to the left. Current magnitude is plotted over the vectors. Other parameters measured by the ADVO and displayed on the page are equivalent to the prior page.

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Histograms of percent occurrence of current speed versus direction for total record. The first page is histogram plots for the ADP. The second page is a histogram plot for the ADVO.

Time history plots of wave height (m), peak period (seconds), number of waves (count), water level (m), temperature (degrees Celsius), and turbidity (NTU) measured by the MacroWave.

Summary table and plots of CTD cast data during mooring recovery. Data includes both down and up cast for turbidity (NTU), dissolved oxygen (mg/l), salinity (ppt), temperature (degrees Celsius), and battery power (voltage).

Appendix C—Station 3

Color contours of current speed versus depth and time, and current direction versus depth and time. Current speed is in cm/s. Current direction is in degrees True. Conversion of cm/s to knots: 51.4 cm/s = 1 knot. Conversion of cm/s to feet/s: 30.48 cm/s = 1 ft/s.

Color contours of current vertical velocity, error velocity, correlation, and intensity versus depth and time. Depth is measured as distance from the ADCP transducer head. Bottom panel is average vertical (water column average) velocity versus depth and time. Velocities are in cm/s. Correlation and intensity are in counts.

Time history plots of water level (pressure sensor in m), temperature (degrees Celsius), pitch and roll of the tilt sensor (degrees True), and heading from the compass (degrees).

Time series vector plots of the measured currents at selected depths referenced to north. For Station 3, data are plotted for every bin (2 m increments) up to approximately 15.5 m above the ADCP. There after the data are plotted for every other bin (4 m increments) to near surface. The length of the vector is equal to the speed of the current according to the speed scale (in cm/s). The direction of the vector equates to the current direction, with the current moving from the centerline toward the tip of the vector. North is towards the top of the paper, east to the right, south to the bottom, and west to the left. For perspective, the current speed at each depth is superimposed on each vector plot (red line).

Time series vector plots of the measured currents at selected depths referenced to east. Vectors have been rotated 45°. This version provides a better perspective of the current intensity. In these plots, east is towards the top of the paper, south to the right, west to the bottom, and north to the left. Time series of current magnitude is superimposed on the vector plots.

Time series vector plot from the Nortek Vector of the measured currents referenced to north. In these plots, the length of the vector is equal to the speed of the current according to the speed scale (in cm/s). The direction of the vector equates to the current direction, with the current moving from the centerline toward the tip of the vector. North is towards the top of the paper, east to the right, south to the bottom, and west to the left. Current magnitude is superimposed over the vectors. Other parameters measured by the Nortek Vector and displayed on the page are water level (pressure sensor in m), temperature (degrees Celsius), signal-to-noise ratio (dBar), signal correlation for each beam (percent), and signal amplitude for each beam (counts).

Time series vector plot from the Nortek Vector of the measured currents referenced to east. Vectors have been rotated 45°. This version provides a better perspective of the current intensity. In these plots, the east is towards the top of the paper, south to the right, west to the bottom, and north to the left. Current magnitude is plotted over the vectors. Other parameters measured by the Nortek Vector and displayed on the page are equivalent to the prior page.

Deployment record statistics for each depth bin. The first table is record statistics for the ADCP. The second page is record statistics for the Nortek Vector.

Percent occurrence tables for each depth bin. Table shows the percent of the measurements within 4 cm/s speed bins, and 24-degree direction bins, is provided. Directions are degrees True.

Current roses of percent occurrence of current speed versus direction for total record. The first page is rose plots for the ADCP. The second page is a rose plot for the Nortek Vector.

Histograms of percent occurrence of current speed versus direction for total record. The first page is histogram plots for the ADCP. The second page is a histogram plot for the Nortek Vector.

Time history plots of wave height (m), peak period (seconds), peak direction (degrees), and water level (m) measured by the ADCP. For comparison, the water level (meters) and current speed and direction are shown for three depths; near surface (green), mid depth (red) and near bottom (blue). Time series of temperature (degrees Celsius) and turbidity (NTU) measured by the MacroLite.

Summary table and plots of CTD cast data during mooring recovery. Data includes both down and up cast for turbidity (NTU), dissolved oxygen (mg/l), salinity (ppt), temperature (degrees Celsius), and battery power (voltage).

4.0 DATA DISCUSSION

4.1 Data Quality and Quantity

Station 1 instruments collected good quality data and the full data set. The bottom mount remained in place as indicated by the ADV pitch, roll, and heading sensors (Appendix A.3). The mount gradually sunk in the bottom sediment as shown by the boundary distance on the ADVO from 6cm to 3cm (A.5).

Station 2 instruments collected data for nearly a full deployment and exhibited a few data quality issues. From the ADP tilt data, it appeared that this tripod did not move after deployment. However, because of the battery pack problem the current meter stopped recording data at day 26 of the deployment and the last four days no reliable data was recorded. This station also had the most evidence of bio-fouling. There was a thin layer of algae covering all surfaces of the mount and instruments. In addition, there were macro algae clinging to the tripod upon recovery. The ADVO obtained good measurements for eight days after which beam 3 malfunctioned. Post deployment tests on the instrument did not indicate any problems with the instrument. Interference of beam 3 could possibly have been macro-algae, possibly fouled on the tripod legs, obstructing the ADV sample volume. The OBS sensor provided good turbidity throughout the deployment.

Station 3 instruments collected good quality data and the full data set. The bottom mount remained in place as indicated by the ADCP pitch, roll, and heading sensors. The Nortek Vector did not have pressure so the water level plot shows as a straight line (C.5). Because of the depth at this site, some surface data my have been lost at times of higher, high tides.

4.2 Data Results

4.2.1 Station 1

Currents are low at station 1 rarely reaching above 0.5 knot (25.7 cm/s). Currents are weakest near the surface and increase with depth. The harbor had an average tidal range of 2 m during the deployment (A.5). The maximum tidal ranges were mid deployment (April 8 and 9) with a tidal range of approximately 3 m. The water temperature record remained fairly steady with fluctuation of about 0.3 °C. A small tidal influence on the temperature was seen in the last week of the deployment.

The maximum current speed reached 35.0 cm/s in the near bottom measurements (A.6). Current directions are north and northwest near the surface and easterly near the bottom. In the very near bottom current (ADVO) the direction is still easterly but the speed drops by about half (3.96 cm/s for averaged current and 15.08 cm/s for maximum current).

The percent occurrence tables (A.7), current roses (A.8), and histograms (A.9) shows the dominant flow is northerly and westerly through most of the water column at the site. This is evident from the percent occurrence tables where 45% (near surface) to 48% (near mid depth) of the current is directed toward 259° to 11° True. The lower water column has flows west northwest until near bottom where the currents are directed toward the east. Generally 99% of currents are less than 0.5 knot (25 cm/s). In the near bottom bins, 79% of the record at 3.1 m above bottom is 0-12 cm/s and 92% of the record at 3.5 cm above bottom is 0-8 cm/s.

Minimal waves were measured at the site (A.10). Figure 6 shows that there is often an increase in the number of waves during an ebb tide. Of note is the increase in turbidity during the last week of the deployment. At the time of the bottom mount retrieval a CTD cast was made and increased turbidity was measured with depth.

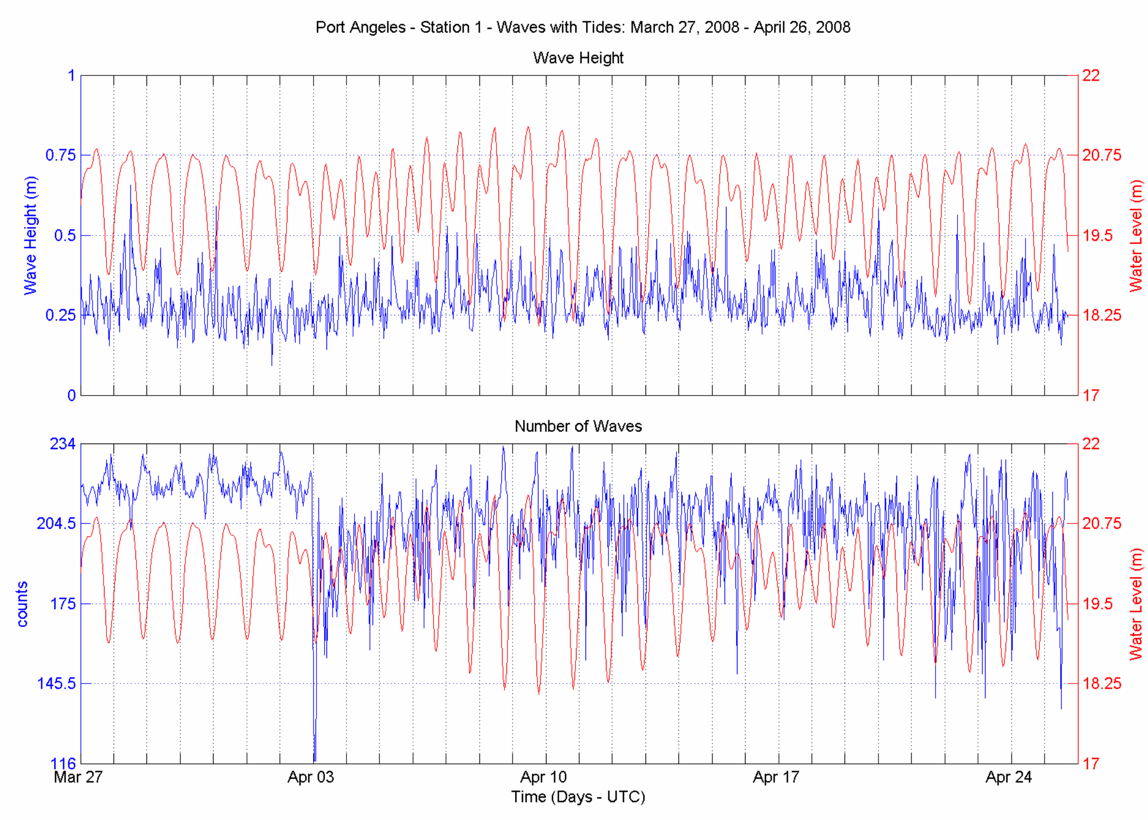


Figure 6. Station 1 wave height and number of waves superimposed on the water level measurements.

4.2.2 Station 2

Station 2 was the shallowest at approximately 10 m of the three stations. Current speeds here are also low but show more tidal signature than station 1. There was one period of high currents near the beginning of the deployment (March 30 and 31). The event is limited to the upper half of the water column (B.4). It is difficult to correlate this event to anything specific. It did occur just following several days of measurable rainfall. However, neither of the other two sites showed a similar signature. Since the snr and amplitude for this current meter did not show anomalies, we have kept the data in the processed file.

The maximum currents reached were 80.8 cm/s near the surface. This occurred during the two day high current event in late March. Outside of this two-day event, the highest current speed was 38.9 cm/s at 257°T in the near surface currents. The highest current in the lower half of the water column was 29.1 cm/s at 14°T. Although the single point current record near bottom collected usable data for only one week, the average and maximum current speed were about half that measured 2 meters above (similar to results seen at station 1).

The percent occurrence tables (B.7), current roses (B.8), and histograms (B.9) shows the dominant flow is northerly in the surface layer, northwest to southwest in the mid layer, and evenly spread in the lower part of the water column at the site. In the very near bottom layer, the low flow is more northwest and southeast in direction. Speeds, outside the high current event in late March, are generally below half a knot (below 24 cm/s).

Minimal waves were also measured at the site (B.10) and appear tidally induced. Figure 7 shows a high correlation between the number of waves and the tidal signature. Turbidity for station 2 was extremely low both during the deployment (B.10) and the final CTD cast upon recovery of the bottom mount (B.11).

4.2.3 Station 3

Station 3 was the most energetic of the three measured sites. The strongest currents are toward the west although the more prolonged currents are toward the east (C.4). The very near bottom currents remained high as well. Maximum currents were close to 1 knot for the entire water column all directed west to southwest (C.6). Unlike the other two sites, the very near bottom currents remained strong. The maximum current at this depth was 39 cm/s toward the east (68.7°T). The current roses (C.8) show that the highest current speeds are toward the west (red to brown color bands) while the majority of the currents are toward the east (30-45% in the lower half of the water column).

Wave heights for station 3 were also low although there were a few longer period waves (6 seconds versus the typical 2 and 4 second waves for sites 2 and 1, respectively). Waves remained fairly tidally generated as no significant wind event occurred during the deployment.

Station 3 also exhibited very low turbidity both during the deployment (C.10) and when the CTD cast was taken upon retrieval of the bottom mount (C.11).

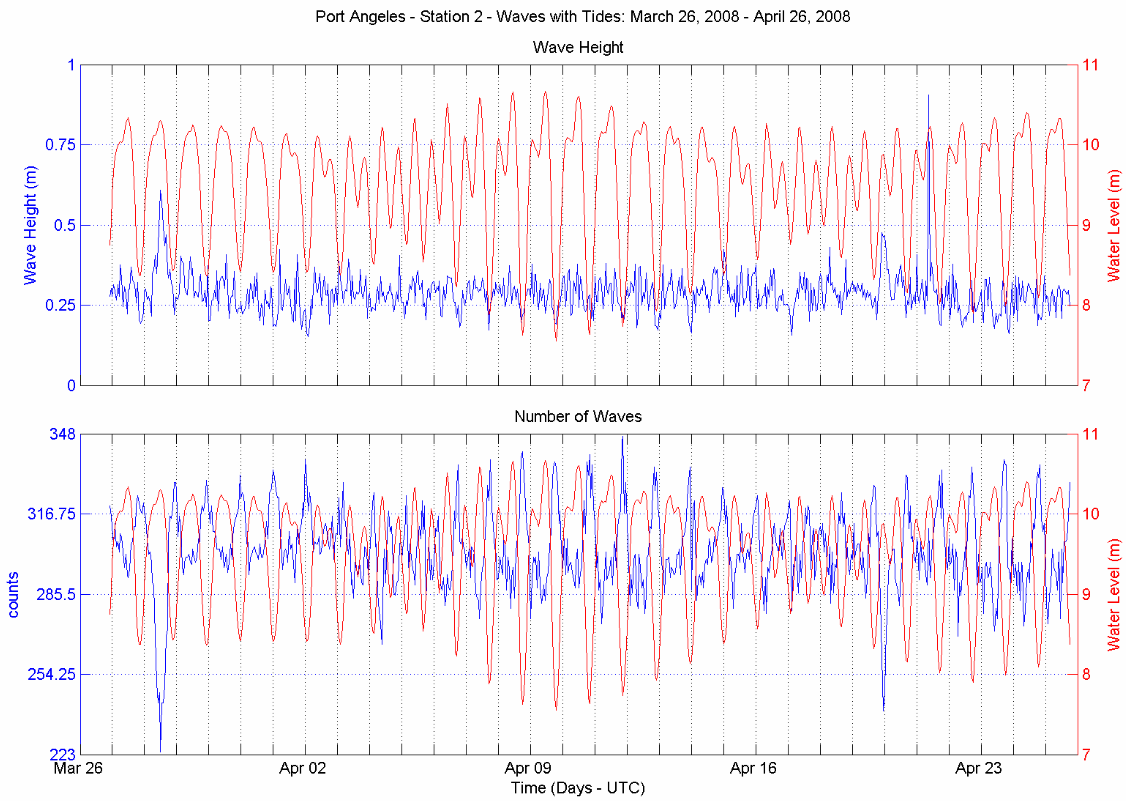


Figure 7. Station 2 wave height and number of waves superimposed on the water level measurements.

4.2.4 Station Comparisons

Some general observations can be made when comparing data from all three stations. For ease in viewing these comparisons a set of figures have been produced superimposing all three station current data. Figure 8 shows the near surface data for March 29 through April 1. The top two panels are the east-west and north-south velocities. For reference both east and north are positive and west and south are negative values. The bottom panels are current speed and direction for the same near surface bin. Figure 9 shows the near bottom current data for the same time period as Figure 8.

1. The strongest currents are at station 3 particularly in the near bottom and often occur during neap tide ranges rather than spring tide ranges. This is in part due to the small tide height changes that occur during the lesser flood and ebbs. The dominant flow at station 3 is easterly.

2. The changes in the current speeds at stations 1 and 2 are lower than at site 3, especially in the near bottom bins. These two sites show much less correlation to the spring and neap tides than station 3.

3. The higher current speeds at stations 1 and 2 do not appear to be correlated to much extent with the higher current speeds at station 3.

4. The large current speed event at station 2 during March 30-31, 2008 was atypical for station 2 and does not appear to correlate to either tides or winds. It is our estimation these currents were most likely generated by a ship since they appear in the top half of the water column and are not repeated elsewhere in the measurements at station 2.

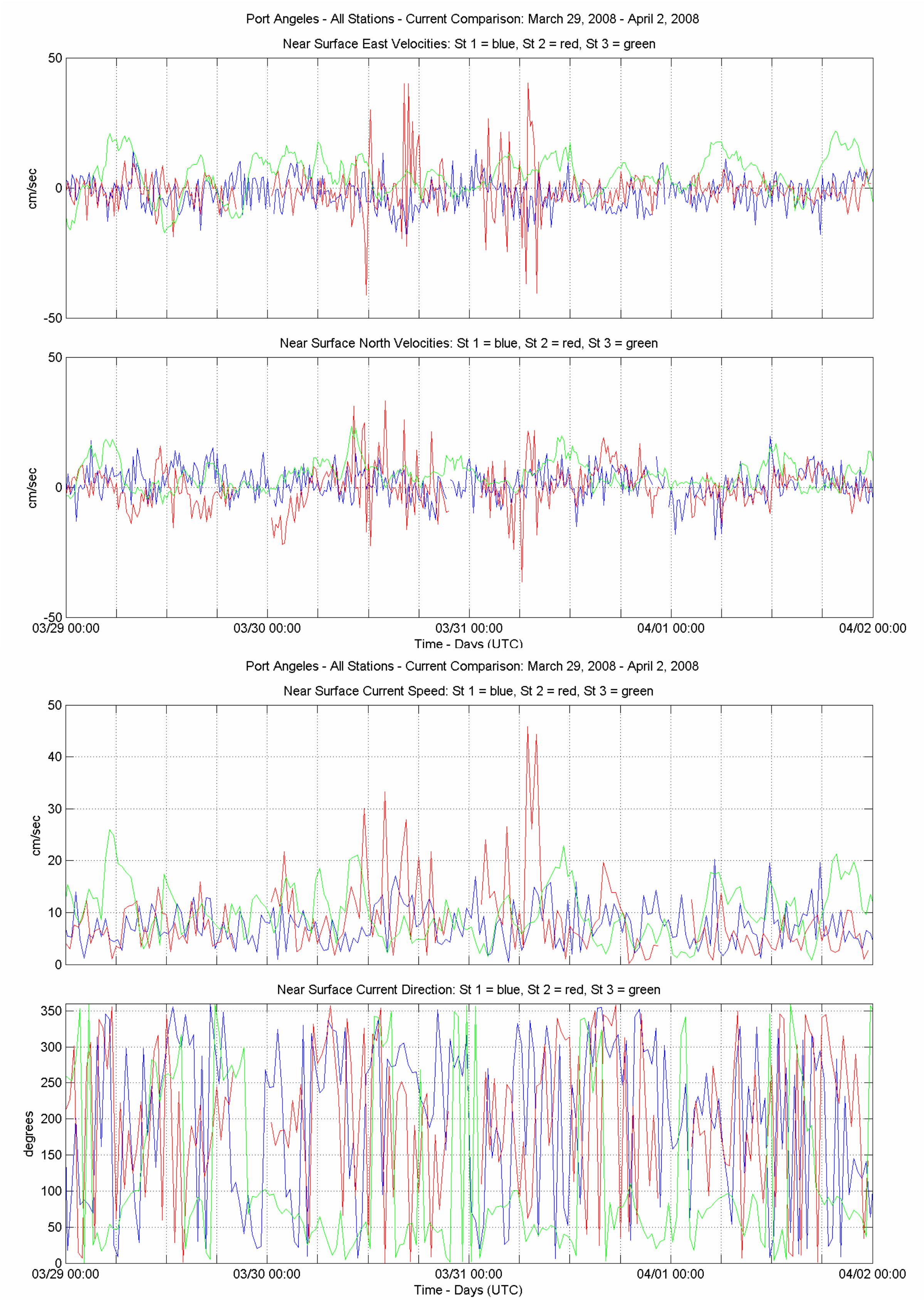


Figure 8. Surface current velocity components (top 2 panels) and current speed and direction (bottom 2 panels) for all three stations during March 29 through April 1, 2008.

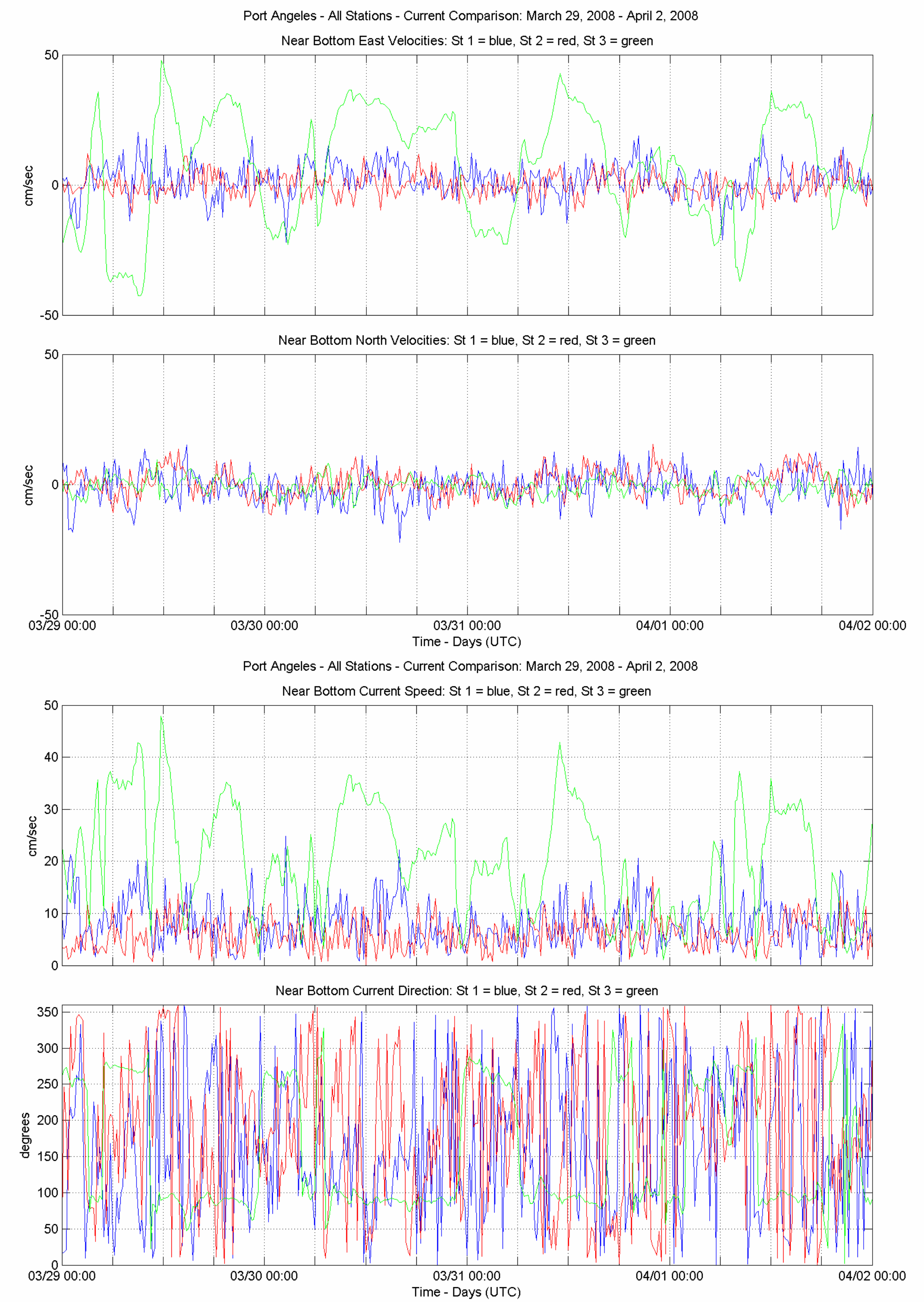


Figure 9. Bottom current velocity components (top 2 panels) and current speed and direction (bottom 2 panels) for all three stations during March 29 through April 1, 2008.

Appendix A

Station 1
Current Measurements

A.1: Color contour plots of current speed and direction
A.2: Color contour plot of ADP data quality parameters
A.3: ADP depth, tilt, and water temperature time history plots
A.4: Time history vector plots of current speed and direction
- **North Orientation**
- **East Orientation**

A.5: ADVo Time history plots of current vectors and data quality parameters
- **North Orientation**
- **East Orientation**

A.6: Current Statistics
- **ADP**
- **ADVo**

A.7: Percent occurrence tables of current speed versus direction
- **ADP**
- **ADVo**

A.8: Percent occurrence roses
- **ADP**
- **ADVo**

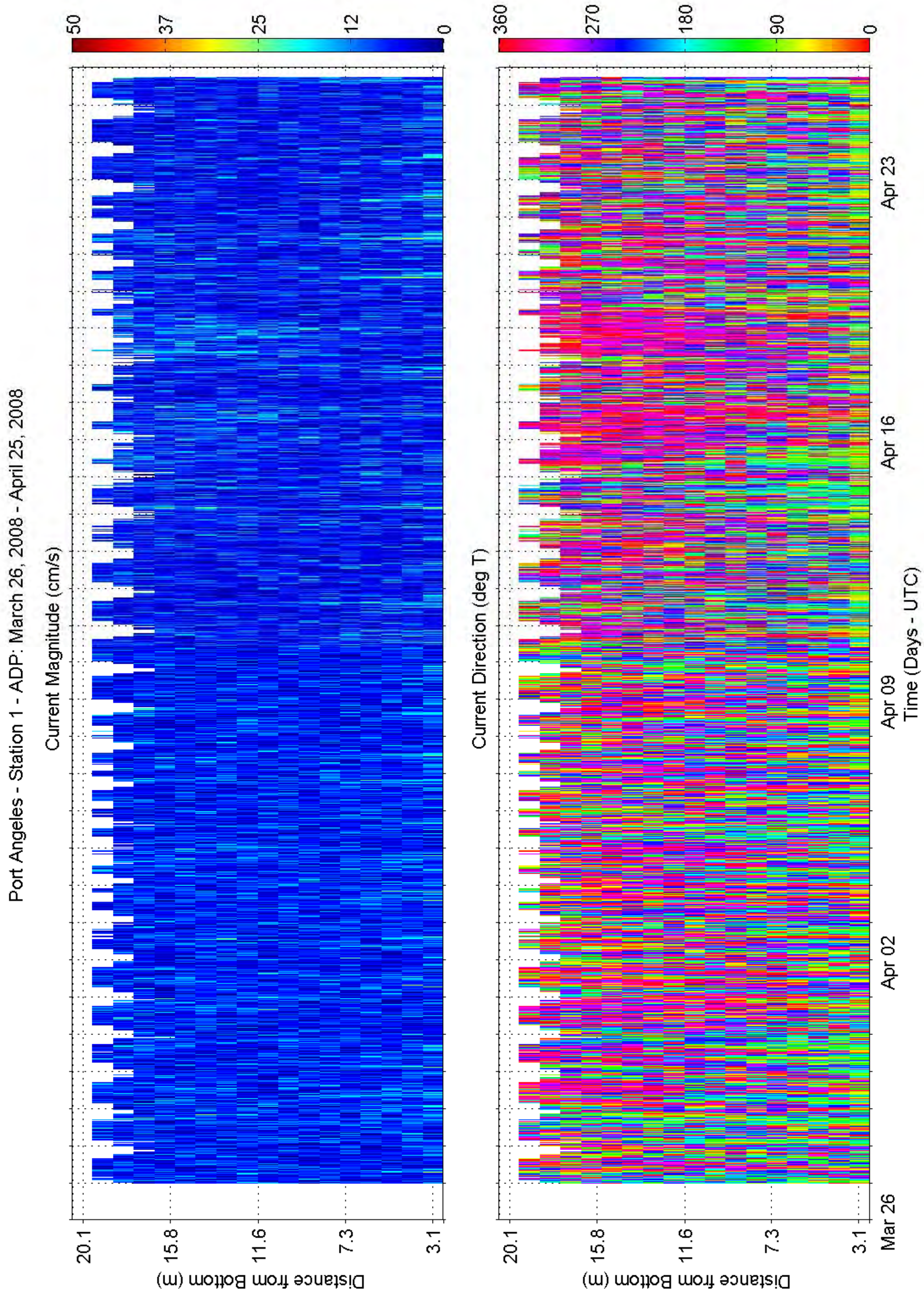
A.9: Percent occurrence histograms
- **ADP**
- **ADVo**

A.10: Time history plots of waves, temperature and turbidity
A.11: CTD Cast Summary

Appendix A.1

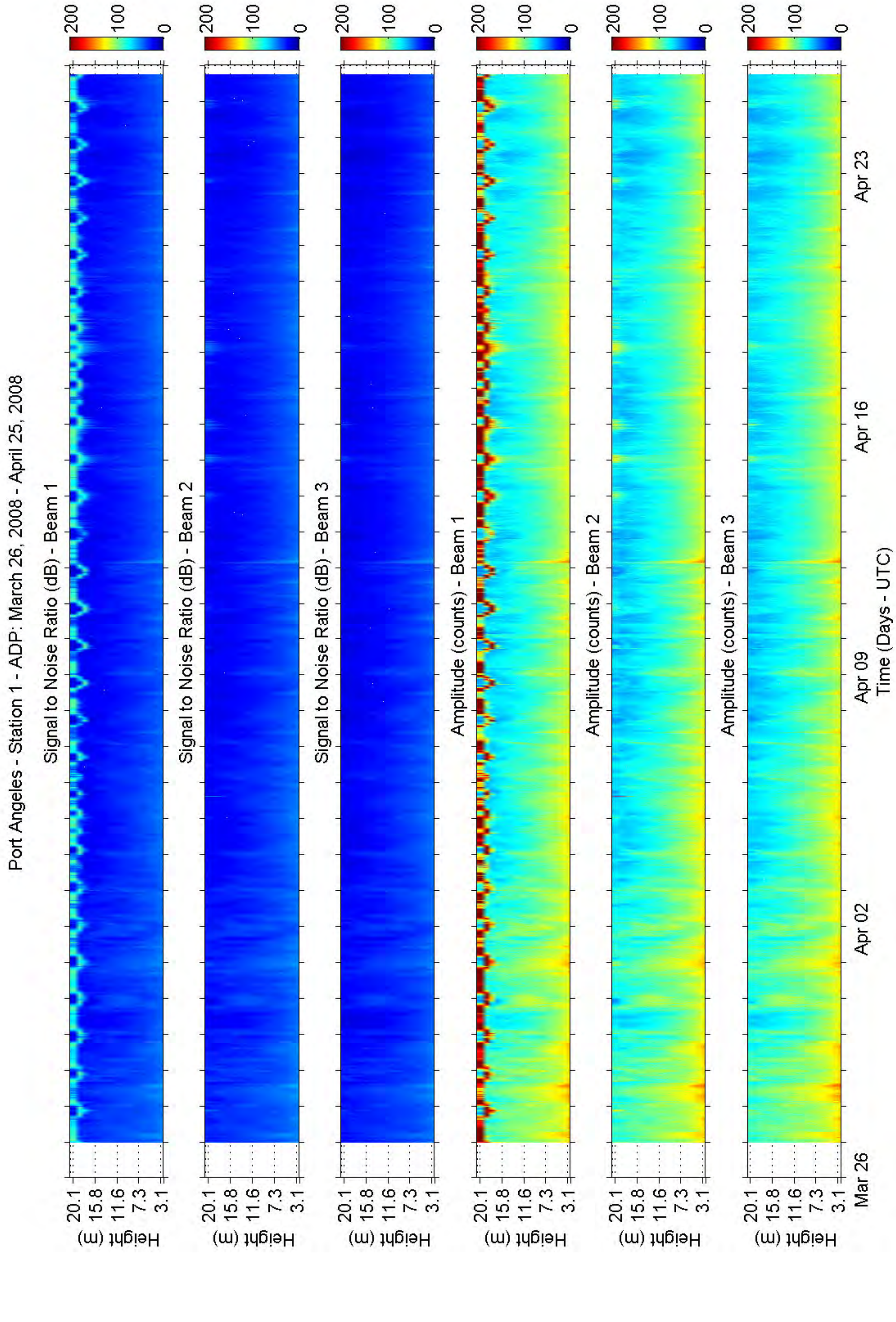
Color contour plots of current speed and direction

Speed is in cm/s, direction is in deg T, Toward.


Port Angeles - Station 1 - ADP: March 26, 2008 - April 25, 2008
Current Magnitude (cm/s)
50
37
25
12
0
Distance from Bottom (m)
20.1
15.8
11.6
7.3
3.1
Current Direction (deg T)
360
270
180
90
0
Distance from Bottom (m)
20.1
15.8
11.6
7.3
3.1
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

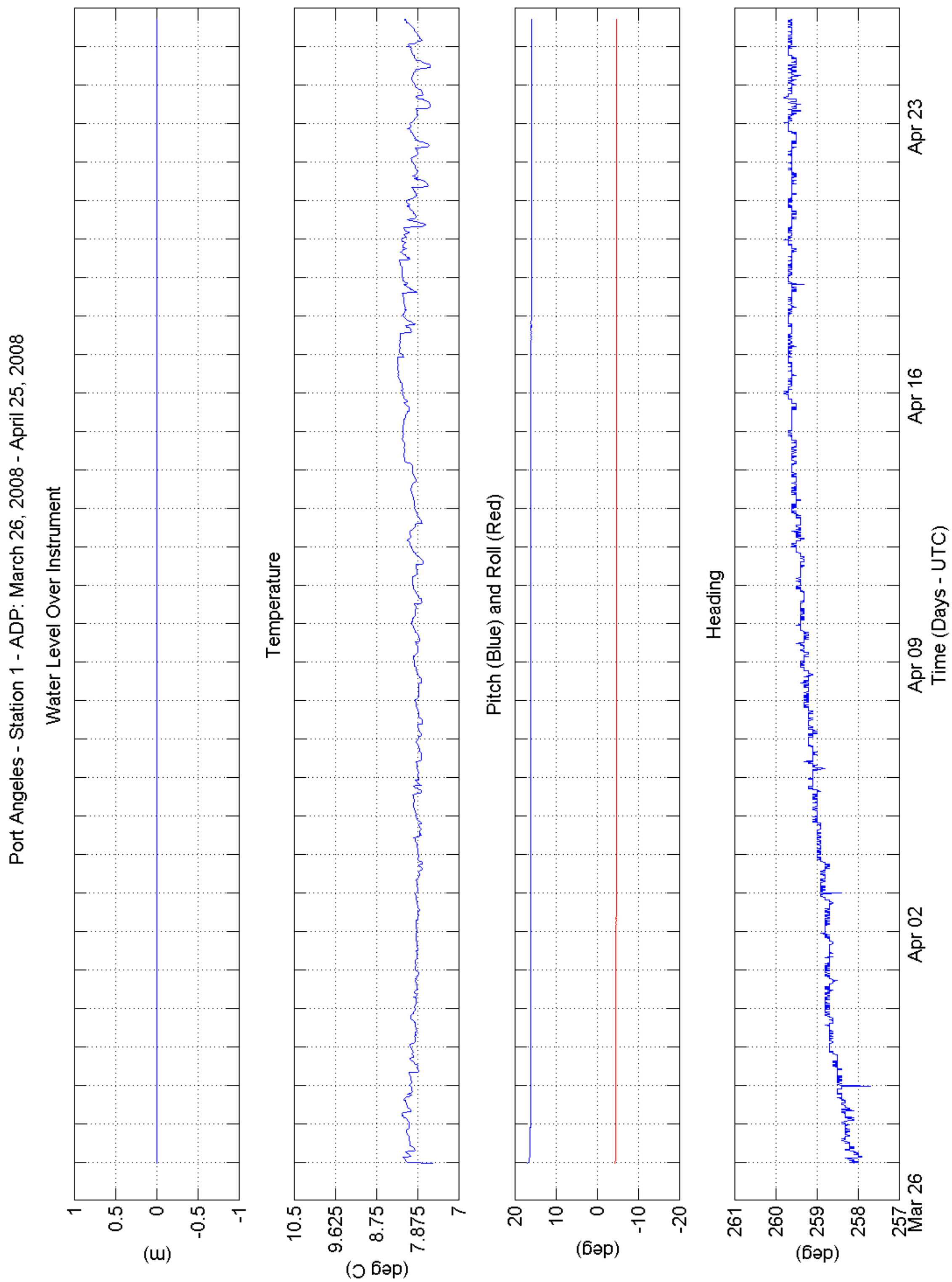
Appendix A.2

Color contour plots of ADP data quality parameters


Port Angeles - Station 1 - ADP: March 26, 2008 - April 25, 2008
Signal to Noise Ratio (dB) - Beam 1
Signal to Noise Ratio (dB) - Beam 2
Signal to Noise Ratio (dB) - Beam 3
Amplitude (counts) - Beam 1
Amplitude (counts) - Beam 2
Amplitude (counts) - Beam 3
Height (m)
20.1
15.8
11.6
7.3
3.1
200
100
0
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix A.3

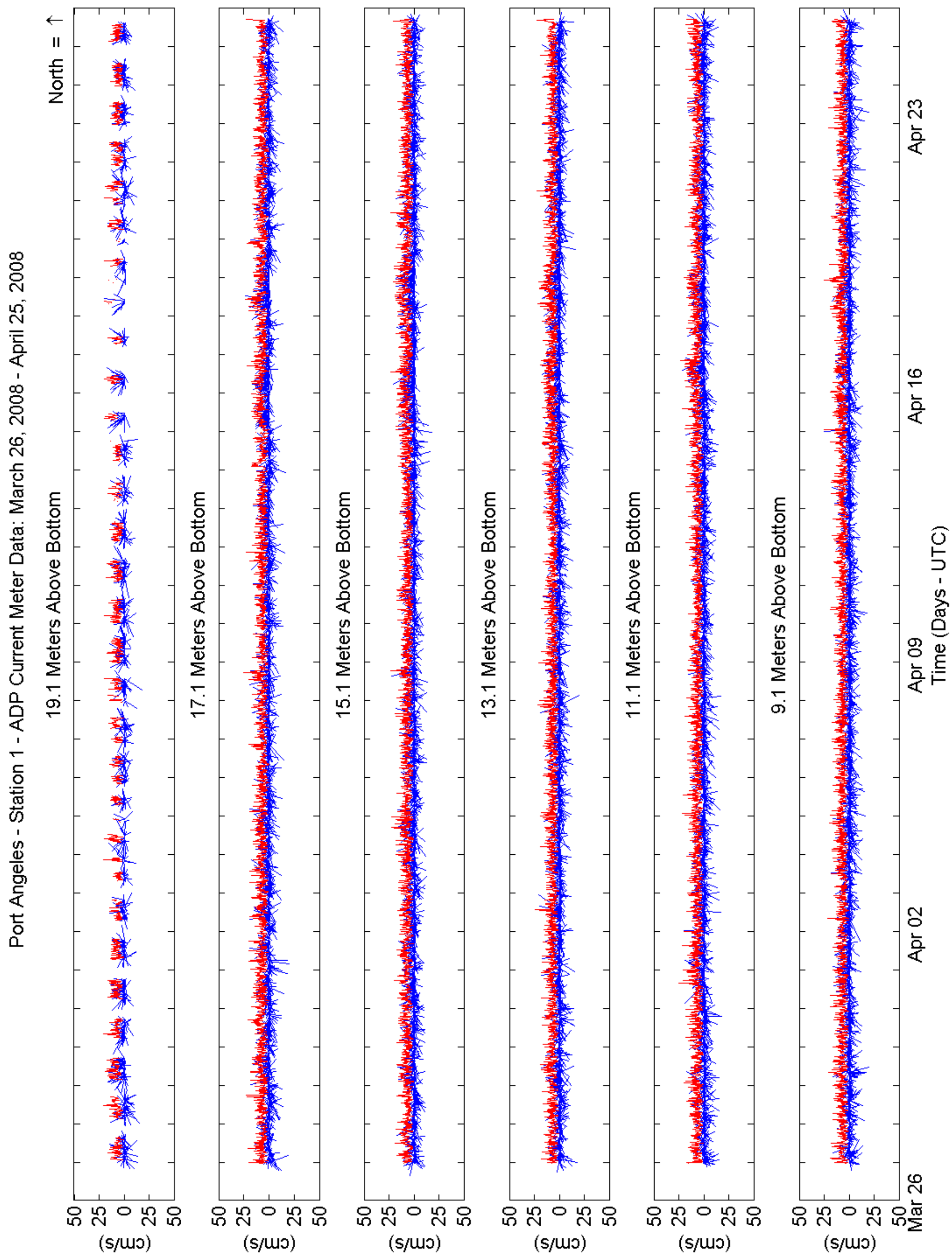
ADP depth, tilt, and water temperature time history plots

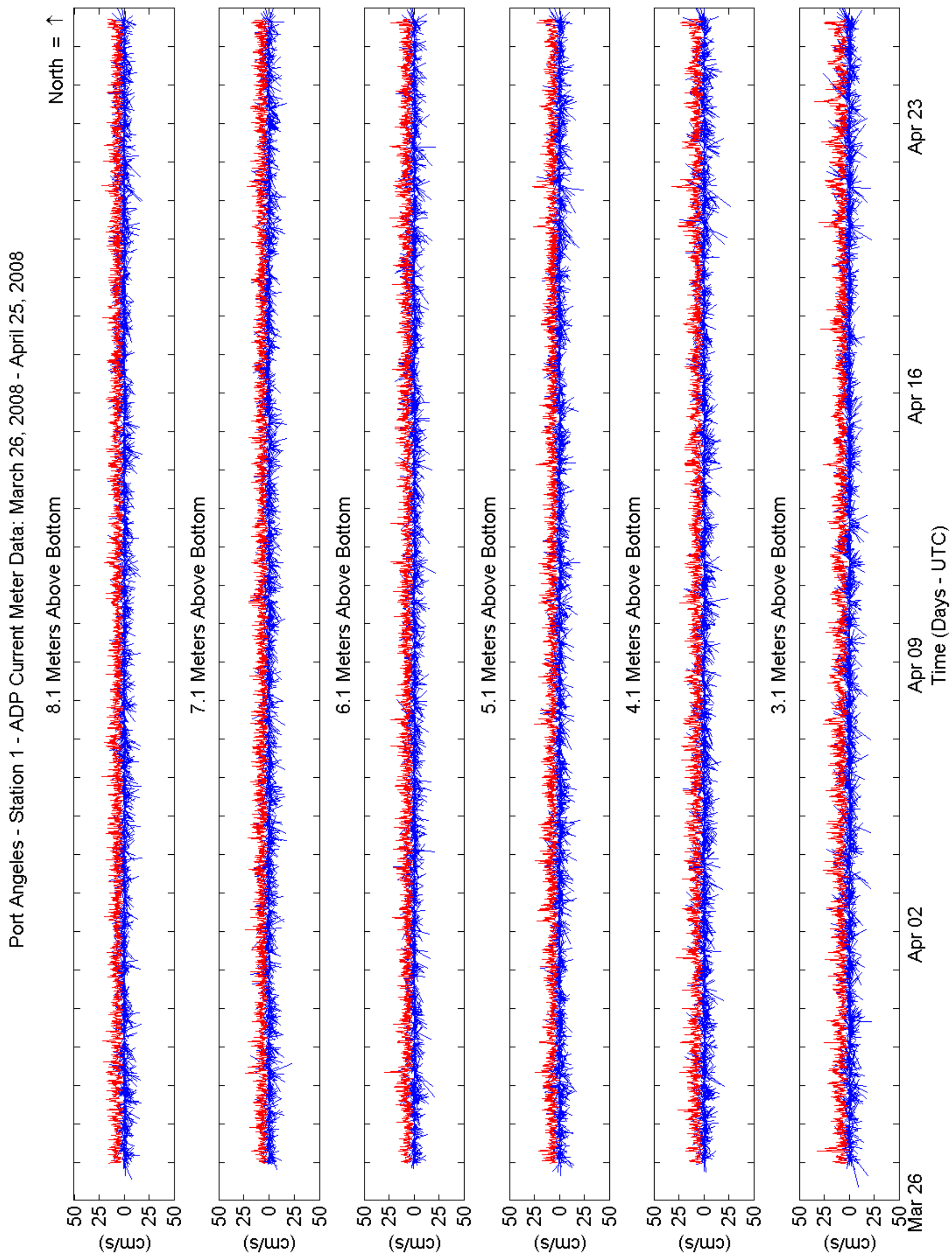

Port Angeles - Station 1 - ADP: March 26, 2008 - April 25, 2008
Water Level Over Instrument
(m)
Temperature
(deg C)
Pitch (Blue) and Roll (Red)
(deg)
Heading
(deg)
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

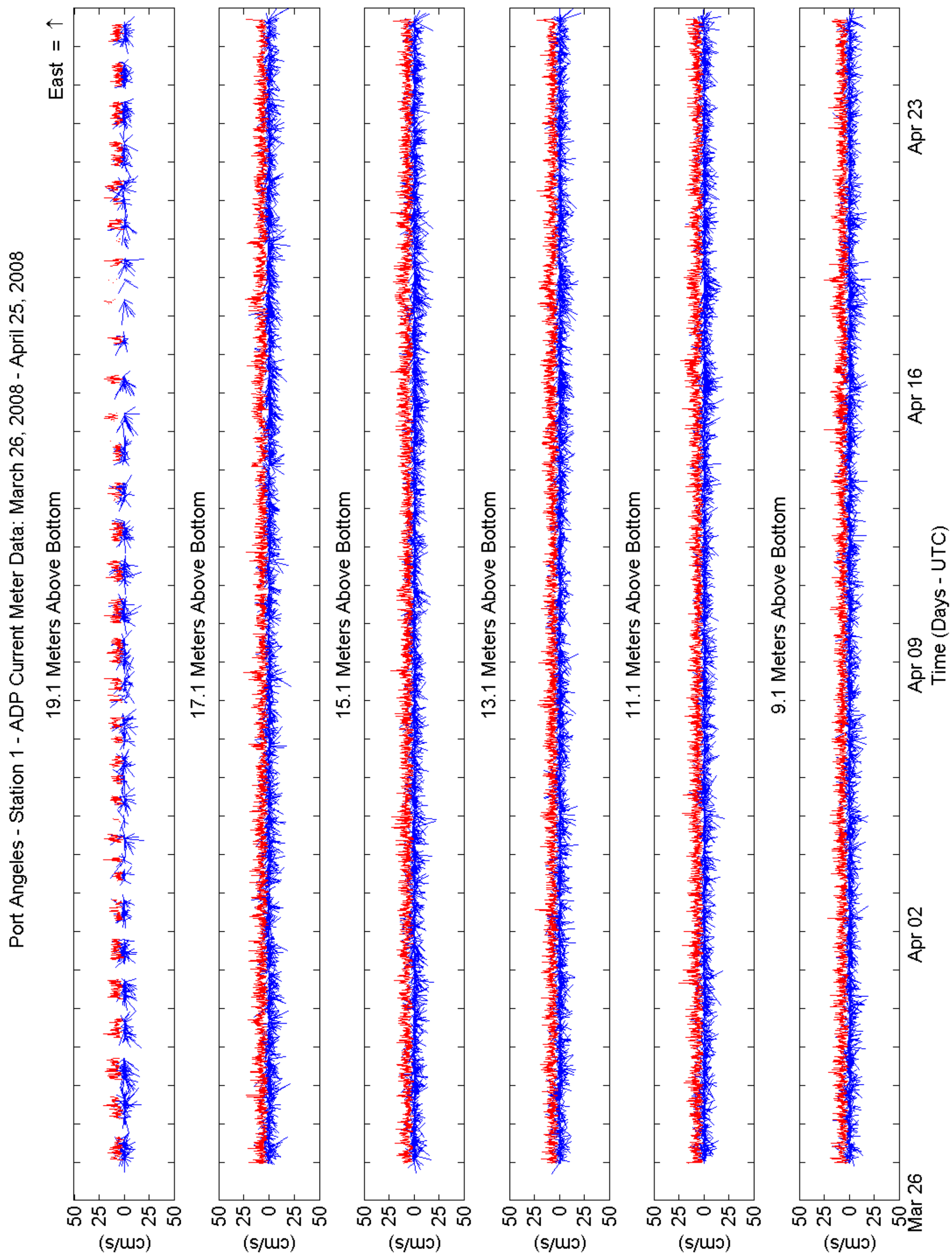
Appendix A.4

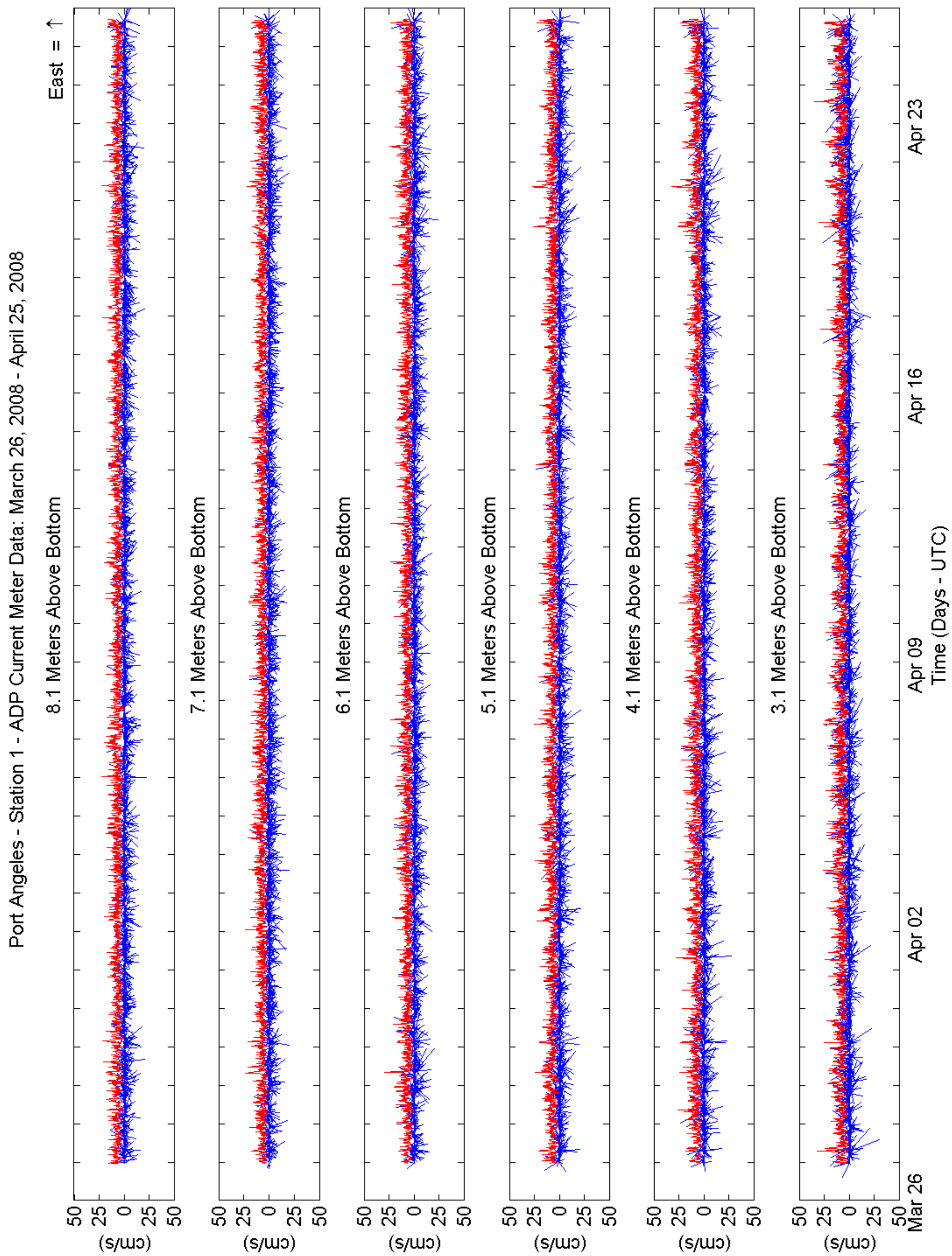
Time history vector plots of current speed and direction

Speed is in cm/s, direction is in deg T, Toward.


Port Angeles - Station 1 - ADP Current Meter Data: March 26, 2008 - April 25, 2008
North = ↑
19.1 Meters Above Bottom
17.1 Meters Above Bottom
15.1 Meters Above Bottom
13.1 Meters Above Bottom
11.1 Meters Above Bottom
9.1 Meters Above Bottom
(cm/s)
50 25 0 25 50
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)


Port Angeles - Station 1 - ADP Current Meter Data: March 26, 2008 - April 25, 2008
North = ↑
8.1 Meters Above Bottom
7.1 Meters Above Bottom
6.1 Meters Above Bottom
5.1 Meters Above Bottom
4.1 Meters Above Bottom
3.1 Meters Above Bottom
(cm/s)
50 25 0 25 50
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

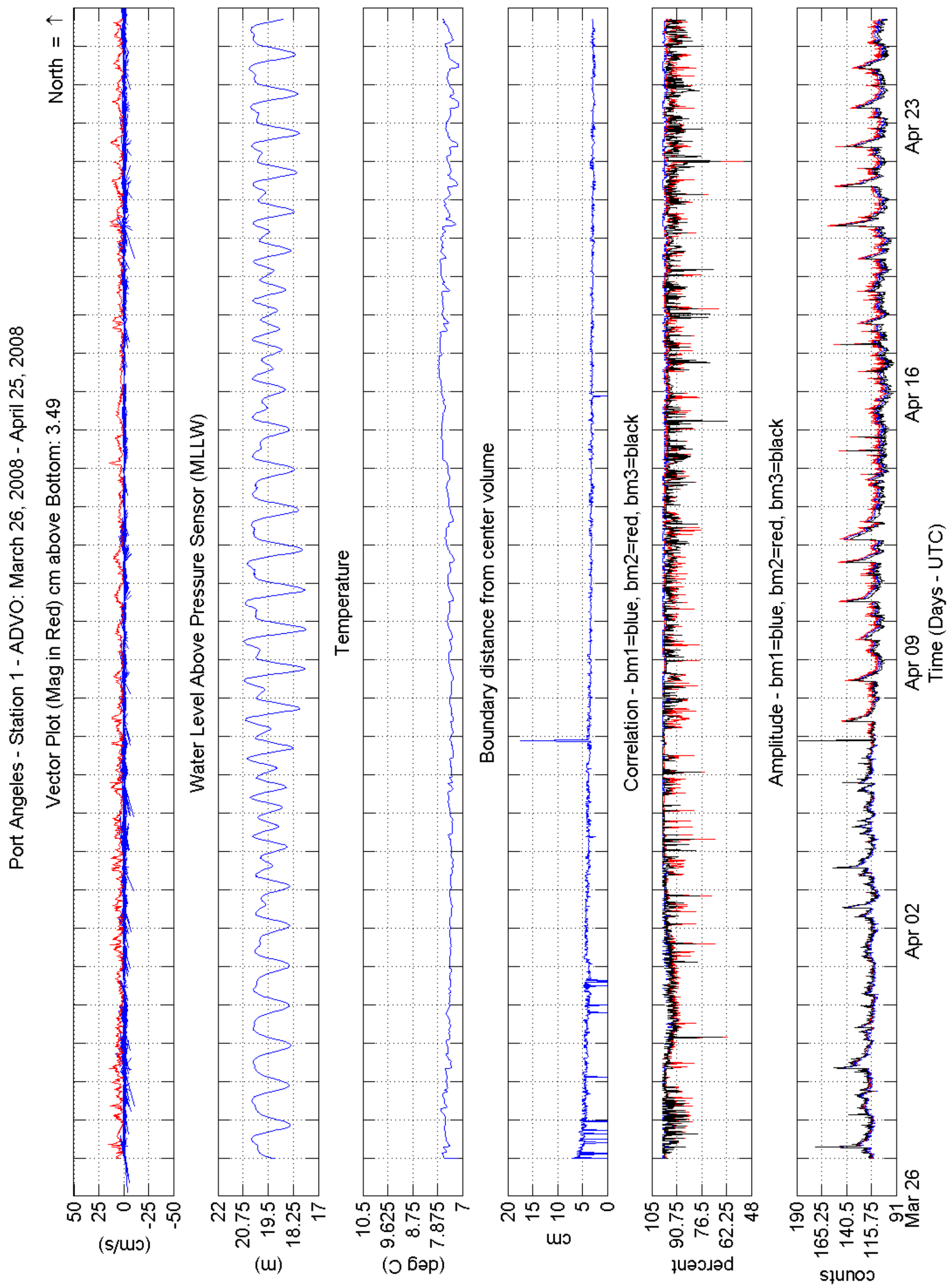

Port Angeles - Station 1 - ADP Current Meter Data: March 26, 2008 - April 25, 2008
East = ↑
19.1 Meters Above Bottom
17.1 Meters Above Bottom
15.1 Meters Above Bottom
13.1 Meters Above Bottom
11.1 Meters Above Bottom
9.1 Meters Above Bottom
50 25 0 25 50
(cm/s)
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

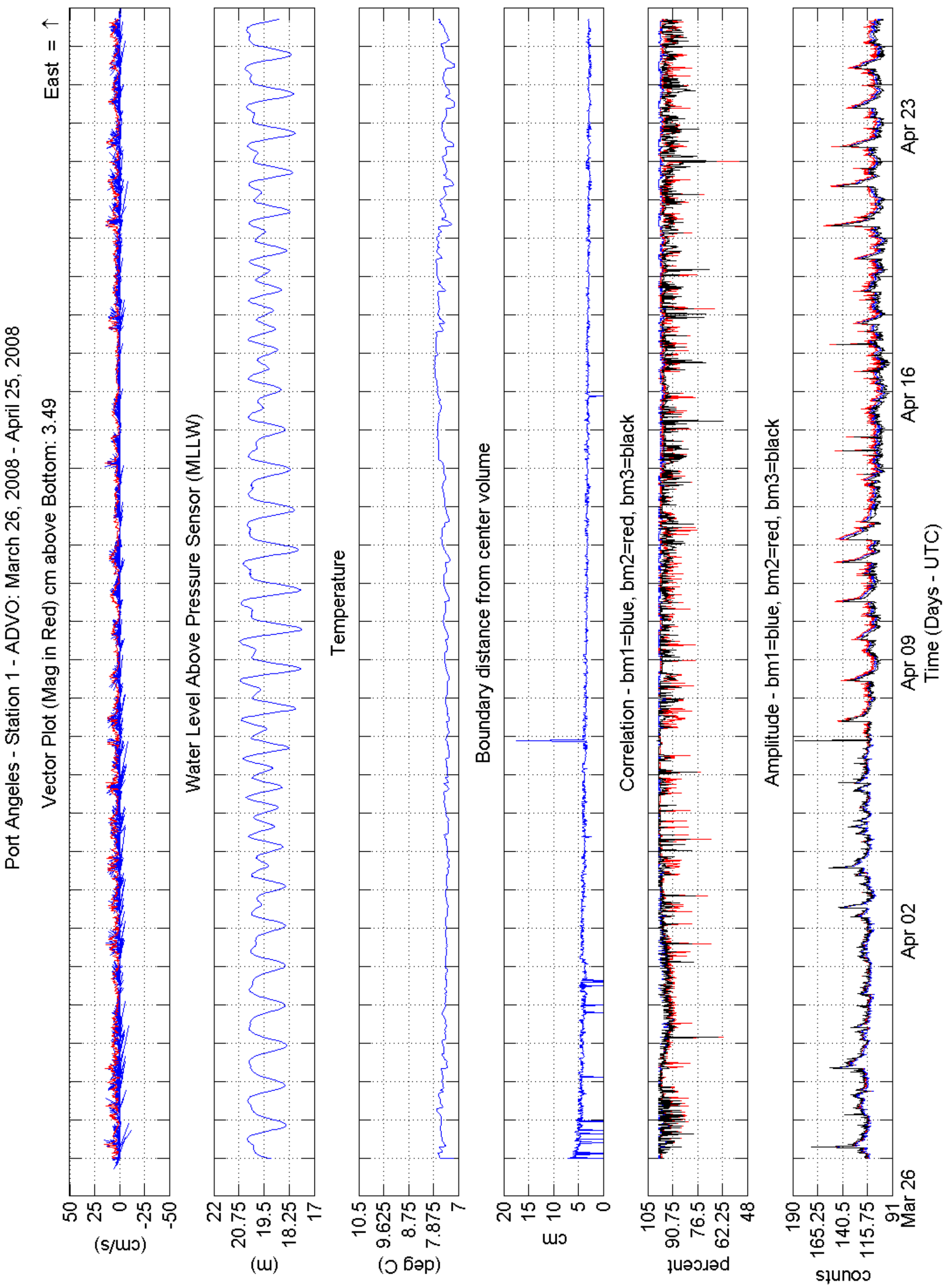


Port Angeles - Station 1 - ADP Current Meter Data: March 26, 2008 - April 25, 2008
East = ↑
8.1 Meters Above Bottom
7.1 Meters Above Bottom
6.1 Meters Above Bottom
5.1 Meters Above Bottom
4.1 Meters Above Bottom
3.1 Meters Above Bottom
(cm/s)
50 25 0 25 50
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix A.5

ADVo Time history plots of current vectors and data quality parameters


Port Angeles - Station 1 - ADVO: March 26, 2008 - April 25, 2008
Vector Plot (Mag in Red) cm above Bottom: 3.49
North = ↑
(cm/s)
Water Level Above Pressure Sensor (MLLW)
(m)
Temperature
(deg C)
Boundary distance from center volume
cm
Correlation - bm1=blue, bm2=red, bm3=black
percent
Amplitude - bm1=blue, bm2=red, bm3=black
counts
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)


Port Angeles - Station 1 - ADVO: March 26, 2008 - April 25, 2008
Vector Plot (Mag in Red) cm above Bottom: 3.49
East = ↑
(cm/s)
50 25 0 -25 -50
Water Level Above Pressure Sensor (MLLW)
(m)
22 20.75 19.5 18.25 17
Temperature
(deg C)
10.5 9.625 8.75 7.875 7
Boundary distance from center volume
cm
20 15 10 5 0
Correlation - bm1=blue, bm2=red, bm3=black
percent
105 90.75 76.5 62.25 48
Amplitude - bm1=blue, bm2=red, bm3=black
counts
190 165.25 140.5 115.75 91
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix A.6

Current Statistics

```
     Date Modified  :  06/04/2008
     Site Name      :  Port Angeles - Station 1
*******************************************************************
** Data produced by:                                             **
**                                                               **
**                    Evans-Hamilton, Inc.                       **
**                   4608 Union Bay Place NE                     **
**                     Seattle, WA 98105                         **
**                       (206) 526-5622                          **
**                                                               **
*******************************************************************
** Meas. Bottom Depth  :  18 m (measured at deployment)
** Instrument Type     :  500 kHz SonTek ADP
** Latitude            :  048 07.968829 N (Degrees Decimal.Minutes)
** Longitude           :  123 27.198021 W (Degrees Decimal.Minutes)
** Magnetic Declination:  17.65 E (Decimal.Degrees)
** Start Time (UTC)    :  03/26/2008 23:15:01 (MM/DD/YYYY hh:mm:ss)
** End Time (UTC)      :  04/25/2008 17:15:01 (MM/DD/YYYY hh:mm:ss)
*******************************************************************
** Column       1: Bin Height above Bottom (m)                   **
**                 (Height of Bin wrt Bottom)                    **
** Column       2: Number of Data Points                         **
** Column       3: Average East (cm/s)                           **
** Column       4: Average North (cm/s)                          **
** Column       5: Average Speed (cm/s)                          **
** Column       6: Maximum Speed (cm/s)                          **
** Column       7: Direction of Maximum Speed (deg T)            **
** Column       8: Minimum Speed (cm/s)                          **
** Column       9: Direction of Minimum Speed (deg T)            **
** Column      10: Net Current Speed (cm/s)                      **
** Column      11: Net Current Direction (deg T)                 **
*******************************************************************
```

Height	DataPts	AvgE	AvgN	AvgSpd	MaxSpd	DirOfMx	MinSpd	DirOfMn	NetSpd	NetDir
End										
20.08	0000	00.00	00.00	00.00	NaN	NaN	NaN	NaN	00.00	NaN
19.08	1220	-0.75	01.89	07.39	20.70	223.2	00.10	107.6	02.03	338.2
18.08	2250	-1.31	02.07	07.44	24.10	249.4	00.10	287.6	02.45	327.7
17.08	2774	-1.54	01.84	07.31	24.80	297.8	00.10	197.7	02.40	320.0
16.08	2846	-1.73	01.78	07.37	26.20	221.3	00.10	017.6	02.48	315.9
15.08	2857	-1.91	01.67	07.29	23.20	347.4	00.00	000.0	02.54	311.3
14.08	2857	-2.05	01.48	07.29	27.60	355.3	00.00	000.0	02.53	305.9
13.08	2857	-1.89	01.22	07.20	24.50	032.6	00.00	000.0	02.25	302.8
12.08	2857	-1.88	01.12	07.14	23.70	290.8	00.10	197.7	02.19	300.7
11.08	2857	-2.05	00.65	07.08	25.10	317.2	00.00	000.0	02.15	287.6
10.08	2857	-1.91	00.56	07.17	27.70	317.0	00.20	107.6	01.99	286.3
09.08	2857	-1.78	00.30	07.06	24.90	355.5	00.00	000.0	01.80	279.6
08.08	2857	-1.54	-0.14	07.08	22.20	271.1	00.20	017.6	01.54	264.9
07.08	2857	-1.49	-0.21	07.19	23.70	160.0	00.10	152.7	01.50	262.1
06.08	2857	-1.11	-0.32	07.31	29.00	225.8	00.00	000.0	01.16	254.0
05.08	2857	-0.64	-0.40	07.46	27.00	233.2	00.10	107.6	00.75	238.0
04.08	2857	-0.02	-0.58	07.85	31.60	212.4	00.10	287.6	00.58	181.7
03.08	2857	02.44	00.11	08.42	35.00	041.5	00.10	197.7	02.44	087.5

```
     Date Modified  :  06/06/2008
     Site Name      :  Port Angeles Station 1
*******************************************************************
** Data produced by:                                             **
**                                                               **
**                  Evans-Hamilton, Inc.                         **
**                 4608 Union Bay Place NE                       **
**                   Seattle, WA 98105                           **
**                     (206) 526-5622                            **
**                                                               **
*******************************************************************
** Meas. Bottom Depth  :  18.3 m (measured at deployment)
** Instrument Type     :  5 MHz Sontek ADVO
** Latitude            :  048 07.96883 N (Degrees Decimal.Minutes)
** Longitude           :  123 27.19802 W (Degrees Decimal.Minutes)
** Magnetic Declination:  17.65 E (Decimal.Degrees)
** Start Time (UTC)    :  03/26/2008 23:30:02 (MM/DD/YYYY hh:mm:ss)
** End Time (UTC)      :  04/25/2008 17:15:02 (MM/DD/YYYY hh:mm:ss)
*******************************************************************
** Column       1: Sensor Height above Bottom (cm)               **
**                 (Height of Sensor wrt Bottom)                 **
** Column       2: Number of Data Points                         **
** Column       3: Average East (cm/s)                           **
** Column       4: Average North (cm/s)                          **
** Column       5: Average Speed (cm/s)                          **
** Column       6: Maximum Speed (cm/s)                          **
** Column       7: Direction of Maximum Speed (deg T)            **
** Column       8: Minimum Speed (cm/s)                          **
** Column       9: Direction of Minimum Speed (deg T)            **
** Column      10: Net Current Speed (cm/s)                      **
** Column      11: Net Current Direction (deg T)                 **
*******************************************************************
Height  DataPts AvgE    AvgN    AvgSpd  MaxSpd  DirOfMx MinSpd  DirOfMn NetSpd  NetDir
*End*
03.50   2853    02.77   -0.80   03.96   15.08   059.5   00.06   000.8   02.89   106.1
```

Appendix A.7

Percent occurrence tables of current speed versus direction

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **3.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.51	1.40	0.88	0.88	1.09	1.09	1.02	1.12	0.95	1.05	1.09	0.84	1.19	0.77	1.05	1.23	17.12
4 - 8	1.79	2.42	2.66	2.56	2.91	3.01	2.03	2.56	2.42	2.10	1.79	2.07	1.93	1.54	1.86	1.61	35.21
8 - 12	1.16	1.75	3.22	2.73	3.26	2.66	1.54	1.79	1.54	1.37	1.26	0.88	1.12	0.70	0.63	1.09	26.67
12 - 16	0.81	1.02	1.16	1.86	2.03	1.44	1.19	0.70	0.63	0.46	0.81	0.60	0.28	0.39	0.25	0.28	13.86
16 - 20	0.11	0.63	0.70	0.81	0.84	0.56	0.28	0.14	0.07	0.28	0.25	0.18	0.07	0.00	0.00	0.11	5.01
20 - 24	0.04	0.11	0.35	0.46	0.21	0.00	0.07	0.04	0.07	0.18	0.07	0.00	0.00	0.04	0.00	0.00	1.61
24 - 28	0.00	0.04	0.04	0.07	0.04	0.00	0.00	0.00	0.00	0.07	0.04	0.07	0.00	0.00	0.00	0.00	0.35
28 - 32	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.14
32 - 36	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	5.39	7.35	9.03	9.42	10.36	8.75	6.13	6.34	5.67	5.50	5.32	4.66	4.59	3.43	3.78	4.31	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **4.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.16	1.33	1.02	1.26	0.91	1.12	1.54	1.37	1.16	1.19	0.91	1.37	0.88	1.09	1.16	1.26	18.69
4 - 8	2.42	2.45	2.56	1.75	2.10	2.73	2.56	2.45	2.80	2.52	2.66	2.35	2.66	2.66	2.17	1.54	38.40
8 - 12	1.72	1.75	1.54	1.89	1.54	1.72	1.79	1.72	2.24	1.65	2.00	1.72	1.58	1.09	0.81	1.54	26.25
12 - 16	0.39	0.67	0.74	0.70	0.77	0.53	0.77	0.74	0.77	1.09	1.26	1.02	0.81	0.39	0.39	0.53	11.52
16 - 20	0.11	0.42	0.39	0.46	0.04	0.21	0.18	0.18	0.18	0.42	0.25	0.60	0.28	0.11	0.04	0.07	3.89
20 - 24	0.04	0.14	0.14	0.07	0.07	0.00	0.00	0.04	0.00	0.11	0.07	0.18	0.11	0.07	0.00	0.00	1.02
24 - 28	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.00	0.04	0.00	0.00	0.00	0.21
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	5.85	6.76	6.37	6.16	5.43	6.30	6.83	6.48	7.18	7.04	7.18	7.21	6.34	5.39	4.55	4.94	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **5.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.23	1.09	1.26	1.19	1.30	1.44	1.02	1.12	0.98	1.44	1.40	1.23	1.47	1.54	1.09	1.12	19.88
4 - 8	3.22	1.96	2.35	2.07	2.10	2.80	2.24	2.35	2.94	3.26	3.05	2.45	2.38	2.56	2.56	2.49	40.74
8 - 12	1.93	1.75	1.19	1.65	1.12	1.58	1.33	1.44	1.54	2.21	2.10	2.24	2.00	1.40	1.26	1.19	25.90
12 - 16	0.77	0.49	0.67	0.21	0.53	0.53	0.67	0.56	0.60	0.74	0.95	0.77	0.81	0.95	0.39	0.39	9.98
16 - 20	0.18	0.18	0.18	0.11	0.04	0.14	0.14	0.25	0.07	0.21	0.42	0.25	0.25	0.21	0.04	0.11	2.73
20 - 24	0.04	0.04	0.00	0.07	0.04	0.00	0.00	0.00	0.07	0.07	0.07	0.07	0.07	0.00	0.04	0.00	0.56
24 - 28	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.11	0.04	0.00	0.00	0.00	0.00	0.21
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	7.35	5.50	5.67	5.29	5.11	6.48	5.39	5.71	6.23	7.91	8.09	7.04	6.97	6.65	5.36	5.29	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **6.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.19	1.58	0.95	1.47	1.30	1.61	1.51	1.47	1.51	1.65	1.19	1.30	1.33	1.96	1.40	0.81	22.19
4 - 8	2.59	2.38	2.00	1.68	1.86	2.31	2.21	2.21	2.42	2.63	2.94	2.63	3.26	3.12	2.59	2.07	38.89
8 - 12	1.33	1.40	1.33	1.26	1.02	1.33	1.51	1.26	1.51	2.21	2.38	2.14	2.31	1.65	1.68	1.61	25.90
12 - 16	0.67	0.49	0.39	0.35	0.25	0.53	0.32	0.67	0.67	0.70	0.91	0.95	0.91	0.81	0.70	0.56	9.84
16 - 20	0.14	0.07	0.07	0.07	0.14	0.07	0.07	0.04	0.04	0.25	0.28	0.32	0.32	0.18	0.25	0.11	2.38
20 - 24	0.04	0.00	0.07	0.07	0.04	0.04	0.00	0.00	0.07	0.11	0.18	0.04	0.00	0.04	0.00	0.07	0.74
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.04
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	5.95	5.92	4.80	4.90	4.59	5.88	5.60	5.64	6.20	7.53	7.91	7.35	8.16	7.74	6.62	5.22	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **7.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.44	1.54	1.05	1.44	0.81	2.07	0.98	1.23	1.47	1.89	1.19	1.16	1.75	1.44	1.44	1.44	22.33
4 - 8	2.07	1.89	2.07	1.89	0.98	1.61	2.42	2.31	2.49	3.01	3.05	3.78	2.77	2.91	2.80	2.49	38.57
8 - 12	1.75	1.47	1.16	1.26	0.95	0.91	1.12	1.54	1.58	1.68	2.45	2.14	2.84	2.21	1.96	2.10	27.09
12 - 16	0.77	0.32	0.35	0.39	0.18	0.35	0.32	0.32	0.81	0.95	1.02	0.81	0.84	0.88	0.70	0.60	9.56
16 - 20	0.25	0.07	0.04	0.07	0.04	0.04	0.04	0.11	0.14	0.18	0.28	0.21	0.21	0.21	0.11	0.14	2.10
20 - 24	0.00	0.04	0.00	0.00	0.00	0.04	0.04	0.04	0.00	0.00	0.04	0.07	0.07	0.00	0.04	0.00	0.35
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.27	5.32	4.66	5.04	2.94	5.01	4.90	5.53	6.48	7.70	8.02	8.16	8.47	7.63	7.04	6.76	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **8.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.19	1.93	1.26	0.98	1.37	1.65	1.26	1.26	1.02	1.58	1.19	1.30	1.37	1.93	1.61	1.47	22.33
4 - 8	2.87	2.10	1.54	1.68	1.89	1.93	1.86	2.45	2.70	2.70	2.87	3.64	2.80	3.43	2.84	2.28	39.55
8 - 12	1.40	1.47	0.81	1.09	0.81	1.16	1.44	1.44	1.65	1.79	2.21	2.28	2.31	2.14	3.05	2.38	27.44
12 - 16	0.49	0.28	0.21	0.25	0.25	0.25	0.32	0.53	0.49	0.60	0.88	0.88	0.98	0.88	0.67	0.56	8.47
16 - 20	0.04	0.07	0.11	0.04	0.07	0.07	0.00	0.04	0.18	0.25	0.18	0.11	0.28	0.25	0.18	0.11	1.93
20 - 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.07	0.07	0.00	0.00	0.00	0.28
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	5.99	5.85	3.92	4.03	4.38	5.04	4.87	5.71	6.02	6.90	7.46	8.26	7.81	8.61	8.33	6.79	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **9.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.44	1.47	1.33	1.02	1.26	1.23	1.05	1.33	1.61	1.44	1.47	1.58	1.37	2.35	1.19	1.65	22.75
4 - 8	2.63	2.73	2.14	1.82	1.65	1.68	2.03	1.58	2.21	3.19	3.36	3.47	3.61	2.84	3.12	2.66	40.71
8 - 12	1.58	1.40	1.09	0.91	0.88	0.63	0.70	1.65	1.58	1.51	1.47	2.35	2.73	2.42	2.17	2.10	25.20
12 - 16	0.63	0.32	0.18	0.28	0.32	0.14	0.25	0.21	0.35	0.67	0.84	0.81	1.09	0.95	1.09	1.02	9.10
16 - 20	0.11	0.07	0.00	0.00	0.00	0.07	0.07	0.00	0.11	0.18	0.18	0.32	0.32	0.25	0.25	0.11	2.00
20 - 24	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.00	0.00	0.04	0.04	0.00	0.00	0.00	0.18
24 - 28	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.07
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.41	5.99	4.73	4.03	4.10	3.75	4.13	4.80	5.88	6.97	7.32	8.54	9.14	8.79	7.84	7.53	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **10.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.65	1.09	1.02	1.02	1.16	1.47	1.23	1.12	1.23	1.54	1.40	1.23	1.30	1.72	1.44	1.61	21.18
4 - 8	2.77	2.45	2.03	1.68	1.96	1.19	1.89	2.56	2.24	2.59	3.19	3.33	3.29	3.43	3.47	2.84	40.92
8 - 12	1.96	1.72	0.95	0.63	0.70	0.81	0.74	1.02	1.23	1.65	2.31	2.63	2.84	2.70	2.77	2.24	26.85
12 - 16	0.63	0.70	0.32	0.14	0.11	0.14	0.42	0.32	0.53	0.56	0.46	0.53	0.95	0.95	1.37	0.81	8.89
16 - 20	0.14	0.00	0.00	0.00	0.07	0.07	0.00	0.04	0.11	0.04	0.18	0.25	0.21	0.32	0.25	0.28	1.93
20 - 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.18	0.00	0.00	0.21
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	7.14	5.95	4.31	3.47	3.99	3.68	4.27	5.04	5.32	6.37	7.53	7.95	8.61	9.28	9.31	7.77	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **11.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed	349	11	34	56	79	101	124	146	169	191	214	236	259	281	304	326	
cm/sec	11	34	56	79	101	124	146	169	191	214	236	259	281	304	326	349	Total
0 - 4	1.30	1.40	1.09	1.47	1.19	1.51	1.19	1.12	1.37	1.12	0.91	1.47	1.33	2.21	1.40	1.79	21.84
4 - 8	2.31	2.56	1.37	2.00	1.23	1.51	1.68	1.68	2.49	2.59	3.68	3.47	3.85	3.75	3.61	3.43	41.20
8 - 12	2.10	1.58	1.02	0.88	0.67	0.70	0.74	1.05	1.19	1.82	1.86	2.21	2.91	2.17	2.56	2.28	25.69
12 - 16	0.63	0.46	0.25	0.11	0.14	0.21	0.21	0.18	0.42	0.74	0.46	0.91	0.91	1.12	1.37	0.67	8.79
16 - 20	0.14	0.18	0.00	0.00	0.04	0.00	0.00	0.04	0.11	0.11	0.14	0.11	0.25	0.28	0.35	0.46	2.17
20 - 24	0.04	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.07	0.00	0.04	0.00	0.04	0.28
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.51	6.23	3.71	4.45	3.26	3.92	3.82	4.06	5.57	6.37	7.07	8.23	9.24	9.56	9.31	8.65	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **12.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	2.10	1.47	1.40	0.81	1.26	1.26	0.91	0.77	1.37	1.61	1.16	1.51	1.54	1.93	1.44	0.98	21.49
4 - 8	2.94	2.98	2.14	1.65	1.68	1.72	1.75	1.72	2.31	2.63	2.73	3.01	3.08	3.99	3.08	3.26	40.64
8 - 12	2.42	1.09	1.26	0.95	0.60	0.67	0.70	0.74	1.12	1.19	1.72	2.03	3.01	2.87	3.12	3.54	26.99
12 - 16	0.84	0.42	0.18	0.14	0.14	0.28	0.53	0.21	0.32	0.56	0.35	0.95	0.91	1.02	1.05	0.88	8.75
16 - 20	0.28	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.14	0.18	0.11	0.25	0.39	0.28	1.75
20 - 24	0.04	0.00	0.04	0.00	0.00	0.04	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.07	0.04	0.14	0.39
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	8.61	5.99	5.04	3.54	3.68	3.96	3.89	3.47	5.11	6.06	6.09	7.67	8.65	10.12	9.10	9.07	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **13.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.58	1.47	1.16	1.44	1.12	1.19	1.23	1.05	1.09	1.40	1.54	1.37	1.19	1.54	1.68	1.54	21.56
4 - 8	2.77	2.56	1.72	1.47	1.61	1.51	1.51	1.93	1.75	2.31	2.52	2.80	2.98	4.10	4.34	3.68	39.52
8 - 12	2.17	1.68	1.05	0.88	1.33	0.60	0.81	0.88	1.09	1.75	1.89	2.24	2.28	3.12	2.84	3.08	27.69
12 - 16	0.84	0.49	0.28	0.21	0.35	0.07	0.07	0.18	0.39	0.35	0.39	0.88	0.67	1.37	1.37	1.16	9.03
16 - 20	0.18	0.11	0.07	0.00	0.00	0.04	0.07	0.04	0.07	0.11	0.11	0.14	0.21	0.14	0.42	0.25	1.93
20 - 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.11	0.00	0.00	0.11	0.00	0.25
24 - 28	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	7.53	6.34	4.27	3.99	4.41	3.40	3.68	4.10	4.38	5.92	6.44	7.53	7.32	10.26	10.75	9.70	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **14.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.65	1.61	1.16	0.63	1.33	1.02	1.09	0.95	0.88	1.44	1.19	1.40	1.58	1.47	1.44	1.82	20.62
4 - 8	3.26	2.63	2.42	2.03	1.65	1.40	1.30	1.58	2.00	2.14	2.49	2.70	3.29	3.75	3.82	3.61	40.01
8 - 12	2.52	1.51	1.12	1.16	0.88	0.74	0.49	0.67	1.05	1.51	2.10	2.10	2.21	3.36	3.15	2.91	27.48
12 - 16	0.88	0.39	0.11	0.21	0.18	0.14	0.11	0.28	0.39	0.21	0.74	0.81	0.98	1.26	1.30	1.58	9.52
16 - 20	0.18	0.11	0.04	0.04	0.07	0.04	0.00	0.04	0.04	0.07	0.07	0.21	0.14	0.28	0.42	0.32	2.03
20 - 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.07	0.04	0.07	0.25
24 - 28	0.04	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.11
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	8.51	6.23	4.87	4.06	4.10	3.33	2.98	3.50	4.34	5.36	6.62	7.25	8.23	10.19	10.15	10.29	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **15.1 meters**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.37	1.61	0.98	1.40	1.05	1.37	1.16	0.91	0.95	1.54	1.05	1.58	1.37	2.00	1.47	1.51	21.28
4 - 8	2.70	3.01	2.03	2.03	1.58	1.72	1.19	1.44	1.68	1.82	2.21	2.87	3.26	4.06	3.68	3.40	38.64
8 - 12	2.07	1.96	1.19	0.81	0.95	0.84	0.63	0.88	0.81	1.33	1.68	2.10	2.66	3.33	3.15	3.15	27.51
12 - 16	1.05	0.67	0.35	0.35	0.28	0.25	0.18	0.18	0.07	0.25	0.63	0.88	0.88	1.30	1.40	1.23	9.91
16 - 20	0.35	0.25	0.14	0.00	0.00	0.00	0.00	0.04	0.04	0.00	0.21	0.07	0.11	0.42	0.42	0.39	2.42
20 - 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.07	0.07	0.25
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	7.53	7.49	4.69	4.59	3.85	4.17	3.15	3.43	3.54	4.94	5.78	7.53	8.30	11.13	10.19	9.73	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **16.1 meters**
Number of observations : 2846
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.58	1.72	1.09	1.19	1.62	1.23	1.83	1.05	0.77	1.05	1.16	1.37	1.19	1.62	1.44	1.41	21.33
4 - 8	3.72	2.88	1.93	1.62	1.48	1.55	1.23	1.65	1.72	1.93	2.14	2.71	3.02	3.90	3.48	3.55	38.55
8 - 12	2.81	1.93	0.95	1.02	0.84	0.70	0.63	0.81	0.84	0.95	1.41	1.79	2.71	2.74	3.41	3.13	26.67
12 - 16	0.98	0.63	0.56	0.42	0.28	0.28	0.11	0.18	0.39	0.25	0.53	0.81	1.02	1.37	1.41	1.23	10.44
16 - 20	0.25	0.14	0.21	0.04	0.11	0.04	0.04	0.07	0.00	0.07	0.11	0.18	0.32	0.35	0.39	0.32	2.60
20 - 24	0.07	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.00	0.07	0.04	0.32
24 - 28	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.00	0.00	0.00	0.11
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	9.42	7.34	4.74	4.29	4.39	3.79	3.83	3.76	3.72	4.25	5.38	6.89	8.33	9.98	10.19	9.66	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **17.1 meters**
Number of observations : 2774
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.30	1.41	1.26	1.19	1.37	1.41	1.12	0.90	1.08	1.33	1.05	1.23	1.15	1.98	1.66	1.73	21.16
4 - 8	3.60	3.46	2.63	1.51	1.84	1.55	1.33	1.44	1.51	2.09	2.02	2.74	3.10	3.64	3.57	3.28	39.33
8 - 12	1.95	2.34	1.91	1.33	0.87	0.76	0.79	0.65	0.61	0.72	1.69	1.87	2.16	2.99	3.10	2.99	26.78
12 - 16	1.01	0.90	0.50	0.32	0.14	0.29	0.00	0.25	0.29	0.36	0.50	0.87	0.90	0.83	1.66	1.23	10.06
16 - 20	0.36	0.18	0.14	0.07	0.04	0.00	0.00	0.04	0.04	0.11	0.18	0.14	0.14	0.18	0.22	0.32	2.16
20 - 24	0.04	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04	0.00	0.04	0.18	0.04	0.00	0.07	0.04	0.47
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.04
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	8.26	8.29	6.45	4.43	4.29	4.00	3.24	3.28	3.57	4.61	5.48	7.03	7.50	9.66	10.27	9.59	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **18.1 meters**
Number of observations : 2250
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.20	1.42	1.33	1.24	0.89	1.24	1.42	0.98	0.98	0.84	0.98	1.51	1.33	1.38	1.33	1.96	20.04
4 - 8	4.13	3.07	2.27	2.44	1.51	1.47	1.56	1.38	1.56	1.82	1.87	2.49	2.80	3.82	3.33	3.51	39.02
8 - 12	2.67	2.18	1.64	1.20	1.47	1.07	0.67	0.49	0.93	1.11	1.29	2.27	2.09	3.02	2.84	2.84	27.78
12 - 16	1.69	1.02	0.58	0.27	0.27	0.18	0.13	0.04	0.22	0.27	0.53	0.67	1.07	0.84	1.38	1.20	10.36
16 - 20	0.49	0.18	0.36	0.09	0.04	0.00	0.00	0.04	0.00	0.04	0.09	0.00	0.04	0.27	0.31	0.36	2.31
20 - 24	0.00	0.09	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04	0.04	0.04	0.00	0.09	0.09	0.00	0.44
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	10.18	7.96	6.18	5.24	4.18	4.00	3.78	2.93	3.69	4.13	4.80	7.02	7.33	9.42	9.29	9.87	100.00

Location : Port Angeles - Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 16.9 meters
Distance Above Bottom: **19.1 meters**
Number of observations : 1220
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.39	1.07	1.39	1.23	1.31	1.80	1.39	0.82	1.23	1.15	0.98	1.15	1.80	1.56	1.48	0.98	20.74
4 - 8	3.44	3.03	3.03	2.13	1.89	2.13	1.07	1.80	1.64	1.97	2.54	2.70	2.54	3.69	2.87	2.79	39.43
8 - 12	2.79	2.70	2.38	1.56	1.31	0.57	0.82	0.82	0.57	1.07	1.23	1.64	2.30	1.56	1.80	2.79	25.90
12 - 16	1.56	0.82	0.74	0.66	0.33	0.25	0.08	0.33	0.16	0.41	0.57	0.41	0.66	1.31	1.56	1.39	11.23
16 - 20	0.16	0.25	0.25	0.00	0.16	0.16	0.00	0.00	0.00	0.00	0.08	0.16	0.16	0.16	0.49	0.25	2.30
20 - 24	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.00	0.08	0.00	0.08	0.00	0.41
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	9.34	7.87	7.87	5.57	5.00	4.92	3.36	3.77	3.61	4.67	5.49	6.07	7.54	8.28	8.28	8.20	100.00

Location : Port Angeles Station 1
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 30.2 meters
Distance Above Bottom: **3.5 cm**
Number of observations : 2853
All data bins e.g. 1 <= x < 2

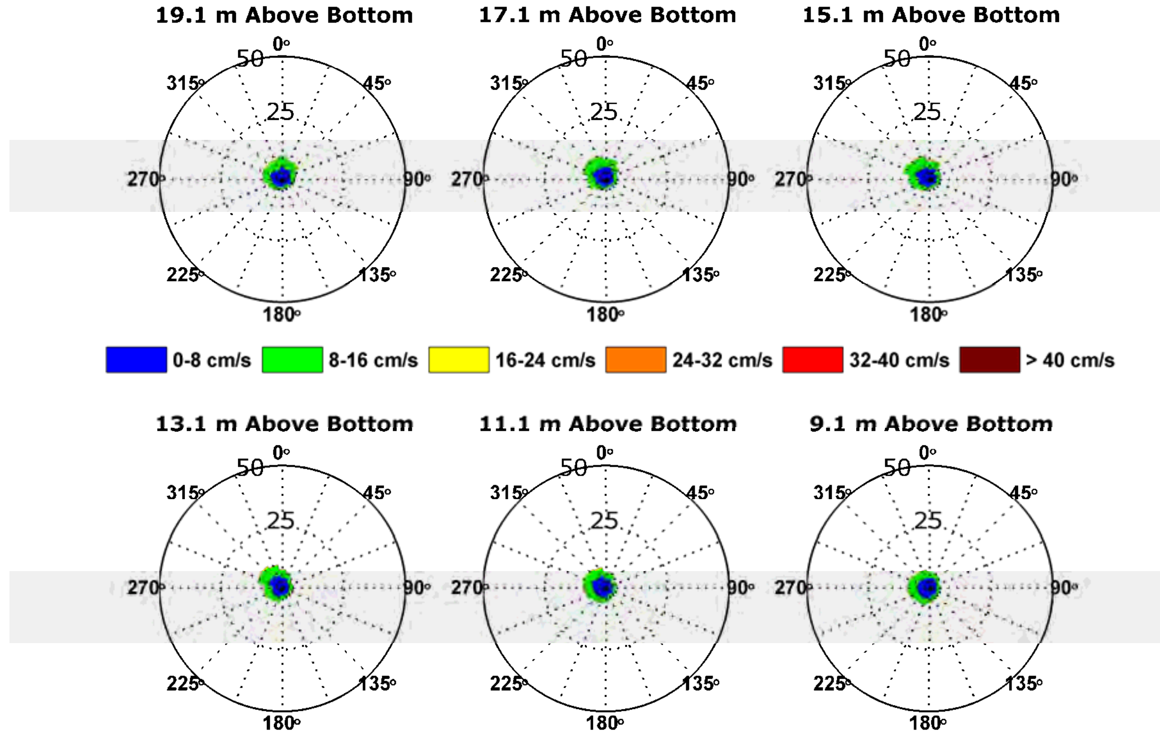
Direction (degrees true)

Speed	349	11	34	56	79	101	124	146	169	191	214	236	259	281	304	326	
cm/sec	11	34	56	79	101	124	146	169	191	214	236	259	281	304	326	349	Total
0 - 4	2.56	2.56	7.29	14.83	8.80	5.78	2.77	1.26	2.56	2.70	2.03	1.30	0.46	0.70	0.81	1.72	58.11
4 - 8	0.81	0.84	5.19	19.17	2.31	1.09	0.70	0.49	2.07	1.12	0.18	0.04	0.00	0.00	0.00	0.46	34.45
8 - 12	0.00	0.11	3.12	2.77	0.11	0.04	0.07	0.07	0.35	0.11	0.00	0.00	0.00	0.00	0.00	0.04	6.76
12 - 16	0.00	0.00	0.35	0.18	0.00	0.00	0.00	0.00	0.11	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.67
16 - 20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20 - 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.36	3.51	15.95	36.94	11.22	6.91	3.54	1.82	5.08	3.93	2.24	1.33	0.46	0.70	0.81	2.21	100.00

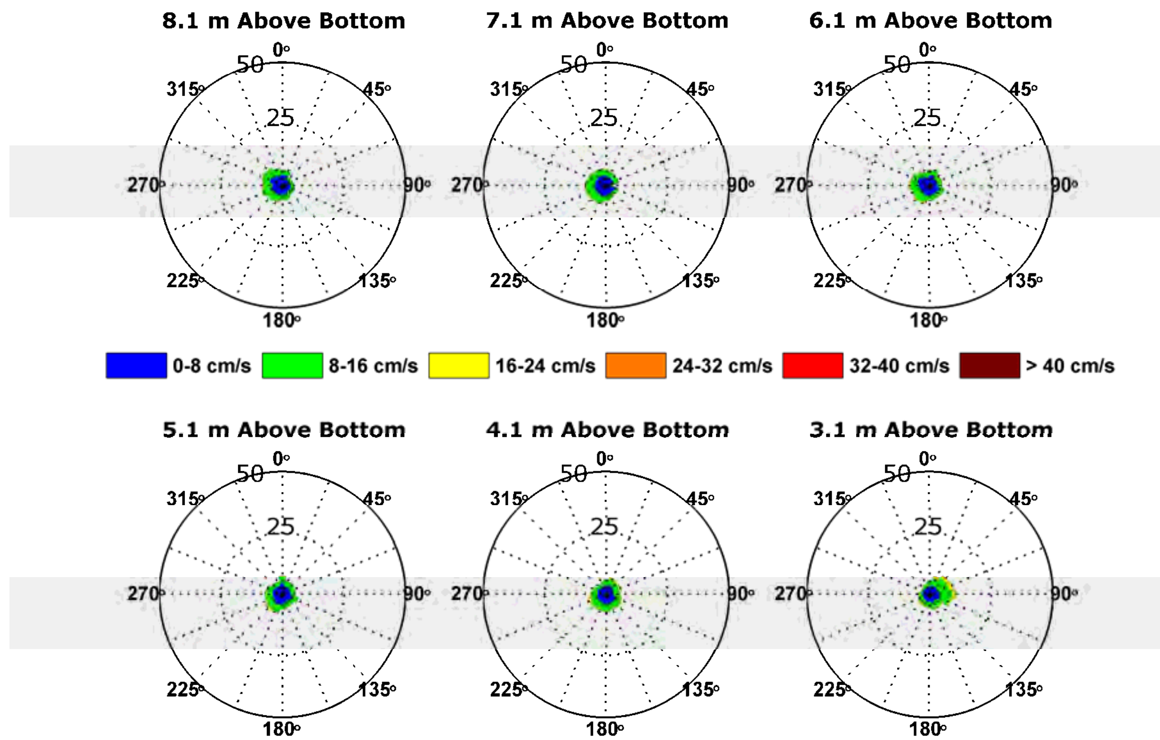
Appendix A.8

Percent occurrence roses

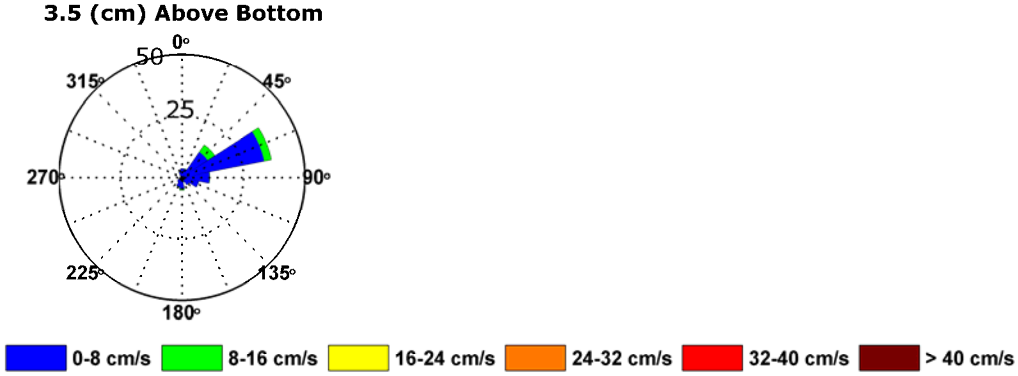
Port Angeles - Station 1 - ADP Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 25, 2008



Port Angeles - Station 1 - ADP Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 25, 2008



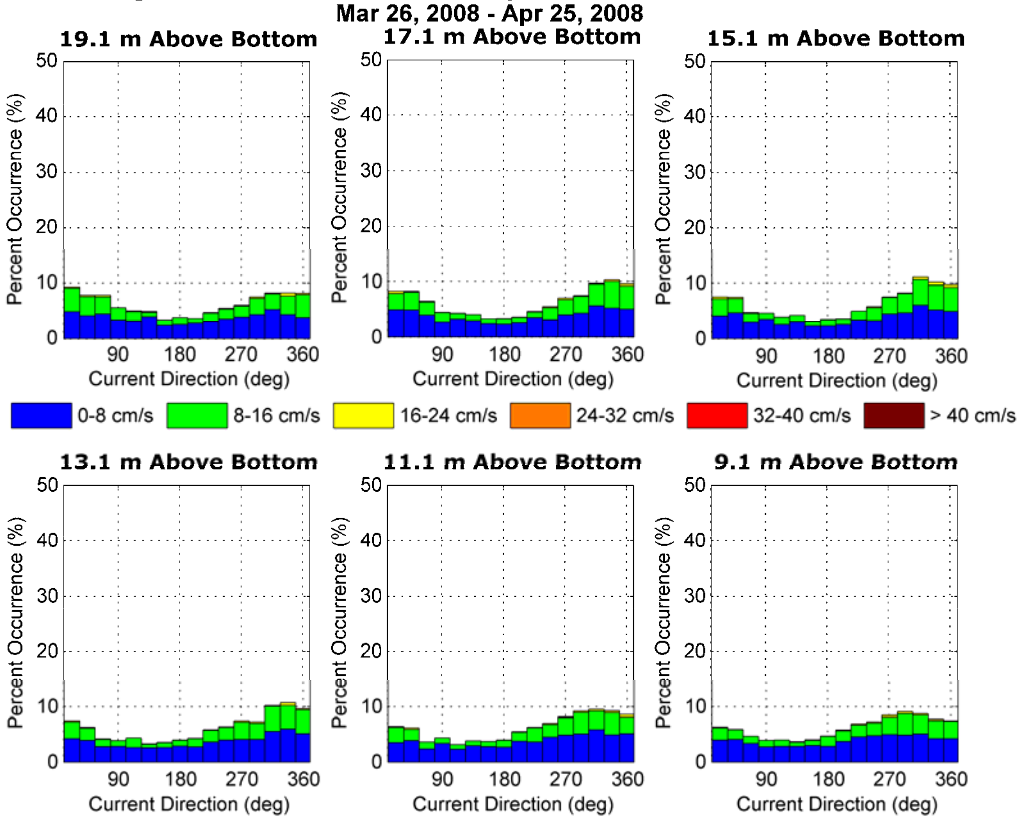
Port Angeles - Station 1 - ADVO Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 25, 2008



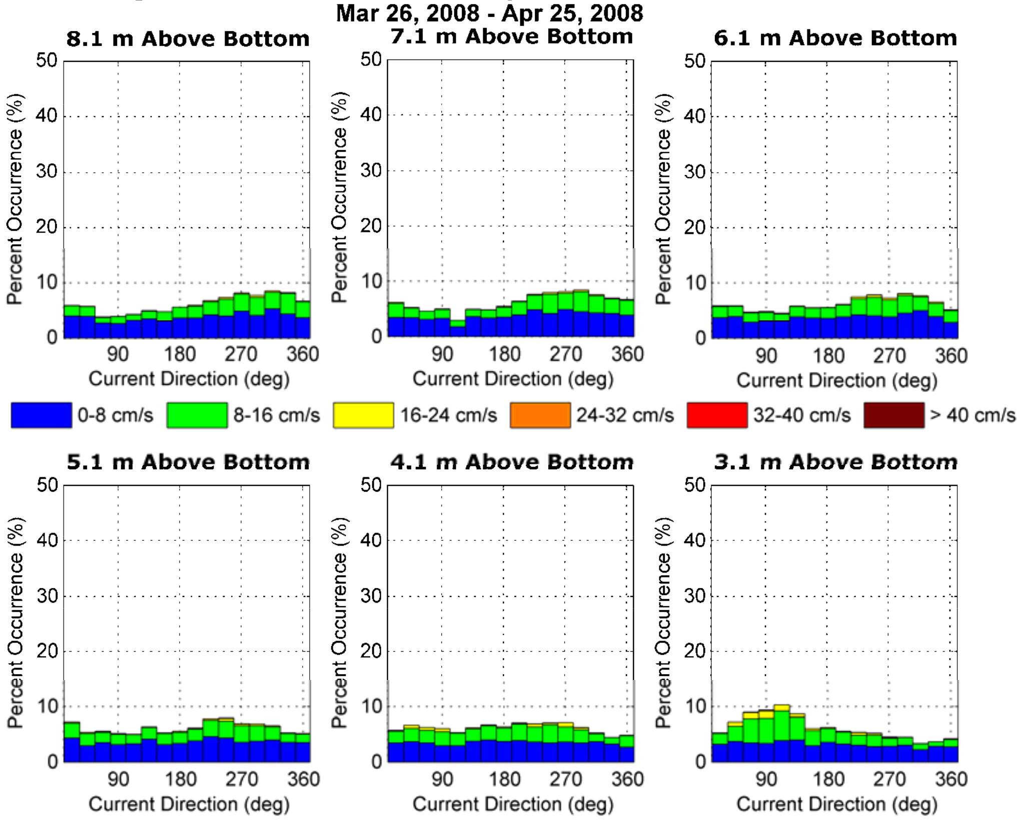
Appendix A.9

Percent occurrence histograms

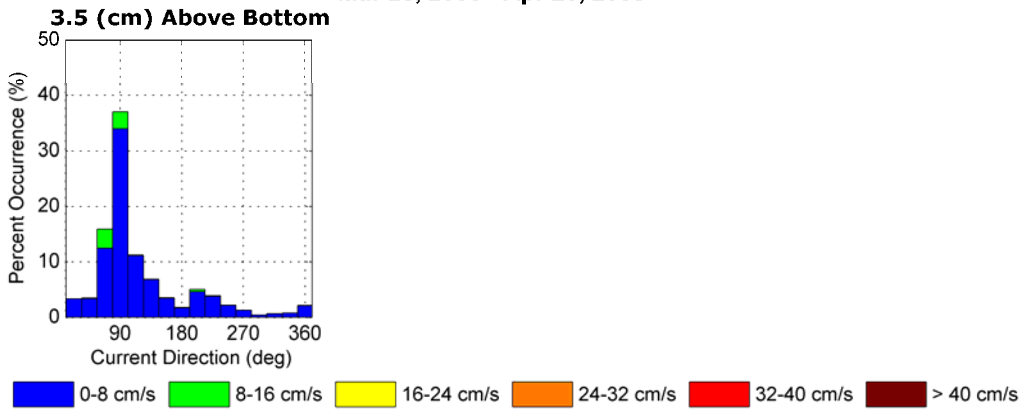
Port Angeles - Station 1 - ADP Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 25, 2008



Port Angeles - Station 1 - ADP Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 25, 2008

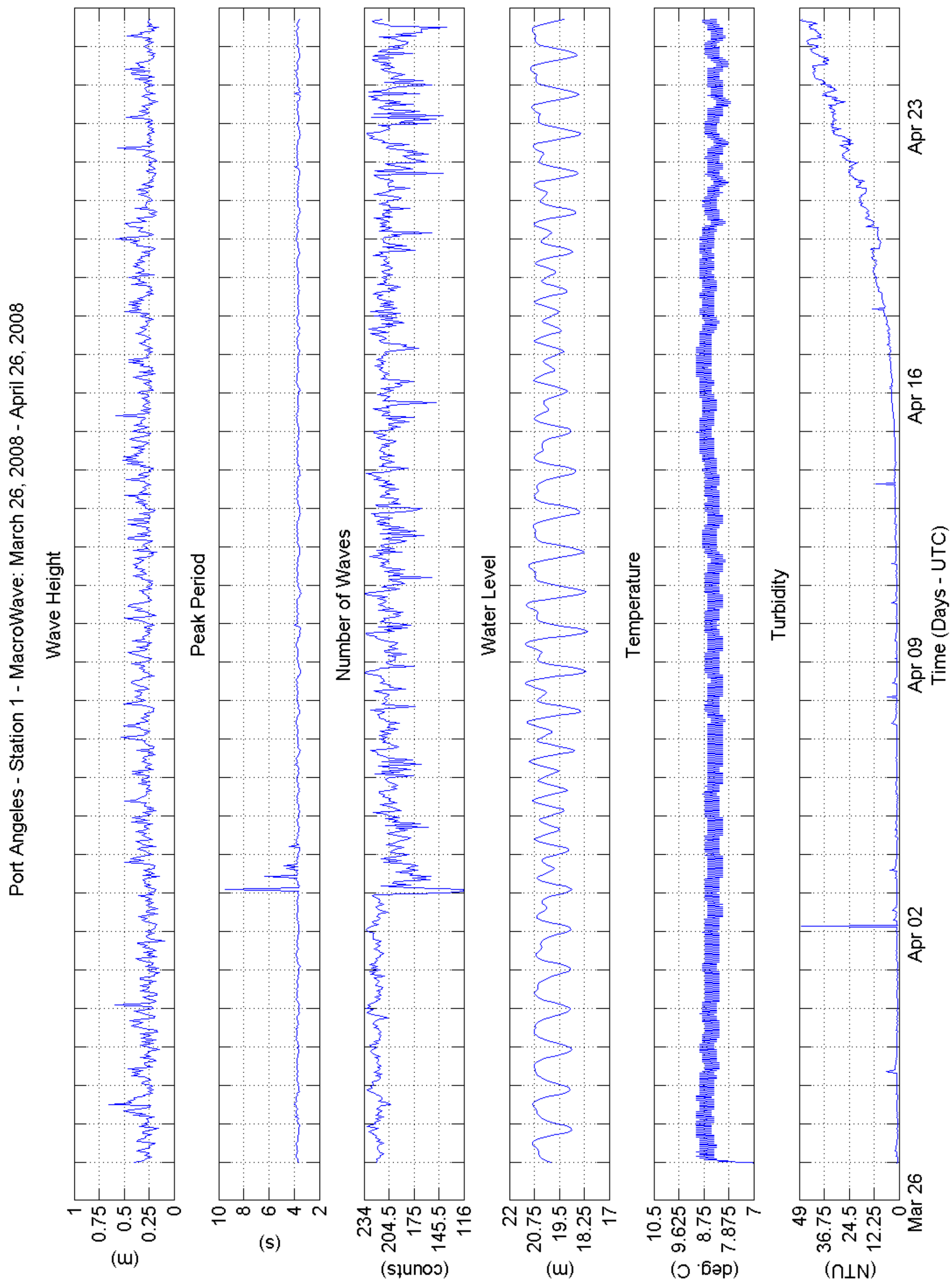


Port Angeles - Station 1 - ADVO Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 25, 2008



Appendix A.10

Time history plots of waves, temperature and turbidity

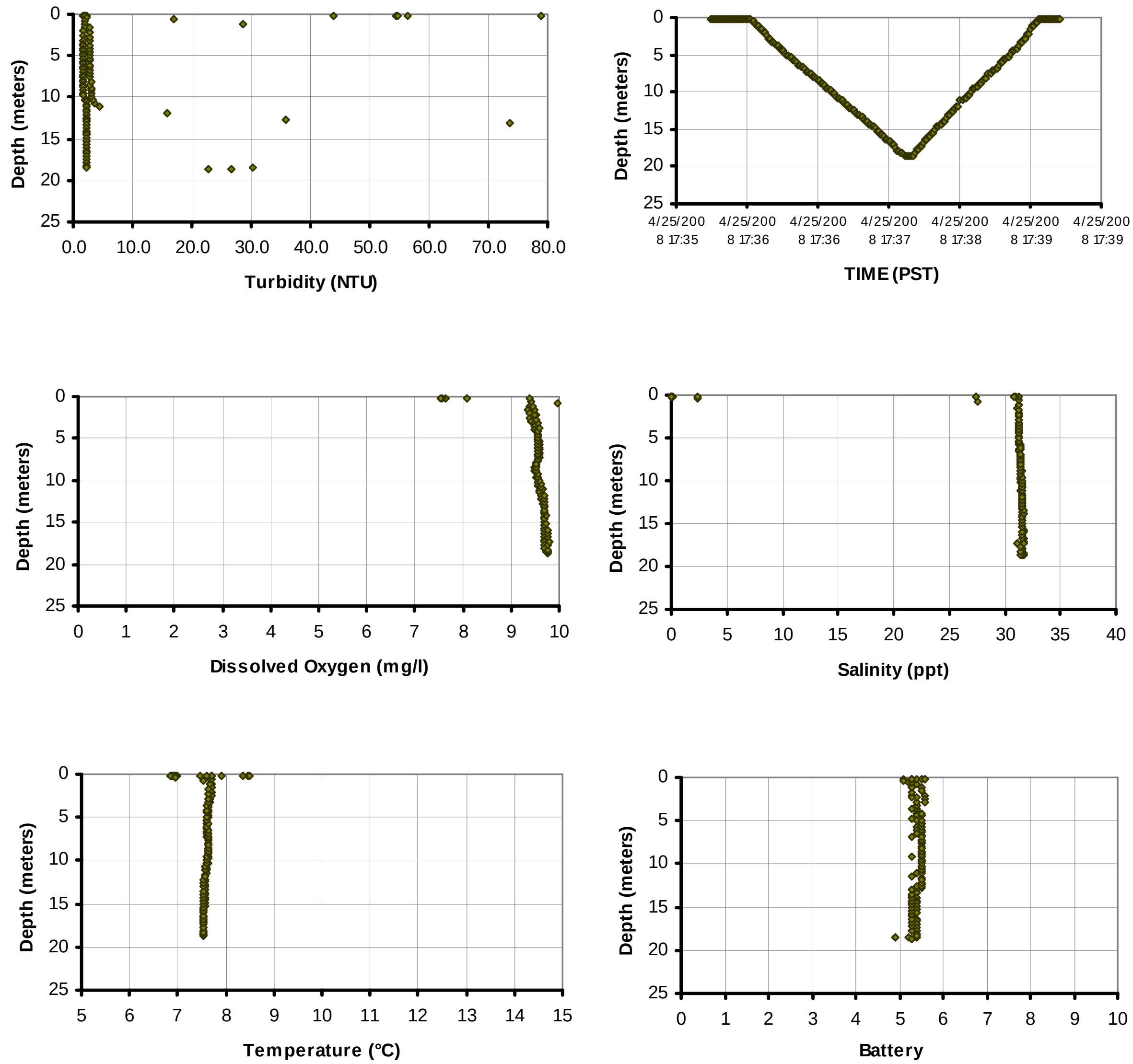

Port Angeles - Station 1 - MacroWave: March 26, 2008 - April 26, 2008
Wave Height
(m)
1
0.75
0.5
0.25
0
Peak Period
(s)
10
8
6
4
2
Number of Waves
(counts)
234
204.5
175
145.5
116
Water Level
(m)
22
20.75
19.5
18.25
17
Temperature
(deg. C)
10.5
9.625
8.75
7.875
7
Turbidity
(NTU)
49
36.75
24.5
12.25
0
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix A.11

CTD Cast Summary

Start Time: 17:35:52
Duration(min): 3.53
Samples: 212

Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	Battery	Temperature (°C)
2-3 (6.6-9.8)	2.2	9.45	31.3	5.47	7.67
9-10 (29.5-32.8)	2.4	9.55	31.5	5.48	7.62
17-18 (55.8-59.1)	465.1	9.74	31.5	5.36	7.55



Appendix B

Station 2
Current Measurements

B.1: Color contour plots of current speed and direction
B.2: Color contour plot of ADP data quality parameters
B.3: ADP depth, tilt, and water temperature time history plots
B.4: Time history vector plots of current speed and direction
- **North Orientation**
- **East Orientation**

B.5: ADVo Time history plots of current vectors and data quality parameters
- **North Orientation**
- **East Orientation**

B.6: Current Statistics
- **ADP**
- **ADVo**

B.7: Percent occurrence tables of current speed versus direction
- **ADP**
- **ADVo**

B.8: Percent occurrence roses
- **ADP**
- **ADVo**

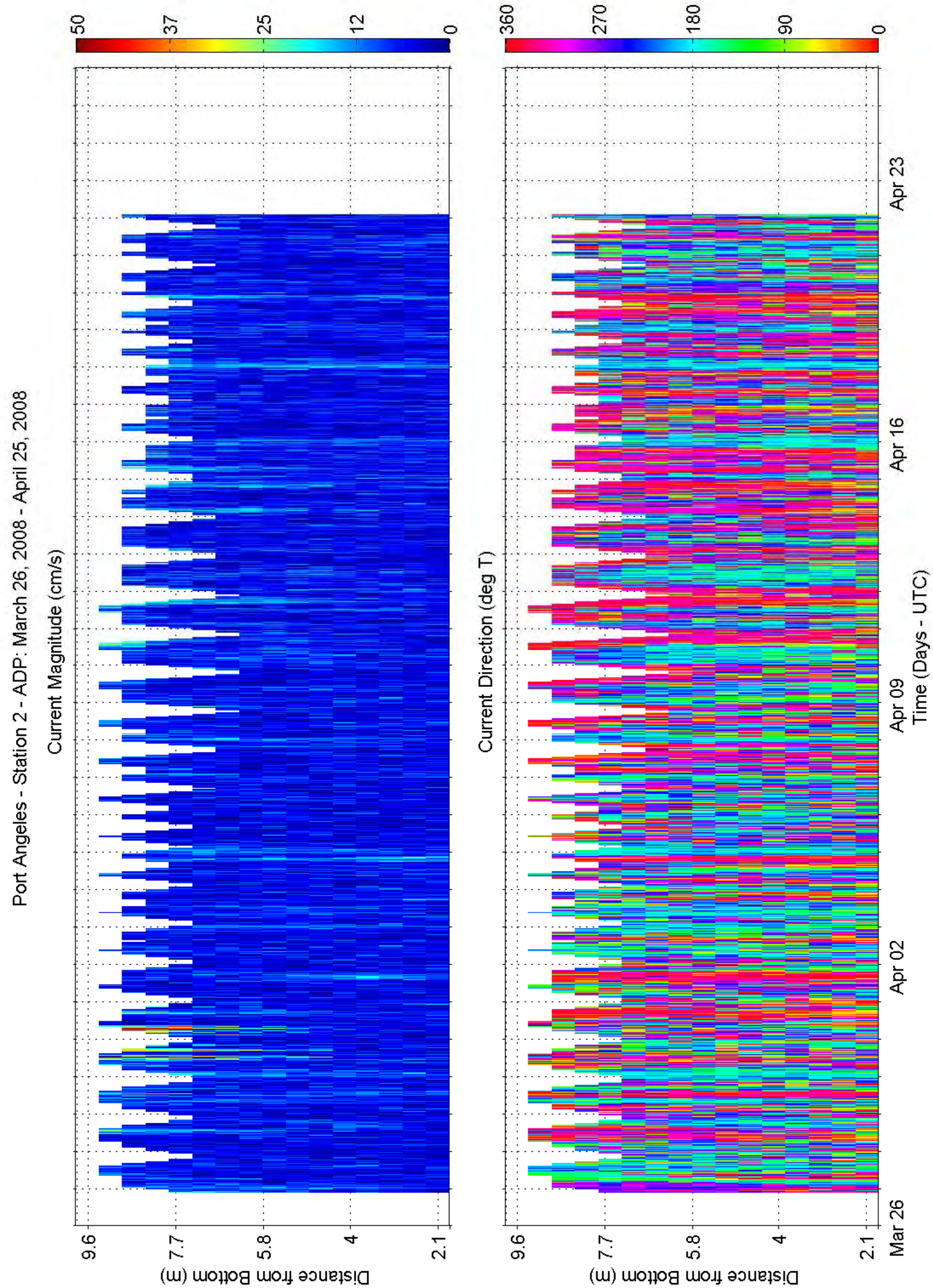
B.9: Percent occurrence histograms
- **ADP**
- **ADVo**

B.10: Time history plots of waves, temperature and turbidity
B.11: CTD Cast Summary

Appendix B.1

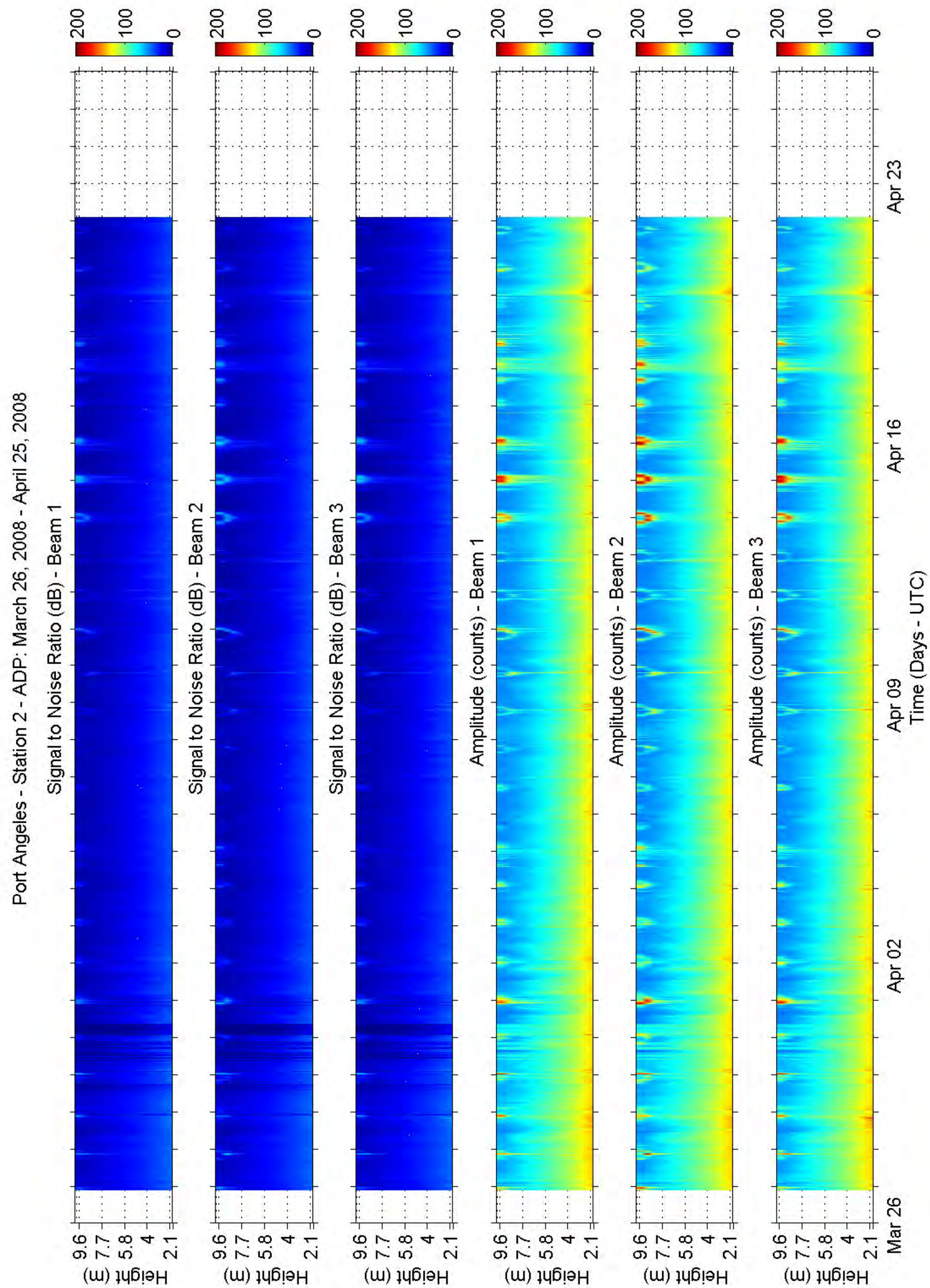
Color contour plots of current speed and direction

Speed is in cm/s, direction is in deg T, Toward.


Port Angeles - Station 2 - ADP: March 26, 2008 - April 25, 2008
Current Magnitude (cm/s)
50
37
25
12
0
Distance from Bottom (m)
9.6
7.7
5.8
4
2.1
Current Direction (deg T)
360
270
180
90
0
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

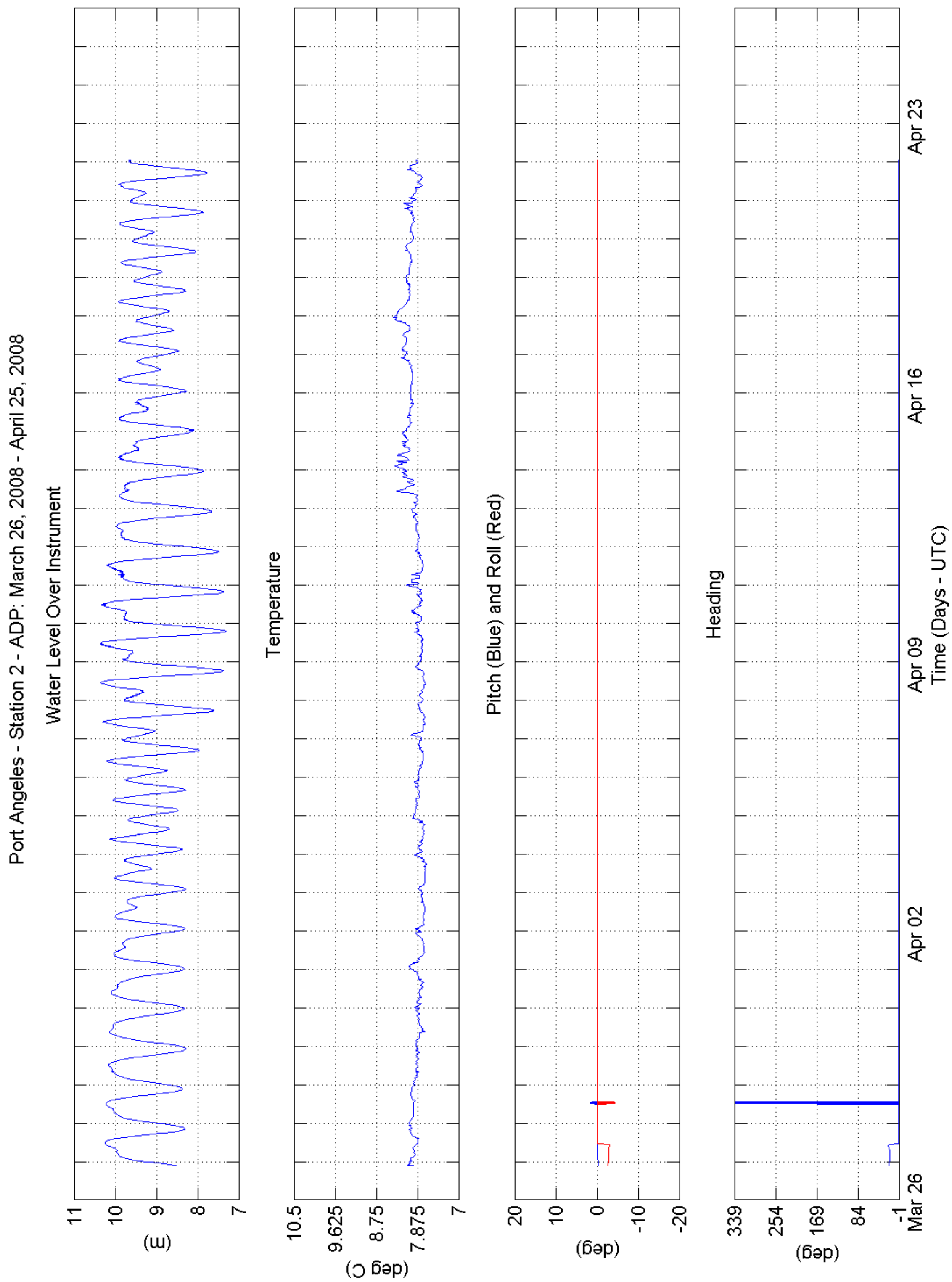
Appendix B.2

Color contour plots of ADP data quality parameters


Port Angeles - Station 2 - ADP: March 26, 2008 - April 25, 2008
Signal to Noise Ratio (dB) - Beam 1
Signal to Noise Ratio (dB) - Beam 2
Signal to Noise Ratio (dB) - Beam 3
Amplitude (counts) - Beam 1
Amplitude (counts) - Beam 2
Amplitude (counts) - Beam 3
Height (m)
9.6
7.7
5.8
4
2.1
200
100
0
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix B.3

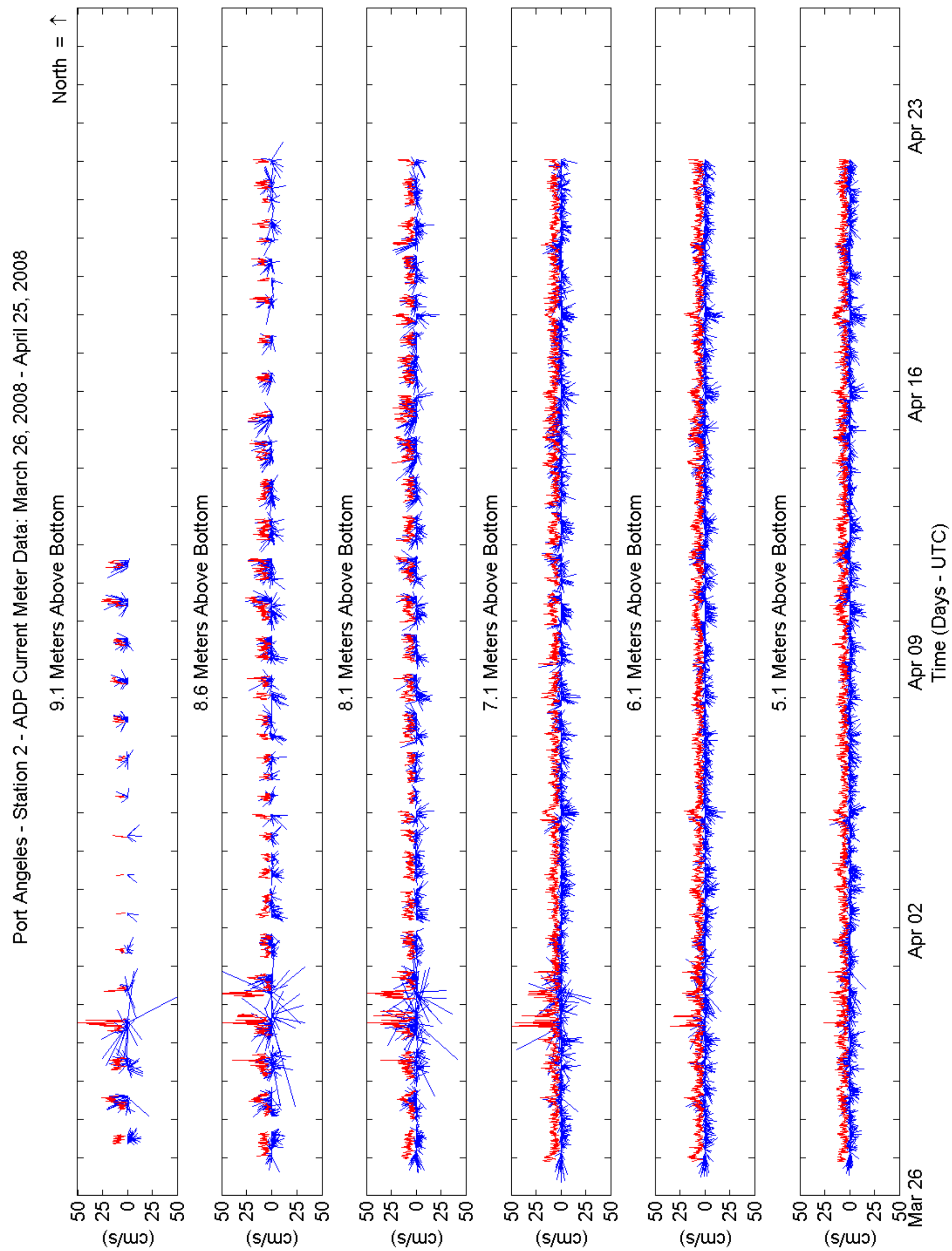
ADP depth, tilt, and water temperature time history plots

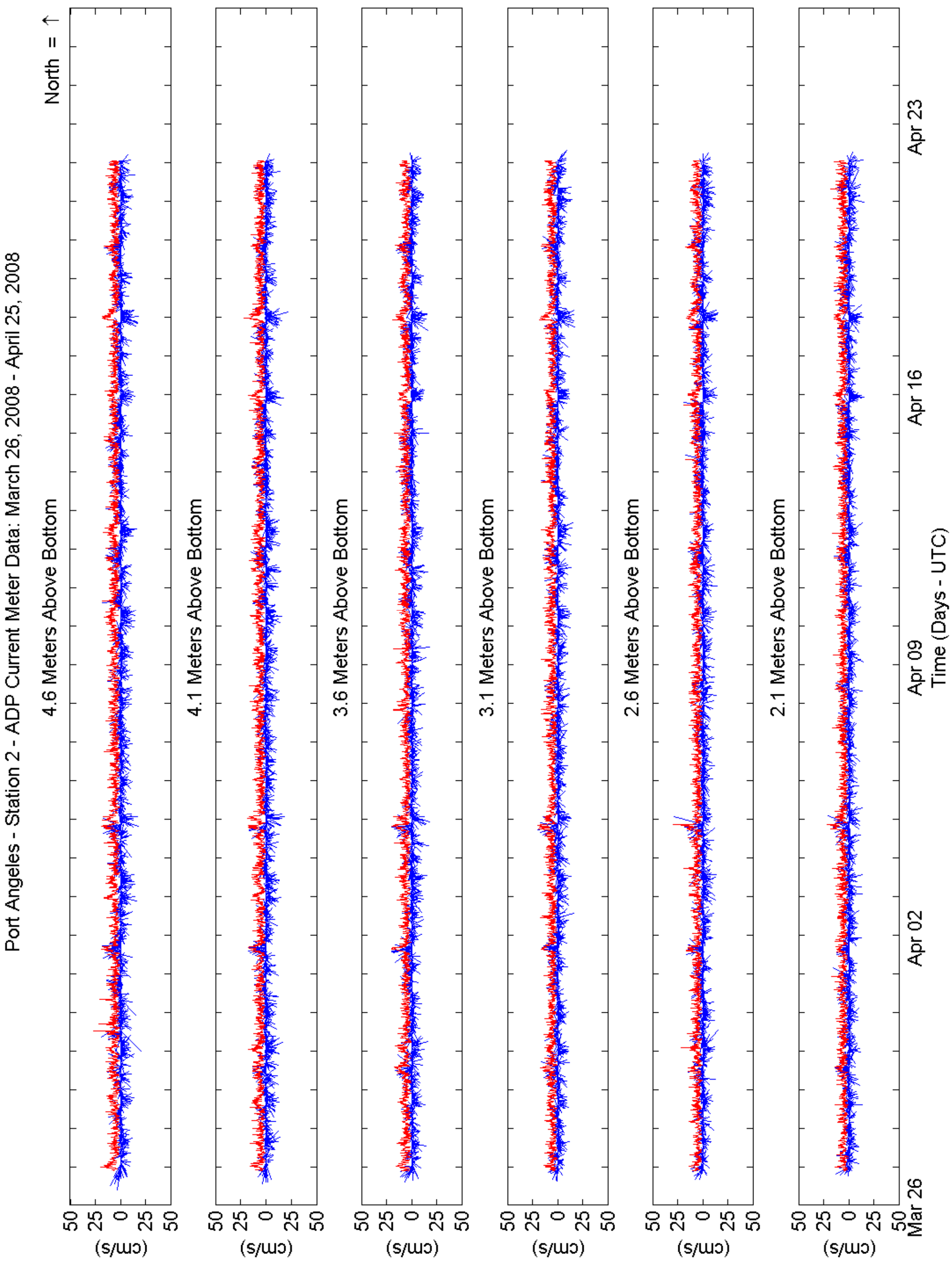

Port Angeles - Station 2 - ADP: March 26, 2008 - April 25, 2008
Water Level Over Instrument
(m)
11
10
9
8
7
Temperature
(deg C)
10.5
9.625
8.75
7.875
7
Pitch (Blue) and Roll (Red)
(deg)
20
10
0
-10
-20
Heading
(deg)
339
254
169
84
-1
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

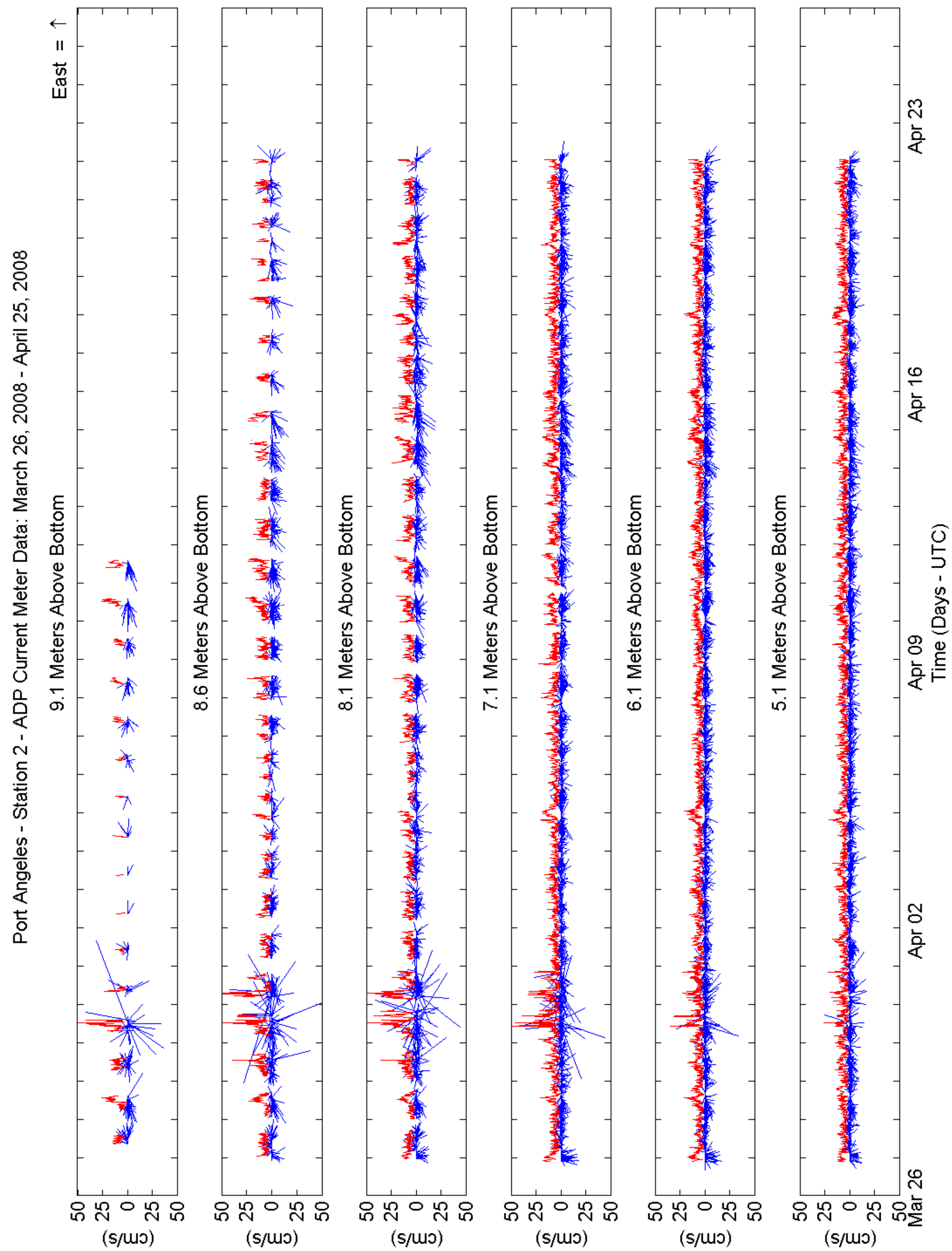
Appendix B.4

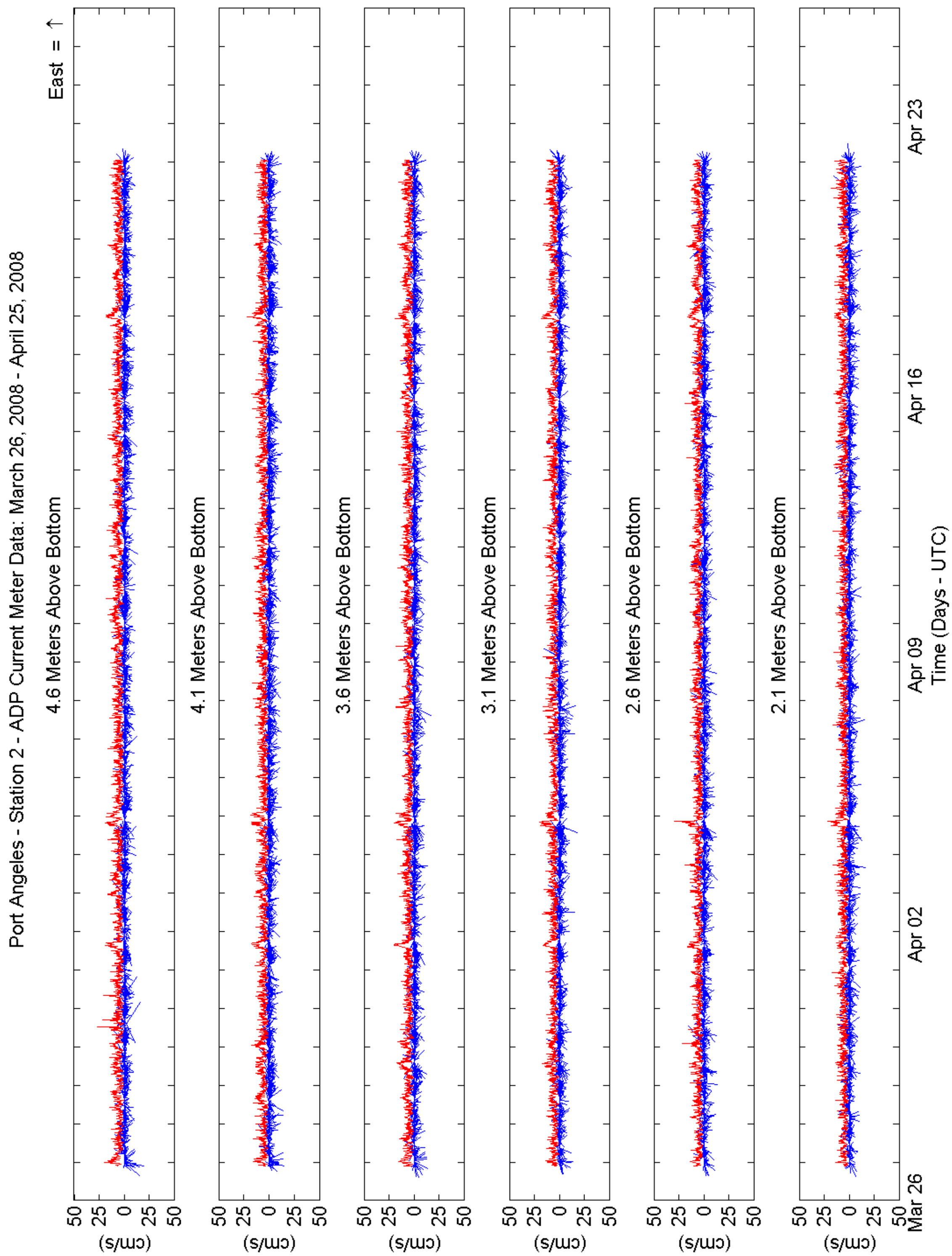
Time history vector plots of current speed and direction

Speed is in cm/s, direction is in deg T, Toward.


Port Angeles - Station 2 - ADP Current Meter Data: March 26, 2008 - April 25, 2008
North = ↑
9.1 Meters Above Bottom
8.6 Meters Above Bottom
8.1 Meters Above Bottom
7.1 Meters Above Bottom
6.1 Meters Above Bottom
5.1 Meters Above Bottom
(cm/s)
50 25 0 25 50
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

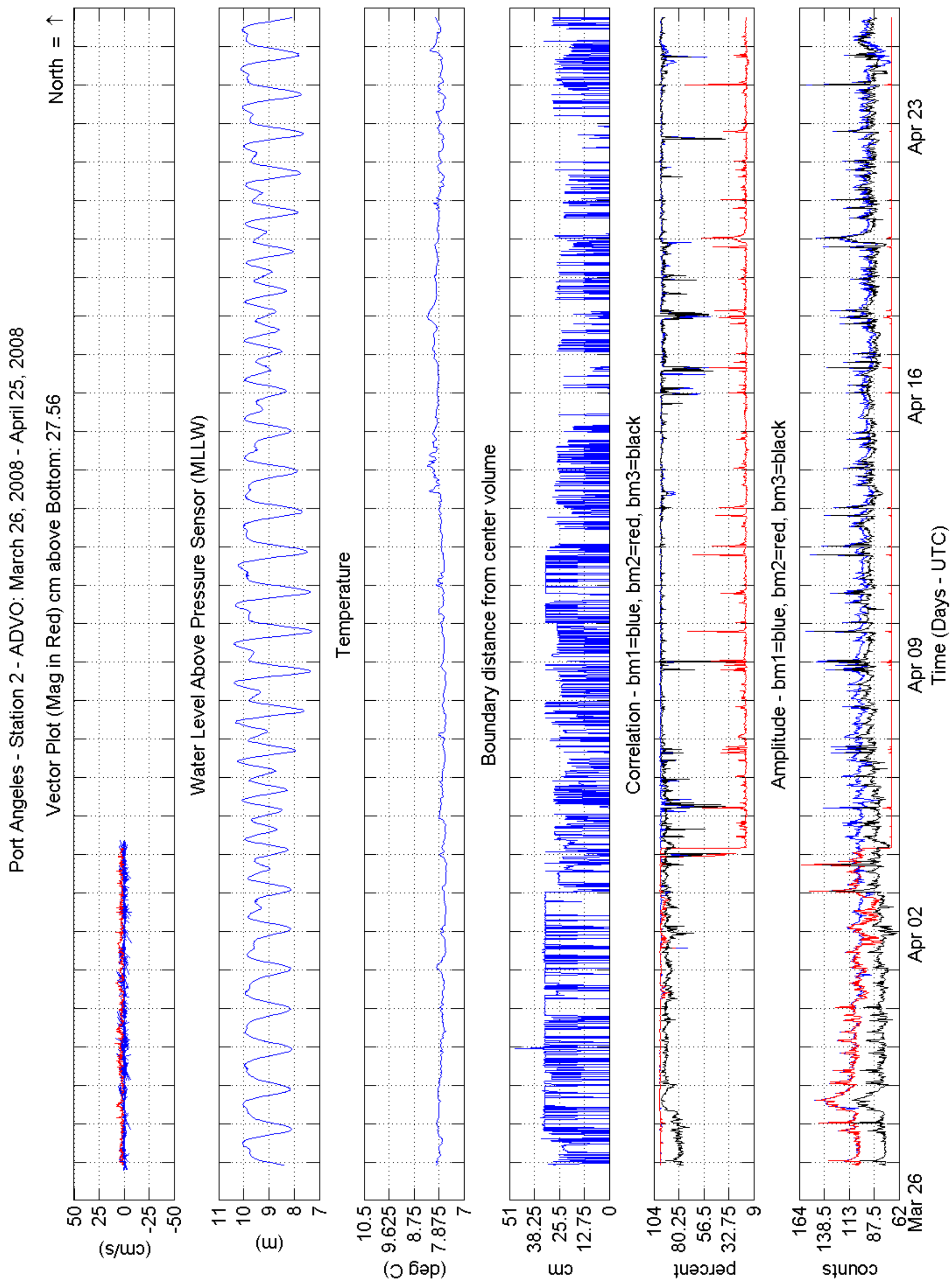

Port Angeles - Station 2 - ADP Current Meter Data: March 26, 2008 - April 25, 2008
North = ↑
4.6 Meters Above Bottom
4.1 Meters Above Bottom
3.6 Meters Above Bottom
3.1 Meters Above Bottom
2.6 Meters Above Bottom
2.1 Meters Above Bottom
(cm/s)
50 25 0 25 50
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

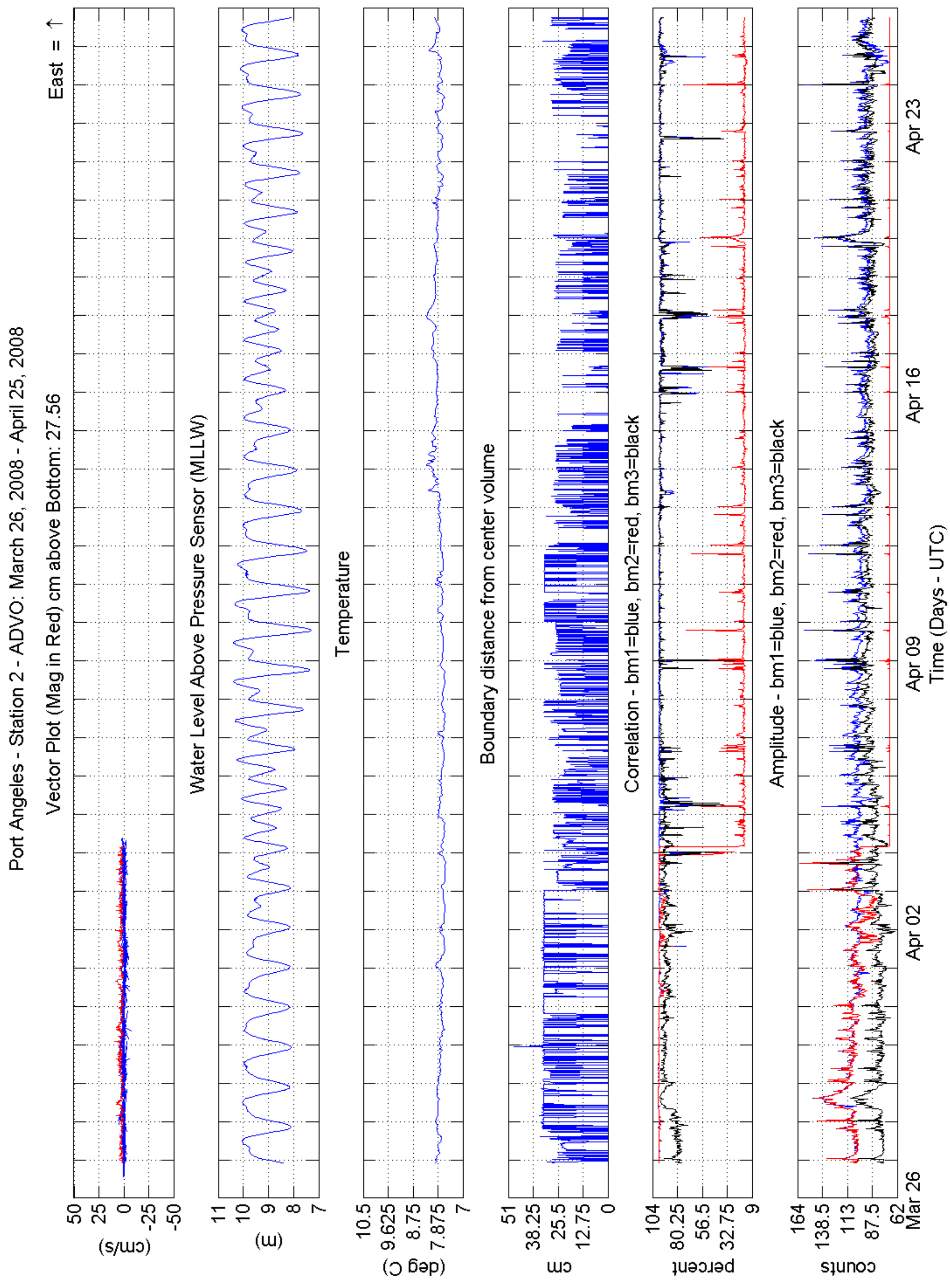

Port Angeles - Station 2 - ADP Current Meter Data: March 26, 2008 - April 25, 2008
East = →
9.1 Meters Above Bottom
8.6 Meters Above Bottom
8.1 Meters Above Bottom
7.1 Meters Above Bottom
6.1 Meters Above Bottom
5.1 Meters Above Bottom
(cm/s)
50 25 0 25 50
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)


Port Angeles - Station 2 - ADP Current Meter Data: March 26, 2008 - April 25, 2008
East = ↑
4.6 Meters Above Bottom
4.1 Meters Above Bottom
3.6 Meters Above Bottom
3.1 Meters Above Bottom
2.6 Meters Above Bottom
2.1 Meters Above Bottom
(cm/s)
50 25 0 25 50
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix B.5

ADVo Time history plots of current vectors and data quality parameters


Port Angeles - Station 2 - ADVO: March 26, 2008 - April 25, 2008
Vector Plot (Mag in Red) cm above Bottom: 27.56
North = ↑
(cm/s)
50 25 0 -25 -50
Water Level Above Pressure Sensor (MLLW)
(m)
11 10 9 8 7
Temperature
(deg C)
10.5 9.625 8.75 7.875 7
Boundary distance from center volume
cm
51 38.25 25.5 12.75 0
Correlation - bm1=blue, bm2=red, bm3=black
percent
104 80.25 56.5 32.75 9
Amplitude - bm1=blue, bm2=red, bm3=black
counts
164 138.5 113 87.5 62
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)


Port Angeles - Station 2 - ADVO: March 26, 2008 - April 25, 2008
Vector Plot (Mag in Red) cm above Bottom: 27.56
East = ↑
(cm/s)
50 25 0 -25 -50
Water Level Above Pressure Sensor (MLLW)
(m)
11 10 9 8 7
Temperature
(deg C)
10.5 9.625 8.75 7.875 7
Boundary distance from center volume
cm
51 38.25 25.5 12.75 0
Correlation - bm1=blue, bm2=red, bm3=black
percent
104 80.25 56.5 32.75 9
Amplitude - bm1=blue, bm2=red, bm3=black
counts
164 138.5 113 87.5 62
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix B.6

Current Statistics

```
     Date Modified  :  06/04/2008
     Site Name      :  Port Angeles - Station 2
*******************************************************************
** Data produced by:                                             **
**                                                               **
**                  Evans-Hamilton, Inc.                         **
**                 4608 Union Bay Place NE                       **
**                   Seattle, WA 98105                           **
**                     (206) 526-5622                            **
**                                                               **
*******************************************************************
** Meas. Bottom Depth  :  10 m (measured at deployment)
** Instrument Type     :  1500 kHz SonTek ADP
** Latitude            :  048 07.331905 N (Degrees Decimal.Minutes)
** Longitude           :  123 25.336211 W (Degrees Decimal.Minutes)
** Magnetic Declination:  17.65 E (Decimal.Degrees)
** Start Time (UTC)    :  03/26/2008 21:30:00 (MM/DD/YYYY hh:mm:ss)
** End Time (UTC)      :  04/22/2008 01:33:00 (MM/DD/YYYY hh:mm:ss)
*******************************************************************
** Column       1: Bin Height above Bottom (m)                   **
**                 (Height of Bin wrt Bottom)                    **
** Column       2: Number of Data Points                         **
** Column       3: Average East (cm/s)                           **
** Column       4: Average North (cm/s)                          **
** Column       5: Average Speed (cm/s)                          **
** Column       6: Maximum Speed (cm/s)                          **
** Column       7: Direction of Maximum Speed (deg T)            **
** Column       8: Minimum Speed (cm/s)                          **
** Column       9: Direction of Minimum Speed (deg T)            **
** Column      10: Net Current Speed (cm/s)                      **
** Column      11: Net Current Direction (deg T)                 **
*******************************************************************
```

Height	DataPts	AvgE	AvgN	AvgSpd	MaxSpd	DirOfMx	MinSpd	DirOfMn	NetSpd	NetDir
End										
09.58	0000	00.00	00.00	00.00	NaN	NaN	NaN	NaN	00.00	NaN
09.08	0266	-1.01	03.04	10.48	76.50	155.8	00.30	287.6	03.20	341.6
08.58	1131	-1.70	01.38	08.31	80.80	020.3	00.20	314.3	02.19	309.1
08.08	1714	-1.44	01.10	07.68	52.60	303.0	00.30	359.3	01.82	307.4
07.58	2111	-1.82	-0.16	07.21	47.60	057.1	00.10	197.7	01.83	265.0
07.08	2382	-1.71	-0.64	06.79	48.60	335.3	00.10	017.6	01.82	249.4
06.58	2488	-1.81	-0.63	06.58	43.60	292.9	00.00	000.0	01.92	250.8
06.08	2512	-1.85	-0.55	06.35	34.70	283.5	00.00	000.0	01.93	253.6
05.58	2512	-1.64	-0.72	06.12	28.50	055.5	00.10	062.6	01.79	246.3
05.08	2512	-1.68	-0.81	06.14	25.70	104.9	00.10	287.6	01.87	244.2
04.58	2512	-1.35	-0.79	06.00	26.40	218.9	00.00	000.0	01.57	239.9
04.08	2512	-1.36	-0.83	06.04	22.10	165.7	00.00	000.0	01.59	238.7
03.58	2512	-1.12	-0.63	05.94	19.80	352.3	00.00	000.0	01.28	240.8
03.08	2512	-0.94	-0.46	05.87	20.10	348.8	00.10	197.7	01.04	243.8
02.58	2512	-0.65	-0.23	05.75	29.10	014.0	00.10	287.6	00.69	250.4
02.08	2512	-0.26	-0.12	05.66	21.90	020.5	00.00	000.0	00.29	244.4

```
     Date Modified  :  06/06/2008
     Site Name      :  Port Angeles Station 2
*******************************************************************
** Data produced by:                                             **
**                                                               **
**                  Evans-Hamilton, Inc.                         **
**                 4608 Union Bay Place NE                       **
**                   Seattle, WA 98105                           **
**                     (206) 526-5622                            **
**                                                               **
*******************************************************************
** Meas. Bottom Depth  :  8.5 m (measured at deployment)
** Instrument Type     :  5 MHz Sontek ADVO
** Latitude            :  048 07.331905 N (Degrees Decimal.Minutes)
** Longitude           :  123 25.336211 W (Degrees Decimal.Minutes)
** Magnetic Declination:  17.65 E (Decimal.Degrees)
** Start Time (UTC)    :  03/26/2008 22:00:03 (MM/DD/YYYY hh:mm:ss)
** End Time (UTC)      :  04/25/2008 18:15:03 (MM/DD/YYYY hh:mm:ss)
*******************************************************************
** Column       1: Sensor Height above Bottom (cm)               **
**                 (Height of Sensor wrt Bottom)                 **
** Column       2: Number of Data Points                         **
** Column       3: Average East (cm/s)                           **
** Column       4: Average North (cm/s)                          **
** Column       5: Average Speed (cm/s)                          **
** Column       6: Maximum Speed (cm/s)                          **
** Column       7: Direction of Maximum Speed (deg T)            **
** Column       8: Minimum Speed (cm/s)                          **
** Column       9: Direction of Minimum Speed (deg T)            **
** Column      10: Net Current Speed (cm/s)                      **
** Column      11: Net Current Direction (deg T)                 **
*******************************************************************
Height  DataPts AvgE    AvgN    AvgSpd  MaxSpd  DirOfMx MinSpd  DirOfMn NetSpd  NetDir
*End*
27.56   0824    00.23   00.36   02.73   11.65   268.6   00.15   204.7   00.42   032.5
```

Appendix B.7

Percent occurrence tables of current speed versus direction

Location : Port Angeles - Station 2
Deployment Dates : **Mar 26, 2008 - Apr 22, 2008**
Average Depth of Instrument : 8.9 meters
Distance Above Bottom: **2.1 meters**
Number of observations : 2512
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	2.07	2.19	1.91	1.63	2.03	2.43	1.55	1.59	1.71	2.23	2.51	1.59	1.99	2.83	1.83	1.91	32.01
4 - 8	3.34	3.07	2.39	2.63	1.99	2.43	2.83	3.14	4.06	3.30	3.70	2.71	2.63	2.59	2.63	2.95	46.38
8 - 12	1.47	1.15	0.92	0.80	0.56	1.00	1.07	1.19	1.67	1.35	1.04	1.11	0.96	1.15	1.04	1.79	18.27
12 - 16	0.32	0.16	0.08	0.24	0.08	0.04	0.12	0.24	0.52	0.24	0.12	0.16	0.12	0.08	0.20	0.36	3.07
16 - 20	0.00	0.04	0.00	0.00	0.00	0.04	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.00	0.08	0.00	0.24
20 - 24	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	7.21	6.65	5.29	5.29	4.66	5.93	5.57	6.21	7.96	7.13	7.36	5.57	5.73	6.65	5.77	7.01	100.00

Location : Port Angeles - Station 2
Deployment Dates : **Mar 26, 2008 - Apr 22, 2008**
Average Depth of Instrument : 8.9 meters
Distance Above Bottom: **3.1 meters**
Number of observations : 2512
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.59	2.15	1.47	1.35	1.31	2.03	1.47	1.75	2.39	2.35	2.19	1.99	2.31	2.63	2.19	1.83	31.01
4 - 8	2.87	2.55	1.87	1.39	1.31	1.91	2.51	3.14	3.58	4.22	4.02	3.38	2.71	2.87	2.99	3.38	44.71
8 - 12	1.75	1.07	0.60	0.44	0.32	0.16	0.60	2.07	2.19	2.43	1.79	1.07	0.92	1.15	1.71	1.47	19.75
12 - 16	0.56	0.24	0.12	0.00	0.08	0.08	0.24	0.24	0.68	0.36	0.16	0.08	0.20	0.28	0.08	0.44	3.82
16 - 20	0.12	0.12	0.00	0.00	0.00	0.04	0.00	0.12	0.04	0.08	0.00	0.04	0.00	0.04	0.00	0.08	0.68
20 - 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.89	6.13	4.06	3.18	3.03	4.22	4.82	7.32	8.88	9.43	8.16	6.57	6.13	6.97	6.97	7.21	100.00

Location : Port Angeles - Station 2
Deployment Dates : **Mar 26, 2008 - Apr 22, 2008**
Average Depth of Instrument : 8.9 meters
Distance Above Bottom: **4.1 meters**
Number of observations : 2512
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed	349	11	34	56	79	101	124	146	169	191	214	236	259	281	304	326	
cm/sec	11	34	56	79	101	124	146	169	191	214	236	259	281	304	326	349	Total
0 - 4	2.11	1.55	1.43	1.39	1.23	1.75	1.79	1.59	1.91	2.91	2.83	2.15	2.11	1.87	2.39	1.71	30.73
4 - 8	2.59	2.47	1.43	1.15	0.68	1.35	1.87	3.82	3.70	4.38	3.46	3.30	3.18	3.07	3.70	2.67	42.87
8 - 12	1.04	1.00	0.44	0.12	0.08	0.52	0.84	2.03	2.91	2.39	1.83	1.27	1.23	1.55	1.67	1.79	20.70
12 - 16	0.44	0.32	0.00	0.00	0.04	0.00	0.08	0.40	0.96	0.88	0.48	0.32	0.20	0.16	0.40	0.36	5.02
16 - 20	0.20	0.04	0.00	0.00	0.00	0.00	0.00	0.04	0.08	0.08	0.00	0.00	0.00	0.00	0.08	0.12	0.64
20 - 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.37	5.37	3.30	2.67	2.03	3.62	4.58	7.92	9.55	10.63	8.60	7.05	6.73	6.65	8.24	6.65	100.00

Location : Port Angeles - Station 2
Deployment Dates : **Mar 26, 2008 - Apr 22, 2008**
Average Depth of Instrument : 8.9 meters
Distance Above Bottom: **5.1 meters**
Number of observations : 2512
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.67	1.67	1.39	1.27	0.92	1.35	1.47	2.35	1.91	2.35	2.19	2.27	2.43	2.35	2.15	1.43	29.18
4 - 8	2.19	2.47	1.19	0.96	0.56	1.51	1.63	2.91	4.26	3.98	4.62	3.74	3.98	3.86	3.03	2.99	43.91
8 - 12	1.91	0.76	0.36	0.20	0.20	0.20	0.84	1.63	3.03	2.43	1.67	1.35	1.67	1.23	2.15	1.55	21.18
12 - 16	0.32	0.20	0.04	0.00	0.04	0.00	0.12	0.40	0.68	0.64	0.64	0.12	0.28	0.28	0.40	0.60	4.74
16 - 20	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.24	0.16	0.04	0.08	0.00	0.12	0.08	0.04	0.84
20 - 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.04	0.12
24 - 28	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.13	5.10	2.99	2.43	1.71	3.11	4.06	7.32	10.11	9.59	9.20	7.56	8.36	7.84	7.80	6.65	100.00

Location : Port Angeles - Station 2
Deployment Dates : **Mar 26, 2008 - Apr 22, 2008**
Average Depth of Instrument : 8.9 meters
Distance Above Bottom: **6.1 meters**
Number of observations : 2512
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	2.11	1.51	0.92	1.23	0.88	1.43	1.71	1.67	2.15	2.15	1.83	1.95	2.23	2.71	1.87	1.67	28.03
4 - 8	2.43	1.63	1.07	1.00	1.43	1.11	1.43	2.35	3.58	5.02	4.10	3.58	3.90	3.46	3.50	3.07	42.75
8 - 12	1.04	0.88	0.48	0.12	0.08	0.28	0.52	1.55	2.71	3.07	2.43	1.31	1.11	2.19	2.03	2.15	21.93
12 - 16	0.68	0.12	0.04	0.04	0.04	0.04	0.12	0.48	0.92	0.60	0.36	0.36	0.20	0.44	0.52	0.88	5.81
16 - 20	0.24	0.04	0.00	0.04	0.00	0.00	0.04	0.04	0.12	0.04	0.08	0.04	0.00	0.08	0.12	0.28	1.15
20 - 24	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.20
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.08
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.04
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.49	4.22	2.51	2.47	2.43	2.87	3.82	6.09	9.55	10.87	8.84	7.25	7.44	8.96	8.04	8.08	100.00

Location : Port Angeles - Station 2
Deployment Dates : **Mar 26, 2008 - Apr 22, 2008**
Average Depth of Instrument : 8.9 meters
Distance Above Bottom: **7.1 meters**
Number of observations : 2382
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.85	1.22	1.30	0.71	1.18	1.30	1.18	1.39	2.35	2.06	1.85	2.43	1.81	1.97	1.68	1.55	25.82
4 - 8	2.31	2.14	1.18	0.97	1.09	1.68	1.47	2.69	3.48	4.83	4.91	3.44	3.36	3.36	2.73	3.40	43.07
8 - 12	1.55	0.80	0.25	0.17	0.17	0.29	0.92	2.35	2.39	2.98	1.39	1.26	1.18	1.51	1.64	2.18	21.03
12 - 16	0.59	0.29	0.04	0.13	0.04	0.00	0.08	0.25	1.22	1.09	0.34	0.25	0.29	0.50	0.92	1.13	7.18
16 - 20	0.21	0.00	0.04	0.00	0.00	0.00	0.00	0.08	0.46	0.13	0.08	0.13	0.08	0.13	0.13	0.38	1.85
20 - 24	0.08	0.00	0.04	0.00	0.00	0.08	0.00	0.00	0.13	0.00	0.04	0.00	0.04	0.00	0.04	0.04	0.50
24 - 28	0.00	0.00	0.04	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.00	0.04	0.21
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.04	0.00	0.13
32 - 36	0.00	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
36 - 40	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.04
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04
Total	6.59	4.49	2.90	2.02	2.56	3.36	3.65	6.76	10.08	11.13	8.61	7.56	6.76	7.56	7.18	8.77	100.00

Location : Port Angeles - Station 2
Deployment Dates : **Mar 26, 2008 - Apr 22, 2008**
Average Depth of Instrument : 8.9 meters
Distance Above Bottom: **8.1 meters**
Number of observations : 1714
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.46	1.63	0.88	1.46	1.40	1.28	0.99	1.46	1.58	1.11	2.10	1.46	1.87	1.75	1.63	1.11	23.16
4 - 8	2.74	2.45	1.52	1.52	1.23	1.75	1.63	2.33	2.68	3.21	2.80	2.86	1.87	2.68	3.44	3.50	38.27
8 - 12	3.09	1.46	0.58	0.47	0.23	0.47	1.11	0.99	1.87	2.10	1.34	1.17	0.99	2.04	2.22	3.56	23.69
12 - 16	1.58	0.58	0.18	0.12	0.06	0.12	0.41	0.29	0.35	0.70	0.82	0.58	0.23	0.41	0.99	1.69	9.10
16 - 20	0.58	0.18	0.29	0.00	0.18	0.00	0.06	0.00	0.58	0.00	0.00	0.12	0.06	0.06	0.41	0.76	3.27
20 - 24	0.12	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.06	0.06	0.29	0.06	0.47	1.17
24 - 28	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.00	0.00	0.12	0.06	0.35
28 - 32	0.06	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.35
32 - 36	0.06	0.06	0.00	0.00	0.06	0.06	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.00	0.00	0.00	0.41
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.12
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.06	0.00	0.00	0.12
Total	9.68	6.42	3.44	3.73	3.15	3.73	4.20	5.08	7.23	7.18	7.23	6.36	5.13	7.29	8.87	11.20	100.00

Location : Port Angeles - Station 2
Deployment Dates : **Mar 26, 2008 - Apr 22, 2008**
Average Depth of Instrument : 8.9 meters
Distance Above Bottom: **9.1 meters**
Number of observations : 266
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.13	0.75	0.75	0.00	1.50	0.75	1.13	0.38	1.50	1.13	1.50	1.13	0.75	1.50	0.75	0.38	15.41
4 - 8	1.88	3.38	0.38	1.50	1.13	1.88	0.75	0.75	1.13	2.26	3.01	0.00	2.63	1.13	2.26	1.50	25.56
8 - 12	7.14	1.50	1.50	1.88	0.00	1.88	1.13	0.75	0.38	1.13	1.50	0.75	0.75	1.50	2.26	2.63	26.69
12 - 16	5.26	1.50	0.38	0.00	0.00	0.38	2.26	1.13	1.13	0.75	0.00	0.00	0.00	0.75	1.50	4.14	19.17
16 - 20	2.26	0.75	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.75	0.00	0.00	0.00	0.75	5.64
20 - 24	0.00	0.38	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.38	0.38	0.00	0.00	0.00	1.88	3.38
24 - 28	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.38	0.00	0.00	0.38	1.50
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.38	0.75
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.38
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.38
40 - 44	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.75
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38
Total	18.05	8.27	3.01	3.76	3.01	5.26	5.26	3.38	4.14	6.02	6.77	3.01	4.89	5.64	7.14	12.03	100.00

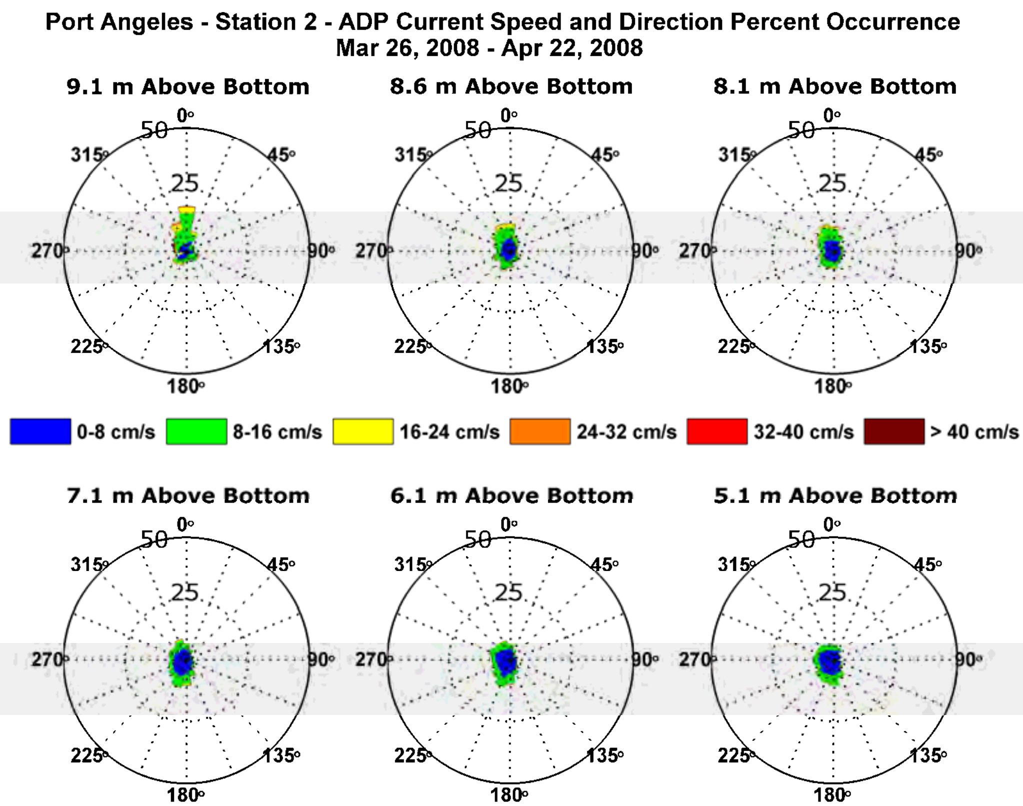
Location : Port Angeles Station 2
Deployment Dates : **Mar 26, 2008 - Apr 25, 2008**
Average Depth of Instrument : 20.1 meters
Distance Above Bottom: **27.6 cm**
Number of observations : 824
All data bins e.g. 1 <= x < 2

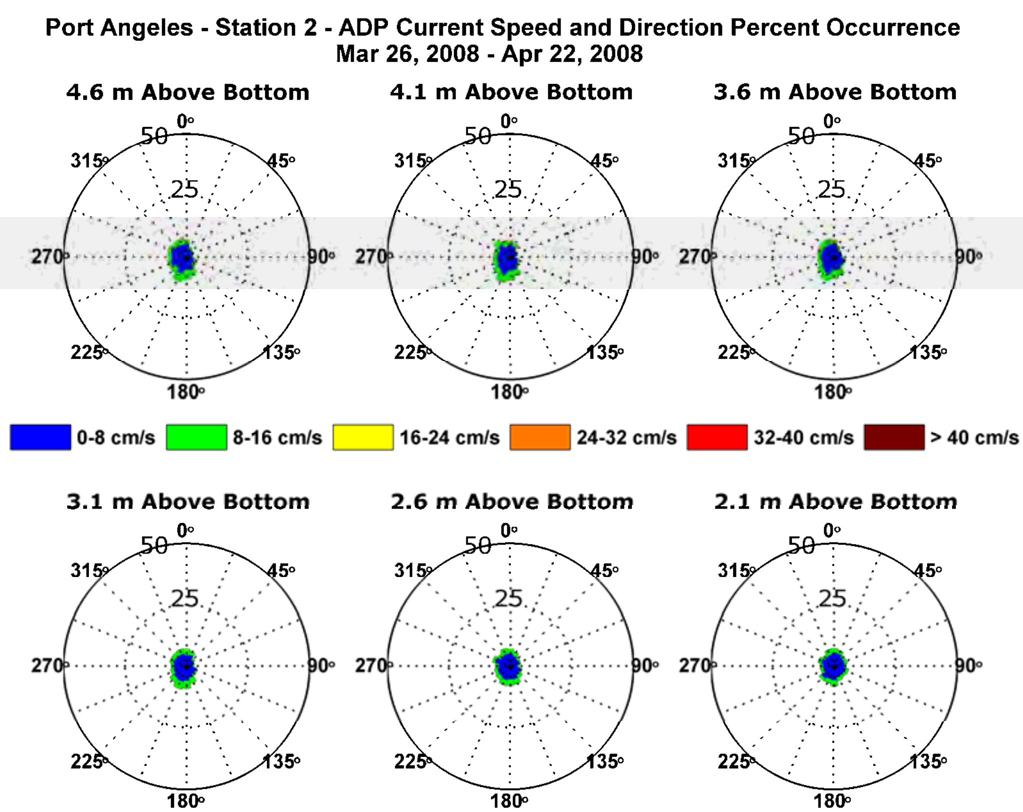
Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	6.07	4.25	7.52	6.67	4.37	4.49	7.28	5.34	3.52	2.91	2.31	3.76	4.49	4.73	6.31	7.40	81.55
4 - 8	2.31	0.73	0.61	0.24	0.00	0.49	2.06	1.94	0.61	0.00	0.61	0.49	1.09	1.70	1.46	3.52	17.84
8 - 12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.12	0.00	0.12	0.00	0.00	0.24	0.61
12 - 16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16 - 20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20 - 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	8.37	4.98	8.13	6.92	4.37	4.98	9.34	7.40	4.13	2.91	3.03	4.25	5.70	6.43	7.77	11.17	100.00

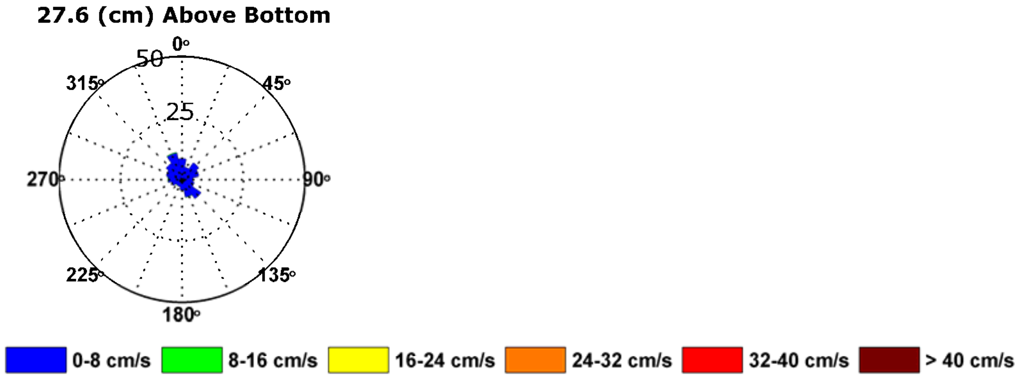
Appendix B.8

Percent occurrence roses


Port Angeles - Station 2 - ADP Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 22, 2008
9.1 m Above Bottom
8.6 m Above Bottom
8.1 m Above Bottom
7.1 m Above Bottom
6.1 m Above Bottom
5.1 m Above Bottom
0-8 cm/s
8-16 cm/s
16-24 cm/s
24-32 cm/s
32-40 cm/s
> 40 cm/s

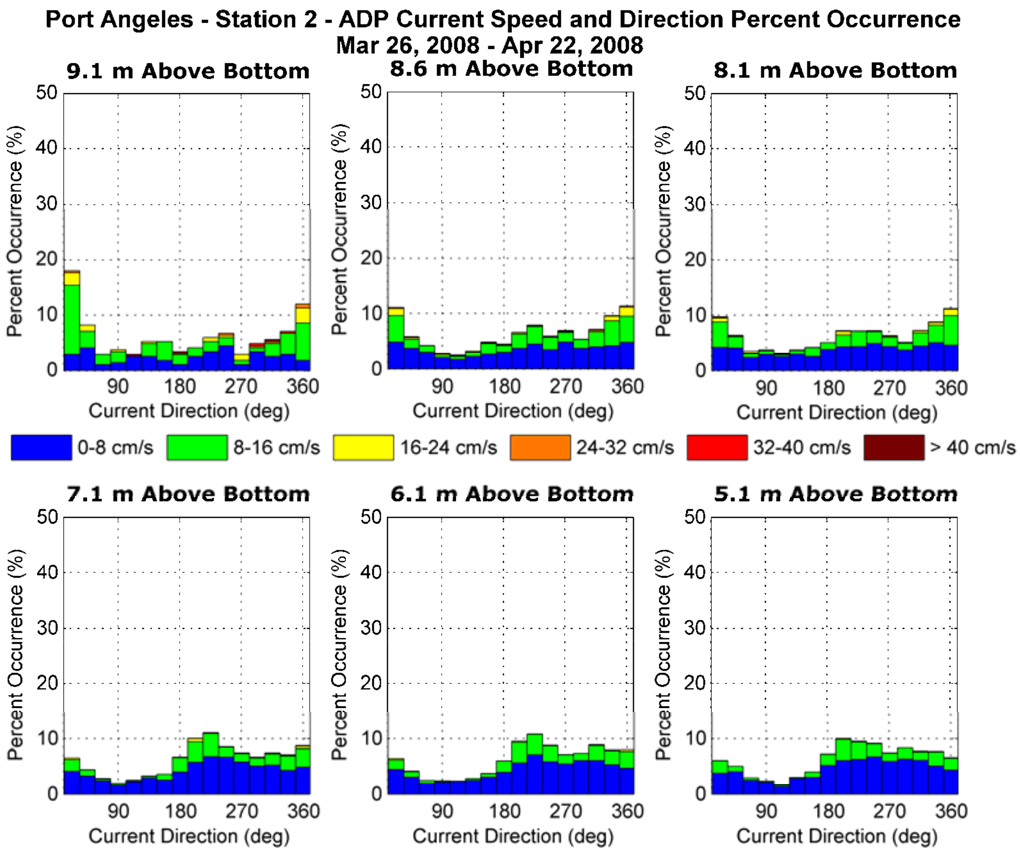

Port Angeles - Station 2 - ADP Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 22, 2008
4.6 m Above Bottom
4.1 m Above Bottom
3.6 m Above Bottom
3.1 m Above Bottom
2.6 m Above Bottom
2.1 m Above Bottom
0-8 cm/s
8-16 cm/s
16-24 cm/s
24-32 cm/s
32-40 cm/s
> 40 cm/s

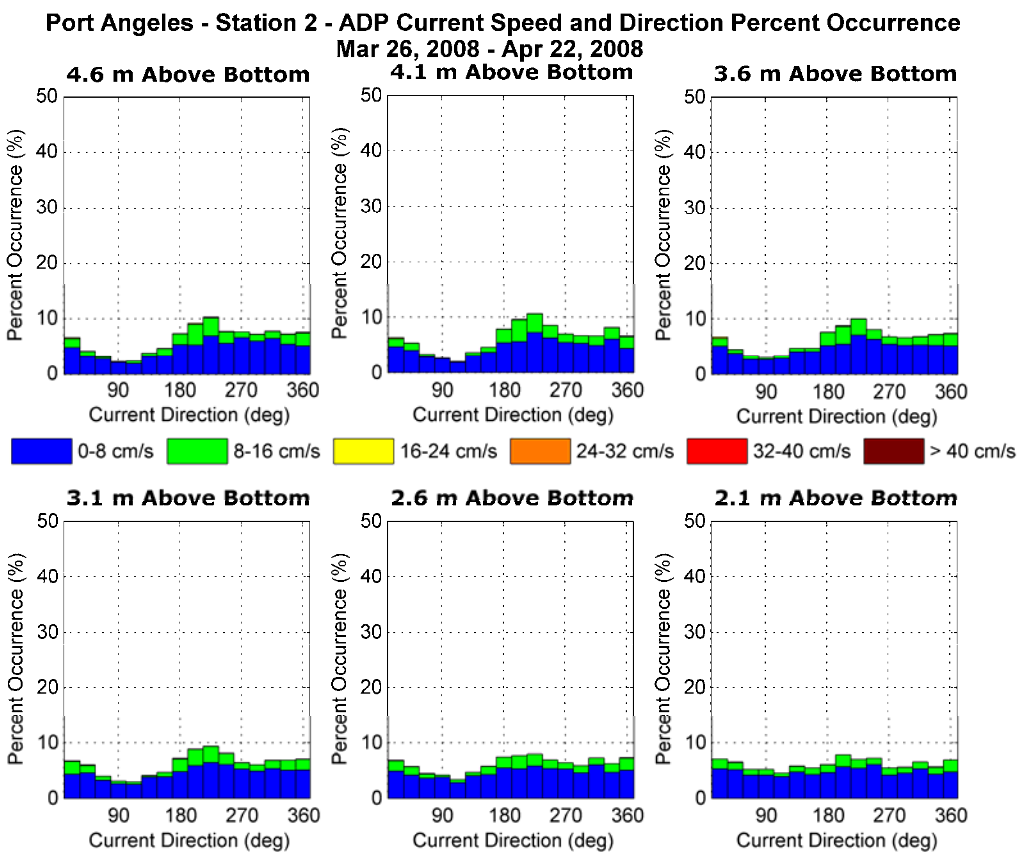
Port Angeles - Station 2 - ADVO Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 25, 2008

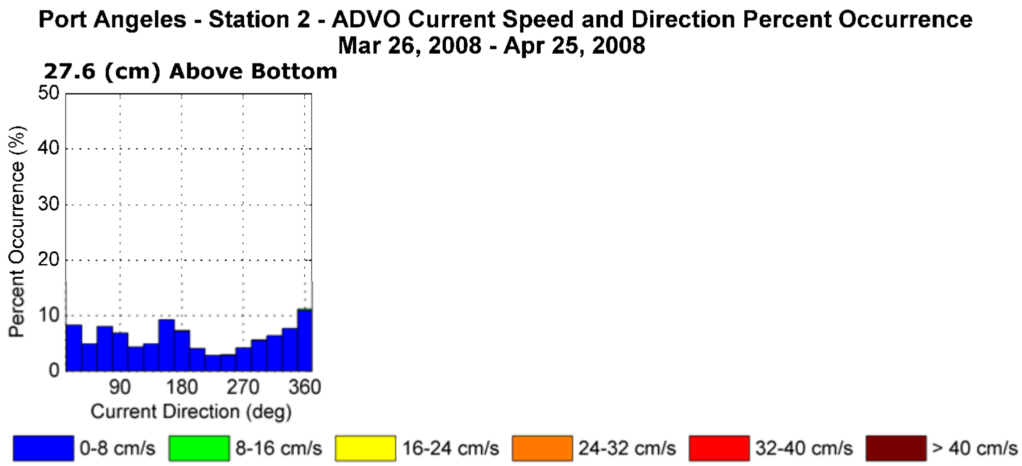


Appendix B.9

Percent occurrence histograms

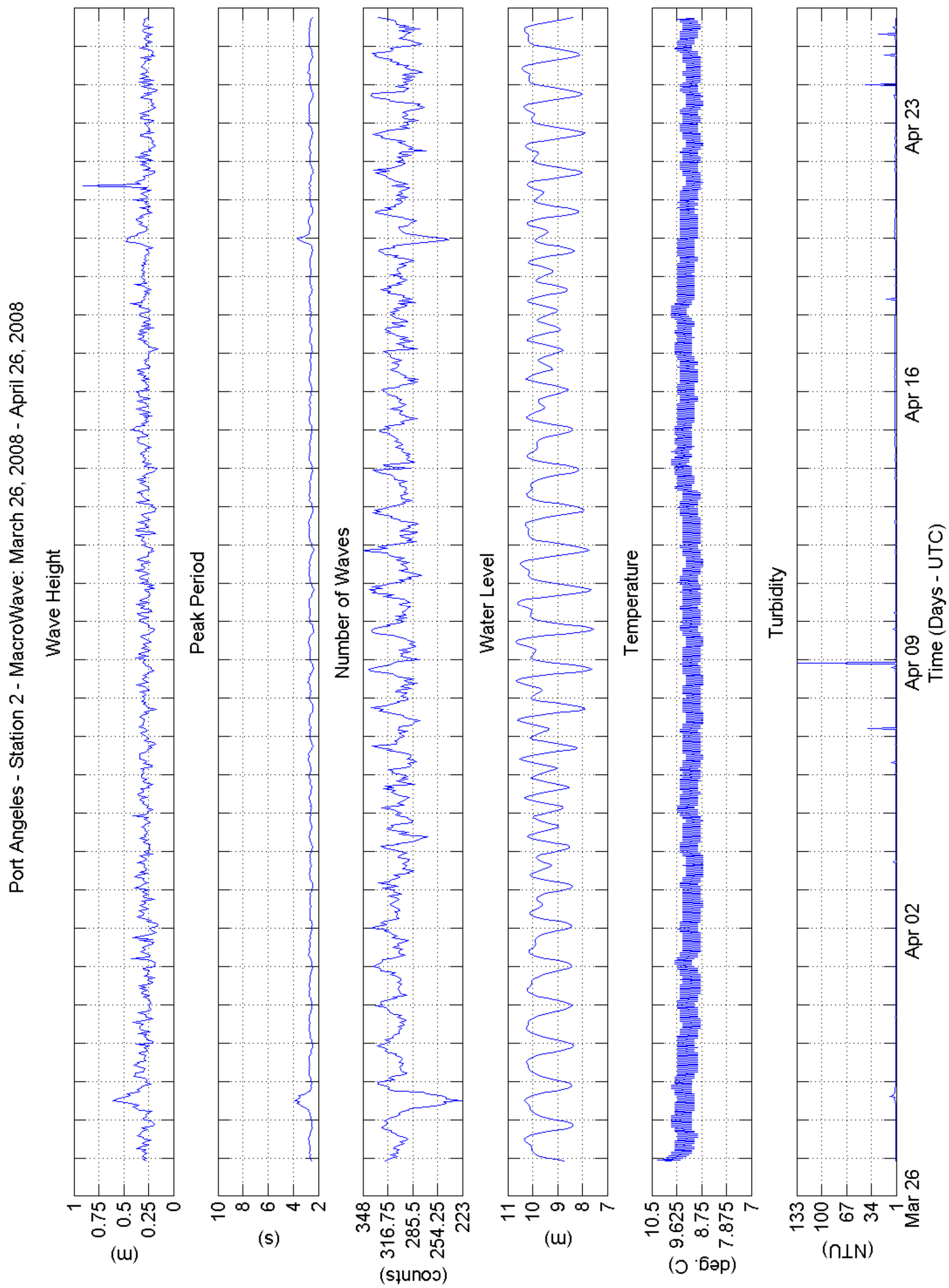

Port Angeles - Station 2 - ADP Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 22, 2008
9.1 m Above Bottom
8.6 m Above Bottom
8.1 m Above Bottom
7.1 m Above Bottom
6.1 m Above Bottom
5.1 m Above Bottom
Percent Occurrence (%)
Current Direction (deg)
0-8 cm/s
8-16 cm/s
16-24 cm/s
24-32 cm/s
32-40 cm/s
> 40 cm/s


Port Angeles - Station 2 - ADP Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 22, 2008
4.6 m Above Bottom
4.1 m Above Bottom
3.6 m Above Bottom
3.1 m Above Bottom
2.6 m Above Bottom
2.1 m Above Bottom
Percent Occurrence (%)
Current Direction (deg)
0-8 cm/s
8-16 cm/s
16-24 cm/s
24-32 cm/s
32-40 cm/s
> 40 cm/s


Port Angeles - Station 2 - ADVO Current Speed and Direction Percent Occurrence
Mar 26, 2008 - Apr 25, 2008
27.6 (cm) Above Bottom
Percent Occurrence (%)
50
40
30
20
10
0
90
180
270
360
Current Direction (deg)
0-8 cm/s
8-16 cm/s
16-24 cm/s
24-32 cm/s
32-40 cm/s
> 40 cm/s

Appendix B.10

Time history plots of waves, temperature and turbidity


Port Angeles - Station 2 - MacroWave: March 26, 2008 - April 26, 2008
Wave Height
(m)
1
0.75
0.5
0.25
0
Peak Period
(s)
10
8
6
4
2
Number of Waves
(counts)
348
316.75
285.5
254.25
223
Water Level
(m)
11
10
9
8
7
Temperature
(deg. C)
10.5
9.625
8.75
7.875
7
Turbidity
(NTU)
133
100
67
34
1
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix B.11

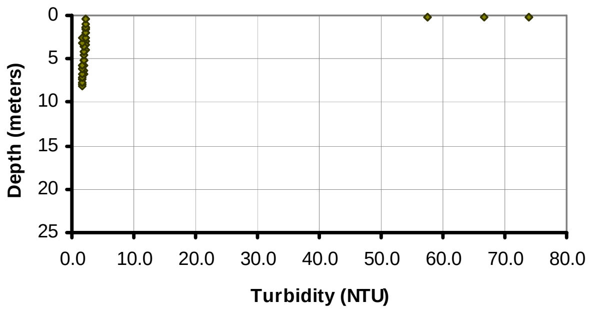
CTD Cast Summary

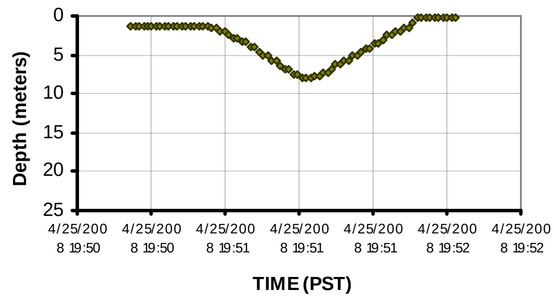
DATE: 7/9/2008

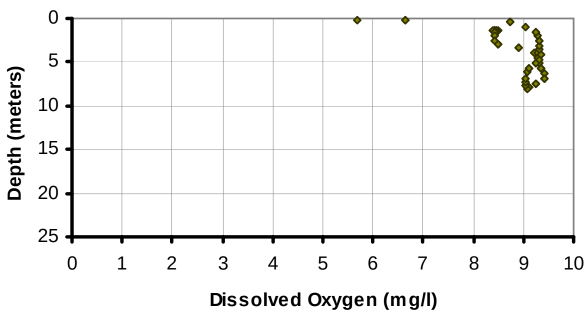
CAST ID: ST2-CTD_Recovery

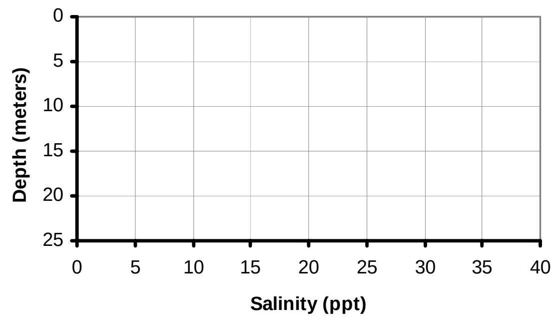
Start Time: 19:50:48
Duration(min): 1.28
Samples: 77

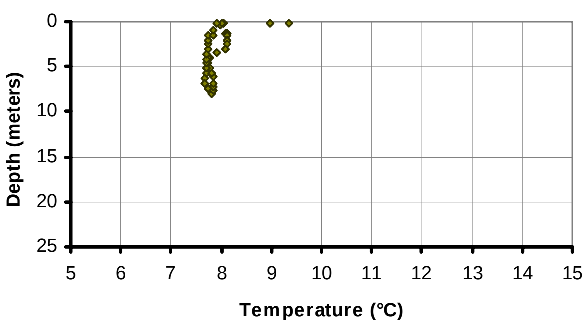
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	Battery	Temperature (°C)
2-3 (6.6-9.8)	2.1	8.83	0.0	5.11	7.93
4-5 (13.1-16.4)	2.0	9.33	0.0	5.05	7.72
7-8 (23.0-26.2)	1.7	9.11	0.0	5.03	7.81

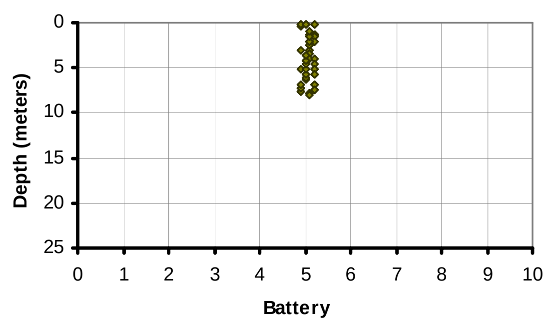












Appendix C

Station 3
Current Measurements

C.1: Color contour plots of current speed and direction
C.2: Color contour plot of ADCP data quality parameters
C.3: ADCP depth, tilt, and water temperature time history plots
C.4: Time history vector plots of current speed and direction
- **North Orientation**
- **East Orientation**

C.5: Nortek Vector Time history plots of current vectors and data quality parameters
- **North Orientation**
- **East Orientation**

C.6: Current Statistics
- **ADCP**
- **Vector**

C.7: Percent occurrence tables of current speed versus direction
- **ADCP**
- **Vector**

C.8: Percent occurrence roses
- **ADCP**
- **Vector**

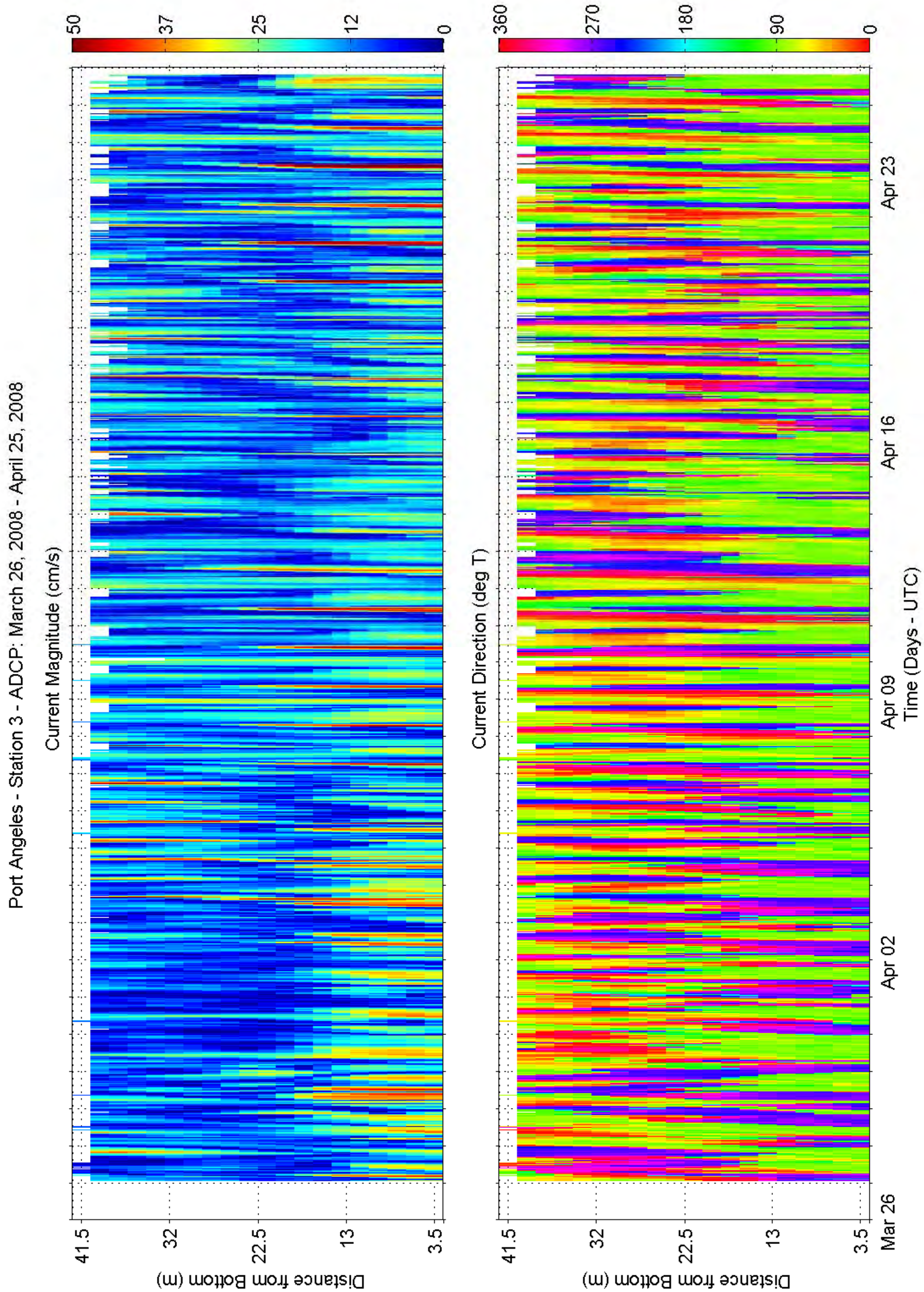
C.9: Percent occurrence histograms
- **ADCP**
- **Vector**

C.10: Time history plots of waves temperature and turbidity
C.11: CTD Cast Summary

Appendix C.1

Color contour plots of current speed and direction

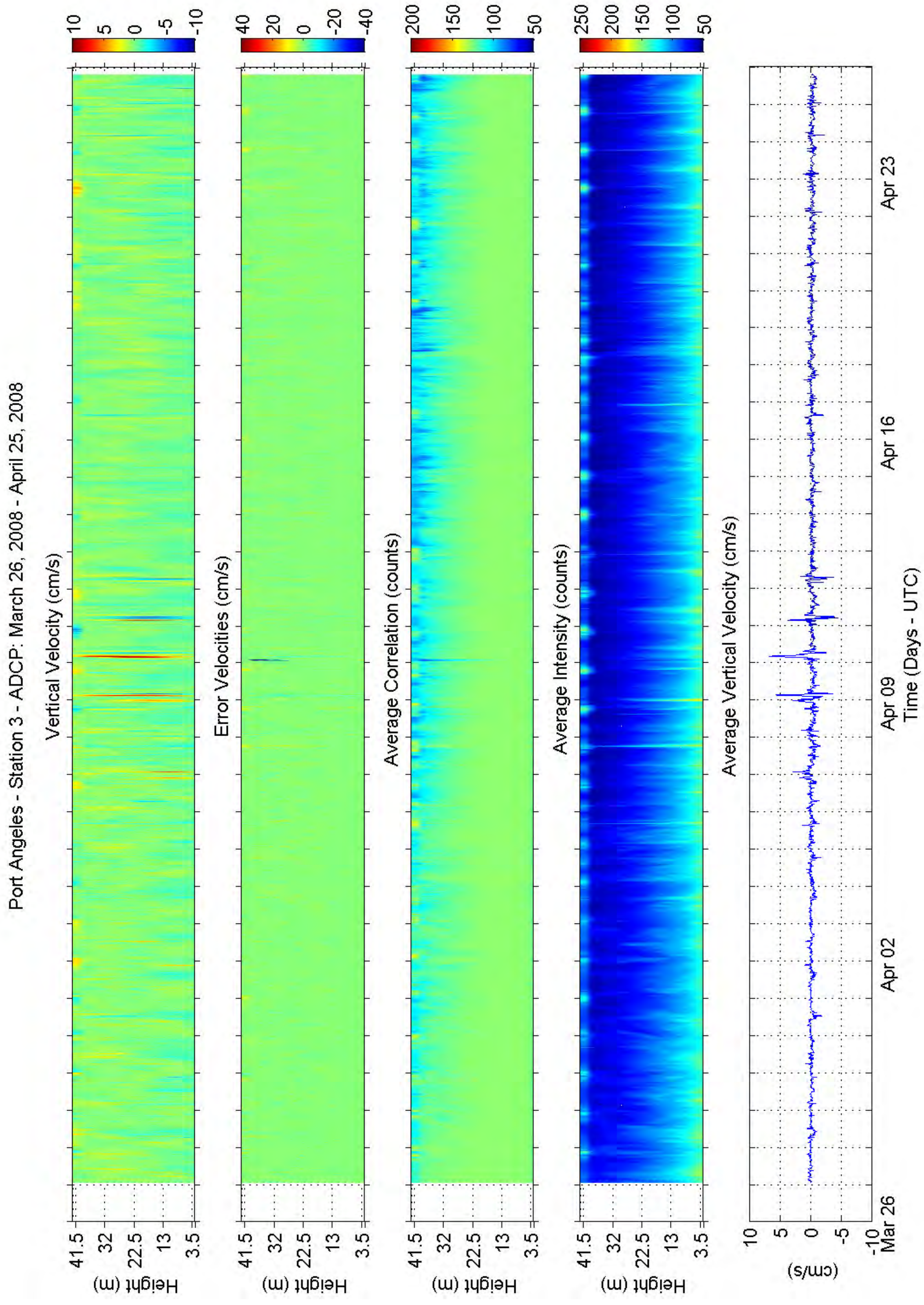
Speed is in cm/s, direction is in deg T, Toward.



Port Angeles - Station 3 - ADCP: March 26, 2008 - April 25, 2008
Current Magnitude (cm/s)
50
37
25
12
0
Distance from Bottom (m)
41.5
32
22.5
13
3.5
Current Direction (deg T)
360
270
180
90
0
Distance from Bottom (m)
41.5
32
22.5
13
3.5
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

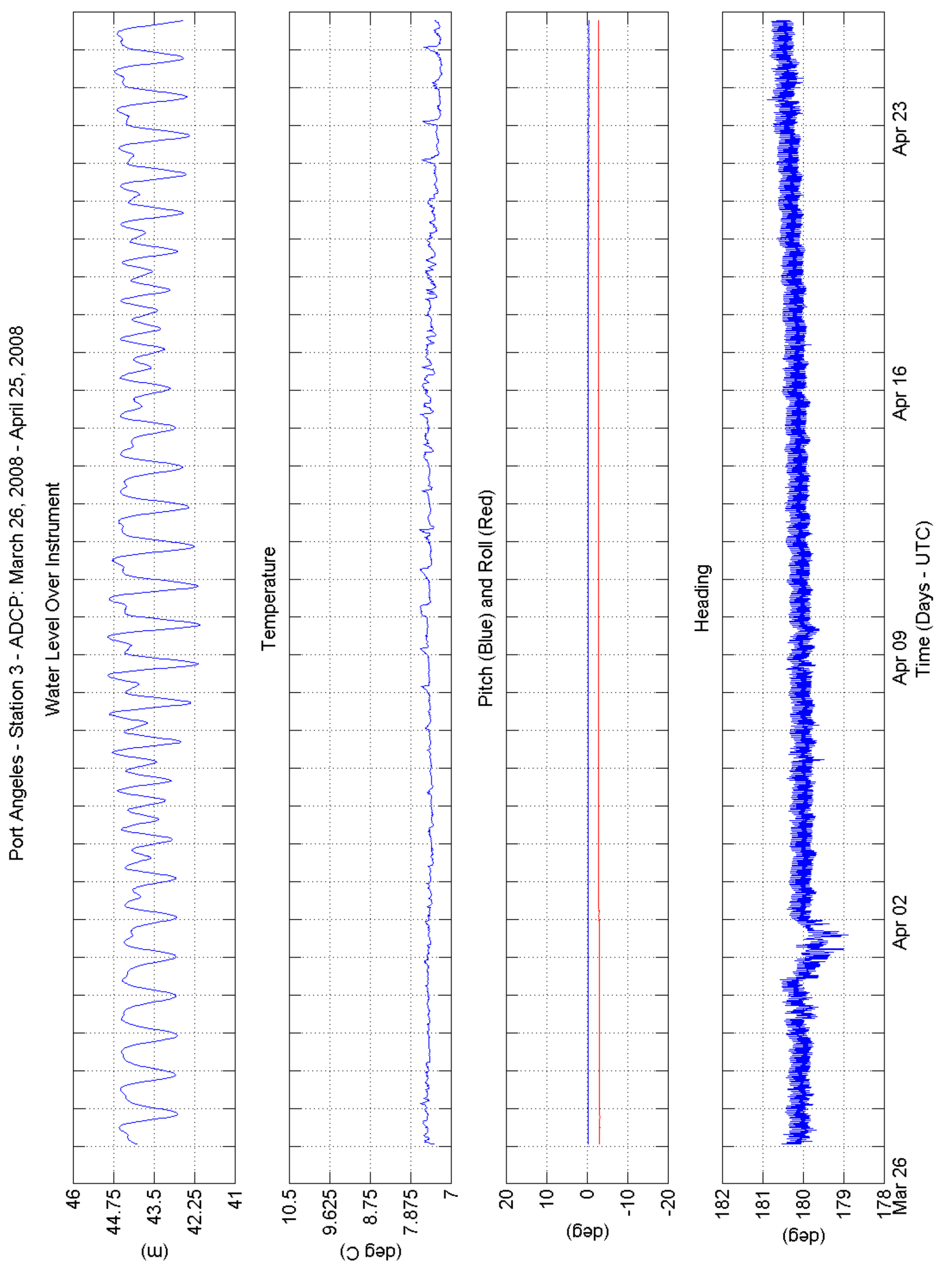
Appendix C.2

Color contour plots of ADCP data quality parameters


Port Angeles - Station 3 - ADCP: March 26, 2008 - April 25, 2008
Vertical Velocity (cm/s)
Error Velocities (cm/s)
Average Correlation (counts)
Average Intensity (counts)
Average Vertical Velocity (cm/s)
Height (m)
(cm/s)
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix C.3

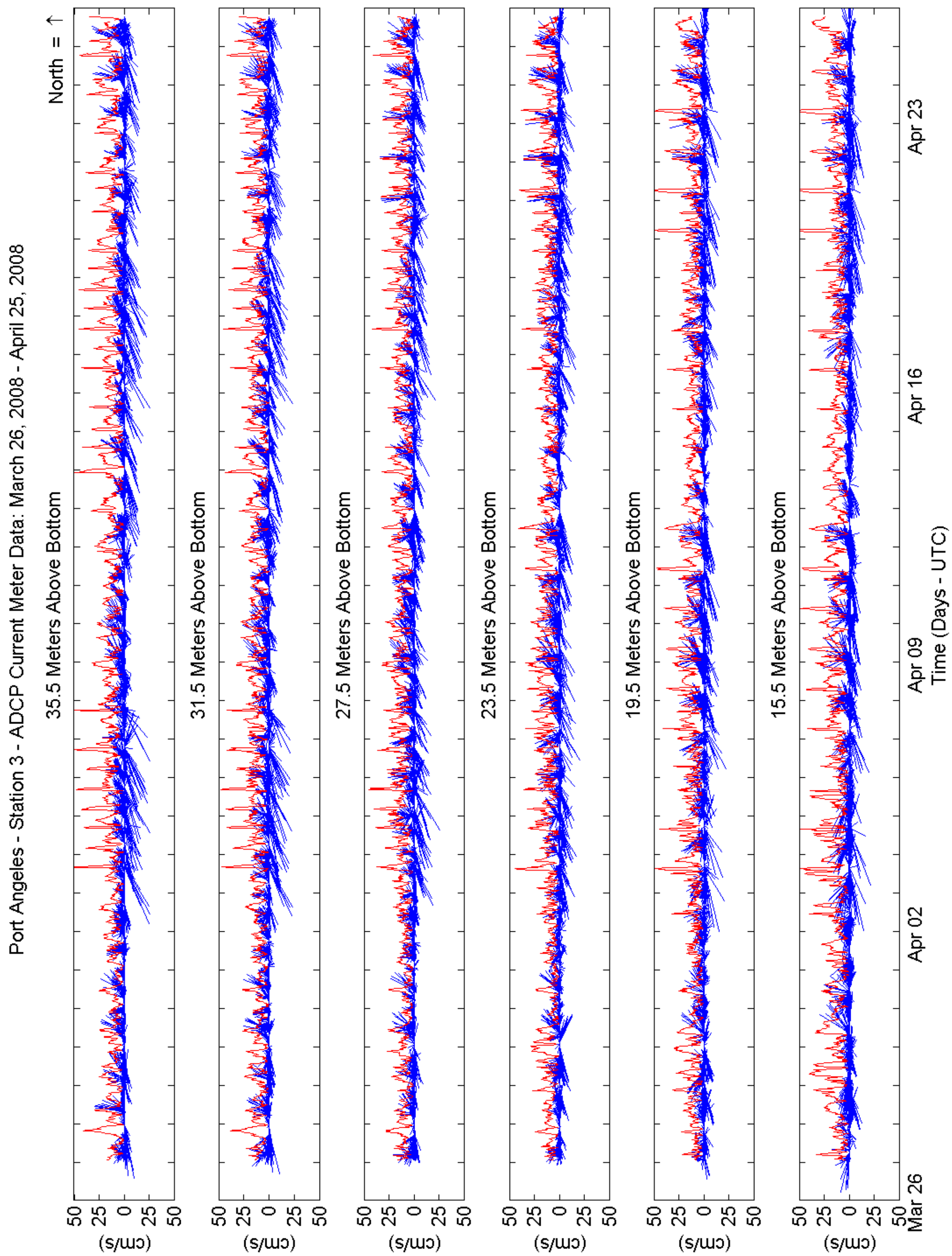
ADCP depth, tilt, and water temperature time history plots

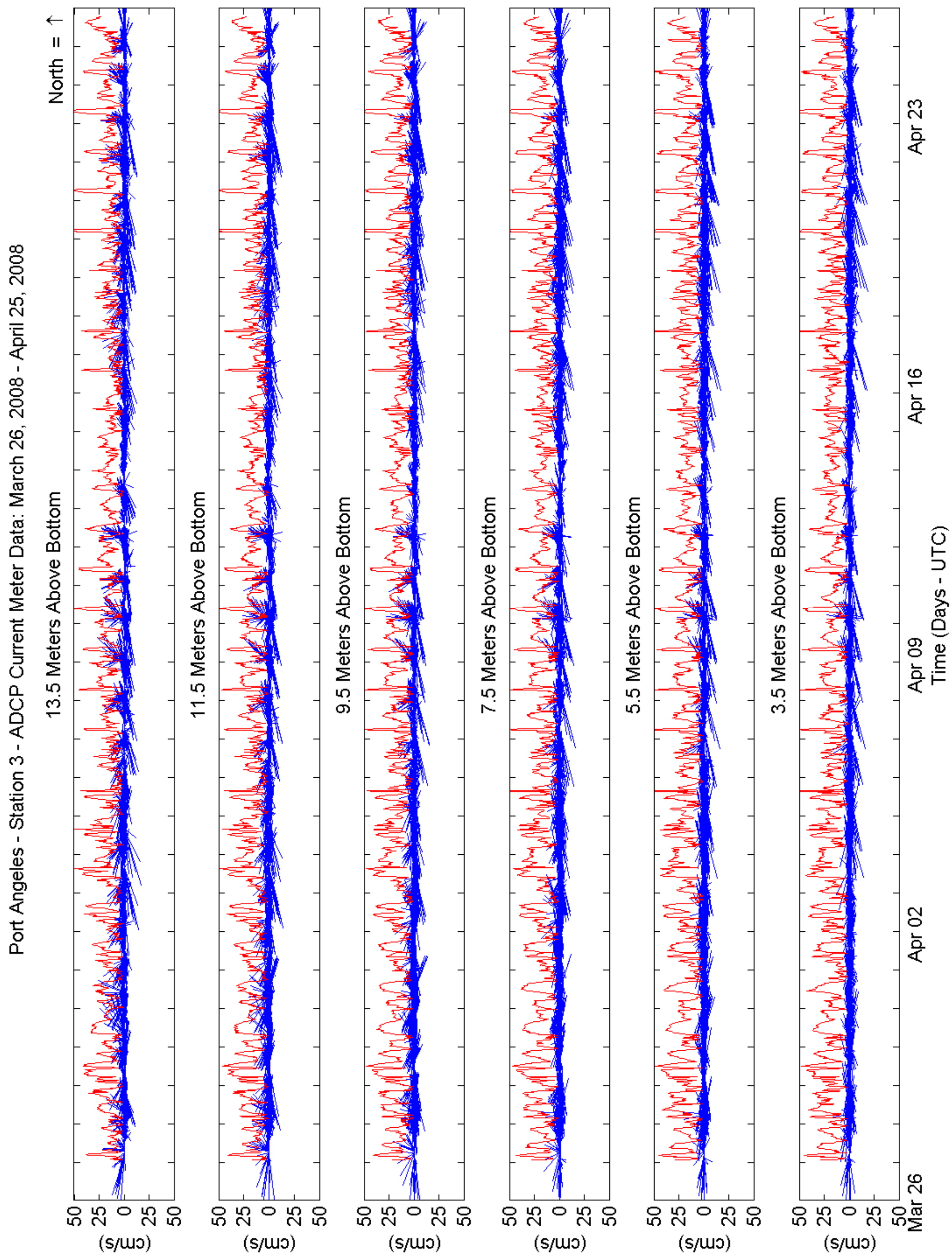

Port Angeles - Station 3 - ADCP: March 26, 2008 - April 25, 2008
Water Level Over Instrument
(m)
46
44.75
43.5
42.25
41
Temperature
(deg C)
10.5
9.625
8.75
7.875
7
Pitch (Blue) and Roll (Red)
(deg)
20
10
0
-10
-20
Heading
(deg)
182
181
180
179
178
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

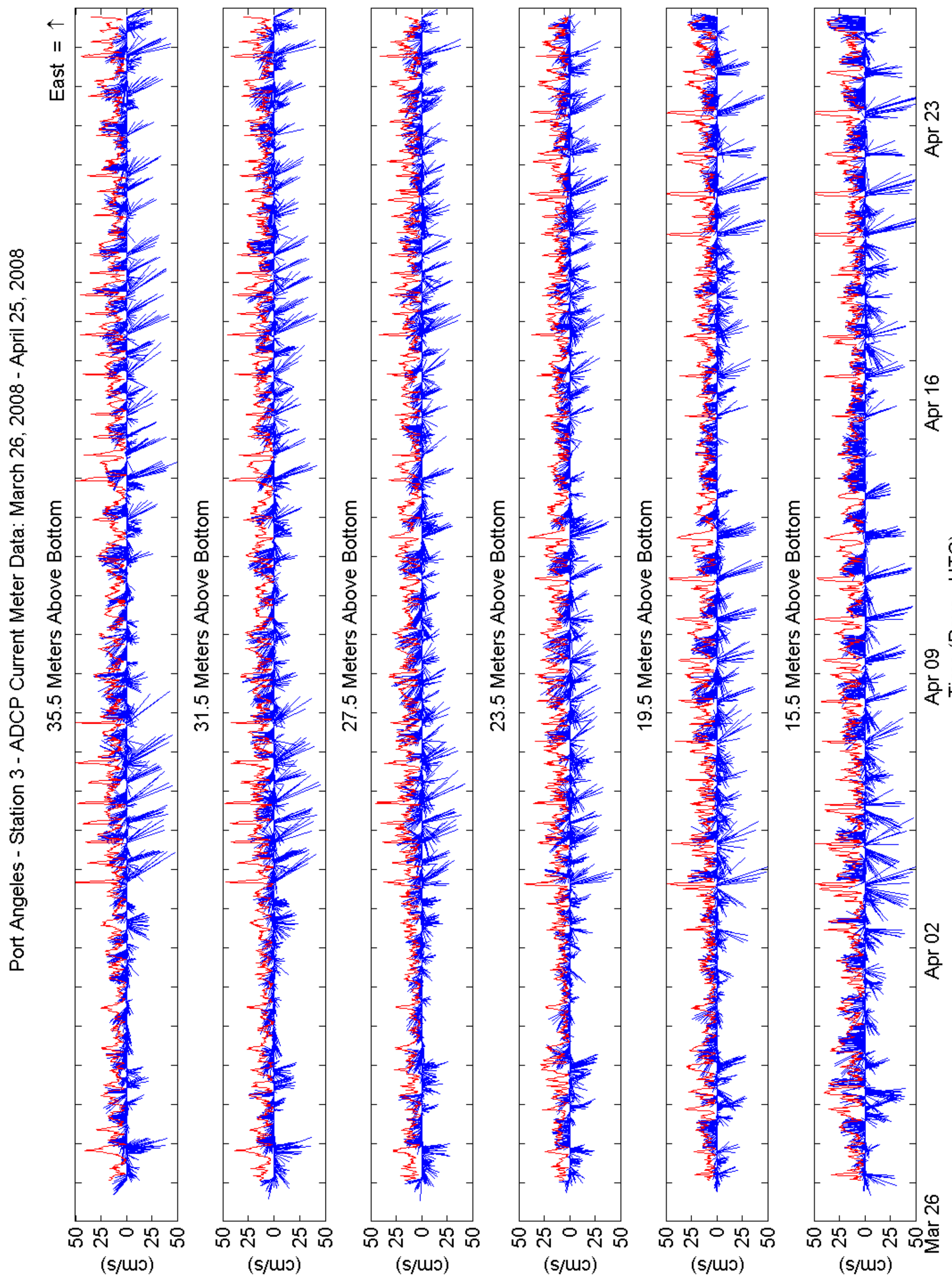
Appendix C.4

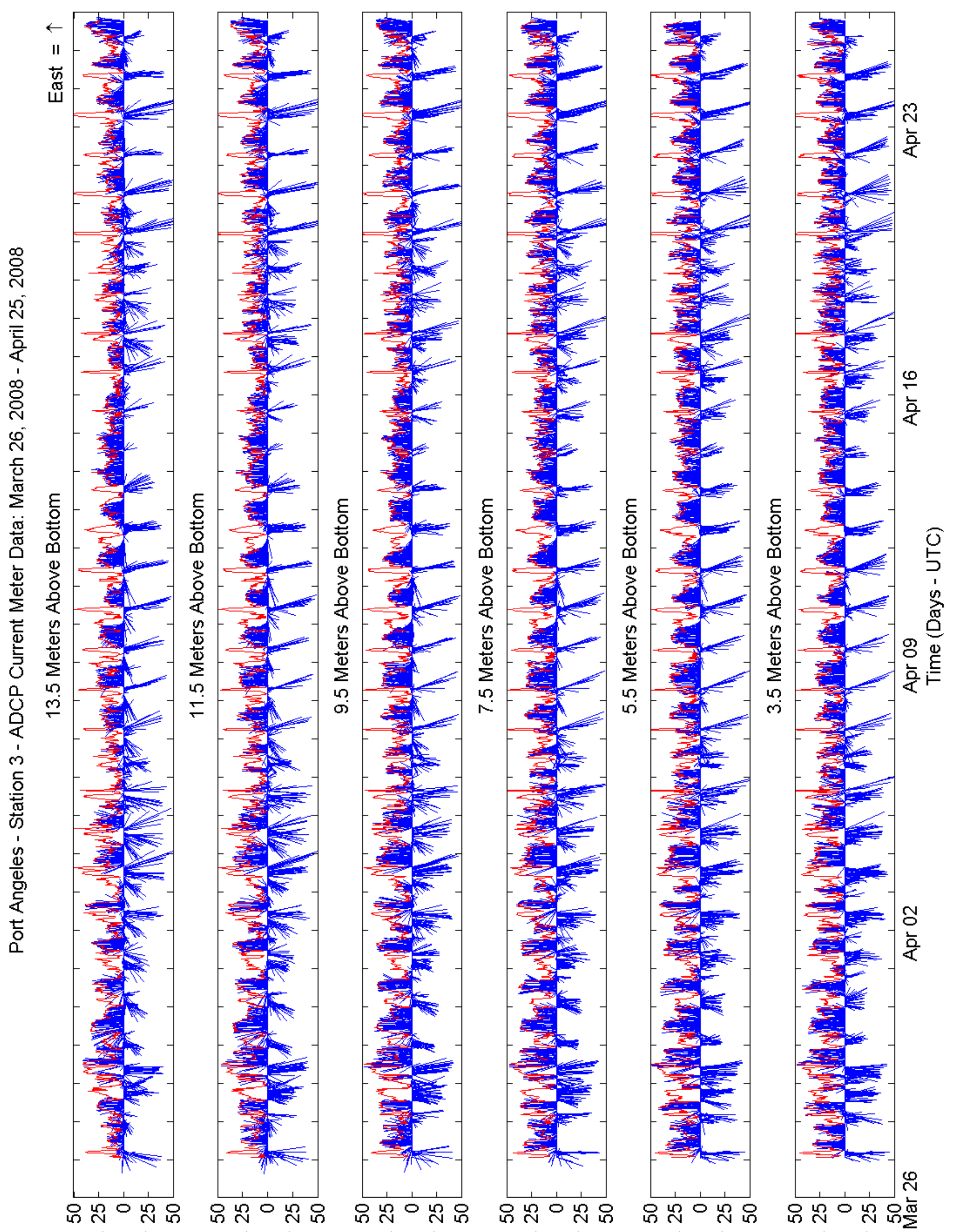
Time history vector plots of current speed and direction

Speed is in cm/s, direction is in deg T, Toward.


Port Angeles - Station 3 - ADCP Current Meter Data: March 26, 2008 - April 25, 2008
North = ↑
35.5 Meters Above Bottom
31.5 Meters Above Bottom
27.5 Meters Above Bottom
23.5 Meters Above Bottom
19.5 Meters Above Bottom
15.5 Meters Above Bottom
(cm/s)
50 25 0 25 50
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

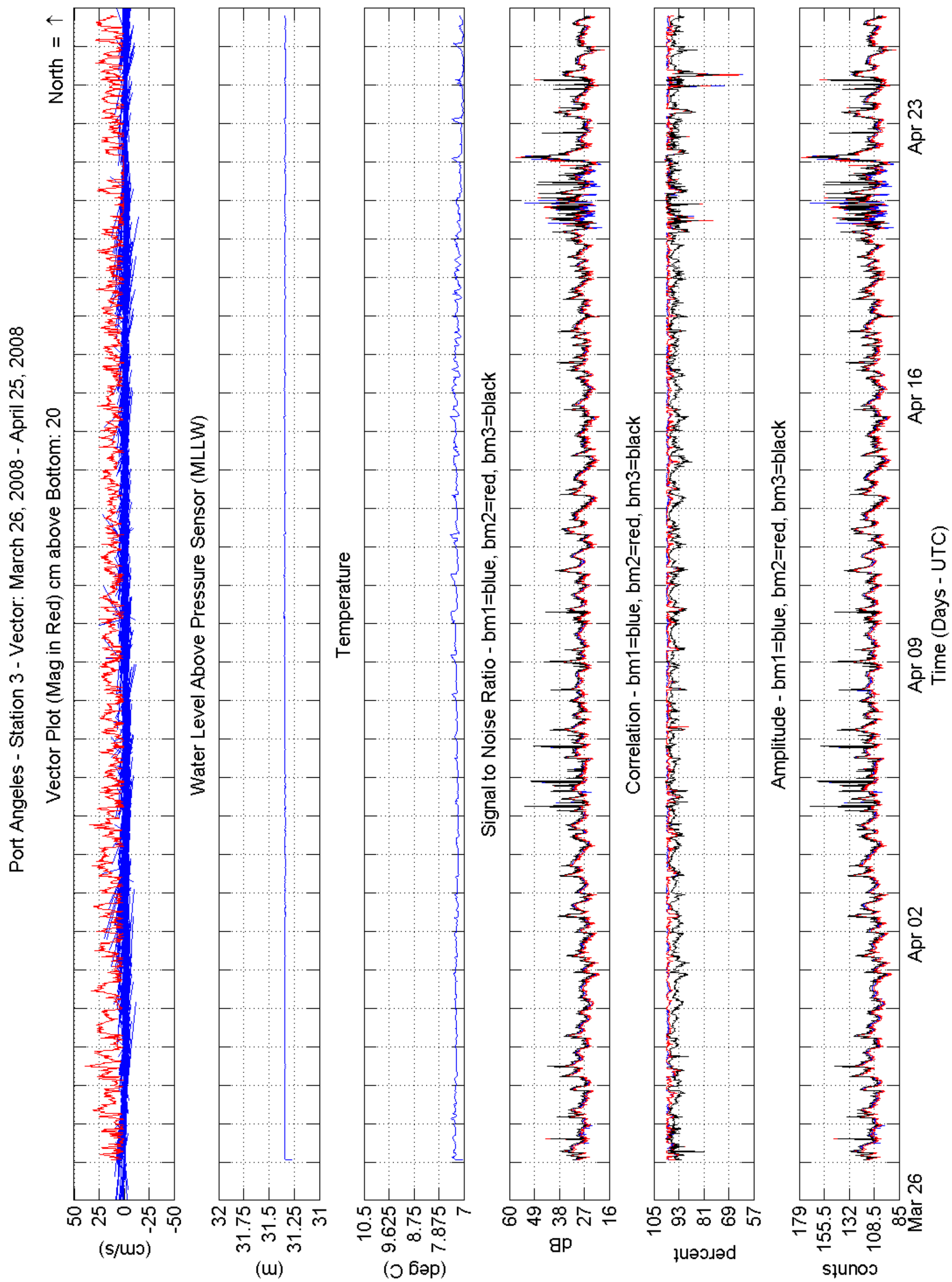

Port Angeles - Station 3 - ADCP Current Meter Data: March 26, 2008 - April 25, 2008
North = ↑
13.5 Meters Above Bottom
11.5 Meters Above Bottom
9.5 Meters Above Bottom
7.5 Meters Above Bottom
5.5 Meters Above Bottom
3.5 Meters Above Bottom
(cm/s)
50 25 0 25 50
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

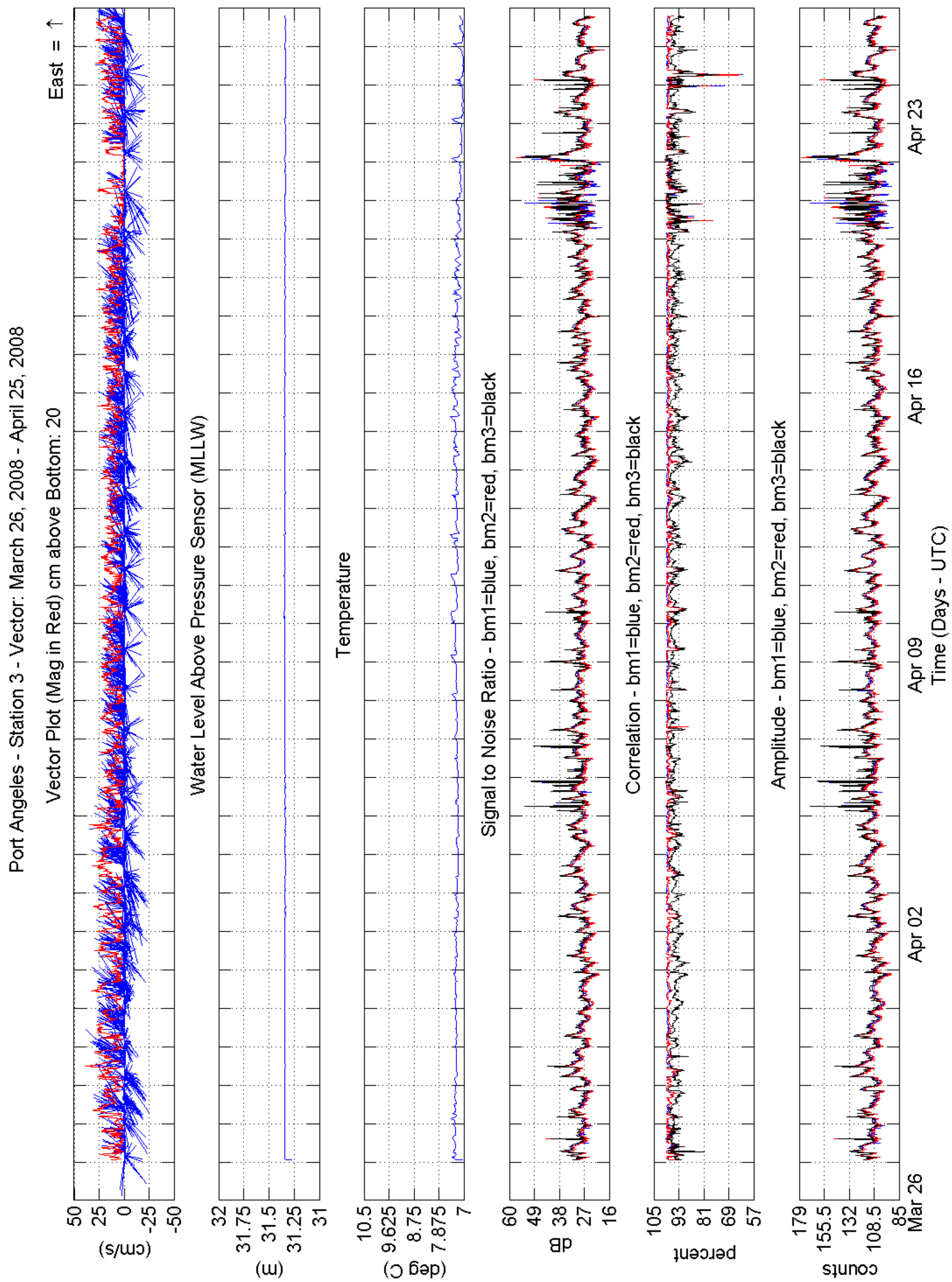

Port Angeles - Station 3 - ADCP Current Meter Data: March 26, 2008 - April 25, 2008
East = ↑
35.5 Meters Above Bottom
31.5 Meters Above Bottom
27.5 Meters Above Bottom
23.5 Meters Above Bottom
19.5 Meters Above Bottom
15.5 Meters Above Bottom
(cm/s)
50 25 0 25 50
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)


Port Angeles - Station 3 - ADCP Current Meter Data: March 26, 2008 - April 25, 2008
East = ↑
13.5 Meters Above Bottom
11.5 Meters Above Bottom
9.5 Meters Above Bottom
7.5 Meters Above Bottom
5.5 Meters Above Bottom
3.5 Meters Above Bottom
(cm/s)
50 25 0 25 50
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix C.5

Nortek Vector Time history plots of current vectors and data quality parameters


Port Angeles - Station 3 - Vector: March 26, 2008 - April 25, 2008
Vector Plot (Mag in Red) cm above Bottom: 20
North = ↑
(cm/s)
Water Level Above Pressure Sensor (MLLW)
(m)
Temperature
(deg C)
Signal to Noise Ratio - bm1=blue, bm2=red, bm3=black
dB
Correlation - bm1=blue, bm2=red, bm3=black
percent
Amplitude - bm1=blue, bm2=red, bm3=black
counts
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)


Port Angeles - Station 3 - Vector: March 26, 2008 - April 25, 2008
Vector Plot (Mag in Red) cm above Bottom: 20
East = ↑
(cm/s)
50 25 0 -25 -50
Water Level Above Pressure Sensor (MLLW)
(m)
32 31.75 31.5 31.25 31
Temperature
(deg C)
10.5 9.625 8.75 7.875 7
Signal to Noise Ratio - bm1=blue, bm2=red, bm3=black
dB
60 49 38 27 16
Correlation - bm1=blue, bm2=red, bm3=black
percent
105 93 81 69 57
Amplitude - bm1=blue, bm2=red, bm3=black
counts
179 155.5 132 108.5 85
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix C.6

Current Statistics

```
     Date Modified  :  06/03/2008
     Site Name      :  Port Angeles - Station 3 ADCP
*******************************************************************
** Data produced by:                                             **
**                                                               **
**                  Evans-Hamilton, Inc.                         **
**                 4608 Union Bay Place NE                       **
**                   Seattle, WA 98105                           **
**                     (206) 526-5622                            **
**                                                               **
*******************************************************************
** Meas. Bottom Depth  :  44 m (145 ft) wrt MLLW (measured at deployment)
** Instrument Type     :  600 kHz RDI ADCP
** Latitude            :  048 07.99078 N (Degrees Decimal.Minutes)
** Longitude           :  123 24.17707 W (Degrees Decimal.Minutes)
** Magnetic Declination:  17.65 E (Decimal.Degrees)
** Start Time (UTC)    :  03/27/2008 01:15:00 (MM/DD/YYYY hh:mm:ss)
** End Time (UTC)      :  04/25/2008 18:59:47 (MM/DD/YYYY hh:mm:ss)
*******************************************************************
** Column      1: Bin Height above Bottom (m)                    **
**                (Height of Bin wrt Bottom)                     **
** Column      2: Number of Data Points                          **
** Column      3: Average East (cm/s)                            **
** Column      4: Average North (cm/s)                           **
** Column      5: Average Speed (cm/s)                           **
** Column      6: Maximum Speed (cm/s)                           **
** Column      7: Direction of Maximum Speed (deg T)             **
** Column      8: Minimum Speed (cm/s)                           **
** Column      9: Direction of Minimum Speed (deg T)             **
** Column     10: Net Current Speed (cm/s)                       **
** Column     11: Net Current Direction (deg T)                  **
*******************************************************************
```

Height	DataPts	AvgE	AvgN	AvgSpd	MaxSpd	DirOfMx	MinSpd	DirOfMn	NetSpd	NetDir
End										
41.47	0068	07.48	03.51	11.01	20.20	090.6	01.70	090.2	08.26	064.9
39.47	2303	06.50	02.51	13.81	54.40	242.7	00.60	062.6	06.97	068.9
37.47	2771	03.82	02.36	13.68	55.00	254.3	00.20	224.3	04.49	058.2
35.47	2837	02.80	02.82	13.42	54.10	242.5	00.10	332.6	03.98	044.8
33.47	2850	02.04	03.14	13.12	51.60	241.9	00.10	107.6	03.74	033.1
31.47	2856	01.50	03.41	12.88	48.10	251.3	00.40	093.6	03.72	023.7
29.47	2856	01.06	03.53	12.59	45.90	248.6	00.10	242.7	03.69	016.7
27.47	2856	00.77	03.52	12.24	45.20	249.4	00.20	171.0	03.60	012.3
25.47	2856	00.73	03.29	11.95	40.70	250.5	00.10	242.7	03.37	012.5
23.47	2856	00.86	02.95	11.72	43.90	257.8	00.20	017.6	03.07	016.3
21.47	2856	01.11	02.60	11.77	50.90	257.8	00.20	314.3	02.83	023.1
19.47	2856	01.44	02.44	12.23	55.60	254.3	00.10	062.6	02.83	030.6
17.47	2856	01.88	02.32	13.15	56.40	254.5	00.20	224.3	02.98	039.0
15.47	2856	02.48	02.20	14.46	58.10	255.6	00.30	269.3	03.31	048.4
13.47	2856	03.20	01.95	15.92	57.10	257.3	00.20	171.0	03.75	058.6
11.47	2856	04.01	01.55	17.22	56.90	257.9	00.00	000.0	04.29	068.9
09.47	2856	04.70	01.04	18.23	55.10	257.6	00.40	287.6	04.81	077.5
07.47	2856	05.20	00.57	18.95	54.60	257.2	00.50	175.8	05.23	083.7
05.47	2856	05.58	00.01	19.19	54.70	257.6	00.30	062.6	05.58	089.9
03.47	2856	05.71	-0.69	18.82	55.00	256.1	00.20	261.1	05.75	096.9

```
     Date Modified  :  06/10/2008
     Site Name      :  Port Angeles Site 3
*******************************************************************
** Data produced by:                                             **
**                                                               **
**                  Evans-Hamilton, Inc.                         **
**                 4608 Union Bay Place NE                       **
**                   Seattle, WA 98105                           **
**                     (206) 526-5622                            **
**                                                               **
*******************************************************************
** Meas. Bottom Depth  :  8.5 m (measured at deployment)
** Instrument Type     :  5 MHz Nortek Vector
** Latitude            :  048 07.99078 N (Degrees Decimal.Minutes)
** Longitude           :  123 24.17707 W (Degrees Decimal.Minutes)
** Magnetic Declination:  17.65 E (Decimal.Degrees)
** Start Time (UTC)    :  03/27/2008 01:15:00 (MM/DD/YYYY hh:mm:ss)
** End Time (UTC)      :  04/25/2008 19:15:00 (MM/DD/YYYY hh:mm:ss)
*******************************************************************
** Column       1: Sensor Height above Bottom (cm)               **
**                (Height of Sensor wrt Bottom)                  **
** Column       2: Number of Data Points                         **
** Column       3: Average East (cm/s)                           **
** Column       4: Average North (cm/s)                          **
** Column       5: Average Speed (cm/s)                          **
** Column       6: Maximum Speed (cm/s)                          **
** Column       7: Direction of Maximum Speed (deg T)            **
** Column       8: Minimum Speed (cm/s)                          **
** Column       9: Direction of Minimum Speed (deg T)            **
** Column      10: Net Current Speed (cm/s)                      **
** Column      11: Net Current Direction (deg T)                 **
*******************************************************************
Height  DataPts AvgE    AvgN    AvgSpd  MaxSpd  DirOfMx MinSpd  DirOfMn NetSpd  NetDir
*End*
20.00   2857    05.38   -0.67   11.55   39.02   068.7   00.01   132.3   05.42   097.1
```

Appendix C.7

Percent occurrence tables of current speed versus direction

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **3.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.14	0.25	0.25	0.49	0.35	0.32	0.46	0.39	0.25	0.32	0.25	0.14	0.25	0.25	0.53	0.18	4.76
4 - 8	0.21	0.39	0.60	1.09	1.37	1.54	0.60	0.63	0.25	0.42	0.74	0.91	0.74	0.28	0.53	0.28	10.54
8 - 12	0.11	0.11	0.67	1.37	2.59	1.75	0.53	0.07	0.25	0.07	0.25	1.12	1.65	0.77	0.42	0.25	11.94
12 - 16	0.00	0.07	0.32	1.86	5.46	1.89	0.11	0.04	0.04	0.00	0.07	1.02	1.75	0.67	0.11	0.04	13.41
16 - 20	0.04	0.04	0.00	1.23	8.65	1.89	0.04	0.00	0.00	0.00	0.00	0.84	2.31	0.42	0.04	0.04	15.51
20 - 24	0.04	0.00	0.07	0.49	10.89	0.98	0.00	0.00	0.00	0.00	0.00	0.67	2.00	0.18	0.00	0.00	15.30
24 - 28	0.00	0.00	0.00	0.11	9.03	0.32	0.00	0.00	0.00	0.00	0.00	0.32	2.03	0.18	0.00	0.04	12.01
28 - 32	0.00	0.00	0.00	0.11	4.48	0.28	0.00	0.00	0.00	0.00	0.00	0.32	1.82	0.04	0.00	0.00	7.04
32 - 36	0.00	0.00	0.00	0.00	2.00	0.07	0.00	0.00	0.00	0.00	0.00	0.18	1.54	0.11	0.00	0.00	3.89
36 - 40	0.00	0.00	0.00	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.53	1.26	0.11	0.00	0.00	2.42
40 - 44	0.00	0.00	0.00	0.00	0.14	0.04	0.00	0.00	0.00	0.00	0.00	0.56	0.77	0.00	0.00	0.00	1.51
44 - 48	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.46	0.00	0.00	0.00	1.09
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.14	0.00	0.00	0.00	0.60
Total	0.53	0.84	1.89	6.72	45.55	9.07	1.72	1.12	0.77	0.81	1.30	7.60	16.70	2.98	1.61	0.81	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **5.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.39	0.18	0.28	0.32	0.63	0.21	0.53	0.35	0.11	0.28	0.32	0.39	0.46	0.42	0.25	0.32	5.39
4 - 8	0.56	0.60	0.74	0.88	1.30	0.67	0.77	0.39	0.28	0.39	0.60	0.88	0.63	0.88	0.35	0.42	10.29
8 - 12	0.14	0.14	0.77	1.44	1.93	1.51	0.46	0.07	0.14	0.11	0.25	0.77	1.12	0.84	0.46	0.21	10.33
12 - 16	0.04	0.18	0.49	2.03	5.39	1.26	0.04	0.00	0.04	0.00	0.04	0.70	1.86	0.98	0.42	0.25	13.69
16 - 20	0.04	0.11	0.18	1.72	8.40	1.16	0.00	0.00	0.00	0.00	0.00	0.53	2.07	0.95	0.07	0.07	15.27
20 - 24	0.04	0.04	0.14	1.19	9.21	1.02	0.00	0.00	0.00	0.00	0.00	0.53	2.35	0.56	0.00	0.07	15.13
24 - 28	0.04	0.00	0.11	0.42	8.44	0.28	0.00	0.00	0.00	0.00	0.00	0.32	1.65	0.25	0.00	0.00	11.48
28 - 32	0.00	0.00	0.04	0.14	4.83	0.25	0.00	0.00	0.00	0.00	0.00	0.39	1.61	0.11	0.00	0.00	7.35
32 - 36	0.00	0.00	0.00	0.07	2.63	0.07	0.00	0.00	0.00	0.00	0.00	0.18	1.58	0.04	0.00	0.00	4.55
36 - 40	0.00	0.00	0.00	0.00	1.02	0.04	0.00	0.00	0.00	0.00	0.00	0.39	1.40	0.00	0.00	0.00	2.84
40 - 44	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.98	0.00	0.00	0.00	1.82
44 - 48	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.39	0.00	0.00	0.00	0.95
48 - >	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.35	0.00	0.00	0.00	0.91
Total	1.23	1.23	2.73	8.19	44.01	6.44	1.79	0.81	0.56	0.77	1.19	6.76	16.42	5.01	1.54	1.33	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **7.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.49	0.32	0.28	0.53	0.35	0.21	0.28	0.28	0.32	0.18	0.14	0.39	0.46	0.25	0.14	0.42	5.01
4 - 8	0.60	0.74	0.91	0.67	1.19	0.70	0.67	0.32	0.25	0.25	0.56	0.81	0.67	0.63	0.74	0.56	10.29
8 - 12	0.28	0.63	0.63	1.72	2.17	1.05	0.42	0.00	0.18	0.18	0.04	0.70	1.33	0.98	0.81	0.60	11.69
12 - 16	0.21	0.28	0.63	2.45	5.18	1.68	0.11	0.00	0.00	0.04	0.00	0.74	1.44	1.02	0.42	0.32	14.50
16 - 20	0.14	0.32	0.25	1.65	7.91	1.37	0.04	0.00	0.00	0.00	0.00	0.49	1.82	1.26	0.18	0.21	15.62
20 - 24	0.07	0.04	0.07	0.84	8.30	0.74	0.00	0.00	0.00	0.00	0.00	0.35	2.07	1.19	0.04	0.04	13.73
24 - 28	0.04	0.00	0.32	0.56	6.97	0.25	0.00	0.00	0.00	0.00	0.00	0.46	1.61	0.35	0.04	0.00	10.57
28 - 32	0.00	0.00	0.04	0.25	5.32	0.25	0.00	0.00	0.00	0.00	0.00	0.42	1.33	0.11	0.00	0.00	7.70
32 - 36	0.00	0.00	0.00	0.14	3.08	0.07	0.00	0.00	0.00	0.00	0.00	0.11	1.68	0.00	0.00	0.00	5.08
36 - 40	0.00	0.00	0.00	0.04	0.67	0.04	0.00	0.00	0.00	0.00	0.00	0.49	1.05	0.04	0.00	0.00	2.31
40 - 44	0.00	0.00	0.00	0.00	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.60	1.16	0.00	0.00	0.00	1.82
44 - 48	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.39	0.00	0.00	0.00	0.88
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.39	0.00	0.00	0.00	0.81
Total	1.82	2.31	3.12	8.82	41.28	6.34	1.51	0.60	0.74	0.63	0.74	6.37	15.37	5.81	2.35	2.14	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **9.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.25	0.42	0.18	0.32	0.46	0.25	0.39	0.53	0.28	0.39	0.18	0.39	0.49	0.28	0.39	0.18	5.32
4 - 8	0.84	0.95	0.91	0.81	1.02	0.77	0.77	0.39	0.21	0.25	0.42	0.98	0.53	0.77	0.91	0.98	11.48
8 - 12	0.56	0.46	0.81	1.86	2.45	1.16	0.39	0.07	0.07	0.07	0.18	0.56	0.95	1.19	0.67	0.98	12.39
12 - 16	0.39	0.46	1.09	2.28	5.39	2.17	0.07	0.04	0.04	0.07	0.00	0.63	1.65	0.95	0.46	0.49	16.14
16 - 20	0.14	0.46	0.35	1.72	7.74	1.05	0.11	0.00	0.00	0.00	0.00	0.42	1.51	1.05	0.56	0.25	15.34
20 - 24	0.07	0.18	0.11	0.81	7.11	0.60	0.04	0.00	0.00	0.00	0.00	0.46	1.51	1.09	0.14	0.11	12.18
24 - 28	0.04	0.00	0.28	0.46	6.58	0.11	0.00	0.00	0.00	0.00	0.00	0.21	1.40	0.98	0.00	0.04	10.08
28 - 32	0.00	0.00	0.07	0.21	5.01	0.18	0.00	0.00	0.00	0.00	0.00	0.28	1.54	0.28	0.00	0.00	7.56
32 - 36	0.00	0.00	0.04	0.00	2.73	0.00	0.00	0.00	0.00	0.00	0.00	0.28	1.02	0.00	0.00	0.00	4.06
36 - 40	0.00	0.00	0.00	0.04	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.39	1.54	0.00	0.00	0.00	2.31
40 - 44	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.35	1.19	0.00	0.00	0.00	1.61
44 - 48	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.46	0.00	0.00	0.00	0.84
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.39	0.00	0.00	0.00	0.67
Total	2.28	2.91	3.82	8.47	38.97	6.27	1.75	1.02	0.60	0.77	0.77	5.53	14.15	6.58	3.12	3.01	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **11.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.35	0.53	0.46	0.56	0.46	0.56	0.32	0.42	0.46	0.28	0.35	0.49	0.25	0.39	0.39	0.49	6.72
4 - 8	0.81	0.91	1.16	0.95	1.19	1.23	0.77	0.32	0.18	0.32	0.60	0.56	0.74	0.74	0.98	0.67	12.08
8 - 12	0.67	0.88	1.02	1.54	2.98	1.93	0.32	0.07	0.04	0.07	0.25	0.60	1.09	0.81	1.12	1.09	14.43
12 - 16	0.18	0.49	0.95	2.70	5.88	1.68	0.14	0.07	0.00	0.04	0.00	0.70	1.37	0.81	0.60	0.63	16.21
16 - 20	0.35	0.46	0.39	1.47	7.81	1.12	0.07	0.00	0.00	0.00	0.04	0.35	1.33	1.05	0.56	0.35	15.34
20 - 24	0.21	0.35	0.42	0.77	6.55	0.42	0.00	0.00	0.00	0.00	0.00	0.42	1.26	1.33	0.25	0.21	12.18
24 - 28	0.04	0.00	0.21	0.35	6.55	0.11	0.00	0.00	0.00	0.00	0.00	0.39	1.33	0.74	0.25	0.04	9.98
28 - 32	0.00	0.00	0.11	0.11	2.56	0.11	0.00	0.00	0.00	0.00	0.00	0.28	1.02	0.32	0.00	0.00	4.48
32 - 36	0.00	0.00	0.04	0.07	1.82	0.00	0.00	0.00	0.00	0.00	0.00	0.35	1.23	0.11	0.00	0.00	3.61
36 - 40	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.28	1.54	0.00	0.00	0.00	2.21
40 - 44	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.98	0.00	0.00	0.00	1.44
44 - 48	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.35	0.00	0.00	0.00	0.74
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.42	0.00	0.00	0.00	0.60
Total	2.59	3.61	4.73	8.51	36.34	7.14	1.61	0.88	0.67	0.70	1.23	5.25	12.89	6.27	4.13	3.47	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **13.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.46	0.53	0.60	0.67	0.39	0.81	0.21	0.32	0.39	0.42	0.39	0.39	0.46	0.42	0.21	0.49	7.11
4 - 8	1.19	0.70	1.33	1.58	1.65	1.12	0.77	0.53	0.21	0.14	0.81	1.02	1.05	0.74	0.77	0.95	14.53
8 - 12	1.12	0.98	1.26	2.38	3.40	1.86	0.25	0.11	0.07	0.11	0.28	0.60	1.19	0.81	0.95	1.12	16.46
12 - 16	0.46	0.42	1.30	2.73	6.86	1.96	0.11	0.04	0.00	0.04	0.07	0.74	1.30	0.53	0.77	0.98	18.28
16 - 20	0.25	0.49	0.67	1.37	7.28	1.44	0.00	0.00	0.00	0.00	0.00	0.49	1.12	0.98	0.77	0.32	15.16
20 - 24	0.32	0.46	0.32	1.26	4.83	0.56	0.00	0.00	0.00	0.00	0.00	0.49	1.05	0.84	0.63	0.35	11.10
24 - 28	0.14	0.14	0.18	0.28	3.78	0.14	0.00	0.00	0.00	0.00	0.00	0.39	0.77	0.81	0.14	0.04	6.79
28 - 32	0.00	0.00	0.18	0.14	1.79	0.04	0.00	0.00	0.00	0.00	0.00	0.46	0.77	0.28	0.11	0.00	3.75
32 - 36	0.00	0.00	0.07	0.14	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.32	1.02	0.14	0.00	0.00	2.31
36 - 40	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.39	1.23	0.14	0.00	0.00	2.24
40 - 44	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.81	0.00	0.00	0.00	1.12
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.39	0.00	0.00	0.00	0.49
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.25	0.00	0.00	0.00	0.67
Total	3.92	3.71	5.88	10.54	31.13	7.91	1.33	0.98	0.67	0.70	1.54	6.06	11.38	5.67	4.34	4.24	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **15.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.49	0.46	0.67	0.95	0.63	0.53	0.39	0.46	0.35	0.39	0.39	0.42	0.46	0.60	0.49	0.42	8.05
4 - 8	1.30	1.19	1.75	1.68	1.44	1.44	1.05	0.25	0.42	0.35	0.53	1.33	1.02	0.98	0.74	1.09	16.53
8 - 12	0.74	1.26	1.44	2.94	3.99	2.07	0.42	0.07	0.07	0.11	0.46	1.16	1.23	1.12	1.02	2.00	20.06
12 - 16	0.63	0.91	1.44	2.52	6.65	2.56	0.21	0.04	0.00	0.04	0.14	0.88	1.12	0.98	0.84	0.91	19.85
16 - 20	0.42	0.70	0.81	1.89	5.11	1.30	0.04	0.00	0.00	0.04	0.07	0.56	0.88	0.46	0.77	0.56	13.59
20 - 24	0.21	0.49	0.46	1.19	3.92	0.39	0.00	0.00	0.00	0.00	0.04	0.63	0.77	0.74	0.53	0.28	9.63
24 - 28	0.14	0.18	0.25	0.39	1.86	0.11	0.00	0.00	0.00	0.00	0.00	0.46	0.46	0.21	0.14	0.14	4.31
28 - 32	0.00	0.04	0.21	0.11	0.53	0.04	0.00	0.00	0.00	0.00	0.00	0.21	0.46	0.39	0.11	0.04	2.10
32 - 36	0.00	0.04	0.07	0.04	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.81	0.32	0.00	0.00	2.56
36 - 40	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.91	0.21	0.00	0.00	1.65
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.32	0.04	0.00	0.00	0.60
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.25	0.04	0.00	0.00	0.42
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.14	0.00	0.00	0.00	0.67
Total	3.92	5.25	7.07	11.69	24.93	8.40	2.10	0.81	0.84	0.91	1.61	7.56	8.79	6.06	4.62	5.43	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **17.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.67	0.91	0.35	0.56	0.49	0.49	0.25	0.53	0.56	0.49	0.74	0.74	0.70	0.39	0.42	0.70	8.96
4 - 8	1.33	1.68	1.51	1.89	1.93	1.93	0.95	0.84	0.35	0.42	0.77	1.33	1.61	1.33	1.26	1.33	20.45
8 - 12	1.65	1.72	2.07	2.87	4.45	2.63	0.46	0.07	0.11	0.18	0.42	1.47	1.12	0.88	0.91	1.12	22.09
12 - 16	0.74	0.88	1.65	3.05	6.48	2.00	0.14	0.00	0.04	0.04	0.11	1.51	0.81	0.56	0.77	1.37	20.10
16 - 20	0.53	0.42	0.77	2.38	3.64	0.67	0.04	0.00	0.00	0.00	0.14	1.19	0.63	0.32	0.53	0.67	11.90
20 - 24	0.25	0.63	0.49	1.05	1.89	0.28	0.00	0.00	0.00	0.00	0.07	0.60	0.60	0.32	0.39	0.49	7.04
24 - 28	0.11	0.32	0.25	0.32	0.88	0.04	0.04	0.00	0.00	0.00	0.00	0.46	0.63	0.32	0.14	0.14	3.61
28 - 32	0.04	0.07	0.21	0.11	0.39	0.00	0.00	0.00	0.00	0.00	0.04	0.49	0.46	0.14	0.14	0.04	2.14
32 - 36	0.00	0.00	0.04	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.04	0.49	0.25	0.14	0.04	0.00	1.26
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.63	0.07	0.00	0.00	1.02
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.21	0.04	0.00	0.00	0.49
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.14	0.00	0.00	0.00	0.39
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.56
Total	5.29	6.62	7.32	12.22	20.41	8.02	1.86	1.44	1.05	1.12	2.31	9.63	7.77	4.48	4.59	5.85	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **19.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.60	0.77	0.49	0.88	0.67	0.60	0.81	0.63	0.56	0.42	0.63	0.88	0.46	0.25	0.63	0.77	10.01
4 - 8	1.19	1.93	2.17	2.80	2.52	1.75	0.84	0.60	0.46	0.67	0.70	1.51	1.47	1.37	1.12	1.47	22.55
8 - 12	1.44	1.16	1.93	3.54	5.18	2.80	0.46	0.07	0.04	0.07	0.49	1.96	1.33	1.23	0.81	1.40	23.88
12 - 16	1.12	1.26	1.54	3.12	5.36	1.47	0.18	0.04	0.04	0.04	0.21	1.65	1.37	0.46	0.60	0.88	19.29
16 - 20	0.67	0.35	1.16	2.17	1.79	0.35	0.04	0.00	0.00	0.04	0.00	1.33	0.63	0.28	0.49	0.91	10.19
20 - 24	0.35	0.42	0.67	1.33	1.05	0.11	0.00	0.00	0.00	0.00	0.07	0.98	0.74	0.00	0.53	0.49	6.72
24 - 28	0.25	0.42	0.07	0.35	0.81	0.11	0.00	0.00	0.00	0.00	0.11	0.60	0.28	0.04	0.11	0.21	3.33
28 - 32	0.07	0.07	0.14	0.11	0.11	0.00	0.00	0.00	0.00	0.00	0.04	0.70	0.28	0.11	0.00	0.00	1.61
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.25	0.25	0.04	0.00	0.04	0.60
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.39	0.00	0.00	0.00	0.81
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.21	0.14	0.00	0.00	0.00	0.39
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.04	0.00	0.00	0.00	0.28
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.35
Total	5.67	6.37	8.16	14.29	17.47	7.18	2.31	1.33	1.09	1.23	2.31	11.06	7.35	3.75	4.27	6.16	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **21.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.70	0.98	0.70	0.74	0.84	0.70	0.67	0.63	0.32	0.53	0.74	0.74	0.70	0.74	0.53	0.49	10.71
4 - 8	1.47	1.61	2.24	2.42	3.50	2.17	0.98	0.35	0.39	0.53	0.74	1.65	1.54	0.98	0.91	1.44	22.90
8 - 12	1.47	1.54	2.80	4.06	4.17	2.14	0.39	0.11	0.07	0.11	0.77	2.03	1.82	0.98	1.02	1.16	24.61
12 - 16	1.12	1.37	2.24	3.29	3.50	1.37	0.07	0.04	0.00	0.07	0.25	1.47	1.44	0.56	0.77	0.81	18.38
16 - 20	0.84	0.77	1.61	1.44	1.65	0.28	0.04	0.00	0.00	0.00	0.14	1.54	1.19	0.21	0.42	0.53	10.64
20 - 24	0.53	0.56	0.84	1.44	0.63	0.07	0.07	0.00	0.00	0.00	0.14	1.12	0.49	0.04	0.14	0.53	6.58
24 - 28	0.28	0.21	0.14	0.21	0.25	0.04	0.00	0.00	0.00	0.00	0.14	1.12	0.35	0.04	0.04	0.18	2.98
28 - 32	0.14	0.14	0.07	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.67	0.25	0.00	0.00	0.00	1.37
32 - 36	0.11	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.49	0.18	0.00	0.00	0.00	0.88
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.11	0.00	0.00	0.00	0.46
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.04	0.00	0.00	0.00	0.28
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.14
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.07
Total	6.65	7.18	10.68	13.62	14.53	6.76	2.21	1.12	0.77	1.23	3.05	11.62	8.09	3.54	3.82	5.11	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **23.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.91	0.60	0.95	0.74	0.84	0.88	0.56	0.70	0.70	0.46	0.56	0.70	0.77	0.74	0.25	0.95	11.27
4 - 8	1.61	1.72	2.59	3.43	2.07	1.79	0.84	0.21	0.21	0.60	0.88	1.33	1.61	1.26	1.23	1.37	22.72
8 - 12	1.12	1.93	2.91	3.92	3.78	1.30	0.28	0.04	0.04	0.04	0.49	2.07	1.96	1.02	0.81	1.05	22.72
12 - 16	1.12	1.37	3.22	3.12	2.63	1.44	0.04	0.04	0.00	0.11	0.39	1.61	1.72	0.56	0.49	0.98	18.80
16 - 20	0.74	1.23	2.07	1.26	1.12	0.32	0.04	0.00	0.00	0.00	0.42	2.31	0.88	0.25	0.42	0.74	11.80
20 - 24	0.56	0.67	1.05	1.30	0.39	0.14	0.07	0.00	0.00	0.00	0.14	1.40	0.88	0.04	0.11	0.46	7.18
24 - 28	0.18	0.25	0.21	0.32	0.11	0.07	0.00	0.00	0.00	0.00	0.11	1.26	0.32	0.00	0.04	0.07	2.91
28 - 32	0.25	0.14	0.07	0.07	0.04	0.00	0.00	0.00	0.00	0.00	0.04	0.81	0.07	0.00	0.00	0.00	1.47
32 - 36	0.14	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.49	0.04	0.00	0.00	0.00	0.74
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.28
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.04	0.00	0.00	0.00	0.11
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.62	7.88	13.06	14.18	10.96	5.92	1.82	0.98	0.95	1.19	3.05	12.32	8.26	3.85	3.33	5.60	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **25.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.77	0.60	0.98	0.70	0.67	0.67	0.53	0.60	0.46	0.49	0.49	0.70	0.42	0.84	0.91	0.56	10.36
4 - 8	1.23	2.14	2.07	2.80	2.03	1.61	0.49	0.28	0.32	0.28	1.09	1.65	1.86	1.26	1.23	0.91	21.25
8 - 12	1.23	2.00	3.40	4.90	2.91	0.88	0.21	0.04	0.07	0.07	0.74	1.58	2.17	1.54	0.95	0.39	23.04
12 - 16	1.19	1.68	3.61	3.05	2.31	0.67	0.07	0.04	0.00	0.00	0.56	1.89	1.51	1.09	0.60	1.26	19.50
16 - 20	0.95	1.54	2.63	1.82	1.02	0.49	0.04	0.00	0.00	0.00	0.46	2.35	1.09	0.21	0.46	0.63	13.66
20 - 24	0.46	0.70	1.09	1.33	0.25	0.21	0.04	0.00	0.00	0.00	0.18	1.86	0.56	0.11	0.14	0.35	7.25
24 - 28	0.25	0.25	0.18	0.28	0.07	0.00	0.00	0.00	0.00	0.00	0.14	1.37	0.14	0.00	0.00	0.14	2.80
28 - 32	0.18	0.11	0.14	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.07	0.56	0.00	0.00	0.00	0.04	1.16
32 - 36	0.18	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.07	0.00	0.00	0.00	0.70
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.21
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.07
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.41	9.00	14.08	14.95	9.28	4.52	1.37	0.95	0.84	0.84	3.71	12.64	7.81	5.04	4.27	4.27	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **27.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.53	0.70	0.67	0.63	0.81	0.77	0.70	0.53	0.21	0.60	0.46	0.60	0.56	0.60	0.84	0.60	9.77
4 - 8	1.30	1.33	1.96	2.77	1.61	0.95	0.67	0.28	0.32	0.53	0.53	1.72	1.75	1.58	1.02	1.16	19.47
8 - 12	1.23	2.49	3.50	3.75	2.63	0.74	0.14	0.04	0.04	0.18	0.70	2.35	2.28	1.51	1.05	1.05	23.63
12 - 16	1.16	1.86	3.36	3.57	2.80	0.42	0.11	0.04	0.00	0.07	0.49	2.28	1.58	0.84	0.88	0.91	20.34
16 - 20	1.02	1.89	3.01	2.17	1.23	0.39	0.00	0.04	0.00	0.00	0.56	2.14	0.77	0.46	0.25	0.60	14.50
20 - 24	0.53	0.74	1.05	1.19	0.35	0.21	0.00	0.00	0.00	0.00	0.11	1.23	0.42	0.00	0.11	0.46	6.37
24 - 28	0.11	0.35	0.25	0.49	0.18	0.00	0.00	0.00	0.00	0.00	0.32	1.19	0.32	0.00	0.00	0.14	3.33
28 - 32	0.25	0.18	0.11	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.07	0.00	0.00	0.00	1.65
32 - 36	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.35	0.00	0.00	0.00	0.00	0.49
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.04	0.00	0.00	0.00	0.28
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.11	0.00	0.00	0.00	0.00	0.14
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.16	9.52	13.90	14.67	9.59	3.47	1.61	0.91	0.56	1.37	3.26	13.17	7.77	4.97	4.13	4.90	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **29.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.63	0.42	0.60	0.67	0.67	0.98	0.56	0.42	0.35	0.53	0.53	0.84	0.67	0.84	0.63	0.60	9.91
4 - 8	1.30	1.37	2.14	1.89	2.03	1.05	0.32	0.35	0.21	0.25	1.09	1.19	1.75	1.30	1.12	0.91	18.24
8 - 12	1.12	2.42	2.52	3.75	2.35	0.81	0.18	0.14	0.04	0.25	0.67	2.07	1.68	1.40	1.05	1.61	22.06
12 - 16	1.19	2.03	3.40	4.20	2.49	0.21	0.18	0.07	0.04	0.07	0.56	2.21	1.33	0.91	0.88	1.05	20.80
16 - 20	1.37	1.93	3.29	2.00	1.79	0.28	0.04	0.00	0.00	0.00	0.42	2.00	0.88	0.32	0.42	0.67	15.37
20 - 24	0.49	0.98	1.23	1.09	0.98	0.25	0.00	0.00	0.00	0.00	0.28	1.54	0.35	0.04	0.14	0.25	7.60
24 - 28	0.25	0.49	0.25	0.49	0.28	0.00	0.00	0.00	0.00	0.00	0.11	0.88	0.21	0.00	0.00	0.00	2.94
28 - 32	0.07	0.07	0.11	0.11	0.04	0.00	0.00	0.00	0.00	0.00	0.14	0.74	0.04	0.00	0.00	0.00	1.30
32 - 36	0.00	0.04	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.04	0.00	0.00	0.00	1.05
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.35	0.04	0.00	0.00	0.00	0.46
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.04	0.00	0.00	0.00	0.21
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.07
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	6.41	9.73	13.59	14.18	10.61	3.57	1.26	0.98	0.63	1.09	3.85	12.96	7.00	4.80	4.24	5.08	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **31.5 meters**
Number of observations : 2856
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.60	0.98	0.88	0.70	0.74	0.35	0.39	0.39	0.49	0.25	0.74	0.77	0.60	0.91	0.53	0.63	9.91
4 - 8	1.02	1.44	1.72	1.75	1.86	1.19	0.46	0.35	0.28	0.49	0.77	1.30	1.47	1.09	0.88	0.91	16.98
8 - 12	1.79	1.75	3.26	2.87	2.91	0.84	0.35	0.11	0.04	0.28	0.98	1.89	1.47	1.26	1.09	1.79	22.65
12 - 16	1.58	2.10	3.61	3.82	3.01	0.53	0.18	0.04	0.00	0.04	0.46	1.44	1.30	1.09	0.77	1.02	20.97
16 - 20	1.05	1.72	3.08	3.22	1.93	0.14	0.00	0.00	0.00	0.00	0.49	2.07	0.49	0.25	0.42	0.39	15.23
20 - 24	0.32	0.88	1.40	1.09	1.30	0.07	0.00	0.00	0.00	0.00	0.18	1.37	0.67	0.07	0.04	0.00	7.35
24 - 28	0.07	0.49	0.28	0.77	0.42	0.00	0.00	0.00	0.00	0.00	0.14	0.95	0.11	0.00	0.00	0.00	3.22
28 - 32	0.07	0.07	0.11	0.11	0.07	0.00	0.00	0.00	0.00	0.00	0.07	0.70	0.11	0.00	0.00	0.00	1.30
32 - 36	0.00	0.04	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.74	0.04	0.00	0.00	0.00	0.98
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.81	0.00	0.00	0.00	0.00	0.84
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.32	0.07	0.00	0.00	0.00	0.42
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.11
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04
Total	6.48	9.45	14.39	14.32	12.22	3.12	1.37	0.88	0.81	1.05	3.99	12.46	6.30	4.66	3.71	4.73	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **33.5 meters**
Number of observations : 2850
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.53	0.63	0.53	0.60	0.88	0.60	0.28	0.67	0.42	0.35	0.32	0.60	0.60	0.91	0.70	0.56	9.16
4 - 8	1.12	1.75	2.04	1.58	1.93	1.05	0.42	0.53	0.28	0.35	0.77	1.16	1.02	1.02	0.98	0.98	16.98
8 - 12	1.79	2.49	2.28	3.23	2.39	1.12	0.35	0.11	0.04	0.39	0.46	2.25	1.37	1.16	1.19	1.72	22.32
12 - 16	1.44	1.89	3.75	5.09	2.67	0.77	0.07	0.00	0.04	0.04	0.60	1.51	1.12	1.05	0.63	0.95	21.65
16 - 20	0.70	0.95	2.98	4.35	2.35	0.28	0.07	0.00	0.00	0.00	0.35	1.44	0.53	0.32	0.32	0.18	14.81
20 - 24	0.18	0.60	1.33	1.47	1.05	0.18	0.04	0.00	0.00	0.00	0.25	1.33	0.42	0.18	0.04	0.00	7.05
24 - 28	0.00	0.49	0.35	0.95	0.70	0.04	0.00	0.00	0.00	0.00	0.11	1.02	0.11	0.00	0.00	0.00	3.75
28 - 32	0.07	0.11	0.11	0.11	0.14	0.00	0.00	0.00	0.00	0.00	0.07	0.67	0.07	0.00	0.00	0.00	1.33
32 - 36	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	1.26	0.00	0.00	0.00	0.00	1.37
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.63	0.07	0.00	0.00	0.00	0.74
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.42	0.07	0.00	0.00	0.00	0.56
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.14	0.00	0.00	0.00	0.00	0.18
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.11
Total	5.82	8.95	13.37	17.37	12.11	4.04	1.23	1.30	0.77	1.12	3.12	12.53	5.37	4.63	3.86	4.39	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **35.5 meters**
Number of observations : 2837
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.46	0.42	0.46	0.81	0.74	0.53	0.53	0.32	0.28	0.18	0.35	0.49	0.42	0.42	0.95	0.60	7.97
4 - 8	1.34	1.76	2.19	2.19	1.80	1.09	0.63	0.14	0.25	0.46	0.85	0.95	1.48	0.99	1.13	1.02	18.26
8 - 12	1.66	2.57	2.78	2.89	2.75	1.13	0.39	0.25	0.14	0.28	0.49	1.69	1.37	1.20	1.06	1.48	22.14
12 - 16	0.95	1.41	3.88	4.86	3.21	0.56	0.18	0.00	0.00	0.11	0.25	1.06	1.27	0.88	0.56	0.56	19.74
16 - 20	0.56	0.81	2.15	5.01	3.07	0.39	0.00	0.00	0.04	0.04	0.42	1.37	0.42	0.28	0.07	0.18	14.80
20 - 24	0.11	0.60	1.06	2.54	1.45	0.25	0.07	0.00	0.00	0.00	0.25	1.06	0.46	0.14	0.07	0.00	8.04
24 - 28	0.07	0.28	0.35	0.99	0.95	0.18	0.00	0.00	0.00	0.00	0.18	0.85	0.11	0.04	0.00	0.00	3.98
28 - 32	0.18	0.11	0.04	0.07	0.39	0.00	0.00	0.00	0.00	0.00	0.07	0.92	0.04	0.00	0.00	0.00	1.80
32 - 36	0.00	0.07	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.14	1.06	0.04	0.00	0.00	0.00	1.34
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.04	0.00	0.00	0.00	0.95
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.32	0.11	0.00	0.00	0.00	0.49
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.32	0.00	0.00	0.00	0.00	0.35
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.14
Total	5.32	8.04	12.90	19.35	14.38	4.12	1.80	0.70	0.70	1.06	3.10	11.14	5.75	3.95	3.84	3.84	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **37.5 meters**
Number of observations : 2771
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.83	0.72	0.76	0.94	0.43	0.43	0.25	0.18	0.32	0.25	0.51	0.47	0.58	0.65	0.90	0.54	8.77
4 - 8	1.52	1.77	2.85	2.53	1.84	1.15	0.40	0.22	0.40	0.25	0.36	1.44	1.08	1.01	1.01	1.05	18.87
8 - 12	1.26	1.59	2.89	3.07	3.32	0.83	0.40	0.14	0.29	0.14	0.51	1.19	1.41	1.15	0.83	0.97	19.99
12 - 16	1.01	1.19	2.45	5.95	3.10	0.83	0.14	0.04	0.00	0.07	0.29	1.23	1.08	0.40	0.18	0.22	18.19
16 - 20	0.36	0.87	1.77	5.20	3.90	0.61	0.04	0.00	0.00	0.11	0.22	1.01	0.51	0.36	0.11	0.18	15.23
20 - 24	0.11	0.43	0.90	3.00	2.24	0.29	0.00	0.00	0.00	0.00	0.32	0.83	0.36	0.07	0.00	0.00	8.55
24 - 28	0.07	0.29	0.25	1.08	1.37	0.22	0.00	0.00	0.00	0.00	0.25	0.83	0.11	0.14	0.00	0.00	4.62
28 - 32	0.11	0.11	0.04	0.11	0.58	0.14	0.00	0.00	0.00	0.00	0.22	0.97	0.04	0.00	0.00	0.00	2.31
32 - 36	0.07	0.07	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.11	0.90	0.11	0.00	0.00	0.00	1.37
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.83	0.07	0.00	0.00	0.00	0.94
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.40	0.11	0.00	0.00	0.00	0.54
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.32	0.00	0.00	0.00	0.00	0.36
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.18	0.04	0.00	0.00	0.00	0.25
Total	5.34	7.04	11.91	21.87	16.89	4.51	1.23	0.58	1.01	0.83	2.92	10.61	5.49	3.79	3.03	2.96	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **39.5 meters**
Number of observations : 2303
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	1.00	0.74	0.83	1.22	0.52	0.39	0.43	0.39	0.26	0.22	0.26	0.35	0.65	0.39	0.43	0.74	8.81
4 - 8	1.04	1.30	2.26	2.78	2.00	1.26	0.43	0.39	0.13	0.09	0.52	1.13	0.69	0.91	0.91	1.09	16.93
8 - 12	1.22	2.00	2.21	3.86	4.08	1.04	0.26	0.22	0.26	0.13	0.26	0.69	1.04	0.74	0.56	0.83	19.41
12 - 16	0.74	1.39	1.95	6.73	4.43	1.09	0.09	0.00	0.00	0.04	0.22	0.61	0.39	0.26	0.09	0.48	18.50
16 - 20	0.30	1.00	0.78	6.43	5.34	0.87	0.09	0.00	0.00	0.04	0.17	1.00	0.65	0.17	0.13	0.00	16.98
20 - 24	0.13	0.17	0.91	2.65	4.13	0.61	0.00	0.00	0.00	0.00	0.13	0.61	0.26	0.13	0.00	0.04	9.77
24 - 28	0.13	0.22	0.43	0.74	2.08	0.52	0.00	0.00	0.00	0.00	0.09	0.56	0.17	0.13	0.00	0.00	5.08
28 - 32	0.09	0.22	0.00	0.17	0.56	0.39	0.00	0.00	0.00	0.00	0.09	0.52	0.09	0.00	0.00	0.00	2.13
32 - 36	0.04	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.09	0.30	0.09	0.00	0.00	0.00	0.69
36 - 40	0.09	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.61	0.13	0.00	0.00	0.00	1.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.13	0.04	0.00	0.00	0.00	0.26
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.35
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.09
Total	4.78	7.08	9.38	24.58	23.32	6.17	1.30	1.00	0.65	0.52	2.08	6.90	4.21	2.74	2.13	3.17	100.00

Location : Port Angeles - Station 3 ADCP
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 43.9 meters
Distance Above Bottom: **41.5 meters**
Number of observations : 68
All data bins e.g. 1 <= x < 2

Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.00	4.41	1.47	1.47	1.47	0.00	0.00	0.00	0.00	1.47	0.00	0.00	0.00	0.00	0.00	0.00	10.29
4 - 8	1.47	4.41	0.00	2.94	5.88	1.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.47	4.41	0.00	22.06
8 - 12	1.47	0.00	2.94	2.94	8.82	4.41	0.00	0.00	0.00	0.00	0.00	0.00	1.47	0.00	1.47	4.41	27.94
12 - 16	1.47	0.00	1.47	10.29	4.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.47	0.00	0.00	19.12
16 - 20	1.47	0.00	0.00	11.76	5.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.12
20 - 24	0.00	0.00	0.00	0.00	1.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.47
24 - 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28 - 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
32 - 36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36 - 40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	5.88	8.82	5.88	29.41	27.94	5.88	0.00	0.00	0.00	1.47	0.00	0.00	1.47	2.94	5.88	4.41	100.00

Location : Port Angeles Site 3
Deployment Dates : **Mar 27, 2008 - Apr 25, 2008**
Average Depth of Instrument : 31.3 meters
Distance Above Bottom: **20 cm**
Number of observations : 2857
All data bins e.g. 1 <= x < 2

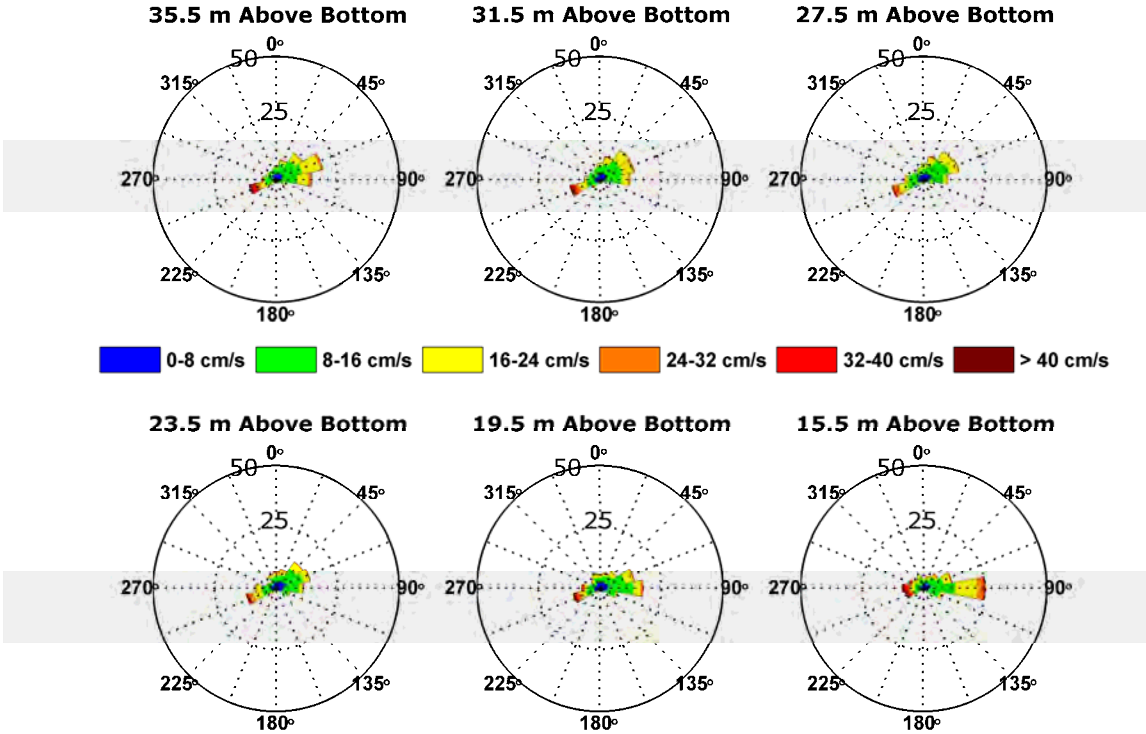
Direction (degrees true)

Speed cm/sec	349 11	11 34	34 56	56 79	79 101	101 124	124 146	146 169	169 191	191 214	214 236	236 259	259 281	281 304	304 326	326 349	Total
0 - 4	0.74	0.70	1.02	0.70	1.02	0.98	1.26	1.44	1.61	1.86	1.61	1.40	0.56	1.02	0.60	0.67	17.15
4 - 8	0.39	0.42	1.79	2.24	1.96	0.81	0.60	0.28	0.32	1.23	2.03	2.14	0.88	0.88	0.35	0.74	17.01
8 - 12	0.18	0.04	2.87	6.27	1.58	0.18	0.11	0.07	0.00	0.25	2.00	2.80	1.19	0.56	0.18	0.60	18.83
12 - 16	0.00	0.04	3.85	9.45	1.37	0.07	0.00	0.00	0.00	0.04	1.33	2.42	0.28	0.14	0.07	0.14	19.18
16 - 20	0.00	0.00	2.28	9.14	0.60	0.00	0.00	0.00	0.00	0.04	1.16	2.31	0.32	0.14	0.04	0.04	16.03
20 - 24	0.04	0.00	0.88	5.46	0.11	0.00	0.00	0.00	0.00	0.00	0.21	0.95	0.00	0.00	0.07	0.07	7.77
24 - 28	0.00	0.00	0.49	2.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.07	0.04	0.04	0.00	3.22
28 - 32	0.00	0.00	0.07	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67
32 - 36	0.00	0.00	0.04	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
36 - 40	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
40 - 44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
44 - 48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48 - >	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	1.33	1.19	13.27	36.26	6.62	2.03	1.96	1.79	1.93	3.40	8.33	12.29	3.29	2.77	1.33	2.24	100.00

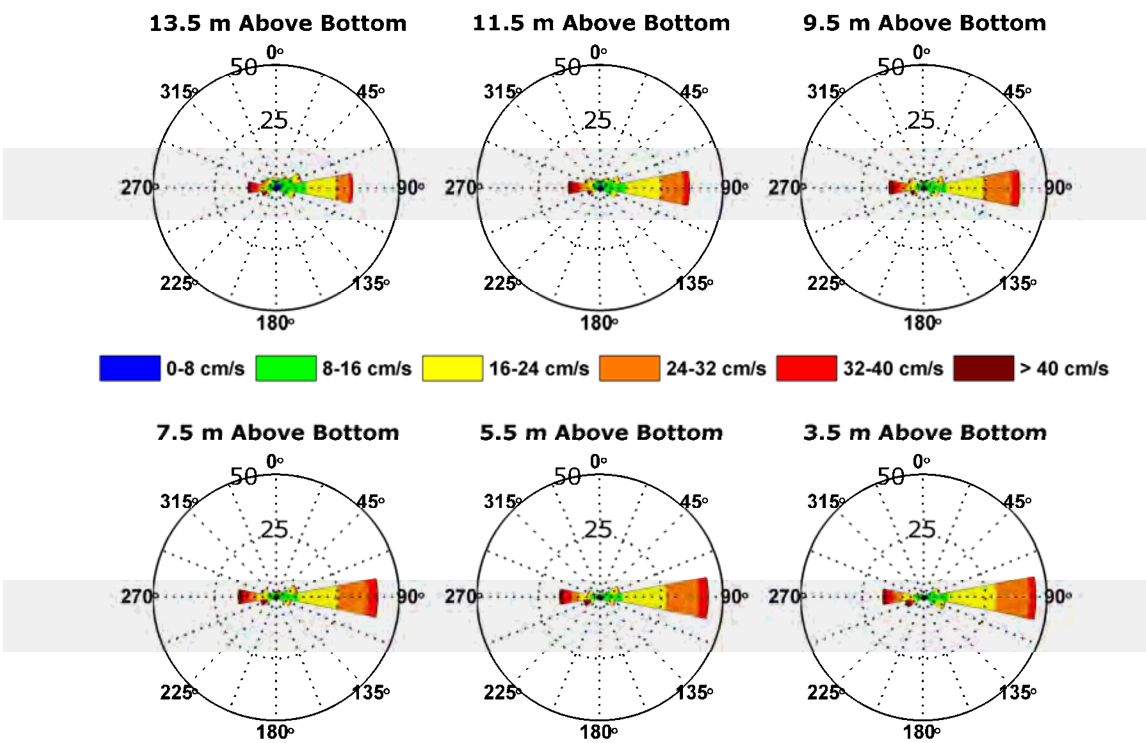
Appendix C.8

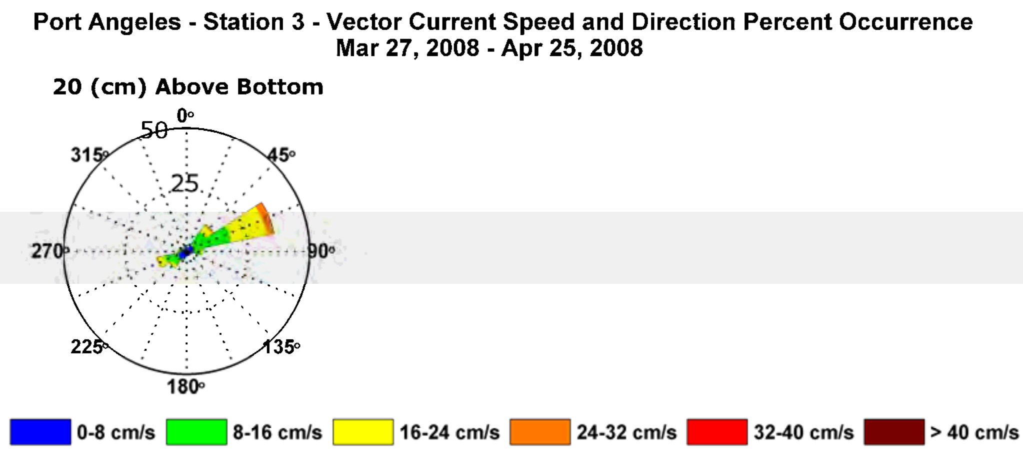
Percent occurrence roses

Port Angeles - Station 3 - ADCP Current Speed and Direction Percent Occurrence
Mar 27, 2008 - Apr 25, 2008



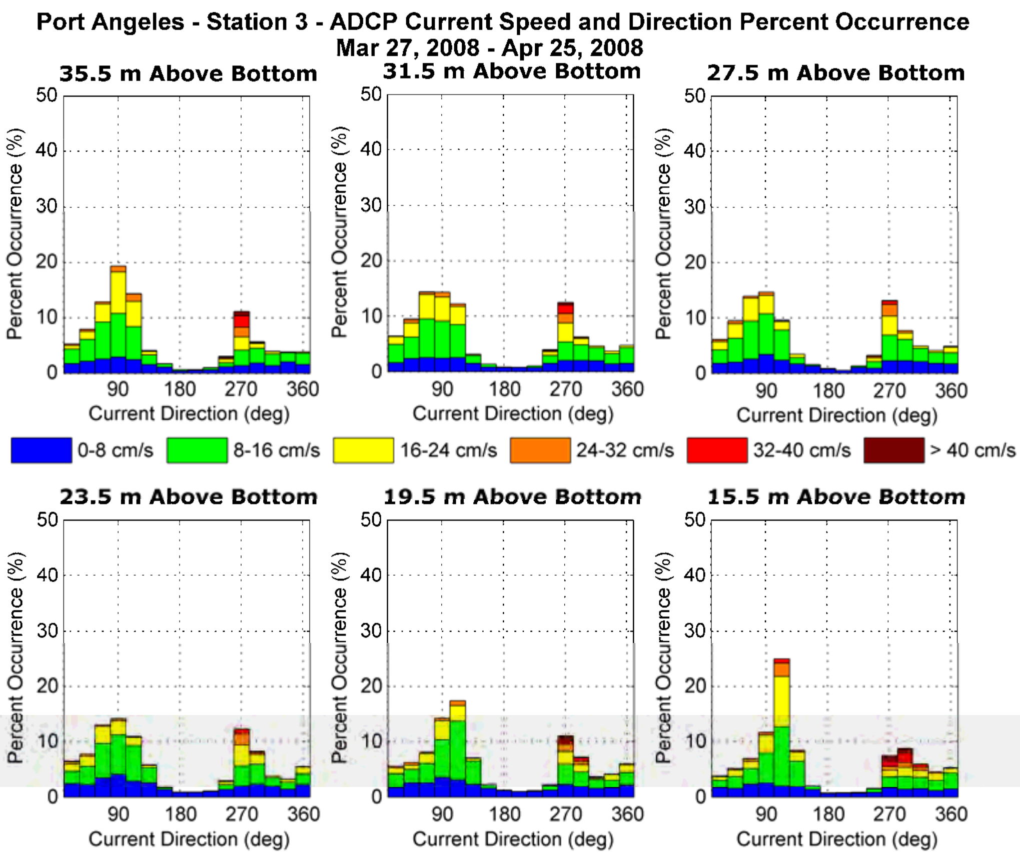
Port Angeles - Station 3 - ADCP Current Speed and Direction Percent Occurrence
Mar 27, 2008 - Apr 25, 2008

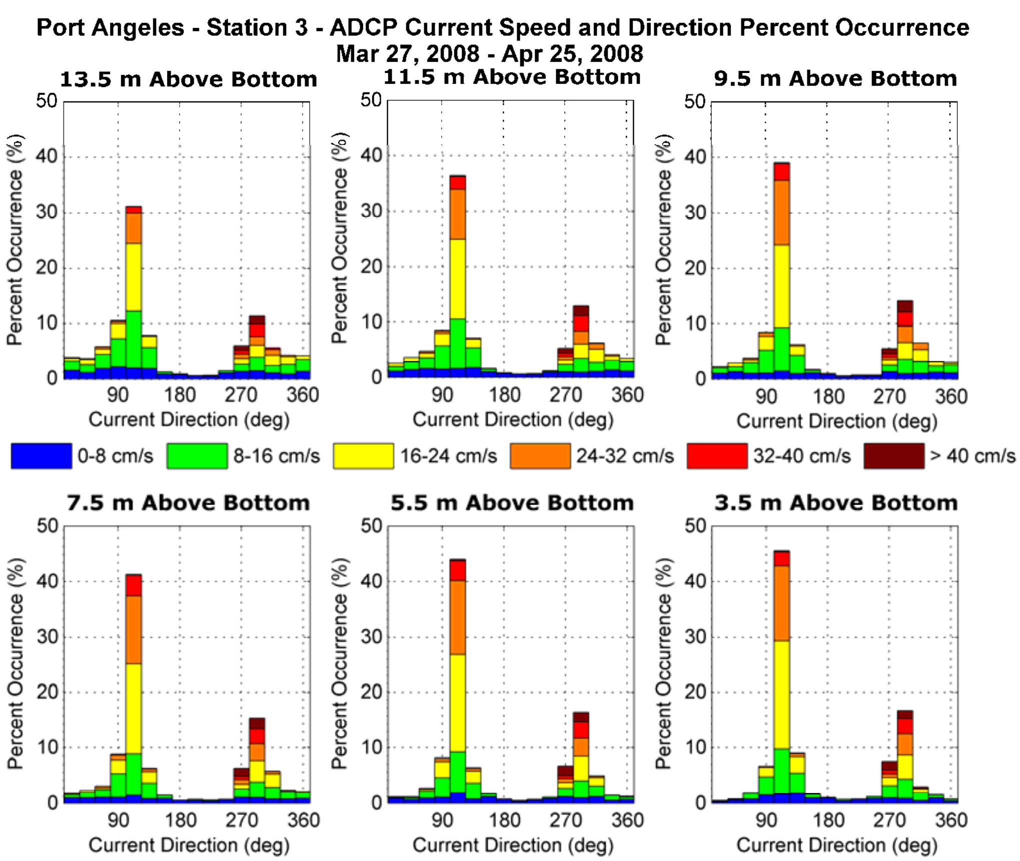


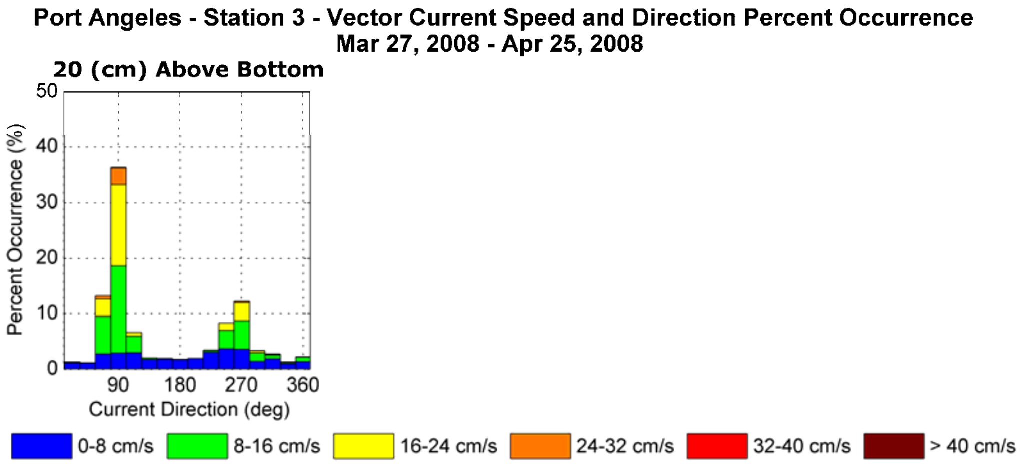

Port Angeles - Station 3 - Vector Current Speed and Direction Percent Occurrence
Mar 27, 2008 - Apr 25, 2008
20 (cm) Above Bottom
0°
45°
90°
135°
180°
225°
270°
315°
50
25
0-8 cm/s
8-16 cm/s
16-24 cm/s
24-32 cm/s
32-40 cm/s
> 40 cm/s

Appendix C.9

Percent occurrence histograms

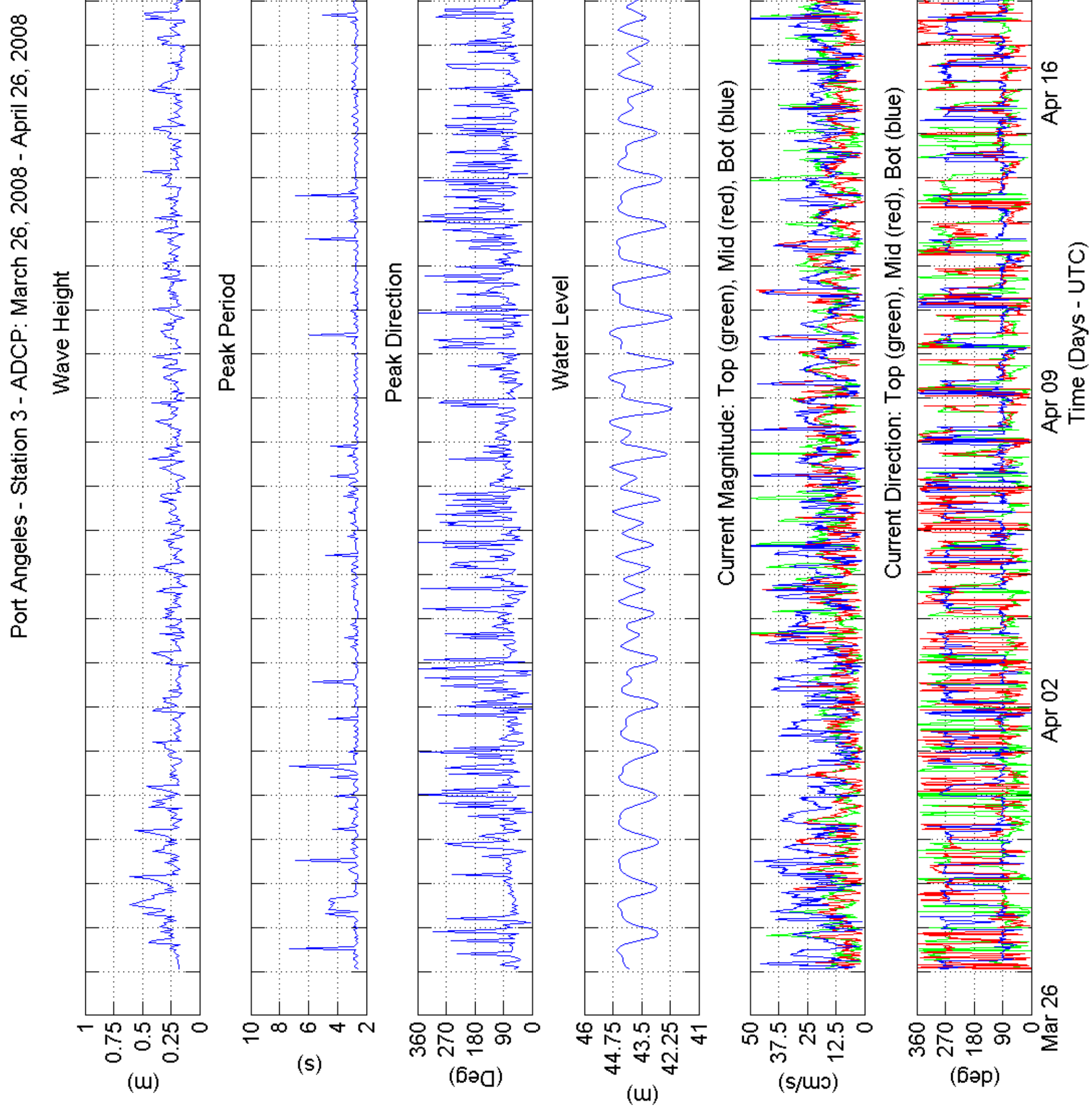

Port Angeles - Station 3 - ADCP Current Speed and Direction Percent Occurrence
Mar 27, 2008 - Apr 25, 2008
35.5 m Above Bottom
31.5 m Above Bottom
27.5 m Above Bottom
23.5 m Above Bottom
19.5 m Above Bottom
15.5 m Above Bottom
Percent Occurrence (%)
Current Direction (deg)
0-8 cm/s
8-16 cm/s
16-24 cm/s
24-32 cm/s
32-40 cm/s
> 40 cm/s

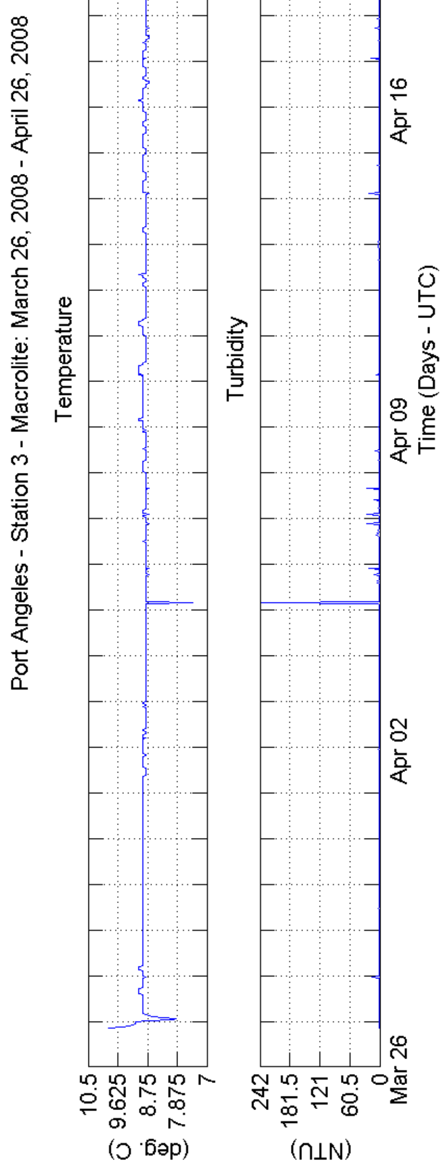

Port Angeles - Station 3 - ADCP Current Speed and Direction Percent Occurrence
Mar 27, 2008 - Apr 25, 2008
13.5 m Above Bottom
11.5 m Above Bottom
9.5 m Above Bottom
7.5 m Above Bottom
5.5 m Above Bottom
3.5 m Above Bottom
Percent Occurrence (%)
Current Direction (deg)
0-8 cm/s
8-16 cm/s
16-24 cm/s
24-32 cm/s
32-40 cm/s
> 40 cm/s


Port Angeles - Station 3 - Vector Current Speed and Direction Percent Occurrence
Mar 27, 2008 - Apr 25, 2008
20 (cm) Above Bottom
Percent Occurrence (%)
50
40
30
20
10
0
90
180
270
360
Current Direction (deg)
0-8 cm/s
8-16 cm/s
16-24 cm/s
24-32 cm/s
32-40 cm/s
> 40 cm/s

Appendix C.10

Time history plots of waves, temperature and turbidity


Port Angeles - Station 3 - ADCP: March 26, 2008 - April 26, 2008
Wave Height
(m)
1
0.75
0.5
0.25
0
Peak Period
(s)
10
8
6
4
2
Peak Direction
(Deg)
360
270
180
90
0
Water Level
(m)
46
44.75
43.5
42.25
41
Current Magnitude: Top (green), Mid (red), Bot (blue)
(cm/s)
50
37.5
25
12.5
0
Current Direction: Top (green), Mid (red), Bot (blue)
(deg)
360
270
180
90
0
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)


Port Angeles - Station 3 - Macrolite: March 26, 2008 - April 26, 2008
Temperature
(deg. C)
10.5
9.625
8.75
7.875
7
Turbidity
(NTU)
242
181.5
121
60.5
0
Mar 26
Apr 02
Apr 09
Apr 16
Apr 23
Time (Days - UTC)

Appendix C.11

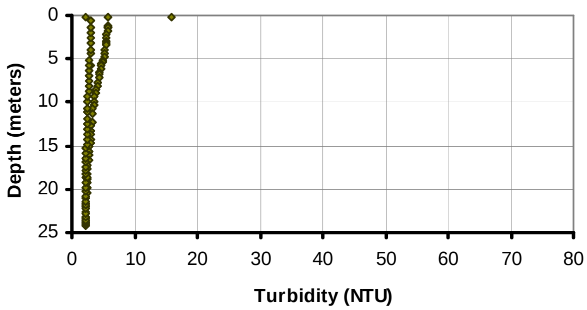
CTD Cast Summary

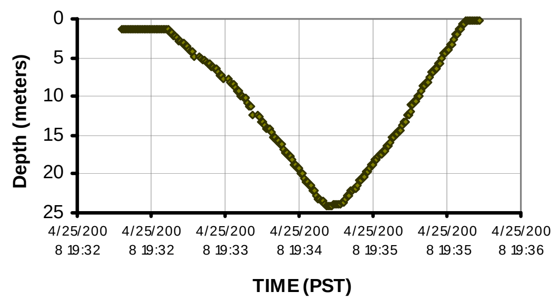
DATE: 7/9/2008

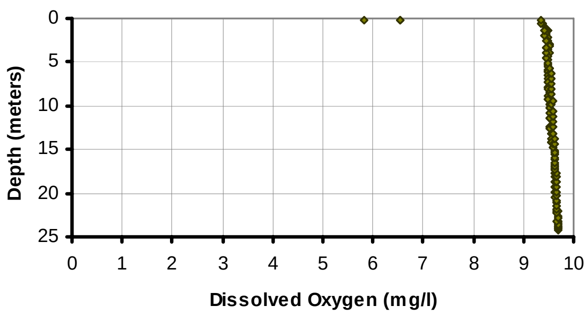
CAST ID: ST3-CTD_Recovery

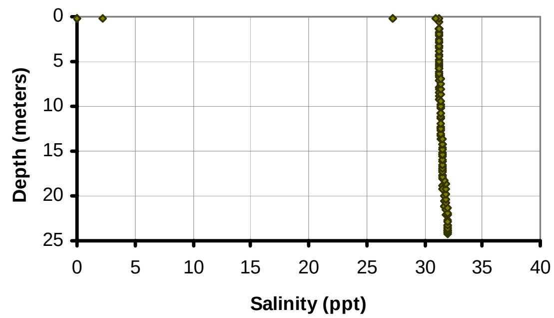
Start Time: 19:32:36
Duration(min): 3.40
Samples: 204

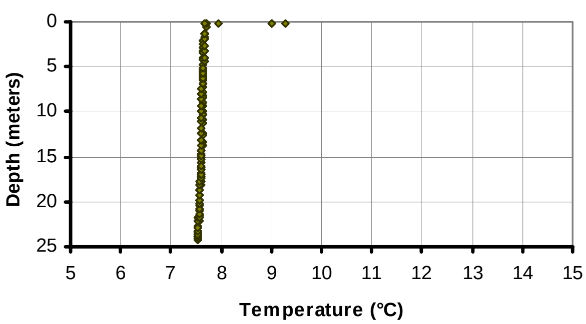
Depth Meters (Feet)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Salinity (ppt)	Battery	Temperature (°C)
2-3 (6.6-9.8)	5.1	9.49	31.3	5.30	7.65
12-13 (39.4-42.7)	2.8	9.55	31.4	5.30	7.62
22-23 (72.2-75.5)	2.2	9.67	31.9	5.33	7.55

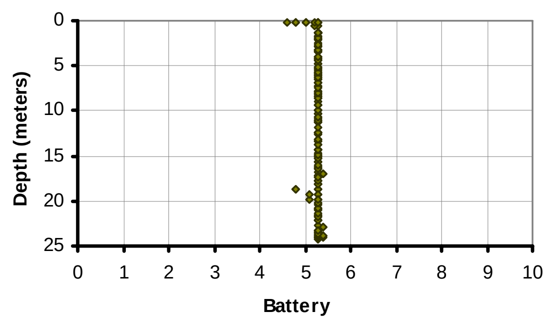












Appendix E
Sediment Trend Analysis Report

(Attachments included on CD)

PORT ANGELES HARBOR SEDIMENT INVESTIGATION

A SEDIMENT TREND ANALYSIS (STA) OF PORT ANGELES HARBOR

February 2009

Prepared for:

DEPARTMENT OF ECOLOGY
State of Washington

Toxics Cleanup Program
Southwest Regional Office

Prepared by:

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1.0 INTRODUCTION

Following about a century of logging and industrial activities inside Ediz Hook at Port Angeles (Fig. 1), the surrounding sediments are known to have various levels of contaminants and a significant amount of wood debris that both covers the bottom or has been transported and subsequently buried. Significant efforts are currently in place through the Washington State Department of Ecology and in association with its prime consultant, Ecology and Environment, Inc., to investigate the extent of the environmental problems and to generate appropriate remedial action. As part of a major ongoing environmental sampling and analytical testing program the Department of Ecology had an additional requirement to assess the present sediment transport regime operating in the harbor. Successful remediation is largely dependent on an understanding of the natural physical processes operating in the environment, the nature of the sediments, their dynamic behaviour and their sources and sinks. This report describes the technique and results of a Sediment Trend Analysis (STA) that is designed, at least partly, to fulfill that requirement.

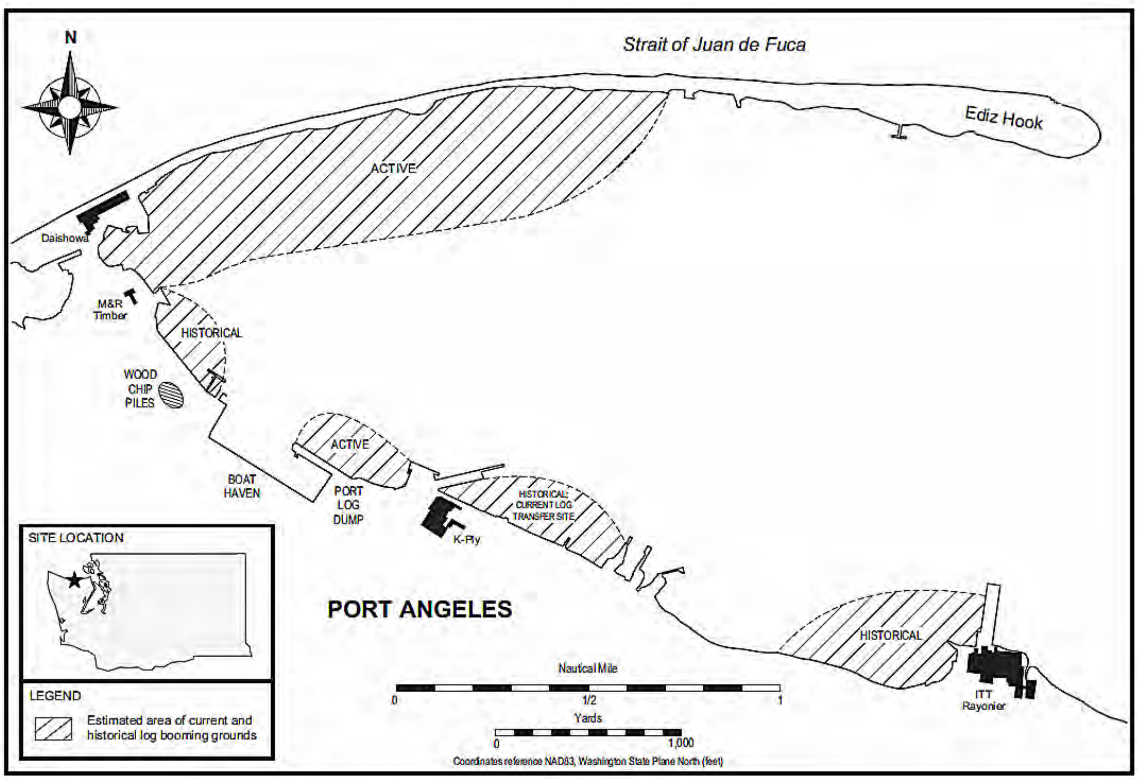

Figure 1: Location map and areas of forest product activities (from Washington State Department of Ecology, 1999)

STA is a technique developed by GeoSea whereby patterns of net sediment transport are determined from relative changes in the grain-size distributions of any “transport-derived” deposit. In addition, the technique enables the dynamic behaviour of the sediments to be determined (i.e., net erosion, net accretion, dynamic equilibrium etc.).

The objectives of the project, as defined in the Sediment Trend Analysis Implementation Plan (Ecology & Environment 2008), were to:

1. Collect 788 sediment grab samples from Port Angeles and adjacent waters.

2. Visually assess and record each sample with respect to the relationship between wood material and sediments. Photograph selected samples to obtain a record of the various relationships between wood material and sediments.

3. Analyze all samples for their grain-size distributions and establish, using the technique of sediment trends, the present patterns of transport and the dynamic behavior of the sediments associated with Port Angeles Harbor. Similar to item 2 (above), photograph selected samples to provide further documentation of sediment-wood material mixtures.

4. Determine areas of erosion, stability (dynamic equilibrium) and deposition as well as identifying sediment sources and sinks.

5. Correlate and discuss the derived patterns of transport with known and/or probable processes as determined by the sediment trends themselves, existing literature and/or ongoing studies.

6. Correlate the results of the STA with existing contaminant data and the qualitative assessments of wood material content.

7. Use the above findings to assess the probable fate and behavior of both wood material and contaminants, optimum monitoring strategies, and remediation options to minimize adverse environmental consequences.

Objectives 1 though 5 are addressed in this report. Objective 6 (correlation of the results of STA with qualitative assessment of wood material content) is also addressed. Objective 7 (optimization of monitoring strategies) could not be completed due to time constraints – sampling was initiated before the STA study could be completed. Objectives 6 (correlation of the results of STS with contaminant data) and 7 (assess remediation options) will be addressed in the sediment investigation report which will be prepared for this study.

2.0 SEDIMENT TREND ANALYSIS

The theory of STA, first published by McLaren and Bowles (1985), demonstrated that, when two sediment samples (d_1 and d_2) are taken sequentially in a known transport direction (for example from a river bed where d_1 is the up-current sample and d_2 is the down-current sample), the sediment distribution of d_2 may become finer (Case B) or coarser (Case C) than d_1; if it becomes finer, the skewness of the distribution must become more negative. Conversely, if d_2 is coarser than d_1, the skewness must become more positive. The sorting will become better (i.e., the value for variance will become less) for both Cases B and C. If either of these two trends is observed, sediment transport from d_1 to d_2 can be inferred. If the trend is different from the two acceptable trends (e.g., if d_2 is finer, better sorted and more positively skewed than d_1), the trend is unacceptable and it cannot be supposed that transport between the two samples has taken place.

In the above example, where the transport direction is unequivocally known, $d_2(s)$ can be related to $d_1(s)$ by a function X(s) where 's' is the grain size. The distribution of X(s) may be determined by:

$$X(s) = d_2(s)/d_1(s)$$

X(s) provides the statistical relationship between the two deposits and its distribution defines the relative probability of each particular grain size being eroded, transported and deposited from d_1 to d_2. It is the shape of the X(s) distribution relative to the shapes of the $d_1(s)$ and $d_2(s)$ distributions that determines the dynamic behavior (stability) of the sediments. There are five defined categories for dynamic behavior which are: (1) Net Erosion, (2) Net Accretion, (3) Dynamic Equilibrium, (4) Total Deposition (Type 1), and (5) Total Deposition (Type 2) (see Figure A6 in Appendix I).

There is now a very large body of literature that uses or discusses STA (e.g., Hughes, 2005; Gao and Collins, 1991, 1992; Gao, 1996, Chang et al., 2001, Le Roux et al., 2002, Le Roux 1994; Héquette et al., 2008) and, as a result, there are a number of methods that have been developed to apply the theory to derive transport pathways. Many of these methods utilize a “black-box” model approach that may not always be successful (e.g., Masselink et al., 2008). For this project a strictly empirical approach is used that is fully described in McLaren and Beveridge (2006) and is available as Appendix I accompanying this report.

It is important to emphasize that STA is not a numerical model and, although statistics are used to accept or reject individual trend lines, it is an empirical technique that establishes a pattern of net sediment transport that can account for all the sample distributions. The latter are simply observations and the derived patterns of transport provide the explanation for their relative changes.

3.0 METHODS

3.1 Data Requirements

STA determines patterns of sediment transport over the area of interest through the particle-size analysis of a large number of sediment grab samples collected on a (mostly) uniformly spaced grid. The sampling plan for this study (Fig. 2) utilized an isotropic regular triangular mesh generated by an in-house ArcView™ application which allowed for examining sample grids at various spacings. As described in more detail in Appendix I, the selection of the distance between samples is based on communications theory which, when applied to STA, suggests that sample sites placed *x* km apart can only reliably detect transport directions occurring over a distance in the order of 2*x* km or more. Directions occurring over distances less than 2*x* km would appear as noise or could create spurious transport pathways through the process of aliasing. In practice, selection of a suitable sample spacing must take into account the number of sedimentological environments, the desired spatial scale of the sediment trends, and the geographic shape and extent of the study area.

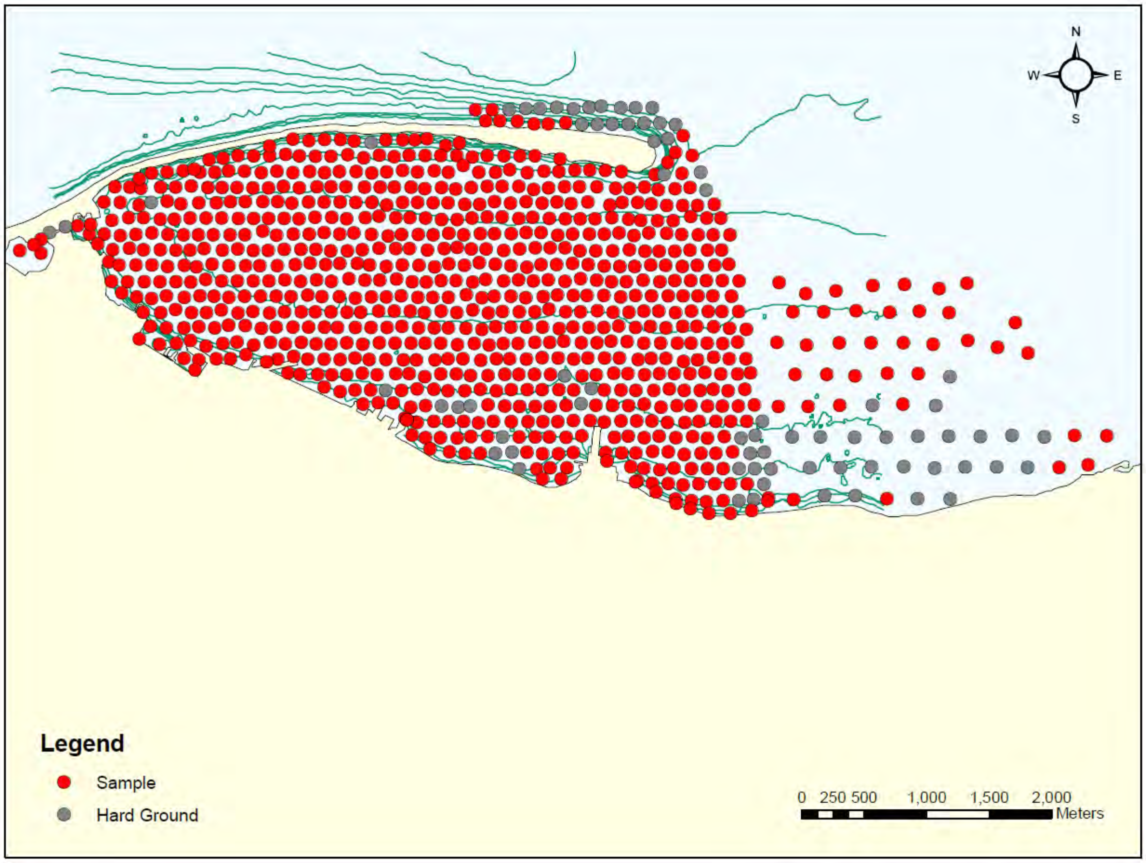

Figure 2: Locations of 765 sample sites and 72 "Hard Ground" locations where no sample was obtained

For this study, a sample spacing of 125 m was chosen to cover the entire area of Port Angeles Harbor lying inside Ediz Hook Spit extending to as far as Lee's Creek to the east. Samples at the same spacing were also obtained from the seaward side of the spit's eastern end. Because of a potential sediment source associated with Morse Creek that flows into the Strait about 3 km east of Lee's Creek, a number of samples were taken at 250 m spacing between Lee's Creek and Morse Creek. A small number of samples (not on the original grid) were also taken from a lagoon associated with the pulp mill activities at the westernmost end of the harbor.

3.2 Field Methods

Sediment grab samples were collected from May 9 to May 27, 2008 using a small rigid hull inflatable equipped with an electric winch and Van-Veen type grab sampler. This device collects the top 10 to 15 cm of sediment. Navigation to and positioning of sample locations were carried out using differential GPS instrumentation to a nominal accuracy of 1.0 m. In most instances, samples were obtained at predetermined locations; however, where the shoreline configuration, anchored ships and structures such as docks and piers precluded dropping the grab at the exact position, the site was changed to be as close as practicable to the planned position. On occasion the grab sampler failed to retrieve a sample, usually the result of strong currents, a scoured bottom, or an impenetrable aquatic weed growth. Following a minimum of three attempts to retrieve a successful sample, the site was abandoned and designated as “Hard Ground”. The actual positions of all samples are shown in Figure 2. Representative samples from each successful grab were stored in plastic bags and transported to the GeoSea laboratory in Brentwood Bay, BC, for grain-size analyses.

All easily observed features concerning each sample were recorded together with a visual assessment of its wood content. The raw data are contained in Appendix II and a map with an accompanying commentary of each parameter makes up Appendix VI.

3.3 Grain-Size Analyses

All samples were analyzed for their complete grain-size distribution using a Malvern MasterSizer 2000 laser particle sizer. The laser-derived distributions were combined with sieve data for particles larger than 1500 microns in diameter using a merging algorithm developed by GeoSea Consulting. The size distributions were entered into a computer equipped with specially developed software to establish sediment trends and transport functions. A more complete description of the grain-size analytical technique is provided in Appendix III and the distributions are contained in an Excel file in Appendix IV.

3.4 The GeoSea GeoDataBase and ArcGIS Maps

Maps and geospatial data were organized using the ArcMap and ArcCatalog applications and the Spatial Analyst tools of ESRI ArcGIS 9.3. A geodatabase was prepared containing all the data necessary to create maps and explore geospatial relationships for this project. The geodatabase is in Microsoft Access database file format, and is stored in the file: “GeoSea Port Angeles 2008 Geodatabase.mdb”. This geodatabase contains the information outlined in the following paragraphs.

3.4.1 Contents of the Geodatabase

3.4.1.1 Background Information

Details of the surrounding environment were taken from digital datasets available from the State of Washington. These include:

1. the surrounding coast, and
2. bathymetry.

3.4.1.2 Sample Descriptors

Sample descriptors were noted at the time of collection and were logged with information on sample location, depth and time. This information is contained in the data base as a Table “Sample Information”

3.4.1.3 GeoSea Study Plan

These data include:

1. the proposed locations of the GeoSea sediment samples; and
2. the geographic extent of the study (Study Boundary).

3.4.1.4 GeoSea Results

These results include:

1. the locations of the GeoSea sediment samples;
2. the grain size parameters of these samples, found in the Table "Grain Size"; and
3. derived results, including the Trend Lines and the Transport Environments.

3.4.1.5 Metadata

Complete metadata are provided for the contributions to the geodatabase from GeoSea, but there are no metadata for the Background Information.

3.4.1.6 Maps

Maps have been provided as a basis for further exploration by the client. All of the maps shown in the report are contained in the database and should be reproducible by the client using the information in the geodatabase.

4.0 PHYSICAL SETTING

Port Angeles lies in the shelter of Ediz Hook, one of a number of large eastward trending spits located on the Washington shoreline of the Strait of Juan de Fuca (Fig. 1). It extends about 5.5. km from the shoreline to its eastern tip, ranges from 30 to 300 m wide and has an average elevation of 5 m. Larson (2006) provides an excellent summary of its Holocene evolution (Fig. 3) demonstrating its association with the Elwha River and its delta, and shoreline erosion of glacially derived sediments. The latter, deposited and reworked as sea level rose from the early Holocence to about 5,000 BP, were driven eastwards by longshore transport in response to waves driven by the dominating westerly winds that characterize the Strait of Juan de Fuca (Fig. 4). Disturbance to the spit's natural evolution began as early as 1910 with the construction of the first dam on the Elwa River followed by another in 1926. The consequent reduction in sediment supply has necessitated a variety of shoreline protective works down its exposed length ever since.

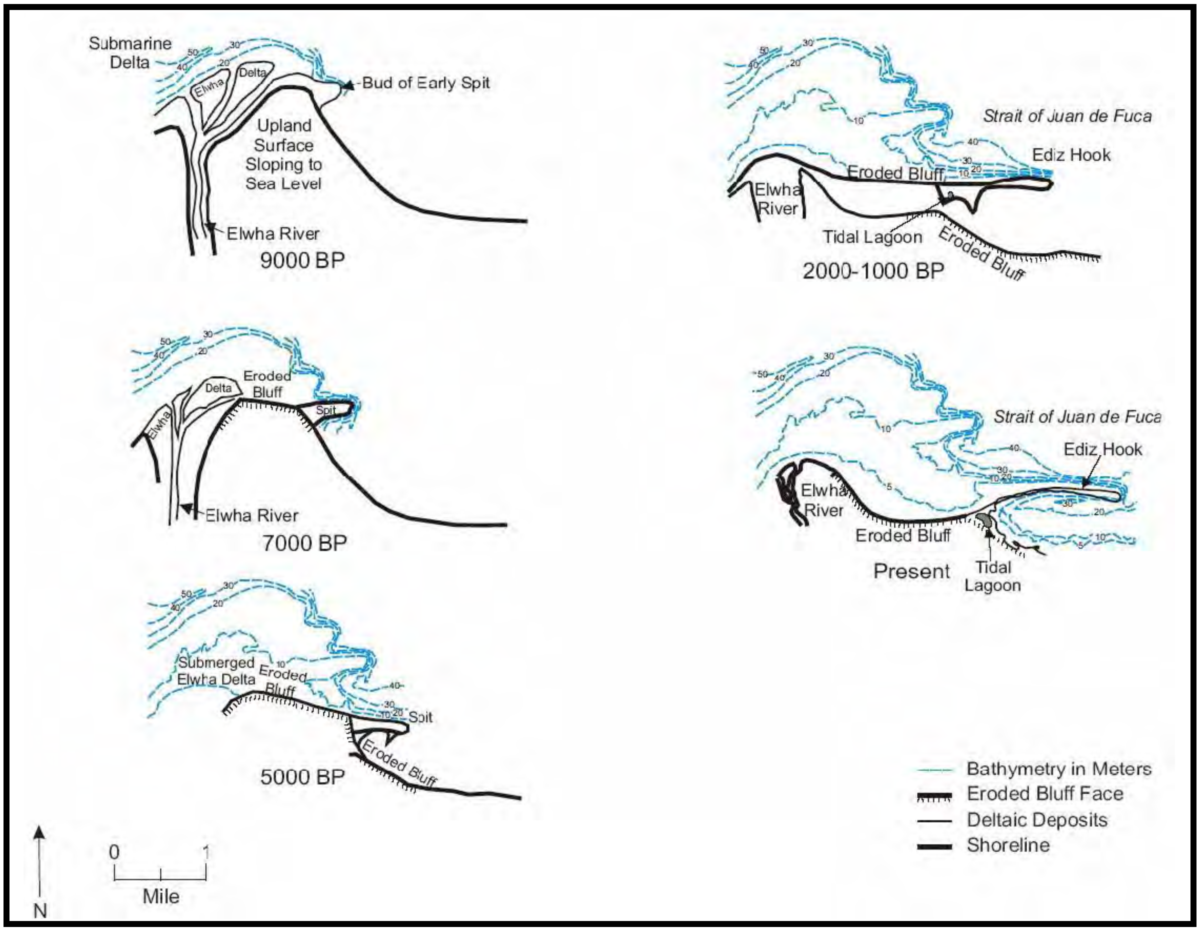

Figure 3: Holocene evolution of Ediz Hook from 9,000 yrs BP to present (taken from Larson Anthropological Archaeological Services Limited, 2006)

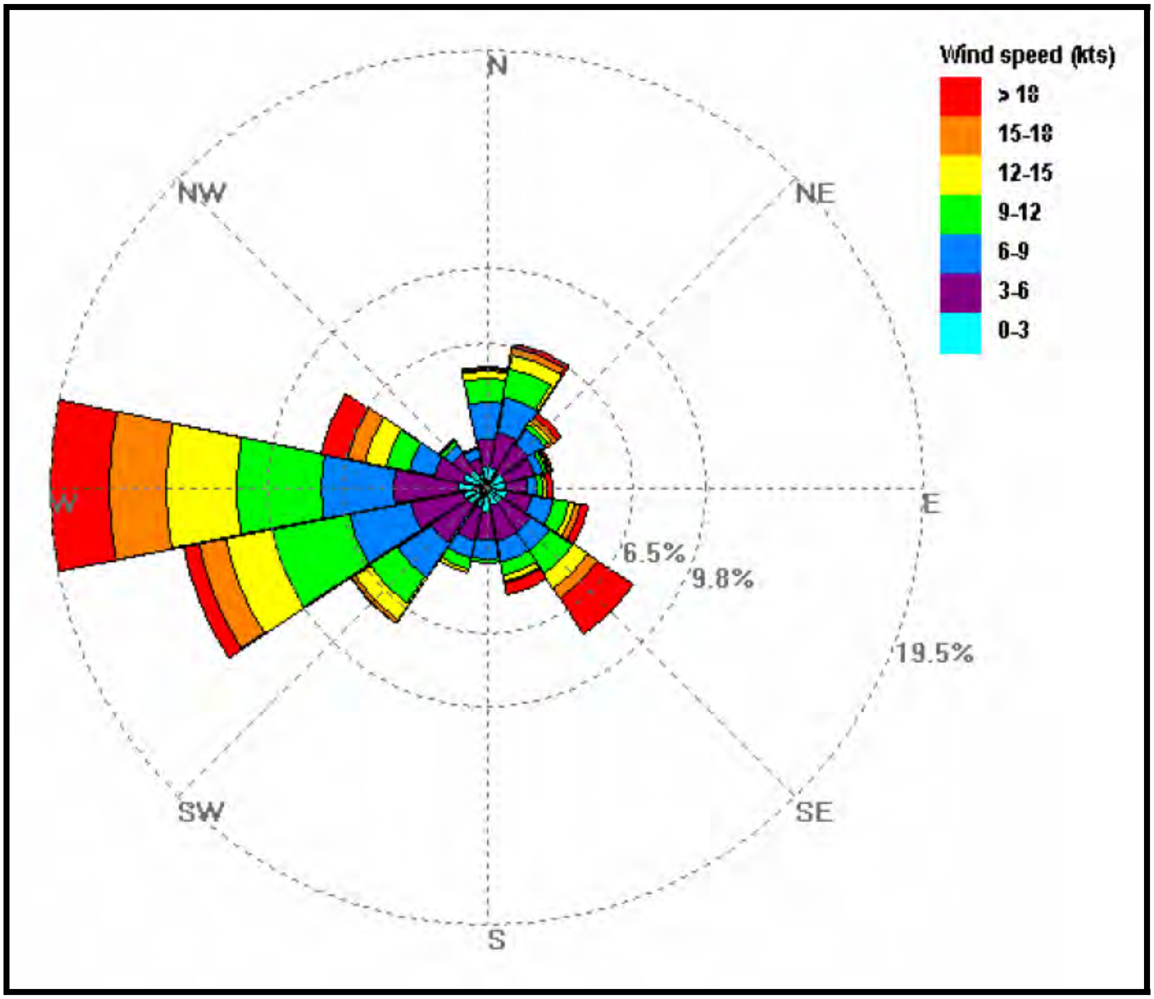

Figure 4: Wind rose for the eastern end of the Strait of Juan de Fuca. Period of record: January-November 2005 (from Haner and Enders, 2007)

The harbor is subject to strong flood tides that propagate eastwards down the Strait of Juan de Fuca and round Ediz Hook in a number of eddies (Malcom Pirnie, 2005). The returning ebb flow tends to be stronger than the flood and its circulation into Port Angeles also produces eddies inside the harbor (Shea et al., 1981). Different studies have led to different conclusions regarding mean surface currents in Port Angeles Harbor (NOAA HAZMAT, 2002). The complexity of the region has been demonstrated with drift cards, pulp mill effluents, the 1985/86 T/V Arco spill, and a hydraulic model (Ebbesmeyer et. al., 1979; Ebbesmeyer et. al., 1991; U. S. Coast Guard, 1986). A more recent surface current model is described in Yang et al. (2003). The tide at Port Angeles is a mixed, semi-diurnal tide with large inequalities in range and time between the two high tides and two low tides each day. The tidal waves in the Strait of Juan de Fuca also experience strong spring and neap tidal cycle variations on a 14-day period. The tidal range in the study area is about 3.0 m in spring tide and 1.0 m in neap tide (Yang et al., 2003).

5.0 ANALYTICAL RESULTS – GRAIN-SIZE ANALYSES

The size analyses of the 765 samples (72 sites were "hard ground") collected from the study area reveal that muddy sand[1] and sandy mud are present in roughly equal amounts (40% and 36%; Table 1). Sand constitutes only about 12% of the bottom types while all other sediment types are found in only minor quantities. A map of the sediment types is shown in Figure 5.

Table 1: Sediment types in the study area (see Figure 5)

SAMPLE TYPE	*NUMBER*	*PERCENTAGE*
Hard Ground (HG)	72	8.6
Gravel (G)	2	0.2
Sandy Gravel (SG)	11	1.3
Gravely Sand (GS)	14	1.7
Sand (S)	100	11.9
Muddy Sand (MS)	338	40.4
Sandy Mud (SM)	297	35.5
Mud (M)	3	0.4
Total	837	100

[1] Sediment types are defined by the quantities of each size (using 20%, 50% and 80% as cutoff values) according to the Wentworth Size Classes. For example, sand is defined as having less than 20% of any other size (i.e. >80% of the full distribution is in the sand sized range which is from 4 phi to -0.75 phi. In the case of mixtures such as muddy sand the sediment contains more than 50% sand, but between 20% and 50% mud; sandy mud has between 20% and 50% sand and >50% mud etc.

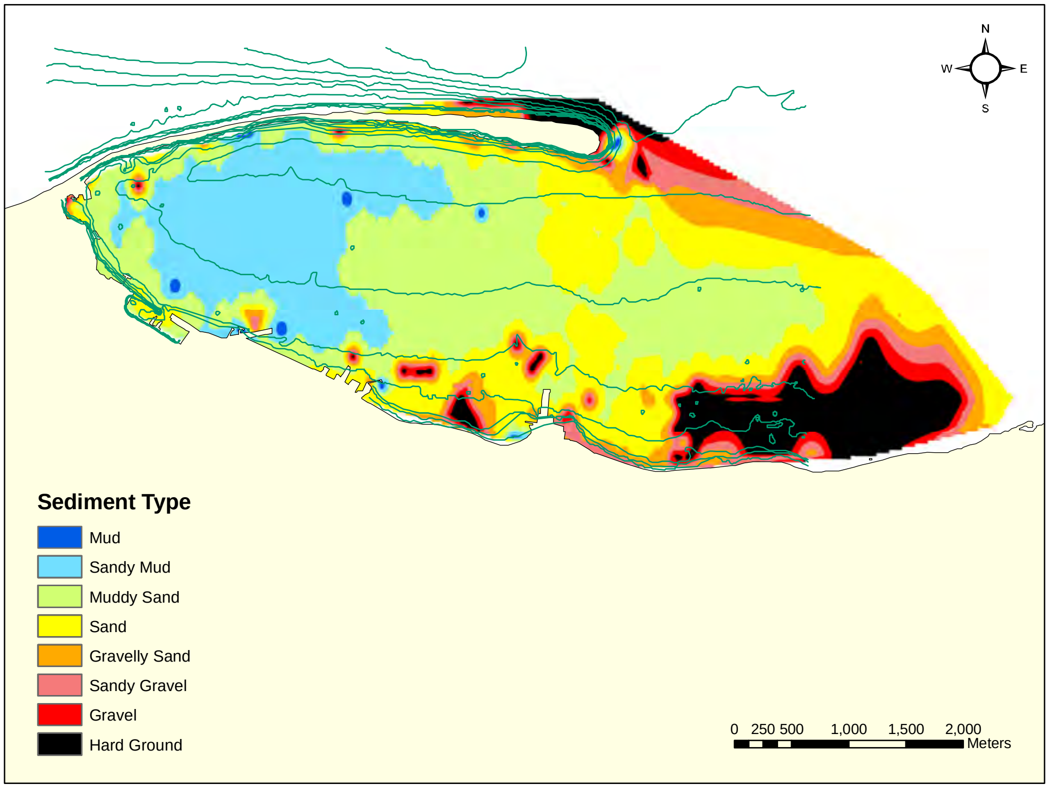

Figure 5: Sediment types in Port Angeles Harbor

6.0 PATTERNS OF SEDIMENT TRANSPORT

Following the procedures described in Appendix I to obtain patterns of sediment transport, it was found that all samples could be accounted for in 191 lines (i.e., sample sequences in which statistically acceptable trends were obtained. The trend statistics together with a location map showing each line (Fig. AV-1) are provided in Appendix V. The net sediment transport pathways are shown in Figure 6.

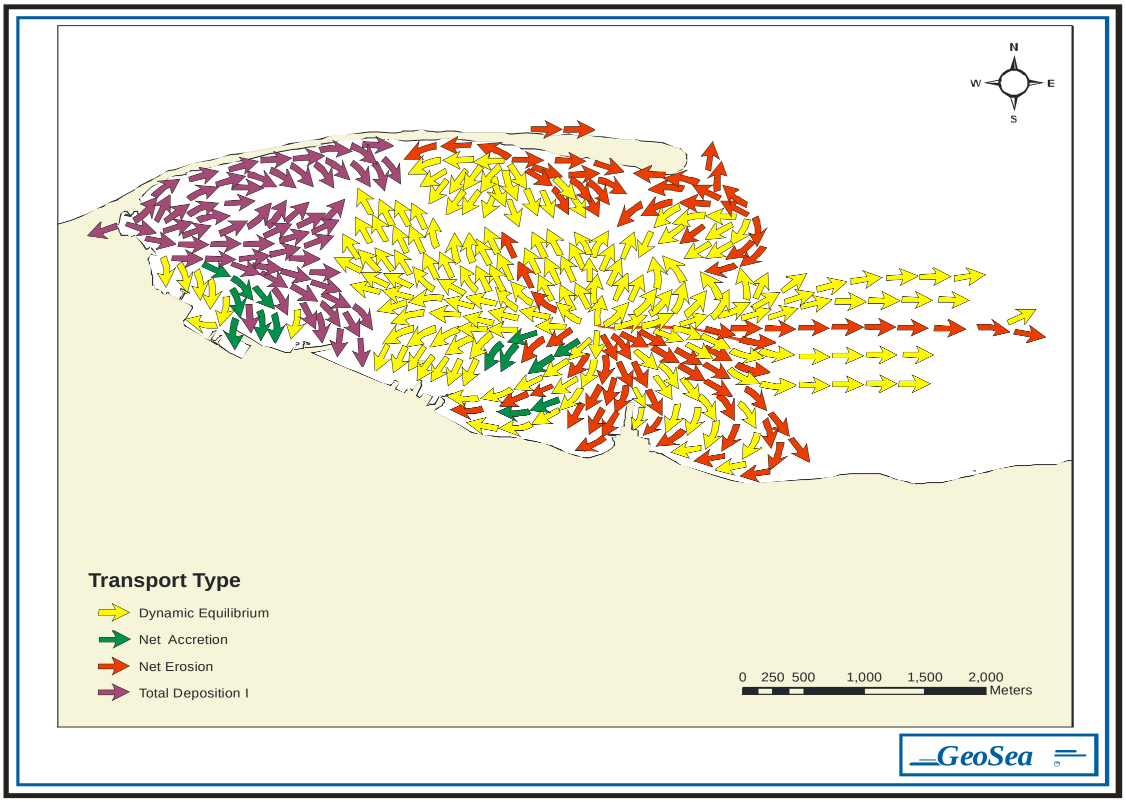

Figure 6: Net sediment transport pathways and dynamic behavior in Port Angeles Harbor

For ease of discussion, the transport lines have been grouped into seven Transport Environments (TEs; Fig. 7). A Transport Environment is defined as an area within which transport lines are associated both geographically and "behaviourally". Transport lines cannot be continued from one TE into another, and so a region in which transport lines naturally end (and begin) forms a boundary between Transport Environments. A summary of the line numbers and dynamic behaviour within each of the TEs is provided in Table 2. Three of the TEs (3, 4 and 5) indicate that the lines originate from small localized areas and these are referred to as "parting zones" (Fig. 8) which are discussed in Section 7.0.

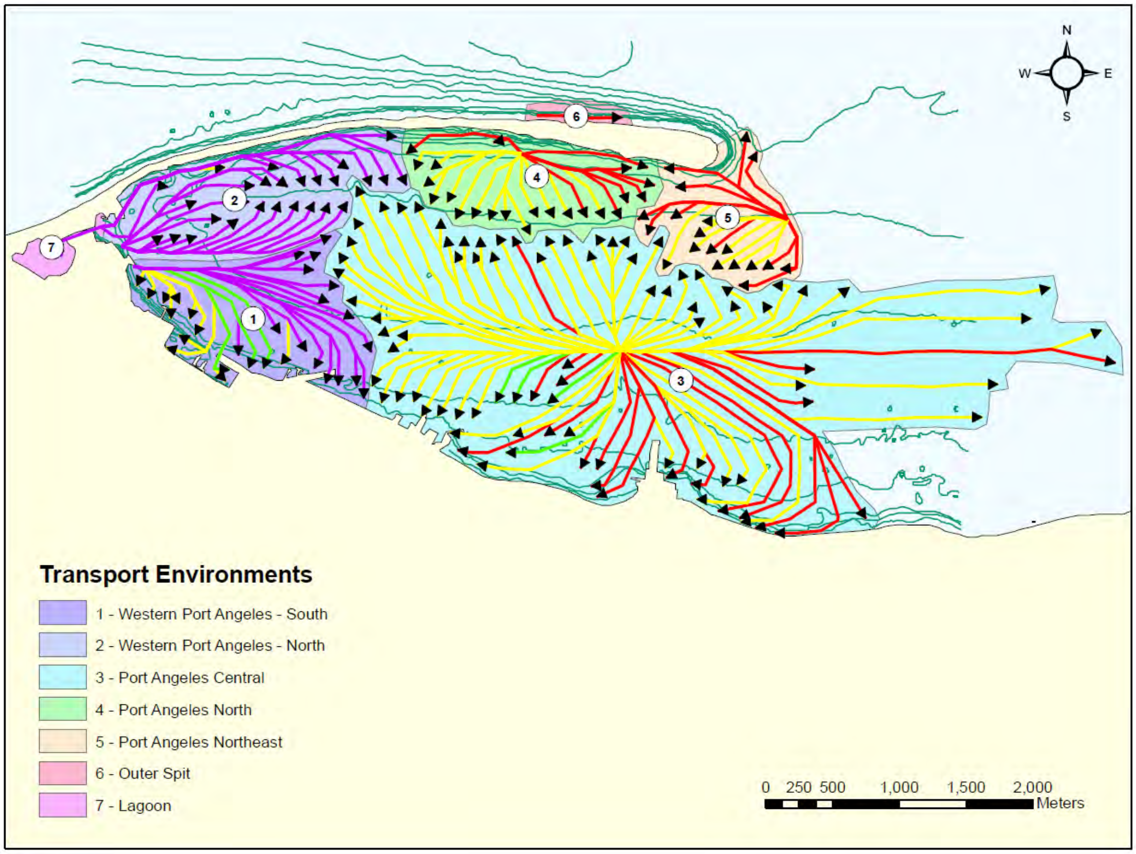

Figure 7: Transport Environments (TEs) as determined from the STA

Table 2: Summary statistics of the dynamic behavior in each of the Transport Environments (see Figure 7)

			DYNAMIC BEHAVIOUR				
TRANSPORT ENVIRONMENTS	Line Numbers (see Fig.AV1)	Total Number of lines	Total Dep.1	Net Accretion	Dynamic Equilibrium	Net Erosion	Mean R^2
1 Western Port Angeles - South	1-30	30	16	4	10	0	0.78±0.18
2: Western Port Angeles - North	31-57	27	26	0	1	0	0.94±0.09
3: Port Angeles - Central	58-147	90	2	4	64	20	0.90±0.13
4: Port Angeles - North	148-170	23	0	0	14	9	0.95±0.06
5: Port Angeles - Northeast	171-189	19	0	0	8	11	0.95±0.15
6: Outer Spit	190	1	0	0	0	1	0.80
7: Lagoon	191	1	1	0	0	0	0.98
	Totals	191	46	8	97	41	
	Percent	100	24	4	51	22	

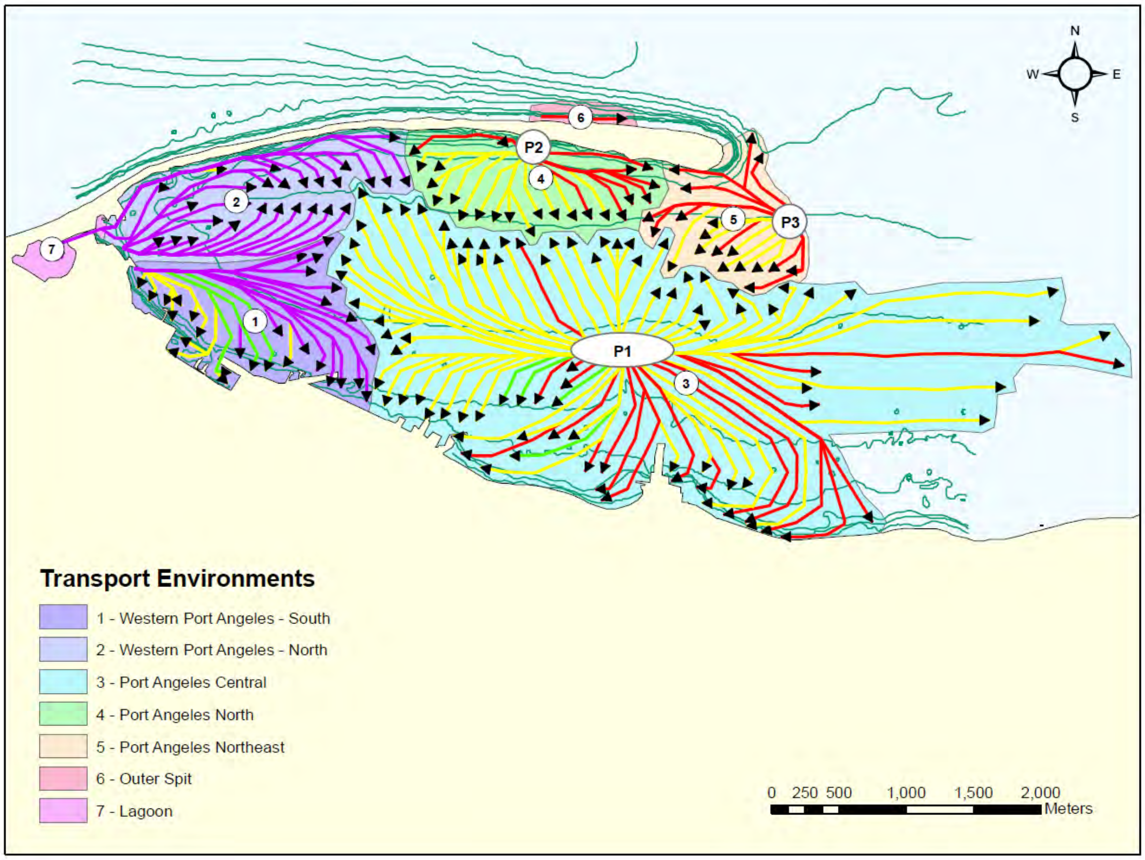

Figure 8: Parting zone areas (P) in Port Angeles Harbor

6.1 TE1: Western Port Angeles - South

(1) Line identifications: Lines 1-30 (Table 2 above; Figure AV-1 in Appendix V).

(2) No. of Lines: 30

(3) R^2: 0.78±0.18

(4) Description: These lines emanate from the far western shoreline of the harbor. They extend eastwards in a radiating pattern that terminates along southern shoreline and at the boundary with the westward trending lines of TE3. Most of the lines are depositional (16 lines of Total Deposition 1 and 4 lines of Net Accretion; Figs. 9 and 10). A further 10 lines (all associated with the southern shoreline) show Dynamic Equilibrium (Fig.11). For reasons that are unclear the R^2 values for TE1 (0.78±0.18) are relatively low compared to all the other TEs (Table 2). Possibly the quantities of fine particles of wood waste in this area have resulted in more "noisy" distributions than elsewhere.

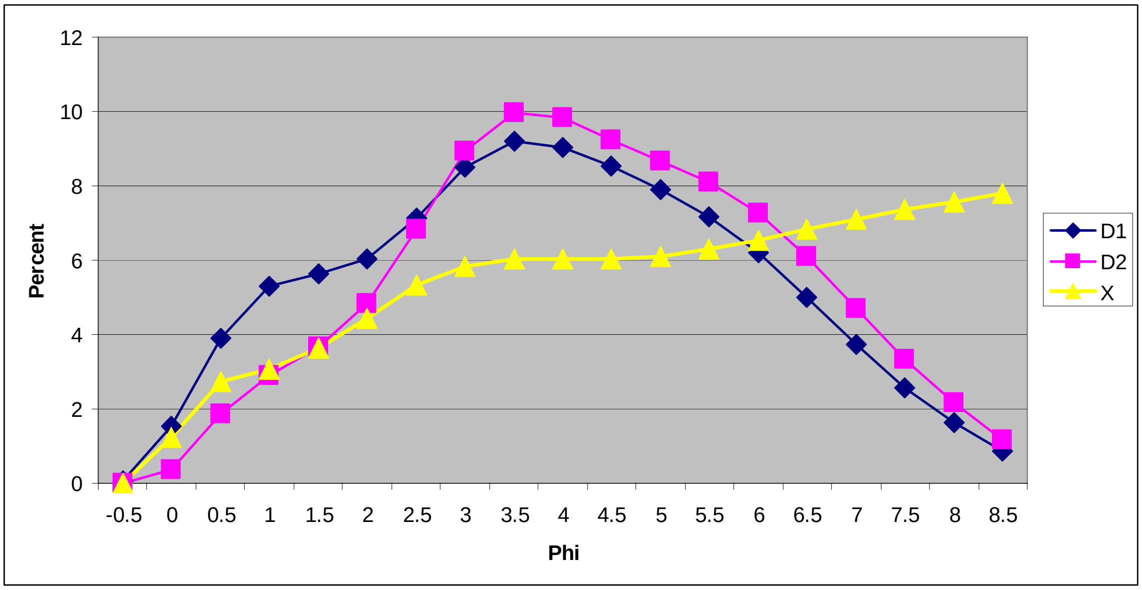

Figure 9: D_1, D_2 and X distributions for Line 26 in TE1 indicating Total Deposition 1 (compare with Figure AI-6D)

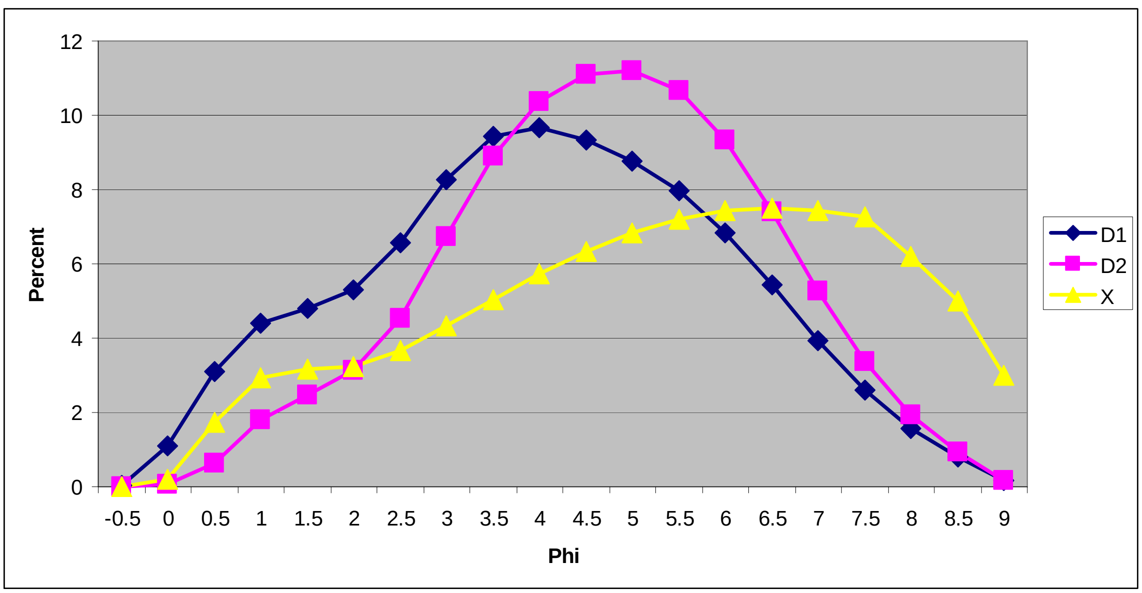

Figure 10: D_1, D_2 and X distributions for Line 14 in TE1 indicating Net Accretion (compare with Figure AI-6B)

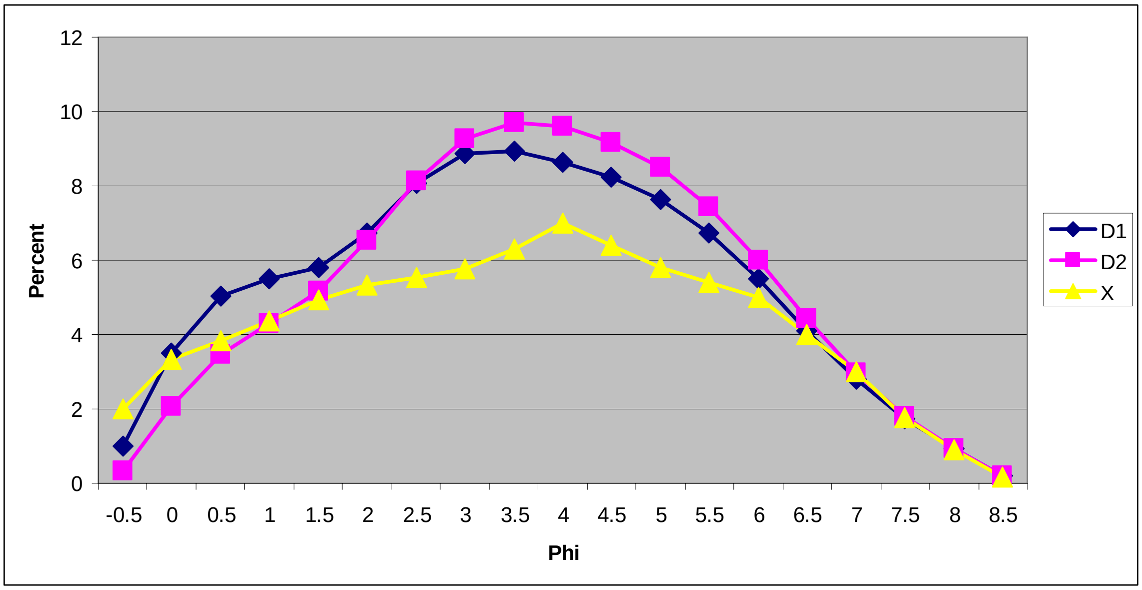

Figure 11: D_1, D_2 and X distributions for Line 7 in TE1 indicating Dynamic Equilibrium (compare with Figure AI-6B)

6.2 TE2: Western Port Angeles - North

(1) Lines 31-57 (Table 2 above; Figure AV-1 in Appendix V).

(2) No. of Lines: 27

(3) R^2: 0.94±0.09

(4) Description: Similar to TE1, these lines also originate at the far western shoreline of the harbor extending as far as the western trending lines of TEs 3 and 4. With the exception of one line in Dynamic Equilibrium (Line 48) all the lines indicate Total Deposition 1 (Fig. 12).

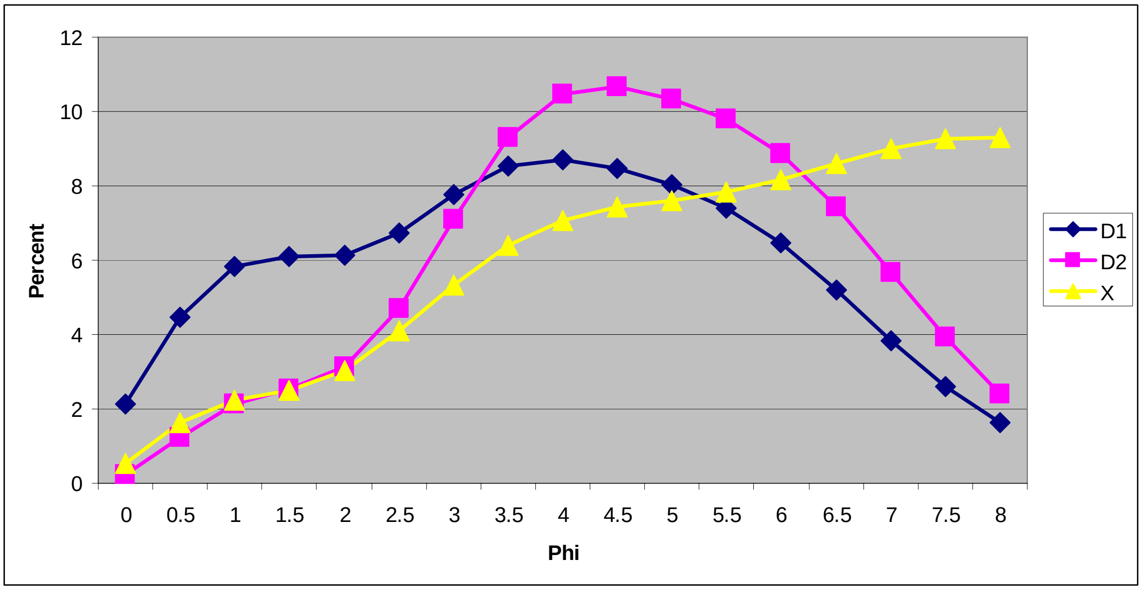

Figure 12: D_1, D_2 and X distributions for Line 31 in TE2 indicating Total Deposition 1 (compare with Figure AI-6D)

6.3 TE3: Port Angeles - Central

(1) Lines 58-147 (Table 2 above; Figure AV-1 in Appendix V).

(2) No. of Lines: 90

(3) R^2: 0.90±0.13

(4) Description: Forming much of the central portion of Port Angeles Harbor, this large group of lines radiates from a large "parting zone" area (P1, Fig. 8) which constitutes a relatively narrow east-west trending region about 2 km long. The largest number of lines indicates that the sediments are in Dynamic Equilibrium (Table 2; Fig. 13), although many of the lines terminating against the southern shoreline are in Net Erosion (Fig. 14).

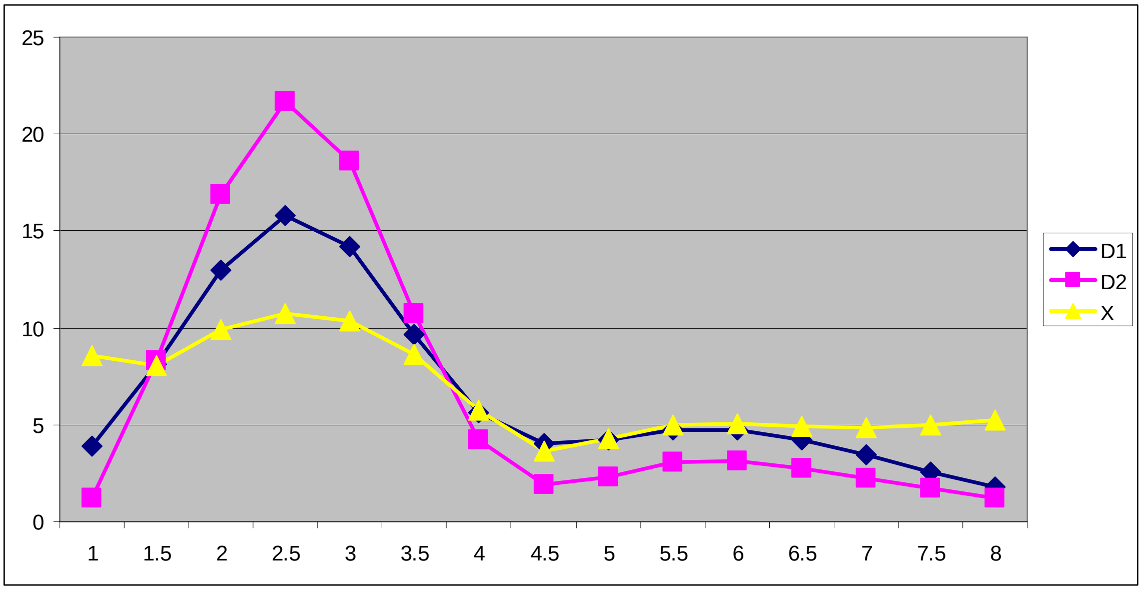

Figure 13: D_1, D_2 and X distributions for Line 58 in TE3 indicating Dynamic Equilibrium (compare with Figure AI-6A)

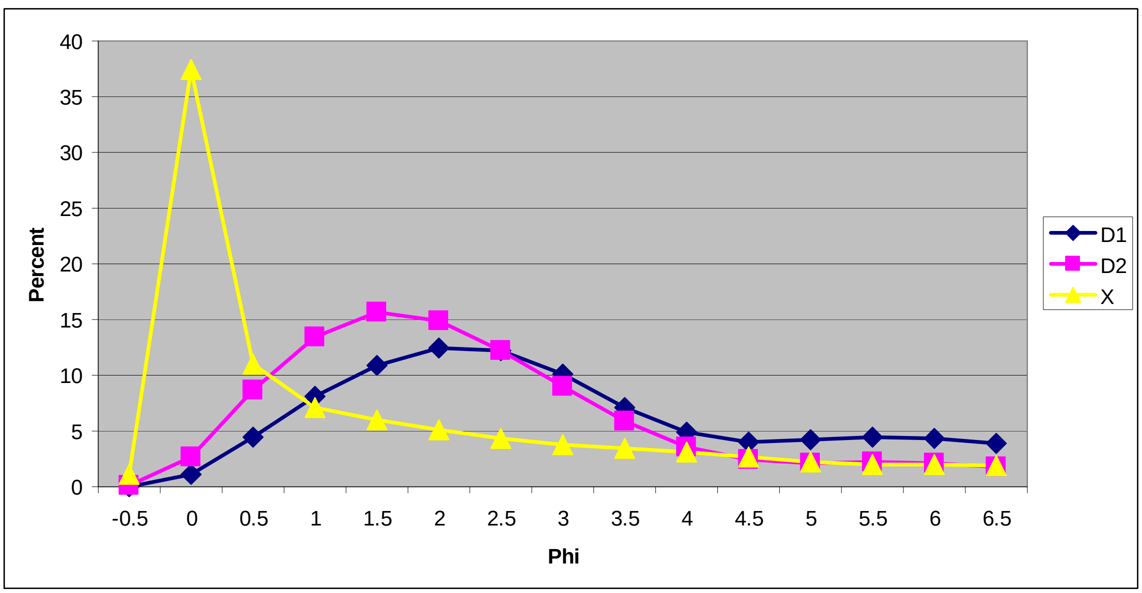

Figure 14: D_1, D_2 and X distributions for Line 71 in TE3 indicating Net Erosion (compare with Figure AI-6B)

6.4 TE4: Port Angeles - North

(1) Lines 148-170 (Table 2 above; Figure AV-1 in Appendix V).

(2) No. of Lines: 23

(3) R^2: 0.95±0.06

(4) Description: All these lines originate from a parting zone (P2, Fig. 8) located close to the south side of Ediz Hook. The lines are relatively short and terminate against TEs 2, 3 and 5. Similar to TE3, most of the lines are in Dynamic Equilibrium (Fig. 15) although the eastward trending lines suggest a dominance of erosion in this area (Fig. 16).

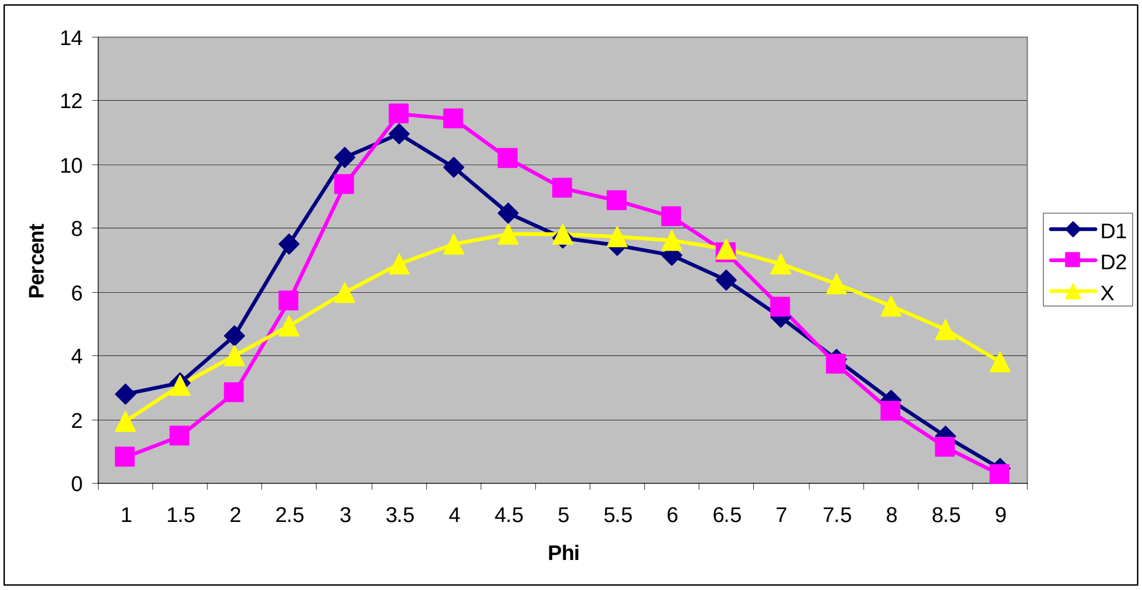

Figure 15: D_1, D_2 and X distributions for Line 158 in TE4 indicating Dynamic Equilibrium (compare with Figure AI-6A)

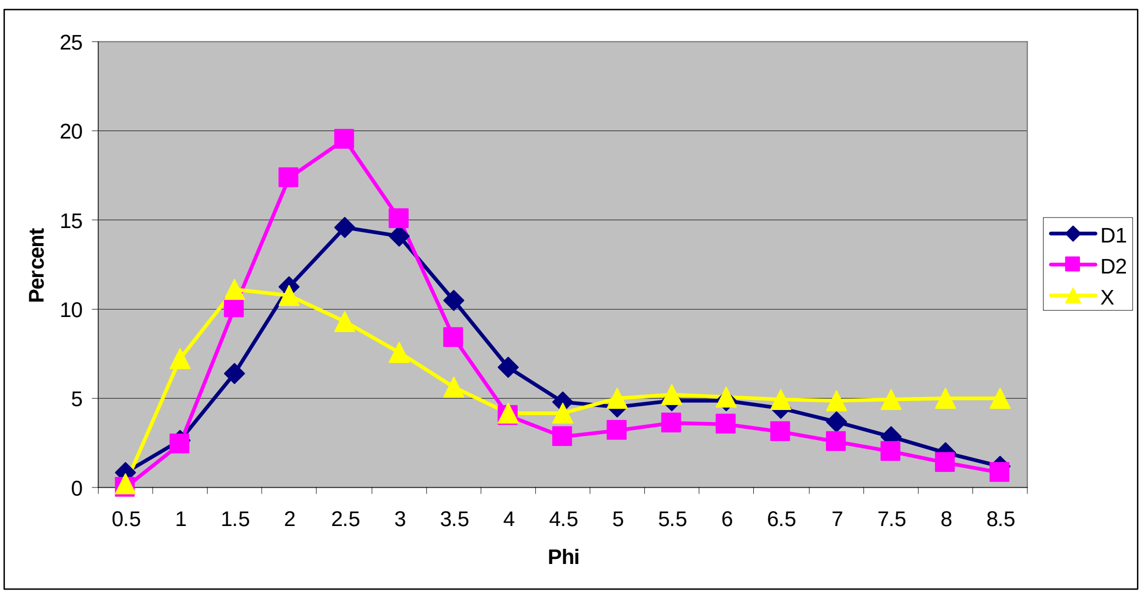

Figure 16: D_1, D_2 and X distributions for Line 169 in TE4 indicating Net Erosion (compare with Figure AI-6B)

6.5 TE5: Port Angeles - Northeast

(1) Lines 171-189 (Table 2 above; Figure AV-1 in Appendix V).

(2) No. of Lines: 19

(3) R^2: 0.95±0.15

(4) Description: Originating from P3 (Fig. 8) these lines generally trend west and southwest into the harbor area. All the lines are either erosional (Fig. 17) or in Dynamic Equilibrium (Fig. 18).

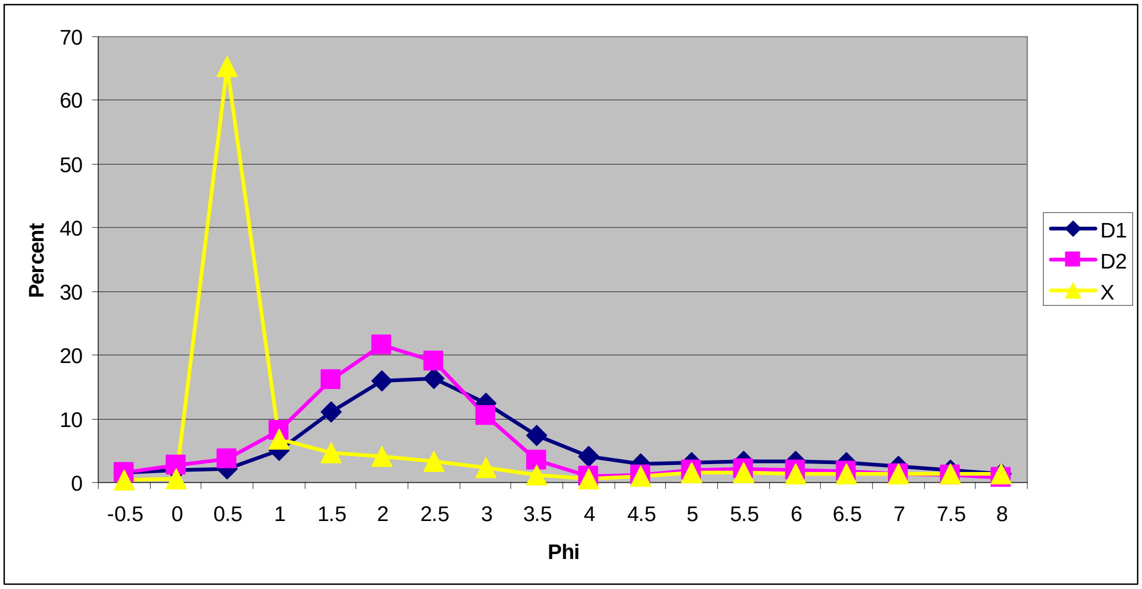

Figure 17: D_1, D_2 and X distributions for Line 187 in TE5 indicating Net Erosion (compare with Figure AI-6B)

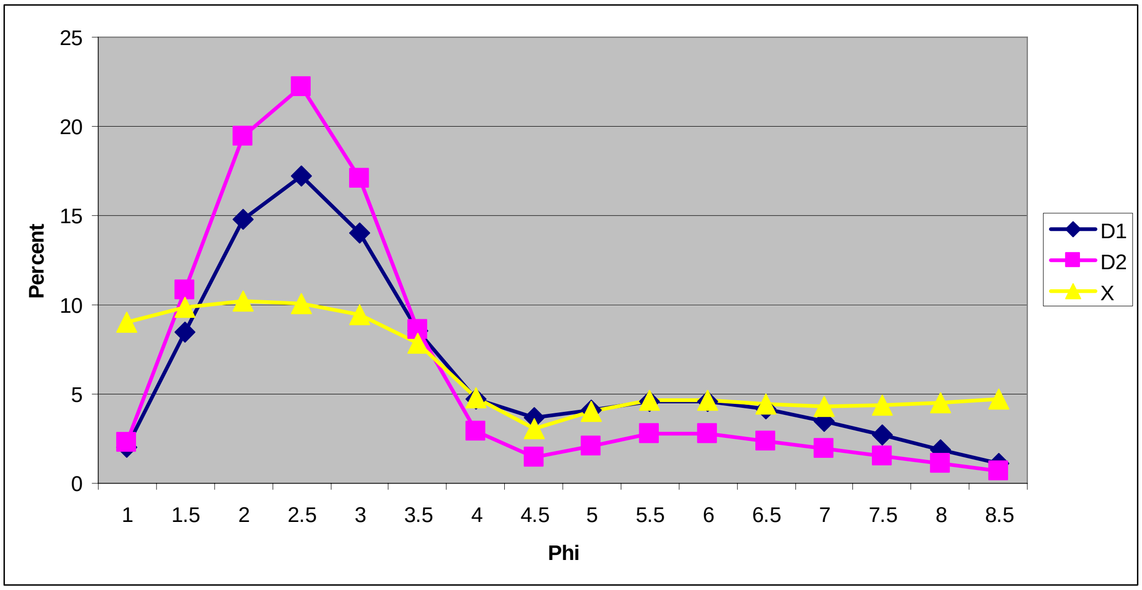

Figure 18: D_1, D_2 and X distributions for Line 181 in TE5 indicating Dynamic Equilibrium (compare with Figure AI-6A)

6.6 TE6: Outer Spit

(1) Line 190 (Table 2 above; Figure AV-1 in Appendix V).

(2) No. of Lines: 1

(3) R^2: 0.80

(4) Description: This single line of samples indicates an erosional environment (Fig.19) eastwards in the direction of spit growth.

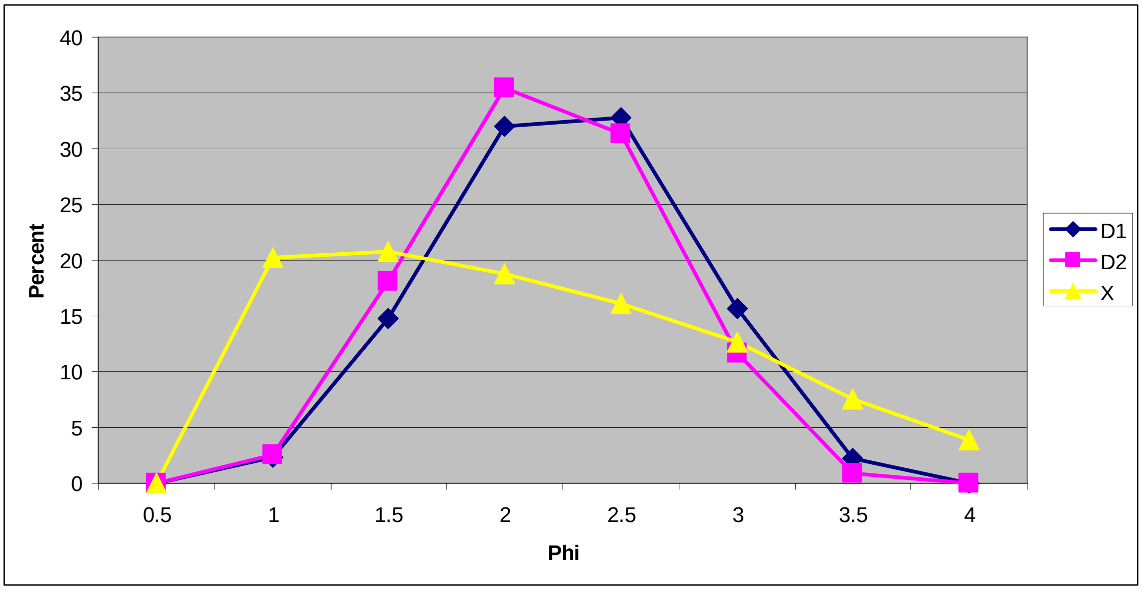

Figure 19: D_1, D_2 and X distributions for Line 190 in TE6 indicating Net Erosion (compare with Figure AI-6B)

6.7 TE7: Lagoon

(1) Line 191 (Table 2 above; Figure AV-1 in Appendix V).

(2) No. of Lines: 1

(3) R^2: 0.98

(4) Description: This single line of samples into the lagoon at the western end of the study area indicates that incoming sediment from the harbor is totally deposited inside the lagoon (Fig. 20).

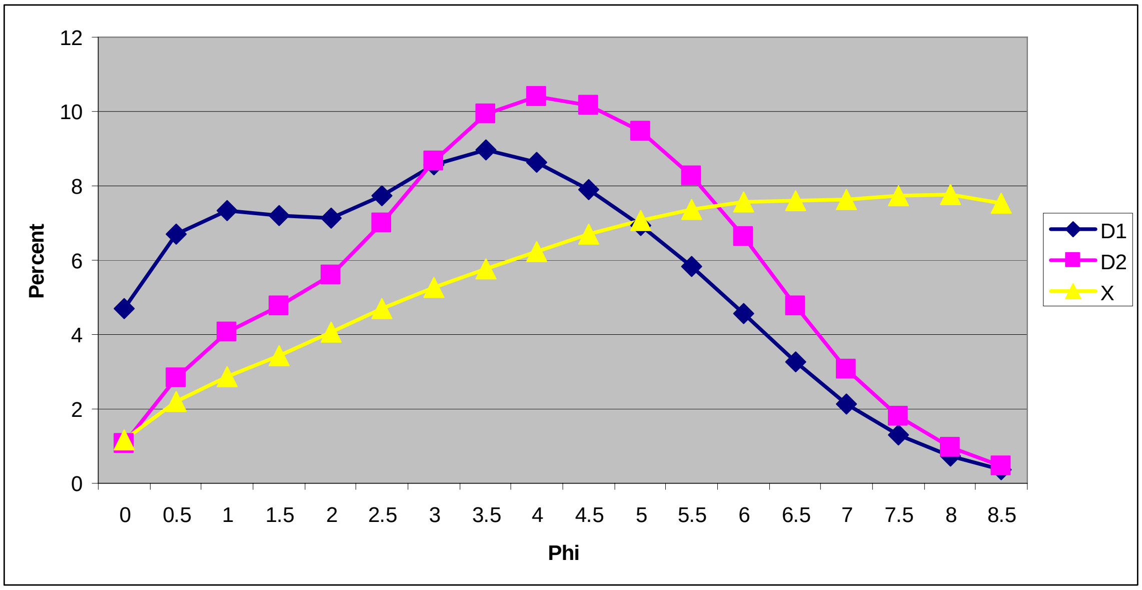

Figure 20: D_1, D_2 and X distributions for Line 191 in TE7 indicating Total Deposition 1 (compare with Figure AI-6D)

7.0 STA DISCUSSION

7.1 Development of a Conceptual Model

The patterns of transport as shown in Figure 6 indicate that sediment sources for the deposits in Port Angeles Harbor are largely confined to the harbor itself. There is not, for example, evidence for a significant input of materials from the Strait of Juan de Fuca, nor do the streams entering the bay seem to be providing sediment in sufficient quantities to leave a “transport signature” into the harbor. Although some of the rivers (Tumwater, Ennis and Morse Creeks; Fig. 21) have small coarse-grained deltas, and are undoubtedly providing some sediment to the system, the amount is apparently too small to assess their zones of influence based on a sampling density of 125 m[(2)]. Some material can enter the harbor through TE5 and losses can occur out of the eastern portion of TE3 (Fig. 7). The harbor, therefore, appears to have acted as a long-term trap for whatever small amounts of sediment are available from both the Strait (including longshore transport) and the small rivers.

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[2] The largest of the small deltas at Ennis Creek has a plan view area of about 28,800 m^2 (or 170 m x 170 m). To establish the extent to which Ennis Creek is providing sediment to the harbor, the delta and surrounding waters would need to be reduced from the present 125 m spacing to about 30 m.

Figure 21: Streams and major outfalls associated with Port Angeles Harbor

The sediment dynamics of the trends suggest that the harbor is now more or less nearing equilibrium and net sediment loss is only slightly less than net sediment gain. This is apparent in the summary of the sediment dynamic behaviors as determined in the transport lines (Table 2). Depositional lines (Net Accretion and Total Deposition 1) make up 28% of all the lines; Net Erosion is 22%, and half of all the lines (51%) are in Dynamic Equilibrium in which there is no net gain or loss of sediment. The 6% difference in favor of accretion suggests that some infilling is still taking place in TEs 1 and 2 which are dominated by transport regimes in total deposition (Fig. 7).

The most striking result of the STA is the discovery of relatively small areas of sea bottom that appear to be the source areas for the sediments in the rest of the harbor. Known as "parting zones" (Fig. 8), the term was first introduced by Stride (1963). Such a term may seem paradoxical in that it implies an area of sea bottom is able to maintain a continuous source of sediment. Because a parting zone clearly cannot be a continuous source of sediment without a replenishment mechanism, its presence implies that two kinds of transport processes are operating: the extreme event which may radically and rapidly re-distribute sediments, during which time the parting zones are replenished with new sediment, followed by the "everyday" transport processes that are captured by the STA[3].

STAs carried out in a number of estuaries have found parting zones to be relatively common, particularly in environments with strong and complex tidal flows (e.g., they have been defined in the Bristol Channel, Morecambe Bay, the Waddenzee tidal basins, the Westerschelde, and in Vancouver Harbor; Cooper and McLaren, 2007; Aldridge, 1997; McLaren et al., 1998). Although the exact nature of an "extreme event" can only be speculated, the Strait of Juan de Fuca has no shortage of severe weather conditions. For example, winds strong enough to overcome the normal estuarine currents of the Strait, even resulting in current reversals as far inland as Dungeness Spit, can occur 2 to 3 times a month during winter (NOAA HAZMAT, 2002). It is also possible that an extreme event merely constitutes a rapid and sudden input of new sediment into the harbor brought about by severe rains with their associated landslips and flooding. With such an input of new sediment, the patterns of transport are quickly reestablished, most likely in response to the complexity of the daily ebb and flood tidal currents as they form a variety of eddies inside the restricted confines of Ediz Hook.

7.2 Correlation with Processes

As discussed above in Section 4 (Physical Setting), a number of current modeling studies have been undertaken in Port Angeles, all of which confirm that the surface currents throughout a tidal cycle are complex. An examination of the various model outputs suggests that all of the net sediment transport directions as determined by the STA can be correlated with a similar current direction during at least one part of any particular tidal cycle. Table 3 provides a synthesis of historical current and modeling information and attempts to examine the findings with the STA pathways.

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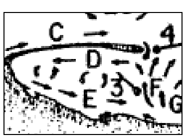
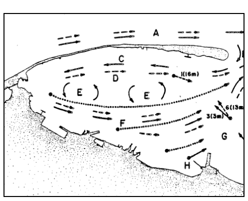
[3] Of course, this explanation begs the question: does the extreme event wipe out the sedimentary signature of the normal, everyday transport processes? The answer can only be based on the experience of numerous sediment trend studies, which is, it doesn't seem to. The Bristol Channel and Carmarthen Bay studies are a case in point. In both, sampling took place over a period of time, encompassing all stages of the tide. In the Bristol Channel, sampling was interrupted by storm events; in Carmarthen Bay sampling took place after a winter of extreme storms. Yet, the STA in both studies revealed a coherent and consistent pattern of net sediment transport explicable by normal, rather than extreme, process events. On the other hand, STA has produced transport patterns explicable only by invoking extreme events to provide the processes responsible for the derived patterns (e.g., the transport patterns in Seattle Harbor). In this case, however, "normal" processes were, in fact, incapable of causing a consistent net transport of sediment.

Table 3: Correlation between historical current and modeling studies with STA pathways

	DESCRIPTION	*CORRELATION*
Ebbesmeyer et al., 1979. (Fig. 2.2.)	Hydraulic model photographs	Direction of surface current patterns difficult to determine. Complex gyres formed in both flood and ebb directions with centres occasionally close to the parting zone locations. The complexity of patterns, although not an easily recognized correlation with STA, does at least demonstrate that the patterns of sediment movement might likewise be complex.
Ebbesmeyer et al., 1979. (page 14)	Measured currents. "Near the shore between Ediz Hook and Dungeness Spit the mean flow is eastward apparently from surface to bottom"	Suggests a good correlation with the eastward moving sediment out of the eastern portion of TE3 (Fig. 7).
Ebbesmeyer et al., 1979. (page 14)	"Within the Harbor one current meter was moored at mid-depth for nineteen days (Site 1). There is a weak mean current eastward at a speed of 0.013 m s^{-1}." Later in the text (page 18) it is noted that currents at Site 1 typically reach 0.1 m s^{-1}.	Site 1 is shown only on a very small scale map, but it appears to be located in the eastern transport portion of TE 4 (Fig. 7). The correlation for direction is good; however the STA suggests high energy, erosional transport in this area which does not correlate well with weak currents.
Ebbesmeyer et al., 1979. (pages 31-32)	Based on patterns of sulfite waste liquor (SWL) and short term current and drogue studies, 6 studies prior to the Ebbesmeyer report produced conflicting patterns of circulation.	Three of the studies suggested an overall counterclockwise circulation which, in part correlates with the incoming sediment in TE 5 near the tip of Ediz Hook and the outgoing sediment in the eastern portion of TE 3. The other three studies have no correlations with the STA. Ebbesmeyer makes an overall conclusion that (as of 1979), "patterns of net circulation in the Harbor cannot be determined based on presently available data."
Shea et al., 1981. (page 414)	 Small scale figure shows mean near surface currents based on historical current meter records.	Only correlation with STA in isolated areas such as the region near "F" which appears similar to TE5 (Fig. 7).
Shea et al., 1981. (page 420)	 Another figure of net speed and direction from measurements and hydraulic modeling.	Very few well defined correlations with STA apparent.
Yang et al., 2003. (p. 8)	Developed a 3-dimensional model, but the report only documents surface currents for its validation.	Model output correlates well with Ebbesmeyer et al. (1979) physical model and with drogue trajectories. As in the previous models there is little direct correlation with the STA transport paths.

There are two difficulties in attempting to correlate the various studies described in Table 3 with the STA results. The first is that most of the research involves only surface currents and little attention has been paid to near-bottom currents which are more likely to be associated with sediment transport. The second is that the results are often synthesized into net current directions, the velocities of which are likely to be very small and they may not necessarily correlate with net sediment movement. The latter is dependant on sediment size and is much more likely to be the result of the strength and duration characteristics found in bottom currents throughout repeated tidal cycles. For example, in many estuaries the tidal wave is asymmetrical; a flood current may be stronger but of shorter duration than the longer duration, but weaker ebb current. Thus mud and sand sized particles may be transported up the estuary during the flood where both are deposited at high water slack. The weaker ebb however, is unable to erode the fine cohesive mud deposits and they remain in place until the returning flood erodes and transports the fines even further up the estuary. Sand, however, is non-cohesive and can be returned down the estuary on the ebb. Because the ebb lasts longer, the result is to produce a net transport of sand down the estuary[4].

As part of the overall Port Angeles study, recent current meter measurements were collected for one month at three localities (Fig. 22; reported in Evans-Hamilton, 2008). A significant finding was the difficulty in correlating ebb and flood current directions among the three meters confirming their complexity as already determined from earlier studies (Table 3). Such complexity was observed during the sediment sampling program in the rotational movement of ships at anchor which were not at all in sync with each other suggesting large differences in tidal current directions at any one instant of time.

[4] It is not to be inferred from this example that similar processes are necessarily happening inside Ediz Hook. The example is put forward to illustrate the difficulty in establishing net sediment transport directions with net current directions.

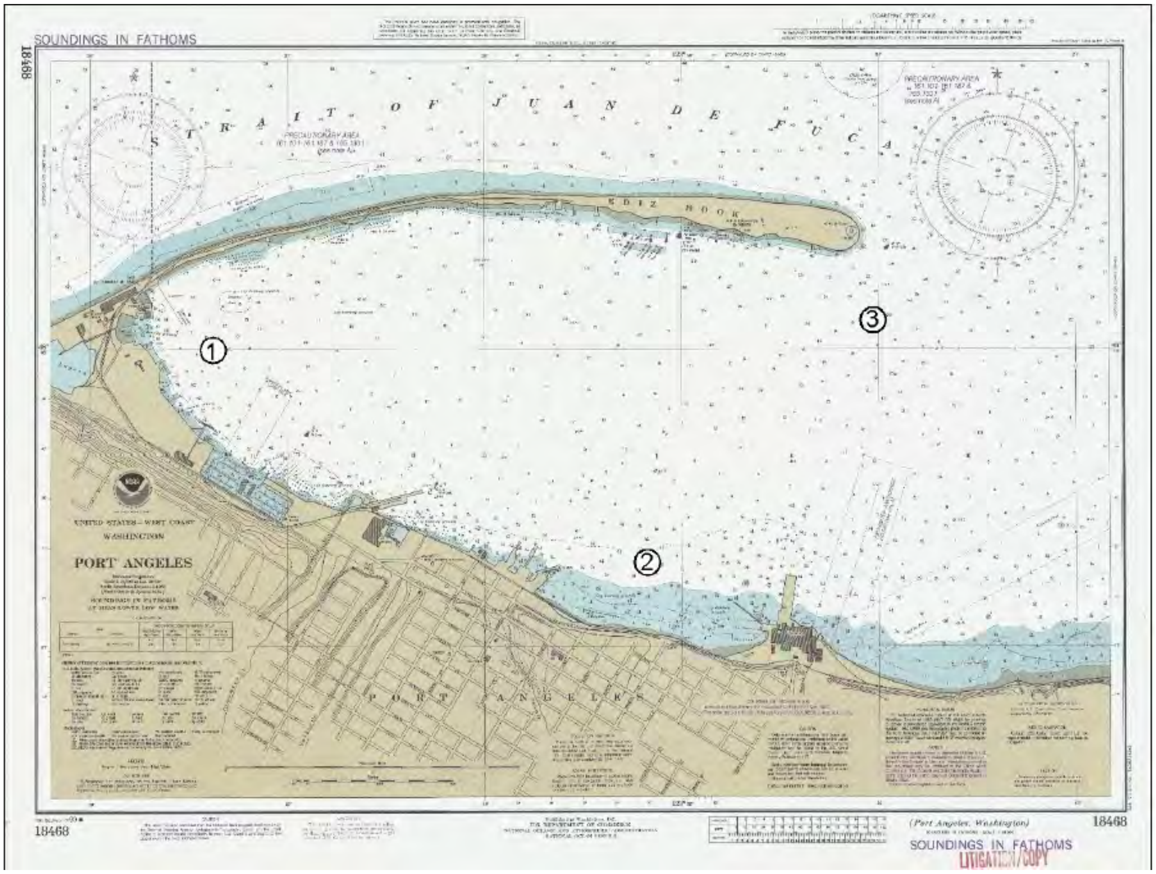


Figure 22: Locations of three current meters (measurements taken from March 26 - April 25, 2008 (Evans-Hamilton, 2008)

The following summarizes the correlation with the current data at each of the three sites with the STA findings.

7.2.1 Current Meter Site 1 (Fig. 22)

Location: At western end of Port Angeles Harbor in TE2 (Fig. 7).

Direction of sediment transport as determined by STA: Due east (90°)

Correlation with current meter data: The dominant direction and strength of currents at this location are in high correlation with the due east movement of sediments (Fig. 23).

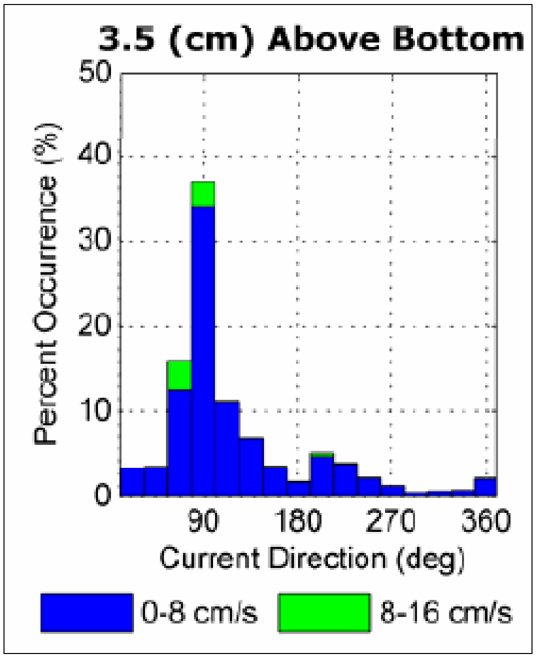


Figure 23: Bottom currents at Station 1.

7.2.2 Current Meter Site 2 (Fig. 22)

<u>Location:</u> On the south side of Port Angeles Harbor within the landward transport regime of TE3 (Fig. 7).

<u>Direction of sediment transport as determined by STA:</u> Southwest (240°)

<u>Correlation with current meter data:</u> As seen in Figure 24, current meter data at 27.6 cm above the bottom (i.e., closest to the bottom) failed to define any preferred direction. Although poorly defined, there is a slight tendency for preferred southwest currents at other depths in the water column (particularly from 3.1 m to 7.1 m above the bottom; Fig. 24). Many of the sediment trends in this area suggest a high energy, net erosion environment which is not confirmed by the relatively low current velocities. Possibly at this location sediments become mobile only during extreme storm events which were not captured during the single month of recorded data.

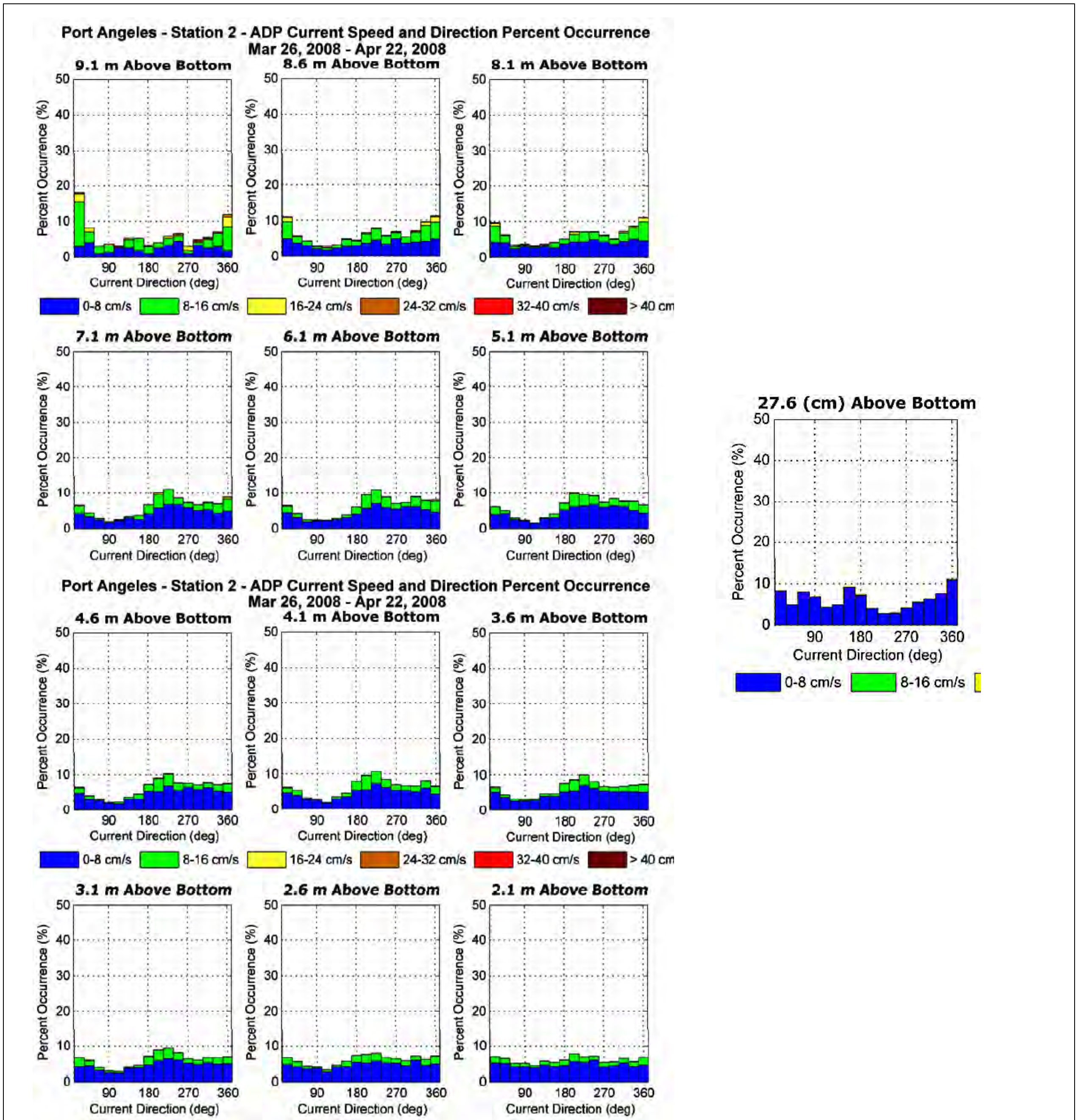


Figure 24: Currents at Station 2.

7.2.3 Current Meter Site 3 (Fig. 22)

Location: Southeast of the tip of Ediz Hook in the westward trending regime of TE5 (Fig. 7).

Direction of sediment transport as determined by STA: West (270°)

Correlation with current meter data: The strongest currents of the three sites were recorded at this location. As seen in Figure 25, currents are strongly bimodal in either the east or west directions. At 20 cm above the bottom the preferred strength and direction of currents appear to be exactly opposite (90°) from the westward trends observed in the STA (Fig. 25). However, at all the other depths, despite duration (% occurrence) favoring the eastward direction, the strongest currents consistently reach strengths of >40 cm. Currents of these strengths are never observed in the eastward direction (Fig. 25).

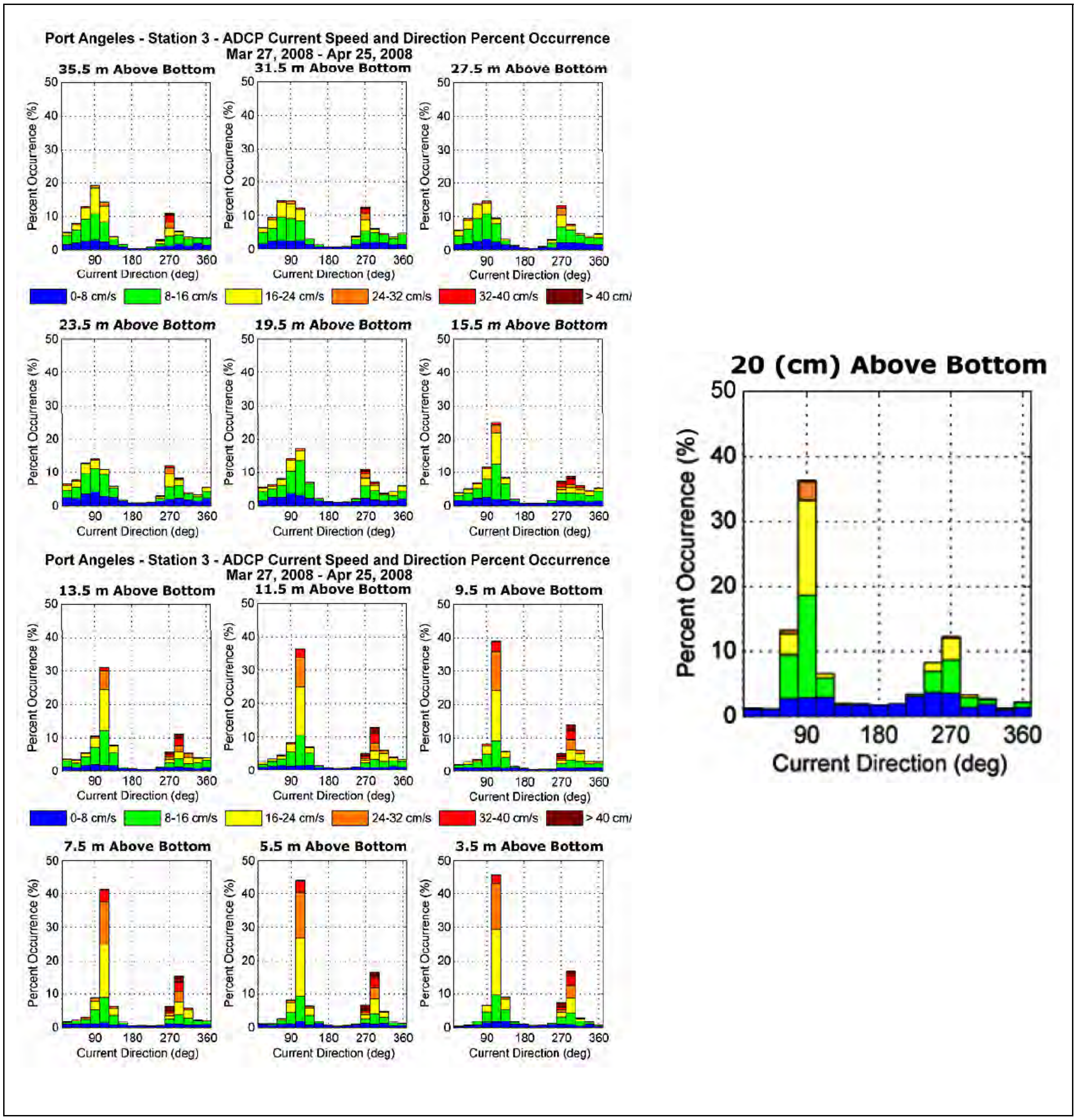


Figure 25: Currents at Station 3.

Sediments at this location are typically muddy sands with a mud content of >20%. With this amount of mud such sediments are fairly cohesive and cannot easily erode at speeds of <40 cm/s (based on the Hjulstrom curve[5]). Despite the dominance of eastward currents it appears probable that very little sediment can be mobilized for transport in this direction. Because the westward currents typically reach speeds of over 40 cm/s, erosion and transport of sediments to the west would likely be favored. It is unknown why the bottom-most record fails to have the strongest currents in the western direction as in the rest of the water column.

7.3 Correlation with Visual Observations

A complete set of maps and descriptive captions of all the visual observations are contained in Appendix VI. Figure 26 shows the locations of wood observed in the sediments superimposed on the transport paths that make up each of the transport environments. Much of the wood is concentrated in TEs 1 and 2 which are associated with the high level of pulp mill activities at the western extremity of the harbor. The boundary between TE's 1 and 2 with the westward trends of TEs 3 and 4 appears to be quite well defined by the degree of wood concentrations. West of the boundary wood in the sediments is abundant, whereas in all the other TEs, with at least one exception, the concentration of wood becomes considerably less and more random. It appears clear that wood is not easily transported across this boundary, although much of the boundary itself is actually delineated by a "line of wood". It is quite possible that the meeting of transport regimes will be an area where wood might become concentrated (this is seen again along the boundary line between TE3 and TE5).

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[5] The Hjulstrom curve is a classic and fundamental graph that describes the velocities required for erosion, transport and deposition for different sized particles. A good one can be viewed on: http://www.geographyalltheway.com/ib_geography/ib_drainage_basins/imagesetc/sediment_in_a_river.pdf

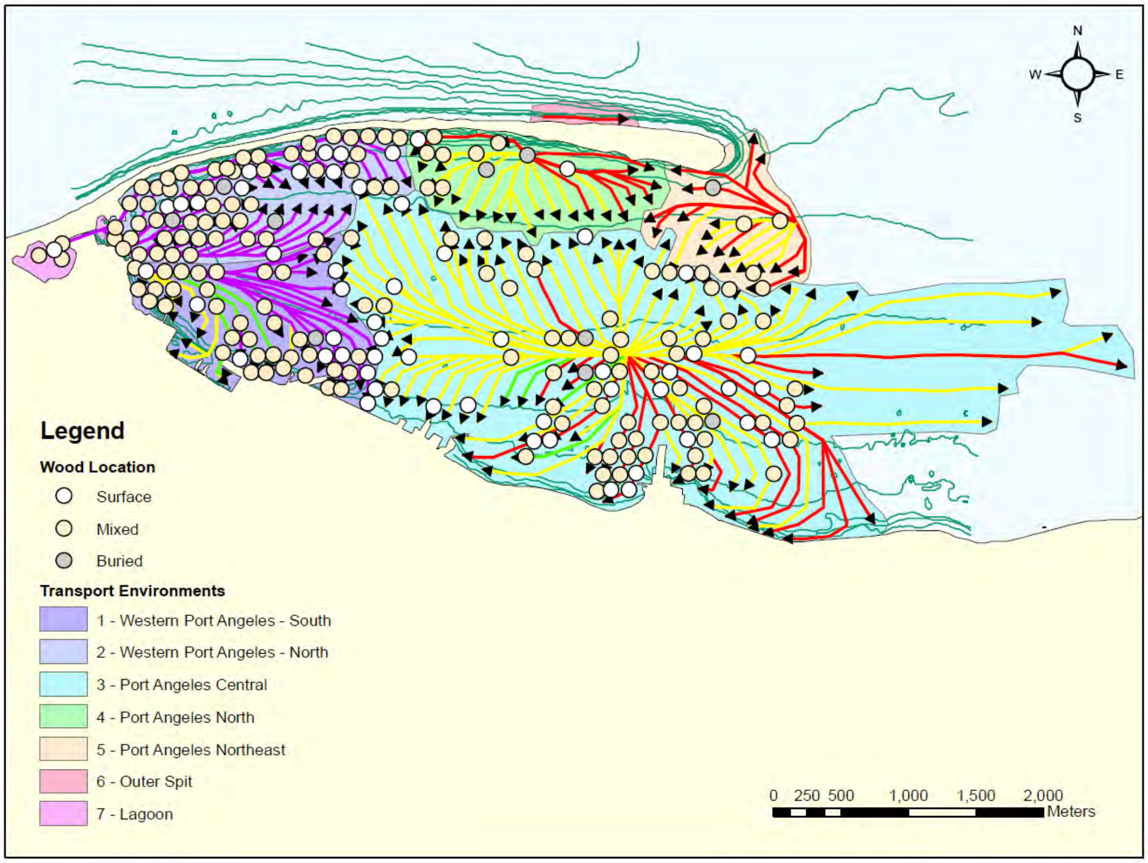

Figure 26: Relationship between wood observations and the results of the STA.

The above mentioned exception is within the area surrounding the Rayonier dock where, historically, there was a log pond and considerable wood waste was deposited (Fig.1). For reasons that are not particularly clear, much of the wood in this area appears to be associated with eroding sediments (note in Figure 26 how much of the wood lies on "red" trend lines that are indicative of net erosion). Such a correlation is somewhat anomalous as it could be expected that wood might be rapidly eroded and dispersed from such areas. Possibly, the amount of wood disposed of on the bottom far exceeds the amount of sediment that is available to this environment (see Photo 7 in Appendix VI). Another possibility is that sawdust was commonly observed in this area (see Fig. AVI – 3) and its mix with sediments has actually produced a more cohesive substrate. Whatever the reason, there is evidence that following the clean up and abandonment of the log pond, shoreline erosion has taken place in this area and that the amount of wood has been decreasing since the cessation of Rayonier activities. According to Bill Beckley (Ridolfi Inc., Nov.14, 2008, pers. com.) shoreline erosion occurred following a jetty and log boom removal *c*. 1997 necessitating shoreline protective works. Since then the amount of wood has also decreased lending support for the eroding trends as shown by the STA. It is unlikely, however, that the wood was transported beyond the boundaries of TE3; rather during an energetic event erosion probably removed the wood and dispersed it more or less randomly throughout the harbor area.

8.0 SUMMARY AND CONCLUSIONS

(1) STA was performed on 765 samples taken from Port Angeles and its immediate vicinity. A further 72 sites were visited but samples were unobtainable due to hard ground conditions.

(2) The textural analysis of the sediments revealed that sandy mud and muddy sand are the most common sediment types (76%), the former being confined in the western half of the study area. A further 12% of samples are sand principally found in the more exposed eastern portion of the harbor. Hard ground dominated the areas seaward of the spit in the Strait of Juan de Fuca and near the shoreline between the harbor entrance and Morse Creek.

(3) 191 sample sequences were found to describe the sediment transport regime of the area under study. These were divided into 7 separate Transport Environments (TEs).

(4) The harbor area, inside the protection of Ediz Hook, is a major sediment trap that has infilled slowly with material derived from the Strait of Juan de Fuca, longshore transport and small tributary rivers. None of these potential sources, however, could be clearly defined in the derived patterns of sediment transport. The latter represents the reworking of the harbor sediments most likely in response to tidal currents. The transport patterns and associated dynamic behaviors of each of the trend lines suggest that the harbor is approaching equilibrium. Depositional trend lines supersede erosional trend lines by only 6%. Deposition is confined to the western end of the harbor and constitutes TEs 1 and 2. The remaining TEs are dominated by trends in Dynamic Equilibrium and Net Erosion. New sediment is supplied to the harbor episodically during extreme events which are likely to be during periods of high rainfall and storm activity. Immediately following a new input of sediment, tidal processes rework the sediments into patterns shown by the STA.

(5) The transport patterns are complex and define three parting zone areas. These are the source regions from which sediment is reworked into the derived transport pathways and which become replenished only at times when new sediment enters the harbor during extreme events.

(6) Previous current measurements, hydraulic and numerical modeling all demonstrate that circulation patterns in the harbor can be complex at all stages of the tide. Gyres form both on the flood and during the ebb. Occasionally the gyres are located in areas fairly close to the parting zones derived by the STA. The recognized complexity of currents within the harbor is confirmed by the similar complexity seen in the sediment transport pathways.

(7) Although measured and modeled currents may correlate with the STA patterns of sediment movement depending on location and specific time during a tide cycle, it is difficult to make meaningful and specific correlations between the two. This is likely because the hydraulic work has concentrated on surficial currents and the data are often presented as net current flows. STA results are more likely to correlate with near-bottom currents and be more dependent on the strength and

duration characteristics of the tidal flows rather than a simple net velocity and direction.

(8) A single month of current meter data collected in a separate field program for this project provided information at three locations. The eastward direction of transport associated with TE's 1 and 2 correlated precisely with the dominant current direction. Near the Rayonier site, the measured currents provided only some agreement with the STA direction of southwest, whereas near Ediz Hook, many of the strongest currents correlated well with the westward transport direction as determined by the sediments.

(9) Despite the small inputs and losses of sediment into and out of the harbor, the patterns of transport suggest that most of the sediment is trapped inside Ediz Hook and has little opportunity to escape. For this reason, the large quantities of wood waste, which for the past century have been added to the harbor sediments, is unlikely to be removed to the Strait of Juan de Fuca by natural processes. Visual observations of wood in the sediment taken at the time of sampling show that there remains a strong association between wood occurrence and the locations of log handling and pulp and paper activities. There is some evidence that wood material cannot easily cross the TE boundaries, and for this reason there are considerable amounts of wood in TEs 1 and 2 which are "held in place" by the westward transport regimes of TEs 3 and 4. Wood content in the latter TEs is considerably less and more randomly located with the exception of the area near the Rayonier dock in TE3. Here the sediments are undergoing net erosion which is likely causing the wood to be gradually dispersed throughout the transport environment of TE3. The amount of wood has been decreasing since Rayonier's activities stopped in the late 1990s.

9.0 ACKNOWLEDGMENTS

Sincere thanks are expressed to Cynthia Erickson of the Washington State Department of Ecology for initiating this portion of the Port Angeles remediation project. The efforts of Bill Richards of Ecology and Environment, Inc. for the contractual arrangements and project management are gratefully acknowledged. Discussions at various times with Dr. Jeff Parsons of Herrera Environmental Consultants were invaluable in the development of some of the concepts presented in this report.

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APPENDIX I

SEDIMENT TREND ANALYSIS

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1.0 MATHEMATICAL PARAMETERS DESCRIBING A GRAIN-SIZE DISTRIBUTION

The following provides a review, discussion, and description of how transport pathways are obtained. It excludes the details of the mathematical proof demonstrating the changes in grain-size distributions that occur with transport as these are contained in McLaren and Bowles (1985).

STA requires for its data the grain-size distributions of sediments collected on regular grid spacing over the aquatic site of interest. The sampled sediments are described in statistical terms (by the moment measures of mean, sorting and skewness) and the basic underlying assumption is that processes causing sediment transport will affect the statistics of the sediments in a predictable way. For this purpose, a grain-size distribution defines for any size class, the probability of the sediment being found in that size class. Size classes are defined in terms of the well-known ϕ (phi) unit, where d is the effective diameter (diameter of the sphere with equivalent volume) of the grain in millimeters.

$$\mathrm{d}(\mathrm{mm}) = 2^{-\phi} \text{ ; or } \log_2 \mathrm{d}(\mathrm{mm}) = -\phi \quad \text{...(1)}$$

Given that the grain-size distribution g(s), where s is the grain size in phi units, is a probability distribution, then

$$\int_{-\infty}^{\infty} g(s)ds = 1 \quad \text{..(2)}$$

In practice, grain-size distributions do not extend over the full range of s, and are not continuous functions of s. Instead discretized versions of g(s) with estimates of g(s) in finite sized bins of 0.5ϕ widths are used. Selection of the bin width is largely empirically derived. An increase in width may result in losing information contained in the distribution whereas a decrease in width may produce an increasingly “noisy” distribution (a discussion of this dilemma is found in Bowles and McLaren, 1985).

Three parameters related to the first 3 central moments of the grain-size distribution are of fundamental importance in STA. They are defined here, both for a continuous g(s) and for its discretized approximation with N size classes. The first parameter is the mean grain size (μ), defined as:

$$\mu = \int_{-\infty}^{\infty} s \cdot g(s)ds \approx \sum_{i=1}^{N} s_i \cdot g(s_i) \quad \text{...(3)}$$

The second parameter is sorting (σ) which is equivalent to the variance of the distribution, defined as:

$$\sigma^2 = \int_{-\infty}^{\infty} (s-\mu)^2 \cdot g(s)ds \approx \sum_{i=1}^{N} (s_i-\mu)^2 \cdot g(s_i) \quad \text{..(4)}$$

Finally, the coefficient of skewness (κ) is defined as:

$$\kappa = \frac{1}{\sigma^3}\int_{-\infty}^{\infty}(s-\mu)^3 \cdot g(s)ds \approx \frac{1}{\sigma^3}\sum_{i=1}^{N}(s_i-\mu)^3 \cdot g(s_i) \quad (5)$$

1.1 Case A (Development of a Lag Deposit)

Consider a sedimentary deposit that has a grain-size distribution g(s) (Figure AI-1). If eroded, the sediment that goes into transport has a new distribution, r(s), which is derived from g(s) according to the function t(s) so that:

$$r(s_i) = k \cdot g(s_i)t(s_i)$$
$$\text{or} \quad t(s_i) = \frac{r(s_i)}{k \cdot g(s_i)} \quad (6)$$

where $g(s_i)$ and $r(s_i)$ define the proportion of the sediment in the i^{th} grain-size class interval for each of the sediment distributions. k is a scaling factor[1] that normalizes r(s) so that:

$$\sum_{i=1}^{N} r(s_i) = 1$$
$$\text{thus} \quad k = \frac{1}{\sum_{i=1}^{N} g(s_i)t(s_i)} \quad (7)$$

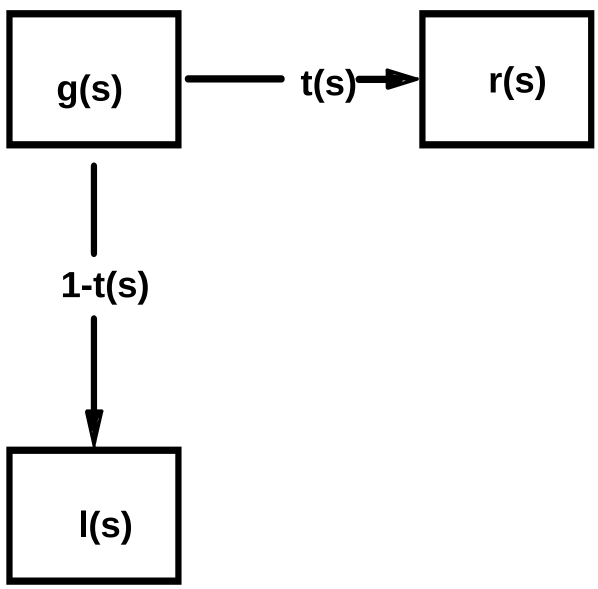

Figure AI-1: Sediment transport model to develop a lag deposit (see the text for a definition of terms).

[1] 'k' is actually more complex than a simple normalizing function, and its derivation and meaning is the subject of further research. It appears to take into account the masses of sediment in the source and in transport, and may be related to the relative strength of the transporting process.

With the removal of r(s) from g(s), the remaining sediment (a lag) has a new distribution denoted by l(s) (Figure AI-1) where:

$$l(s_i) = k \cdot g(s_i)[1 - t(s_i)]$$

$$\text{or} \quad t'(s_i) = \frac{l(s_i)}{k \cdot g(s_i)} \qquad \text{...(8)}$$

$$\text{where} \quad t'(s_i) = 1 - t(s_i)$$

The function t(s) is defined as a sediment transfer function and is described in exactly the same manner as a grain-size probability function except that it is not normalized. It may be thought of as a function that incorporates all sedimentary and dynamic processes that result in initial movement and transport of particular grain sizes.

Data from flume experiments show that distributions of transfer functions change from having a high negative skewness to being nearly symmetrical (although still negatively skewed) as the energy of the eroding/transporting process increases. These two extremes in the shape of t(s) are termed low energy and high-energy transfer functions respectively (Figure A1-2). The shape of t(s) is also dependent, not only on changing energy levels of the process involved in erosion and transport, but also on the initial distribution of the original bed material, g(s) (Figure AI-1). The coarser g(s) is, the less likely it is to be acted upon by a high-energy transfer function. Conversely, the finer g(s) is, the easier it becomes for a high-energy transfer function to operate on it. In other words, the same process may be represented by a high-energy transfer function when acting on fine sediments, and by a low energy transfer function when acting on coarse sediments. The terms high and low energy are, therefore, relative to the distribution of g(s) rather than to the actual process responsible for erosion and transport.

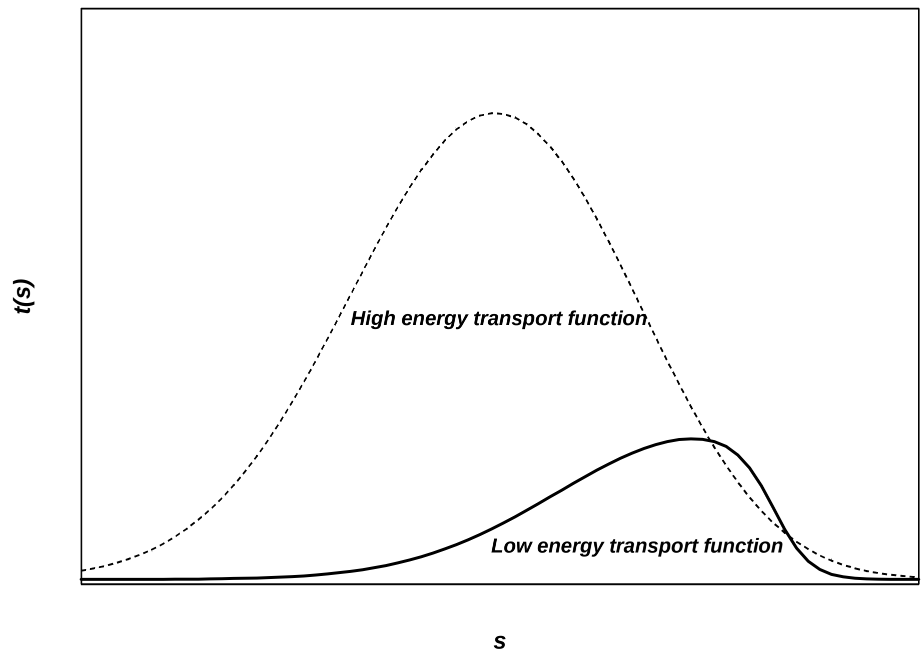

Figure AI-2: Diagram showing the extremes in the shapes of transfer functions t(s).

The fact that t(s) appears to be mainly a negatively skewed function results in r(s), the sediment in transport, always becoming finer and more negatively skewed than g(s). The function 1-t(s) (Figure AI-1) is, therefore, positively skewed, with the result that l(s), the lag remaining after r(s) has been removed, will always be coarser and more positively skewed than the original source sediment. McLaren and Bowles, 1985, provide the mathematical proof for these statements.

If t(s) is applied to g(s) many times (i.e., n times, where n is large), then the variance of both g(s) and l(s) will approach zero (i.e., sorting will become better). Depending on the initial distribution of g(s), it is mathematically possible for variance to become greater before eventually decreasing. In reality, an increase in variance in the direction of transport is rarely observed.

Given two sediments whose distributions are, $d_1(s)$ and $d_2(s)$, and $d_2(s)$ is coarser, better sorted and more positively skewed than $d_1(s)$, it may be possible to infer that $d_2(s)$ is a lag of $d_1(s)$ and that the two distributions were originally the same (Case A; Table AI-1).

Table AI-1: Summary of the interpretations with respect to sediment transport trends when one deposit is compared to another.

CASE	RELATIVE CHANGE IN GRAIN-SIZE DISTRIBUTION BETWEEN DEPOSIT d_2 AND DEPOSIT d_1	INTERPRETATION
A	Coarser Better sorted More positively skewed	(1) d_2 is a lag of d_1. No direction of transport can be determined.
B	Finer Better sorted More negatively skewed	(1) The direction of transport may be from d_1 to d_2. (2) The energy regime is decreasing in the direction of transport. (3) t_1 and t_2 are low energy transfer functions.
C	Coarser Better sorted More positively skewed	(1) The direction of transport may be from d_1 to d_2. (2) The energy regime is decreasing in the direction of transport. (3) t_1 is a high energy transfer function and t_2 is a high or low energy transfer function (Figure AI-4).

1.2 Case B (Sediments Becoming Finer in the Direction of Transport)

Consider a sequence of deposits (d_1(s), d_2(s), d_3(s),..) that follows the direction of net sediment transport (Figure AI-3). Each deposit is derived from its corresponding sediment in transport according to the "3-box model" shown in Figure AI-1. Each d_n(s) can be considered a lag of each r_n(s). Thus, d_n(s) will be coarser, better sorted and more positively skewed than r_n(s). Similarly, each r_n(s) is acted upon by its corresponding t_n(s) with the result that the sediment in transport becomes progressively finer, better sorted and more negatively skewed. Any two sequential deposits (e.g., d_1(s) and d_2(s)) may be related to each other by a function X(s) so that:

$$d_2(s) = k \cdot d_1(s) \cdot X(s)$$

$$\text{or} \quad X(s) = \frac{d_2(s)}{k \cdot d_1(s)} \quad \text{...(9)}$$

$$\text{where} \quad k = \frac{1}{\sum_{i=1}^{N} d_1(s_i) \cdot X(s_i)}$$

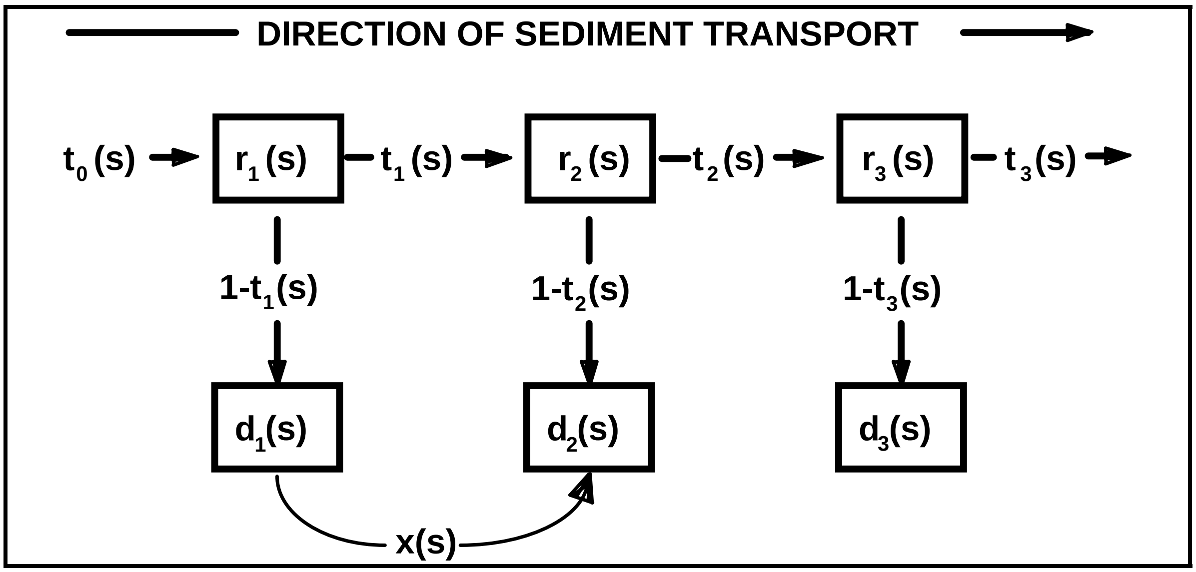

Figure AI-3: Sediment transport model relating deposits in the direction of transport.

As illustrated in Figure AI-3, $d_2(s)$ can also be related to $d_1(s)$ by:

$$d_2(s) = \frac{k \cdot d_1(s) t_1(s)[1 - t_2(s)]}{1 - t_1(s)}$$

$$= k \cdot d_1(s) X(s) \qquad (1) \qquad \text{...(10)}$$

$$\text{where} \quad X(s) = \frac{t_1(s)[1 - t_2(s)]}{1 - t_1(s)} \qquad (2)$$

The function X(s) combines the effects of two transfer functions $t_1(s)$ and $t_2(s)$ (Equation 2). It may also be considered as a transfer function in that it provides the statistical relationship between the two deposits and it incorporates all of the processes responsible for sediment erosion, transport and deposition. The distribution of the deposit $d_2(s)$ will, therefore, change relative to $d_1(s)$ according to the shape of X(s), which in turn is derived from the combination of $t_1(s)$ and $t_2(s)$ as expressed in Equation 2. It is important to note that X(s) can be derived from the distributions of the deposits $d_1(s)$ and $d_2(s)$ (Equation 1) and it provides the relative probability of any particular sized grain being eroded from d_1, transported and deposited at d_2.

Using empirically derived t(s) functions, it can be shown that when the energy level of the transporting process decreases in the direction of transport (i.e., $t_2(s_i) < t_1(s_i)$) and both are low energy functions, then X(s) is always a negatively skewed distribution (Figure AI-4). This will result in $d_2(s)$ becoming finer, better sorted and more negatively skewed than $d_1(s)$. Therefore, given two sediments (d_1 and d_2) where $d_2(s)$ is finer, better sorted and more negatively skewed than $d_1(s)$, it may be possible to infer that the direction of sediment transport is from d_1 to d_2 (Table AI-1).

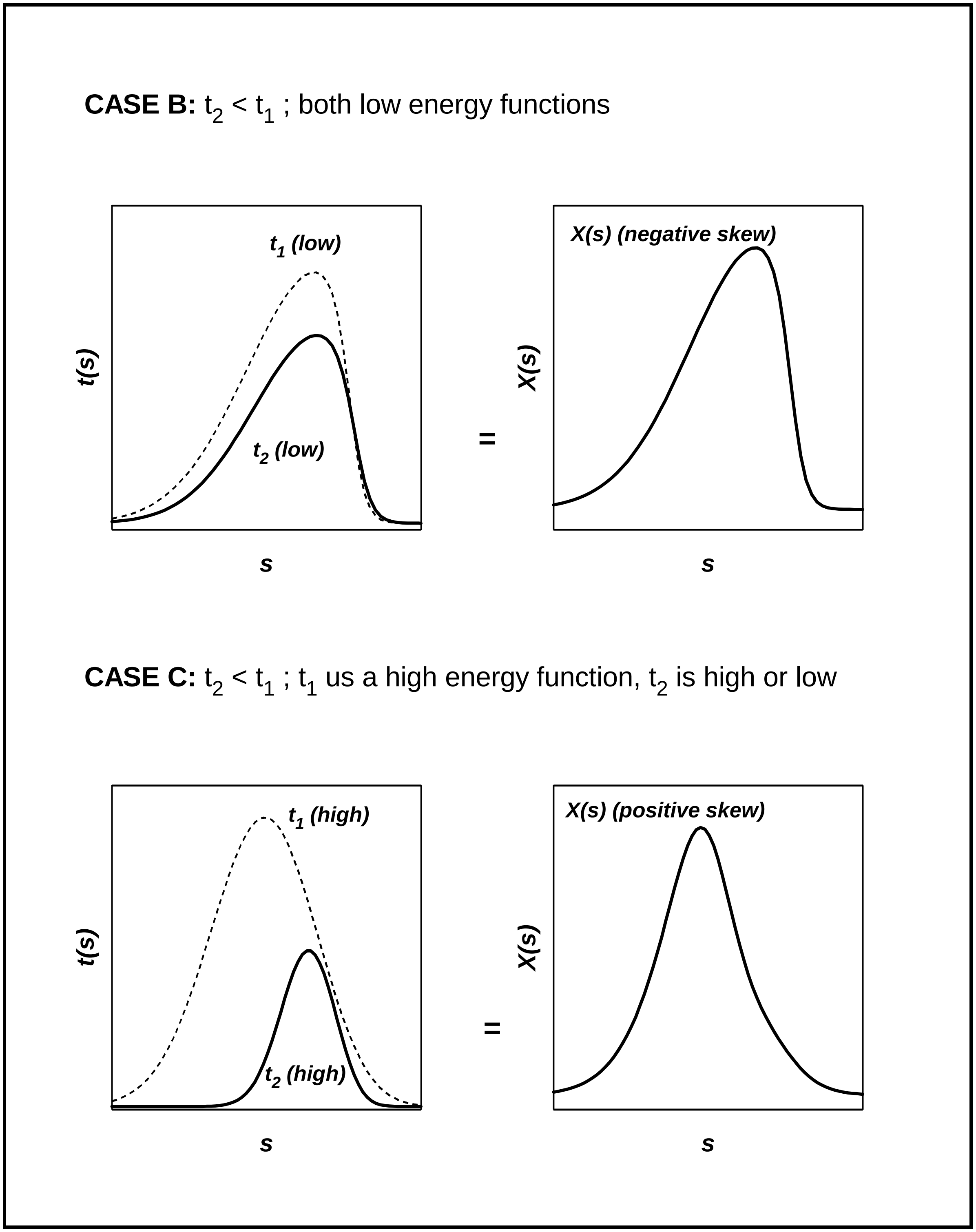

Figure AI-4: Summary diagram of t_1 and t_2 and corresponding X-distribution (Equation 2) for Cases B and C (Table AI-1).

1.3 Case C (Sediments Becoming Coarser in the Direction of Transport)

In the event that $t_1(s)$ is a high energy function and $t_2(s_i) < t_1(s_i)$ (i.e., energy is decreasing in the direction of transport), the result of Equation 2 will produce a positively skewed X(s) distribution (Figure AI-4). Therefore, $d_2(s)$ will become coarser, better sorted and more positively skewed than $d_1(s)$ in the direction of transport. When these changes occur between two deposits, it may be possible to infer that the direction of transport is from d_1 to d_2 (Table AI-1).

Sediment coarsening along a transport path will be limited by the ability of $t_1(s)$ to remain a high-energy function. As the deposits become coarser, it will be less and less likely that the transport processes will maintain high-energy characteristics. With coarsening, the transfer function will eventually revert to its low energy shape (Figure AI-2) with the result that the sediment must become finer again.

Cases A and C produce identical grain-size changes between d_1 and d_2 (Table AI-1). Generally, however, the geological interpretation of the environments being sampled will differentiate between the two Cases.

2.0 METHOD TO DETERMINE TRANSPORT DIRECTION FROM GRAIN-SIZE DISTRIBUTIONS

The above model indicates that grain-size distributions of sedimentary deposits will change in the direction of net sediment transport according to either Case B or Case C (Table AI-1; Figure AI-5). Thus, if any two samples (d_1 and d_2) are compared sequentially (i.e., at two locations within a sedimentary facies), and their distributions are found to change in the described manner, the direction of net sediment transport may be inferred.

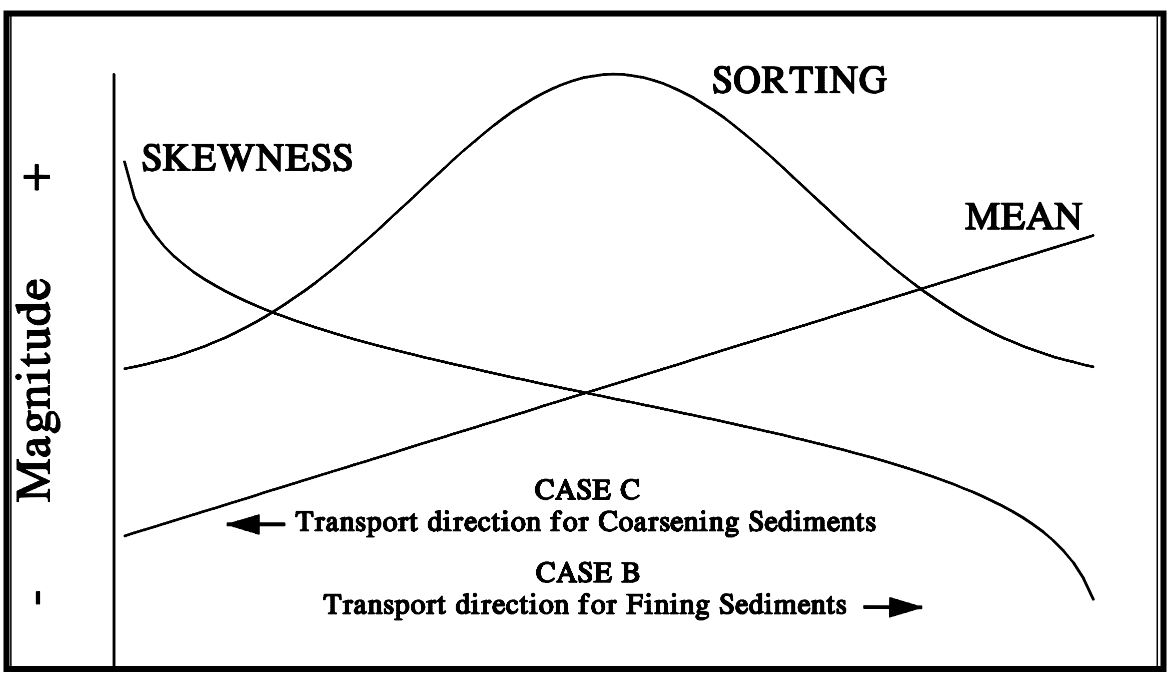

Figure AI-5: Changes in grain-size descriptors along transport paths.

In reality, perfect sequential changes along a transport path as determined by the model and summarized in Figure AI-5 are rarely observed. This is because of a variety of uncertainties that may be introduced in sampling, in the analytical technique to obtain grain-size distributions, in the assumptions of the transport model, and in the statistics used in describing the grain-size distributions. These uncertainties are discussed in further detail below.

2.1 The Use of the Z-Score Statistic

One approach that appears to be successful in minimizing the uncertainties is a simple statistical method whereby the Case (Table AI-1) is determined among all possible sample pairs contained in a specified sequence. Given a sequence of n samples, there are $\frac{n^2 - n}{2}$ directionally orientated pairs that may exhibit a transport trend in one direction, and an equal number of pairs in the opposite direction. When any two samples are compared with respect to their distributions, the mean may become finer (F) or coarser (C), the sorting may become better (B) or poorer (P), and the skewness may become more positive (+) or more negative (-). These three parameters provide 8 possible combinations (Table AI-2).

Table AI-2: All possible combinations of grain-size parameters (* = Case B; Table AI-1: ** = Case C; Table AI-1).

	1*	2	3	4
Mean Sorting Skewness	F B -	C B -	F P -	F B +
	5	6	7**	8
Mean Sorting Skewness	C P +	F P +	C B +	C P -

In sediment trend analysis it is postulated that a certain relationship exists among the set of n samples, and that this relationship is evidenced by particular changes in sediment size descriptors between pairs of samples. Then the number of pairs for which the trend relationship occurs should exceed the number of pairs that would be expected to occur at random by a sufficient amount to state confidently that the trend relationship exists. Suppose the probability of any trend existing between any pair of samples, if the trend relationships were established randomly, is p. Since there are 8 possible trend relationships among 3 sediment descriptors, and it is assumed that each of these is equally likely to occur, the value of p is set at 0.125.

To determine if the number of occurrences that a particular Case exceeds the random probability of 0.125, the following two hypotheses are tested:

H_0: p<0.125, and there is no preferred direction; and
H_1: p>0.125, and transport is occurring in the preferred direction.

Using the Z-score statistic in a one-tailed test (Spiegel, 1961), H_1 is accepted if:

$$Z = \frac{x - Np}{\sqrt{Nqp}} \rangle 1.645 \text{ (at the 5\% level)} \qquad \text{or } \rangle 2.33 \text{ (at the 1\% level)} \quad \text{...(11)}$$

where x is the observed number of pairs representing a particular Case in one of the two opposing directions; and N is the total number of possible unidirectional pairs given by $\frac{n^2 - n}{2}$. The number of samples in the sequence is n; p is 0.125; and q is 1.0 - p = 0.875.

The Z statistic is considered valid for N>30 (i.e., a large sample). Thus, for this application, a suite of 8 or 9 samples is the minimum required to evaluate a transport direction.

2.2 The Use of the Correlation Coefficient R^2

In order to assess the validity of any transport line, we use the Z-score and an additional statistic, the linear correlation coefficient R^2, defined as:

$$R^2 = \frac{\sum_i (\hat{y}_i - \bar{y})^2}{\sum_i (y_i - \bar{y})^2};\ \text{where } \hat{y} = f(x_1, x_2, ...); \text{and } \bar{y} = \frac{1}{N}\sum_i y_i \quad ....(12)$$

The value of R^2 can range from 0 to 1. The definition of R^2 is based on the use of a model to relate a dependent parameter y to one or more independent parameters (x_1,x_2,...). In this case, the model used is a linear one, which can be written as:

$$\hat{y} = a_o + a_1 \cdot x_1 + a_2 \cdot x_2 \ ....(13)$$

The data (y,x_1,x_2) are grain-size distribution statistics, and the parameters (a_0,a_1,a_2) are estimated from the data using a least-squares criterion. The dependent parameter is defined as the skewness and the independent parameters are the mean size and the sorting. An implicit assumption is made that distributions taken from samples along a transport pathway, if plotted in skewness/sorting/mean space (as in Figure AI-5), would tend to be clustered along a straight line. The slopes of the straight line, which are the fitted parameters, would depend on the type of transport (fining or coarsening). While there is no theoretical reason to expect a linear relationship among the three descriptors, there is also no theory predicting any other kind of relationship, so using the principle of Occam's Razor[2], the simplest available relationship was chosen for the model. High values of R^2 (0.8 or greater) together with a significantly high value of the Z-score provide confidence in the validity of the transport line.

A low R^2 may occur, even when the Z-score statistic is acceptable. Based on the empirical evaluation of many sediment trend analyses from many different environments, it appears that low R^2 values may result when: (i) sediments on an assumed transport path are, in reality, from different facies and valid trend statistics occurred accidentally; (ii) the sediments are from a single facies, but the chosen sequence is only a poor approximation of the actual transport path; and (iii) extraneous sediments have been introduced into the natural transport regime, as in the case of dredged material disposal. R^2, therefore, is assessed qualitatively and may provide extra useful information on the sediment transport regime under study.

2.3 Uncertainties

The McLaren and Bowles model requires that the grain-size distributions of the sampled sediments are described in statistical terms (by the moment measures of mean, sorting and skewness. The basic underlying assumption is that sequential deposits following the pathway of net sediment transport will affect the statistics of the particle size distributions of the sediments in a predictable way. Following from this assumption, the size frequency distributions of the sediments provide the data with which to search for patterns of net sediment transport.

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[2]Occam's Razor: Entities ought not to be multiplied except from necessity. (Occam, 14th Century philosopher, died 1349)

As noted above, perfect sequential changes along a transport path as determined by the model are rarely observed. This is because of a variety of uncertainties (i.e., noise) that may be introduced at all stages of carrying out STA. These may be summarized as follows:

2.3.1 Assumptions in the Transport Model

Whatever method is used to describe sediments, STA requires a model of the sediment transport process. The STA model is based on the assumption that smaller grains are generally more easily transported than larger grains (i.e., the probability of transport, on a phi scale, monotonically increases as grain size decreases). Under this assumption, it can be shown that erosion and deposition of sediments will change the moments of their particle size distributions in a predictable way in the direction of transport. However, as seen in transfer functions obtained from sediment data in flume experiments, this assumption may not always be strictly true. More often, the transfer function monotonically increases over only a portion of the available grain sizes before returning to zero. Furthermore, contained within the assumption there is a further “hidden assumption” that the probability of transport of one particular grain size must therefore be independent of the transport of other grain sizes. Factors such as shielding whereby the presence of larger grains may impede the transport of smaller grains, increasing cohesion of the finer grains, or the decreasing ability of the eroding process to carry additional fines with increasing load, all suggest that the transport process is a complicated function related to the sediment distribution and the strength of the erosion process.

Thus the mathematics of the theory demand the somewhat unsatisfactory assertion that the probability of transport must increase monotonically over a sufficiently large range of sizes present in the deposits to produce the predicted changes. As Gao and Collins (1994) pointed out, the technique to determine net transport pathways in a wide variety of different marine and coastal environments has been empirically validated through the use of alternative approaches indicating that such an assumption cannot be too unreasonable.

2.3.2 Temporal Fluctuations

The particle size distribution of a particular facies may be the result of sediment arriving from several different directions and at different times. It is assumed that what is sampled is the average of all the sediment derived from an unknown number of directions. The average transport direction may not conform to that developed for a specific particle population associated with a single transport pathway.

In STA, it is assumed that a sample provides a representation of a specific sediment type (or facies). There is no direct time connotation, nor does the depth to which the sample was taken contain any significance provided that the sample does, in fact, accurately represent the facies.

Consider, for example, a beach face composed of many lamina. Each lamina might represent a particular transport and depositional event that, at a small scale, might be locally different from that of the beach transport regime as a whole. The latter can be determined by sampling the beach face in such a way that a sufficient number of lamina are incorporated in the sample to allow the assumption that the sample now represents an average of the beach face facies. The average distribution of all the lamina making up the beach face can now be compared with a similar sample taken elsewhere on the beach face. To provide another example, d_1 may be a sample representing an accumulation over several tidal cycles whereas d_2 represents several years of deposition. The trend analysis simply determines if there is a possible sediment transport relationship or pathway between the two deposits.

2.3.3 Sample Spacing

The sampling interval (frequency) may be too far apart to detect relevant transport directions. With increasing distance between sample locations there is an increasing possibility of collecting sediments unrelated by transport. Communications theory (discussed in further detail below) indicates that in order to represent accurately a continuous signal with samples, the signal must be sampled at twice the highest frequency contained in the signal (Shannon, 1948). This would imply that for STA, sample sites placed *x* km apart could only reliably detect transport directions occurring over a distance in the order of 2*x* km or more. Directions occurring over distances less than 2*x* km would appear as noise or could create spurious transport pathways through the process of "aliasing".

In practice, selection of a suitable sample spacing must take into account: (i) the number of sedimentological environments likely to be affecting the area under specific study; (ii) the desired spatial scale of the sediment trends; and (iii) the geographic shape and extent of the study area.

2.3.4 Random Environmental and Measurement Uncertainties

All samples will be affected by random errors. These may include unpredictable fluctuations in the depositional environment, the effects of sampling and sub-sampling a representative sediment population, and random measurement errors.

2.4 Communications Analogy

STA is, in many ways, analogous to communications systems. In the latter, information is transmitted to a distant location where a signal is received that includes both the desired information as well as noise. The receiver must be capable of extracting the information from the noisy signal. In sedimentary systems, the information is the transport direction and the received signal is the sediment samples. The goal of STA is to extract the information from the noisy signal. In theory, the information can be recovered by simply subtracting the noise from the signal, an approach that works well in communications systems because the nature of the information and the noise are both well known. This approach, however, will be difficult in STA because neither the nature of the information nor the noise is well understood.

There is a large body of analytical techniques that has been developed to extract signals in communications systems. These techniques generally fall into two categories: signal coding and noise reduction. For example, in FM radio transmission, the signal is coded as a time varying frequency about a carrier frequency. At the receiver, rejecting all frequencies other than the carrier frequency reduces noise. The receiver then looks for the time varying frequency component to extract the original signal. Reducing the noise increases the level of the signal-to-noise ratio enabling the signal to be detected. Coding the signal simply makes it easier to find because there is already prior knowledge of the information. It is important to note that knowing what is being looking for is of critical importance in communications systems: merely analyzing the incoming signal would not be sufficient to interpret the signal correctly.

In STA there is, of course, no opportunity to code the signal. However, other aspects of communications theory (noise reduction) may have applications pertinent to the technique. Typically, noise in communications systems is reduced using filters that selectively reduce the signal level for frequencies outside the frequency range of the signal. If these frequency components contain parts of the signal the filter, too, will reduce them. Knowing the nature of the noise and the signal, filters can be designed that optimally increase the signal-to-noise ratio.

The situation in STA is not as straightforward because there is not a good understanding of the noise and only a limited understanding of the nature of the signal. In this situation, noise reduction by filtering can be problematical because the filtering may remove significant signal components. There are, however, statistical communications techniques that may be applicable to improve the situation.

In a sedimentary system, noise can be considered in two areas.

(1) Sample noise

Even in a "uniform" sediment deposit, individual samples may be corrupted by noise. One way to address this noise would be to take many samples in close proximity and average them to produce a characteristic sample. Another method that implicitly attempts to reduce this noise is curve fitting. For example, there has been considerable research on utilizing a log-hyperbolic curve to describe sediments, as it appears to provide a good fit to many naturally occurring deposits (Barndorff-Nielsen, 1977; Bagnold and Barndorff-Nielsen, 1980). Similar to the concepts of STA, it has been shown that parameters of the log-hyperbolic distribution should change in deterministic ways under the influence of erosion or deposition (Barndorff-Nielsen and Christiansen, 1988). It was proposed that erosion and deposition cause the location-shape invariant parameters of the log-hyperbolic distribution to vary in particular ways when plotted on the “shape-triangle” of the log-hyperbolic distribution (Barndorff-Nielsen et al., 1991; Hartmann and Christiansen, 1992). Not all researchers, however, are convinced that log-hyperbolic distributions provide superior information (e.g., Wyrwoll and Smyth, 1988; Hill and McLaren, 2001),

Curve fitting analysis whether lognormal, or log-hyperbolic, is based on the assumption that sediments follow specific distributions. By fitting a curve to the sedimentary data it is assumed that points that do not fall on the curve are noise and are removed. In theory, this works if in fact sediments do conform to the proposed curve. If they do not, then the curve fitting process removes signal as well as noise and accordingly there may be more noise in the fitted curve than in the original sample. In the present line-by-line approach of STA the pitfalls of curve fitting are avoided, as only the raw data of each sediment grain-size distribution are used from which the log moments are calculated.

(2) Spatial noise

As sediment is transported over a distance, noise may be introduced. To reduce this noise average values of groups of samples could be used. Many of the techniques proposed by researchers are, in reality, efforts to reduce noise in this manner (i.e., the one-dimensional Z-score as described above, or the vector approaches of Gao, 1996, and Le Roux, 1994). These procedures generally involve some form of averaging of samples, which is not strictly valid. If the nature of the noise and the information is not known, the averaging of samples can reduce the information content more than it reduces the noise levels. (An exception is to reduce random noise by averaging a number of samples from the same local environment to generate a better single distribution representative of that environment).

In STA the assumption is that noise is randomly distributed and therefore averages to zero, leaving the true trend as the residual after averaging. While these techniques may in fact reduce noise, signal-processing techniques may provide more refined and controllable methods.

In communications theory it is often convenient to transform the signal from the time domain (i.e. a signal that varies over time) to the frequency domain which shows the frequency spectrum of the signal (i.e. the amount of the signal that is carried by all of the individual frequency components). Mathematically, this is performed using a Fourier transform which converts the signal into its frequency components. After removing the undesirable (noise) components, an inverse transform is performed to transform the signal back to the time domain. In sediment analysis, the signal varies across distance rather than time but exactly the same analysis can be performed. In this case the data (the grain-size distributions of the sediment samples) can be represented as a sum of distance varying sinusoids using a two-dimensional Fourier transform. What the transform produces is a characterization of the sedimentary deposits that shows how they vary over different distance scales. For example, one component would indicate the intensity of changes over a 100 m range, another over a 1 km range etc. (Note that the sample spacing, as discussed above, will set limits as to what distance ranges can be considered.) Having the signal in this form allows the unwanted components to be removed. However, how is it known what is undesirable? In communications systems this can be done because the information is known (if it wasn't, it would be difficult if not impossible to find anything). By analogy, if in performing a simple analysis of the sedimentary data (e.g., mapping the variation in the mean grain size) it is highly unlikely that a transport direction would be discovered. In order to extract the relevant signal it is necessary to make an assumption as to what is being looked for. It is then possible to filter the data to highlight this and detect if in fact a signal corresponding to the assumption is actually present. For example, assume a transport process that would produce the fining of sediments over a 5 km distance. To extract this process, a 2-dimensional Fourier transform can be calculated and all frequency components associated with variations of less than 5 km could be removed. An inverse transform of the data would then highlight variations over the proposed distance scale.

The important feature of this approach (which, in fact, approximates the line-by-line approach as discussed above) is the use of many sample sites to detect the dominant transport direction. This effectively reduces the level of noise. The problem, however, is that it is difficult to mechanize since the number of possible transport directions in a given area can be much too large to try them all. The choosing of a trial transport direction cannot be easily analytically codified and can only be reduced to a manageable level through experience and information from other sources (e.g., bathymetric data).

In using the Z-score statistic, however, a transport trend may be determined whereby all possible pairs in a sample sequence are compared with each other. When either a Case B or Case C trend exceeds random probability within the chosen sample sequence, the direction of net sediment transport can be inferred. As suggested above, the grid spacing must be compatible with the area under study and take into account the number of sedimentological environments likely to be involved, the geographic shape of the study area, and the desired statistical certainty of the pathways. For practical purposes, it has been found that, for regional studies in open ocean environments, sample spacing should not exceed 1 km; in estuaries spacing may be reduced to 500 m. For site-specific studies (e.g., to determine the transport regime for a single marina), sample spacing will be reduced so that a minimum number of samples can be taken to ensure an adequate coverage. Experience has also shown that extra samples should be taken over sites of specific interest (e.g., dredged material disposal sites) and those areas where the regular grid is insufficient to accommodate for specific bathymetric features (e.g., bars and channels).

At present, the line-by-line approach is undertaken as follows: (i) assume the direction of transport over an area comprising many sample sites; (ii) from this assumption predict the sediment trends that should appear at the sample sites; (iii) compare the prediction with the Z-score statistic obtained from the grain-size distributions of the samples; (iv) modify the assumed direction and repeat the comparison until the best fit is achieved.

Following from the communications analogy, when a final and coherent pattern of transport pathways is obtained that encompasses all, or nearly all of the samples, the assumption that there is information (the transport pathways) contained in the signal (the grain-size distributions) has been verified, despite the inability to define accurately all the uncertainties that may be present.

It must be emphasized that the actual processes responsible for the transport of particles along the derived pathways are unknown; they may in one environment be breaking waves in a littoral drift system, in another residual tidal currents and, in still another, incorporate the effects of bioturbation. Nevertheless, one of the great values in obtaining the transport patterns is to assess the probable processes that are likely taking place to achieve such patterns.

3.0 INTERPRETATION OF THE X-DISTRIBUTION

The shape of the X-distribution is important in defining the type of transport (dynamic behavior of the bottom sediments) occurring along a line (erosion, accretion, total deposition, etc.), and thus the computation of X is important. Consider a transport line containing N source/deposit (d_1/d_2) pairs. X is then defined as:

$$X(s)=\sum_{i=1}^{N}\frac{(d_2)_i(s)}{(d_1)_i(s)} \quad \text{..}(14)$$

Often d_2 in one pair is d_1 in another pair, and vice versa. Mean values of d_2 and d_1 are computed through:

$$\bar{d}_1(s)=\sum_{i=1}^{N}(d_1)_i(s);\text{ and }\bar{d}_2(s)=\sum_{i=1}^{N}(d_2)_i(s) \quad \text{.......................................}(15$$

Note that X is not defined as the quotient of the mean value of d_2 divided by the mean value of d_1, even though the results of the two computations are often almost identical. For ease of comparison, d_1, d_2, and X are normalized before plotting in reports, although there is no reason to expect that the integral of the X distribution should be unity. X(s) may be thought of as a function that describes the relative probability of each particle being removed from d_1 and deposited at d_2.

Examination of X-distributions from a large number of different environments has shown that five basic shapes are most common when compared to the distributions of the deposits $d_1(s)$ and $d_2(s)$ (Figure AI-6). These are as follows:

(1) Dynamic Equilibrium: The shape of the X-distributions closely resembles $d_1(s)$ and $d_2(s)$. The relative probability of grains being transported, therefore, is a similar distribution to the actual deposits. Thus, the probability of finding a particular sized grain in the deposit is equal to the probability of its transport and re-deposition (i.e., there must be a grain by grain replacement along the transport path). The bed is neither accreting nor eroding and is, therefore, in dynamic equilibrium.

An X-distribution signifying dynamic equilibrium may be found in either Case B or Case C transport suggesting that there is "fine balance" between erosion and accretion. Often when such environments are determined, both Case B and Case C trends may be significant along the selected sample sequence. This is referred to as a "Mixed Case", and when this occurs it is believed that the transport regime is also approaching a state of dynamic equilibrium.

(2) Net Accretion: The shapes of the three distributions are similar, but the mode of X is finer than the modes of $d_1(s)$ and $d_2(s)$. The mode of X may be thought of as the size that is the most easily transported. Because the modes of the deposits are coarser than X, these sizes are more readily deposited than transported. The bed, therefore, must be in a state of net accretion. Net accretion can only be seen in Case B transport.

(3) Net Erosion: Again the shapes of the three distributions are similar, but the mode of X is coarser than the $d_1(s)$ and $d_2(s)$ modes. This is the reverse of net accretion where the size most easily transported is coarser than the deposits. As result the deposits are undergoing erosion along the transport path. Net erosion can only be seen in Case C transport.

(4) Total Deposition (Type 1): Regardless of the shapes of $d_1(s)$ and $d_2(s)$, the X-distribution more or less increases monotonically over the complete size range of the deposits. Sediment must fine in the direction of transport (Case B); however, the bed is no longer mobile. Rather, it is accreting under a "rain" of sediment that fines with

distance from source. Once deposited, there is no further transport. The occurrence of total deposition is usually confined to cohesive, muddy sediments.

(5) Total Deposition (Type 2): (Horizontal X-Distributions): Occurring only in fine sediments when the mean grain-size is very fine silt or clay, the X-distribution may be essentially horizontal. Such sediments are usually found far from their source and the horizontal nature of the X-distribution suggests that their deposition is no longer related strictly to size sorting. In other words, there is now an equal probability of all sizes being deposited. This form of the X-distribution was first observed in the muddy deposits of a British Columbia fjord and is described in McLaren et al., 1993. Because the trends occur in very fine sediments where any changes in the distributions are extremely small, horizontal X-distributions may be found in both Case B and Case C trends.

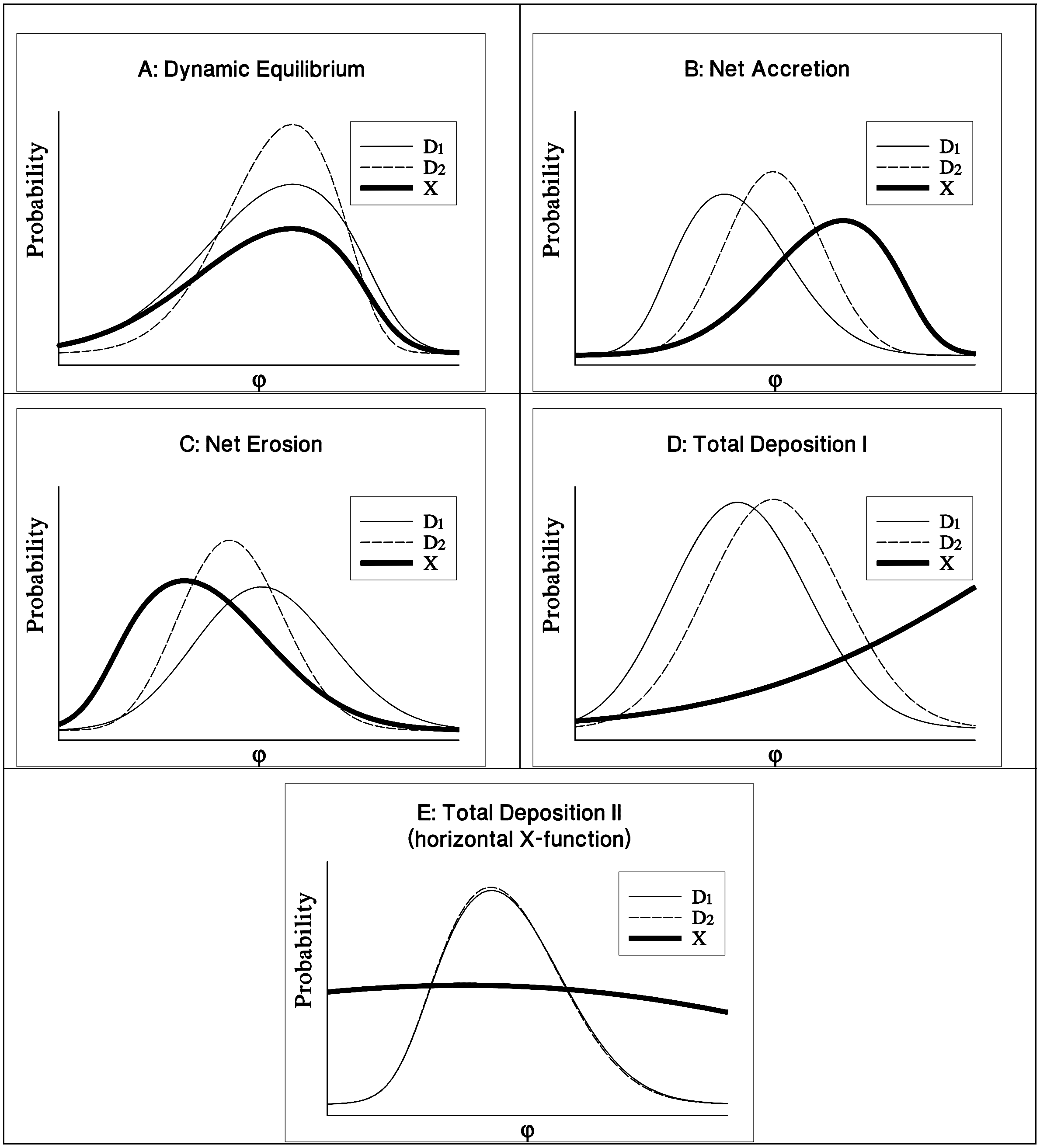

Figure AI-6: Summary of the interpretations given to the shapes of X-distributions relative to the D_1 and D_2 deposits.

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APPENDIX II

SEDIMENT SAMPLE POSITIONS AND DESCRIPTORS

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Proposed Lat	Proposed Long	Actual Lat	Actual Long	Depth(Meters)	Time	Platform	Amount	Color	Consistency	Biota/Detritus
Version 3 Report file for the project.											
1	48.1431822	-123.4204263	48.1430733	-123.4209167	7.2	5/10/2008 17:41	Dinghy	Poor sample	Grey	Loose	TRUE
2	48.1431884	-123.418746	48.1430917	-123.4190967	9.6	5/10/2008 17:48	Dinghy	Half bucket	Grey	Loose	TRUE
3	48.1431945	-123.4170656	48.1431433	-123.4172767	13	5/10/2008 17:53	Dinghy	No sample	N/A	N/A	FALSE
4	48.1432006	-123.4153853	48.1431933	-123.4155217	25	5/10/2008 17:57	Dinghy	No sample	N/A	N/A	FALSE
5	48.1432066	-123.413705	48.1432467	-123.41398	35	5/10/2008 18:02	Dinghy	No sample	N/A	N/A	FALSE
6	48.1432127	-123.4120247	48.1432667	-123.4121817	43	5/10/2008 18:05	Dinghy	No sample	N/A	N/A	FALSE
7	48.1432187	-123.4103444	48.1431617	-123.4104017	44	5/10/2008 18:08	Dinghy	No sample	N/A	N/A	FALSE
8	48.1432247	-123.4086641	48.1433017	-123.408705	54	5/10/2008 18:17	Dinghy	No sample	N/A	N/A	FALSE
9	48.1432306	-123.4069837	48.1434333	-123.4074117	64	5/10/2008 18:20	Dinghy	No sample	N/A	N/A	FALSE
10	48.1432366	-123.4053034	48.1432617	-123.405325	64	5/10/2008 18:25	Dinghy	No sample	N/A	N/A	FALSE
11	48.1432425	-123.4036231	48.1433233	-123.4037083	66	5/10/2008 18:28	Dinghy	No sample	N/A	N/A	FALSE
12	48.1432484	-123.4019428	48.1432783	-123.4019233	66	5/10/2008 18:31	Dinghy	No sample	N/A	N/A	FALSE
13	48.1420607	-123.419577	48.14227	-123.41978	2.5	5/10/2008 17:34	Dinghy	Poor sample	Grey	Loose	FALSE
14	48.1420668	-123.4178967	48.1422767	-123.4182867	3	5/10/2008 17:31	Dinghy	Poor sample	Grey	Loose	FALSE
15	48.1420729	-123.4162164	48.14226	-123.4164083	3.2	5/10/2008 17:28	Dinghy	Half bucket	Grey	Loose	FALSE
16	48.142079	-123.4145361	48.1421083	-123.4145733	2.5	5/10/2008 17:23	Dinghy	Half bucket	Grey	Firm	FALSE
17	48.1420851	-123.4128558	48.1421483	-123.41309	2.8	5/10/2008 17:21	Dinghy	Half bucket	Grey	Firm	FALSE
18	48.1420911	-123.4111756	48.1421683	-123.4111817	47.9	5/10/2008 17:16	Dinghy	Poor sample	Grey	Slurry	FALSE
19	48.1420971	-123.4094953	48.142085	-123.4095483	5.2	5/10/2008 18:12	Dinghy	No sample	N/A	N/A	FALSE
20	48.1421031	-123.407815	48.1420717	-123.40782	6.4	5/10/2008 18:15	Dinghy	No sample	N/A	N/A	FALSE
21	48.142109	-123.4061347	48.1421233	-123.4061717	18	5/10/2008 18:24	Dinghy	No sample	N/A	N/A	FALSE
22	48.1421149	-123.4044544	48.1421	-123.404495	30	5/10/2008 18:27	Dinghy	No sample	N/A	N/A	FALSE
23	48.1421208	-123.4027742	48.14216	-123.4027717	44	5/10/2008 18:30	Dinghy	No sample	N/A	N/A	FALSE
24	48.1421267	-123.4010939	48.1421533	-123.4011383	63	5/10/2008 18:33	Dinghy	No sample	N/A	N/A	FALSE
25	48.1421326	-123.3994136	48.1421483	-123.3994083	63	5/10/2008 18:35	Dinghy	No sample	N/A	N/A	FALSE
26	48.1408575	-123.4405708	48.1408883	-123.4405383	0	5/19/2008 21:22	Dinghy	Full bucket	Grey	Loose	TRUE
27	48.140864	-123.4388905	48.1408367	-123.4388233	17.9	5/19/2008 21:27	Dinghy	Full bucket	Grey	Loose	TRUE
28	48.1408704	-123.4372103	48.140855	-123.4370533	17.5	5/19/2008 21:33	Dinghy	Full bucket	Grey	Loose	TRUE
29	48.1408768	-123.4355301	48.1408917	-123.4354417	14.1	5/19/2008 21:38	Dinghy	Full bucket	Grey	Loose	TRUE
30	48.1408831	-123.4338498	48.1407783	-123.43387	14.1	5/19/2008 21:47	Dinghy	Half bucket	Grey	Loose	TRUE
31	48.1408894	-123.4321696	48.1406667	-123.43214	8.5	5/14/2008 19:04	Dinghy	No sample	N/A	N/A	FALSE
32	48.1408957	-123.4304893	48.140915	-123.4304967	3.3	5/14/2008 18:56	Dinghy	Full bucket	Grey	Loose	TRUE
33	48.140902	-123.4288091	48.1409033	-123.4286867	1.6	5/13/2008 0:50	Dinghy	Poor sample	Grey	Loose	TRUE
34	48.1409083	-123.4271289	48.140895	-123.427375	1.6	5/13/2008 0:42	Dinghy	Poor sample	Grey	Loose	TRUE
35	48.1409145	-123.4254486	48.1410417	-123.4260717	1	5/13/2008 0:35	Dinghy	Poor sample	Grey	Loose	TRUE
36	48.1409207	-123.4237684	48.14045	-123.4241233	12.9	5/13/2008 0:27	Dinghy	Full bucket	Black	Loose	TRUE
37	48.1409269	-123.4220881	48.1406717	-123.422625	1.1	5/13/2008 0:21	Dinghy	Poor sample	Grey	Loose	TRUE
38	48.1409992	-123.4019252	48.1409467	-123.4017117	9.1	5/10/2008 17:00	Dinghy	No sample	N/A	N/A	FALSE
39	48.141005	-123.400245	48.141145	-123.4001733	48	5/10/2008 17:07	Dinghy	No sample	N/A	N/A	FALSE
40	48.1410109	-123.3985647	48.1412517	-123.3986233	63	5/10/2008 18:41	Dinghy	No sample	N/A	N/A	FALSE
41	48.1397037	-123.448122	48.1394617	-123.4480017	8.1	5/19/2008 20:53	Dinghy	Half bucket	Grey	Loose	TRUE
42	48.1397103	-123.4464418	48.13967	-123.4463583	8.6	5/19/2008 20:57	Dinghy	Full bucket	Black	Loose	FALSE
43	48.1397168	-123.4447616	48.1396733	-123.444655	14	5/19/2008 21:02	Dinghy	Half bucket	Grey	Loose	TRUE
44	48.1397233	-123.4430814	48.13966	-123.44299	23.9	5/19/2008 21:07	Dinghy	Full bucket	Black	Loose	TRUE
45	48.1397297	-123.4414012	48.1397617	-123.4412683	34.1	5/19/2008 21:17	Dinghy	Full bucket	Black	Firm	TRUE
46	48.1397362	-123.439721	48.1397283	-123.4398167	39.7	5/26/2008 18:54	Dinghy	Full bucket	Black	Firm	TRUE
47	48.1397426	-123.4380408	48.1396583	-123.4380933	39.7	5/26/2008 18:49	Dinghy	Full bucket	Black	Firm	TRUE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
48	48.139749	-123.4363606	48.13974	-123.4364383	40.3	5/26/2008 18:45	Dinghy	Full bucket	Black	Loose	TRUE
49	48.1397553	-123.4346804	48.13975	-123.4346317	35.5	5/26/2008 18:40	Dinghy	Poor sample	Black	Loose	TRUE
50	48.1397617	-123.4330002	48.1396483	-123.432875	37.6	5/19/2008 21:52	Dinghy	Full bucket	Black	Loose	FALSE
51	48.139768	-123.43132	48.1397683	-123.4312417	32.6	5/14/2008 19:11	Dinghy	Full bucket	Grey	Firm	TRUE
52	48.1397743	-123.4296398	48.1396883	-123.429585	34.2	5/14/2008 18:47	Dinghy	Full bucket	Black	Loose	TRUE
53	48.1397806	-123.4279596	48.1397917	-123.4280467	28.8	5/9/2008 22:18	Dinghy	Poor sample	Grey	Loose	FALSE
54	48.1397868	-123.4262794	48.1397717	-123.4263033	30	5/9/2008 22:34	Dinghy	Half bucket	Grey	Loose	TRUE
55	48.139793	-123.4245992	48.1397833	-123.4246217	31	5/9/2008 22:42	Dinghy	Half bucket	Grey	Loose	FALSE
56	48.1397992	-123.422919	48.1398267	-123.4229433	26	5/9/2008 22:48	Dinghy	Half bucket	Black	Firm	FALSE
57	48.1398054	-123.4212388	48.1396733	-123.4212133	24.7	5/9/2008 22:56	Dinghy	Half bucket	Brown	Firm	FALSE
58	48.1398115	-123.4195586	48.1398483	-123.4195633	17.5	5/9/2008 23:01	Dinghy	Half bucket	Brown	Firm	FALSE
59	48.1398177	-123.4178784	48.1398167	-123.4178267	15.3	5/9/2008 23:04	Dinghy	Half bucket	Brown	Firm	FALSE
60	48.1398238	-123.4161982	48.1397867	-123.41611	6.9	5/9/2008 23:08	Dinghy	Poor sample	Brown	Loose	FALSE
61	48.1398298	-123.414518	48.1398067	-123.4145083	5	5/9/2008 23:11	Dinghy	Poor sample	Brown	Loose	TRUE
62	48.1398359	-123.4128378	48.1395533	-123.4117533	2.2	5/27/2008 18:32	Dinghy	Poor sample	Grey	Loose	TRUE
63	48.1398775	-123.4010763	48.13942	-123.40023	8.9	5/10/2008 21:14	Dinghy	Half bucket	Grey	Loose	TRUE
64	48.1398834	-123.3993961	48.1401017	-123.399405	42	5/10/2008 18:58	Dinghy	Poor sample	Grey	Loose	TRUE
65	48.1398892	-123.3977159	48.13991	-123.397565	59	5/10/2008 18:53	Dinghy	Poor sample	Grey	Loose	TRUE
66	48.1385494	-123.4556729	48.138385	-123.4556833	7.6	5/19/2008 1:33	Dinghy	Full bucket	Black	Loose	TRUE
67	48.1385561	-123.4539928	48.1385283	-123.4540383	2.1	5/19/2008 16:48	Dinghy	Half bucket	Grey	Loose	TRUE
68	48.1385627	-123.4523126	48.13859	-123.4522667	4.9	5/19/2008 20:38	Dinghy	Poor sample	Brown	Loose	TRUE
69	48.1385693	-123.4506325	48.1385117	-123.4505433	21.9	5/19/2008 20:42	Dinghy	Full bucket	Black	Loose	FALSE
70	48.1385759	-123.4489523	48.1384617	-123.4488867	28.4	5/19/2008 20:47	Dinghy	Full bucket	Black	Loose	TRUE
71	48.1385824	-123.4472721	48.1385917	-123.447395	30.1	5/26/2008 17:49	Dinghy	Full bucket	Grey	Firm	TRUE
72	48.1385889	-123.445592	48.1386033	-123.44572	35.6	5/26/2008 17:54	Dinghy	Full bucket	Black	Loose	TRUE
73	48.1385954	-123.4439118	48.138495	-123.44385	47.8	5/26/2008 18:00	Dinghy	Half bucket	Grey	Firm	TRUE
74	48.1386019	-123.4422317	48.1386083	-123.442215	47.8	5/26/2008 18:05	Dinghy	Half bucket	Black	Loose	TRUE
75	48.1386084	-123.4405515	48.1385317	-123.440495	46.8	5/26/2008 18:09	Dinghy	Half bucket	Grey	Loose	TRUE
76	48.1386148	-123.4388713	48.1386017	-123.438695	47.4	5/26/2008 18:14	Dinghy	Full bucket	Black	Firm	TRUE
77	48.1386212	-123.4371912	48.1385017	-123.43709	48.5	5/26/2008 18:20	Dinghy	Full bucket	Black	Firm	FALSE
78	48.1386276	-123.435511	48.13857	-123.4354567	50.7	5/26/2008 18:24	Dinghy	Full bucket	Black	Firm	TRUE
79	48.1386339	-123.4338309	48.1386217	-123.433685	50.7	5/26/2008 18:31	Dinghy	Full bucket	Grey	Firm	TRUE
80	48.1386403	-123.4321507	48.1385367	-123.432	52.6	5/19/2008 21:57	Dinghy	Full bucket	Black	Firm	TRUE
81	48.1386466	-123.4304705	48.138605	-123.4304083	52.7	5/14/2008 19:19	Dinghy	Full bucket	Black	Firm	TRUE
82	48.1386528	-123.4287904	48.13865	-123.4287317	53.1	5/14/2008 18:41	Dinghy	Full bucket	Grey	Firm	TRUE
83	48.1386591	-123.4271102	48.1386117	-123.4271467	52.7	5/14/2008 18:10	Dinghy	Full bucket	Black	Firm	TRUE
84	48.1386653	-123.42543	48.13866	-123.4253383	52.4	5/13/2008 0:55	Dinghy	Poor sample	Black	Firm	TRUE
85	48.1386715	-123.4237499	48.1385917	-123.4237617	53.2	5/13/2008 0:14	Dinghy	Full bucket	Black	Firm	FALSE
86	48.1386777	-123.4220697	48.139075	-123.4221567	43.7	5/12/2008 23:26	Dinghy	Full bucket	Black	Firm	FALSE
87	48.1386839	-123.4203895	48.1385867	-123.4204733	49.5	5/12/2008 23:15	Dinghy	Full bucket	Black	Firm	FALSE
88	48.13869	-123.4187094	48.138615	-123.4187117	50.5	5/12/2008 20:13	Dinghy	Full bucket	Black	Firm	TRUE
89	48.1386961	-123.4170292	48.1387633	-123.4171733	40.2	5/12/2008 20:08	Dinghy	Full bucket	Grey	Firm	TRUE
90	48.1387022	-123.415349	48.1385617	-123.4153183	39.8	5/9/2008 23:18	Dinghy	Full bucket	Brown	Firm	TRUE
91	48.1387083	-123.4136689	48.1386867	-123.4135433	36	5/9/2008 23:23	Dinghy	Full bucket	Brown	Firm	TRUE
92	48.1387143	-123.4119887	48.1386717	-123.41187	28.8	5/9/2008 23:29	Dinghy	Full bucket	Brown	Firm	TRUE
93	48.1387203	-123.4103085	48.1387883	-123.4101933	22	5/9/2008 23:34	Dinghy	Full bucket	Brown	Firm	TRUE
94	48.1387263	-123.4086284	48.1387983	-123.408565	22	5/9/2008 23:37	Dinghy	Half bucket	Brown	Firm	TRUE
95	48.1387323	-123.4069482	48.1387683	-123.40691	13	5/9/2008 23:40	Dinghy	Half bucket	Brown	Loose	TRUE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
96	48.1387382	-123.405268	48.1387367	-123.405225	13	5/9/2008 23:43	Dinghy	Full bucket	Brown	Loose	FALSE
97	48.13875	-123.4019077	48.1384517	-123.40157	9.1	5/10/2008 16:49	Dinghy	Half bucket	Grey	Loose	FALSE
98	48.1387559	-123.4002275	48.1385217	-123.40059	23	5/10/2008 21:23	Dinghy	No sample	N/A	N/A	FALSE
99	48.1387617	-123.3985473	48.138575	-123.3986583	55	5/10/2008 21:31	Dinghy	Poor sample	Grey	Loose	TRUE
100	48.1387675	-123.3968672	48.138665	-123.3967	55	5/10/2008 21:40	Dinghy	No sample	N/A	N/A	FALSE
101	48.1374081	-123.4598633	48.1374367	-123.4596467	11.4	5/18/2008 18:07	Dinghy	Full bucket	Black	Firm	TRUE
102	48.1374148	-123.4581832	48.1374317	-123.4579817	14.8	5/18/2008 20:58	Dinghy	Full bucket	Black	Firm	FALSE
103	48.1374215	-123.456503	48.1372983	-123.4568317	8.7	5/19/2008 1:22	Dinghy	Full bucket	Black	Loose	TRUE
104	48.1374282	-123.4548229	48.1374183	-123.454725	17	5/19/2008 1:38	Dinghy	Full bucket	Black	Loose	TRUE
105	48.1374348	-123.4531428	48.1374	-123.4531383	23.9	5/19/2008 16:54	Dinghy	Full bucket	Black	Loose	TRUE
106	48.1374414	-123.4514627	48.1374667	-123.4514317	30.3	5/19/2008 20:32	Dinghy	Full bucket	Black	Loose	TRUE
107	48.137448	-123.4497826	48.137405	-123.4496467	38.3	5/26/2008 17:43	Dinghy	Full bucket	Black	Firm	TRUE
108	48.1374546	-123.4481024	48.1374433	-123.448135	42	5/26/2008 17:38	Dinghy	Full bucket	Black	Loose	FALSE
109	48.1374611	-123.4464223	48.1374217	-123.4464683	45.1	5/26/2008 17:34	Dinghy	Full bucket	Black	Firm	FALSE
110	48.1374676	-123.4447422	48.13737	-123.4447833	43.2	5/26/2008 17:29	Dinghy	Full bucket	Grey	Firm	TRUE
111	48.1374741	-123.4430621	48.137405	-123.4430783	43	5/26/2008 17:25	Dinghy	Full bucket	Grey	Loose	TRUE
112	48.1374806	-123.4413819	48.1374633	-123.4415083	42.3	5/26/2008 17:22	Dinghy	Full bucket	Black	Firm	TRUE
113	48.137487	-123.4397018	48.1374417	-123.439755	41.6	5/26/2008 17:18	Dinghy	Full bucket	Black	Firm	TRUE
114	48.1374934	-123.4380217	48.1374533	-123.437905	41.2	5/26/2008 17:10	Dinghy	Full bucket	Grey	Firm	TRUE
115	48.1374998	-123.4363416	48.137455	-123.4364417	43	5/26/2008 17:04	Dinghy	Full bucket	Black	Firm	TRUE
116	48.1375062	-123.4346615	48.1375083	-123.434785	44.5	5/26/2008 16:59	Dinghy	Full bucket	Grey	Firm	TRUE
117	48.1375125	-123.4329813	48.1375283	-123.432845	45.7	5/26/2008 16:54	Dinghy	Full bucket	Black	Firm	TRUE
118	48.1375188	-123.4313012	48.1374517	-123.43113	47.2	5/19/2008 22:01	Dinghy	Half bucket	Grey	Loose	TRUE
119	48.1375251	-123.4296211	48.1375083	-123.4295833	48.5	5/14/2008 19:24	Dinghy	Full bucket	Black	Firm	TRUE
120	48.1375314	-123.4279409	48.1375133	-123.4278233	50.5	5/14/2008 18:35	Dinghy	Full bucket	Brown	Firm	TRUE
121	48.1375376	-123.4262608	48.1374483	-123.426285	49.5	5/14/2008 18:04	Dinghy	Full bucket	Black	Firm	TRUE
122	48.1375439	-123.4245807	48.1374967	-123.4244717	53.4	5/13/2008 1:04	Dinghy	Full bucket	Grey	Firm	TRUE
123	48.13755	-123.4229006	48.137445	-123.4229617	53.2	5/13/2008 0:05	Dinghy	Full bucket	Black	Firm	FALSE
124	48.1375562	-123.4212204	48.1375467	-123.4213283	54.8	5/12/2008 23:34	Dinghy	Full bucket	Black	Firm	TRUE
125	48.1375624	-123.4195403	48.1375833	-123.4195983	54.6	5/12/2008 23:10	Dinghy	Poor sample	Grey	Loose	TRUE
126	48.1375685	-123.4178602	48.137575	-123.4180083	54.6	5/12/2008 20:26	Dinghy	Full bucket	Black	Firm	TRUE
127	48.1375746	-123.41618	48.1376267	-123.4162383	53.2	5/12/2008 20:02	Dinghy	Full bucket	Grey	Firm	TRUE
128	48.1375806	-123.4144999	48.1374283	-123.414575	51.4	5/12/2008 19:33	Dinghy	Full bucket	Grey	Firm	TRUE
129	48.1375867	-123.4128198	48.1375317	-123.4129533	50.5	5/12/2008 19:23	Dinghy	Full bucket	Grey	Firm	TRUE
130	48.1375927	-123.4111396	48.137565	-123.4113067	47.1	5/12/2008 18:36	Dinghy	Full bucket	Grey	Firm	TRUE
131	48.1375987	-123.4094595	48.1375583	-123.4096667	46.5	5/12/2008 18:30	Dinghy	Full bucket	Grey	Firm	TRUE
132	48.1376047	-123.4077794	48.1376	-123.40784	46.4	5/12/2008 18:25	Dinghy	Full bucket	Grey	Firm	TRUE
133	48.1376106	-123.4060992	48.1374833	-123.4057833	40	5/9/2008 23:47	Dinghy	Half bucket	Brown	Loose	TRUE
134	48.1376166	-123.4044191	48.1375433	-123.404265	36	5/9/2008 23:53	Dinghy	Half bucket	Brown	Firm	FALSE
135	48.1376225	-123.402739	48.1376133	-123.4027067	34.9	5/10/2008 16:39	Dinghy	Poor sample	Grey	Loose	FALSE
136	48.1376283	-123.4010588	48.1374183	-123.40117	46	5/10/2008 22:06	Dinghy	Half bucket	Grey	Loose	TRUE
137	48.1376342	-123.3993787	48.13751	-123.39943	51	5/10/2008 21:59	Dinghy	Poor sample	Brown	Loose	TRUE
138	48.13764	-123.3976986	48.13761	-123.3977683	52	5/10/2008 21:52	Dinghy	Poor sample	Brown	Loose	TRUE
139	48.1376458	-123.3960184	48.1374467	-123.3960633	52	5/10/2008 21:48	Dinghy	No sample	N/A	N/A	FALSE
140	48.1362801	-123.4606933	48.1362767	-123.4607617	11.4	5/18/2008 18:01	Dinghy	Half bucket	Grey	Firm	FALSE
141	48.1362869	-123.4590132	48.136255	-123.45905	18.1	5/18/2008 18:16	Dinghy	Full bucket	Black	Firm	FALSE
142	48.1362936	-123.4573331	48.1361317	-123.4569933	24.8	5/18/2008 21:07	Dinghy	Poor sample	Black	Loose	FALSE
143	48.1363002	-123.455653	48.136255	-123.4557167	24.5	5/19/2008 1:15	Dinghy	No sample	N/A	N/A	FALSE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
144	48.1363069	-123.4539729	48.1363617	-123.45396	28.7	5/19/2008 1:43	Dinghy	Full bucket	Black	Loose	TRUE
145	48.1363135	-123.4522929	48.1362033	-123.4524717	32.5	5/19/2008 16:59	Dinghy	Full bucket	Grey	Loose	FALSE
146	48.1363201	-123.4506128	48.1362867	-123.45058	38.3	5/19/2008 20:26	Dinghy	Full bucket	Black	Loose	FALSE
147	48.1363267	-123.4489327	48.1363433	-123.4486633	39.3	5/26/2008 15:55	Dinghy	Full bucket	Black	Loose	TRUE
148	48.1363332	-123.4472526	48.1363833	-123.4471517	38	5/26/2008 16:00	Dinghy	Full bucket	Black	Firm	FALSE
149	48.1363398	-123.4455725	48.13637	-123.4455733	38	5/26/2008 16:06	Dinghy	Full bucket	Black	Firm	FALSE
150	48.1363463	-123.4438924	48.1364083	-123.4437383	36.1	5/26/2008 16:12	Dinghy	Full bucket	Black	Firm	TRUE
151	48.1363527	-123.4422124	48.1363617	-123.44212	37	5/26/2008 16:16	Dinghy	Full bucket	Black	Firm	TRUE
152	48.1363592	-123.4405323	48.13632	-123.4406167	37.4	5/26/2008 16:24	Dinghy	Full bucket	Black	Firm	TRUE
153	48.1363656	-123.4388522	48.136395	-123.43878	38.9	5/26/2008 16:32	Dinghy	Full bucket	Black	Firm	TRUE
154	48.136372	-123.4371721	48.13636	-123.4371067	38.9	5/26/2008 16:37	Dinghy	Full bucket	Black	Firm	TRUE
155	48.1363784	-123.435492	48.136435	-123.435415	39.8	5/26/2008 16:40	Dinghy	Full bucket	Grey	Firm	TRUE
156	48.1363848	-123.4338119	48.1363617	-123.4337333	40.3	5/26/2008 16:44	Dinghy	Full bucket	Black	Firm	TRUE
157	48.1363911	-123.4321318	48.1364117	-123.43196	41.6	5/26/2008 16:49	Dinghy	Full bucket	Black	Firm	TRUE
158	48.1363974	-123.4304517	48.1362417	-123.4304383	41.7	5/19/2008 22:06	Dinghy	Full bucket	Black	Firm	TRUE
159	48.1364037	-123.4287716	48.1363783	-123.428715	43.7	5/14/2008 19:31	Dinghy	Full bucket	Black	Firm	TRUE
160	48.1364099	-123.4270916	48.13637	-123.4270983	44.4	5/14/2008 18:28	Dinghy	Full bucket	Grey	Firm	TRUE
161	48.1364162	-123.4254115	48.1363583	-123.4254333	46	5/14/2008 17:49	Dinghy	Full bucket	Black	Firm	TRUE
162	48.1364224	-123.4237314	48.136445	-123.42379	47.1	5/13/2008 1:11	Dinghy	Full bucket	Black	Firm	TRUE
163	48.1364285	-123.4220513	48.13629	-123.421975	46.5	5/13/2008 0:00	Dinghy	Full bucket	Black	Firm	TRUE
164	48.1364347	-123.4203712	48.1363167	-123.420355	54.8	5/12/2008 23:40	Dinghy	Full bucket	Grey	Firm	TRUE
165	48.1364408	-123.4186911	48.13646	-123.4188333	47.9	5/12/2008 22:54	Dinghy	Full bucket	Grey	Firm	FALSE
166	48.1364469	-123.417011	48.1363667	-123.4171167	47.8	5/12/2008 20:31	Dinghy	Full bucket	Grey	Firm	TRUE
167	48.136453	-123.4153309	48.13647	-123.4154367	47.8	5/12/2008 19:55	Dinghy	Full bucket	Grey	Firm	TRUE
168	48.1364591	-123.4136508	48.136445	-123.4136983	46.5	5/12/2008 19:38	Dinghy	Full bucket	Grey	Loose	TRUE
169	48.1364651	-123.4119707	48.1365083	-123.4121283	45.7	5/12/2008 19:18	Dinghy	Full bucket	Grey	Firm	TRUE
170	48.1364711	-123.4102906	48.1363917	-123.4105533	44.4	5/12/2008 18:41	Dinghy	Full bucket	Grey	Firm	TRUE
171	48.1364771	-123.4086105	48.13649	-123.40877	44.8	5/12/2008 18:20	Dinghy	Full bucket	Grey	Firm	TRUE
172	48.1364831	-123.4069304	48.1363467	-123.4063733	43.7	5/12/2008 16:26	Dinghy	Full bucket	Grey	Firm	FALSE
173	48.136489	-123.4052503	48.13648	-123.4051383	42	5/10/2008 22:49	Dinghy	Full bucket	Grey	Firm	TRUE
174	48.1364949	-123.4035702	48.1365117	-123.403425	43	5/10/2008 22:44	Dinghy	Full bucket	Grey	Firm	TRUE
175	48.1365008	-123.4018901	48.1364067	-123.4019967	46	5/10/2008 22:38	Dinghy	Half bucket	Brown	Firm	TRUE
176	48.1365067	-123.40021	48.1363083	-123.4003017	46	5/10/2008 22:31	Dinghy	Half bucket	Grey	Firm	TRUE
177	48.1365125	-123.3985299	48.1362717	-123.3986	45	5/10/2008 22:25	Dinghy	Half bucket	Grey	Firm	TRUE
178	48.1365183	-123.3968498	48.13629	-123.3970033	44	5/10/2008 22:19	Dinghy	Poor sample	Brown	Firm	TRUE
179	48.1365241	-123.3951697	48.1364117	-123.3952183	44	5/10/2008 22:12	Dinghy	Half bucket	Grey	Firm	TRUE
180	48.1351589	-123.4598432	48.1350267	-123.4598633	18.1	5/18/2008 18:21	Dinghy	Full bucket	Black	Loose	FALSE
181	48.1351656	-123.4581631	48.135245	-123.4581017	18.1	5/18/2008 18:26	Dinghy	Full bucket	Black	Loose	FALSE
182	48.1351723	-123.4564831	48.1351617	-123.4564667	20.5	5/18/2008 21:14	Dinghy	Poor sample	Black	Firm	TRUE
183	48.135179	-123.4548031	48.135085	-123.4547333	24.5	5/19/2008 1:06	Dinghy	Full bucket	Black	Loose	TRUE
184	48.1351856	-123.453123	48.1351383	-123.4531617	27.1	5/19/2008 1:51	Dinghy	Full bucket	Black	Loose	TRUE
185	48.1351922	-123.451443	48.1351817	-123.451465	25.9	5/19/2008 17:07	Dinghy	Full bucket	Black	Loose	FALSE
186	48.1351988	-123.4497629	48.1351833	-123.4497683	27.4	5/19/2008 20:22	Dinghy	Half bucket	Black	Firm	FALSE
187	48.1352054	-123.4480829	48.1352267	-123.4480783	28	5/25/2008 19:27	Dinghy	Full bucket	Black	Firm	TRUE
188	48.1352119	-123.4464028	48.1352017	-123.4463017	30	5/25/2008 19:22	Dinghy	Full bucket	Black	Firm	TRUE
189	48.1352184	-123.4447228	48.13521	-123.4447283	31.4	5/25/2008 19:19	Dinghy	Full bucket	Black	Firm	TRUE
190	48.1352249	-123.4430427	48.1351833	-123.4430567	32	5/25/2008 19:16	Dinghy	Full bucket	Black	Firm	TRUE
191	48.1352314	-123.4413627	48.1352117	-123.4413767	33.3	5/25/2008 19:11	Dinghy	Full bucket	Black	Firm	TRUE

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Proposed Lat	Proposed Long	Actual Lat	Actual Long	Depth(Meters)	Time	Platform	Amount	Color	Consistency	Biota/Detritus
Version 3 Report file for the project.											
192	48.1352378	-123.4396826	48.1352433	-123.4398467	34.1	5/25/2008 19:06	Dinghy	Full bucket	Black	Firm	TRUE
193	48.1352442	-123.4380026	48.1352817	-123.4381133	34.9	5/25/2008 19:00	Dinghy	Full bucket	Black	Firm	TRUE
194	48.1352506	-123.4363225	48.1352617	-123.4363067	35.3	5/25/2008 18:56	Dinghy	Full bucket	Black	Loose	TRUE
195	48.135257	-123.4346425	48.13515	-123.434695	35	5/25/2008 18:52	Dinghy	Full bucket	Grey	Firm	TRUE
196	48.1352633	-123.4329624	48.13528	-123.432715	36.1	5/25/2008 18:48	Dinghy	Half bucket	Black	Loose	TRUE
197	48.1352696	-123.4312824	48.135375	-123.4311617	37.2	5/25/2008 18:40	Dinghy	Full bucket	Black	Firm	FALSE
198	48.1352759	-123.4296023	48.1352967	-123.4293583	39	5/19/2008 22:11	Dinghy	Full bucket	Black	Firm	TRUE
199	48.1352822	-123.4279223	48.1352567	-123.4278767	38.9	5/14/2008 19:36	Dinghy	Full bucket	Black	Firm	TRUE
200	48.1352885	-123.4262422	48.1352983	-123.426225	39.7	5/14/2008 18:23	Dinghy	Full bucket	Grey	Firm	TRUE
201	48.1352947	-123.4245621	48.1352117	-123.4245067	40.3	5/14/2008 17:43	Dinghy	Full bucket	Black	Firm	TRUE
202	48.1353009	-123.4228821	48.1351933	-123.4228167	41	5/14/2008 17:28	Dinghy	Full bucket	Black	Firm	TRUE
203	48.135307	-123.421202	48.13529	-123.4212433	41.6	5/12/2008 23:53	Dinghy	Full bucket	Black	Firm	TRUE
204	48.1353132	-123.419522	48.1353867	-123.419585	42.4	5/12/2008 22:48	Dinghy	Full bucket	Black	Firm	TRUE
205	48.1353193	-123.4178419	48.1353583	-123.4179683	37.5	5/12/2008 21:10	Dinghy	Full bucket	Grey	Firm	TRUE
206	48.1353254	-123.4161619	48.1353133	-123.4161633	43.3	5/12/2008 20:36	Dinghy	Full bucket	Grey	Firm	TRUE
207	48.1353315	-123.4144818	48.1354067	-123.4146517	42.3	5/12/2008 19:47	Dinghy	Full bucket	Grey	Loose	TRUE
208	48.1353375	-123.4128017	48.1353367	-123.41291	41	5/12/2008 20:45	Dinghy	Full bucket	Brown	Firm	TRUE
209	48.1353435	-123.4111217	48.1353283	-123.4112267	41	5/12/2008 19:12	Dinghy	Full bucket	Grey	Firm	TRUE
210	48.1353495	-123.4094416	48.13531	-123.4095583	40.3	5/12/2008 18:47	Dinghy	Full bucket	Grey	Firm	TRUE
211	48.1353555	-123.4077616	48.13527	-123.4080267	39.6	5/12/2008 18:14	Dinghy	Full bucket	Grey	Firm	FALSE
212	48.1353615	-123.4060815	48.1353767	-123.4062033	39.6	5/12/2008 18:09	Dinghy	Full bucket	Grey	Firm	TRUE
213	48.1353674	-123.4044014	48.1353017	-123.404415	38.9	5/12/2008 16:38	Dinghy	Full bucket	Grey	Firm	TRUE
214	48.1353733	-123.4027214	48.13521	-123.40306	39	5/12/2008 16:47	Dinghy	Full bucket	Grey	Firm	TRUE
215	48.1353791	-123.4010413	48.1352283	-123.40127	40.3	5/12/2008 16:53	Dinghy	Full bucket	Grey	Firm	TRUE
216	48.135385	-123.3993612	48.1352083	-123.39957	40.3	5/12/2008 16:58	Dinghy	Poor sample	Grey	Firm	TRUE
217	48.1353908	-123.3976812	48.1354867	-123.3976733	41	5/12/2008 17:09	Dinghy	Full bucket	Grey	Firm	TRUE
218	48.1353966	-123.3960011	48.1353583	-123.3960317	41	5/12/2008 17:17	Dinghy	Poor sample	Grey	Firm	TRUE
219	48.1354024	-123.3943211	48.1353517	-123.3944717	39.7	5/12/2008 17:23	Dinghy	Full bucket	Grey	Firm	FALSE
220	48.1340242	-123.4623532	48.1339717	-123.462255	11.4	5/18/2008 17:53	Dinghy	Half bucket	Grey	Firm	FALSE
221	48.134031	-123.4606731	48.133955	-123.46073	11.4	5/18/2008 17:47	Dinghy	Full bucket	Brown	Loose	FALSE
222	48.1340377	-123.4589931	48.1339417	-123.4589883	18.1	5/18/2008 18:33	Dinghy	Full bucket	Black	Loose	FALSE
223	48.1340444	-123.4573131	48.1340383	-123.4573467	17.1	5/18/2008 20:51	Dinghy	Half bucket	Black	Firm	FALSE
224	48.1340511	-123.4556331	48.1340533	-123.455565	18.1	5/18/2008 21:21	Dinghy	Full bucket	Black	Loose	TRUE
225	48.1340577	-123.4539531	48.1339933	-123.45391	20.2	5/19/2008 1:00	Dinghy	Full bucket	Black	Loose	TRUE
226	48.1340643	-123.4522731	48.13396	-123.452245	22.7	5/19/2008 1:56	Dinghy	Full bucket	Black	Loose	TRUE
227	48.1340709	-123.4505931	48.1339933	-123.4505733	23.2	5/19/2008 17:11	Dinghy	Full bucket	Grey	Loose	TRUE
228	48.1340775	-123.4489131	48.1340333	-123.4489833	26	5/19/2008 20:17	Dinghy	Half bucket	Grey	Firm	TRUE
229	48.1340841	-123.4472331	48.134005	-123.4472283	27.2	5/25/2008 17:51	Dinghy	Full bucket	Black	Firm	TRUE
230	48.1340906	-123.4455531	48.13401	-123.445575	28.3	5/25/2008 17:56	Dinghy	Full bucket	Grey	Firm	FALSE
231	48.1340971	-123.4438731	48.1342517	-123.4436817	30.2	5/25/2008 18:00	Dinghy	Full bucket	Black	Firm	TRUE
232	48.1341036	-123.442193	48.134015	-123.4421533	30.4	5/25/2008 18:04	Dinghy	Full bucket	Grey	Loose	TRUE
233	48.13411	-123.440513	48.1340817	-123.4403667	31.2	5/25/2008 18:10	Dinghy	Full bucket	Grey	Firm	FALSE
234	48.1341164	-123.438833	48.1340683	-123.43869	31.5	5/25/2008 18:13	Dinghy	Full bucket	Grey	Firm	TRUE
235	48.1341228	-123.437153	48.134205	-123.437065	32.1	5/25/2008 18:17	Dinghy	Full bucket	Black	Firm	TRUE
236	48.1341292	-123.435473	48.13409	-123.4353733	32.1	5/25/2008 18:21	Dinghy	Full bucket	Black	Firm	TRUE
237	48.1341356	-123.433793	48.1342383	-123.433855	32.6	5/25/2008 18:26	Dinghy	Full bucket	Grey	Firm	TRUE
238	48.1341419	-123.432113	48.1341283	-123.4319833	32.6	5/25/2008 18:30	Dinghy	Full bucket	Grey	Firm	TRUE
239	48.1341482	-123.4304329	48.1339583	-123.4301783	32.8	5/25/2008 18:35	Dinghy	Full bucket	Grey	Firm	TRUE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
240	48.1341545	-123.4287529	48.1340733	-123.428765	35	5/19/2008 22:15	Dinghy	Full bucket	Grey	Firm	TRUE
241	48.1341607	-123.4270729	48.13413	-123.42701	38.9	5/14/2008 19:40	Dinghy	Full bucket	Grey	Firm	TRUE
242	48.134167	-123.4253929	48.13406	-123.4254067	35.5	5/14/2008 18:16	Dinghy	Full bucket	Black	Firm	TRUE
243	48.1341732	-123.4237129	48.1342333	-123.4237483	36.8	5/14/2008 17:38	Dinghy	Full bucket	Black	Firm	TRUE
244	48.1341794	-123.4220328	48.1341267	-123.422135	36.8	5/14/2008 17:33	Dinghy	Full bucket	Grey	Firm	TRUE
245	48.1341855	-123.4203528	48.1342283	-123.4203183	36.9	5/12/2008 23:46	Dinghy	Full bucket	Grey	Firm	TRUE
246	48.1341916	-123.4186728	48.134175	-123.4187867	36.9	5/12/2008 22:43	Dinghy	Full bucket	Grey	Firm	FALSE
247	48.1341978	-123.4169928	48.1342267	-123.4169917	37.5	5/12/2008 20:53	Dinghy	Full bucket	Grey	Firm	TRUE
248	48.1342038	-123.4153128	48.1342533	-123.4153883	38.2	5/12/2008 20:40	Dinghy	Full bucket	Grey	Firm	TRUE
249	48.1342099	-123.4136327	48.1342683	-123.4137683	37.5	5/12/2008 19:43	Dinghy	Full bucket	Grey	Loose	TRUE
250	48.1342159	-123.4119527	48.13412	-123.4120433	36.8	5/12/2008 19:07	Dinghy	Full bucket	Grey	Firm	TRUE
251	48.1342219	-123.4102727	48.1341617	-123.410385	36.4	5/12/2008 19:03	Dinghy	Full bucket	Grey	Firm	TRUE
252	48.1342279	-123.4085927	48.134235	-123.4085867	36.4	5/12/2008 18:58	Dinghy	Full bucket	Grey	Firm	TRUE
253	48.1342339	-123.4069126	48.13416	-123.4070317	40.3	5/12/2008 18:53	Dinghy	Full bucket	Grey	Firm	TRUE
254	48.1342398	-123.4052326	48.1342633	-123.4053933	34.8	5/12/2008 18:04	Dinghy	Full bucket	Grey	Firm	TRUE
255	48.1342457	-123.4035526	48.1341283	-123.4038433	35.2	5/12/2008 17:59	Dinghy	Full bucket	Grey	Firm	TRUE
256	48.1342516	-123.4018726	48.1342667	-123.4022183	35.1	5/12/2008 17:55	Dinghy	Full bucket	Grey	Firm	TRUE
257	48.1342575	-123.4001925	48.1343067	-123.4002517	35.5	5/12/2008 17:51	Dinghy	Full bucket	Grey	Firm	TRUE
258	48.1342633	-123.3985125	48.1342433	-123.3987283	35.6	5/12/2008 17:46	Dinghy	Full bucket	Grey	Firm	FALSE
259	48.1342691	-123.3968325	48.1341533	-123.3969367	35.5	5/12/2008 17:41	Dinghy	Full bucket	Grey	Firm	TRUE
260	48.1342749	-123.3951525	48.134195	-123.3953183	35.2	5/12/2008 17:34	Dinghy	Full bucket	Grey	Firm	TRUE
261	48.1342807	-123.3934724	48.1341783	-123.3935117	355.1	5/12/2008 17:28	Dinghy	Full bucket	Grey	Firm	TRUE
262	48.132903	-123.4615031	48.13331	-123.4614267	3.9	5/18/2008 17:43	Dinghy	Full bucket	Grey	Firm	TRUE
263	48.1329098	-123.4598231	48.13292	-123.45981	11.6	5/18/2008 17:38	Dinghy	Full bucket	Grey	Loose	TRUE
264	48.1329165	-123.4581431	48.1329783	-123.4580383	15.4	5/18/2008 18:36	Dinghy	Full bucket	Black	Loose	FALSE
265	48.1329231	-123.4564632	48.1328667	-123.45648	17.1	5/18/2008 20:46	Dinghy	Full bucket	Black	Firm	TRUE
266	48.1329298	-123.4547832	48.1329233	-123.45472	18.4	5/18/2008 21:28	Dinghy	Full bucket	Grey	Loose	TRUE
267	48.1329364	-123.4531032	48.1328983	-123.4530267	20.6	5/19/2008 0:53	Dinghy	Full bucket	Black	Loose	TRUE
268	48.1329431	-123.4514232	48.1329233	-123.45154	20.6	5/19/2008 16:43	Dinghy	Full bucket	Grey	Firm	TRUE
269	48.1329496	-123.4497433	48.1329917	-123.4499733	22	5/19/2008 17:15	Dinghy	Full bucket	Grey	Firm	TRUE
270	48.1329562	-123.4480633	48.13289	-123.4480467	24.9	5/19/2008 20:13	Dinghy	Full bucket	Black	Firm	TRUE
271	48.1329627	-123.4463833	48.132975	-123.4464333	27.1	5/25/2008 17:47	Dinghy	Half bucket	Grey	Firm	FALSE
272	48.1329693	-123.4447033	48.1328867	-123.4447033	26.7	5/26/2008 16:09	Dinghy	Full bucket	Black	Firm	TRUE
273	48.1329757	-123.4430234	48.13294	-123.4430917	27.1	5/25/2008 17:40	Dinghy	Full bucket	Black	Firm	FALSE
274	48.1329822	-123.4413434	48.132955	-123.4414333	27.7	5/25/2008 17:35	Dinghy	Full bucket	Black	Loose	FALSE
275	48.1329886	-123.4396634	48.1329617	-123.4396083	28.1	5/25/2008 17:30	Dinghy	Full bucket	Grey	Firm	TRUE
276	48.1329951	-123.4379834	48.1329967	-123.4379933	28.7	5/25/2008 17:26	Dinghy	Full bucket	Grey	Firm	TRUE
277	48.1330014	-123.4363035	48.1329433	-123.4363667	29.1	5/25/2008 17:21	Dinghy	Full bucket	Grey	Firm	TRUE
278	48.1330078	-123.4346235	48.1328717	-123.434565	28.7	5/25/2008 17:16	Dinghy	Full bucket	Black	Firm	TRUE
279	48.1330142	-123.4329435	48.1329933	-123.4329617	39.4	5/25/2008 17:11	Dinghy	Full bucket	Black	Loose	TRUE
280	48.1330205	-123.4312635	48.1331467	-123.4311783	30.5	5/25/2008 17:07	Dinghy	Full bucket	Grey	Firm	FALSE
281	48.1330268	-123.4295835	48.1331317	-123.4294417	30.7	5/25/2008 16:54	Dinghy	Half bucket	Grey	Firm	TRUE
282	48.133033	-123.4279036	48.133055	-123.427885	32	5/19/2008 22:20	Dinghy	Full bucket	Grey	Firm	TRUE
283	48.1330393	-123.4262236	48.133025	-123.4260467	31.4	5/14/2008 21:09	Dinghy	Half bucket	Grey	Firm	FALSE
284	48.1330455	-123.4245436	48.133065	-123.4242283	31.4	5/15/2008 0:01	Dinghy	Full bucket	Grey	Firm	TRUE
285	48.1330517	-123.4228636	48.1331533	-123.4227883	32.6	5/15/2008 0:07	Dinghy	Half bucket	Grey	Firm	TRUE
286	48.1330578	-123.4211836	48.133055	-123.4212583	32.7	5/15/2008 17:57	Dinghy	Full bucket	Grey	Firm	TRUE
287	48.133064	-123.4195037	48.13305	-123.4196517	33.5	5/15/2008 18:04	Dinghy	Full bucket	Grey	Firm	FALSE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
288	48.1330701	-123.4178237	48.1330233	-123.4178383	33.8	5/15/2008 21:28	Dinghy	Half bucket	Grey	Firm	TRUE
289	48.1330762	-123.4161437	48.13308	-123.4161	34.4	5/15/2008 21:33	Dinghy	Full bucket	Grey	Firm	TRUE
290	48.1330823	-123.4144637	48.133185	-123.4144417	34.5	5/15/2008 23:59	Dinghy	Half bucket	Grey	Firm	TRUE
291	48.1330883	-123.4127837	48.1331933	-123.4128183	34.1	5/16/2008 0:03	Dinghy	Full bucket	Grey	Firm	TRUE
292	48.1330943	-123.4111037	48.1331817	-123.4112467	30.5	5/16/2008 2:27	Dinghy	Full bucket	Black	Firm	TRUE
293	48.1331003	-123.4094237	48.1330283	-123.4096333	32.5	5/16/2008 16:09	Dinghy	Half bucket	Grey	Firm	TRUE
294	48.1331063	-123.4077438	48.1329733	-123.4079167	31.5	5/16/2008 16:15	Dinghy	Full bucket	Grey	Firm	TRUE
295	48.1331123	-123.4060638	48.133015	-123.40612	31.5	5/16/2008 16:19	Dinghy	Full bucket	Grey	Loose	TRUE
296	48.1331182	-123.4043838	48.133115	-123.4043383	30.7	5/16/2008 16:23	Dinghy	Half bucket	Grey	Firm	TRUE
297	48.1331241	-123.4027038	48.133015	-123.4026133	30.3	5/16/2008 16:26	Dinghy	Half bucket	Grey	Firm	TRUE
298	48.13313	-123.4010238	48.1330083	-123.401055	30.3	5/16/2008 16:30	Dinghy	Half bucket	Grey	Firm	TRUE
299	48.1331358	-123.3993438	48.1330467	-123.3993667	30.8	5/16/2008 16:34	Dinghy	Half bucket	Grey	Firm	TRUE
300	48.1331416	-123.3976638	48.1330733	-123.3977983	30.8	5/16/2008 16:38	Dinghy	Full bucket	Grey	Firm	TRUE
301	48.1331474	-123.3959838	48.1330617	-123.3958617	30.4	5/16/2008 16:42	Dinghy	Full bucket	Grey	Firm	TRUE
302	48.1331532	-123.3943038	48.133125	-123.3943633	30.4	5/16/2008 16:50	Dinghy	Full bucket	Grey	Loose	TRUE
303	48.1317818	-123.460653	48.1319717	-123.4602433	3.9	5/18/2008 17:33	Dinghy	Full bucket	Black	Loose	FALSE
304	48.1317885	-123.4589731	48.1317783	-123.4590733	11.4	5/18/2008 17:29	Dinghy	Poor sample	Grey	Loose	FALSE
305	48.1317952	-123.4572932	48.131815	-123.4573067	15.3	5/18/2008 18:41	Dinghy	Full bucket	Black	Loose	FALSE
306	48.1318019	-123.4556132	48.1317783	-123.4556367	16.6	5/18/2008 20:39	Dinghy	Full bucket	Brown	Firm	TRUE
307	48.1318085	-123.4539333	48.1317467	-123.4538967	18.4	5/18/2008 21:34	Dinghy	Full bucket	Brown	Loose	TRUE
308	48.1318152	-123.4522534	48.1318417	-123.45212	20.3	5/19/2008 0:47	Dinghy	Full bucket	Grey	Firm	TRUE
309	48.1318218	-123.4505734	48.1317333	-123.4507767	19.4	5/19/2008 16:39	Dinghy	Full bucket	Grey	Firm	TRUE
310	48.1318283	-123.4488935	48.13193	-123.4491033	22.8	5/19/2008 17:20	Dinghy	Full bucket	Grey	Firm	TRUE
311	48.1318349	-123.4472135	48.1318033	-123.447255	22.6	5/19/2008 20:07	Dinghy	Full bucket	Grey	Firm	TRUE
312	48.1318414	-123.4455336	48.1318233	-123.4455183	24	5/25/2008 15:54	Dinghy	Full bucket	Grey	Firm	TRUE
313	48.1318479	-123.4438537	48.1318267	-123.44399	24.6	5/25/2008 16:00	Dinghy	Full bucket	Grey	Firm	TRUE
314	48.1318544	-123.4421737	48.131785	-123.4421233	25.2	5/25/2008 16:03	Dinghy	Full bucket	Grey	Firm	FALSE
315	48.1318608	-123.4404938	48.131855	-123.4401667	25.7	5/25/2008 16:06	Dinghy	Full bucket	Grey	Firm	FALSE
316	48.1318673	-123.4388139	48.131965	-123.4386283	26.2	5/25/2008 16:10	Dinghy	Full bucket	Grey	Firm	TRUE
317	48.1318737	-123.4371339	48.1318667	-123.4369017	26.3	5/25/2008 16:13	Dinghy	Half bucket	Grey	Loose	TRUE
318	48.13188	-123.435454	48.131995	-123.435365	26.6	5/25/2008 16:21	Dinghy	Full bucket	Grey	Firm	TRUE
319	48.1318864	-123.433774	48.1319783	-123.433545	26.6	5/25/2008 16:28	Dinghy	Full bucket	Grey	Firm	TRUE
320	48.1318927	-123.4320941	48.13194	-123.4321867	26.9	5/25/2008 17:02	Dinghy	Full bucket	Grey	Firm	TRUE
321	48.131899	-123.4304141	48.13184	-123.4304317	26.7	5/25/2008 16:58	Dinghy	Full bucket	Grey	Firm	TRUE
322	48.1319053	-123.4287342	48.1318867	-123.4287483	26.6	5/25/2008 16:49	Dinghy	Full bucket	Grey	Firm	TRUE
323	48.1319116	-123.4270543	48.1318583	-123.42695	28	5/19/2008 22:24	Dinghy	Full bucket	Grey	Firm	TRUE
324	48.1319178	-123.4253743	48.131835	-123.4251967	27.7	5/14/2008 21:14	Dinghy	Full bucket	Grey	Firm	TRUE
325	48.131924	-123.4236944	48.132035	-123.4236983	28	5/14/2008 23:49	Dinghy	Full bucket	Black	Slurry	TRUE
326	48.1319302	-123.4220144	48.1318583	-123.4219583	28	5/15/2008 0:13	Dinghy	Full bucket	Grey	Firm	TRUE
327	48.1319363	-123.4203345	48.1320517	-123.4204017	29.7	5/15/2008 17:48	Dinghy	Full bucket	Grey	Firm	TRUE
328	48.1319425	-123.4186545	48.1319783	-123.4187483	29.7	5/15/2008 18:09	Dinghy	Full bucket	Grey	Firm	TRUE
329	48.1319486	-123.4169746	48.1319317	-123.4170367	30.1	5/15/2008 21:23	Dinghy	Full bucket	Grey	Firm	TRUE
330	48.1319547	-123.4152946	48.1318083	-123.4152967	29.7	5/15/2008 21:39	Dinghy	Full bucket	Grey	Firm	TRUE
331	48.1319607	-123.4136147	48.1319983	-123.4137967	30	5/15/2008 23:54	Dinghy	Half bucket	Grey	Firm	TRUE
332	48.1319667	-123.4119347	48.132005	-123.4120667	30.1	5/16/2008 0:08	Dinghy	No sample	N/A	N/A	FALSE
333	48.1319728	-123.4102548	48.1321367	-123.410425	30.5	5/16/2008 2:23	Dinghy	Full bucket	Grey	Firm	TRUE
334	48.1319787	-123.4085748	48.1319667	-123.4086883	29	5/16/2008 17:47	Dinghy	Half bucket	Grey	Firm	TRUE
335	48.1319847	-123.4068949	48.1319217	-123.406985	28.2	5/16/2008 17:42	Dinghy	Poor sample	Grey	Firm	TRUE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
336	48.1319906	-123.4052149	48.131935	-123.40532	28	5/16/2008 17:38	Dinghy	Full bucket	Grey	Loose	TRUE
337	48.1319965	-123.403535	48.1319467	-123.403735	28	5/16/2008 17:34	Dinghy	Half bucket	Grey	Firm	TRUE
338	48.1320024	-123.401855	48.1319683	-123.4020483	28	5/16/2008 17:31	Dinghy	Half bucket	Grey	Firm	TRUE
339	48.1320083	-123.4001751	48.1319867	-123.400355	28	5/16/2008 17:13	Dinghy	Full bucket	Grey	Firm	TRUE
340	48.1320141	-123.3984951	48.1319417	-123.3986283	28	5/16/2008 17:09	Dinghy	Half bucket	Grey	Firm	TRUE
341	48.1320199	-123.3968152	48.1319783	-123.3969533	27.6	5/16/2008 17:05	Dinghy	Half bucket	Grey	Firm	TRUE
342	48.1320257	-123.3951352	48.1319917	-123.3951383	27.6	5/16/2008 17:00	Dinghy	Half bucket	Grey	Firm	TRUE
343	48.1320315	-123.3934552	48.1320883	-123.3935767	27.6	5/16/2008 16:57	Dinghy	Full bucket	Grey	Firm	TRUE
344	48.1306606	-123.459803	48.13061	-123.45994	1.9	5/18/2008 17:22	Dinghy	Poor sample	Grey	Loose	TRUE
345	48.1306673	-123.4581231	48.1305933	-123.4581583	10.4	5/18/2008 18:45	Dinghy	Full bucket	Black	Firm	TRUE
346	48.130674	-123.4564432	48.13063	-123.456435	14.5	5/18/2008 18:49	Dinghy	Full bucket	Black	Firm	TRUE
347	48.1306806	-123.4547633	48.1306183	-123.4547317	16.6	5/18/2008 20:31	Dinghy	Full bucket	Black	Loose	TRUE
348	48.1306873	-123.4530834	48.1306183	-123.4530367	18.2	5/18/2008 21:41	Dinghy	Full bucket	Grey	Firm	TRUE
349	48.1306939	-123.4514035	48.13059	-123.45138	19.4	5/19/2008 0:41	Dinghy	Full bucket	Black	Firm	TRUE
350	48.1307005	-123.4497236	48.1307683	-123.4498267	18.4	5/19/2008 16:36	Dinghy	Full bucket	Grey	Firm	TRUE
351	48.130707	-123.4480437	48.1307067	-123.448145	19.5	5/19/2008 17:24	Dinghy	Full bucket	Black	Firm	TRUE
352	48.1307136	-123.4463638	48.1307117	-123.44643	21.3	5/19/2008 20:03	Dinghy	Full bucket	Black	Firm	TRUE
353	48.1307201	-123.4446839	48.1307133	-123.4446867	22.4	5/24/2008 23:57	Dinghy	Full bucket	Grey	Firm	TRUE
354	48.1307266	-123.443004	48.1307067	-123.4429967	23	5/25/2008 0:02	Dinghy	Full bucket	Grey	Firm	TRUE
355	48.130733	-123.4413241	48.13076	-123.4413033	23.7	5/25/2008 0:06	Dinghy	Full bucket	Grey	Firm	TRUE
356	48.1307395	-123.4396442	48.130695	-123.43956	23.7	5/25/2008 0:10	Dinghy	Full bucket	Grey	Firm	TRUE
357	48.1307459	-123.4379643	48.1308233	-123.4378533	24.2	5/25/2008 0:19	Dinghy	Full bucket	Black	Firm	TRUE
358	48.1307523	-123.4362844	48.1306583	-123.436335	23.8	5/25/2008 16:17	Dinghy	Full bucket	Grey	Firm	TRUE
359	48.1307586	-123.4346045	48.13086	-123.43444	24.2	5/25/2008 16:24	Dinghy	Half bucket	Grey	Firm	TRUE
360	48.130765	-123.4329246	48.1308483	-123.432725	24.6	5/25/2008 16:32	Dinghy	Half bucket	Grey	Firm	TRUE
361	48.1307713	-123.4312447	48.1308333	-123.4311467	24.4	5/25/2008 16:36	Dinghy	Half bucket	Grey	Firm	TRUE
362	48.1307776	-123.4295648	48.130895	-123.4293133	24.6	5/25/2008 16:39	Dinghy	Half bucket	Grey	Firm	TRUE
363	48.1307838	-123.4278849	48.130745	-123.4276083	23.9	5/25/2008 16:42	Dinghy	Full bucket	Black	Firm	FALSE
364	48.1307901	-123.426205	48.1307383	-123.426145	25.3	5/19/2008 22:29	Dinghy	Full bucket	Grey	Firm	TRUE
365	48.1307963	-123.4245251	48.1307933	-123.4244683	24.9	5/14/2008 21:20	Dinghy	Full bucket	Grey	Firm	TRUE
366	48.1308025	-123.4228452	48.1308417	-123.422905	25.3	5/14/2008 23:43	Dinghy	Full bucket	Grey	Firm	TRUE
367	48.1308087	-123.4211652	48.1307383	-123.4210767	25.2	5/15/2008 0:19	Dinghy	Full bucket	Grey	Firm	TRUE
368	48.1308148	-123.4194853	48.1309183	-123.4196533	26.3	5/15/2008 17:41	Dinghy	Full bucket	Grey	Firm	TRUE
369	48.1308209	-123.4178054	48.1308383	-123.4178317	26.3	5/15/2008 18:17	Dinghy	Full bucket	Grey	Firm	TRUE
370	48.130827	-123.4161255	48.13087	-123.41621	26.9	5/15/2008 21:18	Dinghy	Full bucket	Grey	Firm	TRUE
371	48.1308331	-123.4144456	48.13081	-123.4146283	26.9	5/15/2008 21:43	Dinghy	Full bucket	Grey	Firm	TRUE
372	48.1308391	-123.4127657	48.1309233	-123.413025	27.1	5/15/2008 23:50	Dinghy	Full bucket	Grey	Firm	TRUE
373	48.1308452	-123.4110858	48.1308467	-123.41121	26.6	5/16/2008 0:14	Dinghy	Half bucket	Grey	Firm	TRUE
374	48.1308512	-123.4094059	48.1309867	-123.409505	26.8	5/16/2008 2:19	Dinghy	Half bucket	Grey	Firm	TRUE
375	48.1308571	-123.4077259	48.1308633	-123.407755	29	5/16/2008 17:53	Dinghy	Full bucket	Grey	Firm	TRUE
376	48.1308631	-123.406046	48.1308333	-123.40624	29	5/16/2008 17:58	Dinghy	Full bucket	Grey	Firm	TRUE
377	48.130869	-123.4043661	48.130785	-123.4045783	25.6	5/16/2008 18:02	Dinghy	Full bucket	Grey	Firm	TRUE
378	48.1308749	-123.4026862	48.130895	-123.4028217	25.8	5/16/2008 18:06	Dinghy	Full bucket	Grey	Slurry	TRUE
379	48.1308808	-123.4010063	48.13081	-123.4010417	25.8	5/16/2008 18:10	Dinghy	Full bucket	Grey	Firm	TRUE
380	48.1308866	-123.3993264	48.1309067	-123.3993667	25.6	5/16/2008 18:16	Dinghy	Poor sample	Grey	Firm	TRUE
381	48.1308924	-123.3976465	48.1308833	-123.3977033	25.2	5/16/2008 18:20	Dinghy	Full bucket	Grey	Firm	TRUE
382	48.1308982	-123.3959665	48.130915	-123.3959683	25.1	5/16/2008 18:26	Dinghy	Full bucket	Grey	Firm	TRUE
383	48.130904	-123.3942866	48.1308683	-123.3942733	24.5	5/16/2008 18:29	Dinghy	Full bucket	Grey	Firm	TRUE

APPENDIX II: Sediment sample positions and descriptors										
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.										
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
384	48.1309098	-123.3926067	48.1309233	-123.39252	24.3	5/16/2008 18:32	Dinghy	Full bucket	Grey	Firm	TRUE
385	48.1295394	-123.4589531	48.12978	-123.458825	1.8	5/18/2008 17:16	Dinghy	Poor sample	Grey	Firm	TRUE
386	48.1295461	-123.4572732	48.129495	-123.4572267	10.7	5/18/2008 17:06	Dinghy	Full bucket	Grey	Firm	FALSE
387	48.1295527	-123.4555933	48.1294433	-123.4555883	12.7	5/18/2008 17:02	Dinghy	Full bucket	Black	Firm	FALSE
388	48.1295594	-123.4539135	48.1295883	-123.453965	14.3	5/18/2008 16:58	Dinghy	Poor sample	Grey	Firm	FALSE
389	48.129566	-123.4522336	48.129525	-123.45207	17.3	5/18/2008 21:47	Dinghy	Full bucket	Black	Firm	TRUE
390	48.1295726	-123.4505537	48.129605	-123.4503983	18.4	5/19/2008 0:35	Dinghy	Full bucket	Black	Firm	TRUE
391	48.1295792	-123.4488739	48.1295833	-123.448905	17.4	5/19/2008 16:33	Dinghy	Full bucket	Black	Firm	TRUE
392	48.1295857	-123.447194	48.1294983	-123.4473483	18.4	5/19/2008 17:31	Dinghy	Full bucket	Black	Loose	TRUE
393	48.1295922	-123.4455142	48.1296067	-123.44558	19.9	5/19/2008 20:00	Dinghy	Full bucket	Grey	Firm	TRUE
394	48.1295987	-123.4438343	48.1296483	-123.4439183	19.8	5/24/2008 21:33	Dinghy	Full bucket	Black	Firm	FALSE
395	48.1296052	-123.4421544	48.129595	-123.442175	20.4	5/24/2008 21:36	Dinghy	Full bucket	Black	Firm	TRUE
396	48.1296117	-123.4404746	48.1296017	-123.4405633	20.7	5/24/2008 21:41	Dinghy	Full bucket	Black	Firm	TRUE
397	48.1296181	-123.4387947	48.129725	-123.4388133	22.1	5/24/2008 23:50	Dinghy	Full bucket	Grey	Firm	TRUE
398	48.1296245	-123.4371148	48.1296317	-123.4372933	22.3	5/24/2008 23:45	Dinghy	Full bucket	Grey	Firm	TRUE
399	48.1296309	-123.435435	48.1296067	-123.4354417	22.3	5/24/2008 23:41	Dinghy	Full bucket	Grey	Firm	TRUE
400	48.1296372	-123.4337551	48.1295433	-123.4337	22.5	5/24/2008 23:37	Dinghy	Full bucket	Grey	Firm	TRUE
401	48.1296435	-123.4320752	48.1296233	-123.4319617	22.8	5/24/2008 23:33	Dinghy	Full bucket	Grey	Firm	TRUE
402	48.1296498	-123.4303953	48.1296167	-123.430355	22.8	5/24/2008 23:29	Dinghy	Full bucket	Grey	Firm	TRUE
403	48.1296561	-123.4287155	48.12966	-123.4287683	22.8	5/24/2008 23:24	Dinghy	Full bucket	Grey	Firm	TRUE
404	48.1296624	-123.4270356	48.1296483	-123.4270367	22.8	5/24/2008 23:19	Dinghy	Full bucket	Grey	Firm	TRUE
405	48.1296686	-123.4253557	48.12961	-123.4253667	25.3	5/19/2008 22:34	Dinghy	Full bucket	Grey	Firm	TRUE
406	48.1296748	-123.4236759	48.1296283	-123.4236583	23.2	5/14/2008 21:25	Dinghy	Full bucket	Grey	Firm	TRUE
407	48.129681	-123.421996	48.12976	-123.4217867	23.2	5/14/2008 23:36	Dinghy	Full bucket	Grey	Firm	TRUE
408	48.1296871	-123.4203161	48.1295633	-123.4201467	23.2	5/15/2008 0:23	Dinghy	Full bucket	Grey	Firm	TRUE
409	48.1296933	-123.4186362	48.1297167	-123.4187567	23.5	5/15/2008 17:37	Dinghy	Full bucket	Grey	Firm	TRUE
410	48.1296994	-123.4169564	48.1296983	-123.41704	24.1	5/15/2008 18:25	Dinghy	Full bucket	Grey	Firm	TRUE
411	48.1297055	-123.4152765	48.1296117	-123.41545	24.2	5/15/2008 21:13	Dinghy	Full bucket	Grey	Firm	TRUE
412	48.1297115	-123.4135966	48.12971	-123.4134933	24.1	5/15/2008 21:47	Dinghy	Full bucket	Grey	Firm	TRUE
413	48.1297176	-123.4119167	48.1297733	-123.412025	24.1	5/15/2008 23:46	Dinghy	Half bucket	Grey	Firm	TRUE
414	48.1297236	-123.4102369	48.1297617	-123.4103083	23.3	5/16/2008 0:18	Dinghy	Full bucket	Grey	Firm	TRUE
415	48.1297296	-123.408557	48.1297533	-123.40877	23.5	5/16/2008 2:15	Dinghy	Full bucket	Grey	Firm	TRUE
416	48.1297355	-123.4068771	48.129755	-123.4069517	23.6	5/16/2008 19:10	Dinghy	Full bucket	Grey	Loose	TRUE
417	48.1297414	-123.4051972	48.1297	-123.4051933	23.9	5/16/2008 19:04	Dinghy	Full bucket	Grey	Loose	TRUE
418	48.1297474	-123.4035173	48.12976	-123.4036217	23.9	5/16/2008 19:00	Dinghy	Half bucket	Grey	Loose	TRUE
419	48.1297532	-123.4018375	48.1297817	-123.40188	23.9	5/16/2008 18:57	Dinghy	Half bucket	Grey	Firm	TRUE
420	48.1297591	-123.4001576	48.1298417	-123.40008	23.9	5/16/2008 18:53	Dinghy	Full bucket	Grey	Firm	TRUE
421	48.1297649	-123.3984777	48.1297617	-123.398495	23.4	5/16/2008 18:49	Dinghy	Full bucket	Grey	Firm	TRUE
422	48.1297708	-123.3967978	48.1297917	-123.39693	23.1	5/16/2008 18:43	Dinghy	Full bucket	Grey	Firm	TRUE
423	48.1297765	-123.3951179	48.12978	-123.395265	22.7	5/16/2008 18:40	Dinghy	Full bucket	Grey	Firm	TRUE
424	48.1297823	-123.3934381	48.129785	-123.3933317	24.3	5/16/2008 18:37	Dinghy	Full bucket	Grey	Firm	TRUE
425	48.1284248	-123.4564233	48.128425	-123.4564733	3.7	5/18/2008 16:46	Dinghy	Poor sample	Grey	Loose	TRUE
426	48.1284315	-123.4547435	48.12841	-123.454585	3.7	5/18/2008 16:50	Dinghy	Full bucket	Grey	Firm	FALSE
427	48.1284381	-123.4530636	48.1285817	-123.453045	12.7	5/18/2008 16:54	Dinghy	Full bucket	Grey	Firm	TRUE
428	48.1284447	-123.4513838	48.128415	-123.4513233	15.6	5/18/2008 21:51	Dinghy	Full bucket	Grey	Firm	TRUE
429	48.1284513	-123.449704	48.1284117	-123.4496733	16.7	5/19/2008 0:27	Dinghy	Full bucket	Black	Firm	TRUE
430	48.1284579	-123.4480242	48.128555	-123.4481067	13.3	5/19/2008 16:30	Dinghy	Full bucket	Grey	Firm	TRUE
431	48.1284644	-123.4463443	48.1283817	-123.446335	15.6	5/19/2008 17:36	Dinghy	Full bucket	Black	Firm	TRUE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
432	48.1284709	-123.4446645	48.1284533	-123.4446733	18.2	5/19/2008 19:56	Dinghy	Full bucket	Grey	Firm	TRUE
433	48.1284774	-123.4429847	48.1284483	-123.44289	18.5	5/24/2008 21:29	Dinghy	Full bucket	Grey	Firm	TRUE
434	48.1284838	-123.4413049	48.1285183	-123.441335	18.8	5/24/2008 21:25	Dinghy	Full bucket	Grey	Firm	TRUE
435	48.1284903	-123.439625	48.1285067	-123.439535	19.4	5/24/2008 21:45	Dinghy	Full bucket	Black	Firm	TRUE
436	48.1284967	-123.4379452	48.1285417	-123.4380167	19.5	5/24/2008 21:49	Dinghy	Full bucket	Grey	Loose	TRUE
437	48.1285031	-123.4362654	48.128515	-123.43634	19.8	5/24/2008 21:55	Dinghy	Full bucket	Grey	Firm	TRUE
438	48.1285095	-123.4345855	48.1285367	-123.434565	19.8	5/24/2008 21:59	Dinghy	Full bucket	Black	Firm	TRUE
439	48.1285158	-123.4329057	48.1285267	-123.4331067	19.8	5/24/2008 22:02	Dinghy	Full bucket	Black	Firm	TRUE
440	48.1285221	-123.4312259	48.1285583	-123.431175	20.4	5/24/2008 22:06	Dinghy	Full bucket	Black	Firm	TRUE
441	48.1285284	-123.429546	48.12855	-123.4294967	20.4	5/24/2008 22:09	Dinghy	Full bucket	Grey	Firm	TRUE
442	48.1285347	-123.4278662	48.1285567	-123.427815	20.8	5/24/2008 22:13	Dinghy	Full bucket	Grey	Loose	TRUE
443	48.1285409	-123.4261864	48.12851	-123.4262733	20.9	5/24/2008 22:17	Dinghy	Full bucket	Grey	Firm	TRUE
444	48.1285471	-123.4245065	48.1286417	-123.4244717	21.1	5/24/2008 22:21	Dinghy	Full bucket	Black	Firm	TRUE
445	48.1285533	-123.4228267	48.1285133	-123.4228117	21.5	5/14/2008 21:29	Dinghy	Full bucket	Grey	Firm	TRUE
446	48.1285595	-123.4211469	48.1286633	-123.4211383	21.5	5/14/2008 23:31	Dinghy	Full bucket	Grey	Firm	FALSE
447	48.1285656	-123.419467	48.1284667	-123.4193517	21.1	5/15/2008 0:29	Dinghy	Full bucket	Grey	Firm	TRUE
448	48.1285717	-123.4177872	48.12861	-123.4178917	21.8	5/15/2008 17:34	Dinghy	Full bucket	Grey	Firm	TRUE
449	48.1285778	-123.4161073	48.1285717	-123.4161183	22.2	5/15/2008 18:29	Dinghy	Full bucket	Grey	Firm	TRUE
450	48.1285839	-123.4144275	48.1286133	-123.4144367	22.2	5/15/2008 21:08	Dinghy	Full bucket	Grey	Loose	TRUE
451	48.12859	-123.4127477	48.1287633	-123.4129283	21.9	5/15/2008 21:51	Dinghy	Half bucket	Grey	Loose	TRUE
452	48.128596	-123.4110678	48.12862	-123.4111283	21.1	5/15/2008 23:42	Dinghy	Full bucket	Grey	Firm	TRUE
453	48.128602	-123.409388	48.1285933	-123.4094917	20.4	5/16/2008 0:27	Dinghy	Half bucket	Grey	Firm	TRUE
454	48.1286079	-123.4077081	48.1286767	-123.4077217	21	5/16/2008 2:11	Dinghy	Full bucket	Grey	Firm	TRUE
455	48.1286139	-123.4060283	48.1286133	-123.4060117	21.5	5/16/2008 19:19	Dinghy	Poor sample	Grey	Firm	TRUE
456	48.1286198	-123.4043485	48.1285683	-123.4043467	22.5	5/16/2008 19:25	Dinghy	Full bucket	Grey	Firm	TRUE
457	48.1286257	-123.4026686	48.1286933	-123.4027383	22.8	5/16/2008 19:28	Dinghy	Full bucket	Grey	Firm	TRUE
458	48.1286316	-123.4009888	48.1286783	-123.40107	22.8	5/16/2008 19:33	Dinghy	Full bucket	Grey	Firm	TRUE
459	48.1286374	-123.3993089	48.128645	-123.399255	22.6	5/16/2008 19:38	Dinghy	Full bucket	Grey	Firm	TRUE
460	48.1286433	-123.3976291	48.1286917	-123.3976167	22.5	5/16/2008 19:41	Dinghy	Half bucket	Grey	Firm	TRUE
461	48.1286491	-123.3959492	48.1287	-123.39578	22	5/16/2008 19:47	Dinghy	Full bucket	Grey	Firm	TRUE
462	48.1286548	-123.3942694	48.128745	-123.3942733	21.7	5/16/2008 19:50	Dinghy	Poor sample	Grey	Loose	TRUE
463	48.1286606	-123.3925896	48.1287117	-123.3924667	21	5/16/2008 19:55	Dinghy	Full bucket	Grey	Firm	TRUE
464	48.1273035	-123.4555734	48.1273533	-123.4556617	10.9	5/18/2008 16:25	Dinghy	Half bucket	Grey	Loose	FALSE
465	48.1273102	-123.4538937	48.1273433	-123.45402	10.9	5/18/2008 16:41	Dinghy	Full bucket	Black	Loose	FALSE
466	48.1273168	-123.4522139	48.1272567	-123.4521333	11.9	5/18/2008 21:57	Dinghy	Full bucket	Grey	Loose	TRUE
467	48.1273234	-123.4505341	48.12738	-123.4505333	14.3	5/18/2008 23:38	Dinghy	Full bucket	Black	Loose	TRUE
468	48.12733	-123.4488543	48.1272967	-123.4488	14.3	5/19/2008 0:19	Dinghy	Half bucket	Black	Firm	FALSE
469	48.1273365	-123.4471745	48.12745	-123.44728	13.3	5/19/2008 16:25	Dinghy	Full bucket	Black	Loose	TRUE
470	48.1273431	-123.4454947	48.1274667	-123.44547	14.1	5/19/2008 17:54	Dinghy	Full bucket	Black	Firm	TRUE
471	48.1273496	-123.4438149	48.1273217	-123.4437633	15.7	5/19/2008 19:52	Dinghy	Full bucket	Grey	Firm	TRUE
472	48.127356	-123.4421351	48.1273917	-123.4422333	18.2	5/22/2008 16:03	Dinghy	Full bucket	Grey	Firm	TRUE
473	48.1273625	-123.4404553	48.1273517	-123.440415	16.7	5/22/2008 16:09	Dinghy	Full bucket	Grey	Firm	TRUE
474	48.1273689	-123.4387755	48.127385	-123.4387133	17.1	5/22/2008 16:15	Dinghy	Full bucket	Grey	Firm	TRUE
475	48.1273753	-123.4370957	48.1273867	-123.437015	17.4	5/22/2008 16:20	Dinghy	Full bucket	Black	Firm	TRUE
476	48.1273817	-123.4354159	48.1274083	-123.4356133	17.7	5/22/2008 16:30	Dinghy	Full bucket	Black	Firm	TRUE
477	48.127388	-123.4337361	48.1273783	-123.4336667	18	5/22/2008 16:35	Dinghy	Full bucket	Black	Firm	TRUE
478	48.1273944	-123.4320563	48.1274233	-123.4319883	17.7	5/22/2008 16:40	Dinghy	Full bucket	Black	Firm	TRUE
479	48.1274007	-123.4303766	48.1274367	-123.4302767	17.7	5/22/2008 16:45	Dinghy	Full bucket	Grey	Firm	TRUE

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
480	48.1274069	-123.4286968	48.127455	-123.4286933	18.2	5/22/2008 16:53	Dinghy	Full bucket	Black	Firm	TRUE
481	48.1274132	-123.427017	48.1274233	-123.4268983	18.2	5/22/2008 17:00	Dinghy	Full bucket	Grey	Firm	TRUE
482	48.1274194	-123.4253372	48.1274333	-123.4252433	18.4	5/22/2008 17:03	Dinghy	Full bucket	Grey	Firm	TRUE
483	48.1274256	-123.4236574	48.1274017	-123.4236933	18.4	5/22/2008 17:15	Dinghy	Full bucket	Grey	Firm	TRUE
484	48.1274318	-123.4219776	48.1273833	-123.4217917	19.5	5/14/2008 21:45	Dinghy	Full bucket	Black	Firm	TRUE
485	48.127438	-123.4202978	48.12733	-123.4201317	19.5	5/14/2008 23:26	Dinghy	Full bucket	Grey	Firm	TRUE
486	48.1274441	-123.418618	48.127475	-123.4186383	19.5	5/15/2008 16:03	Dinghy	Full bucket	Grey	Firm	TRUE
487	48.1274502	-123.4169382	48.1274567	-123.4169567	19.5	5/15/2008 17:29	Dinghy	Full bucket	Grey	Firm	TRUE
488	48.1274563	-123.4152584	48.127535	-123.4153183	19.8	5/15/2008 18:34	Dinghy	Full bucket	Grey	Firm	TRUE
489	48.1274623	-123.4135786	48.1274533	-123.41359	19.1	5/15/2008 21:04	Dinghy	Full bucket	Grey	Firm	TRUE
490	48.1274684	-123.4118988	48.1274117	-123.4117767	18.4	5/15/2008 21:56	Dinghy	Full bucket	Grey	Loose	TRUE
491	48.1274744	-123.4102189	48.127535	-123.41027	0	5/15/2008 23:38	Dinghy	Full bucket	Grey	Firm	TRUE
492	48.1274804	-123.4085391	48.1275367	-123.40862	18.7	5/16/2008 0:31	Dinghy	Full bucket	Grey	Firm	TRUE
493	48.1274863	-123.4068593	48.1275217	-123.4069733	19.1	5/16/2008 2:07	Dinghy	Full bucket	Grey	Loose	TRUE
494	48.1274923	-123.4051795	48.1275583	-123.4053517	19.9	5/16/2008 22:13	Dinghy	Half bucket	Grey	Loose	TRUE
495	48.1274982	-123.4034997	48.1274833	-123.40358	21.2	5/16/2008 22:08	Dinghy	Full bucket	Grey	Firm	TRUE
496	48.127504	-123.4018199	48.1276183	-123.4019517	21.8	5/16/2008 22:04	Dinghy	Half bucket	Grey	Firm	FALSE
497	48.1275099	-123.4001401	48.127545	-123.400335	21.5	5/16/2008 20:21	Dinghy	Poor sample	Grey	Firm	TRUE
498	48.1275157	-123.3984603	48.1276067	-123.3984917	21.5	5/16/2008 20:15	Dinghy	Half bucket	Grey	Firm	TRUE
499	48.1275216	-123.3967805	48.1276267	-123.3969517	21.4	5/16/2008 20:11	Dinghy	Half bucket	Brown	Loose	TRUE
500	48.1275273	-123.3951007	48.1276483	-123.3952117	20.8	5/16/2008 20:08	Dinghy	Full bucket	Grey	Firm	TRUE
501	48.1275331	-123.3934209	48.1275283	-123.3934567	20.2	5/16/2008 20:04	Dinghy	Full bucket	Grey	Firm	TRUE
502	48.1275388	-123.3917411	48.1274283	-123.3916983	19.8	5/16/2008 19:59	Dinghy	Full bucket	Grey	Firm	TRUE
503	48.1261823	-123.4547236	48.126055	-123.454745	4.8	5/18/2008 16:17	Dinghy	Full bucket	Unknown	Unknown	TRUE
504	48.1261889	-123.4530439	48.12623	-123.4529233	10.9	5/18/2008 16:21	Dinghy	Half bucket	Grey	Firm	TRUE
505	48.1261955	-123.4513641	48.126375	-123.451355	5.7	5/18/2008 22:02	Dinghy	Half bucket	Black	Loose	FALSE
506	48.1262021	-123.4496844	48.12597	-123.4496533	6.1	5/18/2008 23:49	Dinghy	Poor sample	Black	Loose	TRUE
507	48.1262087	-123.4480046	48.1262383	-123.44792	10.8	5/19/2008 0:14	Dinghy	Full bucket	Black	Firm	TRUE
508	48.1262152	-123.4463249	48.1263183	-123.44641	9.7	5/19/2008 16:20	Dinghy	Half bucket	Black	Loose	FALSE
509	48.1262217	-123.4446451	48.1260883	-123.444605	11.7	5/19/2008 17:59	Dinghy	Full bucket	Black	Firm	TRUE
510	48.1262282	-123.4429653	48.1262867	-123.4428133	14.1	5/19/2008 19:49	Dinghy	Poor sample	Grey	Firm	TRUE
511	48.1262347	-123.4412856	48.126185	-123.4411683	13.7	5/22/2008 18:06	Dinghy	Full bucket	Grey	Loose	TRUE
512	48.1262411	-123.4396058	48.1262617	-123.4395417	14	5/22/2008 18:12	Dinghy	Full bucket	Grey	Loose	TRUE
513	48.1262475	-123.4379261	48.1262083	-123.437895	14.3	5/22/2008 18:16	Dinghy	Half bucket	Grey	Firm	TRUE
514	48.1262539	-123.4362463	48.126245	-123.4363	15	5/22/2008 18:21	Dinghy	Full bucket	Grey	Firm	TRUE
515	48.1262603	-123.4345666	48.1262533	-123.4346067	15	5/22/2008 18:25	Dinghy	Full bucket	Black	Firm	TRUE
516	48.1262666	-123.4328868	48.126185	-123.43291	15	5/22/2008 18:29	Dinghy	Full bucket	Black	Firm	TRUE
517	48.1262729	-123.431207	48.12625	-123.4310717	15	5/22/2008 18:34	Dinghy	Full bucket	Black	Firm	TRUE
518	48.1262792	-123.4295273	48.1262633	-123.429415	15	5/22/2008 18:37	Dinghy	Full bucket	Black	Firm	TRUE
519	48.1262855	-123.4278475	48.1263133	-123.4276967	15.6	5/22/2008 18:41	Dinghy	Full bucket	Black	Firm	TRUE
520	48.1262917	-123.4261678	48.1262717	-123.4261967	16	5/22/2008 17:35	Dinghy	Full bucket	Grey	Firm	TRUE
521	48.1262979	-123.424488	48.1262733	-123.42449	15.7	5/22/2008 17:28	Dinghy	Full bucket	Grey	Firm	TRUE
522	48.1263041	-123.4228082	48.1262033	-123.4227167	16.3	5/22/2008 17:20	Dinghy	Full bucket	Grey	Firm	TRUE
523	48.1263103	-123.4211285	48.1263117	-123.4209417	18	5/14/2008 21:49	Dinghy	Full bucket	Grey	Loose	TRUE
524	48.1263164	-123.4194487	48.1262133	-123.41931	17.3	5/14/2008 23:21	Dinghy	Full bucket	Grey	Loose	TRUE
525	48.1263226	-123.4177689	48.1263333	-123.4177667	16.8	5/15/2008 16:09	Dinghy	Full bucket	Grey	Firm	TRUE
526	48.1263286	-123.4160892	48.1263483	-123.4161867	16.8	5/15/2008 17:26	Dinghy	Full bucket	Grey	Firm	TRUE
527	48.1263347	-123.4144094	48.126395	-123.4143933	16	5/15/2008 18:41	Dinghy	Full bucket	Grey	Firm	TRUE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
528	48.1263408	-123.4127296	48.1263633	-123.4128433	16.1	5/15/2008 20:59	Dinghy	Half bucket	Grey	Firm	FALSE
529	48.1263468	-123.4110499	48.126505	-123.4112567	16.4	5/15/2008 22:01	Dinghy	Full bucket	Grey	Loose	TRUE
530	48.1263528	-123.4093701	48.1263733	-123.40938	16	5/15/2008 23:34	Dinghy	Full bucket	Grey	Firm	TRUE
531	48.1263587	-123.4076903	48.1263983	-123.40767	15	5/16/2008 0:36	Dinghy	Full bucket	Grey	Firm	TRUE
532	48.1263647	-123.4060106	48.1264617	-123.4062267	16.6	5/16/2008 2:02	Dinghy	Full bucket	Grey	Firm	TRUE
533	48.1263706	-123.4043308	48.12651	-123.4045217	17	5/16/2008 22:19	Dinghy	Full bucket	Grey	Firm	TRUE
534	48.1263765	-123.402651	48.1264283	-123.4026633	18	5/16/2008 22:23	Dinghy	Half bucket	Grey	Firm	TRUE
535	48.1263824	-123.4009713	48.12639	-123.4009433	19.7	5/16/2008 22:27	Dinghy	Full bucket	Grey	Firm	TRUE
536	48.1263882	-123.3992915	48.12642	-123.3990917	19.7	5/16/2008 22:31	Dinghy	Half bucket	Grey	Loose	TRUE
537	48.1263941	-123.3976117	48.1263767	-123.39759	19.8	5/16/2008 22:36	Dinghy	Half bucket	Grey	Firm	TRUE
538	48.1263999	-123.395932	48.1263917	-123.3959133	19.8	5/16/2008 22:40	Dinghy	Full bucket	Grey	Firm	TRUE
539	48.1264056	-123.3942522	48.1264383	-123.3942417	19.8	5/16/2008 22:43	Dinghy	Full bucket	Grey	Firm	TRUE
540	48.1264114	-123.3925724	48.126485	-123.3925733	19.3	5/16/2008 22:46	Dinghy	Full bucket	Grey	Firm	TRUE
541	48.1250676	-123.4521941	48.1250883	-123.452075	10.9	5/18/2008 16:29	Dinghy	Full bucket	Black	Firm	FALSE
542	48.1250742	-123.4505144	48.1250033	-123.4505433	10.9	5/18/2008 16:35	Dinghy	Full bucket	Black	Firm	FALSE
543	48.1250808	-123.4488347	48.1251483	-123.4486317	3.6	5/18/2008 23:55	Dinghy	Half bucket	Black	Loose	FALSE
544	48.1250874	-123.447155	48.1251033	-123.44714	7.4	5/19/2008 0:08	Dinghy	Half bucket	Black	Loose	FALSE
545	48.1250939	-123.4454752	48.125395	-123.4453583	7.2	5/19/2008 16:14	Dinghy	Full bucket	Black	Firm	FALSE
546	48.1251004	-123.4437955	48.1248733	-123.4431683	5.8	5/19/2008 18:06	Dinghy	Full bucket	Black	Firm	FALSE
547	48.1251068	-123.4421158	48.1251333	-123.4420117	13.8	5/19/2008 18:12	Dinghy	Half bucket	Grey	Loose	TRUE
548	48.1251133	-123.4404361	48.1252983	-123.4403383	14	5/22/2008 21:57	Dinghy	Half bucket	Black	Loose	FALSE
549	48.1251197	-123.4387564	48.1251367	-123.4388367	12.8	5/22/2008 22:06	Dinghy	Full bucket	Black	Loose	FALSE
550	48.1251261	-123.4370767	48.125135	-123.4369783	13.9	5/22/2008 22:14	Dinghy	Full bucket	Black	Firm	TRUE
551	48.1251325	-123.4353969	48.1251283	-123.4353133	13.9	5/22/2008 22:22	Dinghy	Full bucket	Black	Firm	TRUE
552	48.1251389	-123.4337172	48.12519	-123.4336733	13.6	5/22/2008 19:27	Dinghy	Full bucket	Black	Firm	TRUE
553	48.1251452	-123.4320375	48.1250817	-123.4321567	13.6	5/22/2008 19:22	Dinghy	Full bucket	Black	Firm	TRUE
554	48.1251515	-123.4303578	48.1250917	-123.4303517	13.6	5/22/2008 19:16	Dinghy	Full bucket	Black	Firm	TRUE
555	48.1251578	-123.428678	48.12508	-123.4285483	13.6	5/22/2008 19:07	Dinghy	Full bucket	Grey	Firm	TRUE
556	48.125164	-123.4269983	48.1251483	-123.4271367	13.6	5/22/2008 19:03	Dinghy	Full bucket	Grey	Loose	TRUE
557	48.1251702	-123.4253186	48.1251183	-123.4250633	14.3	5/22/2008 18:59	Dinghy	Full bucket	Grey	Firm	TRUE
558	48.1251764	-123.4236389	48.1252183	-123.423685	15.6	5/22/2008 18:55	Dinghy	Full bucket	Grey	Firm	TRUE
559	48.1251826	-123.4219591	48.125165	-123.422105	15.6	5/22/2008 18:47	Dinghy	Full bucket	Grey	Firm	TRUE
560	48.1251888	-123.4202794	48.1251417	-123.4202383	15.3	5/14/2008 21:53	Dinghy	Full bucket	Grey	Firm	TRUE
561	48.1251949	-123.4185997	48.1251567	-123.418545	14.6	5/14/2008 23:14	Dinghy	Full bucket	Grey	Loose	TRUE
562	48.125201	-123.41692	48.125235	-123.4170517	13.3	5/15/2008 16:13	Dinghy	Full bucket	Grey	Loose	TRUE
563	48.1252071	-123.4152402	48.12522	-123.41526	13.9	5/15/2008 17:20	Dinghy	Full bucket	Grey	Firm	TRUE
564	48.1252131	-123.4135605	48.1252683	-123.4136217	13.9	5/15/2008 18:46	Dinghy	Full bucket	Grey	Firm	TRUE
565	48.1252192	-123.4118808	48.1252883	-123.411925	13.9	5/15/2008 20:55	Dinghy	Half bucket	Grey	Loose	FALSE
566	48.1252252	-123.410201	48.1252067	-123.4101967	13.3	5/15/2008 22:04	Dinghy	Half bucket	Grey	Firm	TRUE
567	48.1252312	-123.4085213	48.1252667	-123.4087017	14.1	5/15/2008 23:29	Dinghy	Full bucket	Grey	Firm	TRUE
568	48.1252371	-123.4068416	48.1253083	-123.4068567	14.8	5/16/2008 0:40	Dinghy	Full bucket	Grey	Firm	TRUE
569	48.1252431	-123.4051618	48.125335	-123.4052733	14	5/16/2008 1:58	Dinghy	Full bucket	Grey	Firm	TRUE
570	48.125249	-123.4034821	48.1251533	-123.403315	16	5/16/2008 23:17	Dinghy	Full bucket	Grey	Firm	TRUE
571	48.1252549	-123.4018024	48.1252633	-123.4018867	16	5/16/2008 23:14	Dinghy	Half bucket	Grey	Firm	TRUE
572	48.1252607	-123.4001226	48.1252933	-123.4003117	16.6	5/16/2008 23:10	Dinghy	Half bucket	Grey	Loose	TRUE
573	48.1252666	-123.3984429	48.1251433	-123.3983633	17.7	5/16/2008 23:07	Dinghy	Full bucket	Grey	Firm	TRUE
574	48.1252724	-123.3967632	48.1252083	-123.3968867	18.4	5/16/2008 23:03	Dinghy	Full bucket	Grey	Loose	TRUE
575	48.1252782	-123.3950834	48.1254267	-123.395215	18.4	5/16/2008 22:59	Dinghy	Half bucket	Grey	Firm	TRUE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
576	48.1252839	-123.3934037	48.1253033	-123.393475	18	5/16/2008 22:54	Dinghy	Full bucket	Grey	Firm	TRUE
577	48.1252897	-123.391724	48.1252683	-123.3916633	18	5/16/2008 22:50	Dinghy	Half bucket	Grey	Loose	TRUE
578	48.1239855	-123.4412663	48.1241117	-123.4408767	7.6	5/21/2008 16:16	Dinghy	Full bucket	Grey	Loose	TRUE
579	48.1239919	-123.4395866	48.1240067	-123.4395617	11.5	5/21/2008 16:20	Dinghy	Full bucket	Black	Loose	FALSE
580	48.1239983	-123.437907	48.12399	-123.4377333	10.4	5/21/2008 16:28	Dinghy	Full bucket	Black	Loose	TRUE
581	48.1240047	-123.4362273	48.1239717	-123.4361917	9.8	5/24/2008 16:52	Dinghy	Full bucket	Black	Loose	TRUE
582	48.1240111	-123.4345476	48.1239617	-123.4346483	10.6	5/24/2008 17:00	Dinghy	Full bucket	Black	Firm	TRUE
583	48.1240174	-123.4328679	48.1241433	-123.4329283	11.4	5/24/2008 21:21	Dinghy	Full bucket	Grey	Loose	TRUE
584	48.1240237	-123.4311882	48.1239833	-123.43132	11.4	5/24/2008 21:18	Dinghy	Full bucket	Black	Loose	TRUE
585	48.12403	-123.4295085	48.1240883	-123.429335	12.1	5/24/2008 21:14	Dinghy	Full bucket	Black	Firm	TRUE
586	48.1240363	-123.4278288	48.1240983	-123.4279383	12.5	5/24/2008 21:12	Dinghy	Full bucket	Grey	Loose	TRUE
587	48.1240425	-123.4261491	48.123905	-123.426215	12.2	5/24/2008 21:08	Dinghy	Full bucket	Black	Loose	TRUE
588	48.1240488	-123.4244695	48.1241383	-123.4244983	12.7	5/24/2008 21:04	Dinghy	Full bucket	Black	Firm	TRUE
589	48.1240549	-123.4227898	48.12406	-123.4228217	12.2	5/24/2008 21:01	Dinghy	Full bucket	Grey	Firm	TRUE
590	48.1240611	-123.4211101	48.1239883	-123.4212617	10	5/24/2008 20:57	Dinghy	Full bucket	Grey	Firm	TRUE
591	48.1240673	-123.4194304	48.12397	-123.4194467	12.6	5/14/2008 21:57	Dinghy	Full bucket	Grey	Firm	TRUE
592	48.1240734	-123.4177507	48.12407	-123.4176233	12.2	5/14/2008 23:09	Dinghy	Half bucket	Grey	Loose	TRUE
593	48.1240795	-123.416071	48.1241217	-123.4161417	12.2	5/15/2008 16:17	Dinghy	Full bucket	Grey	Firm	TRUE
594	48.1240855	-123.4143913	48.1241383	-123.414405	12.4	5/15/2008 17:17	Dinghy	Full bucket	Grey	Loose	TRUE
595	48.1240916	-123.4127116	48.1241317	-123.4127333	12.2	5/15/2008 18:51	Dinghy	Full bucket	Grey	Loose	TRUE
596	48.1240976	-123.4110319	48.1240483	-123.4111667	10.4	5/15/2008 20:52	Dinghy	No sample	N/A	N/A	FALSE
597	48.1241036	-123.4093522	48.1240333	-123.4092633	12	5/15/2008 22:08	Dinghy	Full bucket	Grey	Loose	TRUE
598	48.1241096	-123.4076725	48.124125	-123.4077633	12.2	5/15/2008 23:25	Dinghy	Full bucket	Grey	Firm	TRUE
599	48.1241155	-123.4059928	48.1241567	-123.405945	14.3	5/16/2008 0:45	Dinghy	Full bucket	Grey	Firm	TRUE
600	48.1241214	-123.4043132	48.1241933	-123.404405	14	5/16/2008 1:55	Dinghy	Full bucket	Grey	Firm	TRUE
601	48.1241273	-123.4026335	48.1240567	-123.4025633	16	5/16/2008 23:26	Dinghy	Full bucket	Grey	Firm	TRUE
602	48.1241332	-123.4009538	48.1242017	-123.4009517	16	5/16/2008 23:30	Dinghy	Full bucket	Grey	Loose	TRUE
603	48.124139	-123.3992741	48.1241517	-123.39936	15.3	5/16/2008 23:34	Dinghy	Half bucket	Grey	Loose	TRUE
604	48.1241449	-123.3975944	48.124165	-123.397715	16	5/16/2008 23:43	Dinghy	Half bucket	Grey	Loose	TRUE
605	48.1241507	-123.3959147	48.124265	-123.3960867	16.3	5/16/2008 23:51	Dinghy	Full bucket	Grey	Loose	TRUE
606	48.1241564	-123.394235	48.124175	-123.3943967	16.3	5/16/2008 23:56	Dinghy	Full bucket	Grey	Firm	TRUE
607	48.1241622	-123.3925553	48.1241533	-123.39257	16.3	5/17/2008 0:01	Dinghy	Half bucket	Grey	Firm	TRUE
608	48.1241679	-123.3908756	48.1242533	-123.3912283	16.7	5/17/2008 0:05	Dinghy	Full bucket	Grey	Loose	TRUE
609	48.1228769	-123.4370576	48.12312	-123.43703	4.6	5/21/2008 16:32	Dinghy	Full bucket	Grey	Firm	TRUE
610	48.1228833	-123.4353779	48.1228317	-123.43526	6.1	5/21/2008 16:37	Dinghy	Full bucket	Black	Firm	TRUE
611	48.1228897	-123.4336983	48.1228983	-123.4336917	7.8	5/21/2008 16:41	Dinghy	Full bucket	Black	Firm	TRUE
612	48.122896	-123.4320186	48.12292	-123.4320217	8.6	5/24/2008 17:04	Dinghy	Full bucket	Black	Firm	TRUE
613	48.1229023	-123.430339	48.122925	-123.430405	9.5	5/24/2008 17:11	Dinghy	No sample	N/A	N/A	FALSE
614	48.1229086	-123.4286593	48.1229167	-123.4286633	9.9	5/24/2008 17:17	Dinghy	Full bucket	Grey	Firm	TRUE
615	48.1229148	-123.4269797	48.12295	-123.4269867	9.7	5/24/2008 17:21	Dinghy	Full bucket	Black	Loose	TRUE
616	48.1229211	-123.4253	48.1229933	-123.4251817	10.1	5/24/2008 17:24	Dinghy	Full bucket	Grey	Loose	TRUE
617	48.1229273	-123.4236204	48.1229217	-123.4237467	10	5/24/2008 20:54	Dinghy	Half bucket	Grey	Firm	TRUE
618	48.1229334	-123.4219407	48.1229033	-123.4219217	7.9	5/24/2008 20:51	Dinghy	Half bucket	Grey	Loose	TRUE
619	48.1229396	-123.4202611	48.12303	-123.4202267	7.9	5/24/2008 20:47	Dinghy	Half bucket	Grey	Firm	TRUE
620	48.1229457	-123.4185814	48.122865	-123.4185317	11.2	5/14/2008 22:01	Dinghy	Half bucket	Grey	Firm	TRUE
621	48.1229518	-123.4169018	48.122985	-123.41688	11	5/14/2008 23:06	Dinghy	Poor sample	Grey	Loose	TRUE
622	48.1229579	-123.4152221	48.1229817	-123.41522	10.6	5/15/2008 16:22	Dinghy	Half bucket	Brown	Loose	TRUE
623	48.122964	-123.4135424	48.12301	-123.413605	10.2	5/15/2008 17:13	Dinghy	Full bucket	Grey	Firm	TRUE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
624	48.12297	-123.4118628	48.1230417	-123.4118267	9.1	5/15/2008 18:56	Dinghy	Poor sample	Grey	Loose	TRUE
625	48.122976	-123.4101831	48.1229583	-123.4101783	9.7	5/15/2008 20:47	Dinghy	Half bucket	Grey	Loose	TRUE
626	48.122982	-123.4085035	48.1231117	-123.4083467	12	5/15/2008 22:14	Dinghy	No sample	N/A	N/A	FALSE
627	48.1229879	-123.4068238	48.122995	-123.406855	11.2	5/15/2008 23:19	Dinghy	Half bucket	Grey	Loose	TRUE
628	48.1229939	-123.4051442	48.1230017	-123.4050833	12.6	5/16/2008 0:50	Dinghy	Full bucket	Grey	Firm	TRUE
629	48.1229998	-123.4034645	48.123035	-123.4035183	13.2	5/16/2008 1:50	Dinghy	Full bucket	Grey	Firm	TRUE
630	48.1230057	-123.4017848	48.1230283	-123.4015583	15	5/17/2008 0:22	Dinghy	Poor sample	Grey	Loose	TRUE
631	48.1230115	-123.4001052	48.12308	-123.3999333	15	5/17/2008 0:28	Dinghy	Full bucket	Grey	Firm	TRUE
632	48.1230174	-123.3984255	48.123005	-123.3983233	13.8	5/17/2008 0:31	Dinghy	Full bucket	Grey	Firm	TRUE
633	48.1230232	-123.3967459	48.123025	-123.3966333	13.8	5/17/2008 0:34	Dinghy	Half bucket	Grey	Firm	TRUE
634	48.123029	-123.3950662	48.123135	-123.3952433	15	5/17/2008 0:16	Dinghy	Half bucket	Grey	Firm	TRUE
635	48.1230347	-123.3933865	48.1229733	-123.39357	15.3	5/17/2008 0:12	Dinghy	Full bucket	Grey	Firm	TRUE
636	48.1230405	-123.3917069	48.1230983	-123.3917983	15.3	5/17/2008 0:09	Dinghy	Full bucket	Grey	Loose	TRUE
637	48.1217682	-123.432849	48.1218717	-123.4328333	4	5/21/2008 16:46	Dinghy	Poor sample	Grey	Firm	TRUE
638	48.1217746	-123.4311694	48.1219683	-123.43119	5.8	5/21/2008 16:49	Dinghy	Poor sample	Black	Firm	TRUE
639	48.1217808	-123.4294898	48.1219867	-123.4295983	5.8	5/21/2008 16:57	Dinghy	Poor sample	Grey	Firm	TRUE
640	48.1217871	-123.4278102	48.1217417	-123.42774	5.8	5/21/2008 17:00	Dinghy	Half bucket	Grey	Loose	TRUE
641	48.1217933	-123.4261305	48.1218333	-123.42611	6.9	5/21/2008 17:04	Dinghy	Half bucket	Black	Loose	TRUE
642	48.1217996	-123.4244509	48.1217833	-123.424385	7.8	5/24/2008 17:27	Dinghy	No sample	N/A	N/A	FALSE
643	48.1218058	-123.4227713	48.1217467	-123.422605	7.1	5/24/2008 17:33	Dinghy	No sample	N/A	N/A	FALSE
644	48.1218119	-123.4210917	48.121775	-123.4213183	7.9	5/24/2008 20:45	Dinghy	No sample	N/A	N/A	FALSE
645	48.1218181	-123.4194121	48.1219317	-123.4193567	8.3	5/24/2008 20:39	Dinghy	Half bucket	Grey	Loose	TRUE
646	48.1218242	-123.4177325	48.121775	-123.4175617	9	5/14/2008 22:05	Dinghy	Half bucket	Grey	Loose	TRUE
647	48.1218303	-123.4160528	48.12183	-123.415965	8.8	5/14/2008 23:01	Dinghy	Full bucket	Grey	Loose	TRUE
648	48.1218363	-123.4143732	48.121815	-123.41428	8.7	5/15/2008 16:26	Dinghy	Poor sample	Grey	Loose	TRUE
649	48.1218424	-123.4126936	48.1218367	-123.4126867	7.6	5/15/2008 17:10	Dinghy	Poor sample	Grey	Loose	TRUE
650	48.1218484	-123.411014	48.12185	-123.4109867	8.1	5/15/2008 19:00	Dinghy	Full bucket	Grey	Loose	TRUE
651	48.1218544	-123.4093344	48.121965	-123.4093917	8.6	5/15/2008 20:42	Dinghy	No sample	N/A	N/A	FALSE
652	48.1218604	-123.4076547	48.121925	-123.4077633	10	5/15/2008 22:18	Dinghy	Half bucket	Grey	Loose	TRUE
653	48.1218663	-123.4059751	48.1218983	-123.4060133	11	5/15/2008 23:15	Dinghy	Half bucket	Grey	Firm	TRUE
654	48.1218722	-123.4042955	48.1218683	-123.4042817	10.7	5/16/2008 0:54	Dinghy	Half bucket	Grey	Loose	TRUE
655	48.1218781	-123.4026159	48.1219767	-123.4026133	11.2	5/16/2008 1:46	Dinghy	Full bucket	Grey	Loose	TRUE
656	48.121884	-123.4009363	48.1218167	-123.40085	13.8	5/17/2008 0:38	Dinghy	Full bucket	Grey	Loose	TRUE
657	48.1218898	-123.3992566	48.1218867	-123.3991483	12	5/17/2008 0:40	Dinghy	Half bucket	Grey	Loose	TRUE
658	48.1218957	-123.397577	48.1219167	-123.3975633	12	5/17/2008 0:45	Dinghy	Half bucket	Grey	Loose	TRUE
659	48.1219015	-123.3958974	48.1219067	-123.3958067	12.9	5/17/2008 0:50	Dinghy	Poor sample	Grey	Loose	TRUE
660	48.1219072	-123.3942178	48.1218733	-123.3941517	13.9	5/17/2008 0:54	Dinghy	Half bucket	Grey	Loose	TRUE
661	48.121913	-123.3925381	48.1219083	-123.39255	14.1	5/17/2008 0:59	Dinghy	Full bucket	Grey	Loose	TRUE
662	48.1219187	-123.3908585	48.1219567	-123.3908433	13.9	5/17/2008 1:04	Dinghy	Poor sample	Grey	Loose	TRUE
663	48.1206594	-123.4286406	48.120855	-123.428325	1.5	5/24/2008 17:37	Dinghy	Poor sample	Grey	Loose	TRUE
664	48.1206656	-123.426961	48.1206217	-123.4269733	3.5	5/24/2008 17:42	Dinghy	Poor sample	Grey	Loose	TRUE
665	48.1206719	-123.4252815	48.12068	-123.42523	5.1	5/24/2008 20:19	Dinghy	Half bucket	Grey	Loose	TRUE
666	48.1206781	-123.4236019	48.1206967	-123.423565	5.7	5/24/2008 20:22	Dinghy	Poor sample	Grey	Loose	TRUE
667	48.1206842	-123.4219223	48.1206767	-123.4219933	6	5/24/2008 20:25	Dinghy	Poor sample	Grey	Loose	TRUE
668	48.1206904	-123.4202427	48.1206417	-123.4203617	6.3	5/24/2008 20:29	Dinghy	Poor sample	Grey	Loose	TRUE
669	48.1206965	-123.4185631	48.1206933	-123.4188283	6.4	5/24/2008 20:33	Dinghy	Half bucket	Grey	Loose	TRUE
670	48.1207026	-123.4168836	48.1206533	-123.4168617	7.1	5/14/2008 22:11	Dinghy	Poor sample	Grey	Loose	TRUE
671	48.1207087	-123.415204	48.120695	-123.415125	7.1	5/14/2008 22:58	Dinghy	Poor sample	Grey	Loose	TRUE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
672	48.1207148	-123.4135244	48.1207067	-123.41349	7.1	5/15/2008 16:31	Dinghy	Half bucket	Grey	Loose	TRUE
673	48.1207208	-123.4118448	48.12066	-123.4119133	7.1	5/15/2008 17:05	Dinghy	Half bucket	Grey	Loose	TRUE
674	48.1207268	-123.4101652	48.1207517	-123.41016	7.8	5/15/2008 19:05	Dinghy	Full bucket	Grey	Loose	TRUE
675	48.1207328	-123.4084856	48.12075	-123.4084433	9.7	5/15/2008 20:35	Dinghy	Full bucket	Grey	Loose	TRUE
676	48.1207387	-123.4068061	48.1207033	-123.4068683	10.2	5/15/2008 22:23	Dinghy	Full bucket	Black	Firm	TRUE
677	48.1207447	-123.4051265	48.120765	-123.40515	9.4	5/15/2008 23:11	Dinghy	Full bucket	Grey	Loose	TRUE
678	48.1207506	-123.4034469	48.1207517	-123.4034283	9.6	5/16/2008 0:58	Dinghy	Half bucket	Grey	Firm	TRUE
679	48.1207565	-123.4017673	48.1207883	-123.4017883	10.2	5/16/2008 1:42	Dinghy	Full bucket	Grey	Loose	TRUE
680	48.1207623	-123.4000877	48.1207	-123.4001117	13.9	5/17/2008 1:14	Dinghy	Full bucket	Grey	Firm	TRUE
681	48.1207682	-123.3984081	48.120725	-123.3981517	11.3	5/17/2008 1:19	Dinghy	Full bucket	Grey	Firm	TRUE
682	48.120774	-123.3967285	48.1208017	-123.3966567	11.3	5/17/2008 1:21	Dinghy	Poor sample	Grey	Loose	TRUE
683	48.1207798	-123.3950489	48.12077	-123.394925	11.5	5/17/2008 1:28	Dinghy	Poor sample	Grey	Firm	TRUE
684	48.1207855	-123.3933694	48.1207767	-123.3932683	12.2	5/17/2008 1:32	Dinghy	Poor sample	Grey	Firm	TRUE
685	48.1207913	-123.3916898	48.1207967	-123.3916417	12.2	5/17/2008 1:36	Dinghy	Half bucket	Grey	Firm	TRUE
686	48.120797	-123.3900102	48.12079	-123.3899217	12.6	5/17/2008 1:43	Dinghy	No sample	N/A	N/A	FALSE
687	48.1195379	-123.4277915	48.1197017	-123.42755	3.5	5/24/2008 17:47	Dinghy	Poor sample	Grey	Loose	TRUE
688	48.1195442	-123.4261119	48.1195183	-123.4261217	3.4	5/24/2008 23:14	Dinghy	Half bucket	Grey	Firm	TRUE
689	48.1195504	-123.4244324	48.119525	-123.4244717	3.4	5/24/2008 18:46	Dinghy	Poor sample	Grey	Loose	TRUE
690	48.1195566	-123.4227529	48.1195333	-123.4227017	4.6	5/24/2008 18:41	Dinghy	Poor sample	Grey	Firm	TRUE
691	48.1195627	-123.4210733	48.1195567	-123.42124	4.6	5/24/2008 18:30	Dinghy	Poor sample	Grey	Loose	TRUE
692	48.1195689	-123.4193938	48.1195883	-123.4194217	4.7	5/24/2008 18:26	Dinghy	Poor sample	Grey	Loose	TRUE
693	48.119575	-123.4177142	48.119625	-123.417845	4.7	5/24/2008 18:22	Dinghy	No sample	N/A	N/A	FALSE
694	48.1195811	-123.4160347	48.1196383	-123.416	6	5/14/2008 22:16	Dinghy	Half bucket	Grey	Loose	TRUE
695	48.1195871	-123.4143551	48.1195567	-123.4143083	5.9	5/14/2008 22:54	Dinghy	Poor sample	Grey	Loose	TRUE
696	48.1195932	-123.4126756	48.119645	-123.4127883	6	5/15/2008 16:35	Dinghy	Half bucket	Grey	Loose	TRUE
697	48.1195992	-123.410996	48.1196483	-123.4110367	5.8	5/15/2008 16:58	Dinghy	Half bucket	Grey	Loose	TRUE
698	48.1196052	-123.4093165	48.11966	-123.4092583	7	5/15/2008 19:10	Dinghy	Full bucket	Grey	Loose	TRUE
699	48.1196171	-123.4059574	48.119555	-123.40585	10.2	5/15/2008 22:27	Dinghy	Full bucket	Black	Firm	TRUE
700	48.119623	-123.4042779	48.1196717	-123.4043383	7.8	5/15/2008 23:07	Dinghy	Full bucket	Grey	Firm	TRUE
701	48.1196289	-123.4025983	48.1195783	-123.4026083	8.1	5/16/2008 1:03	Dinghy	No sample	N/A	N/A	FALSE
702	48.1196348	-123.4009188	48.1196933	-123.4009717	9.2	5/16/2008 1:39	Dinghy	Full bucket	Grey	Firm	TRUE
703	48.1196407	-123.3992392	48.1195733	-123.3991767	12.6	5/17/2008 1:49	Dinghy	Full bucket	Grey	Firm	TRUE
704	48.1196465	-123.3975597	48.1196783	-123.3974217	10.2	5/17/2008 1:51	Dinghy	Full bucket	Grey	Firm	TRUE
705	48.1196523	-123.3958801	48.1195983	-123.3957817	10	5/17/2008 1:54	Dinghy	Poor sample	Grey	Firm	TRUE
706	48.119658	-123.3942006	48.1196567	-123.393995	10	5/17/2008 1:57	Dinghy	Half bucket	Grey	Firm	TRUE
707	48.1196638	-123.392521	48.1196067	-123.392215	8.8	5/17/2008 2:02	Dinghy	No sample	N/A	N/A	FALSE
708	48.1196695	-123.3908414	48.1197667	-123.3907083	8.8	5/17/2008 2:05	Dinghy	No sample	N/A	N/A	FALSE
709	48.1184227	-123.4252629	48.1187483	-123.4256083	0.7	5/24/2008 17:51	Dinghy	Half bucket	Grey	Loose	TRUE
710	48.1184289	-123.4235834	48.1184767	-123.4235367	1.1	5/24/2008 17:55	Dinghy	Half bucket	Grey	Loose	TRUE
711	48.1184351	-123.4219039	48.1184067	-123.4218467	1.1	5/24/2008 18:00	Dinghy	Half bucket	Grey	Loose	TRUE
712	48.1184412	-123.4202244	48.1184	-123.4201933	1.1	5/24/2008 18:03	Dinghy	Poor sample	Grey	Loose	TRUE
713	48.1184473	-123.4185449	48.1184267	-123.4186167	2.8	5/24/2008 18:09	Dinghy	No sample	N/A	N/A	FALSE
714	48.1184534	-123.4168654	48.118515	-123.4167517	3.6	5/24/2008 18:14	Dinghy	No sample	N/A	N/A	FALSE
715	48.1184595	-123.4151858	48.118485	-123.4151917	4.2	5/14/2008 22:23	Dinghy	No sample	N/A	N/A	FALSE
716	48.1184656	-123.4135063	48.118425	-123.4135233	4.4	5/14/2008 22:49	Dinghy	Half bucket	Grey	Loose	TRUE
717	48.1184716	-123.4118268	48.1184333	-123.4118283	3.6	5/15/2008 16:40	Dinghy	Half bucket	Black	Loose	TRUE
718	48.1184776	-123.4101473	48.1184867	-123.4101683	2.8	5/15/2008 16:53	Dinghy	Half bucket	Black	Loose	TRUE
719	48.1184896	-123.4067883	48.1185183	-123.4067033	5.2	5/15/2008 22:35	Dinghy	Poor sample	Grey	Loose	TRUE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
720	48.1184955	-123.4051088	48.11846	-123.4049517	4.6	5/15/2008 22:37	Dinghy	Half bucket	Grey	Loose	TRUE
721	48.1185014	-123.4034293	48.1185183	-123.4034633	6.4	5/15/2008 23:03	Dinghy	Full bucket	Grey	Firm	TRUE
722	48.1185073	-123.4017498	48.1186367	-123.4017433	7.3	5/16/2008 1:07	Dinghy	Full bucket	Grey	Firm	TRUE
723	48.1185131	-123.4000702	48.1185667	-123.4000367	4.5	5/16/2008 1:36	Dinghy	Half bucket	Grey	Loose	TRUE
724	48.118519	-123.3983907	48.1184383	-123.398325	8.8	5/17/2008 2:11	Dinghy	Half bucket	Grey	Firm	TRUE
725	48.1185248	-123.3967112	48.1185017	-123.39647	8.8	5/17/2008 2:15	Dinghy	Half bucket	Grey	Firm	TRUE
726	48.1185306	-123.3950317	48.11853	-123.3949383	8.8	5/17/2008 2:20	Dinghy	Full bucket	Grey	Loose	TRUE
727	48.1185363	-123.3933522	48.1185833	-123.3931017	8.8	5/17/2008 2:24	Dinghy	Poor sample	Grey	Loose	TRUE
728	48.1185421	-123.3916727	48.1184917	-123.3911733	8.8	5/17/2008 2:31	Dinghy	No sample	N/A	N/A	FALSE
729	48.1185478	-123.3899932	48.11856	-123.3897433	8.8	5/17/2008 2:35	Dinghy	No sample	N/A	N/A	FALSE
730	48.1173319	-123.4160165	48.1172983	-123.4160317	20	5/17/2008 22:01	Dinghy	No sample	N/A	N/A	FALSE
731	48.117338	-123.4143371	48.1173083	-123.4141317	2.9	5/14/2008 22:28	Dinghy	Poor sample	Grey	Loose	TRUE
732	48.117344	-123.4126576	48.11737	-123.412715	2.5	5/14/2008 22:44	Dinghy	Half bucket	Grey	Loose	TRUE
733	48.11735	-123.4109781	48.1173533	-123.4109467	2.4	5/15/2008 16:46	Dinghy	Poor sample	Black	Loose	TRUE
734	48.1173738	-123.4042602	48.1175217	-123.4040467	0.9	5/15/2008 22:46	Dinghy	Half bucket	Grey	Loose	FALSE
735	48.1173797	-123.4025807	48.117415	-123.4026183	4.9	5/15/2008 23:00	Dinghy	Poor sample	Grey	Firm	TRUE
736	48.1173856	-123.4009013	48.1173233	-123.40087	5.4	5/16/2008 1:11	Dinghy	Poor sample	Grey	Loose	TRUE
737	48.1173915	-123.3992218	48.1174333	-123.3994367	4.5	5/16/2008 1:33	Dinghy	Poor sample	Grey	Loose	TRUE
738	48.1173973	-123.3975423	48.117355	-123.3975433	7.2	5/17/2008 2:39	Dinghy	Half bucket	Grey	Firm	TRUE
739	48.1174031	-123.3958628	48.1174233	-123.395765	7.4	5/17/2008 2:44	Dinghy	Half bucket	Grey	Firm	TRUE
740	48.1174089	-123.3941833	48.1174233	-123.3940733	7.6	5/17/2008 2:47	Dinghy	Poor sample	Grey	Loose	TRUE
741	48.1174146	-123.3925039	48.11744	-123.3923717	7.6	5/17/2008 2:51	Dinghy	No sample	N/A	N/A	FALSE
742	48.1174203	-123.3908244	48.1174133	-123.39067	6.4	5/17/2008 2:53	Dinghy	No sample	N/A	N/A	FALSE
743	48.117426	-123.3891449	48.1174183	-123.3890217	6.1	5/17/2008 2:54	Dinghy	No sample	N/A	N/A	FALSE
744	48.1162164	-123.4134883	48.11657	-123.4135333	1.5	5/14/2008 22:35	Dinghy	Half bucket	Grey	Loose	TRUE
745	48.1162224	-123.4118089	48.1166483	-123.4115117	1	5/14/2008 22:40	Dinghy	Poor sample	Grey	Loose	TRUE
746	48.1162522	-123.4034117	48.1164783	-123.403285	1.4	5/15/2008 22:52	Dinghy	Poor sample	Grey	Loose	FALSE
747	48.1162581	-123.4017322	48.11626	-123.4017367	2	5/15/2008 22:58	Dinghy	Half bucket	Grey	Loose	TRUE
748	48.1162639	-123.4000528	48.1162517	-123.3999517	3.3	5/16/2008 1:15	Dinghy	Full bucket	Grey	Loose	TRUE
749	48.1162698	-123.3983733	48.11624	-123.3983683	4.5	5/16/2008 1:26	Dinghy	Half bucket	Grey	Firm	TRUE
750	48.1162756	-123.3966939	48.11628	-123.3966967	4.9	5/17/2008 17:45	Dinghy	Poor sample	Grey	Loose	TRUE
751	48.1162814	-123.3950145	48.1162917	-123.39497	5.4	5/17/2008 17:51	Dinghy	Half bucket	Grey	Loose	TRUE
752	48.1162871	-123.393335	48.116315	-123.3933017	5.6	5/17/2008 17:56	Dinghy	Full bucket	Grey	Loose	TRUE
753	48.1162929	-123.3916556	48.116315	-123.391535	5.6	5/17/2008 17:59	Dinghy	Poor sample	Grey	Slurry	TRUE
754	48.1162986	-123.3899761	48.1163333	-123.3897467	5.6	5/17/2008 18:05	Dinghy	No sample	N/A	N/A	FALSE
755	48.1151423	-123.3992044	48.1151833	-123.3991817	1.7	5/16/2008 1:18	Dinghy	Half bucket	Grey	Loose	TRUE
756	48.1151481	-123.397525	48.1150783	-123.397525	2.5	5/16/2008 1:22	Dinghy	Poor sample	Grey	Loose	TRUE
757	48.1151539	-123.3958455	48.11505	-123.39587	3	5/17/2008 18:12	Dinghy	Poor sample	Grey	Firm	TRUE
758	48.1151597	-123.3941661	48.1151483	-123.3940683	3.8	5/17/2008 18:16	Dinghy	Poor sample	Grey	Firm	TRUE
759	48.1151654	-123.3924867	48.1151467	-123.392375	3.8	5/17/2008 18:20	Dinghy	No sample	N/A	N/A	FALSE
760	48.1151711	-123.3908073	48.115185	-123.3908083	3.8	5/17/2008 18:24	Dinghy	No sample	N/A	N/A	FALSE
761	48.1151768	-123.3891279	48.1152983	-123.3892017	3.8	5/17/2008 18:26	Dinghy	Half bucket	Grey	Loose	TRUE
762	48.1197567	-123.3866296	48.1197183	-123.3866833	10.4	5/17/2008 20:32	Dinghy	No sample	N/A	N/A	FALSE
763	48.1197679	-123.3832705	48.119715	-123.3836567	10.4	5/17/2008 20:29	Dinghy	No sample	N/A	N/A	FALSE
764	48.1197791	-123.3799114	48.1197367	-123.3799783	9.5	5/17/2008 20:23	Dinghy	No sample	N/A	N/A	FALSE
765	48.1197901	-123.3765523	48.1197367	-123.3766317	11.5	5/17/2008 20:20	Dinghy	No sample	N/A	N/A	FALSE
766	48.1198011	-123.3731932	48.11981	-123.3731617	9.5	5/17/2008 20:11	Dinghy	No sample	N/A	N/A	FALSE
767	48.1198119	-123.369834	48.11981	-123.3698633	9.5	5/17/2008 20:05	Dinghy	No sample	N/A	N/A	FALSE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
768	48.1198227	-123.3664749	48.1197833	-123.3664733	9.5	5/17/2008 19:59	Dinghy	No sample	N/A	N/A	FALSE
769	48.1198334	-123.3631158	48.1198717	-123.3631133	9.5	5/17/2008 19:55	Dinghy	No sample	N/A	N/A	FALSE
770	48.1198439	-123.3597567	48.1198133	-123.3595517	9.5	5/17/2008 19:53	Dinghy	No sample	N/A	N/A	FALSE
771	48.1198544	-123.3563975	48.1198567	-123.3563817	10.3	5/17/2008 19:48	Dinghy	Half bucket	Grey	Firm	TRUE
772	48.1198648	-123.3530384	48.119875	-123.352925	7.8	5/17/2008 19:41	Dinghy	Poor sample	Black	Firm	TRUE
773	48.1175131	-123.3849333	48.117525	-123.3848483	6.6	5/17/2008 19:02	Dinghy	No sample	N/A	N/A	FALSE
774	48.1175243	-123.3815743	48.1175167	-123.3815067	6.6	5/17/2008 19:06	Dinghy	No sample	N/A	N/A	FALSE
775	48.1175354	-123.3782153	48.1175567	-123.3781583	7.4	5/17/2008 19:11	Dinghy	No sample	N/A	N/A	FALSE
776	48.1175464	-123.3748564	48.11763	-123.3747167	8	5/17/2008 19:18	Dinghy	No sample	N/A	N/A	FALSE
777	48.1175573	-123.3714974	48.1175433	-123.3714333	7.4	5/17/2008 19:21	Dinghy	No sample	N/A	N/A	FALSE
778	48.1175681	-123.3681384	48.1175833	-123.3681417	5.8	5/17/2008 19:23	Dinghy	No sample	N/A	N/A	FALSE
779	48.1175788	-123.3647794	48.1175817	-123.3646933	4.8	5/17/2008 19:25	Dinghy	No sample	N/A	N/A	FALSE
780	48.1175895	-123.3614204	48.117615	-123.3614183	4.8	5/17/2008 19:28	Dinghy	No sample	N/A	N/A	FALSE
781	48.1176	-123.3580615	48.1176433	-123.3579667	5	5/17/2008 19:30	Dinghy	Poor sample	Grey	Loose	TRUE
782	48.1176104	-123.3547025	48.1178233	-123.35489	1.6	5/17/2008 19:37	Dinghy	Half bucket	Grey	Firm	FALSE
783	48.1152583	-123.3865959	48.1152083	-123.38646	1.9	5/17/2008 18:31	Dinghy	Half bucket	Grey	Firm	TRUE
784	48.1152695	-123.3832371	48.1155483	-123.38321	1.9	5/17/2008 18:37	Dinghy	No sample	N/A	N/A	FALSE
785	48.1152807	-123.3798782	48.11546	-123.37995	2.2	5/17/2008 18:40	Dinghy	No sample	N/A	N/A	FALSE
786	48.1152917	-123.3765194	48.1152633	-123.3764917	2.2	5/17/2008 18:46	Dinghy	Half bucket	Grey	Firm	TRUE
787	48.1153027	-123.3731606	48.1152717	-123.37316	4.2	5/17/2008 18:49	Dinghy	No sample	N/A	N/A	FALSE
788	48.1153135	-123.3698018	48.1152717	-123.3697167	2.5	5/17/2008 18:53	Dinghy	No sample	N/A	N/A	FALSE
790	48.1179083	-123.40656	48.1178933	-123.40656	20	5/23/2008 16:40	Beach or shore	Unknown	Unknown	Unknown	FALSE
791	48.116455	-123.4035083	48.116445	-123.4034817	20	5/23/2008 16:51	Beach or shore	Unknown	Unknown	Unknown	FALSE
792	48.1156567	-123.4013333	48.1156567	-123.401335	20	5/23/2008 17:06	Beach or shore	Unknown	Unknown	Unknown	FALSE
793	48.1149233	-123.3990633	48.114925	-123.3990633	20	5/23/2008 17:11	Beach or shore	Unknown	Unknown	Unknown	FALSE
794	48.1145233	-123.3975283	48.1145283	-123.3975583	20	5/23/2008 17:17	Beach or shore	Unknown	Unknown	Unknown	FALSE
795	48.114215	-123.395585	48.114215	-123.39559	20	5/23/2008 17:23	Beach or shore	Unknown	Unknown	Unknown	FALSE
796	48.1142267	-123.3932833	48.1142283	-123.3932833	20	5/23/2008 17:29	Beach or shore	Unknown	Unknown	Unknown	FALSE
797	48.1143833	-123.3909483	48.1143783	-123.3909517	0	5/23/2008 17:38	Beach or shore	Unknown	Unknown	Unknown	FALSE
798	48.1150783	-123.3893017	48.1150783	-123.3893017	0	5/23/2008 17:46	Beach or shore	Unknown	Unknown	Unknown	FALSE
799	48.126505	-123.4568833	48.1265067	-123.456885	5.5	5/27/2008 16:48	Dinghy	Full bucket	Black	Loose	TRUE
800	48.1242633	-123.4509133	48.1242617	-123.450905	4.6	5/27/2008 17:01	Dinghy	Full bucket	Black	Firm	TRUE
801	48.13475	-123.4623567	48.1347233	-123.4622283	5.6	5/27/2008 17:10	Dinghy	Poor sample	Black	Loose	TRUE
802	48.1344433	-123.4636	48.1346067	-123.4635667	3.4	5/27/2008 17:17	Dinghy	Poor sample	Black	Loose	TRUE
803	48.1344883	-123.4649183	48.13451	-123.4649117	3.4	5/27/2008 17:25	Dinghy	No sample	N/A	N/A	FALSE
804	48.134055	-123.4665917	48.1340667	-123.466635	2.2	5/27/2008 17:28	Dinghy	No sample	N/A	N/A	FALSE
805	48.1336183	-123.4675483	48.1336083	-123.4675433	2.6	5/27/2008 17:30	Dinghy	Half bucket	Black	Loose	TRUE
806	48.132645	-123.467505	48.13264	-123.4675	2.6	5/27/2008 17:34	Dinghy	Full bucket	Black	Loose	TRUE
807	48.1328133	-123.4697667	48.1328067	-123.4697633	0.9	5/27/2008 17:40	Dinghy	Full bucket	Black	Loose	TRUE
808	48.1331733	-123.468365	48.1331767	-123.4683467	0.6	5/27/2008 17:46	Dinghy	Half bucket	Brown	Loose	TRUE
809	48.1380067	-123.4570233	48.1380083	-123.4570167	5.9	5/27/2008 17:58	Dinghy	Poor sample	Black	Loose	TRUE
810	48.1394267	-123.4495017	48.139415	-123.4494667	10	5/27/2008 18:04	Dinghy	Half bucket	Black	Loose	TRUE
811	48.1390183	-123.4513633	48.1386733	-123.4511133	14.5	5/27/2008 18:10	Dinghy	Half bucket	Black	Loose	TRUE
812	48.140375	-123.44304	48.1403633	-123.4430217	3.4	5/27/2008 18:16	Dinghy	Half bucket	Black	Loose	FALSE
1000	48.1287082	-123.3866525	48.1286683	-123.386725	20.2	5/26/2008 22:01	Dinghy	Half bucket	Grey	Firm	TRUE
1001	48.1287195	-123.3832928	48.128655	-123.3833867	19.2	5/26/2008 21:58	Dinghy	Half bucket	Grey	Firm	FALSE
1002	48.1287306	-123.3799331	48.1287733	-123.379915	20.3	5/26/2008 21:55	Dinghy	Half bucket	Grey	Firm	TRUE
1003	48.1287417	-123.3765734	48.128725	-123.376345	20.3	5/26/2008 21:51	Dinghy	Half bucket	Grey	Loose	TRUE

APPENDIX II: Sediment sample positions and descriptors											
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.											
Id	**Proposed Lat**	**Proposed Long**	**Actual Lat**	**Actual Long**	**Depth(Meters)**	**Time**	**Platform**	**Amount**	**Color**	**Consistency**	**Biota/Detritus**
Version 3 Report file for the project.											
1004	48.1287526	-123.3732137	48.12876	-123.3731283	20.3	5/26/2008 21:48	Dinghy	Poor sample	Grey	Firm	TRUE
1005	48.1287635	-123.3698539	48.1287417	-123.3699017	19.9	5/26/2008 21:46	Dinghy	Half bucket	Grey	Firm	TRUE
1006	48.126474	-123.3883465	48.12648	-123.3884333	16.7	5/26/2008 21:16	Dinghy	Full bucket	Grey	Firm	TRUE
1007	48.1264853	-123.384987	48.126325	-123.3852067	16.7	5/26/2008 21:19	Dinghy	Half bucket	Grey	Firm	TRUE
1008	48.1264965	-123.3816274	48.1265033	-123.381715	16.7	5/26/2008 21:23	Dinghy	Half bucket	Grey	Firm	TRUE
1009	48.1265076	-123.3782678	48.1265383	-123.3782583	15.8	5/26/2008 21:37	Dinghy	Poor sample	Grey	Loose	TRUE
1010	48.1265186	-123.3749083	48.1264617	-123.374795	16.6	5/26/2008 21:40	Dinghy	Half bucket	Grey	Firm	TRUE
1011	48.1265295	-123.3715487	48.12643	-123.3716433	17.7	5/27/2008 19:19	Dinghy	Half bucket	Grey	Firm	TRUE
1012	48.1242307	-123.3865879	48.1241617	-123.38644	15.7	5/26/2008 21:13	Dinghy	Half bucket	Grey	Loose	TRUE
1013	48.1242419	-123.3832285	48.1241817	-123.38303	15.3	5/26/2008 21:10	Dinghy	Half bucket	Grey	Firm	TRUE
1014	48.1242531	-123.3798691	48.1241117	-123.3799533	15.3	5/26/2008 21:07	Dinghy	Half bucket	Grey	Loose	TRUE
1015	48.1242641	-123.3765097	48.12431	-123.3765483	16	5/26/2008 21:04	Dinghy	Poor sample	Grey	Loose	TRUE
1016	48.1242751	-123.3731503	48.1243133	-123.373205	16.7	5/26/2008 21:00	Dinghy	Poor sample	Grey	Loose	TRUE
1017	48.1242859	-123.3697908	48.1240683	-123.3697967	15	5/26/2008 20:58	Dinghy	No sample	N/A	N/A	FALSE
1018	48.1219756	-123.3882974	48.121905	-123.3882017	12.7	5/26/2008 20:32	Dinghy	Poor sample	Grey	Loose	TRUE
1019	48.1219869	-123.3849381	48.1218867	-123.3849733	12.2	5/26/2008 20:38	Dinghy	Poor sample	Grey	Loose	TRUE
1020	48.1219981	-123.3815789	48.1220433	-123.3815567	12.2	5/26/2008 20:42	Dinghy	Poor sample	Grey	Loose	TRUE
1021	48.1220092	-123.3782196	48.1220367	-123.378075	12.1	5/26/2008 20:47	Dinghy	No sample	N/A	N/A	FALSE
1022	48.1220202	-123.3748603	48.1220933	-123.3748033	13.9	5/26/2008 20:49	Dinghy	Half bucket	Grey	Firm	TRUE
1023	48.1220312	-123.371501	48.121965	-123.3713333	13.9	5/26/2008 20:54	Dinghy	No sample	N/A	N/A	FALSE
1024	48.1266133	-123.36785	48.12669	-123.3679183	18.4	5/27/2008 19:05	Dinghy	Poor sample	Grey	Firm	TRUE
1025	48.1262367	-123.3647067	48.1262167	-123.364675	17.7	5/27/2008 19:26	Dinghy	Poor sample	Grey	Firm	TRUE
1026	48.1258033	-123.3615767	48.12579	-123.3614133	16	5/27/2008 19:32	Dinghy	Poor sample	Grey	Loose	TRUE
1027	48.1282783	-123.36644	48.1279883	-123.3627967	19.8	5/27/2008 19:49	Dinghy	Half bucket	Grey	Firm	TRUE
1030	48.1308317	-123.3883817	48.13079	-123.3882233	24.2	5/28/2008 0:55	Dinghy	Half bucket	Grey	Loose	TRUE
1031	48.130075	-123.3853633	48.1300283	-123.3852583	23.1	5/28/2008 1:00	Dinghy	Full bucket	Grey	Firm	TRUE
1032	48.1302883	-123.38224	48.1302267	-123.3820667	24.2	5/28/2008 1:05	Dinghy	Half bucket	Grey	Firm	TRUE
1033	48.1307	-123.3783567	48.1305933	-123.3781417	25.9	5/28/2008 1:09	Dinghy	Half bucket	Grey	Firm	TRUE
1034	48.130745	-123.3749267	48.1306517	-123.3746833	25.7	5/28/2008 1:13	Dinghy	Half bucket	Grey	Firm	FALSE
1035	48.1306083	-123.371645	48.130425	-123.3710067	25.7	5/28/2008 1:18	Dinghy	Half bucket	Grey	Loose	TRUE
1036	48.1309017	-123.3682783	48.13084	-123.3680217	24.7	5/28/2008 1:24	Dinghy	Poor sample	Grey	Loose	TRUE

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															
26		Wood mixed		Bark - medium	Bark - small		Wood chips					High content	Brown		
27		Wood mixed		Bark - medium			Wood chips					High content	Brown		Black
28		Wood mixed		Bark - medium			Wood chips				Medium content		Brown		Black
29		Wood mixed		Bark - medium			Wood chips					High content	Brown		Black
30		Wood mixed			Bark - small		Wood chips				Medium content		Brown		Black
31				Bark - medium								High content	Brown		Black
32		Wood mixed			Bark - small					Low content					Black
33															
34															
35															
36		Wood mixed			Bark - small					Low content					Black
37															
38															
39															
40															
41		Wood mixed		Bark - medium	Bark - small		Wood chips					High content	Brown		Black
42				Bark - medium			Wood chips					High content	Brown		Black
43		Wood mixed		Bark - medium			Wood chips					High content			Black
44		Wood mixed		Bark - medium			Wood chips	Sawdust				High content			Black
45							Wood chips			Low content			Brown		
46				Bark - medium						Low content					Black
47		Wood mixed			Bark - small					Low content					Black

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Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
48															
49				Bark - medium							Medium content				Black
50															
51		Wood mixed		Bark - medium						Low content					Black
52		Wood mixed		Bark - medium							Medium content				Black
53															
54		Wood mixed		Bark - medium			Wood chips								
55					Bark - small										
56				Bark - medium											
57	Wood buried				Bark - small										
58					Bark - small										
59															
60															
61															
62															
63															
64															
65															
66		Wood mixed			Bark - small		Wood chips	Sawdust				High content			Black
67															
68		Wood mixed			Bark - small		Wood chips	Sawdust				High content	Brown		
69		Wood mixed					Wood chips			Low content			Brown		
70										Low content					Black
71		Wood mixed				Cedar				Low content					Black
72		Wood mixed		Bark - medium			Wood chips				Medium content				Black
73				Bark - medium						Low content					Black
74		Wood mixed		Bark - medium						Low content					Black
75				Bark - medium						Low content					Black
76		Wood mixed					Wood chips			Low content					Black
77															
78															
79															
80															
81															
82															
83															
84	Wood buried						Wood chips			Low content					
85															
86															
87															
88															
89					Bark - small					Low content					Black
90															
91															
92															
93															
94															
95					Bark - small										

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
96															
97															
98															
99															
100															
101		Wood mixed		Bark - medium			Wood chips				Medium content				Black
102		Wood mixed	Bark - large							Low content					Black
103		Wood mixed		Bark - medium			Wood chips					High content			Black
104		Wood mixed		Bark - medium						Low content					Black
105		Wood mixed		Bark - medium							Medium content				Black
106	Wood buried			Bark - medium			Wood chips				Medium content				Black
107				Bark - medium						Low content					Black
108															
109															
110															
111															
112															
113															
114						Cedar				Low content					Black
115		Wood mixed					Wood chips			Low content					Black
116		Wood mixed		Bark - medium						Low content					Black
117															
118		Wood mixed			Bark - small					Low content					Black
119		Wood mixed		Bark - medium						Low content					Black
120															
121															
122															
123															
124															
125															
126															
127															
128															
129															
130															
131															
132															
133															
134															
135	Wood buried							Sawdust		Low content					Black
136		Wood mixed			Bark - small		Wood chips			Low content			Brown		
137															
138															
139															
140		Wood mixed					Wood chips	Sawdust			Medium content				Black
141		Wood mixed		Bark - medium			Wood chips					High content	Brown		Black
142							Wood chips				Medium content		Brown		
143				Bark - medium								High content			Black

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
144							Wood chips				Medium content				Black
145		Wood mixed	Bark - large								Medium content				Black
146		Wood mixed		Bark - medium			Wood chips				Medium content				Black
147		Wood mixed			Bark - small					Low content					Black
148															
149															
150															
151		Wood mixed			Bark - small		Wood chips			Low content					Black
152															
153															
154															
155															
156							Wood chips			Low content					Black
157															
158															
159															
160															
161															
162															
163															
164															
165															
166															
167															
168															
169															
170															
171															
172									Pulp fibers						
173															
174															
175		Wood mixed			Bark - small										Black
176		Wood mixed			Bark - small					Low content					Black
177		Wood mixed			Bark - small					Low content					Black
178															
179		Wood mixed			Bark - small					Low content					Black
180		Wood mixed					Wood chips			Low content					Black
181		Wood mixed	Bark - large							Low content					Black
182	Wood buried			Bark - medium			Wood chips				Medium content		Brown		Black
183		Wood mixed		Bark - medium			Wood chips					High content	Brown		Black
184		Wood mixed		Bark - medium			Wood chips			Low content			Brown		Black
185		Wood mixed		Bark - medium						Low content					Black
186		Wood mixed		Bark - medium							Medium content				Black
187															
188	Wood buried			Bark - medium						Low content					Black
189															
190															
191				Bark - medium						Low content					Black

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
192														Grey	
193															
194															
195															
196															
197															
198															
199															
200															
201															
202															
203															
204															
205															
206															
207															
208															
209															
210															
211															
212															
213															
214															
215															
216		Wood mixed		Bark - medium											Black
217															
218		Wood mixed		Bark - medium						Low content					Black
219															
220		Wood mixed					Wood chips			Low content			Brown		
221		Wood mixed					Wood chips				Medium content		Brown		
222															
223		Wood mixed	Bark - large				Wood chips				Medium content				Black
224		Wood mixed								Low content			Brown		
225		Wood mixed			Bark - small		Wood chips			Low content					Black
226		Wood mixed		Bark - medium			Wood chips			Low content			Brown		Black
227															
228		Wood mixed	Bark - large									High content			Black
229		Wood mixed			Bark - small		Wood chips			Low content					Black
230			Bark - large								Medium content				Black
231															
232		Wood mixed		Bark - medium						Low content					Black
233															
234		Wood mixed					Wood chips			Low content					Black
235															
236															
237															
238															
239															

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
240		Wood mixed		Bark - medium						Low content					Black
241															
242		Wood mixed					Wood chips			Low content					Black
243															
244															
245															
246															
247															
248					Bark - small					Low content					Black
249															
250															
251															
252															
253															
254															
255															
256															
257															
258															
259															
260															
261															
262		Wood mixed					Wood chips				Medium content				Black
263		Wood mixed					Wood chips				Medium content				Black
264		Wood mixed					Wood chips			Low content					Black
265		Wood mixed		Bark - medium			Wood chips			Low content					Black
266		Wood mixed			Bark - small		Wood chips			Low content			Brown		Black
267				Bark - medium			Wood chips				Medium content				Black
268															
269															
270															
271				Bark - medium							Medium content				Black
272															
273															
274		Wood mixed		Bark - medium						Low content					Black
275															
276															
277															
278															
279															
280															
281				Bark - medium						Low content					Black
282															
283															
284															
285															
286		Wood mixed					Wood chips			Low content					Black
287															

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
288															
289															
290															
291															
292															
293															
294															
295															
296															
297															
298															
299															
300															
301															
302															
303		Wood mixed						Sawdust				High content			Black
304			Bark - large				Wood chips					High content			Black
305		Wood mixed		Bark - medium			Wood chips			Low content					Black
306		Wood mixed					Wood chips					High content	Brown		
307		Wood mixed					Wood chips	Sawdust			Medium content		Brown		
308		Wood mixed			Bark - small		Wood chips			Low content			Brown		Black
309															
310															
311		Wood mixed			Bark - small					Low content					Black
312		Wood mixed		Bark - medium						Low content					Black
313															
314															
315				Bark - medium						Low content					Black
316															
317															
318															
319															
320															
321															
322															
323															
324		Wood mixed		Bark - medium											Black
325															
326															
327		Wood mixed		Bark - medium			Wood chips				Medium content				Black
328															
329															
330															
331															
332															
333															
334		Wood mixed					Wood chips			Low content			Brown		
335		Wood mixed			Bark - small		Wood chips			Low content			Brown		

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
336							Wood chips			Low content				Grey	
337		Wood mixed					Wood chips			Low content			Brown		
338															
339															
340		Wood mixed		Bark - medium						Low content					Black
341															
342															
343															
344		Wood mixed					Wood chips				Medium content		Brown		
345		Wood mixed		Bark - medium			Wood chips					High content			Black
346		Wood mixed		Bark - medium						Low content					Black
347															
348		Wood mixed					Wood chips			Low content			Brown		
349															
350															
351															
352															
353															
354															
355															
356						Cedar					Medium content				Black
357															
358															
359				Bark - medium						Low content					Black
360															
361															
362															
363															
364															
365															
366		Wood mixed					Wood chips			Low content			Brown		
367															
368															
369															
370															
371															
372															
373															
374															
375															
376		Wood mixed					Wood chips			Low content			Brown		
377															
378		Wood mixed			Bark - small					Low content					Black
379		Wood mixed			Bark - small					Low content					Black
380															
381		Wood mixed					Wood chips			Low content			Brown		
382															
383															

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
384															
385		Wood mixed					Wood chips			Low content			Brown		
386		Wood mixed					Wood chips				Medium content				Black
387															
388			Bark - large									High content			Black
389		Wood mixed					Wood chips			Low content			Brown		
390															
391															
392		Wood mixed		Bark - medium						Low content					Black
393															
394															
395															
396															
397															
398		Wood mixed	Bark - large			Cedar					Medium content				Black
399		Wood mixed			Bark - small					Low content					Black
400															
401															
402															
403															
404								Sawdust							
405															
406															
407															
408															
409															
410															
411															
412															
413															
414															
415															
416															
417															
418															
419															
420															
421															
422															
423															
424															
425															
426															
427															
428															
429		Wood mixed			Bark - small		Wood chips			Low content					Black
430															
431		Wood mixed					Wood chips	Sawdust		Low content			Brown		

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
432															
433															
434															
435															
436															
437			Bark - large	Bark - medium								High content			Black
438															
439															
440															
441															
442															
443															
444															
445															
446															
447															
448															
449															
450															
451		Wood mixed			Bark - small						Medium content				Black
452															
453															
454															
455															
456															
457															
458		Wood mixed			Bark - small					Low content					Black
459															
460		Wood mixed					Wood chips			Low content			Brown		
461															
462															
463															
464															
465															
466															
467		Wood mixed					Wood chips			Low content					
468		Wood mixed	Bark - large	Bark - medium			Wood chips					High content	Brown		Black
469															
470															
471		Wood mixed			Bark - small					Low content					Black
472	Wood buried				Bark - small					Low content					Black
473										Low content					Black
474															
475															
476							Wood chips			Low content			Brown		
477															
478															
479															

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
480															
481															
482															
483							Wood chips			Low content			Brown		
484															
485															
486		Wood mixed		Bark - medium						Low content					Black
487		Wood mixed					Wood chips			Low content			Brown		
488	Wood buried				Bark - small					Low content					Black
489															
490		Wood mixed		Bark - medium						Low content					Black
491															
492															
493		Wood mixed			Bark - small										Black
494															
495		Wood mixed		Bark - medium						Low content					Black
496															
497															
498															
499															
500															
501															
502															
503															
504															
505		Wood mixed			Bark - small		Wood chips					High content			Black
506					Bark - small		Wood chips	Sawdust				High content	Brown		Black
507		Wood mixed		Bark - medium			Wood chips					High content			Black
508		Wood mixed					Wood chips				Medium content				Black
509		Wood mixed			Bark - small					Low content					Black
510		Wood mixed			Bark - small						Medium content				Black
511				Bark - medium						Low content					Black
512							Wood chips			Low content			Brown		
513		Wood mixed					Wood chips				Medium content		Brown		Black
514					Bark - small		Wood chips			Low content					Black
515															
516							Wood chips			Low content					Black
517															
518															
519															
520															
521															
522		Wood mixed		Bark - medium						Low content					Black
523															
524															
525															
526															
527															

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
528		Wood mixed	Bark - large				Wood chips			Low content					Black
529															
530															
531															
532		Wood mixed		Bark - medium							Medium content				Black
533				Bark - medium						Low content					Black
534															
535															
536			Bark - large							Low content					Black
537															
538															
539															
540															
541															
542															
543		Wood mixed					Wood chips	Sawdust			Medium content				Black
544		Wood mixed		Bark - medium			Wood chips					High content			Black
545		Wood mixed			Bark - small					Low content					Black
546		Wood mixed					Wood chips			Low content			Brown		
547															
548		Wood mixed		Bark - medium			Wood chips			Low content					Black
549		Wood mixed			Bark - small					Low content					Black
550							Wood chips				Medium content				Black
551															
552															
553															
554															
555															
556															
557															
558															
559															
560															
561		Wood mixed			Bark - small										Black
562															
563	Wood buried		Bark - large	Bark - medium	Bark - small		Wood chips				Medium content				Black
564			Bark - large							Low content					Black
565		Wood mixed	Bark - large	Bark - medium											Black
566															
567		Wood mixed			Bark - small		Wood chips			Low content			Brown		
568				Bark - medium			Wood chips			Low content					Black
569															
570															
571															
572															
573															
574															
575															

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
576															
577															
578		Wood mixed					Wood chips			Low content			Brown		
579		Wood mixed			Bark - small		Wood chips					High content			Black
580															
581					Bark - small		Wood chips			Low content					Black
582		Wood mixed			Bark - small					Low content					Black
583															
584															
585															
586															
587		Wood mixed					Wood chips			Low content			Brown		
588															
589															
590															
591															
592															
593															
594		Wood mixed					Wood chips			Low content			Brown		
595				Bark - medium						Low content					Black
596															
597															
598					Bark - small			Sawdust		Low content					Black
599		Wood mixed			Bark - small		Wood chips			Low content			Brown		Black
600															
601															
602				Bark - medium						Low content					Black
603															
604				Bark - medium			Wood chips					High content	Brown		Black
605															
606		Wood mixed			Bark - small					Low content					Black
607															
608															
609					Bark - small		Wood chips				Medium content		Brown		
610															
611															
612															
613							Wood chips					High content			Black
614															
615					Bark - small					Low content					Black
616															
617															
618															
619															
620		Wood mixed		Bark - medium											Black
621															
622															
623		Wood mixed			Bark - small					Low content					Black

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
624															
625															
626															
627															
628															
629		Wood mixed			Bark - small					Low content					Black
630															
631															
632															
633															
634		Wood mixed			Bark - small					Low content					Black
635															
636															
637															
638															
639															
640															
641							Wood chips			Low content			Brown		
642															
643															
644															
645				Bark - medium							Medium content				Black
646		Wood mixed			Bark - small										Black
647															
648					Bark - small						Medium content				Black
649															
650		Wood mixed					Wood chips			Low content			Brown		
651															
652		Wood mixed					Wood chips			Low content			Brown		
653		Wood mixed					Wood chips			Low content			Brown		
654		Wood mixed		Bark - medium						Low content					Black
655	Wood buried			Bark - medium						Low content					Black
656															
657				Bark - medium			Wood chips					High content			Black
658		Wood mixed			Bark - small					Low content					Black
659															
660		Wood mixed			Bark - small		Wood chips			Low content					Black
661															
662															
663															
664															
665															
666															
667															
668					Bark - small					Low content					Black
669				Bark - medium								High content			Black
670															
671															

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
672															
673		Wood mixed					Wood chips			Low content			Brown		
674		Wood mixed					Wood chips			Low content			Brown		
675															
676															
677					Bark - small					Low content					Black
678		Wood mixed								Low content			Brown		
679															
680															
681															
682					Bark - small					Low content					Black
683		Wood mixed					Wood chips			Low content			Brown		
684															
685															
686															
687															
688															
689															
690															
691		Wood mixed		Bark - medium			Wood chips				Medium content		Brown		Black
692															
693															
694															
695		Wood mixed						Sawdust		Low content			Brown		
696		Wood mixed						Sawdust			Medium content		Brown		
697		Wood mixed			Bark - small		Wood chips					High content	Brown		
698		Wood mixed					Wood chips	Sawdust		Low content			Brown		
699															
700		Wood mixed					Wood chips			Low content			Brown		
701															
702															
703															
704															
705															
706															
707															
708															
709															
710															
711															
712															
713															
714															
715															
716		Wood mixed						Sawdust		Low content			Brown		
717		Wood mixed					Wood chips					High content	Brown		
718								Sawdust		Low content			Brown		
719															

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
720		Wood mixed			Bark - small		Wood chips				Medium content		Brown		Black
721		Wood mixed			Bark - small					Low content					Black
722															
723															
724															
725		Wood mixed			Bark - small		Wood chips			Low content					Black
726															
727															
728															
729															
730															
731		Wood mixed						Sawdust				High content	Brown		Black
732					Bark - small			Sawdust				High content			Black
733				Bark - medium			Wood chips					High content	Brown	Grey	Black
734															
735															
736															
737															
738															
739															
740															
741															
742															
743															
744															
745															
746															
747															
748															
749															
750															
751															
752															
753															
754															
755															
756															
757															
758															
759															
760															
761															
762															
763															
764															
765															
766															
767															

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
768															
769															
770															
771															
772															
773															
774															
775															
776															
777															
778															
779															
780															
781															
782															
783															
784															
785															
786															
787															
788															
790															
791															
792															
793															
794															
795															
796															
797															
798															
799															
800															
801		Wood mixed		Bark - medium								High content			Black
802							Wood chips	Sawdust				High content			Black
803															
804															
805		Wood mixed			Bark - small		Wood chips					High content	Brown		Black
806		Wood mixed			Bark - small		Wood chips	Sawdust				High content	Brown		
807		Wood mixed						Sawdust				High content			Black
808		Wood mixed		Bark - medium			Wood chips	Sawdust				High content	Brown		
809		Wood mixed			Bark - small		Wood chips					High content	Brown		Black
810		Wood mixed			Bark - small		Wood chips					High content	Brown		Black
811		Wood mixed					Wood chips					High content			Black
812		Wood mixed						Sawdust				High content	Brown		Black
1000															
1001															
1002															
1003															

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Buried	Mixed	Bark - Large	Bark - Medium	Bark - Small	Cedar	Wood Chips	Sawdust	Pulp Fibres	Low Content	Medium Content	High Content	Brown	Grey	Black
1004															
1005															
1006															
1007															
1008															
1009															
1010															
1011															
1012															
1013															
1014															
1015															
1016															
1017															
1018															
1019															
1020															
1021															
1022															
1023															
1024															
1025															
1026															
1027															
1030															
1031										Low content					
1032															
1033															
1034															
1035															
1036															

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Olive Green	No Decomposition	Low Decomposition	Medium Decompostion	High Decomposition	No Teredos	Low Infestation	Medium Infestation	High Infestation
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26				Medium decomposition		No teredos			
27			Low decomposition				Low infestation		
28					High decomposition				High infestation
29				Medium decomposition					High infestation
30				Medium decomposition					High infestation
31				Medium decomposition					High infestation
32				Medium decomposition		No teredos			
33									
34									
35									
36			Low decomposition			No teredos			
37									
38									
39									
40									
41				Medium decomposition					High infestation
42					High decomposition			Medium infestation	
43			Low decomposition					Medium infestation	
44				Medium decomposition		No teredos			
45					High decomposition				High infestation
46			Low decomposition			No teredos			
47			Low decomposition			No teredos			

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	**Olive Green**	**No Decomposition**	**Low Decomposition**	**Medium Decompostion**	**High Decomposition**	**No Teredos**	**Low Infestation**	**Medium Infestation**	**High Infestation**
48									
49			Low decomposition			No teredos			
50									
51				Medium decomposition		No teredos			
52			Low decomposition		27 High infestation				
53									
54									
55									
56									
57									
58									
59									
60									
61									
62									
63									
64									
65									
66					High decomposition			Medium infestation	
67									
68				Medium decomposition		No teredos			
69				Medium decomposition		No teredos			
70			Low decomposition			No teredos			
71				Medium decomposition		No teredos			
72			Low decomposition			No teredos			
73			Low decomposition			No teredos			
74				Medium decomposition		No teredos			
75				Medium decomposition		No teredos			
76			Low decomposition			No teredos			
77									
78									
79									
80									
81									
82									
83									
84	Olive green	No decomposition				No teredos			
85									
86									
87									
88									
89			Low decomposition			No teredos			
90									
91									
92									
93									
94									
95									

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Olive Green	No Decomposition	Low Decomposition	Medium Decompostion	High Decomposition	No Teredos	Low Infestation	Medium Infestation	High Infestation
96									
97									
98									
99									
100									
101				Medium decomposition		No teredos			
102			Low decomposition		High decomposition	No teredos			
103				Medium decomposition		No teredos			
104				Medium decomposition		No teredos			
105				Medium decomposition		No teredos			
106	Olive green			Medium decomposition		No teredos			
107			Low decomposition			No teredos			
108									
109									
110									
111									
112									
113									
114			Low decomposition			No teredos			
115			Low decomposition					Medium infestation	
116			Low decomposition			No teredos			
117									
118			Low decomposition			No teredos			
119				Medium decomposition					
120									
121									
122									
123									
124									
125									
126									
127									
128									
129									
130									
131									
132									
133									
134									
135				Medium decomposition		No teredos			
136		No decomposition				No teredos			
137									
138									
139									
140					High decomposition	No teredos			
141				Medium decomposition		No teredos			
142				Medium decomposition				Medium infestation	
143				Medium decomposition					

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Olive Green	No Decomposition	Low Decomposition	Medium Decompostion	High Decomposition	No Teredos	Low Infestation	Medium Infestation	High Infestation
144					High decomposition				High infestation
145				Medium decomposition		No teredos			
146			Low decomposition			No teredos			
147			Low decomposition			No teredos			
148									
149									
150									
151				Medium decomposition		No teredos			
152									
153									
154									
155									
156				Medium decomposition		No teredos			
157									
158									
159									
160									
161									
162									
163									
164									
165									
166									
167									
168									
169									
170									
171									
172									
173									
174									
175			Low decomposition			No teredos			
176			Low decomposition			No teredos			
177		No decomposition				No teredos			
178				Medium decomposition					
179		No decomposition				No teredos			
180				Medium decomposition		No teredos			
181				Medium decomposition		No teredos			
182			Low decomposition			No teredos			
183					High decomposition			Medium infestation	
184				Medium decomposition		No teredos			
185				Medium decomposition		No teredos			
186			Low decomposition			No teredos			
187									
188			Low decomposition			No teredos			
189									
190									
191				Medium decomposition		No teredos			

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Olive Green	No Decomposition	Low Decomposition	Medium Decompostion	High Decomposition	No Teredos	Low Infestation	Medium Infestation	High Infestation
192									
193									
194									
195									
196									
197									
198									
199									
200									
201									
202									
203									
204									
205									
206									
207									
208									
209									
210									
211									
212									
213									
214									
215									
216			Low decomposition						
217									
218		No decomposition							
219									
220				Medium decomposition		No teredos			
221			Low decomposition			No teredos			
222									
223					High decomposition	No teredos			
224				Medium decomposition	27 High infestation				
225				Medium decomposition	27 High infestation				
226				Medium decomposition					High infestation
227									
228			Low decomposition			No teredos			
229				Medium decomposition		No teredos			
230			Low decomposition			No teredos			
231									
232			Low decomposition			No teredos			
233									
234					High decomposition	No teredos			
235									
236									
237									
238									
239									

APPENDIX II: Sediment sample positions and descriptors									
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.									
Id									
	Olive Green	No Decomposition	Low Decomposition	Medium Decompostion	High Decomposition	No Teredos	Low Infestation	Medium Infestation	High Infestation
240					High decomposition	No teredos			
241									
242				Medium decomposition					
243									
244									
245									
246									
247									
248		No decomposition				No teredos			
249									
250									
251									
252									
253									
254									
255									
256									
257									
258									
259									
260									
261									
262					High decomposition	No teredos			
263					High decomposition	No teredos			
264					High decomposition	No teredos			
265				Medium decomposition					
266				Medium decomposition					High infestation
267					High decomposition	No teredos			
268									
269									
270									
271			Low decomposition			No teredos			
272									
273									
274					High decomposition		Low infestation		
275									
276									
277									
278									
279									
280									
281			Low decomposition			No teredos			
282									
283									
284									
285									
286					High decomposition			Medium infestation	
287									

APPENDIX II: Sediment sample positions and descriptors									
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.									
Id									
	Olive Green	**No Decomposition**	**Low Decomposition**	**Medium Decompostion**	**High Decomposition**	**No Teredos**	**Low Infestation**	**Medium Infestation**	**High Infestation**
288									
289									
290									
291									
292									
293									
294									
295									
296									
297									
298									
299									
300									
301									
302									
303					High decomposition	No teredos			
304					High decomposition	No teredos			
305					High decomposition	No teredos			
306					High decomposition	No teredos			
307					High decomposition				
308				Medium decomposition		No teredos			
309									
310									
311				Medium decomposition		No teredos			
312			Low decomposition			No teredos			
313									
314									
315			Low decomposition			No teredos			
316									
317									
318									
319									
320									
321									
322									
323									
324			Low decomposition			No teredos			
325									
326									
327				Medium decomposition		No teredos			
328									
329									
330									
331									
332									
333									
334				Medium decomposition		No teredos			
335				Medium decomposition		No teredos			

APPENDIX II: Sediment sample positions and descriptors									
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.									
Id									
	Olive Green	**No Decomposition**	**Low Decomposition**	**Medium Decompostion**	**High Decomposition**	**No Teredos**	**Low Infestation**	**Medium Infestation**	**High Infestation**
336				Medium decomposition		No teredos			
337				Medium decomposition		No teredos			
338									
339									
340			Low decomposition			No teredos			
341									
342									
343									
344				Medium decomposition		No teredos			
345				Medium decomposition		No teredos			
346				Medium decomposition		No teredos			
347									
348				Medium decomposition		No teredos			
349									
350									
351									
352									
353									
354									
355									
356					High decomposition			Medium infestation	
357									
358									
359				Medium decomposition		No teredos			
360									
361									
362									
363									
364									
365									
366				Medium decomposition		No teredos			
367									
368									
369									
370									
371									
372									
373									
374									
375									
376				Medium decomposition		No teredos			
377									
378				Medium decomposition		No teredos			
379				Medium decomposition		No teredos			
380									
381				Medium decomposition			Low infestation		
382									
383									

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	**Olive Green**	**No Decomposition**	**Low Decomposition**	**Medium Decompostion**	**High Decomposition**	**No Teredos**	**Low Infestation**	**Medium Infestation**	**High Infestation**
384									
385				Medium decomposition		No teredos			
386				Medium decomposition		No teredos			
387									
388				Medium decomposition			Low infestation		
389				Medium decomposition		No teredos			
390									
391									
392				Medium decomposition		No teredos			
393									
394									
395									
396									
397									
398				Medium decomposition				Medium infestation	
399				Medium decomposition		No teredos			
400									
401									
402									
403									
404									
405									
406									
407									
408									
409									
410									
411									
412									
413									
414									
415									
416									
417									
418									
419									
420									
421									
422					High decomposition				
423									
424									
425									
426									
427									
428									
429				Medium decomposition		No teredos			
430									
431			Low decomposition			No teredos			

APPENDIX II: Sediment sample positions and descriptors									
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.									
Id									
	Olive Green	No Decomposition	Low Decomposition	Medium Decompostion	High Decomposition	No Teredos	Low Infestation	Medium Infestation	High Infestation
432									
433									
434									
435									
436									
437					High decomposition	No teredos			
438									
439									
440									
441									
442									
443									
444									
445									
446									
447									
448									
449									
450									
451				Medium decomposition		No teredos			
452									
453									
454									
455									
456									
457									
458					High decomposition	No teredos			
459									
460			Low decomposition			No teredos			
461									
462									
463									
464									
465									
466									
467	Olive green			Medium decomposition			Low infestation		
468				Medium decomposition			Low infestation		
469									
470									
471				Medium decomposition		No teredos			
472			Low decomposition			No teredos			
473			Low decomposition			No teredos			
474									
475									
476					High decomposition			Medium infestation	
477									
478									
479									

APPENDIX II: Sediment sample positions and descriptors									
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.									
Id									
	Olive Green	No Decomposition	Low Decomposition	Medium Decompostion	High Decomposition	No Teredos	Low Infestation	Medium Infestation	High Infestation
480									
481									
482									
483				Medium decomposition		No teredos			
484									
485									
486			Low decomposition			No teredos			
487					High decomposition	No teredos			
488					High decomposition				
489									
490				Medium decomposition		No teredos			
491									
492									
493				Medium decomposition		No teredos			
494									
495				Medium decomposition		No teredos			
496									
497									
498									
499									
500									
501									
502									
503									
504									
505					High decomposition	No teredos			
506				Medium decomposition			Low infestation		
507	Olive green				High decomposition	No teredos			
508				Medium decomposition		No teredos			
509				Medium decomposition		No teredos			
510			Low decomposition			No teredos			
511			Low decomposition			No teredos			
512				Medium decomposition				Medium infestation	
513					High decomposition	No teredos			
514				Medium decomposition		No teredos			
515									
516					High decomposition	No teredos			
517									
518									
519									
520									
521									
522			Low decomposition			No teredos			
523									
524									
525									
526									
527									

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Olive Green	No Decomposition	Low Decomposition	Medium Decompostion	High Decomposition	No Teredos	Low Infestation	Medium Infestation	High Infestation
528				Medium decomposition					
529									
530									
531									
532				Medium decomposition		No teredos			
533				Medium decomposition		No teredos			
534									
535									
536			Low decomposition			No teredos			
537									
538									
539									
540									
541									
542									
543					High decomposition	No teredos			
544					High decomposition	No teredos			
545					High decomposition	No teredos			
546				Medium decomposition		No teredos			
547									
548					High decomposition		Low infestation		
549					High decomposition	No teredos			
550					High decomposition			Medium infestation	
551									
552									
553									
554									
555									
556									
557									
558									
559									
560									
561			Low decomposition			No teredos			
562									
563					High decomposition		Low infestation		
564				Medium decomposition			Low infestation		
565				Medium decomposition					
566									
567				Medium decomposition	27 High infestation				
568				Medium decomposition		No teredos			
569									
570									
571									
572									
573									
574									
575									

APPENDIX II: Sediment sample positions and descriptors								
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.								
Id								
	Olive Green	No Decomposition	Low Decomposition	Medium Decompostion	High Decomposition	No Teredos	Low Infestation	Medium Infestation	High Infestation
576									
577									
578			Low decomposition			No teredos			
579			Low decomposition			No teredos			
580									
581	Olive green		Low decomposition				Low infestation		
582			Low decomposition			No teredos			
583									
584									
585									
586									
587				Medium decomposition		No teredos			
588									
589									
590									
591									
592									
593									
594				Medium decomposition		No teredos			
595		No decomposition				No teredos			
596									
597									
598				Medium decomposition		No teredos			
599				Medium decomposition		No teredos			
600									
601									
602				Medium decomposition		No teredos			
603									
604				Medium decomposition				Medium infestation	
605									
606				Medium decomposition		No teredos			
607									
608									
609		No decomposition				No teredos			
610									
611									
612									
613					High decomposition			Medium infestation	
614									
615			Low decomposition			No teredos			
616									
617									
618									
619									
620						No teredos			
621									
622									
623				Medium decomposition		No teredos			

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	**Olive Green**	**No Decomposition**	**Low Decomposition**	**Medium Decompostion**	**High Decomposition**	**No Teredos**	**Low Infestation**	**Medium Infestation**	**High Infestation**
624									
625									
626									
627									
628									
629			Low decomposition			No teredos			
630									
631									
632									
633									
634					High decomposition	No teredos			
635									
636									
637									
638									
639									
640									
641					High decomposition	No teredos			
642									
643									
644									
645			Low decomposition			No teredos			
646			Low decomposition			No teredos			
647									
648			Low decomposition						
649									
650					High decomposition		Low infestation		
651									
652					High decomposition	No teredos			
653				Medium decomposition				Medium infestation	
654			Low decomposition						
655			Low decomposition			No teredos			
656									
657				Medium decomposition		No teredos			
658				Medium decomposition		No teredos			
659									
660				Medium decomposition			Low infestation		
661									
662									
663									
664									
665									
666									
667									
668			Low decomposition			No teredos			
669				Medium decomposition		No teredos			
670									
671									

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Olive Green	No Decomposition	Low Decomposition	Medium Decompostion	High Decomposition	No Teredos	Low Infestation	Medium Infestation	High Infestation
672									
673				Medium decomposition		No teredos			
674				Medium decomposition					
675									
676									
677				Medium decomposition		No teredos			
678			Low decomposition			No teredos			
679									
680									
681									
682				Medium decomposition		No teredos			
683					High decomposition	No teredos			
684									
685									
686									
687									
688									
689									
690									
691				Medium decomposition				Medium infestation	
692									
693									
694									
695				Medium decomposition		No teredos			
696				Medium decomposition		No teredos			
697			Low decomposition				Low infestation		
698				Medium decomposition		No teredos			
699									
700				Medium decomposition				Medium infestation	
701									
702									
703									
704									
705									
706									
707									
708									
709									
710									
711									
712									
713									
714									
715									
716				Medium decomposition		No teredos		Medium infestation	
717							Low infestation		
718				Medium decomposition		No teredos			
719									

APPENDIX II: Sediment sample positions and descriptors									
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.									
Id									
	Olive Green	**No Decomposition**	**Low Decomposition**	**Medium Decompostion**	**High Decomposition**	**No Teredos**	**Low Infestation**	**Medium Infestation**	**High Infestation**
720				Medium decomposition		No teredos			
721			Low decomposition			No teredos			
722									
723									
724									
725					High decomposition	No teredos			
726									
727									
728									
729									
730									
731						No teredos			
732				Medium decomposition		No teredos			
733				Medium decomposition		No teredos			
734									
735									
736									
737									
738									
739									
740									
741									
742									
743									
744									
745									
746									
747									
748									
749									
750									
751									
752									
753									
754									
755									
756									
757									
758									
759									
760									
761									
762									
763									
764									
765									
766									
767									

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	**Olive Green**	**No Decomposition**	**Low Decomposition**	**Medium Decompostion**	**High Decomposition**	**No Teredos**	**Low Infestation**	**Medium Infestation**	**High Infestation**
768									
769									
770									
771									
772									
773									
774									
775									
776									
777									
778									
779									
780									
781									
782									
783									
784									
785									
786									
787									
788									
790									
791									
792									
793									
794									
795									
796									
797									
798									
799									
800									
801			Low decomposition			No teredos			
802				Medium decomposition	27 High infestation				
803									
804									
805				Medium decomposition			Low infestation		
806				Medium decomposition		No teredos			
807					High decomposition	No teredos			
808					High decomposition		Low infestation		
809				Medium decomposition			Low infestation		
810				Medium decomposition				Medium infestation	
811			Low decomposition			No teredos			
812				Medium decomposition					High infestation
1000									
1001									
1002									
1003									

APPENDIX II: Sediment sample positions and descriptors									
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.									
Id									
	Olive Green	**No Decomposition**	**Low Decomposition**	**Medium Decompostion**	**High Decomposition**	**No Teredos**	**Low Infestation**	**Medium Infestation**	**High Infestation**
1004									
1005									
1006									
1007									
1008									
1009									
1010									
1011									
1012									
1013									
1014									
1015									
1016									
1017									
1018									
1019									
1020									
1021									
1022									
1023									
1024									
1025									
1026									
1027									
1030									
1031									
1032									
1033									
1034									
1035									
1036									

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Wood in worm tubes	Worm Tubes	Sea Weed	Broken Shells	Live Shells	Large Clasts	Extreme Odor
1			Sea weed				
2					Live shells		
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21					Live shells		
22							
23							
24							
25							
26	Wood in worm tubes	Worm tubes		Broken shells			
27		Worm tubes		Broken shells			
28		Worm tubes		Broken shells			
29		Worm tubes		Broken shells			
30			Sea weed	Broken shells			
31	Wood in worm tubes						
32		Worm tubes	Sea weed	Broken shells	Live shells		
33				Broken shells			
34			Sea weed				
35			Sea weed			Large clasts	
36			Sea weed				
37			Sea weed	Broken shells			
38							
39							
40		Worm tubes	Sea weed	Broken shells			
41		Worm tubes	Sea weed				
42							
43					Live shells		
44		Worm tubes					
45		Worm tubes					
46		Worm tubes		Broken shells			
47				Broken shells			

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Wood in worm tubes	Worm Tubes	Sea Weed	Broken Shells	Live Shells	Large Clasts	Extreme Odor
48		Worm tubes					
49				Broken shells			
50							
51		Worm tubes		Broken shells			
52				Broken shells			
53							
54				Broken shells			
55							
56							
57							
58							
59							
60							
61							
62		Worm tubes	Sea weed				
63				Broken shells			
64							
65				Broken shells			
66			Sea weed				
67			Sea weed	Broken shells			
68		Worm tubes	Sea weed	Broken shells			
69							Extreme Odor
70		Worm tubes					
71		Worm tubes					
72		Worm tubes					
73		Worm tubes					
74		Worm tubes					
75		Worm tubes					
76		Worm tubes		Broken shells	Live shells		
77							
78		Worm tubes					
79		Worm tubes					
80		Worm tubes		Broken shells			
81		Worm tubes		Broken shells			
82		Worm tubes		Broken shells			
83		Worm tubes		Broken shells			
84							
85							Extreme Odor
86							Extreme Odor
87							
88				Broken shells			
89		Worm tubes		Broken shells			
90							
91					Live shells		
92		Worm tubes		Broken shells			
93		Worm tubes					
94		Worm tubes					
95		Worm tubes					

APPENDIX II: Sediment sample positions and descriptors							
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.							
Id							
	Wood in worm tubes	Worm Tubes	Sea Weed	Broken Shells	Live Shells	Large Clasts	Extreme Odor
96							
97						Large clasts	
98							
99		Worm tubes		Broken shells	Live shells		
100							
101				Broken shells			
102							Extreme Odor
103		Worm tubes		Broken shells			
104		Worm tubes		Broken shells			
105			Sea weed				
106		Worm tubes					
107		Worm tubes					
108							
109							
110		Worm tubes	Sea weed				
111		Worm tubes					
112		Worm tubes		Broken shells			
113		Worm tubes					
114		Worm tubes		Broken shells			
115		Worm tubes					
116		Worm tubes		Broken shells			
117		Worm tubes		Broken shells			
118		Worm tubes		Broken shells			
119		Worm tubes		Broken shells			
120		Worm tubes		Broken shells			
121		Worm tubes		Broken shells			
122		Worm tubes					
123							
124		Worm tubes					
125			Sea weed				
126		Worm tubes		Broken shells	Live shells		
127		Worm tubes		Broken shells	Live shells		
128		Worm tubes					
129					Live shells		
130		Worm tubes			Live shells		
131		Worm tubes		Broken shells			
132		Worm tubes		Broken shells	Live shells		
133		Worm tubes		Broken shells			
134							
135							
136				Broken shells			
137		Worm tubes		Broken shells	Live shells		
138		Worm tubes		Broken shells			
139							
140						Large clasts	
141							Extreme Odor
142							
143							

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Wood in worm tubes	Worm Tubes	Sea Weed	Broken Shells	Live Shells	Large Clasts	Extreme Odor
144			Sea weed				
145							
146							
147				Broken shells			
148							
149							
150		Worm tubes					Extreme Odor
151		Worm tubes					
152		Worm tubes					
153		Worm tubes					
154		Worm tubes		Broken shells			
155		Worm tubes		Broken shells			
156		Worm tubes		Broken shells			
157		Worm tubes		Broken shells			
158		Worm tubes		Broken shells			
159		Worm tubes		Broken shells	Live shells		
160		Worm tubes		Broken shells	Live shells		
161		Worm tubes		Broken shells	Live shells		
162		Worm tubes					
163		Worm tubes		Broken shells	Live shells		
164				Broken shells			
165							
166		Worm tubes		Broken shells	Live shells		
167		Worm tubes			Live shells		
168		Worm tubes			Live shells		
169		Worm tubes			Live shells		
170		Worm tubes		Broken shells	Live shells		
171		Worm tubes		Broken shells	Live shells		
172							
173				Broken shells			
174		Worm tubes		Broken shells			
175		Worm tubes		Broken shells			
176		Worm tubes		Broken shells	Live shells		
177		Worm tubes	Sea weed	Broken shells	Live shells		
178				Broken shells			
179		Worm tubes		Broken shells			
180							
181							Extreme Odor
182		Worm tubes		Broken shells			
183		Worm tubes					
184		Worm tubes		Broken shells			
185							Extreme Odor
186							
187		Worm tubes					
188		Worm tubes		Broken shells			
189		Worm tubes		Broken shells			
190		Worm tubes		Broken shells	Live shells		
191		Worm tubes		Broken shells			

	APPENDIX II: Sediment sample positions and descriptors						
	Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.						
	Id						
	Wood in worm tubes	**Worm Tubes**	**Sea Weed**	**Broken Shells**	**Live Shells**	**Large Clasts**	**Extreme Odor**
192				Broken shells			
193		Worm tubes		Broken shells			
194		Worm tubes		Broken shells			
195		Worm tubes		Broken shells			
196		Worm tubes					
197							
198		Worm tubes					
199		Worm tubes					
200		Worm tubes		Broken shells			
201		Worm tubes		Broken shells			
202		Worm tubes		Broken shells	Live shells		
203		Worm tubes			Live shells		
204		Worm tubes		Broken shells			
205		Worm tubes		Broken shells			
206				Broken shells	Live shells		
207		Worm tubes		Broken shells	Live shells		
208		Worm tubes		Broken shells	Live shells		
209		Worm tubes			Live shells		
210	Wood in worm tubes						
211							
212		Worm tubes					
213		Worm tubes					
214		Worm tubes					
215			Sea weed				
216		Worm tubes		Broken shells			
217		Worm tubes		Broken shells			
218	Wood in worm tubes	Worm tubes		Broken shells			
219							
220						Large clasts	
221							
222							
223							
224		Worm tubes		Broken shells			
225		Worm tubes					
226		Worm tubes					
227		Worm tubes		Broken shells			
228				Broken shells	Live shells		
229		Worm tubes					
230							
231		Worm tubes					
232				Broken shells			
233							
234				Broken shells			
235				Broken shells			
236		Worm tubes					
237		Worm tubes		Broken shells			
238		Worm tubes		Broken shells			
239		Worm tubes		Broken shells			

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Wood in worm tubes	Worm Tubes	Sea Weed	Broken Shells	Live Shells	Large Clasts	Extreme Odor
240				Broken shells			
241		Worm tubes		Broken shells			
242		Worm tubes		Broken shells			
243		Worm tubes		Broken shells			
244		Worm tubes		Broken shells			
245		Worm tubes		Broken shells			
246							
247		Worm tubes		Broken shells	Live shells		
248		Worm tubes		Broken shells			
249		Worm tubes		Broken shells	Live shells		
250		Worm tubes		Broken shells			
251		Worm tubes		Broken shells			
252				Broken shells			
253		Worm tubes		Broken shells			
254				Broken shells			
255				Broken shells			
256		Worm tubes					
257		Worm tubes					
258							
259				Broken shells			
260		Worm tubes		Broken shells			
261		Worm tubes		Broken shells			
262			Sea weed	Broken shells			
263				Broken shells			
264							Extreme Odor
265		Worm tubes		Broken shells			
266		Worm tubes					Extreme Odor
267		Worm tubes					
268		Worm tubes					
269		Worm tubes		Broken shells			
270		Worm tubes					
271							
272		Worm tubes		Broken shells		Large clasts	
273		Worm tubes					
274							
275				Broken shells			
276		Worm tubes		Broken shells			
277		Worm tubes		Broken shells			
278		Worm tubes					
279				Broken shells			
280							
281				Broken shells			
282		Worm tubes		Broken shells			
283							
284				Broken shells			
285		Worm tubes					
286		Worm tubes		Broken shells			
287							

APPENDIX II: Sediment sample positions and descriptors							
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.							
Id							
	Wood in worm tubes	**Worm Tubes**	**Sea Weed**	**Broken Shells**	**Live Shells**	**Large Clasts**	**Extreme Odor**
288				Broken shells			
289				Broken shells			
290				Broken shells			
291		Worm tubes		Broken shells			
292				Broken shells			
293			Sea weed	Broken shells			
294		Worm tubes		Broken shells			
295	Wood in worm tubes			Broken shells			
296		Worm tubes		Broken shells			
297			Sea weed	Broken shells			
298		Worm tubes		Broken shells			
299				Broken shells			
300		Worm tubes		Broken shells			
301	Wood in worm tubes	Worm tubes					
302	Wood in worm tubes	Worm tubes					
303							
304							
305							
306		Worm tubes		Broken shells		Large clasts	
307		Worm tubes					
308		Worm tubes		Broken shells			
309		Worm tubes					
310		Worm tubes					
311		Worm tubes					
312		Worm tubes		Broken shells			
313		Worm tubes		Broken shells			
314							
315							
316		Worm tubes					
317				Broken shells			
318		Worm tubes		Broken shells			
319		Worm tubes		Broken shells			
320		Worm tubes		Broken shells			
321		Worm tubes					
322		Worm tubes		Broken shells			
323		Worm tubes		Broken shells			
324				Broken shells			
325		Worm tubes		Broken shells			
326		Worm tubes		Broken shells			
327		Worm tubes		Broken shells			
328		Worm tubes		Broken shells			
329		Worm tubes		Broken shells			
330		Worm tubes		Broken shells			
331				Broken shells			
332		Worm tubes					
333				Broken shells			
334		Worm tubes		Broken shells			
335	Wood in worm tubes			Broken shells			

APPENDIX II: Sediment sample positions and descriptors							
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.							
Id							
	Wood in worm tubes	Worm Tubes	Sea Weed	Broken Shells	Live Shells	Large Clasts	Extreme Odor
336		Worm tubes		Broken shells			
337				Broken shells			
338		Worm tubes		Broken shells			
339		Worm tubes			Live shells		
340	Wood in worm tubes			Broken shells			
341		Worm tubes	Sea weed	Broken shells			
342		Worm tubes	Sea weed	Broken shells		Large clasts	
343		Worm tubes	Sea weed				
344				Broken shells			
345				Broken shells			Extreme Odor
346				Broken shells			
347		Worm tubes					
348		Worm tubes					
349		Worm tubes					
350		Worm tubes		Broken shells			
351		Worm tubes		Broken shells			
352		Worm tubes					
353		Worm tubes		Broken shells			
354		Worm tubes					
355		Worm tubes					
356		Worm tubes					
357		Worm tubes					
358		Worm tubes		Broken shells			
359		Worm tubes		Broken shells			
360		Worm tubes		Broken shells			
361		Worm tubes					
362		Worm tubes		Broken shells			
363							
364		Worm tubes		Broken shells			
365		Worm tubes		Broken shells			
366		Worm tubes		Broken shells			
367		Worm tubes		Broken shells			
368		Worm tubes		Broken shells			
369		Worm tubes		Broken shells			
370		Worm tubes		Broken shells			
371		Worm tubes					
372		Worm tubes	Sea weed				
373		Worm tubes		Broken shells			
374				Broken shells			
375		Worm tubes		Broken shells			
376		Worm tubes		Broken shells			
377	Wood in worm tubes	Worm tubes		Broken shells		Large clasts	
378	Wood in worm tubes	Worm tubes		Broken shells			
379		Worm tubes		Broken shells			
380		Worm tubes		Broken shells		Large clasts	
381		Worm tubes	Sea weed	Broken shells			
382		Worm tubes		Broken shells			
383		Worm tubes	Sea weed				

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Wood in worm tubes	Worm Tubes	Sea Weed	Broken Shells	Live Shells	Large Clasts	Extreme Odor
384		Worm tubes					
385				Broken shells			Extreme Odor
386							
387							
388							
389		Worm tubes					
390		Worm tubes					
391		Worm tubes					
392		Worm tubes					
393		Worm tubes		Broken shells			
394							
395				Broken shells			
396		Worm tubes					
397		Worm tubes		Broken shells			
398		Worm tubes		Broken shells			
399		Worm tubes					
400		Worm tubes					
401				Broken shells			
402		Worm tubes		Broken shells			
403		Worm tubes					
404		Worm tubes		Broken shells			
405		Worm tubes		Broken shells			
406			Sea weed				
407		Worm tubes		Broken shells			
408		Worm tubes		Broken shells			
409		Worm tubes		Broken shells			
410		Worm tubes					
411		Worm tubes		Broken shells			
412		Worm tubes		Broken shells			
413		Worm tubes		Broken shells			
414		Worm tubes		Broken shells			
415	Wood in worm tubes	Worm tubes		Broken shells			
416		Worm tubes		Broken shells			
417	Wood in worm tubes	Worm tubes		Broken shells			
418		Worm tubes	Sea weed			Large clasts	
419		Worm tubes	Sea weed	Broken shells			
420		Worm tubes		Broken shells			
421		Worm tubes		Broken shells			
422		Worm tubes		Broken shells			
423		Worm tubes		Broken shells			
424	Wood in worm tubes	Worm tubes					
425			Sea weed	Broken shells			
426							
427		Worm tubes					
428		Worm tubes		Broken shells			
429		Worm tubes		Broken shells			
430		Worm tubes					
431				Broken shells			

APPENDIX II: Sediment sample positions and descriptors							
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.							
Id							
	Wood in worm tubes	**Worm Tubes**	**Sea Weed**	**Broken Shells**	**Live Shells**	**Large Clasts**	**Extreme Odor**
432		Worm tubes		Broken shells			
433		Worm tubes					
434		Worm tubes					
435		Worm tubes					
436		Worm tubes		Broken shells			
437				Broken shells			
438		Worm tubes					
439		Worm tubes					
440		Worm tubes		Broken shells			
441		Worm tubes					
442		Worm tubes					
443		Worm tubes					
444		Worm tubes					
445			Sea weed				
446							
447		Worm tubes		Broken shells			
448		Worm tubes					
449		Worm tubes	Sea weed				
450			Sea weed	Broken shells			
451			Sea weed				
452		Worm tubes	Sea weed				
453		Worm tubes	Sea weed	Broken shells			
454		Worm tubes		Broken shells			
455			Sea weed				
456			Sea weed	Broken shells			
457			Sea weed	Broken shells			
458				Broken shells			
459		Worm tubes	Sea weed	Broken shells			
460			Sea weed	Broken shells			
461		Worm tubes		Broken shells		Large clasts	
462		Worm tubes	Sea weed				
463				Broken shells			
464							
465							
466		Worm tubes					
467		Worm tubes		Broken shells			
468							
469		Worm tubes					
470		Worm tubes		Broken shells			
471		Worm tubes		Broken shells			
472		Worm tubes		Broken shells		Large clasts	
473		Worm tubes					
474		Worm tubes					
475		Worm tubes		Broken shells			
476		Worm tubes					
477		Worm tubes		Broken shells			
478		Worm tubes		Broken shells			
479		Worm tubes		Broken shells		Large clasts	

APPENDIX II: Sediment sample positions and descriptors							
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.							
Id							
	Wood in worm tubes	**Worm Tubes**	**Sea Weed**	**Broken Shells**	**Live Shells**	**Large Clasts**	**Extreme Odor**
480		Worm tubes		Broken shells			
481		Worm tubes					
482		Worm tubes					
483		Worm tubes					
484		Worm tubes		Broken shells			
485			Sea weed				
486		Worm tubes	Sea weed	Broken shells			
487		Worm tubes					
488		Worm tubes	Sea weed	Broken shells			
489		Worm tubes	Sea weed				
490		Worm tubes	Sea weed				
491		Worm tubes	Sea weed				
492		Worm tubes	Sea weed				
493		Worm tubes		Broken shells			
494			Sea weed				Extreme Odor
495		Worm tubes		Broken shells			
496						Large clasts	
497		Worm tubes	Sea weed	Broken shells			
498		Worm tubes		Broken shells			
499		Worm tubes	Sea weed	Broken shells			
500		Worm tubes		Broken shells			
501		Worm tubes		Broken shells		Large clasts	
502		Worm tubes	Sea weed	Broken shells			
503				Broken shells			Extreme Odor
504		Worm tubes		Broken shells			
505							
506		Worm tubes		Broken shells	Live shells		
507				Broken shells			Extreme Odor
508							
509		Worm tubes					
510		Worm tubes		Broken shells			
511		Worm tubes		Broken shells			
512		Worm tubes		Broken shells			
513		Worm tubes		Broken shells			
514		Worm tubes					
515		Worm tubes					
516		Worm tubes					
517		Worm tubes		Broken shells			
518		Worm tubes					
519		Worm tubes					
520		Worm tubes					
521		Worm tubes					
522		Worm tubes	Sea weed				
523			Sea weed	Broken shells			
524		Worm tubes	Sea weed				
525		Worm tubes					
526		Worm tubes	Sea weed	Broken shells			
527		Worm tubes					

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Wood in worm tubes	Worm Tubes	Sea Weed	Broken Shells	Live Shells	Large Clasts	Extreme Odor
528							
529		Worm tubes	Sea weed	Broken shells			
530		Worm tubes	Sea weed				
531		Worm tubes		Broken shells	Live shells		
532		Worm tubes					
533		Worm tubes	Sea weed			Large clasts	
534		Worm tubes	Sea weed	Broken shells			
535		Worm tubes	Sea weed				
536		Worm tubes	Sea weed	Broken shells			
537		Worm tubes	Sea weed	Broken shells			
538		Worm tubes					
539		Worm tubes					
540		Worm tubes	Sea weed				
541							
542							
543							Extreme Odor
544							Extreme Odor
545							
546							
547				Broken shells		Large clasts	
548							
549							
550		Worm tubes					
551		Worm tubes					
552		Worm tubes					
553		Worm tubes					
554		Worm tubes					
555		Worm tubes					
556		Worm tubes					
557		Worm tubes					
558		Worm tubes	Sea weed	Broken shells			
559		Worm tubes	Sea weed	Broken shells			
560		Worm tubes	Sea weed				
561			Sea weed				
562		Worm tubes		Broken shells			
563		Worm tubes	Sea weed	Broken shells			
564		Worm tubes	Sea weed	Broken shells			
565							
566		Worm tubes		Broken shells		Large clasts	
567		Worm tubes		Broken shells		Large clasts	
568		Worm tubes	Sea weed	Broken shells			
569		Worm tubes	Sea weed	Broken shells			
570		Worm tubes	Sea weed				
571		Worm tubes	Sea weed				
572				Broken shells		Large clasts	
573		Worm tubes		Broken shells			
574		Worm tubes	Sea weed	Broken shells			
575		Worm tubes	Sea weed	Broken shells			

APPENDIX II: Sediment sample positions and descriptors							
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.							
Id							
	Wood in worm tubes	Worm Tubes	Sea Weed	Broken Shells	Live Shells	Large Clasts	Extreme Odor
576		Worm tubes	Sea weed				
577		Worm tubes	Sea weed				
578		Worm tubes		Broken shells			
579							
580		Worm tubes	Sea weed				
581		Worm tubes		Broken shells			
582		Worm tubes	Sea weed				
583		Worm tubes	Sea weed				
584			Sea weed	Broken shells			
585		Worm tubes	Sea weed				
586			Sea weed				
587		Worm tubes	Sea weed				
588			Sea weed				
589		Worm tubes	Sea weed				
590		Worm tubes					
591		Worm tubes					
592			Sea weed	Broken shells			
593		Worm tubes	Sea weed				
594		Worm tubes	Sea weed			Large clasts	
595		Worm tubes	Sea weed	Broken shells			
596			Sea weed				
597			Sea weed				
598		Worm tubes		Broken shells		Large clasts	
599		Worm tubes	Sea weed		Live shells		
600		Worm tubes	Sea weed			Large clasts	
601		Worm tubes	Sea weed		Live shells		
602		Worm tubes	Sea weed	Broken shells			
603		Worm tubes	Sea weed				
604		Worm tubes	Sea weed				
605		Worm tubes	Sea weed	Broken shells			
606		Worm tubes	Sea weed	Broken shells			
607		Worm tubes	Sea weed		Live shells		
608		Worm tubes	Sea weed	Broken shells	Live shells		
609		Worm tubes					
610		Worm tubes		Broken shells			
611		Worm tubes	Sea weed				
612		Worm tubes	Sea weed				
613				Broken shells		Large clasts	
614		Worm tubes	Sea weed	Broken shells			
615		Worm tubes	Sea weed	Broken shells			
616		Worm tubes	Sea weed				
617		Worm tubes	Sea weed				
618		Worm tubes	Sea weed				
619		Worm tubes	Sea weed				
620		Worm tubes	Sea weed				
621			Sea weed				
622		Worm tubes	Sea weed				
623		Worm tubes	Sea weed	Broken shells			

APPENDIX II: Sediment sample positions and descriptors							
Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.							
Id							
	Wood in worm tubes	**Worm Tubes**	**Sea Weed**	**Broken Shells**	**Live Shells**	**Large Clasts**	**Extreme Odor**
624			Sea weed	Broken shells			
625		Worm tubes	Sea weed			Large clasts	
626							
627		Worm tubes	Sea weed			Large clasts	
628		Worm tubes		Broken shells			
629		Worm tubes	Sea weed				
630		Worm tubes	Sea weed	Broken shells	Live shells	Large clasts	
631		Worm tubes		Broken shells	Live shells		
632		Worm tubes	Sea weed				
633		Worm tubes	Sea weed	Broken shells	Live shells	Large clasts	
634		Worm tubes			Live shells		
635		Worm tubes	Sea weed				
636		Worm tubes		Broken shells	Live shells		
637		Worm tubes	Sea weed				
638		Worm tubes	Sea weed	Broken shells			
639			Sea weed				
640		Worm tubes	Sea weed	Broken shells			
641		Worm tubes	Sea weed	Broken shells			
642			Sea weed				
643			Sea weed	Broken shells		Large clasts	
644			Sea weed			Large clasts	
645		Worm tubes	Sea weed	Broken shells			
646		Worm tubes	Sea weed				
647		Worm tubes	Sea weed	Broken shells			
648		Worm tubes	Sea weed				
649		Worm tubes	Sea weed	Broken shells		Large clasts	
650			Sea weed	Broken shells			
651			Sea weed	Broken shells		Large clasts	
652			Sea weed	Broken shells		Large clasts	
653		Worm tubes	Sea weed	Broken shells		Large clasts	
654		Worm tubes	Sea weed	Broken shells			
655				Broken shells			
656		Worm tubes		Broken shells			
657		Worm tubes	Sea weed	Broken shells			
658			Sea weed	Broken shells	Live shells		
659		Worm tubes	Sea weed	Broken shells	Live shells	Large clasts	
660		Worm tubes	Sea weed	Broken shells			
661		Worm tubes	Sea weed	Broken shells	Live shells		
662		Worm tubes	Sea weed	Broken shells	Live shells	Large clasts	
663				Broken shells			
664			Sea weed				
665			Sea weed				
666			Sea weed	Broken shells		Large clasts	
667			Sea weed	Broken shells			
668			Sea weed	Broken shells			
669			Sea weed	Broken shells		Large clasts	
670			Sea weed	Broken shells		Large clasts	
671			Sea weed	Broken shells			

	APPENDIX II: Sediment sample positions and descriptors						
	Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.						
	Id						
	Wood in worm tubes	**Worm Tubes**	**Sea Weed**	**Broken Shells**	**Live Shells**	**Large Clasts**	**Extreme Odor**
672		Worm tubes	Sea weed	Broken shells			
673		Worm tubes	Sea weed	Broken shells			
674		Worm tubes	Sea weed	Broken shells			
675			Sea weed			Large clasts	
676		Worm tubes	Sea weed				Extreme Odor
677		Worm tubes	Sea weed	Broken shells			
678		Worm tubes	Sea weed	Broken shells			
679			Sea weed	Broken shells			
680		Worm tubes	Sea weed	Broken shells			
681		Worm tubes	Sea weed	Broken shells		Large clasts	
682		Worm tubes	Sea weed	Broken shells	Live shells	Large clasts	
683			Sea weed	Broken shells	Live shells	Large clasts	
684			Sea weed	Broken shells	Live shells	Large clasts	
685		Worm tubes		Broken shells	Live shells	Large clasts	
686							
687			Sea weed				
688		Worm tubes	Sea weed				
689			Sea weed				
690		Worm tubes	Sea weed				
691			Sea weed	Broken shells			
692			Sea weed			Large clasts	
693			Sea weed			Large clasts	
694			Sea weed	Broken shells			
695			Sea weed				
696			Sea weed				
697			Sea weed				
698			Sea weed	Broken shells			
699		Worm tubes	Sea weed	Broken shells			
700		Worm tubes	Sea weed	Broken shells			
701			Sea weed	Broken shells		Large clasts	
702		Worm tubes					
703		Worm tubes	Sea weed	Broken shells			
704		Worm tubes	Sea weed			Large clasts	
705		Worm tubes	Sea weed	Broken shells		Large clasts	
706		Worm tubes	Sea weed	Broken shells		Large clasts	
707							
708							
709		Worm tubes		Broken shells			
710		Worm tubes	Sea weed				
711		Worm tubes	Sea weed	Broken shells			
712		Worm tubes	Sea weed				
713			Sea weed				
714			Sea weed				
715			Sea weed			Large clasts	
716			Sea weed	Broken shells			
717		Worm tubes	Sea weed				
718		Worm tubes	Sea weed	Broken shells			
719			Sea weed				

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	Wood in worm tubes	Worm Tubes	Sea Weed	Broken Shells	Live Shells	Large Clasts	Extreme Odor
720			Sea weed	Broken shells		Large clasts	
721				Broken shells			
722		Worm tubes	Sea weed				
723			Sea weed				
724		Worm tubes	Sea weed				
725		Worm tubes	Sea weed			Large clasts	
726		Worm tubes	Sea weed	Broken shells	Live shells		
727			Sea weed	Broken shells		Large clasts	
728							
729							
730							
731			Sea weed	Broken shells		Large clasts	
732			Sea weed				
733			Sea weed				Extreme Odor
734							
735			Sea weed				
736		Worm tubes	Sea weed				
737			Sea weed				
738		Worm tubes	Sea weed	Broken shells			
739		Worm tubes	Sea weed				
740		Worm tubes	Sea weed	Broken shells			
741							
742							
743							
744			Sea weed	Broken shells		Large clasts	
745			Sea weed			Large clasts	
746							
747		Worm tubes	Sea weed				
748		Worm tubes	Sea weed				
749		Worm tubes	Sea weed				
750		Worm tubes	Sea weed				
751		Worm tubes	Sea weed				
752		Worm tubes	Sea weed	Broken shells			
753			Sea weed	Broken shells		Large clasts	
754							
755		Worm tubes	Sea weed				
756		Worm tubes		Broken shells			
757			Sea weed				
758			Sea weed	Broken shells			
759							
760							
761		Worm tubes	Sea weed	Broken shells			
762							
763							
764							
765							
766							
767							

	APPENDIX II: Sediment sample positions and descriptors						
	Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.						
	Id						
	Wood in worm tubes	**Worm Tubes**	**Sea Weed**	**Broken Shells**	**Live Shells**	**Large Clasts**	**Extreme Odor**
768							
769							
770							
771		Worm tubes	Sea weed	Broken shells			
772							
773							
774							
775							
776							
777							
778							
779							
780							
781	Wood in worm tubes		Sea weed				
782							
783		Worm tubes	Sea weed	Broken shells			
784							
785							
786		Worm tubes	Sea weed				
787							
788							
790							
791							
792							
793							
794							
795							
796							
797							
798							
799		Worm tubes					Extreme Odor
800				Broken shells			
801				Broken shells			
802			Sea weed				Extreme Odor
803							
804							
805			Sea weed				
806			Sea weed	Broken shells			
807		Worm tubes	Sea weed				
808			Sea weed				
809				Broken shells			Extreme Odor
810							
811				Broken shells			
812							
1000		worm tubes		broken shells			
1001							
1002		worm tubes	Sea weed				
1003			Sea weed				

APPENDIX II: Sediment sample positions and descriptors

Note: Not all collected samples had sufficient quantities of sediment for grain-size analysis.

Id	**Wood in worm tubes**	**Worm Tubes**	**Sea Weed**	**Broken Shells**	**Live Shells**	**Large Clasts**	**Extreme Odor**
1004			Sea weed				
1005		worm tubes		broken shells			
1006		worm tubes		broken shells			
1007		worm tubes	Sea weed				
1008		worm tubes	Sea weed				
1009						large clasts	
1010		worm tubes					
1011		worm tubes	Sea weed				
1012			Sea weed				
1013			Sea weed	broken shells			
1014		worm tubes	Sea weed				
1015			Sea weed				
1016			Sea weed				
1017			Sea weed			large clasts	
1018			Sea weed	broken shells			
1019		worm tubes	Sea weed			large clasts	
1020		worm tubes		broken shells			
1021			Sea weed	broken shells		large clasts	
1022		worm tubes		broken shells			
1023			Sea weed	broken shells		large clasts	
1024		worm tubes	Sea weed				
1025		worm tubes	Sea weed	broken shells			
1026		worm tubes		broken shells			
1027		worm tubes	Sea weed	broken shells			
1030		worm tubes		broken shells			
1031		worm tubes		broken shells			
1032		worm tubes		broken shells			
1033		worm tubes		broken shells			
1034							
1035		worm tubes		broken shells			
1036			Sea weed				

APPENDIX III

GRAIN-SIZE ANALYSIS PROTOCOL

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1 INTRODUCTION

GeoSea® uses a Malvern Mastersizer 2000 laser particle sizer for the grain-size analysis of sediments. This unit is state-of-the-art equipment. It is extremely accurate, the results are consistent, and it enables the determination of a large range of particle sizes using a single technique[1]. A laser particle sizer is also the most efficient way to analyze the large numbers of samples that are required in Sediment Trend Analysis. This report describes the methodology used in GeoSea's laboratory.

2 METHODOLOGY

2.1 Malvern Mastersizer 2000 Laser Particle Sizer

Operation of the instrument is based on the principle of laser diffraction. Light from a low power helium-neon laser forms the analyser beam, a collimated, monochromatic (red) beam of light. An additional solid-state blue light source provides greater accuracy in the sub-micron range. Particles from sediment samples enter the analyser beam via a dispersion tank that pumps the material, carried in water, through a sample cell. Light scattered from the suspended sediment is incident on the detector lens. The latter acts as a Fourier Transform Lens forming the far field diffraction patterns of the scattered light at its focal plane. When a particle is in the analyser beam its diffraction pattern is stationary and centred on the optical axis of the lens. At the focal plane a custom designed detector in the form of 52 concentric rings measures the intensity of the scattered light over a range of scattering angles. Un-scattered light is also focused onto an aperture on the detector. The total laser power exiting the optical system through this aperture enables measurement of the sample concentration. A measurement of scattered intensity versus angle measurements is made for both the blue and red analyser beams.

In practice, many particles are simultaneously present in the analyser beam and the scattered light measured on the detector is the sum of all individual patterns overlaid on the central axis. GeoSea sets up the instrument to take 30,000 such measurements, which are then averaged to build up a light scattering characteristic for that sample based upon the population of individual particles. Applying the Mie theory of light scattering, the outputs from the detectors are then processed by a computer to generate a particle size distribution.

Particles scatter light at angles related to their diameter (*i.e.*, the larger the particle, the smaller the angle of scatter and *vice versa*). Over the size range of interest, which is 0.02 micron (μ) and larger for this instrument, scattering is independent of the optical properties of the medium of suspension or the particles themselves. Through a process of constrained least squares fitting of theoretical scattering predictions to the observed data, the computer calculates a volume size distribution that would give rise to the observed scattering characteristics. No *a priori* information about the form of the size distribution

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[1]Most techniques to measure grain-size distributions require sand to be separated from the finer fractions; different analytical methods are used for each split (e.g., settling tube and sedigraph) and the two distributions are then merged together to obtain a complete distribution. Laser analysis does not require such a split, except when very coarse materials are present (coarse sand to gravel-sized fractions).

is assumed, allowing for the characterization of multi-modal distributions with high resolution.

2.2 Laboratory Technique

GeoSea has developed a standard operating procedure (SOP) using the Malvern Mastersizer 2000 laser particle size analyser. This procedure ensures that all parameters and variables will remain consistent throughout sample analysis. The methodology covers the range of sizes normally considered important in sediments, is relatively rapid and requires only small samples. No chemical pre-treatment of the samples is undertaken without prior request[2]. The priority is to determine the size distribution of the naturally occurring sample.

Prior to every analysis, the Mastersizer 2000 automatically aligns the laser beam, and a background measurement of the suspension medium is taken. Samples are initially well mixed before obtaining a representative sub-sample for analysis. The amount of sediment required is about 2 to 4 grams for sands and 0.5 to 1 gram for silt and clay. Samples are introduced into the dispersion unit by wet sieving through a 1mm mesh, eliminating possible blockage of the pumping mechanism by particles that are too large. Dis-aggregation of the sample is achieved by both mechanical stirring and mild ultrasonic dispersion in the sample dispersion unit[3]. If material remains on the 1mm sieve then the weight percent for each of the coarse sizes (-2.0ϕ to 0.5ϕ[4]; 4.0mm to 0.7mm) is obtained by dry sieving at 0.5ϕ intervals.

[2]Occasionally we are asked to remove organic matter by peroxide digestion, or carbonates by treatment with weak acid.

[3]GeoSea has conducted several experiments concerning the degree of ultrasonic dispersion that is desirable. If no ultrasonic dispersion is used, fine particles tend to remain as relatively large aggregates producing an erroneously coarse sediment distribution. With increasing ultrasonic disaggregation a distribution will tend to become increasingly finer as flocs become broken apart. Total disaggregation of the fine material may be desirable for some purposes, but for Sediment Trend Analysis we find that the flocs are best treated as part of the overall grain-size distribution. This is because flocs form particular sized particles that behave as separate entities in the transport regime, whereas total disaggregation would produce a grain-size distribution containing particle sizes that were not actually behaving independently during their transport and deposition. Although we find that increasing the degree of disaggregation changes the specific parameters of a grain-size distribution, it is insufficient to produce significant changes in the derived sediment trend statistics. The degree of ultrasonic dispersion presently used by GeoSea appears to be adequate to break apart the sediment into its component particle sizes without excessive damage to those sizes composed of flocculated material.

[4]ϕ (phi) is the unit of measure most commonly used in sediment size distributions where $\phi = -\frac{\log(mm)}{\log(2)}$.

Table 1: Grain-size scales for sediments.

U.S. Standard Sieve Mesh Number	Diameter (*mm*)	Diameter (*microns*)	Phi Value	Wentworth Size Class	Sediment Type
5	4.00		-2.00	Granule	GRAVEL
6	3.36		-1.75		
7	2.83		-1.50		
8	2.38		-1.25		
10	2.00		-1.00		
12	1.68		-0.75	Very Coarse Sand	SAND
14	1.41		-0.50		
16	1.19		-0.25		
18	1.00		0.00		
20	0.84	840	0.25	Coarse Sand	
25	0.71	710	0.50		
30	0.59	590	0.75		
35	0.50	500	1.00		
40	0.42	420	1.25	Medium Sand	
45	0.35	350	1.50		
50	0.30	300	1.75		
60	0.25	250	2.00		
70	0.21	210	2.25	Fine Sand	
80	0.177	177	2.50		
100	0.149	149	2.75		
120	0.125	125	3.00		
140	0.105	105	3.25	Very Fine Sand	
170	0.088	88	3.50		
200	0.074	74	3.75		
230	0.0625	62.5	4.00		
270	0.053	53	4.25	Coarse Silt	MUD
325	0.044	44	4.50		
	0.037	37	4.75		
	0.031	31	5.00		
	0.0156	15.6	6.00	Medium Silt	
	0.0078	7.8	7.00	Fine Silt	
	0.0039	3.9	8.00	Very Fine Silt	
	0.002	2	9.00	Clay*	
	0.00098	0.98	10.00		
	0.00049	0.49	11.00		
	0.00024	0.24	12.00		
	0.00012	0.12	13.00		
	0.00006	0.06	14.00		

(* The Clay/Silt boundary is sometimes taken at 2 microns, or 9 phi.)

2.3 Merge Method

GeoSea has developed software that allows the dry-sieved weights and measurements from the laser unit to be merged into a final distribution within the range of -2.0ϕ to 15ϕ, in size bins of equal width (0.5 ϕ) in ϕ-space. The results from the Mastersizer 2000 consist of a set of 52 size bins, where the bin width is inversely proportional to the mean particle size in the bin, with the percentage of material in each bin. Sieving is carried out at half-phi intervals from -2.0ϕ to 0.5ϕ. The weights are normalized and the percentage smaller than 0.5ϕ is used to renormalize the MasterSizer data. MasterSizer data in bins for particles larger than 0.5ϕ are removed and replaced with sieve data.

2.4 Presentation of Results

Size distribution data for this project are presented as an Excel file (.xls) in Appendix III. The first line in the file defines the variables and the phi scale, and is followed by the weight percentages for the samples. These files can be easily imported for use in many applications. The interpretation of the data is as follows: the weight percentage shown under a size heading is the amount of material found in a bin with size boundaries set by the previous size heading as the upper size limit and the current size heading as the lower limit. For example, the weight percent shown under the heading 1.5ϕ is the amount in the bin bounded by 1.0ϕ and 1.5ϕ. The -2.0ϕ bin is a special case: if the notation for this bin is “TRUE” then there was material captured by this coarsest sieve; otherwise, the notation is “FALSE” and there was no material on the coarsest sieve.

APPENDIX IV

GRAIN-SIZE DISTRIBUTIONS

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
1	48.14307	-123.421	MS	3.353	1.998	0.377	0	63.22	36.78	FALSE	0	0	0	1.05	3.93	6.74	8.8	9.57	9.18	8.35	7.86
2	48.14309	-123.419	GS	2.245	1.568	-0.729	38.13	59.92	1.95	TRUE	4.75	4.17	1.99	0.97	0.96	0	0.92	9.88	23.85	28.48	17.02
3	48.14314	-123.417	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
4	48.14319	-123.416	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
5	48.14325	-123.414	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
6	48.14327	-123.412	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
7	48.14316	-123.41	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
8	48.1433	-123.409	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
9	48.14343	-123.407	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
10	48.14326	-123.405	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
11	48.14332	-123.404	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
12	48.14328	-123.402	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
13	48.14227	-123.42	S	2.5	0.594	-0.053	0	100	0	FALSE	0	0	0	0	0	0.13	3.65	15.77	30.02	30.66	16.46
14	48.14228	-123.418	S	2.532	0.54	-0.037	0	100	0	FALSE	0	0	0	0	0	0.01	1.78	13.58	31.91	34.14	16.39
15	48.14226	-123.416	S	2.521	0.539	-0.009	0	100	0	FALSE	0	0	0	0	0	0	1.7	14.11	32.49	33.73	15.82
16	48.14211	-123.415	S	2.557	0.52	0.048	0	100	0	FALSE	0	0	0	0	0	0	0.55	12.97	32.33	35.07	16.85
17	48.14215	-123.413	S	2.417	0.524	0	0	100	0	FALSE	0	0	0	0	0	0	2.57	18.17	35.64	31.37	11.49
18	48.14217	-123.411	S	2.398	0.523	0.012	0	100	0	FALSE	0	0	0	0	0	0	2.74	19.14	36.07	30.62	10.78
19	48.14209	-123.41	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
20	48.14207	-123.408	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
21	48.14212	-123.406	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
22	48.1421	-123.405	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
23	48.14216	-123.403	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
24	48.14215	-123.401	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
25	48.14215	-123.399	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
26	48.14089	-123.441	MS	3.787	2.028	0.131	0	53.98	46.02	FALSE	0	0	0	0.88	3.15	5.17	6.33	6.79	7.1	7.62	8.27
27	48.14084	-123.439	SM	4.222	2.075	-0.034	0	44.6	55.4	FALSE	0	0	0	0.28	2.24	4.15	5.33	5.81	6.03	6.33	6.87
28	48.14086	-123.437	SM	4.084	1.921	0.091	0	47.95	52.05	FALSE	0	0	0	0.09	1.53	3.65	5.18	5.94	6.44	7.26	8.43
29	48.14089	-123.435	SM	4.063	1.952	0.088	0	48.15	51.85	FALSE	0	0	0	0.05	1.48	3.82	5.66	6.67	7.02	7.24	7.75
30	48.14078	-123.434	MS	3.315	2.143	0.353	0	61.76	38.24	FALSE	0	0	0.01	1.65	5.36	8.55	9.85	9.17	7.66	6.56	6.33
31	48.14067	-123.432	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
32	48.14092	-123.431	S	1.184	1.291	1.68	0	96.5	3.5	FALSE	0	0	3.13	10.33	17.1	20.38	18.03	12.58	7.6	4.25	2.14
33	48.1409	-123.429	S	1.589	1.184	0.638	4.35	93.21	2.44	TRUE	0.53	0.92	2	3.58	7.36	14.05	18.57	19.63	16.17	9.77	3.94
34	48.1409	-123.427	S	0.937	1.292	0.413	15.17	83.26	1.57	TRUE	3.64	4.73	5.16	6.94	12.51	16.92	18.06	15.18	9.76	4.33	1.05
35	48.14104	-123.426	S	2.268	1.441	1.667	0	88.94	11.06	FALSE	0	0	0	0	2.18	10.02	17.95	22.09	19.07	11.31	4.56
36	48.14045	-123.424	MS	3.233	1.912	0.408	0	68.1	31.9	FALSE	0	0	0.04	1.85	4.24	6.28	7.47	8.49	9.77	10.66	10.35
37	48.14067	-123.423	S	1.095	1.461	0.937	10.39	86.09	3.53	TRUE	2.76	2.94	6.48	8.02	13.79	14.12	16.12	14.56	10.11	5.06	1.74
38	48.14095	-123.402	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
39	48.14115	-123.4	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
40	48.14125	-123.399	SG	0.557	2.068	0.967	66.08	31.8	2.12	TRUE	16.61	14.07	11.22	6.99	7.18	3.71	5.72	8.11	9.16	7.49	4.09
41	48.13946	-123.448	GS	1.092	1.822	-0.418	44.12	55.88	0	TRUE	13.04	10.63	7.21	3.91	2.02	0.92	4.45	11.73	17.9	16.88	9.33
42	48.13967	-123.446	MS	3.243	2.066	0.264	0	62.53	37.47	FALSE	0	0	0.05	2.42	5.65	8.31	9.06	8.27	7.23	6.84	7.14
43	48.13967	-123.445	SM	4.311	2.007	-0.029	0	43.38	56.62	FALSE	0	0	0	0.08	1.57	3.66	4.86	5.22	5.52	6.34	7.56
44	48.13966	-123.443	SM	4.488	2.071	-0.144	0	39.02	60.98	FALSE	0	0	0	0.11	1.85	3.75	4.63	4.68	4.69	5.25	6.39
45	48.13976	-123.441	SM	4.66	2.003	-0.099	0	36.54	63.46	FALSE	0	0	0	0	0.8	2.94	3.99	4.04	4.2	5.22	6.9
46	48.13973	-123.44	SM	4.974	1.763	-0.073	0	29.52	70.48	FALSE	0	0	0	0	0	0.9	2.08	2.51	2.99	4.53	7.11
47	48.13966	-123.438	SM	5.357	1.725	-0.26	0	21.09	78.91	FALSE	0	0	0	0	0	0.55	1.62	1.9	2.03	2.93	4.86
48	48.13974	-123.436	SM	5.156	1.861	-0.241	0	25.66	74.34	FALSE	0	0	0	0	0.15	1.55	2.42	2.39	2.49	3.53	5.47
49	48.13975	-123.435	SM	5.037	1.866	-0.215	0	28.77	71.23	FALSE	0	0	0	0	0.25	1.66	2.31	2.53	3.14	4.53	6.39

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
50	48.13965	-123.433	SM	5.085	1.729	-0.118	0	26.8	73.2	FALSE	0	0	0	0	0	0.57	1.65	2.3	3.03	4.38	6.4
51	48.13977	-123.431	SM	4.684	1.984	-0.094	0	36.02	63.98	FALSE	0	0	0	0	0.66	2.7	3.79	3.99	4.29	5.32	6.89
52	48.13969	-123.43	SM	5.037	1.817	-0.127	0	28.2	71.8	FALSE	0	0	0	0	0.1	1.22	2.13	2.47	3	4.36	6.43
53	48.13979	-123.428	SM	4.923	1.845	-0.115	0	30.9	69.1	FALSE	0	0	0	0	0.22	1.4	2.21	2.87	3.84	5.22	6.82
54	48.13977	-123.426	SM	4.724	1.996	-0.036	0	37.15	62.85	FALSE	0	0	0	0	0.53	2.33	3.4	3.82	4.48	5.94	7.74
55	48.13978	-123.425	SM	4.408	1.84	0.385	0	47.95	52.05	FALSE	0	0	0	0	0.08	0.96	2.15	3.95	6.87	10.18	12.13
56	48.13983	-123.423	MS	3.857	1.89	0.668	0	61.77	38.23	FALSE	0	0	0	0	0	1.25	4.15	8.83	13.22	14.35	11.83
57	48.13967	-123.421	MS	3.94	1.946	0.559	0	59.46	40.54	FALSE	0	0	0	0.04	0.51	1.54	3.9	8.14	12.39	13.68	11.38
58	48.13985	-123.42	S	2.64	1.45	1.882	0	90.24	9.76	FALSE	0	0	0.08	0.27	0.76	2.75	8.82	18.91	25.57	21.24	9.95
59	48.13982	-123.418	S	3.178	1.609	1.607	0	83.05	16.95	FALSE	0	0	0	0	0	0	3.09	13.97	23.14	23.33	14.56
60	48.13979	-123.416	GS	1.384	1.371	0.959	36.12	62.14	1.74	TRUE	1.51	1.4	3.17	6.05	12.09	14.77	16.41	15.82	13.06	8.48	3.76
61	48.13981	-123.415	MS	3.193	1.721	0.972	0	74.48	25.52	FALSE	0	0	0	0	0.43	3.24	7.98	13.81	17.15	15.43	10.39
62	48.13955	-123.412	SG	1.112	1.226	0.946	53.12	45.86	1.02	TRUE	1.55	2.22	4.14	6.54	13.16	18	19.98	16.6	10.28	4.36	1.03
65	48.13991	-123.398	S	1.726	0.962	2.814	0	97.19	2.81	FALSE	0	0	0	0	2.13	13.88	26.6	29.22	18.75	6.14	0.48
66	48.13839	-123.456	MS	3.526	1.985	0.297	0	59.75	40.25	FALSE	0	0	0	0.38	3.31	6.37	8.33	8.61	8.06	7.86	8.27
67	48.13853	-123.454	S	2.079	1.573	1.428	0	88.25	11.75	FALSE	0	0	0	1.83	7.47	13.66	18.17	18.46	14.22	8.23	3.91
68	48.13859	-123.452	MS	2.8	2.059	0.626	0	72.14	27.86	FALSE	0	0	0.2	3.43	7.19	10.26	11.48	10.92	9.32	7.51	6.21
69	48.13851	-123.451	SM	4.553	1.99	-0.15	0	37.93	62.07	FALSE	0	0	0	0.09	1.46	2.94	3.78	4.23	4.78	5.68	6.88
70	48.13846	-123.449	SM	4.879	1.815	-0.111	0	31.39	68.61	FALSE	0	0	0	0	0.06	1.2	2.55	3.25	3.83	4.99	6.82
71	48.13859	-123.447	SM	4.864	1.903	-0.06	0	32.91	67.09	FALSE	0	0	0	0	0.13	1.56	2.85	3.44	4.01	5.22	7.01
72	48.1386	-123.446	SM	5.073	1.75	-0.141	0	26.84	73.16	FALSE	0	0	0	0	0	0.75	1.94	2.48	2.9	4.07	6.19
73	48.13849	-123.444	SM	5.043	1.726	-0.078	0	27.44	72.56	FALSE	0	0	0	0	0	0.65	1.79	2.31	2.77	4.14	6.6
74	48.13861	-123.442	SM	5.205	1.732	-0.235	0	23.88	76.12	FALSE	0	0	0	0	0	0.77	1.93	2.1	2.2	3.35	5.62
75	48.13853	-123.441	SM	5.108	1.763	-0.164	0	26.39	73.61	FALSE	0	0	0	0	0	0.78	2.02	2.46	2.72	3.87	6.09
76	48.1386	-123.439	SM	5.108	1.755	-0.165	0	26.57	73.43	FALSE	0	0	0	0	0	0.78	1.99	2.31	2.63	3.98	6.36
77	48.1385	-123.437	SM	5.228	1.698	-0.161	0	23.3	76.7	FALSE	0	0	0	0	0	0.55	1.5	1.82	2.17	3.4	5.66
78	48.13857	-123.435	SM	4.993	1.715	-0.014	0	28.99	71.01	FALSE	0	0	0	0	0	0.69	1.67	2.08	2.69	4.5	7.38
79	48.13862	-123.434	SM	5.224	1.723	-0.202	0	23.75	76.25	FALSE	0	0	0	0	0	0.72	1.73	1.87	2.11	3.43	5.81
80	48.13854	-123.432	SM	5.145	1.7	-0.085	0	25.69	74.31	FALSE	0	0	0	0	0	0.42	1.46	1.89	2.45	4.03	6.54
81	48.1386	-123.43	SM	5.125	1.685	-0.079	0	25.68	74.32	FALSE	0	0	0	0	0	0.57	1.44	1.73	2.24	3.88	6.6
82	48.13865	-123.429	SM	5.135	1.804	-0.264	0	25.38	74.62	FALSE	0	0	0	0	0	1.06	2.58	2.76	2.64	3.45	5.35
83	48.13861	-123.427	SM	5.122	1.754	-0.156	0	26.24	73.76	FALSE	0	0	0	0	0	0.79	1.91	2.2	2.6	4	6.26
84	48.13866	-123.425	SM	4.976	1.816	-0.186	0	29.55	70.45	FALSE	0	0	0	0	0	1.12	2.71	3.08	3.29	4.45	6.5
85	48.13859	-123.424	SM	4.982	1.805	-0.074	0	31.43	68.57	FALSE	0	0	0	0	0.09	0.91	1.69	2.37	3.64	5.75	7.91
86	48.13907	-123.422	SM	4.859	1.901	-0.034	0	35.39	64.61	FALSE	0	0	0	0	0.16	1.35	2.35	3.03	4.3	6.44	8.49
87	48.13859	-123.42	SM	4.69	1.818	0.369	0	42.89	57.11	FALSE	0	0	0	0	0	0	0.42	3.04	6.33	10.01	11.93
88	48.13862	-123.419	SM	4.68	1.897	0.243	0	42.39	57.61	FALSE	0	0	0	0	0	0.69	1.75	3.32	6.09	9.25	10.95
89	48.13876	-123.417	MS	4.131	1.933	0.599	0	57.76	42.24	FALSE	0	0	0	0	0.12	1.26	2.91	5.71	9.84	13.36	13.74
90	48.13856	-123.415	MS	4.05	1.882	0.789	0	61.57	38.43	FALSE	0	0	0	0	0	0.37	2.1	5.97	11.55	15.56	15.09
91	48.13869	-123.414	MS	4.004	1.822	0.882	0	62.78	37.22	FALSE	0	0	0	0	0	0	1.41	6.28	12.01	15.99	15.57
92	48.13867	-123.412	MS	3.418	1.684	1.336	0	77.27	22.73	FALSE	0	0	0	0	0	0	2.64	11.33	19.15	20.84	15.41
93	48.13879	-123.41	MS	3.449	1.735	1.258	0	75.97	24.03	FALSE	0	0	0	0	0	0	2.74	11.75	19.63	20.71	14.43
94	48.1388	-123.409	MS	3.795	1.892	0.922	0	67.05	32.95	FALSE	0	0	0	0	0	0	2.26	9.8	16.59	17.97	13.27
95	48.13877	-123.407	S	3.049	1.513	1.828	0	86.11	13.89	FALSE	0	0	0	0	0	0	2.86	14.51	25.56	25.26	14.13
96	48.13874	-123.405	S	0.889	1.073	-0.296	8.45	91.55	0	TRUE	2.04	3.34	5.5	8.59	14.17	18.07	18.33	15.02	9.72	4.36	0.87
97	48.13845	-123.402	SG	0.669	1.418	-0.265	58.44	41.56	0	TRUE	10.05	7.16	8.62	7.35	8.93	9.47	13.27	15.16	12.48	6.33	1.17
98	48.13852	-123.401	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
99	48.13858	-123.399	S	1.887	1.502	0.389	15.73	80.56	3.71	TRUE	3.5	3.07	2.66	1.79	0.1	2.18	12.88	24.08	25.55	15.46	4.45
100	48.13867	-123.397	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
101	48.13744	-123.46	MS	3.67	2.058	0.229	0	56.37	43.63	FALSE	0	0	0	0.62	3.29	6.02	7.72	8	7.57	7.38	7.69
102	48.13743	-123.458	SM	4.406	1.933	-0.043	0	41.06	58.94	FALSE	0	0	0	0	0.99	2.94	4.24	4.89	5.42	6.31	7.57
103	48.1373	-123.457	SM	4.47	1.916	-0.055	0	39.47	60.53	FALSE	0	0	0	0	0.81	2.61	3.99	4.78	5.32	6.11	7.28
104	48.13742	-123.455	SM	4.552	1.929	-0.067	0	38.31	61.69	FALSE	0	0	0	0	0.49	2.52	3.92	4.65	5.22	6.06	7.19
105	48.1374	-123.453	SM	4.797	1.932	-0.219	0	32.49	67.51	FALSE	0	0	0	0	0.6	2.45	3.44	3.62	3.8	4.63	6.14
106	48.13747	-123.451	SM	5.2	1.741	-0.23	0	24.23	75.77	FALSE	0	0	0	0	0	0.68	1.72	2.24	2.76	3.81	5.51
107	48.13741	-123.45	SM	4.944	1.895	-0.14	0	30.51	69.49	FALSE	0	0	0	0	0.16	1.61	2.85	3.25	3.54	4.56	6.34
108	48.13744	-123.448	SM	5.292	1.635	-0.196	0	21.01	78.99	FALSE	0	0	0	0	0	0.32	1.34	1.67	1.89	2.97	5.18
109	48.13742	-123.446	SM	4.986	1.74	-0.103	0	28.83	71.17	FALSE	0	0	0	0	0	1.01	2.05	2.24	2.7	4.38	7.08
110	48.13737	-123.445	SM	5.148	1.744	-0.165	0	25.38	74.62	FALSE	0	0	0	0	0	0.75	1.92	2.18	2.4	3.66	6.05
111	48.13741	-123.443	SM	5.161	1.721	-0.14	0	24.98	75.02	FALSE	0	0	0	0	0	0.63	1.63	2.03	2.45	3.73	6.02
112	48.13746	-123.442	SM	5.207	1.651	-0.094	0	23.42	76.58	FALSE	0	0	0	0	0	0.44	1.33	1.51	1.8	3.27	6.1
113	48.13744	-123.44	M	5.496	1.525	-0.176	0	16.18	83.82	FALSE	0	0	0	0	0	0.17	0.82	0.82	0.89	1.96	4.36
114	48.13745	-123.438	SM	5.115	1.712	-0.118	0	25.86	74.14	FALSE	0	0	0	0	0	0.69	1.63	1.98	2.46	3.89	6.34
115	48.13746	-123.436	SM	5.325	1.615	-0.052	0	21.12	78.88	FALSE	0	0	0	0	0	0.16	0.86	1.19	1.63	3.04	5.66
116	48.13751	-123.435	SM	5.031	1.761	-0.107	0	28.2	71.8	FALSE	0	0	0	0	0	0.93	2.04	2.32	2.73	4.24	6.78
117	48.13753	-123.433	SM	4.987	1.764	0.055	0	31.66	68.34	FALSE	0	0	0	0	0	0.45	1.36	2.12	3.43	5.76	8.45
118	48.13745	-123.431	SM	4.896	1.761	0.025	0	32.7	67.3	FALSE	0	0	0	0	0	0.7	1.88	2.47	3.38	5.54	8.41
119	48.13751	-123.43	SM	4.755	1.987	-0.104	0	35.27	64.73	FALSE	0	0	0	0	0.7	2.66	3.59	3.47	3.57	4.97	7.25
120	48.13751	-123.428	SM	4.876	1.826	-0.027	0	33.13	66.87	FALSE	0	0	0	0	0	1.05	2.45	2.99	3.65	5.43	7.9
121	48.13745	-123.426	SM	4.952	1.757	-0.028	0	30.71	69.29	FALSE	0	0	0	0	0	0.77	1.88	2.4	3.19	5.07	7.67
122	48.1375	-123.424	SM	4.974	1.769	-0.008	0	31.19	68.81	FALSE	0	0	0	0	0	0.44	1.9	2.5	3.33	5.38	8
123	48.13745	-123.423	SM	4.641	1.943	0.103	0	40.8	59.2	FALSE	0	0	0	0	0.53	2.05	2.72	3.06	4.49	7.32	9.95
124	48.13755	-123.421	SM	4.675	1.831	0.333	0	42.26	57.74	FALSE	0	0	0	0	0	0.39	1.18	2.73	5.78	9.45	11.58
125	48.13758	-123.42	SM	4.949	1.921	-0.081	0	32.56	67.44	FALSE	0	0	0	0	0.25	1.7	2.37	2.61	3.59	5.59	7.65
126	48.13757	-123.418	MS	4.296	1.851	0.678	0	55.66	44.34	FALSE	0	0	0	0	0	0	0.79	4.28	9.45	14.25	15.12
127	48.13763	-123.416	MS	3.795	1.801	1.004	0	68.86	31.14	FALSE	0	0	0	0	0	0	1.69	7.88	14.81	18.56	16.1
128	48.13743	-123.415	MS	4.043	1.805	0.903	0	63.21	36.79	FALSE	0	0	0	0	0	0	0.26	5.56	12.12	17.04	16.61
129	48.13753	-123.413	MS	3.721	1.779	1.101	0	70.66	29.34	FALSE	0	0	0	0	0	0	1.3	8.59	16.04	19.29	16.01
130	48.13757	-123.411	MS	4.066	1.86	0.847	0	61.99	38.01	FALSE	0	0	0	0	0	0	0.55	6.27	12.66	16.68	15.39
131	48.13756	-123.41	MS	4.063	1.887	0.84	0	62.35	37.65	FALSE	0	0	0	0	0	0	0.52	6.61	13.25	17.01	15.14
132	48.1376	-123.408	MS	3.759	1.87	1.039	0	69.54	30.46	FALSE	0	0	0	0	0	0	1.65	9.37	16.8	19.11	14.7
133	48.13748	-123.406	S	3.214	1.659	1.539	0	81.38	18.62	FALSE	0	0	0	0	0	0	3.69	14.31	22.39	21.92	13.76
134	48.13754	-123.404	S	2.553	1.509	2.014	0	89.06	10.94	FALSE	0	0	0	0	0	3.75	12.94	23.02	25.36	17.02	6.19
135	48.13761	-123.403	S	1.767	0.705	-0.257	0	100	0	FALSE	0	0	0.02	0.67	3.34	9.57	19.75	27.83	24.65	12.11	2.07
136	48.13742	-123.401	S	1.807	0.682	-0.177	0	100	0	FALSE	0	0	0	0.19	2.58	9.01	19.69	28.22	25.28	12.68	2.35
137	48.13751	-123.399	S	2.107	2.003	0.54	18.28	72.71	9	TRUE	3.9	4.66	3.44	3.37	3.67	0.65	7.86	16.13	20.05	16.11	8.03
138	48.13761	-123.398	SG	1.697	2.33	0.61	57.22	36.52	6.26	TRUE	6.11	7.43	8.31	6.47	7.26	2.86	6.03	9.71	11.9	10.79	7.08
139	48.13745	-123.396	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
140	48.13628	-123.461	MS	3.277	1.993	0.398	0	64.69	35.31	FALSE	0	0	0	1.1	4.4	7.6	9.35	9.23	8.39	8.04	8.26
141	48.13625	-123.459	SM	4.408	2.003	-0.04	0	41.24	58.76	FALSE	0	0	0	0.04	1.26	3.3	4.63	5.16	5.45	6.04	7.1
142	48.13613	-123.457	SM	4.672	1.9	-0.114	0	35.8	64.2	FALSE	0	0	0	0	0.5	2.1	3.23	4.01	4.82	5.86	7.09
143	48.13625	-123.456	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
144	48.13636	-123.454	SM	4.42	2.07	-0.206	0	39.27	60.73	FALSE	0	0	0	0.58	2.43	3.92	4.38	4.3	4.44	5.17	6.4
145	48.1362	-123.452	SM	5.119	1.724	-0.183	0	25.17	74.83	FALSE	0	0	0	0	0	0.77	1.89	2.26	2.58	3.69	5.78
146	48.13629	-123.451	SM	5.118	1.744	-0.208	0	25.88	74.12	FALSE	0	0	0	0	0	0.84	1.9	2.31	2.77	3.99	5.99
147	48.13634	-123.449	SM	5.118	1.75	-0.171	0	25.81	74.19	FALSE	0	0	0	0	0	0.7	1.96	2.43	2.79	3.87	5.87
148	48.13638	-123.447	SM	5.038	1.728	-0.065	0	28.17	71.83	FALSE	0	0	0	0	0	0.51	1.6	2.34	3.15	4.63	6.87
149	48.13637	-123.446	SM	4.994	1.713	-0.075	0	28.73	71.27	FALSE	0	0	0	0	0	0.58	1.6	2.38	3.28	4.79	6.97

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
150	48.13641	-123.444	SM	4.998	1.715	-0.045	0	28.52	71.48	FALSE	0	0	0	0	0	0.61	1.63	2.3	3.08	4.6	6.94
151	48.13636	-123.442	SM	5.09	1.712	-0.096	0	26.4	73.6	FALSE	0	0	0	0	0	0.73	1.62	1.99	2.49	3.94	6.48
152	48.13632	-123.441	SM	5.212	1.638	-0.071	0	23.4	76.6	FALSE	0	0	0	0	0	0.26	1.16	1.52	1.97	3.42	6.1
153	48.1364	-123.439	SM	4.952	1.692	0.193	0	31.75	68.25	FALSE	0	0	0	0	0	0	0.31	2.32	4.14	5.93	8.4
154	48.13636	-123.437	SM	5.259	1.635	0.012	0	23.5	76.5	FALSE	0	0	0	0	0	0.16	0.83	1.13	1.73	3.55	6.59
155	48.13643	-123.435	SM	4.911	1.867	0.039	0	33.66	66.34	FALSE	0	0	0	0	0	1.13	2.21	2.73	3.62	5.65	8.28
156	48.13636	-123.434	M	5.439	1.514	0.193	0	19.32	80.68	FALSE	0	0	0	0	0	0	0	0	0.52	3.15	6.39
157	48.13641	-123.432	SM	5.02	1.727	0.075	0	29.89	70.11	FALSE	0	0	0	0	0	0.54	1.42	1.75	2.5	4.73	8.14
158	48.13624	-123.43	SM	4.846	1.78	0.233	0	36.36	63.64	FALSE	0	0	0	0	0	0.37	1.37	2.13	3.75	6.81	10.16
159	48.13638	-123.429	SM	5.095	1.679	0.123	0	28.98	71.02	FALSE	0	0	0	0	0	0.22	0.85	1.17	2.21	4.92	8.59
160	48.13637	-123.427	SM	5.155	1.663	-0.006	0	26.76	73.24	FALSE	0	0	0	0	0	0.36	0.93	1.2	2.09	4.45	7.71
161	48.13636	-123.425	SM	4.934	1.782	0.006	0	32.36	67.64	FALSE	0	0	0	0	0.02	0.93	1.86	2.22	3.12	5.42	8.43
162	48.13645	-123.424	SM	4.784	1.733	0.179	0	36.54	63.46	FALSE	0	0	0	0	0	0.42	1.6	2.35	3.72	6.65	10.07
163	48.13629	-123.422	SM	4.893	1.735	0.138	0	34.38	65.62	FALSE	0	0	0	0	0	0.55	1.2	1.78	3.32	6.41	9.79
164	48.13632	-123.42	SM	4.834	1.815	0.243	0	38.34	61.66	FALSE	0	0	0	0	0	0.39	1.05	2.06	4.5	8.14	10.95
165	48.13646	-123.419	SM	4.653	1.884	0.252	0	42.65	57.35	FALSE	0	0	0	0	0.12	1.04	1.78	2.89	5.44	8.95	11.31
166	48.13637	-123.417	MS	3.985	1.75	0.97	0	64.86	35.14	FALSE	0	0	0	0	0	0	0.88	4.74	11.35	17.2	17.78
167	48.13647	-123.415	MS	3.985	1.738	0.951	0	64.07	35.93	FALSE	0	0	0	0	0	0	0.24	5.3	12.02	17.26	17.1
168	48.13645	-123.414	MS	3.948	1.73	0.977	0	65.56	34.44	FALSE	0	0	0	0	0	0	0.18	5.28	12.58	18.04	17.53
169	48.13651	-123.412	MS	3.971	1.81	0.941	0	64.77	35.23	FALSE	0	0	0	0	0	0	0.35	6.4	13.24	17.69	16.3
170	48.13639	-123.411	MS	3.808	1.822	1.054	0	69.28	30.72	FALSE	0	0	0	0	0	0	0.82	7.94	15.65	19.37	16.18
171	48.13649	-123.409	MS	3.89	1.848	0.979	0	66.79	33.21	FALSE	0	0	0	0	0	0	0.7	7.64	14.99	18.54	15.59
172	48.13635	-123.406	S	3.238	1.578	1.587	0	82.4	17.6	FALSE	0	0	0	0	0	0	2.57	12.46	21.32	22.86	16.06
173	48.13648	-123.405	MS	3.471	1.86	1.189	0	74.23	25.77	FALSE	0	0	0	0	0	0.02	4.6	13.27	19.47	18.79	12.35
174	48.13651	-123.403	MS	3.521	1.825	1.178	0	73.53	26.47	FALSE	0	0	0	0	0	0.01	3.79	12.05	18.45	18.82	13.41
175	48.13641	-123.402	MS	3.832	1.994	0.831	0	64.67	35.33	FALSE	0	0	0	0	0	0.04	4.42	10.91	15.76	15.6	11.27
176	48.13631	-123.4	S	3.17	1.677	1.491	0	81.17	18.83	FALSE	0	0	0	0	0	0.06	6.2	14.94	21.19	20.09	12.97
177	48.13627	-123.399	GS	3.104	1.977	0.656	36.96	49.03	14.01	TRUE	0.77	0.76	1.42	2.05	2.78	0.03	4.31	11.48	17.36	17.83	12.76
178	48.13629	-123.397	MS	3.581	1.814	1.104	0	71.92	28.08	FALSE	0	0	0	0	0	0.01	3.53	11.18	17.45	18.37	13.7
179	48.13641	-123.395	S	2.738	2.317	0.388	18.68	63.18	18.14	TRUE	3.29	2.82	3.33	3.59	4.1	0.04	4.64	11	15.76	15.31	10.27
180	48.13503	-123.46	MS	3.714	2.007	0.219	0	56.31	43.69	FALSE	0	0	0	0.5	3.04	5.48	6.9	7.29	7.46	7.99	8.71
181	48.13524	-123.458	SM	4.726	1.864	-0.123	0	34.16	65.84	FALSE	0	0	0	0	0.21	1.82	3.15	3.94	4.64	5.54	6.74
182	48.13516	-123.456	SM	4.839	1.931	-0.184	0	32.19	67.81	FALSE	0	0	0	0	0.37	2.36	3.39	3.46	3.58	4.59	6.38
183	48.13508	-123.455	SM	4.871	1.851	-0.215	0	30.63	69.37	FALSE	0	0	0	0	0.08	1.78	3.37	3.48	3.35	4.22	6.18
184	48.13514	-123.453	SM	5.03	1.943	-0.298	0	28.53	71.47	FALSE	0	0	0	0	0.2	2.18	3.43	3.31	2.99	3.7	5.48
185	48.13518	-123.451	SM	4.991	1.845	-0.146	0	30.03	69.97	FALSE	0	0	0	0	0.1	1.23	2.26	2.87	3.62	4.94	6.71
186	48.13518	-123.45	SM	5.337	1.635	-0.191	0	20.58	79.42	FALSE	0	0	0	0	0	0.3	1.17	1.49	1.83	2.97	5.13
187	48.13523	-123.448	SM	4.831	1.856	-0.039	0	33.65	66.35	FALSE	0	0	0	0	0	1.22	2.62	3.56	4.4	5.63	7.32
188	48.1352	-123.446	SM	5.095	1.759	-0.136	0	27.25	72.75	FALSE	0	0	0	0	0	0.65	1.74	2.4	3.09	4.43	6.46
189	48.13521	-123.445	SM	5.306	1.671	-0.16	0	21.75	78.25	FALSE	0	0	0	0	0	0.38	1.23	1.58	1.98	3.19	5.42
190	48.13518	-123.443	SM	5.076	1.729	-0.073	0	27	73	FALSE	0	0	0	0	0	0.69	1.66	2.11	2.65	4.1	6.59
191	48.13521	-123.441	SM	5.017	1.761	-0.119	0	28.4	71.6	FALSE	0	0	0	0	0	0.81	2.11	2.6	2.98	4.27	6.63
192	48.13524	-123.44	SM	5.176	1.668	-0.05	0	24.94	75.06	FALSE	0	0	0	0	0	0.43	1.21	1.47	2.03	3.76	6.64
193	48.13528	-123.438	SM	5.035	1.637	0.067	0	27.9	72.1	FALSE	0	0	0	0	0	0.27	1.16	1.56	2.23	4.27	7.65
194	48.13526	-123.436	SM	4.858	1.748	0.071	0	33.39	66.61	FALSE	0	0	0	0	0	0.51	1.94	2.67	3.46	5.46	8.51
195	48.13515	-123.435	SM	4.89	1.684	0.197	0	33.13	66.87	FALSE	0	0	0	0	0	0.44	1.21	1.62	2.68	5.47	9.45
196	48.13528	-123.433	SM	4.853	1.787	0.182	0	35.61	64.39	FALSE	0	0	0	0	0	0.59	1.46	2.21	3.77	6.58	9.67
198	48.1353	-123.429	SM	4.857	1.719	0.155	0	34.67	65.33	FALSE	0	0	0	0	0	0.5	1.35	1.94	3.23	6.09	9.72
199	48.13526	-123.428	SM	5.334	1.58	0.094	0	22.25	77.75	FALSE	0	0	0	0	0	0	0	0.52	1.99	3.98	6.62

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
200	48.1353	-123.426	SM	5.071	1.712	-0.037	0	28.48	71.52	FALSE	0	0	0	0	0	0.42	1.4	1.9	2.72	4.72	7.57
201	48.13521	-123.425	SM	4.93	1.701	0.235	0	34.17	65.83	FALSE	0	0	0	0	0	0.21	0.82	1.32	2.91	6.37	10.33
202	48.13519	-123.423	SM	4.962	1.664	0.173	0	31.91	68.09	FALSE	0	0	0	0	0	0.14	0.83	1.48	2.84	5.71	9.35
203	48.13529	-123.421	SM	4.766	1.779	0.462	0	41.36	58.64	FALSE	0	0	0	0	0	0.09	0.62	1.5	4.15	8.7	12.74
204	48.13539	-123.42	SM	4.548	1.842	0.441	0	46.89	53.11	FALSE	0	0	0	0	0	0.51	1.32	2.86	6.17	10.49	13.14
205	48.13536	-123.418	SM	4.449	1.931	0.378	0	48.79	51.21	FALSE	0	0	0	0	0.18	1.18	2.15	3.95	7.2	10.78	12.36
206	48.13531	-123.416	MS	4.365	1.804	0.643	0	52.94	47.06	FALSE	0	0	0	0	0	0	0.18	3.78	8.77	13.5	14.73
207	48.13541	-123.415	MS	3.891	1.746	1.047	0	67.37	32.63	FALSE	0	0	0	0	0	0	0.3	6.05	13.18	18.41	17.6
208	48.13534	-123.413	MS	3.838	1.773	1.02	0	68.08	31.92	FALSE	0	0	0	0	0	0	1.23	6.85	13.92	18.48	16.82
209	48.13533	-123.411	MS	3.959	1.798	0.96	0	65.08	34.92	FALSE	0	0	0	0	0	0	0.31	6.26	13.31	17.87	16.45
210	48.13531	-123.41	MS	3.551	1.702	1.278	0	75.57	24.43	FALSE	0	0	0	0	0	0	1.33	9.42	17.75	21.18	16.9
211	48.13527	-123.408	MS	3.706	1.715	1.22	0	72.59	27.41	FALSE	0	0	0	0	0	0	0.37	7.44	15.64	20.43	17.93
212	48.13538	-123.406	MS	3.786	1.753	1.126	0	70.25	29.75	FALSE	0	0	0	0	0	0	0.38	7.21	14.98	19.6	17.37
213	48.1353	-123.404	MS	4.251	1.927	0.66	0	56.68	43.32	FALSE	0	0	0	0	0	0	0.72	5.94	11.63	14.98	13.75
214	48.13521	-123.403	S	3.361	1.555	1.555	0	81	19	FALSE	0	0	0	0	0	0	1.12	9.92	19.18	23	18.27
215	48.13523	-123.401	MS	3.982	1.936	0.778	0	62.78	37.22	FALSE	0	0	0	0	0	0	2.08	8.42	14.41	16.48	13.31
216	48.13521	-123.4	MS	3.584	1.795	1.2	0	73.94	26.06	FALSE	0	0	0	0	0	0	2.4	10.25	17.69	19.96	15.4
217	48.13549	-123.398	MS	3.337	1.733	1.376	0	78.91	21.09	FALSE	0	0	0	0	0	0.05	4.63	12.5	19.8	20.64	14.51
218	48.13536	-123.396	MS	3.87	1.872	0.906	0	65.8	34.2	FALSE	0	0	0	0	0	0	1.94	8.48	14.87	17.47	14.34
219	48.13535	-123.394	MS	3.904	1.854	0.911	0	65.47	34.53	FALSE	0	0	0	0	0	0	1.63	7.65	14.15	17.39	15.03
220	48.13397	-123.462	MS	3.125	1.481	0.87	0	79.6	20.4	FALSE	0	0	0	0.32	1.48	3.1	5.68	9.49	13.86	16.86	16.41
221	48.13396	-123.461	MS	3.88	2.041	0.177	0	52.34	47.66	FALSE	0	0	0	0.06	2.16	5.28	7.29	7.62	7.14	7.02	7.56
222	48.13394	-123.459	SM	4.517	1.924	-0.064	0	39.04	60.96	FALSE	0	0	0	0	0.53	2.53	4.01	4.8	5.38	6.18	7.26
223	48.13404	-123.457	SM	4.62	1.963	-0.082	0	37.42	62.58	FALSE	0	0	0	0	0.33	2.6	4.16	4.61	4.85	5.68	7.03
224	48.13405	-123.456	SM	4.718	1.971	-0.166	0	34.7	65.3	FALSE	0	0	0	0	0.53	2.76	3.99	4.08	4.06	4.88	6.46
225	48.13399	-123.454	SM	4.565	2.073	-0.119	0	38.6	61.4	FALSE	0	0	0	0.07	1.43	3.41	4.5	4.62	4.61	5.33	6.73
226	48.13396	-123.452	SM	4.562	1.995	-0.036	0	39.51	60.49	FALSE	0	0	0	0	0.8	2.75	4.01	4.49	4.93	6.05	7.66
227	48.13399	-123.451	SM	4.953	1.899	-0.124	0	30.85	69.15	FALSE	0	0	0	0	0.2	1.74	2.72	2.9	3.23	4.56	6.75
228	48.13403	-123.449	SM	5.135	1.718	-0.102	0	25.89	74.11	FALSE	0	0	0	0	0	0.64	1.58	1.91	2.38	3.88	6.47
229	48.13401	-123.447	M	5.339	1.594	-0.173	0	19.75	80.25	FALSE	0	0	0	0	0	0.3	1.03	1.28	1.6	2.76	5.02
230	48.13401	-123.446	SM	4.939	1.689	0.082	0	30.14	69.86	FALSE	0	0	0	0	0	0.01	1.5	2.72	3.35	4.83	7.52
231	48.13425	-123.444	SM	5.326	1.615	-0.133	0	20.75	79.25	FALSE	0	0	0	0	0	0.29	0.98	1.26	1.7	3.02	5.39
232	48.13401	-123.442	SM	5.063	1.68	-0.014	0	27.3	72.7	FALSE	0	0	0	0	0	0.51	1.31	1.76	2.49	4.27	7.12
233	48.13408	-123.44	SM	5.113	1.717	-0.003	0	27.11	72.89	FALSE	0	0	0	0	0	0.47	1.33	1.76	2.47	4.27	7.09
234	48.13407	-123.439	SM	4.83	1.774	0.165	0	34.54	65.46	FALSE	0	0	0	0	0	0.91	1.78	2.22	3.29	5.79	9.1
235	48.13421	-123.437	SM	4.881	1.75	0.09	0	32.96	67.04	FALSE	0	0	0	0	0	0.75	1.68	2.21	3.26	5.58	8.63
236	48.13409	-123.435	SM	5.194	1.666	0.083	0	26.02	73.98	FALSE	0	0	0	0	0	0.13	0.79	1.16	2.01	4.22	7.5
237	48.13424	-123.434	SM	4.838	1.69	0.273	0	35.72	64.28	FALSE	0	0	0	0	0	0.17	1.02	1.68	3.18	6.49	10.52
238	48.13413	-123.432	SM	4.788	1.753	0.285	0	36.72	63.28	FALSE	0	0	0	0	0	0.73	1.42	1.83	3.26	6.48	10.37
239	48.13396	-123.43	SM	4.803	1.76	0.33	0	37.72	62.28	FALSE	0	0	0	0	0	0.27	1.15	1.9	3.75	7.23	10.89
240	48.13407	-123.429	SM	4.809	1.722	0.261	0	35.34	64.66	FALSE	0	0	0	0	0	0.72	1.4	1.74	2.92	5.93	9.97
241	48.13413	-123.427	SM	4.611	1.763	0.377	0	42.58	57.42	FALSE	0	0	0	0	0	0.58	1.42	2.43	4.69	8.44	11.98
242	48.13406	-123.425	SM	4.653	1.797	0.336	0	41.99	58.01	FALSE	0	0	0	0	0	0.5	1.39	2.63	5.09	8.63	11.58
243	48.13423	-123.424	SM	5.063	1.63	0.073	0	28.63	71.37	FALSE	0	0	0	0	0	0.13	0.74	1.27	2.52	5.13	8.36
244	48.13413	-123.422	SM	4.715	1.744	0.428	0	40.6	59.4	FALSE	0	0	0	0	0	0.41	0.88	1.62	3.94	8.1	12.15
245	48.13423	-123.42	SM	4.675	1.772	0.455	0	43.22	56.78	FALSE	0	0	0	0	0	0	0.24	2.47	5.56	9.69	12.64
246	48.13417	-123.419	SM	4.885	1.807	0.254	0	36.76	63.24	FALSE	0	0	0	0	0	0.19	0.93	2.04	4.35	7.66	10.42
247	48.13423	-123.417	MS	4.273	1.779	0.752	0	55.73	44.27	FALSE	0	0	0	0	0	0	0.17	3.82	9.07	14.15	15.65
249	48.13427	-123.414	MS	4.101	1.812	0.854	0	60.8	39.2	FALSE	0	0	0	0	0	0	0.3	5.49	11.48	15.99	15.84

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
250	48.13412	-123.412	MS	3.863	1.771	1.022	0	67.13	32.87	FALSE	0	0	0	0	0	0	0.61	7.01	14.06	18.23	16.44
251	48.13416	-123.41	MS	3.65	1.697	1.199	0	72.79	27.21	FALSE	0	0	0	0	0	0	0.98	8.25	16.11	20.1	17.12
252	48.13423	-123.409	MS	3.568	1.693	1.296	0	75.19	24.81	FALSE	0	0	0	0	0	0	1.13	9.04	17.32	20.95	17.13
253	48.13416	-123.407	MS	4.087	1.856	0.798	0	61.08	38.92	FALSE	0	0	0	0	0	0	0.6	6.23	12.48	16.4	15.1
254	48.13426	-123.405	MS	3.656	1.676	1.253	0	73.88	26.12	FALSE	0	0	0	0	0	0	0.36	7.51	16.07	21	18.25
255	48.13413	-123.404	S	3.308	1.579	1.605	0	82.24	17.76	FALSE	0	0	0	0	0	0	1.74	10.93	20.03	23.15	17.7
256	48.13427	-123.402	MS	3.955	1.841	0.946	0	65.25	34.75	FALSE	0	0	0	0	0	0	0.38	6.95	14.06	17.99	15.82
257	48.13431	-123.4	S	3.301	1.531	1.62	0	82.34	17.66	FALSE	0	0	0	0	0	0	1.39	10.52	19.86	23.35	18.12
258	48.13424	-123.399	MS	3.684	1.79	1.189	0	72.89	27.11	FALSE	0	0	0	0	0	0	0.94	8.69	16.94	20.56	16.66
259	48.13415	-123.397	MS	4.518	1.96	0.482	0	50.16	49.84	FALSE	0	0	0	0	0	0	0.25	4.77	9.82	13.2	12.7
260	48.13419	-123.395	MS	3.975	1.828	0.946	0	64.88	35.12	FALSE	0	0	0	0	0	0	0.35	6.49	13.43	17.79	16.19
261	48.13418	-123.394	S	3.242	1.462	1.807	0	85.31	14.69	FALSE	0	0	0	0	0	0	0.55	10.27	20.62	25.05	19.53
262	48.13331	-123.461	MS	3.646	2.053	0.276	0	58.05	41.95	FALSE	0	0	0	0.49	3.27	6.01	7.67	8.02	7.92	8.07	8.35
263	48.13292	-123.46	SM	3.975	2.138	0.077	0	49.67	50.33	FALSE	0	0	0	0.44	3.07	5.58	6.81	6.7	6.23	6.28	6.92
264	48.13298	-123.458	SM	4.483	1.982	-0.063	0	40	60	FALSE	0	0	0	0	0.91	3.04	4.37	4.86	5.23	6.05	7.24
265	48.13287	-123.456	SM	4.512	1.978	-0.056	0	39.68	60.32	FALSE	0	0	0	0	0.75	3.07	4.35	4.59	4.85	5.92	7.5
266	48.13292	-123.455	SM	4.474	1.983	-0.033	0	40.62	59.38	FALSE	0	0	0	0	0.73	3.02	4.5	4.99	5.24	6.1	7.49
267	48.1329	-123.453	SM	4.33	2.015	0.021	0	43.88	56.12	FALSE	0	0	0	0	1.32	3.6	4.9	5.23	5.49	6.48	7.94
268	48.13292	-123.452	SM	4.724	1.911	-0.028	0	35.94	64.06	FALSE	0	0	0	0	0.33	2.1	3.11	3.44	4.06	5.65	7.81
269	48.13299	-123.45	SM	5.082	1.651	-0.018	0	26.63	73.37	FALSE	0	0	0	0	0	0.42	1.18	1.6	2.39	4.27	7.1
270	48.13289	-123.448	SM	5.271	1.587	-0.088	0	21.57	78.43	FALSE	0	0	0	0	0	0.2	0.9	1.2	1.73	3.22	5.78
271	48.13298	-123.446	SM	4.879	1.857	-0.016	0	33.29	66.71	FALSE	0	0	0	0	0.12	1.31	2.33	2.85	3.69	5.5	7.87
272	48.13289	-123.445	SM	5.074	1.78	-0.113	0	28.11	71.89	FALSE	0	0	0	0	0	0.89	1.87	2.26	2.87	4.43	6.82
273	48.13294	-123.443	SM	5.003	1.843	-0.059	0	30.71	69.29	FALSE	0	0	0	0	0.15	1.17	1.89	2.35	3.31	5.18	7.47
274	48.13296	-123.441	SM	4.853	1.832	0.09	0	34.6	65.4	FALSE	0	0	0	0	0.17	1.21	1.85	2.29	3.51	5.98	8.88
275	48.13296	-123.44	SM	4.92	1.814	0.11	0	33.14	66.86	FALSE	0	0	0	0	0	0.99	1.79	2.11	3.15	5.6	8.7
276	48.133	-123.438	SM	4.655	1.801	0.24	0	39.81	60.19	FALSE	0	0	0	0	0.14	1.12	1.83	2.55	4.32	7.39	10.51
277	48.13294	-123.436	SM	4.949	1.753	0.193	0	32.86	67.14	FALSE	0	0	0	0	0	0.44	1.15	1.7	3.15	5.98	9.22
278	48.13287	-123.435	SM	4.763	1.816	0.274	0	38.79	61.21	FALSE	0	0	0	0	0	0.53	1.35	2.48	4.68	7.81	10.51
279	48.13299	-123.433	SM	4.612	1.752	0.456	0	42.56	57.44	FALSE	0	0	0	0	0	0.21	1.15	2.46	5.05	8.78	11.99
280	48.13315	-123.431	SM	4.598	1.784	0.437	0	43.56	56.44	FALSE	0	0	0	0	0	0.45	1.24	2.53	5.25	9.11	12.2
281	48.13313	-123.429	MS	4.379	1.707	0.723	0	50.65	49.35	FALSE	0	0	0	0	0	0	0.12	2.89	7.1	11.9	14.67
282	48.13305	-123.428	SM	4.427	1.737	0.673	0	49.19	50.81	FALSE	0	0	0	0	0	0	0.55	2.88	6.66	11.23	14.12
283	48.13303	-123.426	SM	4.584	1.818	0.517	0	45.98	54.02	FALSE	0	0	0	0	0	0	0.39	3.17	6.68	10.62	12.86
284	48.13307	-123.424	MS	4.324	1.724	0.735	0	52.48	47.52	FALSE	0	0	0	0	0	0	0.6	3.17	7.35	12.26	15.03
285	48.13315	-123.423	SM	4.797	1.768	0.249	0	37.89	62.11	FALSE	0	0	0	0	0	0.22	1.03	2.25	4.65	7.93	10.58
286	48.13305	-123.421	SM	4.557	1.755	0.619	0	46.9	53.1	FALSE	0	0	0	0	0	0	0	1.87	6.6	11.2	13.93
287	48.13305	-123.42	MS	4.324	1.766	0.729	0	53.52	46.48	FALSE	0	0	0	0	0	0	0.18	3.62	8.29	13.12	15.09
288	48.13302	-123.418	MS	4.386	1.775	0.651	0	51.82	48.18	FALSE	0	0	0	0	0	0	0.17	3.47	8.03	12.74	14.62
289	48.13308	-123.416	MS	3.835	1.684	1.102	0	67.33	32.67	FALSE	0	0	0	0	0	0	0.34	6.34	13.17	17.92	17.23
290	48.13318	-123.414	MS	3.778	1.726	1.12	0	69.3	30.7	FALSE	0	0	0	0	0	0	0.62	7.3	14.57	18.8	16.92
291	48.13319	-123.413	MS	3.417	1.639	1.408	0	78.36	21.64	FALSE	0	0	0	0	0	0	2.15	10.29	18.56	21.53	16.86
292	48.13318	-123.411	MS	3.737	1.757	1.118	0	70.27	29.73	FALSE	0	0	0	0	0	0	1.02	8.06	15.56	19.24	16.38
293	48.13303	-123.41	MS	3.621	1.768	1.166	0	72.68	27.32	FALSE	0	0	0	0	0	0	2.2	9.56	16.73	19.54	15.72
294	48.13297	-123.408	MS	3.591	1.751	1.155	0	72.87	27.13	FALSE	0	0	0	0	0	0	2.52	9.9	16.9	19.35	15.43
295	48.13302	-123.406	S	3.34	1.557	1.551	0	81.27	18.73	FALSE	0	0	0	0	0	0	1.52	10.3	19.27	22.83	18.04
296	48.13311	-123.404	MS	3.681	1.716	1.283	0	73.7	26.3	FALSE	0	0	0	0	0	0	0.38	7.51	15.8	20.78	18.31
297	48.13302	-123.403	MS	3.981	1.813	0.937	0	64.47	35.53	FALSE	0	0	0	0	0	0	0.34	6.32	13.16	17.61	16.25
298	48.13301	-123.401	MS	3.656	1.682	1.249	0	73.4	26.6	FALSE	0	0	0	0	0	0	0.42	7.83	16.03	20.63	17.88

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
299	48.13305	-123.399	MS	3.712	1.736	1.193	0	72.15	27.85	FALSE	0	0	0	0	0	0	0.42	7.83	15.92	20.32	17.43
300	48.13307	-123.398	MS	4.249	1.947	0.722	0	58.77	41.23	FALSE	0	0	0	0	0	0	0.29	5.55	11.75	16.08	15.08
301	48.13306	-123.396	MS	4.057	1.848	0.887	0	63	37	FALSE	0	0	0	0	0	0	0.3	5.9	12.57	17.21	16.18
302	48.13313	-123.394	MS	3.579	1.666	1.36	0	76.55	23.45	FALSE	0	0	0	0	0	0	0.4	8.07	17	21.98	18.72
303	48.13197	-123.46	MS	3.684	2.177	0.098	0	54.3	45.7	FALSE	0	0	0.05	2.09	4.64	6.7	7.18	6.46	5.85	6.19	7.18
304	48.13178	-123.459	SM	4.447	1.907	-0.06	0	39.9	60.1	FALSE	0	0	0	0	0.65	2.72	4.23	4.92	5.34	6.12	7.34
305	48.13182	-123.457	SM	4.633	1.885	-0.073	0	36.97	63.03	FALSE	0	0	0	0	0.26	1.95	3.38	4.32	5.13	6.16	7.38
306	48.13178	-123.456	MS	3.828	2.078	0.19	0	53.66	46.34	FALSE	0	0	0	0.14	2.81	6.04	7.49	7.15	6.6	6.97	7.95
307	48.13175	-123.454	SM	4.232	1.972	0.092	0	46.19	53.81	FALSE	0	0	0	0	1.08	3.62	5.09	5.44	5.83	7.04	8.62
308	48.13184	-123.452	SM	4.398	1.955	0.105	0	44.15	55.85	FALSE	0	0	0	0	0.68	2.85	4.03	4.5	5.48	7.4	9.29
309	48.13173	-123.451	SM	4.719	1.872	0.077	0	37.7	62.3	FALSE	0	0	0	0	0.2	1.51	2.42	3.1	4.45	6.75	9.08
310	48.13193	-123.449	SM	4.83	1.873	0.016	0	35.03	64.97	FALSE	0	0	0	0	0.17	1.43	2.3	2.85	3.97	6.06	8.42
311	48.1318	-123.447	SM	4.723	1.855	0.155	0	38.83	61.17	FALSE	0	0	0	0	0.13	1.14	2	2.86	4.58	7.31	9.9
312	48.13182	-123.446	SM	4.509	1.888	0.218	0	43.96	56.04	FALSE	0	0	0	0	0.21	1.47	2.59	3.94	6.07	8.64	10.45
313	48.13183	-123.444	SM	4.775	1.848	0.123	0	37.32	62.68	FALSE	0	0	0	0	0.1	1	1.86	2.84	4.63	7.15	9.4
314	48.13179	-123.442	SM	4.968	1.711	0.084	0	31.24	68.76	FALSE	0	0	0	0	0	0.36	1.12	1.92	3.31	5.68	8.47
315	48.13186	-123.44	SM	4.945	1.691	0.164	0	32.49	67.51	FALSE	0	0	0	0	0	0.01	0.8	1.99	3.52	6.14	9.13
316	48.13197	-123.439	SM	5.01	1.81	-0.004	0	31.09	68.91	FALSE	0	0	0	0	0.11	0.88	1.44	2.04	3.42	5.69	8.03
317	48.13187	-123.437	SM	4.887	1.672	0.151	0	33.25	66.75	FALSE	0	0	0	0	0	0.28	0.81	1.72	3.64	6.55	9.38
318	48.132	-123.435	SM	4.714	1.847	0.283	0	40.91	59.09	FALSE	0	0	0	0	0	0.31	1.39	3.01	5.77	8.9	10.8
319	48.13198	-123.434	SM	4.756	1.801	0.374	0	40.22	59.78	FALSE	0	0	0	0	0	0	0.48	2.7	5.51	8.88	11.2
320	48.13194	-123.432	SM	4.94	1.771	0.285	0	35.45	64.55	FALSE	0	0	0	0	0	0	0.06	1.88	4.63	7.8	10.22
321	48.13184	-123.43	SM	4.79	1.795	0.335	0	39.4	60.6	FALSE	0	0	0	0	0	0	0.13	2.66	5.82	9.01	10.91
322	48.13189	-123.429	SM	4.427	1.82	0.538	0	49.63	50.37	FALSE	0	0	0	0	0	0	0.77	3.97	8.34	12.16	13.12
323	48.13186	-123.427	MS	4.33	1.801	0.631	0	52.9	47.1	FALSE	0	0	0	0	0	0	0.24	4.4	9.31	13.37	14.03
324	48.13184	-123.425	MS	4.054	1.777	0.857	0	61.02	38.98	FALSE	0	0	0	0	0	0	0.41	5.7	11.8	16.1	15.58
325	48.13204	-123.424	MS	4.294	1.815	0.665	0	54.1	45.9	FALSE	0	0	0	0	0	0	0.24	4.7	9.84	13.85	14.17
326	48.13186	-123.422	MS	4.236	1.85	0.635	0	55.35	44.65	FALSE	0	0	0	0	0	0.02	1.68	5.03	9.95	13.76	13.94
327	48.13205	-123.42	MS	4.087	1.719	0.84	0	59.5	40.5	FALSE	0	0	0	0	0	0	0.23	4.93	10.71	15.31	15.81
328	48.13198	-123.419	MS	4.439	1.89	0.537	0	50.57	49.43	FALSE	0	0	0	0	0	0	0.41	4.73	9.48	12.88	12.87
329	48.13193	-123.417	SM	4.577	1.872	0.407	0	46.28	53.72	FALSE	0	0	0	0	0	0	0.23	4.19	8.48	11.69	11.91
330	48.13181	-123.415	MS	3.858	1.785	1.03	0	67.43	32.57	FALSE	0	0	0	0	0	0	0.54	7.19	14.44	18.5	16.34
331	48.132	-123.414	MS	3.728	1.695	1.168	0	70.73	29.27	FALSE	0	0	0	0	0	0	0.41	7.48	15.13	19.48	17.25
332	48.132	-123.412	MS	4.005	1.836	0.838	0	62.56	37.44	FALSE	0	0	0	0	0	0	0.89	6.82	13.22	16.76	14.94
333	48.13214	-123.41	MS	3.625	1.749	1.217	0	73.69	26.31	FALSE	0	0	0	0	0	0	1.16	9.07	17.28	20.66	16.53
334	48.13197	-123.409	MS	3.656	1.748	1.156	0	72.52	27.48	FALSE	0	0	0	0	0	0	1.44	8.81	16.49	20	16.46
335	48.13192	-123.407	S	3.326	1.515	1.631	0	82.11	17.89	FALSE	0	0	0	0	0	0	0.99	9.86	19.34	23.43	18.74
336	48.13193	-123.405	MS	3.467	1.592	1.502	0	79.44	20.56	FALSE	0	0	0	0	0	0	0.44	8.63	17.88	22.83	19.19
337	48.13195	-123.404	S	3.296	1.427	1.817	0	84.55	15.45	FALSE	0	0	0	0	0	0	0.4	8.62	18.73	24.51	20.91
338	48.13197	-123.402	MS	3.768	1.699	1.17	0	70.99	29.01	FALSE	0	0	0	0	0	0	0.27	6.4	14.52	19.95	18.33
339	48.13199	-123.4	MS	3.777	1.683	1.219	0	71.44	28.56	FALSE	0	0	0	0	0	0	0.12	5.57	14.16	20.17	19.12
340	48.13194	-123.399	MS	3.626	1.654	1.346	0	75.52	24.48	FALSE	0	0	0	0	0	0	0.3	7.1	15.99	21.6	19.22
341	48.13198	-123.397	S	3.466	1.516	1.574	0	80.31	19.69	FALSE	0	0	0	0	0	0	0.28	7.15	16.66	23.09	20.89
342	48.13199	-123.395	MS	3.535	1.581	1.492	0	78.41	21.59	FALSE	0	0	0	0	0	0	0.28	7.03	16.37	22.54	20.29
343	48.13209	-123.394	MS	3.844	1.741	1.074	0	68.72	31.28	FALSE	0	0	0	0	0	0	1.05	5.78	13.26	18.84	17.97
344	48.13061	-123.46	MS	3.204	1.487	1	0	79.91	20.09	FALSE	0	0	0.2	0.52	0.79	1.3	3.69	9.4	16.49	19.98	17.06
345	48.13059	-123.458	SM	4.381	1.834	-0.037	0	41.21	58.79	FALSE	0	0	0	0	0.1	2.38	4.72	5.26	5.35	6.25	7.89
346	48.13063	-123.456	SM	4.474	1.953	-0.051	0	40.19	59.81	FALSE	0	0	0	0	0.46	3.05	4.59	4.94	5.14	6.03	7.44
347	48.13062	-123.455	SM	4.445	2.003	-0.029	0	41.34	58.66	FALSE	0	0	0	0	0.9	3.28	4.68	4.98	5.21	6.16	7.58

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
348	48.13062	-123.453	SM	4.69	1.951	-0.055	0	36.73	63.27	FALSE	0	0	0	0	0.46	2.39	3.49	3.77	4.29	5.73	7.65
349	48.13059	-123.451	SM	4.616	1.934	-0.023	0	38.47	61.53	FALSE	0	0	0	0	0.66	2.46	3.37	3.62	4.35	6.12	8.26
350	48.13077	-123.45	SM	4.616	1.807	0.202	0	39.85	60.15	FALSE	0	0	0	0	0.16	1.38	2.22	2.85	4.32	7.08	10.11
351	48.13071	-123.448	SM	5.026	1.643	-0.015	0	28.14	71.86	FALSE	0	0	0	0	0	0.4	1.1	1.66	2.71	4.82	7.6
352	48.13071	-123.446	SM	5.099	1.661	0.029	0	27.69	72.31	FALSE	0	0	0	0	0	0.2	0.87	1.45	2.67	4.96	7.76
353	48.13071	-123.445	SM	4.989	1.707	0.074	0	30.9	69.1	FALSE	0	0	0	0	0	0.33	1.06	1.81	3.23	5.69	8.49
354	48.13071	-123.443	SM	4.825	1.757	0.2	0	36.43	63.57	FALSE	0	0	0	0	0	0.29	1.04	2.26	4.48	7.47	10
355	48.13076	-123.441	SM	4.724	1.803	0.278	0	39.62	60.38	FALSE	0	0	0	0	0	0.01	1.27	3.18	5.67	8.43	10.34
356	48.1307	-123.44	SM	4.905	1.712	0.237	0	34.25	65.75	FALSE	0	0	0	0	0	0	0.59	1.97	3.93	6.85	9.74
357	48.13082	-123.438	SM	4.829	1.715	0.261	0	36.43	63.57	FALSE	0	0	0	0	0	0.01	0.91	2.04	4.01	7.26	10.46
358	48.13066	-123.436	SM	4.663	1.745	0.383	0	40.54	59.46	FALSE	0	0	0	0	0	0.22	1.09	2.46	5.01	8.4	11.2
359	48.13086	-123.434	SM	4.492	1.779	0.503	0	46.26	53.74	FALSE	0	0	0	0	0	0.01	1.35	3.33	6.61	10.26	12.45
360	48.13085	-123.433	SM	4.777	1.815	0.303	0	39.06	60.94	FALSE	0	0	0	0	0	0.22	1.12	2.49	5.03	8.27	10.7
361	48.13083	-123.431	SM	4.581	1.827	0.445	0	45.74	54.26	FALSE	0	0	0	0	0	0	0.45	3.54	7.26	10.92	12.39
362	48.1309	-123.429	MS	4.203	1.803	0.71	0	56.34	43.66	FALSE	0	0	0	0	0	0	0.29	5.25	10.79	14.68	14.36
363	48.13074	-123.428	MS	4.353	1.82	0.644	0	52.63	47.37	FALSE	0	0	0	0	0	0	0.21	4.23	9.29	13.44	14.03
364	48.13074	-123.426	MS	4.329	1.821	0.655	0	53.7	46.3	FALSE	0	0	0	0	0	0	0.17	4.23	9.61	13.87	14.35
365	48.13079	-123.424	SM	4.668	1.871	0.376	0	43.92	56.08	FALSE	0	0	0	0	0	0	0.19	3.66	7.69	10.92	11.54
366	48.13084	-123.423	MS	4.146	1.812	0.745	0	58.62	41.38	FALSE	0	0	0	0	0	0	0.31	5.6	11.51	15.52	14.86
367	48.13074	-123.421	MS	4.078	1.788	0.808	0	60.25	39.75	FALSE	0	0	0	0	0	0	0.3	5.76	12.05	16.11	15.17
368	48.13092	-123.42	MS	4.392	1.813	0.596	0	51.28	48.72	FALSE	0	0	0	0	0	0	0.18	4.06	8.99	12.98	13.69
369	48.13084	-123.418	MS	3.912	1.819	0.932	0	65.48	34.52	FALSE	0	0	0	0	0	0	0.63	7.32	14.5	18.12	15.43
370	48.13087	-123.416	MS	4.096	1.828	0.77	0	59.68	40.32	FALSE	0	0	0	0	0	0	1.28	5.65	11.58	15.58	14.85
371	48.13081	-123.415	MS	4.143	1.838	0.738	0	59.03	40.97	FALSE	0	0	0	0	0	0	0.32	5.86	11.99	15.89	14.73
372	48.13092	-123.413	MS	3.584	1.636	1.241	0	73.95	26.05	FALSE	0	0	0	0	0	0	1.08	8.45	16.38	20.36	17.3
373	48.13085	-123.411	MS	3.541	1.68	1.275	0	75.29	24.71	FALSE	0	0	0	0	0	0	1.31	9.43	17.75	21.04	16.72
374	48.13099	-123.41	MS	3.836	1.8	0.961	0	67.19	32.81	FALSE	0	0	0	0	0	0	1.19	7.84	14.87	18.34	15.53
375	48.13086	-123.408	MS	3.455	1.575	1.503	0	79.32	20.68	FALSE	0	0	0	0	0	0	0.44	8.65	18.04	22.86	19.01
376	48.13083	-123.406	MS	3.504	1.581	1.467	0	78.39	21.61	FALSE	0	0	0	0	0	0	0.37	7.9	17.12	22.52	19.46
377	48.13079	-123.405	MS	3.503	1.554	1.481	0	78.41	21.59	FALSE	0	0	0	0	0	0	0.32	7.5	16.8	22.5	19.81
378	48.1309	-123.403	MS	3.599	1.602	1.428	0	76.77	23.23	FALSE	0	0	0	0	0	0	0.15	6.3	15.85	22.13	20.21
379	48.13081	-123.401	S	3.442	1.467	1.629	0	81.05	18.95	FALSE	0	0	0	0	0	0	0.12	6.52	16.96	23.69	21.37
380	48.13091	-123.399	MS	3.622	1.606	1.37	0	75.8	24.2	FALSE	0	0	0	0	0	0	0.25	6.45	15.27	21.54	20
381	48.13088	-123.398	MS	3.722	1.674	1.286	0	73.44	26.56	FALSE	0	0	0	0	0	0	0.12	5.82	14.88	21.04	19.54
382	48.13092	-123.396	MS	4.07	1.825	0.903	0	63.16	36.84	FALSE	0	0	0	0	0	0	0.22	5.17	12.02	17.34	16.9
383	48.13087	-123.394	MS	4.06	1.775	0.977	0	64.16	35.84	FALSE	0	0	0	0	0	0	0	3.96	11.54	17.68	18.12
384	48.13092	-123.393	MS	3.806	1.74	1.147	0	70.46	29.54	FALSE	0	0	0	0	0	0	0.29	6.46	14.23	19.72	18.27
385	48.12978	-123.459	MS	3.426	1.496	0.878	0	75.02	24.98	FALSE	0	0	0.13	0.41	0.71	1.01	2.51	6.88	13.55	18.64	18.25
386	48.12949	-123.457	MS	3.765	1.956	0.126	0	54.75	45.25	FALSE	0	0	0	0.85	2.98	4.91	5.98	6.28	6.68	7.81	9.25
387	48.12944	-123.456	SM	4.261	1.967	-0.005	0	44.37	55.63	FALSE	0	0	0	0.08	1.52	3.62	4.82	5.11	5.43	6.51	8.07
388	48.12959	-123.454	SM	4.541	1.919	-0.042	0	38.99	61.01	FALSE	0	0	0	0	0.46	2.42	3.91	4.59	5.06	6.08	7.58
389	48.12953	-123.452	SM	4.951	1.625	0.141	0	30.41	69.59	FALSE	0	0	0	0	0	0	0.26	2	3.87	5.86	8.25
390	48.1296	-123.45	SM	4.636	1.782	0.1	0	38.62	61.38	FALSE	0	0	0	0	0	1.13	2.38	3.3	4.78	7.11	9.42
391	48.12958	-123.449	SM	4.969	1.671	0.052	0	30.02	69.98	FALSE	0	0	0	0	0	0.33	1.15	1.89	3.1	5.3	8.06
392	48.1295	-123.447	SM	4.86	1.875	-0.025	0	33.9	66.1	FALSE	0	0	0	0	0.13	1.38	2.43	3.02	3.98	5.77	7.88
393	48.12961	-123.446	SM	4.736	1.87	0.047	0	36.74	63.26	FALSE	0	0	0	0	0.15	1.47	2.58	3.28	4.43	6.41	8.57
394	48.12965	-123.444	SM	4.908	1.771	0.072	0	33.1	66.9	FALSE	0	0	0	0	0	0.57	1.47	2.38	3.88	6.18	8.58
395	48.1296	-123.442	SM	4.778	1.851	0.119	0	37.09	62.91	FALSE	0	0	0	0	0	0.92	2	3.09	4.81	7.13	9.15
396	48.1296	-123.441	SM	4.884	1.752	0.137	0	34.48	65.52	FALSE	0	0	0	0	0	0.4	1.16	2.14	3.99	6.78	9.41

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
397	48.12973	-123.439	SM	4.69	1.891	0.157	0	39.81	60.19	FALSE	0	0	0	0	0.12	1.15	2.18	3.37	5.34	7.84	9.69
398	48.12963	-123.437	SM	4.809	1.755	0.136	0	36.46	63.54	FALSE	0	0	0	0	0	0.44	1.2	2.41	4.58	7.47	9.83
399	48.12961	-123.435	SM	4.87	1.864	0.16	0	36.34	63.66	FALSE	0	0	0	0	0.06	0.64	1.36	2.58	4.73	7.39	9.44
400	48.12954	-123.434	SM	4.577	1.809	0.449	0	44.66	55.34	FALSE	0	0	0	0	0	0	0.63	3.57	7.01	10.32	11.86
401	48.12962	-123.432	SM	4.659	1.799	0.385	0	42.05	57.95	FALSE	0	0	0	0	0	0	0.75	3.11	6.31	9.55	11.27
402	48.12962	-123.43	MS	4.386	1.833	0.613	0	51.39	48.61	FALSE	0	0	0	0	0	0	0.24	4.38	9.14	12.94	13.48
403	48.12966	-123.429	SM	4.489	1.808	0.526	0	47.95	52.05	FALSE	0	0	0	0	0	0	0.17	3.75	8.14	11.81	12.83
404	48.12965	-123.427	SM	4.515	1.823	0.484	0	47.61	52.39	FALSE	0	0	0	0	0	0	0.21	3.82	8.1	11.82	12.73
405	48.12961	-123.425	MS	4.355	1.821	0.59	0	51.77	48.23	FALSE	0	0	0	0	0	0	0.83	4.31	8.96	12.85	13.53
406	48.12963	-123.424	MS	4.17	1.785	0.793	0	57.83	42.17	FALSE	0	0	0	0	0	0	0.22	4.84	10.62	15.06	15.25
407	48.12976	-123.422	MS	3.874	1.65	1.003	0	65.21	34.79	FALSE	0	0	0	0	0	0	0.3	5.9	12.58	17.32	16.81
408	48.12956	-123.42	MS	3.506	1.582	1.364	0	76.53	23.47	FALSE	0	0	0	0	0	0	0.46	8.7	17.61	21.79	17.91
409	48.12972	-123.419	MS	4.128	1.768	0.757	0	58.1	41.9	FALSE	0	0	0	0	0	0	0.43	5.37	11.05	15.11	14.84
410	48.1297	-123.417	MS	4.21	1.859	0.645	0	56.07	43.93	FALSE	0	0	0	0	0	0	1.18	5.66	10.97	14.43	13.69
411	48.12961	-123.415	MS	3.868	1.762	0.988	0	66.27	33.73	FALSE	0	0	0	0	0	0	0.57	7.1	14.2	18.07	15.94
412	48.12971	-123.413	MS	4.314	1.879	0.58	0	53.67	46.33	FALSE	0	0	0	0	0	0	0.64	5.42	10.65	13.94	13.2
413	48.12977	-123.412	MS	3.968	1.791	0.869	0	63.31	36.69	FALSE	0	0	0	0	0	0	0.56	6.72	13.41	17.16	15.3
414	48.12976	-123.41	MS	3.763	1.794	1.069	0	69.59	30.41	FALSE	0	0	0	0	0	0	1.08	8.29	15.85	19.25	15.88
415	48.12975	-123.409	MS	3.536	1.639	1.304	0	75.88	24.12	FALSE	0	0	0	0	0	0	0.73	8.95	17.7	21.65	17.46
416	48.12976	-123.407	MS	3.779	1.687	1.136	0	70.07	29.93	FALSE	0	0	0	0	0	0	0.27	6.35	14.35	19.62	18.01
417	48.1297	-123.405	S	3.421	1.486	1.646	0	81.39	18.61	FALSE	0	0	0	0	0	0	0.21	7.21	17.5	23.78	20.91
418	48.12976	-123.404	MS	3.508	1.53	1.55	0	79.44	20.56	FALSE	0	0	0	0	0	0	0.13	6.39	16.48	23.12	21.01
419	48.12978	-123.402	S	3.362	1.428	1.763	0	83.7	16.3	FALSE	0	0	0	0	0	0	0.14	6.98	17.86	24.69	21.87
420	48.12984	-123.4	MS	3.88	1.687	1.123	0	68.7	31.3	FALSE	0	0	0	0	0	0	0.02	4.54	12.87	19.28	19.12
421	48.12976	-123.399	MS	3.865	1.686	1.181	0	69.6	30.4	FALSE	0	0	0	0	0	0	0.05	4.31	12.91	19.57	19.55
422	48.12979	-123.397	MS	3.616	1.567	1.421	0	76.45	23.55	FALSE	0	0	0	0	0	0	0.29	5.75	14.44	21.6	21
423	48.12978	-123.395	MS	4.079	1.824	0.877	0	62.83	37.17	FALSE	0	0	0	0	0	0	0.94	4.71	11.19	16.84	17.09
424	48.12978	-123.393	MS	4.415	1.859	0.625	0	53.03	46.97	FALSE	0	0	0	0	0	0	0.44	3.51	8.5	13.57	14.99
425	48.12843	-123.456	MS	3.045	1.847	0.546	0	75.75	24.25	FALSE	0	0	1.25	2.61	3.38	4.12	6.14	9.81	13.45	14.52	12.21
426	48.12841	-123.455	MS	4.159	1.869	0.27	0	50.86	49.14	FALSE	0	0	0	0	0.49	2.14	3.79	5.71	8.08	10.14	10.72
427	48.12858	-123.453	SM	4.18	1.992	0.125	0	47.66	52.34	FALSE	0	0	0	0	1.1	3.69	5.42	6.02	6.39	7.33	8.54
429	48.12841	-123.45	SM	4.714	1.893	-0.074	0	35.69	64.31	FALSE	0	0	0	0	0.21	2	3.29	3.76	4.31	5.66	7.53
430	48.12855	-123.448	SM	4.944	1.678	-0.018	0	30.16	69.84	FALSE	0	0	0	0	0	0.42	1.36	2.19	3.38	5.36	7.78
431	48.12838	-123.446	SM	4.913	1.831	-0.065	0	31.81	68.19	FALSE	0	0	0	0	0	1.09	2.3	3.06	3.93	5.37	7.23
432	48.12845	-123.445	SM	4.573	1.837	0.152	0	40.28	59.72	FALSE	0	0	0	0	0.16	1.38	2.54	3.73	5.36	7.41	9.32
433	48.12845	-123.443	SM	4.906	1.785	-0.001	0	32.26	67.74	FALSE	0	0	0	0	0	0.74	1.77	2.71	4.07	5.93	7.84
434	48.12852	-123.441	SM	4.941	1.683	0.102	0	31.28	68.72	FALSE	0	0	0	0	0	0.26	1.13	1.91	3.27	5.67	8.52
435	48.12851	-123.44	SM	4.812	1.857	0.019	0	35.07	64.93	FALSE	0	0	0	0	0.14	1.26	2.21	3.02	4.37	6.34	8.28
436	48.12854	-123.438	SM	5.048	1.655	0.017	0	27.9	72.1	FALSE	0	0	0	0	0	0.39	1.04	1.57	2.64	4.79	7.59
437	48.12852	-123.436	SM	4.784	1.857	0.117	0	36.74	63.26	FALSE	0	0	0	0	0.17	1.16	1.88	2.75	4.44	6.88	9.16
438	48.12854	-123.435	SM	4.806	1.874	0.109	0	36.6	63.4	FALSE	0	0	0	0	0.12	1	1.87	2.98	4.8	7.08	8.97
439	48.12853	-123.433	SM	5.051	1.682	0.052	0	29.07	70.93	FALSE	0	0	0	0	0	0.12	0.8	1.74	3.33	5.61	7.93
440	48.12856	-123.431	SM	4.624	1.813	0.312	0	42.76	57.24	FALSE	0	0	0	0	0	0	0.95	3.72	7.08	9.98	10.94
441	48.12855	-123.43	SM	4.477	1.805	0.419	0	46.68	53.32	FALSE	0	0	0	0	0	0.01	1.37	3.95	7.67	10.9	11.94
442	48.12856	-123.428	MS	4.082	1.751	0.741	0	58.73	41.27	FALSE	0	0	0	0	0	0.01	1.44	5.12	10.69	14.91	14.95
443	48.12851	-123.426	SM	4.468	1.863	0.5	0	48.51	51.49	FALSE	0	0	0	0	0	0	0.92	4.3	8.54	11.86	12.36
444	48.12864	-123.424	SM	4.382	1.786	0.529	0	49.93	50.07	FALSE	0	0	0	0	0	0	0.86	4.14	8.47	12.19	13.04
445	48.12851	-123.423	SM	4.507	1.83	0.469	0	47.38	52.62	FALSE	0	0	0	0	0	0	0.21	4.1	8.52	11.87	12.3
446	48.12866	-123.421	MS	4.193	1.819	0.7	0	56.59	43.41	FALSE	0	0	0	0	0	0	0.55	5.47	10.94	14.65	14.21

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
447	48.12847	-123.419	MS	4.155	1.844	0.648	0	57.11	42.89	FALSE	0	0	0	0	0	0	1.3	6.11	11.55	14.75	13.6
448	48.12861	-123.418	MS	3.855	1.812	0.901	0	65.56	34.44	FALSE	0	0	0	0	0	0	1.59	8.1	14.69	17.57	14.6
449	48.12857	-123.416	MS	4.135	1.927	0.563	0	56.14	43.86	FALSE	0	0	0	0	0	0.59	3.15	6.82	11.13	13.4	12.12
450	48.12861	-123.414	MS	4.236	1.92	0.529	0	53.99	46.01	FALSE	0	0	0	0	0	0.02	2.49	6.47	11.06	13.37	11.92
451	48.12876	-123.413	MS	3.963	1.766	0.857	0	62.92	37.08	FALSE	0	0	0	0	0	0	1.23	6.27	12.4	16.45	15.51
452	48.12862	-123.411	MS	3.87	1.889	0.911	0	65.91	34.09	FALSE	0	0	0	0	0	0.03	2.7	8.03	14.46	17.33	14.47
453	48.12859	-123.409	MS	4.045	1.871	0.749	0	60.94	39.06	FALSE	0	0	0	0	0	0	1.52	6.98	12.98	16.11	14.08
454	48.12868	-123.408	MS	3.956	1.84	0.922	0	65	35	FALSE	0	0	0	0	0	0	0.59	6.94	13.93	17.9	15.73
455	48.12861	-123.406	MS	3.871	1.785	0.976	0	67.26	32.74	FALSE	0	0	0	0	0	0	0.39	7.21	14.57	18.72	16.36
456	48.12857	-123.404	MS	3.875	1.731	1.038	0	67.84	32.16	FALSE	0	0	0	0	0	0	0.25	5.97	13.46	18.87	17.77
457	48.12869	-123.403	MS	3.857	1.715	1.184	0	70.16	29.84	FALSE	0	0	0	0	0	0	0.01	4.65	13.43	19.97	19.43
458	48.12868	-123.401	MS	3.929	1.752	1.046	0	67.34	32.66	FALSE	0	0	0	0	0	0	0.28	5.17	12.58	18.72	18.37
459	48.12864	-123.399	MS	4.076	1.773	0.938	0	63.55	36.45	FALSE	0	0	0	0	0	0	0.05	3.86	11.51	17.65	17.96
460	48.12869	-123.398	MS	3.939	1.721	1.116	0	67.95	32.05	FALSE	0	0	0	0	0	0	0.02	3.97	12.24	18.91	19.39
461	48.1287	-123.396	MS	3.975	1.801	1.021	0	66.85	33.15	FALSE	0	0	0	0	0	0	0.11	5.04	12.92	18.83	18.16
462	48.12875	-123.394	MS	3.989	1.717	1.039	0	65.53	34.47	FALSE	0	0	0	0	0	0	0.04	3.92	11.75	18.05	18.57
463	48.12871	-123.392	MS	3.876	1.744	1.134	0	69.43	30.57	FALSE	0	0	0	0	0	0	0.12	5.22	13.33	19.49	18.92
464	48.12735	-123.456	S	2.763	1.112	1.795	0	91.84	8.16	FALSE	0	0	0	0	0	0.01	5.32	16.25	24.34	23.83	15.57
465	48.12734	-123.454	SM	4.559	1.846	0.046	0	39.53	60.47	FALSE	0	0	0	0	0.23	1.74	3	4.01	5.28	6.99	8.65
466	48.12726	-123.452	SM	4.455	1.845	-0.006	0	41.02	58.98	FALSE	0	0	0	0	0.3	2.19	3.63	4.52	5.52	7.03	8.55
467	48.12738	-123.451	SM	4.749	1.663	-0.059	0	32.99	67.01	FALSE	0	0	0	0	0	0.72	2.02	2.92	3.94	5.67	7.93
468	48.1273	-123.449	SM	4.837	1.746	-0.143	0	31.18	68.82	FALSE	0	0	0	0	0	1.16	2.44	3.06	3.74	5.08	6.99
469	48.12745	-123.447	SM	5.164	1.642	-0.189	0	23.41	76.59	FALSE	0	0	0	0	0	0.5	1.53	1.84	2.17	3.4	5.7
470	48.12747	-123.445	SM	4.84	1.873	-0.131	0	32.5	67.5	FALSE	0	0	0	0	0.28	1.88	2.81	3.14	3.68	5.02	6.96
471	48.12732	-123.444	SM	4.927	1.903	-0.1	0	31.75	68.25	FALSE	0	0	0	0	0.18	1.52	2.57	3.21	3.95	5.17	6.81
472	48.12739	-123.442	SM	4.575	1.979	0.043	0	39.92	60.08	FALSE	0	0	0	0	0.31	2.31	3.85	4.73	5.51	6.59	7.84
473	48.12735	-123.44	SM	4.839	1.827	0.018	0	34.25	65.75	FALSE	0	0	0	0	0	0.76	2.27	3.3	4.41	6.09	8.02
474	48.12738	-123.439	SM	5.22	1.614	-0.041	0	23.3	76.7	FALSE	0	0	0	0	0	0.01	0.92	1.54	2.2	3.73	6.19
475	48.12739	-123.437	SM	4.846	1.78	-0.012	0	33.3	66.7	FALSE	0	0	0	0	0	0.62	2.09	3.18	4.32	5.97	7.86
476	48.12741	-123.436	SM	4.998	1.738	-0.034	0	29.58	70.42	FALSE	0	0	0	0	0	0.48	1.63	2.37	3.35	5.12	7.39
477	48.12738	-123.434	SM	5.047	1.659	-0.039	0	27.69	72.31	FALSE	0	0	0	0	0	0.31	1.15	1.85	2.95	4.87	7.28
478	48.12742	-123.432	SM	4.725	1.828	0.091	0	37.5	62.5	FALSE	0	0	0	0	0	0.77	2.14	3.51	5.33	7.37	8.9
479	48.12744	-123.43	SM	4.843	1.758	0.108	0	35.18	64.82	FALSE	0	0	0	0	0	0.28	1.24	2.62	4.73	7.23	9.17
480	48.12745	-123.429	SM	4.653	1.807	0.226	0	41.34	58.66	FALSE	0	0	0	0	0	0.01	1.16	3.87	6.96	9.48	10.29
481	48.12742	-123.427	SM	4.54	1.876	0.308	0	44.8	55.2	FALSE	0	0	0	0	0	0.01	1.73	4.97	8.11	10.21	10.44
482	48.12743	-123.425	MS	4.265	1.871	0.515	0	52.72	47.28	FALSE	0	0	0	0	0	0	1.96	6.19	10.24	12.61	12.06
483	48.1274	-123.424	MS	4.357	1.831	0.483	0	50.62	49.38	FALSE	0	0	0	0	0	0	0.98	5.18	9.56	12.48	12.37
484	48.12738	-123.422	SM	4.803	1.774	0.185	0	37.41	62.59	FALSE	0	0	0	0	0	0	0.65	3.01	5.8	8.48	9.81
485	48.12733	-123.42	MS	4.214	1.92	0.479	0	53.35	46.65	FALSE	0	0	0	0	0	0.03	3.22	7.16	10.82	12.4	11.15
486	48.12747	-123.419	MS	4.2	1.922	0.553	0	54.98	45.02	FALSE	0	0	0	0	0	0.43	2.74	6.28	10.57	13.13	12.38
487	48.12746	-123.417	SM	4.376	1.936	0.377	0	48.63	51.37	FALSE	0	0	0	0	0	0.18	2.95	6.3	9.38	10.89	10.27
488	48.12754	-123.415	MS	3.905	1.945	0.641	0	60.66	39.34	FALSE	0	0	0	0	0	0.93	4.8	9.27	12.98	13.68	11.2
489	48.12745	-123.414	MS	4.065	1.908	0.569	0	56.91	43.09	FALSE	0	0	0	0	0	0.82	3.91	7.22	10.71	12.68	12
490	48.12741	-123.412	SM	4.393	2.026	0.351	0	49.38	50.62	FALSE	0	0	0	0	0	0.75	3.59	6.43	9.17	10.75	10.27
491	48.12754	-123.41	MS	4.027	1.906	0.599	0	58.58	41.42	FALSE	0	0	0	0	0	0.82	3.64	7.38	11.55	13.71	12.41
492	48.12754	-123.409	MS	4.146	1.978	0.381	0	54.01	45.99	FALSE	0	0	0	0	0.71	2.07	3.59	6.13	9.52	11.78	11.3
493	48.12752	-123.407	MS	3.634	1.87	0.909	0	69.93	30.07	FALSE	0	0	0	0	0.45	1.61	4.13	9.13	14.91	17.24	14.09
494	48.12756	-123.405	MS	4.229	1.876	0.657	0	57.25	42.75	FALSE	0	0	0	0	0	0	0.31	5.72	11.56	15.36	14.37
495	48.12748	-123.404	MS	3.968	1.855	0.905	0	64.8	35.2	FALSE	0	0	0	0	0	0	1.06	6.97	13.31	17.25	15.81

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
496	48.12762	-123.402	MS	3.735	1.698	1.232	0	72.47	27.53	FALSE	0	0	0	0	0	0	0.29	6.54	14.71	20.41	18.82
497	48.12754	-123.4	MS	4.109	1.792	0.89	0	62.25	37.75	FALSE	0	0	0	0	0	0	0.01	4.03	11.54	17.32	17.32
498	48.12761	-123.398	MS	4.066	1.763	0.959	0	63.46	36.54	FALSE	0	0	0	0	0	0	0.03	3.83	11.57	17.62	17.84
499	48.12763	-123.397	MS	4.508	1.845	0.566	0	50.29	49.71	FALSE	0	0	0	0	0	0	0.05	3.06	8.12	12.81	14.39
500	48.12765	-123.395	MS	3.726	1.644	1.287	0	73.32	26.68	FALSE	0	0	0	0	0	0	0.06	5.31	14.47	21.01	19.93
501	48.12753	-123.393	MS	3.758	1.651	1.254	0	72.22	27.78	FALSE	0	0	0	0	0	0	0.05	5.13	14.08	20.57	19.73
502	48.12743	-123.392	MS	3.911	1.695	1.137	0	67.98	32.02	FALSE	0	0	0	0	0	0	0.03	4.1	12.43	18.96	19.16
503	48.12606	-123.455	S	2.573	1.464	0.647	0	86.3	13.7	FALSE	0	0	0.73	1.93	3.54	5.91	9.5	13.54	15.82	15.02	11.99
504	48.12623	-123.453	S	2.879	1.23	1.933	0	90.94	9.06	FALSE	0	0	0	0	0	0	4.39	14.65	23.06	24.14	17.08
505	48.12638	-123.451	S	2.646	1.639	1.328	0	82.12	17.88	FALSE	0	0	0	0	0.64	7.3	15.2	19.92	18.27	11.94	5.85
506	48.12597	-123.45	MS	3.64	2.004	0.363	0	58.66	41.34	FALSE	0	0	0	0.04	2.09	5.67	8.32	9.29	8.88	8.2	8.05
507	48.12624	-123.448	SM	4.566	1.868	-0.11	0	37.5	62.5	FALSE	0	0	0	0	0.73	2.35	3.36	3.91	4.62	5.93	7.62
508	48.12632	-123.446	SM	4.991	1.624	-0.147	0	26.59	73.41	FALSE	0	0	0	0	0	0.18	1.67	2.6	3.13	4.25	6.24
509	48.12609	-123.445	SM	4.549	2.054	-0.126	0	38.5	61.5	FALSE	0	0	0	0.32	2.03	3.41	3.72	3.5	3.86	5.32	7.36
510	48.12629	-123.443	GS	1.159	2.469	1.294	36.89	51.01	12.09	TRUE	4.43	7.98	9.4	10.8	32.74	4.1	3.6	2.41	1.63	1.64	2.07
511	48.12619	-123.441	GS	1.21	2.822	1.037	32	49.78	18.21	TRUE	7.5	10.2	16.8	16.29	14.76	1.74	1.79	1.5	1.32	1.5	1.99
512	48.12626	-123.44	SM	4.713	1.838	-0.083	0	34.4	65.6	FALSE	0	0	0	0	0.12	1.78	3.33	3.69	3.97	5.14	7.17
513	48.12621	-123.438	SM	4.618	2.006	-0.047	0	38.01	61.99	FALSE	0	0	0	0	0.48	2.57	4.1	4.87	5.32	5.92	6.85
514	48.12624	-123.436	SM	4.656	1.993	-0.042	0	37.84	62.16	FALSE	0	0	0	0	0.35	2.43	3.87	4.51	5.09	6.08	7.29
515	48.12625	-123.435	SM	5.004	1.692	-0.127	0	27.78	72.22	FALSE	0	0	0	0	0	0.66	1.68	2.29	3.06	4.54	6.71
516	48.12619	-123.433	SM	4.807	1.719	0.046	0	33.91	66.09	FALSE	0	0	0	0	0	0.35	1.75	2.93	4.27	6.21	8.41
517	48.12625	-123.431	SM	4.605	1.776	0.171	0	39.98	60.02	FALSE	0	0	0	0	0	0.56	1.96	3.75	5.94	8.09	9.58
518	48.12626	-123.429	SM	4.629	1.768	0.113	0	39.1	60.9	FALSE	0	0	0	0	0	0.66	2	3.62	5.69	7.85	9.39
519	48.12631	-123.428	SM	4.609	1.795	0.225	0	41.12	58.88	FALSE	0	0	0	0	0	0.33	1.87	3.77	6.11	8.52	10.12
520	48.12627	-123.426	SM	4.549	1.912	0.288	0	44.05	55.95	FALSE	0	0	0	0	0	0.35	2.53	4.95	7.32	9.18	10.01
521	48.12627	-123.424	MS	4.268	1.961	0.354	0	50.38	49.62	FALSE	0	0	0	0	0	1.06	3.97	6.9	9.35	10.44	9.99
522	48.1262	-123.423	SM	4.404	1.886	0.334	0	47.46	52.54	FALSE	0	0	0	0	0	0.35	2.79	5.58	8.25	10.15	10.6
523	48.12631	-123.421	SM	4.506	1.842	0.226	0	44.03	55.97	FALSE	0	0	0	0	0	0.42	2.38	4.74	7.32	9.41	10.16
524	48.12621	-123.419	MS	4.224	2.016	0.335	0	51.03	48.97	FALSE	0	0	0	0	0.09	2.01	4.7	7.12	8.97	9.89	9.67
525	48.12633	-123.418	MS	4.043	2.12	0.378	0	54.49	45.51	FALSE	0	0	0	0	0.47	3.46	6.45	8.7	9.75	9.66	8.7
526	48.12635	-123.416	MS	4.124	2.032	0.451	0	54.17	45.83	FALSE	0	0	0	0	0	1.77	5.05	8.13	10.26	10.81	9.88
527	48.1264	-123.414	MS	4.222	2.035	0.328	0	51.09	48.91	FALSE	0	0	0	0	0.17	2.21	4.75	7.11	9.02	9.95	9.56
528	48.12636	-123.413	MS	4.255	2.019	0.317	0	50.61	49.39	FALSE	0	0	0	0	0.15	1.93	4.34	6.93	9.09	10.1	9.68
529	48.12651	-123.411	MS	3.984	2.028	0.504	0	57.65	42.35	FALSE	0	0	0	0	0.05	2.32	5.65	8.74	11	11.61	10.29
530	48.12637	-123.409	MS	3.931	2.126	0.428	0	57.41	42.59	FALSE	0	0	0	0	1.1	3.95	6.58	8.61	9.99	10.35	9.34
531	48.1264	-123.408	MS	3.973	1.993	0.517	0	58.47	41.53	FALSE	0	0	0	0	0	2.01	5.2	8.55	11.48	12.48	10.85
532	48.12646	-123.406	MS	3.991	1.984	0.576	0	59.56	40.44	FALSE	0	0	0	0	0.3	1.98	4.07	7.37	11.3	13.5	12.25
533	48.12651	-123.405	MS	3.805	1.9	0.81	0	66.03	33.97	FALSE	0	0	0	0	0	0.81	4.47	8.66	13.33	15.82	13.91
534	48.12643	-123.403	MS	3.535	1.862	1.035	0	73.01	26.99	FALSE	0	0	0	0	0	1.35	5.89	10.53	15.05	17.09	14.42
535	48.12639	-123.401	MS	3.599	1.769	1.137	0	73.21	26.79	FALSE	0	0	0	0	0	0.01	3.28	9.71	15.91	18.95	15.97
536	48.12642	-123.399	SM	4.681	1.913	0.25	0	42.84	57.16	FALSE	0	0	0	0	0	0.77	1.82	3.21	6.03	9.45	11.23
537	48.12638	-123.398	MS	3.716	1.711	1.234	0	72.88	27.12	FALSE	0	0	0	0	0	0	0.34	7.02	15.21	20.56	18.52
538	48.12639	-123.396	MS	3.895	1.779	0.989	0	67.51	32.49	FALSE	0	0	0	0	0	0	0.34	6.5	13.84	18.84	17.23
539	48.12644	-123.394	MS	4.035	1.787	0.942	0	64.29	35.71	FALSE	0	0	0	0	0	0	0.07	4.63	12.31	17.96	17.51
540	48.12649	-123.393	MS	3.839	1.769	1.11	0	69.95	30.05	FALSE	0	0	0	0	0	0	0.31	6.5	14.02	19.48	18.21
541	48.12509	-123.452	MS	4.15	1.67	0.55	0	55.06	44.94	FALSE	0	0	0	0	0	0.01	1.58	4.52	9.08	13.36	14.49
542	48.125	-123.451	SM	4.989	1.512	-0.136	0	25.57	74.43	FALSE	0	0	0	0	0	0.24	1.08	1.67	2.53	4.22	6.67
543	48.12515	-123.449	SM	4.908	1.633	-0.145	0	28.08	71.92	FALSE	0	0	0	0	0	0.69	1.79	2.42	3.12	4.52	6.64
544	48.1251	-123.447	SM	4.186	1.785	0.137	0	47.35	52.65	FALSE	0	0	0	0	0.57	2.58	3.99	4.79	5.89	7.93	10.23

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
545	48.12539	-123.445	MS	3.346	1.59	1.24	0	76.59	23.41	FALSE	0	0	0	0	0	0.01	3.81	11.83	18.58	19.69	14.65
547	48.12513	-123.442	SG	0.785	2.611	1.336	44.33	42.69	12.98	TRUE	10.14	14.42	13.31	14.37	19.21	3.59	2.5	1.06	0.42	0.56	1.11
548	48.1253	-123.44	SM	4.66	1.915	-0.109	0	36.15	63.85	FALSE	0	0	0	0	0.5	2.2	3.46	4.16	4.76	5.73	7.05
550	48.12514	-123.437	SM	5.108	1.726	-0.183	0	25.46	74.54	FALSE	0	0	0	0	0	0.91	1.85	2.14	2.59	3.86	5.95
551	48.12513	-123.435	SM	5.04	1.73	-0.12	0	27.2	72.8	FALSE	0	0	0	0	0	0.89	1.83	2.24	2.81	4.23	6.47
552	48.12519	-123.434	SM	4.768	1.888	-0.068	0	34.18	65.82	FALSE	0	0	0	0	0.24	1.8	3.03	3.65	4.18	5.32	7.1
553	48.12508	-123.432	SM	4.547	1.947	-0.02	0	39.19	60.81	FALSE	0	0	0	0	0.35	2.5	4.12	4.8	5.2	6.08	7.45
554	48.12509	-123.43	SM	4.762	1.921	-0.049	0	35.43	64.57	FALSE	0	0	0	0	0.15	1.64	3.13	4.05	4.84	5.93	7.28
555	48.12508	-123.429	SM	4.534	1.903	0.069	0	40.75	59.25	FALSE	0	0	0	0	0.1	1.59	3.65	5.06	5.96	6.98	8.25
556	48.12515	-123.427	SM	4.699	1.895	-0.003	0	36.76	63.24	FALSE	0	0	0	0	0.09	1.49	3.14	4.22	5.08	6.22	7.67
557	48.12512	-123.425	SM	4.174	2.058	0.217	0	49.78	50.22	FALSE	0	0	0	0	0.74	3.62	5.78	6.77	7.33	8.08	8.74
558	48.12522	-123.424	MS	3.849	2.138	0.294	0	55.18	44.82	FALSE	0	0	0	0.03	1.9	5.36	8.04	9.07	8.69	7.87	7.3
559	48.12517	-123.422	MS	3.77	2.155	0.434	0	57.55	42.45	FALSE	0	0	0	0	0.66	5.25	9.59	11.29	10.11	7.95	6.57
560	48.12514	-123.42	SM	4.432	1.903	0.261	0	45.27	54.73	FALSE	0	0	0	0	0	0.48	3.18	6.13	8.12	9.03	9.26
561	48.12516	-123.419	MS	4.083	1.968	0.367	0	53.17	46.83	FALSE	0	0	0	0	0	1.6	5.29	8.69	10.54	10.37	9.04
562	48.12524	-123.417	MS	3.589	1.923	0.777	0	66.76	33.24	FALSE	0	0	0	0	0	2.44	7.12	11.56	14.21	13.66	10.6
563	48.12522	-123.415	MS	3.729	1.975	0.589	0	61.2	38.8	FALSE	0	0	0	0	0.06	2.94	7.26	11.03	12.41	11.2	9.03
564	48.12527	-123.414	MS	3.748	2.096	0.455	0	58.6	41.4	FALSE	0	0	0	0	0.62	4.65	8.76	11.12	10.88	9.07	7.26
565	48.12529	-123.412	MS	3.709	2.15	0.426	0	59.27	40.73	FALSE	0	0	0	0.12	2.24	5.25	8.24	10.16	10.32	9.09	7.51
566	48.12521	-123.41	MS	3.534	2.165	0.512	0	62.61	37.39	FALSE	0	0	0	0.22	2.88	6.41	9.48	10.83	10.37	8.92	7.36
567	48.12527	-123.409	MS	3.563	1.991	0.624	0	65.09	34.91	FALSE	0	0	0	0	1.28	4.55	7.77	10.36	11.77	11.65	10.02
568	48.12531	-123.407	MS	3.692	2.052	0.636	0	64.32	35.68	FALSE	0	0	0	0	0.85	3.91	7.04	9.95	12.07	12.44	10.56
569	48.12534	-123.405	MS	3.648	1.928	0.819	0	67.7	32.3	FALSE	0	0	0	0	0	2.36	6.08	10.07	13.66	14.83	12.46
570	48.12515	-123.403	S	3.054	1.743	1.246	0	80.37	19.63	FALSE	0	0	0	0	0.17	4.19	9.7	14.59	17.17	16.15	11.84
571	48.12526	-123.402	MS	3.549	1.917	0.949	0	70.79	29.21	FALSE	0	0	0	0	0	1.36	7.12	11.84	14.83	15.25	12.48
572	48.12529	-123.4	S	2.415	1.645	1.635	0	86.3	13.7	FALSE	0	0	0	0	1.64	10.16	18.15	21.24	17.59	10.52	4.79
573	48.12514	-123.398	MS	3.378	1.718	1.234	0	77.73	22.27	FALSE	0	0	0	0	0	1.58	4.91	10.24	16.37	19.24	16.09
574	48.12521	-123.397	MS	3.975	1.836	0.857	0	64.16	35.84	FALSE	0	0	0	0	0	0	1.37	6.83	12.73	16.83	15.78
575	48.12543	-123.395	MS	4.279	1.858	0.725	0	56.99	43.01	FALSE	0	0	0	0	0	0	0.13	4.29	10.37	15.21	15.51
576	48.1253	-123.393	MS	4.282	1.829	0.68	0	55.72	44.28	FALSE	0	0	0	0	0	0	0.19	4.51	10.09	14.61	14.99
577	48.12527	-123.392	MS	4.4	1.865	0.62	0	53.03	46.97	FALSE	0	0	0	0	0	0	0.2	4.17	9.04	13.51	14.55
578	48.12411	-123.441	SM	4.43	1.808	0.035	0	41.36	58.64	FALSE	0	0	0	0	0.7	2.18	3.13	3.75	4.81	6.79	9.18
579	48.12401	-123.44	SM	4.69	1.784	-0.077	0	35.05	64.95	FALSE	0	0	0	0	0.43	1.69	2.42	2.95	3.96	5.79	8.02
580	48.12399	-123.438	SM	4.897	1.751	-0.112	0	30.26	69.74	FALSE	0	0	0	0	0.09	1.15	2.09	2.62	3.4	4.92	7.01
581	48.12397	-123.436	SM	4.796	1.729	-0.052	0	32.25	67.75	FALSE	0	0	0	0	0	1.04	2.28	2.93	3.75	5.34	7.48
582	48.12396	-123.435	SM	5.061	1.585	-0.043	0	25.25	74.75	FALSE	0	0	0	0	0	0.34	1.14	1.6	2.23	3.84	6.59
583	48.12414	-123.433	SM	4.524	1.922	-0.052	0	39.02	60.98	FALSE	0	0	0	0	0.45	2.86	4.04	4.32	4.81	6	7.61
584	48.12398	-123.431	SM	4.091	2.19	-0.201	0	44.01	55.99	FALSE	0	0	0.17	2.09	4.21	5.41	5.15	4.35	4.1	4.82	6.17
585	48.12409	-123.429	SM	4.764	1.862	-0.094	0	34.13	65.87	FALSE	0	0	0	0	0.16	1.62	2.98	3.75	4.4	5.52	7.12
586	48.1241	-123.428	SM	4.576	1.927	-0.069	0	38.31	61.69	FALSE	0	0	0	0	0.57	2.42	3.72	4.39	5	6.07	7.48
587	48.12391	-123.426	SM	4.204	2.006	0.008	0	45.84	54.16	FALSE	0	0	0	0.17	2.09	3.88	4.8	5.15	5.71	6.85	8.18
588	48.12414	-123.425	SM	4.446	1.957	0.027	0	41.58	58.42	FALSE	0	0	0	0	0.54	2.66	4.33	5.19	5.68	6.5	7.78
589	48.12406	-123.423	SM	4.267	2.005	0.213	0	47.32	52.68	FALSE	0	0	0	0	0	2.24	5.64	7.49	7.78	7.71	8.05
590	48.12399	-123.421	MS	3.634	2.173	0.414	0	58.56	41.44	FALSE	0	0	0	0	2.01	6.97	10.49	10.83	8.84	6.87	6.22
591	48.12397	-123.419	MS	3.957	1.907	0.361	0	54.46	45.54	FALSE	0	0	0	0	0.06	2.44	5.92	8.69	9.85	9.72	9.19
592	48.12407	-123.418	MS	3.405	1.904	0.606	0	67.06	32.94	FALSE	0	0	0.19	0.68	1.74	3.84	7.29	11.04	12.94	12.08	9.71
593	48.12412	-123.416	MS	3.328	1.966	0.526	0	65.28	34.72	FALSE	0	0	0	0.43	2.98	6.38	9.54	10.99	10.41	8.99	8.01
594	48.12414	-123.414	MS	3.671	2.07	0.433	0	59.01	40.99	FALSE	0	0	0	0	1.78	5.36	8.57	10.17	9.79	8.52	7.59
595	48.12413	-123.413	MS	3.14	1.845	0.751	0	71.94	28.06	FALSE	0	0	0	0.1	2.46	6.26	10.16	12.43	12.35	10.9	9.34

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
596	48.12405	-123.411	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
597	48.12403	-123.409	MS	3.835	2.007	0.446	0	58.76	41.24	FALSE	0	0	0	0	1.09	3.79	6.29	8.34	9.88	10.6	10.12
598	48.12412	-123.408	MS	3.147	1.965	0.944	0	74.26	25.74	FALSE	0	0	0	0	2.09	6.49	10.63	13.29	13.76	12.22	9.38
599	48.12416	-123.406	MS	3.809	2.025	0.57	0	60.6	39.4	FALSE	0	0	0	0	0.26	3.16	6.76	9.9	11.6	11.44	9.8
600	48.12419	-123.404	MS	3.154	1.944	0.936	0	74.48	25.52	FALSE	0	0	0	0.03	1.98	5.98	10.25	13.44	14.42	12.85	9.51
601	48.12406	-123.403	MS	3.388	1.767	1.099	0	74.74	25.26	FALSE	0	0	0	0	0	1.15	6.47	12.13	16.6	17.18	13.38
602	48.1242	-123.401	MS	3.651	1.996	0.74	0	66.04	33.96	FALSE	0	0	0	0	0	2.92	7.49	11.17	13.12	12.95	10.8
603	48.12415	-123.399	MS	4.007	1.966	0.592	0	59.6	40.4	FALSE	0	0	0	0	0	0.81	4.48	8.33	11.84	13.48	12.08
604	48.12416	-123.398	MS	4.003	1.916	0.636	0	60.28	39.72	FALSE	0	0	0	0	0	0.97	3.91	7.19	11.13	13.89	13.34
605	48.12427	-123.396	SM	4.558	1.888	0.399	0	47.31	52.69	FALSE	0	0	0	0	0	0	0.87	4.33	7.97	11.34	12.38
606	48.12418	-123.394	MS	3.955	1.813	0.913	0	65.31	34.69	FALSE	0	0	0	0	0	0	1.19	6.25	12.76	17.47	16.58
607	48.12415	-123.393	MS	4.338	1.834	0.657	0	54.78	45.22	FALSE	0	0	0	0	0	0	0.14	4	9.46	14.21	15.15
608	48.12425	-123.391	MS	4.394	1.928	0.537	0	52.88	47.12	FALSE	0	0	0	0	0	0	0.92	5.19	9.77	13.37	13.46
609	48.12312	-123.437	MS	3.578	1.777	0.545	0	64.66	35.34	FALSE	0	0	0	0.31	1.71	3.27	5.21	7.63	10.17	12.13	12.7
610	48.12283	-123.435	SM	4.837	1.758	-0.051	0	31.85	68.15	FALSE	0	0	0	0	0.06	1.25	2.3	2.68	3.29	4.96	7.51
611	48.1229	-123.434	SM	4.914	1.681	-0.028	0	29.58	70.42	FALSE	0	0	0	0	0	0.7	1.7	2.28	3.1	4.81	7.31
612	48.12292	-123.432	SM	4.822	1.684	0.017	0	31.43	68.57	FALSE	0	0	0	0	0	0.7	1.92	2.63	3.41	5.05	7.59
613	48.12293	-123.43	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
614	48.12292	-123.429	SM	4.256	1.872	0.096	0	45.11	54.89	FALSE	0	0	0	0	0.84	2.9	4.29	4.97	5.69	7.08	8.95
615	48.12295	-123.427	SM	3.875	1.973	-0.038	0	49.48	50.52	FALSE	0	0	0	0.82	3.2	5.22	5.98	5.76	5.54	6.1	7.57
616	48.12299	-123.425	MS	3.864	1.89	0.188	0	53.24	46.76	FALSE	0	0	0	0.04	1.7	4.46	6.15	6.66	7	7.94	9.24
617	48.12292	-123.424	MS	3.499	1.919	0.445	0	61.72	38.28	FALSE	0	0	0	0	1.75	5.86	9.06	10.01	9.18	8.4	8.56
618	48.1229	-123.422	MS	3.864	1.935	0.439	0	57.48	42.52	FALSE	0	0	0	0	0.45	3.4	6.26	8.24	9.35	10.02	10.21
619	48.12303	-123.42	MS	2.991	1.832	0.798	0	74.72	25.28	FALSE	0	0	0	0.13	3.36	7.93	11.27	12.25	11.52	10.48	9.56
620	48.12286	-123.419	MS	3.831	1.81	0.47	0	57.72	42.28	FALSE	0	0	0	0	0.38	2.84	5.42	7.58	9.09	10.24	11.09
621	48.12299	-123.417	MS	3.372	1.919	0.369	0	63.84	36.16	FALSE	0	0	0	0.89	3.42	6.08	8.13	9.11	9.19	9.06	9.06
622	48.12298	-123.415	MS	3.052	1.955	0.77	0	71.06	28.94	FALSE	0	0	0	0.1	3.43	8.47	12.42	13.14	10.94	8.36	7.21
623	48.12301	-123.414	MS	3.041	1.842	0.787	0	73.97	26.03	FALSE	0	0	0	0.06	2.96	7.5	11.01	12.3	11.88	10.87	9.55
624	48.12304	-123.412	S	2.376	1.38	1.75	0	90.59	9.41	FALSE	0	0	0	0	0.96	7.57	15.34	21.23	21.04	14.87	7.21
625	48.12296	-123.41	S	2.465	1.629	1.436	0	84.88	15.12	FALSE	0	0	0	0	1.97	10.1	17.53	19.82	15.97	9.94	5.69
626	48.12311	-123.408	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
627	48.123	-123.407	S	2.433	1.813	1.231	0	82.98	17.02	FALSE	0	0	0	0.89	6.28	12.17	16.22	16.24	12.88	8.7	5.63
628	48.123	-123.405	MS	3.215	1.95	0.86	0	72.33	27.67	FALSE	0	0	0	0.03	1.97	5.92	10.03	12.88	13.52	12.03	9.34
629	48.12304	-123.404	MS	3.175	1.95	0.959	0	73.3	26.7	FALSE	0	0	0	0	0.74	5.75	11.23	14.97	15	11.99	8.22
630	48.12303	-123.402	S	2.675	1.714	1.393	0	83.79	16.21	FALSE	0	0	0	0	1.12	7.97	14.66	18.28	17.16	12.76	7.76
631	48.12308	-123.4	MS	3.233	1.871	1.079	0	75.57	24.43	FALSE	0	0	0	0	0.06	3.82	9.44	14.2	16.24	14.75	10.73
632	48.123	-123.398	MS	3.217	1.903	1.014	0	75.32	24.68	FALSE	0	0	0	0	0.61	4.9	9.63	13.55	15.25	14.15	10.72
633	48.12302	-123.397	MS	3.534	2.012	0.778	0	69.39	30.61	FALSE	0	0	0	0	1.29	4.2	7.05	10.04	12.92	14.06	12.01
634	48.12313	-123.395	MS	3.135	1.801	1.154	0	79.47	20.53	FALSE	0	0	0	0	1.11	4.51	8.28	12.41	15.85	16.53	13.18
635	48.12297	-123.394	MS	3.587	1.728	1.12	0	73.19	26.81	FALSE	0	0	0	0	0	0.03	3.5	9.13	15.52	18.83	16.28
636	48.1231	-123.392	MS	3.824	1.853	0.856	0	66.61	33.39	FALSE	0	0	0	0	0	0.71	3.2	7.72	13.37	16.73	15.08
637	48.12187	-123.433	MS	3.61	1.487	0.535	0	69.22	30.78	FALSE	0	0	0.02	0.65	1.59	1.98	1.83	3.01	7.71	14.95	19.65
638	48.12197	-123.431	SM	4.249	1.876	0.066	0	45.66	54.34	FALSE	0	0	0	0.05	1.2	2.93	4.04	4.63	5.47	7.2	9.39
639	48.12199	-123.43	MS	3.527	2.039	0.34	0	61.57	38.43	FALSE	0	0	0	0.95	3.76	6.28	7.53	7.75	8	8.78	9.44
640	48.12174	-123.428	MS	3.814	1.831	0.173	0	54.76	45.24	FALSE	0	0	0	0.27	2.11	4.11	5.4	5.93	6.57	8.18	10.41
641	48.12183	-123.426	MS	3.536	1.974	0.192	0	58.94	41.06	FALSE	0	0	0.02	1.28	3.88	6.13	7.17	7.08	6.88	7.57	9
642	48.12178	-123.424	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
643	48.12175	-123.423	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
644	48.12178	-123.421	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS																					
Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
645	48.12193	-123.419	MS	3.101	1.754	0.794	0	73.6	26.4	FALSE	0	0	0	0	1.43	6.23	10.6	12.72	12.43	11.27	10.17
646	48.12178	-123.418	MS	3.12	1.555	0.752	0	76.64	23.36	FALSE	0	0	0	0.03	1.62	4.47	7.46	10.29	12.77	14.41	14.12
647	48.12183	-123.416	S	2.736	1.646	0.919	0	81.22	18.78	FALSE	0	0	0	0.27	3.72	7.88	11.66	13.8	13.87	12.41	10.11
648	48.12181	-123.414	S	2.713	1.579	0.831	0	80.43	19.57	FALSE	0	0	0	0.2	3.31	7.65	12.09	14.58	14.15	11.83	9.3
649	48.12184	-123.413	MS	3.141	2.022	0.754	0	70.59	29.41	FALSE	0	0	0	0.23	3.27	7.65	11.58	13.08	11.88	9.45	7.39
650	48.12185	-123.411	MS	3.077	1.648	0.705	0	74.24	25.76	FALSE	0	0	0	0.09	1.98	5.52	9.41	11.84	12.14	11.59	11.24
651	48.12197	-123.409	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
652	48.12192	-123.408	MS	3.453	2.113	0.445	0	62.23	37.77	FALSE	0	0	0	0.29	3.8	7.61	9.87	9.63	8.15	7.35	7.63
653	48.1219	-123.406	MS	3.354	1.961	0.569	0	66.36	33.64	FALSE	0	0	0	0.2	2.88	6.19	9.15	10.54	10.38	9.66	9.05
654	48.12187	-123.404	MS	3.627	1.962	0.647	0	64.38	35.62	FALSE	0	0	0	0	0.42	3.77	7.54	10.54	11.95	11.72	10.27
655	48.12198	-123.403	S	2.671	1.842	1.086	0	80.84	19.16	FALSE	0	0	0	0.64	4.84	9.55	13.56	15.03	13.71	10.81	7.65
656	48.12182	-123.401	MS	3.025	1.919	1.011	0	75.65	24.35	FALSE	0	0	0	0	1.43	7.08	12.47	15.31	14.54	11.47	8.04
657	48.12189	-123.399	MS	3.967	2.007	0.472	0	57.72	42.28	FALSE	0	0	0	0	0	2.27	5.88	9	10.99	11.44	10.24
658	48.12192	-123.398	MS	3.502	2.037	0.661	0	66.51	33.49	FALSE	0	0	0	0	1.11	5.18	8.98	11.41	12.21	11.5	9.42
659	48.12191	-123.396	S	2.477	1.754	1.367	0	86.35	13.65	FALSE	0	0	0	0.45	5.51	10.77	14.47	15.62	14.67	12.11	8.31
660	48.12187	-123.394	MS	3.785	1.906	0.703	0	63.8	36.2	FALSE	0	0	0	0	0	1.22	5.42	9.73	13.04	13.96	12.01
661	48.12191	-123.393	MS	3.717	1.851	0.858	0	67.31	32.69	FALSE	0	0	0	0	0	0.43	4.76	9.88	14.19	15.66	13.42
662	48.12196	-123.391	MS	3.14	1.893	1.034	0	76.13	23.87	FALSE	0	0	0	0	0.75	5.6	10.61	14.09	14.99	13.5	10.22
663	48.12085	-123.428	GS	1.927	1.934	0.746	27.75	62.19	10.06	TRUE	0	0.02	8.14	8.23	10.68	9.9	10.95	9.34	7.57	7.25	7.46
665	48.12068	-123.425	MS	3.546	1.612	0.319	0	63.12	36.88	FALSE	0	0	0	0.1	1.62	3.86	5.57	6.51	7.6	10.06	13.24
666	48.1207	-123.424	MS	3.33	1.731	0.33	0	67.13	32.87	FALSE	0	0	0	0.84	3.01	5.11	6.65	7.78	9.11	10.83	12.1
667	48.12068	-123.422	MS	3.323	1.728	0.364	0	66.38	33.62	FALSE	0	0	0	0.43	2.67	5.11	7.39	8.97	9.85	10.48	10.9
668	48.12064	-123.42	MS	3.486	1.841	0.209	0	62.16	37.84	FALSE	0	0	0.03	1.23	3.38	5.24	6.23	6.62	7.4	9.19	11.17
669	48.12069	-123.419	MS	3.38	1.834	0.347	0	65.29	34.71	FALSE	0	0	0	0.77	3.3	5.69	7.22	7.9	8.62	9.92	11.06
670	48.12065	-123.417	SG	2.199	2.174	0.541	52.91	37.41	9.68	TRUE	2.94	3.57	2.94	3.73	7.46	8.44	11.43	11.82	10.01	7.66	5.95
671	48.12069	-123.415	S	2.39	1.315	1.036	0	88.59	11.41	FALSE	0	0	0	0	2.24	8.75	15.03	18.34	16.96	12.73	8.65
672	48.12071	-123.413	S	2.063	1.46	1.202	0	89.76	10.24	FALSE	0	0	0	1.54	7.7	13.98	17.75	16.85	12.7	8.53	6.03
673	48.12066	-123.412	S	2.371	1.517	0.894	0	86.71	13.29	FALSE	0	0	0	1.44	5.65	10.54	14.16	14.68	12.83	10.73	9.2
674	48.12075	-123.41	MS	3.3	1.831	0.429	0	66.11	33.89	FALSE	0	0	0	0.25	3.29	6.64	8.88	9.04	8.25	8.5	10.1
675	48.12075	-123.408	SM	4.067	1.767	0.163	0	49.37	50.63	FALSE	0	0	0	0.05	0.99	2.72	4.24	5.24	6.16	7.85	10.2
676	48.1207	-123.407	MS	3.925	1.908	0.206	0	52.06	47.94	FALSE	0	0	0	0	1.27	4.17	6.13	6.91	7.23	7.82	8.82
677	48.12076	-123.405	MS	3.275	1.846	0.581	0	68.59	31.41	FALSE	0	0	0	0.19	2.7	5.89	8.87	10.46	10.59	10.3	10.12
678	48.12075	-123.403	MS	3.391	1.956	0.627	0	67.39	32.61	FALSE	0	0	0	0.07	2.41	5.9	8.74	10.19	10.55	10.53	10.13
679	48.12079	-123.402	MS	3.287	1.983	0.757	0	69.77	30.23	FALSE	0	0	0	0.06	2.23	5.99	9.86	12.23	12.35	10.9	8.99
680	48.1207	-123.4	MS	3.275	1.914	0.874	0	71.57	28.43	FALSE	0	0	0	0	0.55	5.15	10.26	13.51	13.74	11.91	9.45
681	48.12073	-123.398	MS	2.928	1.91	1.043	0	77.09	22.91	FALSE	0	0	0	0	2.16	8.09	13.3	15.41	13.95	10.87	7.88
682	48.1208	-123.397	S	2.318	1.713	1.346	0	86	14	FALSE	0	0	0	0.65	6.49	12.8	16.94	16.72	13.27	9.24	6.06
683	48.12077	-123.395	MS	2.806	1.98	1.055	0	78.48	21.52	FALSE	0	0	0	0.22	4.54	10.24	13.88	14.16	12.37	10.12	7.74
684	48.12078	-123.393	MS	3.356	1.735	1.138	0	75.41	24.59	FALSE	0	0	0	0	0	0.95	6.04	12.48	17.56	17.76	13.21
685	48.1208	-123.392	S	2.578	1.456	1.785	0	88.54	11.46	FALSE	0	0	0	0	0	4.19	13.63	21.2	22.03	16.02	8.27
686	48.12079	-123.39	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
687	48.1197	-123.428	S	2.246	0.941	2.439	0	96.24	3.76	FALSE	0	0	0	0	0	1.52	13.25	27.22	29.97	18.47	5.51
688	48.11952	-123.426	S	3.278	1.039	1.43	0	84.77	15.23	FALSE	0	0	0	0	0	0	0.44	4.97	14.15	23.1	24.65
689	48.11953	-123.424	MS	3.349	1.236	-0.003	0	77.24	22.76	FALSE	0	0	0.37	1.07	1.75	1.74	1.26	2.4	7.83	16.8	23.07
690	48.11953	-123.423	MS	3.429	1.238	0.168	0	72.94	27.06	FALSE	0	0	0	0.25	1.46	2.4	2.56	3.24	7.1	14.54	20.89
691	48.11956	-123.421	MS	3.294	1.454	0.091	0	73.35	26.65	FALSE	0	0	0.04	1.35	2.77	3.61	3.61	4.36	7.98	14.07	18.42
692	48.11959	-123.419	S	2.827	1.487	0.54	0	81.38	18.62	FALSE	0	0	0	0.27	3.47	6.95	9.5	10.68	11.66	13.2	13.87
693	48.11962	-123.418	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
694	48.11964	-123.416	S	2.274	1.597	0.777	0	84.88	15.12	FALSE	0	0	0.06	3.08	7.61	11.98	14.41	13.67	10.89	8.49	7.57

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
695	48.11956	-123.414	S	1.775	1	1.255	0	97.19	2.81	FALSE	0	0	0	0.21	5.99	14.48	21.32	22.54	17.42	9.78	4.02
696	48.11964	-123.413	S	2.206	1.379	0.783	0	92.88	7.12	FALSE	0	0	0.75	2.51	5.6	9.4	12.72	14.82	15.57	14.45	10.94
697	48.11965	-123.411	MS	3.007	1.846	0.45	0	74.65	25.35	FALSE	0	0	0.42	2.64	5.02	6.73	7.39	8.02	9.73	11.9	12.47
698	48.11966	-123.409	S	2.239	1.698	1.098	0	84.32	15.68	FALSE	0	0	0	1.94	8.13	14.19	17.08	14.9	10.12	6.66	5.71
699	48.11955	-123.406	MS	3.986	1.746	0.196	0	53.3	46.7	FALSE	0	0	0	0.47	1.87	2.96	3.21	3.31	4.87	8.69	13.04
700	48.11967	-123.404	MS	3.818	1.632	0.235	0	58.54	41.46	FALSE	0	0	0.01	0.67	1.93	2.83	2.9	3.02	5.08	9.93	15.21
701	48.11958	-123.403	G	0.718	2.496	0.908	88.25	9.33	2.42	TRUE	23	13.7	7.98	5.69	7.02	4.15	5.24	5.01	4.19	3.73	3.71
702	48.11969	-123.401	MS	3.414	1.805	0.608	0	67.63	32.37	FALSE	0	0	0	0.03	1.78	5.08	7.75	9	9.62	10.79	12.01
703	48.11957	-123.399	MS	3.257	1.862	0.713	0	70.95	29.05	FALSE	0	0	0	0	2.11	6.17	9.39	10.81	10.99	11.11	10.94
704	48.11968	-123.397	MS	2.92	1.887	1.008	0	77.12	22.88	FALSE	0	0	0	0	2.67	8.19	12.83	14.63	13.45	10.92	8.37
705	48.1196	-123.396	GS	1.209	2.547	0.747	32.95	54.23	12.82	TRUE	23.06	2.37	4.06	5.42	8.54	6.79	8.87	8.66	6.87	4.93	3.55
706	48.11966	-123.394	S	2.662	1.759	1.26	0	82.41	17.59	FALSE	0	0	0	0	2.72	8.92	14.64	17.15	15.51	11.5	7.44
707	48.11961	-123.392	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
708	48.11977	-123.391	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
709	48.11875	-123.426	S	1.977	0.743	1.534	0	98	2	FALSE	0	0	0	0	0	4.73	19.34	31.03	27.51	13.07	2.33
710	48.11848	-123.424	S	2.21	0.834	1.957	0	97.42	2.58	FALSE	0	0	0	0	0	1.86	13.24	26.58	29.84	19.25	6.22
711	48.11841	-123.422	S	2.497	0.811	1.736	0	97.19	2.81	FALSE	0	0	0	0	0	0.04	5.56	18.89	30.37	27.12	12.96
712	48.1184	-123.42	S	2.673	0.928	0.644	0	95.95	4.05	FALSE	0	0	0.33	0.59	0.39	0.54	4.12	13.13	23.25	26.18	19.1
713	48.11843	-123.419	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
714	48.11852	-123.417	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
715	48.11849	-123.415	GS	1.548	1.431	-0.388	31.66	66.42	1.93	TRUE	6.47	2.17	1.8	2.06	3.4	9.83	16.13	19.5	17.47	11.47	5.36
716	48.11843	-123.414	S	1.842	1.751	1.406	0	86.23	13.77	FALSE	0	0	0.11	5.39	12.79	18.66	19.17	14.09	7.48	3.36	2.4
717	48.11843	-123.412	MS	3.064	2.001	0.423	0	68.65	31.35	FALSE	0	0	0.07	2.62	5.7	8.26	9.34	9.22	8.82	8.62	8.36
718	48.11849	-123.41	S	1.997	1.317	1.659	0	92.72	7.28	FALSE	0	0	0	0.43	5.51	12.77	19.5	21.38	17.16	10.04	4.3
719	48.11852	-123.407	MS	3.125	1.775	0.161	0	72.21	27.79	FALSE	0	0	0.95	2.9	4.76	5.76	5.5	5.15	6.78	10.92	14.76
720	48.11846	-123.405	G	0.031	1.824	1.247	85.43	13.49	1.07	TRUE	22.96	17.02	11.58	6.79	6.34	6.27	8.22	7.62	4.93	2.21	0.9
721	48.11852	-123.403	MS	3.454	1.41	0.742	0	72.73	27.27	FALSE	0	0	0	0.19	0.98	1.88	2.99	5.4	10.09	15.78	18.78
722	48.11864	-123.402	MS	3.863	1.15	0.866	0	60.58	39.42	FALSE	0	0	0	0	0.13	0.6	0.63	1.19	4.57	11.75	19.48
723	48.11857	-123.4	MS	3.675	1.529	0.291	0	62.74	37.26	FALSE	0	0	0.01	0.62	1.78	2.65	2.93	3.46	5.99	11.14	16.38
724	48.11844	-123.398	S	3.054	1.501	0.919	0	80.7	19.3	FALSE	0	0	0	0	1.31	4.37	7.4	10.33	13.38	15.9	15.84
725	48.1185	-123.396	MS	3.534	1.724	0.451	0	63.8	36.2	FALSE	0	0	0	0	0.9	4.47	7.13	8.14	8.69	10.18	12.03
726	48.11853	-123.395	MS	3.004	1.983	0.901	0	74.27	25.73	FALSE	0	0	0	0	2.99	9.28	13.34	13.32	11.02	9.17	8.21
727	48.11858	-123.393	MS	3.354	1.917	0.652	0	67.54	32.46	FALSE	0	0	0	0	1	5.53	9.86	12.38	12.42	10.8	8.73
728	48.11849	-123.391	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
729	48.11856	-123.39	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
730	48.1173	-123.416	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
731	48.11731	-123.414	S	1.338	1.18	2.198	0	95.5	4.5	FALSE	0	0	0	4.18	14.83	23.3	24.32	17.49	8.22	2.14	0.37
732	48.11737	-123.413	S	2.464	1.093	0.4	0	94.14	5.86	FALSE	0	0	0.01	0.79	2.52	4.93	9.02	14.8	19.52	19.72	14.85
733	48.11735	-123.411	MS	3.217	1.837	0.285	0	66.75	33.25	FALSE	0	0	0.01	1.34	4.37	7.01	8.23	8.07	7.84	8.72	10.29
734	48.11752	-123.404	GS	0.196	1.35	0.213	48.48	51.17	0.34	TRUE	12.61	12.07	11.89	9.96	10	10.64	12.67	11.13	6.51	1.96	0.06
735	48.11742	-123.403	MS	3.201	1.364	0.792	0	79.8	20.2	FALSE	0	0	0.02	0.49	1.23	2.01	3.62	7.45	13.34	18.37	18.88
736	48.11732	-123.401	MS	3.23	1.394	0.379	0	79.78	20.22	FALSE	0	0	0.66	1.49	1.88	1.55	1.68	4.75	11.62	18.91	21.02
737	48.11743	-123.399	MS	3.413	1.316	0.666	0	75.35	24.65	FALSE	0	0	0.1	0.53	0.98	1.21	1.8	4.55	10.56	17.57	20.66
738	48.11736	-123.398	MS	3.241	1.393	0.543	0	75.61	24.39	FALSE	0	0	0	0.09	1.41	3.32	5.12	7.23	10.62	14.9	17.34
739	48.11742	-123.396	S	2.491	1.484	0.868	0	86.42	13.58	FALSE	0	0	0	0.22	4.47	10.11	13.88	14.03	12.34	11.43	10.96
740	48.11742	-123.394	S	2.036	1.531	1.359	0	89.14	10.86	FALSE	0	0	0	1.51	8.21	15.09	18.93	17.22	11.93	7.23	4.98
741	48.11744	-123.392	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
742	48.11741	-123.391	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
743	48.11742	-123.389	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
744	48.11657	-123.414	S	2.14	0.836	0.906	0	98.17	1.83	FALSE	0	0	0	0	0.94	5.26	14.12	23.76	26.21	18.74	7.91
746	48.11648	-123.403	S	2.504	1.611	0.632	0	85.65	14.35	FALSE	0	0	0.26	3.11	6.35	9	10.19	10.66	11.69	12.9	12.3
747	48.11626	-123.402	S	2.026	0.78	0.973	0	98.52	1.48	FALSE	0	0	0	0	0	6.54	18.22	26.66	25.14	15.42	5.65
748	48.11625	-123.4	S	2.944	1.062	1.772	0	91.27	8.73	FALSE	0	0	0	0	0	0	1.78	11.65	21.62	25.58	20.27
749	48.11624	-123.398	S	3.232	0.977	1.168	0	84.37	15.63	FALSE	0	0	0	0	0	0	1.01	5.75	13.95	21.83	23.74
750	48.11628	-123.397	MS	3.423	0.929	1.166	0	79.32	20.68	FALSE	0	0	0	0	0	0	0.28	2.8	9.7	19.28	25.09
751	48.11629	-123.395	S	2.757	1.466	0.814	0	83.32	16.68	FALSE	0	0	0	0.03	2.51	7.02	10.81	12.73	13.37	13.63	12.91
752	48.11632	-123.393	S	2.028	1.803	1.092	0	85.72	14.28	FALSE	0	0	0.71	5.81	11.55	15.65	15.51	11.78	7.83	6.02	5.72
753	48.11632	-123.392	S	1.706	0.988	1.555	0	96.83	3.17	FALSE	0	0	0	0	5.48	16.4	24.51	23.79	15.35	6.78	2.72
754	48.11633	-123.39	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
755	48.11518	-123.399	S	2.556	0.862	0.697	0	95.97	4.03	FALSE	0	0	0	0	0	1.3	7.82	17.08	23.52	22.63	15.78
756	48.11508	-123.398	S	2.635	0.817	0.735	0	96.22	3.78	FALSE	0	0	0	0	0	0.17	5.97	15.35	23.78	24.81	17.77
757	48.11505	-123.396	S	2.969	0.979	1.615	0	91.53	8.47	FALSE	0	0	0	0	0	0	1.07	10.34	20.51	25.76	21.77
758	48.11515	-123.394	S	3.149	1.121	0.011	0	82.07	17.93	FALSE	0	0	0.03	0.66	1.49	2.09	2.77	5.17	10.79	18.11	22.04
759	48.11515	-123.392	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
760	48.11518	-123.391	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
761	48.1153	-123.389	S	1.725	0.828	1.151	0	98.66	1.34	FALSE	0	0	0	0	3.22	14.22	23.93	25.87	18.86	9.21	2.82
762	48.11972	-123.387	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
763	48.11971	-123.384	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
764	48.11974	-123.38	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
765	48.11974	-123.377	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
766	48.11981	-123.373	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
767	48.11981	-123.37	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
768	48.11978	-123.366	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
769	48.11987	-123.363	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
770	48.11981	-123.36	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
771	48.11986	-123.356	S	3.027	1.643	1.437	0	82.03	17.97	FALSE	0	0	0	0	0	1.64	8.73	15.96	20.16	18.2	11.8
772	48.11988	-123.353	MS	3.563	1.794	0.959	0	69.22	30.78	FALSE	0	0	0	0	0	0.05	5.09	11.83	16.85	16.59	11.9
773	48.11753	-123.385	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
774	48.11752	-123.382	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
775	48.11756	-123.378	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
776	48.11763	-123.375	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
777	48.11754	-123.371	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
778	48.11758	-123.368	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
779	48.11758	-123.365	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
780	48.11762	-123.361	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
781	48.11764	-123.358	S	2.518	0.832	-0.806	0	99.31	0.69	FALSE	0	0	0.37	0.86	1.27	1.98	5.08	12.65	22.38	26.52	20.01
782	48.11782	-123.355	S	1.973	0.576	0.074	0	100	0	FALSE	0	0	0	0	0	2.82	17.87	31.83	29.72	14.77	2.94
783	48.11521	-123.386	S	2.445	1.004	0.811	0	95.94	4.06	FALSE	0	0	0	0	1.09	4.44	10.21	16.92	21.34	20.58	14.52
784	48.11555	-123.383	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
785	48.11546	-123.38	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
786	48.11526	-123.376	S	2.671	0.586	-0.05	0	99.86	0.14	FALSE	0	0	0	0	0	0	1.37	10.75	26.15	32.76	22.16
787	48.11527	-123.373	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
788	48.11527	-123.37	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
790	48.11789	-123.407	SG	-0.073	1.239	0.269	64.72	35.18	0.1	TRUE	16.32	13.73	11.55	9.84	12.7	13.74	11.35	6.64	2.75	0.81	0.23
791	48.11644	-123.403	SG	0.044	1.473	0.331	70.37	29.63	0	TRUE	20.05	13.62	10.86	8.11	8.51	7.63	9.72	9.43	7.06	3.79	1.18
792	48.11566	-123.401	SG	0.458	1.251	-0.351	56.09	43.91	0	TRUE	10.65	7.86	6.45	6.81	12.43	16.4	17.45	13.25	6.78	1.86	0.07
793	48.11492	-123.399	SG	0.583	1.402	-0.281	55.73	44.27	0	TRUE	12.3	7.33	6.51	6.69	9.83	11.38	14.8	14.73	10.67	4.91	0.85
794	48.11453	-123.398	SG	0.139	1.527	0.075	73.31	26.69	0	TRUE	24.24	11.27	6.49	4.67	6.56	9.03	12.65	12.68	8.66	3.44	0.33

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
795	48.11422	-123.396	GS	0.826	1.146	-0.543	22.69	77.31	0	TRUE	5.05	4.54	4.82	6.11	12.55	17.36	19.5	16.28	9.77	3.63	0.4
796	48.11423	-123.393	GS	0.388	1.226	0.179	37.79	62.17	0.04	TRUE	7.38	7.42	9.05	12.2	19.47	14.25	12.36	8.11	4.76	2.85	1.54
797	48.11438	-123.391	GS	0.325	1.188	-0.101	40.96	58.92	0.12	TRUE	8.91	9.09	8.78	9.12	15.06	17.37	16.19	9.97	3.93	0.92	0.24
798	48.11508	-123.389	GS	0.72	1.25	-0.463	31.54	68.46	0	TRUE	7	6.3	6.1	7.55	12.53	10.85	17.21	17.97	11.19	3.21	0.09
799	48.12651	-123.457	SM	4.962	1.456	-0.199	0	23.69	76.31	FALSE	0	0	0	0	0	0.02	0.95	2.25	3.07	3.91	5.48
800	48.12426	-123.451	SM	4.807	1.585	-0.114	0	31.08	68.92	FALSE	0	0	0	0	0	0.46	1.47	2.4	3.65	5.59	7.87
801	48.13472	-123.462	MS	2.261	2.125	0.966	0	76.71	23.29	FALSE	0	0	0.14	5.57	12.62	17.55	16.28	10.32	4.74	2.56	3.01
802	48.13461	-123.464	MS	3.48	2.045	0.163	0	59.23	40.77	FALSE	0	0	0.06	2.13	4.6	6.54	7.19	7.03	6.99	7.55	8.38
803	48.13451	-123.465	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
804	48.13407	-123.467	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
805	48.13361	-123.468	SM	4.508	1.724	-0.113	0	37.6	62.4	FALSE	0	0	0	0	0.4	1.8	2.89	3.67	4.63	6.18	8.16
806	48.13264	-123.468	SM	4.142	1.993	-0.126	0	44.58	55.42	FALSE	0	0	0	0.44	2.44	4.3	5.29	5.47	5.47	5.95	7.02
808	48.13318	-123.468	SM	4.092	1.728	0.218	0	49.76	50.24	FALSE	0	0	0	0	0.33	2.38	3.96	5.11	6.64	8.8	10.83
809	48.13801	-123.457	MS	3.37	2.139	0.271	0	60.71	39.29	FALSE	0	0	0.03	2.11	5.59	8.26	8.79	7.73	6.66	6.58	7.23
810	48.13942	-123.449	SM	4.347	1.986	-0.026	0	42.41	57.59	FALSE	0	0	0	0.04	1.23	3.35	4.81	5.44	5.71	6.26	7.26
811	48.13867	-123.451	MS	2.677	1.797	0.849	0	79.66	20.34	FALSE	0	0	0	1.47	5.61	9.63	12.19	12.75	11.97	10.58	8.77
1000	48.12867	-123.387	MS	3.829	1.705	1.144	0	69.26	30.74	FALSE	0	0	0	0	0	0	0.23	5.76	13.52	19.23	18.33
1001	48.12866	-123.383	MS	3.628	1.646	1.342	0	75.55	24.45	FALSE	0	0	0	0	0	0	0.29	6.92	15.8	21.65	19.42
1002	48.12877	-123.38	MS	4.015	1.805	0.913	0	63.72	36.28	FALSE	0	0	0	0	0	0	0.88	5.46	11.91	17	16.7
1003	48.12873	-123.376	MS	3.911	1.79	0.945	0	66.49	33.51	FALSE	0	0	0	0	0.07	0.34	1.42	5.48	12.42	17.87	17.27
1004	48.12876	-123.373	MS	3.65	1.605	1.377	0	75	25	FALSE	0	0	0	0	0	0	0.12	5.85	15.04	21.36	20.01
1005	48.12874	-123.37	S	3.355	1.463	1.704	0	82.75	17.25	FALSE	0	0	0	0	0	0	0.34	8.17	18.34	24.13	20.54
1006	48.12648	-123.388	MS	3.798	1.72	1.198	0	71.35	28.65	FALSE	0	0	0	0	0	0	0.1	5.58	14.5	20.48	18.94
1007	48.12633	-123.385	MS	4.002	1.761	1.001	0	65.48	34.52	FALSE	0	0	0	0	0	0	0.04	4.41	12.25	18.27	18.12
1008	48.1265	-123.382	MS	3.842	1.733	1.118	0	69.4	30.6	FALSE	0	0	0	0	0	0	0.22	5.94	13.75	19.4	18.28
1009	48.12654	-123.378	MS	3.405	2.025	0.724	0	72.02	27.98	FALSE	0	0	0	0.92	3.24	5.04	6.13	8.12	11.79	14.63	13.41
1010	48.12646	-123.375	MS	3.737	1.642	1.308	0	73.09	26.91	FALSE	0	0	0	0	0	0	0.03	5.06	14.25	20.86	20
1011	48.12643	-123.372	S	3.447	1.528	1.568	0	80.55	19.45	FALSE	0	0	0	0	0	0	0.23	7.44	17.73	23.7	20.34
1012	48.12416	-123.386	MS	4.104	1.818	0.836	0	61.13	38.87	FALSE	0	0	0	0	0	0	1.01	5.03	10.71	15.77	16.34
1013	48.12418	-123.383	MS	3.592	1.779	1.097	0	73.56	26.44	FALSE	0	0	0	0	0.24	1.07	3.25	8.22	14.91	18.93	16.72
1014	48.12411	-123.38	MS	3.812	1.724	1.173	0	70.43	29.57	FALSE	0	0	0	0	0	0	0.29	6.1	13.69	19.46	18.64
1015	48.12431	-123.377	MS	3.952	1.751	0.97	0	65.9	34.1	FALSE	0	0	0	0	0	0	0.86	4.99	12.02	17.87	17.82
1016	48.12431	-123.373	MS	3.574	1.559	1.414	0	77.08	22.92	FALSE	0	0	0	0	0	0	0.46	6.37	15.11	21.82	20.58
1017	48.12407	-123.37	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
1018	48.1219	-123.388	MS	3.596	1.931	0.73	0	67.39	32.61	FALSE	0	0	0	0	0.88	3.38	6.37	9.58	12.41	13.69	12.27
1019	48.12189	-123.385	MS	3.274	1.777	1.055	0	76.75	23.25	FALSE	0	0	0	0.04	1.04	3.12	6.5	11.28	15.81	17.13	13.77
1020	48.12204	-123.382	MS	3.375	1.664	1.248	0	79.32	20.68	FALSE	0	0	0.02	0.37	0.69	1.07	3.03	8.49	16.19	20.81	18.14
1021	48.12204	-123.378	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
1022	48.12209	-123.375	S	3.055	1.726	1.232	0	82.07	17.93	FALSE	0	0	0	0	1.52	4.54	7.94	11.98	16.02	17.52	14.33
1023	48.12197	-123.371	HG							FALSE	0	0	0	0	0	0	0	0	0	0	0
1024	48.12669	-123.368	S	3.364	1.479	1.701	0	82.93	17.07	FALSE	0	0	0	0	0	0	0.33	8.08	18.28	24.29	20.76
1025	48.12622	-123.365	MS	3.567	1.735	1.179	0	73.89	26.11	FALSE	0	0	0	0	0	0	2.29	9.9	17.36	20.04	15.77
1026	48.12579	-123.361	S	2.571	1.366	1.918	0	91.67	8.33	FALSE	0	0	0	0	0	4.14	12.07	19.22	22.03	18.64	11.22
1027	48.12799	-123.363	MS	3.658	1.678	1.202	0	73.08	26.92	FALSE	0	0	0	0	0	0.31	1.92	6.73	14.09	19.44	18.42
1028	48.12083	-123.428	MS	3.524	1.6	1.472	0	78.11	21.89	FALSE	0	0	0	0	0	0	0.38	7.81	16.81	22.23	19.5
1029	48.12084	-123.428	MS	3.648	1.894	0.883	0	68.95	31.05	FALSE	0	0	0	0	0.1	2.35	5.56	9.05	12.76	15.12	14.04
1030	48.13079	-123.388	MS	3.703	1.672	1.327	0	74.04	25.96	FALSE	0	0	0	0	0	0	0.13	5.94	15.04	21.17	19.62
1031	48.13003	-123.385	MS	3.881	1.78	1.093	0	68.95	31.05	FALSE	0	0	0	0	0	0	0.27	6.03	13.58	19.14	18.17
1032	48.13023	-123.382	MS	3.808	1.66	1.171	0	69.78	30.22	FALSE	0	0	0	0	0	0	0.11	5.26	13.54	19.46	18.78

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

Sample Id	Lat	Long	Type	Mean	Sorting	Skewness	Pct_Grave	Pct_Sand	Pct_Mud	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
1033	48.13059	-123.378	MS	3.63	1.627	1.358	0	75.05	24.95	FALSE	0	0	0	0	0	0	0.29	6.8	15.48	21.2	19.32
1034	48.13065	-123.375	S	3.181	1.335	1.977	0	87.51	12.49	FALSE	0	0	0	0	0	0	0.4	9.25	20.3	25.88	21.08
1035	48.13043	-123.371	MS	3.5	1.591	1.471	0	78.42	21.58	FALSE	0	0	0	0	0	0	0.39	8.13	17.35	22.5	19.21
1036	48.13084	-123.368	S	3.362	1.538	1.598	0	81.58	18.42	FALSE	0	0	0	0	0	0	0.52	9.68	19.33	23.62	18.82

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

	PHI												
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
1	7.73	7.53	6.97	6.07	5.01	3.91	2.86	1.96	1.27	0.78	0.41	0.02	0
2	4.13	0.08	0	0.3	0.85	0.67	0.3	0.15	0.19	0.21	0.11	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0
13	3.29	0	0	0	0	0	0	0	0	0	0	0	0
14	2.18	0	0	0	0	0	0	0	0	0	0	0	0
15	2.14	0	0	0	0	0	0	0	0	0	0	0	0
16	2.23	0	0	0	0	0	0	0	0	0	0	0	0
17	0.76	0	0	0	0	0	0	0	0	0	0	0	0
18	0.65	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0
26	8.67	8.62	8.2	7.5	6.52	5.28	3.91	2.66	1.69	1.01	0.52	0.1	0
27	7.56	8.24	8.7	8.72	8.17	7.02	5.49	3.91	2.57	1.57	0.83	0.17	0
28	9.44	9.88	9.6	8.67	7.27	5.66	4.13	2.87	1.92	1.23	0.68	0.14	0
29	8.47	9.1	9.27	8.75	7.57	5.99	4.35	2.96	1.92	1.19	0.63	0.12	0
30	6.63	6.89	6.82	6.33	5.48	4.38	3.24	2.22	1.44	0.88	0.46	0.09	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0.96	0.54	0.52	0.57	0.56	0.49	0.39	0.28	0.16	0	0	0	0
33	0.96	0.34	0.5	0.54	0.42	0.31	0.24	0.17	0	0	0	0	0
34	0.03	0.23	0.39	0.34	0.23	0.19	0.17	0.14	0	0	0	0	0
35	1.76	1.7	2.1	2	1.57	1.19	0.92	0.71	0.51	0.31	0.04	0	0
36	8.93	7.24	5.93	5.03	4.26	3.39	2.46	1.64	1.02	0.6	0.32	0.01	0
37	0.6	0.59	0.69	0.63	0.51	0.43	0.36	0.28	0.18	0.04	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0
40	1.3	0.24	0.35	0.65	0.73	0.64	0.53	0.44	0.35	0.25	0.14	0.01	0
41	1.98	0	0	0	0	0	0	0	0	0	0	0	0
42	7.56	7.69	7.38	6.61	5.42	4.03	2.71	1.69	1.01	0.6	0.31	0.01	0
43	8.58	9.03	8.99	8.67	8.06	7.02	5.58	4.02	2.64	1.59	0.83	0.17	0
44	7.66	8.63	9.11	9.14	8.69	7.72	6.32	4.74	3.26	2.04	1.09	0.24	0
45	8.46	9.33	9.47	9.14	8.53	7.64	6.44	5.05	3.67	2.43	1.37	0.41	0
46	9.39	10.51	10.66	10.31	9.66	8.65	7.23	5.57	3.91	2.44	1.23	0.3	0
47	7.19	9.14	10.36	10.96	11.05	10.48	9.13	7.22	5.14	3.27	1.71	0.46	0
48	7.65	9.37	10.27	10.45	10.11	9.28	7.99	6.41	4.77	3.24	1.86	0.58	0
49	7.97	9.02	9.69	10.03	9.95	9.26	7.95	6.22	4.43	2.83	1.51	0.35	0

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS													
PHI													
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
50	8.48	10	10.71	10.76	10.34	9.4	7.87	5.99	4.1	2.5	1.24	0.29	0
51	8.39	9.36	9.63	9.34	8.65	7.66	6.41	5.03	3.68	2.45	1.38	0.4	0
52	8.49	9.93	10.55	10.48	9.88	8.8	7.35	5.74	4.19	2.8	1.59	0.47	0
53	8.33	9.51	10.19	10.26	9.72	8.61	7.1	5.46	3.91	2.57	1.43	0.34	0
54	8.92	9.13	8.75	8.35	8.07	7.61	6.72	5.46	4.04	2.71	1.54	0.48	0
55	11.64	9.59	7.63	6.63	6.3	5.97	5.25	4.2	3.06	2.02	1.12	0.27	0
56	8.15	5.76	5.09	5.22	5.27	4.9	4.14	3.18	2.24	1.45	0.8	0.18	0
57	7.88	5.69	5.21	5.49	5.64	5.31	4.53	3.51	2.49	1.6	0.88	0.19	0
58	1.89	0.01	0.53	1.68	1.91	1.6	1.25	1.01	0.82	0.6	0.34	0.02	0
59	4.96	0.71	1.09	2.53	3.05	2.72	2.17	1.7	1.33	0.96	0.57	0.13	0
60	0.85	0.01	0.27	0.51	0.5	0.4	0.33	0.28	0.23	0.12	0	0	0
61	6.04	4.27	4.16	4.22	3.82	3.08	2.27	1.58	1.06	0.67	0.37	0.02	0
62	0.03	0.24	0.39	0.35	0.28	0.26	0.25	0.21	0.13	0	0	0	0
65	0	0.31	0.59	0.38	0.2	0.24	0.35	0.37	0.28	0.07	0	0	0
66	8.57	8.31	7.57	6.59	5.48	4.3	3.15	2.15	1.38	0.85	0.45	0.02	0
67	2.3	2.19	2.23	1.99	1.61	1.26	0.97	0.71	0.47	0.27	0.03	0	0
68	5.63	5.42	5.14	4.62	3.9	3.06	2.23	1.52	0.99	0.62	0.34	0.02	0
69	8.08	8.96	9.39	9.41	8.96	7.96	6.44	4.73	3.15	1.9	0.98	0.2	0
70	8.69	9.92	10.34	10.18	9.65	8.66	7.17	5.4	3.68	2.24	1.11	0.26	0
71	8.69	9.67	9.87	9.55	8.92	8.02	6.82	5.43	4.03	2.73	1.56	0.48	0
72	8.52	10.14	10.77	10.71	10.24	9.28	7.8	5.97	4.12	2.53	1.28	0.32	0
73	9.18	10.78	11.12	10.69	9.92	8.86	7.42	5.72	4.01	2.49	1.25	0.31	0
74	7.9	9.47	10.5	11.09	11.04	10.15	8.49	6.46	4.46	2.74	1.37	0.34	0
75	8.45	9.97	10.52	10.53	10.23	9.44	8.04	6.21	4.32	2.67	1.35	0.34	0
76	8.53	9.78	10.36	10.57	10.38	9.56	8.07	6.19	4.28	2.63	1.3	0.31	0
77	8.2	10.09	10.98	11.11	10.74	9.83	8.34	6.46	4.53	2.82	1.43	0.36	0
78	9.97	11.16	11.06	10.38	9.57	8.53	7.12	5.46	3.82	2.39	1.22	0.31	0
79	8.07	9.59	10.53	11.03	10.92	10.03	8.43	6.49	4.56	2.86	1.46	0.36	0
80	8.9	10.3	10.78	10.75	10.37	9.47	7.97	6.1	4.24	2.64	1.35	0.34	0
81	9.22	10.73	11.11	10.88	10.33	9.32	7.78	5.93	4.1	2.54	1.28	0.32	0
82	7.55	9.29	10.32	10.77	10.66	9.85	8.33	6.41	4.46	2.77	1.4	0.35	0
83	8.48	9.91	10.5	10.58	10.28	9.47	8.04	6.22	4.36	2.71	1.37	0.34	0
84	8.4	9.44	9.82	10.03	10.07	9.48	8.01	5.97	3.93	2.3	1.13	0.26	0
85	9.08	9.24	9.15	9.31	9.53	9.17	7.93	6.08	4.13	2.49	1.24	0.31	0
86	9.27	8.88	8.31	8.24	8.52	8.47	7.62	6.06	4.25	2.61	1.32	0.34	0
87	11.15	9.01	7.39	6.97	7.17	7.11	6.38	5.13	3.72	2.44	1.37	0.42	0
88	10.33	8.55	7.25	7.01	7.28	7.25	6.56	5.33	3.91	2.58	1.45	0.44	0
89	10.83	7.14	4.97	4.61	4.98	5.13	4.73	3.94	3.01	2.09	1.22	0.41	0
90	10.92	6.53	4.32	4.08	4.48	4.6	4.25	3.61	2.84	2.04	1.25	0.44	0
91	11.52	7.06	4.52	3.93	4.13	4.22	3.93	3.35	2.64	1.89	1.14	0.39	0
92	7.9	3.25	2.17	2.68	3.11	3.03	2.64	2.16	1.66	1.17	0.68	0.16	0
93	6.71	2.62	2.24	3.12	3.58	3.41	2.91	2.33	1.76	1.22	0.69	0.16	0
94	7.15	3.8	3.41	4.08	4.48	4.38	3.93	3.29	2.55	1.77	1.02	0.25	0
95	3.79	0.23	0.76	2.13	2.64	2.35	1.86	1.45	1.12	0.8	0.46	0.1	0
96	0	0	0	0	0	0	0	0	0	0	0	0	0
97	0	0	0	0	0	0	0	0	0	0	0	0	0
98	0	0	0	0	0	0	0	0	0	0	0	0	0
99	0.17	0.01	0.47	0.83	0.64	0.41	0.39	0.46	0.45	0.33	0.12	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
	PHI												
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
101	8.08	8.14	7.75	7.03	6.07	4.93	3.72	2.6	1.7	1.04	0.55	0.1	0
102	8.69	9.41	9.69	9.44	8.58	7.19	5.53	3.93	2.59	1.59	0.83	0.16	0
103	8.57	9.59	10.02	9.75	8.8	7.34	5.63	4	2.66	1.66	0.9	0.19	0
104	8.26	9.1	9.64	9.66	9.01	7.73	6.09	4.43	2.99	1.85	0.98	0.2	0
105	7.82	9.15	9.9	10.09	9.71	8.72	7.18	5.38	3.66	2.26	1.19	0.25	0
106	7.51	9.25	10.38	10.91	10.89	10.16	8.65	6.62	4.53	2.73	1.33	0.32	0
107	8.2	9.51	10.05	9.98	9.47	8.54	7.23	5.7	4.17	2.79	1.58	0.48	0
108	7.66	9.74	11.23	11.96	11.74	10.55	8.64	6.45	4.37	2.66	1.33	0.31	0
109	9.38	10.5	10.77	10.6	10.04	8.94	7.33	5.5	3.76	2.3	1.15	0.27	0
110	8.42	9.95	10.68	10.84	10.49	9.54	8.02	6.19	4.37	2.76	1.42	0.36	0
111	8.5	10.23	10.9	10.85	10.4	9.49	8.05	6.25	4.4	2.73	1.37	0.34	0
112	8.98	10.77	11.4	11.28	10.69	9.62	8.05	6.17	4.29	2.65	1.33	0.32	0
113	7.15	9.53	11.31	12.41	12.6	11.66	9.69	7.21	4.81	2.87	1.41	0.33	0
114	8.86	10.47	10.99	10.84	10.31	9.34	7.84	6.01	4.17	2.57	1.28	0.31	0
115	8.59	10.63	11.39	11.32	10.86	9.98	8.53	6.66	4.69	2.93	1.49	0.38	0
116	9.16	10.44	10.65	10.34	9.82	8.94	7.56	5.84	4.08	2.54	1.28	0.32	0
117	10.09	10.23	9.66	9.2	8.95	8.46	7.41	5.88	4.19	2.64	1.36	0.35	0
118	10.32	10.59	9.96	9.38	8.99	8.34	7.12	5.47	3.76	2.29	1.14	0.28	0
119	9.05	9.64	9.35	8.86	8.4	7.75	6.72	5.38	3.97	2.67	1.53	0.47	0
120	9.65	10.07	9.69	9.25	8.91	8.3	7.15	5.59	3.93	2.45	1.23	0.31	0
121	9.71	10.49	10.34	9.92	9.42	8.59	7.25	5.56	3.86	2.38	1.19	0.29	0
122	9.65	9.96	9.71	9.58	9.45	8.82	7.5	5.75	3.98	2.47	1.27	0.33	0
123	10.67	9.65	8.26	7.5	7.27	6.98	6.23	5.08	3.78	2.54	1.45	0.46	0
124	11.16	9.4	7.96	7.39	7.21	6.83	6.01	4.88	3.66	2.5	1.44	0.46	0
125	8.8	9.07	9.03	9	8.88	8.38	7.35	5.95	4.44	3.02	1.75	0.57	0
126	11.76	7.46	5.1	4.85	5.33	5.45	4.96	4.1	3.15	2.21	1.31	0.44	0
127	9.82	4.64	2.87	3.37	4.16	4.28	3.79	3.03	2.27	1.57	0.93	0.23	0
128	11.62	6.38	3.87	3.8	4.44	4.63	4.22	3.48	2.66	1.86	1.1	0.36	0
129	9.43	4.44	2.86	3.28	3.85	3.85	3.39	2.77	2.15	1.53	0.92	0.3	0
130	10.45	5.98	4.11	4.17	4.63	4.68	4.27	3.6	2.84	2.05	1.24	0.44	0
131	9.82	5.4	3.81	4.11	4.69	4.77	4.37	3.7	2.93	2.12	1.29	0.45	0
132	7.92	3.64	2.78	3.46	4.02	4.02	3.64	3.11	2.5	1.82	1.1	0.37	0
133	5.29	1.52	1.61	2.58	2.87	2.58	2.18	1.84	1.51	1.12	0.67	0.16	0
134	0.77	0.15	1.16	1.84	1.78	1.51	1.31	1.16	0.96	0.68	0.38	0.02	0
135	0	0	0	0	0	0	0	0	0	0	0	0	0
136	0.01	0	0	0	0	0	0	0	0	0	0	0	0
137	2.06	0.34	0.91	1.53	1.59	1.39	1.23	1.09	0.91	0.65	0.36	0.08	0
138	3.4	1.55	1.3	1.59	1.75	1.69	1.49	1.23	0.94	0.65	0.37	0.08	0
139	0	0	0	0	0	0	0	0	0	0	0	0	0
140	8.32	7.78	6.81	5.7	4.6	3.56	2.62	1.83	1.22	0.76	0.4	0.02	0
141	8.26	9.09	9.34	9.04	8.29	7.13	5.71	4.22	2.9	1.83	0.99	0.21	0
142	8.18	9.08	9.75	9.94	9.45	8.24	6.56	4.78	3.21	1.97	1.02	0.21	0
143	0	0	0	0	0	0	0	0	0	0	0	0	0
144	7.66	8.71	9.43	9.6	9.04	7.79	6.1	4.36	2.86	1.74	0.91	0.19	0
145	8.2	10.08	11.05	11.23	10.76	9.64	7.94	5.98	4.09	2.5	1.26	0.3	0
146	8.08	9.61	10.43	10.76	10.67	9.9	8.34	6.28	4.21	2.48	1.19	0.27	0
147	8.19	9.97	10.75	10.78	10.37	9.5	8.06	6.21	4.3	2.63	1.31	0.32	0
148	9.08	10.41	10.68	10.39	9.89	9.04	7.65	5.85	4.01	2.43	1.2	0.28	0
149	9.12	10.47	10.8	10.55	10.01	9.07	7.54	5.63	3.74	2.19	1.05	0.2	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
	PHI											
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
150	9.36	10.87	11.13	10.61	9.8	8.73	7.27	5.54	3.8	2.32	1.15	0.27	0
151	9.15	10.8	11.13	10.7	10.03	9.1	7.7	5.93	4.11	2.53	1.27	0.31	0
152	8.97	10.82	11.36	11.17	10.66	9.72	8.19	6.24	4.26	2.58	1.28	0.31	0
153	10.64	11.35	10.59	9.46	8.64	7.93	6.91	5.49	3.9	2.43	1.23	0.32	0
154	9.49	10.97	11.06	10.63	10.18	9.52	8.28	6.53	4.6	2.87	1.47	0.38	0
155	10.04	10.21	9.42	8.65	8.22	7.79	6.96	5.72	4.29	2.9	1.66	0.53	0
156	9.26	10.98	11.49	11.33	10.91	10.13	8.78	6.95	4.95	3.12	1.61	0.43	0
157	10.82	11.46	10.59	9.52	8.81	8.16	7.15	5.74	4.16	2.68	1.42	0.4	0
158	11.76	11.06	9.35	8.08	7.56	7.23	6.52	5.34	3.95	2.62	1.47	0.45	0
159	11.02	11.21	10.21	9.4	9.07	8.65	7.64	6.07	4.31	2.7	1.39	0.37	0
160	10.02	10.52	10.13	9.95	10.04	9.65	8.33	6.33	4.24	2.52	1.23	0.3	0
161	10.35	10.46	9.69	9.11	8.87	8.41	7.33	5.73	4.01	2.48	1.25	0.32	0
162	11.73	11.06	9.57	8.59	8.18	7.65	6.54	5.01	3.43	2.1	1.06	0.27	0
163	11.33	10.73	9.43	8.68	8.49	8.12	7.08	5.5	3.79	2.32	1.17	0.3	0
164	11.25	9.69	8.13	7.57	7.67	7.58	6.82	5.51	4.03	2.67	1.51	0.48	0
165	11.12	9.26	7.59	7	7.06	6.94	6.24	5.08	3.76	2.53	1.44	0.46	0
166	12.91	7	3.79	3.44	4.08	4.33	3.93	3.18	2.39	1.66	1	0.34	0
167	12.15	6.82	4.19	3.98	4.44	4.44	3.88	3.07	2.28	1.58	0.94	0.31	0
168	11.97	6.26	3.66	3.71	4.4	4.51	3.95	3.09	2.24	1.51	0.89	0.22	0
169	10.79	5.78	3.72	3.82	4.36	4.43	3.99	3.31	2.56	1.82	1.09	0.36	0
170	9.32	4.18	2.72	3.35	4.06	4.12	3.67	3.06	2.41	1.74	1.06	0.36	0
171	9.33	4.68	3.27	3.69	4.23	4.24	3.85	3.26	2.59	1.88	1.13	0.39	0
172	7.14	2.04	1.29	2.19	2.72	2.56	2.12	1.69	1.33	0.96	0.58	0.14	0
173	5.72	2.62	2.49	3.18	3.49	3.35	3.03	2.63	2.15	1.57	0.94	0.31	0
174	7.01	3.42	2.74	3.15	3.42	3.31	2.99	2.58	2.09	1.53	0.93	0.32	0
175	6.67	4.32	3.92	4.18	4.35	4.31	4.05	3.57	2.89	2.08	1.24	0.42	0
176	5.72	2.16	1.77	2.33	2.61	2.5	2.21	1.88	1.5	1.08	0.63	0.15	0
177	6.57	3.01	2.26	2.62	2.87	2.78	2.49	2.11	1.67	1.19	0.7	0.17	0
178	7.68	4.03	3.09	3.32	3.56	3.49	3.18	2.71	2.12	1.49	0.87	0.21	0
179	4.89	2.18	1.91	2.46	2.81	2.81	2.59	2.23	1.77	1.26	0.74	0.18	0
180	8.94	8.55	7.85	7.01	6	4.83	3.61	2.53	1.67	1.02	0.53	0.1	0
181	8.1	9.34	10.17	10.34	9.75	8.42	6.64	4.79	3.19	1.96	1.02	0.21	0
182	8.06	9.21	9.86	10.01	9.58	8.56	7.07	5.41	3.85	2.52	1.4	0.34	0
183	8.16	9.5	10.28	10.55	10.19	9.07	7.34	5.39	3.59	2.15	1.06	0.24	0
184	7.25	8.42	9.25	9.9	10.14	9.62	8.28	6.44	4.54	2.89	1.55	0.43	0
185	8.31	9.28	9.68	9.8	9.7	9.08	7.8	6.05	4.23	2.65	1.39	0.32	0
186	7.69	9.77	10.96	11.47	11.44	10.68	9.06	6.89	4.67	2.79	1.37	0.33	0
187	8.9	9.75	9.8	9.44	8.95	8.19	6.98	5.44	3.83	2.42	1.27	0.28	0
188	8.47	9.74	10.2	10.26	10.11	9.49	8.16	6.29	4.32	2.61	1.28	0.3	0
189	7.97	9.93	10.91	11.16	10.94	10.17	8.73	6.8	4.77	2.96	1.5	0.38	0
190	9.2	10.78	11.04	10.56	9.84	8.89	7.55	5.89	4.16	2.61	1.34	0.35	0
191	9.01	10.33	10.55	10.3	9.89	9.09	7.68	5.85	3.99	2.42	1.2	0.29	0
192	9.41	10.9	11.05	10.65	10.15	9.38	8.04	6.24	4.34	2.66	1.33	0.33	0
193	10.75	12	11.47	10.38	9.48	8.57	7.27	5.57	3.79	2.25	1.09	0.24	0
194	10.84	11.24	10.26	9.21	8.56	7.93	6.84	5.32	3.67	2.23	1.09	0.26	0
195	12.26	12.38	10.68	9	8.09	7.49	6.58	5.23	3.69	2.29	1.16	0.29	0
196	11.32	10.95	9.52	8.34	7.8	7.4	6.61	5.38	3.94	2.59	1.43	0.43	0
198	11.84	11.43	9.81	8.62	8.19	7.83	6.89	5.37	3.67	2.2	1.07	0.26	0
199	9.14	10.58	10.88	10.75	10.56	9.98	8.7	6.82	4.77	2.92	1.44	0.36	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS												
	PHI												
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
200	9.75	10.41	10.1	9.8	9.72	9.27	8.02	6.14	4.15	2.45	1.18	0.27	0
201	12.21	11.38	9.53	8.35	8.05	7.84	7.05	5.64	3.99	2.46	1.23	0.31	0
202	11.56	11.42	10.15	9.23	8.86	8.37	7.21	5.51	3.73	2.23	1.1	0.27	0
203	13.56	11.26	8.24	6.48	6.16	6.29	6.03	5.2	4.02	2.78	1.62	0.55	0
204	12.4	9.51	6.99	6.04	6.13	6.21	5.72	4.73	3.54	2.39	1.38	0.45	0
205	11	8.32	6.45	6	6.2	6.19	5.61	4.62	3.49	2.41	1.42	0.48	0
206	11.99	8.16	5.93	5.56	5.83	5.73	5.05	4.05	3.02	2.08	1.23	0.4	0
207	11.83	6.01	3.36	3.34	3.99	4.13	3.68	2.97	2.25	1.6	0.97	0.33	0
208	10.78	5.34	3.2	3.45	4.12	4.18	3.67	2.93	2.21	1.56	0.94	0.31	0
209	10.87	5.82	3.75	3.84	4.34	4.36	3.89	3.21	2.49	1.78	1.08	0.37	0
210	8.99	3.4	1.98	2.74	3.48	3.46	2.96	2.35	1.8	1.29	0.78	0.19	0
211	10.77	4.72	2.45	2.74	3.43	3.57	3.19	2.63	2.04	1.46	0.89	0.3	0
212	10.7	4.98	2.79	3.03	3.71	3.85	3.48	2.87	2.21	1.57	0.94	0.32	0
213	9.65	6.1	4.71	4.83	5.29	5.4	5.04	4.32	3.38	2.38	1.39	0.46	0
214	9.5	3.19	1.36	1.97	2.67	2.68	2.26	1.78	1.36	0.98	0.6	0.15	0
215	8.07	4.57	3.72	4.26	4.86	4.98	4.59	3.84	2.93	1.99	1.13	0.35	0
216	8.24	3.47	2.24	2.78	3.37	3.46	3.16	2.69	2.14	1.54	0.92	0.3	0
217	6.79	2.36	1.64	2.39	2.94	2.93	2.62	2.22	1.77	1.28	0.76	0.18	0
218	8.7	4.75	3.62	3.99	4.42	4.39	3.96	3.3	2.56	1.8	1.06	0.35	0
219	9.61	5.27	3.65	3.8	4.27	4.37	4.01	3.37	2.59	1.81	1.06	0.34	0
220	12.4	7.25	3.57	2.08	1.85	1.79	1.5	1.05	0.66	0.4	0.24	0.01	0
221	8.21	8.45	8.2	7.57	6.67	5.52	4.24	3.02	2	1.23	0.64	0.12	0
222	8.35	9.16	9.55	9.49	8.91	7.74	6.12	4.39	2.87	1.71	0.87	0.17	0
223	8.18	8.87	9.25	9.32	8.93	7.96	6.51	4.88	3.37	2.12	1.13	0.24	0
224	7.95	8.94	9.53	9.7	9.34	8.35	6.86	5.17	3.59	2.29	1.24	0.29	0
225	7.92	8.52	8.73	8.74	8.47	7.74	6.56	5.1	3.63	2.35	1.27	0.3	0
226	8.8	9.09	8.89	8.57	8.16	7.43	6.29	4.89	3.47	2.22	1.2	0.28	0
227	8.75	9.78	9.9	9.58	9.1	8.37	7.25	5.83	4.31	2.89	1.64	0.51	0
228	9.04	10.52	10.82	10.54	10.09	9.29	7.95	6.19	4.33	2.68	1.35	0.34	0
229	7.77	10.07	11.43	11.95	11.78	10.79	8.95	6.65	4.42	2.62	1.29	0.3	0
230	10.2	11.56	11.37	10.39	9.27	8.09	6.71	5.16	3.62	2.26	1.15	0.28	0
231	8.11	10.2	11.24	11.51	11.28	10.42	8.83	6.74	4.6	2.77	1.35	0.32	0
232	9.84	11.24	11.2	10.52	9.77	8.85	7.49	5.76	3.97	2.41	1.19	0.29	0
233	9.71	10.96	10.84	10.16	9.49	8.72	7.59	6.07	4.4	2.82	1.46	0.39	0
234	11.46	11.8	10.58	9.03	7.86	6.99	6.07	4.95	3.72	2.54	1.46	0.46	0
235	10.85	11.31	10.46	9.36	8.52	7.74	6.65	5.25	3.75	2.4	1.29	0.3	0
236	10.21	11.15	10.7	9.97	9.48	8.92	7.89	6.36	4.61	2.94	1.53	0.42	0
237	12.65	11.95	9.91	8.36	7.72	7.34	6.53	5.2	3.66	2.24	1.11	0.28	0
238	12.63	12.26	10.27	8.33	7.18	6.5	5.78	4.81	3.67	2.53	1.47	0.48	0
239	12.51	11.58	9.51	7.88	7.12	6.7	6.05	5.03	3.81	2.61	1.51	0.49	0
240	12.65	12.64	10.76	8.75	7.46	6.66	5.83	4.77	3.57	2.41	1.37	0.43	0
241	13.03	11.39	8.88	7.2	6.56	6.23	5.58	4.53	3.31	2.18	1.21	0.36	0
242	12.17	10.57	8.48	7.24	6.86	6.6	5.93	4.81	3.52	2.32	1.29	0.39	0
243	10.48	10.86	10.37	10.04	9.91	9.32	7.86	5.82	3.79	2.18	1.04	0.2	0
244	13.49	11.84	9.17	7.32	6.58	6.22	5.63	4.68	3.56	2.45	1.44	0.49	0
245	12.61	10.31	7.89	6.71	6.57	6.54	6	4.94	3.65	2.41	1.34	0.41	0
246	11.16	10.11	8.68	7.87	7.64	7.4	6.71	5.56	4.21	2.87	1.65	0.54	0
247	12.88	8.61	5.75	4.93	5.06	5.08	4.6	3.78	2.87	2	1.19	0.4	0
249	11.71	7.16	4.7	4.25	4.51	4.56	4.19	3.53	2.76	1.96	1.18	0.4	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
	PHI											
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
250	10.77	5.77	3.66	3.61	4.02	4.02	3.6	2.97	2.29	1.63	0.97	0.32	0
251	10.23	4.72	2.75	2.99	3.51	3.51	3.06	2.47	1.88	1.33	0.79	0.19	0
252	9.62	4.04	2.27	2.66	3.22	3.22	2.84	2.34	1.85	1.35	0.83	0.21	0
253	10.26	5.94	4.21	4.37	4.9	4.98	4.51	3.73	2.83	1.95	1.13	0.37	0
254	10.69	4.42	2.22	2.67	3.47	3.59	3.13	2.48	1.86	1.31	0.78	0.19	0
255	8.69	2.57	1.03	1.78	2.51	2.55	2.2	1.8	1.44	1.07	0.65	0.16	0
256	10.06	5.32	3.56	3.74	4.25	4.34	4	3.4	2.68	1.92	1.15	0.39	0
257	9.1	2.87	1.22	1.88	2.53	2.5	2.08	1.64	1.28	0.94	0.58	0.14	0
258	9.11	3.65	2.13	2.77	3.52	3.65	3.33	2.83	2.26	1.65	0.99	0.33	0
259	9.42	6.39	5.22	5.49	6.11	6.35	6	5.16	4.04	2.84	1.67	0.58	0
260	10.62	5.69	3.66	3.71	4.21	4.33	3.99	3.4	2.68	1.92	1.15	0.39	0
261	9.3	2.15	0.4	1.4	2.32	2.35	1.91	1.47	1.14	0.86	0.54	0.13	0
262	8.24	7.69	7.05	6.5	5.86	4.95	3.81	2.68	1.73	1.04	0.54	0.1	0
263	7.64	8.05	8.07	7.76	7.12	6.13	4.86	3.55	2.39	1.47	0.78	0.16	0
264	8.31	8.96	9.19	9.08	8.57	7.56	6.11	4.49	3.02	1.85	0.97	0.2	0
265	8.63	9.09	9.18	9.03	8.52	7.51	6.09	4.54	3.12	1.97	1.06	0.23	0
266	8.56	9	9.05	8.87	8.36	7.4	6.02	4.49	3.07	1.91	1.01	0.21	0
267	8.91	9.06	8.75	8.29	7.67	6.76	5.53	4.17	2.89	1.82	0.97	0.2	0
268	9.44	10.02	9.76	9.16	8.44	7.52	6.34	5	3.65	2.43	1.36	0.39	0
269	9.68	11.03	11.23	10.88	10.26	9.2	7.59	5.66	3.81	2.29	1.14	0.27	0
270	8.54	10.54	11.49	11.69	11.35	10.32	8.55	6.35	4.21	2.47	1.18	0.27	0
271	9.63	10.14	9.73	9.12	8.63	8	6.97	5.56	4.04	2.64	1.45	0.42	0
272	8.97	10.02	10.11	9.93	9.71	9.15	7.94	6.22	4.37	2.71	1.38	0.36	0
273	9.2	9.86	9.72	9.38	9.05	8.49	7.44	5.98	4.38	2.9	1.62	0.48	0
274	10.73	10.87	9.89	8.8	8.03	7.35	6.45	5.27	3.97	2.71	1.56	0.5	0
275	10.8	11.08	10.11	8.95	8.11	7.41	6.53	5.4	4.13	2.87	1.7	0.57	0
276	11.95	11.31	9.62	8.12	7.18	6.47	5.6	4.52	3.36	2.28	1.31	0.41	0
277	11.22	11.33	10.21	8.98	8.15	7.48	6.6	5.42	4.08	2.78	1.6	0.52	0
278	11.42	10.55	9.02	7.87	7.28	6.83	6.1	5.05	3.84	2.64	1.53	0.5	0
279	12.93	11.56	9.3	7.48	6.46	5.83	5.15	4.27	3.28	2.29	1.37	0.46	0
280	12.78	11.07	8.73	7.11	6.36	5.91	5.27	4.39	3.37	2.36	1.41	0.48	0
281	13.96	10.97	7.91	6.08	5.32	4.89	4.32	3.55	2.73	1.94	1.19	0.45	0
282	13.75	11.04	8.11	6.29	5.47	4.98	4.4	3.67	2.89	2.11	1.34	0.51	0
283	12.26	9.88	7.59	6.39	6.05	5.88	5.41	4.61	3.61	2.56	1.53	0.53	0
284	14.07	10.7	7.43	5.62	5	4.71	4.24	3.54	2.74	1.94	1.18	0.42	0
285	11.22	10.18	8.84	8.13	7.92	7.53	6.59	5.2	3.7	2.37	1.28	0.37	0
286	13.29	10.48	7.77	6.33	5.87	5.61	5.1	4.31	3.36	2.38	1.42	0.49	0
287	13.23	9.55	6.63	5.35	5.08	4.94	4.49	3.78	2.93	2.07	1.24	0.42	0
288	12.79	9.28	6.59	5.57	5.53	5.48	4.98	4.09	3.05	2.06	1.18	0.38	0
289	12.32	7.2	4.42	3.69	3.66	3.48	3.04	2.51	1.98	1.46	0.91	0.32	0
290	11.1	5.92	3.61	3.35	3.58	3.54	3.18	2.67	2.11	1.52	0.92	0.3	0
291	8.96	3.49	1.95	2.41	2.9	2.84	2.45	2	1.58	1.15	0.7	0.17	0
292	10.01	5.01	3.21	3.32	3.68	3.63	3.24	2.72	2.15	1.55	0.92	0.3	0
293	8.94	4.12	2.72	3.12	3.57	3.49	3.07	2.55	2.02	1.47	0.89	0.3	0
294	8.78	4.13	2.82	3.22	3.61	3.49	3.03	2.49	1.94	1.38	0.82	0.2	0
295	9.32	3.07	1.32	1.97	2.67	2.67	2.24	1.76	1.35	0.97	0.59	0.14	0
296	10.92	4.59	2.23	2.52	3.21	3.32	2.98	2.51	2.04	1.54	0.98	0.36	0
297	10.8	5.86	3.84	3.89	4.34	4.37	3.96	3.33	2.61	1.86	1.1	0.37	0
298	10.61	4.65	2.55	2.86	3.43	3.42	2.98	2.42	1.89	1.37	0.83	0.21	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
PHI													
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
299	10.22	4.45	2.52	2.93	3.58	3.64	3.23	2.67	2.09	1.51	0.91	0.3	0
300	10.02	5.38	3.7	4.17	5.03	5.33	5.03	4.36	3.51	2.57	1.57	0.57	0
301	10.83	5.82	3.78	3.94	4.52	4.61	4.21	3.57	2.83	2.05	1.25	0.43	0
302	10.38	3.67	1.56	2.27	3.2	3.34	2.91	2.34	1.82	1.32	0.81	0.2	0
303	7.96	8.09	7.75	7.21	6.47	5.44	4.18	2.91	1.86	1.11	0.57	0.1	0
304	8.6	9.54	9.93	9.69	8.83	7.42	5.69	3.98	2.56	1.52	0.78	0.15	0
305	8.39	9.08	9.57	9.74	9.33	8.18	6.48	4.65	3.04	1.83	0.94	0.19	0
306	8.51	8.33	7.78	7.11	6.32	5.35	4.21	3.07	2.08	1.29	0.67	0.13	0
307	9.47	9.38	8.86	8.19	7.34	6.22	4.93	3.65	2.54	1.63	0.88	0.19	0
308	9.91	9.4	8.62	8	7.39	6.53	5.4	4.17	3	1.99	1.11	0.25	0
309	10.2	9.98	9.21	8.56	8.07	7.39	6.33	5	3.63	2.4	1.34	0.39	0
310	9.83	9.93	9.35	8.78	8.37	7.8	6.81	5.46	3.99	2.62	1.44	0.42	0
311	10.91	10.2	8.86	7.93	7.53	7.15	6.36	5.15	3.77	2.48	1.36	0.39	0
312	10.59	9.48	8.21	7.44	7.07	6.6	5.74	4.57	3.31	2.16	1.19	0.28	0
313	10.33	9.93	9.01	8.34	7.98	7.5	6.57	5.25	3.81	2.5	1.39	0.41	0
314	10.39	10.82	10.27	9.6	9.09	8.4	7.22	5.61	3.9	2.38	1.18	0.29	0
315	10.88	10.86	9.98	9.27	8.9	8.33	7.16	5.51	3.78	2.3	1.15	0.29	0
316	9.48	9.83	9.6	9.32	9.07	8.51	7.44	5.94	4.33	2.84	1.57	0.47	0
317	10.88	10.87	10.18	9.56	9.1	8.31	6.92	5.15	3.42	2.02	0.99	0.23	0
318	10.73	9.43	8.13	7.47	7.29	7.01	6.28	5.15	3.84	2.58	1.46	0.46	0
319	11.45	10.16	8.58	7.55	7.08	6.69	6.03	5.05	3.88	2.69	1.56	0.51	0
320	10.87	10.09	8.92	8.16	7.87	7.57	6.86	5.7	4.3	2.91	1.65	0.51	0
321	10.87	9.64	8.39	7.73	7.49	7.18	6.42	5.26	3.91	2.62	1.48	0.47	0
322	11.28	8.68	6.96	6.33	6.17	5.87	5.19	4.22	3.16	2.15	1.24	0.39	0
323	11.54	8.35	6.35	5.74	5.72	5.54	4.94	4.02	2.98	2	1.12	0.34	0
324	11.43	7.24	5.08	4.63	4.68	4.5	3.98	3.26	2.49	1.75	1.04	0.34	0
325	11.29	7.97	6.1	5.64	5.63	5.38	4.74	3.87	2.93	2.04	1.2	0.39	0
326	10.98	7.6	5.72	5.33	5.47	5.37	4.8	3.91	2.93	2	1.16	0.37	0
327	12.51	8.39	5.77	4.88	4.74	4.51	3.95	3.16	2.34	1.6	0.93	0.23	0
328	10.21	7.45	6.12	5.99	6.14	5.97	5.37	4.48	3.48	2.46	1.47	0.5	0
329	9.77	7.54	6.6	6.74	7.06	6.9	6.11	4.92	3.62	2.42	1.38	0.43	0
330	10.43	5.46	3.52	3.59	4.01	4.01	3.59	2.99	2.34	1.68	1.02	0.34	0
331	10.98	5.61	3.37	3.24	3.54	3.47	3.05	2.51	1.97	1.43	0.87	0.22	0
332	9.94	5.8	4.26	4.41	4.8	4.75	4.22	3.44	2.6	1.79	1.04	0.33	0
333	9	3.71	2.3	2.89	3.51	3.51	3.12	2.6	2.06	1.49	0.9	0.23	0
334	9.33	4.06	2.52	3.08	3.71	3.71	3.25	2.64	2.03	1.43	0.85	0.21	0
335	9.74	3.19	1.28	1.87	2.51	2.46	2.03	1.6	1.26	0.95	0.6	0.15	0
336	10.47	3.53	1.29	1.91	2.79	2.93	2.52	2.01	1.56	1.14	0.71	0.18	0
337	11.38	3.49	0.71	1.18	2.04	2.16	1.79	1.39	1.1	0.86	0.57	0.15	0
338	11.52	5.29	2.79	2.98	3.65	3.74	3.29	2.67	2.04	1.46	0.89	0.22	0
339	12.3	5.58	2.64	2.7	3.45	3.64	3.24	2.63	2.03	1.46	0.89	0.3	0
340	11.32	4.43	1.87	2.27	3.11	3.28	2.9	2.36	1.85	1.35	0.84	0.22	0
341	12.23	4.3	1.16	1.53	2.53	2.79	2.4	1.85	1.38	0.99	0.62	0.16	0
342	11.91	4.37	1.45	1.8	2.7	2.91	2.55	2.05	1.61	1.19	0.75	0.19	0
343	11.82	5.76	3.12	3.17	3.82	3.95	3.53	2.89	2.22	1.58	0.94	0.31	0
344	10.46	5.02	2.82	2.69	2.82	2.45	1.76	1.12	0.69	0.44	0.26	0.01	0
345	9.25	9.88	10.03	9.78	8.92	7.37	5.42	3.55	2.1	1.13	0.51	0.08	0
346	8.54	9.05	9.22	9.15	8.67	7.61	6.06	4.38	2.88	1.73	0.88	0.17	0
347	8.56	8.86	8.86	8.7	8.24	7.32	5.98	4.48	3.07	1.92	1.01	0.21	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
PHI												
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
348	8.95	9.36	9.31	9.08	8.6	7.72	6.46	5.02	3.62	2.39	1.34	0.39	0
349	9.62	9.83	9.34	8.73	8.14	7.35	6.21	4.82	3.43	2.21	1.2	0.28	0
350	11.72	11.37	9.91	8.42	7.32	6.4	5.42	4.32	3.2	2.17	1.24	0.39	0
351	9.85	10.85	10.92	10.68	10.25	9.27	7.6	5.53	3.58	2.05	0.96	0.18	0
352	9.8	10.53	10.45	10.24	9.99	9.3	7.89	5.99	4.05	2.41	1.17	0.27	0
353	10.28	10.62	10.13	9.61	9.24	8.61	7.4	5.72	3.94	2.39	1.17	0.28	0
354	10.9	10.3	9.25	8.52	8.17	7.69	6.72	5.32	3.77	2.35	1.19	0.3	0
355	10.7	9.87	8.77	8.01	7.6	7.12	6.24	5.01	3.65	2.4	1.32	0.38	0
356	11.16	10.89	9.81	8.88	8.31	7.74	6.78	5.41	3.88	2.46	1.26	0.33	0
357	11.73	10.94	9.44	8.42	7.99	7.56	6.63	5.24	3.68	2.27	1.13	0.29	0
358	12.16	11.29	9.61	8.1	7.08	6.29	5.42	4.39	3.3	2.26	1.31	0.41	0
359	12.25	10.45	8.45	7.05	6.25	5.63	4.9	4.03	3.09	2.17	1.29	0.43	0
360	11.23	10.21	8.77	7.79	7.3	6.88	6.17	5.13	3.92	2.7	1.57	0.52	0
361	11.17	8.88	7.26	6.72	6.69	6.47	5.79	4.74	3.54	2.39	1.35	0.42	0
362	10.98	7.57	5.83	5.45	5.44	5.17	4.53	3.66	2.73	1.86	1.07	0.33	0
363	11.43	8.25	6.37	5.8	5.71	5.44	4.83	3.99	3.07	2.17	1.3	0.44	0
364	11.46	7.98	5.96	5.47	5.57	5.48	4.95	4.09	3.1	2.12	1.22	0.39	0
365	9.92	8	7.05	7.01	7.16	6.96	6.22	5.12	3.87	2.66	1.54	0.51	0
366	10.82	6.88	5.05	4.9	5.2	5.15	4.6	3.72	2.75	1.84	1.04	0.25	0
367	10.85	6.86	5.05	4.86	5.01	4.82	4.21	3.4	2.55	1.75	1.01	0.25	0
368	11.38	8.42	6.57	5.96	5.89	5.7	5.11	4.2	3.16	2.14	1.21	0.37	0
369	9.48	5.02	3.69	4.11	4.59	4.49	3.93	3.2	2.44	1.71	1.01	0.32	0
370	10.75	6.85	5.04	4.81	4.97	4.83	4.29	3.53	2.69	1.87	1.09	0.34	0
371	10.24	6.27	4.7	4.84	5.29	5.27	4.71	3.82	2.84	1.91	1.07	0.27	0
372	10.38	4.91	2.91	3.02	3.41	3.3	2.8	2.18	1.62	1.11	0.65	0.15	0
373	9.06	3.75	2.32	2.88	3.43	3.36	2.87	2.28	1.72	1.21	0.72	0.17	0
374	9.44	4.85	3.44	3.84	4.37	4.35	3.85	3.11	2.32	1.57	0.89	0.21	0
375	10.32	3.61	1.52	2.1	2.85	2.87	2.42	1.91	1.48	1.08	0.67	0.17	0
376	11.01	4.01	1.6	2.1	2.91	2.98	2.52	1.98	1.52	1.11	0.7	0.18	0
377	11.49	4.35	1.73	2.09	2.84	2.9	2.44	1.9	1.45	1.06	0.66	0.17	0
378	12.12	4.67	1.7	2	2.9	3.12	2.73	2.18	1.69	1.24	0.78	0.21	0
379	12.39	4.29	1.18	1.59	2.54	2.69	2.22	1.65	1.22	0.88	0.56	0.14	0
380	12.3	4.97	1.91	2.12	3	3.24	2.85	2.26	1.71	1.21	0.73	0.18	0
381	12.05	4.98	2.11	2.39	3.29	3.53	3.14	2.55	1.97	1.43	0.88	0.3	0
382	11.5	6.01	3.64	3.8	4.51	4.67	4.25	3.55	2.78	2	1.21	0.42	0
383	12.85	6.7	3.54	3.31	4.06	4.43	4.16	3.51	2.72	1.91	1.13	0.37	0
384	11.49	5.17	2.61	2.85	3.63	3.83	3.46	2.86	2.23	1.6	0.97	0.32	0
385	12.95	7.03	3.75	3.04	3.15	2.89	2.18	1.39	0.81	0.47	0.26	0.01	0
386	10	9.69	8.64	7.32	5.98	4.68	3.46	2.41	1.58	0.96	0.49	0.02	0
387	9.22	9.56	9.28	8.68	7.83	6.64	5.18	3.69	2.42	1.46	0.75	0.15	0
388	8.88	9.53	9.55	9.19	8.55	7.53	6.13	4.54	3.05	1.84	0.92	0.18	0
389	10.17	11	11.01	10.58	9.82	8.6	6.94	5.1	3.38	2	0.97	0.18	0
390	10.5	10.29	9.64	9.08	8.49	7.5	6.06	4.43	2.95	1.8	0.94	0.19	0
391	10.19	11	10.82	10.31	9.67	8.67	7.16	5.34	3.59	2.14	1.05	0.24	0
392	9.31	9.7	9.44	9.08	8.73	8.11	7.01	5.55	4.01	2.61	1.44	0.42	0
393	9.85	9.98	9.45	8.85	8.29	7.54	6.42	5.03	3.62	2.37	1.32	0.39	0
394	10.04	10.28	9.82	9.29	8.82	8.15	7.02	5.52	3.92	2.47	1.26	0.33	0
395	9.99	9.73	9.05	8.5	8.12	7.56	6.57	5.24	3.81	2.51	1.4	0.41	0
396	10.6	10.31	9.49	8.89	8.57	8.04	6.98	5.48	3.86	2.39	1.2	0.3	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
PHI												
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
397	10.11	9.43	8.53	7.94	7.62	7.16	6.3	5.09	3.76	2.51	1.41	0.43	0
398	10.53	9.9	9.03	8.63	8.54	8.12	7	5.36	3.62	2.13	1.02	0.19	0
399	10.13	9.65	8.79	8.15	7.8	7.41	6.69	5.61	4.31	2.98	1.71	0.55	0
400	11.27	9.63	8.12	7.21	6.69	6.18	5.43	4.46	3.4	2.36	1.38	0.45	0
401	11.06	9.8	8.53	7.7	7.16	6.58	5.74	4.67	3.52	2.41	1.4	0.45	0
402	11.21	8.42	6.68	6.03	5.8	5.47	4.87	4.06	3.17	2.26	1.37	0.47	0
403	11.25	8.92	7.31	6.64	6.37	5.99	5.29	4.33	3.27	2.24	1.29	0.41	0
404	10.93	8.47	6.96	6.55	6.57	6.36	5.66	4.58	3.37	2.24	1.25	0.38	0
405	11.3	8.43	6.63	6.01	5.87	5.58	4.94	4.04	3.05	2.09	1.2	0.38	0
406	11.85	7.98	5.72	5.02	4.92	4.7	4.2	3.49	2.71	1.92	1.14	0.38	0
407	12.3	7.64	5.09	4.32	4.13	3.81	3.23	2.53	1.87	1.27	0.73	0.17	0
408	10.05	4.26	2.45	2.81	3.25	3.09	2.54	1.94	1.42	0.99	0.59	0.14	0
409	11.29	7.66	5.76	5.29	5.22	4.9	4.24	3.39	2.52	1.71	0.98	0.23	0
410	10.15	6.91	5.5	5.4	5.59	5.43	4.83	3.93	2.93	1.97	1.11	0.33	0
411	10.39	5.85	4.06	4.01	4.22	4.07	3.58	2.93	2.26	1.59	0.94	0.23	0
412	9.81	6.79	5.59	5.67	5.98	5.87	5.25	4.28	3.19	2.14	1.21	0.37	0
413	10.17	5.96	4.38	4.45	4.75	4.63	4.06	3.27	2.43	1.64	0.92	0.22	0
414	9.25	4.45	3.06	3.5	3.99	3.93	3.47	2.88	2.25	1.61	0.96	0.31	0
415	9.38	3.67	2.18	2.87	3.5	3.4	2.84	2.18	1.6	1.1	0.63	0.15	0
416	11.48	5.56	3.18	3.28	3.8	3.79	3.29	2.64	1.99	1.39	0.82	0.2	0
417	11.8	3.98	1.15	1.62	2.49	2.58	2.14	1.64	1.27	0.96	0.61	0.16	0
418	12.31	4.37	1.29	1.69	2.67	2.88	2.46	1.9	1.43	1.05	0.66	0.17	0
419	12.16	3.66	0.56	1.15	2.26	2.48	2.05	1.52	1.12	0.83	0.53	0.14	0
420	12.89	6.2	3.05	3.01	3.79	4.02	3.59	2.87	2.15	1.5	0.9	0.22	0
421	13.22	6.27	2.9	2.74	3.51	3.78	3.43	2.81	2.16	1.55	0.94	0.32	0
422	13.38	5.42	1.81	1.87	2.83	3.13	2.73	2.13	1.59	1.14	0.72	0.19	0
423	12.04	6.38	3.67	3.66	4.43	4.72	4.35	3.62	2.79	1.97	1.18	0.41	0
424	12.02	7.78	5.32	4.98	5.48	5.73	5.36	4.53	3.49	2.42	1.42	0.48	0
425	8.26	5.1	3.73	3.49	3.39	2.95	2.24	1.52	0.95	0.57	0.3	0.01	0
426	9.78	8.44	7.65	7.36	6.99	6.12	4.82	3.42	2.21	1.32	0.68	0.14	0
427	9.18	9.03	8.44	7.77	7.07	6.16	4.99	3.71	2.54	1.59	0.85	0.18	0
429	8.92	9.5	9.59	9.45	9.02	8.09	6.67	5.01	3.44	2.15	1.14	0.25	0
430	9.66	10.52	10.66	10.51	10.07	9.03	7.32	5.29	3.41	1.95	0.92	0.17	0
431	8.83	9.7	9.89	9.72	9.34	8.56	7.27	5.62	3.95	2.5	1.34	0.31	0
432	10.38	10.41	9.7	8.72	7.73	6.7	5.55	4.31	3.11	2.06	1.15	0.28	0
433	9.2	9.83	9.95	9.82	9.42	8.53	7.11	5.4	3.74	2.37	1.28	0.3	0
434	10.51	11.06	10.62	9.94	9.27	8.36	6.99	5.31	3.62	2.2	1.1	0.27	0
435	9.43	9.69	9.46	9.13	8.71	7.95	6.74	5.26	3.76	2.46	1.37	0.4	0
436	9.88	10.95	11.01	10.63	10.03	9.03	7.48	5.6	3.77	2.25	1.1	0.26	0
437	10.3	10.17	9.37	8.56	7.93	7.26	6.33	5.15	3.87	2.63	1.51	0.47	0
438	9.79	9.64	9.07	8.53	8.08	7.47	6.53	5.31	3.99	2.72	1.56	0.5	0
439	9.53	10.21	10.3	10.17	9.87	9.09	7.66	5.82	3.96	2.39	1.18	0.28	0
440	10.09	8.74	7.92	7.72	7.65	7.19	6.18	4.82	3.4	2.17	1.17	0.27	0
441	10.83	9.04	7.73	7.11	6.8	6.33	5.48	4.34	3.12	2.02	1.09	0.24	0
442	11.6	7.9	5.81	5.23	5.15	4.84	4.16	3.25	2.34	1.54	0.85	0.19	0
443	10.53	8.35	7.05	6.58	6.34	5.93	5.23	4.34	3.37	2.39	1.43	0.49	0
444	11.22	8.77	7.22	6.64	6.4	5.92	5.05	3.96	2.87	1.9	1.08	0.26	0
445	10.39	8.25	7.11	6.82	6.74	6.38	5.6	4.52	3.35	2.23	1.24	0.37	0
446	10.77	7.37	5.69	5.38	5.43	5.2	4.57	3.7	2.77	1.89	1.09	0.34	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
	PHI											
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
447	9.81	6.59	5.35	5.43	5.69	5.5	4.79	3.8	2.75	1.8	0.99	0.22	0
448	9	5.08	4.01	4.38	4.69	4.45	3.81	3.04	2.28	1.57	0.91	0.22	0
449	8.94	6.47	5.63	5.7	5.77	5.45	4.74	3.82	2.86	1.95	1.12	0.35	0
450	8.66	6.36	5.79	6.06	6.21	5.86	5.08	4.08	3.03	2.05	1.16	0.35	0
451	11.04	6.77	4.73	4.45	4.63	4.5	3.94	3.14	2.31	1.55	0.87	0.2	0
452	8.89	4.86	3.64	3.93	4.28	4.2	3.8	3.26	2.63	1.92	1.17	0.4	0
453	9.27	5.57	4.4	4.72	5.15	5.09	4.52	3.68	2.76	1.87	1.06	0.25	0
454	9.92	5.21	3.57	3.87	4.42	4.48	4.07	3.41	2.66	1.87	1.1	0.35	0
455	10.01	4.83	3.13	3.65	4.41	4.52	4	3.2	2.35	1.56	0.88	0.2	0
456	11.53	5.57	3.16	3.42	4.18	4.3	3.77	2.97	2.19	1.5	0.88	0.22	0
457	12.66	5.69	2.57	2.66	3.53	3.81	3.46	2.86	2.24	1.64	1.02	0.36	0
458	12.22	5.83	3.02	3.19	4.05	4.28	3.82	3.09	2.35	1.67	1.01	0.34	0
459	12.53	6.42	3.52	3.57	4.45	4.76	4.33	3.52	2.64	1.82	1.07	0.35	0
460	13.42	6.44	2.91	2.74	3.63	4.04	3.75	3.1	2.38	1.69	1.02	0.35	0
461	11.79	5.4	2.73	3.06	4.05	4.4	4.05	3.38	2.64	1.9	1.15	0.4	0
462	13.21	6.93	3.68	3.38	4.01	4.22	3.82	3.12	2.36	1.65	0.98	0.32	0
463	12.36	5.59	2.6	2.74	3.63	3.94	3.61	3	2.35	1.7	1.04	0.36	0
464	6.51	1.69	0.86	1.34	1.46	1.11	0.7	0.44	0.31	0.21	0.03	0	0
465	9.64	9.86	9.63	9.17	8.46	7.34	5.87	4.3	2.89	1.79	0.94	0.2	0
466	9.29	9.41	9.45	9.42	8.89	7.59	5.76	3.9	2.39	1.36	0.68	0.12	0
467	9.77	10.79	11.22	11.1	10.24	8.57	6.37	4.21	2.49	1.33	0.59	0.09	0
468	8.71	9.94	10.75	11.03	10.5	9.06	6.98	4.81	3	1.72	0.86	0.16	0
469	8.28	10.28	11.4	11.76	11.4	10.19	8.23	5.95	3.86	2.23	1.07	0.2	0
470	8.73	9.77	10.05	9.86	9.34	8.4	7.01	5.37	3.76	2.38	1.27	0.29	0
471	8.36	9.36	9.68	9.53	9.1	8.37	7.24	5.81	4.27	2.84	1.58	0.47	0
472	8.78	9.12	8.94	8.5	7.92	7.14	6.08	4.82	3.53	2.35	1.32	0.39	0
473	9.4	9.84	9.61	9.19	8.76	8.09	6.98	5.49	3.88	2.41	1.2	0.3	0
474	8.72	10.48	11.28	11.4	10.99	9.95	8.24	6.17	4.16	2.5	1.23	0.3	0
475	9.27	9.87	9.89	9.7	9.34	8.52	7.12	5.34	3.57	2.11	1.01	0.22	0
476	9.25	10.19	10.38	10.2	9.77	8.91	7.49	5.7	3.91	2.38	1.19	0.29	0
477	9.28	10.4	10.79	10.82	10.47	9.45	7.72	5.63	3.67	2.13	1.03	0.2	0
478	9.47	9.39	9.15	8.92	8.57	7.82	6.58	5.04	3.5	2.17	1.09	0.27	0
479	9.9	9.72	9.29	9.03	8.84	8.29	7.1	5.42	3.68	2.18	1.04	0.23	0
480	9.56	8.5	7.98	8.02	8.14	7.76	6.65	5.06	3.41	2.01	0.95	0.18	0
481	9.32	8.08	7.45	7.36	7.35	6.97	6.07	4.8	3.44	2.21	1.19	0.28	0
482	9.65	7.41	6.35	6.18	6.18	5.86	5.09	4.04	2.92	1.92	1.07	0.25	0
483	10.06	7.72	6.6	6.49	6.6	6.29	5.42	4.21	2.95	1.87	1	0.22	0
484	9.66	9.01	8.61	8.57	8.58	8.14	7.02	5.41	3.71	2.22	1.08	0.24	0
485	8.56	6.64	6.05	6.23	6.38	6.04	5.18	4.05	2.9	1.89	1.05	0.24	0
486	9.44	6.8	5.73	5.72	5.82	5.53	4.84	3.94	2.99	2.07	1.2	0.38	0
487	8.66	7.46	7.04	6.95	6.77	6.27	5.43	4.37	3.26	2.2	1.24	0.37	0
488	7.8	5.62	5.02	5.16	5.27	5.01	4.37	3.5	2.56	1.69	0.93	0.21	0
489	9.56	7.22	5.95	5.54	5.41	5.09	4.47	3.62	2.7	1.82	1.03	0.24	0
490	8.42	6.78	6.11	6.17	6.39	6.3	5.76	4.85	3.74	2.58	1.48	0.47	0
491	9.09	6.34	5.27	5.32	5.51	5.28	4.58	3.62	2.61	1.71	0.95	0.22	0
492	8.91	6.76	5.94	6.06	6.23	5.92	5.1	3.98	2.86	1.87	1.04	0.24	0
493	8.37	4.29	3.11	3.52	4.01	3.99	3.55	2.89	2.18	1.49	0.85	0.2	0
494	9.92	5.88	4.43	4.89	5.66	5.82	5.25	4.25	3.11	2.05	1.13	0.28	0
495	10.4	5.45	3.46	3.68	4.35	4.51	4.13	3.46	2.7	1.93	1.15	0.39	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
PHI												
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
496	11.69	5.06	2.38	2.61	3.39	3.58	3.19	2.61	2.03	1.47	0.9	0.3	0
497	12.03	6.38	3.81	3.88	4.64	4.87	4.44	3.64	2.75	1.89	1.1	0.35	0
498	12.56	6.72	3.88	3.72	4.32	4.49	4.09	3.4	2.62	1.85	1.09	0.36	0
499	11.85	8.01	5.74	5.45	5.95	6.16	5.71	4.77	3.61	2.46	1.41	0.46	0
500	12.55	5.3	2.21	2.39	3.29	3.54	3.14	2.51	1.9	1.35	0.83	0.21	0
501	12.66	5.6	2.51	2.6	3.4	3.59	3.16	2.53	1.93	1.39	0.86	0.22	0
502	13.29	6.69	3.35	3.02	3.61	3.82	3.48	2.89	2.24	1.61	0.98	0.33	0
503	8.33	5.16	2.95	1.7	1.14	0.88	0.7	0.52	0.36	0.24	0.03	0	0
504	7.62	1.65	0.25	1.01	1.65	1.57	1.14	0.74	0.5	0.34	0.21	0.01	0
505	2.99	2.77	3.24	3.24	2.74	2.07	1.47	1.01	0.67	0.43	0.23	0.01	0
506	8.11	7.86	7.24	6.45	5.6	4.65	3.59	2.56	1.69	1.04	0.56	0.11	0
507	8.97	9.72	10.04	9.96	9.28	7.93	6.11	4.24	2.69	1.58	0.81	0.16	0
508	8.52	10.45	11.7	12.08	11.43	9.77	7.43	5.02	3.03	1.64	0.74	0.12	0
509	8.97	9.61	9.44	8.87	8.12	7.18	6.01	4.72	3.46	2.33	1.33	0.42	0
510	2.4	2.49	2.42	2.31	2.2	2.01	1.73	1.39	1.03	0.69	0.4	0.12	0
511	2.56	2.97	3.18	3.19	3.05	2.76	2.32	1.81	1.3	0.85	0.47	0.14	0
512	9.18	10.37	10.59	10.11	9.19	7.91	6.35	4.71	3.2	1.96	0.99	0.23	0
513	7.88	8.69	9.05	8.98	8.52	7.67	6.44	5.01	3.59	2.35	1.3	0.38	0
514	8.21	8.67	8.8	8.75	8.47	7.8	6.65	5.19	3.71	2.4	1.32	0.39	0
515	8.83	10.27	10.96	11.08	10.65	9.49	7.62	5.47	3.51	2.02	0.97	0.18	0
516	9.98	10.5	10.28	9.84	9.29	8.33	6.8	4.96	3.21	1.84	0.87	0.16	0
517	10.09	9.9	9.41	8.87	8.25	7.32	5.99	4.44	2.98	1.79	0.89	0.18	0
518	9.89	9.69	9.33	9.06	8.68	7.79	6.31	4.54	2.91	1.66	0.78	0.14	0
519	10.39	9.72	8.86	8.24	7.8	7.16	6.08	4.68	3.22	1.95	0.96	0.22	0
520	9.71	8.8	7.87	7.29	6.96	6.57	5.85	4.8	3.6	2.42	1.37	0.42	0
521	8.67	7.44	6.79	6.62	6.54	6.17	5.37	4.26	3.07	2	1.1	0.25	0
522	9.73	8.37	7.37	6.96	6.84	6.5	5.66	4.44	3.13	1.98	1.06	0.24	0
523	9.6	8.62	7.95	7.74	7.67	7.23	6.17	4.67	3.11	1.8	0.84	0.16	0
524	8.57	7.35	6.6	6.37	6.31	6.03	5.33	4.29	3.14	2.07	1.14	0.34	0
525	7.31	6.21	5.83	5.9	5.94	5.66	5.01	4.11	3.11	2.13	1.22	0.38	0
526	8.27	6.9	6.14	5.84	5.68	5.4	4.85	4.06	3.13	2.17	1.25	0.4	0
527	8.32	7.13	6.51	6.37	6.34	6.04	5.33	4.31	3.19	2.13	1.19	0.36	0
528	8.39	7.14	6.48	6.35	6.39	6.19	5.52	4.48	3.28	2.14	1.15	0.27	0
529	8	6.15	5.35	5.3	5.42	5.3	4.77	3.91	2.9	1.93	1.07	0.25	0
530	7.49	5.93	5.27	5.3	5.47	5.35	4.81	3.96	2.98	2.02	1.15	0.36	0
531	7.89	5.66	4.98	5.3	5.7	5.59	4.9	3.84	2.71	1.72	0.92	0.2	0
532	8.8	5.88	4.77	4.9	5.22	5.14	4.6	3.77	2.83	1.92	1.09	0.33	0
533	9.04	4.89	3.45	3.86	4.52	4.6	4.09	3.29	2.44	1.65	0.94	0.22	0
534	8.69	3.97	2.3	2.72	3.46	3.67	3.35	2.78	2.14	1.5	0.88	0.22	0
535	9.38	4.13	2.39	2.84	3.53	3.62	3.21	2.61	2	1.41	0.84	0.21	0
536	10.33	8.28	7.01	6.92	7.25	7.2	6.49	5.32	3.98	2.69	1.53	0.49	0
537	11.22	4.72	2.24	2.58	3.39	3.59	3.22	2.64	2.05	1.48	0.9	0.3	0
538	10.75	4.94	2.82	3.35	4.32	4.58	4.1	3.27	2.39	1.6	0.91	0.22	0
539	11.81	5.98	3.44	3.61	4.43	4.69	4.26	3.47	2.62	1.81	1.06	0.34	0
540	11.44	4.98	2.38	2.76	3.74	4.05	3.7	3.05	2.36	1.68	1.01	0.34	0
541	12.02	8.5	6.52	6.34	6.57	6.05	4.68	3.06	1.75	0.93	0.46	0.08	0
542	9.16	11.12	12.36	12.79	12.11	10.13	7.29	4.5	2.42	1.17	0.48	0.07	0
543	8.88	10.74	11.95	12.23	11.32	9.33	6.81	4.45	2.67	1.52	0.76	0.14	0
544	11.36	10.93	9.71	8.39	7.12	5.76	4.3	2.93	1.83	1.06	0.54	0.09	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS												
	PHI												
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
545	8.01	4.03	3.15	3.49	3.53	3.01	2.26	1.59	1.09	0.73	0.43	0.1	0
547	1.72	2.19	2.52	2.7	2.66	2.39	1.93	1.4	0.92	0.54	0.27	0.07	0
548	8.3	9.17	9.63	9.7	9.26	8.2	6.61	4.83	3.22	1.97	1.04	0.23	0
550	8.17	9.92	10.97	11.31	10.91	9.71	7.88	5.82	3.94	2.45	1.33	0.31	0
551	8.74	10.35	11.06	11.03	10.38	9.15	7.46	5.58	3.83	2.4	1.28	0.29	0
552	8.85	9.9	10.1	9.71	8.99	7.94	6.57	5.04	3.57	2.32	1.29	0.37	0
553	8.69	9.33	9.37	9.03	8.41	7.44	6.11	4.61	3.18	2	1.08	0.24	0
554	8.42	9.05	9.24	9.19	8.9	8.16	6.9	5.32	3.74	2.39	1.31	0.38	0
555	9.17	9.35	8.99	8.51	8.03	7.31	6.15	4.67	3.17	1.91	0.94	0.22	0
556	8.85	9.39	9.4	9.13	8.67	7.83	6.56	5.03	3.52	2.23	1.2	0.28	0
557	8.72	8.04	7.23	6.72	6.44	6.05	5.29	4.21	3.02	1.94	1.05	0.24	0
558	6.93	6.58	6.34	6.27	6.21	5.81	4.92	3.72	2.52	1.52	0.78	0.16	0
559	6.14	6.05	5.91	5.75	5.6	5.29	4.64	3.7	2.66	1.72	0.93	0.21	0
560	9.07	8.62	8.07	7.6	7.19	6.62	5.7	4.49	3.18	1.99	1.01	0.26	0
561	7.64	6.81	6.59	6.66	6.63	6.14	5.13	3.83	2.57	1.54	0.78	0.16	0
562	7.16	5.01	4.36	4.43	4.5	4.24	3.64	2.85	2.04	1.32	0.71	0.16	0
563	7.27	6.26	5.74	5.42	5.12	4.68	3.99	3.11	2.2	1.39	0.74	0.16	0
564	6.23	5.88	5.83	5.81	5.7	5.3	4.53	3.5	2.43	1.5	0.77	0.16	0
565	6.33	5.73	5.53	5.52	5.5	5.22	4.54	3.56	2.51	1.59	0.84	0.18	0
566	6.14	5.38	5.04	4.99	4.98	4.74	4.15	3.29	2.35	1.5	0.8	0.18	0
567	7.7	5.8	4.86	4.64	4.6	4.31	3.69	2.86	2.01	1.29	0.7	0.15	0
568	7.5	5.07	4.11	4.22	4.58	4.63	4.21	3.45	2.56	1.7	0.94	0.22	0
569	8.24	4.93	3.66	3.76	4.12	4.14	3.74	3.06	2.29	1.54	0.87	0.2	0
570	6.56	3	1.95	2.28	2.72	2.72	2.34	1.82	1.31	0.87	0.5	0.11	0
571	7.91	4.25	2.9	3.15	3.7	3.85	3.53	2.93	2.23	1.54	0.9	0.22	0
572	2.2	1.76	1.92	1.98	1.9	1.73	1.5	1.2	0.86	0.55	0.29	0.01	0
573	9.29	3.8	1.86	2.23	2.9	3.01	2.65	2.14	1.64	1.17	0.71	0.17	0
574	10.62	5.65	3.57	3.8	4.53	4.74	4.31	3.53	2.64	1.79	1.02	0.24	0
575	11.48	6.91	4.66	4.58	5.14	5.32	4.93	4.17	3.24	2.28	1.34	0.44	0
576	11.33	7.15	5.14	5.12	5.62	5.63	5	4.03	2.99	2.04	1.18	0.38	0
577	11.57	7.6	5.4	5.15	5.61	5.76	5.31	4.45	3.42	2.39	1.41	0.47	0
578	10.83	11.1	10.31	9.13	7.91	6.61	5.17	3.7	2.41	1.43	0.73	0.14	0
579	9.78	10.6	10.62	10.16	9.31	7.99	6.27	4.44	2.85	1.68	0.86	0.17	0
580	8.99	10.33	10.92	10.83	10.12	8.79	6.99	5.07	3.36	2.04	1.07	0.22	0
581	9.44	10.71	11.18	10.87	9.88	8.32	6.41	4.52	2.93	1.78	0.95	0.2	0
582	9.51	11.5	12.21	11.91	10.93	9.36	7.32	5.18	3.31	1.92	0.93	0.18	0
583	8.93	9.59	9.67	9.35	8.66	7.52	5.99	4.35	2.9	1.78	0.95	0.21	0
584	7.54	8.61	9.23	9.24	8.51	7.1	5.32	3.6	2.25	1.32	0.69	0.14	0
585	8.6	9.52	9.9	9.88	9.42	8.4	6.85	5.06	3.4	2.09	1.11	0.24	0
586	8.65	9.25	9.4	9.26	8.8	7.82	6.36	4.67	3.11	1.87	0.96	0.2	0
587	9.01	9.13	8.85	8.38	7.64	6.54	5.13	3.67	2.41	1.47	0.78	0.16	0
588	8.89	9.34	9.17	8.67	8	7.05	5.78	4.34	2.99	1.87	1	0.22	0
589	8.41	8.31	7.85	7.39	6.97	6.38	5.42	4.21	2.98	1.91	1.04	0.24	0
590	6.34	6.38	6.15	5.86	5.56	5.08	4.3	3.32	2.33	1.48	0.8	0.18	0
591	8.6	7.94	7.33	6.85	6.36	5.58	4.45	3.17	2.02	1.16	0.57	0.11	0
592	7.57	6.31	5.58	4.98	4.34	3.66	2.93	2.18	1.49	0.92	0.47	0.09	0
593	7.56	7.16	6.47	5.52	4.5	3.56	2.73	2	1.37	0.86	0.46	0.09	0
594	7.25	7.05	6.61	5.98	5.33	4.67	3.9	3.03	2.15	1.38	0.74	0.16	0
595	7.96	6.52	5.07	3.94	3.25	2.8	2.33	1.78	1.22	0.75	0.39	0.02	0

APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS

PHI

Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
596	0	0	0	0	0	0	0	0	0	0	0	0	0
597	8.64	7.01	5.92	5.47	5.31	5	4.32	3.37	2.37	1.49	0.8	0.17	0
598	6.41	4.29	3.3	3.05	3.08	3.05	2.8	2.35	1.79	1.21	0.67	0.15	0
599	7.67	6.05	5.29	5.12	5.06	4.79	4.21	3.41	2.55	1.72	0.98	0.23	0
600	6.01	3.76	3.05	3.19	3.44	3.37	2.95	2.32	1.66	1.07	0.58	0.13	0
601	7.84	3.95	2.76	3.1	3.51	3.41	2.88	2.22	1.6	1.07	0.61	0.14	0
602	7.58	4.94	3.86	3.97	4.38	4.44	4.02	3.26	2.4	1.59	0.89	0.21	0
603	8.57	5.5	4.41	4.8	5.44	5.52	4.93	3.92	2.82	1.82	0.99	0.23	0
604	9.86	6.24	4.55	4.6	5.12	5.19	4.63	3.69	2.68	1.77	1	0.24	0
605	10.41	7.58	6.08	6.14	6.75	6.91	6.29	5.09	3.71	2.42	1.33	0.4	0
606	11.07	5.63	3.31	3.56	4.4	4.66	4.2	3.39	2.51	1.72	1	0.32	0
607	11.82	7.46	5.05	4.86	5.5	5.78	5.32	4.35	3.2	2.13	1.19	0.37	0
608	10.17	6.56	4.97	5.21	5.92	6.14	5.67	4.72	3.59	2.46	1.42	0.46	0
609	11.53	9.19	6.74	4.92	3.84	3.16	2.58	1.97	1.4	0.91	0.52	0.12	0
610	9.81	10.98	11.03	10.41	9.45	8.17	6.57	4.86	3.29	2.05	1.1	0.24	0
611	9.68	11.16	11.56	11.11	10.06	8.54	6.7	4.84	3.22	1.97	1.04	0.22	0
612	10.13	11.66	11.84	10.98	9.58	7.92	6.15	4.43	2.97	1.84	0.99	0.22	0
613	0	0	0	0	0	0	0	0	0	0	0	0	0
614	10.4	10.73	9.94	8.58	7.17	5.86	4.61	3.39	2.3	1.42	0.74	0.15	0
615	9.29	10.34	10.17	8.88	7.04	5.21	3.64	2.41	1.5	0.88	0.44	0.02	0
616	10.05	9.96	9.08	7.74	6.23	4.76	3.46	2.39	1.57	0.96	0.5	0.09	0
617	8.91	8.58	7.47	6.05	4.76	3.7	2.83	2.06	1.41	0.88	0.46	0.09	0
618	9.54	8.21	6.83	5.88	5.31	4.78	4.04	3.11	2.16	1.35	0.71	0.15	0
619	8.21	6.34	4.56	3.38	2.79	2.43	2.04	1.57	1.09	0.69	0.37	0.02	0
620	11.07	9.91	8.05	6.21	4.85	3.93	3.19	2.47	1.77	1.15	0.62	0.13	0
621	8.9	8.26	7.18	5.91	4.67	3.56	2.58	1.78	1.15	0.7	0.36	0.02	0
622	7	6.53	5.42	4.15	3.22	2.67	2.28	1.84	1.36	0.89	0.48	0.1	0
623	7.83	5.99	4.52	3.61	3.12	2.72	2.23	1.66	1.12	0.69	0.36	0.02	0
624	2.38	1.08	1.43	1.73	1.54	1.17	0.86	0.65	0.5	0.33	0.12	0	0
625	3.86	3.14	2.59	2.11	1.81	1.62	1.39	1.07	0.73	0.44	0.22	0.01	0
626	0	0	0	0	0	0	0	0	0	0	0	0	0
627	3.96	3.12	2.64	2.35	2.18	1.99	1.69	1.3	0.9	0.56	0.29	0.01	0
628	6.61	4.72	3.83	3.6	3.53	3.32	2.88	2.28	1.66	1.1	0.61	0.14	0
629	5.39	3.93	3.47	3.45	3.5	3.38	3	2.4	1.73	1.11	0.59	0.13	0
630	4.08	2.29	1.93	2.13	2.28	2.19	1.87	1.45	1.03	0.67	0.36	0.02	0
631	6.33	3.49	2.64	2.9	3.26	3.26	2.89	2.32	1.72	1.16	0.66	0.15	0
632	6.51	3.53	2.54	2.84	3.32	3.4	3.03	2.4	1.73	1.13	0.62	0.14	0
633	7.81	4.29	3.03	3.36	3.97	4.11	3.73	3.06	2.32	1.59	0.92	0.23	0
634	7.61	3.28	1.77	2.1	2.69	2.81	2.5	2.01	1.52	1.06	0.63	0.15	0
635	9.91	4.5	2.52	2.9	3.62	3.71	3.2	2.48	1.79	1.21	0.7	0.17	0
636	9.81	5.09	3.31	3.68	4.42	4.55	4.04	3.22	2.36	1.59	0.91	0.22	0
637	17.83	11.45	5.61	2.96	2.6	2.66	2.27	1.55	0.9	0.49	0.27	0.01	0
638	10.75	10.63	9.49	8.22	7.17	6.12	4.87	3.49	2.25	1.31	0.66	0.13	0
639	9.08	7.79	6.42	5.52	4.97	4.37	3.53	2.56	1.67	0.99	0.51	0.11	0
640	11.78	11.27	9.29	7.04	5.31	4.12	3.16	2.26	1.48	0.87	0.44	0.02	0
641	9.93	9.57	8.21	6.58	5.15	3.98	2.96	2.06	1.33	0.8	0.41	0.02	0
642	0	0	0	0	0	0	0	0	0	0	0	0	0
643	0	0	0	0	0	0	0	0	0	0	0	0	0
644	0	0	0	0	0	0	0	0	0	0	0	0	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
	PHI												
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
645	8.74	6.81	4.94	3.68	2.99	2.53	2.04	1.49	0.99	0.6	0.31	0.01	0
646	11.47	7.71	4.63	2.96	2.29	1.93	1.52	1.06	0.66	0.39	0.2	0.01	0
647	7.5	5.16	3.53	2.63	2.15	1.79	1.39	0.98	0.63	0.38	0.14	0	0
648	7.32	5.81	4.49	3.26	2.22	1.44	0.93	0.62	0.42	0.28	0.11	0	0
649	6.06	5.13	4.43	3.99	3.77	3.52	3.05	2.36	1.62	0.97	0.48	0.09	0
650	10.43	8.38	5.64	3.44	2.29	1.83	1.54	1.17	0.78	0.46	0.22	0.01	0
651	0	0	0	0	0	0	0	0	0	0	0	0	0
652	7.9	7.33	6.16	5.15	4.59	4.2	3.64	2.83	1.95	1.19	0.6	0.12	0
653	8.31	7.16	5.82	4.76	4.09	3.58	2.97	2.24	1.52	0.93	0.48	0.1	0
654	8.17	6.21	4.99	4.57	4.51	4.32	3.78	2.97	2.09	1.32	0.71	0.16	0
655	5.05	3.41	2.7	2.55	2.54	2.38	2.01	1.52	1.04	0.65	0.35	0.02	0
656	5.32	3.73	3.18	3.22	3.31	3.14	2.69	2.08	1.46	0.93	0.51	0.11	0
657	7.9	5.85	5.1	5.41	5.87	5.8	5.04	3.87	2.66	1.64	0.85	0.18	0
658	6.69	4.64	4.02	4.35	4.74	4.62	3.95	3	2.06	1.29	0.68	0.15	0
659	4.44	1.98	1.3	1.57	1.89	1.89	1.64	1.3	0.96	0.65	0.37	0.08	0
660	8.41	5.47	4.39	4.61	4.99	4.84	4.14	3.18	2.22	1.42	0.77	0.17	0
661	8.97	5.18	3.64	3.79	4.33	4.4	3.88	3.03	2.14	1.38	0.75	0.17	0
662	6.36	3.57	2.59	2.81	3.21	3.24	2.85	2.24	1.61	1.05	0.58	0.13	0
663	6.54	4.47	2.53	1.55	1.33	1.29	1.1	0.79	0.48	0.27	0.11	0	0
665	14.57	12.65	8.75	5.2	3.16	2.28	1.82	1.36	0.89	0.51	0.25	0.01	0
666	11.71	9.67	7.12	5.06	3.68	2.73	1.93	1.26	0.75	0.43	0.22	0.01	0
667	10.58	9.35	7.56	5.68	4.03	2.72	1.78	1.13	0.71	0.43	0.23	0.01	0
668	11.67	10.21	7.84	5.79	4.42	3.44	2.55	1.71	1.03	0.57	0.28	0.01	0
669	10.8	9.11	6.98	5.28	4.14	3.26	2.42	1.64	1.01	0.57	0.29	0.01	0
670	4.84	3.94	3.2	2.73	2.46	2.19	1.79	1.3	0.85	0.49	0.24	0.01	0
671	5.88	4.06	2.7	1.71	1.08	0.72	0.52	0.36	0.22	0.05	0	0	0
672	4.66	3.45	2.25	1.35	0.9	0.73	0.62	0.48	0.32	0.14	0	0	0
673	7.47	5.12	2.85	1.46	0.97	0.88	0.79	0.6	0.38	0.21	0.02	0	0
674	11.15	10.05	7.34	4.76	3.27	2.6	2.15	1.64	1.1	0.65	0.32	0.01	0
675	11.92	11.86	10.21	8.07	6.24	4.84	3.64	2.56	1.66	0.98	0.49	0.08	0
676	9.72	9.9	9.14	7.77	6.28	4.91	3.7	2.65	1.78	1.11	0.59	0.12	0
677	9.47	7.92	5.95	4.4	3.52	3.01	2.48	1.84	1.21	0.71	0.35	0.01	0
678	8.86	6.91	5.16	4.19	3.84	3.59	3.11	2.41	1.68	1.05	0.56	0.12	0
679	7.15	5.58	4.48	3.9	3.68	3.47	3.05	2.43	1.75	1.13	0.62	0.14	0
680	7.02	5.05	3.96	3.65	3.63	3.45	2.98	2.31	1.63	1.05	0.58	0.13	0
681	5.44	3.74	2.96	2.89	3.02	2.95	2.56	1.98	1.37	0.86	0.46	0.1	0
682	3.81	2.45	1.94	1.94	1.98	1.82	1.46	1.05	0.69	0.43	0.23	0.01	0
683	5.22	3.27	2.47	2.55	2.83	2.84	2.51	2	1.44	0.95	0.53	0.12	0
684	7.41	3.73	2.81	3.22	3.54	3.32	2.74	2.08	1.48	0.99	0.56	0.12	0
685	3.2	1.49	1.5	1.72	1.68	1.45	1.2	0.95	0.71	0.48	0.26	0.01	0
686	0	0	0	0	0	0	0	0	0	0	0	0	0
687	0.31	0.02	0.71	1.01	0.7	0.4	0.31	0.31	0.25	0.06	0	0	0
688	17.45	7.7	1.77	0.56	1.3	1.69	1.3	0.67	0.24	0	0	0	0
689	20.94	12.46	4.57	1.12	0.93	1.4	1.29	0.74	0.24	0	0	0	0
690	20.5	13.79	6.29	2.13	1.16	1.3	1.22	0.78	0.34	0.05	0	0	0
691	17.14	11.47	5.85	2.88	2.01	1.75	1.34	0.81	0.39	0.15	0	0	0
692	11.78	7.64	3.94	2.05	1.51	1.33	1.03	0.64	0.33	0.14	0	0	0
693	0	0	0	0	0	0	0	0	0	0	0	0	0
694	7.11	5.83	3.8	2.02	1.06	0.74	0.64	0.52	0.35	0.16	0	0	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
	PHI												
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
695	1.43	0.77	0.65	0.51	0.35	0.25	0.19	0.09	0	0	0	0	0
696	6.13	2.36	0.81	0.75	0.97	0.91	0.65	0.39	0.22	0.05	0	0	0
697	10.33	6.9	4.35	3.34	3.09	2.74	2.1	1.37	0.79	0.44	0.23	0.01	0
698	5.59	4.75	3.3	2.09	1.5	1.26	1.07	0.8	0.52	0.29	0.1	0	0
699	14.88	13.1	9.45	6.35	4.7	3.95	3.3	2.51	1.68	1.01	0.53	0.11	0
700	16.96	14	8.94	5.07	3.39	2.96	2.64	2.03	1.32	0.74	0.36	0.02	0
701	3.55	2.99	2.3	1.83	1.59	1.4	1.14	0.82	0.52	0.3	0.15	0.01	0
702	11.57	9.08	6.04	3.98	3.15	2.87	2.53	1.97	1.36	0.84	0.45	0.1	0
703	9.43	6.87	4.69	3.65	3.37	3.16	2.67	1.99	1.32	0.81	0.43	0.09	0
704	6.05	4.21	3.2	2.92	2.92	2.78	2.39	1.83	1.28	0.81	0.44	0.09	0
705	2.62	2.03	1.81	1.88	1.99	1.93	1.66	1.26	0.85	0.52	0.27	0.06	0
706	4.53	2.97	2.42	2.36	2.36	2.19	1.85	1.43	1	0.64	0.35	0.02	0
707	0	0	0	0	0	0	0	0	0	0	0	0	0
708	0	0	0	0	0	0	0	0	0	0	0	0	0
709	0	0.09	0.72	0.74	0.37	0.08	0	0	0	0	0	0	0
710	0.44	0	0.42	0.83	0.6	0.31	0.21	0.2	0	0	0	0	0
711	2.25	0	0.09	0.93	1.01	0.58	0.2	0	0	0	0	0	0
712	8.33	1.44	0.01	0.55	0.98	0.73	0.32	0.02	0	0	0	0	0
713	0	0	0	0	0	0	0	0	0	0	0	0	0
714	0	0	0	0	0	0	0	0	0	0	0	0	0
715	1.75	0.61	0.54	0.55	0.42	0.27	0.18	0.02	0	0	0	0	0
716	2.78	2.95	2.63	2.18	1.81	1.48	1.13	0.78	0.49	0.27	0.03	0	0
717	7.64	6.68	5.84	5.16	4.42	3.48	2.47	1.58	0.93	0.52	0.26	0.01	0
718	1.64	1.15	1.3	1.32	1.13	0.89	0.67	0.47	0.3	0.06	0	0	0
719	14.74	10.73	5.87	2.89	1.99	1.93	1.74	1.27	0.75	0.4	0.2	0.01	0
720	0.74	0.86	0.82	0.67	0.55	0.48	0.4	0.31	0.2	0.12	0.02	0	0
721	16.65	11.02	5.64	2.7	1.86	1.77	1.58	1.18	0.76	0.46	0.27	0.01	0
722	22.21	18.02	10.43	4.32	1.62	1.21	1.35	1.19	0.78	0.39	0.12	0	0
723	17.78	14.31	8.69	4.37	2.47	2.07	1.94	1.56	1.02	0.57	0.26	0.01	0
724	12.16	6.93	3.16	1.76	1.72	1.8	1.54	1.08	0.67	0.39	0.23	0.01	0
725	12.27	10.29	7.43	5.19	3.91	3.14	2.44	1.73	1.1	0.64	0.33	0.01	0
726	6.94	5.16	3.7	3.05	2.96	2.91	2.62	2.12	1.54	1	0.56	0.13	0
727	6.82	5.49	4.99	4.96	4.81	4.19	3.22	2.2	1.37	0.79	0.41	0.02	0
728	0	0	0	0	0	0	0	0	0	0	0	0	0
729	0	0	0	0	0	0	0	0	0	0	0	0	0
730	0	0	0	0	0	0	0	0	0	0	0	0	0
731	0.65	0.94	0.84	0.69	0.62	0.56	0.45	0.3	0.09	0	0	0	0
732	7.99	2.91	0.83	0.56	0.65	0.55	0.32	0.03	0	0	0	0	0
733	10.86	9.57	7.26	5.16	3.76	2.82	2.02	1.32	0.77	0.42	0.15	0	0
734	0	0.17	0.24	0.09	0	0	0	0	0	0	0	0	0
735	14.39	8.17	3.7	1.9	1.63	1.6	1.33	0.9	0.53	0.31	0.13	0	0
736	16.22	8.67	3.37	1.61	1.69	1.8	1.43	0.86	0.44	0.24	0.11	0	0
737	17.39	10.62	4.93	2.28	1.73	1.7	1.44	0.97	0.55	0.3	0.12	0	0
738	15.59	10.65	5.6	2.53	1.44	1.25	1.14	0.86	0.53	0.29	0.11	0	0
739	8.99	5.59	2.62	1.22	0.99	1.06	0.93	0.64	0.36	0.16	0	0	0
740	4.04	3.08	2.06	1.4	1.15	1.05	0.89	0.65	0.41	0.18	0	0	0
741	0	0	0	0	0	0	0	0	0	0	0	0	0
742	0	0	0	0	0	0	0	0	0	0	0	0	0
743	0	0	0	0	0	0	0	0	0	0	0	0	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
	PHI												
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
744	1.24	0.01	0.44	0.73	0.47	0.18	0	0	0	0	0	0	0
746	9.19	5.26	2.53	1.48	1.35	1.31	1.06	0.7	0.41	0.23	0.03	0	0
747	0.88	0.12	0.51	0.52	0.28	0.06	0	0	0	0	0	0	0
748	10.38	2.94	0.46	0.82	1.4	1.29	0.82	0.45	0.28	0.22	0.03	0	0
749	18.08	9.27	2.81	0.46	0.54	0.95	0.89	0.52	0.2	0	0	0	0
750	22.18	13	4.41	0.45	0.15	0.82	1	0.64	0.21	0	0	0	0
751	10.3	6.61	3.52	1.85	1.27	1.09	0.91	0.66	0.42	0.25	0.1	0	0
752	5.14	3.82	2.55	1.88	1.65	1.48	1.19	0.82	0.5	0.28	0.11	0	0
753	1.8	1.38	0.72	0.26	0.16	0.22	0.24	0.18	0	0	0	0	0
754	0	0	0	0	0	0	0	0	0	0	0	0	0
755	7.84	2.53	0.46	0.21	0.35	0.34	0.15	0	0	0	0	0	0
756	8.38	2.27	0.31	0.32	0.48	0.35	0.06	0	0	0	0	0	0
757	12.08	3.86	0.53	0.52	1.11	1.11	0.72	0.37	0.2	0.05	0	0	0
758	18.92	11.08	4.02	0.72	0.28	0.64	0.69	0.42	0.08	0	0	0	0
759	0	0	0	0	0	0	0	0	0	0	0	0	0
760	0	0	0	0	0	0	0	0	0	0	0	0	0
761	0.53	0.28	0.35	0.28	0.18	0.14	0.1	0	0	0	0	0	0
762	0	0	0	0	0	0	0	0	0	0	0	0	0
763	0	0	0	0	0	0	0	0	0	0	0	0	0
764	0	0	0	0	0	0	0	0	0	0	0	0	0
765	0	0	0	0	0	0	0	0	0	0	0	0	0
766	0	0	0	0	0	0	0	0	0	0	0	0	0
767	0	0	0	0	0	0	0	0	0	0	0	0	0
768	0	0	0	0	0	0	0	0	0	0	0	0	0
769	0	0	0	0	0	0	0	0	0	0	0	0	0
770	0	0	0	0	0	0	0	0	0	0	0	0	0
771	5.53	2.38	2	2.5	2.67	2.39	1.94	1.51	1.15	0.82	0.49	0.11	0
772	6.91	4.47	4.28	4.6	4.46	3.85	3.07	2.34	1.71	1.17	0.67	0.15	0
773	0	0	0	0	0	0	0	0	0	0	0	0	0
774	0	0	0	0	0	0	0	0	0	0	0	0	0
775	0	0	0	0	0	0	0	0	0	0	0	0	0
776	0	0	0	0	0	0	0	0	0	0	0	0	0
777	0	0	0	0	0	0	0	0	0	0	0	0	0
778	0	0	0	0	0	0	0	0	0	0	0	0	0
779	0	0	0	0	0	0	0	0	0	0	0	0	0
780	0	0	0	0	0	0	0	0	0	0	0	0	0
781	8.2	0.69	0	0	0	0	0	0	0	0	0	0	0
782	0.05	0	0	0	0	0	0	0	0	0	0	0	0
783	6.84	1.76	0.21	0.42	0.69	0.57	0.32	0.1	0	0	0	0	0
784	0	0	0	0	0	0	0	0	0	0	0	0	0
785	0	0	0	0	0	0	0	0	0	0	0	0	0
786	6.67	0.14	0	0	0	0	0	0	0	0	0	0	0
787	0	0	0	0	0	0	0	0	0	0	0	0	0
788	0	0	0	0	0	0	0	0	0	0	0	0	0
790	0.15	0.12	0.07	0	0	0	0	0	0	0	0	0	0
791	0.03	0	0	0	0	0	0	0	0	0	0	0	0
792	0	0	0	0	0	0	0	0	0	0	0	0	0
793	0	0	0	0	0	0	0	0	0	0	0	0	0
794	0	0	0	0	0	0	0	0	0	0	0	0	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
	PHI												
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
795	0	0	0	0	0	0	0	0	0	0	0	0	0
796	0.55	0.05	0	0	0	0	0	0	0	0	0	0	0
797	0.25	0.17	0	0	0	0	0	0	0	0	0	0	0
798	0	0	0	0	0	0	0	0	0	0	0	0	0
799	8	11.13	13.81	14.71	13.24	10.04	6.46	3.62	1.86	0.94	0.44	0.07	0
800	9.63	10.62	11.29	11.71	11.3	9.54	6.81	4.08	2.1	0.98	0.41	0.06	0
801	3.91	4.21	4.06	3.79	3.41	2.82	2.08	1.37	0.83	0.47	0.24	0.01	0
802	8.76	8.46	7.71	6.78	5.7	4.45	3.19	2.09	1.27	0.74	0.37	0.02	0
803	0	0	0	0	0	0	0	0	0	0	0	0	0
804	0	0	0	0	0	0	0	0	0	0	0	0	0
805	9.88	10.87	11.13	10.72	9.57	7.7	5.48	3.45	1.95	1.03	0.48	0.02	0
806	8.21	9.11	9.53	9.39	8.55	7.03	5.12	3.3	1.9	1.01	0.46	0.02	0
808	11.71	11.18	9.81	8.23	6.68	5.16	3.7	2.45	1.52	0.91	0.49	0.09	0
809	7.72	7.61	7.07	6.34	5.47	4.42	3.29	2.25	1.43	0.86	0.45	0.09	0
810	8.31	9.03	9.28	9.06	8.33	7.1	5.55	3.97	2.62	1.61	0.86	0.18	0
811	6.69	4.81	3.59	2.98	2.61	2.19	1.66	1.13	0.71	0.43	0.23	0.01	0
1000	12.18	6.11	3.31	3.11	3.58	3.67	3.3	2.74	2.14	1.54	0.93	0.31	0
1001	11.48	4.47	1.83	2.21	3.11	3.33	2.97	2.4	1.84	1.31	0.79	0.19	0
1002	11.77	6.55	3.95	3.7	4.21	4.4	4.08	3.43	2.65	1.86	1.1	0.36	0
1003	11.62	5.93	3.36	3.36	4.04	4.27	3.91	3.23	2.46	1.71	0.99	0.24	0
1004	12.61	5.46	2.29	2.22	2.89	3.08	2.76	2.25	1.76	1.28	0.79	0.2	0
1005	11.23	3.68	1.05	1.48	2.27	2.38	2	1.57	1.22	0.9	0.56	0.13	0
1006	11.74	5.07	2.38	2.64	3.51	3.77	3.42	2.82	2.19	1.58	0.96	0.32	0
1007	12.39	6.23	3.32	3.31	4.14	4.47	4.09	3.33	2.51	1.74	1.03	0.34	0
1008	11.82	5.58	2.88	2.95	3.69	3.92	3.57	2.94	2.25	1.58	0.94	0.3	0
1009	8.75	4.35	2.57	2.83	3.53	3.76	3.43	2.82	2.14	1.47	0.85	0.21	0
1010	12.88	5.68	2.38	2.33	3.13	3.41	3.07	2.49	1.91	1.37	0.85	0.29	0
1011	11.1	3.57	1.11	1.8	2.76	2.87	2.4	1.84	1.37	0.99	0.6	0.15	0
1012	12.27	7.23	4.37	3.89	4.38	4.66	4.37	3.67	2.81	1.95	1.15	0.38	0
1013	10.22	4.52	2.27	2.51	3.26	3.5	3.19	2.64	2.03	1.44	0.86	0.22	0
1014	12.26	5.78	2.76	2.66	3.38	3.67	3.38	2.81	2.2	1.59	0.99	0.35	0
1015	12.34	6.36	3.43	3.33	4.1	4.42	4.05	3.26	2.4	1.61	0.92	0.23	0
1016	12.74	5.03	1.72	1.93	2.91	3.18	2.74	2.07	1.49	1.04	0.64	0.16	0
1017	0	0	0	0	0	0	0	0	0	0	0	0	0
1018	8.81	5.56	4	3.89	4.18	4.14	3.63	2.86	2.06	1.36	0.76	0.18	0
1019	8.05	3.78	2.41	2.76	3.23	3.16	2.67	2.05	1.48	1	0.57	0.13	0
1020	10.51	3.93	1.47	1.84	2.67	2.86	2.49	1.97	1.5	1.09	0.68	0.17	0
1021	0	0	0	0	0	0	0	0	0	0	0	0	0
1022	8.22	3.26	1.42	1.68	2.28	2.42	2.14	1.73	1.32	0.95	0.58	0.15	0
1023	0	0	0	0	0	0	0	0	0	0	0	0	0
1024	11.19	3.38	0.77	1.41	2.37	2.51	2.1	1.62	1.25	0.93	0.58	0.14	0
1025	8.52	3.61	2.43	3.11	3.71	3.63	3.11	2.47	1.85	1.28	0.74	0.18	0
1026	4.36	0.97	0.53	1.05	1.31	1.2	0.98	0.81	0.66	0.5	0.3	0.01	0
1027	12.17	5.82	2.73	2.44	3.01	3.24	2.97	2.45	1.89	1.35	0.82	0.21	0
1028	11.39	4.38	1.64	1.86	2.64	2.85	2.56	2.11	1.66	1.22	0.76	0.19	0
1029	9.96	5.74	3.5	3.16	3.53	3.69	3.44	2.9	2.25	1.59	0.95	0.32	0
1030	12.14	5.08	2.1	2.23	3.06	3.31	3	2.49	1.97	1.46	0.93	0.33	0
1031	11.76	5.41	2.62	2.75	3.64	4.01	3.75	3.16	2.47	1.78	1.08	0.38	0
1032	12.64	6.37	3.35	3.05	3.52	3.61	3.23	2.63	2.01	1.41	0.84	0.21	0

	APPENDIX IV - GRAIN-SIZE DISTRIBUTIONS											
	PHI											
Sample Id	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
1033	11.96	5.2	2.31	2.29	2.92	3.08	2.76	2.27	1.79	1.31	0.81	0.21	0
1034	10.6	2.66	0.27	1.01	1.89	1.93	1.51	1.11	0.87	0.68	0.44	0.11	0
1035	10.84	4.02	1.63	2.04	2.8	2.91	2.53	2.04	1.58	1.15	0.71	0.18	0
1036	9.61	3	1.15	1.86	2.63	2.68	2.27	1.78	1.36	0.97	0.58	0.14	0

APPENDIX V

SEDIMENT TREND STATISTICS FOR ALL SAMPLE LINES

LIST OF FIGURES

Definitions

(i) R^2 = multiple correlation coefficient derived from the mean, sorting and skewness of each sample pair making up a significant trend. This is a relative indication of how well the samples are related by transport.

(ii) Case B: Sediments becoming finer, better sorted and more negatively skewed in the direction of transport.

(iii) Case C: Sediments becoming coarser, better sorted and more positively skewed in the direction of transport.

(iv) N = number of possible pairs in the line of samples.

(v) X = number of pairs making a particular trend in a specific direction.

(vi) Z= Z-score statistic: ** are those trends significant at the 99% level. * are those trends significant at the 95% level. (Only trends at the 99% level are accepted.)

(vii) Down = transport in the "down-line" direction.

Up = transport in the "up-line" direction.

(viii) Status defines the dynamic behaviour of the sediments making up the line of samples (i.e., Net Erosion, Net Accretion, Dynamic Equilibrium etc.) See Appendix I for a complete explanation.

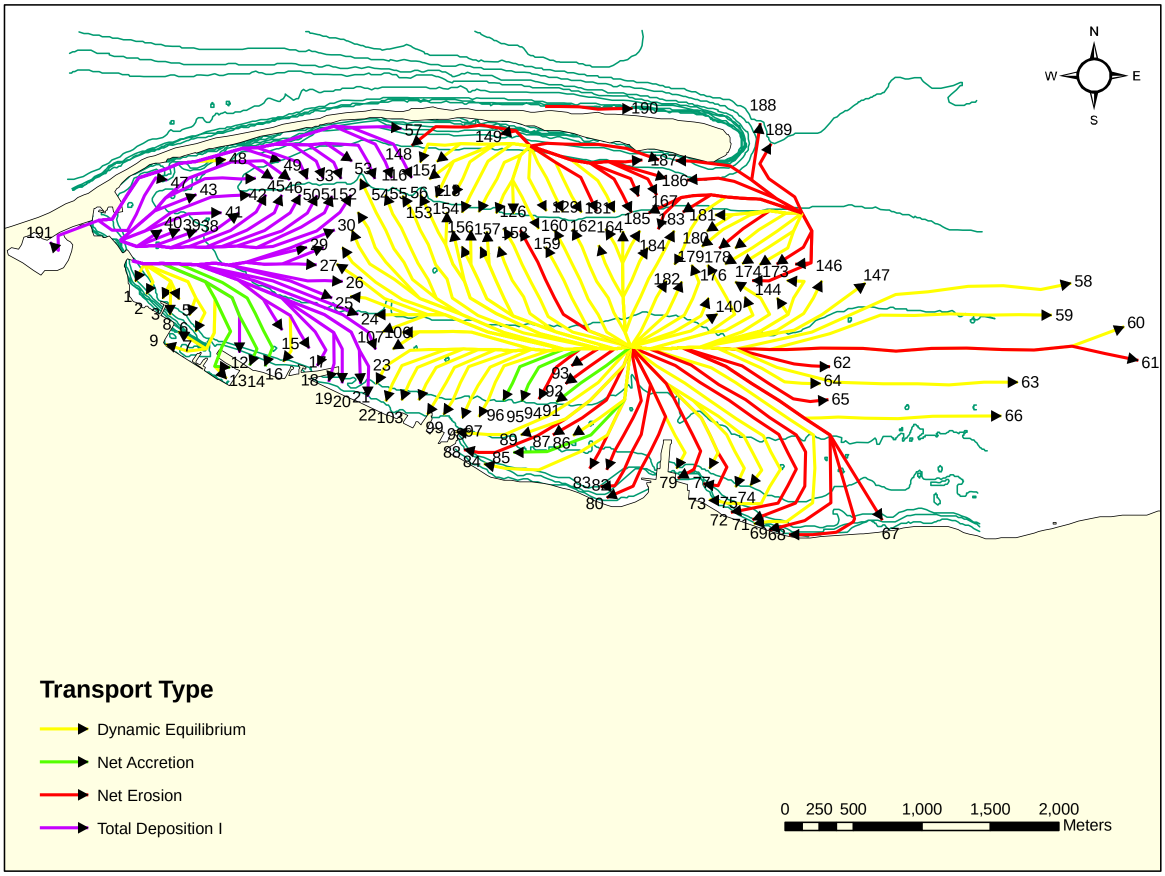

Figure AV-1: Sample lines used in the STA.

Line		R2	N	X	Z		Interpretation
1	B Down:		3	1	1.09		Dynamic Equilibrium
	Up:		3	0	-0.65		
	C Down:	1.00	3	2	2.84	**	
	Up:		3	0	-0.65		
2	B Down:		6	2	1.54		Dynamic Equilibrium
	Up:		6	0	-0.93		
	C Down:	0.99	6	3	2.78	**	
	Up:		6	0	-0.93		
3	B Down:		6	2	1.54		Dynamic Equilibrium
	Up:		6	0	-0.93		
	C Down:	1.00	6	3	2.78	**	
	Up:		6	0	-0.93		
4	B Down:		6	2	1.54		Dynamic Equilibrium
	Up:		6	0	-0.93		
	C Down:	1.00	6	3	2.78	**	
	Up:		6	1	0.31		
5	B Down:	1.00	6	3	2.78	**	Dynamic Equilibrium
	Up:		6	2	1.54		
	C Down:		6	0	-0.93		
	Up:		6	0	-0.93		
6	B Down:	0.98	10	4	2.63	**	Dynamic Equilibrium
	Up:		10	1	-0.24		
	C Down:		10	3	1.67	*	
	Up:		10	0	-1.20		
7	B Down:	0.80	15	7	4.00	**	Dynamic Equilibrium
	Up:		15	3	0.88		
	C Down:		15	1	-0.68		
	Up:		15	0	-1.46		
8	B Down:		28	6	1.43		Dynamic Equilibrium
	Up:		28	0	-2.00		
	C Down:	0.98	28	15	6.57	**	
	Up:		28	0	-2.00		
9	B Down:	0.64	36	12	3.78	**	Dynamic Equilibrium
	Up:		36	0	-2.27		
	C Down:	0.89	36	15	5.29	**	
	Up:		36	2	-1.26		
10	B Down:	0.90	36	14	4.79	**	Dynamic Equilibrium
	Up:		36	2	-1.26		
	C Down:	0.99	36	10	2.77	**	
	Up:		36	2	-1.26		
11	B Down:	0.86	36	17	6.30	**	Net Accretion
	Up:		36	3	-0.76		
	C Down:		36	8	1.76	*	
	Up:		36	1	-1.76		

Line		R2	N	X	Z		Interpretation
12	B Down:	0.80	21	8	3.55	**	Total Deposition I
	Up:		21	5	1.57		
	C Down:		21	2	-0.41		
	Up:		21	2	-0.41		
13	B Down:	0.76	36	24	9.83	**	Net Accretion
	Up:		36	1	-1.76		
	C Down:		36	1	-1.76		
	Up:		36	2	-1.26		
14	B Down:	0.73	45	24	8.28	**	Net Accretion
	Up:		45	7	0.62		
	C Down:		45	4	-0.73		
	Up:		45	0	-2.54		
15	B Down:	0.77	36	18	6.80	**	Total Deposition I
	Up:		36	4	-0.25		
	C Down:		36	1	-1.76		
	Up:		36	3	-0.76		
16	B Down:	0.73	45	12	2.87	**	Dynamic Equilibrium
	Up:		45	4	-0.73		
	C Down:	0.99	45	13	3.32	**	
	Up:		45	5	-0.28		
17	B Down:	0.82	45	11	2.42	**	Total Deposition I
	Up:		45	9	1.52		
	C Down:		45	3	-1.18		
	Up:		45	9	1.52		
18	B Down:	0.95	45	13	3.32	**	Total Deposition I
	Up:		45	7	0.62		
	C Down:		45	2	-1.63		
	Up:		45	9	1.52		
19	B Down:	0.58	55	23	6.57	**	Total Deposition I
	Up:		55	6	-0.36		
	C Down:		55	5	-0.76		
	Up:		55	5	-0.76		
20	B Down:	0.53	55	28	8.61	**	Total Deposition I
	Up:		55	5	-0.76		
	C Down:		55	2	-1.99		
	Up:		55	3	-1.58		
21	B Down:	0.57	55	27	8.21	**	Total Deposition I
	Up:		55	5	-0.76		
	C Down:		55	1	-2.40		
	Up:		55	3	-1.58		
22	B Down:	0.65	66	26	6.61	**	Total Deposition I
	Up:		66	8	-0.09		
	C Down:		66	9	0.28		
	Up:		66	4	-1.58		

Line		R2	N	X	Z		Interpretation
23	B Down:	0.69	45	20	6.48	**	Total Deposition I
	Up:		45	7	0.62		
	C Down:		45	0	-2.54		
	Up:		45	1	-2.08		
24	B Down:	0.67	28	14	6.00	**	Total Deposition I
	Up:		28	5	0.86		
	C Down:		28	0	-2.00		
	Up:		28	0	-2.00		
25	B Down:	0.70	36	17	6.30	**	Total Deposition I
	Up:		36	7	1.26		
	C Down:		36	0	-2.27		
	Up:		36	0	-2.27		
26	B Down:	0.76	45	14	3.78	**	Total Deposition I
	Up:		45	7	0.62		
	C Down:		45	2	-1.63		
	Up:		45	0	-2.54		
27	B Down:	0.38	66	27	6.98	**	Total Deposition I
	Up:		66	9	0.28		
	C Down:		66	3	-1.95		
	Up:		66	1	-2.70		
28	B Down:	0.31	55	22	6.17	**	Total Deposition I
	Up:		55	10	1.27		
	C Down:		55	1	-2.40		
	Up:		55	1	-2.40		
29	B Down:	0.67	36	21	8.32	**	Total Deposition I
	Up:		36	6	0.76		
	C Down:		36	0	-2.27		
	Up:		36	1	-1.76		
30	B Down:	0.66	45	29	10.54	**	Total Deposition I
	Up:		45	6	0.17		
	C Down:		45	0	-2.54		
	Up:		45	1	-2.08		
31	B Down:	0.94	78	38	9.67	**	Total Deposition I
	Up:		78	14	1.46		
	C Down:		78	0	-3.34		
	Up:		78	2	-2.65		
32	B Down:	0.97	66	45	13.68	**	Total Deposition I
	Up:		66	8	-0.09		
	C Down:		66	0	-3.07		
	Up:		66	2	-2.33		
33	B Down:	0.96	55	31	9.84	**	Total Deposition I
	Up:		55	6	-0.36		
	C Down:		55	0	-2.80		
	Up:		55	4	-1.17		

Line		R2	N	X	Z		Interpretation
34	B Down:	0.97	45	30	10.99	**	Total Deposition I
	Up:		45	8	1.07		
	C Down:		45	0	-2.54		
	Up:		45	1	-2.08		
35	B Down:	0.99	36	26	10.83	**	Total Deposition I
	Up:		36	5	0.25		
	C Down:		36	2	-1.26		
	Up:		36	1	-1.76		
36	B Down:	0.97	28	20	9.43	**	Total Deposition I
	Up:		28	2	-0.86		
	C Down:		28	1	-1.43		
	Up:		28	1	-1.43		
37	B Down:	0.99	15	11	7.12	**	Total Deposition I
	Up:		15	0	-1.46		
	C Down:		15	0	-1.46		
	Up:		15	1	-0.68		
38	B Down:	1.00	6	4	4.01	**	Total Deposition I
	Up:		6	0	-0.93		
	C Down:		6	0	-0.93		
	Up:		6	2	1.54		
39	B Down:	1.00	3	2	2.84	**	Total Deposition I
	Up:		3	0	-0.65		
	C Down:		3	0	-0.65		
	Up:		3	1	1.09		
40	B Down:	1.00	3	2	2.84	**	Total Deposition I
	Up:		3	0	-0.65		
	C Down:		3	0	-0.65		
	Up:		3	1	1.09		
41	B Down:	0.97	10	6	4.54	**	Total Deposition I
	Up:		10	0	-1.20		
	C Down:		10	1	-0.24		
	Up:		10	2	0.72		
42	B Down:	0.99	15	9	5.56	**	Total Deposition I
	Up:		15	1	-0.68		
	C Down:		15	0	-1.46		
	Up:		15	1	-0.68		
43	B Down:	1.00	3	2	2.84	**	Total Deposition I
	Up:		3	1	1.09		
	C Down:		3	0	-0.65		
	Up:		3	0	-0.65		
44	B Down:	0.97	21	13	6.85	**	Total Deposition I
	Up:		21	2	-0.41		
	C Down:		21	0	-1.73		
	Up:		21	3	0.25		

Line		R2	N	X	Z		Interpretation
45	B Down:	1.00	21	8	3.55	**	Total Deposition I
	Up:		21	3	0.25		
	C Down:		21	0	-1.73		
	Up:		21	1	-1.07		
46	B Down:	0.95	21	11	5.53	**	Total Deposition I
	Up:		21	3	0.25		
	C Down:		21	0	-1.73		
	Up:		21	1	-1.07		
47	B Down:	0.89	21	10	4.87	**	Total Deposition I
	Up:		21	0	-1.73		
	C Down:		21	2	-0.41		
	Up:		21	6	2.23	*	
48	B Down:		36	6	0.76		Dynamic Equilibrium
	Up:		36	7	1.26		
	C Down:	0.99	36	15	5.29	**	
	Up:		36	5	0.25		
49	B Down:	0.96	36	16	5.80	**	Total Deposition I
	Up:		36	3	-0.76		
	C Down:		36	8	1.76	*	
	Up:		36	6	0.76		
50	B Down:	0.96	55	24	6.98	**	Total Deposition I
	Up:		55	3	-1.58		
	C Down:		55	8	0.46		
	Up:		55	7	0.05		
51	B Down:	0.96	78	34	8.30	**	Total Deposition I
	Up:		78	7	-0.94		
	C Down:		78	9	-0.26		
	Up:		78	10	0.09		
52	B Down:	0.65	91	40	9.07	**	Total Deposition I
	Up:		91	7	-1.39		
	C Down:		91	9	-0.75		
	Up:		91	18	2.10	*	
53	B Down:	0.85	91	40	9.07	**	Total Deposition I
	Up:		91	8	-1.07		
	C Down:		91	10	-0.44		
	Up:		91	18	2.10	*	
54	B Down:	0.81	136	71	14.00	**	Total Deposition I
	Up:		136	6	-2.85		
	C Down:		136	13	-1.04		
	Up:		136	21	1.04		
55	B Down:	0.68	91	42	9.71	**	Total Deposition I
	Up:		91	7	-1.39		
	C Down:		91	11	-0.12		
	Up:		91	13	0.52		

Line		R2	N	X	Z		Interpretation
56	B Down:	0.93	105	45	9.41	**	Total Deposition I
	Up:		105	8	-1.51		
	C Down:		105	10	-0.92		
	Up:		105	19	1.73	*	
57	B Down:	0.98	105	38	7.34	**	Total Deposition I
	Up:		105	18	1.44		
	C Down:		105	14	0.26		
	Up:		105	16	0.85		
58	B Down:		91	1	-3.29		Dynamic Equilibrium
	Up:		91	0	-3.61		
	C Down:	0.99	91	74	19.85	**	
	Up:		91	5	-2.02		
59	B Down:		120	11	-1.10		Dynamic Equilibrium
	Up:		120	1	-3.86		
	C Down:	1.00	120	81	18.22	**	
	Up:		120	13	-0.55		
60	B Down:		190	13	-2.36		Dynamic Equilibrium
	Up:		190	1	-4.99		
	C Down:	0.99	190	128	22.87	**	
	Up:		190	17	-1.48		
61	B Down:		210	12	-2.97		Net Erosion
	Up:		210	3	-4.85		
	C Down:	0.97	210	136	22.90	**	
	Up:		210	16	-2.14		
62	B Down:		45	7	0.62		Net Erosion
	Up:		45	0	-2.54		
	C Down:	1.00	45	15	4.23	**	
	Up:		45	5	-0.28		
63	B Down:		91	7	-1.39		Dynamic Equilibrium
	Up:		91	0	-3.61		
	C Down:	0.99	91	54	13.51	**	
	Up:		91	8	-1.07		
64	B Down:		45	8	1.07		Dynamic Equilibrium
	Up:		45	0	-2.54		
	C Down:	0.98	45	22	7.38	**	
	Up:		45	5	-0.28		
65	B Down:		36	1	-1.76		Net Erosion
	Up:		36	0	-2.27		
	C Down:	1.00	36	21	8.32	**	
	Up:		36	6	0.76		
66	B Down:		91	4	-2.34		Dynamic Equilibrium
	Up:		91	4	-2.34		
	C Down:	0.97	91	64	16.68	**	
	Up:		91	4	-2.34		

Line		R2	N	X	Z	Interpretation
67	B Down:		45	2	-1.63	Net Erosion
	Up:		45	3	-1.18	
	C Down:	0.80	45	26	9.18 **	
	Up:		45	1	-2.08	
68	B Down:		91	2	-2.97	Net Erosion
	Up:		91	5	-2.02	
	C Down:	0.10	91	42	9.71 **	
	Up:		91	3	-2.65	
69	B Down:		66	3	-1.95	Net Erosion
	Up:		66	3	-1.95	
	C Down:	0.83	66	28	7.35 **	
	Up:		66	2	-2.33	
70	B Down:		66	4	-1.58	Dynamic Equilibrium
	Up:		66	1	-2.70	
	C Down:	0.62	66	32	8.84 **	
	Up:		66	5	-1.21	
71	B Down:		55	3	-1.58	Net Erosion
	Up:		55	2	-1.99	
	C Down:	0.78	55	33	10.65 **	
	Up:		55	2	-1.99	
72	B Down:		55	6	-0.36	Net Erosion
	Up:		55	5	-0.76	
	C Down:	0.79	55	18	4.54 **	
	Up:		55	5	-0.76	
73	B Down:		91	9	-0.75	Dynamic Equilibrium
	Up:		91	2	-2.97	
	C Down:	0.42	91	46	10.98 **	
	Up:		91	2	-2.97	
74	B Down:	0.68	28	10	3.71 **	Dynamic Equilibrium
	Up:		28	0	-2.00	
	C Down:	0.95	28	12	4.86 **	
	Up:		28	2	-0.86	
75	B Down:	0.98	21	10	4.87 **	Dynamic Equilibrium
	Up:		21	0	-1.73	
	C Down:	0.76	21	7	2.89 **	
	Up:		21	2	-0.41	
76	B Down:		28	2	-0.86	Net Erosion
	Up:		28	1	-1.43	
	C Down:	0.75	28	16	7.14 **	
	Up:		28	1	-1.43	
77	B Down:		15	2	0.10	Dynamic Equilibrium
	Up:		15	0	-1.46	
	C Down:	0.60	15	7	4.00 **	
	Up:		15	1	-0.68	

Line		R2	N	X	Z		Interpretation
78	B Down:		28	6	1.43		Net Erosion
	Up:		28	0	-2.00		
	C Down:	0.89	28	12	4.86	**	
	Up:		28	2	-0.86		
79	B Down:	0.74	21	8	3.55	**	Dynamic Equilibrium
	Up:		21	2	-0.41		
	C Down:		21	2	-0.41		
	Up:		21	0	-1.73		
80	B Down:		36	6	0.76		Net Erosion
	Up:		36	3	-0.76		
	C Down:	0.81	36	17	6.30	**	
	Up:		36	2	-1.26		
81	B Down:		28	1	-1.43		Net Erosion
	Up:		28	5	0.86		
	C Down:	0.86	28	10	3.71	**	
	Up:		28	1	-1.43		
82	B Down:		15	0	-1.46		Net Erosion
	Up:		15	4	1.66	*	
	C Down:	0.92	15	8	4.78	**	
	Up:		15	1	-0.68		
83	B Down:		15	0	-1.46		Net Erosion
	Up:		15	1	-0.68		
	C Down:	0.84	15	8	4.78	**	
	Up:		15	2	0.10		
84	B Down:		36	2	-1.26		Dynamic Equilibrium
	Up:		36	2	-1.26		
	C Down:	0.77	36	20	7.81	**	
	Up:		36	2	-1.26		
85	B Down:	0.84	15	6	3.22	**	Net Accretion
	Up:		15	0	-1.46		
	C Down:		15	3	0.88		
	Up:		15	4	1.66	*	
86	B Down:		6	0	-0.93		Dynamic Equilibrium
	Up:		6	1	0.31		
	C Down:	0.84	6	3	2.78	**	
	Up:		6	2	1.54		
87	B Down:		15	2	0.10		Net Erosion
	Up:		15	0	-1.46		
	C Down:	0.99	15	9	5.56	**	
	Up:		15	1	-0.68		
88	B Down:		28	3	-0.29		Net Erosion
	Up:		28	0	-2.00		
	C Down:	0.90	28	18	8.29	**	
	Up:		28	1	-1.43		

Line		R2	N	X	Z		Interpretation
89	B Down:		10	2	0.72		Dynamic Equilibrium
	Up:		10	0	-1.20		
	C Down:	0.87	10	4	2.63	**	
	Up:		10	1	-0.24		
90	B Down:		28	4	0.29		Dynamic Equilibrium
	Up:		28	2	-0.86		
	C Down:	0.54	28	14	6.00	**	
	Up:		28	0	-2.00		
91	B Down:	0.81	6	3	2.78	**	Net Accretion
	Up:		6	1	0.31		
	C Down:		6	1	0.31		
	Up:		6	0	-0.93		
92	B Down:		6	1	0.31		Net Erosion
	Up:		6	0	-0.93		
	C Down:	0.99	6	5	5.25	**	
	Up:		6	0	-0.93		
93	B Down:		6	1	0.31		Net Erosion
	Up:		6	1	0.31		
	C Down:	1.00	6	3	2.78	**	
	Up:		6	1	0.31		
94	B Down:		21	2	-0.41		Net Erosion
	Up:		21	3	0.25		
	C Down:	1.00	21	10	4.87	**	
	Up:		21	2	-0.41		
95	B Down:	0.82	21	7	2.89	**	Net Accretion
	Up:		21	5	1.57		
	C Down:		21	4	0.91		
	Up:		21	1	-1.07		
96	B Down:	0.88	28	8	2.57	**	Net Accretion
	Up:		28	6	1.43		
	C Down:		28	6	1.43		
	Up:		28	2	-0.86		
97	B Down:	0.75	45	14	3.78	**	Dynamic Equilibrium
	Up:		45	5	-0.28		
	C Down:		45	5	-0.28		
	Up:		45	1	-2.08		
98	B Down:	0.46	55	16	3.72	**	Dynamic Equilibrium
	Up:		55	4	-1.17		
	C Down:		55	4	-1.17		
	Up:		55	4	-1.17		
99	B Down:	0.72	66	32	8.84	**	Dynamic Equilibrium
	Up:		66	11	1.02		
	C Down:		66	6	-0.84		
	Up:		66	7	-0.47		

Line		R2	N	X	Z		Interpretation
100	B Down:	0.79	66	38	11.07	**	Dynamic Equilibrium
	Up:		66	8	-0.09		
	C Down:		66	2	-2.33		
	Up:		66	6	-0.84		
101	B Down:	0.81	78	42	11.04	**	Dynamic Equilibrium
	Up:		78	7	-0.94		
	C Down:		78	2	-2.65		
	Up:		78	9	-0.26		
102	B Down:	0.82	91	60	15.41	**	Dynamic Equilibrium
	Up:		91	7	-1.39		
	C Down:		91	2	-2.97		
	Up:		91	8	-1.07		
103	B Down:	0.91	105	77	18.85	**	Dynamic Equilibrium
	Up:		105	7	-1.81		
	C Down:		105	2	-3.28		
	Up:		105	8	-1.51		
104	B Down:	0.90	120	94	21.81	**	Dynamic Equilibrium
	Up:		120	8	-1.93		
	C Down:		120	3	-3.31		
	Up:		120	5	-2.76		
105	B Down:	0.96	66	54	17.03	**	Dynamic Equilibrium
	Up:		66	6	-0.84		
	C Down:		66	2	-2.33		
	Up:		66	2	-2.33		
106	B Down:	0.97	66	54	17.03	**	Dynamic Equilibrium
	Up:		66	6	-0.84		
	C Down:		66	2	-2.33		
	Up:		66	2	-2.33		
107	B Down:	0.98	36	20	7.81	**	Dynamic Equilibrium
	Up:		36	5	0.25		
	C Down:		36	2	-1.26		
	Up:		36	3	-0.76		
108	B Down:	0.97	55	33	10.65	**	Dynamic Equilibrium
	Up:		55	7	0.05		
	C Down:		55	3	-1.58		
	Up:		55	6	-0.36		
109	B Down:	0.98	55	34	11.06	**	Dynamic Equilibrium
	Up:		55	8	0.46		
	C Down:		55	2	-1.99		
	Up:		55	5	-0.76		
110	B Down:	0.95	55	36	11.87	**	Dynamic Equilibrium
	Up:		55	5	-0.76		
	C Down:		55	3	-1.58		
	Up:		55	5	-0.76		

Line		R2	N	X	Z		Interpretation
111	B Down:	0.96	55	31	9.84	**	Dynamic Equilibrium
	Up:		55	6	-0.36		
	C Down:		55	2	-1.99		
	Up:		55	4	-1.17		
112	B Down:	0.89	66	35	9.96	**	Dynamic Equilibrium
	Up:		66	7	-0.47		
	C Down:		66	6	-0.84		
	Up:		66	5	-1.21		
113	B Down:	0.88	66	41	12.19	**	Dynamic Equilibrium
	Up:		66	5	-1.21		
	C Down:		66	5	-1.21		
	Up:		66	6	-0.84		
114	B Down:	0.90	105	72	17.37	**	Dynamic Equilibrium
	Up:		105	7	-1.81		
	C Down:		105	11	-0.63		
	Up:		105	7	-1.81		
115	B Down:	0.85	91	49	11.93	**	Dynamic Equilibrium
	Up:		91	5	-2.02		
	C Down:		91	7	-1.39		
	Up:		91	10	-0.44		
116	B Down:	0.91	66	36	10.33	**	Dynamic Equilibrium
	Up:		66	6	-0.84		
	C Down:		66	6	-0.84		
	Up:		66	4	-1.58		
117	B Down:	0.92	55	24	6.98	**	Dynamic Equilibrium
	Up:		55	2	-1.99		
	C Down:		55	7	0.05		
	Up:		55	2	-1.99		
118	B Down:	0.91	45	15	4.23	**	Dynamic Equilibrium
	Up:		45	2	-1.63		
	C Down:		45	7	0.62		
	Up:		45	1	-2.08		
119	B Down:	0.86	28	11	4.29	**	Dynamic Equilibrium
	Up:		28	2	-0.86		
	C Down:		28	7	2.00	*	
	Up:		28	1	-1.43		
120	B Down:		28	4	0.29		Dynamic Equilibrium
	Up:		28	1	-1.43		
	C Down:	0.98	28	8	2.57	**	
	Up:		28	0	-2.00		
121	B Down:	0.96	28	9	3.14	**	Dynamic Equilibrium
	Up:		28	1	-1.43		
	C Down:	0.98	28	8	2.57	**	
	Up:		28	0	-2.00		

Line		R2	N	X	Z		Interpretation
122	B Down:		28	7	2.00	*	Dynamic Equilibrium
	Up:		28	0	-2.00		
	C Down:	0.99	28	11	4.29	**	
	Up:		28	4	0.29		
123	B Down:	0.86	28	10	3.71	**	Dynamic Equilibrium
	Up:		28	0	-2.00		
	C Down:	0.99	28	10	3.71	**	
	Up:		28	3	-0.29		
124	B Down:		28	4	0.29		Dynamic Equilibrium
	Up:		28	0	-2.00		
	C Down:	0.98	28	12	4.86	**	
	Up:		28	3	-0.29		
125	B Down:	0.96	28	12	4.86	**	Dynamic Equilibrium
	Up:		28	0	-2.00		
	C Down:		28	7	2.00	*	
	Up:		28	6	1.43		
126	B Down:	0.97	28	14	6.00	**	Net Erosion
	Up:		28	0	-2.00		
	C Down:		28	5	0.86		
	Up:		28	2	-0.86		
127	B Down:		21	4	0.91		Dynamic Equilibrium
	Up:		21	0	-1.73		
	C Down:	0.97	21	7	2.89	**	
	Up:		21	4	0.91		
128	B Down:	0.97	28	10	3.71	**	Dynamic Equilibrium
	Up:		28	0	-2.00		
	C Down:		28	5	0.86		
	Up:		28	7	2.00	*	
129	B Down:		28	1	-1.43		Dynamic Equilibrium
	Up:		28	1	-1.43		
	C Down:	0.98	28	17	7.71	**	
	Up:		28	5	0.86		
130	B Down:		15	0	-1.46		Dynamic Equilibrium
	Up:		15	0	-1.46		
	C Down:	0.99	15	11	7.12	**	
	Up:		15	4	1.66	*	
131	B Down:		15	0	-1.46		Dynamic Equilibrium
	Up:		15	0	-1.46		
	C Down:	1.00	15	10	6.34	**	
	Up:		15	4	1.66	*	
132	B Down:		10	0	-1.20		Dynamic Equilibrium
	Up:		10	0	-1.20		
	C Down:	0.99	10	8	6.45	**	
	Up:		10	2	0.72		

Line		R2	N	X	Z		Interpretation
133	B Down:		15	0	-1.46		Dynamic Equilibrium
	Up:		15	0	-1.46		
	C Down:	0.99	15	13	8.69	**	
	Up:		15	2	0.10		
134	B Down:		15	0	-1.46		Dynamic Equilibrium
	Up:		15	0	-1.46		
	C Down:	0.99	15	11	7.12	**	
	Up:		15	3	0.88		
135	B Down:		28	2	-0.86		Dynamic Equilibrium
	Up:		28	0	-2.00		
	C Down:	0.98	28	19	8.86	**	
	Up:		28	5	0.86		
136	B Down:		10	0	-1.20		Dynamic Equilibrium
	Up:		10	0	-1.20		
	C Down:	0.99	10	7	5.50	**	
	Up:		10	0	-1.20		
137	B Down:		6	0	-0.93		Dynamic Equilibrium
	Up:		6	0	-0.93		
	C Down:	0.99	6	6	6.48	**	
	Up:		6	0	-0.93		
138	B Down:		15	1	-0.68		Dynamic Equilibrium
	Up:		15	1	-0.68		
	C Down:	0.99	15	11	7.12	**	
	Up:		15	2	0.10		
139	B Down:		6	0	-0.93		Dynamic Equilibrium
	Up:		6	0	-0.93		
	C Down:	1.00	6	5	5.25	**	
	Up:		6	0	-0.93		
140	B Down:		3	0	-0.65		Dynamic Equilibrium
	Up:		3	0	-0.65		
	C Down:	1.00	3	2	2.84	**	
	Up:		3	0	-0.65		
141	B Down:		21	0	-1.73		Dynamic Equilibrium
	Up:		21	0	-1.73		
	C Down:	1.00	21	19	10.80	**	
	Up:		21	2	-0.41		
142	B Down:		15	1	-0.68		Dynamic Equilibrium
	Up:		15	0	-1.46		
	C Down:	0.98	15	10	6.34	**	
	Up:		15	2	0.10		
143	B Down:		36	0	-2.27		Dynamic Equilibrium
	Up:		36	0	-2.27		
	C Down:	0.99	36	26	10.83	**	
	Up:		36	1	-1.76		

Line		R2	N	X	Z		Interpretation
144	B Down:		28	0	-2.00		Dynamic Equilibrium
	Up:		28	1	-1.43		
	C Down:	0.98	28	20	9.43	**	
	Up:		28	1	-1.43		
145	B Down:		45	1	-2.08		Dynamic Equilibrium
	Up:		45	3	-1.18		
	C Down:	0.96	45	19	6.03	**	
	Up:		45	6	0.17		
146	B Down:		36	4	-0.25		Dynamic Equilibrium
	Up:		36	2	-1.26		
	C Down:	0.98	36	19	7.31	**	
	Up:		36	2	-1.26		
147	B Down:		28	0	-2.00		Dynamic Equilibrium
	Up:		28	1	-1.43		
	C Down:	0.99	28	22	10.57	**	
	Up:		28	2	-0.86		
148	B Down:		21	2	-0.41		Net Erosion
	Up:		21	2	-0.41		
	C Down:	0.91	21	7	2.89	**	
	Up:		21	6	2.23	*	
149	B Down:		3	0	-0.65		Net Erosion
	Up:		3	0	-0.65		
	C Down:	1.00	3	2	2.84	**	
	Up:		3	1	1.09		
150	B Down:	0.99	28	14	6.00	**	Dynamic Equilibrium
	Up:		28	2	-0.86		
	C Down:		28	1	-1.43		
	Up:		28	7	2.00	*	
151	B Down:	0.99	15	9	5.56	**	Dynamic Equilibrium
	Up:		15	0	-1.46		
	C Down:		15	1	-0.68		
	Up:		15	4	1.66	*	
152	B Down:	0.99	10	8	6.45	**	Dynamic Equilibrium
	Up:		10	0	-1.20		
	C Down:		10	2	0.72		
	Up:		10	0	-1.20		
153	B Down:	0.96	15	8	4.78	**	Dynamic Equilibrium
	Up:		15	1	-0.68		
	C Down:		15	2	0.10		
	Up:		15	3	0.88		
154	B Down:	0.98	15	11	7.12	**	Dynamic Equilibrium
	Up:		15	1	-0.68		
	C Down:		15	2	0.10		
	Up:		15	0	-1.46		

Line		R2	N	X	Z		Interpretation
155	B Down:	0.98	15	11	7.12	**	Dynamic Equilibrium
	Up:		15	0	-1.46		
	C Down:		15	2	0.10		
	Up:		15	0	-1.46		
156	B Down:	1.00	15	10	6.34	**	Dynamic Equilibrium
	Up:		15	0	-1.46		
	C Down:		15	3	0.88		
	Up:		15	0	-1.46		
157	B Down:	0.97	10	5	3.59	**	Dynamic Equilibrium
	Up:		10	1	-0.24		
	C Down:		10	1	-0.24		
	Up:		10	0	-1.20		
158	B Down:	0.99	6	4	4.01	**	Dynamic Equilibrium
	Up:		6	1	0.31		
	C Down:		6	0	-0.93		
	Up:		6	0	-0.93		
159	B Down:	0.89	15	6	3.22	**	Dynamic Equilibrium
	Up:		15	3	0.88		
	C Down:	0.89	15	5	2.44	**	
	Up:		15	0	-1.46		
160	B Down:	1.00	6	4	4.01	**	Dynamic Equilibrium
	Up:		6	2	1.54		
	C Down:		6	0	-0.93		
	Up:		6	0	-0.93		
161	B Down:	0.96	10	4	2.63	**	Dynamic Equilibrium
	Up:		10	3	1.67	*	
	C Down:		10	1	-0.24		
	Up:		10	1	-0.24		
162	B Down:		10	2	0.72		Dynamic Equilibrium
	Up:		10	0	-1.20		
	C Down:	0.97	10	5	3.59	**	
	Up:		10	1	-0.24		
163	B Down:		10	2	0.72		Net Erosion
	Up:		10	1	-0.24		
	C Down:	0.99	10	6	4.54	**	
	Up:		10	0	-1.20		
164	B Down:		10	0	-1.20		Dynamic Equilibrium
	Up:		10	1	-0.24		
	C Down:	0.93	10	7	5.50	**	
	Up:		10	0	-1.20		
165	B Down:		15	0	-1.46		Net Erosion
	Up:		15	0	-1.46		
	C Down:	0.96	15	11	7.12	**	
	Up:		15	2	0.10		

Line		R2	N	X	Z		Interpretation
166	B Down:		10	0	-1.20		Net Erosion
	Up:		10	0	-1.20		
	C Down:	1.00	10	6	4.54	**	
	Up:		10	0	-1.20		
167	B Down:		15	0	-1.46		Net Erosion
	Up:		15	1	-0.68		
	C Down:	0.80	15	9	5.56	**	
	Up:		15	1	-0.68		
168	B Down:		10	0	-1.20		Net Erosion
	Up:		10	1	-0.24		
	C Down:	0.92	10	6	4.54	**	
	Up:		10	0	-1.20		
169	B Down:		15	0	-1.46		Net Erosion
	Up:		15	0	-1.46		
	C Down:	0.99	15	11	7.12	**	
	Up:		15	1	-0.68		
170	B Down:		21	0	-1.73		Net Erosion
	Up:		21	1	-1.07		
	C Down:	0.78	21	8	3.55	**	
	Up:		21	4	0.91		
171	B Down:		10	0	-1.20		Net Erosion
	Up:		10	0	-1.20		
	C Down:	0.99	10	7	5.50	**	
	Up:		10	3	1.67	*	
172	B Down:		6	0	-0.93		Net Erosion
	Up:		6	0	-0.93		
	C Down:	1.00	6	4	4.01	**	
	Up:		6	2	1.54		
173	B Down:		6	0	-0.93		Net Erosion
	Up:		6	0	-0.93		
	C Down:	1.00	6	4	4.01	**	
	Up:		6	2	1.54		
174	B Down:		6	1	0.31		Dynamic Equilibrium
	Up:		6	0	-0.93		
	C Down:	1.00	6	3	2.78	**	
	Up:		6	1	0.31		
175	B Down:		6	0	-0.93		Dynamic Equilibrium
	Up:		6	0	-0.93		
	C Down:	1.00	6	3	2.78	**	
	Up:		6	2	1.54		
176	B Down:		6	1	0.31		Dynamic Equilibrium
	Up:		6	0	-0.93		
	C Down:	1.00	6	4	4.01	**	
	Up:		6	1	0.31		

Line		R2	N	X	Z		Interpretation
177	B Down:		6	0	-0.93		Dynamic Equilibrium
	Up:		6	0	-0.93		
	C Down:	0.99	6	5	5.25	**	
	Up:		6	0	-0.93		
178	B Down:		10	0	-1.20		Net Erosion
	Up:		10	0	-1.20		
	C Down:	1.00	10	5	3.59	**	
	Up:		10	2	0.72		
179	B Down:		15	1	-0.68		Dynamic Equilibrium
	Up:		15	0	-1.46		
	C Down:	0.99	15	7	4.00	**	
	Up:		15	3	0.88		
180	B Down:		10	0	-1.20		Dynamic Equilibrium
	Up:		10	0	-1.20		
	C Down:	1.00	10	6	4.54	**	
	Up:		10	3	1.67	*	
181	B Down:		10	0	-1.20		Dynamic Equilibrium
	Up:		10	0	-1.20		
	C Down:	1.00	10	5	3.59	**	
	Up:		10	3	1.67	*	
182	B Down:		28	3	-0.29		Dynamic Equilibrium
	Up:		28	0	-2.00		
	C Down:	1.00	28	17	7.71	**	
	Up:		28	5	0.86		
183	B Down:		15	1	-0.68		Net Erosion
	Up:		15	0	-1.46		
	C Down:	0.94	15	7	4.00	**	
	Up:		15	4	1.66	*	
184	B Down:		36	0	-2.27		Net Erosion
	Up:		36	2	-1.26		
	C Down:	0.96	36	16	5.80	**	
	Up:		36	8	1.76	*	
185	B Down:		28	0	-2.00		Net Erosion
	Up:		28	2	-0.86		
	C Down:	0.96	28	13	5.43	**	
	Up:		28	6	1.43		
186	B Down:		15	0	-1.46		Net Erosion
	Up:		15	1	-0.68		
	C Down:	1.00	15	5	2.44	**	
	Up:		15	1	-0.68		
187	B Down:		15	0	-1.46		Net Erosion
	Up:		15	0	-1.46		
	C Down:	0.34	15	6	3.22	**	
	Up:		15	0	-1.46		

Line		R2	N	X	Z		Interpretation
188	B Down:		6	0	-0.93		Net Erosion
	Up:		6	0	-0.93		
	C Down:	0.93	6	5	5.25	**	
	Up:		6	0	-0.93		
189	B Down:		10	0	-1.20		Net Erosion
	Up:		10	1	-0.24		
	C Down:	1.00	10	8	6.45	**	
	Up:		10	0	-1.20		
190	B Down:		15	1	-0.68		Net Erosion
	Up:		15	0	-1.46		
	C Down:	0.80	15	8	4.78	**	
	Up:		15	0	-1.46		
191	B Down:	0.98	6	3	2.78	**	Total Deposition I
	Up:		6	1	0.31		
	C Down:		6	2	1.54		
	Up:		6	0	-0.93		

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APPENDIX VI

MAPS OF SEDIMENT DESCRIPTORS AND SEDIMENT PHOTOGRAPHS

LIST OF FIGURES

LIST OF PHOTOGRAPHS

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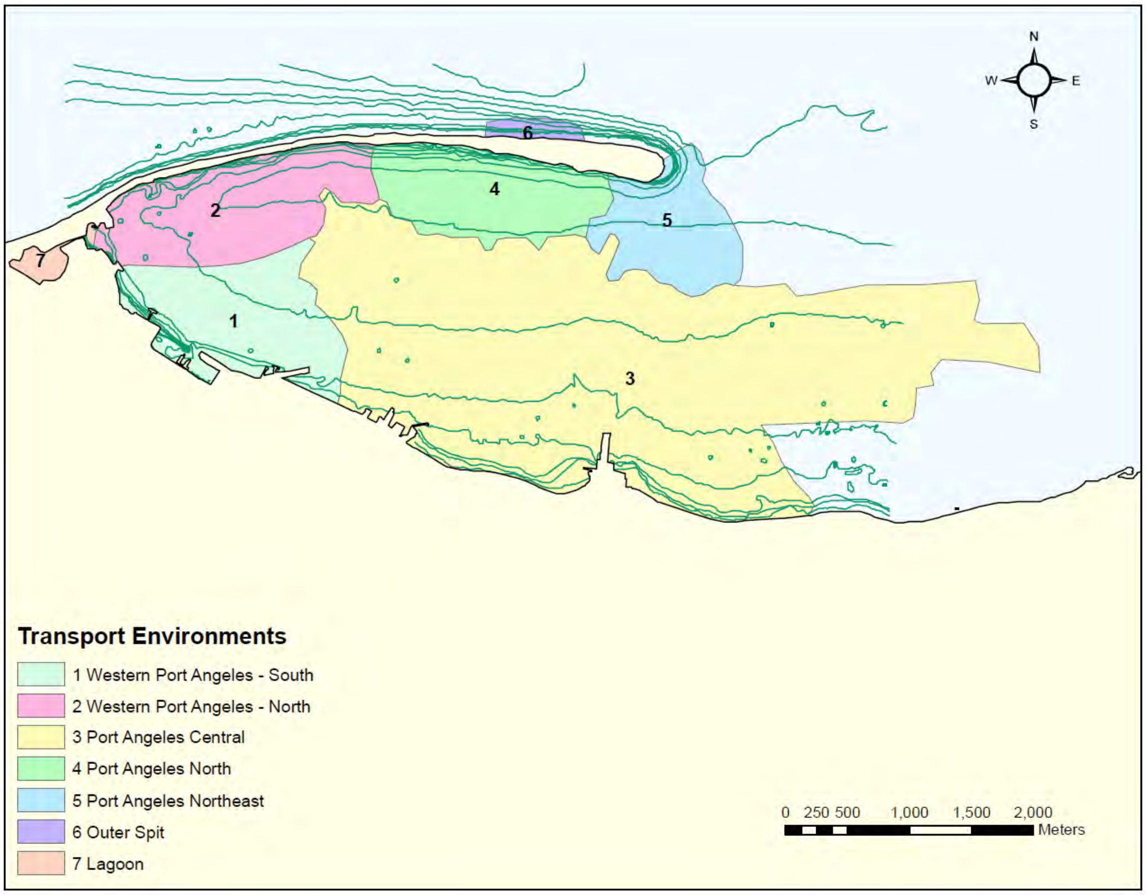
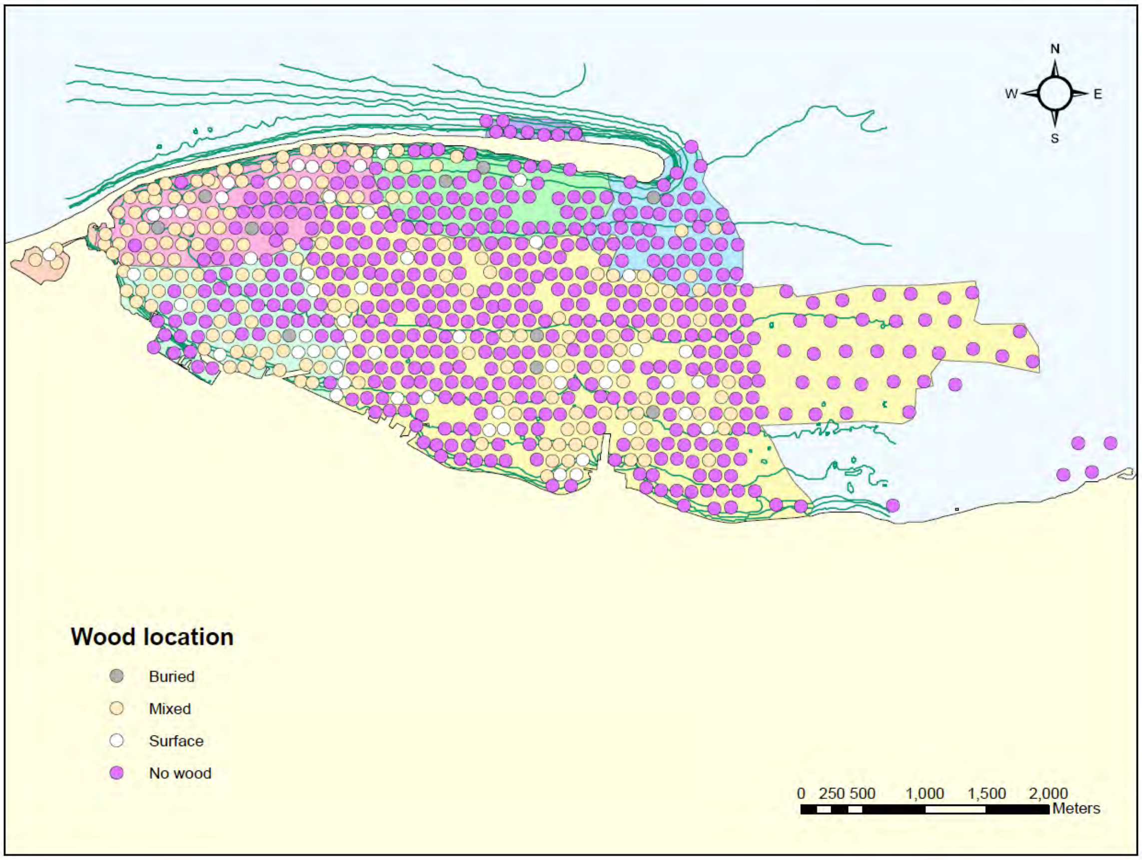
VISUAL DESCRIPTORS USED AT THE TIME OF SAMPLING		
INTRODUCTORY SHOWING THE TRANSPORT ENVIRONMENTS (TE'S) AS DETERMINED BY THE SEDIMENT TREND ANALYSIS (TE'S 1 TO 7).		
Type	**Detail**	
Wood location	**Buried**	**Figure AVI-1**
	Mixed	**Figure AVI-1**
	Surface	**Figure AVI-1**
	No wood	**Figure AVI-1**
Bark size	**Large**	**Figure AVI-2 (a and b)**
	Medium	**Figure AVI-2 (a and b)**
	Small	**Figure AVI-2 (a and b)**
Wood type	**Cedar**	**Figure AVI-3**
	Sawdust	**Figure AVI-3**
	Wood chips	**Figure AVI-3**
	No wood	**Figure AVI-3**
Wood content	**High**	**Figure AVI-4**
	Medium	**Figure AVI-4**
	Low	**Figure AVI-4**
	No wood	**Figure AVI-4**
Sample color	**Black**	**Figure AVI-5**
	Brown	**Figure AVI-5**
	Grey	**Figure AVI-5**
	Olive Green	**Figure AVI-5**
	No wood	**Figure AVI-5**
Decomposition	**High**	**Figure AVI-6**
	Medium	**Figure AVI-6**
	Low	**Figure AVI-6**
	None	**Figure AVI-6**
	No wood	**Figure AVI-6**
Infestation	**High**	**Figure AVI-7**
	Medium	**Figure AVI-7**
	Low	**Figure AVI-7**
	No teredos	**Figure AVI-7**
	No wood	**Figure AVI-7**
Wood in worm tubes	**Yes/No**	**Figure AVI-8**
Worm Tubes		**Figure AVI-9**
Seaweed		**Figure AVI-10**
Broken Shells		**Figure AVI-11**
Live Shells		**Figure AVI-12**
Large Clasts		**Figure AVI-13**
Extreme Odor		**Figure AVI-14**

SEDIMENT PHOTOGRAHS		
		PAGE NO.

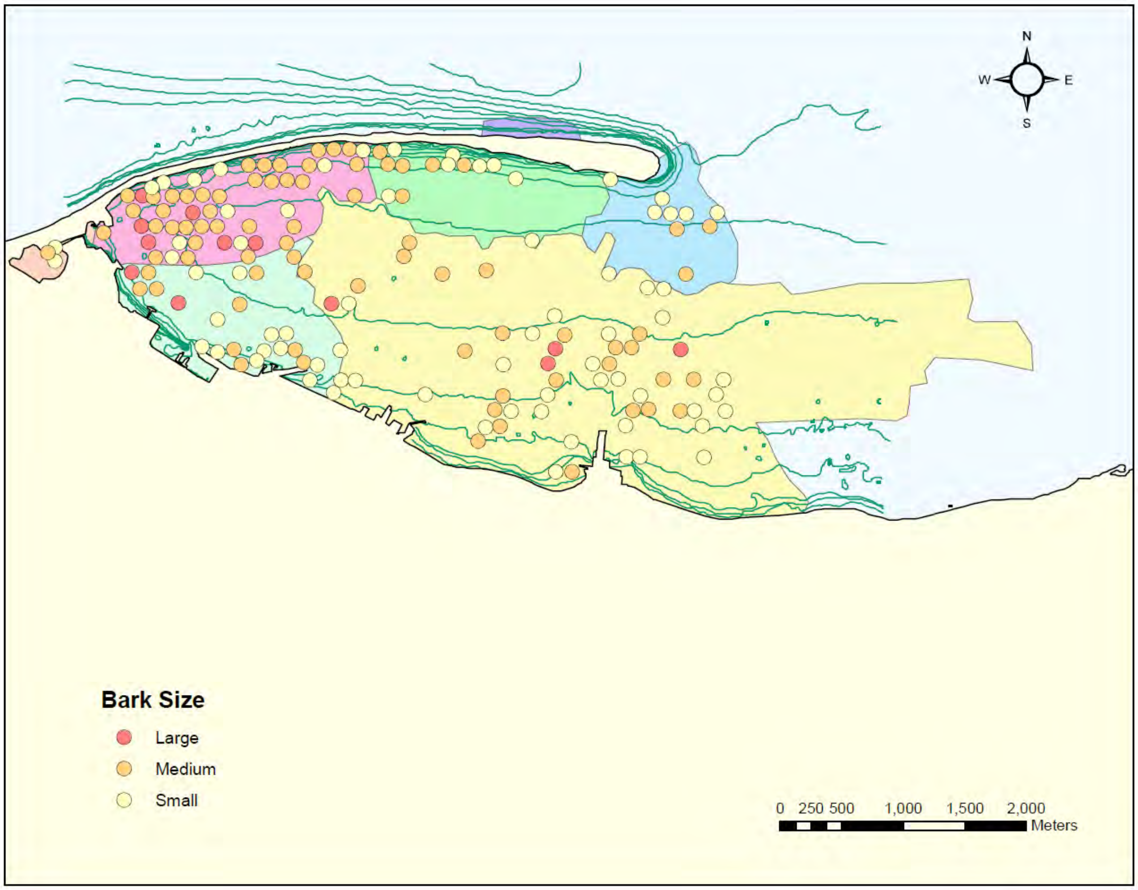


INTRODUCTORY FIGURE SHOWING THE TRANSPORT ENVIRONMENTS AS DETERMINED BY THE SEDIMENT TREND ANALYSIS (TE'S 1 TO 7).

TE'S ARE SHOWN AS BACKGROUND IN THE FOLLOWING MAPS. THEY ARE ALSO SHOWN TOGETHER WITH THE SEDIMENT PATHWAYS IN THE MAIN REPORT AS 7.

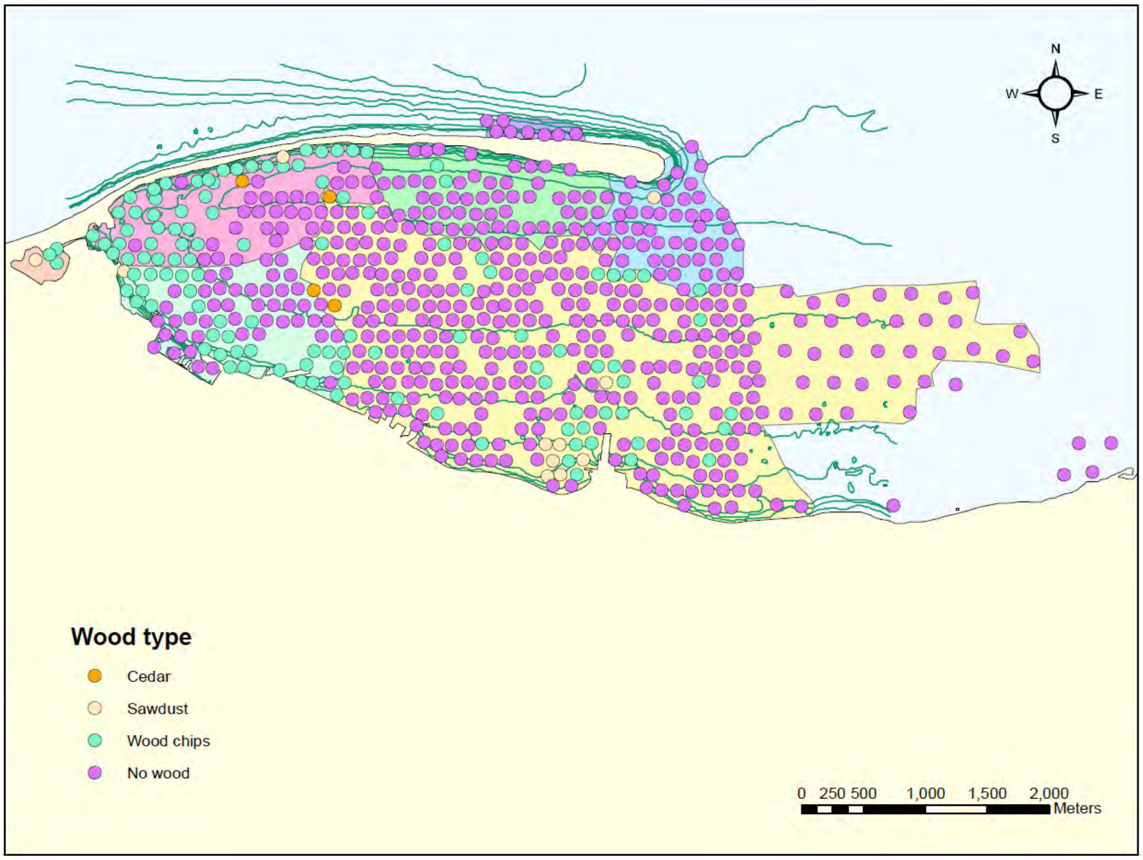


AVI-1: Wood is located primarily in TEs 1 and 2; and in the other known areas of forest product activities (Figure 1 of the report). Most of the wood is buried reflecting the depositional environment of TEs 1 and 2 and the dynamic nature of the environments elsewhere. The presence of wood decreases rapidly east of TEs 1 and 2 as it cannot be easily transported past the boundaries of TEs 3 and 4.

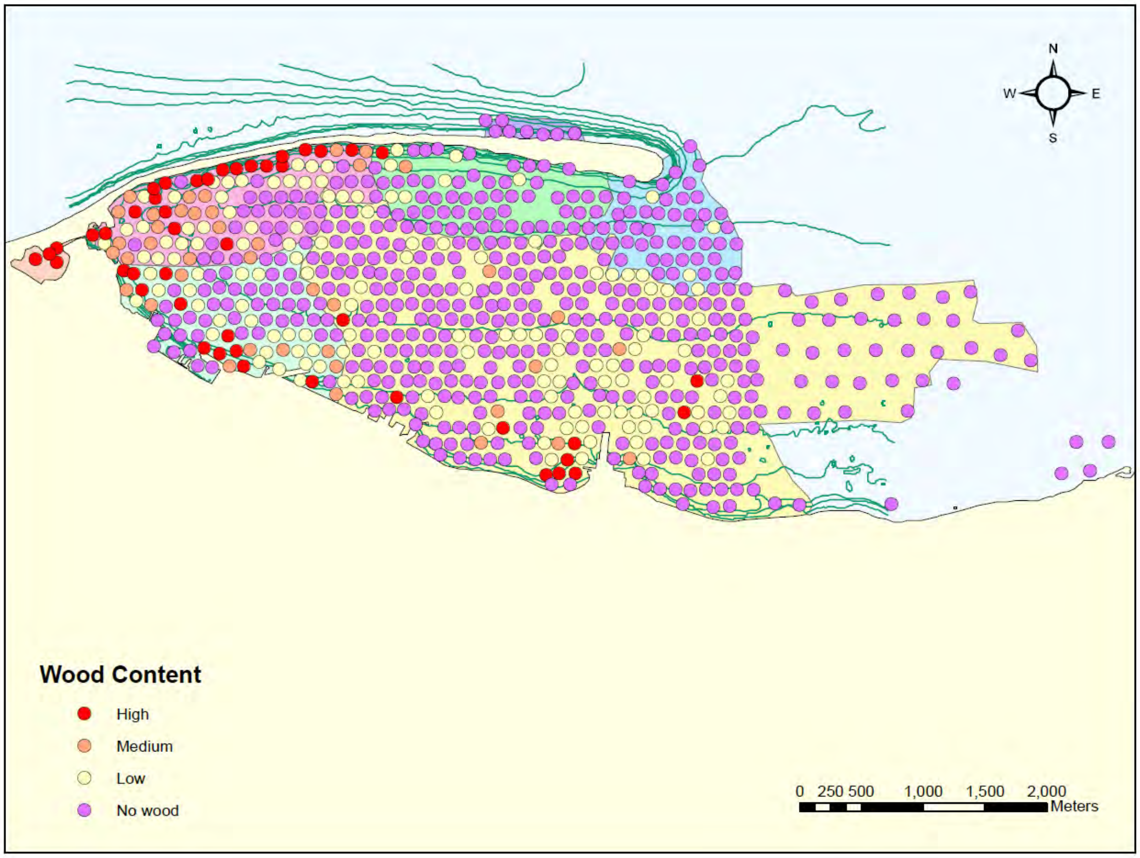


AVI-2a: Most of the bark associated with TEs 1 and 2 is either large or medium size (see Figure AVI-2b). Small sizes are probably more common than as shown on the map given the difficulty in seeing such sizes easily.

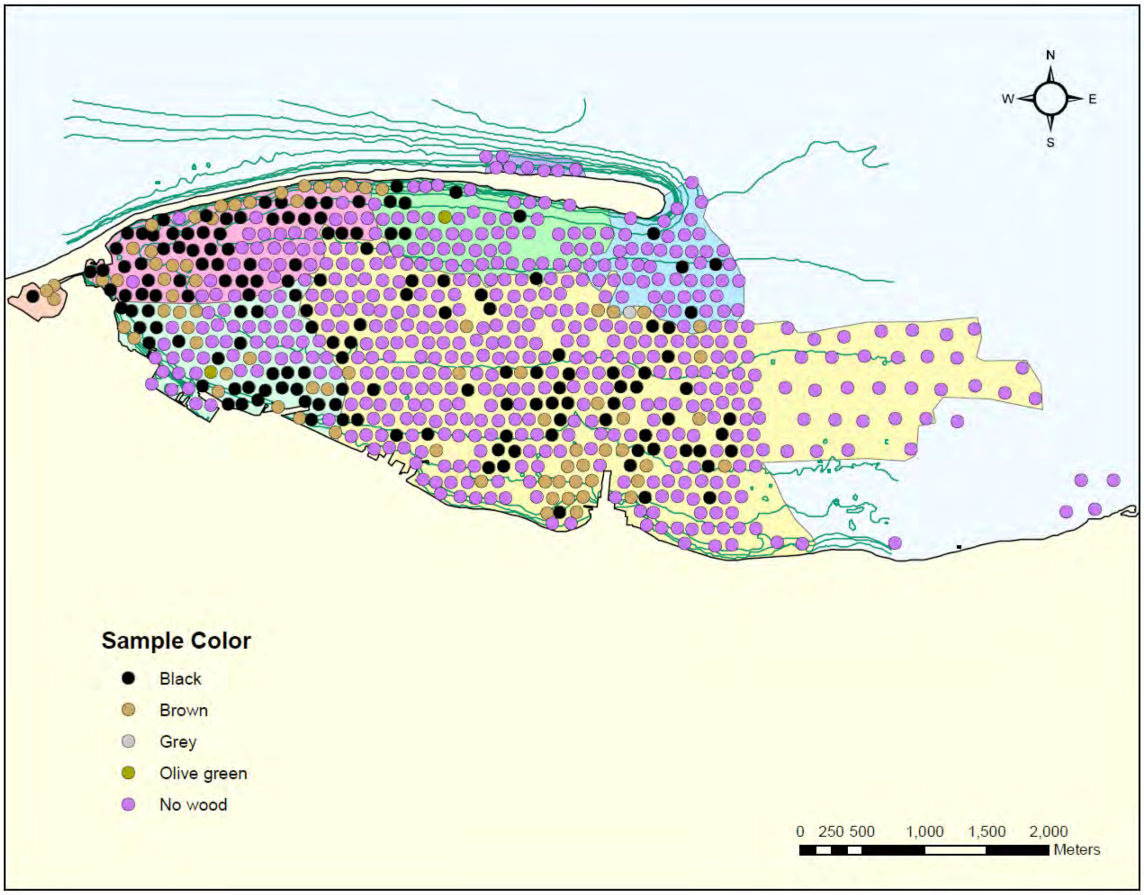
AVI-2b: Examples of large (at top) and medium sized bark.



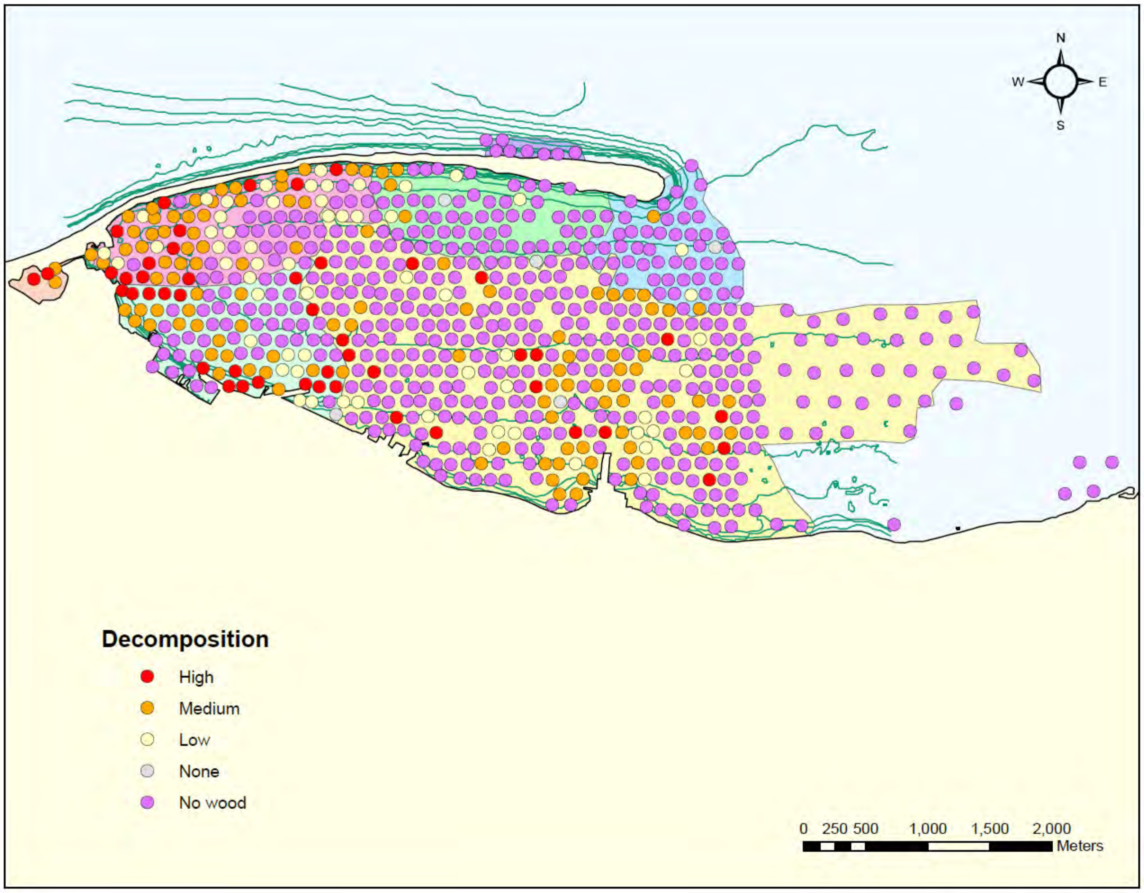
AVI-3: Sawdust appears to be most commonly associated with the Rayonier site. Wood chips were the most easily recognized wood type in the sediments.



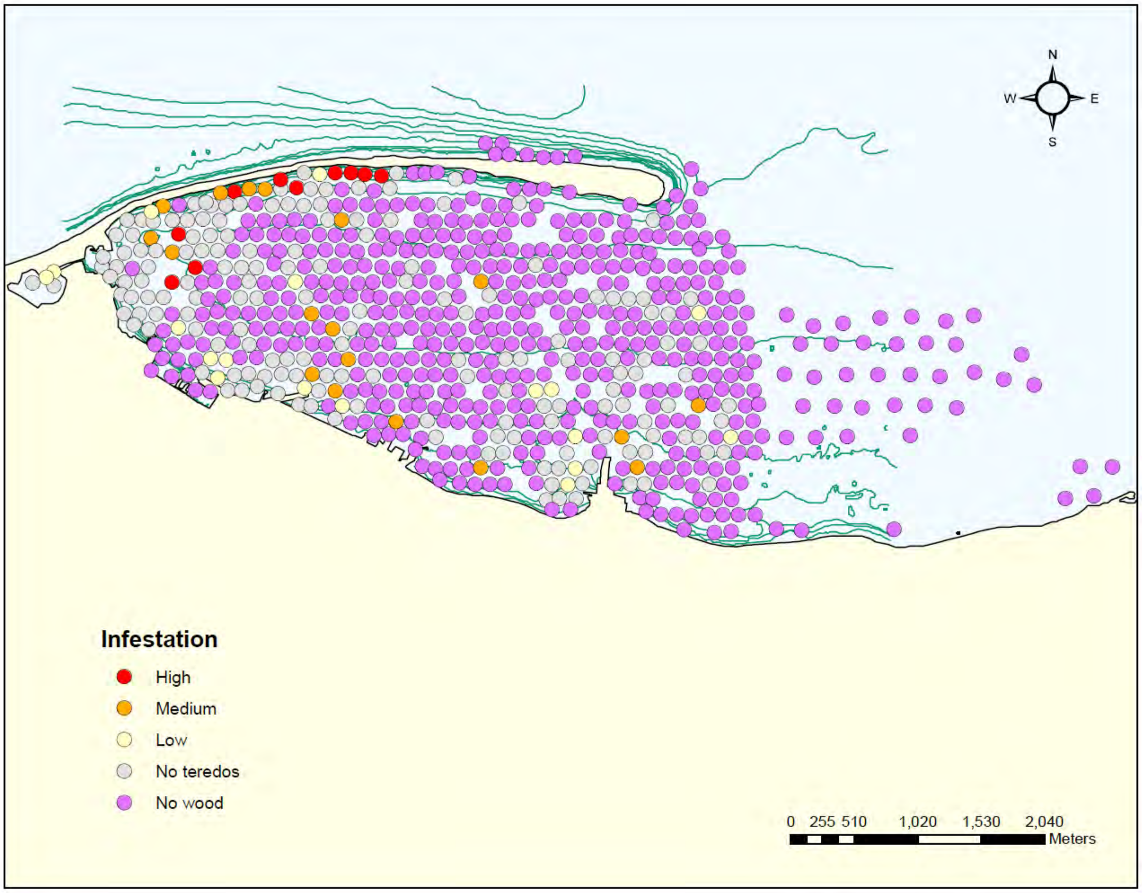
AVI-4: High concentrations appear to be associated with nearshore sediments, particularly along the south side of Ediz Hook, the active port log dump, and at the Rayonier site.



AVI-5: Because black wood is located throughout the area, it does not appear to be related necessarily to anoxic conditions that might be more expected in TEs 1 and 2 where Total Deposition 1 is taking place.



AVI-6: The highest concentrations of wood showing the greatest amount of decomposition are in TEs 1 and 2 which might be expected in the environment of Total Deposition 1. An increase in decomposition is more likely in an area favoring an anoxic environment.



AVI-7: Teredos are generally rare throughout the study area but appear highest along the shoreline of Ediz Hook.

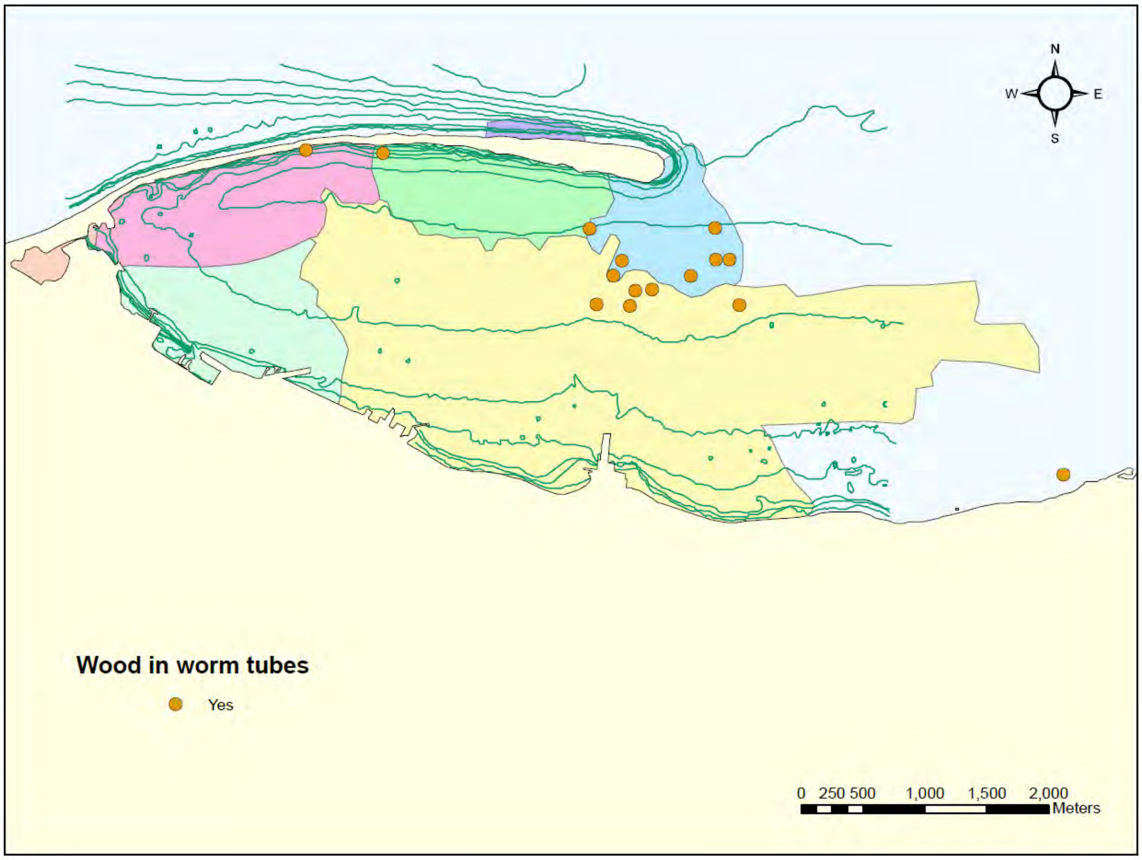


Figure AVI-8: This descriptor was included when it was observed that certain worm tubes constructed in relatively sandy sediment also contained wood fragments as part of the matrix in the building material. In mud sediments such tubes did not exist.

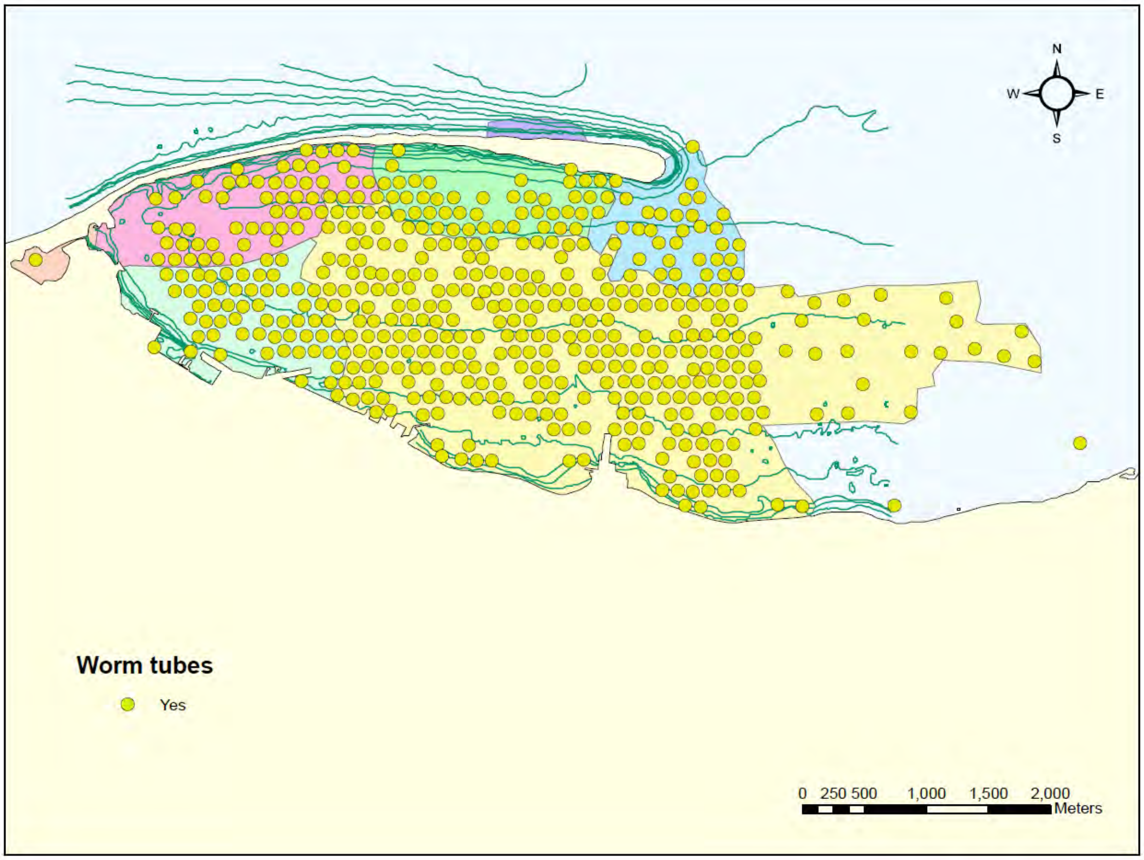


Figure AVI-9: Worm tubes in the sediment are more or less ubiquitous.

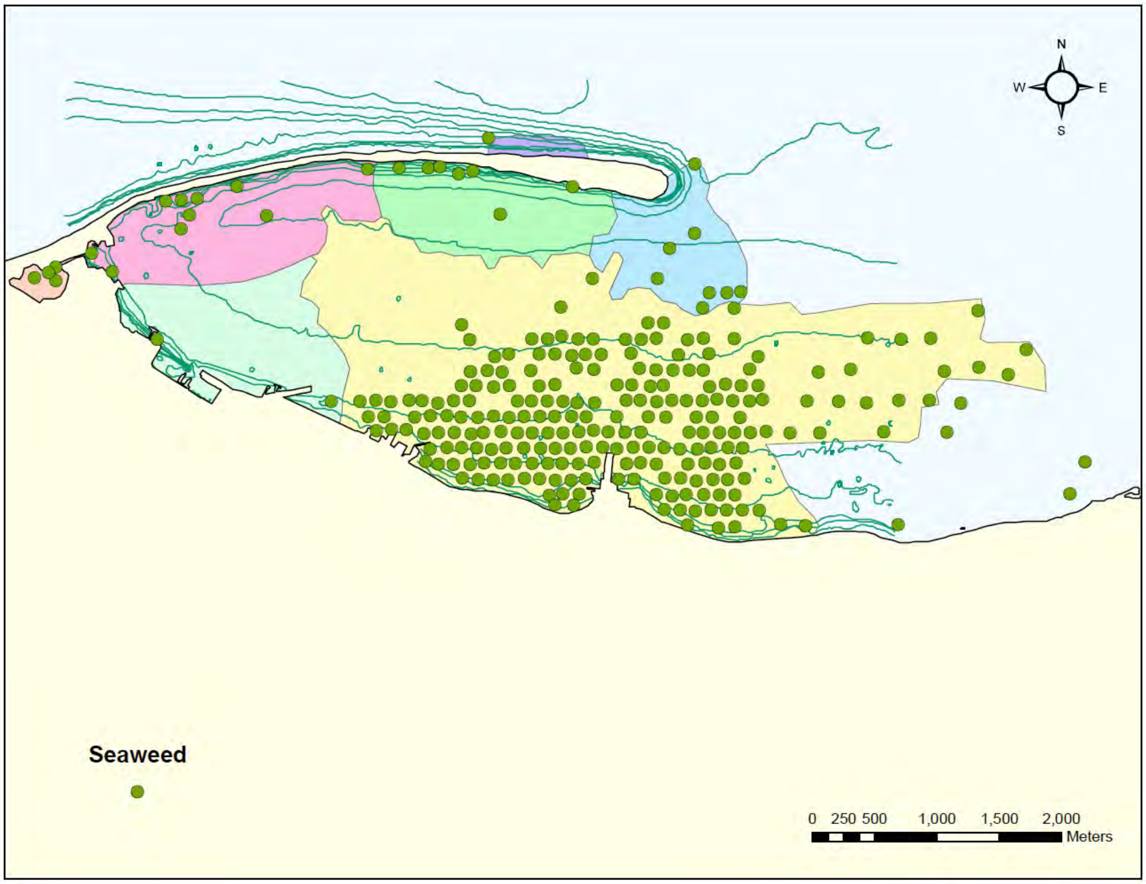


Figure AVI-10: Various forms of bottom attached seaweed are present on the coarser sediment bottoms.

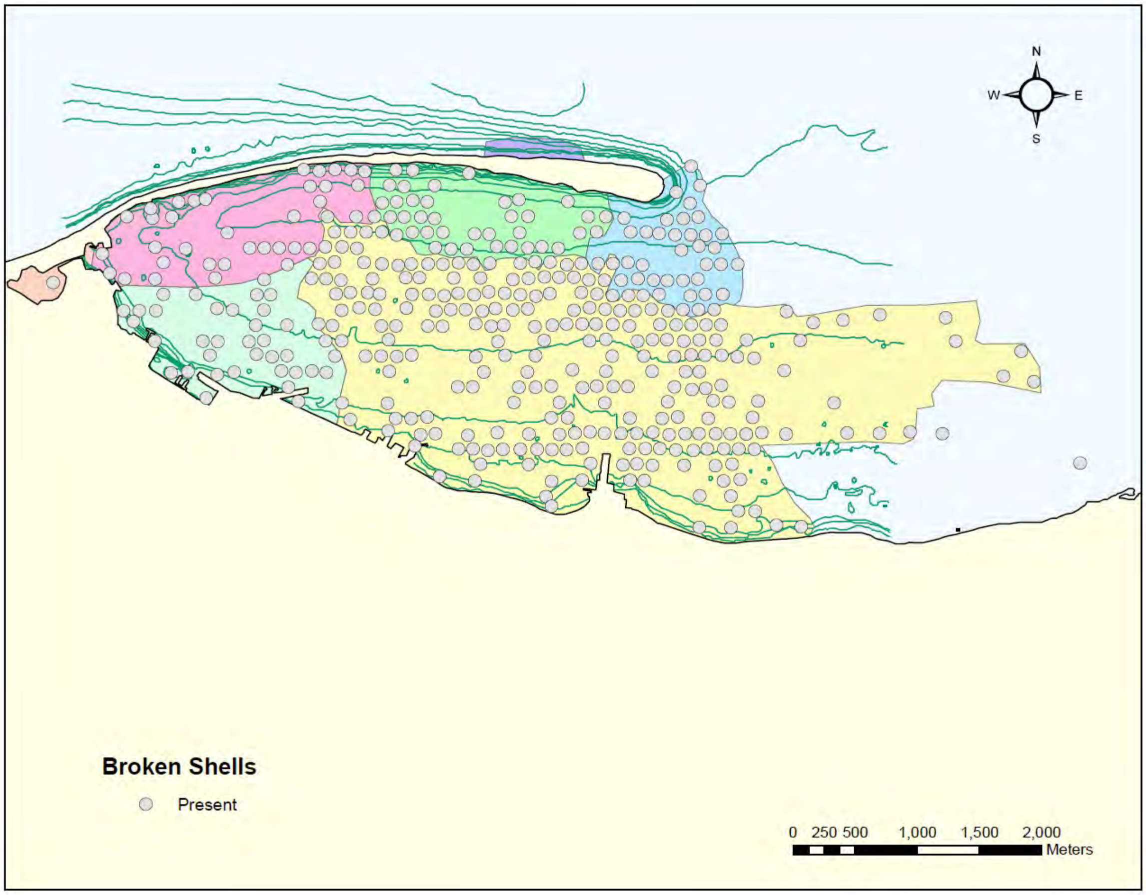


Figure AVI-11: Broken shells contained in the samples are common and widespread.

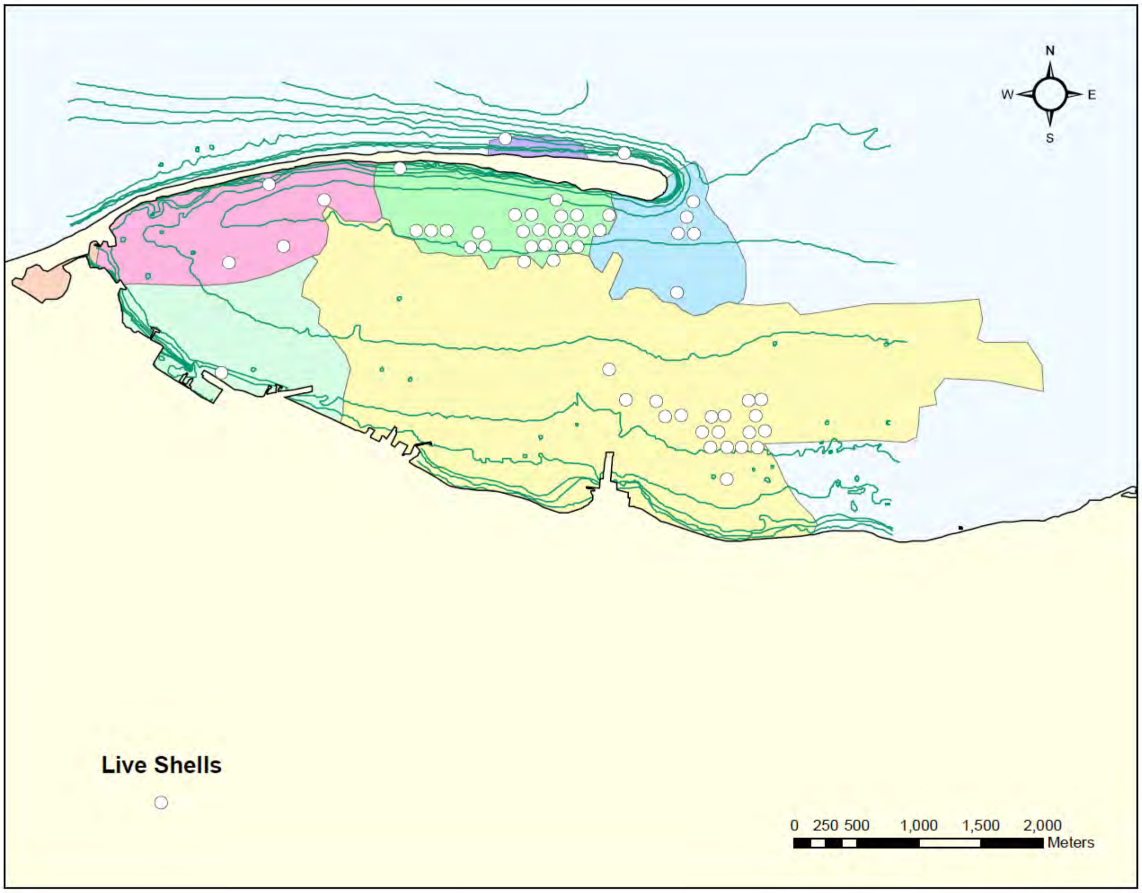


Figure AVI-12: Living shells (gastropods or pelecypods) are relatively rare. Their presence in the two or three clusters shown on the map correlates reasonably well with the eroding transport regimes found in TEs 3, 4 and 5, although the reason for this is not understood.

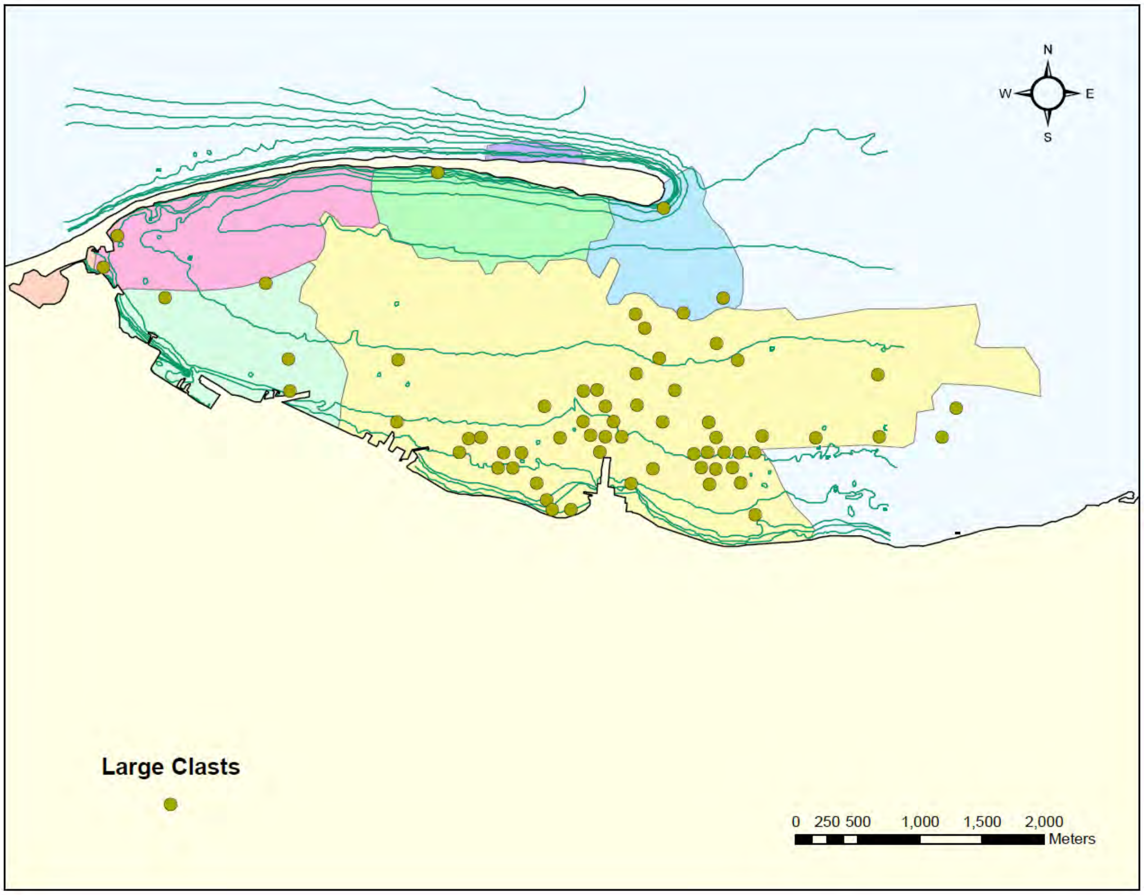


Figure AVI-13: The presence of particularly large clasts is common in the areas of eroding trend lines in TE3. The large clasts found elsewhere are likely to be anthropogenic.

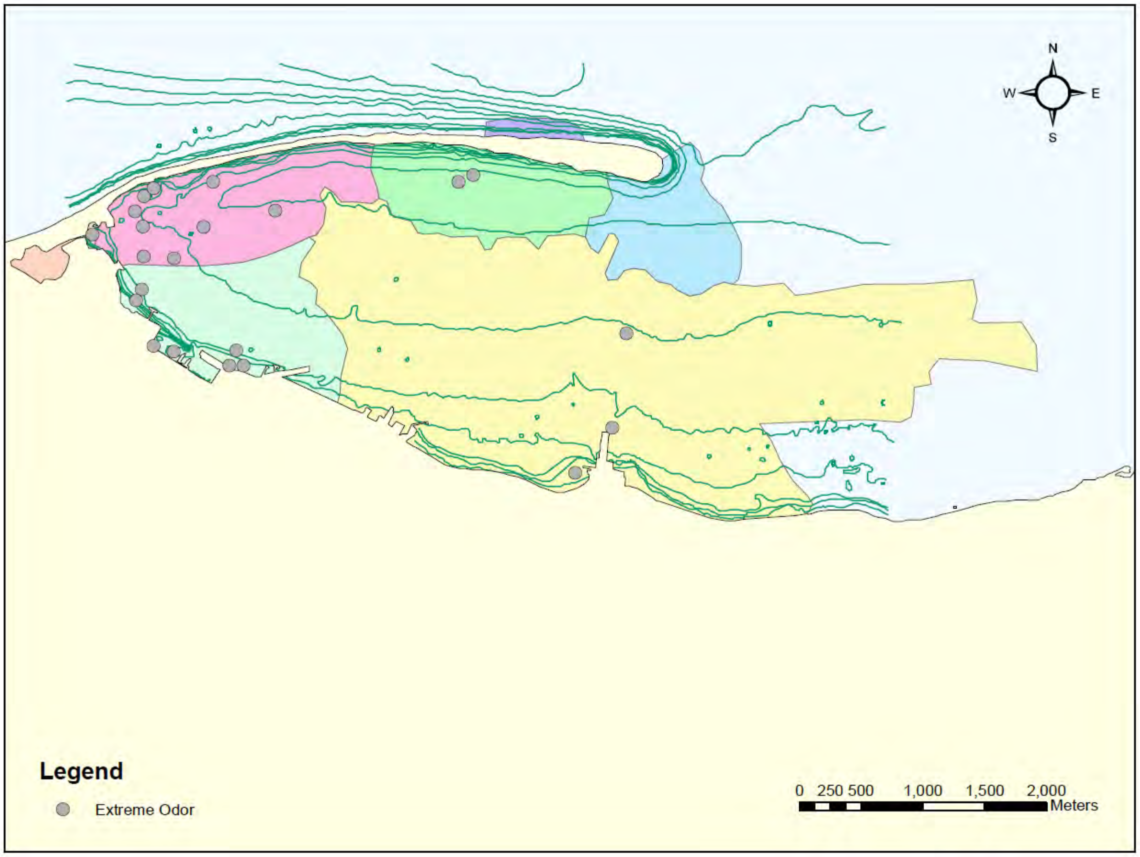


Figure AVI-14: Sediments with extreme (sulfide) odors are principally found in TEs 1 and 2 where anoxic sediments are more likely to occur than elsewhere. The two occurrences immediately south of the mid-portion of Ediz Hook were taken within the boundaries of a floating fish farming operation.

SEDIMENT PHOTOGRAPHS

Note: In the planning stages of this project it was hoped that photographs taken of the sediments at the time of sampling could document visually the relationship of bark/wood and sediment. Unfortunately the mud content in the samples obscured the visibility of the wood which precluded obtaining useful information. The following photographs are examples of how typical sediments appeared at the time of sampling. For a much better documentation of how wood and sediment are related, see the sediment vertical profiling system (SVPS) photography contained in the Washington State Department of Ecology, Port Angeles Harbor wood waste study, 1999.

Photo 1: Grab sample of sample 247 taken in a muddy sand found in TE3. The top of the sediment (at the sediment-water interface) is seen as lighter colour above the 25 cent coin. No wood was found in this sample, but there is a buried pelecypod shell visible.

Photo 2: Another view of Sample 247.

Photo 3: Sample 135 in TE1 containing buried wood and sawdust which are not visible in the photo.

Photo 4: Sample 392 in TE1 is sandy mud containing small amounts of medium-sized bark which are not visible.

Photo 5: Sample 119 (sandy mud) taken from TE4 which was found to contain small amounts of bark.

Photo 6: Sample 605 (sandy mud) taken from TE4.

Photo 7: A vertical profile photo (SVPS image) from Washington State Department of Ecology (1999) taken from the log booming near the former ITT Rayonier facility. Such large amounts of wood debris were not found in the samples taken for this study which has identified this area in TE3 as erosional.

Photo 8: An SVPS image from the Washington State Department of Ecology (1999) report showing wood particles (pulp) within the sediment column. The photo was taken near the K-Ply wood chip loading dock on the south side of TE1

Appendix F
Cultural Resources Monitoring Report

(Included in its entirety on CD)

Cultural Resources Monitoring for Port Angeles Harbor Sediment Characterization Study

October 21, 2009

Prepared for:

Washington Department of Ecology
Toxics Cleanup Program
Southwest Regional Office
300 Desmond Drive SE
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Prepared by:

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Telephone: 206/624-9537

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List of Figures

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List of Abbreviations and Acronyms

°F	degrees Fahrenheit
BP	before present
DAHP	Department of Archaeology and Historic Preservation
E & E	Ecology and Environment, Inc.
GOIA	Governor's Office of Indian Affairs
LEKT (or Tribe)	Lower Elwha Klallam Tribe
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places

1 Management Summary/Abstract

During summer 2008, Ecology and Environment, Inc., was under contract with the State of Washington Department of Ecology to conduct a sediment characterization study of Port Angeles Harbor, Washington. This project was deemed to require cultural resources monitoring based on Executive Order 05-05 which requires state agencies to consult with DAHP and the affected Tribes to determine potential impacts to cultural resources and appropriate protocols. The recent Port Angeles Graving Dock cultural resource discoveries have heightened awareness of the need for monitoring in this area. A legal agreement between the Lower Elwha Klallam Tribe (LEKT or Tribe) and the Department of Ecology established the need for portions of soil investigation project on the Rayonier Site which were part of this project to be monitored for cultural resources. Since the extent of the Rayonier Site has not yet been fully defined, this agreement was considered during cultural resource planning in the Harbor. Monitoring protocols were consistent with the Tribe Monitoring and Discovery Plan.

Fieldwork for this project occurred in two phases, initially from June 6 to June 20, and later from July 13 to July 23.

The monitoring effort resulted in the recording of one submerged site, Area “B” (actual location redacted) dating from the prehistoric to protohistoric, and one sample with four pieces of burned shell that was recorded as an isolated occurrence.

This report has been redacted to avoid inclusion of information that could help identify the locations of the artifacts encountered during this study. If additional details are required, please contact:

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Site Manager/Environmental Engineer
Department of Ecology
Southwest Regional Office/Toxic Cleanup Department
(360) 407-6254
cgro461@ecy.wa.gov

2 Introduction

Ecology and Environment, Inc., (E & E) was tasked to provide cultural resources monitoring for the Port Angeles Harbor Sediment Characterization Study (E & E 2008). This study included collecting harbor sediment core samples and testing the sediments for chemical contamination. A legal agreement between the Washington State Department of Ecology (Ecology) and the Lower Elwha Klallam Tribe (LEKT, or Tribe) required Ecology to provide cultural resources monitoring for samples taken from the Rayonier site, the full extent of which is not yet defined. In consideration of this agreement, and under compliance with Executive Order 05-05, it was agreed that core samples, taken from sediment of a certain depth and during surface grab sampling in the areas immediately surrounding the mouth of Ennis Creek near the former Rayonier Mill dock, would need to be monitored by a cultural resource specialist. A consultation with the Department of Archaeology and Historic Preservation (DAHP) ascertained that the project met the description of a "Capital Improvement Project" and was subject to stipulations under Executive Order 05-05.

Cultural resources monitoring is not commonly conducted for offshore projects; however, past climatological and geological conditions in coastal Washington suggest that submerged archaeological sites may be present. These are sites that would have been inundated with seawater as a result of rising sea levels from glacial melting in the terminal Pleistocene and early Holocene. Other submerged cultural resources protected under state and federal legislations include shipwrecks and plane crash sites.

3 Setting

Natural Setting

The City of Port Angeles is located in Clallam County, Washington, along the northern coast of the Olympic Peninsula. It sits on a natural harbor, which Spanish explorers named Puerto de Nuestra Señora de Los Angeles (Oldham 2007). The surrounding topography gently slopes from the foothills of the Olympic National Park to Port Angeles Harbor, which opens to the Strait of Juan de Fuca. A long sand spit, Ediz Hook, juts into the Strait of Juan de Fuca. Elevations of 400 to 500 feet are found at the southeastern border of the city. Tumwater, Valley, Peabody, White, Ennis, and Lees creeks cut through the city and empty into Port Angeles Harbor.

Geology and Geomorphology

The retreat of glaciers at the end of the Pleistocene is largely responsible for creating the current morphology of the Puget Sound Basin (Shipman 1989:11), which includes the Port Angeles area. A mile-thick glacier covered Washington until around 14,000 years before present (BP), when the glacier began to melt rapidly. While the melting of the glacier caused sea levels to rise, the release of the glacier's weight from the earth's crust caused the earth to rebound and rise. By approximately 6,500 years BP, the northern part of Washington, including the study area, had completed the bulk of the rebounding (Stilson et al. 2003). Evidence suggests that the sea level was approximately 60 meters lower than present levels in the late Pleistocene (around 10,700 years BP; (Mosher and Hewitt 2004). Port Angeles Harbor was formed approximately 5,000 years BP when Ediz Hook began to form (Wessen 2007).

The rising sea level is thought to have inundated many of the older archaeological sites that would have been associated with older beach lines. Most sites were probably village sites typically found 5 to 20 feet above the high water mark and near the mouths of rivers and other areas that would have offered a diverse range of desirable resources. Resource procurement sites may well have been on landforms of higher elevation (Stilson et al. 2003). There are no known village or habitation sites in northern Washington that date to older than 4,300 years BP (Stilson et al. 2003). There could be well-preserved archaeological sites currently underwater in many areas along the Washington coast.

Climate

The average annual precipitation for Clallam County is consistently less than 30 inches per year (Western Regional Climate Center 2007). Average maximum temperatures range from 65 to 70 degrees Fahrenheit (°F) during summer, rarely exceeding 90°F, and from 45 to 50°F in winter, rarely dropping below 30°F (Western Regional Climate Center 2007).

Fauna
Marine resources include harbor seals (*Phoca vitulina*) and sea otters (*Enhydra lutris*) as well as shellfish such as littleneck clams (*Protothaca staminea*), butter clams (*Saxidomus giganteus*), horse clams (*Tresus sp.*), heart cockles (*Clinicardium nuttallii*) and bent nose clams (*Macoma nasuta*). Salmon was a primary resource for early inhabitants (Wilt and Roulette 2001).

Flora
The project area is within the *Tsuga heterophylla* Zone of Western Washington and the area is characterized by extensive stands of conifer forest that include species such as Douglas fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), western red cedar (*Thuja plicata)*, red alder (*Alnus rubra*), bigleaf maple (*Acer macrophyllum*), and Pacific madrone (*Arbutus menziesii*).

Other flora found within the project area include western blackcurrant (*Ribes petiolare*), golden currant (*Ibes aureum*), western chokecherry (*Prunus virginiana demissa*), squaw potato (*Perideridia oregana*), Indian potato (*Orogenia linearifolia*), and creeping juniper (*Juniperus horizontalis*). Indigenous populations likely used all of these edible plants to supplement the wide variety of saltwater, terrestrial, and freshwater resources in the Port Angeles Harbor vicinity (Wilt and Roulette 2001).

Cultural Setting

Prehistory
The earliest archaeological sites recorded in the northern Puget Sound Lowland date to approximately 4,300 years BP. Lower sea levels in the terminal Pleistocene and early Holocene may have allowed the area to be inhabited then (Shipman 1989).

In later prehistory, groups in the northwest were expert hunter-gatherers who lived in permanent villages. Although wild resources formed the base of their subsistence, the groups had individuals who specialized in crafts such as hunting, fishing, and tool making. By 1,000 years BP, settlements of several hundred people could be found. Plentiful, large cedar trees were used for building houses as well as dug-out canoes. Canoes were used for travel, resource exploitation, and maintaining long-distance social networks (Fagan 1991 (2000)).

Ethnography and Ethnohistory
The traditional territory of the Klallam stretched along the south shoreline of the Strait of Juan de Fuca, from the Hoko River east to Discovery Bay (Gunther 1927). The Klallam lived in small villages located in sheltered coves that were protected from the sea by sand spits and had a sufficiently wide beach for outdoor activities (Gunther 1927). Winter villages consisted of from one to six cedar plank houses. Villages on coastlines had houses arranged facing the water. Temporary shelters were constructed of mats of woven rushes and resembled the permanent plank houses (Gunther 1927). These shelters were used as resource-gathering campsites.

The Klallam often traveled to areas of seasonal resource gathering and established temporary campsites for collection and processing. Gunther (1927) also observed that when an extended stay in the resource area was expected, cedar planks were transported and used to reinforce the mat structures. People boiled water and cooked food in watertight wooden boxes or baskets by heating rocks and dropping them into the water.

According to Gunther (1927), Klallam people hunted whales, porpoises, blackfish, and seals. Seal hunting was the most economically viable practice. When a seal was caught it was shared by the entire village. Whales were taken opportunistically. Unlike the nearby Makah, the Klallam did not set out on whale hunts but rather waited until a whale was sighted near their village before pursuing it (Gunther 1927). Only men from wealthy families could be involved in taking whales, a hereditary right. Waterfowl such as ducks were ensnared using nets strung between high poles to catch ducks in flight. These nets were set up on sand spits or in marshes during early morning or dusk. Ducks were also trapped at night from canoes with a net affixed to a long cedar pole. From the canoe, the hunter could bring the net down over swimming ducks. Geese and swans were trapped in the same manner (Gunther 1927). Elk and deer were hunted with bow and arrow throughout the Olympic Peninsula. Gunther (1927) states that the Klallam had no traditional, tribal, or familial hunting grounds; the whole Olympic Range was available to everyone. Land mammals such as deer, bear, and elk were more often hunted if they wandered onto the beach. An animal sighted on the beach was at times chased into the water. Hunters would follow the animal in a canoe until it was exhausted (Gunther 1927:205). One source states that the peoples of the Northwest Coast made blankets using dog wool (Waterman 1924).

The locations of burial sites varied over time and among groups. In some parts of Western Washington, small offshore islands or wooded slopes close to villages were cemetery areas. Isolated burial sites have been found in a variety of locations. Winter villages usually had an associated cemetery, which was at the end of a sand spit or in a wooded area (Gunther 1927). Sand spit burials were either laid directly on the sand or supported on scaffoldings two to three feet high. The body was often covered by a small shed or placed in a canoe and cemeteries on sand spits were well away from areas used for habitation or for resource processing activities (Gunther 1927). Shortly after Euroamerican contact, entire villages were decimated by disease and thus became cemeteries (Stilson et al. 2003). Most belongings were given away at death (Eells 1887).

For ceremonial purposes, the Klallam used ochre. Anhydrous iron (III) oxide, or yellow ochre, turns red when heated. According to Gunther (1927), the ochre was “burnt in the fire” and spread on the skin in a base of deer tallow with the fingers. The best ochre was obtained from Hood Canal, and the Klallam traveled there to collect it. The ochre was carried in small deerskin bags and was sometimes traded with the Makah or Vancouver Island people (Gunther 1927).

History

The first European contact with the Klallam was in July 1788, by Robert Duffin, an Englishman who had been sent on a longboat expedition from the west coast of Vancouver Island. Maritime exploration brought the Spanish to Klallam territory in 1790 when Manuel Quimper anchored his boat in Freshwater Bay near the Elwha River. The first exploration of the Olympic Peninsula was conducted by George Vancouver in 1792.

These early explorers brought diseases to the indigenous people. The tribes had no immunity against sicknesses such as smallpox, measles, influenza, and tuberculosis. Whole villages were decimated (Lower Elwha Klallam Tribe 2008; Oldham 2007; University of Idaho 2008).

In 1859 the Cherbourg Land Company formed to plat a town site and sell lots. The U.S. Army Corps of Engineers plated a federal townsite on land designated as a federal reserve by President Abraham Lincoln. In 1861 the first trading post was established. The Ediz Hook lighthouse opened in 1865 (Oldham 2007).

The Puget Sound Co-operative Colony revitalized the community after several years of declining interest. The Colony set up along the west side of Ennis Creek. By 1890 the town had 3,000 residents (Oldham 2007).

As more and more European homesteaders arrived in the late 19th century, many Klallam people were displaced. The Indian Reorganization Act of 1934 helped the Tribe obtain 327 acres of land, which officially became the Elwha Klallam Reservation in 1968 when the Tribe became federally recognized. In 1974 the Tribe regained its fishing rights from the State of Washington and built a fish hatchery (Lower Elwha Klallam Tribe 2008).

Regulatory Setting

State Regulations and Standards

In Washington State several laws and statutes protect archaeological sites and Native American graves. These include:

- *The Indian Graves and Records Act [RCW 27.44]*: Protects Native American burials, petroglyphs, and pictographs from intentional disturbance.
- *The Archaeological Sites and Resources Act [RCW 27.53]*: States that a permit is required before knowingly disturbing any historic or prehistoric archaeological resource or site on private or public land.
- *Abandoned and Historic Cemeteries and Historic Graves [RCW 68.60.040 and RWC 68.60.050]*: Establishes protection for historic cemeteries and graves. Persons disturbing historic graves through inadvertence, including disturbance through construction, must reinter the remains under the supervision of the DAHP.
- The Advisory Council on Historic Preservation also has pertinent guidelines such as *Archaeological Excavation and Removal Permit [WAC 25-48]*.

Washington Governor Chris Gregoire signed Executive Order 05-05 into action in November 2005. This order requires state agencies with capital improvement projects to integrate the DAHP, Governor's Office of Indian Affairs (GOIA), and concerned tribes into their capital project planning process. The purpose of this order is to ensure that state agencies take actions to avoid or mitigate adverse effects their undertakings may have on cultural resources, and to ensure that the Native American community has a chance to express its concerns with projects that could adversely affect tribal interests. Executive Order 05-05 also mandates that state agency employees managing such projects undergo government-provided training on the importance and treatment of cultural resources.

Federal Regulations
Cultural resources are protected by the National Historic Preservation Act (NHPA) of 1966, Archaeological and Historic Preservation Act of 1974, Archaeological Resources Protection Act of 1979, and regulations (36 CFR 800) that implement Section 106 of the NHPA. Section 106 requires federal agencies to consider the effects of their actions on properties listed, or eligible for listing, in the National Register of Historic Places (NRHP).

Various other laws and guidelines also ensure protection of cultural resources:

- EO 11593: Protection and Enhancement of Cultural Environment (16 U.S.C. 470 [Supp. 1, 1971]).
- Native American Graves Protection and Repatriation Act (PL 101 – 601; U.S.C. 3001–3013).
- Determination of Eligibility for Inclusion in the National Register (36 CFR 63).
- Recovery of Scientific, Prehistoric, and Archaeological Data (36 CFR 66).
- Curation of Federally Owned and Federally Administered Archaeological Collections (36 CFR 79).
- DoD Directive 4710.1 (outlines the policy to incorporate historic preservation requirements into all DoD activities).

4 Investigation Design

The methods described here ensure this project's consistency with standard cultural resources monitoring practices and the LEKT Monitoring and Discovery Plan, provided to E & E by the Tribe.

Prescribed cultural resources monitoring required a qualified archaeologist to be present during collection of sediment samples from cores taken in water depths of less than 50 feet in Port Angeles Harbor. Beach (intertidal) sediment samples were collected using stainless steel spoons. Core samples were collected using a 12-foot vibracorer. As needed, an impact or gravity corer was employed to facilitate successful sampling. In most cases, the cores were advanced to a depth of 4 feet or refusal. In some locations, the cores were advanced to a maximum depth of 12 feet. Further details can be found in the Sampling and Analysis Plan (E & E 2008).

Notification was provided to the LEKT and the City of Port Angeles archaeologist 24 hours prior to the start of sampling activities requiring archaeological monitoring. An E & E archaeologist examined sediment samples taken in Port Angeles Harbor from water depths of less than 50 feet. If a potential cultural artifact was encountered during sample homogenization the E & E samplers alerted the E&E archaeologist immediately and the item was cleaned and checked. Cultural materials that may have been encountered included, but were not limited to, fire modified rock, animal bone, lithic debitage, flaked or ground stone tools, cordage and fibers, charcoal, ash, exotic rocks and minerals, historic bottles, ceramic shards, nails, wire, and wood. Finds were documented using photographs, sketches, and scaled drawings, if appropriate, and written descriptions.

Discoveries of artifacts were reported to the LEKT, City of Port Angeles, and Ecology once the nature of the find had been ascertained. The points of contact for the Tribe were:

- Primary Contact: Bill White, Tribal Archaeologist (360) 460-1617
- Secondary Contact: Larry Dunn, Tribal Cleanup Project Manager (360) 452-8471 X126

The points of contact for the City of Port Angeles were:

- Primary: Derek Beery, City of Port Angeles Archaeologist (360) 417-4704
- Secondary: Nathan West, Deputy Director of Community and Economic Development (360) 417-4751

In addition, Dr. Rob Whitlam of DAHP (360-586-3080) was kept informed of all communications with the LEKT and the City of Port Angeles archaeologist.

Discovered artifacts were carefully cleaned, analyzed, and treated according to the LEKT's request, and the property owner was notified of the recovery. Aquatic land ownership in the harbor includes the following:

- Washington Department of Natural Resources, Brady Scott, (360) 732-0013
- Port of Port Angeles, Dave Hagiwara, (360) 457-1138
- Private owners
- Rayonier Properties, LLC

Since artifacts encountered are the property of the landowner from where the artifacts are recovered, all found artifacts have been returned to the appropriate landowners.

The City of Port Angeles was not a landowner in this project; however, the City archaeologist had an interest in the results of the monitoring and was present when E & E conducted sampling near Ennis Creek. This area is of particular interest due to the existence of a historic, ethnographic Klallam village and insufficient knowledge of the boundaries of this site. There were no known archaeological sites at the planned sampling locations.

No human remains were identified. Had human remains been encountered, the E & E archaeologist would have immediately notified the Port Angeles City Police, the Port Angeles archaeologist, and the Clallam County Coroner. The Tribe and the DAHP would also have been notified had it been determined that the remains were of Native American origin. Documentation (photographs) of human remains would not have been collected until approval was issued by the City of Port Angeles archaeologist and/or the Tribe. Contact information for the police and the Coroner was as follows:

- Port Angeles Police Department (non-emergency): (360) 452-4545
- Clallam County Coroner: Deborah Kelly: (360) 417-2297

5 Monitoring Methods

The archaeologist was present to monitor the opening of each sediment core. Once opened, the archaeologist looked at the stratigraphy to determine whether there were indications of cultural resources. Indications that a sedimentological layer may contain cultural resources include a very high concentration of shell fragments that could indicate the presence of a shell midden, concentrations of charcoal in the strata that could be an indicator of a culturally produced fire, and the presence of historic or prehistoric artifacts. This did not involve handling the core in any way. The sediment sample intervals were monitored by the archaeologist as they were removed from the core and homogenized in pre-cleaned bowls prior to being placed in sample jars.

The archaeologist observed and/or aided in the homogenization of the sediment. This gave the opportunity to observe artifacts that may have been present in the cores. Any large objects removed from the sediment sample were cleaned by the archaeologist to verify that rocks weren't incised, and none of the shell that was found was burned or displayed cultural modification.

Following sample collection, the E & E geologist analyzed the remaining core to document the lithology of the sample locale. Once the lithological analysis was complete the core was turned over to the archaeologist. The remaining portions of the core not used as sample material were screened with nested sieves. Roughly half the remaining sediment was removed and water screened through 1/4 inch and 1/8 inch nested sieves. This was done by the archaeologist to help identify artifacts. If there were no signs of cultural deposits in the sampled portion, no further sieving was done on that interval. If there was potential for the presence of cultural materials then the rest of the interval was also screened.

6 Report of Findings

Two core samples yielded cultural materials. While the 12–14” interval (intervals were measured with the harbor floor assigned a depth of 0”) of the Area “A” sample (actual location redacted) was being screened, four pieces of highly fragmented, burned shell were recovered (Figure 1). No other artifacts were recovered from the core. The pieces were too fragmentary to identify the species of the shell. This locale was in the vicinity of the I’*e*’nis ethnographic village.

Figure 1 Burned shell from Area “A” 12–14 inches below surface

One core collected from Area “B” (actual location redacted) yielded an abundance of burned shell (Figures 2, 4, and 5), and three obsidian pressure flakes (Figure 3). The shell was highly fragmentary with most of the pieces less than 1 centimeter in length or width. Species identification of such small fragments is unlikely. The obsidian pressure flakes are too small to be used for obsidian sourcing studies.

The Area “B” artifacts were intermixed with wood waste and were stratigraphically located higher in the core than the main wood waste layer. The wood waste layer would date only as far back as the earliest operation of the former Rayonier Mill at the turn of the 20th century. While the burned shell could have resulted from either prehistoric or historical era activities, the obsidian debitage is most likely from the prehistoric, possibly associated with the ethnographic village of I’*e*’nis which was likely occupied prior to the first historical documentation of the site. The location of the artifacts on top of the later-deposited, mill-produced wastes indicates that the artifacts were deposited into the water sometime after the mill began operations-possibly from land-leveling activities for a phase of expansion or new equipment installation. The find is in a disturbed context and has little scientific value. The shell is extremely fragmentary and its species cannot be identified.

Figure 2 Burned shell from Area “B” 0–6 inches below surface

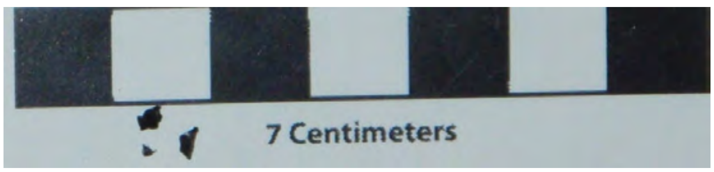

Figure 3 Obsidian pressure flakes from Area “B” 6–24 inches below surface

Figure 4 Burned shell from Area “B” 6–24 inches below surface

Figure 5 Burned shell from Area "B" 24–36 inches below surface

7 Discussion and Interpretations

The ethnographic village of I'*e*'nis is known to have been in the vicinity of the former Rayonier Mill site. Gunther (1927) documented that many activities took place on the shore including shellfish procurement and processing activities.

The burned shell from Area "A" (actual location redacted) could have been washed into the water by wave action at high tide or redeposited by currents from deposition further up the shore such as from the Area "B"(actual location redacted) core sample locale. Area "B" had a much more dense concentration of burned shell.

The amount of shell recovered from Area "B" (actual location redacted) represents a large deposit and is probably the result of one large synchronous depositional episode. While the geological data illustrate the possibility of encountering intact buried cultural resources in the project area, the juxtaposition of the shell on top of and mixed into the upper layers of wood waste is indicative of a dumping event that occurred in the later years of mill operation. Since the pieces of shell are too small for the species to be determined, and the obsidian pressure flakes are too small for sourcing analysis, little information could be attained from further study of these recoveries.

8 Management Considerations

The recovery of burned shell from Area "A" is not unexpected since a well documented ethnographic village of I'*e*'nis is known to have existed in the area, and burned shell is one of the most common recoveries from coastal archaeological sites. It is unlikely that the artifacts recovered from Area "B" were from their primary point of deposition (since burned shell fragments were mixed with wood waste throughout the depth of the core). The disturbed nature of the finds makes their recovery of little scientific value.

Additional archaeological deposits may be located in harbor and offshore contexts. The results of this monitoring project show that Port Angeles Harbor and shoreline developments may impact intact, buried cultural resources. There may be need for continued cultural resources monitoring of marine projects in nearshore and offshore areas demonstrated to have sensitivity for buried cultural resources. Criteria would be evidence that submerged sediments were deposited sometime after the terminal Pleistocene or throughout the Holocene, and that these sediments became submerged due to rising sea levels.

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10 Appendices

DAHP Site Forms

For access to these forms, please contact:

Department of Archaeology and Historic Preservation
PO Box 48343
Olympia, WA 98504-8343

(360) 586-3065

Appendix G
Screening Level Human Health and Ecological Risk Assessment

(Attachments included on CD)

Port Angeles Harbor
Marine Environment

Screening Level Human Health and Ecological Risk Assessment

FINAL

Prepared for

Washington State Department of Ecology
Toxics Cleanup Program
300 Desmond Drive
Lacey, Washington 98504

Contract No. C0700036
Work Assignment No. EANE020

December 2012

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Attachments

List of Acronyms

Item	Definition
ADAFs	age-dependent adjustments factors
AF	adherence factor
ALM	adult lead model
AT	averaging time
AT_c	averaging time for carcinogens
AT_{nc}	averaging time for noncarcinogens
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BW	body weight
Cal EPA	California Environmental Protection Agency
CDC	Centers for Disease Control and Prevention
CDI_o	chronic daily intake from the oral exposure route
CF	conversion factor
C_n	chemical concentration in food item n
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
CSM	conceptual site model
CSOs	combined sewer outfalls
CT	central tendency
CWA	Clean Water Act
d/y	days/years
DAD	Dermally Absorbed Dose
DA_{event}	absorbed dose per event
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
dioxins	polychlorinated dibenzodioxins
DNWR	Dungeness National Wildlife Refuge
E & E	Ecology and Environment, Inc.
Ecology	Washington State Department of Ecology
ED	exposure duration
EE_{diet}	estimated exposure from diet
$EE_{sediment}$	estimated exposure from sediment ingestion
EE_{total}	total exposure
EF	exposure frequency
EF_{fish}	exposure frequency of contaminants in fish
EF_{sed}	exposure frequency to sediments
EPCs	exposure point concentrations
ERA	ecological risk assessment
EV	event frequency
FDA	Food and Drug Administration
FI	fractional intake
F_n	fraction of diet represented by food item n

Item	**Definition**
furans	dibenzofurans
g/d	grams per day
g/kg/d	grams per kilogram per day
GI	gastrointestinal
GSD	geometric standard deviation
Harbor	Port Angeles Harbor
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic
IHS	indicator hazardous substance
IR	ingestion rate
$IR_{a\ or\ c}$	ingestion rate for adult or child
IR_{bottom}	ingestion rate for bottom fish
IR_{fish}	fish/shellfish ingestion rate
$IR_{pelagic}$	ingestion rate for pelagic fish
IR_{sed}	sediment ingestion rate
$IR_{shellfish}$	ingestion rate for shellfish
kg	kilogram
kg/mg	kilograms per milligrams
KM	Kaplan-Meier
LEKT	Lower Elwha Klallam Tribe
LOAEL	lowest observed adverse effect level
MDL	method detection limit
MRLs	minimal risk levels
MTCA	(Washington State) Model Toxics Control Act
NCEA	National Center for Environmental Assessment
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effect level
NPDES	National Pollutant Discharge Elimination System
ORNL	Oak Ridge National Laboratory
PAHs	polycyclic aromatic hydrocarbons
PbB	blood lead
POTW	publicly owned treatment works
PPRTVs	Provisional Peer Reviewed Toxicity Values
PQL	practical quantitation limit
PRGs	preliminary remediation goals
RBCs	risk-based concentrations
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
ROS	regression on order statistics
RPD	redox-potential discontinuity
SA	Skin surface area available for contact

Item	Definition
SAB	Science Advisory Board
SEIDG	Summary of Existing Information and Data Gaps Report
SF	slope factor
SMS	Sediment Management Standards
SQS	sediment quality standard
STP	sewage treatment plant
STSC	Superfund Health Risk Technical Support Center
SUF	site use factor
SVOCs	semi-volatile organic compounds
TBT	tributyltin
TEF	toxicity equivalency factor
TEQ	total toxicity equivalents
TOCs	total organic carbons
TRVs	Toxicity Reference Values
UCL	upper confidence limit
U.S. EPA	United States Environmental Protection Agency
μg/dL	micrograms per deciliter
USFWS	U.S. Fish and Wildlife Service
VOCs	volatile organic compounds
WAC	Washington Administrative Code
WOE	weight-of-evidence

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Executive Summary

Port Angeles Harbor, Washington, has been identified as a priority environmental restoration project by the Washington State Department of Ecology (Ecology) as part of the Puget Sound Initiative. Environmental investigations throughout the harbor have indicated that chemicals in marine sediments and biota may pose a risk to human and environmental receptors. Ecology has tasked Ecology and Environment, Inc., with conducting sediment investigations and a risk assessment focusing on the marine environment and associated terrestrial and aquatic source areas.

The City of Port Angeles is on the northern coast of the Olympic Peninsula in Clallam County, Washington. The harbor is considered a deep-water harbor, with depths greater than 90 feet near the eastern end of Ediz Hook. Port Angeles Harbor is affected by current and historical chemical inputs from industrial and municipal sources.

Potential constituents of concern to harbor sediments and biota were identified based on known chemical associations with historical and current land uses, as well as a significant amount of data collected during prior sediment investigations within the harbor. The following chemicals were previously identified as potential constituents of concern:

- Dioxins and furans
- Polychlorinated biphenyls (PCBs)
- Chlorinated pesticides
- Semi-volatile organic compounds (SVOCs), including polycyclic aromatic hydrocarbons (PAHs), phenols, and phthalates
- Resin acids/guaiacols
- Tributyltin (TBT)
- Ammonia, sulfides, and total organic carbons (TOCs)
- Heavy metals, including inorganic and organic forms

Numerous studies have characterized chemical constituents in sediment and distribution of wood waste in Port Angeles Harbor. Data from reports written over the past approximately 10 years were used in the human health and ecological risk assessments and include data from the Sediment Investigation (E & E 2012), as well as, historical data for the harbor including the Rayonier area.

Human Health Risk Assessment Summary

For the human health risk assessment, potential exposure to chemicals in sediment and fish and shellfish tissue for a subsistence fisher, recreational fisher, residential user, and recreational user were evaluated based on site-specific exposure parameters and are shown in Table ES-1. The potential excess cancer risks exceeded the Ecology threshold of 1 in 100,000 (1×10^{-5}) for the subsistence and recreational fisher receptors. Table ES-2 is a summary of compounds that exceed 1×10^{-6} for each receptor and exposure pathway.

Table ES-1 Summary of Excess Cancer Risk Results

Pathways	Subsistence Fisher (RME)	Subsistence Fisher (CT)	Recreational Fisher (RME)	Recreational Fisher (CT)	Residential User	Recreational User
Sediment - Ingestion	5.2E-06	5.2E-06	2.0E-06	6.0E-07	2.0E-06	2.8E-07
Sediment - Dermal	8.0E-06	8.7E-07	3.2E-06	1.1E-07	2.7E-06	4.7E-07
Tissue - Ingestion[1]	1.2E-02	6.1E-03	2.8E-04	2.0E-04	--	--
Total Excess Cancer Risk	**1.2E-02**	**6.1E-03**	**2.8E-04**	**2.0E-04**	**5.2E-06**	**7.5E-07**

Note: Shaded cell indicates excess cancer risk greater than 1 x 10-5.
1 – Includes PCBs as Aroclors
RME = reasonable maximum exposure
CT = central tendency
cPAH, TCDD TEQ, and PCBs were calculated using a concentration of one half the reporting limit for non-detected values.

Table ES-2 Summary of Compounds that Exceed Excess Cancer Risk Threshold of 1 in 1,000,000

Pathway	Compound	Subsistence Fisher (RME)	Subsistence Fisher (CT)	Recreational Fisher (RME)	Recreational Fisher (CT)
Sediment Ingestion	Arsenic	3.5E-06	3.5E-06	1.4E-06	
Sediment Ingestion	TCDD TEQ[1]	1.6E-06	1.6E-06	6.0E-06	
Sediment Dermal	Arsenic	4.4E-06			
Sediment Dermal	TCDD TEQ[1]	3.2E-06		1.3E-06	
Fish Ingestion	Arsenic (Inorganic)	7.0E-03	3.5E-03	2.2E-04	1.5E-04
Fish Ingestion	PCB - Aroclors[1]	1.4E-03	6.8E-04	1.3E-05	9.4E-06
Fish Ingestion	PCB TEQ[1]	2.9E-04	1.4E-04	9.0E-06	6.3E-06
Fish Ingestion	cPAH[1]	3.2E-04	1.6E-04	1.1E-06	7.8E-06
Fish Ingestion	TCDD TEQ[1]	2.8E-03	1.4E-03	1.9E-05	1.3E-05
Fish Ingestion	DDE	4.2E-06	2.1E-06		
Fish Ingestion	DDT	2.5E-05	1.3E-05		
Fish Ingestion	alpha-BHC	5.1E-04	2.6E-04	1.6E-05	1.1E-05
Fish Ingestion	beta-BHC	6.8E-05	3.4E-05	2.0E-06	1.4E-06
Fish Ingestion	Lindane	1.4E-05	7.1E-06		
Fish Ingestion	Pentachlorophenol	2.2E-05	1.1E-05		
Fish Ingestion	Hexachlorobenzene	2.0E-06	2.0E-06	2.0E-06	2.0E-06

Notes:

Compound exceeds cancer risk threshold of 1 x 10^{-6} at specified risk level.
1 - Values calculated including non-detected compounds at one-half detection limit.
RME = reasonable maximum exposure
CT = central tendency

Noncancer hazards also exceeded Ecology's threshold of 1.0 for the subsistence and recreational fisher scenarios. Table ES-3 is a summary of compounds that exceed a HQ of 1.0 for each receptor and exposure pathway.

Table ES-3 Summary of Compounds that Exceed Hazard Quotient Threshold

Pathway	Compound	Subsistence Fisher (RME)		Subsistence Fisher (CT)		Recreational Fisher (RME)		Recreational Fisher (CT)	
		Adult	Child	Adult	Child	Adult	Child	Adult	Child
Fish Ingestion	Arsenic (Inorganic)	14.4	28.5	7.2	14.2		1.8		1.3
Fish Ingestion	Cadmium	3.2	6.3	1.6	3.2				
Fish Ingestion	Cobalt	3.5	6.9	1.7	3.5				
Fish Ingestion	Copper	1.9	3.8		1.9				
Fish Ingestion	Iron	2.5	4.9	1.2	2.4				
Fish Ingestion	Selenium	1.2	2.5		1.2				
Fish Ingestion	Silver		1.3						
Fish Ingestion	Vanadium		1.2						
Fish Ingestion	Zinc		1.1						
Fish Ingestion	Methylmercury	5.1	10.2	2.6	5.1				
Fish Ingestion	PCBs - Aroclors[1]	31.3	62.0	15.6	31.0		1.3		
Fish Ingestion	PCB TEQ[1]	1.8	3.5		1.7				
Fish Ingestion	TCDD TEQ[1]	17.5	34.7	8.8	17.4				
All	Total HI (PCB Aroclors)	83	170	42	83	3.6	6.1	2.4	4.2
All	Total HI (PCB TEQs)	54	110	27	54	3	5	2	3.4

Notes:

Compound exceeds Ecology HQ threshold of 1.0 at specified level.
1 - Values calculated including non-detected compounds at one-half detection limit.
RME = reasonable maximum exposure
CT = central tendency
HI = hazard index

Cancer risks and noncancer hazards for the residential and recreational users were below the Ecology threshold. The largest contributors to hazards and risks were exposure to arsenic, total PCBs, and 2,3,7,8-TCDD TEQ through ingestion of fish and shellfish.

Results from lead modeling indicate that exposure to lead in fish and shellfish may result in blood lead levels for a child above the United States Environmental Protection Agency (U.S. EPA) level of concern.

These risks and hazards may be considerably influenced by uncertainties associated with the IHSs and exposure pathways contributing to the greatest proportion of total risks:

- Small sample numbers used to estimate EPCs for tissues;
- Inclusion of IHSs likely present at concentrations consistent with reference concentrations (arsenic, pesticides);
- Quantification of seafood ingestion rates for the LEKT and recreational users of Port Angeles Harbor; and

- Lack of sediment-specific exposure parameters, particularly for dermal exposure assessment.

Further evaluation of the impacts of the uncertainty in the assessment is warranted based on the results.

Ecological Risk Assessment Summary

The ecological risk assessment was conducted in accordance with Washington State and U.S. EPA guidance. Eight assessment endpoints were evaluated: (1) marine plants and macroalgae, (2) benthic invertebrates, (3) fish, (4) carnivorous birds, (5) omnivorous birds, (6) herbivorous birds, (7) carnivorous mammals, and (8) omnivorous mammals. A summary of potential risks to these assessment endpoints is provided in Table ES-4. In brief, marine vegetation and benthic invertebrates are the receptor groups most at risk from current environmental conditions in Port Angeles Harbor. For these assessment endpoints, sediment habitat degradation by wood waste and selected metals and organic contaminants appear to be the most critical stressor. Arsenic may pose a risk to fish and omnivorous mammals.

Table ES-4 Summary of Potential Risks to Assessment Endpoints in Port Angeles Harbor

Assessment Endpoint	Representative Species	Summary and Conclusion
Marine plants and macroalgae	Eel grass, kelp	About 25% of the near-shore environment in the harbor has been degraded by wood waste based on studies conducted in 1998 and 2008. The primary areas of accumulation are located in the western portion of the harbor along the base of Ediz Hook, in the Lagoon Area, along the waterfront at the Port of Port Angeles Management Area, and in the Log Pond Area and surrounding the west side of the Rayonier Mill Dock. In areas with adequate light penetration, the sediment environment provides important habitat for marine vegetation. Because a considerable portion of the near-shore sediment environment in Port Angeles Harbor has been degraded by wood waste, it seems reasonable to hypothesize that the ability of Port Angeles Harbor to support marine plants and marcoalgae has been compromised.
Benthic invertebrates	Clams, polychaetes, crabs	Three measures were used to assess potential risks to benthic invertebrates: (1) sediment chemical concentrations compared with benchmarks, (2) bioassay testing, and (3) evaluation of sediment habitat quality. All three measures suggest that the benthic invertebrate community may be impaired at the site. First, several metals (arsenic, cadmium, mercury, and zinc) and organic chemicals (bis[2-ethylhexyl]phthalate, butylbenzylphthalate, 4-methylphenol, and phenol) were found to exceed

Table ES-4 Summary of Potential Risks to Assessment Endpoints in Port Angeles Harbor

Assessment Endpoint	Representative Species	Summary and Conclusion
		SMS criteria. Second, sediment samples from 29 stations submitted for bioassay testing failed to meet SMS criteria. Third, sediment habitat quality has been impaired by wood waste accumulation in about 25% of the harbor. Based on these three measures, benthic invertebrate community impairment is most evident in the Inner Harbor Area near the base of Ediz Hook, Lagoon Area, Marina Area, and near the Rayonier facility.
Fish	Rock sole, lingcod	Possible risk from arsenic.[2] No unacceptable risks from other chemicals.
Carnivorous birds	Bald eagle, cormorant	No unacceptable risks.[1]
Omnivorous birds	Greater scaup	No unacceptable risks.[1]
Herbivorous birds	Brant	No unacceptable risks.[1]
Carnivorous mammals	Harbor seal	No unacceptable risks.[1]
Omnivorous mammals	Raccoon	Possible risk from arsenic.[2] No unacceptable risks from other chemicals.

Key:
CSL = Cleanup Screening Level
SMS = Sediment Management Standards
Notes:
1 = Hazard quotient (HQ) marginally greater than 1.
2 = HQ < 1 for all chemicals evaluated.

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1.0 Introduction

Port Angeles Harbor (harbor), Washington, has been identified as a priority environmental restoration project by the Washington State Department of Ecology (Ecology) as part of the Puget Sound Initiative. Ecology's Toxics Cleanup Program has identified the harbor for focused source control actions, sediment cleanup, and restoration efforts. Environmental investigations throughout the harbor have indicated that potential chemicals of concern generated by intensive industrialization and urbanization activities exist within the harbor. These investigations have indicated that chemicals in marine sediments and biota may pose a risk to human and environmental receptors.

As part of the effort to clean up and restore the harbor, there is a need to characterize potential risks from marine sediment throughout the harbor as related to current and historic potential contaminant sources. Ecology has tasked Ecology and Environment, Inc., (E & E) with conducting sediment investigations and a risk assessment focusing on the marine environment and associated terrestrial and aquatic source areas. Consultants for the Rayonier Corporation began a remedial investigation/feasibility study (RI/FS) of the upland and marine portion of the site. The current sediment investigation provides data to supplement that effort.

1.1 Risk Assessment Overview

This risk assessment provides the methodology and results for the human health and ecological risk assessment. This assessment follows the protocol outlined in the risk assessment work plan submitted as Attachment D of the Sampling and Analysis Plan (E & E 2008a). In addition, technical memoranda providing additional details on indicator hazardous substance (IHS) identification and the human health and ecological exposure parameters (E & E 2009a and b) were provided to Ecology for review and comment on.

1.2 Document Structure

In addition to the Introduction, this document consists of the following sections:

Section 2, Background – Provides background information for the risk assessments including location and setting, history, potential contaminants of concern, migration pathways and data evaluation.

Section 3, Human Health Risk Assessment (HHRA) – Provides the methodology and results for the HHRA including the selection of IHSs, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis.

Section 4, Ecological Risk Assessment (ERA) – Provides the methodology and results for the ERA.

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2.0 Background

2.1 Location and Setting

The City of Port Angeles is on the northern coast of the Olympic Peninsula in Clallam County, Washington (Figure 2-1). The city features 26 miles (42 km) of marine shoreline, including Ediz Hook, a 2.5-mile-long sand spit. The harbor is bounded to the west and south by the City of Port Angeles and to the north by Ediz Hook. The harbor is considered a deep-water harbor, with depths greater than 90 feet near the eastern end of Ediz Hook. Intertidal shorelines exist in the southeastern portion of the harbor (E & E 2008b).

Port Angeles Harbor is affected by current and historical chemical inputs from industrial and municipal sources and wood waste inputs from current and historical processing activities and log rafting. The marine waters of Port Angeles Harbor are listed as impaired by the State of Washington under Section 303(d) of the Clean Water Act (CWA), due to low dissolved oxygen levels and fecal coliform (U.S. EPA 2009).

2.2 History

Over the past century, Port Angeles Harbor has hosted a number of industries, including saw mills and plywood manufacturing, pulp and paper production facilities, marine shipping and transport, boat building and refurbishing, marinas, and commercial fishing enterprises. Since the early 1900s, pulp and paper mills have dominated Port Angeles's industrial sector. Between 1914 and 1941, four major mills and one plywood manufacturing company began operations along the Port Angeles waterfront. One of those mills, Nippon, remains in operation. K-Ply, a plywood manufacturing facility, closed in March 2008. Sizable over-water log booming areas along the nearshore of the harbor were, and in some cases still are, associated with these businesses.

Prior to passage of the CWA in1972, untreated process effluent from the mill facilities was discharged into the harbor (Shea et al. 1981). Following passage of the CWA, industrial wastewater from mills was treated before discharge to the harbor. Pulp and paper mill-treated effluents continued to be discharged into the harbor until 2008. The Rayonier Mill site was one significant source of constituents of concern in marine sediments from various chemicals derived from the paper and pulp mill process, and remediation/redevelopment of this site is an important component of the Port Angeles Harbor investigation.

Port Angeles Harbor has supported many industries associated with commercial and recreational shipping, including goods transport, ferry services, and other marine logistical operations. Petroleum-based facilities have been a significant part of the harbor's industrial community as part of those shipping services. A number of petroleum bulk stations and terminals have been located near the harbor waterfront since the 1920s in conjunction with the shipping and lumber industries. Many of these facilities have experienced episodes with leaking aboveground and underground storage tanks. There have been crude oil and fuel spills since the 1980s from tankers refueling or running aground. Other general businesses along the Port Angeles waterfront include automotive services, telecommunications, a newspaper, and other urban businesses.

The City of Port Angeles has an estimated population of 18,640 people (Oldham 2007), with associated municipal wastewater and stormwater infrastructure to support the local community. Historically and currently, the harbor has received discharges from the combined sewer outfalls (CSOs), the City of Port Angeles wastewater outfall on the southeast side of the harbor, septic systems in various stages of disrepair outside the city limits, and non-point source runoff from stormwater (CPAPWD 2006, CCMRC 2001). The harbor also receives direct surface water discharge from the six freshwater creeks in the area, all of which have varying degrees of residential and commercial land-use influences. Five of the creeks are listed as impaired in terms of water quality and biological quality by the Clallam County Stream Keepers (CCDCD 2004).

Shellfish harvesting and fishing historically have been important commercial and subsistence activities in the harbor, particularly for the Lower Elwha Klallam Tribe (LEKT), who are subsistence-level consumers of shellfish (ATSDR 2000a, Ecology 2008a). Harbor fisheries have been impacted by environmental quality issues (Beaverson 1998, CCMRC 2001). Anthropogenic impacts from various sources including wastewater pollution, industrial-based contaminants, and stormwater runoff may have contributed to apparent declines in shellfish and fish populations, as well as to the closure of historical shellfish tracts for commercial harvesting (Beaverson 1998, CCMRC 2001).

2.2.1 Demographics and Land Use

The greater Port Angeles area has a long history of inhabitation and mixed land uses. Native Americans from the LEKT were the first humans to settle in and around Port Angeles, primarily near the mouth of Ennis Creek. Two former Klallam villages, I'e'nis and Tse-whit-zen, once stood where Port Angeles is today. The approximately 650 members of the LEKT currently reside in the lower Elwha River Valley and on bluffs just west of Port Angeles (Ecology 2008a). Tribal lands include about 1,000 acres on and near the Elwha River (Ecology 2008a). The Lower Elwha Klallam Tribe's reservation lands (427 acres) are located on the east side of the Elwha River at its mouth, on the northern edge of the Olympic Peninsula directly across from Victoria, British Columbia. Fishing and gathering are important tribal activities (NWIFC 2008).

Spanish explorers en route to exploring Vancouver Island named the town's natural harbor Puerto de Nuestra Señora de Los Angeles (History Link 2008). From 1887 to 1904, the property now occupied by Rayonier was used by the Puget Sound Cooperative Colony (Integral 2006). In 1890, the city of Port Angeles became incorporated. During the early part of the twentieth century, establishment of lumber, pulp, paper, and plywood mills along the harbor boosted the local economy (History Link 2008). The immediate harbor surroundings are diversified in their use, ranging from commercial to residential.

Within the city limits of Port Angeles, zoning today includes mixed industrial, commercial, recreational, and residential. In addition to mixed residential and commercial structures, the City of Port Angeles contains publicly owned treatment works (POTW), the Olympic Memorial Hospital, and elementary through senior high schools.

Clallam County has had higher growth rates than the state average over the past eight years. The census data demonstrate a 9.7 percent (%) population growth rate, which is higher than the state's average annual growth rate of 8.5%. The 2006 population estimate for Clallam County was 70,400 persons, and the county contained 33,517 housing units at the end of 2006. The 2000 census indicated 3,692 units currently occupied in the City of Port Angeles. The census also reported a total of 30,683 housing units for all of Clallam County, 11% of which were located in Port Angeles. The total area of Clallam County is 1,739.45 square miles, with an average of 37.1 occupants per square mile, according to the 2000 census. The census also reported an average of 2.31 persons per household and a median household income of $40,391 per person. The per capita income in 1999 was $19,517. Persons who fell below the poverty level as defined by the federal government totaled 12.3% of the county's population (Census 2008).

2.2.2 Climate

The average annual precipitation for Clallam County is consistently less than 30 inches per year (NOAA 2008a). This is one of the lowest rates in the state, where precipitation ranges from greater than 240 inches per year to less than 25 inches per year. Average maximum temperatures in this coastal zone range from 65° to 70° F during summer and 45° to 50° F during winter (NOAA 2008a). Peak temperatures are rarely greater than 90° F in the summer or lower than 30° F in the winter. The coldest temperatures are typically associated with cold air blowing from the interior of Canada and down through the Puget Sound area. Freezing temperatures generally arrive in November (NOAA 2008).

Wind data collected in 2006 from an Ecology monitoring station (No. 53009) at the base of Ediz Hook showed prevailing winds from the west and west-southwest, with an average wind speed of 6.5 knots. Wind speeds at Ediz Hook typically are lowest between March and November and highest between November and late February. Wind speeds recorded on the bluff south of the Rayonier property between 1997 and 1999 averaged 2 to 3 knots (Malcolm Pirnie 2006).

2.2.3 Geology

The geology of Port Angeles Harbor area is discussed in a variety of published reports, some of which pertain to environmental investigations conducted in the area. A summary of the environmental investigations is provided in the Port Angeles Harbor Final Summary of Existing Information and Identification of Data Gaps Report (E & E 2008b). The geology of the Rayonier Mill area is discussed in detail by Malcolm Pirnie (2006) and briefly summarized below. Elevations in the industrial area (near the former Rayonier Mill location) range from sea level to approximately 75 feet above sea level. Terrain elevations decrease to the north (toward the water) and increase to the south (toward the Olympic Mountains). Hills within a mile southeast and southwest of the former Rayonier Mill site gradually rise toward the foothills of the Olympic Mountains, which are approximately five miles from the site.

The local geology is characterized by Tertiary bedrock overlain by Pleistocene deposits and recent alluvium deposit. The industrial area (including the former Rayonier Mill site) lies in an area of alluvium deposited by Ennis Creek, beach deposits from the Strait of Juan de Fuca, and fill material. Along the bluffs south of the former Rayonier Mill site lie deposits of Vashon Till, which is a mix of gravel and cobbles in a matrix of sand, clay, and silt. Depth to bedrock in the area is unknown but likely variable, based on local isolated outcrops of the Tertiary Twin River Formation (Malcolm Pirnie 2006).

Area groundwater has been characterized by HLA (1993), Landau (1997), and U.S. Environmental Protection Agency (U.S. EPA; E & E 1998). There is unconfined groundwater beneath the former Rayonier Mill site in a shallow water-bearing zone consisting of near-surface fill and alluvial deposits. The depth to groundwater in this zone ranges from less than 1 foot below ground surface (bgs) to 12 feet bgs. The water-bearing zone varies from 12 feet bgs to more than 30 feet bgs. Groundwater elevations are influenced by tides (E & E 1998) and to a lesser degree by surface water fluctuations in Ennis Creek (Malcolm Pirnie 2006).

Groundwater elevation measurements made in previous investigations indicate a predominantly northerly groundwater flow direction toward Port Angeles Harbor, with a locally variable lateral component of Ennis Creek. The Uplands Remedial Investigation (Integral 2006) presents an analysis of groundwater conditions at the site. The gradient after the first high tide was measured at 0.0072 feet per foot and 0.0082 feet per foot after the first low tide (HLA 1993). For more information on area-wide geology see Appendix I of the Sediment Investigation Report (E & E 2012).

2.2.4 Geology and Sediment

Several previous sediment investigations in Port Angeles Harbor have focused on characterization of wood waste and contaminants associated with industrial, municipal, and commercial sources (SAIC 1999, Foster Wheeler 2001). As Malcolm Pirnie reported (2006), these studies have shown that wood waste covers approximately 25% (500 acres) of the bottom of Port Angeles Harbor. Most of the wood waste occurs in the north and west portions of the harbor. Size and abundance of wood debris decrease offshore (Malcolm Pirnie 2006). As part of the present Sediment Investigation, geology of Port Angeles Harbor sediments and nature and distribution of wood waste have been further characterized. Pertinent results are presented in Section 8 of the Sediment Investigation Report. Section 8 in the Sediment Investigation Report provides a discussion and figures of wood-waste distribution in Port Angeles Harbor based on data collected in 2008; compares 2008 wood waste data with similar data from SAIC (1999); and examines relationships between wood waste, TOC, guaiacols, and organic acids.

2.2.5 Hydrology

Water movement in Port Angeles Harbor is affected by tides, stream flow, wind, waves, coriolis force, and shoreline and bottom configuration. Collectively, these influences result in directional currents, tidal eddies, vertical mixing, and other water movements (Pirnie 2007a). Harbor hydrology is discussed further in Section 9 and Appendices D and I of the Sediment Investigation Report.

Stream Flow

The harbor receives direct surface water discharge from six freshwater creeks in the area, Tumwater, Valley, Peabody, White, Ennis, and Lees. White and Ennis creeks converge and run through the former Rayonier Mill site as Ennis Creek. These flows have the potential to transport contaminants to the harbor. Stream flow is discussed further in Section 10 and Appendix I of the Sediment Investigation Report.

Tides and Currents

Tides and currents are discussed further in Section 10 and Appendix D and I of the Sediment Investigation Report (E & E 2012). Tides in the area are mixed semi-diurnal (i.e., tides occur every six hours with low tides of different magnitudes), and with a mean time range of 4.6 feet. Due to strong and persistent wind stress from the west and an intense eastward boundary current along the southern shoreline of the Strait of Juan de Fuca, surface currents are strongly eastward east of Lees Creek. However, strong tidal eddies are common in areas protected by Ediz Hook. These motions are not coherent across the harbor in the form of a single eddy, including several eddies. Rather, they appear to be small, localized events of short duration. It appears that strong eastward surface currents within the harbor caused by west winds are balanced by westward counterflows near the bed.

Wind

Studies using drift sheets have indicated that wind can quickly transport surface water from Port Angeles Harbor to Dungeness Spit. Prevailing winds throughout most of the year (March – October) are from the west and west-southwest, and for the remainder of the year have no consistent direction (Malcolm Pirnie 2006). Wind is also responsible for generation of waves and resulting alongshore drift. Wind is discussed further in Section 10 and Appendix I of the Sediment Investigation Report.

2.2.6 Ecology

Port Angeles Harbor is an urban embayment with commercial, industrial, and recreational uses. The harbor is partially protected from the Strait of Juan de Fuca by Ediz Hook. Ennis Creek, a freshwater creek, flows through the former Rayonier Mill area and discharges to the marine waters approximately 500 feet east of the Rayonier dock (Malcolm Pirnie 2006). Morse, Lee's, Ennis, and White Creeks flow into the eastern harbor area, whereas Peabody, Valley, and Tumwater Creeks flow into the central harbor area. These creeks flow through the City of Port Angeles and nearby areas and convey contaminants from residential, commercial, and industrial activities to the Harbor. The aquatic environment in Port Angeles Harbor is an ecological transition zone between marine habitat west of Port Angeles and estuarine habitat east of the harbor (Shea et al. 1981). Marine species present in the area include salmonids, bottomfish, shellfish (crabs and clams), algae, and other species. Shea et al. (1981) place the organisms found in the Port Angeles area into the following categories:

- Phytoplankton and other marine plants
- Zooplankton
- Shellfish

- Other invertebrates
- Fish
- Birds
- Mammals

Phytoplankton and other marine plants

This category includes phytoplankton, benthic algae and macroalgae, and seagrasses. Phytoplankton includes green algae, blue-green algae, euglenoids, diatoms, dinoflagellates, and microflagellates. These species are the primary producers that support the higher organisms in the food web.

Benthic diatoms and macroalgae are found on bottom substrates in Port Angeles Harbor. Seagrass (particularly eelgrass, *Zostera marina*) occurs in the Port Angeles area, primarily inside Ediz Hook and inside Dungeness Spit, east of Port Angeles (Malcolm Pirnie 2006).

Zooplankton

Zooplankton are small primary consumers that feed mainly on phytoplankton. These animals float and drift in the water, providing a major food source for higher-trophic-level animals such as baitfish, sportfish, and commercially fished species. Three types of zooplankton, icthyoplankton (eggs and larval forms of fish and shellfish), microzooplankton (microscopic organisms), and macrozooplankton (very small, but visible, marine animals) occur in Port Angeles Harbor. Icthyoplankton are found seasonally in the harbor. Microplankton and macroplankton are found in abundance in the harbor area (Malcolm Pirnie 2006).

Shellfish

Shellfish include clams, crabs, and shrimp. Clams are bottom-feeders, while shrimp and crabs consume living or dead organic material. Several species of shellfish are found in the harbor area, including the Dungeness crab (*Cancer magister*), horse clam (*Tresus capax*), and geoduck (*Panope abrup*). Shellfish harvest is restricted in sections of Port Angeles Harbor due to pollution (Clallam County Department of Health and Human Services 2007) and biotoxins.

Fish

As described in the Marine Remedial Investigation (Malcolm Pirnie 2006), more than 60 species of marine fish have been documented in the Port Angeles area. Five salmonid species (Chinook, coho, chum, pink, and sockeye salmon) may occur in the harbor. Steelhead and cutthroat trout may occur in Tumwater and Ennis creeks when they are migrating or following schools of forage fish. Salmonids generally migrate through the Port Angeles area as adults returning to freshwater areas to spawn or as juveniles migrating to open water. Some species (for example Chinook and coho salmon) may occur in the harbor area year-round, particularly if forage fish are present.

Common bottomfish species in Port Angeles Harbor include lingcod, copper rockfish, quillback rockfish, black rockfish, English sole, Dover sole, rock sole, starry flounder, sand dabs, and perch (Malcolm Pirnie 2006). The migratory range for bottomfish is limited, and these species may be found year-round in the harbor and surrounding area.

Forage fish found in Port Angeles include herring, smelt, anchovies, and sand lance. Herring and sand lance may be found in Port Angeles year-round, although they likely migrate and are seasonally abundant (Malcolm Pirnie 2006).

Species such as clam, flatfish, and crab are found on the subtidal areas of the bench along the southern portion of the harbor. Rockfish are occasionally found around some of the structures, such as the Rayonier deep water outfall (Malcolm Pirnie 2006).

In 2006 and 2007, the National Oceanic and Atmospheric Administration (NOAA) surveyed fish species by seining at three intertidal locations within Port Angeles Harbor (two Ediz Hook sites and one Ennis Creek site). Results of the seining are presented in Table 2-1 (NOAA 2008b). Over 40 species were collected, which shows that the intertidal fish community in Port Angeles Harbor is diverse. Based on abundance, surf smelt and shiner perch appear to be the dominant fish species in the intertidal zone.

Rockfish consumption is restricted in Port Angeles Harbor due to dioxin and PCB contamination (Clallam County Department of Health and Human Services 2007).

Birds

Marine birds found in the Port Angeles area principally use the U.S. Fish and Wildlife Service (USFWS) Dungeness National Wildlife Refuge (DNWR), which includes Dungeness Spit, Dungeness Bay, and the surrounding open water (Shea et al. 1981). Shorebirds and waterfowl (ducks and geese) are migratory species, and abundance generally is highest in fall and winter. Species noted in the harbor include loons, grebes, cormorants, herons, geese, dabbling ducks, sea ducks, rails, gulls, and kingfishers. Grebes, cormorants, and waterfowl are found along the long stretch of shoreline west of Port Angeles (Malcolm Pirnie 2006).

Intertidal and shallow tidal submerged grasses such as eelgrass and associated benthic invertebrates are food resources used by many birds. Diving ducks (bay ducks), cormorants, grebes, herons, hawks, eagles, gulls, terns, kingfishers, and alcids all may consume fish. Areas of particularly abundant food and shelter for birds as noted by Shea et al. (1981) include the mouth of Morse Creek and the Dungeness River. Eelgrass (found in nearshore beds) also is a principal dietary component for brant and other herbivorous species (Malcolm Pirnie 2006).

Mammals

Twenty species of marine mammals, including seals, sea lions, whales, and porpoises, are found in or near Port Angeles Harbor (Malcolm Pirnie 2006). The species most commonly observed are the harbor seal (*Phoca vitulina*), California sea lion (*Zalophus californianus*), northern sea lion (*Eumetropias jubata*), Minke whale (*Balaenoptera acutorostrata*), orca (*Orcinus orca*), Dall's porpoise (*Phocoenoides dalli*), and harbor porpoise (*Phocoena phocoena*). Pinniped mammals (seals) are primarily concentrated with marine birds in the area surrounding the DNWR. Certain marine mammals may also be expected to use the area surrounding the former

Rayonier Mill site in Port Angeles Harbor. For example, harbor seals have been observed swimming and apparently foraging in the marine environment near the mill, but haul-out locations are lacking in this area (Malcolm Pirnie 2006). Harbor seals have also been seen to use log rafting locations in the west end of harbor near the marina.

Threatened and Endangered Species

According to Malcolm Pirnie (2006), species of concern that inhabit the northern portion of the Olympic Peninsula include the Steller's sea lion (*Eumetopias jubatus*), Pacific harbor porpoise (*Phocoena phocoena*), orca whale (*Orcinus orca*), brown pelican (*Pelecanus occidentalis*), bald eagle (*Haliaeetus leucocephalus*), merlin (*Falco columbarius*), peregrine falcon (*Falco peregrinus*), common murre (*Uria aalge*), marbled murrelet (*Brachyramphus marmoratus*), pileated woodpecker (*Dryocopus pileatus*), western toad (*Bufo boreas*), Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*), Hood Canal summer chum (*Oncorhynchus keta*), bull trout (*Salvelinus confluentus*), and coho salmon (*Oncorhynchus kisutch*). Given their habitat requirements, many of these species have the potential to occur in Port Angeles Harbor.

2.3 Potential Constituents of Concern

Potential constituents of concern to harbor sediments and biota were identified based on known chemical associations with historical and current land uses, as well as a significant amount of data collected during prior sediment investigations within the harbor (E & E 1998 and 1999, Malcolm Pirnie 2006 and 2007). These investigations identified chemicals that exceed the Washington Sediment Management Standards (SMS), those that are commonly associated with wood debris degradation that could contribute to exceeding SMS biological criteria, and those known to bioaccumulate. The following chemicals were identified in the Port Angeles Final Summary of Existing Information and Data Gaps Report (SDEIG; E & E 2008b) as potential constituents of concern:

- Dioxins and furans
- Polychlorinated biphenyls (PCBs)
- Chlorinated pesticides
- Semi-volatile organic compounds (SVOCs), including polycyclic aromatic hydrocarbons (PAHs), phenols, and phthalates
- Resin acids/guaiacols
- Tributyltin (TBT)
- Ammonia, sulfides, and total organic carbons (TOCs)
- Heavy metals, including inorganic and organic forms

Many of these chemicals are known to be persistent in the environment and potentially bioaccumulative. Of particular concern are polychlorinated dibenzodioxins (dioxins) and dibenzofurans (furans), PCBs, and PAHs. Dioxins/furans are byproducts formed during combustion of organic compounds in the presence of chloride and during pulp bleaching practices. Dioxin/furan-producing processes include incineration of municipal and medical wastes, boilers/industrial furnaces, diesel heavy-duty trucks, sintering plants, automobiles using either leaded or unleaded gasoline, oil-fired utilities, lightweight aggregate kilns that combust hazardous waste, petroleum refining, crematoria, and drum reclamation. Penta (pentacholorophenol) is sometimes used as a wood preservative in lumber and plywood mills; its production produces dioxins/furans. Usually carried out to sediments in an oil/penta phase, dioxins/furans are left behind once the oil and penta degrade. This dioxin/furan contamination of technical-grade penta has an identifiable chemical signature that is different than either stack emissions or combustion byproducts. Dioxins/furans can also be produced as byproducts from production of PCB mixtures. Dioxin/furan source assessments conducted in Washington show incinerators, hog fuel (wood waste) boilers, mills that produce bleached pulp and paper, cement kilns, and municipal wastewater treatment plants as medium to high priority for source reduction/control (Ecology 1998).

PCBs are synthetic mixtures of chlorinated compounds that are no longer manufactured in the U.S. but are still found in many products. PCBs have been used as coolants and lubricants in electrical equipment (transformers, capacitors) and are found in older fluorescent lighting fixtures and electrical appliances, paints, pesticide additives, sealants, and hydraulic oils (ATSDR 2000b). PCBs were extensively used in ship manufacturing as a fire retardant, and may be introduced into waters through ship-building and decommissioning activities, as well as during ship maintenance and release of oily bilgewater.

Dichlorodiphenyltrichloroethane (DDT) is a chlorinated pesticide once widely used in the U.S. before it was banned in 1972. Dichlorodiphenyldichloroethylene (DDE) and dichlorodiphenyldichloroethane (DDD) are derivatives of DDT that contaminate commercial DDT preparations; their use has also been banned. These fairly insoluble chemicals are highly persistent in the environment, particularly in sediment and biota (ATSDR 2002).

SVOCs are a class of compounds that include PAHs, phenols, methylphenols, and phthalates. Pyrogenic PAHs are a group of over 100 chemicals formed during incomplete burning of coal, oil and gas, garbage, or other organic substances. PAHs are usually found as a mixture of two or more chemicals in coal tar, crude oil, creosote, marine diesel fuel and exhaust, automobile exhaust, street runoff, roofing tar, and products used to make dyes, plastics, and pesticides (ATSDR 1996). Phenols are a class of widely distributed chemicals that are both manufactured and naturally occurring. Phenols are used primarily in production of phenolic resins and manufacture of synthetic fibers, slimicides, and disinfectants, as well as in various consumer products (ATSDR 2006). Cresols are methylphenols; with PAHs, they make up creosote, which is produced from high temperature treatment of wood or coal, or from the resin of the creosote bush. Creosote is used as a preservative in marine lumber applications (dolphins, pilings). Creosoted pilings and remnants are a continuous source of marine pollution because they leach methylphenols and PAHs to marine waters and sediments. Abandoned pilings usually wash up on beaches and leach PAHs into the coastal habitat for years (MRC 2008). Phthalates are widely distributed synthetic compounds, used primarily in vinyl products, plastics, and personal care products such as fragrances and nail polish. Phthalates are widely present in CSO and stormwater discharges.

Resin acids and guaiacols are plant-derived chemicals found in association with wood debris, hardwood tar, and pulp and paper mill processes (Malcolm Pirnie 2007a). Resin acids are a component of most softwoods and are usually released from wood chips during the pulping process. Their acute toxicity towards fish and other aquatic life has been shown in previous studies. Resin acids may account for as much as 70% of the toxicity of effluents (Li et al. 1996). Guaiacols are toxic to humans as well as to aquatic organisms.

Tributyltin (TBT) is a highly toxic compound used as an anti-fouling agent in marine paints applied to the bottom of boats. It is ubiquitous in use and can be released to marine sediments through leaching from paint into the water and when vessel hulls are scraped. Any harbor or bay with large international vessel traffic will have on-going TBT sources. NOAA's Mussel Watch Program, a long-term status and trends program that monitors contaminants in sediments and mussels, includes TBT as an important monitored analyte (NOAA 2007).

Metals such as inorganic arsenic, lead, zinc, copper, mercury, and cadmium occur naturally from geologic processes and are also used extensively in manmade products (including paints, cigarettes, fertilizers, industrial solvents, batteries, thermometers, dental fillings, light bulbs, and more; ATSDR 2008a). Common sources of metals from anthropogenic sources include car brake dust, incineration, medical and municipal waste, boat paints, other vessel-related sources (for example anodes and mercury-containing instruments), and automotive manufacturing and wrecking disposal (ATSDR 2008a).

2.4 Chemical Migration Pathways

Chemicals enter Port Angeles Harbor through numerous pathways. These include discharge of contaminated groundwater, stormwater runoff, dry or wet (precipitation) deposition of airborne compounds, and discharge of industrial and municipal wastewater into streams and waterways/harbor. Discussed below are sources of chemical contaminants, chemicals known to enter Port Angeles Harbor, media and pathways through which these chemicals enter the harbor, and the fate of these compounds once in the harbor. Potential sources of aquatic sediment contamination were discussed in detail by E & E (2008b). Historical Combined Sewer Outfalls (CSOs), outfalls, and wood waste locations are provided in Figure 2-2.

2.4.1 Chemical Release and Transport

This section discusses the potential chemical releases and transport of compounds to Port Angeles Harbor. For additional discussion, see Section 2 of the Sediment Investigation Report (E & E 2012).

Wood Product Facilities

Chemicals associated with wood product facilities include resins and fatty acids/guaiacols, PAHs, PCBs, dioxins/furans, and volatile organic compounds (VOCs). Resins and fatty acids/guaiacols are associated with wood waste byproducts and log booming areas, and enter the harbor through stormwater runoff. PAHs are released during fuel leaks/spills and heavy machinery use and migrate to the harbor in groundwater. PCBs and dioxins/furans from hydraulic fluid spills/leaks, and common processes from pulp and paper mill wastewater streams, including wood bleaching, hog fuel burning and wood waste may enter the harbor. PCB- and dioxin/furan-contaminated stormwater also enters the harbor. VOCs enter the harbor through contaminated site runoff (E & E 2008b). Ammonia and sulfide production are also byproducts of wood waste.

This risk assessment also will evaluate potential effects of wood debris in Port Angeles Harbor.

Marine/Shipping Services

Several chemicals are released during boat building/repair and operations in Port Angeles Harbor. Heavy metals, PCBs, SVOCs, and TBT are released during boat building and repair, particularly as paint is applied to or scraped from boat hulls (TBT is a component of older boat hull paint). Gasoline and diesel spills, leaking underground storage tanks, creosote pilings, and boat exhaust release PAHs to the environment. These compounds enter the harbor directly and in groundwater and stormwater (E & E 2008b).

Creosote-treated Lumber

PAHs from creosote-treated lumber leach directly into marine waters at rates that depend on several factors, including water chemistry, temperature, and salinity, as well as wood type and age (E & E 2008b).

Petroleum Storage Facilities

SVOCs (including total petroleum hydrocarbons) and heavy metals from crude and refined petroleum products are the primary chemicals of concern associated with petroleum-based facilities, possibly including leaking underground or aboveground storage tanks, and major fuel spills. Petroleum products have entered soil and groundwater at many locations along the harbor waterfront. Groundwater may have been a route for chemical migration to harbor sediments. Stormwater runoff from these areas also may contribute petroleum compounds to the harbor environment. Acute point-source spills, particularly of heavier oil materials, are potential pathways for these compounds into marine sediments and biota (E & E 2008b).

Municipal Works

The City of Port Angeles operates several facilities along the harbor. A sewage treatment plant (STP) located near the Rayonier site has one deepwater outfall discharge point that began discharging in 1969. Since then, the STP has had occasional untreated effluent discharges to the harbor. The city also has an extensive stormwater system operating under a National Pollutant Discharge Elimination System (NPDES) permit that drains approximately 10,000 acres (4,047 ha) of the Port Angeles watershed. Several stormwater outfalls discharged untreated stormwater to the harbor in the past. The STP receives leachates from the Mt. Pleasant Landfill, which holds solid waste from the decommissioned Rayonier Mill.

Historically and currently, the Harbor has received discharges from CSO, the city of Port Angeles wastewater outfall on the side of the Harbor, septic systems in various stages of maintenance outside the city limits, and non-point source runoff from stormwater. Historically, there were eleven CSOs that discharged untreated sewer and stormwater discharge into the Harbor. Currently, four CSOs remain, discharging into the Harbor during heavy storms (E & E 2008b).

Chemicals of potential concern in stormwater, effluent, and untreated sewage include heavy metals, phenols, dioxins, PCBs, pesticides, and SVOCs. Total organic carbon/total suspended solids, organic chemicals, and metals are a concern in biosolids released to the harbor (E & E 2008b).

Commercial Fish

Chemicals associated with commercial fish pens include PCBs, pesticides, and dioxins/furans. Farmed salmon are fed a concentrated feed derived from smaller fish that may contain pollutants. Salmon, a relatively oily, fatty fish, can bioaccumulate the PCBs, dioxins, and pesticides from the feed. Excess feed and feces from the pens is released to the ocean floor, and may introduce chemicals into the sediment and biota, as well as cause habitat damage by smothering the benthic community beneath and around the net cages (E & E 2008b).

Residential Inputs

SVOCs, PCBs, pesticides and heavy metals are found in some commercial and residential products, as well as on road surfaces (SVOCs and metals only). These chemicals become associated with stormwater runoff from yards, roads, and other paved surfaces, which then enters the harbor. These compounds also enter septic systems, which may leak and contaminate surface and groundwater (E & E 2008b).

2.4.2 Fate of Chemicals in the Harbor

Waterborne chemicals discharged into Port Angeles Harbor can be affected by water movement, including tidal action, currents, and eddies. Chemicals may volatilize, be diluted, or be broken down in the water column (for example, through photolysis). Other chemicals may adsorb to organic material in the water column or partition to sediment.

VOCs and aromatic acids are highly unstable and are removed rapidly from the water column through various mechanisms, including volatilization and/or dilution and dispersal in seawater (E & E 1998). PAHs in the aquatic environment are present in dissolved form and adsorbed to particulate materials in the water column. PAHs also partition to sediment (E & E 2008b). Low molecular weight PAHs (LPAHs) dissolve more readily in the water column than do heavier PAH compounds. The higher molecular weight PAH (HPAHs)compounds in creosote tend to accumulate in sediment and can be introduced to filter feeding benthic organisms (E & E 2008b).

PCBs in the aquatic environment are highly persistent, with low solubility in water. PCBs have a high affinity for suspended solids and sediment, particularly those high in organic carbon. PCBs are highly soluble in animal fat tissue; they have low water solubility and high octanol/water partition coefficients.

As a result of their relatively low water solubility, dioxins/furans strongly adsorb to sediments and bioaccumulate in aquatic organisms. Because they degrade very slowly by chemical and biological processes, dioxins/furans are persistent environmental contaminants (Smith et al. 1988).

Chemicals in sediment and water can be taken in by marine biota through various feeding and filtering uptake mechanisms, particularly for benthic organisms, whose life stages are closely associated with the sediment layers. Certain compounds including PCBs, PAHs, heavy metals, and dioxins/furans present in lower-level benthic animals such as clams, shrimp, mussels, and worms may bioaccumulate up the food web to higher-level predators such as salmon, rockfish, and lingcod. Chemical uptake by seagrasses and macroalgae also is possible, but less well studied compared with uptake by fish and benthic invertebrates (Chiou 2002).

In situ bioturbation by burrowing organisms such as geoduck, clams, and worms can re-suspend or re-release contaminants into the upper surface sediment layers and water column. Releases of pesticides, PCBs, and dioxins/furans from the feces of pen-reared salmon into sediment also may occur (E & E 2008b).

2.5 Data Evaluation

Available chemical data for Port Angeles Harbor collected within approximately the previous 10 years were evaluated to determine usability according to the data quality criteria discussed in the SAP (E & E 2008a). In addition, data collected by E & E during the 2008 field event was evaluated for usability according to these criteria. The rules for data treatment are described in *Human Health and Ecological Risk Assessment Work Plan*, submitted as Attachment D of the SAP (E & E 2008a).

2.5.1 Previous Investigations

The document *Summary of Existing Information and Identification of Data Gaps Report* (E & E 2008b) identified sources of chemical contaminants associated with historical and on-going commercial and industrial activities in the harbor and general urban point and non-point input sources to the harbor (CSOs, creek discharges, run-off). This information was used to identify data needs for further characterization of the harbor and to support the human health and ecological risk assessment.

Environmental investigations throughout the harbor have indicated that chemicals of concern generated by industrial and urban activities exist within the marine sediments and biota of the harbor. Prior investigations conducted in the harbor over the past 15 years include the following:

- U.S. EPA Dioxin and Furan Concentrations in Puget Sound Crabs (1991a)
- U.S. EPA Expanded Site Investigation of Rayonier Mill (E & E 1998 and 1999)
- Ecology Marine Sediment Monitoring Program (Ecology 1998a and b)
- Ecology Port Angeles Harbor Wood Waste Study (SAIC 1999)
- Rayonier Log Pond Survey for Remedial Investigations (Foster Wheeler 2001)
- Washington State Department of Transportation Port Angeles Graving Dock (GeoEngineers 2003)
- Washington Department of Health Consultation: Rayonier Mill Site Exposure Investigation (WDOH 2005)

- Sampling and Analysis Report, Sediment Grab Sampling and Log Density Survey, Nippon Paper Industries USA Pulp and Paper Mill Port Angeles Facility (Anchor Environmental LLC 2005).

- Remedial Investigation for the Marine Environment near the Former Rayonier Mill Site (Malcolm Pirnie 2006)

- Phase 2 Addendum for the Marine Environment near the Former Rayonier Mill Site (Malcolm Pirnie 2007)

- Environmental Baseline Investigation, DNR Lease 22-077766: Nippon Paper Industries USA Co., Ltd., Port Angeles, Washington (Exponent 2008)

2.5.2 Data Used in Risk Assessments

Numerous studies have characterized chemical constituents in sediment and distribution of wood waste in Port Angeles Harbor. Data from all of the above listed reports was determined to be of appropriate quality to be used in the human health and ecological risk assessments except as indicated in Table 2-2.

The following study is considered relevant for evaluating ecological impacts to marine benthic invertebrates at the site, but not for assessing human health risks because it does not include contaminant data:

- Ecology Port Angeles Harbor Wood Waste Study (SAIC 1999)

Sampling locations from the Sediment Investigation Report (E & E 2012) are shown in Figures 3-1 through 3-5 for sediment and tissue.

Table 2-3 shows the media and sample number of Port Angeles Harbor site samples from each study used in the risk assessments. Table 2-4 shows the number of samples from the reference location, Dungeness Bay.

Over the past approximately 10 years, the preferred analytical method for analysis of PCBs in environmental media has changed. Historically, Aroclor analysis was considered the preferred method. Currently, it is recognized that analysis of environmental samples for PCB congeners, dioxin-like PCB congeners in particular, provides better information regarding the true nature of PCB contamination. However, PCB congener analysis is considerably more expensive than Aroclor analysis. The studies used as data sources for the risk assessment (see above listing) provide both Aroclor and congener data. The number of Aroclor and PCB congener samples reported for Port Angeles Harbor and Dungeness Bay from these studies is listed in Table 2-5. Individual congener data not was available electronically from all reports (i.e. Malcolm Pirnie 2007); therefore, total congener results presented in the report were included in the risk assessment.

Scale 1:24,000

Figure 2-1

Port Angeles Hrbor, Washington

Port Angeles Harbor and Vicinity

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N W E S

0 395 790 1,580 2,370 3,160 3,950 4,740
Feet

Scale 1:26,000

Figure 2-2

Port Angeles Harbor, Washington

Port Angeles Harbor CSOs, Outfalls, & Woodwaste Location Map

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N
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W
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0 0.125 0.25 0.5 0.75 1 1.25
Miles
Scale 1:24,000

Figure 2-3

Port Angeles Harbor, Washington

Port Angeles Harbor Grab Sample Locations

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Sample Location Type Designator	
TH	Tissue Horse Clam
TG	Tissue Geoduck
TL	Tissue Ling Cod
TM	Tissue Macroalgae

Figure 2-4

Port Angeles Harbor, Washington

Port Angeles Harbor
Tissue Sample Locations

(for location of Reference Area Tissue Sample Locations see Figure 3-2)

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Table 2-1 Beach Seining Results for Ediz Hook and Ennis Creek Sites (NOAA 2008b)

Year	2006		2007	
Sites	E. Hook Sites	Ennis Cr.	E. Hook Sites	Ennis Cr.
Effort (# of hauls)	13	10	28	14
Chinook 0+ hatchery	0	2	3	13
Chinook 0+ wild	5	9	511	79
Chinook 1+ hatchery	0	0	2	3
Chinook 1+ wild	0	1	0	1
Coho 0+ hatchery	0	3	0	8
Coho 0+ wild	1	54	0	0
Coho 1+ hatchery	0	0	0	7
Coho 1+ wild	0	0	0	6
Chum salmon 0+	14	1	415	17
Pink salmon 0+	212	0	0	0
Steelhead juv wild	0	2	0	0
Cutthroat juv wild	0	16	0	3
American shad	0	13	0	1
Pacific herring	0	20	185	5
Surf smelt	171	262	13	1,202
Northern anchovy	0	0	8	13
Sand lance	0	64	1065	2
Striped perch	20	0	89	0
Pile perch	1	0	12	0
Shiner perch	168	136	100	5
English sole	13	272	5	17
Sand dab	0	1	47	25
Starry flounder	2	12	8	2
Sand sole	0	153	4	10
Unid sculpin	0	0	2	4
Buffalo sculpin	7	22	25	10
Great sculpin	1	0	9	0
Silver spotted sculpin	5	5	32	0
Staghorn sculpin	60	33	78	10
Bay pipefish	42	1	5	3
Tube snout	10	1	8	0
Snake prickleback	0	2	0	0
Crescent gunnel	21	8	36	1
Saddleback gunnel	5	19	48	7
Pinpoint gunnel	24	20	83	9
Red gunnel	0	0	2	0
Unid gunnel	0	5	0	0
Northern clingfish	0	0	3	0
Tomcod	0	0	1	0

Table 2-1 Beach Seining Results for Ediz Hook and Ennis Creek Sites
(NOAA 2008b)

Year	2006		2007	
Sites	E. Hook Sites	Ennis Cr.	E. Hook Sites	Ennis Cr.
Sandfish	0	0	2	2
Lingcod	4	3	49	1
Unid greenling	17	31	8	0
Unid rockfish	14	0	0	1
Threespine stickleback	0	0	1	0
Totals	**817**	**1,171**	**2,859**	**1,467**

Table 2-2 Rationale for Exclusion from Risk Assessments

Previous Investigation	Rationale for Exclusion
Washington Department of Health Consultation: Rayonier Mill Site Exposure Investigation (WDOH 2005)	Original samples were composite and no quality control data provided in report. Sample quality cannot be confirmed as suitable for use in risk assessment.
Washington State Department of Transportation Port Angeles Graving Dock (GeoEngineers 2003)	Two composite results from one core sample. Location of samples has since been dredged.
Rayonier Log Pond Survey for Remedial Investigations (Foster Wheeler 2001)	Composite debris samples of log pond. Individual sample results not available.
Ecology Marine Sediment Monitoring Program (MSMP) (Ecology 1998a and b)	Data not collected in past 10 years. More recent sediment data available.
U.S. EPA Dioxin and Furan Concentrations in Puget Sound Crabs (U.S. EPA 1991a)	Data not collected in past 10 years. More recent tissue data available.

Table 2-3 Port Angeles Harbor Sample Numbers by Study

Study	Sample Type														
	Bull Kelp Fronds	Coonstripe Shrimp Whole	Dungeness Crab		Eel Grass Leaves	Geoduck Whole	Horse Clam			Lingcod		Red Rock Crab Muscle	Rock Sole		Sediment
			Muscle	HP			Whole	Viscera	Edible Tissue	Whole	Fillet		Whole	Fillet	
E & E 1998															69
E & E 1999						3[a]						3			
Anchor 2005															4
Malcolm Pirnie 2006		3	3	3		3	9						3	3	101
Malcolm Pirnie 2007			8	8				10	16						49
Exponent 2008															15
E & E 2012	1				1	1	8			2	2				188
Grand Total	**1**	**3**	**11**	**11**	**1**	**7**	**17**	**10**	**16**	**2**	**2**	**3**	**3**	**3**	**426**

Notes:
a - Siphon, mantle, and adductor muscle were resected. Considered whole-body samples because these three tissue make up the bulk of the geoduck mass.

Key:
E&E = Ecology and Environment, Inc.
HP = hepatopancreas

Table 2-4 Dungeness Bay Sample Numbers by Study

Study	Sample Type										
	Coonstripe Shrimp Whole	Dungeness Crab		Geoduck Whole	Horse Clam			Red Rock Crab Muscle	Rock Sole Whole	Sediment	Starry Flounder Fillet
		Muscle	HP		Whole	Viscera	Edible Tissue				
E & E 1998										3	
E & E 1999				1[a]				1			
Malcolm Pirnie 2006	3	3	3	3	3				1		2
Malcolm Pirnie 2007		7	7			5	8			11	
E & E 2012				1	2					3	
Grand Total	**3**	**10**	**10**	**5**	**5**	**5**	**8**	**1**	**1**	**17**	**2**

Notes:
a - Siphon, mantle, and adductor muscle were resected. Considered whole-body samples because these three tissue make up the bulk of the geoduck mass.

Key:
E&E = Ecology and Environment, Inc.
HP = hepatopancreas

Table 2-5 Summary of PCB Analysis by Sample Type

Area and Sample Type	Number of Samples: PCB Aroclors	Number of Samples: PCB Congeners	Number of Samples: Dioxin-Like Congeners Only	Investigation
Port Angeles Harbor				
Subtital Sediment	344	49		E & E (1998, 2012), Malcolm Pirnie (2006), and Exponent (2008) for Aroclor data. Malcolm Pirnie (2007) for congener data.
Intertidal Sediment	29			Malcolm Pirnie (2006) and E & E (2012).
Bull Kelp			1	E & E (2012).
Eel Grass			1	E & E (2012).
Coonstrip Shrimp	3			Malcolm Pirnie (2006).
Dungeness Crab Hepatopancreas	3	8		Malcolm Pirnie (2006) for Aroclor data. Malcolm Pirnie (2007) for congener data.
Dungeness Crab Muscle	3	8		Malcolm Pirnie (2006) for Aroclor data. Malcolm Pirnie (2007) for congener data.
Geoduck	6		1	E & E (1999) and Malcolm Pirnie (2006) for Aroclor data. Malcolm Pirnie 2007 for congener data.
Horse Clam Whole Body	9		8	Malcolm Pirnie (2006) for Arolor data. E & E (2012) for congener data.
Horse Clam Viscera		10		Malcolm Pirnie (2007).
Horse Clam Edible Tissue		16		Malcolm Pirnie (2007).
Ling Cod Whole Body			2	E & E (2012).
Ling Cod Fillet			2	E & E (2012).
Red Rock Crab	3			E & E (1999).
Rock Sole Whole Body	3			Malcolm Pirnie (2006).
Rock Sole Fillet	3			Malcolm Pirnie (2006).
Dungeness Bay				
Subtital Sediment	6	11		E & E (1998, 2012) for Aroclors. Malcolm Pirnie (2007) for congeners.
Intertidal Sediment				None.
Bull Kelp				None.
Eel Grass				None.

Coonstrip Shrimp	3			Malcolm Pirnie (2006).
Dungeness Crab Hepatopancreas	3	7		Malcolm Pirnie (2006) for Aroclor data. Malcolm Pirnie (2007) for congener data.
Dungeness Crab Muscle	3	7		Malcolm Pirnie (2006) for Aroclor data. Malcolm Pirnie (2007) for congener data.
Geoduck	4		1	Malcolm Pirnie (2006) and E & E (1999) for Aroclor data. E & E (2012) for congener data.
Horse Clam Whole Body	3		2	Malcolm Pirnie (2006) for Aroclor data. E & E (2012) for congener data.
Horse Clam Viscera		5		Malcolm Pirnie (2007).
Horse Clam Edible Tissue		8		Malcolm Pirnie (2007).
Ling Cod Whole Body				None.
Ling Cod Fillet				None.
Red Rock Crab	1			E & E (1999).
Rock Sole Whole Body	1			Malcolm Pirnie (2006).
Rock Sole Fillet				None.

Key:
E & E = Ecology and Environment, Inc.
PCB = polychlorinated biphenyl

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3.0 Human Health Risk Assessment

3.1 Selection of Indicator Hazardous Substances

Washington State Model Toxics Control Act (MTCA) acknowledges that at some sites where a large number of chemicals are present, it can be useful to eliminate from further consideration those chemicals that represent a small contribution to overall threat to human health and the environment. Chemicals that are not screened out and thus are evaluated in risk assessments are referred to as potential indicator hazardous substances (IHSs) under the MTCA (Washington Administrative Code [WAC] 173-340-703; Ecology 2007a). This section outlines the IHS selection process for compounds to be retained for the HHRA.

Several parameters were considered in the selection of potential IHSs, including the following:

1. Screening values based on toxicological and physical characteristics of each chemical
2. Reference concentrations
3. Evaluation of essential nutrients
4. Frequency of detection

These parameters are consistent with the U.S. EPA document *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)* (U.S. EPA 1989) and are discussed in further detail throughout this section. Figure 3-1 presents the general IHS screening process that was used for intertidal sediment and tissue data. The process varies slightly for the selection of human health and ecological IHSs.

Carcinogenic polycyclic aromatic hydrocarbons (cPAHs), dioxins/furans, and PCBs were evaluated as groups of compounds using the approaches described in *Evaluating the Toxicity and Assessing the Carcinogenic Risk of Environmental Mixtures Using Toxicity Equivalency Factors* (Ecology 2007b).

IHS screening tables are provided in Attachment A. Based on the exposure media identified in the preliminary conceptual site model (CSM) from the Sampling and Analysis Plan (E & E 2008a) and included in this document as Figure 3-1, screening was conducted for all sediment samples (intertidal and subtidal sediment combined; Table A-1), beach/intertidal sediment only (Table A-2), fish and shellfish (Table A-3), and bull kelp (Table A-4). Table A-5 indicates which samples were classified as beach/intertidal sediment samples.

3.1.1 Screening Values

The first step in selecting potential IHSs to be evaluated in the HHRA is to assess the site concentration as compared to a risk based screening value. E & E identified target analytes, or potential IHSs, based on data from prior investigations and chemical concentrations in harbor sediments exceeding Washington State SMS (Ecology 1995) and chemicals commonly associated with wood debris degradation (E & E 2008b). The following chemicals were previously identified as target analytes at the site:

- Dioxins and furans
- PCBs
- Chlorinated pesticides
- SVOCs, including PAHs, phenols, and phthalates
- Resin acids/guaiacols
- Tributyltin (TBT)
- Heavy metals, including inorganic and organic forms
- Ammonia, sulfides, and total organic carbon

Screening values typically are selected from a variety of sources for media that could be primary sources of exposure (e.g., sediment, tissue). As noted in the preliminary CSM, people who may have contact with exposure media in Port Angeles Harbor include subsistence and recreational fishers, recreational users, and area residents.

Subsistence fishers may be exposed to site-related chemicals primarily through dermal exposure to beach/intertidal sediment, incidental ingestion of beach/intertidal sediment, and ingestion of fish and shellfish. Dermal contact and ingestion of surface water are expected to provide relatively minor exposure and are not quantified in the risk assessment. Exposure pathways are the same for the recreational fisher population, although the frequency and magnitude of exposure are expected to be lower.

Residential users may experience exposure to site-related chemicals through dermal exposure to beach/intertidal sediment, and incidental ingestion of beach/intertidal sediment. As with the subsistence and recreation fisher populations, dermal contact and ingestion of surface water are expected to provide relatively minor exposure and are not quantified in the risk assessment. Residential users also may consume fish and shellfish. However, because this exposure pathway is assessed for the recreational and subsistence fisher scenarios, it is not quantitatively evaluated for the residential user. Exposure pathways are the same for the recreational user as for the residential user, although frequency and magnitude of exposure may differ.

3.1.1.1 Sediment

The primary pathways for human contact with contaminated sediments are direct contact (dermal contact and incidental ingestion) with beach/intertidal sediment, and indirect contact via ingestion of marine biota such as fish and shellfish that contact marine surface sediments (intertidal and subtidal sediments). However, there are no marine sediment quality standard (SQS) numerical concentration criteria for the protection of human health (WAC 173-204-320). Sediment screening was conducted in two different ways, representing the different methods of exposure. Screening was conducted for all sediment samples (intertidal and subtidal sediment combined) based ingestion of biota. Screening was also conducted on intertidal sediments only based on direct contact with sediment. Screening criteria for all sediment sample and intertidal sediment samples only are discussed below.

All Sediments

Contaminant tissue data is available for the primary recreational and subsistence fish and shellfish obtained from Port Angeles Harbor. Sediment samples, including all intertidal and subtidal sediments, were screened to ensure all bioaccumulative compounds detected in sediment were evaluated in the risk assessment. If a compound was identified as a potential IHS in intertidal or subtidal sediment based on bioaccumulative properties, it was included as an IHS in the quantitative risk evaluation for tissue (see Section 3.3). Potential risks from consuming contaminants in fish and shellfish were derived from tissue concentrations only.

There is no readily available sediment screening values for persistent bioaccumulative chemicals protective of ingestion of marine biota that come in contact with surface sediments. Therefore, compounds that have a potential to bioaccumulate or bioconcentrate in marine biota, contributing to significant human health risk, were retained as potential IHSs in intertidal and subtidal surface sediments if the compound was not an essential nutrient (see Section 3.1.3), the frequency of detection was greater than 5% (see Section 3.1.4) and the concentration exceeded the area reference concentration (see Section 3.1.2). Organic contaminants in sediment whose octanol-water partition coefficient logarithm (log K_{ow}) exceeded 3.5 were retained as potential IHSs. Log K_{ow} refers to the logarithm of the octanol-water partition coefficient and is proportional to an analyte's tendency to bioaccumulate. The log K_{ow} values used for this screening are provided in Table 4-1. In many instances, log K_{ow} values were not available. In those cases the compound was retained as a potential IHS if identified as an important bioaccumulative compound by U.S. EPA (2000). Any bioaccumulative metal potentially contributing to significant human health risk via the fish or shellfish ingestion pathway was also retained as a potential IHS. Inorganic compounds were identified as bioaccumulative if they are listed as such by U.S. EPA (2000). The screening process for subtidal/intertidal sediments is outlined in the potential IHS decision flow chart for all sediment samples (Figure 3-2).

Intertidal Sediments Only

Although direct contact with beach and intertidal sediments is expected to be less than the frequency and duration of direct contact with soil in a residential setting, MTCA soil cleanup levels for unrestricted land use were used to select potential IHSs due to a lack of appropriate risk-based screening levels (RBSLs) for sediment. The equations used to calculate the MTCA cleanup levels incorporate exposure via ingestion only.

Potential IHSs in beach/intertidal sediments were identified by comparing the maximum sediment concentration to MTCA Method B levels for unrestricted land use, when available. In the case of lead and #2 diesel, no Method B level was available so the Method A level for unrestricted land use was used for screening. cPAHs are evaluated as a group; therefore, the Method B level was used for screening all cPAHs. In the case of ammonia and ammonia as nitrogen, a MTCA Method B level was not available. In those cases the residential screening level from the U.S. EPA Regional Screening Table (U.S. EPA 2008a) was used.

3.1.1.2 Tissue

Analytical data are available for coonstripe shrimp, Dungeness crab (hepatopancreas and edible muscle), geoduck (whole tissue without shell), horse clam (edible tissue, visceral cavity, and whole tissue without shell), lingcod (fillet and whole), red rock crab (muscle), rock sole (fillet and whole), bull kelp, and eel grass. Tables 3-1 and 2-3 show the Port Angeles Harbor tissue sample number by type used in the HHRA.

U.S. EPA's Regional Screening Calculator was used to develop fish tissue RBSLs. The calculator uses a default fish consumption rate of 54 grams per day (g/d). Although this value is conservative for ingestion of fish and shellfish by recreational fisher scenarios (U.S. EPA 1997a), it is not appropriate for subsistence fisher scenarios. To identify potential IHSs for the subsistence fisher scenario, site-specific exposure parameters (i.e. body weight, averaging time, fish consumption rate, and exposure duration) were used to account for LEKT subsistence activities. Exposure parameters for the subsistence fisher scenario were based on recommendations from the MTCA Science Advisory Board (SAB; Ecology 2008b, 2009a). Site-specific exposure parameters used to develop site-specific tissue RBSLs are shown in Table 3-2. For screening purposes, it was assumed that 100% of the fish diet is site-related.

Potential IHSs in fish and shellfish tissue were identified by comparing maximum concentrations against site-specific tissue screening levels. Screening was conducted at a target cancer risk of 1×10^{-6} and a target hazard quotient of 0.1 to account for potential exposure to multiple IHSs. The resulting list of potential IHSs will conservatively be used for both subsistence and recreational fisher scenarios in the risk assessment.

Bull kelp is an edible seaweed. No site-specific ingestion rate was available for the local consumption of bull kelp. It is assumed local consumption of bull kelp is significantly lower than consumption of fish and shellfish. To screen IHSs in bull kelp, 10 times the site-specific tissue screening level discussed above was used. This screening value assumes an ingestion rate of 58.3 g/d for bull kelp or seaweed. This is assumed to be a very conservative ingestion rate. For comparison, the median consumption rate of seaweed or kelp for Asians and Pacific Islander communities is 0.014 grams per kilogram per day (g/kg/d) or 1.106 g/d for a 79 kg person (Sechena et al.1999). Although exposure to contaminants in bull kelp is a minor exposure pathway and not expected to contribute significantly to the overall potential risk at the site, contaminants in bull kelp were screened to determine potential IHSs and ensure no additional potential IHSs would be identified through screening this media. Note exposure to contaminants in bull kelp is not a significant exposure pathway and not quantitatively evaluated in the HHRA. Although eelgrass contaminant data are available, eelgrass is primarily a food source for ecological receptors and will not be evaluated in the HHRA.

All species and tissue types were screened separately. If a potential IHS was identified in a specific fish or shellfish tissue, it was determined to be a potential IHS for all fish and shellfish. IHSs for bull kelp were evaluated separately from the fish and shellfish IHSs.

3.1.2 Evaluation of Reference Concentrations

Concentrations of hazardous substances that are consistently present in the environment in the vicinity of a site and are the result of human activities unrelated to releases from that site are referred to as "area background" (Ecology 2007a). Concentrations of hazardous substances consistently present in the environment in areas that have not been influenced by localized human activities, such as concentrations resulting from geologic processes or global cycling of anthropogenic-generated substances, are referred to as "natural background" (Ecology 2007a).

The SMSs (WAC 173-204-200) provide a slightly different term, "reference sediment sample." A reference sediment sample or area provides a clean comparison area for bioassay testing. The reference area sample and the investigational area sample must have similar grain size and organic content, and be similar in other physical and chemical parameters. In addition, Ecology mandates that the reference sample must not exceed SQS of WAC 173-204-320 for the protection of benthos.

Selection of appropriate background and reference areas for the Port Angeles Harbor sediment investigation was presented by E & E (2008c). The physical and geomorphological characteristics of Dungeness Bay, combined with the analysis of long-shore current tendencies along the north Olympic Peninsula, suggest that Dungeness Bay is the most appropriate reference site for Port Angeles Harbor (E & E 2008c). Samples from this area were used to determine concentrations of natural and anthropogenic compounds in surface sediment, fish, and shellfish for comparison with site investigation samples.

Consistent with MTCA methods for defining background concentrations (WAC 173-340-709), where there were an appropriate number of samples, statistical methods were used to determine reference concentrations. MTCA requires 20 soil samples for statistical analysis to determine area background and 10 samples to determine natural background. No minimum sample size is outlined in MTCA for sediment or tissue samples.

If the data set included at least 10 samples and closely fit a lognormal or normal distribution, the reference concentration was determined based on the statistical approach outlined below. Due to sample size limitations, this approach was only used to determine the reference concentration for dioxins and PCBs in sediment and not for compounds in tissue:

1. The distribution of the reference data set was determined using Number Cruncher Statistical System Version 07.1.9 (Hintze 2008).

2. For lognormally distributed data sets, the reference concentration was defined as the true upper 90th percentile or four times the true 50th percentile, whichever was lower.

3. For normally distributed data sets, the reference concentration was defined as the true upper 80th percentile or four times the true 50th percentile, whichever was lower.

4. Measurements below the reporting limit were assigned a value equal to one-half of the method detection limit (MDL). (Note in most cases historical data reporting limits are not defined as MDL or practical quantitation limit (PQL). In those cases, nondetects were assigned one-half the reported limit.)

If fewer than 10 samples were available for a given media or contaminant, as was the case for IHSs in tissue and IHSs other than dioxins and PCBs in sediment, the maximum detected concentration was used to represent the reference concentration for the purposes of comparing to site samples during IHS determination. If a contaminant was sampled in Dungeness Bay but not detected in a given media no reference value was used for comparison.

Concentrations used for reference in sediment and tissue are presented in Attachment A, Tables A-6 and A-7. A summary of which type of site sample was compared to specific reference samples is provided in Table 3-3.

3.1.3 Evaluation of Essential Nutrients

U.S. EPA (1989) recommends removing chemicals from further consideration if they are considered “essential nutrients,” that is, naturally occurring chemicals essential to human life. These chemicals are toxic only at very high doses, and are present at concentrations that would not be due to chemical sources for Port Angeles Harbor (E & E 2008b). The essential nutrients that were eliminated from the list of IHSs include magnesium, calcium, sodium, and potassium.

3.1.4 Frequency of Detection

Analytes not detected in any sample and that do not have maximum detection limits exceeding applicable screening levels are not evaluated in the HHRA. Analytes with a low frequency of detection (less than 5%) were eliminated from further consideration unless identified as potential IHSs in other media (i.e. tissue or sediment). Hexachlorobenzene was retained as an IHS in beach/intertidal sediments though it was infrequently detected (detected once in 24 samples) because it was determined to be an IHS in tissue.

Detection limits were reviewed to ensure the value was sufficiently low to detect compounds present at levels that have the potential to impact human health. For compounds that were not detected in a given media, maximum detection limits were compared to applicable screening levels. Compounds that had detection limits above applicable screening levels and were not already identified as IHSs in the respective media are discussed in the paragraphs below. In all other instances, the detection limits were found to be appropriate.

Antimony, 1-methylnaphthalene, and fluorene had maximum detection limits greater than applicable screening levels in at least two different tissues types. Numerous metals have been identified as potential IHSs in sediment and tissue; therefore, antimony was added as a potential IHS for tissue. 2-methylnaphthalene was identified as a potential IHS in tissue and sediment. Because its sources, fate, and transport were similar to those for 2-methylnaphthalene, 1-methylnaphthalene was added as an IHS in tissue. Multiple PAHs were identified as potential IHSs in both sediment and tissue. Also, fluorene was identified as a potential IHS in sediment. Therefore, fluorene was included as a potential IHS in tissue.

Dieldrin, heptachlor, and heptachlor epoxide results in geoduck and horse clam samples (whole) had maximum detection limits greater than the applicable screening level. These compounds were identified as potential IHSs in sediment. Therefore, these pesticides were included as potential IHSs in tissue.

Results of numerous SVOCs in horse clams samples (whole) and lingcod (fillet and whole) had maximum detection limits greater than the applicable screening level. These specific compounds were not identified as potential IHSs in sediment and, in most cases, were not detected in sediment or any other tissue sample. Based on this evaluation, these compounds were not included as IHSs and were not quantitatively evaluated in the HHRA. Elimination of these compounds as IHSs is discussed in the uncertainty section of the HHRA.

3.1.5 Potential Indicator Hazardous Substances Results

The final list of potential IHSs for inclusion in the HHRA is provided in Table 3-4. Potential IHSs were selected for intertidal and subtidal sediments (combined), beach/intertidal sediments, fish and shellfish, and bull kelp. As previously mentioned, sediment samples (intertidal and subtidal sediments combined) were screened to ensure all bioaccumulative compounds detected in sediment were evaluated in the risk assessment. If a compound was identified as a potential IHS in intertidal or subtidal sediment based on bioaccumulative properties, it will be included as an IHS in the quantitative risk evaluation for tissue (see Section 3.3). Potential risks from consuming contaminants in fish and shellfish were derived from tissue concentrations only.

Carcinogenic PAHs, dioxins and furans, and PCBs were evaluated as groups of compounds. In some instances, individual analytical data were available for screening. For example, analytical data were available in some media for benzo(a)pyrene, PCB-77, or 1,2,3,4,6,7,8-HpCDD. In addition, data were also available for the groups of compounds such as total cPAHs, total PCBs, and dioxins/furans reported as a total toxicity equivalents (TEQ) concentration. The results were screened both as an individual compound and as a group of compounds based on the results available. If an individual compound or the group of compounds was identified as a potential IHS in the given media, then the full group was determined to be a potential IHS.

3.2 Revised Conceptual Site Models

In general terms, a CSM depicts media that may contain site-related constituents, potential human and ecological receptors, and potential routes of exposure of receptors to site-related constituents. A complete exposure pathway must exist for exposure and subsequent risks to occur. A complete pathway must include the following elements (U.S. EPA 1989):

- A source and mechanism for release of constituents
- A transport or retention medium
- A point of potential human contact (exposure point) with the affected medium
- An exposure route

The exposure pathway is not considered complete if any one of these elements is missing.

3.2.1 Chemical Migration Pathways

Chemicals enter Port Angeles Harbor through numerous pathways. These include discharge of contaminated groundwater, stormwater runoff, dry or wet (precipitation) deposition of airborne compounds, leaks and spills, and discharge of industrial and municipal wastewater into streams and waterways/harbor. Sources of chemical contaminants, chemicals known to enter Port Angeles Harbor, media and pathways through which these chemicals enter the harbor, and the fate of these compounds once in the harbor were discussed in the SAP (E & E 2008a). These sources and migration pathways have not changed based on the IHS screening results.

3.2.2 Revised Conceptual Site Model for Human Receptors

The Port Angeles HHRA evaluates the risk from site-related constituents to four groups of receptors:

- Current/future subsistence fisher, adult and child
- Current/future recreational fisher, adult and child
- Current/future residential user, adult and child
- Current/future recreational user, adult and child

A preliminary CSM for human receptors in the Port Angeles Harbor environment was provided in the SAP (E & E 2008a). Based on comments from Ecology on the Draft Technical Memorandum #1 Indicator Hazardous Substances Selection and Revised Conceptual Site Model (E & E 2009a), the final CSM has changed by the addition of the sediment inhalation pathway. This pathway is considered a minor pathway and is not quantitatively evaluated in the HHRA. The final CSM is provided as Figure 3-3 and discussed below.

Subsistence fishers may be exposed to site-related chemicals through dermal exposure to surface water and beach/intertidal sediment, incidental ingestion of surface water and beach/intertidal sediment, ingestion of fish and shellfish, and inhalation of volatiles from beach/intertidal sediment. Minimal direct contact with subtidal sediments is expected to occur through netfishing and to contribute insignificant risk. Exposure to intertidal and subtidal sediments may occur through bioaccumulation and biomagnification in the food chain, occurring in fish and shellfish. Exposure to contaminants in fish and shellfish may occur through direct ingestion of these foods. Exposure to surface water, both through incidental ingestion or dermal exposure, is assumed to be a minor exposure pathway and will not contribute significantly to the overall risk to subsistence fishers. Due to the wet environment in Port Angeles and the presence of only one volatile IHS, inhalation of volatiles from sediment is also assumed to be a minor pathway. Therefore, ingestion and dermal contact with surface water and the inhalation of volatiles from sediment will not be evaluated quantitatively in the HHRA. Exposure pathways are the same for the recreational fisher population, although the frequency and magnitude of exposure are expected to be lower.

Residential users may experience dermal exposure to surface water and beach/intertidal sediment, incidental ingestion of surface water and beach/intertidal sediment, and inhalation of volatiles from beach/intertidal sediment. Residential users also may consume fish and shellfish but consumption rates are expected to be much higher in the recreational and subsistence fisher populations. Therefore, seafood consumption is assessed for the recreational and subsistence fisher scenarios and will not be quantitatively evaluated for the residential user. Additionally, while all residential users may contact directly or ingest surface water or inhale volatiles from sediment, these pathways are expected to provide relatively minor exposure and will not be quantified in the HHRA. Exposure pathways are the same for the recreational and residential users, although frequency and magnitude of exposure may differ.

The final CSM presents exposure pathways and receptors of concern for Port Angeles Harbor. The final CSM identifies potentially complete and incomplete or minor exposure routes.

Complete routes of exposure are quantitatively evaluated in the HHRA. Incomplete or minor pathways are not included in the quantitative determination of risk in the HHRA.

3.3 Exposure Point Concentrations

Following U.S. EPA guidance (U.S. EPA 2002), the 95% upper confidence limit (UCL) of the mean concentration was calculated as a conservative estimate of the average exposure concentration for each IHS. The distribution of each data set (reported concentrations of the IHS in the exposure media) was first tested. The 95% UCL was then calculated using U.S. EPA's ProUCL software version 4.00.02 (Singh et al. 2007) for the distribution that best fit the data.

Singh et al. (2006) studied the performances of the various 95% UCL computation methods employed by ProUCL including the simple substitution methods for data sets with nondetect observations. They concluded that the UCLs obtained using the simple substitution methods, including the replacement of nondetects by detection limits or one-half the detection limit, do not perform well even when the percentage of nondetect observations is low, such as 5–10%. Singh et al. (2006) recommend avoiding the use of substitution methods to compute 95% UCL for data sets with nondetect observations. Therefore, in calculating the 95% UCL, nondetected values were addressed based on frequency of detection and distribution of the dataset, as described by U.S. EPA (Singh et al. 2006, 2007). Specifically, the regression on order statistics (ROS) method and Kaplan-Meier (KM) method, as incorporated into ProUCL, were used to handle data sets with nondetect observations and multiple detection limits. If the calculated UCL concentration was higher than the maximum detected concentration in the data set, the maximum detected concentration was used as the EPC (U.S. EPA 2002).

It is not desirable to compute an estimate for the EPC term based on a data set with less than 5 members, especially when nondetects may be present in the data set (U.S. EPA 2007a). Therefore, when the sample number is less than 5 the EPC is set at the maximum detected concentration.

For direct sediment contact routes (ingestion and dermal contact), EPCs were estimated directly from measured concentrations in beach/intertidal sediment. Attachment B, Table B-1 shows the EPC for beach/intertidal sediment IHSs.

For subsistence and recreational fisher exposure scenarios, measured analyte concentrations in fish and shellfish tissue samples were used as the EPC values for fish and shellfish ingestion. Attachment B, Tables B-2 through B-9 show EPCs for all tissue IHSs. To ensure all bioaccumulative compounds were evaluated, if a compound was identified as a potential IHS in intertidal/subtidal sediment based on bioaccumulative properties, it was included in the quantitative risk evaluation for tissue. Based on this, tributyltin, tributyltin oxide, anthracene, aldrin, endosulfan I, endosulfan II, endrin, methoxychlor, bis(2-ethylhexyl)phthalate, and dibenzofuran were included for quantitative risk assessment in tissue.

Table 3-5 indicates which species and tissue data were used to calculate EPCs for each fish and shellfish category. Hepatopancreas (crab butter) and muscle tissue concentration data are available for Dungeness crab. Muscle tissue concentrations are used to calculate the Dungeness crab EPCs for assessing potential risk to the recreational fisher. Whole Dungeness crab tissue (muscle and crab butter combined) is used to calculate the Dungeness crab EPCs for assessing potential risk to the subsistence fisher. Based on the Fish Consumption Survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation (Suquamish Tribe 2000), adult respondents indicated they consumed only Dungeness crab meat 74% of the time and 24% of the time they consumed whole Dungeness crab (meat and crab butter combined). LEKT staff performed a survey to compare the LEKT dietary habits with the habits of the Suquamish Tribes and found that the majority of LEKT members believed their diets were similar to those of the Suquamish Tribe (Ecology 2008a). Whole crab concentrations are calculated based on the assumption that the whole body composition of the crab is 75% muscle and 25% hepatopancreas (Malcolm Pirnie 2006, DOH 2005). This is close to hepatopancreas percentage composition identified in other studies (31% by Winward Environmental LLC 2007, 21% by Toy 1996).

Whole body, edible tissue, and visceral cavity concentration data are available for horse clams. Edible tissue concentrations are used to calculate the horse clam EPCs for assessing potential risk to the recreational fisher. Whole tissue and reconstituted whole tissue (edible tissue plus visceral cavity) concentrations are combined to calculate the horse clam dioxin/furans and PCB EPCs for assessing potential risk to the subsistence fisher. Based on the Suquamish Tribe Consumption Survey (Suquamish Tribe 2000), 20% of respondents consume whole clams, 36% consume siphon and strap, 42% consume siphon only, and 2% consume siphon and stomach. Whole tissue concentrations are calculated based on the assumption that visceral tissue composition is 56% of the whole organism and edible tissue composition is 44% (Malcolm Pirnie 2006). Historical reports (Malcolm Pirnie 2007) indicate the sheath of the siphon for bivalve samples (i.e. horse clam and geoduck) was discarded prior to analysis. This sheath was included in the bivalve samples from the Sediment Investigation Report (E & E 2012).

A single IHS list was developed for all tissue (i.e. if a compound was determined to be an IHS in a specific tissue type, it was identified as an IHS for all tissue types), but some IHSs in a tissue were either not tested, not included in historical reports, or not detected in any sample. If the IHS was not detected in any sample of a given species, the compound was not included in the final risk calculations (i.e., risks were not calculated based on detection limits when all results in the media were nondetect).

Numerous compounds identified as IHSs in tissue have no analytical data available for one or more specific tissue types, as identified in Table 3-6. These compounds were either not analyzed for in the specific tissue or the data were not presented in historical reports. When no analytical data were available for these compounds, the compounds were not included in the final risk calculations. Impacts of this approach are discussed in the uncertainty section (Section 3.8). Of most importance are those IHSs that are bioaccumulative and for which SQS exist, including:

- Silver (coonstripe shrimp, Dungeness crab [muscle and hepatopancreas], rock sole)
- Bis(2-ethylhexyl)phthalate (coonstripe shrimp, Dungeness crab [muscle and hepatopancreas], rock sole)
- Dibenzofuran (coonstripe shrimp, Dungeness crab [muscle and hepatopancreas], rock sole)

Treatment of cPAHs, dioxins and furans, and PCBs for calculation of EPCs is discussed in Section 3.6.3.

3.4 Exposure Assessment Overview

The following section outlines the methodology for the human health exposure assessment, while Section 3.5 presents values for the exposure parameters to be used in quantitatively assessing potential exposure to human receptors.

The exposure assessment describes how potential contaminant exposure to receptors is quantified for each anticipated exposure pathway. The information from the exposure and toxicity assessments is then combined to generate quantitative estimates of risk.

Exposures are quantified using an algorithm that represents exposure. Inputs to this algorithm are assumptions based on site-specific and other applicable information. U.S. EPA (1989, 1991c) provides a generalized exposure algorithm used in risk assessment, which is modified for each exposure pathway:

$$Intake = \frac{EPC \times IR \times EF \times ED}{BW \times AT}$$

Where:

EPC	=	Exposure point concentration: the chemical concentration contacted over the exposure period at the exposure point
IR	=	Ingestion rate: the amount of exposure medium contacted per unit time or event
EF	=	Exposure frequency: how often exposure occurs
ED	=	Exposure duration: how long exposure occurs
BW	=	Body weight: the average body weight over the exposure period
AT	=	Averaging time: period over which exposure is averaged

The variables shown in the exposure algorithm above are called exposure factors and vary according to the population being evaluated. Each population (subsistence fisher, recreational fisher, residential user, and recreational user) is characterized by exposure factor assumptions about the ingestion rate, frequency of contact with exposure media, duration of exposure, and other parameters unique to each population. Exposure factors were obtained from several regulatory agency and literature sources, including State of Washington's MTCA (Ecology 2007a), the U.S. EPA (1989, 1991b, 1997a, 2004), and LEKT (Ecology 2008a, 2008b; U.S. EPA 2007b), and are described in this section.

3.4.1 Quantification of Exposure

Exposure of human receptors to chemicals in Port Angeles Harbor occurs through oral exposure (beach/intertidal sediment), intake of fish and shellfish, and dermal exposure (beach/intertidal sediment) routes. Chemical exposure of populations via each route is quantified using measured media concentrations and the equations described below. The values for the exposure factors listed in these equations vary depending on the exposure scenario, but the method for calculating the exposures is consistent across scenarios, as shown in the equations below.

3.4.1.1 Oral Exposure to Sediment

All four exposure scenarios quantitatively evaluated in the HHRA (subsistence fishers, recreational fishers, residential users, and recreational users) are expected to incidentally consume beach/intertidal sediment.

Ingestion of chemicals in sediment is expressed as the chronic daily intake from the oral exposure route (CDI_o), which is the estimated daily chemical intake for one chemical for an individual, occurring over the exposure duration for each scenario.

The CDI_o is calculated as follows (U.S. EPA1991c):

$$CDI_o = \frac{EPC \times IR \times EF \times ED \times CF}{BW \times AT}$$

Where:

CDI_o = Chronic daily intake from oral exposure route (mg/kg-day)

EPC = Chemical-specific exposure point concentration in the exposure medium (sediment; mg/kg)

IR = Ingestion rate (g/d)

EF = Exposure frequency (d/y)

ED = Exposure duration (years)

CF = Conversion factor (10^{-3} kilograms per gram; kg/g)

BW = Body weight (kg)

AT = Averaging time (days)

3.4.1.2 Intake of Fish and Shellfish

Intake of fish and shellfish also represents an oral exposure, though exposures via seafood consumption are calculated differently than those for oral exposure to sediment.

Total intake of fish and shellfish includes the consumption of six representative species (ling cod, rock sole, coonstripe shrimp, horse clam, Dungeness crab, and geoduck). Total intake of fish and shellfish is calculated as the sum of exposure of all individual species. Specifically, intake of fish and shellfish is calculated as follows:

$$CDIo = \frac{EF \times ED \times FI \times CF}{BW \times AT} \times \sum EPCi \times IRi$$

Where:

CDI_o = Chronic daily intake from oral exposure route (mg/kg-day)

EF = Exposure frequency (d/y)

ED = Exposure duration (years)

FI = Fractional intake, fraction of media contacted that is assumed to be from the contaminated source (unitless)

CF = Conversion factor (10^{-3} kilograms per gram; kg/g)

BW = Body weight (kg)

AT = Averaging time (days)

EPCi = Chemical-specific exposure point concentration in pelagic fish, bottom fish, Dungeness crab, geoduck, horse clam, and coonstripe shrimp separately (mg/kg)

IR_i = Ingestion rate of pelagic fish, bottom fish, Dungeness crab, geoduck, horse clam, and coonstripe shrimp separately (g/d)

3.4.1.3 Dermal Exposure to Sediment

All four exposure scenarios quantitatively evaluated in the HHRA are expected to involve dermal exposure to beach/intertidal sediment. Dermal exposure to surface water is expected to contribute only a minor amount to total chemical exposure and is not quantitatively evaluated in the HHRA.

Dermal chemical exposure is calculated using the following two equations (U.S. EPA 2004):

$$DAD = \frac{DAevent \times EV \times ED \times EF \times SA}{BW \times AT}$$

Where:

DAD = Dermally Absorbed Dose (mg/kg-day)

DA_{event} = Absorbed dose per event (milligrams per centimeter squared per event; mg/cm^2-event), chemical-specific value

EV = Event frequency (events/day)

ED = Exposure duration (years)

EF = Exposure frequency (d/y)

SA = Skin surface area available for contact (centimeters squared; cm^2)

BW = Body weight (kg)

AT = Averaging time (days)

The DA_{event} is calculated using the following equation:

$$DA_{event} = EPC_{sed} \times CF \times AF \times ABS_{dermal}$$

Where:

EPC_{sed} = Exposure point concentration in sediment (mg/kg)

CF = Conversion factor (10^{-6} kilograms per milligrams; kg/mg)

AF = Adherence factor of sediment to skin (mg/cm^2-event)

ABS_{dermal} = Dermal absorption fraction (unitless)

The dermal exposure factors used in the equations above will vary depending on the exposure scenario being evaluated (i.e., subsistence fisher versus residential user, adult versus child), and are discussed in Section 3.5. One exception is the ABS_{dermal} exposure factor, which is chemical-specific instead of scenario-specific.

The ABS_{dermal} is the fraction of a chemical in sediment applied to the skin that is absorbed into the bloodstream. The ABS_{dermal} is a chemical-specific value. There is significant uncertainty regarding values for ABS_{dermal} for sediment. Experimental evidence suggests that ABS_{dermal} may be a function of AF; specifically, ABS_{dermal} has been observed to increase as the AF decreases below the quantity of soil necessary to completely cover the skin in a thin layer of soil particles (U.S. EPA 2004).

Only soil ABS_{dermal} values are available from U.S. EPA. The amount of chemical absorbed from sediment depends on chemical, physical, and biological factors. U.S. EPA (2004) recommends applying the soil values for sediment until more information becomes available on dermal absorption from contaminants in sediment. The uncertainties associated with this approach are discussed in the uncertainty section, Section 3.7.

The ABS_{dermal} values were obtained from the U.S. EPA document *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)*, Exhibit 3-4 (2004) and are presented in Table 3-7. Absorption values are available for only some of the IHSs. The dermal pathway will not be evaluated quantitatively for compounds without ABS_{dermal} values. This approach is consistent with U.S. EPA recommendations (2004).

3.4.2 Exposure to Noncarcinogenic and Carcinogenic Compounds

Exposure to noncarcinogenic compounds is evaluated for a child and an adult receptor separately.

Exposure to carcinogenic compounds is evaluated based on exposure to a combined child/adult receptor. The CDI is calculated using age adjustments to account for the total exposure duration. Specifically, the CDI_o (oral exposure) is calculated as shown in the following equation:

$$CDIo = \frac{EPC \times FI \times CF}{AT} \times \left(\frac{EDc \times EFc \times IRc}{BWc} + \frac{(EDa - EDc) \times EFa \times IRa}{BWa} \right)$$

Where:

CDI_o = Chronic daily intake from oral exposure route (mg/kg-day)

EPC = Chemical-specific exposure point concentration in the exposure medium (sediment or fish and shellfish) (mg/kg)

FI = Fractional intake, fraction of media contacted that is assumed to be from the contaminated source (unitless)

CF = Conversion factor (10^{-3} kilograms per gram; kg/g)

AT = Averaging time (days)

$IR_{a\ or\ c}$ = Ingestion rate for adult or child (g/d)

$EF_{a\ or\ c}$ = Exposure frequency for adult or child (d/y)

$ED_{a\ or\ c}$ = Exposure duration for adult or child (years)

$BW_{a\ or\ c}$ = Body weight for adult or child (kg)

Age-adjusted dermal chemical exposure is calculated using the following equation:

$$DAD = \frac{DA_{event} \times EV \times ED_c \times EF_c \times SA_c}{BW_c \times AT} + \frac{DA_{event} \times EV \times (ED_a - ED_c) \times EF_a \times SA_a}{BW_a \times AT}$$

Where:

DAD = Dermally Absorbed Dose (mg/kg-day)

DA_{event} = Absorbed dose per event (mg/cm^2-event); chemical-specific value; calculated separately for child and adult

EV = Event frequency (events/day)

$ED_{a \text{ or } c}$ = Exposure duration for adult or child (years)

$EF_{a \text{ or } c}$ = Exposure frequency for adult or child (d/y)

$SA_{a \text{ or } c}$ = Skin surface area available for contact for adult or child (centimeters squared; cm^2)

$BW_{a \text{ or } c}$ = Body weight for adult or child (kg)

AT = Averaging time (days)

3.4.3 Exposure to Mutagenic Compounds

Recent U.S. EPA guidance (U.S. EPA 2005a) provides a protocol on how to evaluate exposure to carcinogenic compounds having a mutagenic mode of action. U.S. EPA age-dependent adjustments factors (ADAFs) of cancer potency are based on the assumption that cancer risks generally are higher from early-life exposures than from similar exposures later in life. U.S. EPA (2005a) recommends the following age adjustment:

1. For exposures before 2 years of age (i.e., spanning a 2-year time interval from the first day of birth until a child’s 2nd birthday), a 10-fold adjustment.

2. For exposures between 2 and <16 years of age (i.e., spanning a 14-year time interval from a child’s 2nd birthday until his or her 16th birthday), a 3-fold adjustment.

3. For exposures after 16 years of age, no adjustment.

U.S. EPA is recommending the ADAFs described above only for mutagenic carcinogens, because the data for non-mutagenic carcinogens were considered to be too limited and the modes of action too diverse to use non-mutagenic carcinogens as a category for which a general default adjustment factor approach can be applied. The California Environmental Protection Agency (Cal EPA) considers this approach insufficiently health-protective and has issued a draft proposal to apply the default cancer potency factor age adjustments described above to all carcinogens unless data are available that allow for development of chemical-specific cancer potency factor age adjustments (Cal EPA 2008). The Cal EPA proposal is in the public review draft stage and has not been finalized. In addition, Ecology has not fully evaluated impacts of U.S. EPA's or Cal EPA's guidance to Ecology's protocol (McCormack 2009). Therefore, for this HHRA, ADAFs will only be used for evaluating IHSs that are considered mutagens by U.S. EPA (2005a). The only mutagenic IHS is cPAHs.

Default exposure factors, specifically fish and shellfish ingestion rates, are not available for the age ranges identified for analysis (U.S. EPA 2008b). In addition, site-specific consumption surveys have not specifically evaluated these age ranges. In the document *Lower Duwamish Waterway Remedial Investigation: Baseline Human Health Risk Assessment* (Winward Environmental LLC 2007), risks from compounds having a mutagenic mode of action (specifically cPAHs) were evaluated based on dose estimates adjusted upward to account for potential greater susceptibility of children from 0 to 2 and from 2 to 6 years of age compared with older children and adults in the following manner:

$$cPAH\ risk\ ages\ 0\ to\ 6 = [(dose\ cPAH_{overall} \times 2/6 \times 10) + (dose\ cPAH_{overall} \times 4/6 \times 3)] \times cPAH\ Slope\ Factor$$

This dose adjustment was made in the final risk characterization rather than as an adjustment to exposure or to carcinogenic potency. This approach was developed with instruction from U.S. EPA Region 10 (Winward Environmental LLC 2007). The same approach is used in this HHRA to evaluate potential exposure to cPAHs. Specifically, potential exposure to mutagens is assessed by calculating risk for the age groups 0 to 6 years of age and adult exposure separately. Since the Port Angeles Harbor HHRA evaluates a combined adult and child receptor for exposure to carcinogens, this adjustment was made at the intake calculation as shown in the following equation:

$$cPAH\ risk = [(dose\ cPAH_{child} \times 2/6 \times 10) + (dose\ cPAH_{child} \times 4/6 \times 3) + \left(\frac{EPC \times FI \times CF \times (ED_a - ED_c) \times EF_a \times IR_a}{AT \times BW_a}\right)] \times cPAH\ Slope\ Factor$$

3.5 Identification of Exposure Scenarios

The overview of the exposure assessment provided in Section 3.4 provides the foundation for how exposures, or intake estimates, were calculated for each exposure scenario. The following section provides a discussion of the exposure parameters used to quantify the estimates, including factors for a reasonable maximum exposure (RME) scenario and a central tendency (CT) scenario for each receptor population, as applicable.

The RME and CT scenarios are defined by U.S. EPA (1989). The RME scenario is a combination of high-end and average exposure values and is used to represent the highest reasonable exposure that could occur. The CT scenario is based on average estimates of exposure. The RME scenario provides a health-protective estimate of exposure that is reasonable but is still well above the average exposure level, while the CT scenario provides an estimate of exposure for most individuals within a population.

Relevant exposure media and receptors are discussed in Section 3.2. The following exposure scenarios are quantitatively evaluated in the HHRA using the equations provided in Section 3.4:

- Current/future Subsistence Fisher – Adult (RME and CT)
- Current/future Subsistence Fisher – Child (RME and CT)
- Current/future Recreational Fisher – Adult (RME and CT)
- Current/future Recreational Fisher – Child (RME and CT)
- Current/future Residential User – Adult
- Current/future Residential User – Child
- Current/future Recreational User – Adult
- Current/future Recreational User – Child

Descriptions of the oral and dermal exposure routes for all receptors, including exposure factors relevant to each scenario, are described and defined in the following sections. Exposure parameters for the RME and CT are presented for the each subsistence fisher and recreational fisher scenarios. The residential user and recreational user represent high-end and median exposure, respectively, for people engaged in recreational activities at the site. Therefore, further breakdown of these receptors by RME and CT scenarios is not warranted. Table 3-8 provides a summary of exposure factors used in the HHRA. Detailed information for each receptor is provided in this section and Attachment C tables.

3.5.1 Subsistence Fisher

Subsistence fishers may have direct contact (incidental ingestion and dermal exposure) with sediment during harvesting of clams, crab, or fish. Contact with sediment is expected to be minimal during netfishing or crabbing by boat, but common during clamming activities. Therefore, direct exposure to sediment during clamming is quantitatively evaluated in the HHRA. Subsistence fishers may also have indirect contact with sediment through ingestion of fish and shellfish harvested from the harbor.

It is assumed that children (less than 6 years of age) will accompany their parents during subsistence harvesting activities. Direct contact (incidental ingestion and dermal exposure) with sediment is assessed assuming children will play on the beach during times when their parents are clamming. Children may also have indirect contact with sediment through ingestion of fish and shellfish harvested from the harbor by their parents.

These pathways are quantitatively evaluated in the HHRA based on the exposure parameters described in this section. Exposure parameters are presented in Attachment C, Table C-1 and C-2.

3.5.1.1 Adult Subsistence Fisher

A site-specific average BW of 79 kg is used based on information presented in *Site-Specific Proposal for Modifying the Default MTCA Fish Consumption Exposure Parameters* (Ecology 2008a). This value is consistent with LEKT recommendations (Ecology 2008a) and was agreed to by the SAB (Ecology 2008b and 2009a). The site-specific BW is based on obesity rates among Tribal members (Ecology 2008a).

Exposure duration (ED) is the number of years a receptor potentially is exposed to contaminants from a site. The number of years subsistence fishers are expected to harvest from the harbor is assumed to be 70 years (Ecology 2008a). This value is consistent with LEKT recommendations and was agreed to by the SAB (Ecology 2008b). This value is based on Tribal census and demographic information provided by LEKT that indicates:

> …Tribal members live on or near the LEKT reservation for periods longer than 30 years (Attachment A). LEK Tribal environmental staff interviewed registered tribal elders (those over 55 years of age) who live on or adjacent to the LEK Tribal reservation. Of the 128 Tribal elders interviewed, 35 (27%) have never lived on or near the LEK Tribal reservation while 93 (73%) have resided on or near the reservation. Tribal elders had a range of 10 to 97 years residency time on the reservation with 52% of the elders falling between 54 and 75 years in residence. Of the 73% of Tribal elders that have lived on or near the Reservation at some point in their lives, the 90th percentile residence time is 72 years. The LEKT registry officer (Lola Moses) indicated that over 95% of those Tribal members under the age of 45 have lived on or near the reservation their entire lives. (Ecology 2008a)

The averaging time for noncarcinogenic effects (AT_{nc}) is equal to the ED in units of days. Therefore, potential exposures to contaminants in Port Angeles Harbor are averaged over the 70-year ED (i.e., 25,550 days). Since intake is averaged over a lifetime for carcinogenic effects, U.S. EPA recommends an averaging time for carcinogenic effects (AT_c) of 70 years in units of days (i.e., 25,550 days; U.S. EPA 1989).

The exposure frequency to sediments (EF_{sed}) during clamming activities is estimated to be 104 days/years (d/y). It is assumed a subsistence fisher would harvest clams during half the minus tides in the harbor. There were 208 minus tides recorded in 2007 at the Port Angeles Harbor NOAA station (NOAA 2009). Day and night tides were included in the count since clamming was observed during night hours, as well as during daytime.

There is no readily available information on sediment ingestion rate (IR_{sed}) during subsistence activities. It is assumed that incidental ingestion of sediment during clamming would be similar to incidental ingestion of soil in a residential setting. Therefore, the recommended U.S. EPA default adult soil ingestion rate of 0.1 g/d is used as the IR_{sed}.

For assessing dermal exposure, it is assumed that clamming would occur, on average, one time per day, resulting in an event frequency (EV) of 1. It is assumed both men and women participate in clamming activities and that during clamming heads, forearms, hands, lower legs, and feet are exposed. The dermal surface area (SA) is calculated based on the sum of the average mean values of body parts for males and females (U.S. EPA 1997a, Table 6-4) averaged for men and women. The resulting SA is 6,125.5 cm^2.

There is significant uncertainty about the sediment-to-skin adherence factor (AF) used in assessing the dose from dermal exposure. U.S. EPA (2004) presents a range of AFs for soil, including values for wet soil. Increasing moisture content increases the ability of sediments to adhere to skin (Kissel et al. 1996). Therefore, contact with sediment presents opportunity for relatively high dermal adherence (Shoaf et al. 2005a). The increased moisture content may also affect the relative percent absorbed (U.S. EPA 2004). An AF of 0.6 mg/cm^2-event is used to evaluate dermal contact with sediments for the RME scenario, based on the geometric mean of the activity-specific–surface-area-weighted soil AF for pipe layers exposed to wet soil (U.S. EPA 2004, Exhibit 3-3). This value is slightly higher than weighted-AF values derived using post-activity sediment loading values from Shoaf et al. (2005b). The CT scenario is evaluated using an AF of 0.1 mg/cm^2-event. This AF is based on the activity specific-surface area weighted soil AF for a farmer, using the geometric mean (U.S. EPA 2004, Exhibit 3-3).

To assess exposure to contaminants in fish and shellfish, a fish/shellfish ingestion rate (IR_{fish}) of 583 g/d is used. This value is based on the ingestion of pelagic fish, bottom fish, and shellfish for the Suquamish Tribe and has been found to be appropriate for use for LEKT ingestion assumptions (U.S. EPA 2007b, Ecology 2008a). Ingestion rates are broken down further by the following ingestion rates: an ingestion rate for pelagic fish ($IR_{pelagic}$) of 56 g/d; an ingestion rate for bottom fish (IR_{bottom}) of 29 g/d; and an ingestion rate for shellfish ($IR_{shellfish}$) of 498 g/d. These values are consistent with LEKT recommendations and were agreed to by the SAB (Charles 2009 provided as Attachment H; Ecology 2008b).

These ingestion rates are based on annual averages therefore the exposure frequency of contaminants in fish (EF_{fish}) of 365 d/y. Ingestion of pelagic fish is evaluated based on contaminant concentrations in lingcod and ingestion of bottom fish is evaluated based on contaminant concentrations in rock sole (Suquamish Tribe 2000, Charles 2009[1]).

Ingestion of shellfish is evaluated based on contaminant concentrations in shrimp, Dungeness crab, horse clams, and geoduck. As provided by LEKT (Charles 2009, provided as Attachment H), the shellfish ingestion rate is allocated as approximately 30% Dungeness crab (149.4 g/d), 30% geoduck (149.4 g/d), 30% horse clam (149.4 g/d), and 10% coonstripe shrimp (49.8 g/d). Based on the Suquamish consumption survey (2000), ingestion of red rock crab is significantly lower than the ingestion of Dungeness crab (mean consumption rate of 0.008 g/kg-d from red rock crab compared to 0.144 g/kg-d for Dungeness crab). There are only three red rock crab samples from Port Angeles Harbor available for use in the HHRA. These samples were collected in 1998 (E & E 1999). There are more Dungeness crab tissue samples from Port Angeles Harbor than red rock crab samples and the most recent tissue data is available for Dungeness crab. Therefore, contaminant concentrations in Dungeness crab are used to evaluate ingestion of crab from Port Angeles Harbor.

MTCA defines the fish diet fraction as "…the percentage of the total fish and/or shellfish in an individual's diet that is obtained or has the potential to be obtained from the site" (WAC 173-340-200). The fish diet fraction is represented by the fractional intake (FI) exposure parameter. LEKT proposes use of an FI of 1.0. The LEKT proposal is consistent with the U.S. EPA Region 10 Framework (2007b), which recommends the use of a relative source contribution equal to

[1] Note that LEKT (Charles 2009) provided ingestion rates for bottom fish based on consumption of rock sole and starry flounder but no site data are available for starry flounder. Therefore, rock sole data are used to evaluate the ingestion of bottom fish.

100%. Ecology and U.S. EPA have used this value when evaluating health risks for tribes at several cleanup sites in Washington (Ecology 2008a).

Based on Ecology's evaluation (2008a), the use of a fish diet fraction of 1.0 in combination with the Suquamish consumption rates could lead to exposure estimates that fall above the 95th percentile value generally used by Ecology when establishing cleanup levels. Ecology has also used or is considering using a fish diet fraction less than 50% in some areas used by different tribes (Ecology 2008a). For this evaluation, the RME scenario is evaluated using an FI of 1.0, indicating all fish and shellfish consumed by a subsistence fisher are harvested from the harbor. The CT scenario is evaluated using a FI of 0.5, indicating half of the fish and shellfish consumed are from the harbor.

3.5.1.2 Child Subsistence Fisher

An MTCA default BW of 16 kg is used in the HHRA (Ecology 2007, Equations 740-1 and 740-2) to evaluate exposure to a child subsistence fisher. The MTCA default child ED of 6 years is used (Ecology 2007). The AT_{nc} is equal to the ED in units of days; therefore, potential exposures to contaminants in Port Angeles Harbor were averaged over the 6-year ED (i.e., 2,190 days). Since intake is averaged over a lifetime for carcinogenic effects, U.S. EPA recommends an AT_c of 70 years in units of days (i.e., 25,550 days; 1989).

This scenario is evaluated assuming a child is exposed to beach/intertidal sediments while playing at the beach while parents are clamming. Therefore, the child EF_{sed} is estimated to be 104 d/y, consistent with the EF_{sed} for adults.

It is assumed that incidental ingestion of sediment during beach playing would be similar to incidental ingestion of soil in a residential setting. Therefore, the recommended U.S. EPA and MTCA default child soil ingestion rate of 0.2 g/d is used as the IR_{sed} (U.S. EPA 1997a, Ecology 2007).

As with the adult exposure scenario, it is assumed that beach playing would occur, on average, one time per day, resulting in an EV of 1. It is also assumed that during beach playing, children have their faces, forearms, hands, lower legs, and feet exposed. The SA is calculated based on the sum of the mean values of body parts for children less than 6 years of age (U.S. EPA 2004, Table C-1). The resulting SA to be used in the HHRA is 2,800 cm^2.

There is significant uncertainty in the AF for marine sediments, as discussed in Section 3.5.1.1. For the RME scenario, an AF of 3.3 mg/cm^2-event is used to evaluate dermal contact with sediments. This value is based on the 95th percentile of the activity-specific–surface-area-weighted soil AF for children playing in wet soil (U.S. EPA 2004, Exhibit 3-3). This value is similar to the weighted AF derived using post-activity sediment loading values from Shoaf et al. (2005a). For the CT scenario, an AF of 0.2 mg/cm^2-event is used based on the geometric mean of the activity specific-surface area weighted soil AF for children playing in wet soil (U.S. EPA 2004, Exhibit 3-3).

When adequate Tribal-specific studies for children's consumption rates are unavailable, U.S. EPA recommends four options to develop site-specific child fish and shellfish consumption rates

(U.S. EPA 2007b). For this evaluation, a ratio of adult to child consumption rates from the Columbia River Inter-Tribal Fish Commission (1994) study is applied to the LEKT adult consumption rates to estimate an IR_{fish} for children. The IR_{fish} for children under six years of age is calculated as 40% of the adult IR_{fish}, resulting in an IR_{fish} for children of 233 g/d. Ingestion rates are further broken down by the following ingestion rates using the same child to adult ratios: $IR_{pelagic}$ of 22 g/d; IR_{bottom} of 12 g/d; and $IR_{shellfish}$ of 199 g/d. These ingestion rates are based on an EF_{fish} of 365 d/y. The shellfish ingestion rate for children is allocated using the same percentages as for adults. That is, 30% for Dungeness crab, geoduck, and horse clam each (60 g/d each) and 10% (19 g/d) for coonstripe shrimp.

As with the adult scenario, the RME scenario is evaluated using an FI of 1.0. The CT scenario is evaluated using an FI of 0.5.

3.5.2 Recreational Fisher

The recreational fisher scenario is similar to the subsistence fisher scenario; the primary differences are frequency and magnitude. Recreational fishers may have direct contact (incidental ingestion and dermal exposure) with sediment during harvesting of clams, crab, or fish. As with the subsistence fisher, direct exposure to sediment during clamming is quantitatively evaluated in the HHRA, representing the activity with highest exposure. Recreational fishers may also have indirect contact with sediment through ingestion of fish and shellfish harvested from the harbor.

As with the subsistence fisher scenario, it is assumed that children (less than 6 years of age) will accompany their parents during harvesting activities. Direct contact (incidental ingestion and dermal exposure) with sediment for children is based on the assumption that children will play at the beach when their parents are harvesting seafood. Children may also have indirect contact with sediment through ingestion of fish and shellfish harvested from the harbor by their parents.

These pathways are quantitatively evaluated in the HHRA based on the exposure parameters described in this section. Exposure parameters are presented in Attachment C, Table C-3 and C-4.

3.5.2.1 Adult Recreational Fisher

MTCA and U.S EPA default values for BW (70 kg) and ED (30 years) are used (U.S. EPA 1997a, Ecology 2007). An AT_{nc} of 10,950 days, representing averaging over the ED of 30 years, is used. The default MTCA AT_c of 75 years (27,375 days) is used (Ecology 2007).

No site-specific data are available for recreational harvesting levels in Port Angeles Harbor. Collection and consumption habits were available for Duwamish River and Elliott Bay (King County 1999). It is assumed that similar recreational collection patterns would exist for Port Angeles Harbor. The RME EF_{sed} of 53 d/y is based on the average of the high end collection frequency estimates from the King County report. This value is consistent with approximately one-fourth of the minus tides in Port Angeles Harbor (NOAA 2009). The CT EF_{sed} of 37 d/y is based on the average of the mean collection frequency estimates from the King County report (King County 1999).

As with the subsistence fisher scenario, the recommended U.S. EPA default adult soil ingestion rate of 0.1 g/d is used as the IR_{sed}.

For assessing dermal exposure for the RME scenario, an EV of 1, an SA of 6,125.5 cm^2, and an AF of 0.6 mg/cm^2-event is used, consistent with the values presented for a subsistence fisher. The CT scenario is evaluated using the same values for EV and SA but with an AF of 0.1 mg/cm^2-event. This AF is based on the activity-specific–surface-area-weighted soil adherence factor for a farmer, using the geometric mean (U.S. EPA 2004, Exhibit 3-3).

To assess exposure to contaminants in fish and shellfish, an IR_{fish} of 76.5 g/d is used for the RME scenario and an IR_{fish} of 54 g/d is used for the CT scenario. The RME value is based on the 95^{th} percentile of the per capita distribution of fish and shellfish intake (U.S. EPA 1997a, Table 10-7). This equates to approximately two-and-a-half 8-ounce meals per week. The CT value is based on the MTCA default value (Ecology 2007) and is equivalent to approximately one-and-a-half 8-ounce meals per week. The ingestion rates for pelagic fish, bottom fish, and shellfish for the recreational fisher were developed using the same percentile breakdown as that for the subsistence fisher (85.4% shellfish, 9.6% pelagic fish, and 5% bottom fish). The following ingestion rates are used for the RME scenario: $IR_{pelagic}$ of 7.3 g/d; IR_{bottom} of 3.8 g/d; and $IR_{shellfish}$ of 65.3 g/d (19.6 g/d each for Dungeness crab, geoduck, and horse clam, and 6.5 g/d for coonstripe shrimp). The following ingestion rates are used for the CT scenario: $IR_{pelagic}$ of 5.2 g/d; IR_{bottom} of 2.7 g/d; and $IR_{shellfish}$ of 46.1 g/d (13.8 g/d each for Dungeness crab, geoduck, and horse clam, and 4.7 g/d for coonstripe shrimp). These ingestion rates are annual ingestion rates and therefore the values are based on an EF_{fish} of 365 days per year (d/y).

The MTCA default FI of 0.5 is used for the RME and CT scenarios (Ecology 2007), indicating half the fish and shellfish consumed are harvested from the harbor.

3.5.2.2 Child Recreational Fisher

An MTCA default BW of 16 kg is used in the HHRA (Ecology 2007, Equations 740-1 and 740-2). The MTCA default child ED of 6 years will also be used (Ecology 2007). The AT_{nc} is equal to the ED in units of days; therefore, potential exposures to contaminants in Port Angeles Harbor are averaged over the 6-year ED (i.e., 2,190 days). Since intake is averaged over a lifetime for carcinogenic effects, MTCA recommends an AT_c of 75 years in units of days (i.e., 27,375 days; Ecology 2007). These values are used for both the RME and CT scenarios.

The child recreational fisher scenario assumes a child will play at the beach while his or her parents are clamming as well as during other activities such as picnics. There is no site-specific recreational exposure frequency available for Port Angeles Harbor. A human use survey for the shoreline areas of Lake Union, Lake Washington, and Lake Sammamish presents event frequencies by recreational use (Parametrix 2003). It is assumed that these recreational use event frequencies are similar to use patterns at Port Angeles Harbor. Therefore, the child RME EF_{sed} for playing on the beach is estimated to be 65 d/y, consistent with the 95^{th} percentile for children aged 0 to 6 years playing and digging in sand (Parametrix 2003). The child CT EF_{sed} for playing on the beach is estimated to be 10 d/y, consistent with the 50^{th} percentile for children aged 0 to 6 years playing on and digging in sand (Parametrix 2003). Although the RME value is higher than the EF_{sed} for adults, it assumes the child will accompany his or her parents to the beach but engage in more beach playing activities, or activities that result in direct contact with sediment, than will his or her parents. The CT scenario does not make this assumption.

It is assumed that incidental ingestion of sediment during beach play would be similar to incidental ingestion for soil in a residential setting. Therefore, the recommended U.S. EPA default child soil ingestion rate of 0.2 g/d is used as the IR_{sed} for both the RME and CT scenarios (U.S. EPA 1997a).

As with the RME child subsistence fisher scenario, an EV of 1, an SA of 2,800 cm^2, and an AF of 3.3 mg/cm^2-event is used to assess dermal exposure to contaminants for the RME scenario. For the CT scenario, an AF of 0.2 mg/cm^2-event is used, consistent with the CT child subsistence fisher scenario.

As for the subsistence fisher, the IR_{fish} for children under 6 years of age was calculated using 40% of the adult IR_{fish} for the RME and CT scenarios, respectively. To assess exposure to contaminants in fish and shellfish for recreational fishers, an IR_{fish} of 30.6 g/d is used for the RME and 21.6 g/d for the CT scenarios. Due to a lack of site-specific ingestion rates for recreational users of the harbor, it is assumed that the ratio of child to adult consumption would be similar for recreational fishers and subsistence fishers. Ingestion rates were broken down further using the same child to adult ratios: RME scenario: $IR_{pelagic}$ of 2.9 g/d, IR_{bottom} of 1.5 g/d, and $IR_{shellfish}$ of 26.1 g/d (7.8 g/d each for Dungeness crab, geoduck, and horse clam, and 2.7 g/d for coonstripe shrimp); CT scenario: $IR_{pelagic}$ of 2.1 g/d, IR_{bottom} of 1.1 g/d, and $IR_{shellfish}$ of 18.4 g/d (5.5 g/d each for Dungeness crab, geoduck, and horse clam, and 1.9 g/d for coonstripe shrimp). These ingestion rates are based on an EF_{fish} of 365 d/y.

The MTCA default FI of 0.5 is used for both the RME and CT scenarios (Ecology 2007).

3.5.3 Residential User

The residential user represents the high end of recreational use of the harbor. This scenario assumes a local resident uses the area at a higher frequency and magnitude than a recreational user not living in the Port Angeles area. A residential user may have direct contact (incidental ingestion and dermal exposure) with sediment during recreational use of the harbor beaches such as during harvesting of clams, crab, or fish; playing at the beach; picnicking; or walking pets. While residential users also may consume fish and shellfish from the harbor, this scenario will focus on more intensive contact with beach/intertidal sediment.

These pathways are quantitatively evaluated in the HHRA based on the exposure parameters described in this section. Exposure parameters are presented in Attachment C, Table C-5 and C-6.

3.5.3.1 Adult Residential User

MTCA and U.S EPA default values for BW (70 kg) and ED (30 y) are used to evaluate exposure for the residential user (U.S. EPA 1997a, Ecology 2007). An AT_{nc} of 10,950 days, representing averaging over the ED of 30 years, is used. The default MTCA AT_c of 75 years (27,375 days) is used (Ecology 2007).

No site-specific data are available on recreational use of Port Angeles Harbor. The human use survey for the shoreline areas of Lake Union, Lake Washington, and Lake Sammamish presents a frequency of 234 d/y, which is the 95th percentile for adults aged 18 to 59 years playing on and digging in sand (Parametrix 2003). Because of limited accessibility to beaches in Port Angeles Harbor and the lack of tidal influences in the Parametrix study area, this value is an overestimate of EF for Port Angeles Harbor. Therefore, an EF of 50 d/y, or approximately 75% of the child EF_{sed} of 65 d/y (see Section 3.5.3.2), was selected as an appropriate adult EF for direct contact with beach/intertidal sediment.

As with the subsistence and recreational fisher scenarios, the recommended U.S. EPA default adult soil ingestion rate of 0.1 g/d is used as the IR_{sed}.

For assessing dermal exposure, an EV of 1, an SA of 6,125.5 cm^2, and an AF of 0.6 mg/cm^2-event is used, consistent with the values for the subsistence and recreational fisher scenarios.

3.5.3.2 Child Residential User

An MTCA default BW of 16 kg is used in the HHRA (Ecology 2007, Equations 740-1 and 740-2). The MTCA default child ED of 6 years will also be used (Ecology 2007). The AT_{nc} is equal to the ED in units of days; therefore, potential exposures to contaminants in Port Angeles Harbor were averaged over the 6-year ED (i.e., 2,190 days). Since intake is averaged over a lifetime for carcinogenic effects, MTCA recommends an AT_c of 75 years in units of days (i.e., 27,375 days; Ecology 2007).

There is no site-specific recreational exposure frequency available for Port Angeles Harbor. It is assumed that recreational use event frequencies at Lake Union, Lake Washington, and Lake Sammamish are similar to patterns at Port Angeles Harbor. Therefore, the child EF_{sed} for playing on the beach is estimated to be 65 d/y, consistent with the 95th percentile of children aged 0 to 6 years playing on and digging in sand (Parametrix 2003).

It is assumed that incidental ingestion of sediment during beach playing would be similar to incidental ingestion for soil in a residential setting. Therefore, the recommended U.S. EPA default child soil ingestion rate of 0.2 g/d was used as the IR_{sed} (U.S. EPA 1997a).

As with the child subsistence fisher and recreational fisher scenarios, an EV of 1, SA of 2800 cm^2, and AF of 3.3 mg/cm^2-event is used.

3.5.4 Recreational User

The recreational user represents an average level of recreational use of the harbor. This scenario is very similar to residential user but assumes a local resident uses the area at a higher frequency and magnitude than a recreational user not living in the Port Angeles area. A recreational user may have direct contact (incidental ingestion and dermal exposure) with sediment during harvesting of clams, crab, or fish; playing at the beach; picnicking; or walking pets. While the recreational user also may consume fish and shellfish from the harbor, this scenario will focus on more intensive contact with beach/ intertidal sediment.

These pathways are quantitatively evaluated in the HHRA based on the exposure parameters described in this section. Exposure parameters are presented in Attachment C, Table C-7 and C-8.

3.5.4.1 Adult Recreational User

The exposure parameters for the recreational user are the same as for the residential user except for exposure frequency. For the recreational user, it is assumed that the recreational use event frequencies at Lake Union, Lake Washington, and Lake Sammamish are similar to patterns at Port Angeles Harbor. Therefore, the adult EF_{sed} for playing on the beach is estimated to be 6 d/y, consistent with the 50^{th} percentile of adults aged 18 to 59 years playing on and digging in sand (Parametrix 2003).

3.5.4.2 Child Recreational User

The exposure parameters for the recreational user are the same as for the residential user except for exposure frequency. For the recreational user, it is assumed that these recreational use event frequencies at Lake Union, Lake Washington, and Lake Sammamish are similar to patterns at Port Angeles Harbor. Therefore, the adult EF_{sed} for playing on the beach is estimated to be 10 d/y, consistent with the 50^{th} percentile of children aged 0 to 6 years playing and digging in sand (Parametrix 2003).

3.6 Toxicity Assessment

The toxicity assessment compiles information on adverse health effects that the IHSs could cause and provides an estimate of the dose-response relationship for each IHS (the relationship between the extent of exposure and increased likelihood and/or severity of adverse effects). The dose-response relationship provides the basis for development of toxicity values used in the risk assessment. Toxicity values for each IHS are provided in this section. A brief narrative describing the toxicity of each IHS is provided in Attachment D.

Toxicity values were chosen according to the following hierarchy recommended in U.S. EPA's *Human Health Toxicity Values in Superfund Risk Evaluations* (2003a):

1. Integrated Risk Information System (IRIS) Computer Database (U.S. EPA 2009a). IRIS is the preferred source of information because this database contains the most recent toxicity values that have been reviewed extensively by U.S. EPA.

2. U.S. EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs). The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) develops PPRTVs on a chemical-specific basis. These toxicity values were obtained from the U.S. EPA Regional Screening Value Tables (2008a) when a toxicity value is not available on IRIS.

3. Other Values. In the absence of established values from IRIS or PPRTVs, toxicity values from several sources (Cal EPA toxicity values, U.S. EPA regional toxicologists, Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profiles, or National Center for Environmental Assessment (NCEA)) may be used.

It is acknowledged that multiple Tier 3 sources for toxicity values exist. For the toxicity values used in this assessment, the following hierarchy was used for the Tier 3 values:

1. ATSDR minimal risk levels (MRLs; ATSDR 2008b).
2. Cal EPA toxicity values.
3. U.S. EPA Superfund program's Health Effects Assessment Summary Tables (HEAST) as obtained from U.S. EPA.

This hierarchy is consistent with the hierarchy used by U.S. EPA in development of the Regional Screening Tables (U.S. EPA 2008a). Therefore, if no IRIS values are obtained from Tier 2 and Tier 3 sources, toxicity values were obtained from the Regional Screening Tables.

Per MTCA 173-340-708, a subchronic reference dose may be used to evaluate potential noncarcinogenic effects resulting from exposure to hazardous substances over short periods of time. This value may be used in place of the chronic reference dose where it can be demonstrated that a particular hazardous substance will degrade to negligible concentrations during the exposure period. For this evaluation, chronic reference doses are used for all exposure scenarios.

When no other values are available, surrogate values were selected based on similar structure, mechanism of action, and toxicity.

The approach for assessing the toxicity of carcinogenic and noncarcinogenic IHSs is presented in the following sections. Special subpopulations may be more susceptible to the toxic effects of exposure to IHSs. These subpopulations include the elderly, infants and children, people with pre-existing illnesses, and fetuses. As described in the following sections, uncertainty factors are used to provide additional protection for sensitive subpopulations.

3.6.1 Assessment of Carcinogens

U.S. EPA (2005b) uses a weight-of-evidence (WOE) approach to evaluate the likelihood that a substance is a carcinogen. U.S. EPA uses standard descriptors as part of the hazard narrative to express the conclusion regarding the WOE for carcinogenic hazard potential. U.S. EPA recommends five standard hazard descriptors: "Carcinogenic to Humans," "Likely to Be Carcinogenic to Humans," "Suggestive Evidence of Carcinogenic Potential," "Inadequate Information to Assess Carcinogenic Potential," and "Not Likely to Be Carcinogenic to Humans." Under U.S. EPA's 1986 guidelines for carcinogen risk assessment, the WOE was described by categories A through E. These categories are (A) human carcinogen, (B1 or B2) probable human carcinogen, (C) possible human carcinogen, and (D) not classifiable as a human carcinogen, and (E) not a carcinogen to humans (U.S. EPA 1986). When available, the 2005 WOE categories were used but for most IHSs only the 1986 WOE classification was available.

The toxicity of a chemical at low doses is often estimated from high-dose cancer bioassays. The most versatile forms of low-dose extrapolation are dose-response models that characterize risk as a probability over a range of environmental exposure levels. When a dose-response model is not developed for lower doses, another form of low-dose extrapolation is a safety assessment that characterizes the safety of one lower dose, with no explicit characterization of risks above or below that dose. Although this type of extrapolation may be adequate for evaluation of some decision options, it may not be adequate for other purposes that require a quantitative characterization of risks across a range of doses. At this time, safety assessment is the default approach for tumors that arise through a nonlinear mode of action; however, U.S. EPA continues to explore methods for quantifying dose-response relationships over a range of environmental exposure levels for tumors that arise through a nonlinear mode of action (U.S. EPA 2005b). The carcinogenic potency is represented by an IHS's cancer slope factor (SF) and is expressed as risk per milligram per kilogram per day [$(mg/kg\text{-}day)^{-1}$].

U.S. EPA (2004) has not developed SFs for dermal exposure to all chemicals, but has provided a method for extrapolating dermal SFs from oral SFs. This route-to-route extrapolation has a scientific basis because an absorbed chemical's distribution, metabolism, and elimination patterns are usually similar regardless of exposure route. However, dermal toxicity values are typically based on absorbed dose, whereas oral exposures are usually expressed in terms of administered dose. Consequently, if adequate data on the gastrointestinal (GI) absorption of an IHS are available, then dermal SFs may be derived by applying a GI absorbance factor to the oral toxicity value (U.S. EPA 2004). For chemicals lacking a GI absorbance value, absorbance is assumed to be 100% and the oral SF is used to estimate toxicity via dermal absorption.

For dioxin and furan mixtures, MTCA recommends a GI absorption factor of 0.6 (Ecology 2007a). This value is within the range (0.4 to 0.6) supported by the Science Advisory Panel based on available congener-specific analyses in Washington State (Ecology 2007c, 2007d). For this assessment, a GI absorption for of 0.6 was used for dioxin and furan mixtures.

Oral and dermal toxicity data, including oral and dermal SFs, GI absorption factors, WOE classification, and mutagenic identification are listed in Table 3-9.

3.6.2 Assessment of Noncarcinogens

To evaluate noncarcinogenic effects, U.S. EPA (1989) defines acceptable exposure levels as those to which the human population, including sensitive subgroups, may be exposed without adverse effects during a lifetime or part of a lifetime, incorporating an adequate margin of safety. The potential for adverse health effects associated with noncarcinogens (for example, organ damage, immunological effects, birth defects, and skin irritation) usually is assessed by comparing the estimated average daily intake (that is, exposure dose) to a reference dose (RfD).

U.S. EPA develops the RfD by identifying the no observed adverse effect level (NOAEL) or lowest observed adverse effect level (LOAEL) in the scientific literature. NOAELs and LOAELs may be derived from either human epidemiological studies or animal studies; however, because human data are often lacking, these levels are usually derived from laboratory animal studies in which relatively high doses are administered. Uncertainty factors are then applied to the NOAELs and LOAELs to compensate for the data limitations inherent in the experiments, in addition to uncertainties associated with extrapolating high-dose animal data to the relatively low-dose environmental exposure situations in humans.

RfDs are expressed in units of mg/kg-day. The RfD is an estimate (with uncertainty possibly spanning an order of magnitude) of the daily intake to humans (including sensitive subgroups) that should not result in an appreciable risk of deleterious effects. U.S. EPA assigns a qualitative level of confidence (low, medium, or high) to the study used to derive the toxicity value, database, and RfD. The relative degree of uncertainty associated with the RfDs and the level of confidence U.S. EPA assigns to the data and the toxicity value are considered when evaluating the quantitative results of the risk assessment.

U.S. EPA (2004) has not developed reference doses for dermal exposure to all chemicals, but has provided a method for extrapolating dermal RfDs from oral RfDs. If adequate data regarding the GI absorption of an IHS are available, then dermal RfDs may be derived by applying a GI absorbance factor to the oral toxicity value (U.S. EPA 2004). For chemicals lacking a GI absorbance value, absorbance is assumed to be 100% and the oral RfDs are used to estimate toxicity via dermal absorption. A GI absorption for of 0.6 was used for dioxin and furan mixtures.

Oral and dermal toxicity data, including oral and dermal RfDs, GI absorption factor, critical effect, and target organ are presented in Table 3-10. Target organ data were obtained from U.S. EPA's IRIS database (U.S. EPA 2009a) and ATSDR's MRL list (ATSDR 2008b).

3.6.3 Assessment of Carcinogenic PAHs, Dioxin/Furans, and PCBs

As mentioned in Section 3.1, cPAHs, dioxins and furans, and PCBs are evaluated as groups of compounds. Consistent with MTCA (Ecology 2007b), toxicity equivalency factor (TEF) methodology is used to evaluate the toxicity and assess the risks of each group of compounds. The TEF is the relative toxicity of a chemical compared to a reference chemical. For this assessment, the TEF is applied to results for each sample during calculation of the EPCs.

Carcinogenic PAHs are defined by MTCA (Ecology 2007a) as those PAHs identified as Group A (known human) or Group B (probable human) carcinogens by the U.S. EPA. Carcinogenic PAHs include benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. To evaluate the toxicity of cPAHs, benzo(a)pyrene is used as a reference chemical. The TEFs used to evaluate the toxicity of each compound are provided by MTCA in WAC 173-340-900 Table 708-2 (Ecology 2007a). The total toxicity of cPAHs was calculated as a sum of the individual cPAH compounds multiplied by the respective TEF.

Dioxins and furans comprise 210 interrelated chemicals that may occur together in mixtures. To evaluate the toxicity of dioxins and furans, 2,3,7,8-TCDD is used as the reference chemical because it is the most toxic and best studied (Ecology 2007b). The TEFs used to evaluate the toxicity of each compound are provided by MTCA in WAC 173-340-900 Table 708-1 (Ecology 2007a) and are consistent with TEFs used by U.S. EPA and the World Health Organization (Van den Berg et al. 2006). TEQ to 2,3,7,8-TCDD was calculated as a sum of the individual dioxin and furan congeners multiplied by the respective TEF.

PCBs are a group of synthetic organic chemicals that include 209 individual congeners. Commercial mixtures of PCBs were manufactured in the United States under the trademark

"Aroclor." MTCA allows for two options for assessing the risk of PCBs. One method is to analyze the samples for total PCBs (as Aroclors) where the entire PCB mixture is assumed to be equitoxic and one cancer potency factor for PCBs is assigned to the entire mixture. For this method, all Aroclors are summed to determine a total PCB value. The other method allows the samples to be analyzed for PCB congeners and the toxicity and risks of the PCB mixtures is assessed using TEFs. For this methodology, TEFs from WAC 173-340-900 Table 708-4 are used determine the toxicity of the 12 dioxin-like PCBs, and 2,3,7,8-TCDD is used as the reference compound (Ecology 2007b).

Analytical data from historical reports include some data as congeners and some as Aroclors. Aroclor PCB and dioxin-like congener PCB risk were both calculated to show risk of PCBs based on availability of data. For this assessment, when Aroclor data were available, the Aroclors were summed to derive a concentration for total PCBs. The cancer SF for total PCBs was used to assess cancer risk and the oral RfD for Aroclor 1254 was used to determine the noncarcinogenic hazard for the mixture. When concentration data were available for the 12 dioxin-like PCBs, these data in conjunction with the TEFs from MTCA were used to calculate a PCB TEQ. Again, this PCB TEQ uses toxicity data for 2,3,7,8-TCDD as a reference chemical. Risks and HIs were calculated separately by including congener or Aroclor data for tissue. For Dungeness crab and horse clam tissue, data were available for total congeners (dioxin-like and non dioxin-like PCBs). To ensure this fraction was not already included in the risks assessed for total Aroclors and PCB TEQ, total congeners were not included in the risk calculations.

The EPCs for cPAHs, 2,3,7,8-TCDD TEQ, and PCBs were calculated two separate ways, one method based on nondetected compounds assigned a concentration of zero and the other method based on nondetected compounds assigned a concentration of one-half of the detection limits. Risks were calculated separately for each method.

3.6.4 Resin Compounds and Sulfides

Resin compounds include retene, guaiacol, chlorinated guaiacols, and resin acids. Wood resins or resin acids are plant-derived chemicals found in association with wood debris, hardwood tar, and pulp and paper mill processes (Malcolm Pirnie 2006). Resin acids are a component of most softwoods and are usually released from wood chips during the pulping process. Their acute toxicity toward fish and other aquatic life has been shown in previous studies. Resin acids may account for as much as 70% of the toxicity of effluents (Li et al. 1996). Guaiacols can be absorbed through the skin. They appear to be about one-third as toxic as phenol and have pharmacological properties similar to phenol (HSDB 2009). Human toxicity data were not available from any of the resin compounds identified as IHSs. Therefore, these compounds were not quantitatively evaluated in the risk assessment.

3.6.5 Assessment of Arsenic and Mercury

Inorganic arsenic has been implicated as the primary toxic form to both aquatic life and humans. Approximately 85 to 90% of the arsenic in the edible parts of marine fish and shellfish is organic arsenic (e.g., arsenobetaine, arsenochloline, dimethylarsinic acid) and approximately 10% is inorganic arsenic (U.S. EPA 2003b). For this study, inorganic arsenic was measured in most tissue and therefore, the inorganic results were used to determine the risk from exposure to arsenic in fish and shellfish tissue. For lingcod, only total arsenic data were available. Because of this, the total arsenic EPC was multiplied by 10% to determine the inorganic arsenic fraction. The toxicity data for inorganic arsenic were then used to assess risks and hazards.

Both mercury and methyl mercury were identified as IHSs in fish and shellfish. Only methyl mercury results were available from Malcolm Pirnie (2006), who assumed that 100% of mercury identified was in the form of methyl mercury. It does not appear that speciation of mercury was conducted in this study. For the current HHRA, mercury in fish and shellfish was assumed to be 100% in the methyl mercury form (U.S. EPA 1993b). The maximum EPC between mercury and methyl mercury was used to evaluate mercury in tissue using toxicity data for methyl mercury.

3.6.6 Assessment of Lead

Lead and tetraethyl lead were identified as IHSs in tissue. Only tetraethyl lead results were available from Malcolm Pirnie (2006), who assumed that 100% of lead identified was in the form of tetraethyl lead. It does not appear that speciation of lead was conducted in this study. Therefore, for this assessment lead in fish and shellfish tissue was assumed to be total lead. The results of lead and tetraethyl lead were used to evaluate lead in fish using the methodology described in this section.

Although the toxic effects from lead exposure are well known, there are no verified or consensus toxicity values available for lead in IRIS, HEAST, or other sources. The absence of authoritative toxicity values reflects the scientific community’s inability to agree on a threshold dose for lead’s non-carcinogenic effects or to satisfactorily estimate its carcinogenic potency, despite a large body of scientific literature on its toxicological effects.

Due to the lack of toxicity values, exposure to lead was assessed using physiologically based toxicokinetic models for children and adults. The exposure estimates derived using these models were then compared to acceptable exposure limits. Lead modeling inputs and results are presented in Attachment I.

3.6.6.1 Child (IEUBK)

Models have been adopted to assess blood lead dose-response relationships in adults and children in lead-contaminated areas. Young children are the segment of the population at greatest risk from lead exposure because in comparison to adults, their intake of lead from the GI tract is greater (50% for children versus 5% for adults), and their developing organ systems are more sensitive to the toxic effects of lead. Therefore, the lead Integrated Exposure Uptake Biokinetic (IEUBK) model is recommended (U.S. EPA 2007c) to assess potential impacts to children from exposure to lead.

The IEUBK model predicts blood lead levels in young children resulting from multiple pathways of exposure, including intake via air, soil, drinking water, and diet. Default parameters exist in the model for intake of lead via the listed pathways. Site-specific data can also be input into the model to derive site-specific results. For this assessment, the IEUBK Model Win32 v.1.0.264 was used. All input values used in the model are presented in Attachment I, Tables I-1 and I-2, and are discussed in this section. Because lead was identified as an IHS in tissue, adjustments to default input parameters were made based on lead concentrations in locally caught fish. Lead was not identified as an IHS in sediment; therefore, no adjustments to the soil (or sediment) lead concentration were made.

The IEUBK dietary intake parameter does include consumption of fish from local sources as a default parameter; therefore, intake via fish consumption was included as an “alternate” dietary source of lead. The default daily dietary lead intake values for each age apply to a typical child in the United States. These estimates are derived from U.S. Food and Drug Administration (FDA) food monitoring data collected 1995-2003 (U.S. EPA 2007c). Site-specific data can be used to alter the default dietary intake rates due to the consumption of local fish. Information on fish tissue lead concentrations and the percentage of locally caught and consumed fish to all consumed meat (fish and game are included in the meat category) is input into the model. Updated dietary lead intake estimates from the U.S. Food and Drug Administration Total Diet Study (FDA 2006) and food consumption data from the Third National Health and Nutrition Examination Survey (NHANES III; CDC 1997) were used in this assessment.

The IEUBK model requires input of lead intake in units of micrograms of lead per gram of tissue (μg Pb/g), requiring modification of existing tissue concentrations and intake levels, as shown in Attachment I, Table I-2. To derive the alternate dietary value of lead in locally caught fish and shellfish for the subsistence fisher and recreational fisher receptors, the concentration of lead in the fish or shellfish (mg Pb/kg) was multiplied by the ingestion rate (g/d) for that food source yielding the intake of lead per day (μg Pb/d). These values for intake of lead in each fish and shellfish group then were divided by the total ingestion rate (g/d) of locally caught seafood to determine the daily dietary lead concentration in μg Pb/g.

The IEUBK model also requires input of the percentage of alternative meat sources (e.g., fish and shellfish) among all meat sources. These values are listed in Attachment I, Table I-1. However, under the subsistence fisher scenario, the amount of all fish and shellfish consumed is greater than the IEUBK default for all meats, so the percentage of meat consumed as fish and shellfish is greater than 100% (U.S. EPA 1994; calculated as the average for each of the seven age group aged 0 to less than 7 years of age). Therefore, the daily dietary lead concentration must be adjusted to calculate an equivalent dose of lead at 100% of the meat consumption (i.e., 93.5 g/d). To determine the dietary intake of lead at 100% of the meat consumption rate used in the IEUBK model, the daily dietary intake of lead at the total subsistence IR was multiplied by the ratio of the total subsistence IR (i.e., 233 g/d and 116.5 g/d) to the total meat consumption rate used in the IEUBK model (i.e., 93.5 g/d).

For the recreational fisher, the dietary lead concentration at the total ingestion rate was calculated in the same manner as for the subsistence fisher scenario. The percentage of locally caught fish and shellfish is the percentage of fish and shellfish from Port Angeles Harbor among all meats; no adjustment to total meat intake was required.

The IEUBK model has been validated using central tendency input parameters. IEUBK guidance (U.S. EPA 2007c) calls for central tendency (i.e., average) inputs and, specifically, arithmetic means should be used for the lead concentration term (U.S. EPA 2007d). Therefore, average concentrations for fish and shellfish were used as the EPC, where available. Lead was detected in horse clam and geoduck samples and average concentrations were calculated for use in the IEUBK model. For these calculations, one-half the detection limit was used for nondetected values. Lead was tested for but not detected in lingcod samples. Therefore, the average lead concentration was set at one-half the average detection limit. For coonstripe shrimp, Dungeness crab and rock sole lead results were assumed to be tetraethyl lead (Malcolm Pirnie 2006). Since no other lead data is available for these media, the tetraethyl lead results were used to calculate an average lead concentration for coonstripe shrimp, Dungeness crab and rock sole used in the IEUBK model.

The maternal blood lead at birth of the child in micrograms per deciliter (μg/dL) was set equal to the blood lead level of an adult, which was derived from the adult lead model (ALM; see Section 3.6.6.2).

3.6.6.2 Adult (ALM)

The ALM (U.S. EPA 2003c, 2005c) is used to evaluate adult lead risks in non-residential scenarios. The ALM assesses the risks to a developing fetus from potential lead exposures of pregnant women or women of child-bearing age in the workplace. The target fetal blood lead level used in this assessment is 10 μg/dL. The ALM can be used to calculate preliminary remediation goals (PRGs), or screening levels, for lead in soil, or can be used to calculate predicted blood-lead concentrations in adult women workers and fetuses of those workers. This model was used to evaluate the potential risks of exposure to lead in sediment and fish and shellfish caught at the site.

The ALM was designed to evaluate exposure to the most sensitive subpopulations, the fetuses of pregnant women. Although developed to evaluate exposure to adults in a worker scenario, it can be used to evaluate exposure to adults. The ALM is essentially an equation that estimates an average blood lead level based on additional exposure (above baseline levels) to lead in soil and air. The model applies a biokinetic slope factor (BKSF) to exposure estimates to derive an estimate of blood lead concentrations related to exposure levels. Ingestion exposure is the primary pathway evaluated in the model. A separate input in the equation for inhalation of lead from dust in the air is not necessary because the majority of airborne dust is not inhaled into areas of the lung where absorption of chemicals could occur. The default equation in the ALM is based on soil ingestion only. The equation may be modified to take into account sediment ingestion and the ingestion of lead in locally caught seafood, as shown in the following equation (these adjustments are consistent with U.S. EPA recommendations [U.S. EPA 2009b]):

$$PbB_{central,adult} = PbK_0 + \frac{BKSF \times \left[\left(Cs \times IRs \times EFs \times AFs\right) + \left(IRf \times EFf \times AFf\right)\right]}{AT}$$

Where:

$PbB_{central,adult}$	=	geometric mean blood lead level for adults, central estimate (μg/dL)
PbB_0	=	maternal baseline blood lead level (μg/dL)
BKSF	=	biokinetic slope factor (μg/dL)
Cs	=	lead concentration in sediment (μg/g)
IRs	=	sediment ingestion rate (g/d)
EFs	=	sediment exposure frequency (d/y)
AFs	=	sediment absorption fraction (unitless)

IRf = daily lead intake from fish and shellfish (g/d)
EFf = exposure frequency for fish and shellfish (d/y)
AFf = absorption fraction from food (unitless)
AT = averaging time (d/y)

To calculate the 95th percentile blood lead level among fetuses of adults, a population geometric standard deviation (GSD), representing the variability of blood lead in the population, is applied to the central estimate on blood lead levels for adults. The equation is as follows:

$$PbB_{95,adult} = PbB_{central,adult} \times GSD^{1.645}$$

Where:

$PbB_{95,adult}$ = 95th percentile estimate of blood lead level for adults (μg/dL)
GSD = population geometric standard deviation (unitless)
1.645 = 95th percentile value for the Student's t distribution

Fetal blood lead levels are predicted on the basis of the U.S. EPA assumption that fetal blood lead levels at birth are 90% of the maternal blood lead level. Therefore, the 95th percentile estimate fetal blood lead level is estimated as follows:

$$PbB_{95,fetal} = PbB_{95,adult} \times R$$

Where:

$PbB_{95,fetal}$ = 95th percentile estimate of blood lead level for fetus (μg/dL)
R = fetal-to-maternal constant of proportionality (unitless)

Inputs for this evaluation are presented in Table I-3 of Attachment I. Default U.S. EPA values were used for populations in the Western U.S. Although lead in sediment was not identified as an IHS, the average lead concentration in sediment was used to represent the lead concentration in soil. The IR for sediment and EFs for sediment and fish ingestion were adjusted based on values presented in Attachment C. The daily lead intake from subsistence foods (g/d) was calculated by summing the IR of specific food source by the concentration of lead in that item. These values are presented in Table I-4. The absorption fraction from food was set at 0.12, based on U.S. EPA's recommendations (U.S. EPA 2009b).

3.7 Risk Characterization

The risk characterization is the calculation of upper-bound excess lifetime cancer risks and noncarcinogenic hazards for each scenario described in the final CSM. The exposure parameters described in Section 3.5 were integrated with the toxicity information provided in Section 3.6 to obtain risk and hazard estimates for each scenario. Risks and hazards are summed for each target population across all pathways to obtain an estimate of total potential excess cancer risk and across all pathways with the same target organ to obtain an estimate of hazard. Risks and hazards were calculated in two different ways: (1) using EPCs for 2,3,7,8-TCDD TEQ, Total PCBs, and cPAHs calculated using zero for all nondetect results, and (2) using EPCs calculated using one-half the reporting limit for nondetect results. Nondetects did not figure greatly in the EPC calculations; the risks and hazards are similar for both EPC calculation methods.

As described in Section 3.6.3, MTCA (Ecology 2007b) allows for two options for assessing the risk of PCBs. One method uses total PCBs results (as Aroclors) where the entire PCB mixture is assumed to be equitoxic. The other method allows the samples to be analyzed for PCB congeners and the toxicity and risks of the PCB mixtures is assessed using TEFs. Aroclor PCB and dioxin-like congener PCB risk were both calculated to show risk of PCBs based on availability of data.

3.7.1 Risks for Carcinogens

The potential for someone to develop cancer as a result of exposure to Port Angeles Harbor media is estimated using the exposure and toxicity assumptions. The estimated intake is multiplied by the chemical-specific SF to determine the cancer risk, as shown below:

$$Risk = CDI \times SF$$

where:

CDI = Chronic daily intake (mg/kg-day)

SF = Slope factor $(mg/kg\text{-}day)^{-1}$

The calculated risk is an upper-bound probability of an individual developing cancer over a lifetime. The actual risk is likely to be no more than, and probably less than, the calculated risk. It should be noted that this linear relationship is valid only at low doses and can overestimate risk when estimated over several orders of magnitude (U.S. EPA 2005b).

Cancer risks are determined separately for exposure to each chemical through each exposure pathway. People may be exposed to IHSs through multiple pathways; for that reason, cancer risks are then summed across the exposure pathways representative of each exposure scenario to obtain the total potential excess lifetime cancer risk for each scenario. Calculated cancer risks are provided in Attachment C, Tables C-9 through C-20, and summarized in Table 3-11. Cancer risks were calculated separately using PCB Aroclor and congener data and are shown in Attachment C tables. The summary provided in Table 3-11 only provides results using PCB Aroclor data since that data is available for all media and resulted in the largest excess cancer risk.

Ecology has set acceptable target levels at 1×10^{-5} for multiple exposure pathways and/or multiple IHSs, and requires that the risk for an individual IHS via individual exposure pathways not exceed 1×10^{-6}.

3.7.2 Hazards for Noncarcinogens

The potential for adverse effects resulting from exposure to noncarcinogens is assessed by comparing the chemical-specific intake to its RfD, yielding an HQ, as follows:

$$HQ = \frac{CDI}{RfD}$$

Where:

HQ = Hazard quotient (unitless)

CDI = Chronic daily intake (mg/kg-day)

RfD = Reference dose (mg/kg-day)

HQs are provided for exposure to individual chemicals through each exposure pathway, for each target population. HQs for individual chemicals are summed to yield a hazard index (HI). A person could be exposed to multiple IHSs through various pathways. Therefore, the HIs are also summed across all exposure pathways for each scenario. The IHS-specific HQs are summed separately according to the major health effects and target organs affected, because the effects of exposure may not be additive for all IHSs, and summing all effects may lead to overestimating the potential for adverse health effects. The HI was separated by target organ including Aroclor data only, since that data is available for all media and resulted in the largest total HI. Calculated HIs are provided in Attachment C, Tables C-21 through C-44, and summarized in Table 3-13. HIs were calculated separately using PCB Aroclor and congener data and are shown in Attachment C tables. The summary provided in Table 3-13 only provides results using PCB Aroclor data since that data is available for all media and resulted in the largest total HI.

3.7.3 Risk Characterization Results

As noted, risks and hazards were calculated using two types of EPCs for 2,3,7,8-TCDD TEQ, PCBs (sum or Aroclors and PCB TEQ), and cPAHs: (1) a value of zero was assumed for all nondetect results, and (2) a value of one-half the reporting limit was used for nondetect results. Nondetect values did not figure greatly in the EPC calculations so the risks and hazards are the similar for both methods. Therefore, this discussion will focus on risks and hazards calculated based on EPCs in which one-half the reporting limit was used for nondetect values.

Potential excess cancer risks are presented in Table 3-11 and shown graphically in Figure 3-4. This table and figure include PCBs as Aroclors since these calculations include the most available data and result in the highest risk levels. The potential excess cancer risks (at one significant figure) for the subsistence fisher are 1 in 100 ($1x\ 10^{-2}$; RME) and 6 in 1,000 (6×10^{-3}; CT). Potential excess cancer risk for the recreational fisher were 3 in 10,000 (3×10^{-4}; RME) and 2 in 10,000 (2×10^{-4}; CT). Potential excess cancer risks for the residential and recreational users were 5 in 1,000,000 (5×10^{-6}; RME) and 7 in 10,000,000 (7×10^{-7}; CT). These risks exceed the Ecology threshold of 1 in 100,000 (1×10^{-5}) for all fishing receptors (subsistence fisher and recreational fisher). The residential and recreational user levels are below Ecology's threshold. Risks do not change substantially when including PCBs as congeners for the tissue data (see Table C-9 through C-12). Compounds that exceed Ecology's risk threshold of 1×10^{-6} for each receptor are shown in Table 3-12. For the subsistence and recreational fisher scenarios, the majority of the risks are from exposure to contaminants in fish and shellfish, as shown in Figure 3-4. Excess cancer risks from exposure to sediment were primarily driven by exposure to arsenic and 2,3,7,8-TCDD TEQ. The relative contribution to the excess cancer risk for the subsistence fisher (RME) scenario, the highest exposed receptor, are shown in Figure 3-5; arsenic accounts for approximately 58% of the total excess cancer risk.

Noncancer hazards by target organ are shown in Table 3-13 and Figure 3-6. HIs exceeded Ecology's threshold of 1.0 for the subsistence and recreational fisher scenarios. Compounds that exceed Ecology's HQ threshold of 1.0 for each receptor are shown in Table 3-14. The largest contributors to hazards are exposure to arsenic, total PCBs (as Aroclors) and 2,3,7,8-TCDD TEQ through ingestion of fish and shellfish. For the child subsistence user (RME), which is potentially the highest exposed receptor, exposure to contaminants in fish and shellfish accounts for approximately 99% of the total hazard with exposure to 2,3,7,8-TCDD TEQ representing 21%, arsenic representing 17%, and PCBs (as Aroclors) representing 37% of the overall risk.

It is important to note that arsenic was identified as an IHS based on the concentrations in Dungeness crab, geoduck, and horse clam. Concentrations of arsenic in coonstripe shrimp, lingcod, and rock sole collected from the harbor were less than the concentrations in samples from the reference site. The concentrations of arsenic in the other seafood species were similar to reference concentrations. Therefore, the risks associated with seafood consumption are driven by tissue concentrations in the Dungeness crab, geoduck, and horse clam. Harbor arsenic concentrations in Dungeness crab muscle were 0.001 mg/kg compared to a reference concentration of 0.1 mg/kg. Similarly arsenic concentrations in harbor geoduck were 1.41 mg/kg compared to 0.4 mg/kg in the reference location; whole horse clam arsenic concentrations were 1.35 mg/kg in the harbor and 0.74 mg/kg in the reference location.

3.7.4 Lead Modeling Results

As discussed in Section 3.5.6, risks from exposure to lead were not quantified as they were for other IHSs. Lead modeling was conducted for children using the IEUBK model, and for adults using the ALM. Results are discussed in the following subsections.

3.7.4.1 IEUBK Results

The IEUBK model was run using default parameters except for the inclusion of lead in locally caught fish and shellfish. The model was run for the subsistence and recreational fishers only since lead was not identified as an IHS in sediment, and sediment was the only exposure media for the recreational and residential users. Model output is provided in the form of a probability density curve that shows the probability of blood lead concentrations occurring in a hypothetical population of children. This curve shows a plausible distribution of blood lead concentrations centered on the geometric mean blood lead concentration predicted by the model from available information about children's exposure to lead. From this distribution, the model calculates the probability that children's blood lead concentrations will exceed a level of concern (U.S. EPA 1994).

EPA and the Centers for Disease Control and Prevention (CDC) have determined that childhood blood lead (PbB) concentrations at or above 10 μg Pb/dL present risks to children's health (CDC 1991). Therefore, a value of 10 μg/dL is generally used as the blood lead level of concern and is the threshold used in this assessment. The probability density curves designate the percentage of children predicted to have blood lead levels that exceed the threshold. Probability density curves were generated for this site and are provided in Attachment I. EPA's risk reduction goal for contaminated sites is that no more than 5% of the population exposed to lead will have blood lead levels greater than 10 μg/dL (U.S. EPA 2003d). The IEUBK model gives potential percentages of children with blood lead levels above 10 μg/dL for the subsistence fisher scenario of 56.6% (RME) and 29.7% (CT). These results are above the 5% U.S EPA threshold. Results for the recreational fisher scenario were below this threshold, with 2.4% (RME) and 1.7% (CT) above 10 μg/dL blood lead levels.

3.7.4.2 ALM Results

The ALM was used to estimate risks from lead exposure adult women and to the most sensitive population, a developing fetus. The model was run for the subsistence and recreational fishers only since lead was not identified as an IHS in sediment, which is the only exposure media for the recreational and residential users. A threshold was used of no more than a 5% probability that fetuses exposed to lead would exceed a blood lead level of 10 µg/dL, consistent with the EPA and ATSDR levels used in the IEBUK model (CDC 1991, U.S. EPA 2003d). Results of the ALM are presented in Table I-5 of Attachment I. The blood lead levels in adults for all receptors is 1.4 µg/dL (RME), with a probability of 0.3% that the fetal blood lead level would be greater than 10 µg/dL. The levels for all receptors are below the EPA threshold of 5%.

3.8 Uncertainty Assessment

Uncertainty is inherent in every step of the risk assessment process and is discussed in this section based on its impact on the risk assessment results. The risk characterization combines and integrates the results from data collection and evaluation, the exposure assessment, and the toxicity assessment to obtain quantitative estimates of the potential risks posed by site contamination. The following sections and Table 3-15 briefly describe some uncertainties associated with each step of the process and the way they likely affect the overall risk estimates.

3.8.1 Environmental Sampling and Analysis

Samples collected during the investigations were intended to characterize the nature and extent of contamination at the site. While this sampling approach is sound for site characterization, it can result in uncertainties in estimating the average concentration, or EPC, that people may contact over time.

For example, although many sampling locations were selected in a random or systematic fashion using a grid system, some sampling locations were selected in a purposeful or directed manner to focus on particular areas where contamination was known or suspected to be present. Samples collected in this manner provide considerable information about the site but are not statistically representative of contamination that may be present on the site and may overestimate the average concentration that people may be exposed to.

In addition, there were low sample numbers for IHSs in tissue. In many instances only three samples were available for a specific tissue type. For most of the tissue data sets, risks were determined based on the EPC set at the maximum concentration detected at the site rather than an estimate of the mean concentration. This is because for small data sets, the mean may exceed the highest individual sample results resulting in an overestimation of risk. Because of biased sampling, the maximum concentration may represent a hotspot of contamination and may result in a high EPC. In some instances, no data was available for a particular media and chemical combination (see Table 3-6), which may result in an underestimate of risk at the site.

There was limited sampling in Dungeness Bay, the reference site, for both tissue and sediment. True background concentrations may be higher or lower than was determined based on the current sampling. As previously indicated, in small data sets the upper confidence limit on the mean may be higher than the current maximum detected concentration which could potentially over-estimate the site-related risks. In addition, reference species and tissue type were not available for all site fish and shellfish samples. For example, ling cod and rock sole samples were not available from Dungeness Bay; therefore, starry founder fillets and whole rock sole samples were used for comparison to fillets and whole fish samples, respectively. The site and reference data sets used for comparison are shown in Table 3-3. Although a few potential IHSs were eliminated for ling cod or rock sole based on comparison to surrogate reference site species, those compounds were added as IHS based on screening criteria in other fish or shellfish species. Therefore this issue could potentially over-estimate the site-related risks.

For many compounds, human health screening levels were not available. These compounds were retained as IHSs and, if possible, quantitatively evaluated in the HHRA. This conservative approach may have resulted in inclusion of compounds that had negligible impact on risk. This uncertainty may have slightly overestimated risk.

3.8.2 Exposure Point Concentration Uncertainties

Because of the variability and uncertainty inherent in the sampling and analysis processes (Section 3.8.1), the chemical concentrations reported may differ from the actual chemical concentrations. Uncertainty is introduced by the use of estimated, or J-qualified, results, which may not have the same precision and accuracy as data meeting all standard QC criteria. There is also uncertainty associated with the use of nondetect results, or assuming IHS concentrations are based on the reported limits, which may overestimate or underestimate the true concentrations present.

EPCs for sediment and tissue were estimated directly from IHS concentrations measured in those media. To avoid underestimating the average long-term exposure point concentration, the value used for each IHS was either the 95% UCL of the mean or the maximum observed concentration. This approach is likely to overestimate the actual average concentrations of the IHSs in the exposure media, except potentially in small data sets as discussed in Section 3.8.1.

For IHSs in tissue, numerous compounds were not detected or not tested for in a specific tissue type, and therefore were not included in the final risk calculations. This may underestimate the risk at the site.

There is uncertainty in the application of TEFs to determine the toxicity of a group of compounds which may over or underestimate risk at a site. This methodology was used to determine the EPC for cPAHs, PCBs, and 2,3,7,8-TCDD TEQ. In addition, historical reports often did not document how the grouped concentration was determined (e.g., treatment of nondetect results, source of TEFs) which adds an area of uncertainty. When possible, the concentration for the group was recalculated using the methodology described in Section 3.6.3 but this was not always possible.

For some compounds, the EPC in whole tissue was calculated based on assumption of percentage of composition of body parts (i.e. muscle to hepatopancreas tissue). This composition most likely varies by animal causing the calculated EPC to either over or underestimate the true concentration. In addition, the inorganic arsenic concentration in lingcod was estimated based on a percentage of the total arsenic measured. True percentages of inorganic arsenic to total arsenic in fish may actually be less than 10%, the value used in this assessment. It is important to note that since lingcod ingestion rates are low, this area of uncertainty had a small impact on overall risk at the site.

In addition, EPCs (and corresponding risks) were calculated based on chemical concentrations in representative species (e.g., lingcod representing pelagic fish; rock sole representing bottom fish; limited clams, shrimp, and crab representing all shellfish, etc.). Use of these few species may over or underestimate risks for populations that in actuality consume a more varied diet.

3.8.3 Exposure Assessment Uncertainties

All exposure calculations assume that the chemical concentrations in sediment and tissue will remain constant over the duration of exposure; up to 70 years for a subsistence fisher. Actual concentrations could remain the same or decrease, depending on both site-specific and chemical-specific factors. Under favorable conditions, many organic chemicals can degrade in sediment and biota as the result of chemical or biological transformations. Since inorganic compounds do not degrade and are relatively immobile, the concentrations of inorganic IHS in sediment would be expected to remain relatively stable. Over time, the inorganic chemicals present in sediment can become more tightly bound in the solid phase and subsequently become less bioavailable to both aquatic biota and people. Migration of contaminated sediments away from the source area would tend to reduce the concentrations of all contaminants in site sediments, resulting in a decrease in tissue concentrations, over the long term. Similarly, deposition of sediment from non-urban or industrialized areas in the harbor could result in reduced chemical concentrations over time.

Selection of appropriate exposure parameters is typically a challenging exercise in conducting human health risk assessment as it is difficult to make generalizations about potentially impacted populations and site-specific exposure studies are very rare. Nevertheless, the risk assessor must make the best assumptions possible based on available information. While there are limited studies available for contact with soil, even fewer studies have been conducted to estimate exposures to sediment, in terms of frequency of contact, adherence of sediment to skin, and incidental ingestion of sediment through hand-to-mouth contact. For this reason, many sediment ingestion and dermal exposure parameters are based on studies of human contact with soil, which may result in an under- or overestimation of risk.

The individual exposure parameter values used in the RME calculations were selected to represent a high-end estimate of exposure for an individual that is a conservative, or protective, estimate of actual exposures. The exposure values selected were either standard default values consistent with the MTCA regulation or recommendations from Ecology's Science Advisory Board (SAB), or were conservatively protective estimates selected based on best professional judgment. In some cases, values were based on studies conducted for other Puget Sound populations and water bodies and may or may not be representative of the populations evaluated for Port Angeles Harbor. As a result, the calculated potential exposures probably overestimate the actual exposure for most individuals in the receptor populations. Estimated risks based on CT, or mean or median, exposure values may be considerably lower than the estimates based on RME assumptions presented in this assessment, but may still have a tendency to overestimate the true risk at the site.

As briefly mentioned above, additional uncertainty is associated with the procedures used to estimate dermal absorption of chemicals from sediment, specifically ABS_{dermal} and AFs. Uncertainties with this approach are due to the limited information available on sediment-specific values and the application of soil values to represent exposure to sediment. These uncertainties are discussed in detail in Sections 3.4.1 and 3.5.1.1. Dermal absorption of IHSs in sediment was estimated using conservative absorption factors for soil recommended by U.S. EPA. The recommended default values, which generally fall at the upper ends of the ranges that have been observed in absorption studies, may not reflect actual dermal absorption for sediment. These uncertainties had a large impact on the overall risk at the site, specifically in regards to the impacts from dermal exposure to arsenic, cPAHs, and dioxins/furans in sediment.

Recreational fish ingestion rates were not available for this site and so values based on the general U.S. population or default Ecology values were used in this assessment, representing uncertainty in exposure. Since fish ingestion represents a major source of the risk at the site, this uncertainty has a large impact.

Significant uncertainty in the ingestion rates for the subsistence fisher has been documented during the SAB review process (Ecology 2008a). Areas of uncertainty include: application of the Suquamish seafood consumption study dataset to the LEKT; the quality and quantity of the shellfish habitat currently present in Port Angeles Harbor; exclusion of salmon from the total fish diet: relative percent of fish and shellfish contaminant body burden attributed to the site compared to other marine environments; information on harvests from other areas other than Puget Sound; and sustaining and managing harvestable shellfish habitat based on consumption habits of the LEKT (Ecology 2008a). Since this route of exposure contributes the greatest amount of risk for subsistence fishers, these uncertainties could significantly impact the total risk results for this most sensitive exposure population.

3.8.4 Toxicity Assessment Uncertainties

The basic uncertainties associated with the derivation of toxicity values in the toxicity assessment include:

- Uncertainties arising from the design, execution, or relevance of the scientific studies that form the basis of the assessment; and

- Uncertainties involved in extrapolation from the underlying scientific studies to the exposure situation being evaluated, including variable responses to chemical exposure within human and animal populations, between species, and between routes of exposure.

These uncertainties could result in a toxicity estimate based directly on the underlying studies that either underestimates or overestimates the true toxicity of a chemical. The toxicity assessment process compensates for these basic uncertainties through: the use of UFs and modifying factors in the derivation of RfDs for assessing noncarcinogenic effects; and the method of calculating the 95% UCL value from the linearized multistage model to derive low-dose SFs for assessing cancer risks. This approach ensures that the potential toxicity of a chemical to humans is unlikely to be underestimated; however, actual toxicity may be substantially overestimated as a result. There is significant uncertainty in how to address risks from mutagenic compounds. A method slightly different than recommended by U.S. EPA (2005b) was used to determine the risks from exposure to cPAH, adding to the uncertainty in the risk determination.

The use of adjusted oral toxicity values to evaluate dermal risks is an additional source of uncertainty to the dermal risk estimates, because the biokinetics (uptake, distribution, metabolism, and elimination) from dermal exposure may be different from ingestion.

In the absence of information to the contrary, U.S. EPA guidelines indicate that carcinogenic risks should be treated as additive and that HIs for similar noncarcinogenic effects should also be treated as additive. The assumption of risk additivity ignores possible synergisms or antagonisms among different chemicals, which would increase or decrease their toxic effects and could tend to underestimate or overestimate total site risks.

For some IHSs no toxicity data was available. In some instances, toxicity data for surrogate compounds was used which may over or underestimate the toxicity of the compound. In other instances when appropriate surrogate data could not be identified, these IHSs were excluded from quantitative evaluation in the HHRA. These compounds include sulfides and resin compounds.

The slope factor used to assess cancer risk from potential exposure to dioxin and furans is based on the 1997 HEAST slope factor for 2,3,7,8-TCDD, a value of 150,000 $(mg/kg\text{-}d)^{-1}$. Uncertainties remain regarding quantitative estimates of upper-bound cancer risk from dioxin and related compounds. U.S. EPA (2003f) found the slope factors, based on the most sensitive cancer responses calculated by authors of peer-reviewed publications, fall in a range of approximately 0.6×10^{-3} to 5×10^{-3} per pg TEQ/kg bodyweight/day (0.6 to 5×10^{6} $[mg/kg\text{-}d]^{-1}$). The HEAST value falls within this range although could under- or overestimate the true cancer potency dioxins and furans. The ranges of estimates of upper-bound cancer potency calculated from the human and animal data overlap. The range above is bounded on the upper end by the estimate of slope from the Hamburg cohort epidemiology study and on the lower end by the estimates from the Ott and Zober epidemiology study, with the NIOSH piece-wise linear epidemiology model and the reanalyzed Kociba rat study falling intermediate in this range (U.S. EPA 2003f). <u>Consequently, U.S. EPA (2003f) suggests the use of 1×10^{-3} per pg TEQ/kg body weight/day as an estimator of upper-bound cancer risk for both background intakes and</u>

incremental intakes above background (10^6 [mg/kg-day]$^{-1}$). U.S. EPA (2003f) also identified uncertainty in the application of the TEF approach to evaluating dioxins and furans.

In 2004, the U.S. EPA, asked the National Research Council (NRC) of the National Academies to review its 2003 draft Reassessment. The NRC report (2006) describes the Reassessment as very comprehensive in its review and analysis of the extensive scientific literature on TCDD, other dioxins. However, the NRC report finds substantial room for improvement in the quantitative approaches used by EPA to characterize risks. The committee concludes that EPA's decision to rely solely on a default linear model lacked adequate scientific support. The report recommends that EPA provide risk estimates using both nonlinear and linear methods to extrapolate below a point of departure (NRC 2006).

3.8.5 Risk Characterization Uncertainties

As explained earlier, intentionally conservative, health-protective assumptions are used throughout the risk assessment process so that the true risk is unlikely to be underestimated. The cumulative effect of this approach could be to substantially overestimate the true risk at the site.

For some compounds, the site concentration does not greatly exceed the reference concentration. Therefore, excess risks and hazards attributable to site related contaminants may not greatly exceed the risks from exposure to reference concentrations. For instance, the EPC for arsenic in sediment at the site (based on the 95% UCL) is 6.87 mg/kg. The concentration in reference sediments is 7.1 mg/kg indicating potentially all risk due to exposure to arsenic in sediment is related to reference concentrations. This is also the case for many of the pesticides. For instance, the site-specific EPCs are slightly greater than the reference maximum concentration for 4,4'-DDT (0.0017 mg/kg site versus 0.0034 mg/kg reference), alpha-benzene hexachloride (BHC; 0.038 mg/kg site versus 0.03 mg/kg reference), beta-BHC (0.015 mg/kg site versus 0.013 mg/kg reference), and lindane (0.004 mg/kg site versus 0.003 mg/kg reference). Based on this limited evaluation, there is significant uncertainty in the risks attributable to site related contaminants over the reference levels of these compounds.

Neither the IEUBK model nor ALM were specifically designed to account for lead in locally caught food, especially at consumption rates consistent with a subsistence level. Both models were adjusted to account for this exposure pathway but uncertainty exists in the adjustments which may over or underestimate the risk at the site.

Risks were assessed based on whole food concentrations and impact on chemical intake based on food preparation, or on an "as consumed" level, was not considered. Food preparation methods could have an impact on chemical concentrations which could result in an over or underestimation in risks.

3.9 Conclusions

The potential excess cancer risks exceed the Ecology threshold of 1 in 100,000 (1×10^{-5}) for the subsistence and recreational fish receptors. Noncancer hazards exceeded Ecology's threshold of 1.0 for the subsistence and recreational fisher scenarios. Cancer risks and noncancer hazards for the residential and recreational users are below the Ecology threshold. The largest contributors to hazards and risks are exposure to arsenic, total PCBs, and 2,3,7,8-TCDD TEQ through ingestion of fish and shellfish.

Results from the IEUBK and ALM model indicate that exposure to lead in fish and shellfish may result in blood lead levels for a child above the U.S. EPA level of concern.

These risks and hazards may be considerably influenced by uncertainties associated with the IHSs and exposure pathways contributing to the greatest proportion of total risks:

- Small sample numbers used to estimate EPCs for tissues;
- Inclusion of IHSs likely present at concentrations consistent with reference concentrations (arsenic, pesticides);
- Quantification of seafood ingestion rates for the LEKT and recreational users of Port Angeles Harbor; and
- Lack of sediment-specific exposure parameters, particularly for dermal exposure assessment.

Further evaluation of the impacts of the uncertainty in the assessment is warranted based on the results. Further sampling of biota would help reduce these uncertainties.

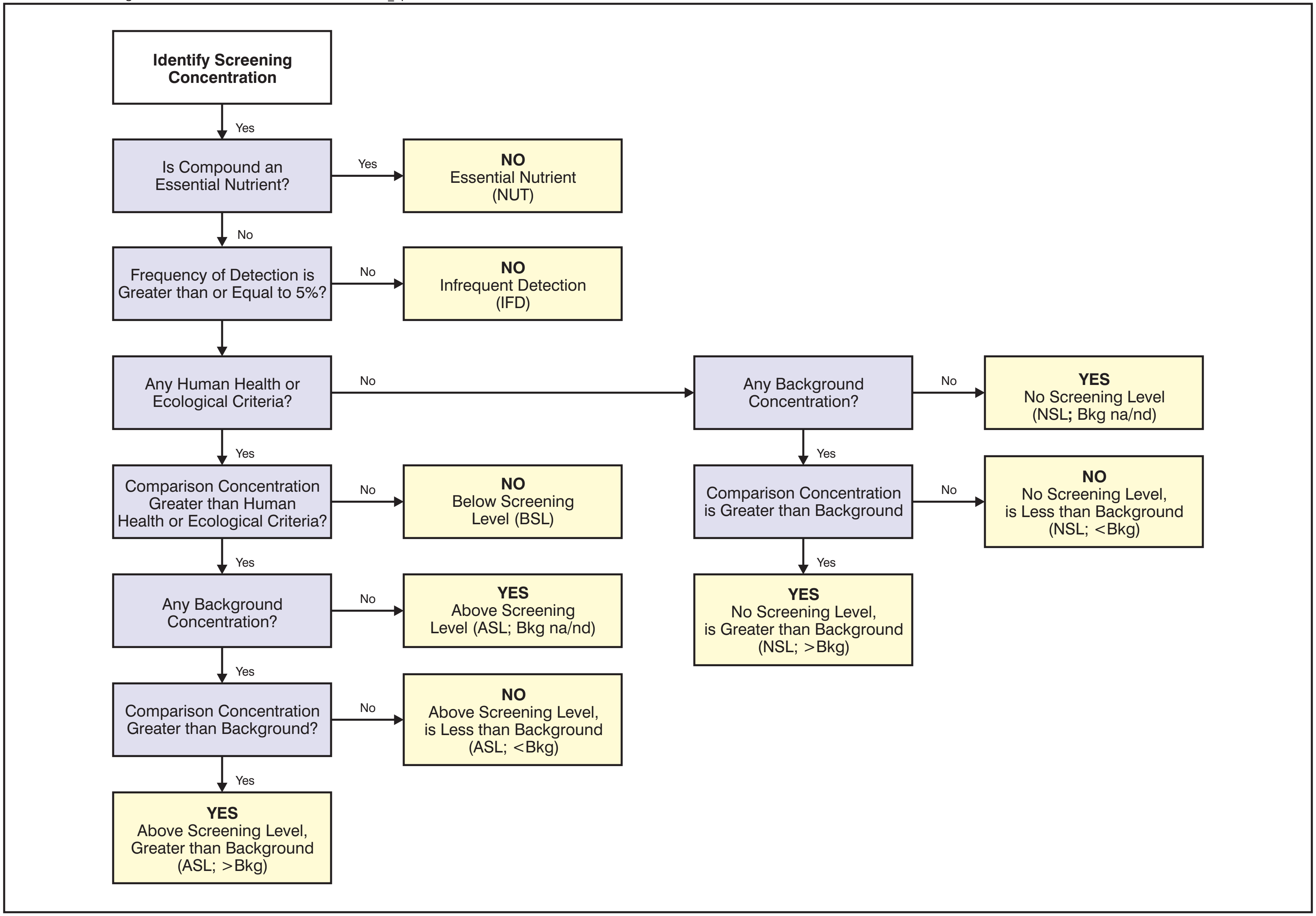

Figure 3-1 Potential IHS Decision Flow Chart for Intertidal Sediment and Tissue Samples

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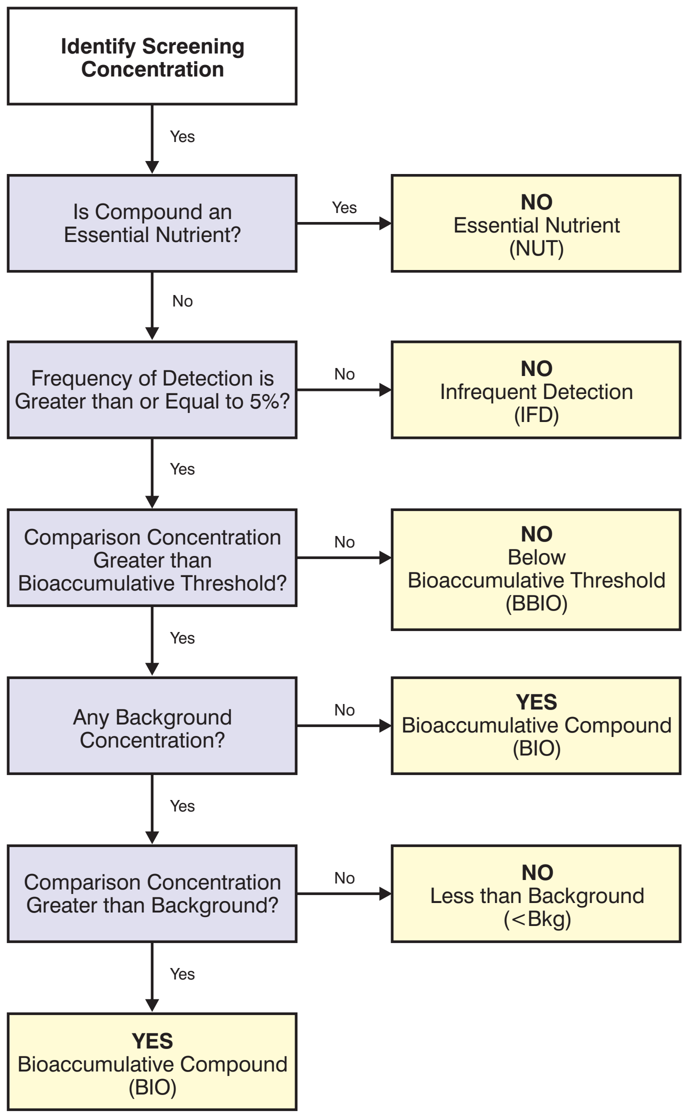

Figure 3-2 Potential IHS Decision Flow Chart for Subtidal and Intertidal Sediment Samples

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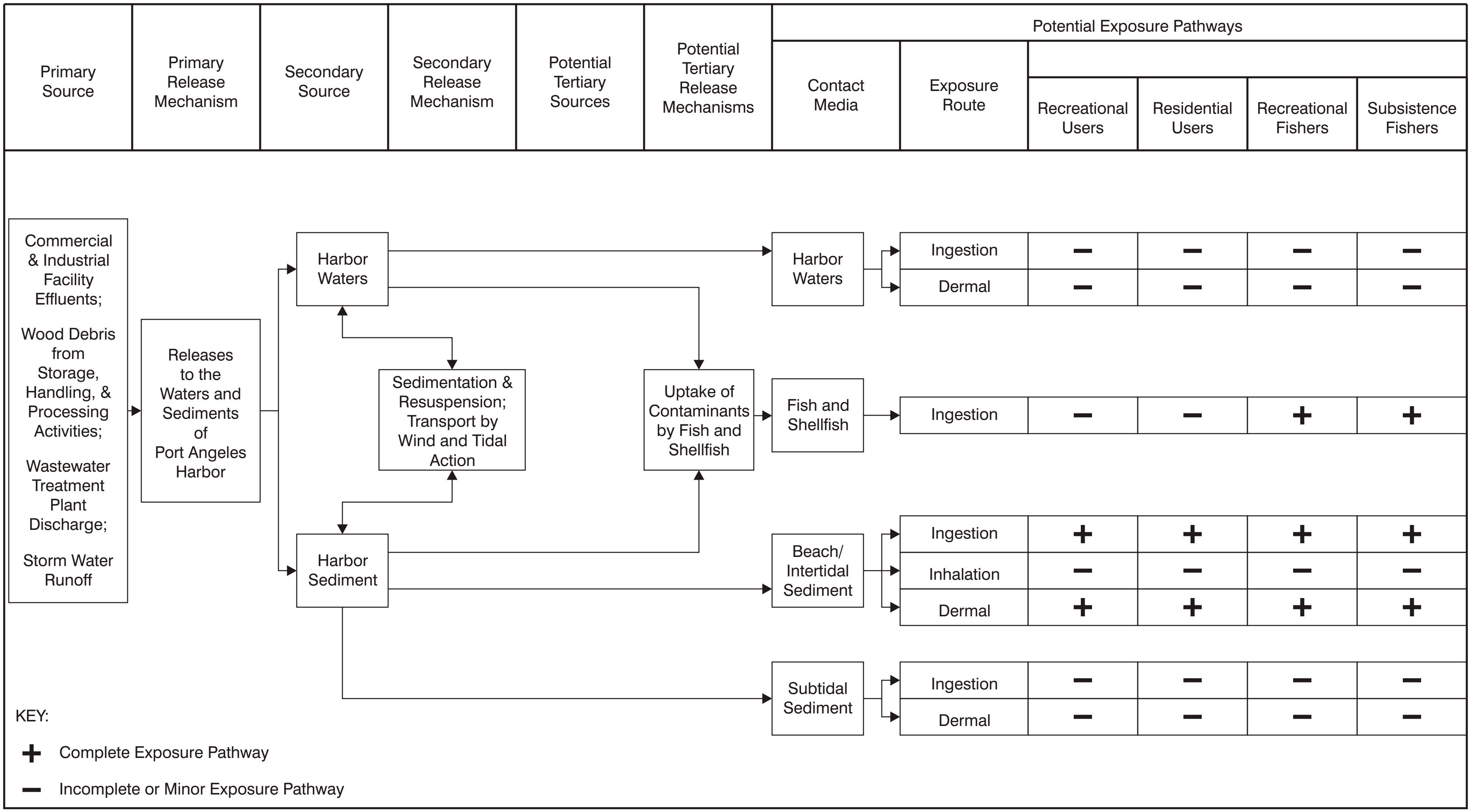

SOURCE: Ecology and Environment, Inc. 2009

Figure 3-3 HHRA Final Conceptual Site Model

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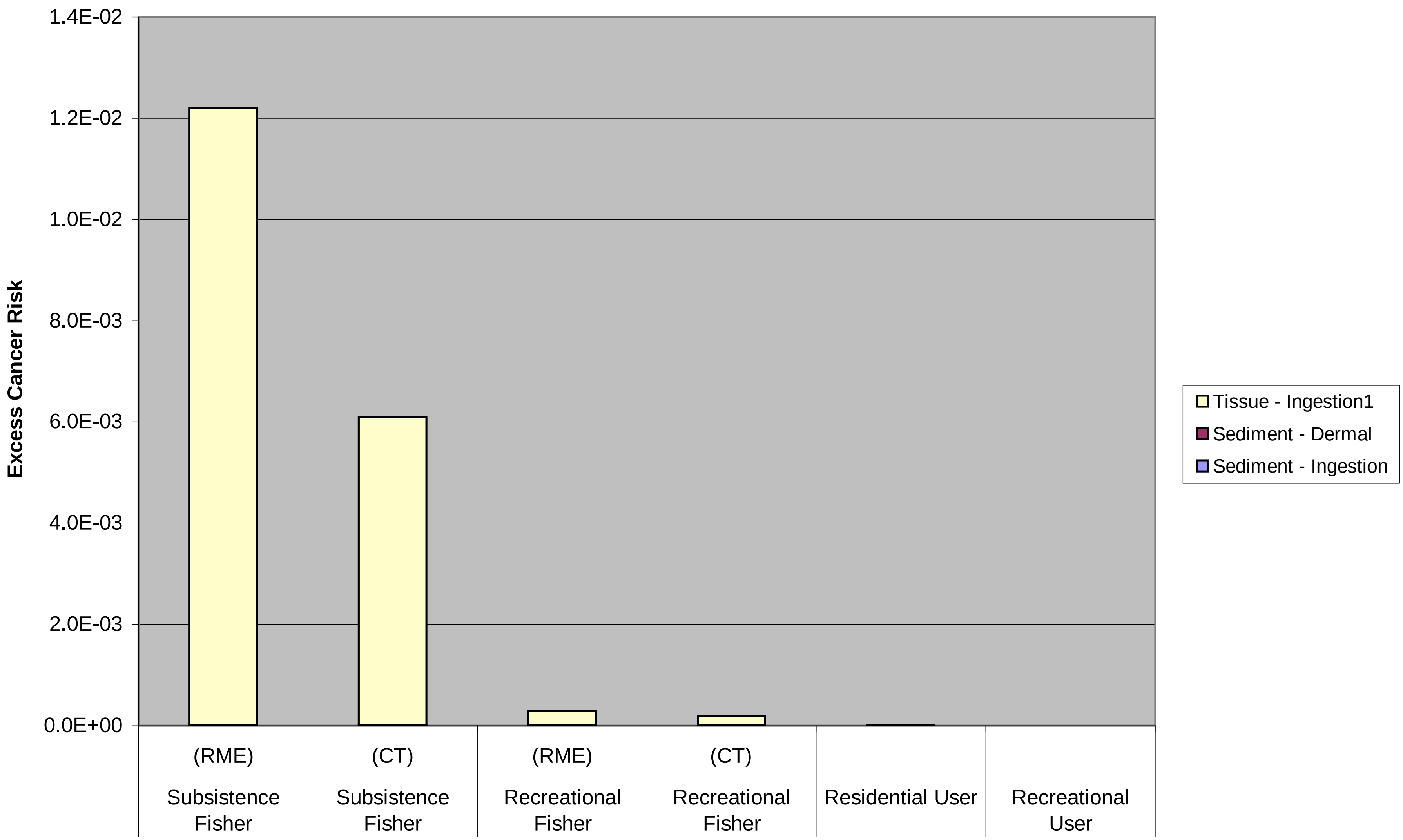

Figure 3-4. Potential Excess Cancer Risk by Receptor

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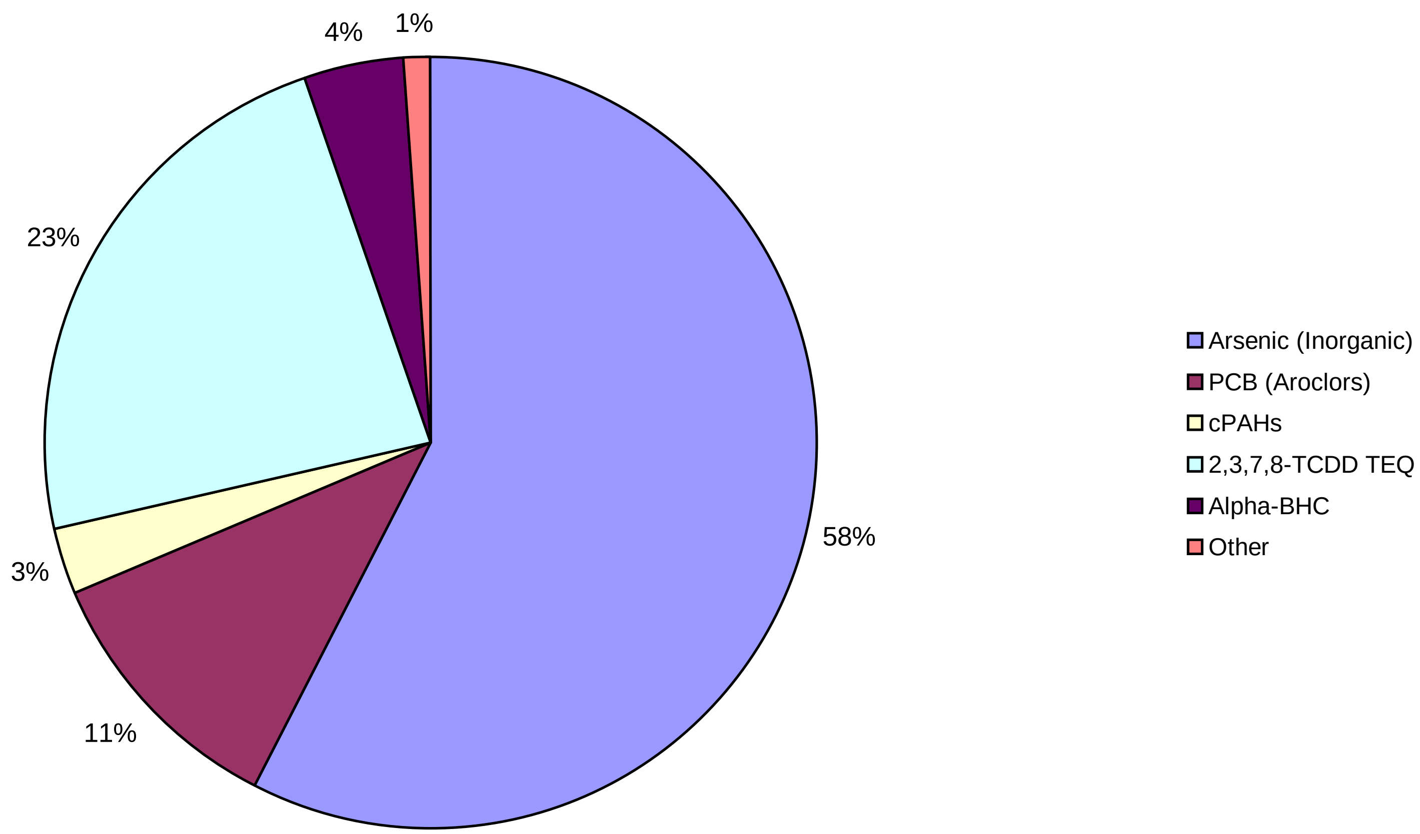
Figure 3-5. Relative Contribution to the Subsistence Fisher (RME) Excess Cancer Risk



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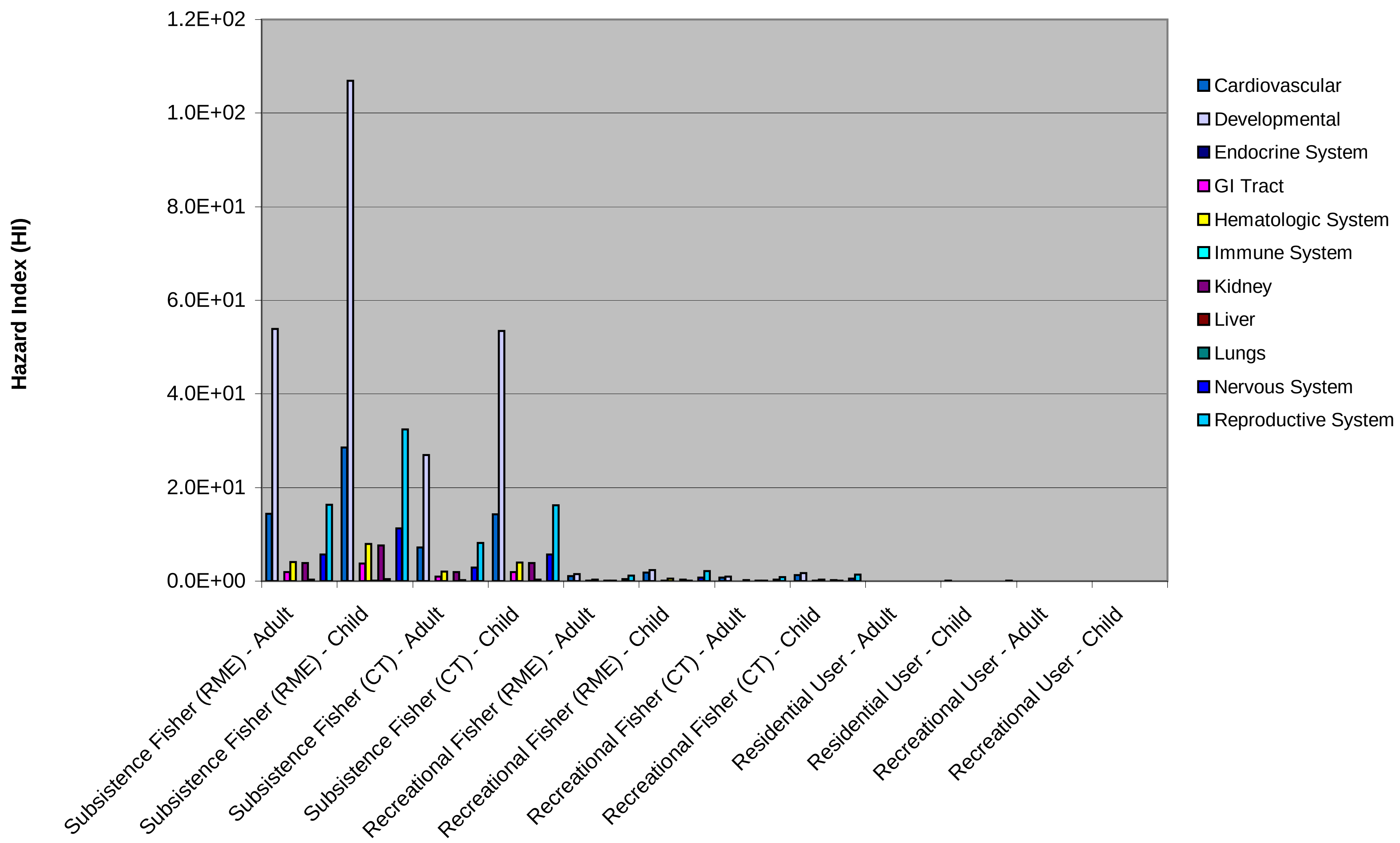

Figure 3-6. Hazard Index by Target Organ

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Table 3-1 Port Angeles Harbor Tissue Sample Number by Type

Tissue	Sample Typle								
	Bull Kelp	Coonstripe Shrimp	Dungeness Crab	Eel Grass	Geoduck	Horse Clam	Lingcod	Red Rock Crab	Rock Sole
Edible Tissue						16			
Fillet									3
Hepatopancreas			11						
Leaves	1			1					
Muscle			11						
Skin-on Fillet							2		
Visceral Cavity						10			
Whole Fish							2		
Whole Organism		3			7	17		3	3
Grand Total	**1**	**3**	**22**	**1**	**7**	**43**	**4**	**3**	**6**

Table 3-2 Site-Specific Subsistence Fisher Exposure Parameters Used for Screening

Exposure Parameter	U.S. EPA Regional Screening Calculator Default	Site-Specific Value
Average body weight (kg)	70	79
Averaging time (years)	30 – noncarcinogens 70 – carcinogens	70 – noncarcinogens and carcinogens
Fish ingestion rate (g/d)	54	583
Exposure duration (years)	30	70

Table 3-3 Summary of Reference Data Screening Comparisons

Port Angeles Harbor Matrix	Subset or Species	Tissue	Reference Data Set[1]
Sediment	Intertidal and Subtidal	NA	Subtidal Sediments
	Intertidal	NA	Subtidal Sediments
Tissue	Bull Kelp	Leaves	None
	Eel Grass	Leaves	None
	Coonstripe Shrimp	Whole Organism	Coonstripe Shrimp – Whole Organism
	Dungeness Crab	Hepatopancreas	Dungeness Crab – Hepatopancreas
	Dungeness Crab	Muscle	Dungeness Crab – Muscle
	Geoduck	Whole Organism Minus Shell	Geoduck – Whole Organism Minus Shell
	Horse Clam	Edible Tissue	Horse Clam – Edible Tissue
	Horse Clam	Visceral Cavity	Horse Clam – Visceral Cavity
	Horse Clam	Whole Organism Minus Shell	Horse Clam – Whole Organism Minus Shell
	Ling Cod	Skin-on Fillet	Starry Flounder – Fillet[2]
	Ling Cod	Whole Organism	Rock Sole – Whole Organism[2]
	Red Rock Crab	Whole Organism	Red Rock Crab – Muscle
	Rock Sole	Fillet	Starry Founder – Fillet[2]
	Rock Sole	Whole Fish	Rock Sole – Whole Organism

Notes:

1 - Reference data set from Dungeness Bay.

2 - When reference values for a particular Species/Tissue combination were not available, values for the same tissue from a similar species were used.

NA = Not applicable

Table 3-4 IHS Results for Port Angeles Harbor Human Health Risk Assessment

Chemical	Intertidal and Subtidal Sediment	Beach/Intertidal Sediment Only	Fish and Shellfish Tissue	Bull Kelp
Inorganics				
Sulfide		X		
Aluminum			X	
Antimony			X	
Arsenic	X	X	X	X
Barium			X	
Cadmium	X		X	X
Cobalt			X	
Copper	X		X	
Iron			X	
Lead	X		X	
Manganese			X	
Mercury	X		X	
Nickel	X		X	
Selenium			X	
Silver	X		X	
Vanadium			X	
Zinc	X		X	
Organometals				
Tributyltin	X			
Tributyltin Oxide	X			
Methyl Mercury			X	
Tetraethyl Lead			X	
Organic Acids				
12-Chlorodehydroabietic Acid		X		
14-Chlorodehydroabietic Acid		X		
1,2,3,4,4a,9,10,10a-Phenanthrenecarboxylic Acid		X		
9,10-Dichlorostearic Acid		X		
Abietic Acid		X		
Dehydroabietic Acid		X		
Dichlorodehydroabietic Acid		X		
Isopimaric Acid		X		
Linoleic Acid		X		

Table 3-4 IHS Results for Port Angeles Harbor Human Health Risk Assessment

Chemical	Intertidal and Subtidal Sediment	Beach/Intertidal Sediment Only	Fish and Shellfish Tissue	Bull Kelp
Linolenic Acid		X		
Neoabietic Acid		X		
Oleic Acid		X		
Oleic-Linolenic Acid Mixture		X		
Palustric Acid		X		
Pimaric Acid		X		
Sandaracopimaric Acid		X		
3,4,6-Trichloroguaiacol (Ac)		X		
3,4-Dichloroguaiacol		X		
4,5,6-Trichloroguaiacol		X		
4,5-Dichloroguaiacol		X		
4,6-Dichloroguaiacol		X		
4-Chloroguaiacol		X		
Guaiacol (2-Methoxyphenol)		X		
Polycyclic Aromatic Hydrocarbons (PAHs)				
1-Methylnaphthalene		X	X	
2-Methylnaphthalene	X		X	
Acenaphthene	X		X	
Acenaphthylene	X	X	X	X
Anthracene	X			
Benzo(e)pyrene			X	X
Benzo(ghi)perylene	X	X	X	
Carcinogenic PAHs	X		X	
Dibenzothiophene			X	X
Fluoranthene	X		X	
Fluorene	X		X	
Naphthalene			X	
Perylene			X	
Phenanthrene	X	X	X	
Pyrene	X		X	
Polychlorinated Biphenyls (PCBs)				
PCB	X	X	X	

Table 3-4 IHS Results for Port Angeles Harbor Human Health Risk Assessment

Chemical	Intertidal and Subtidal Sediment	Beach/Intertidal Sediment Only	Fish and Shellfish Tissue	Bull Kelp
Dioxins and Furans				
Dioxins and Furans as 2,3,7,8-TCDD TEQs	X	X	X	X
Pesticides				
4,4'-DDD	X		X	
4,4'-DDE	X		X	
4,4'-DDT	X		X	
Aldrin	X			
Alpha-BHC	X		X	
Beta-BHC	X		X	
Delta-BHC	X	X	X	
Dieldrin	X		X	
Endosulfan I	X	X		
Endosulfan II	X	X		
Endosulfan Sulfate		X		
Endrin	X			
Endrin Aldehyde		X		
Endrin Ketone		X		
gamma-Chlordane			X	
Heptachlor	X		X	
Heptachlor Epoxide	X		X	
Lindane	X		X	
Methoxychlor	X			
Semivolatile Organic Compounds (SVOCs)				
Bis(2-Ethylhexyl) Phthalate	X			
Dibenzofuran	X			
Pentachlorophenol			X	
Pyridine			X	
Retene		X		
Volatile Organic Compounds (VOCs)				
Hexachlorobenzene			X	

Table 3-5 Seafood Consumption Categories for Developing EPCs

Seafood Category	Representative Species	Tissue	Receptor
Pelagic fish	Lingcod	Fillet	Subsistence Fisher Recreational Fisher
Bottom fish	Rock sole	Fillet	Subsistence Fisher Recreational Fisher
Shellfish	Dungeness crab	Whole	Subsistence Fisher
	Dungeness crab	Muscle	Recreational Fisher
	Geoduck	Whole	Subsistence Fisher Recreational Fisher
	Horse clam	Whole	Subsistence Fisher
	Horse clam	Edible tissue[1]	Recreational Fisher
	Coonstripe shrimp	Whole	Subsistence Fisher Recreational Fisher

[1]Only dioxin and PCB data available for edible tissue. Concentrations for contaminants in whole tissue used for all other IHSs.

Table 3-6 Tissue Indicator Hazardous Substances With No Analytical Data Available

Species	Tissue	Analyte	Bioaccumulative (Yes/No)	Sediment Quality Standard Available (Yes/No)
Coonstripe Shrimp	Whole	Aluminum	No	No
		Antimony	No	No
		Barium	No	No
		Cobalt	No	No
		Iron	No	No
		Manganese	No	No
		Nickel	Yes	No
		Silver	**Yes**	**Yes**
		Vanadium	No	No
		Tributyltin	Yes	No
		Tributyltin Oxide	Yes	No
		1-Methylnaphthalene	No	No
		3,3'Dichlorobenzidine	No	No
		4-Chloroaniline	No	No
		Aldrin	Yes	No
		Endosulfan I	Yes	No
		Endosulfan II	Yes	No
		Endrin	Yes	No
		gamma-Chlordane	Yes	No
		Heptachlor	Yes	No
		Heptachlor Epoxide	Yes	No
		Bis(2-ethylhexyl)phthalate	**Yes**	**Yes**
		Dibenzofuran	**Yes**	**Yes**
		M-Nitroaniline	No	No
		Hexachlorobenzene	No	Yes
Dungeness Crab	Muscle & Hepatopancreas	Aluminum	No	No
		Antimony	No	No
		Barium	No	No
		Cobalt	No	No
		Iron	No	No
		Manganese	No	No
		Nickel	Yes	No

Table 3-6 Tissue Indicator Hazardous Substances With No Analytical Data Available

Species	Tissue	Analyte	Bioaccumulative (Yes/No)	Sediment Quality Standard Available (Yes/No)
		Silver	**Yes**	**Yes**
		Vanadium	No	No
		Tributyltin	Yes	No
		Tributyltin Oxide	Yes	No
		1-Methylnaphthalene	No	No
		3,3'Dichlorobenzidine	No	No
		4-Chloroaniline	No	No
		Aldrin	Yes	No
		Dieldrin	No	No
		Endosulfan I	Yes	No
		Endosulfan II	Yes	No
		Endrin	Yes	No
		gamma-Chlordane	Yes	No
		Heptachlor	Yes	No
		Heptachlor Epoxide	Yes	No
		Bis(2-ethylhexyl)phthalate	**Yes**	**Yes**
		Dibenzofuran	**Yes**	**Yes**
		M-Nitroaniline	No	No
		Hexachlorobenzene	No	Yes
Geoduck	Whole	Tributyltin	Yes	No
		Tributyltin Oxide	Yes	No
Horse Clam[1]	Whole	Aluminum	No	No
		Cobalt	No	No
		Iron	No	No
		Manganese	No	No
		Vanadium	No	No
		Tributyltin	Yes	No
		Tributyltin Oxide	Yes	No
Ling Cod	Fillet	Aluminum	No	No
		Cobalt	No	No
		Iron	No	No
		Manganese	No	No
		Vanadium	No	No

Table 3-6 Tissue Indicator Hazardous Substances With No Analytical Data Available

Species	Tissue	Analyte	Bioaccumulative (Yes/No)	Sediment Quality Standard Available (Yes/No)
		Tributyltin	Yes	No
		Tributyltin Oxide	Yes	No
		4,4'-DDD	Yes	No
		4,4'-DDE	Yes	No
		4,4'-DDT	Yes	No
		Aldrin	Yes	No
		Alpha-BHC	Yes	No
		Beta-BHC	Yes	No
		Delta-BHC	Yes	No
		Dieldrin	No	No
		Endosulfan I	Yes	No
		Endosulfan II	Yes	No
		Endrin	Yes	No
		gamma-Chlordane	Yes	No
		Heptachlor	Yes	No
		Heptachlor Epoxice	Yes	No
		Lindane	Yes	No
		Pyridine	No	No
Rock Sole	Fillet	Aluminum	No	No
		Antimony	No	No
		Barium	No	No
		Cobalt	No	No
		Iron	No	No
		Manganese	No	No
		Nickel	Yes	No
		Silver	**Yes**	**Yes**
		Vanadium	No	No
		Tributyltin	Yes	No
		Tributyltin Oxide	Yes	No
		1-Methylnaphthalene	No	No
		3,3'-Dichlorobenzidine	No	No
		4-Chloroaniline	No	No
		Aldrin	Yes	No

Table 3-6 Tissue Indicator Hazardous Substances With No Analytical Data Available

Species	Tissue	Analyte	Bioaccumulative (Yes/No)	Sediment Quality Standard Available (Yes/No)
		Dieldrin	No	No
		Endosulfan I	Yes	No
		Endosulfan II	Yes	No
		Endrin	Yes	No
		gamma-Chlordane	Yes	No
		Heptachlor	Yes	No
		Heptachlor Epoxide	Yes	No
		Bis(2-ethylhexyl)phthalate	**Yes**	**Yes**
		Dibenzofuran	**Yes**	**Yes**
		M-Nitroaniline	No	No
		Hexachlorobenzene	No	Yes

Notes:

1 - Horse clam edible and visceral tissue was only analyzed for PCBs and dioxins/furans and, therefore, not included in table.

Bolded text indicates compound identified as bioaccumulative and has SQS criteria.

Table 3-7 Dermal Absorption Fraction from Soil

Indicator Hazardous Substance	ABSd Value	Reference	Note
Metals			
Aluminum	NA		
Antimony	NA		
Arsenic	0.03	EPA 2004	
Barium	NA		
Cadmium	0.001	EPA 2004	
Cobalt	NA		
Copper	NA		
Iron	NA		
Lead	NA		
Manganese	NA		
Mercury (inorganic salts)	NA		
Nickel (soluble salts)	NA		
Selenium	NA		
Silver	NA		
Vanadium	NA		
Zinc	NA		
Organometals			
Tributyltin	NA		
Tributyltin oxide	NA		
Methyl mercury	NA		
Tetraethyl lead	NA		
Polyychlorinated Biphenyls			
Total PCBs	0.14	EPA 2004	
Polycyclic Aromatic Hydrocarbons (PAHs)			
1-Methylnaphthalene	0.13	EPA 2004	
2-Methylnaphthalene	0.13	EPA 2004	
Acenaphthene	0.13	EPA 2004	
Acenaphthylene	0.13	EPA 2004	
Anthracene	0.13	EPA 2004	
Benzo(ghi)perylene	0.13	EPA 2004	
Carcinogenic PAHs	0.13	EPA 2004	
Fluoranthene	0.13	EPA 2004	
Fluorene	0.13	EPA 2004	

Table 3-7 Dermal Absorption Fraction from Soil

Indicator Hazardous Substance	ABSd Value	Reference	Note
Naphthalene	0.13	EPA 2004	
Phenanthrene	0.13	EPA 2004	
Pyrene	0.13	EPA 2004	
Dioxins and Furans			
2,3,7,8-TCDD TEQ	0.03	EPA 2004	
Pesticides			
4,4'-DDD	0.3	EPA 2004	Surrogate = 4,4'-DDT
4,4'-DDE	0.3	EPA 2004	Surrogate = 4,4'-DDT
4,4'-DDT	0.3	EPA 2004	
Aldrin	0.1	EPA 2004	
Alpha-BHC	0.1	EPA 2004	
Beta-BHC	0.1	EPA 2004	
Delta-BHC	0.1	EPA 2004	
Dieldrin	0.1	EPA 2004	
Endosulfan I	0.1	EPA 2004	
Endosulfan II	0.1	EPA 2004	
Endosulfan Sulfate	0.1	EPA 2004	
Endrin	0.1	EPA 2004	
Endrin Aldehyde	0.1	EPA 2004	
Endrin Ketone	0.1	EPA 2004	
gamma-Chlordane	0.4	EPA 2004	Surrogate = chlordane
Heptachlor	0.1	EPA 2004	
Heptachlor Epoxide	0.1	EPA 2004	
Lindane	0.1	EPA 2004	
Methoxychlor	0.10	EPA 2004	
Semivolatile Organic Compounds			
Bis(2-Ethylhexyl)phthalate	0.1	EPA 2004	
Dibenzofuran	0.1	EPA 2004	
m-Nitroaniline	0.1	EPA 2004	
Pentachlorophenol	0.25	EPA 2004	
Pyridine	0.1	EPA 2004	
Hexachlorobenzene	0.1	EPA 2004	

ABSd = Dermal Absorption Fraction
NA = Not available

Table 3-8. Summary of Exposure Factors

Exposure Route	Parameter Code	Parameter Definition	Units	Subsistence Fisher - Adult		Subsistence Fisher - Child		Recreational Fisher - Adult		Recreational Fisher - Child		Residential User - Adult	Residential User - Child	Recreational User - Adult	Rrecreational User - Child
				RME Value	CT Value	RME Value	CT Value	RME Value	CT Value	RME Value	CT Value	Value	Value	Value	Value
Ingestion - Sediment	CDI_{sed}	Chronic Daily Intake of Chemical - sediment	mg/kg-d	--	--	--	--	--	--	--	--	--	--	--	--
	EPC_{sed}	Exposure Point Concentration - sediment	mg/kg	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL
	$IR_{sed - a}$	Ingestion Rate - sediment, adult	g/d	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.2	0.1	0.2
	$EF_{sed - a}$	Exposure Frequency - sediment, adult	d/y	104	104	104	104	53	37	65	10	50	65	6	10
	$ED_{sed -a}$	Exposure Duration - sediment, adult	y	70	70	6	6	30	30	6	6	30	6	30	6
	BW_a	Body Weight, adult	kg	79	79	16	16	70	70	16	16	70	16	70	16
	AT_c	Averaging Time - cancer	days	25,550	25,550	25,550	25,550	27,375	27,375	27,375	27,375	27,375	27,375	27,375	27,375
	AT_{nc}	Averaging Time - non-cancer	days	25,550	25,550	2,190	2,190	10,950	10,950	2,190	2,190	10,950	2,190	10,950	2,190
	CF_{sed}	Conversion Factor - sediment	kg/g	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Ingestion - Fish and Shellfish	CDI_{fish}	Chronic Daily Intake of Chemical - fish	mg/kg-d	--	--	--	--	--	--	--	--	--	--	--	--
	EPC_{fish}	Exposure Point Concentration - fish	mg/kg	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	--	--	--	--
	$IR_{fish - a}$	Ingestion Rate - fish, adult	g/d	583	583	233	233	76.5	54.0	30.6	21.6	--	--	--	--
	$IR_{pelagic-a}$	Ingestion Rate - pelagic fish, adult	g/d	56	56	22	22	7.3	5.2	2.9	2.1	--	--	--	--
	$IR_{bottom-a}$	Ingestion Rate - bottom fish, adult	g/d	29	29	12	12	3.8	2.7	1.5	1.1	--	--	--	--
	$IR_{shellfish-a}$	Ingestion Rate - shellfish, adult[1]	g/d	498	498	199	199	65.3	46.1	26.1	18.4	--	--	--	--
	$EF_{fish - a}$	Exposure Frequency - fish, adult	d/y	365	365	365	365	365	365	365	365	--	--	--	--
	$ED_{fish - a}$	Exposure Duration - fish, adult	y	70	70	6	6	30	30	6	6	--	--	--	--
	BW_a	Body Weight, Adult	kg	79	79	16	16	70	70	16	16	--	--	--	--
	AT_c	Averaging Time - cancer	days	25,550	25,550	25,550	25,550	27,375	27,375	27,375	27,375	--	--	--	--
	AT_{nc}	Averaging Time - non-cancer	days	25,550	25,550	2,190	2,190	10,950	10,950	2,190	2,190	--	--	--	--
	CF_{fish}	Conversion Factor - fish	kg/g	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	--	--	--	--
	FIfish	Fractional Intake from contaminated source - fish	unitless	1	0.5	1	0.5	0.5	0.5	0.5	0.5	--	--	--	--
Dermal - Sediment	DAD	Dermally Absorbed Dose	mg/kg-d	--	--	--	--	--	--	--	--	--	--	--	--
	DA_{event}	Absorbed Dose Per Event	mg/cm^2-event	--	--	--	--	--	--	--	--	--	--	--	--
	SA_a	Surface Area, adult	cm^2	6,125.5	6,125.5	2,800	2,800	6,125.5	6,125.5	2,800	2,800	6,125.5	2,800	6,125.5	2,800
	Ev_a	Event Frequency, adult	events/d	1	1	1	1	1	1	1	1	1	1	1	1
	$EF_{sed - a}$	Exposure Frequency - sediment, adult	d/y	104	104	104	104	53	37	65	10	50	65	6	10
	$ED_{sed -a}$	Exposure Duration - sediment, adult	y	70	70	6	6	30	30	6	6	30	6	30	6
	BW_a	Body Weight, adult	kg	79	79	16	16	70	70	16	16	70	16	70	16
	AT_c	Averaging Time - cancer	days	25,550	25,550	25,550	25,550	27,375	27,375	27,375	27,375	27,375	27,375	27,375	27,375
	AT_{nc}	Averaging Time - non-cancer	days	25,550	25,550	2,190	2,190	10,950	10,950	2,190	2,190	10,950	2,190	10,950	2,190
	EPC_{sed}	Exposure Point Concentration - sediment	unitless	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL	95% UCL
	AF	Soil-to-skin Adherence Factor	mg/cm^2-event	0.6	0.1	3.3	0.2	0.6	0.1	3.3	0.2	0.6	3.3	0.6	3.3
	ABS_{dermal}	Dermal Absorption Fraction	Unitless	Chem.-specific	Chem.-specific	Chem.-specific	Chem.-specific	Chem.-specific	Chem.-specific	Chem.-specific	Chem.-specific	Chem.-specific	Chem.-specific	Chem.-specific	Chem.-specific
	CF_{sed}	Conversion Factor - sediment	mg/kg	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001

Notes:

1 - Shellfish ingestion rate will be divided by 30% Dungeness crab, 30% Horse clam, 30% geoduck and 10% shrimp.

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Table 3-9 Cancer Toxicity Data - Oral/Dermal

Indicator Hazardous Substances	Oral Cancer Slope Factor	GI Absorption Factor(1)	Adjusted Dermal Cancer Slope Factor (2)	Units	Mutagen (Yes/No)	Weight of Evidence/ Cancer Guideline Description	Source	Date of Slope Factor (MM/DD/YY)(3)	Notes
Metals									
Arsenic	1.5	1	1.5	(mg/kg-d)-1	No	A	IRIS	6/1/1995	Surrogate = Arsenic (Inorganic)
Arsenic (Inorganic)	1.5	1	1.5	(mg/kg-d)-1	No	A	IRIS	6/1/1995	
Polyychlorinated Biphenyls									
Total PCBs	2	1	2	(mg/kg-d)-1	No		IRIS	10/1/1994	Surrogate = Aroclor 1254
Polycyclic Aromatic Hydrocarbons (PAHs)									
1-Methylnaphthalene	0.029	1	0.029	(mg/kg-d)-1	No		PPRTV	9/12/2008	Surrogate = 2-Methylnaphthalene
Carcinogenic PAHs	7.3	1	7.3	(mg/kg-d)-1	Yes	B2	IRIS	7/1/1992	Reference = benzo(a)pyrene
Dioxins and Furans									
2,3,7,8-TCDD TEQ	150000	0.6	250000	(mg/kg-d)-1	No		Ecology	(4)	Reference = 2,3,7,8-TCDD
Pesticides									
4,4'-DDD	0.24	1	0.24	(mg/kg-d)-1	No	B2	IRIS	8/22/1988	
4,4'-DDE	0.34	1	0.34	(mg/kg-d)-1	No	B2	IRIS	1/1/1991	
4,4'-DDT	0.34	1	0.34	(mg/kg-d)-1	No	B2	IRIS	1/1/1991	
Aldrin	17	1	17	(mg/kg-d)-1	No	B2	IRIS	1/1/1991	
Alpha-BHC	6.3	1	6.3	(mg/kg-d)-1	No	B2	IRIS	1/1/1991	
Beta-BHC	1.8	1	1.8	(mg/kg-d)-1	No	C	IRIS	1/1/1991	
Dieldrin	16	1	16	(mg/kg-d)-1	No	B2	IRIS	1/1/1991	
gamma-Chlordane	0.35	1	0.35	(mg/kg-d)-1	No	B2	IRIS	2/7/1998	Surrogate = chlordane (technical)
Heptachlor	4.5	1	4.5	(mg/kg-d)-1	No	B2	IRIS	1/1/1991	
Heptachlor Epoxide	9.1	1	9.1	(mg/kg-d)-1	No	B2	IRIS	1/1/1991	
Lindane	1.1	1	1.1	(mg/kg-d)-1	No		Cal EPA	9/12/2008	

Table 3-9 Cancer Toxicity Data - Oral/Dermal

Indicator Hazardous Substances	Oral Cancer Slope Factor	GI Absorption Factor(1)	Adjusted Dermal Cancer Slope Factor (2)	Units	Mutagen (Yes/No)	Weight of Evidence/ Cancer Guideline Description	Source	Date of Slope Factor (MM/DD/YY)(3)	Notes
Semivolatile Organic Compounds									
Bis(2-Ethylhexyl)phthalate	0.014	1	0.014	(mg/kg-d)-1	No		IRIS	9/7/1988	
Pentachlorophenol	0.12	1	0.12	(mg/kg-d)-1	No	B2	IRIS	3/1/1991	
Volatile Organic Compounds									
Hexachlorobenzene	1.6	1	1.6	(mg/kg-d)-1	No	B2	IRIS	3/1/1991	

HEAST = Health Effects Assessment Summary Tables.
IRIS = Integrated Risk Information System.
N/A = Not Applicable or Not Available.
NCEA = National Center for Environmental Assessment.
PPRTV = Provision Peer- Revised Toxicity Values
SF = Slope Factor

(1) Refer to Risk Assessment Guidance for Superfund, Part E (EPA 2004).
(2) Dermal SF = Oral SF/GI Absorption factor.
(3) For IRIS values, the date IRIS profile last updated.
For all other values, the date of latest EPA Regional Screening Values.
(4) Value provided by Ecology (2007b).

EPA 1986 Classification:

A-Human carcinogen
B1-Probable human carcinogen-indicates that limited human data are available
B2-Probable human carcinogen-indicates sufficient evidence in animals and
inadequate or no evidence in humans
C-Possible human carcinogen
D-Not classifiable as a human carcinogen
E-Evidence of noncarcinogenicity for humans

EPA 2005 Classification:

Carcinogenic to Humans
Likely to be carcinogenic to humans
Suggestive Evidence of Carcinogenic Potential
Inadequate Information to Assess Carcinogenic Potential
Not Likely to Be Carcinogenic to Humans

Table 3-10 Non-Cancer Toxicity Date - Oral/Dermal

Indicator Hazardous Substance	Oral RfD Value	GI Absorption Factor (1)	Adjusted Dermal RfD(2)	Units	Critical Effect	Target Organ	Sources of RfD:Target Organ	Dates of RfD Target Organ (MM/DD/YY)(3)	Notes
Metals									
Aluminum	1.0E+00	1	1.0E+00	mg/kg-d	Minimal neurotoxicity in offspring	Nervous System	PPRTV	9/12/2008	
Antimony	4.0E-04	0.15	6.0E-05	mg/kg-d	Longevity, blood glucose, cholesterol	Whole Body	IRIS	2/1/1991	
Arsenic	3.0E-04	1	3.0E-04	mg/kg-d	Hyperpigmentation, keratosis and possible vascular complications	Cardiovascular, Skin	IRIS	6/1/1995	Surrogate = Arsenic (Inorganic)
Arsenic (Inorganic)	3.0E-04	1	3.0E-04	mg/kg-d	Hyperpigmentation, keratosis and possible vascular complications	Cardiovascular, Skin	IRIS	6/1/1995	
Barium	2.0E-01	0.07	1.4E-02	mg/kg-d	Nephropathy	Kidney	IRIS	7/11/2005	
Cadmium	1.0E-03	0.025	2.5E-05	mg/kg-d	Significant proteinuria	Kidney	IRIS	1/1/1991	
Cobalt	3.0E-04	1	3.0E-04	mg/kg-d	Polycythemia	Hematologic System	PPRTV	9/12/2008	
Copper	4.0E-02	1	4.0E-02	mg/kg-d		GI Tract	HEAST	9/12/2008	
Iron	7.0E-01	1	7.0E-01	mg/kg-d			PPRTV	9/12/2008	
Lead		1		mg/kg-d					
Manganese	1.4E-01	0.04	5.6E-03	mg/kg-d	CNS effects	Nervous System	IRIS	11/1/1995	
Mercury	3.0E-04	0.07	2.1E-05	mg/kg-d	Autoimmune effects	Immune System, Nervous System, Kidney	IRIS	5/1/1995	Surrogate = Mercury (Inorganic salts)
Nickel	2.0E-02	0.04	8.0E-04	mg/kg-d	Decreased body and organ weights		IRIS	9/1/1991	Surrogate = Nickel (soluble salts)
Selenium	5.0E-03	1	5.0E-03	mg/kg-d	Clinical selenosis	Skin	IRIS	6/1/1991	
Silver	5.0E-03	0.04	2.0E-04	mg/kg-d	Argyria	Skin	IRIS	12/1/1991	

Table 3-10 Non-Cancer Toxicity Date - Oral/Dermal

Indicator Hazardous Substance	Oral RfD Value	GI Absorption Factor (1)	Adjusted Dermal RfD(2)	Units	Critical Effect	Target Organ	Sources of RfD:Target Organ	Dates of RfD Target Organ (MM/DD/YY)(3)	Notes
Vanadium	5.0E-03	0.026	1.3E-04	mg/kg-d		Kidney	IRIS	6/30/1988	Based on vanadium pentoxide with molecular weight adjustment.
Zinc	3.0E-01	1	3.0E-01	mg/kg-d	Decreases in erythrocyte Cu, Zn-superoxide dismutase (ESOD) activity in healthy adult male and female volunteers	Hematologic System	IRIS	8/3/2005	
Organometals									
Tributyltin	3.0E-04	1	3.0E-04	mg/kg-d	Immunosuppression	Immune System	PPRTV	9/12/2008	
Tributyltin oxide	3.0E-04	1	3.0E-04	mg/kg-d	Immunosuppression	Immune System	IRIS	9/1/1997	
Methyl mercury	1.0E-04	1	1.0E-04	mg/kg-d		Nervous System, Developmental	IRIS	7/27/2001	
Tetraethyl lead	1.0E-07	1	1.0E-07	mg/kg-d	Histopathology of liver and thymus	Liver	IRIS	4/10/1987	
Polyychlorinated Biphenyls									
Total PCBs	2.0E-05	1	2.0E-05	mg/kg-d	Ocular exudate, inflamed and prominent Meibomian glands, distorted growth of finger and toe nails; decreased antibody response to sheep erythrocytes	Immune System, Nervous System	IRIS	10/1/1996	Surrogate = Aroclor 1254
Polycyclic Aromatic Hydrocarbons (PAHs)									
1-Methylnaphthalene	7.0E-02	1	7.0E-02	mg/kg-d	Pulmonary alveolar proteinosis	Lung	ATSDR	4/1/2009	
2-Methylnaphthalene	4.0E-03	1	4.0E-03	mg/kg-d	Pulmonary alveolar proteinosis	Lung	IRIS	12/22/2003	
Acenaphthene	6.0E-02	1	6.0E-02	mg/kg-d	Hepatotoxicity	Liver	IRIS	11/1/1990	

Table 3-10 Non-Cancer Toxicity Date - Oral/Dermal

Indicator Hazardous Substance	Oral RfD Value	GI Absorption Factor [1]	Adjusted Dermal RfD[2]	Units	Critical Effect	Target Organ	Sources of RfD:Target Organ	Dates of RfD Target Organ (MM/DD/YY)[3]	Notes
Acenaphthylene	6.0E-02	1	6.0E-02	mg/kg-d		Liver	IRIS	11/1/1990	Surrogate = Acenaphthene
Anthracene	3.0E-01	1	3.0E-01	mg/kg-d	No observed effects	Liver	IRIS	1/1/1991	
Benzo(ghi)perylene	3.0E-02	1	3.0E-02	mg/kg-d		Kidney	IRIS	1/1/1991	Surrogate = Pyrene
Fluoranthene	4.0E-02	1	4.0E-02	mg/kg-d	Nephropathy, increased liver weights, hematological alterations, and clinical effects	Liver	IRIS	12/1/1990	
Fluorene	4.0E-02	1	4.0E-02	mg/kg-d	Decreased RBC, packed cell volume and hemoglobin	Blood	IRIS	12/1/1990	
Naphthalene	2.0E-02	1	2.0E-02	mg/kg-d	Decreased mean terminal body weight in males	Nervous System	IRIS	9/17/1998	
Phenanthrene	3.0E-01	1	3.0E-01	mg/kg-d		Liver	IRIS	1/1/1991	Surrogate = Anthracene
Pyrene	3.0E-02	1	3.0E-02	mg/kg-d	Kidney effects (renal tubular pathology, decreased kidney weights)	Kidney	IRIS	1/1/1991	
Dioxins and Furans									
2,3,7,8-TCDD TEQ	1.0E-09	0.6	6.0E-10	mg/kg-d		Developmental	ATSDR	9/12/2008	Reference = 2,3,7,8-TCDD
Pesticides									
4,4'-DDT	5.0E-04	1	5.0E-04	mg/kg-d	Liver lesions	Liver	IRIS	1/1/1991	
Aldrin	3.0E-05	1	3.0E-05	mg/kg-d	Liver toxicity	Liver	IRIS	1/1/1991	
Alpha-BHC	8.0E-03	1	8.0E-03	mg/kg-d	Liver toxicity	Liver	ATSDR	4/1/2009	
Dieldrin	5.0E-05	1	5.0E-05	mg/kg-d	Liver lesions	Liver	IRIS	1/1/1991	

Table 3-10 Non-Cancer Toxicity Date - Oral/Dermal

Indicator Hazardous Substance	Oral RfD Value	GI Absorption Factor (1)	Adjusted Dermal RfD(2)	Units	Critical Effect	Target Organ	Sources of RfD:Target Organ	Dates of RfD Target Organ (MM/DD/YY)(3)	Notes
Endosulfan I	6.0E-03	1	6.0E-03	mg/kg-d	Reduced body weight gain in males and females; increased incidence of marked progressive glomerulonephrosis and blood vessel aneurysms in males	Liver	IRIS	10/1/1994	Surrogate = endosulfan
Endosulfan II	6.0E-03	1	6.0E-03	mg/kg-d	Reduced body weight gain in males and females; increased incidence of marked progressive glomerulonephrosis and blood vessel aneurysms in males	Liver	IRIS	10/1/1994	Surrogate = endosulfan
Endosulfan Sulfate	6.0E-03	1	6.0E-03	mg/kg-d	Reduced body weight gain in males and females; increased incidence of marked progressive glomerulonephrosis and blood vessel aneurysms in males	Liver	IRIS	10/1/1994	Surrogate = endosulfan
Endrin	3.0E-04	1	3.0E-04	mg/kg-d	Mild histological lesions in liver, occasional convulsions	Liver, Nervous System	IRIS	10/1/1989	
Endrin Aldehyde	3.0E-04	1	3.0E-04	mg/kg-d	Mild histological lesions in liver, occasional convulsions	Liver	IRIS	10/1/1989	Surrogate = endrin
Endrin Ketone	3.0E-04	1	3.0E-04	mg/kg-d	Mild histological lesions in liver, occasional convulsions	Liver	IRIS	10/1/1989	Surrogate = endrin
gamma-Chlordane	5.0E-04	1	5.0E-04	mg/kg-d	Hepatic necrosis	Liver	IRIS	2/7/1998	Surrogate = chlordane

Table 3-10 Non-Cancer Toxicity Date - Oral/Dermal

Indicator Hazardous Substance	Oral RfD Value	GI Absorption Factor [1]	Adjusted Dermal RfD[2]	Units	Critical Effect	Target Organ	Sources of RfD:Target Organ	Dates of RfD Target Organ (MM/DD/YY)[3]	Notes
									(technical)
Heptachlor	5.0E-04	1	5.0E-04	mg/kg-d	Liver weight increases in males	Liver, Immune System	IRIS	1/1/1991	
Heptachlor Epoxide	1.3E-05	1	1.3E-05	mg/kg-d	Increased liver-to-body weight ratio in both males and females	Liver	IRIS	1/1/1991	
Lindane	3.0E-04	1	3.0E-04	mg/kg-d	Liver and kidney toxicity	Liver, Kidney, Immune System	IRIS	3/1/1998	
Methoxychlor	5.0E-03	1	5.0E-03	mg/kg-d	Excessive loss of litters	Reproductive System	IRIS	4/1/1992	
Semivolatile Organic Compounds									
Bis(2-Ethylhexyl)phthalate	2.0E-02	1	2.0E-02	mg/kg-d	Increased relative weight	Reproductive System	IRIS	9/7/1988	
Dibenzofuran	2.0E-03	1	2.0E-03	mg/kg-d	Renal pathology	Kidney	NCEA	9/12/2008	
Pentachlorophenol	3.0E-02	1	3.0E-02	mg/kg-d	Liver and kidney pathology	Liver, Kidney, Endocrine System	IRIS	3/1/1991	
Pyridine	1.0E-03	1	1.0E-03	mg/kg-d	Increased liver weight	Liver	IRIS	9/30/1987	
Volatile Organic Compounds									
Hexachlorobenzene	8.0E-04	1	8.0E-04	mg/kg-d	Liver effects	Liver, Developmental	IRIS	3/1/1991	

IRIS = Integrated Risk Information System.
HEAST = Health Effects Assessment Summary Tables.
NCEA = National Center for Environmental Assessment.
N/A = Not Applicable or Not Available.
RfD = Reference Dose.

(1) Refer to Risk Assessment Guidance for Superfund, Part E (EPA 2004).
(2) Dermal RfD = Oral RfD x GI Absorption Factor.
(3) For IRIS values, the date IRIS profile last updated.
For all other values, the date of latest EPA Regional Screening Values.

Table 3-11 Summary of Excess Cancer Risk for Port Angeles Harbor Marine Sediment Investigation

	Pathways	Subsistence Fisher (RME)	Subsistence Fisher (CT)	Recreational Fisher (RME)	Recreational Fisher (CT)	Residential User	Recreational User
ND = 0 RL	Sediment - Ingestion	5.6E-06	5.6E-06	2.2E-06	6.5E-07	2.1E-06	3.1E-07
	Sediment - Dermal	8.9E-06	9.8E-07	3.6E-06	1.2E-07	3.6E-06	5.3E-07
	Tissue - Ingestion[1]	1.1E-02	5.7E-03	2.6E-04	1.8E-04	--	--
	Total Excess Cancer Risk	**1.1E-02**	**5.7E-03**	**2.7E-04**	**1.8E-04**	**5.7E-06**	**8.4E-07**
ND = 0.5 RL	Sediment - Ingestion	5.2E-06	5.2E-06	2.0E-06	6.0E-07	2.0E-06	2.8E-07
	Sediment - Dermal	8.0E-06	8.7E-07	3.2E-06	1.1E-07	3.2E-06	4.7E-07
	Tissue - Ingestion[1]	1.2E-02	6.1E-03	2.8E-04	2.0E-04	--	--
	Total Excess Cancer Risk	**1.2E-02**	**6.1E-03**	**2.8E-04**	**2.0E-04**	**5.2E-06**	**7.5E-07**

Note:

Shaded cell indicates excess cancer risk greater than 1 x 10^{-5}.

1 - Includes PCBs as Aroclors.

Key:
ND = 0 RL indicates cPAH, TCDD TEQ, and PCBs were calculated using a concentration of zero for non-deteced values.
ND = 0.5 RL indicates cPAH, TCDD TEQ, and PCBs were calculated using a concentration of one half the reporting limit for non-deteced values.

Table 3-12 Summary of Compounds that Exceed Ecology Excess Cancer Risk Threshold

Pathway	Compound	Subsistence Fisher (RME)	Subsistence Fisher (CT)	Recreational Fisher (RME)	Recreational Fisher (CT)
Sediment Ingestion	Arsenic	3.5E-06	3.5E-06	1.4E-06	
Sediment Ingestion	TCDD TEQ[1]	1.6E-06	1.6E-06	6.0E-07	
Sediment Dermal	Arsenic	4.4E-06			
Sediment Dermal	TCDD TEQ[1]	3.2E-06		1.3E-06	
Fish Ingestion	Arsenic (Inorganic)	7.0E-03	3.5E-03	2.2E-04	1.5E-04
Fish Ingestion	PCB - Aroclors[1]	1.4E-03	6.8E-04	1.3E-05	9.4E-06
Fish Ingestion	PCB TEQ[1]	2.9E-04	1.4E-04	9.0E-06	6.3E-06
Fish Ingestion	cPAH[1]	3.2E-04	1.6E-04	1.1E-05	7.8E-06
Fish Ingestion	TCDD TEQ[1]	2.8E-03	1.4E-03	1.9E-05	1.3E-05
Fish Ingestion	DDE	4.2E-06	2.1E-06		
Fish Ingestion	DDT	2.5E-05	1.3E-05		
Fish Ingestion	alpha-BHC	5.1E-04	2.6E-04	1.6E-05	1.1E-05
Fish Ingestion	beta-BHC	6.8E-05	3.4E-05	2.0E-06	1.4E-06
Fish Ingestion	Lindane	1.4E-05	7.1E-06		
Fish Ingestion	Pentachlorophenol	2.2E-05	1.1E-05		
Fish Ingestion	Hexachlorobenzene	2.0E-06	2.0E-06	2.0E-06	2.0E-06

Notes:

Compound exceeds Ecology cancer risk threshold of 1×10^{-6} at specified risk level.

1 - Values calculated including non-detected compounds at one-half detection limit.

Key:

RME = reasonable maximum exposed

CT = central tendancy

Table 3-13 Summary of Hazard Indices for Port Angeles Harbor Marine Sediment Investigation

	Pathways	Subsistence Fisher (RME)		Subsistence Fisher (CT)		Recreational Fisher (RME)		Recreational Fisher (CT)		Residential User		Recreational User	
ND = 0 RL		Adult	Child	Adult	Child	Adult	Child	Adult	Child	Adult	Child	Adult	Child
	Cardiovascular	1.4E+01	2.9E+01	7.2E+00	1.4E+01	1.0E+00	1.9E+00	7.4E-01	1.3E+00	5.1E-03	6.5E-02	6.1E-04	1.0E-02
	Developmental[1]	4.8E+01	9.5E+01	2.4E+01	4.8E+01	1.1E+00	1.9E+00	7.8E-01	1.4E+00	2.2E-05	3.0E-04	2.6E-06	4.6E-05
	Endocrine System	5.7E-03	1.1E-02	2.9E-03	5.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	GI Tract	1.9E+00	3.8E+00	9.5E-01	1.9E+00	5.9E-02	1.0E-01	4.2E-02	7.3E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Hematologic System	4.0E+00	8.0E+00	2.0E+00	4.0E+00	3.0E-01	5.3E-01	2.1E-01	3.7E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Immune System	4.0E-02	7.9E-02	2.0E-02	3.9E-02	3.0E-03	5.3E-03	2.1E-03	3.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Kidney	3.9E+00	7.6E+00	1.9E+00	3.8E+00	1.6E-01	2.7E-01	1.1E-01	1.9E-01	3.5E-07	4.8E-06	4.1E-08	7.3E-07
	Liver	1.2E+00	1.4E+00	1.1E+00	1.2E+00	9.9E-01	1.0E+00	9.9E-01	9.9E-01	2.5E-05	3.4E-04	3.0E-06	5.3E-05
	Lungs	1.8E-02	3.5E-02	8.8E-03	1.7E-02	1.3E-03	2.2E-03	9.0E-04	1.6E-03	3.1E-07	4.2E-06	3.7E-08	6.5E-07
	Nervous System	5.7E+00	1.1E+01	2.9E+00	5.7E+00	4.2E-01	7.4E-01	3.0E-01	5.2E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Reproductive System	1.6E+01	3.2E+01	8.2E+00	1.6E+01	1.2E+00	2.1E+00	8.3E-01	1.4E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Skin	1.6E+01	3.2E+01	8.2E+00	1.6E+01	1.2E+00	2.1E+00	8.3E-01	1.4E+00	5.1E-03	6.5E-02	6.1E-04	1.0E-02
	Whole Body	9.1E-02	1.8E-01	4.6E-02	9.0E-02	6.8E-03	1.2E-02	4.8E-03	8.3E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Not Classified	3.3E+01	6.6E+01	1.6E+01	3.3E+01	8.6E-01	1.7E+00	6.0E-01	1.0E+00	1.4E-02	1.9E-01	1.7E-03	2.9E-02
ND = 0.5 RL													
	Cardiovascular	1.4E+01	2.9E+01	7.2E+00	1.4E+01	1.0E+00	1.9E+00	7.4E-01	1.3E+00	5.1E-03	6.5E-02	6.1E-04	1.0E-02
	Developmental[1]	5.4E+01	1.1E+02	2.7E+01	5.3E+01	1.5E+00	2.4E+00	9.7E-01	1.7E+00	2.2E-05	3.0E-04	2.6E-06	4.6E-05
	Endocrine System	5.7E-03	1.1E-02	2.9E-03	5.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	GI Tract	1.9E+00	3.8E+00	9.5E-01	1.9E+00	5.9E-02	1.0E-01	4.2E-02	7.3E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Hematologic System	4.0E+00	8.0E+00	2.0E+00	4.0E+00	3.0E-01	5.3E-01	2.1E-01	3.7E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Immune System	4.0E-02	7.9E-02	2.0E-02	3.9E-02	3.0E-03	5.3E-03	2.1E-03	3.7E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Kidney	3.9E+00	7.6E+00	1.9E+00	3.8E+00	1.6E-01	2.7E-01	1.1E-01	1.9E-01	3.5E-07	4.8E-06	4.1E-08	7.3E-07
	Liver	2.9E-01	4.8E-01	1.9E-01	2.8E-01	9.7E-02	1.0E-01	9.5E-02	9.8E-02	2.5E-05	3.4E-04	3.0E-06	5.3E-05
	Lungs	1.8E-02	3.5E-02	8.8E-03	1.7E-02	1.3E-03	2.2E-03	9.0E-04	1.6E-03	3.1E-07	4.2E-06	3.7E-08	6.5E-07
	Nervous System	5.7E+00	1.1E+01	2.9E+00	5.7E+00	4.2E-01	7.4E-01	3.0E-01	5.2E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table 3-13 Summary of Hazard Indices for Port Angeles Harbor Marine Sediment Investigation

	Pathways	Subsistence Fisher (RME)		Subsistence Fisher (CT)		Recreational Fisher (RME)		Recreational Fisher (CT)		Residential User		Recreational User	
	Reproductive System	1.6E+01	3.2E+01	8.2E+00	1.6E+01	1.2E+00	2.1E+00	8.3E-01	1.4E+00	5.1E-03	6.5E-02	6.1E-04	1.0E-02
	Skin	1.6E+01	3.2E+01	8.2E+00	1.6E+01	1.2E+00	2.1E+00	8.3E-01	1.4E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Whole Body	9.1E-02	1.8E-01	4.6E-02	9.0E-02	6.8E-03	1.2E-02	4.8E-03	8.3E-03	1.2E-02	1.6E-01	1.4E-03	2.4E-02
	Not Classified	3.4E+01	6.7E+01	1.7E+01	3.4E+01	9.2E-01	1.7E+00	6.5E-01	1.1E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Shaded cell indicates HI greater than 1.0.

1 - Includes PCBs as Aroclors.

Key:

ND = 0 RL indicates cPAH, TCDD TEQ, and PCBs were calculated using a concentration of zero for non-deteced values.

ND = 0.5 RL indicates cPAH, TCDD TEQ, and PCBs were calculated using a concentration of one half the reporting limit for non-deteced values.

Table 3-14 Summary of Compounds that Exceed Ecology Hazard Quotient Threshold

Pathway	Compound	Subsistence Fisher (RME)		Subsistence Fisher (CT)		Recreational Fisher (RME)		Recreational Fisher (CT)	
		Adult	Child	Adult	Child	Adult	Child	Adult	Child
Fish Ingestion	Arsenic (Inorganic)	14.4	28.5	7.2	14.2		1.8		1.3
Fish Ingestion	Cadmium	3.2	6.3	1.6	3.2				
Fish Ingestion	Cobalt	3.5	6.9	1.7	3.5				
Fish Ingestion	Copper	1.9	3.8		1.9				
Fish Ingestion	Iron	2.5	4.9	1.2	2.4				
Fish Ingestion	Selenium	1.2	2.5		1.2				
Fish Ingestion	Silver		1.3						
Fish Ingestion	Vanadium		1.2						
Fish Ingestion	Zinc		1.1						
Fish Ingestion	Methylmercury	5.1	10.2	2.6	5.1				
Fish Ingestion	PCBs - Aroclors[1]	31.3	62.0	15.6	31.0		1.3		
Fish Ingestion	PCB TEQ[1]	1.8	3.5		1.7				
Fish Ingestion	TCDD TEQ[1]	17.5	34.7	8.8	17.4				
All	Total HI (PCB Aroclors)	83	170	42	83	3.6	6.1	2.4	4.2
All	Total HI (PCB TEQs)	54	110	27	54	3	5	2	3.4

Notes:

Compound exceeds Ecology HQ threshold of 1.0 at specified level.

1 - Values calculated including non-detected compounds at one-half detection limit.

Key:

RME = reasonable maximum exposed
CT = central tendency
HI = hazard index

Table 3-15 Human Health Risk Assessment Uncertainties

Area of Uncertainty	Potential Impact on Risk
Environmental Sampling and Analysis	
Low sample numbers for tissue	Over- or Underestimate
No analytical data for some IHSs	Underestimate
Targeted sampling	Overestimate
Limited reference sampling	Over- or Underestimate
Lack of screening levels	Overestimate
Exposure Point Concentrations	
Inclusion of estimated results	Overestimate
Inclusion of non-detected chemicals in EPC calculation	Over- or Underestimate
Use of 95 UCL or maximum concentration	Overestimate
Exclusion of non-detected chemicals	Underestimate
No analytical results for some IHSs	Underestimate
Limited data on whole body burden	Over- or Underestimate
cPAH, 2,3,7,8-TCDD TEQ and Total PCB EPCs	Overestimate
Arsenic concentrations in tissue	Overestimate
Exposure Assessment	
Change in chemical concentrations not considered	Over- or Underestimate
Use of high end and default values	Overestimate
Dermal exposure to sediment	Over- or Underestimate
Subsistence fisher ingestion rates and fish diet fraction	Overestimate
Use of representative species	Over- or Underestimate
Toxicity Assessment	
Determination of toxicity values	Over- or Underestimate
Dermal toxicity values	Over- or Underestimate
Assumption of additive impacts	Overestimate
Not including synergistic effects	Underestimate
Use of surrogates	Over- or Underestimate
Exclusion of IHSs lacking toxicity data	Underestimate
Use of lead models	Over- or Underestimate
Evaluation of dioxin and furan cancer potency	Over- or Underestimate
Risk Characterization	
Not considering risk caused by reference concentrations	Overestimate
Not including preparation of food	Over- or Underestimate

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4.0 Ecological Risk Assessment

4.1 Introduction

This section presents an ERA for the marine environment of Port Angeles Harbor. The purpose of the ERA is to determine whether or not sediment contamination from historical and ongoing municipal, commercial, and industrial activities poses a risk to ecological receptors at the site, including threatened and endangered species. The results of this ERA may be used to help determine whether or not remedial measures are necessary to protect and/or restore the natural environment and, if so, to aid in selection of appropriate remedial goals and measures.

The methodology used in the ERA is consistent with Washington State and U.S. EPA guidance including, but not limited to:

- *Washington State Sediment Management Standard, Chapter 173-204 WAC* (Ecology 1995)
- *Model Toxics Control Act, Chapter 70.105D RCW, and Cleanup Regulation, Chapter 173-340 WAC* (Ecology 2007a)
- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (U.S. EPA 1997c)
- *Guidelines for Ecological Risk Assessment* (U.S. EPA 1998)
- *Wildlife Exposure Factors Handbook* (U.S. EPA 1993)

In addition to the above-mentioned state and federal guidance documents, E & E used publications from Oak Ridge National Laboratory (ORNL) and articles from the peer-reviewed literature, as appropriate.

The remainder of this section is organized as follows:

- Section 4.2 presents the problem formulation for the ERA
- Sections 4.3 to 4.6 present risk evaluations for marine vegetation, benthic invertebrates, fish, and wildlife, respectively
- Section 4.7 identifies and discusses sources of uncertainty in the ERA
- Section 4.8 presents a summary and conclusions

4.2 Problem Formulation

Problem formulation is the first step in the ERA process and identifies the goals, breadth, and focus of the assessment (U.S. EPA 1997c, 1998). The problem-formulation step identifies ecological receptors, chemicals of potential concern (i.e., stressors), contaminated media, and exposure pathways. A conceptual model is then developed to summarize the relationship between stressors and receptors. Lastly, assessment endpoints and measures (previously called measurement endpoints) are developed to guide the remaining steps of the risk assessment process. The problem formulation step for the Port Angeles Harbor marine environment is presented below.

4.2.1 Site Ecology

A description of the ecological resources of Port Angeles Harbor is provided in Section 2.2.6. In brief, Port Angeles Harbor is a diverse marine environment and includes a wide array of marine habitats (e.g., intertidal, subtidal, open water) and organism groups (e.g., benthic invertebrates, fish, birds, and marine mammals).

4.2.2 Contaminant Sources and Migration Pathways

Potentially significant sources of contaminants to Port Angeles Harbor include wood products facilities (pulp and paper mill facilities), marine/shipping operations, use of treated lumber in docks and piers, petroleum storage facilities, leaks and spills of petroleum products from underground storage tanks or shipping activities, the City of Port Angeles combined sewer outfalls and sewage treatment plant, commercial fish and shellfish farming and harvesting, and residential and commercial properties. The following groups of chemicals are considered to be of potential concern in Port Angeles Harbor based on historical and current land uses:

- Dioxins and furans
- PCBs
- Chlorinated pesticides
- PAHs, phenols, phthalates, and other SVOCs
- Resin acids/guaiacols
- Butyltin compounds
- Sulfide, ammonia, and wood waste
- Heavy metals

These chemicals can enter the harbor through numerous pathways, including stormwater runoff, discharges of contaminated groundwater, dry and wet atmospheric deposition, leaching from creosote-treated piles, and discharge of industrial and municipal wastewater and effluents into the harbor and into streams that flow into the harbor. Additional discussion of the sources, migration, and fate of chemicals in Port Angeles Harbor can be found in Section 2.3 and 2.4 of this risk assessment, Sections 2.1 and 2.2 of the Sediment Investigation Report, and the Final Summary of Existing Information and Identification of Data Gaps Report (E&E 2008b).

4.2.3 Indicator Hazardous Substance Selection

4.2.3.1 Ecological Screening Process

Chemicals in sediment to be included in the ERA were selected based on three factors: (1) frequency of detection; (2) comparing maximum concentrations from the site with reference (Dungeness Bay; see discussion in Section 3.1.2), and (3) comparing maximum concentrations from the site with sediment screening benchmarks (see Figure 3-1 for decision flowchart). Washington State Sediment Quality Standards (SQS, Ecology 1995) were used preferentially as screening benchmarks. Other sources of sediment benchmarks were consulted for chemicals not addressed by WAC 173-204-320. Table 4-1 lists the screening benchmarks used and their sources. Also, if a chemical did not exceed its respective sediment benchmark but had a log K_{ow} greater than 3.5, it was retained as an IHS in sediment. Such chemicals may pose a risk to wildlife that feed on biota from Port Angeles Harbor. The sediment screening was conducted for intertidal and subtidal sediments combined and also for intertidal sediment only.

Chemicals in biota (i.e., vegetation, fish, and shellfish) to be included in the ERA were selected based on two factors: (1) frequency of detection and (2) comparing maximum concentrations from the site with reference (Dungeness Bay). Screening benchmarks were not used to select IHSs in biota because reliable tissue screening benchmarks are available for only a limited number of well-studied chemicals. Hence, most chemicals analyzed in biota cannot be evaluated through use of screening benchmarks. In all, nine different biological sample types were separately screened for IHSs:

- Bull kelp (*Nereocystis luetkeana*; blades)
- Eel grass (*Zostera spp*.; leaves)
- Coonstripe shrimp (*Pandalus danae*; whole organism)
- Dungeness crab (*Cancer magister*; hepatopanceas)
- Dungeness crab muscle
- Geoduck (*Panope abrup*; whole organism)
- Horse clam (*Tresus capax*; whole organism)
- Lingcod (*Ophiodon elongatus*; whole organism)
- Rock sole (*Pleuronectes bilineatus;* whole organism).

Table 3-3 lists reference sample types used for comparison with samples from Port Angeles Harbor. Unfortunately, every sample type collected at Port Angeles Harbor was not also collected from Dungeness Bay. For example, lingcod were collected from Port Angeles Harbor, but not from Dungeness Bay. In such cases, a suitable surrogate reference sample type was used for comparison. In this case, lingcod data from Port Angeles Harbor were compared with reference data for rock sole (see Table 3-3).

During the screening process, hepatopancreas and muscle tissue data for Dungeness crab were screened separately for IHSs (see Tables E-6 and E-7, respectively). This approach is considered conservative because the elevated concentrations or organic contaminants present in the lipid-rich hepatopancreas were not "diluted" by comparatively lower concentrations in muscle.

Lastly, the screening process for horse clams was based on 17 whole-organism samples from Port Angeles from E & E (2012) and Malcolm Pirnie (2006); these samples were analyzed for a wide range of chemicals, including dioxins/furans. The horse clam viscera and edible tissue samples from Malcolm Pirnie (2007), which were analyzed only for dioxins/furans, were not included in the screening process for the ERA. This exclusion made no difference in the IHS list for the ERA because dioxins/furans were already selected as IHSs for horse clam based on the whole-organisms screening results.

Finally, Sections 3.1.2 and 3.1.3 provide additional discussion of reference and evaluation of essential nutrients, respectively.

4.2.3.2 Ecological Screening Results

Comprehensive screening tables are provided in Attachment E for intertidal and subtidal sediments combined, intertidal sediment only, and the nine biological sample types listed above.

Based on these comprehensive tables, a list of IHSs for inclusion in the ERA was developed (see Table 4-2). Selected metals, organic acids, organometals, PAHs, PCBs, dioxins/furans, pesticides, and SVOCs were identified as IHSs in sediment and biological tissues. In addition, ammonia, sulfide, wood waste, diesel fuel, and motor oil were identified as IHSs in sediment.

4.2.4 Ecological Conceptual Site Model

The ecology of Port Angeles Harbor indicates that five principal groups of ecological receptors have a high potential to be exposed to contaminants that accumulate in sediment or the food chain: marine plants and macroalgae, benthic invertebrates, fish, birds, and mammals. Figure 4-1 provides a CSM figure for these receptor groups. Seagrasses and macroalgae may be exposed to site-related chemicals through direct contact with and uptake from sediment. Benthic invertebrates and fish may be exposed to site-related chemicals through direct contact with sediment and ingestion of food that has accumulated contaminants. Vegetation, benthic invertebrates, and fish also may be exposed to chemicals in water, but this means of exposure likely is minimal for the hydrophobic contaminants that are the focus of this assessment. Birds and mammals may be exposed to site-related chemicals through incidental ingestion of sediment and consumption of contaminated prey. Dermal exposure of birds and mammals to chemicals in sediment is considered a negligible route of exposure due to the protection provided by their external coverings (fur and feathers). Exposure through surface water consumption also is negligible for wildlife because wildlife do not drink salt water and because chemicals occur at much lower concentrations in water than in sediment or biota.

4.2.5 Assessment Endpoints and Measures

In an ERA, assessment endpoints are expressions of the ecological resources that are to be protected (U.S. EPA 1997c). An assessment endpoint consists of an ecological entity and a characteristic of the entity that it is important to protect. According to U.S. EPA (1998), assessment endpoints do not represent a desired achievement or goal, and should not contain words such as “protect” or “restore” or indicate a direction for change such as loss or increase. Assessment endpoints are distinguished from management goals by their neutrality (U.S. EPA 1998).

Measurements used to evaluate risks to the assessment endpoints are termed “measures” and may include measures of effect (e.g., results of sediment toxicity tests), measures of exposure (e.g., chemical concentrations in sediment) and/or measures of ecosystem and receptor characteristics (e.g., habitat quality; U.S. EPA 1998). Based on the site ecology, site-related contaminants, and ecological CSM, the ecological resources most at risk from sediment contamination at Port Angeles Harbor include marine vegetation, benthic invertebrates, dermersal fishes, mammals, and birds. The assessment endpoints and measures for these receptors are listed in Table 4-3. Receptors with low potential for contact with contaminated sediment, such as phytoplankton and zooplankton, were not evaluated in the ERA.

4.3 Risk Evaluation for Marine Plants and Macroalgae

As indicated in Table 4-3, one measure—sediment habitat quality—was used to evaluate potential impacts to marine plants and macroalgae in Port Angeles Harbor. Chemicals in sediment also may impact these organisms; however, no sediment benchmarks for evaluating impacts to marine plants and macroalgae are available. The existing marine sediment benchmarks are based on field and laboratory toxicity studies with marine invertebrates. Consequently, they are useful for evaluating potential impacts to marine benthic invertebrates, but not to marine vegetation.

Port Angeles Harbor has been used by the timber and wood products industries for decades (E & E 2008b). Three studies have been conducted to determine the amount of wood debris in Port Angeles Harbor: (1) a sediment profile imaging/plane view camera survey conducted by Science Applications International Corporation in November 1998 (SAIC 1999); (2) an estimation of the amount of wood debris in sediment grab samples conducted during the current sediment investigation in 2008; and (3) a sediment trend analysis conducted by GeoSea Consulting in May 2008 (GeoSea 2009). The results of the studies were similar even though they were conducted 10 years apart. All three studies found that 20 to 25% of the sediment surface area of Port Angeles Harbor is affected by wood debris and that most of the debris is located in the inner portion of the harbor. The primary areas of accumulation are located in the western portion of the harbor along the base of Ediz Hook, in the Lagoon Area, along the waterfront at the Port of Port Angeles Management Area, and in the Log Pond area and surrounding the west side of the Rayonier Mill dock (see Figures 8-1 through 8-6 in the Sediment Investigation Report). Section 8 of the Sediment Investigation Report provides additional details regarding wood waste distribution in Port Angeles Harbor based on the 1998 and 2008 studies.

SAIC (1999) found that areas of sediment with heavy wood waste accumulation were generally characterized by a high sediment oxygen demand. In some of these areas, methane bubbles and bacterial mats were observed, indicating that the sediments were anoxic. These conditions are detrimental to plant growth and reproduction and also adversely affect benthic invertebrates.

In areas with adequate light penetration, the sediment environment provides important habitat for marine vegetation. Because a considerable portion of the near-shore sediment environment in Port Angeles Harbor has been degraded by wood waste, it seems reasonable to hypothesize that the ability of Port Angeles Harbor to support marine plants and macroalgae has been compromised in these areas.

4.4 Benthic Invertebrate Risk Evaluation

As indicated in Table 4-3, three different measures were used to assess potential risks to the benthic-invertebrate community in Port Angeles Harbor: (1) comparison of sediment chemical concentrations with sediment benchmarks; (2) sediment bioassays; and (3) sediment habitat quality. These three measures are discussed in turn below.

4.4.1 Comparison of Sediment Chemical Concentrations with Benchmarks

An evaluation of chemical concentrations in surface sediments from Port Angeles Harbor was conducted according to the Washington State Sediment Management Standards (SMS, WAC 173-204) in Section 5.1 of the Sediment Investigation Report. A summary of the evaluation is presented in this section. Chemical concentrations in sediment samples were compared to Sediment Quality Standards (SQSs) and Cleanup Screening Levels (CSLs). Several stations in the study contained either very low or very high amounts of total organic carbon (TOC). In cases where a sediment sample contained TOC of less than 0.5% or greater than 3.5%, Ecology recommends that the chemical be evaluated against the Lowest Apparent Effects Threshold (LAET) value instead of other criteria for that chemical. The LAET is the dry weight chemical concentration from which the TOC-normalized SQS and CSL values are derived.

The 2008 sediment investigation identified 13 stations with one or more chemicals that exceeded Washington State criteria (see Table 4-4). Overall, four metals and four organic compounds exceeded criteria. Most of the stations (11 of 13) with exceedences were located between the area surrounding the Boat Haven Marina and base of Ediz Hook. The remaining two were located adjacent to the Rayonier Mill pier (see Figure 5.4-1 in Sediment Investigation Report). Metals that exceeded standards were mercury, zinc, cadmium, and arsenic. Organic compounds that exceeded standards were bis(2-ethylhexyl)phthalate, butylbenzylphthalate, 4-methylphenol, and phenol.

Station IH01A had three chemicals exceeding regulatory criteria—cadmium, mercury, and zinc (see Table 4-4). Three chemicals exceeded criteria at Station IH02A—arsenic, mercury, and zinc. Mercury and zinc exceeded criteria at Stations IE09A and IE13A, while mercury and cadmium exceeded criteria at Station LA01A. Mercury exceeded the SQS, CSL, and LAET at Station LA03A, while butylbenzylphthalate exceeded only the LAET at this station. Butylbenzylphthalate and phenol exceeded the SQS and LAET at Station MA04A, but not the CSL.

Sections 5.2 and 5.3 of the Sediment Investigation Report also provides an evaluation of chemicals exceeding criteria in subsurface sediment samples from Port Angeles Harbor (Figure 5.4-2 in the Sediment Investigation Report). The subsurface results were generally similar to the surface results (i.e., the same chemicals and stations were generally identified as exceeding criteria).

4.4.2 Sediment Bioassays

Sediment samples were collected from 59 locations in Port Angeles Harbor and three locations in Dungeness Bay (reference) and submitted to New Fields Northwest in Port Gamble, Washington, for bioassay testing. The bioassay report from New Fields is provided as an appendix to the Sediment Investigation Report. Section 6.0 of the Sediment Investigation Report presents and interprets the bioassay results. A summary of that evaluation is provided here.

Three sediment bioassays were run to identify toxicity in Port Angeles Harbor: (1) 10-day amphipod bioassay using *Eohaustorius estuarius*, (2) acute larval bioassay using *Dendraster excentricus* (echinoderm), and (3) chronic 20-day juvenile polychaete bioassay using *Neanthes arenaceodentata*. The criteria for establishing whether a bioassay sample exceeds SQS or CSL criteria are presented in Table 6-1 in the Sediment Investigation Report.

Twenty-nine samples from Port Angeles Harbor exceeded SQS and/or CSL criteria (see Table 4-5). A figure showing the location of these stations is provided in Section 6.0 of the Sediment Investigation Report. Station ED04A failed the CSL criteria for both the *E. estuarius* (amphipod) and the *D. excentricus* (larval) bioassays. One station failed the SMS criteria for the *N. arenaceodentata* (polychaete) growth bioassay— Station MA02A located off the Boat Haven Marina. Twnety-nine stations exceeded the SQS for the larval bioassay, 12 of which also failed CSL criteria (Table 4-5). Nineteen of the stations that exceeded the SQS criteria were located along the shoreline between the K-Ply and the Inner Ediz Hook area; five were located offshore in the middle of the harbor; two off the end of Ediz Hook and in the Fish Pen area; and three near the Rayonier Mill pier. Stations that exceeded the larval CSL were located between the Boat Launch area and Inner Ediz Hook (five stations) and five in the middle of the Harbor and three surrounding the Rayonier Mill Pier.

Section 6.3 of the Sediment Investigation Report discusses relationships between bioassay and surface sediment chemistry exceedences. Five stations were identified with co-occurring chemical and bioassay SMS exceedences. These stations were location in the inner harbor area (IH02A), lagoon area (LA02A), inner Ediz Hook area (IE09A), marina area (MA01A), and near the Rayonier facility (ED04A). It is worth noting that bioassays were conducted at many stations where no chemicals exceeded criteria; however, at 24 of these stations there was a SQS or CSL failure in the larval bioassay. The cause of theses failures may be the result of the cumulative effect of multiple chemicals, individual chemicals without criteria, and/or physical factors.

Finally, Section 6.4 of the revised Sediment Investigation Report examines relationships between bioassay results, conventional parameters (e.g. sulfide and ammonia), and wood debris parameters (e.g., percent wood debris and organic acids). There was a strong relationship between amphipod mortality and ammonia; a moderate relationship between echinoderm larval survival and percent fines; and a slight negative relationship between echinoderm larval survival and sulfide.

4.4.3 Sediment Habitat Quality

Port Angeles Harbor has been used by the timber and wood products industries for decades, resulting in wood-waste accumulation in sediment in some areas of the harbor (E & E 2008b). Wood waste forms a layer over the natural sediments and essentially suffocates the native benthic invertebrates as it decomposes. Wood waste decomposition also results in elevated levels of ammonia and sulfide in bottom waters, both of which can be toxic to benthic invertebrates. As described in Section 4.3, one study in 1998 and two studies in 2008 have examined the amount of wood debris in Port Angeles Harbor sediments. The results of the studies were similar even though they were conducted 10 years apart. All three studies found that 20 to 25% of the sediment surface area of Port Angeles Harbor is affected by wood debris and that most of the debris is located in the inner portion of the harbor. The primary areas of accumulation are located in the western portion of the harbor along the base of Ediz Hook, in the Lagoon Area, along the waterfront at the Port of Port Angeles Management Area, and in the Log Pond area and surrounding the west side of the Rayonier Mill dock (see Figures 8-1 through 8-6 in the Sediment Investigation Report). Section 9 of the Sediment Investigation Report provides additional details regarding wood waste distribution in Port Angeles Harbor based on the 1998 and 2008 studies.

The sediment environment provides important habitat for many species of marine invertebrates. Because a considerable portion of the sediment environment in Port Angeles Harbor has been degraded by wood waste, it seems reasonable to hypothesize that the ability of Port Angeles Harbor to support a healthy benthic invertebrate community has been compromised in some areas.

4.4.4 Summary of Risk Evaluation for the Benthic Invertebrate Community

In summary, the three measures used to assess potential risks to benthic invertebrates in Port Angeles Harbor all suggest that this assessment endpoint may be impaired in some areas of the harbor. First, four metals (arsenic, cadmium, mercury, and zinc), two phthalates (bis[2-ethylhexyl]phthalate and butylbenzylphthalate), and two phenolic compounds (4-methylphenol and phenol) were found to exceed SMS criteria. Second, sediment samples from 29 stations submitted for bioassay testing failed to meet SMS criteria. Third, sediment habitat quality has been impaired by wood waste accumulation in about 25% of the harbor. Overall, benthic invertebrate community impairment is most evident in the Inner Harbor Area near the base of Ediz Hook, Lagoon Area, Marina Area, and near the Rayonier facility.

4.5 Fish Risk Evaluation

As indicated in Table 4-3, only one measure was selected to evaluate potential impacts to fish in Port Angeles Harbor—whole-body fish chemical concentrations compared with critical tissue residue risk-based concentrations (RBCs) for effects on fish. The available whole-body fish chemical data for Port Angeles Harbor consists of two lingcod samples collected in 2008 and three rock sole samples from Malcolm Pirnie (2006). IHSs in fish whole-body samples were selected based on frequency of detection and comparison with reference (see Tables E-10 and E-12). Based on this screening approach, arsenic, inorganic arsenic, chromium, copper, mercury, selenium, methylmercury, high molecular weight PAHs, PCBs, and dioxins/furans were identified as IHSs in fish.

To determine whether any of these chemicals may pose a risk to fish in Port Angeles Harbor, the maximum concentrations of these 10 chemicals in lingcod and rock sole were compared with critical tissue RBCs from the literature (see Table 4-6). Arsenic in rock sole exceeded the arsenic RBC. No other chemicals exceeded the relevant available RBCs. In general, these results suggest that fish in Port Angeles Harbor are unlikely to be adversely affected by the current levels of most contaminants, except perhaps by arsenic.

As noted in Section 2.2.6, a number of threatened and/or endangered salmonid species may use Port Angeles Harbor for part of their life cycle. It is expected that any potential risk to migratory salmon from arsenic would be lower than for resident demersal species (i.e., lingcod, rock sole, etc.).

Lastly, it should be noted that no chlorinated pesticide data are available for the fish whole-body samples from Port Angeles Harbor. Hence, whether or not this group of chemicals may be adversely affecting fish at the site remains an open question.

This section is not divided into separate subsections for exposure characterization, effects characterization, and risk characterization as per USEPA (1998) because of its short length and small amount of available data (5 samples); however, all three elements are present. The whole body fish data in Table 4-6 constitute the exposure characterization, the tissue screening benchmarks in Table 4-6 constitute the effects characterization, and the shading applied to the table constitutes the risk characterization.

4.6 Wildlife Risk Evaluation

This section presents an evaluation of potential risks to wildlife in Port Angeles Harbor. The evaluation was performed in accordance with state, federal, and other available guidance for ecological risk assessment (e.g., Ecology 2007a, U.S. EPA 1997c, 1998, Sample et al. 1996). The wildlife risk evaluation consists of three parts: (1) exposure assessment, (2) ecological effects assessment, and (3) risk characterization. The exposure assessment (Section 4.6.1) estimates wildlife exposure to site-related chemicals using measured concentrations of chemicals in environmental media and exposure parameters for the chosen receptor species. The ecological effects assessment (Section 4.6.2) summarizes the potential toxic effects of facility-related chemicals on wildlife by establishing a toxicity reference value for each chemical for each receptor. The exposure assessment and ecological effects assessment comprise the analysis phase in the USEPA ecological risk assessment paradigm. The risk characterization (Section 4.6.3) combines the results of the exposure and ecological effects assessments to provide an estimate of risk to wildlife at the site.

4.6.1 Exposure Assessment

This section discusses potential wildlife exposures to organic chemicals and metals at the site.

Potential receptors and exposure pathways were generally discussed in Section 2.2.6 and identified in the ecological CSM (Section 4.2.4 and Figure 4-1). This section describes specific wildlife exposure scenarios that will be evaluated in the assessment, estimates levels of chemicals in exposure media, and quantifies exposure.

4.6.1.1 Wildlife Exposure Scenarios and Pathways

Six wildlife species representing different functional groups were evaluated:

- Brant (*Branta bernicla*)
- Double-crested cormorant (*Phalacrocorax auritus*)
- Greater scaup (*Aythya marila*)
- Harbor seal (*Phoca vitulina*)
- Raccoon (*Procyon lotor*)
- Bald eagle (*Haliaeetus leucocephalus*)

The cormorant, harbor seal, and bald eagle are piscivorous and therefore may be highly exposed to bioaccumulative contaminants. The omnivorous raccoon is known to forage in the intertidal zone and thus may be exposed to contaminants in water, sediment, and prey. The brant and scaup are waterfowl that often forage in shallow water habitats and thus may be exposed to contaminants in water, sediment, and prey.

For these six wildlife receptors, exposure from incidental ingestion of contaminated sediment and consumption of contaminated prey were evaluated. Exposure through drinking was not quantitatively evaluated because Port Angeles Harbor is a saltwater system, and it is presumed that wildlife consume freshwater when drinking. Wildlife may consume small amounts of salt water while feeding in Port Angeles Harbor, but such consumption is likely to account for only a small fraction of total chemical exposure because chemicals typically occur at much greater concentrations in sediment and biota compared with water. In addition, direct contact with contaminated water and sediment is assumed to be a minor route of exposure for wildlife due to the protection provided by fur and feathers and will not be quantitatively evaluated. A summary of important life-history characteristics of the chosen receptor species is provided below.

Brant

The brant is a small goose that breeds in the Arctic, winters from Alaska south to Baja California, and remains near saltwater throughout the year (Kaufman 1996). Brant feed almost exclusively on plants. During the winter, they feed predominantly on eelgrass, salt marsh plants, and green algae. During the breeding season, brant feed on Arctic grasses and sedges, forbs, and moss. Brant forage on exposed vegetation and rooted plants in shallow water but do not dive; at high tide, they feed on dislodged leaves floating at the surface.

Double-Crested Cormorant

The double-crested cormorant is the most widely distributed cormorant in North America (Kauffman 1996). It is very adaptable and will use almost any aquatic habitat, including rocky northern coasts, mangrove swamps, large reservoirs, and small ponds. The double-crested cormorant nests in trees near water, on sea cliffs, or on ground on islands. The diet of this species varies with season and place and includes a wide variety of fish, crabs, shrimp, crayfish, frogs, salamanders, eels, and sometimes snakes, mollusks, and plant material. It forages mostly by diving from the surface and swimming underwater, propelled by its feet. This species may forage in clear or muddy water and usually forages at mid to upper levels more often than near the bottom.

Greater Scaup

Greater scaup breed in Alaska and northern Canada and spend the winter on the Pacific or Atlantic coast (Kaufman 1996). During summer, this species occurs on lakes and bogs in semi-open country near the northern limits of the boreal forest, and out onto the tundra. In winter, greater scaup occur mainly on coastal bays, lagoons, and estuaries. In winter, the diet includes mainly mussels, clams, oysters, snails, and other mollusks. In summer, the diet includes plants such as pondweeds, wild celery, sedges, and grasses, as well as insects and crustaceans. The greater scaup usually forages by diving and swimming underwater; bringing larger food items to the surface to be eaten. Occasionally, the greater scaup will forage by dabbling or upending in shallow water.

Harbor Seal

Harbor seals range from Alaska to Baja California along the Pacific coast (U.S. EPA 1993). They inhabit a wide variety of environments and are able to tolerate a wide range of temperatures and water salinities. In western North America, the harbor seal inhabits tidal mudflats, sand bars, shoals, river deltas, estuaries, bays, coastal rocks, and offshore islets, even ranging up rivers into freshwater areas in search of food. Habitats used for haulouts include cobble and sand beaches, tidal mud flats, offshore rocks and reefs, and man-made objects such as piers and log booms. The diet of the harbor seal varies seasonally and includes bottom-dwelling fish such as sole and flounder; invertebrates such as octopus, crabs, and clams; and pelagic species that can be caught in periodic aggregations, such as herring and squid. Harbor seals are opportunistic, consuming different prey in relation to their availability and ease of capture. They hunt alone or in small groups.

Raccoon

The raccoon is the most abundant and widespread medium-sized omnivore in North America. Raccoons are found near virtually every aquatic habitat (U.S. EPA 1993). They also are common in suburban residential areas and cultivated and abandoned farmlands. Raccoons use surface water for both drinking and foraging. Raccoons are omnivores and opportunistic feeders. They feed primarily on fleshy fruits, nuts, acorns, and corn, but also eat grain, insects, frogs, crayfish, eggs, and virtually any animal and vegetable matter. The diet composition depends on location and season, although plant material is usually a more important component of the diet than animal material. Typically, it is only in the spring and early summer that raccoons eat more animal than plant material. Raccoons typically are active from sunset to sunrise, but will change their activity pattern to accommodate food availability. For example, salt marsh raccoons may become active during the day to take advantage of low tide.

Bald Eagle

The bald eagle is a top predator in many aquatic ecosystems in North America and the second largest raptor (bird of prey) in North America (Peterson1980). Bald eagles are found throughout North America, and extensive breeding populations are found in Alaska and northern Canada and along the Atlantic Coast from Florida to Maine and up through the Maritime Provinces of Canada (Buehler 2000). Bald eagles are opportunistic foragers that frequently scavenge for dead or dying fish, waterfowl, and mammals, or steal prey from other birds. They are typically found in coastal areas or along the margins of rivers and lakes. Bald eagles are known to occur in the northern portion of the Olympic Peninsula (see Section 2.2.6) and may use Port Angeles Harbor and nearby coastal areas for foraging. Because the bald eagle consumes larger and presumably older fishes than the cormorant, its exposure to bioaccumulative chemicals likely is greater.

4.6.1.2 Wildlife Exposure Calculations

Chemical exposure for wildlife was calculated as the sum of exposures from diet and incidental sediment ingestion. Dietary exposure was calculated by multiplying the chemical concentration in each food item by its fraction of the total diet and summing the contribution from each item, then multiplying that sum by the receptor's site use factor (SUF), exposure duration (ED), and ingestion rate (IR), and dividing by the receptor's body weight (BW), as shown in the following equation:

$$EE_{diet} = ([(C_1 \text{ x } F_1) + (C_2 \text{ x } F_2) + \ldots (C_n \text{ x } F_n)] \text{ x SUF x ED x IR})/BW$$

where:

EE_{diet} = Estimated exposure from diet (mg/kg-day)

C_n = Chemical concentration in food item *n* (mg/kg wet weight)

F_n = Fraction of diet represented by food item *n*

SUF = Site use factor (unitless)

ED = Exposure duration (unitless)

IR = Ingestion rate of receptor (kg wet weight/day)

BW = Body weight of receptor (kg)

The SUF indicates the portion of an animal's home range represented by the site. If the home range is larger than the site, the SUF equals the site area divided by the home range area. If the site area is greater than or equal to the home range, the SUF is equal to 1. If definitive information on the home range size for a given receptor is lacking, and one can reasonably assume that the site provides ample food and habitat resources to support the receptor, then an SUF of 1 may be assumed. ED is the percentage of the year spent in the site area by the receptor species. Home-range size, IR, diet composition, and BW for the brant, double-crested cormorant, greater scaup, harbor seal, bald eagle, and raccoon were taken from U.S. EPA (1993), Dunning (1993), Kaufman (1996), or other applicable references, or were based on professional judgment. The values and sources are provided in Table 4-7. Attachment F provides additional supporting information for the wildlife exposure parameters used in the ERA.

Wildlife exposure to chemicals through incidental sediment ingestion was estimated in a manner similar to that used for dietary exposure. Specifically, the sediment chemical concentration was multiplied by the sediment IR and then multiplied by the SUF and ED and divided by BW, as shown in the following equation:

$$EE_{sediment} = (C_S \text{ x } IR_S \text{ x SUF x ED})/BW$$

where:

$EE_{sediment}$ = Estimated exposure from incidental sediment ingestion (mg/kg-day)

C_S = Chemical concentration in sediment (mg/kg dry weight)

IR_S= Sediment ingestion rate of receptor (kg dry weight/day)

SUF, ED, and BW are as defined above.

The raccoon, brant, cormorant, eagle, and scaup were assumed to ingest intertidal sediment incidentally while foraging. Because of its ability to dive and forage at depths of 100 m or greater, the harbor seal was assumed to be capable of ingesting both intertidal and subtidal sediment. For the brant, scaup, and raccoon, estimates of sediment ingestion were taken from the literature. The values are provided in Table 4-7. For the bald eagle, cormorant, and harbor seal, a sediment ingestion rate of 2% of diet was conservatively assumed.

The total exposure for a receptor was calculated as the sum of the exposure from diet and incidental sediment ingestion, as represented by the following equation:

$$EE_{total} = EE_{diet} + EE_{sediment}$$

where:

EE_{total} = total exposure (mg/kg-day)

EE_{diet} = estimated exposure from diet (mg/kg-day)

$EE_{sediment}$ = estimated exposure from sediment ingestion (mg/kg-day)

Exposure was estimated for chemicals identified as IHSs in eel grass and bull kelp, fish and shellfish, and/or sediment (see listing in Table 4-2), with the following exceptions:

- Ammonia, sulfide, and woody debris, because these substances are of concern for bottom-dwelling organisms (e.g., benthic invertebrates and flatfish) with prolonged or constant exposure to sediment and bottom waters, not wildlife;

- Organic acids and guaiacols, because no toxicity reference values for wildlife are available for these chemicals; and

- Diesel fuel and motor oil, because no toxicity reference values for wildlife are available for these bulk parameters.

If a chemical was identified as an IHS in one biological sample type and/or sediment, wildlife exposure to that chemical was estimated based on its concentration in all biological sample types consumed and from sediment (i.e., exposure from all sources was considered). The number of IHSs evaluated for the harbor seal was slightly greater than for the raccoon, brant, cormorant, eagle, and scaup because of different assumptions made regarding sediment exposure. As noted above, it was assumed that the harbor seal may be exposed to intertidal and subtidal sediment while foraging, but the other receptors would most likely be exposure only to intertidal sediment (see Section 4.6.1.3 for rationale).

4.6.1.3 Exposure Point Concentrations

Exposure point concentrations (EPCs) for chemicals in sediment and biota were determined as described below.

Sediment

ProUCL version 4.0 software was used to calculate EPCs for chemicals in sediment. For most chemicals, the 95% or 97.5% UCL of the average concentration was used as the EPC (see Table 4-8). For chemicals that were detected in only one or a few samples, the maximum detected concentration was used as the EPC. If a chemical was not detected in sediment, one-half of the maximum detection limit was used as the EPC. The sediment EPCs were used to estimate exposure from incidental sediment ingestion, as described in Section 4.6.1.2.

For the harbor seal, chemical concentrations in intertidal and subtidal sediments were used to estimate sediment EPCs. The harbor seal usually forages by diving, often to depths of 100 m and sometimes as great as 500 m. Hence, the harbor seal may incidentally ingest sediment throughout the harbor at various depths. The harbor seal may also forage in the intertidal zone.

For the raccoon, brant, cormorant, eagle, and scaup, only intertidal sediment data were used to estimate sediment EPCs. Based on their behavior, these five receptors are unlikely to contact or ingest subtidal sediment. For example, the raccoon forages in the intertidal zone and at the water's edge. The brant forages by wading or tipping up in shallow water, or by walking on tidal flats or on shore. The cormorant forages for fish by diving, usually in the upper and middle part of the water column. In reality, the cormorant probably does not ingest sediment while feeding. Two percent (2%) sediment ingestion was assumed for the cormorant to be conservative, although an assumption of no sediment ingestion for this receptor would also be defensible. The eagle catches fish by cruising very low over the water surface, taking prey by surprise. The eagle may also land on the shore to feed on carrion. For the eagle, 2% sediment ingestion was assumed to be conservative, although an assumption of no sediment ingestion for this receptor also would be defensible. The greater scaup feeds mostly on mussels, clams, oysters, and snails and focuses its foraging where food it most abundant and accessible, in the intertidal zone.

Eel Grass and Bull Kelp

The chemical data for eel grass and bull kelp are very limited; only one sample of each species is available. The average of the eel grass and bull kelp concentration for each chemical was used as the EPC for that chemical in marine vegetation (see Table 4-9). These EPCs were used as input for the exposure assessment for the brant and scaup.

Shellfish

Available chemical data for whole-body samples of coonstripe shrimp, Dungeness crab, geoduck, horse clam, and red rock clam were used to develop shellfish EPCs for the ERA. Chemical-specific EPCs for each species were estimated as follows:

- **Coonstripe shrimp –** Because sample size was limited (n = 3), the maximum detected concentration or one-half of the maximum detection limit was used as the EPC.

- **Dungeness crab –** Whole-body Dungeness crab chemical concentrations were estimated from separate chemical analyses of hepatopancreas and muscle tissue, assuming that an average crab is 75% muscle and 25% hepatopancreas (see Section 3.3). Because the number of observations was limited for most chemicals (n = 3), the maximum detected concentration or one-half of the maximum detection limit was used as the EPC. For dioxins/furans and PCBs, the sample size was great enough for a UCL to be calculated using ProUCL version 4 software (see Attachment G for summary of ProUCL output).

- **Geoduck –** Because sample size was limited (n = 1 to 7), the maximum detected concentration or one-half of the maximum detection limit was used as the EPC.

- **Horse clam –** The horse clam database consists of whole-body samples (n = 17) and reconstituted whole-body samples (n = 10). Reconstituted whole-body chemical concentrations were estimated based on separate chemical analysis of visceral cavity and edible tissue, assuming that an average clam is 56% viscera and 44% edible tissue (see Section 3.3). For most chemicals, ProUCL version 4 software was used to calculate an EPC because an adequate number of observations (n = 8 to 27) were available (see Attachment G for summary of ProUCL output). When the number of observations was limited (less than 8), the maximum detected concentration was used as the EPC. When all observations were reported as nondetected, one-half of the maximum detection limit was used as the EPC.

For each chemical, the EPCs for the coonstripe shrimp, Dungeness crab, geoduck, and horse clam were averaged to arrive at an average shellfish EPC for Port Angeles Harbor (see Table 4-10). The average shellfish EPCs were used in the exposure assessment for the raccoon, scaup, and cormorant.

Fish

Available chemical data for whole-body samples of lingcod and rock sole were used to develop fish EPCs for the ERA. An EPC for each species was estimated as follows:

- **Lingcod –** Because sample size was limited (n = 2), the maximum detected concentration or one-half of the maximum detection limit was used as the EPC.

- **Rock sole –** Because sample size was limited (n = 3), the maximum detected concentration or one-half of the maximum detection limit was used as the EPC.

For each chemical, the EPCs for the lingcod and rock sole were averaged to arrive at an average fish EPC for Port Angeles Harbor (see Table 4-11). The average fish EPCs were used in the exposure assessment for the bald eagle, cormorant, seal, and raccoon.

4.6.2 Ecological Effects Assessment

4.6.2.1 Toxicity Reference Values (TRVs)

No observed adverse effect levels (NOAELs) and LOAELs for the chemicals of interest for this ERA were taken from the peer-reviewed literature. The values and sources are provided in Table 4-12. These NOAELs and LOAELs were not scaled for differences in body weight between the test species and wildlife receptors being evaluated because this practice is no longer considered appropriate (Allard et al. 2007). Therefore, information on test-species body weight is not included in Table 4-12.

4.6.2.2 Treatment of PAHs, Dioxins/Furans, and PCBs

PAHs were grouped into low and high molecular weight fractions for evaluation. The LPAH fraction was calculated as the sum of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene (Ecology 1995). The HPAH fraction was calculated as the sum of fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene (Ecology 1995).

Dioxins and furans were evaluated as a group, as described in Section 3.6.3. Mammalian-based TEQs were calculated using the recently updated mammalian TEFs from Van den Berg et al. (2006). Avian-based TEQs were calculated using avian TEFs from Van den Berg et al. (1998). The exposure estimates were compared to a TRV for 2,3,7,8-tetrachlorodioenzofuran (TCDD, see Table 4-12).

Two risk estimates are presented for PCBs—one based on the sum of Aroclors and one based on dioxin-like PCBs. For the sum of Aroclors, the exposure estimate was compared with a TRV developed from studies with Aroclor 1254 (see Table 4-12). For dioxin-like PCBs, a TEQ was calculated as described above for dioxin/furans and compared to a TRV for 2,3,7,8-TCDD.

As per the final *Risk Assessment Work Plan* (E & E 2008a), EPCs for LPAHs, HPAHs, dioxins/furans, and dioxin-like PCBs were calculated two ways: (1) assuming a concentration of zero for undetected congeners/chemicals and (2) assuming a concentration equal to one-half the reported detection limit for undetected congeners/chemicals. Exposure estimates and risks are presented for both ways for these chemical groups and are designated as ND = 0 and ND = 0.5 in Tables 4-13 to 4-18.

4.6.3 Wildlife Risk Characterization

4.6.3.1 Risk Calculation Methodology

The potential risks posed by site-related chemicals were determined by calculating a hazard quotient (HQ) for each contaminant for each endpoint species. The HQ was determined by dividing the total exposure (EE_{total}) by the TRV, as shown in the following equation:

$$HQ = EE_{total}/TRV$$

Hazard quotients for each receptor were calculated based on both the NOAEL and LOAEL TRVs, and are abbreviated as HQ-NOAEL and HQ-LOAEL, respectively. For a given receptor and chemical, a HQ-NOAEL greater than 1.0 indicates that the estimated exposure exceeds the highest dose at which no adverse effect was observed. Such a result does not necessarily imply that the receptor is at risk, especially if the HQ-NOAEL is only marginally above 1.0. An HQ-LOAEL greater than 1.0 suggests that a chronic adverse affect is possible to an individual receptor, assuming that the estimated exposure for that receptor is accurate. Tables 4-13 through 4-18 present the estimated exposures from food and soil/sediment ingestion, total exposure, and HQs for the brant, eagle, cormorant, harbor seal, raccoon, and scaup.

4.6.3.2 Risk Results

In general, risks to wildlife from the IHSs identified in Table 4-2 were low, as evidenced by the following results:

- No unacceptable risks were found for the brant, eagle, cormorant, and scaup; that is, all HQs were less than 1.0 (see Tables 4-13, 4-14, 4-15, and 4-18).

- For the raccoon, the HQ-NOAEL for hexachlorobenzene and arsenic exceeded 1.0 (see Table 4-17). However, the high HQ for hexachlorobenzene is an artifact of an elevated detection limit for this chemical in horse clam (see Table 4-10) and lingcod (see Table 4-11). If only detected concentration of hexachlorobenzene were used to estimate exposure, the total exposure from this chemical to the raccoon would be about 100 times lower, and no risk would be predicted. The HQ for arsenic is not an artifact. However, only the HQ-NOAEL, not the HQ-LOAEL, exceeded 1.0 for this receptor. As noted above, an HQ-NOAEL greater than 1.0 does not necessarily indicate adverse effect.

- For the harbor seal, the HQ-NOAEL for hexachlorobenzene exceeded 1.0. However, as noted above, the high HQ for hexachlorobenzene is an artifact of an elevated detection limit in some biota samples. In reality, this chemical is unlikely to pose a risk to the seal. Overall, it seems that no chemicals pose an actual risk to harbor seals foraging in Port Angeles Harbor.

- Risks to threatened and endangered bird and mammal species possible using Port Angeles Harbor (see Section 2.2.6) are expected to be negligible given these risk results.

4.7 Uncertainty Evaluation

Sources of uncertainty in the ERA include the following:

- No sediment benchmarks were available to evaluate potential risks to benthic invertebrates from guaiacols and resin and fatty acids (see Table 4-1). Hence, the potential contribution of these chemicals to benthic invertebrate community impairment at the site is uncertain.

- No data are available for guaiacols and resin and fatty acids in marine plants, shellfish, or fish. Hence, exposure of wildlife to these chemicals could not be evaluated. Moreover, no wildlife TRVs are available for these chemicals. Hence, even if exposure could be estimated, risk could not be. Overall, wildlife exposure to and risk from guaiacols and resin and fatty acids are poorly understood at the site.

- For screening purposes, it was assumed that no reference data were available when all reference samples for a given sample type and chemical were "non-detect". In such cases, if the chemical was detected in that sample type from Port Angeles Harbor, it was considered an IHS for Port Angeles Harbor, even if the detected concentration at Port Angeles Harbor was less than the reference detection limit. This approach was used during the screening process to avoid inappropriately eliminating chemicals as IHSs at the site due to elevated reference detection limits. This approach is conservative and resulted in a greater number of chemicals being identified as IHSs than if reference detection limits, regardless of magnitude, were used in the screening process.

- The Washington States SQS for organic chemicals were normalized to 1% TOC for screening purposes. Because sediment TOC levels in Port Angeles Harbor typically are greater than 1%, the approach used was conservative and likely resulted in a greater number of chemicals being identified as potential IHSs in sediment than if sample-specific TOC levels were incorporated into the screening process.

- The available sample size was small for most biological sample types, including eel grass (one sample), bull kelp (one sample), lingcod (two samples), rock sole (three samples), coonstripe shrimp (three samples), and geoduck (seven samples). Consequently, the EPCs for these sample types are not well defined. Also, for eel grass and bull kelp, no information on variability is available. Sample size was larger for Dungeness crab and horse clam (see Table 4-10), but not all IHSs were measured in all samples. As a result, except for a few chemicals, the sample size was not large enough to support calculation of a UCL (see Tables G-1 and G-2 in Attachment G). Because of these sample size limitations, the maximum concentration often was used as the EPC to estimate wildlife dietary exposure.

- The biological sample data available for use in the ERA was, in many cases, not ideal for estimating exposure and risk to the wildlife species evaluated. For example, the available fish data were for large predatory species (lingcod and rock sole) preferred by recreational and subsistence fishers. The piscivorous wildlife receptors evaluated in this ERA, such as the cormorant, are unlikely to prey on these species. In reality, the cormorant is more likely to prey on smaller fish species that reside near the water surface. These smaller fish species most likely have lower contaminant levels than lingcod and flatfish. Overall, the fish data used in this ERA likely resulted in conservative estimates of exposure and risk for piscivorous wildlife.

- Much of the biological sample data used in this ERA was taken from Malcolm Pirnie (2006 and 2007, see Tables 2-3 and 2-4). These studies were focused on the Rayonier facility. Fish and shellfish data were collected from other areas of the harbor in other studies; however, we cannot rule out the possibility that the area near the Rayonier facility may be over represented by the available biological sample data. If so, then the fish and shellfish EPCs used in this ERA may be biased high.

- No pesticide or PCB data were available for eel grass or bull kelp for inclusion in the draft ERA (see Table 4-9). As such, potential risks to herbivorous wildlife from these chemicals could not be fully evaluated.

- The PCB analytical results for biota samples from the site varies among studies, with older studies typically reporting Aroclor data and more recent studies typically reporting congener data (see Section 2.5.2). Across all studies, more sample types have been analyzed for Aroclors than PCB congeners (see Table 2-5). Both types of PCB data were used in the ERA and potential risks from Aroclors and dioxin-like PCBs are presented separately (see Tables 4-13 to 4-18). No unacceptable wildlife risks were identified for the sum of Aroclors or for dioxin-like PCBs, suggesting that the analytical method used to analyze biota samples for PCBs does not have a marked influence on the risk results.

- No data are available for many chlorinated pesticides in lingcod and rock sole (see Table 4-11). As such, potential risks to piscivorous wildlife from these chemicals could not be fully evaluated. Also, potential risks to fish from these chemicals could not be evaluated.

- Wildlife TRVs are not available for some SVOCs identified as IHSs at the site, including butylbenzylphthalate, p-cresol, pyridine, and retene (see Table 4-12). Hence, potential wildlife risks from these chemicals could not be evaluated.

4.8 Summary and Conclusions

A summary of potential risks to the assessment endpoints evaluated in this assessment is provided in Table 4-19. In brief, marine vegetation and benthic invertebrates are the receptor groups most at risk from current environmental conditions in Port Angeles Harbor. For these assessment endpoints, sediment habitat degradation by wood waste appears to be the most critical stressor. Arsenic may pose a risk to fish and omnivorous mammals. There are inherent uncertainties in the risk evaluation for fish and wildlife due to the limited number of whole-body fish samples that were available for use in the ERA and lack of data for some chemicals in fish tissue (see Section 4.7). These uncertainties should be considered when using the results from this ERA for risk management purposes.

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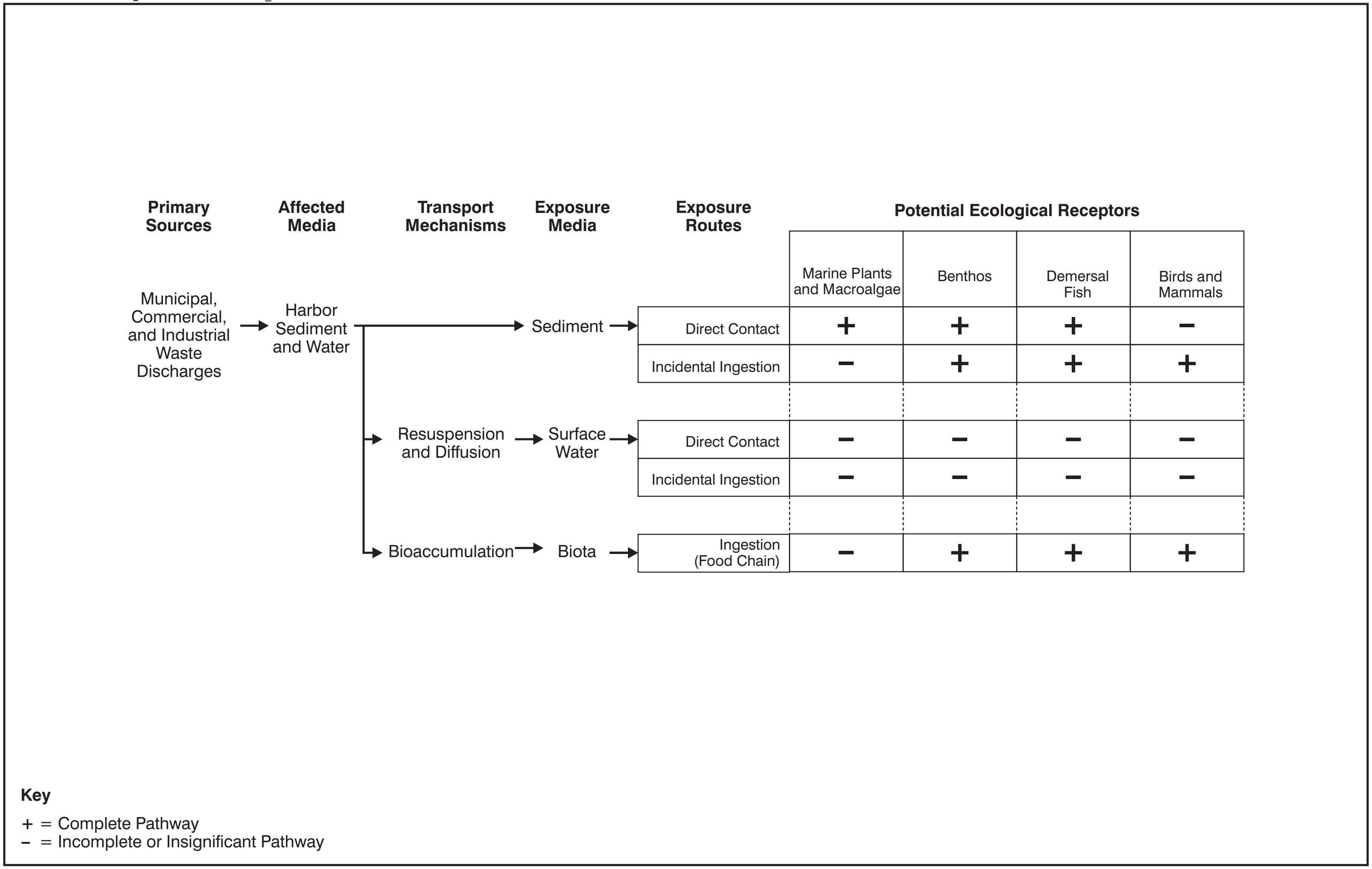

SOURCE: Ecology and Environment, Inc. 2009

Figure 4-1 Ecological Conceptual Site Model, Port Angeles Harbor Sediment Investigation

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Table 4-1. Sediment Screening Benchmarks and Octanol-Water Partition Coefficients for Port Angeles Harbor Ecological Risk Assessment.

CAS Number	Chemical Name	log Kow	log Kow source	Sediment Screening Benchmark (mg/kg dry)	Benchmark Source	Remarks
Metals						
7429-90-5	ALUMINUM	na	na	na	na	
7440-36-0	ANTIMONY	na	na	2	MacDonald et al. 1999	Effects Range- Low, U.S.
7440-38-2	ARSENIC	na	na	57	WAC 173-204-320 Table 1 (Ecology 1995)	
7440-39-3	BARIUM	na	na	48	MacDonald et al. 1999	Apparent effect threshold, amphipod toxicity, Puget Sound, WA
7440-41-7	BERYLLIUM	na	na	0.36	MacDonald et al. 1999	Apparent effect threshold, microtox bioassay, Puget Sound, WA.
7440-43-9	CADMIUM	na	na	5.1	WAC 173-204-320 Table 1 (Ecology 1995)	
7440-47-3	CHROMIUM, TOTAL	na	na	260	WAC 173-204-320 Table 1 (Ecology 1995)	
7440-48-4	COBALT	na	na	na	na	
7440-50-8	COPPER	na	na	390	WAC 173-204-320 Table 1 (Ecology 1995)	
7439-86-6	IRON	na	na	37000	MacDonald et al. 1999	Apparent effect threshold, microtox bioassay, Puget Sound, WA.
7439-92-1	LEAD	na	na	450	WAC 173-204-320 Table 1 (Ecology 1995)	
7439-93-2	LITHIUM	na	na	na	na	
7439-95-4	MAGNESIUM	na	na	na	na	
7439-96-5	MANGANESE	na	na	480	MacDonald et al. 1999	Apparent effect threshold, oyster larvae toxicity, Puget Sound, WA.
7439-97-6	MERCURY	na	na	0.41	WAC 173-204-320 Table 1 (Ecology 1995)	
7439-98-7	MOLYBDENUM	na	na	na	na	
7440-02-0	NICKEL	na	na	28	MacDonald et al. 1999	Apparent effect threshold, microtox bioassay, Puget Sound, WA.
7440-04-2	OSMIUM	na	na	na	na	
7440-9-7	POTASSIUM	na	na	na	na	
7782-49-2	SELENIUM	na	na	1.00	MacDonald et al. 1999	Apparent effect threshold, amphipod toxicity, Puget Sound, WA
7440-22-4	SILVER	na	na	6.1	WAC 173-204-320 Table 1 (Ecology 1995)	
7440-66-6	ZINC	na	na	410	WAC 173-204-320 Table 1 (Ecology 1995)	
Organometalics						
78763-54-9	Butyltin	na	na	na	na	
1002-53-5	Dibutyltin	na	na	na	na	
56573-85-4	Tributyltin	na	na	0.073	Michelsen et al. 1996	Puget Sound Dredge Disposal Authority
Sediment Management Standard (SMS) Organic Compounds						
91-20-3	NAPHTHALENE	3.3	CHPPM (2008)	0.99	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
208-96-8	ACENAPHTHYLENE	4.1	CHPPM (2008)	0.66	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
83-32-9	ACENAPHTHENE	3.9	CHPPM (2008)	0.16	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
86-73-7	FLUORENE	4.2	CHPPM (2008)	0.23	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
85-01-8	PHENANTHRENE	4.5	CHPPM (2008)	1.00	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
120-12-7	ANTHRACENE	4.5	CHPPM (2008)	2.20	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
91-57-6	2-METHYLNAPHTHALENE	3.9	CHPPM (2008)	0.38	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
206-44-0	FLUORANTHENE	5	CHPPM (2008)	1.60	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
129-00-0	PYRENE	4.9	CHPPM (2008)	10.00	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
56-55-3	BENZO(A)ANTHRACENE	5.7	CHPPM (2008)	1.10	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
218-01-9	CHRYSENE	5.7	CHPPM (2008)	1.10	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
56832-73-6	BENZOFLUORANTHENE ISOMER	na	na	2.30	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
50-32-8	BENZO(A)PYRENE	6	CHPPM (2008)	0.99	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
193-39-5	INDENO(1,2,3-C,D)PYRENE	6.6	CHPPM (2008)	0.34	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
53-70-3	DIBENZ(A,H)ANTHRACENE	6.5	CHPPM (2008)	0.12	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
191-24-2	BENZO(G,H,I)PERYLENE	6.6	CHPPM (2008)	0.31	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
95-50-1	1,2-DICHLOROBENZENE	3.38	CHPPM (2008)	0.023	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
106-46-7	1,4-DICHLOROBENZENE	3.5	CHPPM (2008)	0.031	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
120-82-1	1,2,4-TRICHLOROBENZENE	4	CHPPM (2008)	0.0081	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
118-74-1	HEXACHLOROBENZENE	5.3	CHPPM (2008)	0.0038	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
131-11-3	DIMETHYL PHTHALATE	1.56	CHPPM (2008)	0.53	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
84-66-2	DIETHYL PHTHALATE	2.5	CHPPM (2008)	0.61	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
84-74-2	DI-N-BUTYL PHTHALATE	4.7	CHPPM (2008)	2.20	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
85-68-7	BENZYL BUTYL PHTHALATE	4.9	CHPPM (2008)	0.049	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
117-81-7	BIS(2-ETHYLHEXYL) PHTHALATE	5.1	CHPPM (2008)	0.47	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
117-84-0	DI-N-OCTYLPHTHALATE	8.1	CHPPM (2008)	0.58	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
132-64-9	DIBENZOFURAN	4.1	CHPPM (2008)	0.15	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
87-68-3	HEXACHLOROBUTADIENE	4.8	CHPPM (2008)	0.039	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
86-30-6	N-NITROSODIPHENYLAMINE	3.1	CHPPM (2008)	0.11	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
LPAH	LOW MOLECULAR WEIGHT PAHS	3.1 - 4.5	CHPPM (2008)	3.70	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
HPAH	HIGH MOLECULAR WEIGHT PAHS	4.9 - 6.6	CHPPM (2008)	9.60	WAC 173-204-320 Table 1 (Ecology 1995)	SMS for 1% total organic carbon
108-95-2	PHENOL	1.5	CHPPM (2008)	0.42	WAC 173-204-320 Table 1 (Ecology 1995)	

Table 4-1. Sediment Screening Benchmarks and Octanol-Water Partition Coefficients for Port Angeles Harbor Ecological Risk Assessment.

CAS Number	Chemical Name	log Kow	log Kow source	Sediment Screening Benchmark (mg/kg dry)	Benchmark Source	Remarks
95-48-7	2-METHYLPHENOL (O-CRESOL)	1.95	CHPPM (2008)	0.063	WAC 173-204-320 Table 1 (Ecology 1995)	
106-44-5	4-METHYLPHENOL (P-CRESOL)	1.9	CHPPM (2008)	0.67	WAC 173-204-320 Table 1 (Ecology 1995)	
105-67-9	2,4-DIMETHYLPHENOL	2.3	CHPPM (2008)	0.029	WAC 173-204-320 Table 1 (Ecology 1995)	
87-86-5	PENTACHLOROPHENOL	5.1	CHPPM (2008)	0.36	WAC 173-204-320 Table 1 (Ecology 1995)	
100-51-6	BENZYL ALCOHOL	1.1	CHPPM (2008)	0.057	WAC 173-204-320 Table 1 (Ecology 1995)	
65-85-0	BENZOIC ACID	1.87	CHPPM (2008)	0.65	WAC 173-204-320 Table 1 (Ecology 1995)	
Pesticides						
309-00-2	ALDRIN	5.51	Chemfate	0.00044	MacDonald et al. 1999	Apparent effect threshold, benthic infauna abundance, Puget Sound, WA.
319-84-6	ALPHA-BHC (ALPHA-HEXACHLOROCYCLOHEXANE)	3.8	Chemfate	0.0003	MacDonald et al. 1999	Sediment quality criterion, no effect threshold, St Lawrence River, Canada.
319-85-7	BETA-BHC (BETA-HEXACHLOROCYCLOHEXANE)	3.78	Chemfate	0.0002	MacDonald et al. 1999	Sediment quality criterion, no effect threshold, St Lawrence River, Canada.
319-86-8	Delta-BHC (Delta Hexachlorocyclohexane)	4.14	Chemfate	0.13	MacDonald et al. 1999	Guideline, Sediment Quality Advisory @ 1% OC, U.S.
58-89-9	GAMMA-BHC (LINDANE)	3.61	Chemfate	0.0003	MacDonald et al. 1999	Working Sediment Quality Guideline, interim, British Columbia.
57-74-9	CHLORDANE	5.54	Chemfate	0.0005	MacDonald et al. 1999	Criterion; Effects range low. British Columbia.
5103-74-9	CIS-CHLORDANE	na	na	na	na	
5566-34-7	GAMMA-CHLORDANE	na	na	0.00002	MacDonald et al. 1999	Chronic criterion @ 1% OC, NY State.
510-15-6	CHLOROBENZILATE	4.36	Chemfate	na	na	
96-12-8	1,2-DIBROMO-3-CHLOROPROPANE	2.26	Chemfate	na	na	
72-54-8	4,4'-DDD	6.02	Chemfate	0.016	MacDonald et al. 1999	Apparent effects threshold, benthic infauna abundance, Puget Sound, WA.
72-55-9	4,4'-DDE	5.69	Chemfate	0.009	MacDonald et al. 1999	Apparent effects threshold, benthic infauna abundance, Puget Sound, WA.
50-29-3	4,4'-DDT	6.53	Jones et al. 1997	0.0039	MacDonald et al. 1999	Apparent effects threshold, amphipod toxicity, Puget Sound, Washington
2303-16-4	Diallate	4.8	Chemfate	na	na	
60-57-1	Dieldrin	5.37	Jones et al. 1997	0.00002	MacDonald et al. 1999	Effects range low - U.S.
1115-29-7	Endosulfan	4.1	Jones et al. 1997	0.00004	MacDonald et al. 1999	Chronic criterion at 1% OC, NY State.
959-98-8	Endosulfan I	3.83	Chemfate	0.0029	MacDonald et al. 1999	Guideline, sediment quality advisory level, 1% OC
33213-65-9	Endosulfan II	3.83	Chemfate	0.014	MacDonald et al. 1999	Guideline, sediment quality advisory level, 1% OC
1031-07-8	Endosulfan sulfate	na	na	na	na	
72-20-8	Endrin	5.06	Jones et al. 1997	0.00002	MacDonald et al. 1999	Working Sediment Quality Guideline, Effects Range Low, British Columbia.
7421-93-4	Endrin aldehyde	na	na	na	na	
53494-70-5	Endrin ketone	na	na	na	na	
76-44-8	Heptachlor	6.1	Jones et al. 1997	0.00004	MacDonald et al. 1999	Criterion, 99th percentile chronic permissible conc., British Columbia.
1024-57-3	Heptachlor epoxide	5.4	Chemfate	0.001	MacDonald et al. 1999	Sediment quality criterion, no effect threshold, St. Lawrence River, Canada
118-74-1	Hexachlorobenzene	5.31	Chemfate	0.022	MacDonald et al. 1999	Apparent effect threshold, benthic infauna abundance, Puget Sound, WA.
77-47-4	Hexachloropentadiene	5.04	Chemfate	0.007	MacDonald et al. 1999	Chronic criterion at 1% OC, NY State.
465-73-6	Isodrin	na	na	na	na	
72-43-5	Methoxychlor	5.08	Jones et al. 1997	0.006	MacDonald et al. 1999	Chronic criterion at 1% OC, NY State.
8001-35-2	Toxaphene	4.82	Chemfate	0.000002	MacDonald et al. 1999	Criterion, equilibrium partitioning method, 1% OC, United States.
Dioxins and Furans						
1746-01-6	2,3,7,8-TCDD	6.8	CHPPM (2008)	0.1	MacDonald et al. 1999	Criterion at 1% OC, NY State.
Polychlorinated Biphenyls						
PCB-Tot-AroND05	TOTAL PCB	6.5	CHPPM (2008)	0.12	SMS converted to mg/kg dry	12 mg/kg organic carbon
Inorganic Analytes						
18496-25-8	Sulfide	na		45	MacDonald et al. 1999	Apparent Effect Threshold, microtox bioassay, Puget Sound, WA.
AmmoniaN	Ammonia (NH3) as Nitrogen (N)	na		340	Cubbage et al 1997 for freshwater sediment	Probable Aapparent Effects Threshold, amphipod toxicity, WA State.
Phenols (non-SMS)						
95-95-4	2,4,5-Trichlorophenol	3.72	CHPPM (2008)	0.003	MacDonald et al. 1999	Apparent Effect Threshold, benthic infauna abundance, Puget Sound, WA.
88-06-2	2,4,6-Trichlorophenol	3.7	CHPPM (2008)	0.006	MacDonald et al. 1999	Apparent Effect Threshold, benthic infauna abundance, Puget Sound, WA.
120-83-2	2,4-Dichlorophenol	2.9	CHPPM (2008)	0.005	MacDonald et al. 1999	Apparent Effect Threshold, amphipod toxicity, Puget Sound, WA.
51-28-5	2,4-Dinitrophenol	1.54	CHPPM (2008)	na	na	
95-57-8	2-Chlorophenol	2.15	CHPPM (2008)	0.008	MacDonald et al. 1999	Apparent Effect Threshold, amphipod toxicity, Puget Sound, WA.
88-75-5	2-Nitrophenol	1.79	CHPPM (2008)	na	na	
59-50-7	4-Chloro-3-methylphenol	3.1	CHPPM (2008)	na	na	
100-02-7	4-Nitrophenol	1.91	CHPPM (2008)	na	na	
534-52-1	4,6-Dinitro-2-Methylphenol	2.12	CHPPM (2008)	na	na	
Guaiacols						
483-65-8	Retene	6.35	Toxikos 2006	1.2	MacDonald et al. 1999	Apparent Effect Threshold, amphipod toxicity, Puget Sound, WA.
90-05-1	Guaiacol (2-Methoxyphenol)	na	na	0.58	MacDonald et al. 1999	Apparent Effect Threshold, benthic infauna abundance, Puget Sound, WA.
16766-30-6	4-Chloroguaiacol	1.98	Toxikos 2006	na	na	
77102-94-4	3,4-Dicloroguaiacol	2.63	Toxikos 2006	na	na	
2460-49-3	4,5-Dichloroguaiacol	2.63	Toxikos 2006	na	na	
16766-31-7	4,6-Dichloroguaiacol	2.63	Toxikos 2006	na	na	

Table 4-1. Sediment Screening Benchmarks and Octanol-Water Partition Coefficients for Port Angeles Harbor Ecological Risk Assessment.

CAS Number	Chemical Name	log Kow	log Kow source	Sediment Screening Benchmark (mg/kg dry)	Benchmark Source	Remarks
2539-17-5	Tetrachloroguaiacol	na	na	na	na	
57057-83-7	3,4,5-Trichloroguaiacol (Ac)	na	na	na	na	
60712-44-9	3,4,6-Trichloroguaiacol (Ac)	na	na	na	na	
2668-24-8	4,5,6 Trichloroguaiacol	na	na	na	na	
Resin and Fatty Acids						
65310-45-4	12-Chlorodehydroabietic Acid	8.23	Toxikos 2006	na	na	
65281-76-7	14-Chlorodehydroabietic Acid	8.05	Toxikos 2006	na	na	
5829-48-1	9,10-Dichlorostearic Acid	na	na	na	na	
514-10-3	Abietic Acid	na	na	na	na	
1740-19-8	Dehydroabietic Acid	6.52	Toxikos 2006	na	na	
57055-39-7	Dichlorodehydroabietic Acid	na	na	na	na	
5835-26-7	Isopimaric Acid	7.5	Toxikos 2006	na	na	
463-40-1	Linolenic Acid	na	na	na	na	
471-77-2	Neoabietic Acid	na	na	na	na	
112-80-1	Oleic Acid	na	na	na	na	
1945-53-5	Palustric Acid	na	na	na	na	
127-27-5	Pimaric Acid	6.45	Toxikos 2006	na	na	
471-74-9	Sandaracopimaric Acid	na	na	na	na	
Organic Compounds (non-SMS)						
121-14-2	2,4-Dinitrotoluene	1.98	CHPPM (2008)	na	na	
606-20-2	2,6-Dinitrotoluene	1.72	CHPPM (2008)	na	na	
91-58-7	2-Chloronaphthalene	3.38	CHPPM (2008)	na	na	
88-74-4	2-Nitroaniline	1.85	CHPPM (2008)	na	na	
91-94-1	3,3'-Dichlorobenzidine	3.51	CHPPM (2008)	na	na	
101-55-3	4-Bromophenyl phenyl ether	5.24	CHPPM (2008)	na	na	
106-47-8	4-Chloroaniline	1.83	CHPPM (2008)	na	na	
7005-72-3	4-Chlorophenyl-phenylether	4.08	CHPPM (2008)	na	na	
100-01-6	4-Nitroaniline	1.39	CHPPM (2008)	na	na	
86-74-8	Carbazole	na	na	0.97	MacDonald et al. 1999	Apparent Effect Threshold, benthic infauna abundance, Puget Sound, WA.
67-72-1	Hexachloroethane	3.93	CHPPM (2008)	0.14	MacDonald et al. 1999	Apparent Effect Threshold, oyster larvae toxicity, Puget Sound, WA.
78-59-1	Isophorone	1.67	CHPPM (2008)	2.4	MacDonald et al. 1999	Chronic Marine EqP Threshold,, 1% OC, U.S.
90-12-0	1-Methylnaphthalene	na	na	0.052	MacDonald et al. 1999	Apparent Effect Threshold, benthic effects, Northern California.
99-09-2	m-Nitroaniline	1.37	CHPPM (2008)	na	na	
98-95-3	Nitrobenzene	1.85	CHPPM (2008)	1.65	MacDonald et al. 1999	Chronic Marine EqP Threshold, 1% OC, U.S.
621-64-7	N-Nitrosodi-n-propylamine	1.36	CHPPM (2008)	na	na	
108-60-1	2,2'-Oxybis[1-chloropropane]	2.48	CHPPM (2008)	na	na	
111-91-1	bis(2-Chloroethoxy)Methane	0.75	CHPPM (2008)	na	na	
111-44-4	Bis(2-Chloroethyl)Ether	1.29	CHPPM (2008)	na	na	

Key: CHPPM = Center for Health Promotion and Preventative Medicine
na = not available or not applicable
SMS = Sediment Management Standards
USEPA = United States Environmental Protection Agency
WAC = Washington [State] Administrative Code

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Table 4-2 Indicator Hazardous Substances for Port Angeles Harbor Ecological Risk Assessment.

Chemical Name	Matrix			
	Intertidal and Subtidal Sediment	Intertidal Sediment Only	Eel Grass and Bull Kelp	Fish[a] and Shellfish
Polychlorinated Biphenyls (PCBs)				
PCB Aroclors	X	X	X	X
Dioxin-like PCB congeners	X		X	X
Polycyclic Aromatic Hydrocarbons (PAHs)				
High Molecular Weight PAHs (HPAHs)	X	X	X	X
Low Molecular Weight PAHs (LPAH)	X	X	X	X
Pesticides				
4,4'-DDD	X	X		X
4,4'-DDE	X	X		X
4,4'-DDT	X	X		X
Alpha-BHC	X			X
Beta-BHC	X	X		X
cis-Chlordane	X			
Delta-BHC	X (b)	X		X
Dieldrin	X	X		
Endosulfan I	X (b)	X		
Endosulfan II	X (b)	X		
Endosulfan Sulfate	X	X		
Endrin	X	X		
Endrin Aldehyde	X	X		
Endrin Ketone	X	X		
gamma-Chlordane	X			X
Heptachlor	X	X		
Heptachlor Epoxide	X	X		
Lindane	X			X
Methoxychlor	X (b)	X		
Toxaphene		X		
Semivolatile Organic Compounds (SVOCs)				
9H-Carbazole	X			
Bis(2-Ethylhexyl) Phthalate	X	X (b)		
Butyl benzyl phthalate	X	X		
Dibenzofuran	X			
Dibutyl phthalate	X (b)			
Hexachlorobenzene				X
p-Cresol	X			
Pentachlorophenol		X (b)		
Phenol	X			
Pyridine				X
Retene	X	X		

Table 4-2 Indicator Hazardous Substances for Port Angeles Harbor Ecological Risk Assessment.

Chemical Name	Matrix			
	Intertidal and Subtidal Sediment	Intertidal Sediment Only	Eel Grass and Bull Kelp	Fish[a] and Shellfish
Dioxins and Furans				
PCDDs/PCDFs	X (b)	X	X	X
Organometals				
Dibutyltin ion	X			
Methylmercury				X
Tetraethyl lead				X
Tributyltin	X (b)			
Metals				
Antimony	X		X	X
Arsenic	X		X	X
Arsenic, inorganic				X
Barium	X	X	X	X
Beryllium	X			X
Cadmium	X	X	X	X
Chromium			X	X
Cobalt	X			X
Copper	X		X	X
Iron	X			
Lead	X			X
Manganese				X
Mercury	X	X	X	X
Nickel	X	X	X	X
Selenium	X			X
Silver			X	X
Thallium	X			
Vanadium	X			X
Zinc	X		X	X
Inorganics				
Ammonia	X			
Ammonia (NH3) as Nitrogen (N)	X			
Sulfide	X	X		
Wood Waste				
Volume Fraction Woody Debris	X			
Organic Acids				
12-Chlorodehydroabietic Acid		X		
14-Chlorodehydroabietic Acid		X		
1-Phenanthrenecarboxylic acid, 1,2,3,4,4a,9,10,10a-	X	X		
9,10-Dichlorostearic acid		X		
Abietic Acid	X	X		
Benzoic Acid	X	X		X
Dehydroabietic Acid	X	X		
Dichlorodehydroabietic Acid		X		

Table 4-2 Indicator Hazardous Substances for Port Angeles Harbor Ecological Risk Assessment.

Chemical Name	Matrix			
	Intertidal and Subtidal Sediment	Intertidal Sediment Only	Eel Grass and Bull Kelp	Fish[a] and Shellfish
Isopimaric Acid	X	X		
Linoleic Acid	X	X		
Linolenic Acid		X		
Neoabietic Acid	X	X		
Oleic Acid	X	X		
Oleic-Linolenic Acid Mixture	X	X		
Pimaric Acid		X		
Palustric Acid	X	X		
Sandaracopimaric Acid	X	X		
Guaiacols				
3,4,6-Trichloroguaiacol (Ac)		X		
3,4-Dicloroguaiacol		X		
4,5,6 Trichloroguaiacol		X		
4,5-Dichloroguaiacol		X		
4,6-Dichloroguaiacol		X		
4-Chloroguaiacol		X		
Petroleum				
#2 Diesel	X			
Motor Oil	X	X		

Footnote:
a = For fish, only arsenic, inorganic arsenic, chromium, copper, mercury, selenium, methylmercury, LPAHs, HPAHs, PCBs, and dioxins/furans were identified as IHSs. For shellfish, all chemicals in this column are IHSs.
b = Included based on log Kow > 3.5. Maximum sediment concentration did not exceed sediment benchmark.

Key:
BHC = benzene hexachloride
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPC = exposure point concentration
PCDD = polychlorinated dibenzo-p-dioxins
PCDF = polychlorinated dibenzo-p-furans

Table 4-3 Assessment Endpoints, Measures, and Data Sources for the Ecological Risk Assessment for the Port Angeles Harbor Marine Environment

Assessment Endpoint[a]	Representative Species	Measure	Data Needs	Data Sources
Marine plants and macroalgae	Eelgrass, kelp	Sediment habitat quality.	Wood-waste distribution in sediment.	SAIC (1999). Additional data collected as part of 2008 harbor-wide study.
Benthos	Clams, polychaetes, crabs	Sediment chemical concentrations compared with marine sediment standards and benchmarks.	Results for site-related chemicals in sediment.	Historic data available (see Section 2.5). Additional data collected as part of 2008 harbor-wide study.
		Sediment bioassay results.	Sediment bioassays results.	Fifty five (55) samples tested as part of 2008 harbor-wide study. Some historic data available in limited area around Rayonier site
		Sediment habitat quality.	Wood-waste distribution in sediment.	As above for marine vegetation and macroalgae.
Fish	Rock sole, lingcod	Fish-tissue chemical concentrations compared with tissue standards and benchmarks.	Results for site-related chemicals in fish (whole body).	Lingcod collected in 2008 and rock sole from Malcolm Pirnie (2006).
Carnivorous birds	Bald eagle, cormorant	HQ method based on measured concentration of site-related chemicals in sediment and fish.	Results for site-related chemicals in sediment and fish (whole body).	Historic and 2008 data for chemicals in sediment and fish.
Omnivorous birds	Greater scaup	HQ method based on measured concentration of site-related chemicals in sediment, marine vegetation, and marine invertebrates.	Results for site-related chemicals in sediment, marine vegetation, and invertebrates (whole body).	Historic and 2008 data for chemicals in sediment and marine invertebrates. 2008 data for chemicals in kelp and eel grass.
Herbivorous birds	Brant	HQ method based on measured concentration of site-related chemicals in sediment and marine vegetation.	Results for site-related chemicals in sediment and marine vegetation.	Historic and 2008 data for chemicals in sediment. 2008 data for kelp and eel grass.
Carnivorous mammals	Harbor seal	HQ method based on measured concentration of site-related chemicals in sediment, marine fish, and marine invertebrates.	Results for site-related chemicals in sediment, fish (whole body), and marine invertebrates (whole body).	Historic and 2008 data for chemicals in sediment, marine invertebrates, and fish.

Table 4-3 Assessment Endpoints, Measures, and Data Sources for the Ecological Risk Assessment for the Port Angeles Harbor Marine Environment

Assessment Endpoint[a]	Representative Species	Measure	Data Needs	Data Sources
Omnivorous mammals	Raccoon	HQ method based on measured concentration of site-related chemicals in sediment, marine fish, and marine invertebrates.	Results for site-related chemicals in sediment, fish (whole body), and marine invertebrates (whole body).	Historic and 2008 data for chemicals in sediment, marine invertebrates, and fish.

Note:
[a] Sustainability (growth, survival, and reproduction) of listed communities and wildlife populations in Port Angeles Harbor.

Key:
HQ = hazard quotient.

Table 4-4 Summary of Results for Surface Sediment Samples from Port Angeles Harbor that Exceeded Washington State Sediment Management Standards.

Station[1]	Chemical	Result (mg/kg)	% TOC	TOC-Normalized Result (mg/kg OC)	SQS		Exceeds or Equals SQS	CSL		Exceeds or Equals CSL	LAET (mg/kg)	Exceeds or Equals LAET
					Value	Units		Value	Units			
ED04A	4-Methylphenol	410	5.13	na	0.67	mg/kg	TRUE	0.67	mg/kg	TRUE	670	TRUE
IE09A	Mercury	1.2	3.33	na	0.41	mg/kg	TRUE	0.59	mg/kg	TRUE	0.41	TRUE
	Zinc	860	3.33	na	410	mg/kg	TRUE	960	mg/kg	FALSE	410	TRUE
IE13A	Mercury	1.9	8.29	na	0.41	mg/kg	TRUE	0.59	mg/kg	TRUE	0.41	TRUE
	Zinc	610	8.29	na	410	mg/kg	TRUE	960	mg/kg	FALSE	410	TRUE
IE16A	Mercury	1.3	4.9	na	0.41	mg/kg	TRUE	0.59	mg/kg	TRUE	0.41	TRUE
IH01A	Cadmium	7.4	17.2	na	5.1	mg/kg	TRUE	6.7	mg/kg	TRUE	5.1	TRUE
	Mercury	3.5	17.2	na	0.41	mg/kg	TRUE	0.59	mg/kg	TRUE	0.41	TRUE
	Zinc	1600	17.2	na	410	mg/kg	TRUE	960	mg/kg	TRUE	410	TRUE
IH02A	Arsenic	69	25.4	na	57	mg/kg	TRUE	93	mg/kg	FALSE	57	TRUE
	Mercury	1.3	25.4	na	0.41	mg/kg	TRUE	0.59	mg/kg	TRUE	0.41	TRUE
	Zinc	460	25.4	na	410	mg/kg	TRUE	960	mg/kg	FALSE	410	TRUE
LA01A	Cadmium	5.9	11.7	na	5.1	mg/kg	TRUE	6.7	mg/kg	FALSE	5.1	TRUE
	Mercury	0.45	11.7	na	0.41	mg/kg	TRUE	0.59	mg/kg	FALSE	0.41	TRUE
LA02A	Mercury	0.59	10.3	na	0.41	mg/kg	TRUE	0.59	mg/kg	TRUE	0.41	TRUE
LA03A	Butylbenzylphthalate	0.073	9.17	0.80	4.9	mg/kg OC	FALSE	64	mg/kg OC	FALSE	63	TRUE
	Mercury	0.59	9.17	na	0.41	mg/kg	TRUE	0.59	mg/kg	TRUE	0.41	TRUE
MA01A	bis(2-Ethylhexyl)phthalate	0.56	1.13	49.6	47	mg/kg OC	TRUE	78	mg/kg OC	FALSE	1300	FALSE
MA03A	Phenol	0.61	2.38	na	0.42	mg/kg	TRUE	1.2	mg/kg	FALSE	420	TRUE
MA04A	Butylbenzylphthalate	0.67	8.49	7.9	4.9	mg/kg OC	TRUE	64	mg/kg OC	FALSE	63	TRUE
	Phenol	0.74	8.49	na	0.42	mg/kg	TRUE	1.2	mg/kg	FALSE	420	TRUE
MD04A	Phenol	0.76	2.16	na	0.42	mg/kg	TRUE	1.2	mg/kg	FALSE	420	TRUE

Table 4-4 Summary of Results for Surface Sediment Samples from Port Angeles Harbor that Exceeded Washington State Sediment Management Standards.

Station[1]	Chemical	Result (mg/kg)	% TOC	TOC-Normalized Result (mg/kg OC)	SQS		Exceeds or Equals SQS	CSL		Exceeds or Equals CSL	LAET (mg/kg)	Exceeds or Equals LAET
					Value	Units		Value	Units			

Note: [1]Stations with exceedences based on undetected (U-qualified) results are not included.

Key:

CSL = cleanup screening level
LAET = lowest apparent effect threshold
mg/kg = milligrams per kilogram
mg/kg OC = milligrams per kilogram organic carbon
na = na applicable
SQS =sediment quality standard
TOC = total organic carbon
TRUE = exceeds standard

Table 4-5 Summary of Results of Sediment Bioassay Failures for 68 Samples from 59 Stations in Port Angeles Harbor.

Sample	Percent Fines	TOC (%)	*E. estuarius* (amphipod)		*N. arenaceodentata* (polychaete)			*D. excentricus* (larvae)	
			Reference Station (Batch Number) for Comparison	Mean Mortality (%)	Reference Station (Batch Number) for Comparison	Mean Mortality (%)	MIG (mg/ind/day)	Reference Station (Batch Number) for Comparison	Mean Normal Survivorship (%) Control Adjusted
Port Angeles Harbor Stations									
BA01A	71.5	2.04	--	--	--	--	--	RF03A (1)	36.6
BL01A	57.2	5.03	--	--	--	--	--	RF03A (2)	44.5
BL03A	71.1	2.51	--	--	--	--	--	RF03A (2)	56.4
BL04A	5.6	0.64	--	--	--	--	--	RF02A (2)	68
BL06A	62.3	1.89	--	--	--	--	--	RF03A (1)	39
ED04A	76.7	5.13	RF03A (3)	100	--	--	--	RF03A (3)	21.4
EH02A	9.7	0.62	--	--	--	--	--	RF02A (1)	74.4
FP01A	10.3	1.03	--	--	--	--	--	RF02A (1)	73.6
IE03A	65.5	6.48	--	--	--	--	--	RF03A (1)	57
IE04A	67.9	4.81	--	--	--	--	--	RF03A (1)	53.4
IE06A	42.6	33.2	--	--	--	--	--	RF03A (1)	47.2
IE07A UV	17.9	15.4	--	--	--	--	--	RF02A (4)	69
IE09A	66.5	3.33	--	--	--	--	--	RF03A (2)	55.9
IE14A	78.2	2.79	--	--	--	--	--	RF03A (1)	42.4
IE15A	74.7	2.48	--	--	--	--	--	RF03A (1)	45
IH02A	62	25	--	--	--	--	--	RF03A (2)	57.2
IH03A	42.9	11.7	--	--	--	--	--	RF03A (2)	58.3
IH06A	45.9	2.09	--	--	--	--	--	RF03A (2)	64.1
KP01A	70.7	4.21	--	--	--	--	--	RF03A (2)	61.4
KP02A	61.4	5.31	--	--	--	--	--	RF03A (2)	63.2
KP05A	70.9	1.09	--	--	--	--	--	RF03A (1)	52.2
KP06A	61.4	1.72	--	--	--	--	--	RF03A (1)	58.4
LA02A UV	69.7	10.3	--	--	--	--	--	RF03A (4)	29.5
MA01A	23.9	1.13	--	--	--	--	--	RF02A (2)	73.5

Table 4-5 Summary of Results of Sediment Bioassay Failures for 68 Samples from 59 Stations in Port Angeles Harbor.

Sample	Percent Fines	TOC (%)	*E. estuarius* (amphipod)		*N. arenaceodentata* (polychaete)			*D. excentricus* (larvae)	
			Reference Station (Batch Number) for Comparison	Mean Mortality (%)	Reference Station (Batch Number) for Comparison	Mean Mortality (%)	MIG (mg/ind/day)	Reference Station (Batch Number) for Comparison	Mean Normal Survivorship (%) Control Adjusted
MA02A	74.1	4.02	--	--	RF03A (1)	--	0.38	RF03A (1)	46.5
MA05A	73.5	2.46	--	--	--	--	--	RF03A (1)	55.5
MA06A	66.7	1.36	--	--	--	--	--	RF03A (1)	37.3
MD02A	69.6	3.62	--	--	--	--	--	RF03A (3)	36.3
MD03A	67.2	1.24	--	--	--	--	--	RF03A (3)	48
Reference Stations									
REF01A (1)	1.3	0.213	--	6	--	0	0.68	--	90.9
REF01A(2)	2.3	1.213	--	5	--	0	0.65	--	90
REF01A (3)	3.3	2.213	--	6	--	0	0.75	--	83.5
REF01A (4)	4.3	3.213	--	5	--	NA	NA	--	99.5
REF02A (1)	2.2	0.403	--	6	--	4	0.71	--	88.9
REF02A (2)	3.2	1.403	--	2	--	0	0.43	--	88
REF02A (3)	4.2	2.403	--	10	--	0	0.78	--	87.4
REF02A (4)	5.2	3.403	--	4	--	NA	NA	--	95.9
REF03A (1)	73.7	1.42	--	11	--	16	0.56	--	72.8
REF03A (2)	74.7	2.42	--	11	--	0	0.48	--	80.3
REF03A (3)	75.7	3.42	--	23	--	4	0.68	--	66.5
REF03A (4)	76.7	4.42	--	12	--	NA	NA	--	87.8

Table 4-5 Summary of Results of Sediment Bioassay Failures for 68 Samples from 59 Stations in Port Angeles Harbor.

Sample	Percent Fines	TOC (%)	*E. estuarius* (amphipod)		*N. arenaceodentata* (polychaete)			*D. excentricus* (larvae)	
			Reference Station (Batch Number) for Comparison	Mean Mortality (%)	Reference Station (Batch Number) for Comparison	Mean Mortality (%)	MIG (mg/ind/day)	Reference Station (Batch Number) for Comparison	Mean Normal Survivorship (%) Control Adjusted

Key:

-- (double dash)	= no SQS or CSL failure
mg/ind/day	= milligrams per Individual per day
MIG	= Mean Individual Growth
NA	= Not Analyzed.
TOC	= total organic carbon
value	= SQS exceedence
value	= CLS exceedence

Table 4-6 Maximum Whole-Body Fish Concentrations Compared with Critical Tissue RBCs for Effects on Fish.

Analyte	EPC Lingcod[a] (mg/kg)	EPC Rock Sole[b] (mg/kg)	RBC (mg/kg)	Critical Effect	RBC Source
Polychlorinated Biphenyls (PCBs)					
Sum of Aroclors (ND=0)	2.7E-02	0.0	3.7	NOAEL for growth.	Windward (2004).
Sum of Aroclors (ND=0.5)	3.8E-02	2.85E-03	3.7	NOAEL for growth.	Windward (2004).
Polycyclic Aromatic Hydrocarbons (PAHs)					
LPAHs (ND = 0)	5.2E-04	1.04E-03	na	na	na
LPAHs (ND = 0.5)	1.3E-01	1.39E-03	na	na	na
HPAHs (ND = 0)	6.1E-04	3.90E-04	na	na	na
HPAHs (ND = 0.5)	7.3E-04	1.23E-03	na	na	na
Dioxins/furans					
2,3,7,8-TCDD TEQ (ND = 0)[c]	1.61E-07	4.91E-10	7.20E-05	NOAEL for growth.	Windward (2004).
2,3,7,8-TCDD TEQ (ND = 0.5)[c]	2.11E-07	1.93E-06	7.20E-05	NOAEL for growth.	Windward (2004).
Organometals					
Methyl Mercury	na	5.00E-02	0.2	NOAEL for survival.	Windward (2004).
Metals					
Arsenic	0.59	2.8	1.7	5th %tile literature[d]	Dyer et al. 2000.
Arsenic, inorganic	na	0.013	1.7	"	"
Chromium	0.33	na	0.69	"	"
Copper	0.63	0.24	3.1	"	"
Mercury	0.22	na	0.46	"	"
Selenium	na	0.40	1.1	"	"

Table 4-6 Maximum Whole-Body Fish Concentrations Compared with Critical Tissue RBCs for Effects on Fish.

Key:

Black fill = HQ >1

HPAH = high molecular weight PAHs

mg/kg = milligrams per kilogram

na = not available or not applicable

ND=0 = non-detects set equal to zero

ND=0.5 = non-detects set equal to one-half detection limit

NOAEL = no observed adverse effect level

RBC = risk-based concentration

TCDD = tetrachlorodibenzo-p-dioxin

TEF = toxic equivalency factor

TEQ = toxic equivalent

Footnotes:

a = Maximum detected concentration or one-half maximum non-detected concentration from Table E-10.

b = Maximum detected concentration or one-half maximum non-detected concentration from Table E-11.

c = EPCs calculated using TEFs for fish from Van den Berg et al. (1998).

d = Corresponds to literature based fifth percentile of effects residues, calculated from all single chemical laboratory tests focusing on community and population level effects such as mortality, growth, reproduction, behavior, and morphology (Dyer et al. 2000).

Table 4-7 Exposure Parameters for Wildlife Receptor Species, Port Angeles Harbor Marine Environment Ecological Risk Assessment.

	Diet Composition			Spatial and Temporal Factors			Ingestion Rates				
							Food			Sediment	
Species	Marine Plants and/or Macroalgae	Shellfish	Fish	Site Use Factor	Exposure Duration	Body Weight (kg)	Food Ingestion (kg/d) wet [g]	Percent Moisture in Diet [h]	Food Ingestion (kg/d) dry [i]	Percent Sed. in Diet (dry)	Sediment Ingestion (kg/d) dry [j]
Herbivores											
Brant[a]	100%			1.0	0.25	1.23	0.55	88%	0.067	8.2%	0.0055
Carnivores											
Bald Eagle[b]			100%	1.0	1.0	5.35	0.54	68%	0.173	2%	0.0035
Double-Crested Cormorant[c]		5%	95%	1.0	1.0	1.54	0.24	68%	0.077	2%	0.0015
Harbor Seal[d]			100%	1.0	1.0	77.5	2.43	68%	0.78	2%	0.016
Omnivores											
Greater Scaup[e]	10%	90%		1.0	0.67	0.96	0.26	78%	0.057	3.3%	0.0019
Raccoon[f]		90%	10%	1.0	1.0	5.8	0.91	68%	0.29	9.4%	0.027

Footnotes:

a - Diet from USEPA (1993) for Canada goose. Body weight from Dunning (1993). Food ingestion (dry) calculated from allometric equation for all birds from USEPA (1993). Percent sediment in diet based on Beyer et al. (1994) for Canada goose. Exposure duration (i.e. fraction of year at site) from Wahl (1995). Home range size varies based on food availability (USEPA 1993). Site use factor of 1.0 assumes that food resources in Port Angeles Harbor are adequate to support this species during the time of year (mid-Feb. to mid-May) it is likely to be present.

b - Diet conservatively assumed to consist entirely of fish from Port Angeles Harbor. Body weight from Dunning (1993). Food ingestion (dry) calculated from allometric equation for all birds from USEPA (1993). Two percent sediment in diet conservatively assumed. Site use factor of 1.0 assumed based in average territory length of 3.5 km for bald eagle pairs in San Juan Islands, WA (USEPA 1993).

c - Diet based on discussion in Kaufman (1996) indicating that this species eats primarily fish but also consumes shrimp, crabs, mollusks, and other aquatic life. Body weight from Dunning (1993). Food ingestion (dry) calculated from allometric equation for all birds from USEPA (1993). Two percent sediment in diet conservatively assumed. Site use factor of 1.0 assumes that food resources in Port Angeles Harbor are adequate to support this species.

d - Diet based on USEPA (1993) for Washington State coastal island. Body weight from USEPA (1993). Food ingestion (wet) calculated from allometric equation for free-living harbor seals from USEPA (1993). Two percent sediment in diet conservatively assumed. Site use factor of 1.0 assumed based on discussion in USEPA (1993) indicating that harbor seals are considered fairly sedentary, with individuals showing year-round site fidelity.

e - Diet based on discussion in Kaufman (1996) indicating that this species consumes mainly invertebrates in winter but also some plant material. Body weigh from Dunning (1993). Food ingestion (dry) calculated from allometric equation for all birds from USEPA (1993). Percent sediment in diet based on Beyer et al. (1994) for mallard. Exposure duration from Wahl (1995). Site use factor of 1.0 assumes that food resources at the site are adequate to support this species during the time of year (late Sept. to mid-May) it is likely to be present at Port Angeles Harbor.

Table 4-7 Exposure Parameters for Wildlife Receptor Species, Port Angeles Harbor Marine Environment Ecological Risk Assessment.

f - Diet from USEPA (1993) for Washington State tidewater/mudflats. Body weigh from USEPA (1993). Food ingestion (dry) calculated from allometric equation for all mammals from USEPA (1993). Percent sediment in diet based on Beyer et al. (1994). Site use factor of 1.0 assumes that food resources in the intertidal zone of Port Angeles Harbor are adequately plentiful to support this species.

g - Wet food ingestion rate was used to estimate dietary exposure because tissue chemical concentrations were reported on a wet-weight basis.

h - Food moisture assumptions of 68%, 78%, and 88% for carnivores, omnivores, and herbivores, respectively from USEPA (1999, Table 5-1, footnote e).

i - Dry food ingestion rate (IR-dry) calculated from wet food ingestion rate (IR-wet) and food moisture content using the following equation: IR-dry = IR-wet x (1-food moisture content fraction).

j - Calculated from dry food ingestion rate and % sediment in diet. Dry sediment ingestion rate was used to estimate exposure from incidental sediment ingestion because sediment chemical concentrations were reported on a dry-weight basis.

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale
INTERTIDAL SEDIMENT									
Polychlorinated Biphenyl (PCB)									
Sum of Aroclors, ND=0	mg/kg	26	5	0.230	0.096	0.12	0.12	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Sum of Aroclors, ND=0.5	mg/kg	26	5	0.232	0.097	0.13	0.13	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Dioxin-like PCB congener TEQ, ND=0	mg/kg	na	na	na	na	na	na	na	na
Dioxin-like PCB congener TEQ, ND=0.5	mg/kg	na	na	na	na	na	na	na	na
Dioxin-like PCB congener TEQ, ND=0 (avian)	mg/kg	na	na	na	na	na	na	na	na
Dioxin-like PCB congener TEQ, ND=0.5 (avian)	mg/kg	na	na	na	na	na	na	na	na
Polycyclic Aromatic Hydrocarbons (PAHs)									
LPAHs ND=0	mg/kg	27	13	0.40	0.09	0.23	0.23	99% KM (Chebyshev) UCL	ProUCL recommendation
LPAHs ND=0.5	mg/kg	27	13	0.40	0.10	0.091	0.091	95% KM (% Bootstrap) UCL	ProUCL recommendation
HPAHs ND=0	mg/kg	29	15	1.18	0.20	0.20	0.20	95% KM (t) UCL	ProUCL recommendation

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale
HPAHs ND=0.5	mg/kg	29	15	1.18	0.22	0.22	0.22	95% KM (% Bootstrap) UCL	ProUCL recommendation
Pesticides									
4,4'-DDD	mg/kg	26	10	2.7E-02	5.4E-03	9.8E-03	9.8E-03	97.5% KM (Chebyshev) UCL	ProUCL recommendation
4,4'-DDE	mg/kg	26	7	5.8E-03	1.7E-03	1.1E-03	1.1E-03	95% KM (t) UCL	ProUCL recommendation
4,4'-DDT	mg/kg	26	9	1.7E-02	4.4E-03	6.9E-03	6.9E-03	97.5% KM (Chebyshev) UCL	ProUCL recommendation
Alpha-BHC	mg/kg	26	7	7.7E-04	5.1E-04	5.3E-04	5.3E-04	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Beta-BHC	mg/kg	26	12	4.5E-03	4.8E-04	8.30E-04	8.30E-04	95% KM (% Bootstrap) UCL	ProUCL recommendation
Delta-BHC	mg/kg	26	11	2.8E-03	5.2E-04	5.9E-04	5.9E-04	95% KM (t) UCL	ProUCL recommendation
Dieldrin	mg/kg	21	6	1.2E-03	6.7E-04	6.76E-04	6.76E-04	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Endosulfan I	mg/kg	21	3	5.1E-04	2.7E-04	5.10E-04	5.10E-04	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Endosulfan II	mg/kg	21	7	1.6E-03	4.2E-04	5.30E-04	5.30E-04	95% KM (% Bootstrap) UCL	ProUCL recommendation

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale
Endosulfan Sulfate	mg/kg	21	5	1.5E-03	6.5E-04	5.86E-04	5.86E-04	95% KM (% Bootstrap) UCL	ProUCL recommendation
Endrin	mg/kg	21	5	1.8E-03	8.0E-04	7.08E-04	7.08E-04	95% KM (% Bootstrap) UCL	ProUCL recommendation
Endrin Aldehyde	mg/kg	21	10	1.1E-03	5.5E-04	5.1E-04	5.1E-04	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Endrin Ketone	mg/kg	21	5	1.1E-03	4.9E-04	4.1E-04	4.1E-04	95% KM (t) UCL	ProUCL recommendation
gamma-Chlordane	mg/kg	21	8	6.0E-04	3.5E-04	3.1E-06	3.1E-06	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Heptachlor	mg/kg	21	7	5.8E-04	3.5E-04	3.36E-04	3.36E-04	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Heptachlor Epoxide	mg/kg	21	11	1.8E-03	4.5E-04	7.20E-04	7.20E-04	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Lindane	mg/kg	26	9	2.2E-03	6.4E-04	4.8E-04	4.8E-04	95% KM (t) UCL	ProUCL recommendation
Methoxychlor	mg/kg	21	4	5.7E-03	2.7E-03	2.1E-03	2.1E-03	95% KM (t) UCL	ProUCL recommendation
Toxaphene	mg/kg	21	3	4.3E-02	2.3E-02	4.3E-02	4.3E-02	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale
Semivolatile Organic Compounds (SVOCs)									
Bis(2-ethylhexyl)phthalate	mg/kg	27	9	0.13	0.040	0.030	0.030	95% KM (t) UCL	ProUCL recommendation
Butyl benzyl phthalate	mg/kg	29	2	0.073	0.046	0.025	0.025	95% KM (t) UCL	ProUCL recommendation
Hexachlorobenzene	mg/kg	29	1	0.019	0.019	0.019	0.019	Maximum Detected Conc.	Only 1 detected value.
p-Cresol	mg/kg	27	6	0.370	0.100	0.068	0.068	95% KM (BCA) UCL	ProUCL recommendation
Pentachlorophenol	mg/kg	29	2	0.097	0.057	0.097	0.097	Maximum Detected Conc.	No UCL Stats recommended.
Phenol	mg/kg	27	9	0.110	0.038	0.031	0.031	95% KM (t) UCL	ProUCL recommendation
Pyridine	mg/kg	5	0	None	None	None	0.029	One-half of max. detection limit	No detected values
Retene	mg/kg	24	6	0.200	0.074	0.052	0.052	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Dioxins/furans									
2,3,7,8-TCDD TEQs; ND=0	mg/kg	27	27	6.2E-05	9.9E-06	2.10E-05	2.10E-05	97.5% KM (Chebyshev) UCL	ProUCL recommendation
2,3,7,8-TCDD TEQs; ND=0.5	mg/kg	27	27	6.2E-05	9.9E-06	1.60E-05	1.60E-05	95% KM (Chebyshev) UCL	ProUCL recommendation
2,3,7,8-TCDD TEQs; ND=0 (avian)	mg/kg	27	27	6.2E-05	6.3E-06	3.60E-05	3.60E-05	99% Chebyshev (mean, sd) UCL	ProUCL recommendation

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale
2,3,7,8-TCDD TEQs; ND=0.5 (avian)	mg/kg	27	27	6.2E-05	6.3E-06	1.90E-05	1.90E-05	95% Chebyshev (mean, sd) UCL	ProUCL recommendation
Organometals									
Methylmercury	mg/kg	na	na	na	na	na	na	na	na
Tetraethyl lead	mg/kg	na	na	na	na	na	na	na	na
Metals									
Antimony	mg/kg	21	10	0.59	0.24	0.22	0.22	95% KM (t) UCL	ProUCL recommendation
Arsenic	mg/kg	26	26	9.9	3.1	4.6	4.6	95% KM (Chebyshev) UCL	ProUCL recommendation
Arsenic, inorganic	mg/kg	na	na	na	na	na	na	na	na
Barium	mg/kg	21	21	53.0	12.2	16.7	16.7	95% KM (BCA) UCL	ProUCL recommendation
Beryllium	mg/kg	na	na	na	na	na	na	na	na
Cadmium	mg/kg	26	18	5.9	0.57	0.79	0.79	95% KM (BCA) UCL	ProUCL recommendation
Chromium	mg/kg	21	21	40	23.4	26.0	26.0	95% KM (t) UCL	ProUCL recommendation
Cobalt	mg/kg	na	na	na	na	na	na	na	na
Copper	mg/kg	26	26	61.0	23.7	27.7	27.7	95% KM (BCA) UCL	ProUCL recommendation
Lead	mg/kg	26	26	84.5	14.6	47.0	47.0	97.5% KM (Chebyshev) UCL	ProUCL recommendation
Manganese	mg/kg	na	na	na	na	na	na	na	na
Mercury	mg/kg	28	23	0.59	0.11	0.29	0.29	97.5% KM (Chebyshev) UCL	ProUCL recommendation

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale
Nickel	mg/kg	21	21	62	28.4	32.5	32.5	95% KM (BCA) UCL	ProUCL recommendation
Selenium	mg/kg	5	3	0.60	0.50	0.6	0.6	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Silver	mg/kg	21	21	0.18	0.05	0.06	0.06	95% KM (BCA) UCL	ProUCL recommendation
Vanadium	mg/kg	na	na	na	na	na	na	na	na
Zinc	mg/kg	26	26	320	47	96	96	95% KM (Chebyshev) UCL	ProUCL recommendation
INTERTIDAL AND SUBTIDAL SEDIMENT									
Polychlorinated Biphenyl (PCB)									
Sum of Aroclors, ND=0	mg/kg	277	97	0.640	0.086	0.039	0.039	95% KM (t) UCL	ProUCL recommendation
Sum of Aroclors, ND=0.5	mg/kg	277	97	0.641	0.100	0.047	0.047	95% KM (t) UCL	ProUCL recommendation
Dioxin-like PCB congener TEQ, ND=0	mg/kg	na	na	na	na	na	na	na	na
Dioxin-like PCB congener TEQ, ND=0.5	mg/kg	na	na	na	na	na	na	na	na
Dioxin-like PCB congener TEQ, ND=0 (avian)	mg/kg	na	na	na	na	na	na	na	na
Dioxin-like PCB congener TEQ, ND=0.5 (avian)	mg/kg	na	na	na	na	na	na	na	na

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale
Polycyclic Aromatic Hydrocarbons (PAHs)									
HPAHs ND=0	mg/kg	300	157	28.36	1.56	1.07	1.07	95% KM (t) UCL	ProUCL recommendation
HPAHs ND=0.5	mg/kg	300	157	28.36	1.57	1.09	1.09	95% KM (BCA) UCL	ProUCL recommendation
LPAHs ND=0	mg/kg	291	163	25.71	0.74	1.10	1.10	97.5% KM (Chebyshev) UCL	ProUCL recommendation
LPAHs ND=0.5	mg/kg	291	163	25.71	0.75	0.90	0.90	95% KM (Chebyshev) UCL	ProUCL recommendation
Semivolatile Organic Compounds (SVOCs)									
9H-Carbazole	mg/kg	na	na	na	na	na	na	na	na
Bis(2-ethylhexyl)phthalate	mg/kg	196	94	2.8	0.093533	0.077689	0.077689	95% KM (% Bootstrap) UCL	ProUCL recommendation
Butyl benzyl phthalate	mg/kg	212	17	0.670	0.073	0.026	0.026	95% KM (% Bootstrap) UCL	ProUCL recommendation
Dibenzofuran	mg/kg	263	115	2.70	0.076	0.058	0.058	95% KM (BCA) UCL	ProUCL recommendation
Dibutylphthalate	mg/kg	210	20	0.04	0.020	0.010	0.010	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Hexachlorobenzene	mg/kg	198	2	0.020	0.020	0.020	0.020	95% KM (% Bootstrap) UCL	ProUCL recommendation
p-Cresol	mg/kg	276	150	41	0.425	0.885	0.885	95% KM (Chebyshev) UCL	ProUCL recommendation

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale
Pentachlorophenol	mg/kg	220	4	0.098	0.064	0.097	0.097	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Phenol	mg/kg	272	134	0.760	0.085	0.061	0.061	95% KM (% Bootstrap) UCL	ProUCL recommendation
Pyridine	mg/kg	55	1	0.0042	na	na	0.0042	Maximum Detected Conc.	Only 1 detected value.
Retene	mg/kg	233	141	630.000	5.960	20.680	20.680	97.5% KM (Chebyshev) UCL	ProUCL recommendation
Pesticides									
4,4'-DDD	mg/kg	191	61	6.5E-02	5.0E-03	2.6E-03	2.6E-03	95% KM (BCA) UCL	ProUCL recommendation
4,4'-DDE	mg/kg	126	35	1.4E-02	2.1E-03	1.0E-03	1.0E-03	95% KM (t) UCL	ProUCL recommendation
4,4'-DDT	mg/kg	124	57	1.1E-01	6.1E-03	4.2E-03	4.2E-03	95% KM (t) UCL	ProUCL recommendation
Alpha-BHC	mg/kg	125	28	1.8E-03	6.4E-04	2.8E-04	2.8E-04	95% KM (t) UCL	ProUCL recommendation
Beta-BHC	mg/kg	126	36	4.0E-02	2.1E-03	1.5E-03	1.5E-03	95% KM (BCA) UCL	ProUCL recommendation
cis-Chlordane	mg/kg	73	29	2.2E-02	1.5E-03	1.3E-03	1.3E-03	95% KM (BCA) UCL	ProUCL recommendation
Delta-BHC	mg/kg	126	19	2.6E-03	5.3E-04	3.2E-04	3.2E-04	95% KM (% Bootstrap) UCL	ProUCL recommendation
Dieldrin	mg/kg	73	10	9.3E-03	2.0E-03	7.2E-04	7.2E-04	95% KM (t) UCL	ProUCL recommendation
Endosulfan I	mg/kg	73	7	2.9E-03	8.1E-04	2.8E-04	2.8E-04	95% KM (t) UCL	ProUCL recommendation

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale
Endosulfan II	mg/kg	73	17	4.9E-03	1.4E-03	7.4E-04	7.4E-04	95% KM (t) UCL	ProUCL recommendation
Endosulfan Sulfate	mg/kg	73	15	1.3E-02	3.2E-03	1.4E-03	1.4E-03	95% KM (t) UCL	ProUCL recommendation
Endrin	mg/kg	73	9	3.6E-03	1.2E-03	6.6E-04	6.6E-04	95% KM (t) UCL	ProUCL recommendation
Endrin Aldehyde	mg/kg	73	17	2.5E-03	7.8E-04	4.8E-04	4.8E-04	95% KM (t) UCL	ProUCL recommendation
Endrin Ketone	mg/kg	73	7	1.1E-03	4.9E-04	3.3E-04	3.3E-04	95% KM (t) UCL	ProUCL recommendation
gamma-Chlordane	mg/kg	73	28	8.5E-03	1.7E-03	1.1E-03	1.1E-03	95% KM (BCA) UCL	ProUCL recommendation
Heptachlor	mg/kg	73	16	1.6E-03	5.8E-04	3.3E-04	3.3E-04	95% KM (t) UCL	ProUCL recommendation
Heptachlor Epoxide	mg/kg	73	32	7.0E-03	1.1E-03	8.2E-04	8.2E-04	95% KM (% Bootstrap) UCL	ProUCL recommendation
Lindane	mg/kg	126	25	8.4E-03	1.3E-03	5.4E-04	5.4E-04	95% KM (t) UCL	ProUCL recommendation
Methoxychlor	mg/kg	73	5	5.7E-03	2.8E-03	2.0E-03	2.0E-03	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Toxaphene	mg/kg	73	3	4.3E-02	2.3E-02	4.3E-02	4.3E-02	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Dioxins/furans									
2,3,7,8-TCDD TEQs; ND=0	mg/kg	271	271	1.21E-04	1.04E-05	1.72E-05	1.72E-05	97.5% KM (Chebyshev) UCL	ProUCL recommendation

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale
2,3,7,8-TCDD TEQs; ND=0.5	mg/kg	271	271	1.49E-04	1.18E-05	2.03E-05	2.03E-05	97.5% KM (Chebyshev) UCL	ProUCL recommendation
Organometals									
Dibutyltin ion	mg/kg	5	1	0.0055	na	na	0.0055	Maximum Detected Conc.	Only 1 detected value.
Methylmercury	mg/kg	na	na	na	na	na	na	na	na
Tetraethyl lead	mg/kg	na	na	na	na	na	na	na	na
Tributyltin + Tributyltin ion	mg/kg	17	9	0.04	na	na	0.04	Maximum Detected Conc.	No UCL calculated.
Metals									
Antimony	mg/kg	236	82	9.9	0.5	0.39	0.39	95% KM (% Bootstrap) UCL	ProUCL recommendation
Arsenic	mg/kg	307	294	69.0	6.2	6.7	6.7	95% KM (BCA) UCL	ProUCL recommendation
Arsenic, inorganic	mg/kg	na	na	na	na	na	na	na	na
Barium	mg/kg	236	236	53.0	23.4	24.5	24.5	95% KM (BCA) UCL	ProUCL recommendation
Beryllium	mg/kg	68	11	2.6	0.67	0.43	0.43	95% KM (% Bootstrap) UCL	ProUCL recommendation
Cadmium	mg/kg	307	287	5610	20.8	134	134	97.5% KM (Chebyshev) UCL	ProUCL recommendation
Chromium	mg/kg	265	265	54.1	27.0	27.9	27.9	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale
Cobalt	mg/kg	68	68	909	34.696	115.82	115.82	95% KM (Chebyshev) UCL	ProUCL recommendation
Copper	mg/kg	307	307	28700	122	308	308	95% KM (BCA) UCL	ProUCL recommendation
Lead	mg/kg	289	289	10500.0	49.2	122.6	122.6	95% KM (BCA) UCL	ProUCL recommendation
Manganese	mg/kg	68	67	420	220	232	232	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Mercury	mg/kg	316	290	8.90	0.22	0.35	0.35	95% KM (Chebyshev) UCL	ProUCL recommendation
Nickel	mg/kg	236	236	62	26.6	27.5	27.5	95% Student's-t UCL	ProUCL recommendation
Selenium	mg/kg	121	52	3.80	0.98	0.77	0.77	95% KM (% Bootstrap) UCL	ProUCL recommendation
Silver	mg/kg	265	204	1.20	0.12	0.13	0.13	95% KM (BCA) UCL	ProUCL recommendation
Thallium	mg/kg	68	30	3.40	1.41	1.19	1.19	95% KM (t) UCL	ProUCL recommendation
Vanadium	mg/kg	68	68	87.5	48.412	51.453	51.453	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
Zinc	mg/kg	308	308	2010	103	127	127	95% KM (BCA) UCL	ProUCL recommendation

Table 4-8 Exposure Point Concentrations for Sediment for Use in Estimating Wildlife Risks from Incidental Sediment Ingestion.

Chemical Name[a]	Units	Number of Observations	Number of Detects	Maximum[b]	Arithmetic Average[b]	UCL[c]	EPC	Statistic	Rationale

Footnotes:

a. Organic acids and guaiacols are not included in this table and subsequent tables because no tissue data or toxicity reference values are available for these chemicals.

b. Maximum and average of detected concentrations.

c. ProUCL was directed to consider non-detects and use all available methods to calculate UCLs.

Key:
BHC = benzene hexachloride
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPC = exposure point concentration
HPAH = high molecular weight PAHs

KM (t) UCL = UCL based on Kaplan-Meier estimate using standard normal distribution cutoff value
KM (Chebyshev) UCL = UCL based on Kaplan-Meier estimate using Chebyshev inequality
KM (BCA) UCL = UCL based on Kaplan-Meier estimate using bias-corrected accelerated bootstrap method cutoff value
LPAH = low molecular weight PAHs
na = not analyzed or not applicable
ND = non-detect
TCDD = tetrachlorodibenzo-p- dioxin
TEQ = toxic equivalent
UCL = upper confidence limit

Table 4-9 Exposure Point Concentration for Bull Kelp and Eel Grass Samples.

Analyte	EPC Bull Kelp[1] (mg/kg)	EPC Eel Grass[2] (mg/kg)	Average EPC[3] (mg/kg)
Sample Size -->	1	1	na
Polychlorinated Biphenyls (PCBs)			
Sum of Aroclors, ND=0	0.00	0.00	0.00
Sum of Aroclors, ND=0.5	0.013	0.013	1.30E-02
Dioxin-like PCB congener TEQ, ND=0 (avian)[4]	8.99E-11	1.48E-08	7.44E-09
Dioxin-like PCB congener TEQ, ND=0.5 (avian)[4]	5.07E-09	2.26E-08	1.38E-08
Polycyclic Aromatic Hydrocarbons (PAHs)			
LPAHs (ND=0)	0.0025	0.0030	0.0028
LPAHs (ND=0.5)	0.0032	0.0040	0.0036
HPAHs (ND=0)	0.0038	0.0054	0.0046
HPAHs (ND=0.5)	0.0039	0.0055	0.0047
Pesticides			
4,4'-DDD	na	na	
4,4'-DDE	na	na	
4,4'-DDT	na	na	
DDT and metabolites	na	na	
Alpha-BHC	na	na	
Beta-BHC	na	na	
Delta-BHC	na	na	
Dieldrin	na	na	
Endosulfan I	na	na	
Endosulfan II	na	na	
Endosulfan Sulfate	na	na	
Endrin	na	na	
Endrin Aldehyde	na	na	
Endrin Ketone	na	na	
gamma-Chlordane	na	na	
Heptachlor	na	na	
Heptachlor Epoxide	na	na	
Lindane	na	na	
Methoxychlor	na	na	
Toxaphene	na	na	

Table 4-9 Exposure Point Concentration for Bull Kelp and Eel Grass Samples.

Analyte	EPC Bull Kelp[1] (mg/kg)	EPC Eel Grass[2] (mg/kg)	Average EPC[3] (mg/kg)
Semivolatile Organic Compounds (SVOCs)			
Bis(2-ethylhexyl)phthalate	0.95	0.95	0.95
Butyl Benzyl Phthalate	0.95	0.95	0.95
Hexachlorobenzene	0.95	0.95	0.95
p-Cresol	0.95	0.95	0.95
Pentachlorophenol	4.80	4.85	4.83
Phenol	0.31	0.95	0.63
Pyridine	na	na	
Retene	na	na	
Dioxins/furans			
2,3,7,8-TCDD (ND=0)	1.20E-09	6.66E-08	3.39E-08
2,3,7,8-TCDD (ND=0.5)	1.02E-07	1.28E-07	1.15E-07
2,3,7,8-TCDD TEQs; ND=0 (avian)[4]	7.46E-10	5.32E-08	2.70E-08
2,3,7,8-TCDD TEQs; ND=0.5 (avian)[4]	2.62E-07	2.10E-07	2.36E-07
Organometals			
Methyl Mercury	na	na	
Tetraethyl Lead	na	na	
Metals			
Antimony	0.0005	0.057	0.029
Arsenic	6.00	0.72	3.36
Arsenic, Inorganic	na	na	
Barium	0.97	1.20	1.09
Beryllium	na	na	
Cadmium	0.18	0.79	0.49
Chromium	0.078	0.32	0.20
Cobalt	na	na	
Copper	0.30	1.00	0.65
Lead	0.05	0.05	0.05
Manganese	na	na	
Mercury	0.011	0.02	0.02
Nickel	0.11	0.75	0.43
Selenium	na	na	
Silver	0.007	0.05	0.03
Vanadium	na	na	
Zinc	2.90	7.60	5.25

Table 4-9 Exposure Point Concentration for Bull Kelp and Eel Grass Samples.

Analyte	EPC Bull Kelp[1] (mg/kg)	EPC Eel Grass[2] (mg/kg)	Average EPC[3] (mg/kg)

Key:
BHC= benezenehexachloroide
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPC = exposure point concentration
HPAH = high molecular weight PAHs
LPAH = low molecular weight PAHs
mg/kg = milligrams per kilogram
na = not available or not applicable
ND=0 = non-detects set equal to zero
ND=0.5 = non-detects set equal to one-half detection limit
TCDD = tetrachlorodibenzo-p-dioxin
TEF = toxic equivalency factor

Footnotes:
1 = Maximum detected concentration or one-half maximum non-detect from Table E-3.
2 = Maximum detected concentration or one-half maximum non-detect from Table E-4.
3 = Average EPC for bull kelp and eel grass
4 = Calculated using avian TEFs from Van den Berg et al. (1998).

Table 4-10 Exposure Point Concentrations for Shellfish Whole-Body Samples.

Analyte	EPC Coonstripe Shrimp[1] (mg/kg)	EPC Dungeness Crab[2] (mg/kg)	EPC Geoduck[3] (mg/kg)	EPC Horse Clam[4] (mg/kg)	Average Shellfis h EPC (mg/kg)
Sample Size -->	3	3 to 11	1 to 7	4 to 27	na
Polychlorinated Biphenyls (PCBs)					
Sum of Aroclors (ND=0)	6.90E-03	2.78E-01	1.03E-02	2.97E-02	8.12E-02
Sum of Aroclors (ND=0.5)	8.80E-03	2.78E-01	1.59E-02	3.07E-02	8.34E-02
Dioxin-like PCB congener TEQ, ND=0	na	1.41E-05	4.61E-08	3.37E-07	4.83E-06
Dioxin-like PCB congener TEQ, ND=0.5	na	1.42E-05	6.11E-08	3.57E-07	4.87E-06
Dioxin-like PCB congener TEQ, ND=0 (avian)[5]	na	1.91E-05	1.30E-07	4.96E-07	6.58E-06
Dioxin-like PCB congener TEQ, ND=0.5 (avian)[5]	na	1.92E-05	1.48E-07	5.35E-07	6.63E-06
Polycyclic Aromatic Hydrocarbons (PAHs)					
LPAHs (ND = 0)	1.46E-02	1.22E-03	2.40E-03	2.01E-01	5.48E-02
LPAHs (ND = 0.5)	1.46E-02	1.69E-03	3.10E-03	2.01E-01	5.51E-02
HPAHs (ND = 0)	4.72E-03	1.42E-03	7.65E-03	2.76E-01	7.24E-02
HPAHs (ND = 0.5)	5.34E-03	2.20E-03	7.73E-03	2.76E-01	7.28E-02
Pesticides					
4,4'-DDD	1.60E-04	2.45E-04	1.60E-04	1.23E-03	4.49E-04
4,4'-DDE	1.65E-04	3.67E-03	1.60E-03	5.00E-04	1.48E-03
4,4'-DDT	1.30E-03	3.10E-02	1.70E-03	3.00E-03	9.25E-03
DDT and metabolites	1.63E-03	3.49E-02	3.46E-03	4.73E-03	1.12E-02
Alpha-BHC	6.40E-04	7.10E-04	3.80E-02	4.66E-04	9.95E-03
Beta-BHC	6.00E-03	7.95E-04	1.50E-02	4.21E-04	5.55E-03
Delta-BHC	1.55E-04	9.55E-04	1.60E-03	1.55E-04	7.16E-04
Dieldrin	na	na	1.05E-04	1.00E-04	1.03E-04
Endosulfan I	na	na	5.50E-05	5.50E-05	5.50E-05
Endosulfan II	na	na	1.25E-04	1.25E-04	1.25E-04
Endosulfan Sulfate	na	na	1.60E-04	1.65E-04	1.63E-04
Endrin	na	na	2.00E-04	2.00E-04	2.00E-04
Endrin Aldehyde	na	na	1.20E-04	1.20E-04	1.20E-04
Endrin Ketone	na	na	1.20E-04	1.20E-04	1.20E-04
gamma-Chlordane	na	na	5.50E-05	4.20E-04	2.38E-04
Heptachlor	na	na	6.50E-05	4.65E-04	2.65E-04
Heptachlor Epoxide	na	na	6.00E-05	6.00E-05	6.00E-05
Lindane	1.00E-04	4.12E-04	4.00E-03	1.33E-03	1.46E-03

Table 4-10 Exposure Point Concentrations for Shellfish Whole-Body Samples.

Analyte	EPC Coonstripe Shrimp[1] (mg/kg)	EPC Dungeness Crab[2] (mg/kg)	EPC Geoduck[3] (mg/kg)	EPC Horse Clam[4] (mg/kg)	Average Shellfish EPC (mg/kg)
Methoxychlor	na	na	6.50E-04	6.50E-04	6.50E-04
Toxaphene	na	na	4.70E-03	4.75E-03	4.73E-03
Semivolatile Organic Compounds (SVOCs)					
Bis(2-ethylhexyl)phthalate	na	na	0.2	1	0.6
Butyl Benzyl Phthalate	na	na	0.25	1	0.62
Hexachlorobenzene	na	na	6.20E-04	1	0.50
p-Cresol	na	na	0.25	1	0.62
Pentachlorophenol	0.05	0.05	1.20	5	1.57
Phenol	na	na	0.08	1	0.54
Pyridine	0.28	0.01	0.41	0.01	0.18
Retene	na	na	na	na	
Dioxins/furans					
2,3,7,8-TCDD TEQ (ND = 0)	1.42E-09	6.40E-06	1.09E-07	1.13E-07	1.66E-06
2,3,7,8-TCDD TEQ (ND = 0.5)	2.43E-07	6.43E-06	1.54E-07	2.48E-07	1.77E-06
2,3,7,8-TCDD TEQs; ND=0 (avian)[5]	4.72E-10	1.51E-06	5.70E-07	1.18E-07	5.50E-07
2,3,7,8-TCDD TEQs; ND=0.5 (avian)[5]	3.26E-07	1.84E-06	5.94E-07	3.70E-07	7.83E-07
Organometals					
Methyl Mercury	3.00E-02	1.30E-01	4.00E-02	1.00E-02	5.25E-02
Tetraethyl Lead	7.00E-03	1.70E-02	9.90E-01	2.00E+00	7.53E-01
Metals					
Antimony	na	na	0.0077	0.019	0.014
Arsenic	8.5	13.0	5.3	9.1	9.0
Arsenic, inorganic	0.01	0.06	1.41	0.78	0.56
Barium	na	na	0.68	1.97	1.32
Beryllium	na	na	0.01	na	0.006
Cadmium	0.04	0.93	0.48	0.26	0.43
Chromium	na	na	0.49	1.45	0.97
Cobalt	na	na	0.55	na	0.55
Copper	5.1	29.0	7.4	1.8	10.8
Lead	na	na	1.05	0.80	0.92
Manganese	na	na	29.9	na	29.9
Mercury	na	na	0.08	0.02	0.05
Nickel	na	na	0.86	1.2	1.05
Selenium	0.10	1.38	0.82	1.00	0.83

Table 4-10 Exposure Point Concentrations for Shellfish Whole-Body Samples.

Analyte	EPC Coonstripe Shrimp[1] (mg/kg)	EPC Dungeness Crab[2] (mg/kg)	EPC Geoduck[3] (mg/kg)	EPC Horse Clam[4] (mg/kg)	Average Shellfish EPC (mg/kg)
Silver	na	na	0.94	0.86	0.90
Vanadium	na	na	1.58	na	1.58
Zinc	12.6	43.6	24.2	9.6	22.5

Key:
BHC= benezenehexachloroide
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPC = exposure point concentration
HPAH = high molecular weight PAHs
LPAH = low molecular weight PAHs
mg/kg = milligrams per kilogram
na = not available or not applicable
ND=0 = non-detects set equal to zero
ND=0.5 = non-detects set equal to one-half detection limit
TCDD = tetrachlorodibenzo-p-dioxin
TEF = toxic equivalency factor

Footnotes:
1 = Maximum detected concentration or one-half maximum non-detected concentration from Table E-5.
2 = EPC determined by ProUCL or maximum concentration used if sample size < 8 (see Table G-1).
3 = Maximum detected concentration or one-half maximum non-detected concentration from Table E-8.
4 = EPC determined by Pro UCL or maximum concentration used if sample size < 9 (see Table G-2).
5 = Calculated using avian TEFs from Van den Berg et a. (1998).

Table 4-11 Exposure Point Concentrations for Fish Whole-Body Samples.

Analyte	EPC Lingcod[1] (mg/kg)	EPC Rock Sole[2] (mg/kg)	Average Fish EPC[3] (mg/kg)
Sample Size -->	2	2 to 3	na
Polychlorinated Biphenyls (PCBs)			
Sum of Aroclors (ND=0)	2.70E-02	0.00	1.35E-02
Sum of Aroclors (ND=0.5)	3.80E-02	2.85E-03	2.04E-02
Dioxin-like PCB congener TEQ, ND=0	6.14E-07	na	6.14E-07
Dioxin-like PCB congener TEQ, ND=0.5	6.96E-07	na	6.96E-07
Dioxin-like PCB congener TEQ, ND=0 (avian)[4]	7.76E-07	na	7.76E-07
Dioxin-like PCB congener TEQ, ND=0.5 (avian)[4]	8.19E-07	na	8.19E-07
Polycyclic Aromatic Hydrocarbons (PAHs)			
LPAHs (ND = 0)	5.16E-04	1.04E-03	7.78E-04
LPAHs (ND = 0.5)	1.30E-03	1.39E-03	1.34E-03
HPAHs (ND = 0)	6.10E-04	3.90E-04	5.00E-04
HPAHs (ND = 0.5)	7.30E-04	1.23E-03	9.80E-04
Pesticides			
4,4'-DDD	na	1.60E-04	1.60E-04
4,4'-DDE	na	1.65E-04	1.65E-04
4,4'-DDT	na	3.90E-04	3.90E-04
DDT and metabolites	na	7.15E-04	7.15E-04
Alpha-BHC	na	1.40E-04	1.40E-04
Beta-BHC	na	1.80E-04	1.80E-04
cis-Chlordane	na	na	
Delta-BHC	na	1.55E-04	1.55E-04
Dieldrin	na	na	
Endosulfan I	na	na	
Endosulfan II	na	na	
Endosulfan Sulfate	na	na	
Endrin	na	na	
Endrin Aldehyde	na	na	
Endrin Ketone	na	na	
gamma-Chlordane	na	na	
Heptachlor	na	na	
Heptachlor Epoxide	na	na	
Lindane	na	1.00E-04	1.00E-04

Table 4-11 Exposure Point Concentrations for Fish Whole-Body Samples.

Analyte	EPC Lingcod[1] (mg/kg)	EPC Rock Sole[2] (mg/kg)	Average Fish EPC[3] (mg/kg)
Methoxychlor	na	na	
Toxaphene	na	na	
Semivolatile Organic Compounds (SVOCs)			
9H-Carbazole	na	na	
Bis(2-ethylhexyl)phthalate	1.0	na	1.0
Butyl Benzyl Phthalate	1.0	na	1.0
Dibenzofuran	1.0	na	1.0
Dibutylphthalate	1.0	na	1.0
Hexachlorobenzene	1.0	na	1.0
p-Cresol	1.0	na	1.0
Pentachlorophenol	4.9	0.0	2.5
Phenol	1.0	na	1.0
Pyridine	na	0.0	0.0
Retene	na	na	
Dioxins/furans			
2,3,7,8-TCDD (ND = 0)	9.72E-08	1.47E-09	4.93E-08
2,3,7,8-TCDD (ND = 0.5)	1.49E-07	3.74E-07	2.61E-07
2,3,7,8-TCDD TEQs; ND=0 (avian)[4]	2.90E-07	4.91E-10	1.45E-07
2,3,7,8-TCDD TEQs; ND=0.5 (avian)[4]	3.55E-07	2.38E-06	1.37E-06
Organometals			
Dibutyltin	na	na	
Methyl Mercury	na	5.00E-02	5.00E-02
Tetraethyl Lead	na	7.00E-03	7.00E-03
Tributyltin	na	na	
Metals			
Antimony	0.00046	na	0.00046
Arsenic	0.59	2.77	1.68
Arsenic, inorganic	na	0.013	0.013
Barium	0.042	na	0.042
Beryllium	na	na	
Cadmium	0.042	0.005	0.023
Chromium	0.33	na	0.33
Cobalt	na	na	
Copper	0.63	0.24	0.44
Lead	0.04	na	0.04

Table 4-11 Exposure Point Concentrations for Fish Whole-Body Samples.

Analyte	EPC Lingcod[1] (mg/kg)	EPC Rock Sole[2] (mg/kg)	Average Fish EPC[3] (mg/kg)
Manganese	na	na	
Mercury	0.22	na	0.22
Nickel	0.096	na	0.096
Selenium	na	0.40	0.40
Silver	0.042	na	0.042
Vanadium	na	na	
Zinc	11	4.7	7.8

Key:

BHC= benezenehexachloroide

DDD = dichlorodiphenyldichloroethane

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyltrichloroethane

EPC = exposure point concentration

HPAH = high molecular weight PAHs

LPAH = low molecular weight PAHs

mg/kg = milligrams per kilogram

na = not available or not applicable

ND=0 = non-detects set equal to zero

ND=0.5 = non-detects set equal to one-half detection limit

TCDD = tetrachlorodibenzo-p-dioxin

Footnotes:

1 = Maximum detected concentration or one-half maximum non-detected concentration from Table E-10.

2 = Maximum detected concentration or one-half maximum non-detected concentration from Table E-11.

3 = Average of EPCs for lingcod and rock sole whole body samples.

4 = Calculated using avian TEFs from Van den Berg et al. (1998).

Table 4-12 Toxicity Reference Values for Birds and Mammals.

Analyte	Wildlife Class	NOAEL (mg/kg-day)	Critical Effect	LOAEL (mg/kg-day)	Critical Effect	Reference and Comments
Polychlorinated Biphenyls (PCBs)						
Total PCBs	Birds	0.18	Reproduction	1.8	Reproduction	Sample et al. (1996) for Aroclor 1254.
	Mammals	0.14	Reproduction	0.69	Reproduction	Sample et al. (1996) for Aroclor 1254 effects on mink.
Dioxin-like PCB congener TEQ	Birds	1.4E-05	Reproduction	1.4E-04	Reproduction	Sample et al. (1996) for 2,3,7,8-TCDD.
	Mammals	1.0E-06	Reproduction	1.0E-05	Reproduction	Sample et al. (1996) for 2,3,7,8-TCDD.
Polycyclic Aromatic Hydrocarbons (PAHs)						
LPAHs	Birds	na	na	na	na	na
	Mammals	65.6	Growth	110	Growth	USEPA (2007e). Highest bounded NOAEL (65.5 mg/kg-d) below the lowest bounded LOAEL (110 mg/kg-d) for reproduction, growth, or survival.
HPAHs	Birds	2	Growth	20	Growth	USEPA (2007e); from Appendix 5.2A for European starling.
	Mammals	0.615	Survival	3.07	Survival	USEPA (2007a). Highest bounded NOAEL (0.615 mg/kg-day) below the lowest bounded LOAEL (3.07 mg/kg-day) for reproduction, growth, or survival.
Pesticides						
DDT and metabolites	Birds	0.227	Growth	0.281	Reproduction	USEPA (2007f). Highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, or survival.
	Mammals	0.147	Reproduction	0.247	Reproduction	
Alpha-BHC	Birds	0.56	Reproduction	2.25	Reproduction	Sample et al. (1996) for BHC mixed isomers.
	Mammals	0.014	Reproduction	0.14	Reproduction	Sample et al. (1996) for BHC mixed isomers.

Table 4-12 Toxicity Reference Values for Birds and Mammals.

Analyte	Wildlife Class	NOAEL (mg/kg-day)	Critical Effect	LOAEL (mg/kg-day)	Critical Effect	Reference and Comments
Beta-BHC	Birds	0.56	Repoduction	2.25	Reproduction	Sample et al. (1996) for BHC mixed isomers.
	Mammals	0.4	Growth	2	Growth	Sample et al. (1996) for Beta-BHC.
Delta-BHC	Birds	0.56	Reproduction	2.25	Reproduction	Sample et al. (1996) for BHC mixed isomers.
	Mammals	0.014	Reproduction	0.14	Reproduction	Sample et al. (1996) for BHC mixed isomers.
Dieldrin	Birds	0.0709	Growth	0.179	Survival	USEPA (2007g). Highest bounded NOAEL below the lowest bounded LOAEL for reproduction, growth, or survival.
	Mammals	0.015	Reproduction	0.03	Reproduction	
Endosulfan I	Birds	10	Reproduction	na	na	Sample et al. (1996) for endosulfan.
	Mammals	0.15	Reproduction	na	na	Sample et al. (1996) for endosulfan.
Endosulfan II	Birds	10	Reproduction	na	na	Sample et al. (1996) for endosulfan.
	Mammals	0.15	Reproduction	na	na	Sample et al. (1996) for endosulfan.
Endosulfan Sulfate	Birds	11.1	Reproduction	na	na	NYSDEC (2002).
	Mammals	0.15	na	na	na	NYSDEC (2002).
Endrin	Birds	0.01	Reproduction	0.1	Reproduction	Sample et al. (1996).
	Mammals	0.092	Reproduction	0.92	Reproduction	Sample at al. (1996).
Endrin Aldehyde	Birds	0.01	Reproduction	0.1	Reproduction	Sample et al. (1996) for endrin.
	Mammals	0.092	Reproduction	0.92	Reproduction	Sample at al. (1996) for endrin.
Endrin Ketone	Birds	0.01	Reproduction	0.1	Reproduction	Sample et al. (1996) for endrin.
	Mammals	0.092	Reproduction	0.92	Reproduction	Sample at al. (1996) for endrin.
gamma-Chlordane	Birds	2.14	Survival	10.7	Survival	Sample et al. (1996) for chlordane.
	Mammals	4.6	Reproduction	9.2	Reproduction	Sample et al. (1996) for chlordane.
Heptachlor	Birds	0.05	na	na	na	NYSDEC (2002).
	Mammals	0.2	Reproduction	1	Reproduction	CH2MHILL (2000).

Table 4-12 Toxicity Reference Values for Birds and Mammals.

Analyte	Wildlife Class	NOAEL (mg/kg-day)	Critical Effect	LOAEL (mg/kg-day)	Critical Effect	Reference and Comments
Heptachlor Epoxide	Birds	0.005	na	na	na	NYSDEC (2002).
	Mammals	0.075	na	na	na	NYSDEC (2002).
Lindane	Birds	5.71	Reproduction	8.57	Reproduction	CH2MHILL (2000).
	Mammals	8	Reproduction	na	na	CH2MHILL (2000).
Methoxychlor	Birds	2	na	na	na	NYSDEC (2002).
	Mammals	4	Reproduction	8	Reproduction	Sample et al. (1996)
Toxaphene	Birds	na	na	na	na	NA
	Mammals	8	Reproduction	na	na	Sample et al. (1996).
Semivolatile Organic Compounds (SVOCs)						
9H-Carbazole	Birds	na	na	na	na	na
	Mammals	na	na	na	na	na
Bis(2-ethylhexyl)phthalate	Birds	1.11	Reproduction	na	na	Sample et al. (1996).
	Mammals	18.33	Reproduction	183.3	Reproduction	Sample et al. (1996).
Butyl Benzyl Phthalate	Birds	na	na	na	na	na
	Mammals	na	na	na	na	na
Dibenzofuran	Birds	na	na	na	na	na
	Mammals	na	na	na	na	na
Dibutylphthalate	Birds	na	na	na	na	na
	Mammals	na	na	na	na	na
Hexachlorobenzene	Birds	0.56	Reproduction	2.25	Reproduction	Sample et al. (1996) for BHC mixed isomers.
	Mammals	0.014	Reproduction	0.14	Reproduction	Sample et al. (1996) for BHC mixed isomers.
p-Cresol	Birds	na	na	na	na	na
	Mammals	219.2	Reproduction	na	na	Sample et al. (1996) for o-cresol.

Table 4-12 Toxicity Reference Values for Birds and Mammals.

Analyte	Wildlife Class	NOAEL (mg/kg-day)	Critical Effect	LOAEL (mg/kg-day)	Critical Effect	Reference and Comments
Pentachlorophenol	Birds	6.73	Reproduction	na	na	USEPA (2007d). Lowest NOAEL for reproduction, growth, or survival.
	Mammals	8.42	Reproduction and Growth	9.45	Reproduction	USEPA (2007h). NOAEL value is geometric mean of 25 NOAELs for reproduction and growth. LOAEL value is lowest LOAEL greater than geometric mean NOAEL.
Phenol	Birds	6	na	na	na	NYSDEC (2002).
	Mammals	523	na	na	na	NYSDEC (2002).
Pyridine	Birds	na	na	na	na	na
	Mammals	na	na	na	na	na
Retene	Birds	na	na	na	na	na
	Mammals	na	na	na	na	na
Dioxins/furans						
2,3,7,8-TCDD	Birds	1.4E-05	Reproduction	1.4E-04	Reproduction	Sample et al. (1996).
	Mammals	1.0E-06	Reproduction	1.0E-05	Reproduction	Sample et al. (1996).

Table 4-12 Toxicity Reference Values for Birds and Mammals.

Analyte	Wildlife Class	NOAEL (mg/kg-day)	Critical Effect	LOAEL (mg/kg-day)	Critical Effect	Reference and Comments
Organometals						
Butyltins	Birds	12.4	Reproduction	31	Reproduction	CH2MHILL (2000).
	Mammals	23.4	Reproduction	35	Reproduction	CH2MHILL (2000).
Methylmercury	Birds	0.068	Reproduction	0.37	Reproduction	CH2MHILL (2000).
	Mammals	0.032	Reproduction	0.16	Reproduction	CH2MHILL (2000).
Tetraethyl Lead	Birds	1.13	Reproduction	11.3	Reproduction	Sample et al. (1996) for lead acetate.
	Mammals	8	Reproduction	80	Reproduction	Sample et al. (1996) for lead acetate.
Metals						
Antimony	Birds	na	na	na	na	na
	Mammals	0.059	Reproduction	0.59	Reproduction	USEPA (2005k). Highest bounded NOAEL (0.059 mg/kg-d) for growth or reproduction below lowest bounded LOAEL (0.59 mg/kg-d) for growth or reproduction from 20 laboratory toxicity studies.
Arsenic	Birds	2.24	Reproduction	3.55	Growth	USEPA(2005d). Lowest NOAEL for growth, reproduction, or survival from nine laboratory toxicity studies. Lowest LOAEL for growth, reproduction, or survival greater than selected NOAEL.
	Mammals	1.04	Growth	1.66	Growth	USEPA (2005d). Highest bounded NOAEL for growth, reproduction, or survival less than lowest bounded LOAEL for growth, reproduction, or survival from 62 laboratory toxicity studies.

Table 4-12 Toxicity Reference Values for Birds and Mammals.

Analyte	Wildlife Class	NOAEL (mg/kg-day)	Critical Effect	LOAEL (mg/kg-day)	Critical Effect	Reference and Comments
Arsenic, inorganic	Birds	2.24	Reproduction	3.55	Growth	USEPA(2005d). Lowest NOAEL for growth, reproduction, or survival from nine laboratory toxicity studies. Lowest LOAEL for growth, reproduction, or survival greater than selected NOAEL.
	Mammals	1.04	Growth	1.66	Growth	USEPA (2005d). Highest bounded NOAEL for growth, reproduction, or survival less than lowest bounded LOAEL for growth, reproduction, or survival from 62 laboratory toxicity studies.
Barium	Birds	20.8	Survival	41.7	Survival	Sample et al. (1996).
	Mammals	51.8	Reproduction, growth, and survival	121	Growth and survival	USEPA (2005e). Geometric mean NOAEL for growth, reproduction, and survival from 12 laboratory toxicity studies. Lowest bounded LOAEL for reproduction, growth, or survival greater than geometric mean NOAEL.
Beryllium	Birds	na	na	na	na	na
	Mammals	0.532	Survival	na	na	USEPA (2005f). Lowest NOAEL for growth, reproduction, or survival from four laboratory toxicity studies.
Cadmium	Birds	1.47	Reproduction, growth, and survival	2.37	Reproduction	USEPA (2005g). Geometric mean NOAEL for growth, reproduction, and survival from 49 laboratory toxicity studies. Lowest bounded LOAEL for growth, reproduction, or survival greater than geometric mean NOAEL.

Table 4-12 Toxicity Reference Values for Birds and Mammals.

Analyte	Wildlife Class	NOAEL (mg/kg-day)	Critical Effect	LOAEL (mg/kg-day)	Critical Effect	Reference and Comments
	Mammals	0.77	Growth	1	Growth	USEPA (2005g). Highest bounded NOAEL (0.77 mg/kg-d) for reproduction, growth, or survival less than the lowest bounded LOAEL (1.0 mg/kg-d) from 141 laboratory toxicity studies.
Chromium	Birds	2.66	Reproduction, growth, and survival	2.78	Survival	USEPA (2008c). Geometric mean NOAEL for growth, reproduction, and survival from 17 laboratory toxicity studies. Lowest bounded LOAEL for reproduction, growth, or survival greater than geometric mean NOAEL.
	Mammals	9.24	Reproduction and growth	na	na	USEPA (2008c). Geometric mean NOAEL for reprodcution and growth from 10 studies with trivalent chromium.
Cobalt	Birds	7.61	Growth	7.8	Growth	USEPA (2005h). Geometric mean NOAEL for growth from 10 toxicity studies. Lowest bounded LOAEL for growth or reproduction greater than geometric mean NOAEL.
	Mammals	7.33	Reproduction and Growth	10.9	Reproduction	USEPA (2005h). Geometric mean NOAEL for reproduction and growth based on 21 laboratory toxicity studies. Lowest bounded LOAEL for growth or reproduction greater than geometric mean NOAEL.

Table 4-12 Toxicity Reference Values for Birds and Mammals.

Analyte	Wildlife Class	NOAEL (mg/kg-day)	Critical Effect	LOAEL (mg/kg-day)	Critical Effect	Reference and Comments
Copper	Birds	4.05	Reproduction	4.68	Growth	USEPA (2007i). Highest bounded NOAEL for reproduction, growth, or survival (4.05 mg/kg-day) lower than the lowest bounded LOAEL for reproduction, growth, or survival (4.68 mg/kg-day).
	Mammals	5.6	Reproduction	6.79	Growth	USEPA (2007i). Highest bounded NOAEL for reproduction, growth, or survival (5.6 mg/kg-day) lower than the lowest bounded LOAEL for reproduction, growth, or survival (6.79 mg/kg-day).
Lead	Birds	1.63	Reproduction	1.94	Reproduction	USEPA (2005i). Highest bounded NOAEL (1.63 mg/kg-d) for growth, reproduction, or survival lower than the lowest bounded LOAEL (1.94 mg/kg-d) for growth, reproduction, or survival based on 57 laboratory toxicity studies.
	Mammals	4.7	Growth	5	Growth	USEPA (2005i). Highest bounded NOAEL (4.7 mg/kg-d) for growth, reproduction, or survival lower than the lowest bounded LOAEL (5 mg/kg-d) for growth, reproduction, or survival based on 220 laboratory toxicity studies.
Manganese	Birds	179	Reproduction and Growth	348	Growth	USEPA (2007j). Geometric mean NOAEL for reproduction and growth. Lowest bounded LOAEL for reproduction or growth greater than geometric mean NOAEL.

Table 4-12 Toxicity Reference Values for Birds and Mammals.

Analyte	Wildlife Class	NOAEL (mg/kg-day)	Critical Effect	LOAEL (mg/kg-day)	Critical Effect	Reference and Comments
	Mammals	51.5	Reproduction and Growth	65	Growth	USEPA (2007j). Geometric mean NOAEL for reproduction and growth. Lowest bounded LOAEL for reprodcution or growth greater than geometric mean NOAEL.
Mercury	Birds	0.45	Reproduction	0.9	Reproduction	Sample et al. (1996).
	Mammals	13.2	Reproduction and survival	na	na	Sample et al. (1996).
Nickel	Birds	6.71	Growth and survival	11.5	Growth	USEPA (2007k). Geometric mean NOAEL for reproduction and growth. Lowest bounded LOAEL for reproduction or growth greater than geometric mean NOAEL.
	Mammals	1.7	Reproduction	2.71	Reproduction	USEPA (2007k). Highest bounded NOAEL for reproduction, growth, or survival below lowest bounded LOAEL for reproduction, growth, or survival.
Selenium	Birds	0.291	Survival	0.368	Reproduction	USEPA (2007l). Highest bounded NOAEL for reproduction, growth, or survival below lowest bounded LOAEL for reproduction, growth, or survival.
	Mammals	0.143	Growth	0.145	Reproduction	USEPA (2007l). Highest bounded NOAEL for reproduction, growth, or survival below lowest bounded LOAEL for reproduction, growth, or survival.
Silver	Birds	2.02	Growth	20.2	Growth	USEPA (2006). Lowest LOAEL for reproduction or growth divided by 10.
	Mammals	6.02	Growth	60.2	Growth	USEPA (2006). Lowest LOAEL for reproduction or growth divided by 10.

Table 4-12 Toxicity Reference Values for Birds and Mammals.

Analyte	Wildlife Class	NOAEL (mg/kg-day)	Critical Effect	LOAEL (mg/kg-day)	Critical Effect	Reference and Comments
Vanadium	Birds	0.344	Growth	0.413	Reproduction	USEPA (2005j). Highest bounded NOAEL (0.344 mg/kg-d) for growth, reproduction, or survival less than lowest bounded LOAEL (0.413 mg/kg-d) for reproduction, growth, or survival based on 94 laboratory toxicity studies.
	Mammals	4.16	Reproduction and growth	5.11	Growth	USEPA (2005j). Highest bounded NOAEL (4.16 mg/kg-d) for growth or reproduction less than lowest bounded LOAEL (5.11 mg/kg-d) for growth, reproduction, or survival based on 94 laboratory toxicity studies.
Thallium	Birds	NA	NA	NA	NA	NA
	Mammals	0.0074	Reproduction	0.074	Reproduction	Sample et al. (1996).
Zinc	Birds	66.1	Reproduction and Growth	66.5	Reproduction	USEPA (2007m). Geometric mean NOAEL for reproduction and growth. Lowest bounded LOAEL for reproduction or growth greater than geometric mean NOAEL.
	Mammals	75.4	Reproduction and Growth	75.9	Reproduction	USEPA (2007m). Geometric mean NOAEL for reproduction and growth. Lowest bounded LOAEL for reproduction or growth greater than geometric mean NOAEL.

Key:
BHC= benezenehexachloroide
DDT = dichlorodiphenyltrichloroethane
HPAH = high molecular weight PAHs
LOAEL = lowest observed adverse effect level
LPAH = low molecular weight PAHs
mg/kg/day = milligrams per kilogram per day
NA = not available
NOAEL = no observed adverse effect level
TRV = toxicity reference value

Table 4-13 Brant Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Polychlorinated Biphenyls (PCBs)							
Sum of Aroclors (ND=0)	1.3E-04	0.0E+00	1.3E-04	0.18	1.8	7.5E-04	7.5E-05
Sum of Aroclors (ND=0.5)	1.5E-04	1.5E-03	1.6E-03	0.18	1.8	8.9E-03	8.9E-04
Dioxin-like PCB congener TEQ, ND=0 (avian)	na	8.3E-10	8.3E-10	1.4E-05	1.4E-04	5.9E-05	5.9E-06
Dioxin-like PCB congener TEQ, ND=0.5 (avian)	na	1.5E-09	1.5E-09	1.4E-05	1.4E-04	1.1E-04	1.1E-05
Polycyclic Aromatic Hydrocarbons (PAHs)							
LPAHs (ND = 0)	2.6E-04	3.1E-04	5.6E-04	na	na	na	na
LPAHs (ND = 0.5)	1.0E-04	4.0E-04	5.0E-04	na	na	na	na
HPAHs (ND = 0)	2.2E-04	5.1E-04	7.3E-04	2	20	3.7E-04	3.7E-05
HPAHs (ND = 0.5)	2.5E-04	5.3E-04	7.7E-04	2	20	3.9E-04	3.9E-05
Pesticides							
4,4'-DDD	1.1E-05	na	1.1E-05	0.227	0.281	4.8E-05	3.9E-05
4,4'-DDE	1.2E-06	na	1.2E-06	0.227	0.281	5.4E-06	4.4E-06
4,4'-DDT	7.7E-06	na	7.7E-06	0.227	0.281	3.4E-05	2.7E-05
DDT and metabolites	2.0E-05	na	2.0E-05	0.227	0.281	8.7E-05	7.1E-05
Alpha-BHC	5.9E-07	na	5.9E-07	0.56	2.25	1.1E-06	2.6E-07
Beta-BHC	9.3E-07	na	9.3E-07	0.56	2.25	1.7E-06	4.1E-07
Delta-BHC	6.6E-07	na	6.6E-07	0.56	2.25	1.2E-06	2.9E-07
Dieldrin	7.6E-07	na	7.6E-07	0.0709	0.179	1.1E-05	4.2E-06
Endosulfan I	5.7E-07	na	5.7E-07	10	na	5.7E-08	na

Table 4-13 Brant Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Endosulfan II	5.9E-07	na	5.9E-07	10	na	5.9E-08	na
Endosulfan Sulfate	6.6E-07	na	6.6E-07	11.1	na	5.9E-08	na
Endrin	7.9E-07	na	7.9E-07	0.01	0.1	7.9E-05	7.9E-06
Endrin Aldehyde	5.7E-07	na	5.7E-07	0.01	0.1	5.7E-05	5.7E-06
Endrin Ketone	4.6E-07	na	4.6E-07	0.01	0.1	4.6E-05	4.6E-06
gamma-Chlordane	3.4E-09	na	3.4E-09	2.14	10.7	1.6E-09	3.2E-10
Heptachlor	3.8E-07	na	3.8E-07	0.05	na	7.5E-06	na
Heptachlor Epoxide	8.1E-07	na	8.1E-07	0.005	na	1.6E-04	na
Lindane	5.4E-07	na	5.4E-07	5.71	8.57	9.5E-08	6.3E-08
Methoxychlor	2.4E-06	na	2.4E-06	2	na	1.2E-06	na
Toxaphene	4.8E-05	na	4.8E-05	na	na	na	na
Semivolatile Organic Compounds (SVOCs)							
Bis(2-ethylhexyl)phthalate	3.4E-05	1.1E-01	1.1E-01	1.11	na	9.6E-02	na
Butyl Benzyl Phthalate	2.8E-05	1.1E-01	1.1E-01	na	na	na	na
Hexachlorobenzene	2.1E-05	1.1E-01	1.1E-01	0.56	2.25	1.9E-01	4.7E-02
p-Cresol	7.6E-05	1.1E-01	1.1E-01	na	na	na	na
Pentachlorophenol	1.1E-04	5.4E-01	5.4E-01	6.73	na	8.0E-02	na
Phenol	3.5E-05	7.0E-02	7.0E-02	6	na	1.2E-02	na
Pyridine	3.2E-05	0.0E+00	3.2E-05	na	na	na	na
Retene	5.8E-05	0.0E+00	5.8E-05	na	na	na	na

Table 4-13 Brant Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Dioxins/furans							
TCDD TEQs; ND=0 (avian)	4.0E-08	1.3E-08	5.3E-08	1.4E-05	1.4E-04	3.8E-03	3.8E-04
TCDD TEQs; ND=0.5 (avian)	2.1E-08	2.6E-08	4.8E-08	1.4E-05	1.4E-04	3.4E-03	3.4E-04
Organometals							
Methyl Mercury	na	na	na	0.068	0.37	na	na
Tetraethyl Lead	na	na	na	1.13	11.3	na	na
Metals							
Antimony	2.5E-04	3.2E-03	3.5E-03	na	na	na	na
Arsenic	5.1E-03	3.8E-01	3.8E-01	2.24	3.55	1.7E-01	1.1E-01
Arsenic, Inorganic	na	na	na	2.24	3.55	na	na
Barium	1.9E-02	1.2E-01	1.4E-01	20.8	41.7	6.7E-03	3.4E-03
Beryllium	na	na	na	na	na	na	na
Cadmium	8.8E-04	5.4E-02	5.5E-02	1.47	2.37	3.7E-02	2.3E-02
Chromium	2.9E-02	2.2E-02	5.1E-02	2.66	2.78	1.9E-02	1.8E-02
Cobalt	na	na	na	7.61	7.8	na	na
Copper	3.1E-02	7.3E-02	1.0E-01	4.05	4.68	2.6E-02	2.2E-02
Lead	5.3E-02	5.1E-03	5.8E-02	1.63	1.94	3.5E-02	3.0E-02
Manganese	na	na	na	179	348	na	na
Mercury	3.2E-04	1.8E-03	2.1E-03	0.45	0.9	4.7E-03	2.3E-03
Nickel	3.6E-02	4.8E-02	8.4E-02	6.71	11.5	1.3E-02	7.3E-03
Selenium	6.2E-04	0.0E+00	6.2E-04	0.291	0.368	2.1E-03	1.7E-03
Silver	6.7E-05	2.9E-03	3.0E-03	2.02	20.2	1.5E-03	1.5E-04

Table 4-13 Brant Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Vanadium	na	na	na	0.344	0.413	na	na
Zinc	1.1E-01	5.9E-01	6.9E-01	66.1	66.5	1.1E-02	1.0E-02

Key:
Black fill = HQ >1
EE-diet = estimated chemical exposure from diet
EE-sed = estimated chemical exposure from incidental sediment ingestion
EE-total = total chemical exposure
EPC = exposure point concentration
HPAH = high molecular weight PAHs
HQ = hazard quotient
LPAH = low molecular weight PAHs
LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level
mg/kg = milligrams per kilogram
mg/kg/day = milligrams per kilogram per day
na = not available or not applicable

Table 4-14 Eagle Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Polychlorinated Biphenyls (PCBs)							
Sum of Aroclors (ND = 0)	7.9E-05	1.4E-03	1.4E-03	0.18	1.8	8.0E-03	8.0E-04
Sum of Aroclors (ND=0.5)	8.5E-05	2.1E-03	2.1E-03	0.18	1.8	1.2E-02	1.2E-03
Dioxin-like PCB congener TEQ, ND=0 (avian)	na	7.8E-08	7.8E-08	1.4E-05	1.4E-04	5.6E-03	5.6E-04
Dioxin-like PCB congener TEQ, ND=0.5 (avian)	na	8.3E-08	8.3E-08	1.4E-05	1.4E-04	5.9E-03	5.9E-04
Polycyclic Aromatic Hydrocarbons (PAHs)							
LPAHs (ND = 0)	1.5E-04	7.9E-05	2.3E-04	na	na	na	na
LPAHs (ND = 0.5)	6.0E-05	1.4E-04	2.0E-04	na	na	na	na
HPAHs (ND = 0)	1.3E-04	5.0E-05	1.8E-04	2	20	9.1E-05	9.1E-06
HPAHs (ND = 0.5)	1.4E-04	9.9E-05	2.4E-04	2	20	1.2E-04	1.2E-05
Pesticides							
4,4'-DDD	6.4E-06	1.6E-05	2.3E-05	0.227	0.281	9.9E-05	8.0E-05
4,4'-DDE	7.2E-07	1.7E-05	1.7E-05	0.227	0.281	7.7E-05	6.2E-05
4,4'-DDT	4.5E-06	3.9E-05	4.4E-05	0.227	0.281	1.9E-04	1.6E-04
DDT and metabolites	1.2E-05	7.2E-05	8.4E-05	0.227	0.281	3.7E-04	3.0E-04
Alpha-BHC	3.5E-07	1.4E-05	1.4E-05	0.56	2.25	2.6E-05	6.4E-06
Beta-BHC	5.4E-07	1.8E-05	1.9E-05	0.56	2.25	3.3E-05	8.3E-06
Delta-BHC	3.9E-07	1.6E-05	1.6E-05	0.56	2.25	2.9E-05	7.1E-06
Dieldrin	4.4E-07	na	4.4E-07	0.0709	0.179	6.2E-06	2.5E-06
Endosulfan I	3.3E-07	na	3.3E-07	10	na	3.3E-08	na

Table 4-14 Eagle Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Endosulfan II	3.5E-07	na	3.5E-07	10	na	3.5E-08	na
Endosulfan Sulfate	3.8E-07	na	3.8E-07	11.1	na	3.5E-08	na
Endrin	4.6E-07	na	4.6E-07	0.01	0.1	4.6E-05	4.6E-06
Endrin Aldehyde	3.3E-07	na	3.3E-07	0.01	0.1	3.3E-05	3.3E-06
Endrin Ketone	2.7E-07	na	2.7E-07	0.01	0.1	2.7E-05	2.7E-06
gamma-Chlordane	2.0E-09	na	2.0E-09	2.14	10.7	9.4E-10	1.9E-10
Heptachlor	2.2E-07	na	2.2E-07	0.05	na	4.4E-06	na
Heptachlor Epoxide	4.7E-07	na	4.7E-07	0.005	na	9.4E-05	na
Lindane	3.2E-07	1.0E-05	1.0E-05	5.71	8.57	1.8E-06	1.2E-06
Methoxychlor	1.4E-06	na	1.4E-06	2	na	6.9E-07	na
Toxaphene	2.8E-05	na	2.8E-05	na	na	na	na
Semivolatile Organic Compounds (SVOCs)							
Bis(2-ethylhexyl)phthalate	2.0E-05	1.0E-01	1.0E-01	1.11	na	9.1E-02	na
Butyl Benzyl Phthalate	1.7E-05	1.0E-01	1.0E-01	na	na	na	na
Hexachlorobenzene	1.2E-05	1.0E-01	1.0E-01	0.56	2.25	1.8E-01	4.5E-02
p-Cresol	4.4E-05	1.0E-01	1.0E-01	na	na	na	na
Pentachlorophenol	6.3E-05	2.5E-01	2.5E-01	6.73	na	3.7E-02	na
Phenol	2.0E-05	1.0E-01	1.0E-01	6	na	1.7E-02	na
Pyridine	1.9E-05	9.1E-04	9.3E-04	na	na	na	na
Retene	3.4E-05	0.0E+00	3.4E-05	na	na	na	na

Table 4-14 Eagle Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Dioxins/furans							
TCDD TEQs; ND=0 (avian)	2.4E-08	1.5E-08	3.8E-08	1.4E-05	1.4E-04	2.7E-03	2.7E-04
TCDD TEQs; ND=0.5 (avian)	1.2E-08	1.4E-07	1.5E-07	1.4E-05	1.4E-04	1.1E-02	1.1E-03
Organometals							
Methyl Mercury	na	5.0E-03	5.0E-03	0.068	0.37	7.4E-02	1.4E-02
Tetraethyl Lead	na	7.1E-04	7.1E-04	1.13	11.3	6.3E-04	6.3E-05
Metals							
Antimony	1.4E-04	4.6E-05	1.9E-04	na	na	na	na
Arsenic	3.0E-03	1.7E-01	1.7E-01	2.24	3.55	7.7E-02	4.9E-02
Arsenic, inorganic	na	1.3E-03	1.3E-03	2.24	3.55	5.9E-04	3.7E-04
Barium	1.1E-02	4.2E-03	1.5E-02	20.8	41.7	7.3E-04	3.6E-04
Beryllium	na	na	na	na	na	na	na
Cadmium	5.2E-04	2.3E-03	2.9E-03	1.47	2.37	1.9E-03	1.2E-03
Chromium	1.7E-02	3.3E-02	5.0E-02	2.66	2.78	1.9E-02	1.8E-02
Cobalt	na	na	na	7.61	7.8	na	na
Copper	1.8E-02	4.4E-02	6.2E-02	4.05	4.68	1.5E-02	1.3E-02
Lead	3.1E-02	4.2E-03	3.5E-02	1.63	1.94	2.1E-02	1.8E-02
Manganese	na	na	na	179	348	na	na
Mercury	1.9E-04	2.2E-02	2.2E-02	0.45	0.9	5.0E-02	2.5E-02
Nickel	2.1E-02	9.7E-03	3.1E-02	6.71	11.5	4.6E-03	2.7E-03
Selenium	3.6E-04	4.0E-02	4.1E-02	0.291	0.368	1.4E-01	1.1E-01
Silver	3.9E-05	4.2E-03	4.2E-03	2.02	20.2	2.1E-03	2.1E-04

Table 4-14 Eagle Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Vanadium	na	na	na	0.344	0.413	na	na
Zinc	6.3E-02	7.9E-01	8.5E-01	66.1	66.5	1.3E-02	1.3E-02

Key:
Black fill = HQ >1
EE-diet = estimated chemical exposure from diet
EE-sed = estimated chemical exposure from incidental sediment ingestion
EE-total = total chemical exposure
EPC = exposure point concentration
HPAH = high molecular weight PAHs
HQ = hazard quotient
LPAH = low molecular weight PAHs
LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level
mg/kg = milligrams per kilogram
mg/kg/day = milligrams per kilogram per day
na = not available or not applicable

Table 4-15 Cormorant Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Polychlorinated Biphenyls (PCBs)							
Sum of Aroclors, ND=0	1.2E-04	2.6E-03	2.7E-03	0.18	1.8	1.5E-02	1.5E-03
Sum of Aroclors, ND=0.5	1.3E-04	3.7E-03	3.8E-03	0.18	1.8	2.1E-02	2.1E-03
Dioxin-like PCB congener TEQ, ND=0 (avian)	na	1.7E-07	1.7E-07	1.4E-05	1.4E-04	1.2E-02	1.2E-03
Dioxin-like PCB congener TEQ, ND=0.5 (avian)	na	1.7E-07	1.7E-07	1.4E-05	1.4E-04	1.2E-02	1.2E-03
Polycyclic Aromatic Hydrocarbons (PAHs)							
LPAHs (ND = 0)	2.2E-04	5.4E-04	7.7E-04	na	na	na	na
LPAHs (ND = 0.5)	8.9E-05	6.3E-04	7.2E-04	na	na	na	na
HPAHs (ND = 0)	1.9E-04	6.4E-04	8.3E-04	2	20	4.2E-04	4.2E-05
HPAHs (ND = 0.5)	2.1E-04	7.1E-04	9.3E-04	2	20	4.6E-04	4.6E-05
Pesticides							
4,4'-DDD	9.5E-06	2.7E-05	3.7E-05	0.227	0.281	1.6E-04	1.3E-04
4,4'-DDE	1.1E-06	3.6E-05	3.7E-05	0.227	0.281	1.6E-04	1.3E-04
4,4'-DDT	6.7E-06	1.3E-04	1.4E-04	0.227	0.281	6.0E-04	4.9E-04
DDT and metabolites	1.7E-05	1.9E-04	2.1E-04	0.227	0.281	9.3E-04	7.5E-04
Alpha-BHC	5.2E-07	9.8E-05	9.9E-05	0.56	2.25	1.8E-04	4.4E-05
Beta-BHC	8.1E-07	7.0E-05	7.1E-05	0.56	2.25	1.3E-04	3.1E-05
Delta-BHC	5.7E-07	2.9E-05	2.9E-05	0.56	2.25	5.2E-05	1.3E-05
Dieldrin	6.6E-07	8.0E-07	1.5E-06	0.0709	0.179	2.1E-05	8.1E-06
Endosulfan I	5.0E-07	4.3E-07	9.3E-07	10	na	9.3E-08	na

Table 4-15 Cormorant Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Endosulfan II	5.2E-07	9.7E-07	1.5E-06	10	na	1.5E-07	na
Endosulfan Sulfate	5.7E-07	1.3E-06	1.8E-06	11.1	na	1.7E-07	na
Endrin	6.9E-07	1.6E-06	2.2E-06	0.01	0.1	2.2E-04	2.2E-05
Endrin Aldehyde	5.0E-07	9.4E-07	1.4E-06	0.01	0.1	1.4E-04	1.4E-05
Endrin Ketone	4.0E-07	9.4E-07	1.3E-06	0.01	0.1	1.3E-04	1.3E-05
gamma-Chlordane	3.0E-09	1.9E-06	1.9E-06	2.14	10.7	8.7E-07	1.7E-07
Heptachlor	3.3E-07	2.1E-06	2.4E-06	0.05	na	4.8E-05	na
Heptachlor Epoxide	7.0E-07	4.7E-07	1.2E-06	0.005	na	2.3E-04	na
Lindane	4.7E-07	2.6E-05	2.7E-05	5.71	8.57	4.7E-06	3.1E-06
Methoxychlor	2.1E-06	5.1E-06	7.1E-06	2	na	3.6E-06	na
Toxaphene	4.2E-05	3.7E-05	7.9E-05	na	na	na	na
Semivolatile Organic Compounds (SVOCs)							
Bis(2-ethylhexyl)phthalate	3.0E-05	1.5E-01	1.5E-01	1.11	na	1.4E-01	na
Butyl Benzyl Phthalate	2.5E-05	1.5E-01	1.5E-01	na	na	na	na
Hexachlorobenzene	1.9E-05	1.5E-01	1.5E-01	0.56	2.25	2.7E-01	6.8E-02
p-Cresol	6.6E-05	1.5E-01	1.5E-01	na	na	na	na
Pentachlorophenol	9.4E-05	3.8E-01	3.8E-01	6.73	na	5.6E-02	na
Phenol	3.0E-05	1.5E-01	1.5E-01	6	na	2.5E-02	na
Pyridine	2.8E-05	2.7E-03	2.7E-03	na	na	na	na
Retene	5.1E-05	0.0E+00	5.1E-05	na	na	na	na

Table 4-15 Cormorant Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Dioxins/furans							
TCDD TEQs; ND=0 (avian)	3.5E-08	2.6E-08	6.1E-08	1.4E-05	1.4E-04	4.3E-03	4.3E-04
TCDD TEQs; ND=0.5 (avian)	1.9E-08	2.1E-07	2.3E-07	1.4E-05	1.4E-04	1.6E-02	1.6E-03
Organometals							
Methyl Mercury	na	7.8E-03	7.8E-03	0.068	0.37	1.1E-01	2.1E-02
Tetraethyl Lead	na	6.9E-03	6.9E-03	1.13	11.3	6.1E-03	6.1E-04
Metals							
Antimony	2.1E-04	1.7E-04	3.9E-04	na	na	na	na
Arsenic	4.5E-03	3.2E-01	3.2E-01	2.24	3.55	1.4E-01	9.1E-02
Arsenic, inorganic	na	6.3E-03	6.3E-03	2.24	3.55	2.8E-03	1.8E-03
Barium	1.6E-02	1.6E-02	3.3E-02	20.8	41.7	1.6E-03	7.8E-04
Beryllium	na	4.4E-05	4.4E-05	na	na	na	na
Cadmium	7.7E-04	6.8E-03	7.5E-03	1.47	2.37	5.1E-03	3.2E-03
Chromium	2.5E-02	5.6E-02	8.2E-02	2.66	2.78	3.1E-02	2.9E-02
Cobalt	na	4.3E-03	4.3E-03	7.61	7.8	5.7E-04	5.5E-04
Copper	2.7E-02	1.5E-01	1.8E-01	4.05	4.68	4.3E-02	3.8E-02
Lead	4.6E-02	1.3E-02	5.9E-02	1.63	1.94	3.6E-02	3.0E-02
Manganese	na	2.3E-01	2.3E-01	179	348	1.3E-03	6.7E-04
Mercury	2.8E-04	3.3E-02	3.3E-02	0.45	0.9	7.4E-02	3.7E-02
Nickel	3.2E-02	2.2E-02	5.4E-02	6.71	11.5	8.1E-03	4.7E-03
Selenium	5.4E-04	6.6E-02	6.6E-02	0.291	0.368	2.3E-01	1.8E-01
Silver	5.8E-05	1.3E-02	1.3E-02	2.02	20.2	6.5E-03	6.5E-04

Table 4-15 Cormorant Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Vanadium	na	1.2E-02	1.2E-02	0.344	0.413	3.6E-02	3.0E-02
Zinc	9.4E-02	1.3E+00	1.4E+00	66.1	66.5	2.2E-02	2.1E-02

Key:
Black fill = HQ >1
EE-diet = estimated chemical exposure from diet
EE-sed = estimated chemical exposure from incidental sediment ingestion
EE-total = total chemical exposure
EPC = exposure point concentration
HPAH = high molecular weight PAHs
HQ = hazard quotient
LPAH = low molecular weight PAHs
LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level
mg/kg = milligrams per kilogram
mg/kg/day = milligrams per kilogram per day
na = not available or not applicable

Table 4-16 Harbor Seal Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Polychlorinated Biphenyls (PCBs)							
Sum of Aroclors (ND=0)	8.1E-06	na	8.1E-06	0.14	0.69	5.8E-05	1.2E-05
Sum of Aroclors (ND=0.5)	9.7E-06	6.4E-04	6.5E-04	0.14	0.69	4.6E-03	9.4E-04
Dioxin-like PCB congener TEQ, ND=0	na	1.9E-08	1.9E-08	1.0E-06	1.0E-05	1.9E-02	1.9E-03
Dioxin-like PCB congener TEQ, ND=0.5	na	2.2E-08	2.2E-08	1.0E-06	1.0E-05	2.2E-02	2.2E-03
Polycyclic Aromatic Hydrocarbons (PAHs)							
LPAHs (ND = 0)	2.2E-04	2.4E-05	2.5E-04	65.6	110	3.7E-06	2.2E-06
LPAHs (ND = 0.5)	2.3E-04	4.2E-05	2.7E-04	65.6	110	4.1E-06	2.4E-06
HPAHs (ND = 0)	2.3E-04	1.6E-05	2.4E-04	0.615	3.07	3.9E-04	7.9E-05
HPAHs (ND = 0.5)	1.9E-04	3.1E-05	2.2E-04	0.615	3.07	3.5E-04	7.1E-05
Pesticides							
4,4'-DDD	5.4E-07	5.0E-06	5.6E-06	0.147	0.247	3.8E-05	2.2E-05
4,4'-DDE	2.1E-07	5.2E-06	5.4E-06	0.147	0.247	3.7E-05	2.2E-05
4,4'-DDT	8.7E-07	1.2E-05	1.3E-05	0.147	0.247	8.9E-05	5.3E-05
DDT and metabolites	1.6E-06	2.2E-05	2.4E-05	0.147	0.247	1.6E-04	9.7E-05
Alpha-BHC	5.8E-08	4.4E-06	4.4E-06	0.014	0.14	3.2E-04	3.2E-05
Beta-BHC	3.1E-07	5.6E-06	6.0E-06	0.4	2	1.5E-05	3.0E-06
cis-Chlordane	2.7E-07	na	2.7E-07	4.6	9.2	5.8E-08	2.9E-08
Delta-BHC	6.6E-08	4.9E-06	4.9E-06	0.014	0.14	3.5E-04	3.5E-05
Dieldrin	1.5E-07	na	1.5E-07	0.015	0.03	9.9E-06	5.0E-06

Table 4-16 Harbor Seal Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Endosulfan I	5.8E-08	na	5.8E-08	0.15	na	3.9E-07	na
Endosulfan II	1.5E-07	na	1.5E-07	0.15	na	1.0E-06	na
Endosulfan Sulfate	2.9E-07	na	2.9E-07	0.15	na	1.9E-06	na
Endrin	1.4E-07	na	1.4E-07	0.092	0.92	1.5E-06	1.5E-07
Endrin Aldehyde	9.9E-08	na	9.9E-08	0.092	0.92	1.1E-06	1.1E-07
Endrin Ketone	6.8E-08	na	6.8E-08	0.092	0.92	7.4E-07	7.4E-08
gamma-Chlordane	2.3E-07	na	2.3E-07	4.6	9.2	4.9E-08	2.5E-08
Heptachlor	6.8E-08	na	6.8E-08	0.2	1	3.4E-07	6.8E-08
Heptachlor Epoxide	1.7E-07	na	1.7E-07	0.075	na	2.3E-06	na
Lindane	1.1E-07	3.1E-06	3.2E-06	8	na	4.1E-07	na
Methoxychlor	4.1E-07	na	4.1E-07	4	8	1.0E-07	5.2E-08
Toxaphene	8.9E-06	na	8.9E-06	8	na	1.1E-06	na
Semivolatile Organic Compounds (SVOCs)							
9H-Carbazole	9.7E-06	na	9.7E-06	na	na	na	na
Bis(2ethylhexyl)phthalate	1.6E-05	3.1E-02	3.1E-02	18.33	183.3	1.7E-03	1.7E-04
Butyl Benzyl Phthalate	5.4E-06	3.1E-02	3.1E-02	na	na	na	na
Dibenzofuran	1.2E-05	3.1E-02	3.1E-02	na	na	na	na
Dibutylphthalate	2.0E-06	3.1E-02	3.1E-02	na	na	na	na
Hexachlorobenzene[a]	4.1E-06	3.1E-02	3.1E-02	0.014	0.14	2.2	0.2
p-Cresol	1.8E-04	3.1E-02	3.2E-02	219.2	na	1.4E-04	na
Pentachlorophenol	2.0E-05	7.8E-02	7.8E-02	8.42	9.45	9.2E-03	8.2E-03
Phenol	1.3E-05	3.1E-02	3.1E-02	523	na	6.0E-05	na

Table 4-16 Harbor Seal Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Pyridine	8.7E-07	2.8E-04	2.8E-04	na	na	na	na
Retene	4.3E-03	na	4.3E-03	na	na	na	na
Dioxins/furans							
2,3,7,8-TCDD (ND = 0)	3.6E-09	1.5E-09	5.1E-09	1.0E-06	1.0E-05	5.1E-03	5.1E-04
2,3,7,8-TCDD (ND = 0.5)	4.2E-09	8.2E-09	1.2E-08	1.0E-06	1.0E-05	1.2E-02	1.2E-03
Organometals							
Dibutyltin ion	1.1E-06	na	1.1E-06	23.4	35	4.9E-08	3.2E-08
Methyl Mercury	na	1.6E-03	1.6E-03	0.032	0.16	4.9E-02	9.8E-03
Tetraethyl Lead	na	2.2E-04	2.2E-04	8	80	2.7E-05	2.7E-06
Tributyltin + tributyltin ion	8.3E-06	na	8.3E-06	23.4	35	3.5E-07	2.4E-07
Metals							
Antimony	8.1E-05	1.4E-05	9.5E-05	0.059	0.59	1.6E-03	1.6E-04
Arsenic	1.4E-03	5.3E-02	5.4E-02	1.04	1.66	5.2E-02	3.3E-02
Arsenic, inorganic	na	4.1E-04	4.1E-04	1.04	1.66	3.9E-04	2.5E-04
Barium	5.1E-03	1.3E-03	6.4E-03	51.8	121	1.2E-04	5.3E-05
Beryllium	8.9E-05	na	8.9E-05	0.532	na	1.7E-04	na
Cadmium	2.8E-02	7.3E-04	2.8E-02	0.77	1	3.7E-02	2.8E-02
Chromium	5.8E-03	1.0E-02	1.6E-02	9.24	na	1.7E-03	na
Cobalt	2.4E-02	na	2.4E-02	7.33	10.9	3.3E-03	2.2E-03
Copper	6.4E-02	1.4E-02	7.7E-02	5.6	6.79	1.4E-02	1.1E-02
Lead	2.5E-02	1.3E-03	2.7E-02	4.7	5	5.7E-03	5.3E-03
Manganese	4.8E-02	na	4.8E-02	51.5	65	9.3E-04	7.4E-04

Table 4-16 Harbor Seal Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Mercury	7.2E-05	6.9E-03	7.0E-03	13.2	na	5.3E-04	na
Nickel	5.7E-03	3.0E-03	1.8E-02	1.7	2.71	1.1E-02	6.7E-03
Selenium	1.6E-04	1.3E-02	1.3E-02	0.143	0.145	8.9E-02	8.8E-02
Silver	2.7E-05	1.3E-03	1.3E-03	6.02	60.2	2.2E-04	2.2E-05
Thallium	2.5E-04	na	2.5E-04	0.0074	0.074	3.3E-02	3.3E-03
Vanadium	1.1E-02	na	1.1E-02	4.16	5.11	2.6E-03	2.1E-03
Zinc	2.6E-02	2.5E-01	2.7E-01	75.4	75.9	3.6E-03	3.6E-03

Key:
Black fill = HQ >1
EE-diet = estimated chemical exposure from diet
EE-sed = estimated chemical exposure from incidental sediment ingestion
EE-total = total chemical exposure
EPC = exposure point concentration
HPAH = high molecular weight PAHs
HQ = hazard quotient
LPAH = low molecular weight PAHs
LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level
mg/kg = milligrams per kilogram
mg/kg/day = milligrams per kilogram per day
na = not available or not applicable

Footnote:
a = Risk driven by elevated detection limit (2 mg/kg) for hexachlorobenzene in lingcod whole-body samples.

Table 4-17 Raccoon Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Polychlorinated Biphenyls (PCBs)							
Sum of Aroclors (ND=0)	5.6E-04	1.2E-02	1.2E-02	0.14	0.69	8.7E-02	1.8E-02
Sum of Aroclors (ND=0.5)	6.1E-04	1.2E-02	1.3E-02	0.14	0.69	9.1E-02	1.8E-02
Dioxin-like PCB congener TEQ, ND=0	na	6.9E-07	6.9E-07	1.0E-06	1.0E-05	6.9E-01	6.9E-02
Dioxin-like PCB congener TEQ, ND=0.5	na	7.0E-07	7.0E-07	1.0E-06	1.0E-05	7.0E-01	7.0E-02
Polycyclic Aromatic Hydrocarbons (PAHs)							
LPAHs (ND = 0)	1.1E-03	7.8E-03	8.8E-03	65.6	110	1.3E-04	8.0E-05
LPAHs (ND = 0.5)	4.2E-04	7.8E-03	8.2E-03	65.6	110	1.3E-04	7.5E-05
HPAHs (ND = 0)	9.3E-04	1.0E-02	1.1E-02	0.615	3.07	1.8E-02	3.6E-03
HPAHs (ND = 0.5)	1.0E-03	1.0E-02	1.1E-02	0.615	3.07	1.8E-02	3.7E-03
Pesticides							
4,4'-DDD	4.5E-05	6.6E-05	1.1E-04	0.147	0.247	7.6E-04	4.5E-04
4,4'-DDE	5.1E-06	2.1E-04	2.2E-04	0.147	0.247	1.5E-03	8.8E-04
4,4'-DDT	3.2E-05	1.3E-03	1.3E-03	0.147	0.247	9.1E-03	5.4E-03
DDT and metabolites	8.3E-05	1.6E-03	1.7E-03	0.147	0.247	1.1E-02	6.8E-03
Alpha-BHC	2.5E-06	1.4E-03	1.4E-03	0.014	0.14	1.0E-01	1.0E-02
Beta-BHC	3.9E-06	7.9E-04	7.9E-04	0.4	2	2.0E-03	4.0E-04
Delta-BHC	2.7E-06	1.0E-04	1.1E-04	0.014	0.14	7.6E-03	7.6E-04
Dieldrin	3.1E-06	1.4E-05	1.8E-05	0.015	0.03	1.2E-03	5.9E-04
Endosulfan I	2.4E-06	7.8E-06	1.0E-05	0.15	na	6.8E-05	na
Endosulfan II	2.5E-06	1.8E-05	2.0E-05	0.15	na	1.3E-04	na

Table 4-17 Raccoon Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Endosulfan Sulfate	2.7E-06	2.3E-05	2.6E-05	0.15	na	1.7E-04	na
Endrin	3.3E-06	2.8E-05	3.2E-05	0.092	0.92	3.4E-04	3.4E-05
Endrin Aldehyde	2.4E-06	1.7E-05	1.9E-05	0.092	0.92	2.1E-04	2.1E-05
Endrin Ketone	1.9E-06	1.7E-05	1.9E-05	0.092	0.92	2.0E-04	2.0E-05
gamma-Chlordane	1.4E-08	3.4E-05	3.4E-05	4.6	9.2	7.3E-06	3.6E-06
Heptachlor	1.6E-06	3.7E-05	3.9E-05	0.2	1	1.9E-04	3.9E-05
Heptachlor Epoxide	3.4E-06	8.5E-06	1.2E-05	0.075	na	1.6E-04	na
Lindane	2.3E-06	2.1E-04	2.1E-04	8	na	2.6E-05	na
Methoxychlor	9.8E-06	9.2E-05	1.0E-04	4	8	2.5E-05	1.3E-05
Toxaphene	2.0E-04	6.7E-04	8.7E-04	8	na	1.1E-04	na
Semivolatile Organic Compounds (SVOCs)							
Bis(2-ethylhexyl)phthalate	1.4E-04	1.0E-01	1.0E-01	18.33	183.3	5.7E-03	5.7E-04
Butyl Benzyl Phthalate	1.2E-04	1.0E-01	1.0E-01	na	na	na	na
Hexachlorobenzene[a]	8.8E-05	8.6E-02	8.6E-02	0.014	0.14	6.2	0.6
p-Cresol	3.2E-04	1.0E-01	1.0E-01	219.2	na	4.7E-04	na
Pentachlorophenol	4.5E-04	2.6E-01	2.6E-01	8.42	9.45	3.1E-02	2.8E-02
Phenol	1.4E-04	9.2E-02	9.2E-02	523	na	1.8E-04	na
Pyridine	1.4E-04	2.5E-02	2.5E-02	na	na	na	na
Retene	2.4E-04	0.0E+00	2.4E-04	na	na	na	na
Dioxins/furans							
2,3,7,8-TCDD (ND = 0)	9.8E-08	2.3E-07	3.3E-07	1.0E-06	1.0E-05	3.3E-01	3.3E-02
2,3,7,8-TCDD (ND = 0.5)	7.4E-08	2.5E-07	3.3E-07	1.0E-06	1.0E-05	3.3E-01	3.3E-02

Table 4-17 Raccoon Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Organometals							
Methyl Mercury	na	8.2E-03	8.2E-03	0.032	0.16	2.6E-01	5.1E-02
Tetraethyl Lead	na	1.1E-01	1.1E-01	8	80	1.3E-02	1.3E-03
Metals							
Antimony	1.0E-03	1.9E-03	2.9E-03	0.059	0.59	5.0E-02	5.0E-03
Arsenic	2.1E-02	1.3E+00	1.3E+00	1.04	1.66	1.3	0.8
Arsenic, inorganic	na	8.0E-02	8.0E-02	1.04	1.66	7.7E-02	4.8E-02
Barium	7.8E-02	1.9E-01	2.7E-01	51.8	121	5.1E-03	2.2E-03
Beryllium	na	7.9E-04	7.9E-04	0.532	na	1.5E-03	na
Cadmium	3.7E-03	6.1E-02	6.4E-02	0.77	1	8.4E-02	6.4E-02
Chromium	1.2E-01	1.4E-01	2.6E-01	9.24	na	2.8E-02	na
Cobalt	na	7.8E-02	7.8E-02	7.33	10.9	1.1E-02	7.2E-03
Copper	1.3E-01	1.5E+00	1.7E+00	5.6	6.79	3.0E-01	2.5E-01
Lead	2.2E-01	1.3E-01	3.5E-01	4.7	5	7.4E-02	7.0E-02
Manganese	na	4.2E+00	4.2E+00	51.5	65	8.2E-02	6.5E-02
Mercury	1.4E-03	1.1E-02	1.2E-02	13.2	na	9.2E-04	na
Nickel	1.5E-01	1.5E-01	3.0E-01	1.7	2.71	1.8E-01	1.1E-01
Selenium	2.6E-03	1.2E-01	1.3E-01	0.143	0.145	8.8E-01	8.6E-01
Silver	2.8E-04	1.3E-01	1.3E-01	6.02	60.2	2.1E-02	2.1E-03
Vanadium	na	2.2E-01	2.2E-01	4.16	5.11	5.4E-02	4.4E-02
Zinc	4.5E-01	3.3E+00	3.7E+00	75.4	75.9	5.0E-02	4.9E-02

Key:

Table 4-17 Raccoon Exposure Estimates and Hazard Quotients.

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL

Black fill = HQ >1
EE-diet = estimated chemical exposure from diet
EE-sed = estimated chemical exposure from incidental sediment ingestion
EE-total = total chemical exposure
EPC = exposure point concentration
HPAH = high molecular weight PAHs
HQ = hazard quotient
LPAH = low molecular weight PAHs
LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level
mg/kg = milligrams per kilogram
mg/kg/day = milligrams per kilogram per day
na= not available or not applicable

Footnote:
a = Risk driven by elevated detection limit (2 mg/kg) for hexachlorobenzene in lingcod and horse clam whole-body samples.

Table 4-18 Greater Scaup Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Polychlorinated Biphenyls (PCBs)							
Sum of Aroclors (ND=0)	1.6E-04	1.3E-02	1.3E-02	0.18	1.8	7.4E-02	7.4E-03
Sum of Aroclors (ND=0.5)	1.7E-04	1.4E-02	1.4E-02	0.18	1.8	7.8E-02	7.8E-03
Dioxin-like PCB congener TEQ, ND=0 (avian)	na	1.1E-06	1.1E-06	1.4E-05	1.4E-04	7.6E-02	7.6E-03
Dioxin-like PCB congener TEQ, ND=0.5 (avian)	na	1.1E-06	1.1E-06	1.4E-05	1.4E-04	7.7E-02	7.7E-03
Polycyclic Aromatic Hydrocarbons (PAHs)							
LPAHs (ND = 0)	3.0E-04	9.0E-03	9.3E-03	na	na	na	na
LPAHs (ND = 0.5)	1.2E-04	9.0E-03	9.1E-03	na	na	na	na
HPAHs (ND = 0)	2.6E-04	1.2E-02	1.2E-02	2	20	6.1E-03	6.1E-04
HPAHs (ND = 0.5)	2.9E-04	1.2E-02	1.2E-02	2	20	6.1E-03	6.1E-04
Pesticides							
4,4'-DDD	1.3E-05	7.3E-05	8.6E-05	0.227	0.281	3.8E-04	3.1E-04
4,4'-DDE	1.5E-06	2.4E-04	2.4E-04	0.227	0.281	1.1E-03	8.6E-04
4,4'-DDT	9.1E-06	1.5E-03	1.5E-03	0.227	0.281	6.7E-03	5.4E-03
DDT and metabolites	2.3E-05	1.8E-03	1.8E-03	0.227	0.281	8.1E-03	6.5E-03
Alpha-BHC	7.0E-07	1.6E-03	1.6E-03	0.56	2.25	2.9E-03	7.2E-04
Beta-BHC	1.1E-06	9.0E-04	9.0E-04	0.56	2.25	1.6E-03	4.0E-04
Delta-BHC	7.8E-07	1.2E-04	1.2E-04	0.56	2.25	2.1E-04	5.2E-05
Dieldrin	8.9E-07	1.7E-05	1.8E-05	0.0709	0.179	2.5E-04	9.8E-05
Endosulfan I	6.7E-07	8.9E-06	9.6E-06	10	na	9.6E-07	na
Endosulfan II	7.0E-07	2.0E-05	2.1E-05	10	na	2.1E-06	na

Table 4-18 Greater Scaup Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Endosulfan Sulfate	7.7E-07	2.6E-05	2.7E-05	11.1	na	2.4E-06	na
Endrin	9.3E-07	3.3E-05	3.3E-05	0.01	0.1	3.3E-03	3.3E-04
Endrin Aldehyde	6.7E-07	2.0E-05	2.0E-05	0.01	0.1	2.0E-03	2.0E-04
Endrin Ketone	5.4E-07	2.0E-05	2.0E-05	0.01	0.1	2.0E-03	2.0E-04
gamma-Chlordane	4.0E-09	3.9E-05	3.9E-05	2.14	10.7	1.8E-05	3.6E-06
Heptachlor	4.4E-07	4.3E-05	4.4E-05	0.05	na	8.7E-04	na
Heptachlor Epoxide	5.9E-07	9.8E-06	1.0E-05	0.005	na	2.1E-03	na
Lindane	6.4E-07	2.4E-04	2.4E-04	5.71	8.57	4.2E-05	2.8E-05
Methoxychlor	2.8E-06	1.1E-04	1.1E-04	2	na	5.4E-05	na
Toxaphene	5.7E-05	7.7E-04	8.2E-04	na	na	na	na
Semivolatile Organic Compounds (SVOCs)							
Bis(2-ethylhexyl)phthalate	4.0E-05	1.2E-01	1.2E-01	1.11	na	1.1E-01	na
Butyl Benzyl Phthalate	3.3E-05	1.2E-01	1.2E-01	na	na	na	na
Hexachlorobenzene	2.5E-05	9.8E-02	9.8E-02	0.56	2.25	1.8E-01	4.4E-02
p-Cresol	8.9E-05	1.2E-01	1.2E-01	na	na	na	na
Pentachlorophenol	1.3E-04	3.4E-01	3.4E-01	6.73	na	5.1E-02	na
Phenol	4.1E-05	9.9E-02	9.9E-02	6	na	1.7E-02	na
Pyridine	3.8E-05	2.9E-02	2.9E-02	na	na	na	na
Retene	6.9E-05	0.0E+00	6.9E-05	na	na	na	na

Table 4-18 Greater Scaup Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Dioxins/furans							
TCDD TEQs; ND=0 (avian)	4.8E-08	9.0E-08	1.4E-07	1.4E-05	1.4E-04	9.8E-03	9.8E-04
TCDD TEQs; ND=0.5 (avian)	2.5E-08	1.3E-07	1.6E-07	1.4E-05	1.4E-04	1.1E-02	1.1E-03
Organometals							
Methyl Mercury	na	8.5E-03	8.5E-03	0.068	0.37	1.3E-01	2.3E-02
Tetraethyl Lead	na	1.2E-01	1.2E-01	8	80	1.5E-02	1.5E-03
Metals							
Antimony	2.9E-04	2.7E-03	3.0E-03	na	na	na	na
Arsenic	6.1E-03	1.5E+00	1.5E+00	2.24	3.55	6.8E-01	4.3E-01
Arsenic, inorganic	na	9.2E-02	9.2E-02	2.24	3.55	4.1E-02	2.6E-02
Barium	2.2E-02	2.3E-01	2.6E-01	20.8	41.7	1.2E-02	6.2E-03
Beryllium	na	9.1E-04	9.1E-04	na	na	na	na
Cadmium	1.0E-03	7.8E-02	7.9E-02	1.47	2.37	5.4E-02	3.3E-02
Chromium	3.4E-02	1.6E-01	2.0E-01	2.66	2.78	7.3E-02	7.0E-02
Cobalt	na	9.0E-02	9.0E-02	7.61	7.8	1.2E-02	1.2E-02
Copper	3.7E-02	1.8E+00	1.8E+00	4.05	4.68	4.5E-01	3.9E-01
Lead	6.2E-02	1.5E-01	2.1E-01	1.63	1.94	1.3E-01	1.1E-01
Manganese	na	4.9E+00	4.9E+00	179	348	2.7E-02	1.4E-02
Mercury	3.8E-04	8.7E-03	9.1E-03	0.45	0.9	2.0E-02	1.0E-02
Nickel	4.3E-02	1.8E-01	2.2E-01	6.71	11.5	3.3E-02	1.9E-02
Selenium	7.3E-04	1.3E-01	1.3E-01	0.291	0.368	4.6E-01	3.7E-01
Silver	7.9E-05	1.5E-01	1.5E-01	2.02	20.2	7.3E-02	7.3E-03

Table 4-18 Greater Scaup Exposure Estimates and Hazard Quotients

Analyte	EE-sed (mg/kg/d)	EE-diet (mg/kg/d)	EE-total (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL (mg/kg/d)	HQ-NOAEL	HQ-LOAEL
Vanadium	na	2.6E-01	2.6E-01	0.344	0.413	7.5E-01	6.2E-01
Zinc	1.3E-01	3.8E+00	3.9E+00	66.1	66.5	5.9E-02	5.8E-02

Key:
Black fill = HQ >1
EE-diet = estimated chemical exposure from diet
EE-sed = estimated chemical exposure from incidental sediment ingestion
EE-total = total chemical exposure
EPC = exposure point concentration
HPAH = high molecular weight PAHs
HQ = hazard quotient
LPAH = low molecular weight PAHs
LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level
mg/kg = milligrams per kilogram
mg/kg/day = milligrams per kilogram per day
na = not available or not applicable

Table 4-19 Summary of Potential Risks to Assessment Endpoints at Port Angeles Harbor.

Assessment Endpoint	Representative Species	Summary and Conclusion
Marine plants and macroalgae	Eel grass, kelp	About 25% of the near-shore environment in the harbor has been degraded by wood waste based on studies conducted in 1998 and 2008. The primary areas of accumulation are located in the western portion of the harbor along the base of Ediz Hook, in the Lagoon Area, along the waterfront at the Port of Port Angeles Management Area, and in the Log Pond Area and surrounding the west side of the Rayonier Mill Dock. In areas with adequate light penetration, the sediment environment provides important habitat for marine vegetation. Because a considerable portion of the near-shore sediment environment in Port Angeles Harbor has been degraded by wood waste, it seems reasonable to hypothesize that the ability of Port Angeles Harbor to support marine plants and macroalgae has been compromised.
Benthos	Clams, polychaetes, crabs	Three measures were used to assess potential risks to benthos: (1) sediment chemical concentrations compared with benchmarks; (2) bioassay testing; and (3) evaluation of sediment habitat quality. All three measures suggest that the benthic community may be impaired at the site. First, several metals (arsenic, cadmium, mercury, and zinc) and organic chemicals (bis[2-ethylhexyl]phthalate, butylbenzylphthalate, 4-methylphenol, and phenol) were found to exceed SMS criteria. Second, sediment samples from 29 stations submitted for bioassay testing failed to meet SMS criteria. Third, sediment habitat quality has been impaired by wood waste accumulation in about 25% of the harbor. Benthic community impairment is most evident in the Inner Harbor Area near the base of Ediz Hook, Lagoon Area, Marina Area, and near the Rayonier facility.
Fish	Rock sole, lingcod	Possible risk from arsenic.[2] No unacceptable risks from other chemicals (i.e., all hazard quotients less than 1).
Carnivorous birds	Bald eagle, cormorant	No unacceptable risks.[1]
Omnivorous birds	Greater scaup	No unacceptable risks.[1]
Herbivorous birds	Brant	No unacceptable risks.[1]
Carnivorous mammals	Harbor seal	No unacceptable risks.[1]
Omnivorous mammals	Raccoon	Possible risk from arsenic.[2] No unacceptable risks from other chemicals.

Key:
CSL = Cleanup Screening Level
SMS = Sediment Management Standards
1 = Hazard quotient (HQ) marginally greater than 1.
2 = HQ < 1 for all chemicals evaluated.

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Attachment A – Human Health Indicator Hazardous Substances and Background Tables

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TABLE A-1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Intertidal/Subtidal Sediment

Scenario Timeframe: Future
Medium: Intertidal/Subtidal Sediment
Exposure Medium: Intertidal/Subtidal Sediment

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Log Kow	Log Kow > 3.5	IHS Flag	Rationale for Selection or Deletion (3)
Intertidal/	16766-30-6	4-Chloroguaiacol	153	2	1%	0.12	0.02	mg/kg	0.12	--	--	NA	NA	NO	IFD
Subtidal	90-05-1	Guaiacol (2-Methoxyphenol)	153	2	1%	0.12	0.026	mg/kg	0.12	--	--	NA	NA	NO	IFD
Sediment	2539-17-5	Tetrachloroguaiacol	207	1	0%	2.1	0.019	mg/kg	2.1	--	--	NA	NA	NO	IFD
	7429-90-5	Aluminum	68	68	100%	--	24100	mg/kg	24100	22400	2	NA	NA	NO	BBIO
	7440-36-0	Antimony	236	82	35%	2.4	9.9	mg/kg	9.9	0.2	65	0.730	NO	NO	BBIO
	7440-38-2	Arsenic	308	295	96%	20	69	mg/kg	69	7.1	88	0.680	NO	YES	BIO
	7440-39-3	Barium	236	236	100%	--	53	mg/kg	53	45.6	8	0.230	NO	NO	BBIO
	7440-41-7	Beryllium	68	11	16%	0.81	2.6	mg/kg	2.6	0.46	3	-0.570	NO	NO	BBIO
	7440-43-9	Cadmium	308	288	94%	1.6	5610	mg/kg	5610	2.1	35	-0.070	NO	YES	BIO
	7440-70-2	Calcium	68	68	100%	--	45600	mg/kg	45600	53100	0	NA	NA	NO	NUT
	7440-47-3	Chromium	265	265	100%	--	54.1	mg/kg	54.1	47.5	3	0.230	NO	NO	BBIO
	7440-48-4	Cobalt	68	68	100%	--	909	mg/kg	909	11.5	6	0.230	NO	NO	BBIO
	7440-50-8	Copper	308	308	100%	--	28700	mg/kg	28700	36	71	-0.570	NO	YES	BIO
	7439-89-6	Iron	68	68	100%	--	220000	mg/kg	220000	33300	7	NA	NA	NO	BBIO
	7439-92-1	Lead	290	290	100%	--	10500	mg/kg	10500	8.3	135	0.730	NO	YES	BIO
	7439-95-4	Magnesium	68	68	100%	--	17900	mg/kg	17900	13300	3	NA	NA	NO	BBIO
	7439-96-5	Manganese	68	67	99%	0.15	420	mg/kg	420	284	10	0.230	NO	NO	NUT
	7439-97-6	Mercury	317	291	92%	0.16	8.9	mg/kg	8.9	0.13	99	0.620	NO	YES	BIO
	7440-02-0	Nickel	236	236	100%	--	66	mg/kg	66	45	6	-0.570	NO	YES	BIO
	7440-09-7	Potassium	68	68	100%	--	4330	mg/kg	4330	3730	2	NA	NA	NO	NUT
	7782-49-2	Selenium	122	53	43%	78	3.8	mg/kg	78	--	--	0.240	NO	NO	BBIO
	7440-22-4	Silver	265	204	77%	1.26	1.2	mg/kg	1.26	0.433	6	0.230	NO	YES	BIO
	7440-23-5	Sodium	68	68	100%	--	112600	mg/kg	112600	17900	9	NA	NA	NO	NUT
	7440-28-0	Thallium	68	30	44%	2.4	3.4	mg/kg	3.4	--	--	NA	NA	NO	BBIO
	7440-62-2	Vanadium	68	68	100%	--	87.5	mg/kg	87.5	67.9	8	NA	NA	NO	BBIO
	7440-66-6	Zinc	309	309	100%	--	2010	mg/kg	2010	88.7	61	-0.470	NO	YES	BIO
	65310-45-4	12-Chlorodehydroabietic Acid	181	4	3%	2.1	0.77	mg/kg	2.1	--	--	NA	NA	NO	IFD
	1740-19-8	1-Phenanthrenecarboxylic acid, 1,2,3,4,4a,9,10,10a	127	82	65%	0.5	46	mg/kg	46	--	--	NA	NA	NO	BBIO
	514-10-3	Abietic Acid	179	101	58%	0.79	110	mg/kg	110	--	--	NA	NA	NO	BBIO
	65-85-0	Benzoic Acid	265	23	9%	6.7	0.354	mg/kg	6.7	--	--	1.870	NO	NO	BBIO
	1740-19-3	Dehydroabietic Acid	54	35	65%	0.52	20	mg/kg	20	--	--	NA	NA	NO	BBIO
	57055-39-7	Dichlorodehydroabietic Acid	180	1	1%	2.1	0.096	mg/kg	2.1	--	--	NA	NA	NO	IFD
	5835-26-7	Isopimaric Acid	181	31	17%	2.1	8.1	mg/kg	8.1	--	--	NA	NA	NO	BBIO
	60-33-3	Linoleic Acid	54	5	9%	2.1	7.6	mg/kg	7.6	--	--	NA	NA	NO	BBIO
	463-40-1	Linolenic Acid	127	6	5%	0.5	1.4	mg/kg	1.4	--	--	NA	NA	NO	IFD
	471-77-2	Neoabietic Acid	80	4	5%	0.5	3.1	mg/kg	3.1	--	--	NA	NA	NO	BBIO
	112-80-1	Oleic Acid	127	36	28%	0.5	2.3	mg/kg	2.3	--	--	NA	NA	NO	BBIO
	Oleic-Linol-Mix	Oleic-Linolenic Acid Mixture	54	40	74%	1.1	12	mg/kg	12	--	--	NA	NA	NO	BBIO
	1945-53-5	Palustric Acid	89	6	7%	0.5	1.9	mg/kg	1.9	--	--	NA	NA	NO	BBIO

TABLE A-1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Intertidal/Subtidal Sediment

Scenario Timeframe: Future
Medium: Intertidal/Subtidal Sediment
Exposure Medium: Intertidal/Subtidal Sediment

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Log Kow	Log Kow > 3.5	IHS Flag	Rationale for Selection or Deletion (3)
	127-27-5	Pimaric Acid	181	5	3%	2.1	0.54	mg/kg	2.1	--	--	NA	NA	NO	IFD
	471-74-9	Sandaracopimaric Acid	127	11	9%	0.5	7.5	mg/kg	7.5	--	--	NA	NA	NO	BBIO
	14488-53-0	Dibutyltin ion	5	1	20%	0.0056	0.0055	mg/kg	0.0056	--	--	NA	NA	NO	BBIO
	688-73-3	Tributyltin	12	6	50%	0.0018	0.012	mg/kg	0.012	--	--	NA	NA	YES	BIO
	36643-28-4	Tributyltin ion	5	3	60%	0.0038	0.04	mg/kg	0.04	--	--	NA	NA	YES	BIO
	18496-25-8	Sulfide	200	194	97%	5	7130	mg/kg	7130	408	80	NA	NA	NO	BBIO
	7664-41-7	Ammonia	56	56	100%	--	641	mg/kg	641	--	--	NA	NA	NO	BBIO
	AmmoniaN	Ammonia (NH3) as Nitrogen (N)	123	123	100%	--	403	mg/kg	403	25.4	32	NA	NA	NO	BBIO
	57057-83-7	3,4,5-Trichloroguaiacol (Ac)	207	1	0%	2.1	0.019	mg/kg	2.1	--	--	NA	NA	NO	IFD
	60712-44-9	3,4,6-Trichloroguaiacol (Ac)	153	2	1%	0.12	0.02	mg/kg	0.12	--	--	NA	NA	NO	IFD
	77102-94-4	3,4-Dicloroguaiacol	153	2	1%	0.12	0.02	mg/kg	0.12	--	--	NA	NA	NO	IFD
	2668-24-8	4,5,6 Trichloroguaiacol	153	1	1%	0.12	0.019	mg/kg	0.12	--	--	NA	NA	NO	IFD
	2460-49-3	4,5-Dichloroguaiacol	153	1	1%	0.12	0.019	mg/kg	0.12	--	--	NA	NA	NO	IFD
	16766-31-7	4,6-Dichloroguaiacol	153	2	1%	0.12	0.02	mg/kg	0.12	--	--	NA	NA	NO	IFD
	CPAH-TEQ0	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	301	209	69%	0	1.6286	mg/kg	1.6286	--	--	NA	NA	YES	BIO
	CPAH-TEQ05	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	301	209	69%	0.036545	1.6286	mg/kg	1.6286	--	--	NA	NA	YES	BIO
	90-12-0	1-Methylnaphthalene	232	51	22%	0.254	1.9	mg/kg	1.9	--	--	NA	NA	NO	BBIO
	91-57-6	2-Methylnaphthalene	291	143	49%	0.254	3	mg/kg	3	--	--	3.900	YES	YES	BIO
	9HCarb	9H-Carbazole	67	9	13%	0.132	0.628	mg/kg	0.628	--	--	NA	NA	NO	BBIO
	9HFluor	9H-Fluorene	67	42	63%	0.254	1.18	mg/kg	1.18	--	--	NA	NA	NO	BBIO
	83-32-9	Acenaphthene	291	121	42%	0.254	4.9	mg/kg	4.9	--	--	3.900	YES	YES	BIO
	208-96-8	Acenaphthylene	291	121	42%	0.254	7.934	mg/kg	7.934	--	--	4.100	YES	YES	BIO
	120-12-7	Anthracene	290	176	61%	0.0489	1.5	mg/kg	1.5	--	--	4.500	YES	YES	BIO
	56-55-3	Benz[a]anthracene	289	194	67%	0.131	1.39	mg/kg	1.39	--	--	5.700	YES	YES	BIO
	50-32-8	Benzo(a)pyrene	290	189	65%	0.0489	1.14	mg/kg	1.14	--	--	6.000	YES	YES	BIO
	205-99-2	Benzo(b)fluoranthene	289	198	69%	0.056	1.88	mg/kg	1.88	--	--	NA	NA	YES	BIO
	191-24-2	Benzo(ghi)perylene	292	148	51%	0.254	0.506	mg/kg	0.506	--	--	6.600	YES	YES	BIO
	207-08-9	Benzo(k)fluoranthene	291	179	62%	0.07	0.754	mg/kg	0.754	--	--	NA	NA	YES	BIO
	218-01-9	Chrysene	288	206	72%	0.0859	2.21	mg/kg	2.21	--	--	5.700	YES	YES	BIO
	53-70-3	Dibenzo(a,h)anthracene	301	72	24%	0.254	0.142	mg/kg	0.254	--	--	6.500	YES	YES	BIO
	132-64-9	Dibenzofuran	263	115	44%	0.254	2.7	mg/kg	2.7	--	--	4.100	YES	YES	BIO
	206-44-0	Fluoranthene	287	236	82%	0.047	15	mg/kg	15	0.0211	208	5.000	YES	YES	BIO
	86-73-7	Fluorene	224	117	52%	0.12	4.1	mg/kg	4.1	--	--	4.200	YES	YES	BIO
	193-39-5	Indeno(1,2,3-cd)pyrene	290	138	48%	0.254	0.499	mg/kg	0.499	--	--	6.600	YES	YES	BIO
	91-20-3	Naphthalene	289	178	62%	0.254	6.3	mg/kg	6.3	--	--	3.300	NO	NO	BBIO
	85-01-8	Phenanthrene	289	229	79%	0.019	11.8	mg/kg	11.8	0.016	211	4.500	YES	YES	BIO
	129-00-0	Pyrene	287	232	81%	0.046	8.39	mg/kg	8.39	0.0215	207	4.900	YES	YES	BIO
	101-55-3	4-Bromophenyl phenyl ether	165	2	1%	0.057	0.02	mg/kg	0.057	--	--	5.240	YES	NO	IFD
	53469-21-9	PCB-aroclor 1242	277	10	4%	0.074	0.096	mg/kg	0.096	--	--	6.500	YES	NO	IFD

TABLE A-1

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Port Angeles Harbor Marine Environment - Intertidal/Subtidal Sediment

Scenario Timeframe: Future
Medium: Intertidal/Subtidal Sediment
Exposure Medium: Intertidal/Subtidal Sediment

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Log Kow	Log Kow > 3.5	IHS Flag	Rationale for Selection or Deletion (3)
	11097-69-1	PCB-aroclor 1254	277	33	12%	0.074	0.64	mg/kg	0.64	--	--	6.500	YES	YES	BIO
	11096-82-5	PCB-aroclor 1260	277	77	28%	0.074	0.41	mg/kg	0.41	--	--	6.500	YES	YES	BIO
	11100-14-4	PCB-aroclor 1268	8	1	13%	0.003	0.25	mg/kg	0.25	--	--	6.500	YES	YES	BIO
	37680-65-2	PCB-018	15	3	20%	0.0016	0.00081	mg/kg	0.0016	--	--	6.500	YES	YES	BIO
	7012-37-5	PCB-028	7	6	86%	0.00036	0.0018	mg/kg	0.0018	--	--	6.500	YES	YES	BIO
	16606-02-3	PCB-031	8	3	38%	0.0016	0.0011	mg/kg	0.0016	--	--	6.500	YES	YES	BIO
	41464-39-5	PCB-044	15	10	67%	0.00042	0.0018	mg/kg	0.0018	--	--	6.500	YES	YES	BIO
	35693-99-3	PCB-052	15	12	80%	0.00085	0.0027	mg/kg	0.0027	--	--	6.500	YES	YES	BIO
	32598-10-0	PCB-066	15	10	67%	0.0011	0.002	mg/kg	0.002	--	--	6.500	YES	YES	BIO
	70362-50-4	PCB-081	7	1	14%	0.0043	0.0011	mg/kg	0.0043	--	--	6.500	YES	YES	BIO
	38380-02-8	PCB-087	15	7	47%	0.0013	0.0029	mg/kg	0.0029	--	--	6.500	YES	YES	BIO
	37680-73-2	PCB-101	15	13	87%	0.00009	0.0042	mg/kg	0.0042	--	--	6.500	YES	YES	BIO
	32598-14-4	PCB-105	7	6	86%	0.00056	0.0017	mg/kg	0.0017	--	--	6.500	YES	YES	BIO
	38380-03-9	PCB-110	8	6	75%	0.000088	0.0031	mg/kg	0.0031	--	--	6.500	YES	YES	BIO
	31508-00-6	PCB-118	7	6	86%	0.00056	0.004	mg/kg	0.004	--	--	6.500	YES	YES	BIO
	38380-07-3	PCB-128	7	5	71%	0.0006	0.0015	mg/kg	0.0015	--	--	6.500	YES	YES	BIO
	35065-28-2	PCB-138	15	13	87%	0.000093	0.0054	mg/kg	0.0054	--	--	6.500	YES	YES	BIO
	52712-04-6	PCB-141	8	3	38%	0.00031	0.00085	mg/kg	0.00085	--	--	6.500	YES	YES	BIO
	52663-63-5	PCB-151	8	4	50%	0.00025	0.00069	mg/kg	0.00069	--	--	6.500	YES	YES	BIO
	35065-27-1	PCB-153	15	11	73%	0.00077	0.0054	mg/kg	0.0054	--	--	6.500	YES	YES	BIO
	38380-08-4	PCB-156	7	5	71%	0.00033	0.0011	mg/kg	0.0011	--	--	6.500	YES	YES	BIO
	74472-42-7	PCB-158	7	2	29%	0.00073	0.00077	mg/kg	0.00077	--	--	6.500	YES	YES	BIO
	35065-30-6	PCB-170	15	8	53%	0.00069	0.0018	mg/kg	0.0018	--	--	6.500	YES	YES	BIO
	35065-29-3	PCB-180	15	12	80%	0.00024	0.0032	mg/kg	0.0032	--	--	6.500	YES	YES	BIO
	52663-69-1	PCB-183	15	4	27%	0.00057	0.0012	mg/kg	0.0012	--	--	6.500	YES	YES	BIO
	74472-48-3	PCB-184	7	1	14%	0.0014	0.00088	mg/kg	0.0014	--	--	6.500	YES	YES	BIO
	52663-68-0	PCB-187	15	7	47%	0.0012	0.0017	mg/kg	0.0017	--	--	6.500	YES	YES	BIO
	52663-78-2	PCB-195	7	2	29%	0.00077	0.00082	mg/kg	0.00082	--	--	6.500	YES	YES	BIO
	40186-72-9	PCB-206	15	1	7%	0.00094	0.00027	mg/kg	0.00094	--	--	6.500	YES	YES	BIO
	2051-24-3	PCB-209	7	1	14%	0.00089	0.00027	mg/kg	0.00089	--	--	6.500	YES	YES	BIO
	1336-36-3	PCB	53	53	100%	--	0.64	mg/kg	0.64	--	--	6.500	YES	YES	BIO
	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	277	97	35%	0	0.64	mg/kg	0.64	--	--	6.500	YES	YES	BIO
	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	277	97	35%	0.111	0.6414	mg/kg	0.6414	--	--	6.500	YES	YES	BIO
	PCB-Tot-Cong	PCB, Sum of Congeners	65	65	100%	--	2.93	mg/kg	2.93	0.0012	65	6.500	YES	YES	BIO
	PCB-TOT-CON-TO	PCB, Sum of Congeners, per gram TOC	65	65	100%	--	43.02	mg/kg	43.02	0.106	65	6.500	YES	YES	BIO
	PCDD/PCDF-TEQ	Dioxins and Furans as 2,3,7,8-TCDD TEQs	40	40	100%	--	5.348E-05	mg/kg	5.348E-05	--	--	6.800	YES	YES	BIO
	PCDD/PCDF-TEQ	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	272	272	100%	--	1.213E-04	mg/kg	1.213E-04	5.200E-08	268	6.800	YES	YES	BIO
	PCDD/PCDF-TEQ	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	272	272	100%	--	1.495E-04	mg/kg	1.495E-04	8.750E-07	209	6.800	YES	YES	BIO
	35822-46-9	1,2,3,4,6,7,8-HpCDD	216	211	98%	2.700E-05	5.090E-03	mg/kg	5.090E-03	8.060E-06	167	NA	NA	YES	BIO

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Medium: Intertidal/Subtidal Sediment
Exposure Medium: Intertidal/Subtidal Sediment

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Log Kow	Log Kow > 3.5	IHS Flag	Rationale for Selection or Deletion (3)
	67562-39-4	1,2,3,4,6,7,8-HpCDF	216	195	90%	3.200E-06	1.430E-03	mg/kg	1.430E-03	1.820E-06	166	NA	NA	NO	BBIO
	55673-89-7	1,2,3,4,7,8,9-HpCDF	195	153	78%	6.222E-06	3.670E-05	mg/kg	3.670E-05	1.110E-07	131	NA	NA	NO	BBIO
	39227-28-6	1,2,3,4,7,8-HxCDD	216	180	83%	4.700E-06	2.753E-05	mg/kg	2.753E-05	1.910E-07	148	NA	NA	YES	BIO
	70648-26-9	1,2,3,4,7,8-HxCDF	195	168	86%	7.750E-07	3.730E-05	mg/kg	3.730E-05	2.240E-07	145	NA	NA	YES	BIO
	57653-85-7	1,2,3,6,7,8-HxCDD	216	203	94%	4.000E-06	1.910E-04	mg/kg	1.910E-04	1.010E-06	145	NA	NA	YES	BIO
	57117-44-9	1,2,3,6,7,8-HxCDF	196	175	89%	7.980E-07	1.650E-05	mg/kg	1.650E-05	1.280E-07	148	NA	NA	NO	BBIO
	19408-74-3	1,2,3,7,8,9-HxCDD	216	195	90%	3.300E-06	4.280E-05	mg/kg	4.280E-05	8.200E-07	140	NA	NA	NO	BBIO
	72918-21-9	1,2,3,7,8,9-HxCDF	195	116	59%	1.320E-06	2.110E-05	mg/kg	2.110E-05	--	--	NA	NA	NO	BBIO
	40321-76-4	1,2,3,7,8-PeCDD	216	184	85%	3.300E-06	2.516E-05	mg/kg	2.516E-05	2.360E-07	144	NA	NA	YES	BIO
	57117-41-6	1,2,3,7,8-PeCDF	196	172	88%	5.360E-07	1.933E-05	mg/kg	1.933E-05	1.060E-07	152	NA	NA	NO	BBIO
	60851-34-5	2,3,4,6,7,8-HxCDF	196	167	85%	1.117E-06	1.590E-05	mg/kg	1.590E-05	1.250E-07	143	NA	NA	NO	BBIO
	57117-31-4	2,3,4,7,8-PeCDF	196	180	92%	5.360E-07	2.245E-05	mg/kg	2.245E-05	1.880E-07	152	NA	NA	YES	BIO
	1746-01-6	2,3,7,8-TCDD	216	184	85%	7.500E-07	4.430E-05	mg/kg	4.430E-05	1.160E-07	148	NA	NA	YES	BIO
	51207-31-9	2,3,7,8-TCDF	209	195	93%	8.700E-07	2.860E-05	mg/kg	2.860E-05	7.790E-07	136	NA	NA	YES	BIO
	3268-87-9	OCDD	216	215	100%	5.400E-05	3.120E-02	mg/kg	3.120E-02	5.370E-05	169	8.200	YES	YES	BIO
	39001-02-0	OCDF	216	194	90%	9.500E-06	5.420E-03	mg/kg	5.420E-03	3.020E-06	170	8.000	YES	YES	BIO
	72-54-8	4,4'-DDD	192	62	32%	0.0074	0.065	mg/kg	0.065	--	--	6.020	YES	YES	BIO
	72-55-9	4,4'-DDE	127	35	28%	0.0071	0.014	mg/kg	0.014	--	--	5.690	YES	YES	BIO
	50-29-3	4,4'-DDT	125	58	46%	0.006	0.11	mg/kg	0.11	--	--	6.530	YES	YES	BIO
	309-00-2	Aldrin	73	23	32%	0.00025	0.0019	mg/kg	0.0019	0.0049	0	5.510	YES	YES	BIO
	319-84-6	Alpha-BHC	126	29	23%	0.0011	0.003	mg/kg	0.003	0.0015	2	3.800	YES	YES	BIO
	319-85-7	Beta-BHC	127	35	28%	0.0084	0.04	mg/kg	0.04	0.0022	5	3.780	YES	YES	BIO
	5103-71-9	cis-Chlordane	73	29	40%	0.00025	0.022	mg/kg	0.022	0.00066	7	NA	NA	NO	BBIO
	319-86-8	Delta-BHC	127	19	15%	0.0047	0.0026	mg/kg	0.0047	--	--	4.140	YES	YES	BIO
	60-57-1	Dieldrin	73	10	14%	0.00052	0.0093	mg/kg	0.0093	--	--	5.370	YES	YES	BIO
	959-98-8	Endosulfan I	73	7	10%	0.00028	0.0029	mg/kg	0.0029	--	--	3.830	YES	YES	BIO
	33213-65-9	Endosulfan II	73	17	23%	0.0042	0.0049	mg/kg	0.0049	--	--	3.830	YES	YES	BIO
	1031-07-8	Endosulfan Sulfate	73	15	21%	0.00072	0.013	mg/kg	0.013	--	--	NA	NA	NO	BBIO
	72-20-8	Endrin	73	9	12%	0.001	0.0036	mg/kg	0.0036	--	--	5.060	YES	YES	BIO
	7421-93-4	Endrin Aldehyde	73	17	23%	0.0006	0.0025	mg/kg	0.0025	--	--	NA	NA	NO	BBIO
	53494-70-5	Endrin Ketone	73	7	10%	0.0006	0.0011	mg/kg	0.0011	--	--	NA	NA	NO	BBIO
	5566-34-7	gamma-Chlordane	73	28	38%	0.00025	0.0085	mg/kg	0.0085	0.00074	16	NA	NA	NO	BBIO
	76-44-8	Heptachlor	73	16	22%	0.00032	0.0016	mg/kg	0.0016	--	--	6.100	YES	YES	BIO
	1024-57-3	Heptachlor Epoxide	73	32	44%	0.0012	0.007	mg/kg	0.007	0.00088	13	5.400	YES	YES	BIO
	58-89-9	Lindane	127	25	20%	0.0085	0.0084	mg/kg	0.0085	0.0041	1	3.610	YES	YES	BIO
	72-43-5	Methoxychlor	73	5	7%	0.0032	0.0057	mg/kg	0.0057	--	--	5.080	YES	YES	BIO
	8001-35-2	Toxaphene	73	3	4%	0.024	0.043	mg/kg	0.043	--	--	4.820	YES	NO	IFD
	68476-34-6	#2 Diesel	119	82	69%	33	1300	mg/kg	33	12	67	NA	NA	NO	BBIO
	PHCMOT	Motor Oil	117	96	82%	8.5	3100	mg/kg	8.5	10	90	NA	NA	NO	BBIO

TABLE A-1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Intertidal/Subtidal Sediment

Scenario Timeframe: Future
Medium: Intertidal/Subtidal Sediment
Exposure Medium: Intertidal/Subtidal Sediment

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Log Kow	Log Kow > 3.5	IHS Flag	Rationale for Selection or Deletion (3)
	120-82-1	1,2,4-Trichlorobenzene	198	2	1%	0.11	0.02	mg/kg	0.11	--	--	4.000	YES	NO	IFD
	95-95-4	2,4,5-Trichlorophenol	165	2	1%	0.26	0.098	mg/kg	0.26	--	--	3.720	YES	NO	IFD
	88-06-2	2,4,6-Trichlorophenol	232	3	1%	0.593	0.098	mg/kg	0.593	--	--	3.700	YES	NO	IFD
	120-83-2	2,4-Dichlorophenol	165	2	1%	0.24	0.098	mg/kg	0.24	--	--	2.900	NO	NO	IFD
	105-67-9	2,4-Dimethylphenol	221	6	3%	0.087	0.099	mg/kg	0.099	--	--	2.300	NO	NO	IFD
	51-28-5	2,4-Dinitrophenol	165	2	1%	0.65	0.2	mg/kg	0.65	--	--	1.540	NO	NO	IFD
	121-14-2	2,4-Dinitrotoluene	165	2	1%	0.23	0.098	mg/kg	0.23	--	--	1.980	NO	NO	IFD
	606-20-2	2,6-Dinitrotoluene	165	2	1%	0.32	0.098	mg/kg	0.32	--	--	1.720	NO	NO	IFD
	91-58-7	2-Chloronaphthalene	165	2	1%	0.047	0.02	mg/kg	0.047	--	--	3.380	NO	NO	IFD
	95-57-8	2-Chlorophenol	165	2	1%	0.044	0.02	mg/kg	0.044	--	--	2.150	NO	NO	IFD
	88-74-4	2-Nitroaniline	165	2	1%	0.25	0.098	mg/kg	0.25	--	--	1.850	NO	NO	IFD
	88-75-5	2-Nitrophenol	165	2	1%	0.23	0.098	mg/kg	0.23	--	--	1.790	NO	NO	IFD
	91-94-1	3,3'-Dichlorobenzidine	137	1	1%	0.29	0.098	mg/kg	0.29	--	--	3.510	YES	NO	IFD
	534-52-1	4,6-Dinitro-2-Methylphenol	165	2	1%	0.5	0.2	mg/kg	0.5	--	--	2.120	NO	NO	IFD
	59-50-7	4-Chloro-3-Methylphenol	165	2	1%	0.099	0.098	mg/kg	0.099	--	--	3.100	NO	NO	IFD
	106-47-8	4-Chloroaniline	120	1	1%	0.59	0.098	mg/kg	0.59	--	--	1.830	NO	NO	BBIO
	7005-72-3	4-Chlorophenyl-Phenylether	165	2	1%	0.05	0.02	mg/kg	0.05	--	--	4.080	YES	NO	IFD
	100-01-6	4-Nitroaniline	164	2	1%	0.3	0.098	mg/kg	0.3	--	--	1.390	NO	NO	IFD
	100-02-7	4-Nitrophenol	165	2	1%	0.39	0.098	mg/kg	0.39	--	--	1.910	NO	NO	IFD
	100-51-6	Benzyl Alcohol	158	4	3%	0.086	0.047	mg/kg	0.086	--	--	1.100	NO	NO	IFD
	117-81-7	Bis(2-Ethylhexyl) Phthalate	196	94	48%	0.18	2.8	mg/kg	2.8	--	--	5.100	YES	YES	BIO
	85-68-7	Butyl benzyl phthalate	212	17	8%	0.11	0.67	mg/kg	0.67	--	--	NA	NA	NO	BBIO
	86-74-8	Carbazole	165	48	29%	0.039	0.81	mg/kg	0.81	--	--	NA	NA	NO	BBIO
	84-74-2	Dibutyl phthalate	210	20	10%	0.23	0.04	mg/kg	0.23	--	--	NA	NA	NO	BBIO
	84-66-2	Diethyl phthalate	212	23	11%	0.25	0.093	mg/kg	0.25	--	--	2.500	NO	NO	BBIO
	131-11-3	Dimethyl phthalate	212	7	3%	0.13	0.026	mg/kg	0.13	--	--	1.560	NO	NO	IFD
	117-84-0	Di-N-Octyl Phthalate	212	6	3%	0.084	0.088	mg/kg	0.088	--	--	8.100	YES	NO	IFD
	118-74-1	Hexachlorobenzene	198	2	1%	0.15	0.02	mg/kg	0.15	--	--	5.300	YES	NO	IFD
	87-68-3	Hexachlorobutadiene	198	2	1%	0.098	0.02	mg/kg	0.098	--	--	4.800	YES	NO	IFD
	77-47-4	Hexachlorocyclopentadiene	161	2	1%	0.26	0.098	mg/kg	0.26	--	--	NA	NA	NO	IFD
	78-59-1	Isophorone	165	2	1%	0.049	0.02	mg/kg	0.049	--	--	1.670	NO	NO	IFD
	99-09-2	m-Nitroaniline	146	1	1%	0.45	0.098	mg/kg	0.45	--	--	1.370	NO	NO	IFD
	98-95-3	Nitrobenzene	165	3	2%	0.052	0.02	mg/kg	0.052	--	--	1.850	NO	NO	IFD
	621-64-7	N-Nitrosodi-n-propylamine	164	2	1%	0.21	0.098	mg/kg	0.21	--	--	1.360	NO	NO	IFD
	86-30-6	N-Nitrosodiphenylamine	198	3	2%	0.16	0.02	mg/kg	0.16	--	--	3.100	NO	NO	IFD
	95-48-7	o-Cresol	220	5	2%	0.24	0.04	mg/kg	0.24	--	--	1.950	NO	NO	IFD
	106-44-5	p-Cresol	276	150	54%	0.283	41	mg/kg	41	0.049	96	1.900	NO	NO	BBIO
	87-86-5	Pentachlorophenol	221	4	2%	0.6	0.098	mg/kg	0.6	--	--	5.100	YES	NO	IFD
	108-95-2	Phenol	272	134	49%	0.297	0.76	mg/kg	0.76	0.12	24	1.500	NO	NO	BBIO

TABLE A-1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Intertidal/Subtidal Sediment

Scenario Timeframe: Future
Medium: Intertidal/Subtidal Sediment
Exposure Medium: Intertidal/Subtidal Sediment

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Log Kow	Log Kow > 3.5	IHS Flag	Rationale for Selection or Deletion (3)
	110-86-1	Pyridine	55	1	2%	0.21	0.0042	mg/kg	0.21	--	--	NA	NA	NO	IFD
	483-65-8	Retene	233	141	61%	0.244	630	mg/kg	630	--	--	NA	NA	NO	BBIO
	95-50-1	1,2-Dichlorobenzene	198	3	2%	0.091	0.02	mg/kg	0.091	--	--	3.380	NO	NO	IFD
	541-73-1	1,3-Dichlorobenzene	165	2	1%	0.044	0.02	mg/kg	0.044	--	--	NA	NA	NO	IFD
	106-46-7	1,4-Dichlorobenzene	198	8	4%	0.14	0.03	mg/kg	0.14	--	--	3.500	NO	NO	IFD
	108-60-1	2,2'-Oxybis[1-chloropropane]	165	2	1%	0.047	0.02	mg/kg	0.047	--	--	2.480	NO	NO	IFD
	78-93-3	2-Butanone	67	1	1%	0.0336	0.0211	mg/kg	0.0336	--	--	NA	NA	NO	IFD
	67-64-1	Acetone	67	3	4%	0.0418	0.109	mg/kg	0.109	--	--	NA	NA	NO	IFD
	111-91-1	Bis(2-Chloroethoxy)Methane	165	2	1%	0.052	0.02	mg/kg	0.052	--	--	0.750	NO	NO	IFD
	111-44-4	Bis(2-Chloroethyl)Ether	165	2	1%	0.044	0.02	mg/kg	0.044	--	--	1.290	NO	NO	IFD
	75-15-0	Carbon Disulfide	67	1	1%	0.0336	0.0384	mg/kg	0.0384	--	--	NA	NA	NO	IFD
	67-72-1	Hexachloroethane	165	2	1%	0.042	0.02	mg/kg	0.042	--	--	3.930	YES	NO	IFD
	75-09-2	Methylene Chloride	67	1	1%	0.0336	0.0122	mg/kg	0.0336	--	--	NA	NA	NO	IFD
	108-88-3	Toluene	67	1	1%	0.0336	0.018	mg/kg	0.0336	--	--	NA	NA	NO	IFD

(1) Maximum of detected concentrations or highest detection limit used for screening.

(2) Reference from Dungeness Bay samples.

(3) Rationale Codes:

Selection Reason: Bioaccumulative Compound (BIO)

Deletion Reason: Below bioaccumulative threshold (BBIO)

Essential Nutrient (NUT)

Infrequently detected (IFD)

Definitions:

NA = Not Available

-- = Not applicable

IHS = Indicator Hazardous Substance

mg/kg = milligrams per kilogram

TABLE A-2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Beach/Intertidal Sediment

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
Beach/ Intertidal Sediment	18496-25-8	Sulfide	17	13	76%	0.00951	1220	mg/kg	1220	4.08E+02	4	--	--	YES	NSL; >Bkg
	AVS	Acid Volatile Sulfides (AVS)	5	4	80%	0.4	506	mg/kg	506	--	--	--	--	YES	NSL; Bkg na/nd
	7664-41-7	Ammonia	5	5	100%	--	21.3	mg/kg	21.3	--	--	--	--	YES	NSL; Bkg na/nd
	AmmoniaN	Ammonia (NH3) as Nitrogen (N)	11	11	100%	--	38.4	mg/kg	38.4	2.54E+01	1	--	--	YES	NSL; >Bkg
	57057-83-7	3,4,5-Trichloroguaiacol (Ac)	23	1	4%	0.64	0.019	mg/kg	0.64	--	--	--	--	NO	IFD
	60712-44-9	3,4,6-Trichloroguaiacol (Ac)	18	2	11%	0.02	0.02	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
	77102-94-4	3,4-Dicloroguaiacol	18	2	11%	0.02	0.02	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
	2668-24-8	4,5,6 Trichloroguaiacol	18	1	6%	0.02	0.019	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
	2460-49-3	4,5-Dichloroguaiacol	18	1	6%	0.02	0.019	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
	16766-31-7	4,6-Dichloroguaiacol	18	2	11%	0.02	0.02	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
	16766-30-6	4-Chloroguaiacol	18	2	11%	0.02	0.02	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
	90-05-1	Guaiacol (2-Methoxyphenol)	18	1	6%	0.02	0.019	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
	2539-17-5	Tetrachloroguaiacol	23	1	4%	0.64	0.019	mg/kg	0.64	--	--	--	--	NO	IFD
	7440-36-0	Antimony	21	10	48%	0.239999995	0.589999974	mg/kg	0.589999974	2.00E-01	4	3.20E+01	0	NO	BSL
	7440-38-2	Arsenic	26	26	100%	--	9.9	mg/kg	9.9	7.10E+00	1	6.70E-01	26	YES	ASL; >Bkg
	7440-39-3	Barium	21	21	100%	--	53	mg/kg	53	4.56E+01	1	1.60E+04	0	NO	BSL
	7440-43-9	Cadmium	26	18	69%	0.00052	5.9	mg/kg	5.9	2.10E+00	1	8.00E+01	0	NO	BSL
	7440-47-3	Chromium	21	21	100%	--	40	mg/kg	40	4.75E+01	0	--	--	NO	NSL; <Bkg
	7440-50-8	Copper	26	26	100%	--	61	mg/kg	61	3.60E+01	3	3.00E+03	0	NO	BSL
	7439-92-1	Lead	26	26	100%	--	84.5	mg/kg	84.5	8.30E+00	4	2.50E+02	0	NO	BSL
	7439-97-6	Mercury	28	23	82%	0.01	0.59	mg/kg	0.59	1.30E-01	5	2.00E+00	0	NO	BSL
	7440-02-0	Nickel	21	21	100%	--	62	mg/kg	62	4.50E+01	1	1.60E+03	0	NO	BSL
	7782-49-2	Selenium	5	3	60%	0.2	0.6	mg/kg	0.6	--	--	4.00E+02	0	NO	BSL
	7440-22-4	Silver	21	21	100%	--	0.18	mg/kg	0.18	4.33E-01	0	4.00E+02	0	NO	BSL
	7440-66-6	Zinc	26	26	100%	--	320	mg/kg	320	8.87E+01	1	2.40E+04	0	NO	BSL
	65310-45-4	12-Chlorodehydroabietic Acid	15	1	7%	0.64	0.096	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
	65281-76-7	14-Chlorodehydroabietic Acid	15	1	7%	0.64	0.096	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
	1740-19-8	1-Phenanthrenecarboxylic acid, 1,2,3,4,4a,9,10,10a	10	5	50%	0.29	5	mg/kg	5	--	--	--	--	YES	NSL; Bkg na/nd
	5829-48-1	9,10-Dichlorostearic acid	10	1	10%	0.5	0.096	mg/kg	0.5	--	--	--	--	YES	NSL; Bkg na/nd
	514-10-3	Abietic Acid	15	9	60%	0.37	4.8	mg/kg	4.8	--	--	--	--	YES	NSL; Bkg na/nd
	65-85-0	Benzoic Acid	29	3	10%	1.9	0.26	mg/kg	1.9	--	--	3.20E+05	0	NO	BSL
	1740-19-3	Dehydroabietic Acid	5	4	80%	0.35	3.2	mg/kg	3.2	--	--	--	--	YES	NSL; Bkg na/nd
	57055-39-7	Dichlorodehydroabietic Acid	15	1	7%	0.64	0.096	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
	5835-26-7	Isopimaric Acid	15	2	13%	0.64	1.4	mg/kg	1.4	--	--	--	--	YES	NSL; Bkg na/nd
	60-33-3	Linoleic Acid	5	1	20%	0.64	0.79	mg/kg	0.79	--	--	--	--	YES	NSL; Bkg na/nd
	463-40-1	Linolenic Acid	10	1	10%	0.5	0.096	mg/kg	0.5	--	--	--	--	YES	NSL; Bkg na/nd
	471-77-2	Neoabietic Acid	5	1	20%	0.5	0.68	mg/kg	0.68	--	--	--	--	YES	NSL; Bkg na/nd
	112-80-1	Oleic Acid	10	1	10%	0.5	0.096	mg/kg	0.5	--	--	--	--	YES	NSL; Bkg na/nd
	Oleic-Linol-Mix	Oleic-Linolenic Acid Mixture	5	2	40%	0.41	0.97	mg/kg	0.97	--	--	--	--	YES	NSL; Bkg na/nd
	1945-53-5	Palustric Acid	10	2	20%	0.5	0.64	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
	127-27-5	Pimaric Acid	15	1	7%	0.64	0.096	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
	471-74-9	Sandaracopimaric Acid	10	1	10%	0.5	0.096	mg/kg	0.5	--	--	--	--	YES	NSL; Bkg na/nd
	CPAH-TEQ0	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	29	12	41%	0	0.1323	mg/kg	0.1323	--	--	1.40E-01	0	NO	BSL
	CPAH-TEQ05	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	29	12	41%	0.014345	0.132725	mg/kg	0.132725	--	--	1.40E-01	0	NO	BSL
	90-12-0	1-Methylnaphthalene	24	2	8%	0.019	0.019	mg/kg	0.019	--	--	--	--	YES	NSL; Bkg na/nd
	91-57-6	2-Methylnaphthalene	27	5	19%	0.019	0.024	mg/kg	0.024	--	--	3.20E+02	0	NO	BSL
	83-32-9	Acenaphthene	27	6	22%	0.019	0.034	mg/kg	0.034	--	--	4.80E+03	0	NO	BSL

TABLE A-2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Beach/Intertidal Sediment

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
	208-96-8	Acenaphthylene	27	6	22%	0.019	0.019	mg/kg	0.019	--	--	--	--	YES	NSL; Bkg na/nd
	120-12-7	Anthracene	27	6	22%	0.019	0.043	mg/kg	0.043	--	--	2.40E+04	0	NO	BSL
	56-55-3	Benz[a]anthracene	27	10	37%	0.019	0.089	mg/kg	0.089	--	--	1.00E+00	0	NO	BSL
	50-32-8	Benzo(a)pyrene	27	9	33%	0.019	0.094	mg/kg	0.094	--	--	1.00E-01	0	NO	BSL
	205-99-2	Benzo(b)fluoranthene	27	10	37%	0.019	0.12	mg/kg	0.12	--	--	1.00E+00	0	NO	BSL
	191-24-2	Benzo(ghi)perylene	28	7	25%	0.041	0.033	mg/kg	0.041	--	--	--	--	YES	NSL; Bkg na/nd
	207-08-9	Benzo(k)fluoranthene	27	9	33%	0.019	0.13	mg/kg	0.13	--	--	1.00E+00	0	NO	BSL
	218-01-9	Chrysene	27	12	44%	0.019	0.14	mg/kg	0.14	--	--	1.00E+01	0	NO	BSL
	53-70-3	Dibenzo(a,h)anthracene	29	4	14%	0.043	0.019	mg/kg	0.043	--	--	1.00E+00	0	NO	BSL
	132-64-9	Dibenzofuran	27	5	19%	0.019	0.041	mg/kg	0.041	--	--	1.60E+02	0	NO	BSL
	206-44-0	Fluoranthene	27	17	63%	0.019	0.41	mg/kg	0.41	2.11E-02	11	3.20E+03	0	NO	BSL
	86-73-7	Fluorene	27	6	22%	0.019	0.039	mg/kg	0.039	--	--	3.20E+03	0	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	27	6	22%	0.019	0.03	mg/kg	0.03	--	--	1.00E+00	0	NO	BSL
	91-20-3	Naphthalene	27	9	33%	0.019	0.095	mg/kg	0.095	--	--	5.00E+00	0	NO	BSL
	85-01-8	Phenanthrene	27	14	52%	0.019	0.18	mg/kg	0.18	1.60E-02	12	--	--	YES	NSL; >Bkg
	129-00-0	Pyrene	27	18	67%	0.019	0.29	mg/kg	0.29	2.15E-02	12	2.40E+03	0	NO	BSL
	101-55-3	4-Bromophenyl phenyl ether	24	1	4%	0.019	0.019	mg/kg	0.019	--	--	--	--	NO	IFD
	11096-82-5	PCB-aroclor 1260	26	7	27%	0.0015	0.23	mg/kg	0.23	--	--	--	--	YES	NSL; Bkg na/nd
	1336-36-3	PCB	5	5	100%	--	0.23	mg/kg	0.23	--	--	1.00E+00	0	NO	BSL
	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	26	5	19%	0	0.23	mg/kg	0.23	--	--	1.00E+00	0	NO	BSL
	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	26	5	19%	0.0805	0.2316	mg/kg	0.2316	--	--	1.00E+00	0	NO	BSL
	PCDD/PCDF-TEQ	Dioxins and Furans as 2,3,7,8-TCDD TEQs	5	5	100%	--	2.35035E-05	mg/kg	2.35035E-05	--	--	1.10E-05	3	YES	ASL; Bkg na/nd
	PCDD/PCDF-TEQ	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	27	27	100%	--	9.41442E-05	mg/kg	9.41442E-05	5.20E-08	25	1.10E-05	5	YES	ASL; >Bkg
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	27	27	100%	--	9.41442E-05	mg/kg	9.41442E-05	8.75E-07	8	1.10E-05	5	YES	ASL; >Bkg
	35822-46-9	1,2,3,4,6,7,8-HpCDD	27	25	93%	0.000001236	0.00102	mg/kg	0.00102	8.06E-06	8	--	--	YES	NSL; >Bkg
	67562-39-4	1,2,3,4,6,7,8-HpCDF	27	19	70%	0.00000011	0.000278	mg/kg	0.000278	1.82E-06	9	--	--	YES	NSL; >Bkg
	55673-89-7	1,2,3,4,7,8,9-HpCDF	26	10	38%	0.000000498	0.000011	mg/kg	0.000011	1.11E-07	6	--	--	YES	NSL; >Bkg
	39227-28-6	1,2,3,4,7,8-HxCDD	27	22	81%	0.0000004	0.0000176	mg/kg	0.0000176	1.91E-07	10	--	--	YES	NSL; >Bkg
	70648-26-9	1,2,3,4,7,8-HxCDF	27	14	52%	0.000000592	0.000021709	mg/kg	0.000021709	2.24E-07	10	--	--	YES	NSL; >Bkg
	57653-85-7	1,2,3,6,7,8-HxCDD	27	25	93%	0.000000431	0.0000761	mg/kg	0.0000761	1.01E-06	7	--	--	YES	NSL; >Bkg
	57117-44-9	1,2,3,6,7,8-HxCDF	27	17	63%	0.000000536	0.0000105	mg/kg	0.0000105	1.28E-07	10	--	--	YES	NSL; >Bkg
	19408-74-3	1,2,3,7,8,9-HxCDD	27	25	93%	0.000000393	0.0000385	mg/kg	0.0000385	8.20E-07	8	--	--	YES	NSL; >Bkg
	72918-21-9	1,2,3,7,8,9-HxCDF	26	6	23%	1.320E-06	9.660E-07	mg/kg	1.320E-06	--	--	--	--	YES	NSL; Bkg na/nd
	40321-76-4	1,2,3,7,8-PeCDD	27	25	93%	1.890E-07	1.440E-05	mg/kg	1.440E-05	2.36E-07	10	--	--	YES	NSL; >Bkg
	57117-41-6	1,2,3,7,8-PeCDF	27	17	63%	5.360E-07	8.520E-06	mg/kg	8.520E-06	1.06E-07	13	--	--	YES	NSL; >Bkg
	60851-34-5	2,3,4,6,7,8-HxCDF	27	17	63%	5.650E-07	1.140E-05	mg/kg	1.140E-05	1.25E-07	11	--	--	YES	NSL; >Bkg
	57117-31-4	2,3,4,7,8-PeCDF	27	22	81%	5.360E-07	1.430E-05	mg/kg	1.430E-05	1.88E-07	13	--	--	YES	NSL; >Bkg
	1746-01-6	2,3,7,8-TCDD	27	25	93%	9.100E-08	4.430E-05	mg/kg	4.430E-05	1.16E-07	13	1.10E-05	2	YES	ASL; >Bkg
	51207-31-9	2,3,7,8-TCDF	25	19	76%	1.140E-07	2.470E-05	mg/kg	2.470E-05	7.79E-07	6	--	--	YES	NSL; >Bkg
	3268-87-9	OCDD	27	27	100%	--	8.780E-03	mg/kg	8.780E-03	5.37E-05	9	--	--	YES	NSL; >Bkg
	39001-02-0	OCDF	27	18	67%	3.628E-06	9.411E-04	mg/kg	9.411E-04	3.02E-06	8	--	--	YES	NSL; >Bkg
	72-54-8	4,4'-DDD	26	10	38%	3.200E-04	2.700E-02	mg/kg	2.700E-02	--	--	4.20E+00	0	NO	BSL
	72-55-9	4,4'-DDE	26	7	27%	1.800E-03	5.800E-03	mg/kg	0.0058	--	--	2.90E+00	0	NO	BSL
	50-29-3	4,4'-DDT	26	9	35%	3.200E-04	1.700E-02	mg/kg	1.700E-02	--	--	3.00E+00	0	NO	BSL
	309-00-2	Aldrin	21	12	57%	1.300E-04	2.100E-03	mg/kg	2.100E-03	4.90E-03	0	5.90E-02	0	NO	BSL
	319-84-6	Alpha-BHC	26	3	12%	1.100E-03	7.700E-04	mg/kg	0.0011	1.50E-03	0	1.60E-01	0	NO	BSL
	319-85-7	Beta-BHC	26	3	12%	1.800E-03	4.500E-03	mg/kg	0.0045	2.20E-03	1	5.60E-01	0	NO	BSL
	5103-71-9	cis-Chlordane	21	7	48%	5.600E-04	3.200E-04	mg/kg	0.00056	6.60E-04	0	--	--	NO	NSL; <Bkg

TABLE A-2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Beach/Intertidal Sediment

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
	319-86-8	Delta-BHC	26	10	38%	3.700E-03	2.800E-03	mg/kg	0.0037	--	--	--	--	YES	NSL; Bkg na/nd
	60-57-1	Dieldrin	21	3	29%	1.000E-03	1.200E-03	mg/kg	0.0012	--	--	6.30E-02	0	NO	BSL
	959-98-8	Endosulfan I	21	3	14%	1.400E-04	5.100E-04	mg/kg	5.100E-04	--	--	--	--	YES	NSL; Bkg na/nd
	33213-65-9	Endosulfan II	21	4	19%	3.900E-03	1.600E-03	mg/kg	0.0039	--	--	--	--	YES	NSL; Bkg na/nd
	1031-07-8	Endosulfan Sulfate	21	5	24%	4.100E-04	1.500E-03	mg/kg	1.500E-03	--	--	--	--	YES	NSL; Bkg na/nd
	72-20-8	Endrin	21	2	10%	2.000E-03	6.600E-04	mg/kg	0.002	--	--	2.40E+01	0	NO	BSL
	7421-93-4	Endrin Aldehyde	21	10	48%	3.000E-04	1.100E-03	mg/kg	1.100E-03	--	--	--	--	YES	NSL; Bkg na/nd
	53494-70-5	Endrin Ketone	21	5	24%	3.000E-04	1.100E-03	mg/kg	1.100E-03	--	--	--	--	YES	NSL; Bkg na/nd
	5566-34-7	gamma-Chlordane	21	5	24%	6.000E-04	6.000E-04	mg/kg	0.0006	7.40E-04	0	--	--	NO	NSL; <Bkg
	76-44-8	Heptachlor	21	5	24%	6.300E-04	4.900E-04	mg/kg	0.00063	--	--	2.20E-01	0	NO	BSL
	1024-57-3	Heptachlor Epoxide	21	8	38%	9.800E-04	1.800E-03	mg/kg	0.0018	8.80E-04	2	1.10E-01	0	NO	BSL
	58-89-9	Lindane	26	7	27%	5.400E-04	2.200E-03	mg/kg	0.0022	4.10E-03	0	1.00E-02	0	NO	BSL
	72-43-5	Methoxychlor	21	4	19%	1.600E-03	5.700E-03	mg/kg	5.700E-03	--	--	4.00E+02	0	NO	BSL
	8001-35-2	Toxaphene	21	3	14%	0.012	0.043	mg/kg	0.043	--	--	9.10E-01	0	NO	BSL
	68476-34-6	#2 Diesel	21	10	48%	17	110	mg/kg	110	1.20E+01	5	--	--	YES	NSL; >Bkg
	PHCMOT	Motor Oil	21	12	57%	7.2	370	mg/kg	7.2	1.00E+01	12	--	--	NO	NSL; <Bkg
	120-82-1	1,2,4-Trichlorobenzene	29	1	3%	0.029	0.019	mg/kg	0.029	--	--	8.00E+02	0	NO	IFD
	95-95-4	2,4,5-Trichlorophenol	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	8.00E+03	0	NO	IFD
	88-06-2	2,4,6-Trichlorophenol	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	9.10E+01	0	NO	IFD
	120-83-2	2,4-Dichlorophenol	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	2.40E+02	0	NO	IFD
	105-67-9	2,4-Dimethylphenol	29	1	3%	0.019	0.019	mg/kg	0.019	--	--	1.60E+03	0	NO	IFD
	51-28-5	2,4-Dinitrophenol	24	1	4%	0.19	0.19	mg/kg	0.19	--	--	1.60E+02	0	NO	IFD
	121-14-2	2,4-Dinitrotoluene	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	1.60E+02	0	NO	IFD
	606-20-2	2,6-Dinitrotoluene	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	8.00E+01	0	NO	IFD
	91-58-7	2-Chloronaphthalene	24	1	4%	0.019	0.019	mg/kg	0.019	--	--	6.40E+03	0	NO	IFD
	95-57-8	2-Chlorophenol	24	1	4%	0.019	0.019	mg/kg	0.019	--	--	4.00E+02	0	NO	IFD
	88-74-4	2-Nitroaniline	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
	88-75-5	2-Nitrophenol	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
	534-52-1	4,6-Dinitro-2-Methylphenol	24	1	4%	0.19	0.19	mg/kg	0.19	--	--	--	--	NO	IFD
	59-50-7	4-Chloro-3-Methylphenol	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
	7005-72-3	4-Chlorophenyl-Phenylether	24	1	4%	0.019	0.019	mg/kg	0.019	--	--	--	--	NO	IFD
	100-01-6	4-Nitroaniline	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
	100-02-7	4-Nitrophenol	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
	117-81-7	Bis(2-Ethylhexyl) Phthalate	27	9	33%	0.019	0.13	mg/kg	0.13	--	--	7.10E+01	0	NO	BSL
	85-68-7	Butyl benzyl phthalate	29	2	7%	0.029	0.073	mg/kg	0.073	--	--	1.60E+04	0	NO	BSL
	86-74-8	Carbazole	24	2	8%	0.019	0.019	mg/kg	0.019	--	--	5.00E+01	0	NO	BSL
	84-74-2	Dibutyl phthalate	29	1	3%	0.051	0.019	mg/kg	0.051	--	--	8.00E+03	0	NO	IFD
	84-66-2	Diethyl phthalate	29	2	7%	0.068	0.019	mg/kg	0.068	--	--	6.40E+04	0	NO	BSL
	131-11-3	Dimethyl phthalate	29	1	3%	0.035	0.019	mg/kg	0.035	--	--	8.00E+04	0	NO	IFD
	117-84-0	Di-N-Octyl Phthalate	29	1	3%	0.024	0.019	mg/kg	0.024	--	--	1.60E+03	0	NO	IFD
	118-74-1	Hexachlorobenzene	29	1	3%	0.041	0.019	mg/kg	0.041	--	--	6.30E-01	0	NO	IFD
	87-68-3	Hexachlorobutadiene	29	1	3%	0.028	0.019	mg/kg	0.028	--	--	1.30E+01	0	NO	IFD
	77-47-4	Hexachlorocyclopentadiene	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	4.80E+02	0	NO	IFD
	78-59-1	Isophorone	24	1	4%	0.019	0.019	mg/kg	0.019	--	--	1.10E+03	0	NO	IFD
	98-95-3	Nitrobenzene	24	1	4%	0.019	0.019	mg/kg	0.019	--	--	4.00E+01	0	NO	IFD
	621-64-7	N-Nitrosodi-n-propylamine	24	1	4%	0.097	0.097	mg/kg	0.097	--	--	1.40E-01	0	NO	IFD
	86-30-6	N-Nitrosodiphenylamine	29	1	3%	0.043	0.019	mg/kg	0.043	--	--	2.00E+02	0	NO	IFD
	95-48-7	o-Cresol	29	1	3%	0.066	0.019	mg/kg	0.066	--	--	4.00E+03	0	NO	IFD

TABLE A-2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Beach/Intertidal Sediment

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
	106-44-5	p-Cresol	27	6	22%	0.019	0.37	mg/kg	0.37	4.90E-02	2	4.00E+02	0	NO	BSL
	87-86-5	Pentachlorophenol	29	2	7%	0.17	0.097	mg/kg	0.17	--	--	8.30E+00	0	NO	BSL
	108-95-2	Phenol	27	9	33%	0.028	0.11	mg/kg	0.11	1.20E-01	0	4.80E+04	0	NO	BSL
	483-65-8	Retene	24	6	25%	0.019	0.2	mg/kg	0.2	--	--	--	--	YES	NSL; Bkg na/nd
	95-50-1	1,2-Dichlorobenzene	29	1	3%	0.026	0.019	mg/kg	0.026	--	--	7.20E+03	0	NO	IFD
	541-73-1	1,3-Dichlorobenzene	24	1	4%	0.019	0.019	mg/kg	0.019	--	--	--	--	NO	IFD
	106-46-7	1,4-Dichlorobenzene	29	1	3%	0.037	0.019	mg/kg	0.037	--	--	4.20E+01	0	NO	IFD
	108-60-1	2,2'-Oxybis[1-chloropropane]	24	1	4%	0.019	0.019	mg/kg	0.019	--	--	1.40E+01	0	NO	IFD
	111-91-1	Bis(2-Chloroethoxy)Methane	24	1	4%	0.019	0.019	mg/kg	0.019	--	--	--	--	NO	IFD
	111-44-4	Bis(2-Chloroethyl)Ether	24	1	4%	0.019	0.019	mg/kg	0.019	--	--	9.10E-01	0	NO	IFD
	67-72-1	Hexachloroethane	24	1	4%	0.019	0.019	mg/kg	0.019	--	--	7.10E+01	0	NO	IFD

(1) Maximum of detected concentration or highest detection limit used for screening.

(2) Background from Dungeness Bay samples.

(3) Screening Toxicity Value from MTCA Method B Unrestricted Land Use, unless indicated otherwise in text.

(4) Rationale Codes:

Selection Reason: Above Screening Levels; Greater than Background/Reference (ASL; >Bkg)
Above Screening Levels; No background/reference available or all background non-detect (ASL; Bkg na/nd)
No Screening Level; Detected above background/reference (NSL;>Bkg)
No Screening Level; No background/reference available or all background/reference non-detect (NSL; Bkg na/nd)

Deletion Reason: Below Screening Level (BSL)
Infrequently Detected (IFD)
No Screening Level; Detected below background/reference (NSL; <Bkg)

Definitions: -- = Not applicable
IHS = Indicator Hazardous Substance

TABLE A-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Fish and Shellfish Tissue

Scenario Timeframe: Current
Medium: Fish and Shellfish Tissue
Exposure Medium: Fish and Shellfish Tissue

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
Coonstripe	7440-38-2	Arsenic	3	3	100%	--	8.48	mg/kg	8.48	12.9	0	0.0000942	3	NO	ASL; <Bkg
Shrimp	7440-38-2-Inorg	Arsenic, Inorganic	3	3	100%	--	0.009	mg/kg	0.009	0.012	0	0.0000942	3	NO	ASL;<Bkg
	7440-43-9	Cadmium	3	3	100%	--	0.04	mg/kg	0.04	0.04	0	0.0141	3	NO	ASL; <Bkg
	7440-50-8	Copper	3	3	100%	--	5.14	mg/kg	5.14	5.19	0	0.565	3	NO	ASL; <Bkg
	7440-66-6	Zinc	3	3	100%	--	12.6	mg/kg	12.6	11.2	3	4.24	3	YES	ASL; >Bkg
	22967-92-6	Methylmercury(1+)	3	3	100%	--	0.03	mg/kg	0.03	0.05	0	0.00141	3	NO	ASL; <Bkg
	78-00-2	Tetraethyl Lead	3	3	100%	--	0.007	mg/kg	0.007	0.004	3	0.00000141	3	YES	ASL; >Bkg
	CPAH-TEQ0	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	3	3	100%	--	0.0000485	mg/kg	0.0000485	--	--	0.0000194	2	YES	ASL; Bkg na/nd
	CPAH-TEQ05	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	3	3	100%	--	0.000281	mg/kg	0.000281	--	--	0.0000194	3	YES	ASL; Bkg na/nd
	91-57-6	2-Methylnaphthalene	3	3	100%	--	0.0018	mg/kg	0.0018	--	--	0.0565	0	NO	BSL
	83-32-9	Acenaphthene	3	3	100%	--	0.0048	mg/kg	0.0048	--	--	0.848	0	NO	BSL
	208-96-8	Acenaphthylene	3	3	100%	--	0.00055	mg/kg	0.00055	--	--	--	--	YES	NSL; Bkg na/nd
	120-12-7	Anthracene	3	3	100%	--	0.00032	mg/kg	0.00032	--	--	4.24	0	NO	BSL
	56-55-3	Benz[a]anthracene	3	1	33%	0.00017	0.00043	mg/kg	0.00043	--	--	0.000194	1	YES	ASL; Bkg na/nd
	205-99-2	Benzo(b)fluoranthene	3	1	33%	0.00315	0.00032	mg/kg	0.00315	--	--	0.000194	1	YES	ASL; Bkg na/nd
	218-01-9	Chrysene	3	2	67%	0.00017	0.00055	mg/kg	0.00055	--	--	0.0194	0	NO	BSL
	206-44-0	Fluoranthene	3	3	100%	--	0.0027	mg/kg	0.0027	--	--	0.565	0	NO	BSL
	7782-41-4	Fluorene	3	3	100%	--	0.00077	mg/kg	0.00077	--	--	0.848	0	NO	BSL
	91-20-3	Naphthalene	3	3	100%	--	0.0052	mg/kg	0.0052	0.00078	3	0.283	3	NO	BSL
	85-01-8	Phenanthrene	3	3	100%	--	0.0032	mg/kg	0.0032	0.00031	3	--	--	YES	NSL; >Bkg
	129-00-0	Pyrene	3	3	100%	--	0.0017	mg/kg	0.0017	--	--	0.424	0	NO	BSL
	11096-82-5	PCB-aroclor 1260	3	3	100%	--	0.0069	mg/kg	0.0069	--	--	0.0000707	3	YES	ASL; Bkg na/nd
	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	3	3	100%	--	0.0069	mg/kg	0.0069	--	--	0.0000707	3	YES	ASL; Bkg na/nd
	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	3	3	100%	--	0.0088	mg/kg	0.0088	--	--	0.0000707	3	YES	ASL; Bkg na/nd
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	3	3	100%	--	1.416E-09	mg/kg	1.416E-09	4.000E-10	2	0.0000000011	1	YES	ASL; >Bkg
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	3	3	100%	--	2.429E-07	mg/kg	2.429E-07	3.425E-07	0	0.0000000011	3	NO	ASL; <Bkg
	37871-00-4	Total HpCDD	3	2	67%	7.200E-07	1.140E-06	mg/kg	1.140E-06	--	--	0.000000109	2	YES	ASL; Bkg na/nd
	3268-87-9	OCDD	3	3	100%	--	2.690E-06	mg/kg	2.690E-06	1.370E-06	2	0.00000362	0	NO	BSL
	39001-02-0	OCDF	3	2	67%	5.200E-07	2.030E-06	mg/kg	2.030E-06	1.120E-06	1	0.00000362	0	NO	BSL
	50-29-3	4,4'-DDT	3	3	100%	--	0.0013	mg/kg	0.0013	--	--	0.000416	3	YES	ASL; Bkg na/nd
	319-84-6	Alpha-BHC	3	3	100%	--	0.00064	mg/kg	0.00064	0.00071	0	0.0000224	3	NO	ASL; <Bkg
	319-85-7	Beta-BHC	3	1	33%	0.002	0.006	mg/kg	0.006	--	--	0.0000785	1	YES	ASL; Bkg na/nd
	110-86-1	Pyridine	3	3	100%	--	0.28	mg/kg	0.28	0.18	2	0.0141	3	YES	ASL; >Bkg
Dungeness	7440-38-2	Arsenic	3	3	100%	--	14.5	mg/kg	14.5	13.2	3	0.0000942	3	YES	ASL; >Bkg
Crab -	7440-38-2-Inorg	Arsenic, Inorganic	3	3	100%	--	0.23	mg/kg	0.23	0.65	0	0.0000942	3	NO	ASL;<Bkg
Hepatopancreas	7440-43-9	Cadmium	3	3	100%	--	3.66	mg/kg	3.66	1.46	3	0.0141	3	YES	ASL; >Bkg
	7440-50-8	Copper	3	3	100%	--	99.8	mg/kg	99.8	54.9	3	0.565	3	YES	ASL; >Bkg
	7782-49-2	Selenium	3	3	100%	--	2.8	mg/kg	2.8	2	3	0.0707	3	YES	ASL; >Bkg
	7440-66-6	Zinc	3	3	100%	--	25.3	mg/kg	25.3	22.6	2	4.24	3	YES	ASL; >Bkg
	22967-92-6	Methylmercury(1+)	3	3	100%	--	0.22	mg/kg	0.22	0.1	3	0.00141	3	YES	ASL; >Bkg
	78-00-2	Tetraethyl Lead	3	3	100%	--	0.05	mg/kg	0.05	0.03	3	0.00000141	3	YES	ASL; >Bkg
	CPAH-TEQ0	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	3	1	33%	0	0.0002246	mg/kg	0.0002246	--	--	0.0000194	1	YES	ASL; Bkg na/nd
	CPAH-TEQ05	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	3	1	33%	0.00009185	0.0002746	mg/kg	0.0002746	--	--	0.0000194	1	YES	ASL; Bkg na/nd
	83-32-9	Acenaphthene	3	2	67%	0.00008	0.00049	mg/kg	0.00049	0.00017	2	0.848	0	NO	BSL
	208-96-8	Acenaphthylene	3	2	67%	0.00012	0.00017	mg/kg	0.00017	--	--	--	--	YES	NSL; Bkg na/nd
	120-12-7	Anthracene	3	3	100%	--	0.00095	mg/kg	0.00095	0.0017	0	4.24	0	NO	BSL

TABLE A-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Fish and Shellfish Tissue

Scenario Timeframe: Current
Medium: Fish and Shellfish Tissue
Exposure Medium: Fish and Shellfish Tissue

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
	56-55-3	Benz[a]anthracene	3	1	33%	0.00017	0.00073	mg/kg	0.00073	--	--	0.000194	1	YES	ASL; Bkg na/nd
	205-99-2	Benzo(b)fluoranthene	3	1	33%	0.00015	0.00038	mg/kg	0.00038	--	--	0.000194	1	YES	ASL; Bkg na/nd
	191-24-2	Benzo(ghi)perylene	3	1	33%	0.0002	0.00034	mg/kg	0.00034	--	--	--	--	YES	NSL; Bkg na/nd
	207-08-9	Benzo(k)fluoranthene	3	1	33%	0.00017	0.00035	mg/kg	0.00035	--	--	0.00194	0	NO	BSL
	218-01-9	Chrysene	3	1	33%	0.00017	0.00066	mg/kg	0.00066	--	--	0.0194	0	NO	BSL
	53-70-3	Dibenzo(a,h)anthracene	3	1	33%	0.00015	0.00039	mg/kg	0.00039	--	--	0.0000194	1	YES	ASL; Bkg na/nd
	206-44-0	Fluoranthene	3	1	33%	0.00037	0.0013	mg/kg	0.0013	--	--	0.565	0	NO	BSL
	7782-41-4	Fluorene	3	2	67%	0.00037	0.00048	mg/kg	0.00048	--	--	0.848	0	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	3	1	33%	0.00018	0.00033	mg/kg	0.00033	--	--	0.000194	1	YES	ASL; Bkg na/nd
	91-20-3	Naphthalene	3	3	100%	--	0.00087	mg/kg	0.00087	0.001	0	0.283	0	NO	BSL
	85-01-8	Phenanthrene	3	3	100%	--	0.0012	mg/kg	0.0012	0.0057	0	--	--	NO	NSL;<Bkg
	129-00-0	Pyrene	3	1	33%	0.00039	0.0012	mg/kg	0.0012	--	--	0.424	0	NO	BSL
	11097-69-1	PCB-aroclor 1254	3	3	100%	--	0.23	mg/kg	0.23	0.011	3	0.0000707	3	YES	ASL; >Bkg
	11096-82-5	PCB-aroclor 1260	3	3	100%	--	0.73	mg/kg	0.73	0.017	3	0.0000707	3	YES	ASL; >Bkg
	1336-36-3	PCB	3	3	100%	--	0.96	mg/kg	0.96	0.033	3	0.0000707	3	YES	ASL; >Bkg
	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	3	3	100%	--	0.96	mg/kg	0.96	0.028	3	0.0000707	3	YES	ASL; >Bkg
	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	3	3	100%	--	0.960095	mg/kg	0.960095	0.02895	3	0.0000707	3	YES	ASL; >Bkg
	PCB-Tot-Cong	PCB, Sum of Congeners	8	8	100%	--	5.79952	mg/kg	5.79952	0.04945	8	--	--	YES	NSL; >Bkg
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	11	11	100%	--	3.837E-05	mg/kg	3.837E-05	1.200E-06	9	0.0000000011	11	YES	ASL; >Bkg
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	11	11	100%	--	3.837E-05	mg/kg	3.837E-05	1.200E-06	9	0.0000000011	11	YES	ASL; >Bkg
	35822-46-9	1,2,3,4,6,7,8-HpCDD	3	3	100%	--	2.780E-06	mg/kg	2.780E-06	7.600E-07	2	--	--	YES	NSL; >Bkg
	67562-39-4	1,2,3,4,6,7,8-HpCDF	3	2	67%	1.600E-07	8.800E-07	mg/kg	8.800E-07	--	--	--	--	YES	NSL; Bkg na/nd
	39227-28-6	1,2,3,4,7,8-HxCDD	3	1	33%	1.600E-07	5.300E-07	mg/kg	5.300E-07	--	--	--	--	YES	NSL; Bkg na/nd
	70648-26-9	1,2,3,4,7,8-HxCDF	3	1	33%	1.900E-07	7.600E-07	mg/kg	7.600E-07	--	--	--	--	YES	NSL; Bkg na/nd
	57653-85-7	1,2,3,6,7,8-HxCDD	3	3	100%	--	2.740E-06	mg/kg	2.740E-06	6.800E-07	3	--	--	YES	NSL; >Bkg
	57117-44-9	1,2,3,6,7,8-HxCDF	3	1	33%	1.900E-07	3.700E-07	mg/kg	3.700E-07	--	--	--	--	YES	NSL; Bkg na/nd
	19408-74-3	1,2,3,7,8,9-HxCDD	3	1	33%	1.600E-07	6.300E-07	mg/kg	6.300E-07	--	--	--	--	YES	NSL; Bkg na/nd
	40321-76-4	1,2,3,7,8-PeCDD	3	1	33%	1.200E-07	1.210E-06	mg/kg	1.210E-06	3.400E-07	1	--	--	YES	NSL; >Bkg
	57117-41-6	1,2,3,7,8-PeCDF	3	1	33%	1.400E-07	7.200E-07	mg/kg	7.200E-07	--	--	0.0000000362	1	YES	ASL; Bkg na/nd
	57117-31-4	2,3,4,7,8-PeCDF	3	2	67%	1.300E-07	1.950E-06	mg/kg	1.950E-06	3.600E-07	1	0.0000000036	2	YES	ASL; >Bkg
	1746-01-6	2,3,7,8-TCDD	3	1	33%	7.000E-08	5.000E-07	mg/kg	5.000E-07	--	--	0.0000000011	1	YES	ASL; Bkg na/nd
	51207-31-9	2,3,7,8-TCDF	3	2	67%	3.000E-07	1.920E-06	mg/kg	1.920E-06	6.900E-07	2	0.0000000109	2	YES	ASL; >Bkg
	72-55-9	4,4'-DDE	3	3	100%	--	0.013	mg/kg	0.013	0.014	0	0.000416	3	NO	ASL; <Bkg
	50-29-3	4,4'-DDT	3	3	100%	--	0.11	mg/kg	0.11	0.0049	3	0.000416	3	YES	ASL; >Bkg
	319-84-6	Alpha-BHC	3	3	100%	--	0.002	mg/kg	0.002	0.0018	1	0.0000224	3	YES	ASL; >Bkg
	319-85-7	Beta-BHC	3	3	100%	--	0.0021	mg/kg	0.0021	0.0034	0	0.0000785	3	NO	ASL; <Bkg
	319-86-8	Delta-BHC	3	1	33%	0.00035	0.00082	mg/kg	0.00082	0.00062	1	--	--	YES	NSL; >Bkg
Dungeness Crab - Muscle	7440-38-2	Arsenic	3	3	100%	--	12.8	mg/kg	12.8	10.4	3	0.0000942	3	YES	ASL; >Bkg
	7440-38-2-Inorg	Arsenic, Inorganic	3	2	67%	0.004	0.011	mg/kg	0.011	0.01	1	0.0000942	2	YES	ASL; >Bkg
	7440-43-9	Cadmium	3	3	100%	--	0.015	mg/kg	0.015	0.013	3	0.0141	1	YES	ASL; >Bkg
	7440-50-8	Copper	3	3	100%	--	5.64	mg/kg	5.64	5.09	2	0.565	3	YES	ASL; >Bkg
	7782-49-2	Selenium	3	3	100%	--	0.9	mg/kg	0.9	0.7	2	0.0707	3	YES	ASL; >Bkg
	7440-66-6	Zinc	3	3	100%	--	50.2	mg/kg	50.2	41.7	3	4.24	3	YES	ASL; >Bkg
	22967-92-6	Methylmercury(1+)	3	3	100%	--	0.11	mg/kg	0.11	0.09	2	0.00141	3	YES	ASL; >Bkg
	78-00-2	Tetraethyl Lead	3	3	100%	--	0.006	mg/kg	0.006	0.007	0	0.00000141	3	NO	ASL; <Bkg
	85-01-8	Phenanthrene	3	2	67%	0.00019	0.00024	mg/kg	0.00024	0.0002	2	--	--	YES	NSL; >Bkg
	11097-69-1	PCB-aroclor 1254	3	3	100%	--	0.015	mg/kg	0.015	0.013	1	0.0000707	3	YES	ASL; >Bkg

TABLE A-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Fish and Shellfish Tissue

Scenario Timeframe: Current
Medium: Fish and Shellfish Tissue
Exposure Medium: Fish and Shellfish Tissue

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
	11096-82-5	PCB-aroclor 1260	3	3	100%	--	0.035	mg/kg	0.035	0.014	1	0.0000707	3	YES	ASL; >Bkg
	1336-36-3	PCB	3	1	33%	0.017	0.05	mg/kg	0.05	0.028	1	0.0000707	1	YES	ASL; >Bkg
	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	3	3	100%	--	0.05	mg/kg	0.05	0.027	1	0.0000707	3	YES	ASL; >Bkg
	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	3	3	100%	--	0.05095	mg/kg	0.05095	0.02795	1	0.0000707	3	YES	ASL; >Bkg
	PCB-Tot-Cong	PCB, Sum of Congeners	8	8	100%	--	0.17881	mg/kg	0.17881	0.00192	8	--	--	YES	NSL; >Bkg
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	11	8	73%	0.000E+00	6.500E-07	mg/kg	6.500E-07	2.000E-08	8	0.0000000011	8	YES	ASL; >Bkg
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	11	8	73%	2.963E-07	6.560E-07	mg/kg	6.560E-07	1.780E-08	8	0.0000000011	8	YES	ASL; >Bkg
	72-55-9	4,4'-DDE	3	2	67%	0.00033	0.0008	mg/kg	0.0008	0.014	0	0.000416	2	NO	ASL; <Bkg
	50-29-3	4,4'-DDT	3	1	33%	0.001	0.0047	mg/kg	0.0047	0.005	0	0.000416	1	NO	ASL; <Bkg
	319-86-8	Delta-BHC	3	2	67%	0.0016	0.001	mg/kg	0.0016	--	--	--	--	YES	NSL; Bkg na/nd
	58-89-9	Lindane	3	2	67%	0.001	0.001	mg/kg	0.001	0.0017	0	0.000128	2	NO	ASL; <Bkg
Geoduck -	7429-90-5	Aluminum	3	3	100%	--	92.3	mg/kg	92.3	--	--	14.1	3	YES	ASL; Bkg na/nd
Whole	7440-36-0	Antimony	5	1	20%	0.05	0.0077	mg/kg	0.05	--	--	0.00565	1	YES	ASL; Bkg na/nd
	7440-38-2	Arsenic	7	7	100%	--	5.25	mg/kg	5.25	4.21	3	0.0000942	7	YES	ASL
	7440-38-2-Inorg	Arsenic, Inorganic	3	3	100%	--	1.41	mg/kg	1.41	0.4	3	0.0000942	3	YES	ABSL; >Bkg
	7440-39-3	Barium	4	4	100%	--	0.682	mg/kg	0.682	0.996	0	2.83	0	NO	BSL
	7440-41-7	Beryllium	3	1	33%	0.004	0.0056	mg/kg	0.0056	--	--	0.0283	0	NO	BSL
	7440-43-9	Cadmium	7	7	100%	--	0.48	mg/kg	0.48	0.3	3	0.0141	7	YES	ASL
	7440-70-2	Calcium	3	3	100%	--	1500	mg/kg	1500	--	--	--	--	NO	NUT
	7440-47-3	Chromium	4	4	100%	--	0.49	mg/kg	0.49	0.43	2	21	0	NO	BSL
	7440-48-4	Cobalt	3	3	100%	--	0.553	mg/kg	0.553	--	--	0.00424	3	YES	ASL; Bkg na/nd
	7440-50-8	Copper	7	7	100%	--	7.43	mg/kg	7.43	2.6	5	0.565	7	YES	ASL
	7439-89-6	Iron	3	3	100%	--	911	mg/kg	911	--	--	9.89	3	NO	NUT
	7439-92-1	Lead	4	4	100%	--	1.05	mg/kg	1.05	1.04	1	--	--	YES	NSL; >Bkg
	7439-95-4	Magnesium	3	3	100%	--	714	mg/kg	714	--	--	--	--	NO	NUT
	7439-96-5	Manganese	3	3	100%	--	29.9	mg/kg	29.9	--	--	1.98	2	YES	ASL; Bkg na/nd
	7439-97-6	Mercury	4	3	75%	0.05	0.082	mg/kg	0.082	--	--	0.00424	3	YES	ASL; >Bkg
	7440-02-0	Nickel	5	5	100%	--	0.86	mg/kg	0.86	--	--	0.283	3	YES	ASL; Bkg na/nd
	7440-09-7	Potassium	3	3	100%	--	2820	mg/kg	2820	--	--	--	--	NO	NUT
	7782-49-2	Selenium	6	6	100%	--	0.824	mg/kg	0.824	0.943	0	0.0707	6	NO	ASL; <Bkg
	7440-22-4	Silver	4	4	100%	--	0.94	mg/kg	0.94	0.739	1	0.0707	4	YES	ASL
	7440-23-5	Sodium	3	3	100%	--	4210	mg/kg	4210	--	--	--	--	NO	NUT
	7440-62-2	Vanadium	3	3	100%	--	1.58	mg/kg	1.58	--	--	0.0989	3	YES	ASL; Bkg na/nd
	7440-66-6	Zinc	7	7	100%	--	24.2	mg/kg	24.2	54.1	0	4.24	7	NO	ASL; <Bkg
	22967-92-6	Methylmercury(1+)	3	3	100%	--	0.04	mg/kg	0.04	0.03	1	0.00141	3	YES	ASL
	78-00-2	Tetraethyl Lead	3	3	100%	--	0.99	mg/kg	0.99	0.29	3	0.00000141	3	YES	ASL
	CPAH-TEQ0	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	4	2	50%	0	0.000767	mg/kg	0.000767	0.0001	2	0.0000194	2	YES	ASL
	CPAH-TEQ05	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	4	2	50%	0.33085	0.0007745	mg/kg	0.33085	0.0001483	2	0.0000194	2	YES	ASL
	83-32-9	Acenaphthene	4	2	50%	0.49	0.00017	mg/kg	0.49	0.00024	0	0.848	0	NO	BSL
	208-96-8	Acenaphthylene	4	2	50%	0.5	0.000227	mg/kg	0.5	0.00054	0	--	--	NO	ASL; <Bkg
	120-12-7	Anthracene	4	1	25%	0.16	0.00021	mg/kg	0.16	0.0003	0	4.24	0	NO	BSL
	56-55-3	Benz[a]anthracene	4	1	25%	0.49	0.0013	mg/kg	0.49	0.00049	1	0.000194	1	YES	ASL
	50-32-8	Benzo(a)pyrene	4	3	75%	0.49	0.00046	mg/kg	0.49	0.000151	2	0.0000194	2	YES	ASL
	205-99-2	Benzo(b)fluoranthene	4	2	50%	0.098	0.00091	mg/kg	0.098	--	--	0.000194	2	YES	ASL; Bkg na/nd
	191-24-2	Benzo(ghi)perylene	4	3	75%	0.49	0.00034	mg/kg	0.49	0.000136	--	--	--	YES	NSL; <Bkg
	207-08-9	Benzo(k)fluoranthene	4	1	25%	0.1	0.00032	mg/kg	0.1	--	--	0.00194	0	YES	ASL; Bkg na/nd
	218-01-9	Chrysene	4	2	50%	0.49	0.0012	mg/kg	0.49	0.00038	2	0.0194	0	YES	ASL
	53-70-3	Dibenzo(a,h)anthracene	4	1	25%	0.5	0.000085	mg/kg	0.000085	--	--	0.0000194	1	YES	ASL

TABLE A-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Fish and Shellfish Tissue

Scenario Timeframe: Current
Medium: Fish and Shellfish Tissue
Exposure Medium: Fish and Shellfish Tissue

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
	206-44-0	Fluoranthene	4	3	75%	0.49	0.0015	mg/kg	0.49	0.001	2	0.565	0	NO	BSL
	86-73-7	Fluorene	4	1	25%	0.49	0.00037	mg/kg	0.49	--	--	0.565	0	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	4	2	50%	0.49	0.00042	mg/kg	0.49	0.00022	1	0.000194	1	YES	ASL
	91-20-3	Naphthalene	4	2	50%	0.49	0.00067	mg/kg	0.49	0.00085	0	0.283	0	YES	ASL
	85-01-8	Phenanthrene	4	3	75%	0.078	0.001	mg/kg	0.078	0.0011	0	--	--	YES	NSL; >Bkg
	129-00-0	Pyrene	4	2	50%	0.16	0.0012	mg/kg	0.16	0.00043	2	0.424	0	NO	BSL
	11097-69-1	PCB-aroclor 1254	6	2	33%	0.02	0.0074	mg/kg	0.02	0.0035	2	0.0000707	2	YES	ASL
	11096-82-5	PCB-aroclor 1260	6	5	83%	0.0019	0.0059	mg/kg	0.0059	--	--	0.0000707	5	YES	ASL; Bkg na/nd
	32598-13-3	PCB-077	1	1	100%	--	0.00000165	mg/kg	0.00000165	0.000000993	1	0.0000109	0	NO	BSL
	32598-14-4	PCB-105	1	1	100%	--	0.0000236	mg/kg	0.0000236	0.0000108	1	0.0000362	0	NO	BSL
	74472-37-0	PCB-114	1	1	100%	--	0.0000055	mg/kg	0.0000055	0.00000136	1	0.0000362	0	NO	BSL
	31508-00-6	PCB-118	1	1	100%	--	0.0000741	mg/kg	0.0000741	0.0000325	1	0.0000362	1	YES	ASL
	65510-44-3	PCB-123	1	1	100%	--	0.0000025	mg/kg	0.0000025	0.00000112	1	0.0000362	0	NO	BSL
	57465-28-8	PCB-126	1	1	100%	--	0.000000416	mg/kg	0.000000416	--	--	0.0000000109	1	YES	ASL; Bkg na/nd
	38380-08-4	PCB-156	1	1	100%	--	0.0000219	mg/kg	0.0000219	0.00000284	1	0.0000362	0	NO	BSL
	52663-72-6	PCB-167	1	1	100%	--	0.0000142	mg/kg	0.0000142	0.00000242	1	0.0000362	0	NO	BSL
	39635-31-9	PCB-189	1	1	100%	--	0.00000335	mg/kg	0.00000335	0.000000108	1	0.0000362	0	NO	BSL
	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	6	5	83%	0	0.0103	mg/kg	0.0103	0.0035	3	0.0000707	5	YES	ASL
	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	6	5	83%	0.00285	0.0159	mg/kg	0.0159	0.0054	5	0.0000707	5	YES	ASL
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	7	4	57%	0	0.0000001555	mg/kg	0.0000001555	0.000000016	4	0.0000000011	4	YES	ASL
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	7	4	57%	0.0000004357885	0.0000002146	mg/kg	0.0000004357885	0.0000014352	0	0.0000000011	4	NO	ASL; <Bkg
	35822-46-9	1,2,3,4,6,7,8-HpCDD	4	1	25%	0.00000056	0.000000497	mg/kg	0.00000056	--	--	--	--	YES	NSL; Bkg na/nd
	57653-85-7	1,2,3,6,7,8-HxCDD	4	1	25%	0.00000036	0.000000108	mg/kg	0.00000036	0.000000054	1	--	--	YES	NSL; >Bkg
	19408-74-3	1,2,3,7,8,9-HxCDD	4	1	25%	0.00000033	0.000000053	mg/kg	0.00000033	--	--	--	--	YES	NSL; Bkg na/nd
	40321-76-4	1,2,3,7,8-PeCDD	4	1	25%	0.00000033	0.000000054	mg/kg	0.00000033	--	--	--	--	YES	NSL; Bkg na/nd
	57117-31-4	2,3,4,7,8-PeCDF	4	1	25%	0.0000002	0.00000008	mg/kg	0.0000002	--	--	0.0000000036	1	YES	ASL; Bkg na/nd
	51207-31-9	2,3,7,8-TCDF	7	3	43%	0.00000048	0.00000057	mg/kg	0.00000057	0.00000009	3	0.0000000109	3	YES	ASL
	3268-87-9	OCDD	7	4	57%	0.00000124	0.0000079	mg/kg	0.0000079	0.000003	4	0.00000362	2	YES	ASL
	39001-02-0	OCDF	7	1	14%	0.00000267	0.00006	mg/kg	0.00006	--	--	0.00000362	1	YES	ASL; Bkg na/nd
	72-55-9	4,4'-DDE	7	5	71%	0.00033	0.0016	mg/kg	0.0016	0.00084	2	0.000416	4	YES	ASL
	50-29-3	4,4'-DDT	4	3	75%	0.00025	0.0017	mg/kg	0.0017	0.0017	0	0.000416	3	NO	ASL; <Bkg
	319-84-6	Alpha-BHC	7	7	100%	--	0.038	mg/kg	0.038	0.033	1	0.0000224	7	YES	ASL
	319-85-7	Beta-BHC	7	7	100%	--	0.015	mg/kg	0.015	0.013	1	0.0000785	7	YES	ASL
	319-86-8	Delta-BHC	7	6	86%	0.00011	0.0016	mg/kg	0.0016	0.077	0	--	--	NO	NSL; <Bkg
	58-89-9	Lindane	7	6	86%	0.00011	0.004	mg/kg	0.004	0.003	1	0.000128	6	YES	ASL
	118-74-1	Hexachlorobenzene	4	3	75%	0.49	0.00062	mg/kg	0.49	--	--	0.0000883	3	YES	ASL; Bkg na/nd
	110-86-1	Pyridine	6	3	50%	0.018	0.409	mg/kg	0.409	--	--	0.0141	3	YES	ASL; Bkg na/nd
Horse Clam - Edible Tissue	PCB-Tot-Cong	PCB, Sum of Congeners	16	16	100%	--	0.00374	mg/kg	0.00374	0.00014	16	--	--	YES	NSL; >Bkg
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	16	16	100%	--	6.000E-09	mg/kg	6.000E-09	1.080E-07	0	0.0000000011	8	NO	ASL; <Bkg
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	16	16	100%	--	6.700E-08	mg/kg	6.700E-08	3.300E-08	6	0.0000000011	16	YES	ASL; >Bkg
Horse Clam - Visceral Cavity	PCB-Tot-Cong	PCB, Sum of Congeners	10	10	100%	--	0.06701	mg/kg	0.06701	0.00149	10	--	--	YES	NSL; >Bkg
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	10	10	100%	--	1.180E-07	mg/kg	1.180E-07	6.000E-09	10	0.0000000011	10	YES	ASL; >Bkg
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	10	10	100%	--	1.430E-07	mg/kg	1.430E-07	5.700E-08	10	0.0000000011	10	YES	ASL; >Bkg
Horse Clam - Whole	7440-36-0	Antimony	8	2	25%	0.0011	0.021	mg/kg	0.021	--	--	0.00565	2	YES	ASL; Bkg na/nd
	7440-38-2	Arsenic	17	17	100%	--	23.34	mg/kg	23.34	4.21	3	0.0000942	17	YES	ASL

TABLE A-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Fish and Shellfish Tissue

Scenario Timeframe: Current
Medium: Fish and Shellfish Tissue
Exposure Medium: Fish and Shellfish Tissue

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
	7440-38-2-Inorg	Arsenic, Inorganic	9	9	100%	--	1.35	mg/kg	1.35	0.4	5	0.0000942	9	YES	ASL; >Bkg
	7440-39-3	Barium	8	8	100%	--	3	mg/kg	3	0.996	4	2.83	1	YES	ASL
	7440-43-9	Cadmium	17	17	100%	--	0.35	mg/kg	0.35	0.3	2	0.0141	17	YES	ASL
	7440-47-3	Chromium	8	8	100%	--	1.8	mg/kg	1.8	0.43	8	21	0	NO	BSL
	7440-50-8	Copper	17	17	100%	--	2.5	mg/kg	2.5	2.6	0	0.565	17	NO	ASL; <Bkg
	7439-92-1	Lead	8	4	50%	0.32	1	mg/kg	1	1.04	0	--	--	NO	NSL; <Bkg
	7439-97-6	Mercury	8	7	88%	0.0082	0.027	mg/kg	0.027	--	--	0.00424	7	YES	ASL; Bkg na/nd
	7440-02-0	Nickel	8	8	100%	--	1.4	mg/kg	1.4	--	--	0.283	8	YES	ASL; Bkg na/nd
	7782-49-2	Selenium	9	9	100%	--	1.9	mg/kg	1.9	0.943	1	0.0707	9	YES	ASL
	7440-22-4	Silver	8	8	100%	--	1.2	mg/kg	1.2	0.739	3	0.0707	8	YES	ASL
	7440-66-6	Zinc	17	17	100%	--	12	mg/kg	12	54.1	0	4.24	17	NO	ASL; <Bkg
	22967-92-6	Methylmercury(1+)	9	9	100%	--	0.01	mg/kg	0.01	0.03	0	0.00141	9	NO	ASL; <Bkg
	78-00-2	Tetraethyl Lead	9	9	100%	--	2.91	mg/kg	2.91	0.29	6	0.00000141	9	YES	ASL
	CPAH-TEQ0	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	17	9	53%	0	0.004419	mg/kg	0.004419	0.0001	9	0.0000194	9	YES	ASL
	CPAH-TEQ05	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	17	9	53%	1.51	0.0044265	mg/kg	1.51	0.0001483	9	0.0000194	9	YES	ASL
	90-12-0	1-Methylphenanthrene	8	7	88%	0.000355	0.0133	mg/kg	0.0133	--	--	--	--	YES	NSL; Bkg na/nd
	91-57-6	2-Methylnaphthalene	17	8	47%	2.4	0.0014	mg/kg	2.4	0.00057	9	0.0565	0	YES	ASL
	83-32-9	Acenaphthene	17	9	53%	2.4	0.0035	mg/kg	2.4	0.00024	9	0.848	0	YES	ASL
	208-96-8	Acenaphthylene	17	10	59%	2	0.00035	mg/kg	2	0.000044	10	--	--	YES	NSL; >Bkg
	120-12-7	Anthracene	17	5	29%	2	0.0022	mg/kg	2	0.0003	9	4.24	0	NO	BSL
	56-55-3	Benz[a]anthracene	17	10	59%	2.4	0.0039	mg/kg	2.4	0.000095	10	0.000194	9	YES	ASL
	50-32-8	Benzo(a)pyrene	17	9	53%	2	0.0014	mg/kg	2	0.000065	9	0.0000194	8	YES	ASL
	205-99-2	Benzo(b)fluoranthene	17	9	53%	2	0.0043	mg/kg	2	--	--	0.000194	9	YES	ASL; Bkg na/nd
	192-97-2	Benzo(e)pyrene	8	8	100%	--	0.00348	mg/kg	0.00348	0.000102	8	--	--	YES	NSL; >Bkg
	191-24-2	Benzo(ghi)perylene	17	11	65%	2	0.00093	mg/kg	2	0.000120	11	--	--	YES	NSL; >Bkg
	207-08-9	Benzo(k)fluoranthene	17	9	53%	2	0.039	mg/kg	2	--	--	0.00194	1	YES	ASL; Bkg na/nd
	218-01-9	Chrysene	17	9	53%	2	0.0076	mg/kg	2	0.00038	9	0.0194	0	YES	ASL
	53-70-3	Dibenzo(a,h)anthracene	17	7	41%	2	0.00046	mg/kg	2	--	--	0.0000194	3	YES	ASL; Bkg na/nd
	132-65-0	Dibenzothiophene	8	8	100%	--	0.00021	mg/kg	0.00021	--	--	--	--	YES	NSL; Bkg na/nd
	206-44-0	Fluoranthene	17	9	53%	2	0.036	mg/kg	2	0.001	9	0.565	0	YES	ASL
	86-73-7	Fluorene	17	10	59%	2	0.0044	mg/kg	2	0.000179	10	0.565	0	YES	NSL; >Bkg
	193-39-5	Indeno(1,2,3-cd)pyrene	17	13	76%	2	0.00098	mg/kg	2	0.000073	13	0.000194	8	YES	ASL
	91-20-3	Naphthalene	17	1	6%	0.000434	0.0417	mg/kg	0.0417	0.00085	1	0.283	0	NO	BSL
	2245-38-7	Naphthalene, 1,6,7-Trimethyl	8	1	13%	0.000116	0.00604	mg/kg	0.00604	0.00017	0	--	--	NO	NSL; <Bkg
	85-01-8	Phenanthrene	17	9	53%	2.4	0.024	mg/kg	2.4	0.0011	9	--	--	YES	NSL; >Bkg
	129-00-0	Pyrene	17	9	53%	2	0.036	mg/kg	2	0.00043	9	0.424	0	YES	ASL
	198-55-0	Perylene	8	8	100%	--	0.00608	mg/kg	0.00608	0.000475	8	--	--	YES	NSL; >Bkg
	11097-69-1	PCB-aroclor 1254	9	9	100%	--	0.017	mg/kg	0.017	0.0035	9	0.0000707	9	YES	ASL
	11096-82-5	PCB-aroclor 1260	9	9	100%	--	0.023	mg/kg	0.023	--	--	0.0000707	9	YES	ASL; Bkg na/nd
	32598-13-3	PCB-077	8	8	100%	--	0.00000409	mg/kg	0.00000409	0.000000993	7	0.0000109	0	NO	BSL
	32598-14-4	PCB-105	8	8	100%	--	0.0000714	mg/kg	0.0000714	0.0000108	8	0.0000362	3	YES	ASL
	74472-37-0	PCB-114	8	8	100%	--	0.00000356	mg/kg	0.00000356	0.00000136	3	0.0000362	0	NO	BSL
	31508-00-6	PCB-118	8	8	100%	--	0.000231	mg/kg	0.000231	0.0000325	8	0.0000362	8	YES	ASL
	65510-44-3	PCB-123	8	8	100%	--	0.0000026	mg/kg	0.0000026	0.00000112	6	0.0000362	0	NO	BSL
	57465-28-8	PCB-126	8	1	13%	0.0000008	0.00000117	mg/kg	0.00000117	--	--	0.0000000109	1	YES	ASL; Bkg na/nd
	38380-08-4	PCB-156	8	8	100%	--	0.0000495	mg/kg	0.0000495	0.00000284	8	0.0000362	2	YES	ASL
	52663-72-6	PCB-167	8	8	100%	--	0.0000534	mg/kg	0.0000534	0.00000242	8	0.0000362	2	YES	ASL

TABLE A-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Fish and Shellfish Tissue

Scenario Timeframe: Current
Medium: Fish and Shellfish Tissue
Exposure Medium: Fish and Shellfish Tissue

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
	32774-16-6	PCB-169	8	1	13%	0.00000296	0.000000527	mg/kg	0.00000296	--	--	0.0000000362	1	YES	ASL; Bkg na/nd
	39635-31-9	PCB-189	8	8	100%	--	0.0000114	mg/kg	0.0000114	0.000000108	8	0.0000362	0	NO	BSL
	1336-36-3	PCB	9	9	100%	--	0.036	mg/kg	0.036	--	--	0.0000707	9	YES	ASL; Bkg na/nd
	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	9	9	100%	--	0.036	mg/kg	0.036	0.0035	9	0.0000707	9	YES	ASL
	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	9	9	100%	--	0.03695	mg/kg	0.03695	0.0054	9	0.0000707	9	YES	ASL
	PCB-Tot-Cong	PCB, Sum of Congeners	10	10	100%	--	0.038674	mg/kg	0.038674	--	--	--	--	YES	NSL; Bkg na/nd
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	27	25	93%	0	0.0000004108	mg/kg	0.0000004108	0.000000016	16	0.0000000011	19	YES	ASL
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	27	25	93%	0.0000003995505	0.0000004721	mg/kg	0.0000004721	0.0000014352	0	0.0000000011	25	NO	ASL; <Bkg
	35822-46-9	1,2,3,4,6,7,8-HpCDD	17	9	53%	0.00000067	0.00000587	mg/kg	0.00000587	--	--	--	--	YES	NSL; Bkg na/nd
	67562-39-4	1,2,3,4,6,7,8-HpCDF	17	6	35%	0.000025	0.00000039	mg/kg	0.000025	--	--	--	--	YES	NSL; Bkg na/nd
	39227-28-6	1,2,3,4,7,8-HxCDD	17	1	6%	0.0000002	0.000000065	mg/kg	0.0000002	--	--	--	--	YES	NSL; Bkg na/nd
	70648-26-9	1,2,3,4,7,8-HxCDF	17	2	12%	0.00000017	0.000000067	mg/kg	0.00000017	--	--	--	--	YES	NSL; Bkg na/nd
	57653-85-7	1,2,3,6,7,8-HxCDD	17	6	35%	0.00000022	0.000000325	mg/kg	0.000000325	0.000000054	6	--	--	YES	NSL; >Bkg
	19408-74-3	1,2,3,7,8,9-HxCDD	17	4	24%	0.00000021	0.00000013	mg/kg	0.00000021	--	--	--	--	YES	NSL; Bkg na/nd
	40321-76-4	1,2,3,7,8-PeCDD	17	1	6%	0.00000027	0.000000061	mg/kg	0.00000027	--	--	--	--	YES	NSL; Bkg na/nd
	57117-31-4	2,3,4,7,8-PeCDF	17	4	24%	0.00000016	0.000000084	mg/kg	0.00000016	--	--	0.0000000036	4	YES	ASL; Bkg na/nd
	1746-01-6	2,3,7,8-TCDD	17	3	18%	0.00000021	0.000000063	mg/kg	0.00000021	--	--	0.0000000011	3	YES	ASL; Bkg na/nd
	51207-31-9	2,3,7,8-TCDF	17	1	6%	0.00000022	0.000000049	mg/kg	0.00000022	0.00000009	0	0.0000000109	1	YES	ASL
	3268-87-9	OCDD	17	15	88%	0.00000077	0.0000569	mg/kg	0.0000569	0.000003	6	0.00000362	5	YES	ASL
	39001-02-0	OCDF	17	7	41%	5.370E-07	0.000000688	mg/kg	0.000000688	--	--	0.00000362	0	NO	BSL
	72-54-8	4,4'-DDD	13	2	15%	0.00032	0.0016	mg/kg	0.0016	--	--	0.000589	2	YES	ASL; Bkg na/nd
	72-55-9	4,4'-DDE	13	3	23%	0.00033	0.00087	mg/kg	0.00087	0.00084	1	0.000416	2	YES	ASL
	50-29-3	4,4'-DDT	13	8	62%	0.0025	0.0051	mg/kg	0.0051	0.0017	7	0.000416	8	YES	ASL
	319-84-6	Alpha-BHC	13	3	23%	0.00088	0.00063	mg/kg	0.00088	0.033	0	0.0000224	3	NO	ASL; <Bkg
	319-85-7	Beta-BHC	13	2	15%	0.00036	0.00045	mg/kg	0.00045	0.013	0	0.0000785	2	NO	ASL; <Bkg
	5566-34-7	gamma-Chlordane	4	1	25%	0.00011	0.00042	mg/kg	0.00042	--	--	--	--	YES	NSL; Bkg na/nd
	58-89-9	Lindane	13	3	23%	0.001	0.002	mg/kg	0.002	0.003	0	0.000128	3	NO	ASL; <Bkg
Ling Cod - Fillet	208-96-8	Acenaphthylene	2	1	50%	6.080E-05	8.800E-05	mg/kg	8.800E-05	--	--	--	--	YES	NSL; Bkg na/nd
	56-55-3	Benz[a]anthracene	2	1	50%	1.210E-05	4.000E-05	mg/kg	4.000E-05	--	--	0.000194	0	NO	BSL
	50-32-8	Benzo(a)pyrene	2	1	50%	3.460E-05	2.200E-05	mg/kg	3.460E-05	--	--	0.0000194	1	YES	ASL
	191-24-2	Benzo(ghi)perylene	2	1	50%	3.930E-05	5.800E-05	mg/kg	5.800E-05	--	--	--	--	YES	NSL; Bkg na/nd
	205-82-3	Benzo(j,k)fluoranthene	2	1	50%	0.000026	0.000011	mg/kg	0.000026	--	--	--	--	YES	NSL; Bkg na/nd
	192-97-2	Benzo(e)pyrene	2	1	50%	0.000306	0.000028	mg/kg	0.000306	--	--	--	--	YES	NSL; Bkg na/nd
	218-01-9	Chrysene	2	2	100%	--	0.00002	mg/kg	0.00002	--	--	0.0194	0	NO	BSL
	132-65-0	Dibenzothiophene	2	2	100%	--	0.000041	mg/kg	0.000041	--	--	--	--	YES	NSL; Bkg na/nd
	193-39-5	Indeno(1,2,3-cd)pyrene	2	1	50%	0.0000408	0.000036	mg/kg	0.0000408	--	--	0.000194	0	NO	BSL
	198-55-0	Perylene	2	1	50%	0.0000373	0.00003	mg/kg	0.0000373	--	--	--	--	YES	NSL; Bkg na/nd
	7440-38-2	Arsenic	2	2	100%	--	0.77	mg/kg	0.77	5.69	0	0.0000942	2	NO	ASL; <Bkg
	7440-47-3	Chromium	2	2	100%	--	0.065	mg/kg	0.065	--	--	21	0	NO	BSL
	7440-50-8	Copper	2	2	100%	--	0.55	mg/kg	0.55	0.22	2	0.565	0	NO	BSL
	7439-97-6	Mercury	2	2	100%	--	0.097	mg/kg	0.097	--	--	0.00424	2	YES	ASL; >Bkg
	7440-02-0	Nickel	2	2	100%	--	0.074	mg/kg	0.074	--	--	0.283	0	NO	BSL
	7440-66-6	Zinc	2	2	100%	--	6.3	mg/kg	6.3	5.75	1	4.24	2	YES	ASL; >Bkg
	32598-13-3	PCB-077	2	2	100%	--	0.000000916	mg/kg	0.000000916	--	--	0.0000109	0	NO	BSL
	32598-14-4	PCB-105	2	2	100%	--	0.000226	mg/kg	0.000226	--	--	0.0000362	2	YES	ASL; Bkg na/nd
	74472-37-0	PCB-114	2	2	100%	--	0.0000138	mg/kg	0.0000138	--	--	0.0000362	0	NO	BSL
	31508-00-6	PCB-118	2	2	100%	--	0.000666	mg/kg	0.000666	--	--	0.0000362	2	YES	ASL; Bkg na/nd
	65510-44-3	PCB-123	2	2	100%	--	0.00000494	mg/kg	0.00000494	--	--	0.0000362	0	NO	BSL

TABLE A-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Fish and Shellfish Tissue

Scenario Timeframe: Current
Medium: Fish and Shellfish Tissue
Exposure Medium: Fish and Shellfish Tissue

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
	57465-28-8	PCB-126	2	2	100%	--	0.000000809	mg/kg	0.000000809	--	--	0.0000000109	2	YES	ASL; Bkg na/nd
	38380-08-4	PCB-156	2	2	100%	--	0.000137	mg/kg	0.000137	--	--	0.0000362	2	YES	ASL; Bkg na/nd
	52663-72-6	PCB-167	2	2	100%	--	0.0000472	mg/kg	0.0000472	--	--	0.0000362	1	YES	ASL; Bkg na/nd
	39635-31-9	PCB-189	2	2	100%	--	0.00000616	mg/kg	0.00000616	--	--	0.0000362	0	NO	BSL
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	2	2	100%	--	1.337E-07	mg/kg	1.337E-07	5.330E-08	2	0.0000000011	2	YES	ASL; >Bkg
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	2	2	100%	--	2.219E-07	mg/kg	2.219E-07	9.252E-07	0	0.0000000011	2	NO	ASL; <Bkg
	57653-85-7	1,2,3,6,7,8-HxCDD	2	1	50%	4.850E-08	5.400E-08	mg/kg	5.400E-08	--	--	--	--	YES	NSL; Bkg na/nd
	51207-31-9	2,3,7,8-TCDF	2	2	100%	--	1.420E-07	mg/kg	1.420E-07	--	--	0.0000000109	2	YES	ASL; Bkg na/nd
	39001-02-0	OCDF	2	2	100%	--	1.010E-07	mg/kg	1.010E-07	9.694E-05	0	0.00000362	0	NO	BSL
Ling Cod - Whole	208-96-8	Acenaphthylene	2	2	100%	--	0.000125	mg/kg	0.000125	--	--	--	--	YES	NSL; Bkg na/nd
	56-55-3	Benz[a]anthracene	2	2	100%	--	0.000048	mg/kg	0.000048	--	--	0.000194	0	NO	BSL
	50-32-8	Benzo(a)pyrene	2	2	100%	--	0.000046	mg/kg	0.000046	--	--	0.0000194	2	YES	ASL; Bkg na/nd
	205-99-2	Benzo(b)fluoranthene	2	1	50%	0.0000168	0.000021	mg/kg	0.000021	--	--	0.000194	0	NO	BSL
	191-24-2	Benzo(ghi)perylene	2	2	100%	--	0.000158	mg/kg	0.000158	--	--	--	--	YES	NSL; Bkg na/nd
	205-82-3	Benzo(j,k)fluoranthene	2	2	100%	--	0.000036	mg/kg	0.000036	--	--	--	--	YES	NSL; Bkg na/nd
	192-97-2	Benzo(e)pyrene	2	2	100%	--	0.000045	mg/kg	0.000045	--	--	--	--	YES	NSL; Bkg na/nd
	218-01-9	Chrysene	2	2	100%	--	0.000086	mg/kg	0.000086	--	--	0.0194	0	NO	BSL
	132-65-0	Dibenzothiophene	2	2	100%	--	0.000049	mg/kg	0.000049	--	--	--	--	YES	NSL; Bkg na/nd
	86-73-7	Fluorene	2	2	100%	--	0.000483	mg/kg	0.000483	--	--	0.565	0	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	2	1	50%	0.0000398	0.000067	mg/kg	0.000067	--	--	0.000194	0	NO	BSL
	2245-38-7	Naphthalene, 1,6,7-Trimethyl	2	1	50%	0.000145	0.000125	mg/kg	0.000125	--	--	--	--	YES	NSL; Bkg na/nd
	7440-38-2	Arsenic	2	2	100%	--	0.59	mg/kg	0.59	1.24	0	0.0000942	2	NO	ASL; <Bkg
	7440-47-3	Chromium	2	2	100%	--	0.33	mg/kg	0.33	--	--	21	0	NO	BSL
	7440-50-8	Copper	2	2	100%	--	0.63	mg/kg	0.63	0.48	2	0.565	1	YES	ASL; >Bkg
	7439-97-6	Mercury	2	2	100%	--	0.22	mg/kg	0.22	--	--	0.00424	2	YES	ASL; >Bkg
	7440-02-0	Nickel	2	2	100%	--	0.096	mg/kg	0.096	--	--	0.283	0	NO	BSL
	7440-66-6	Zinc	2	2	100%	--	11	mg/kg	11	13.2	0	4.24	2	NO	ASL; <Bkg
	32598-13-3	PCB-077	2	2	100%	--	0.00000168	mg/kg	0.00000168	--	--	0.0000109	0	NO	BSL
	32598-14-4	PCB-105	2	2	100%	--	0.0017	mg/kg	0.0017	--	--	0.0000362	2	YES	ASL; Bkg na/nd
	74472-37-0	PCB-114	2	2	100%	--	0.000118	mg/kg	0.000118	--	--	0.0000362	2	YES	ASL; Bkg na/nd
	31508-00-6	PCB-118	2	2	100%	--	0.00551	mg/kg	0.00551	--	--	0.0000362	2	YES	ASL; Bkg na/nd
	65510-44-3	PCB-123	2	2	100%	--	0.0000178	mg/kg	0.0000178	--	--	0.0000362	0	NO	BSL
	57465-28-8	PCB-126	2	2	100%	--	0.00000341	mg/kg	0.00000341	--	--	0.0000000109	2	YES	ASL; Bkg na/nd
	38380-08-4	PCB-156	2	2	100%	--	0.00136	mg/kg	0.00136	--	--	0.0000362	2	YES	ASL; Bkg na/nd
	52663-72-6	PCB-167	2	2	100%	--	0.000319	mg/kg	0.000319	--	--	0.0000362	2	YES	ASL; Bkg na/nd
	39635-31-9	PCB-189	2	2	100%	--	0.0000836	mg/kg	0.0000836	--	--	0.0000362	1	YES	ASL; Bkg na/nd
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	2	2	100%	--	7.115E-07	mg/kg	0.0000007115	--	--	0.0000000011	2	YES	ASL; Bkg na/nd
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	2	2	100%	--	8.397E-07	mg/kg	8.397E-07	--	--	0.0000000011	2	YES	ASL; Bkg na/nd
	57653-85-7	1,2,3,6,7,8-HxCDD	2	2	100%	--	1.670E-07	mg/kg	1.670E-07	--	--	--	--	YES	NSL; Bkg na/nd
	57117-41-6	1,2,3,7,8-PeCDF	2	1	50%	4.820E-08	5.700E-08	mg/kg	5.700E-08	--	--	0.0000000362	1	YES	ASL; Bkg na/nd
	57117-31-4	2,3,4,7,8-PeCDF	2	1	50%	4.820E-08	7.600E-08	mg/kg	7.600E-08	--	--	0.0000000036	1	YES	ASL; Bkg na/nd
	1746-01-6	2,3,7,8-TCDD	2	2	100%	--	6.500E-08	mg/kg	6.500E-08	--	--	0.0000000011	2	YES	ASL; Bkg na/nd
	51207-31-9	2,3,7,8-TCDF	1	1	100%	--	2.240E-07	mg/kg	2.240E-07	--	--	0.0000000109	1	YES	ASL; Bkg na/nd
	39001-02-0	OCDF	2	2	100%	--	9.600E-08	mg/kg	9.600E-08	--	--	0.00000362	0	NO	BSL
Red Rock Crab - Muscle	7429-90-5	Aluminum	3	3	100%	--	4.96	mg/kg	4.96	0.873	3	14.1	0	NO	BSL
	7440-38-2	Arsenic	3	3	100%	--	11.2	mg/kg	11.2	22	0	0.0000942	3	NO	ASL; <Bkg
	7440-39-3	Barium	3	3	100%	--	0.24	mg/kg	0.24	--	--	2.83	0	NO	BSL
	7440-43-9	Cadmium	3	3	100%	--	0.39	mg/kg	0.39	0.107	3	0.0141	3	YES	ASL; >Bkg

TABLE A-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Fish and Shellfish Tissue

Scenario Timeframe: Current
Medium: Fish and Shellfish Tissue
Exposure Medium: Fish and Shellfish Tissue

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
	7440-70-2	Calcium	3	3	100%	--	7170	mg/kg	7170	1760	3	--	--	NO	NUT
	7440-47-3	Chromium	3	3	100%	--	0.18	mg/kg	0.18	0.11	3	21	0	NO	BSL
	7440-48-4	Cobalt	3	3	100%	--	0.105	mg/kg	0.105	0.087	1	0.00424	3	YES	ASL
	7440-50-8	Copper	3	3	100%	--	8.21	mg/kg	8.21	8.44	0	0.565	3	NO	ASL; <Bkg
	7439-89-6	Iron	3	3	100%	--	12.8	mg/kg	12.8	3.72	3	9.89	3	YES	ASL; >Bkg
	7439-92-1	Lead	3	3	100%	--	0.018	mg/kg	0.018	--	--	--	--	YES	NSL; Bkg na/nd
	7439-95-4	Magnesium	3	3	100%	--	977	mg/kg	977	528	3	--	--	NO	NUT
	7439-96-5	Manganese	3	3	100%	--	1.23	mg/kg	1.23	0.44	3	1.98	0	NO	BSL
	7439-97-6	Mercury	3	2	67%	0.05	1.155	mg/kg	1.155	0.089	1	0.00424	1	YES	ASL; >Bkg
	7440-02-0	Nickel	3	3	100%	--	0.422	mg/kg	0.422	0.121	3	0.283	2	YES	ASL; >Bkg
	7440-09-7	Potassium	3	3	100%	--	3290	mg/kg	3290	3470	0	--	--	NO	NUT
	7782-49-2	Selenium	3	3	100%	--	1.23	mg/kg	1.23	1.38	0	0.0707	3	NO	ASL; <Bkg
	7440-22-4	Silver	3	3	100%	--	1.161	mg/kg	1.161	0.155	3	0.0707	3	YES	ASL; >Bkg
	7440-23-5	Sodium	3	3	100%	--	5650	mg/kg	5650	3490	3	--	--	NO	NUT
	7440-62-2	Vanadium	3	3	100%	--	0.739	mg/kg	0.739	0.171	3	0.0989	3	YES	ASL; >Bkg
	7440-66-6	Zinc	3	3	100%	--	61.9	mg/kg	61.9	67.8	0	4.24	3	NO	ASL; <Bkg
	65-85-0	Benzoic Acid	3	1	33%	0.888	0.804	mg/kg	0.888	--	--	56.5	0	NO	BSL
	11096-82-5	PCB-aroclor 1260	3	3	100%	--	0.22	mg/kg	0.22	0.0015	3	0.0000707	3	YES	ASL; >Bkg
	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	3	3	100%	--	0.22	mg/kg	0.22	0.0015	3	0.0000707	3	YES	ASL; >Bkg
	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	3	3	100%	--	0.2295	mg/kg	0.2295	0.0105	3	0.0000707	3	YES	ASL; >Bkg
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	3	3	100%	--	6.870E-08	mg/kg	6.870E-08	--	--	0.0000000011	2	YES	ASL; Bkg na/nd
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	3	3	100%	--	6.900E-08	mg/kg	6.900E-08	--	--	0.0000000011	3	YES	ASL; Bkg na/nd
	51207-31-9	2,3,7,8-TCDF	3	2	67%	2.000E-07	6.800E-07	mg/kg	6.800E-07	--	--	0.0000000109	2	YES	ASL; Bkg na/nd
	39001-02-0	OCDF	3	3	100%	--	2.400E-06	mg/kg	2.400E-06	--	--	0.00000362	0	NO	BSL
	72-55-9	4,4'-DDE	3	3	100%	--	0.002	mg/kg	0.002	0.00087	1	0.000416	3	YES	ASL; >Bkg
	319-84-6	Alpha-BHC	3	3	100%	--	0.0013	mg/kg	0.0013	0.0046	0	0.0000224	3	NO	ASL; <Bkg
	106-44-5	p-Cresol	2	1	50%	0.0377	0.0236	mg/kg	0.0377	--	--	0.0707	0	NO	BSL
	87-86-5	Pentachlorophenol	3	1	33%	0.194	0.461	mg/kg	0.461	--	--	0.00118	1	YES	ASL; Bkg na/nd
	108-95-2	Phenol	3	1	33%	0.152	0.0597	mg/kg	0.152	--	--	4.24	0	NO	BSL
	110-86-1	Pyridine	3	2	67%	0.0777	4.15	mg/kg	4.15	2.78	1	0.0141	2	YES	ASL; >Bkg
Rock Sole - Fillet	7440-38-2	Arsenic	3	3	100%	--	2.69	mg/kg	2.69	5.69	0	0.0000942	3	NO	ASL; <Bkg
	7440-38-2-Inorg	Arsenic, Inorganic	3	1	33%	0.004	0.005	mg/kg	0.005	0.005	0	0.0000942	1	NO	ASL:<Bkg
	7440-43-9	Cadmium	3	3	100%	--	0.013	mg/kg	0.013	0.002	3	0.0141	0	NO	BSL
	7440-50-8	Copper	3	3	100%	--	0.61	mg/kg	0.61	0.22	3	0.565	2	YES	ASL; >Bkg
	7782-49-2	Selenium	3	2	67%	0.3	0.4	mg/kg	0.4	0.3	1	0.0707	2	YES	ASL; >Bkg
	7440-66-6	Zinc	3	3	100%	--	12.8	mg/kg	12.8	5.75	3	4.24	3	YES	ASL; >Bkg
	22967-92-6	Methylmercury(1+)	3	3	100%	--	0.02	mg/kg	0.02	0.02	0	0.00141	3	NO	ASL; <Bkg
	78-00-2	Tetraethyl Lead	3	3	100%	--	0.15	mg/kg	0.15	0.004	3	0.00000141	3	YES	ASL; >Bkg
	83-32-9	Acenaphthene	3	3	100%	--	0.00024	mg/kg	0.00024	--	--	0.848	0	NO	BSL
	120-12-7	Anthracene	3	1	33%	0.00012	0.00015	mg/kg	0.00015	--	--	4.24	0	NO	BSL
	206-44-0	Fluoranthene	3	2	67%	0.00045	0.00042	mg/kg	0.00045	0.00041	1	0.565	0	NO	BSL
	91-20-3	Naphthalene	3	3	100%	--	0.00069	mg/kg	0.00069	--	--	0.283	0	NO	BSL
	85-01-8	Phenanthrene	3	3	100%	--	0.00068	mg/kg	0.00068	0.00051	3	--	--	YES	NSL; >Bkg
	11097-69-1	PCB-aroclor 1254	3	3	100%	--	0.007	mg/kg	0.007	--	--	0.0000707	3	YES	ASL; Bkg na/nd
	11096-82-5	PCB-aroclor 1260	3	3	100%	--	0.0061	mg/kg	0.0061	--	--	0.0000707	3	YES	ASL; Bkg na/nd
	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	3	3	100%	--	0.0131	mg/kg	0.0131	--	--	0.0000707	3	YES	ASL; Bkg na/nd
	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	3	3	100%	--	0.01405	mg/kg	0.01405	--	--	0.0000707	3	YES	ASL; Bkg na/nd
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	3	2	67%	0.000E+00	1.017E-09	mg/kg	1.017E-09	5.330E-08	0	0.0000000011	0	NO	BSL

TABLE A-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Fish and Shellfish Tissue

Scenario Timeframe: Current
Medium: Fish and Shellfish Tissue
Exposure Medium: Fish and Shellfish Tissue

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag	Rationale for Selection or Deletion (4)
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	3	2	67%	1.922E-07	2.731E-07	mg/kg	2.731E-07	9.252E-07	0	0.0000000011	2	NO	ASL; <Bkg
	39001-02-0	OCDF	3	2	67%	9.000E-07	3.390E-06	mg/kg	3.390E-06	9.694E-05	0	0.00000362	0	NO	BSL
	72-55-9	4,4'-DDE	3	3	100%	--	0.001	mg/kg	0.001	0.0008	3	0.000416	3	YES	ASL; >Bkg
	50-29-3	4,4'-DDT	3	3	100%	--	0.0016	mg/kg	0.0016	0.00049	3	0.000416	3	YES	ASL; >Bkg
	319-84-6	Alpha-BHC	3	3	100%	--	0.0011	mg/kg	0.0011	--	--	0.0000224	3	YES	ASL; Bkg na/nd
	319-85-7	Beta-BHC	3	1	33%	0.00099	0.001	mg/kg	0.001	--	--	0.0000785	1	YES	ASL; Bkg na/nd
	319-86-8	Delta-BHC	3	2	67%	0.00031	0.00099	mg/kg	0.00099	--	--	--	--	YES	NSL; Bkg na/nd
	58-89-9	Lindane	3	1	33%	0.001	0.0007	mg/kg	0.001	0.00033	1	0.000128	1	YES	ASL; >Bkg
Rock Sole - Whole	7440-38-2	Arsenic	3	3	100%	--	2.77	mg/kg	2.77	1.24	3	0.0000942	3	YES	ASL; >Bkg
	7440-38-2-Inorg	Arsenic, Inorganic	3	3	100%	--	0.013	mg/kg	0.013	--	--	0.0000942	3	YES	ASL; >Bkg
	7440-43-9	Cadmium	3	2	67%	0.002	0.005	mg/kg	0.005	0.02	0	0.0141	0	NO	BSL
	7440-50-8	Copper	3	3	100%	--	0.24	mg/kg	0.24	0.48	0	0.565	0	NO	BSL
	7782-49-2	Selenium	3	3	100%	--	0.4	mg/kg	0.4	--	--	0.0707	3	YES	ASL; Bkg na/nd
	7440-66-6	Zinc	3	3	100%	--	4.66	mg/kg	4.66	13.2	0	4.24	1	NO	ASL; <Bkg
	22967-92-6	Methylmercury(1+)	3	3	100%	--	0.05	mg/kg	0.05	0.01	3	0.00141	3	YES	ASL; >Bkg
	78-00-2	Tetraethyl Lead	3	3	100%	--	0.007	mg/kg	0.007	0.02	0	0.00000141	3	NO	ASL; <Bkg
	206-44-0	Fluoranthene	2	1	50%	0.00037	0.00039	mg/kg	0.00039	--	--	0.565	0	NO	BSL
	91-20-3	Naphthalene	2	1	50%	0.00055	0.00057	mg/kg	0.00057	0.00077	0	0.283	0	NO	BSL
	85-01-8	Phenanthrene	2	2	100%	--	0.00047	mg/kg	0.00047	0.00055	0	--	--	NO	NSL;<Bkg
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	3	1	33%	0.000E+00	1.473E-09	mg/kg	1.473E-09	--	--	0.0000000011	1	YES	ASL; Bkg na/nd
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	3	1	33%	1.014E-06	3.738E-07	mg/kg	1.014E-06	--	--	0.0000000011	1	YES	ASL; Bkg na/nd
	3268-87-9	OCDD	3	1	33%	2.610E-06	4.910E-06	mg/kg	4.910E-06	--	--	0.00000362	1	YES	ASL; Bkg na/nd
	50-29-3	4,4'-DDT	2	2	100%	--	0.00039	mg/kg	0.00039	0.001	0	0.000416	0	NO	BSL

(1) Maximum of detected concentration or highest detection limit used for screening.

(2) Reference from Dungeness Bay samples.

(3) Screening Toxicity Value from USEPA Regional Screening Level Calculator using site-specific parameters.

(4) Rationale Codes:

Selection Reason:
- Above Screening Levels: Greater than Background/Reference (ASL; >Bkg)
- Above Screening Levels; No background/reference available or all background/reference non-detect (ASL; Bkg na/nd)
- No Screening Level; Detected above background/reference (NSL;>Bkg)
- No Screening Level; No background/reference available or all background/reference non-detect (NSL;Bkg na/nd)

Deletion Reason:
- Above Screening Level; Detected below background/reference (ASL;<Bkg)
- Below Screening Level (BSL)
- Essential Nutrient (NUT)

Definitions:
-- = Not applicable
IHS = Indicator Hazardous Substance

TABLE A-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF INDICATOR HAZARDOUS SUBSTANCES

Port Angeles Harbor Marine Environment - Bull Kelp

Scenario Timeframe: Current
Medium: Bull Kelp
Exposure Medium: Bull Kelp

Analyte Group	CAS Number	Chemical	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Reference Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Screening	IHS Flag (Y/N)	Rationale for Selection or Deletion (4)
Bull Kelp	208-96-8	Acenaphthylene	1	1	100%	--	9.00E-05	mg/kg	0.00009	--	--	--	--	YES	NSL; Bkg na/nd
	120-12-7	Anthracene	1	1	100%	--	5.32E-04	mg/kg	0.000532	--	--	4.24E+01	0	NO	BSL
	192-97-2	Benzo(e)pyrene	1	1	100%	--	4.00E-04	mg/kg	0.0004	--	--	--	--	YES	NSL; Bkg na/nd
	132-65-0	Dibenzothiophene	1	1	100%	--	1.28E-04	mg/kg	0.000128	--	--	--	--	YES	NSL; Bkg na/nd
	7782-41-4	Fluorene	1	1	100%	--	0.000166	mg/kg	0.000166	--	--	8	0	NO	BSL
	7440-38-2	Arsenic	1	1	100%	--	6	mg/kg	6	--	--	9.42E-04	1	YES	ASL; Bkg na/nd
	7440-39-3	Barium	1	1	100%	--	0.97	mg/kg	0.97	--	--	2.83E+01	0	NO	BSL
	7440-43-9	Cadmium	1	1	100%	--	0.18	mg/kg	0.18	--	--	1.41E-01	1	YES	ASL; Bkg na/nd
	7440-47-3	Chromium	1	1	100%	--	0.078	mg/kg	0.078	--	--	2.10E+02	0	NO	BSL
	7440-50-8	Copper	1	1	100%	--	0.3	mg/kg	0.3	--	--	5.65E+00	0	NO	BSL
	7439-97-6	Mercury	1	1	100%	--	0.011	mg/kg	0.011	--	--	0.042	0	NO	BSL
	7440-02-0	Nickel	1	1	100%	--	0.11	mg/kg	0.11	--	--	2.830	0	NO	BSL
	7440-22-4	Silver	1	1	100%	--	0.0069	mg/kg	0.0069	--	--	7.07E-01	0	NO	BSL
	7440-66-6	Zinc	1	1	100%	--	2.9	mg/kg	2.9	--	--	4.24E+01	0	NO	BSL
	32598-14-4	PCB-105	1	1	100%	--	0.000000715	mg/kg	0.000000715	--	--	3.62E-04	0	NO	BSL
	31508-00-6	PCB-118	1	1	100%	--	0.00000184	mg/kg	0.00000184	--	--	3.62E-04	0	NO	BSL
	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	1	1	100%	--	1.200E-09	mg/kg	1.200E-09	--	--	1.10E-08	0	NO	BSL
	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	1	1	100%	--	1.016E-07	mg/kg	1.016E-07	--	--	1.10E-08	1	YES	ASL; Bkg na/nd
	67562-39-4	1,2,3,4,6,7,8-HpCDF	1	1	100%	--	5.800E-08	mg/kg	5.800E-08	--	--	--	--	YES	NSL; Bkg na/nd
	3268-87-9	OCDD	1	1	100%	--	1.550E-06	mg/kg	1.550E-06	--	--	3.62E-05	0	NO	BSL
	39001-02-0	OCDF	1	1	100%	--	1.080E-07	mg/kg	1.080E-07	--	--	3.62E-05	0	NO	BSL

(1) Maximum of detected concentration or highest detection limit used for screening.

(2) Reference from Dungeness Bay samples.

(3) Screening Toxicity Value from USEPA Regional Screening Level Calculator using site-specific parameters.

(4) Rationale Codes:

Selection Reason: Above Screening Levels; No background/reference available or all background/reference non-detect (ASL; Bkg na/nd)

No Screening Level; No background/reference available (NSL; Bkg na)

Deletion Reason: Below Screening Level (BSL)

Definitions: -- = Not applicable

IHS = Indicator Hazardous Substance

TABLE A-5

IDENTIFICATION OF BEACH/INTERTIDAL SEDIMENT SAMPLES

Port Angeles Harbor Marine Environment

Study Reference	Sample Number
E & E 2009	CO01A
E & E 2009	EC01A
E & E 2009	EC02A
E & E 2009	EC05A
E & E 2009	EE01A
E & E 2009	EE01B
E & E 2009	EE02A
E & E 2009	EE02B
E & E 2009	EE02C
E & E 2009	EE03A
E & E 2009	EE03B
E & E 2009	EE03C
E & E 2009	EE04A
E & E 2009	EE04B
E & E 2009	EE04C
E & E 2009	EE05A
E & E 2009	EI01A
E & E 2009	EI02B
E & E 2009	LA01A
E & E 2009	LA02A
E & E 2009	LA02B
E & E 2009	LA02C
E & E 2009	LA02X
E & E 2009	LA03A
Malcolm Pirnie 2006	RAYONR05IT-04
Malcolm Pirnie 2006	RAYONR05IT-05
Malcolm Pirnie 2006	RAYONR05IT-06
Malcolm Pirnie 2006	RAYONR05IT-07
Malcolm Pirnie 2006	RAYONR05IT-08

Key

E & E 2009 = Port Angeles Harbor Sediment Investigation Report

Malolm Pirinie 2006 = Remedial Investigation for the Marine Environment Near the Former Rayonier Mill Site, Port Angeles, Washington on, Agency Review Draft

Table A-6
Background Sediment Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Sulfide	18496-25-8	3	2	408	mg/kg	408	Max Det Conc	NObs < 10
Ammonia (NH3) as Nitrogen (N)	AmmoniaN	3	3	25.4	mg/kg	25.4	Max Det Conc	NObs < 10
Preserved Total Solids	PTS	3	3	79.6	%	79.6	Max Det Conc	NObs < 10
Total Organic Carbon	TOC	14	14	1.42	%	1.415	Stat Analysis	NObs > 10
Total Solids	TS	3	3	79.6	%	79.6	Max Det Conc	NObs < 10
Particle/Grain Size, Fines (Silt/Clay)	PGS-Fines	3	3	73.7	%	73.7	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale <-1	PGS-Phi<-1	3	1	10.2	%	10.2	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale >10	PGS-Phi>10	1	1	11.5	%	11.5	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 0 to 1	PGS-Phi0-1	3	3	21.7	%	21.7	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale -1 to 0	PGS-Phi-1-0	3	3	12.7	%	12.7	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 1 to 2	PGS-Phi1-2	3	3	52	%	52	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 2 to 3	PGS-Phi2-3	3	3	34.1	%	34.1	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 3 to 4	PGS-Phi3-4	3	3	19.8	%	19.8	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 4 to 5	PGS-Phi4-5	2	2	20.3	%	20.3	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 5 to 6	PGS-Phi5-6	1	1	15.5	%	15.5	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 6 to 7	PGS-Phi6-7	1	1	11.1	%	11.1	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 7 to 8	PGS-Phi7-8	1	1	6.5	%	6.5	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 8 to 9	PGS-Phi8-9	1	1	4.9	%	4.9	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 9 to 10	PGS-Phi9-10	1	1	4	%	4	Max Det Conc	NObs < 10
3,4,5-Trichloroguaiacol (Ac)	57057-83-7	3	0	--	mg/kg	None	None	Not Detected
3,4,6-Trichloroguaiacol (Ac)	60712-44-9	3	0	--	mg/kg	None	None	Not Detected
3,4-Dicloroguaiacol	77102-94-4	3	0	--	mg/kg	None	None	Not Detected
4,5,6 Trichloroguaiacol	2668-24-8	3	0	--	mg/kg	None	None	Not Detected
4,5-Dichloroguaiacol	2460-49-3	3	0	--	mg/kg	None	None	Not Detected
4,6-Dichloroguaiacol	16766-31-7	3	0	--	mg/kg	None	None	Not Detected
4-Chloroguaiacol	16766-30-6	3	0	--	mg/kg	None	None	Not Detected
Guaiacol (2-Methoxyphenol)	90-05-1	3	0	--	mg/kg	None	None	Not Detected
Tetrachloroguaiacol	2539-17-5	3	0	--	mg/kg	None	None	Not Detected
Aluminum	7429-90-5	3	3	22400	mg/kg	22400	Max Det Conc	NObs < 10
Antimony	7440-36-0	6	3	0.02	mg/kg	0.02	Max Det Conc	NObs < 10
Arsenic	7440-38-2	6	6	7.1	mg/kg	7.1	Max Det Conc	NObs < 10
Barium	7440-39-3	6	6	45.6	mg/kg	45.6	Max Det Conc	NObs < 10
Beryllium	7440-41-7	3	1	0.46	mg/kg	0.46	Max Det Conc	NObs < 10
Cadmium	7440-43-9	6	6	2.1	mg/kg	2.1	Max Det Conc	NObs < 10
Calcium	7440-70-2	3	3	53100	mg/kg	53100	Max Det Conc	NObs < 10
Chromium	7440-47-3	6	6	47.5	mg/kg	47.5	Max Det Conc	NObs < 10
Cobalt	7440-48-4	3	3	11.5	mg/kg	11.5	Max Det Conc	NObs < 10

Table A-6

Background Sediment Concentrations

Port Angeles Harbor - Marine Sediment Investigation

Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Copper	7440-50-8	6	6	36	mg/kg	36	Max Det Conc	NObs < 10
Iron	7439-89-6	3	3	33300	mg/kg	33300	Max Det Conc	NObs < 10
Lead	7439-92-1	6	6	8.3	mg/kg	8.3	Max Det Conc	NObs < 10
Magnesium	7439-95-4	3	3	13300	mg/kg	13300	Max Det Conc	NObs < 10
Manganese	7439-96-5	3	3	284	mg/kg	284	Max Det Conc	NObs < 10
Mercury	7439-97-6	6	5	0.13	mg/kg	0.13	Max Det Conc	NObs < 10
Nickel	7440-02-0	6	6	45	mg/kg	45	Max Det Conc	NObs < 10
Potassium	7440-09-7	3	3	3730	mg/kg	3730	Max Det Conc	NObs < 10
Selenium	7782-49-2	3	0	--	mg/kg	None	None	Not Detected
Silver	7440-22-4	6	5	0.433	mg/kg	0.433	Max Det Conc	NObs < 10
Sodium	7440-23-5	3	3	17900	mg/kg	17900	Max Det Conc	NObs < 10
Thallium	7440-28-0	3	0	--	mg/kg	None	None	Not Detected
Vanadium	7440-62-2	3	3	67.9	mg/kg	67.9	Max Det Conc	NObs < 10
Zinc	7440-66-6	6	6	88.7	mg/kg	88.7	Max Det Conc	NObs < 10
12-Chlorodehydroabietic Acid	65310-45-4	3	0	--	mg/kg	None	None	Not Detected
14-Chlorodehydroabietic Acid	65281-76-7	3	0	--	mg/kg	None	None	Not Detected
1-Phenanthrenecarboxylic acid, 1,2,3,4,4a,9,10,10a	1740-19-8	3	0	--	mg/kg	None	None	Not Detected
9,10-Dichlorostearic acid	5829-48-1	3	0	--	mg/kg	None	None	Not Detected
Abietic Acid	514-10-3	3	0	--	mg/kg	None	None	Not Detected
Benzoic Acid	65-85-0	6	0	--	mg/kg	None	None	Not Detected
Dichlorodehydroabietic Acid	57055-39-7	3	0	--	mg/kg	None	None	Not Detected
Isopimaric Acid	5835-26-7	3	0	--	mg/kg	None	None	Not Detected
Linolenic Acid	463-40-1	3	0	--	mg/kg	None	None	Not Detected
Neoabietic Acid	471-77-2	3	0	--	mg/kg	None	None	Not Detected
Oleic Acid	112-80-1	3	0	--	mg/kg	None	None	Not Detected
Palustric Acid	1945-53-5	3	0	--	mg/kg	None	None	Not Detected
Pimaric Acid	127-27-5	3	0	--	mg/kg	None	None	Not Detected
Sandaracopimaric Acid	471-74-9	3	0	--	mg/kg	None	None	Not Detected
Butyltin	78763-54-9	3	0	--	mg/kg	None	None	Not Detected
Dibutyltin	1002-53-5	3	0	--	mg/kg	None	None	Not Detected
Tributyltin	688-73-3	3	0	--	mg/kg	None	None	Not Detected
Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	CPAH-TEQ0	6	0	--	mg/kg	None	None	Not Detected
Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	CPAH-TEQ05	6	0	--	mg/kg	None	None	Not Detected
High MW PAHs ND=0	HPAH0	6	2	0.043	mg/kg	0.043	Max Det Conc	NObs < 10
High MW PAHs ND=0.5	HPAH05	6	2	0.1262	mg/kg	0.1262	Max Det Conc	NObs < 10
Low MW PAHs ND=0	LPAH0	6	3	0.0247	mg/kg	0.0247	Max Det Conc	NObs < 10
Low MW PAHs ND=0.5	LPAH05	6	3	0.10005	mg/kg	0.10005	Max Det Conc	NObs < 10

Table A-6
Background Sediment Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Total PAHs ND=0	TotPAH0	6	3	0.0677	mg/kg	0.0677	Max Det Conc	NObs < 10
Total PAHs ND=0.5	TotPAH05	6	3	0.22625	mg/kg	0.22625	Max Det Conc	NObs < 10
1-Methylnaphthalene	90-12-0	6	0	--	mg/kg	None	None	Not Detected
2-Methylnaphthalene	91-57-6	6	0	--	mg/kg	None	None	Not Detected
9H-Carbazole	9HCarb	3	0	--	mg/kg	None	None	Not Detected
9H-Fluorene	9HFluor	3	0	--	mg/kg	None	None	Not Detected
Acenaphthene	83-32-9	6	0	--	mg/kg	None	None	Not Detected
Acenaphthylene	208-96-8	6	0	--	mg/kg	None	None	Not Detected
Anthracene	120-12-7	6	0	--	mg/kg	None	None	Not Detected
Benz[a]anthracene	56-55-3	6	0	--	mg/kg	None	None	Not Detected
Benzo(a)pyrene	50-32-8	6	0	--	mg/kg	None	None	Not Detected
Benzo(b)fluoranthene	205-99-2	6	0	--	mg/kg	None	None	Not Detected
Benzo(ghi)perylene	191-24-2	6	0	--	mg/kg	None	None	Not Detected
Benzo(k)fluoranthene	207-08-9	6	0	--	mg/kg	None	None	Not Detected
Chrysene	218-01-9	6	0	--	mg/kg	None	None	Not Detected
Dibenzo(a,h)anthracene	53-70-3	6	0	--	mg/kg	None	None	Not Detected
Dibenzofuran	132-64-9	6	0	--	mg/kg	None	None	Not Detected
Fluoranthene	206-44-0	6	1	0.0211	mg/kg	0.0211	Max Det Conc	NObs < 10
Fluorene	86-73-7	3	0	--	mg/kg	None	None	Not Detected
Indeno(1,2,3-cd)pyrene	193-39-5	6	0	--	mg/kg	None	None	Not Detected
Naphthalene	91-20-3	6	0	--	mg/kg	None	None	Not Detected
Phenanthrene	85-01-8	6	2	0.016	mg/kg	0.016	Max Det Conc	NObs < 10
Pyrene	129-00-0	6	2	0.0215	mg/kg	0.0215	Max Det Conc	NObs < 10
4-Bromophenyl phenyl ether	101-55-3	3	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1016	12674-11-2	3	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1221	11104-28-2	3	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1232	11141-16-5	3	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1242	53469-21-9	6	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1248	12672-29-6	3	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1254	11097-69-1	6	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1260	11096-82-5	6	0	--	mg/kg	None	None	Not Detected
PCB, Sum of Aroclors, ND0	PCB-Tot-Aro ND0	3	0	--	mg/kg	None	None	Not Detected
PCB, Sum of Aroclors, ND05	PCB-Tot-AroND05	3	0	--	mg/kg	None	None	Not Detected
PCB, Sum of Congeners	PCB-Tot-Cong	11	11	0.0014	mg/kg	0.0012	Stat Analysis	NObx > 10
PCB, Sum of Congeners, per gram TOC	PCB-TOT-CON-TOC	11	11	0.14	mg/kg	0.106	Stat Analysis	NObx > 10
Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	17	15	8.562E-07	mg/kg	5.20E-08	Stat Analysis	NObx > 10
Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	17	15	9.42E-07	mg/kg	8.75E-07	Stat Analysis	NObx > 10

Table A-6
Background Sediment Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Total HpCDD	37871-00-4	6	4	0.0000194	mg/kg	0.0000194	Max Det Conc	NObs < 10
Total HpCDF	38998-75-3	6	1	0.00000425	mg/kg	0.00000425	Max Det Conc	NObs < 10
Total HxCDD	34465-46-8	6	3	0.0000107	mg/kg	0.0000107	Max Det Conc	NObs < 10
Total HxCDF	55684-94-1	6	2	0.00000246	mg/kg	0.00000246	Max Det Conc	NObs < 10
Total PeCDD	36088-22-9	6	2	0.00000296	mg/kg	0.00000296	Max Det Conc	NObs < 10
Total PeCDF	30402-15-4	6	3	0.0000026	mg/kg	0.0000026	Max Det Conc	NObs < 10
Total TCDD	41903-57-5	6	2	0.00000262	mg/kg	0.00000262	Max Det Conc	NObs < 10
Total TCDF	30402-14-3	3	2	0.0000011	mg/kg	0.0000011	Max Det Conc	NObs < 10
TOTAL TETRA_FURANS	55722-27-5	3	3	0.00000473	mg/kg	0.00000473	Max Det Conc	NObs < 10
1,2,3,4,6,7,8-HpCDD	35822-46-9	6	4	0.00000806	mg/kg	0.00000806	Max Det Conc	NObs < 10
1,2,3,4,6,7,8-HpCDF	67562-39-4	6	1	0.00000182	mg/kg	0.00000182	Max Det Conc	NObs < 10
1,2,3,4,7,8,9-HpCDF	55673-89-7	3	1	1.11E-07	mg/kg	0.000000111	Max Det Conc	NObs < 10
1,2,3,4,7,8-HxCDD	39227-28-6	6	2	1.91E-07	mg/kg	0.000000191	Max Det Conc	NObs < 10
1,2,3,4,7,8-HxCDF	70648-26-9	3	1	2.24E-07	mg/kg	0.000000224	Max Det Conc	NObs < 10
1,2,3,6,7,8-HxCDD	57653-85-7	6	3	0.00000101	mg/kg	0.00000101	Max Det Conc	NObs < 10
1,2,3,6,7,8-HxCDF	57117-44-9	3	2	1.28E-07	mg/kg	0.000000128	Max Det Conc	NObs < 10
1,2,3,7,8,9-HxCDD	19408-74-3	6	3	0.00000082	mg/kg	0.00000082	Max Det Conc	NObs < 10
1,2,3,7,8,9-HxCDF	72918-21-9	3	0	--	mg/kg	None	None	Not Detected
1,2,3,7,8-PeCDD	40321-76-4	6	1	2.36E-07	mg/kg	0.000000236	Max Det Conc	NObs < 10
1,2,3,7,8-PeCDF	57117-41-6	3	1	1.06E-07	mg/kg	0.000000106	Max Det Conc	NObs < 10
2,3,4,6,7,8-HxCDF	60851-34-5	3	1	1.25E-07	mg/kg	0.000000125	Max Det Conc	NObs < 10
2,3,4,7,8-PeCDF	57117-31-4	3	3	1.88E-07	mg/kg	0.000000188	Max Det Conc	NObs < 10
2,3,7,8-TCDD	1746-01-6	6	1	1.16E-07	mg/kg	0.000000116	Max Det Conc	NObs < 10
2,3,7,8-TCDF	51207-31-9	6	2	7.79E-07	mg/kg	0.000000779	Max Det Conc	NObs < 10
OCDD	3268-87-9	6	3	0.0000537	mg/kg	0.0000537	Max Det Conc	NObs < 10
OCDF	39001-02-0	6	1	0.00000302	mg/kg	0.00000302	Max Det Conc	NObs < 10
4,4'-DDD	72-54-8	6	0	--	mg/kg	None	None	Not Detected
4,4'-DDE	72-55-9	3	0	--	mg/kg	None	None	Not Detected
4,4'-DDT	50-29-3	3	0	--	mg/kg	None	None	Not Detected
Aldrin	309-00-2	3	2	0.0049	mg/kg	0.0049	Max Det Conc	NObs < 10
Alpha-BHC	319-84-6	3	1	0.0015	mg/kg	0.0015	Max Det Conc	NObs < 10
Beta-BHC	319-85-7	3	2	0.0022	mg/kg	0.0022	Max Det Conc	NObs < 10
cis-Chlordane	5103-71-9	3	3	0.00066	mg/kg	0.00066	Max Det Conc	NObs < 10
Delta-BHC	319-86-8	3	0	--	mg/kg	None	None	Not Detected
Dieldrin	60-57-1	3	0	--	mg/kg	None	None	Not Detected
Endosulfan I	959-98-8	3	0	--	mg/kg	None	None	Not Detected
Endosulfan II	33213-65-9	3	0	--	mg/kg	None	None	Not Detected

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Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Endosulfan Sulfate	1031-07-8	3	0	--	mg/kg	None	None	Not Detected
Endrin	72-20-8	3	0	--	mg/kg	None	None	Not Detected
Endrin Aldehyde	7421-93-4	3	0	--	mg/kg	None	None	Not Detected
Endrin Ketone	53494-70-5	3	0	--	mg/kg	None	None	Not Detected
gamma-Chlordane	5566-34-7	3	1	0.00074	mg/kg	0.00074	Max Det Conc	NObs < 10
Heptachlor	76-44-8	3	0	--	mg/kg	None	None	Not Detected
Heptachlor Epoxide	1024-57-3	3	3	0.00088	mg/kg	0.00088	Max Det Conc	NObs < 10
Lindane	58-89-9	3	1	0.0041	mg/kg	0.0041	Max Det Conc	NObs < 10
Methoxychlor	72-43-5	3	0	--	mg/kg	None	None	Not Detected
Toxaphene	8001-35-2	3	0	--	mg/kg	None	None	Not Detected
#2 Diesel	68476-34-6	3	2	12	mg/kg	12	Max Det Conc	NObs < 10
Gasoline	86290-81-5	3	0	--	mg/kg	None	None	Not Detected
Motor Oil	PHCMOT	3	1	10	mg/kg	10	Max Det Conc	NObs < 10
1,2,4-Trichlorobenzene	120-82-1	3	0	--	mg/kg	None	None	Not Detected
2,4,5-Trichlorophenol	95-95-4	3	0	--	mg/kg	None	None	Not Detected
2,4,6-Trichlorophenol	88-06-2	6	0	--	mg/kg	None	None	Not Detected
2,4-Dichlorophenol	120-83-2	3	0	--	mg/kg	None	None	Not Detected
2,4-Dimethylphenol	105-67-9	3	0	--	mg/kg	None	None	Not Detected
2,4-Dinitrophenol	51-28-5	3	0	--	mg/kg	None	None	Not Detected
2,4-Dinitrotoluene	121-14-2	3	0	--	mg/kg	None	None	Not Detected
2,6-Dinitrotoluene	606-20-2	3	0	--	mg/kg	None	None	Not Detected
2-Chloronaphthalene	91-58-7	3	0	--	mg/kg	None	None	Not Detected
2-Chlorophenol	95-57-8	3	0	--	mg/kg	None	None	Not Detected
2-Nitroaniline	88-74-4	3	0	--	mg/kg	None	None	Not Detected
2-Nitrophenol	88-75-5	3	0	--	mg/kg	None	None	Not Detected
3,3'-Dichlorobenzidine	91-94-1	1	0	--	mg/kg	None	None	Not Detected
4,6-Dinitro-2-Methylphenol	534-52-1	3	0	--	mg/kg	None	None	Not Detected
4-Chloro-3-Methylphenol	59-50-7	3	0	--	mg/kg	None	None	Not Detected
4-Chloroaniline	106-47-8	3	0	--	mg/kg	None	None	Not Detected
4-Chlorophenyl-Phenylether	7005-72-3	3	0	--	mg/kg	None	None	Not Detected
4-Nitroaniline	100-01-6	3	0	--	mg/kg	None	None	Not Detected
4-Nitrophenol	100-02-7	3	0	--	mg/kg	None	None	Not Detected
Benzyl Alcohol	100-51-6	3	0	--	mg/kg	None	None	Not Detected
Bis(2-Ethylhexyl) Phthalate	117-81-7	3	0	--	mg/kg	None	None	Not Detected
Butyl benzyl phthalate	85-68-7	3	0	--	mg/kg	None	None	Not Detected
Carbazole	86-74-8	3	0	--	mg/kg	None	None	Not Detected
Dibutyl phthalate	84-74-2	3	0	--	mg/kg	None	None	Not Detected

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Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Diethyl phthalate	84-66-2	3	0	--	mg/kg	None	None	Not Detected
Dimethyl phthalate	131-11-3	3	0	--	mg/kg	None	None	Not Detected
Di-N-Octyl Phthalate	117-84-0	3	0	--	mg/kg	None	None	Not Detected
Hexachlorobenzene	118-74-1	3	0	--	mg/kg	None	None	Not Detected
Hexachlorobutadiene	87-68-3	3	0	--	mg/kg	None	None	Not Detected
Hexachlorocyclopentadiene	77-47-4	3	0	--	mg/kg	None	None	Not Detected
Isophorone	78-59-1	3	0	--	mg/kg	None	None	Not Detected
m-Nitroaniline	99-09-2	3	0	--	mg/kg	None	None	Not Detected
Nitrobenzene	98-95-3	3	0	--	mg/kg	None	None	Not Detected
N-Nitrosodi-n-propylamine	621-64-7	3	0	--	mg/kg	None	None	Not Detected
N-Nitrosodiphenylamine	86-30-6	3	0	--	mg/kg	None	None	Not Detected
o-Cresol	95-48-7	3	0	--	mg/kg	None	None	Not Detected
p-Cresol	106-44-5	6	1	0.049	mg/kg	0.049	Max Det Conc	NObs < 10
Pentachlorophenol	87-86-5	3	0	--	mg/kg	None	None	Not Detected
Phenol	108-95-2	6	2	0.12	mg/kg	0.12	Max Det Conc	NObs < 10
Retene	483-65-8	6	0	--	mg/kg	None	None	Not Detected
1,2-Dichlorobenzene	95-50-1	3	0	--	mg/kg	None	None	Not Detected
1,3-Dichlorobenzene	541-73-1	3	0	--	mg/kg	None	None	Not Detected
1,4-Dichlorobenzene	106-46-7	3	0	--	mg/kg	None	None	Not Detected
2,2'-Oxybis[1-chloropropane]	108-60-1	3	0	--	mg/kg	None	None	Not Detected
2-Butanone	78-93-3	3	0	--	mg/kg	None	None	Not Detected
Acetone	67-64-1	3	0	--	mg/kg	None	None	Not Detected
Bis(2-Chloroethoxy)Methane	111-91-1	3	0	--	mg/kg	None	None	Not Detected
Bis(2-Chloroethyl)Ether	111-44-4	3	0	--	mg/kg	None	None	Not Detected
Carbon Disulfide	75-15-0	3	0	--	mg/kg	None	None	Not Detected
Hexachloroethane	67-72-1	3	0	--	mg/kg	None	None	Not Detected
Methylene Chloride	75-09-2	3	0	--	mg/kg	None	None	Not Detected
Toluene	108-88-3	3	0	--	mg/kg	None	None	Not Detected

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Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Sulfide	18496-25-8	3	2	408	mg/kg	408	Max Det Conc	NObs < 10
Ammonia (NH3) as Nitrogen (N)	AmmoniaN	3	3	25.4	mg/kg	25.4	Max Det Conc	NObs < 10
Preserved Total Solids	PTS	3	3	79.6	%	79.6	Max Det Conc	NObs < 10
Total Organic Carbon	TOC	14	14	1.42	%	1.415	Stat Analysis	NObs > 10
Total Solids	TS	3	3	79.6	%	79.6	Max Det Conc	NObs < 10
Particle/Grain Size, Fines (Silt/Clay)	PGS-Fines	3	3	73.7	%	73.7	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale <-1	PGS-Phi<-1	3	1	10.2	%	10.2	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale >10	PGS-Phi>10	1	1	11.5	%	11.5	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 0 to 1	PGS-Phi0-1	3	3	21.7	%	21.7	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale -1 to 0	PGS-Phi-1-0	3	3	12.7	%	12.7	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 1 to 2	PGS-Phi1-2	3	3	52	%	52	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 2 to 3	PGS-Phi2-3	3	3	34.1	%	34.1	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 3 to 4	PGS-Phi3-4	3	3	19.8	%	19.8	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 4 to 5	PGS-Phi4-5	2	2	20.3	%	20.3	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 5 to 6	PGS-Phi5-6	1	1	15.5	%	15.5	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 6 to 7	PGS-Phi6-7	1	1	11.1	%	11.1	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 7 to 8	PGS-Phi7-8	1	1	6.5	%	6.5	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 8 to 9	PGS-Phi8-9	1	1	4.9	%	4.9	Max Det Conc	NObs < 10
Particle/Grain Size, Phi Scale 9 to 10	PGS-Phi9-10	1	1	4	%	4	Max Det Conc	NObs < 10
3,4,5-Trichloroguaiacol (Ac)	57057-83-7	3	0	--	mg/kg	None	None	Not Detected
3,4,6-Trichloroguaiacol (Ac)	60712-44-9	3	0	--	mg/kg	None	None	Not Detected
3,4-Dicloroguaiacol	77102-94-4	3	0	--	mg/kg	None	None	Not Detected
4,5,6 Trichloroguaiacol	2668-24-8	3	0	--	mg/kg	None	None	Not Detected
4,5-Dichloroguaiacol	2460-49-3	3	0	--	mg/kg	None	None	Not Detected
4,6-Dichloroguaiacol	16766-31-7	3	0	--	mg/kg	None	None	Not Detected
4-Chloroguaiacol	16766-30-6	3	0	--	mg/kg	None	None	Not Detected
Guaiacol (2-Methoxyphenol)	90-05-1	3	0	--	mg/kg	None	None	Not Detected
Tetrachloroguaiacol	2539-17-5	3	0	--	mg/kg	None	None	Not Detected
Aluminum	7429-90-5	3	3	22400	mg/kg	22400	Max Det Conc	NObs < 10
Antimony	7440-36-0	6	3	0.02	mg/kg	0.02	Max Det Conc	NObs < 10
Arsenic	7440-38-2	6	6	7.1	mg/kg	7.1	Max Det Conc	NObs < 10
Barium	7440-39-3	6	6	45.6	mg/kg	45.6	Max Det Conc	NObs < 10
Beryllium	7440-41-7	3	1	0.46	mg/kg	0.46	Max Det Conc	NObs < 10
Cadmium	7440-43-9	6	6	2.1	mg/kg	2.1	Max Det Conc	NObs < 10
Calcium	7440-70-2	3	3	53100	mg/kg	53100	Max Det Conc	NObs < 10
Chromium	7440-47-3	6	6	47.5	mg/kg	47.5	Max Det Conc	NObs < 10
Cobalt	7440-48-4	3	3	11.5	mg/kg	11.5	Max Det Conc	NObs < 10

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Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Copper	7440-50-8	6	6	36	mg/kg	36	Max Det Conc	NObs < 10
Iron	7439-89-6	3	3	33300	mg/kg	33300	Max Det Conc	NObs < 10
Lead	7439-92-1	6	6	8.3	mg/kg	8.3	Max Det Conc	NObs < 10
Magnesium	7439-95-4	3	3	13300	mg/kg	13300	Max Det Conc	NObs < 10
Manganese	7439-96-5	3	3	284	mg/kg	284	Max Det Conc	NObs < 10
Mercury	7439-97-6	6	5	0.13	mg/kg	0.13	Max Det Conc	NObs < 10
Nickel	7440-02-0	6	6	45	mg/kg	45	Max Det Conc	NObs < 10
Potassium	7440-09-7	3	3	3730	mg/kg	3730	Max Det Conc	NObs < 10
Selenium	7782-49-2	3	0	--	mg/kg	None	None	Not Detected
Silver	7440-22-4	6	5	0.433	mg/kg	0.433	Max Det Conc	NObs < 10
Sodium	7440-23-5	3	3	17900	mg/kg	17900	Max Det Conc	NObs < 10
Thallium	7440-28-0	3	0	--	mg/kg	None	None	Not Detected
Vanadium	7440-62-2	3	3	67.9	mg/kg	67.9	Max Det Conc	NObs < 10
Zinc	7440-66-6	6	6	88.7	mg/kg	88.7	Max Det Conc	NObs < 10
12-Chlorodehydroabietic Acid	65310-45-4	3	0	--	mg/kg	None	None	Not Detected
14-Chlorodehydroabietic Acid	65281-76-7	3	0	--	mg/kg	None	None	Not Detected
1-Phenanthrenecarboxylic acid, 1,2,3,4,4a,9,10,10a	1740-19-8	3	0	--	mg/kg	None	None	Not Detected
9,10-Dichlorostearic acid	5829-48-1	3	0	--	mg/kg	None	None	Not Detected
Abietic Acid	514-10-3	3	0	--	mg/kg	None	None	Not Detected
Benzoic Acid	65-85-0	6	0	--	mg/kg	None	None	Not Detected
Dichlorodehydroabietic Acid	57055-39-7	3	0	--	mg/kg	None	None	Not Detected
Isopimaric Acid	5835-26-7	3	0	--	mg/kg	None	None	Not Detected
Linolenic Acid	463-40-1	3	0	--	mg/kg	None	None	Not Detected
Neoabietic Acid	471-77-2	3	0	--	mg/kg	None	None	Not Detected
Oleic Acid	112-80-1	3	0	--	mg/kg	None	None	Not Detected
Palustric Acid	1945-53-5	3	0	--	mg/kg	None	None	Not Detected
Pimaric Acid	127-27-5	3	0	--	mg/kg	None	None	Not Detected
Sandaracopimaric Acid	471-74-9	3	0	--	mg/kg	None	None	Not Detected
Butyltin	78763-54-9	3	0	--	mg/kg	None	None	Not Detected
Dibutyltin	1002-53-5	3	0	--	mg/kg	None	None	Not Detected
Tributyltin	688-73-3	3	0	--	mg/kg	None	None	Not Detected
Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	CPAH-TEQ0	6	0	--	mg/kg	None	None	Not Detected
Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=	CPAH-TEQ05	6	0	--	mg/kg	None	None	Not Detected
High MW PAHs ND=0	HPAH0	6	2	0.043	mg/kg	0.043	Max Det Conc	NObs < 10
High MW PAHs ND=0.5	HPAH05	6	2	0.1262	mg/kg	0.1262	Max Det Conc	NObs < 10
Low MW PAHs ND=0	LPAH0	6	3	0.0247	mg/kg	0.0247	Max Det Conc	NObs < 10
Low MW PAHs ND=0.5	LPAH05	6	3	0.10005	mg/kg	0.10005	Max Det Conc	NObs < 10

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Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Total PAHs ND=0	TotPAH0	6	3	0.0677	mg/kg	0.0677	Max Det Conc	NObs < 10
Total PAHs ND=0.5	TotPAH05	6	3	0.22625	mg/kg	0.22625	Max Det Conc	NObs < 10
1-Methylnaphthalene	90-12-0	6	0	--	mg/kg	None	None	Not Detected
2-Methylnaphthalene	91-57-6	6	0	--	mg/kg	None	None	Not Detected
9H-Carbazole	9HCarb	3	0	--	mg/kg	None	None	Not Detected
9H-Fluorene	9HFluor	3	0	--	mg/kg	None	None	Not Detected
Acenaphthene	83-32-9	6	0	--	mg/kg	None	None	Not Detected
Acenaphthylene	208-96-8	6	0	--	mg/kg	None	None	Not Detected
Anthracene	120-12-7	6	0	--	mg/kg	None	None	Not Detected
Benz[a]anthracene	56-55-3	6	0	--	mg/kg	None	None	Not Detected
Benzo(a)pyrene	50-32-8	6	0	--	mg/kg	None	None	Not Detected
Benzo(b)fluoranthene	205-99-2	6	0	--	mg/kg	None	None	Not Detected
Benzo(ghi)perylene	191-24-2	6	0	--	mg/kg	None	None	Not Detected
Benzo(k)fluoranthene	207-08-9	6	0	--	mg/kg	None	None	Not Detected
Chrysene	218-01-9	6	0	--	mg/kg	None	None	Not Detected
Dibenzo(a,h)anthracene	53-70-3	6	0	--	mg/kg	None	None	Not Detected
Dibenzofuran	132-64-9	6	0	--	mg/kg	None	None	Not Detected
Fluoranthene	206-44-0	6	1	0.0211	mg/kg	0.0211	Max Det Conc	NObs < 10
Fluorene	86-73-7	3	0	--	mg/kg	None	None	Not Detected
Indeno(1,2,3-cd)pyrene	193-39-5	6	0	--	mg/kg	None	None	Not Detected
Naphthalene	91-20-3	6	0	--	mg/kg	None	None	Not Detected
Phenanthrene	85-01-8	6	2	0.016	mg/kg	0.016	Max Det Conc	NObs < 10
Pyrene	129-00-0	6	2	0.0215	mg/kg	0.0215	Max Det Conc	NObs < 10
4-Bromophenyl phenyl ether	101-55-3	3	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1016	12674-11-2	3	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1221	11104-28-2	3	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1232	11141-16-5	3	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1242	53469-21-9	6	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1248	12672-29-6	3	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1254	11097-69-1	6	0	--	mg/kg	None	None	Not Detected
PCB-aroclor 1260	11096-82-5	6	0	--	mg/kg	None	None	Not Detected
PCB, Sum of Aroclors, ND0	PCB-Tot-Aro ND0	3	0	--	mg/kg	None	None	Not Detected
PCB, Sum of Aroclors, ND05	PCB-Tot-AroND05	3	0	--	mg/kg	None	None	Not Detected
PCB, Sum of Congeners	PCB-Tot-Cong	11	11	0.0014	mg/kg	0.0012	Stat Analysis	NObx > 10
PCB, Sum of Congeners, per gram TOC	PCB-TOT-CON-TOC	11	11	0.14	mg/kg	0.106	Stat Analysis	NObx > 10
Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	17	15	8.562E-07	mg/kg	5.20E-08	Stat Analysis	NObx > 10
Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	17	15	9.42E-07	mg/kg	8.75E-07	Stat Analysis	NObx > 10

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Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Total HpCDD	37871-00-4	6	4	0.0000194	mg/kg	0.0000194	Max Det Conc	NObs < 10
Total HpCDF	38998-75-3	6	1	0.00000425	mg/kg	0.00000425	Max Det Conc	NObs < 10
Total HxCDD	34465-46-8	6	3	0.0000107	mg/kg	0.0000107	Max Det Conc	NObs < 10
Total HxCDF	55684-94-1	6	2	0.00000246	mg/kg	0.00000246	Max Det Conc	NObs < 10
Total PeCDD	36088-22-9	6	2	0.00000296	mg/kg	0.00000296	Max Det Conc	NObs < 10
Total PeCDF	30402-15-4	6	3	0.0000026	mg/kg	0.0000026	Max Det Conc	NObs < 10
Total TCDD	41903-57-5	6	2	0.00000262	mg/kg	0.00000262	Max Det Conc	NObs < 10
Total TCDF	30402-14-3	3	2	0.0000011	mg/kg	0.0000011	Max Det Conc	NObs < 10
TOTAL TETRA_FURANS	55722-27-5	3	3	0.00000473	mg/kg	0.00000473	Max Det Conc	NObs < 10
1,2,3,4,6,7,8-HpCDD	35822-46-9	6	4	0.00000806	mg/kg	0.00000806	Max Det Conc	NObs < 10
1,2,3,4,6,7,8-HpCDF	67562-39-4	6	1	0.00000182	mg/kg	0.00000182	Max Det Conc	NObs < 10
1,2,3,4,7,8,9-HpCDF	55673-89-7	3	1	1.11E-07	mg/kg	0.000000111	Max Det Conc	NObs < 10
1,2,3,4,7,8-HxCDD	39227-28-6	6	2	1.91E-07	mg/kg	0.000000191	Max Det Conc	NObs < 10
1,2,3,4,7,8-HxCDF	70648-26-9	3	1	2.24E-07	mg/kg	0.000000224	Max Det Conc	NObs < 10
1,2,3,6,7,8-HxCDD	57653-85-7	6	3	0.00000101	mg/kg	0.00000101	Max Det Conc	NObs < 10
1,2,3,6,7,8-HxCDF	57117-44-9	3	2	1.28E-07	mg/kg	0.000000128	Max Det Conc	NObs < 10
1,2,3,7,8,9-HxCDD	19408-74-3	6	3	0.00000082	mg/kg	0.00000082	Max Det Conc	NObs < 10
1,2,3,7,8,9-HxCDF	72918-21-9	3	0	--	mg/kg	None	None	Not Detected
1,2,3,7,8-PeCDD	40321-76-4	6	1	2.36E-07	mg/kg	0.000000236	Max Det Conc	NObs < 10
1,2,3,7,8-PeCDF	57117-41-6	3	1	1.06E-07	mg/kg	0.000000106	Max Det Conc	NObs < 10
2,3,4,6,7,8-HxCDF	60851-34-5	3	1	1.25E-07	mg/kg	0.000000125	Max Det Conc	NObs < 10
2,3,4,7,8-PeCDF	57117-31-4	3	3	1.88E-07	mg/kg	0.000000188	Max Det Conc	NObs < 10
2,3,7,8-TCDD	1746-01-6	6	1	1.16E-07	mg/kg	0.000000116	Max Det Conc	NObs < 10
2,3,7,8-TCDF	51207-31-9	6	2	7.79E-07	mg/kg	0.000000779	Max Det Conc	NObs < 10
OCDD	3268-87-9	6	3	0.0000537	mg/kg	0.0000537	Max Det Conc	NObs < 10
OCDF	39001-02-0	6	1	0.00000302	mg/kg	0.00000302	Max Det Conc	NObs < 10
4,4'-DDD	72-54-8	6	0	--	mg/kg	None	None	Not Detected
4,4'-DDE	72-55-9	3	0	--	mg/kg	None	None	Not Detected
4,4'-DDT	50-29-3	3	0	--	mg/kg	None	None	Not Detected
Aldrin	309-00-2	3	2	0.0049	mg/kg	0.0049	Max Det Conc	NObs < 10
Alpha-BHC	319-84-6	3	1	0.0015	mg/kg	0.0015	Max Det Conc	NObs < 10
Beta-BHC	319-85-7	3	2	0.0022	mg/kg	0.0022	Max Det Conc	NObs < 10
cis-Chlordane	5103-71-9	3	3	0.00066	mg/kg	0.00066	Max Det Conc	NObs < 10
Delta-BHC	319-86-8	3	0	--	mg/kg	None	None	Not Detected
Dieldrin	60-57-1	3	0	--	mg/kg	None	None	Not Detected
Endosulfan I	959-98-8	3	0	--	mg/kg	None	None	Not Detected
Endosulfan II	33213-65-9	3	0	--	mg/kg	None	None	Not Detected

Table A-6
Background Sediment Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Endosulfan Sulfate	1031-07-8	3	0	--	mg/kg	None	None	Not Detected
Endrin	72-20-8	3	0	--	mg/kg	None	None	Not Detected
Endrin Aldehyde	7421-93-4	3	0	--	mg/kg	None	None	Not Detected
Endrin Ketone	53494-70-5	3	0	--	mg/kg	None	None	Not Detected
gamma-Chlordane	5566-34-7	3	1	0.00074	mg/kg	0.00074	Max Det Conc	NObs < 10
Heptachlor	76-44-8	3	0	--	mg/kg	None	None	Not Detected
Heptachlor Epoxide	1024-57-3	3	3	0.00088	mg/kg	0.00088	Max Det Conc	NObs < 10
Lindane	58-89-9	3	1	0.0041	mg/kg	0.0041	Max Det Conc	NObs < 10
Methoxychlor	72-43-5	3	0	--	mg/kg	None	None	Not Detected
Toxaphene	8001-35-2	3	0	--	mg/kg	None	None	Not Detected
#2 Diesel	68476-34-6	3	2	12	mg/kg	12	Max Det Conc	NObs < 10
Gasoline	86290-81-5	3	0	--	mg/kg	None	None	Not Detected
Motor Oil	PHCMOT	3	1	10	mg/kg	10	Max Det Conc	NObs < 10
1,2,4-Trichlorobenzene	120-82-1	3	0	--	mg/kg	None	None	Not Detected
2,4,5-Trichlorophenol	95-95-4	3	0	--	mg/kg	None	None	Not Detected
2,4,6-Trichlorophenol	88-06-2	6	0	--	mg/kg	None	None	Not Detected
2,4-Dichlorophenol	120-83-2	3	0	--	mg/kg	None	None	Not Detected
2,4-Dimethylphenol	105-67-9	3	0	--	mg/kg	None	None	Not Detected
2,4-Dinitrophenol	51-28-5	3	0	--	mg/kg	None	None	Not Detected
2,4-Dinitrotoluene	121-14-2	3	0	--	mg/kg	None	None	Not Detected
2,6-Dinitrotoluene	606-20-2	3	0	--	mg/kg	None	None	Not Detected
2-Chloronaphthalene	91-58-7	3	0	--	mg/kg	None	None	Not Detected
2-Chlorophenol	95-57-8	3	0	--	mg/kg	None	None	Not Detected
2-Nitroaniline	88-74-4	3	0	--	mg/kg	None	None	Not Detected
2-Nitrophenol	88-75-5	3	0	--	mg/kg	None	None	Not Detected
3,3'-Dichlorobenzidine	91-94-1	1	0	--	mg/kg	None	None	Not Detected
4,6-Dinitro-2-Methylphenol	534-52-1	3	0	--	mg/kg	None	None	Not Detected
4-Chloro-3-Methylphenol	59-50-7	3	0	--	mg/kg	None	None	Not Detected
4-Chloroaniline	106-47-8	3	0	--	mg/kg	None	None	Not Detected
4-Chlorophenyl-Phenylether	7005-72-3	3	0	--	mg/kg	None	None	Not Detected
4-Nitroaniline	100-01-6	3	0	--	mg/kg	None	None	Not Detected
4-Nitrophenol	100-02-7	3	0	--	mg/kg	None	None	Not Detected
Benzyl Alcohol	100-51-6	3	0	--	mg/kg	None	None	Not Detected
Bis(2-Ethylhexyl) Phthalate	117-81-7	3	0	--	mg/kg	None	None	Not Detected
Butyl benzyl phthalate	85-68-7	3	0	--	mg/kg	None	None	Not Detected
Carbazole	86-74-8	3	0	--	mg/kg	None	None	Not Detected
Dibutyl phthalate	84-74-2	3	0	--	mg/kg	None	None	Not Detected

Table A-6
Background Sediment Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Chemical Name	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Diethyl phthalate	84-66-2	3	0	--	mg/kg	None	None	Not Detected
Dimethyl phthalate	131-11-3	3	0	--	mg/kg	None	None	Not Detected
Di-N-Octyl Phthalate	117-84-0	3	0	--	mg/kg	None	None	Not Detected
Hexachlorobenzene	118-74-1	3	0	--	mg/kg	None	None	Not Detected
Hexachlorobutadiene	87-68-3	3	0	--	mg/kg	None	None	Not Detected
Hexachlorocyclopentadiene	77-47-4	3	0	--	mg/kg	None	None	Not Detected
Isophorone	78-59-1	3	0	--	mg/kg	None	None	Not Detected
m-Nitroaniline	99-09-2	3	0	--	mg/kg	None	None	Not Detected
Nitrobenzene	98-95-3	3	0	--	mg/kg	None	None	Not Detected
N-Nitrosodi-n-propylamine	621-64-7	3	0	--	mg/kg	None	None	Not Detected
N-Nitrosodiphenylamine	86-30-6	3	0	--	mg/kg	None	None	Not Detected
o-Cresol	95-48-7	3	0	--	mg/kg	None	None	Not Detected
p-Cresol	106-44-5	6	1	0.049	mg/kg	0.049	Max Det Conc	NObs < 10
Pentachlorophenol	87-86-5	3	0	--	mg/kg	None	None	Not Detected
Phenol	108-95-2	6	2	0.12	mg/kg	0.12	Max Det Conc	NObs < 10
Retene	483-65-8	6	0	--	mg/kg	None	None	Not Detected
1,2-Dichlorobenzene	95-50-1	3	0	--	mg/kg	None	None	Not Detected
1,3-Dichlorobenzene	541-73-1	3	0	--	mg/kg	None	None	Not Detected
1,4-Dichlorobenzene	106-46-7	3	0	--	mg/kg	None	None	Not Detected
2,2'-Oxybis[1-chloropropane]	108-60-1	3	0	--	mg/kg	None	None	Not Detected
2-Butanone	78-93-3	3	0	--	mg/kg	None	None	Not Detected
Acetone	67-64-1	3	0	--	mg/kg	None	None	Not Detected
Bis(2-Chloroethoxy)Methane	111-91-1	3	0	--	mg/kg	None	None	Not Detected
Bis(2-Chloroethyl)Ether	111-44-4	3	0	--	mg/kg	None	None	Not Detected
Carbon Disulfide	75-15-0	3	0	--	mg/kg	None	None	Not Detected
Hexachloroethane	67-72-1	3	0	--	mg/kg	None	None	Not Detected
Methylene Chloride	75-09-2	3	0	--	mg/kg	None	None	Not Detected
Toluene	108-88-3	3	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Coonstripe Shrimp	Whole Organism	Lipids	LIPIDS	3	3	0.82	%	0.82	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Total Solids	TS	3	3	23.2	%	23.2	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Arsenic	7440-38-2	3	3	12.9	mg/kg	12.9	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Arsenic, Inorganic	7440-38-2-Inorg	3	3	0.012	mg/kg	0.012	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Cadmium	7440-43-9	3	3	0.04	mg/kg	0.04	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Copper	7440-50-8	3	3	5.19	mg/kg	5.19	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Selenium	7782-49-2	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Zinc	7440-66-6	3	3	11.2	mg/kg	11.2	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Methylmercury(1+)	22967-92-6	3	3	0.05	mg/kg	0.05	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Tetraethyl Lead	78-00-2	3	3	0.004	mg/kg	0.004	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0)	CPAH-TEQ0	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0.5)	CPAH-TEQ05	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	High MW PAHs	HPAH	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	High MW PAHs ND=0	HPAH0	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	High MW PAHs ND=0.5	HPAH05	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Low Molecular Weight Polycyclic Aromatic Hydrocarb	LPAH	3	3	0.0000011	mg/kg	0.0000011	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Low MW PAHs ND=0	LPAH0	3	3	0.00105	mg/kg	0.00105	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Low MW PAHs ND=0.5	LPAH05	3	3	0.00121	mg/kg	0.00121	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Total PAHs ND=0	TotPAH0	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Total PAHs ND=0.5	TotPAH05	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	2-Methylnaphthalene	91-57-6	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Acenaphthene	83-32-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Acenaphthylene	208-96-8	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Anthracene	120-12-7	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Benz[a]anthracene	56-55-3	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Benzo(a)pyrene	50-32-8	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Benzo(b)fluoranthene	205-99-2	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Benzo(ghi)perylene	191-24-2	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Benzo(k)fluoranthene	207-08-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Benzofluoranthenes, Total (b+k+j)	BnzFluor-bkj	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Chrysene	218-01-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Dibenzo(a,h)anthracene	53-70-3	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Fluoranthene	206-44-0	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Fluorene	86-73-7	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Indeno(1,2,3-cd)pyrene	193-39-5	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Naphthalene	91-20-3	3	3	0.00078	mg/kg	0.00078	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Phenanthrene	85-01-8	3	1	0.00031	mg/kg	0.00031	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Pyrene	129-00-0	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	PCB-aroclor 1242	53469-21-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	PCB-aroclor 1254	11097-69-1	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	PCB-aroclor 1260	11096-82-5	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	PCB	1336-36-3	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	PCB, Sum of Aroclors, ND0	PCB-Tot-Aro ND0	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	PCB, Sum of Aroclors, ND05	PCB-Tot-AroND05	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	3	3	4.98E-10	mg/kg	4.98E-10	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	3	3	3.42539E-07	mg/kg	3.42539E-07	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Total HpCDD	37871-00-4	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Total HpCDF	38998-75-3	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Total HxCDD	34465-46-8	3	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Coonstripe Shrimp	Whole Organism	Total HxCDF	55684-94-1	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Total PeCDD	36088-22-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Total PeCDF	30402-15-4	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Total TCDD	41903-57-5	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Total TCDF	30402-14-3	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	1,2,3,4,6,7,8-HpCDD	35822-46-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	1,2,3,4,6,7,8-HpCDF	67562-39-4	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	1,2,3,4,7,8,9-HpCDF	55673-89-7	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	1,2,3,4,7,8-HxCDD	39227-28-6	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	1,2,3,4,7,8-HxCDF	70648-26-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	1,2,3,6,7,8-HxCDD	57653-85-7	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	1,2,3,6,7,8-HxCDF	57117-44-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	1,2,3,7,8,9-HxCDD	19408-74-3	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	1,2,3,7,8,9-HxCDF	72918-21-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	1,2,3,7,8-PeCDD	40321-76-4	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	1,2,3,7,8-PeCDF	57117-41-6	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	2,3,4,6,7,8-HxCDF	60851-34-5	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	2,3,4,7,8-PeCDF	57117-31-4	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	2,3,7,8-TCDD	1746-01-6	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	2,3,7,8-TCDF	51207-31-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	OCDD	3268-87-9	3	3	0.00000137	mg/kg	0.00000137	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	OCDF	39001-02-0	3	2	0.00000112	mg/kg	0.00000112	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	4,4'-DDD	72-54-8	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	4,4'-DDE	72-55-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	4,4'-DDT	50-29-3	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Alpha-BHC	319-84-6	3	3	0.00071	mg/kg	0.00071	Max Det Conc	NObs < 10
Coonstripe Shrimp	Whole Organism	Beta-BHC	319-85-7	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Delta-BHC	319-86-8	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Lindane	58-89-9	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Pentachlorophenol	87-86-5	3	0	--	mg/kg	None	None	Not Detected
Coonstripe Shrimp	Whole Organism	Pyridine	110-86-1	3	3	0.18	mg/kg	0.18	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Lipids	LIPIDS	3	3	6	%	6	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Total Solids	TS	3	3	21.6	%	21.6	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Arsenic	7440-38-2	3	3	13.2	mg/kg	13.2	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Arsenic, Inorganic	7440-38-2-Inorg	3	3	0.65	mg/kg	0.65	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Cadmium	7440-43-9	3	3	1.46	mg/kg	1.46	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Copper	7440-50-8	3	3	54.9	mg/kg	54.9	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Selenium	7782-49-2	3	3	2	mg/kg	2	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Zinc	7440-66-6	3	3	22.6	mg/kg	22.6	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Methylmercury(1+)	22967-92-6	3	3	0.1	mg/kg	0.1	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Tetraethyl Lead	78-00-2	3	3	0.03	mg/kg	0.03	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0)	CPAH-TEQ0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0.5)	CPAH-TEQ05	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	High MW PAHs	HPAH	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	High MW PAHs ND=0	HPAH0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	High MW PAHs ND=0.5	HPAH05	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Low Molecular Weight Polycyclic Aromatic Hydrocarb	LPAH	3	3	0.0000067	mg/kg	0.0000067	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Low MW PAHs ND=0	LPAH0	3	3	0.0067	mg/kg	0.0067	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Low MW PAHs ND=0.5	LPAH05	3	3	0.00686	mg/kg	0.00686	Max Det Conc	NObs < 10

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Dungeness Crab	Hepatopancreas	Total PAHs ND=0	TotPAH0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Total PAHs ND=0.5	TotPAH05	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	2-Methylnaphthalene	91-57-6	3	2	0.00074	mg/kg	0.00074	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Acenaphthene	83-32-9	3	1	0.00017	mg/kg	0.00017	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Acenaphthylene	208-96-8	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Anthracene	120-12-7	3	1	0.0017	mg/kg	0.0017	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Benz[a]anthracene	56-55-3	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Benzo(a)pyrene	50-32-8	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Benzo(b)fluoranthene	205-99-2	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Benzo(ghi)perylene	191-24-2	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Benzo(k)fluoranthene	207-08-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Benzofluoranthenes, Total (b+k+j)	BnzFluor-bkj	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Chrysene	218-01-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Dibenzo(a,h)anthracene	53-70-3	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Fluoranthene	206-44-0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Fluorene	86-73-7	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Indeno(1,2,3-cd)pyrene	193-39-5	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Naphthalene	91-20-3	3	3	0.001	mg/kg	0.001	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Phenanthrene	85-01-8	3	3	0.0057	mg/kg	0.0057	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Pyrene	129-00-0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	PCB-aroclor 1242	53469-21-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	PCB-aroclor 1254	11097-69-1	3	2	0.011	mg/kg	0.011	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	PCB-aroclor 1260	11096-82-5	3	2	0.017	mg/kg	0.017	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	PCB	1336-36-3	3	2	0.033	mg/kg	0.033	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	PCB, Sum of Aroclors, ND0	PCB-Tot-Aro ND0	3	2	0.028	mg/kg	0.028	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	PCB, Sum of Aroclors, ND05	PCB-Tot-AroND05	3	2	0.02895	mg/kg	0.02895	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	PCB, Sum of Congeners	PCB-Tot-Cong	7	7	0.04945	mg/kg	0.04945	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	10	10	0.000001367	mg/kg	1.20E-06	Stat Analysis	NObs > 10
Dungeness Crab	Hepatopancreas	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	10	10	0.000001393	mg/kg	1.20E-06	Stat Analysis	NObs > 10
Dungeness Crab	Hepatopancreas	Total HpCDD	37871-00-4	3	3	0.00000122	mg/kg	0.00000122	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Total HpCDF	38998-75-3	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Total HxCDD	34465-46-8	3	3	0.00000179	mg/kg	0.00000179	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Total HxCDF	55684-94-1	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Total PeCDD	36088-22-9	3	1	0.00000034	mg/kg	0.00000034	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Total PeCDF	30402-15-4	3	3	0.00000124	mg/kg	0.00000124	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Total TCDD	41903-57-5	3	2	0.00000059	mg/kg	0.00000059	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Total TCDF	30402-14-3	3	3	0.00000297	mg/kg	0.00000297	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	1,2,3,4,6,7,8-HpCDD	35822-46-9	3	3	0.00000076	mg/kg	0.00000076	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	1,2,3,4,6,7,8-HpCDF	67562-39-4	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	1,2,3,4,7,8,9-HpCDF	55673-89-7	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	1,2,3,4,7,8-HxCDD	39227-28-6	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	1,2,3,4,7,8-HxCDF	70648-26-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	1,2,3,6,7,8-HxCDD	57653-85-7	3	3	0.00000068	mg/kg	0.00000068	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	1,2,3,6,7,8-HxCDF	57117-44-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	1,2,3,7,8,9-HxCDD	19408-74-3	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	1,2,3,7,8,9-HxCDF	72918-21-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	1,2,3,7,8-PeCDD	40321-76-4	3	1	0.00000034	mg/kg	0.00000034	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	1,2,3,7,8-PeCDF	57117-41-6	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	2,3,4,6,7,8-HxCDF	60851-34-5	3	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Dungeness Crab	Hepatopancreas	2,3,4,7,8-PeCDF	57117-31-4	3	2	0.00000036	mg/kg	0.00000036	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	2,3,7,8-TCDD	1746-01-6	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	2,3,7,8-TCDF	51207-31-9	3	3	0.00000069	mg/kg	0.00000069	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	OCDD	3268-87-9	3	2	0.00000132	mg/kg	0.00000132	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	OCDF	39001-02-0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	4,4'-DDD	72-54-8	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	4,4'-DDE	72-55-9	3	2	0.014	mg/kg	0.014	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	4,4'-DDT	50-29-3	3	2	0.0049	mg/kg	0.0049	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Alpha-BHC	319-84-6	3	3	0.0018	mg/kg	0.0018	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Beta-BHC	319-85-7	3	2	0.0034	mg/kg	0.0034	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Delta-BHC	319-86-8	3	1	0.00062	mg/kg	0.00062	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Lindane	58-89-9	3	1	0.0025	mg/kg	0.0025	Max Det Conc	NObs < 10
Dungeness Crab	Hepatopancreas	Pentachlorophenol	87-86-5	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Hepatopancreas	Pyridine	110-86-1	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Lipids	LIPIDS	3	3	0.4	%	0.4	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Total Solids	TS	3	3	17.2	%	17.2	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Arsenic	7440-38-2	3	3	10.4	mg/kg	10.4	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Arsenic, Inorganic	7440-38-2-Inorg	3	3	0.01	mg/kg	0.01	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Cadmium	7440-43-9	3	2	0.013	mg/kg	0.013	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Copper	7440-50-8	3	3	5.09	mg/kg	5.09	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Selenium	7782-49-2	3	3	0.7	mg/kg	0.7	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Zinc	7440-66-6	3	3	41.7	mg/kg	41.7	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Methylmercury(1+)	22967-92-6	3	3	0.09	mg/kg	0.09	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Tetraethyl Lead	78-00-2	3	3	0.007	mg/kg	0.007	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0)	CPAH-TEQ0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0.5)	CPAH-TEQ05	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	High MW PAHs	HPAH	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	High MW PAHs ND=0	HPAH0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	High MW PAHs ND=0.5	HPAH05	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Low Molecular Weight Polycyclic Aromatic Hydrocarb	LPAH	3	1	0.0000002	mg/kg	0.0000002	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Low MW PAHs ND=0	LPAH0	3	1	0.0002	mg/kg	0.0002	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Low MW PAHs ND=0.5	LPAH05	3	1	0.000635	mg/kg	0.000635	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Total PAHs ND=0	TotPAH0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Total PAHs ND=0.5	TotPAH05	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	2-Methylnaphthalene	91-57-6	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Acenaphthene	83-32-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Acenaphthylene	208-96-8	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Anthracene	120-12-7	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Benz[a]anthracene	56-55-3	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Benzo(a)pyrene	50-32-8	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Benzo(b)fluoranthene	205-99-2	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Benzo(ghi)perylene	191-24-2	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Benzo(k)fluoranthene	207-08-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Benzofluoranthenes, Total (b+k+j)	BnzFluor-bkj	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Chrysene	218-01-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Dibenzo(a,h)anthracene	53-70-3	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Fluoranthene	206-44-0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Fluorene	86-73-7	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Indeno(1,2,3-cd)pyrene	193-39-5	3	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Dungeness Crab	Muscle	Naphthalene	91-20-3	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Phenanthrene	85-01-8	3	1	0.0002	mg/kg	0.0002	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Pyrene	129-00-0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	PCB-aroclor 1242	53469-21-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	PCB-aroclor 1254	11097-69-1	3	1	0.013	mg/kg	0.013	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	PCB-aroclor 1260	11096-82-5	3	1	0.014	mg/kg	0.014	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	PCB	1336-36-3	3	1	0.028	mg/kg	0.028	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	PCB, Sum of Aroclors, ND0	PCB-Tot-Aro ND0	3	1	0.027	mg/kg	0.027	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	PCB, Sum of Aroclors, ND05	PCB-Tot-AroND05	3	1	0.02795	mg/kg	0.02795	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	PCB, Sum of Congeners	PCB-Tot-Cong	7	7	0.00192	mg/kg	0.00192	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	10	7	0.000000034	mg/kg	2.00E-08	Stat Analysis	NObs > 10
Dungeness Crab	Muscle	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	10	7	0.000000054	mg/kg	1.78E-08	Stat Analysis	NObs > 10
Dungeness Crab	Muscle	Total HpCDD	37871-00-4	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Total HpCDF	38998-75-3	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Total HxCDD	34465-46-8	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Total HxCDF	55684-94-1	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Total PeCDD	36088-22-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Total PeCDF	30402-15-4	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Total TCDD	41903-57-5	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Total TCDF	30402-14-3	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	1,2,3,4,6,7,8-HpCDD	35822-46-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	1,2,3,4,6,7,8-HpCDF	67562-39-4	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	1,2,3,4,7,8,9-HpCDF	55673-89-7	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	1,2,3,4,7,8-HxCDD	39227-28-6	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	1,2,3,4,7,8-HxCDF	70648-26-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	1,2,3,6,7,8-HxCDD	57653-85-7	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	1,2,3,6,7,8-HxCDF	57117-44-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	1,2,3,7,8,9-HxCDD	19408-74-3	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	1,2,3,7,8,9-HxCDF	72918-21-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	1,2,3,7,8-PeCDD	40321-76-4	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	1,2,3,7,8-PeCDF	57117-41-6	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	2,3,4,6,7,8-HxCDF	60851-34-5	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	2,3,4,7,8-PeCDF	57117-31-4	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	2,3,7,8-TCDD	1746-01-6	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	2,3,7,8-TCDF	51207-31-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	OCDD	3268-87-9	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	OCDF	39001-02-0	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	4,4'-DDD	72-54-8	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	4,4'-DDE	72-55-9	3	2	0.014	mg/kg	0.014	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	4,4'-DDT	50-29-3	3	1	0.005	mg/kg	0.005	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Alpha-BHC	319-84-6	3	2	0.0016	mg/kg	0.0016	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Beta-BHC	319-85-7	3	1	0.0037	mg/kg	0.0037	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Delta-BHC	319-86-8	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Lindane	58-89-9	3	2	0.0017	mg/kg	0.0017	Max Det Conc	NObs < 10
Dungeness Crab	Muscle	Pentachlorophenol	87-86-5	3	0	--	mg/kg	None	None	Not Detected
Dungeness Crab	Muscle	Pyridine	110-86-1	3	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Lipids	LIPIDS	4	4	2.1	%	2.1	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Total Solids	TS	3	3	25.1	%	25.1	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Aluminum	7429-90-5	1	1	57.7	mg/kg	57.7	Max Det Conc	NObs < 10

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Geoduck	Whole OrganismXshell	Antimony	7440-36-0	2	1	0.082	mg/kg	0.082	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Arsenic	7440-38-2	5	5	4.21	mg/kg	4.21	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Arsenic, Inorganic	7440-38-2-Inorg	3	3	0.4	mg/kg	0.4	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Barium	7440-39-3	2	2	0.996	mg/kg	0.996	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Beryllium	7440-41-7	1	1	0.0051	mg/kg	0.0051	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Cadmium	7440-43-9	5	5	0.3	mg/kg	0.3	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Calcium	7440-70-2	1	1	1930	mg/kg	1930	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Chromium	7440-47-3	2	2	0.43	mg/kg	0.43	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Cobalt	7440-48-4	1	1	0.641	mg/kg	0.641	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Copper	7440-50-8	4	4	2.6	mg/kg	2.6	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Iron	7439-89-6	1	1	940	mg/kg	940	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Lead	7439-92-1	2	2	1.04	mg/kg	1.04	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Magnesium	7439-95-4	1	1	565	mg/kg	565	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Manganese	7439-96-5	1	1	179	mg/kg	179	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Mercury	7439-97-6	2	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Nickel	7440-02-0	2	2	0.592	mg/kg	0.592	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Potassium	7440-09-7	1	1	3090	mg/kg	3090	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Selenium	7782-49-2	4	4	0.943	mg/kg	0.943	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Silver	7440-22-4	1	1	0.739	mg/kg	0.739	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Sodium	7440-23-5	1	1	2700	mg/kg	2700	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Vanadium	7440-62-2	1	1	1.92	mg/kg	1.92	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Zinc	7440-66-6	5	5	54.1	mg/kg	54.1	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Benzoic Acid	65-85-0	2	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Methylmercury(1+)	22967-92-6	3	3	0.03	mg/kg	0.03	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Tetraethyl Lead	78-00-2	3	3	0.29	mg/kg	0.29	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0)	CPAH-TEQ0	4	2	0.0001	mg/kg	0.0001	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0.5)	CPAH-TEQ05	4	2	0.0001483	mg/kg	0.0001483	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	High MW PAHs	HPAH	3	3	0.0000025	mg/kg	0.0000025	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	High MW PAHs ND=0	HPAH0	4	3	0.00245	mg/kg	0.00245	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	High MW PAHs ND=0.5	HPAH05	4	3	0.0028351	mg/kg	0.0028351	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Low Molecular Weight Polycyclic Aromatic Hydrocarb	LPAH	3	3	0.0000018	mg/kg	0.0000018	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Low MW PAHs ND=0	LPAH0	4	3	0.00183	mg/kg	0.00183	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Low MW PAHs ND=0.5	LPAH05	4	3	0.001975	mg/kg	0.001975	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Total PAHs ND=0	TotPAH0	4	2	0.0001	mg/kg	0.0001	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Total PAHs ND=0.5	TotPAH05	4	2	0.0001483	mg/kg	0.0001483	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	1-Methylnaphthalene	90-12-0	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2-Methylnaphthalene	91-57-6	4	1	0.00057	mg/kg	0.00057	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Acenaphthene	83-32-9	4	2	0.00024	mg/kg	0.00024	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Acenaphthylene	208-96-8	4	1	0.00054	mg/kg	0.00054	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Anthracene	120-12-7	4	2	0.0003	mg/kg	0.0003	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Benz[a]anthracene	56-55-3	4	1	0.00049	mg/kg	0.00049	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Benzo(a)pyrene	50-32-8	4	2	0.0001	mg/kg	0.0001	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Benzo(e)pyrene	192-97-2	1	1	0.000151	mg/kg	0.000151	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Benzo(b)fluoranthene	205-99-2	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Benzo(ghi)perylene	191-24-2	4	1	0.000136	mg/kg	0.000136	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Benzo(k)fluoranthene	207-08-9	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Benzofluoranthenes, Total (b+k+j)	BnzFluor-bkj	3	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Chrysene	218-01-9	4	1	0.00038	mg/kg	0.00038	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Dibenzo(a,h)anthracene	53-70-3	4	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Geoduck	Whole OrganismXshell	Dibenzofuran	132-64-9	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Fluoranthene	206-44-0	4	3	0.001	mg/kg	0.001	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Fluorene	86-73-7	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Indeno(1,2,3-cd)pyrene	193-39-5	4	2	0.00022	mg/kg	0.00022	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Naphthalene	91-20-3	4	1	0.00085	mg/kg	0.00085	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Naphthalene, 1,6,7-Trimethyl	2245-38-7	1	1	0.000151	mg/kg	0.000151	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Phenanthrene	85-01-8	4	3	0.0011	mg/kg	0.0011	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Pyrene	129-00-0	4	1	0.00043	mg/kg	0.00043	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	4-Bromophenyl phenyl ether	101-55-3	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	PCB-aroclor 1242	53469-21-9	3	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	PCB-aroclor 1254	11097-69-1	4	2	0.0035	mg/kg	0.0035	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	PCB-aroclor 1260	11096-82-5	4	1	0.0014	mg/kg	0.0014	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	PCB-077	32598-13-3	1	1	0.000000993	mg/kg	0.000000993	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	PCB-081	70362-50-4	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	PCB-105	32598-14-4	1	1	0.0000108	mg/kg	0.0000108	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	PCB-114	74472-37-0	1	1	0.00000136	mg/kg	0.00000136	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	PCB-118	31508-00-6	1	1	0.0000325	mg/kg	0.0000325	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	PCB-123	65510-44-3	1	1	0.00000112	mg/kg	0.00000112	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	PCB-126	57465-28-8	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	PCB-156	38380-08-4	1	1	0.00000284	mg/kg	0.00000284	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	PCB-167	52663-72-6	1	1	0.00000242	mg/kg	0.00000242	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	PCB-169	32774-16-6	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	PCB-189	39635-31-9	1	1	0.000000108	mg/kg	0.000000108	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	PCB	1336-36-3	3	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	PCB, Sum of Aroclors, ND0	PCB-Tot-Aro ND0	4	2	0.0035	mg/kg	0.0035	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	PCB, Sum of Aroclors, ND05	PCB-Tot-AroND05	4	2	0.0054	mg/kg	0.0054	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	5	3	0.000000016	mg/kg	0.000000016	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	5	2	1.4352E-06	mg/kg	1.4352E-06	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Total HpCDD	37871-00-4	5	1	0.000000293	mg/kg	0.000000293	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Total HpCDF	38998-75-3	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Total HxCDD	34465-46-8	4	1	0.00000009	mg/kg	0.00000009	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Total HxCDF	55684-94-1	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Total PeCDD	36088-22-9	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Total PeCDF	30402-15-4	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Total TCDD	41903-57-5	4	1	0.000000102	mg/kg	0.000000102	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Total TCDF	30402-14-3	3	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	TOTAL TETRA_FURANS	55722-27-5	1	1	0.000000227	mg/kg	0.000000227	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	1,2,3,4,6,7,8-HpCDD	35822-46-9	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,2,3,4,6,7,8-HpCDF	67562-39-4	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,2,3,4,7,8,9-HpCDF	55673-89-7	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,2,3,4,7,8-HxCDD	39227-28-6	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,2,3,4,7,8-HxCDF	70648-26-9	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,2,3,6,7,8-HxCDD	57653-85-7	4	1	0.000000054	mg/kg	0.000000054	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	1,2,3,6,7,8-HxCDF	57117-44-9	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,2,3,7,8,9-HxCDD	19408-74-3	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,2,3,7,8,9-HxCDF	72918-21-9	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,2,3,7,8-PeCDD	40321-76-4	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,2,3,7,8-PeCDF	57117-41-6	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2,3,4,6,7,8-HxCDF	60851-34-5	4	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
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Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Geoduck	Whole OrganismXshell	2,3,4,7,8-PeCDF	57117-31-4	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2,3,7,8-TCDD	1746-01-6	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2,3,7,8-TCDF	51207-31-9	5	1	0.00000009	mg/kg	0.00000009	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	OCDD	3268-87-9	5	2	0.000003	mg/kg	0.000003	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	OCDF	39001-02-0	5	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	4,4'-DDD	72-54-8	4	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	4,4'-DDE	72-55-9	5	2	0.00084	mg/kg	0.00084	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	4,4'-DDT	50-29-3	3	2	0.0017	mg/kg	0.0017	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Aldrin	309-00-2	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Alpha-BHC	319-84-6	5	5	0.033	mg/kg	0.033	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Beta-BHC	319-85-7	5	5	0.013	mg/kg	0.013	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	cis-Chlordane	5103-71-9	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Delta-BHC	319-86-8	4	3	0.077	mg/kg	0.077	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Dieldrin	60-57-1	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Endosulfan I	959-98-8	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Endosulfan II	33213-65-9	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Endosulfan Sulfate	1031-07-8	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Endrin	72-20-8	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Endrin Aldehyde	7421-93-4	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Endrin Ketone	53494-70-5	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	gamma-Chlordane	5566-34-7	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Heptachlor	76-44-8	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Heptachlor Epoxide	1024-57-3	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Lindane	58-89-9	5	4	0.003	mg/kg	0.003	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Methoxychlor	72-43-5	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Toxaphene	8001-35-2	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,2,4-Trichlorobenzene	120-82-1	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2,4,5-Trichlorophenol	95-95-4	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2,4,6-Trichlorophenol	88-06-2	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2,4-Dichlorophenol	120-83-2	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2,4-Dimethylphenol	105-67-9	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2,4-Dinitrophenol	51-28-5	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2,4-Dinitrotoluene	121-14-2	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2,6-Dinitrotoluene	606-20-2	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2-Chloronaphthalene	91-58-7	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2-Chlorophenol	95-57-8	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2-Nitroaniline	88-74-4	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2-Nitrophenol	88-75-5	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	3,3'-Dichlorobenzidine	91-94-1	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	4,6-Dinitro-2-Methylphenol	534-52-1	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	4-Chloro-3-Methylphenol	59-50-7	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	4-Chloroaniline	106-47-8	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	4-Chlorophenyl-Phenylether	7005-72-3	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	4-Nitroaniline	100-01-6	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	4-Nitrophenol	100-02-7	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Benzyl Alcohol	100-51-6	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Bis(2-Ethylhexyl) Phthalate	117-81-7	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Butyl benzyl phthalate	85-68-7	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Carbazole	86-74-8	1	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
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Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Geoduck	Whole OrganismXshell	Dibutyl phthalate	84-74-2	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Diethyl phthalate	84-66-2	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Dimethyl phthalate	131-11-3	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Di-N-Octyl Phthalate	117-84-0	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Hexachlorobenzene	118-74-1	2	1	0.00073	mg/kg	0.00073	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	Hexachlorobutadiene	87-68-3	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Hexachlorocyclopentadiene	77-47-4	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Isophorone	78-59-1	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	m-Nitroaniline	99-09-2	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Nitrobenzene	98-95-3	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	N-Nitrosodi-n-propylamine	621-64-7	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	N-Nitrosodiphenylamine	86-30-6	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	o-Cresol	95-48-7	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	p-Cresol	106-44-5	2	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Pentachlorophenol	87-86-5	5	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Phenol	108-95-2	2	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Pyridine	110-86-1	4	1	66.3	mg/kg	66.3	Max Det Conc	NObs < 10
Geoduck	Whole OrganismXshell	1,2-Dichlorobenzene	95-50-1	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,3-Dichlorobenzene	541-73-1	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	1,4-Dichlorobenzene	106-46-7	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	2,2'-Oxybis[1-chloropropane]	108-60-1	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Bis(2-Chloroethoxy)Methane	111-91-1	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Bis(2-Chloroethyl)Ether	111-44-4	1	0	--	mg/kg	None	None	Not Detected
Geoduck	Whole OrganismXshell	Hexachloroethane	67-72-1	1	0	--	mg/kg	None	None	Not Detected
Horse Clam	Edible Tissue	PCB, Sum of Congeners	PCB-Tot-Cong	8	8	0.00014	mg/kg	0.00014	Max Det Conc	NObs < 10
Horse Clam	Edible Tissue	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	8	8	0.000000108	mg/kg	0.000000108	Max Det Conc	NObs < 10
Horse Clam	Edible Tissue	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	8	8	0.000000033	mg/kg	0.000000033	Max Det Conc	NObs < 10
Horse Clam	Visceral Cavity	PCB, Sum of Congeners	PCB-Tot-Cong	5	5	0.00149	mg/kg	0.00149	Max Det Conc	NObs < 10
Horse Clam	Visceral Cavity	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	5	5	0.000000006	mg/kg	0.000000006	Max Det Conc	NObs < 10
Horse Clam	Visceral Cavity	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	5	5	0.000000057	mg/kg	0.000000057	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Lipids	LIPIDS	5	5	1.6	%	1.6	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Total Solids	TS	3	3	24.4	%	24.4	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Antimony	7440-36-0	2	1	0.006	mg/kg	0.006	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Arsenic	7440-38-2	5	5	2.4	mg/kg	2.4	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Arsenic, Inorganic	7440-38-2-Inorg	3	3	0.74	mg/kg	0.74	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Barium	7440-39-3	2	2	1.1	mg/kg	1.1	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Cadmium	7440-43-9	5	5	0.4	mg/kg	0.4	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Chromium	7440-47-3	2	2	0.4	mg/kg	0.4	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Copper	7440-50-8	5	5	3.8	mg/kg	3.8	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Lead	7439-92-1	2	2	0.22	mg/kg	0.22	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Mercury	7439-97-6	2	1	0.018	mg/kg	0.018	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Nickel	7440-02-0	2	2	1.4	mg/kg	1.4	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Selenium	7782-49-2	3	2	0.4	mg/kg	0.4	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Silver	7440-22-4	2	2	2.2	mg/kg	2.2	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Zinc	7440-66-6	5	5	12	mg/kg	12	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Benzoic Acid	65-85-0	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Methylmercury(1+)	22967-92-6	3	3	0.01	mg/kg	0.01	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Tetraethyl Lead	78-00-2	3	3	0.17	mg/kg	0.17	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0)	CPAH-TEQ0	5	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Horse Clam	Whole OrganismXshell	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0.5)	CPAH-TEQ05	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	High MW PAHs	HPAH	3	3	0.0000018	mg/kg	0.0000018	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	High MW PAHs ND=0	HPAH0	5	3	0.00179	mg/kg	0.00179	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	High MW PAHs ND=0.5	HPAH05	5	3	0.0024351	mg/kg	0.0024351	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Low Molecular Weight Polycyclic Aromatic Hydrocarb	LPAH	3	3	0.000002	mg/kg	0.000002	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Low MW PAHs ND=0	LPAH0	5	3	0.00196	mg/kg	0.00196	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Low MW PAHs ND=0.5	LPAH05	5	3	0.00202	mg/kg	0.00202	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Total PAHs ND=0	TotPAH0	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Total PAHs ND=0.5	TotPAH05	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1-Methylnaphthalene	90-12-0	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2-Methylnaphthalene	91-57-6	5	1	0.00061	mg/kg	0.00061	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Acenaphthene	83-32-9	5	5	0.00021	mg/kg	0.00021	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Acenaphthylene	208-96-8	5	1	0.000044	mg/kg	0.000044	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Anthracene	120-12-7	5	1	0.00014	mg/kg	0.00014	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Benz[a]anthracene	56-55-3	5	1	0.000095	mg/kg	0.000095	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Benzo(a)pyrene	50-32-8	5	1	0.000065	mg/kg	0.000065	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Benzo(e)pyrene	192-97-2	2	2	0.000102	mg/kg	0.000102	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Benzo(b)fluoranthene	205-99-2	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Benzo(ghi)perylene	191-24-2	5	2	0.00012	mg/kg	0.00012	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Benzo(k)fluoranthene	207-08-9	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Benzofluoranthenes, Total (b+k+j)	BnzFluor-bkj	3	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Chrysene	218-01-9	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Dibenzo(a,h)anthracene	53-70-3	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Dibenzofuran	132-64-9	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Fluoranthene	206-44-0	5	3	0.0012	mg/kg	0.0012	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Fluorene	86-73-7	5	1	0.000179	mg/kg	0.000179	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Indeno(1,2,3-cd)pyrene	193-39-5	5	1	0.000073	mg/kg	0.000073	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Naphthalene	91-20-3	5	3	0.00069	mg/kg	0.00069	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Naphthalene, 1,6,7-Trimethyl	2245-38-7	2	1	0.00017	mg/kg	0.00017	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Perylene	198-55-0	2	1	0.000475	mg/kg	0.000475	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Phenanthrene	85-01-8	5	3	0.00095	mg/kg	0.00095	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Pyrene	129-00-0	5	3	0.00059	mg/kg	0.00059	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	4-Bromophenyl phenyl ether	101-55-3	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	PCB-aroclor 1242	53469-21-9	3	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	PCB-aroclor 1254	11097-69-1	3	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	PCB-aroclor 1260	11096-82-5	3	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	PCB-077	32598-13-3	2	2	0.00000125	mg/kg	0.00000125	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	PCB-081	70362-50-4	2	1	0.000000405	mg/kg	0.000000405	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	PCB-105	32598-14-4	2	2	0.000014	mg/kg	0.000014	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	PCB-114	74472-37-0	2	2	0.000000736	mg/kg	0.000000736	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	PCB-118	31508-00-6	2	2	0.0000282	mg/kg	0.0000282	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	PCB-123	65510-44-3	2	2	0.000000986	mg/kg	0.000000986	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	PCB-126	57465-28-8	2	1	0.000000111	mg/kg	0.000000111	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	PCB-156	38380-08-4	2	2	0.00000271	mg/kg	0.00000271	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	PCB-167	52663-72-6	2	2	0.0000022	mg/kg	0.0000022	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	PCB-169	32774-16-6	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	PCB-189	39635-31-9	2	1	0.000000269	mg/kg	0.000000269	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	PCB	1336-36-3	3	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	PCB, Sum of Aroclors, ND0	PCB-Tot-Aro ND0	3	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Horse Clam	Whole OrganismXshell	PCB, Sum of Aroclors, ND05	PCB-Tot-AroND05	3	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	5	3	2.32E-08	mg/kg	2.32E-08	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	5	3	1.4256E-06	mg/kg	1.4256E-06	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Total HpCDD	37871-00-4	5	3	0.000000277	mg/kg	0.000000277	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Total HpCDF	38998-75-3	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Total HxCDD	34465-46-8	5	2	0.000000069	mg/kg	0.000000069	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Total HxCDF	55684-94-1	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Total PeCDD	36088-22-9	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Total PeCDF	30402-15-4	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Total TCDD	41903-57-5	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Total TCDF	30402-14-3	3	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	TOTAL TETRA_FURANS	55722-27-5	2	1	0.000000051	mg/kg	0.000000051	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	1,2,3,4,6,7,8-HpCDD	35822-46-9	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,2,3,4,6,7,8-HpCDF	67562-39-4	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,2,3,4,7,8,9-HpCDF	55673-89-7	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,2,3,4,7,8-HxCDD	39227-28-6	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,2,3,4,7,8-HxCDF	70648-26-9	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,2,3,6,7,8-HxCDD	57653-85-7	5	1	0.000000053	mg/kg	0.000000053	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	1,2,3,6,7,8-HxCDF	57117-44-9	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,2,3,7,8,9-HxCDD	19408-74-3	5	1	0.000000051	mg/kg	0.000000051	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	1,2,3,7,8,9-HxCDF	72918-21-9	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,2,3,7,8-PeCDD	40321-76-4	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,2,3,7,8-PeCDF	57117-41-6	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,3,4,6,7,8-HxCDF	60851-34-5	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,3,4,7,8-PeCDF	57117-31-4	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,3,7,8-TCDD	1746-01-6	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,3,7,8-TCDF	51207-31-9	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	OCDD	3268-87-9	5	1	0.00000278	mg/kg	0.00000278	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	OCDF	39001-02-0	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	4,4'-DDD	72-54-8	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	4,4'-DDE	72-55-9	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	4,4'-DDT	50-29-3	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Aldrin	309-00-2	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Alpha-BHC	319-84-6	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Beta-BHC	319-85-7	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	cis-Chlordane	5103-71-9	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Delta-BHC	319-86-8	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Dieldrin	60-57-1	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Endosulfan I	959-98-8	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Endosulfan II	33213-65-9	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Endosulfan Sulfate	1031-07-8	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Endrin	72-20-8	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Endrin Aldehyde	7421-93-4	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Endrin Ketone	53494-70-5	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	gamma-Chlordane	5566-34-7	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Heptachlor	76-44-8	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Heptachlor Epoxide	1024-57-3	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Lindane	58-89-9	5	2	0.00037	mg/kg	0.00037	Max Det Conc	NObs < 10
Horse Clam	Whole OrganismXshell	Methoxychlor	72-43-5	2	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Horse Clam	Whole OrganismXshell	Toxaphene	8001-35-2	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,2,4-Trichlorobenzene	120-82-1	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,4,5-Trichlorophenol	95-95-4	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,4,6-Trichlorophenol	88-06-2	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,4-Dichlorophenol	120-83-2	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,4-Dimethylphenol	105-67-9	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,4-Dinitrophenol	51-28-5	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,4-Dinitrotoluene	121-14-2	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,6-Dinitrotoluene	606-20-2	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2-Chloronaphthalene	91-58-7	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2-Chlorophenol	95-57-8	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2-Nitroaniline	88-74-4	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2-Nitrophenol	88-75-5	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	3,3'-Dichlorobenzidine	91-94-1	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	4,6-Dinitro-2-Methylphenol	534-52-1	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	4-Chloro-3-Methylphenol	59-50-7	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	4-Chloroaniline	106-47-8	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	4-Chlorophenyl-Phenylether	7005-72-3	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	4-Nitroaniline	100-01-6	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	4-Nitrophenol	100-02-7	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Benzyl Alcohol	100-51-6	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Bis(2-Ethylhexyl) Phthalate	117-81-7	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Butyl benzyl phthalate	85-68-7	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Carbazole	86-74-8	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Dibutyl phthalate	84-74-2	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Diethyl phthalate	84-66-2	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Dimethyl phthalate	131-11-3	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Di-N-Octyl Phthalate	117-84-0	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Hexachlorobenzene	118-74-1	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Hexachlorobutadiene	87-68-3	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Hexachlorocyclopentadiene	77-47-4	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Isophorone	78-59-1	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	m-Nitroaniline	99-09-2	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Nitrobenzene	98-95-3	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	N-Nitrosodi-n-propylamine	621-64-7	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	N-Nitrosodiphenylamine	86-30-6	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	o-Cresol	95-48-7	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	p-Cresol	106-44-5	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Pentachlorophenol	87-86-5	5	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Phenol	108-95-2	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Pyridine	110-86-1	3	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,2-Dichlorobenzene	95-50-1	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,3-Dichlorobenzene	541-73-1	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	1,4-Dichlorobenzene	106-46-7	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	2,2'-Oxybis[1-chloropropane]	108-60-1	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Bis(2-Chloroethoxy)Methane	111-91-1	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Bis(2-Chloroethyl)Ether	111-44-4	2	0	--	mg/kg	None	None	Not Detected
Horse Clam	Whole OrganismXshell	Hexachloroethane	67-72-1	2	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	Aluminum	7429-90-5	1	1	0.873	mg/kg	0.873	Max Det Conc	NObs < 10

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Red Rock Crab	Muscle	Antimony	7440-36-0	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	Arsenic	7440-38-2	1	1	22	mg/kg	22	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Barium	7440-39-3	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	Beryllium	7440-41-7	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	Cadmium	7440-43-9	1	1	0.107	mg/kg	0.107	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Calcium	7440-70-2	1	1	1760	mg/kg	1760	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Chromium	7440-47-3	1	1	0.11	mg/kg	0.11	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Cobalt	7440-48-4	1	1	0.087	mg/kg	0.087	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Copper	7440-50-8	1	1	8.44	mg/kg	8.44	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Iron	7439-89-6	1	1	3.72	mg/kg	3.72	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Lead	7439-92-1	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	Magnesium	7439-95-4	1	1	528	mg/kg	528	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Manganese	7439-96-5	1	1	0.44	mg/kg	0.44	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Mercury	7439-97-6	1	1	0.089	mg/kg	0.089	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Nickel	7440-02-0	1	1	0.121	mg/kg	0.121	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Potassium	7440-09-7	1	1	3470	mg/kg	3470	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Selenium	7782-49-2	1	1	1.38	mg/kg	1.38	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Silver	7440-22-4	1	1	0.155	mg/kg	0.155	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Sodium	7440-23-5	1	1	3490	mg/kg	3490	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Vanadium	7440-62-2	1	1	0.171	mg/kg	0.171	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Zinc	7440-66-6	1	1	67.8	mg/kg	67.8	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Benzoic Acid	65-85-0	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	PCB-aroclor 1254	11097-69-1	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	PCB-aroclor 1260	11096-82-5	1	1	0.0015	mg/kg	0.0015	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	PCB, Sum of Aroclors, ND0	PCB-Tot-Aro ND0	1	1	0.0015	mg/kg	0.0015	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	PCB, Sum of Aroclors, ND05	PCB-Tot-AroND05	1	1	0.0105	mg/kg	0.0105	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Dioxins and Furans as 2,3,7,8-TCDD TEQs	PCDD/PCDF-TEQs	1	1	0	mg/kg	0	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	Total HpCDD	37871-00-4	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	2,3,7,8-TCDF	51207-31-9	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	OCDD	3268-87-9	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	OCDF	39001-02-0	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	TETRACHLORINATED DIBENZOFURANS, (TOTAL)	TCDF	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	TETRACHLORINATED DIBENZO-P-DIOXINS, (TOTAL)	TCDD	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	4,4'-DDE	72-55-9	1	1	0.00087	mg/kg	0.00087	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Alpha-BHC	319-84-6	1	1	0.0046	mg/kg	0.0046	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Beta-BHC	319-85-7	1	1	0.0016	mg/kg	0.0016	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Delta-BHC	319-86-8	1	1	0.00086	mg/kg	0.00086	Max Det Conc	NObs < 10
Red Rock Crab	Muscle	Lindane	58-89-9	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	Hexachlorobenzene	118-74-1	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	p-Cresol	106-44-5	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	Pentachlorophenol	87-86-5	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	Phenol	108-95-2	1	0	--	mg/kg	None	None	Not Detected
Red Rock Crab	Muscle	Pyridine	110-86-1	1	1	2.78	mg/kg	2.78	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Lipids	LIPIDS	1	1	3.3	%	3.3	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Total Solids	TS	1	1	25.5	%	25.5	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Arsenic	7440-38-2	1	1	1.24	mg/kg	1.24	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Arsenic, Inorganic	7440-38-2-Inorg	1	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Rock Sole	Whole Fish	Cadmium	7440-43-9	1	1	0.02	mg/kg	0.02	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Copper	7440-50-8	1	1	0.48	mg/kg	0.48	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Selenium	7782-49-2	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Zinc	7440-66-6	1	1	13.2	mg/kg	13.2	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Methylmercury(1+)	22967-92-6	1	1	0.01	mg/kg	0.01	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Tetraethyl Lead	78-00-2	1	1	0.02	mg/kg	0.02	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0)	CPAH-TEQ0	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0.5)	CPAH-TEQ05	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	High MW PAHs	HPAH	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	High MW PAHs ND=0	HPAH0	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	High MW PAHs ND=0.5	HPAH05	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Low Molecular Weight Polycyclic Aromatic Hydrocarb	LPAH	1	1	0.0000015	mg/kg	0.0000015	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Low MW PAHs ND=0	LPAH0	1	1	0.00153	mg/kg	0.00153	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Low MW PAHs ND=0.5	LPAH05	1	1	0.00165	mg/kg	0.00165	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Total PAHs ND=0	TotPAH0	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Total PAHs ND=0.5	TotPAH05	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	2-Methylnaphthalene	91-57-6	1	1	0.00057	mg/kg	0.00057	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Acenaphthene	83-32-9	1	1	0.00021	mg/kg	0.00021	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Acenaphthylene	208-96-8	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Anthracene	120-12-7	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Benz[a]anthracene	56-55-3	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Benzo(a)pyrene	50-32-8	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Benzo(b)fluoranthene	205-99-2	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Benzo(ghi)perylene	191-24-2	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Benzo(k)fluoranthene	207-08-9	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Benzofluoranthenes, Total (b+k+j)	BnzFluor-bkj	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Chrysene	218-01-9	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Dibenzo(a,h)anthracene	53-70-3	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Fluoranthene	206-44-0	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Fluorene	7782-41-4	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Indeno(1,2,3-cd)pyrene	193-39-5	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Naphthalene	91-20-3	1	1	0.00077	mg/kg	0.00077	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Phenanthrene	85-01-8	1	1	0.00055	mg/kg	0.00055	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Pyrene	129-00-0	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	PCB-aroclor 1242	53469-21-9	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	PCB-aroclor 1254	11097-69-1	1	1	0.0028	mg/kg	0.0028	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	PCB-aroclor 1260	11096-82-5	1	1	0.0031	mg/kg	0.0031	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	PCB	1336-36-3	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	PCB, Sum of Aroclors, ND0	PCB-Tot-Aro ND0	1	1	0.0059	mg/kg	0.0059	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	PCB, Sum of Aroclors, ND05	PCB-Tot-AroND05	1	1	0.00685	mg/kg	0.00685	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Total HpCDD	37871-00-4	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Total HpCDF	38998-75-3	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Total HxCDD	34465-46-8	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Total HxCDF	55684-94-1	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Total PeCDD	36088-22-9	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Total PeCDF	30402-15-4	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Total TCDD	41903-57-5	1	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Rock Sole	Whole Fish	Total TCDF	30402-14-3	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	1,2,3,4,6,7,8-HpCDD	35822-46-9	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	1,2,3,4,6,7,8-HpCDF	67562-39-4	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	1,2,3,4,7,8,9-HpCDF	55673-89-7	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	1,2,3,4,7,8-HxCDD	39227-28-6	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	1,2,3,4,7,8-HxCDF	70648-26-9	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	1,2,3,6,7,8-HxCDD	57653-85-7	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	1,2,3,6,7,8-HxCDF	57117-44-9	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	1,2,3,7,8,9-HxCDD	19408-74-3	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	1,2,3,7,8,9-HxCDF	72918-21-9	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	1,2,3,7,8-PeCDD	40321-76-4	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	1,2,3,7,8-PeCDF	57117-41-6	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	2,3,4,6,7,8-HxCDF	60851-34-5	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	2,3,4,7,8-PeCDF	57117-31-4	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	2,3,7,8-TCDD	1746-01-6	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	2,3,7,8-TCDF	51207-31-9	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	OCDD	3268-87-9	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	OCDF	39001-02-0	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	4,4'-DDD	72-54-8	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	4,4'-DDE	72-55-9	1	1	0.0022	mg/kg	0.0022	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	4,4'-DDT	50-29-3	1	1	0.001	mg/kg	0.001	Max Det Conc	NObs < 10
Rock Sole	Whole Fish	Alpha-BHC	319-84-6	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Beta-BHC	319-85-7	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Delta-BHC	319-86-8	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Lindane	58-89-9	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Pentachlorophenol	87-86-5	1	0	--	mg/kg	None	None	Not Detected
Rock Sole	Whole Fish	Pyridine	110-86-1	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Lipids	LIPIDS	2	2	0.95	%	0.95	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Total Solids	TS	2	2	19.9	%	19.9	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Arsenic	7440-38-2	2	2	5.69	mg/kg	5.69	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Arsenic, Inorganic	7440-38-2-Inorg	2	1	0.005	mg/kg	0.005	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Cadmium	7440-43-9	2	2	0.002	mg/kg	0.002	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Copper	7440-50-8	2	2	0.22	mg/kg	0.22	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Selenium	7782-49-2	2	2	0.3	mg/kg	0.3	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Zinc	7440-66-6	2	2	5.75	mg/kg	5.75	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Methylmercury(1+)	22967-92-6	2	2	0.02	mg/kg	0.02	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Tetraethyl Lead	78-00-2	2	2	0.004	mg/kg	0.004	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0)	CPAH-TEQ0	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Carcinogenic Polycyclic Aromatic Hydrocarbons (ND=0.5)	CPAH-TEQ05	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	High MW PAHs	HPAH	1	1	0.0000004	mg/kg	0.0000004	Max Det Conc	NObs < 10
Starry Flounder	Fillet	High MW PAHs ND=0	HPAH0	1	1	0.00041	mg/kg	0.00041	Max Det Conc	NObs < 10
Starry Flounder	Fillet	High MW PAHs ND=0.5	HPAH05	1	1	0.0012501	mg/kg	0.0012501	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Low Molecular Weight Polycyclic Aromatic Hydrocarb	LPAH	1	1	0.0000005	mg/kg	0.0000005	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Low MW PAHs ND=0	LPAH0	1	1	0.00051	mg/kg	0.00051	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Low MW PAHs ND=0.5	LPAH05	1	1	0.000945	mg/kg	0.000945	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Total PAHs ND=0	TotPAH0	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Total PAHs ND=0.5	TotPAH05	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	2-Methylnaphthalene	91-57-6	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Acenaphthene	83-32-9	1	0	--	mg/kg	None	None	Not Detected

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Starry Flounder	Fillet	Acenaphthylene	208-96-8	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Anthracene	120-12-7	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Benz[a]anthracene	56-55-3	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Benzo(a)pyrene	50-32-8	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Benzo(b)fluoranthene	205-99-2	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Benzo(ghi)perylene	191-24-2	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Benzo(k)fluoranthene	207-08-9	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Benzofluoranthenes, Total (b+k+j)	BnzFluor-bkj	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Chrysene	218-01-9	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Dibenzo(a,h)anthracene	53-70-3	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Fluoranthene	206-44-0	1	1	0.00041	mg/kg	0.00041	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Fluorene	7782-41-4	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Indeno(1,2,3-cd)pyrene	193-39-5	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Naphthalene	91-20-3	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Phenanthrene	85-01-8	1	1	0.00051	mg/kg	0.00051	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Pyrene	129-00-0	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	PCB-aroclor 1242	53469-21-9	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	PCB-aroclor 1254	11097-69-1	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	PCB-aroclor 1260	11096-82-5	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	PCB	1336-36-3	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	PCB, Sum of Aroclors, ND0	PCB-Tot-Aro ND0	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	PCB, Sum of Aroclors, ND05	PCB-Tot-AroND05	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	PCDD/PCDF-TEQ0	2	1	5.3382E-08	mg/kg	5.3382E-08	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	PCDD/PCDF-TEQ05	2	1	9.25297E-07	mg/kg	9.25297E-07	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Total HpCDD	37871-00-4	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Total HpCDF	38998-75-3	2	1	0.00000243	mg/kg	0.00000243	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Total HxCDD	34465-46-8	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Total HxCDF	55684-94-1	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Total PeCDD	36088-22-9	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Total PeCDF	30402-15-4	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Total TCDD	41903-57-5	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Total TCDF	30402-14-3	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	1,2,3,4,6,7,8-HpCDD	35822-46-9	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	1,2,3,4,6,7,8-HpCDF	67562-39-4	2	1	0.00000243	mg/kg	0.00000243	Max Det Conc	NObs < 10
Starry Flounder	Fillet	1,2,3,4,7,8,9-HpCDF	55673-89-7	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	1,2,3,4,7,8-HxCDD	39227-28-6	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	1,2,3,4,7,8-HxCDF	70648-26-9	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	1,2,3,6,7,8-HxCDD	57653-85-7	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	1,2,3,6,7,8-HxCDF	57117-44-9	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	1,2,3,7,8,9-HxCDD	19408-74-3	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	1,2,3,7,8,9-HxCDF	72918-21-9	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	1,2,3,7,8-PeCDD	40321-76-4	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	1,2,3,7,8-PeCDF	57117-41-6	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	2,3,4,6,7,8-HxCDF	60851-34-5	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	2,3,4,7,8-PeCDF	57117-31-4	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	2,3,7,8-TCDD	1746-01-6	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	2,3,7,8-TCDF	51207-31-9	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	OCDD	3268-87-9	2	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	OCDF	39001-02-0	2	1	0.00009694	mg/kg	0.00009694	Max Det Conc	NObs < 10

Table A-7
Background Tissue Concentrations
Port Angeles Harbor - Marine Sediment Investigation

Species	Tissue	Chemical	CAS #	No. Observed	No. Detected	Maximum Detected Concentration	Units	Reference Value Used for Comparison	Derivation	Rationale
Starry Flounder	Fillet	4,4'-DDD	72-54-8	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	4,4'-DDE	72-55-9	1	1	0.0008	mg/kg	0.0008	Max Det Conc	NObs < 10
Starry Flounder	Fillet	4,4'-DDT	50-29-3	1	1	0.00049	mg/kg	0.00049	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Alpha-BHC	319-84-6	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Beta-BHC	319-85-7	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Delta-BHC	319-86-8	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Lindane	58-89-9	1	1	0.00033	mg/kg	0.00033	Max Det Conc	NObs < 10
Starry Flounder	Fillet	Pentachlorophenol	87-86-5	1	0	--	mg/kg	None	None	Not Detected
Starry Flounder	Fillet	Pyridine	110-86-1	1	0	--	mg/kg	None	None	Not Detected

Attachment B – Human Health Exposure Point Concentrations

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TABLE B-1

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediments
Exposure Medium: Beach/Intertidal Sediments

Chemical of Potential Concern	Units	95% UCL	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Arsenic	mg/kg	3.693E+00	9.900E+00	mg/kg	3.693E+00	95t Students t-test	
PCB, Sum of Aroclors, ND0	mg/kg	4.000E-02	2.300E-01	mg/kg	4.000E-02	95% KM (t) UCL	
PCB, Sum of Aroclors, ND05	mg/kg	4.277E-02	2.316E-01	mg/kg	4.277E-02	95% KM (t) UCL	
PCB TEQ, ND0	mg/kg	NA	NA		0.000E+00		
PCB, TEQ ND05	mg/kg	NA	NA		0.000E+00		
1-Methylnaphthalene	mg/kg	NA	1.900E-02	mg/kg	1.900E-02	Max	Only 2 detected values
Acenaphthylene	mg/kg	1.202E-02	1.600E-02	mg/kg	1.202E-02	95% KM (t) UCL	
Benzo(ghi)perylene	mg/kg	9.170E-03	3.300E-02	mg/kg	9.170E-03	95% KM (t) UCL	
Phenanthrene	mg/kg	3.870E-02	1.800E-01	mg/kg	3.870E-02	97.5% KM (Chebyshev) UCL	
2,3,7,8-TCDD TEQ, ND0	mg/kg	2.140E-05	6.156E-05	mg/kg	2.140E-05	97.5% KM (Chebyshev) UCL	
2,3,7,8-TCDD TEQ, ND05	mg/kg	1.640E-05	6.156E-05	mg/kg	1.640E-05	95% KM (t) UCL	
Delta-BHC	mg/kg	5.890E-04	2.800E-03	mg/kg	5.890E-04	95% KM (t) UCL	
Endosulfan I	mg/kg	1.953E-04	5.100E-04	mg/kg	1.953E-04	95% KM (t) UCL	
Endosulfan II	mg/kg	5.310E-04	1.600E-03	mg/kg	5.310E-04	95% KM (t) UCL	
Endosulfan Sulfate	mg/kg	5.522E-04	1.500E-03	mg/kg	5.522E-04	95% KM (t) UCL	
Endrin Aldehyde	mg/kg	5.012E-04	1.100E-03	mg/kg	5.012E-04	95% KM (t) UCL	
Endrin Ketone	mg/kg	4.109E-04	1.100E-03	mg/kg	4.109E-04	95% KM (t) UCL	
Hexachlorobenzene	mg/kg	1.900E-02	1.900E-02	mg/kg	1.900E-02	Maximum Detected Conc.	Only 1 detected value.

Key:

EPC= Exposure Point Concentration
Max = Maximum Detected
NA = Not available; Congner data not available for use in HHRA
UCL = Upper Confidence Limit

TABLE B-2

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Coonstripe Shrimp
Exposure Medium: Coonstripe Shrimp

Chemical of Potential Concern	Units	95% UCL	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Aluminum	mg/kg	NT	NT		0.000E+00		
Antimony	mg/kg	NT	NT		0.000E+00		
Arsenic (Inorganic)	mg/kg	NA	9.000E-03	mg/kg	9.000E-03	Max	
Barium	mg/kg	NT	NT		0.000E+00		
Cadmium	mg/kg	NA	4.000E-02	mg/kg	4.000E-02	Max	
Cobalt	mg/kg	NT	NT		0.000E+00		
Copper	mg/kg	NA	5.140E+00	mg/kg	5.140E+00	Max	
Iron	mg/kg	NT	NT		0.000E+00		
Lead	mg/kg	NT	NT		0.000E+00		
Manganese	mg/kg	NT	NT		0.000E+00		
Mercury	mg/kg	NT	NT		0.000E+00		
Nickel	mg/kg	NT	NT		0.000E+00		
Selenium	mg/kg	ND	ND		0.000E+00	No Detected Values	
Silver	mg/kg	NT	NT		0.000E+00		
Vanadium	mg/kg	NT	NT		0.000E+00		
Zinc	mg/kg	NA	1.260E+01	mg/kg	1.260E+01	Max	
Tributyltin	mg/kg	NT	NT		0.000E+00		
Tributyltin oxide	mg/kg	NT	NT		0.000E+00		
Methyl mercury	mg/kg	NA	3.000E-02	mg/kg	3.000E-02	Max	
Tetraethyl lead	mg/kg	NA	7.000E-03	mg/kg	7.000E-03	Max	
PCB, Sum of Aroclors, ND0	mg/kg	NA	6.900E-03	mg/kg	6.900E-03	Max	
PCB, Sum of Aroclors, ND05	mg/kg	NA	8.800E-03	mg/kg	8.800E-03	Max	
PCB TEQ, ND0	mg/kg	NT	NT		0.000E+00		
PCB TEQ, ND05	mg/kg	NT	NT		0.000E+00		
1-Methylnaphthalene	mg/kg	NT	NT		0.000E+00		
2-Methylnaphthalene	mg/kg	NA	1.800E-03	mg/kg	1.800E-03	Max	
Acenaphthene	mg/kg	NA	4.800E-03	mg/kg	4.800E-03	Max	
Acenaphthylene	mg/kg	NA	5.500E-04	mg/kg	5.500E-04	Max	
Anthracene	mg/kg	NA	3.200E-04	mg/kg	3.200E-04	Max	
Benzo(ghi)perylene	mg/kg	ND	ND		0.000E+00	No Detected Values	
cPAHs, ND0	mg/kg	NA	4.850E-05	mg/kg	4.850E-05	Max	
cPAHs, ND05	mg/kg	NA	2.810E-04	mg/kg	2.810E-04	Max	
Fluoranthene	mg/kg	NA	2.700E-03	mg/kg	2.700E-03	Max	
Fluorene	mg/kg	NA	7.700E-04	mg/kg	7.700E-04	Max	
Naphthalene	mg/kg	NA	5.200E-03	mg/kg	5.200E-03	Max	
Phenanthrene	mg/kg	NA	3.200E-03	mg/kg	3.200E-03	Max	
Pyrene	mg/kg	NA	1.700E-03	mg/kg	1.700E-03	Max	

Chemical of Potential Concern	Units	95% UCL	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
2,3,7,8-TCDD TEQ, ND0	mg/kg	NA	1.416E-09	mg/kg	1.416E-09	Max	
2,3,7,8-TCDD TEQ, ND05	mg/kg	NA	2.243E-07	mg/kg	2.243E-07	Max	
4,4'-DDD	mg/kg	ND	ND		0.000E+00	No Detected Values	
4,4'-DDE	mg/kg	ND	ND		0.000E+00	No Detected Values	
4,4'-DDT	mg/kg	NA	1.300E-03		1.300E-03	Max	
Aldrin	mg/kg	NT	NT		0.000E+00		
Alpha-BHC	mg/kg	NA	6.400E-04	mg/kg	6.400E-04	Max	
Beta-BHC	mg/kg	NA	6.000E-03	mg/kg	6.000E-03	Max	
Delta-BHC	mg/kg	ND	ND		0.000E+00	No Detected Values	
Dieldrin	mg/kg	NT	NT		0.000E+00		
Endosulfan I	mg/kg	NT	NT		0.000E+00		
Endosulfan II	mg/kg	NT	NT		0.000E+00		
Endrin	mg/kg	NT	NT		0.000E+00		
gamma-Chlordane	mg/kg	NT	NT		0.000E+00		
Heptachlor	mg/kg	NT	NT		0.000E+00		
Heptachlor Epoxide	mg/kg	NT	NT		0.000E+00		
Lindane	mg/kg	ND	ND		0.000E+00	No Detected Values	
Methoxychlor	mg/kg	NT	NT		0.000E+00		
Bis(2-Ethylhexyl)phthalate	mg/kg	NT	NT		0.000E+00		
Dibenzofuran	mg/kg	NT	NT		0.000E+00		
Pentachlorophenol	mg/kg	ND	ND		0.000E+00	No Detected Values	
Pyridine	mg/kg	NA	2.800E-01	mg/kg	2.800E-01	Max	
Hexachlorobenzene	mg/kg	NT	NT		0.000E+00		

Key:

EPC= Exposure Point Concentration

Max = Maximum Detected

NA = Not applicable; sample number less than 5

ND = All results were non-detect. Not included in risk calculations.

NT = Not tested for or results not indicated in historical report. Not included in risk calculations.

UCL = Upper Confidence Limit

TABLE B-3

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Dungeness Crab - Muscle
Exposure Medium: Dungeness Crab - Muscle

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Aluminum	mg/kg	NT	NT		0.000E+00		
Antimony	mg/kg	NT	NT		0.000E+00		
Arsenic (Inorganic)	mg/kg	NA	1.100E-02	mg/kg	1.100E-02	Max Det	
Barium	mg/kg	NT	NT		0.000E+00		
Cadmium	mg/kg	NA	1.500E-02	mg/kg	1.500E-02	Max Det	
Cobalt	mg/kg	NT	NT		0.000E+00		
Copper	mg/kg	None	5.640E+00	mg/kg	5.640E+00	Max Det	
Iron	mg/kg	NT	NT		0.000E+00		
Lead	mg/kg	NT	NT		0.000E+00		
Manganese	mg/kg	NT	NT		0.000E+00		
Mercury	mg/kg	NT	NT		0.000E+00		
Nickel	mg/kg	NT	NT		0.000E+00		
Selenium	mg/kg	NA	9.000E-01	mg/kg	9.000E-01	Max Det	
Silver	mg/kg	NT	NT		0.000E+00		
Vanadium	mg/kg	NT	NT		0.000E+00		
Zinc	mg/kg	NA	5.020E+01	mg.kg	5.020E+01	Max Det	
Tributyltin	mg/kg	NT	NT		0.000E+00		
Tributyltin oxide	mg/kg	NT	NT		0.000E+00		
Methyl mercury	mg/kg	NA	1.100E-01	mg/kg	1.100E-01	Max Det	
Tetraethyl lead	mg/kg	NA	6.000E-03	mg/kg	6.000E-03	Max Det	
PCB, Sum of Aroclors, ND0	mg/kg	NA	5.000E-02	mg/kg	5.000E-02	Max Det	
PCB, Sum of Aroclors, ND05	mg/kg	NA	5.095E-02	mg/kg	5.095E-02	Max Det	
PCB TEQ, ND0	mg/kg	NT	NT		0.000E+00		
PCB TEQ, ND05	mg/kg	NT	NT		0.000E+00		
PCB, Sum of Congeners	mg/kg	1.007E-01	1.788E-01	mg/kg	1.007E-01	95% Approximate Gamma UCL	
1-Methylnaphthalene	mg/kg	NT	NT		0.000E+00		
2-Methylnaphthalene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Acenaphthene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Acenaphthylene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Anthracene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Benzo(ghi)perylene	mg/kg	ND	ND		0.000E+00	No Detected Values	
cPAHs, ND0	mg/kg	ND	ND		0.000E+00	No Detected Values	
cPAHs, ND05	mg/kg	ND	ND		0.000E+00	No Detected Values	
Fluoranthene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Fluorene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Naphthalene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Phenanthrene	mg/kg	NA	2.400E-04	mg/kg	2.400E-04	Max Det	
Pyrene	mg/kg	ND	ND		0.000E+00	No Detected Values	
2,3,7,8-TCDD TEQ, ND0	mg/kg	3.167E-07	6.500E-07	mg/kg	3.167E-07	95% KM (t) UCL	
2,3,7,8-TCDD TEQ, ND05	mg/kg	3.439E-07	6.560E-07	mg/kg	3.439E-07	95% KM (t) UCL	
4,4'-DDD	mg/kg	ND	ND		0.000E+00	No Detected Values	
4,4'-DDE	mg/kg	NA	8.000E-04	mg/kg	8.000E-04	Max Det	

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
4,4'-DDT	mg/kg	NA	4.700E-03	mg/kg	4.700E-03	Max Det	
Aldrin	mg/kg	NT	NT		0.000E+00		
Alpha-BHC	mg/kg	ND	ND		0.000E+00	No Detected Values	
Beta-BHC	mg/kg	ND	ND		0.000E+00	No Detected Values	
Delta-BHC	mg/kg	NA	1.000E-03	mg/kg	1.000E-03	Max Det	
Dieldrin	mg/kg	NT	NT		0.000E+00		
Endosulfan I	mg/kg	NT	NT		0.000E+00		
Endosulfan II	mg/kg	NT	NT		0.000E+00		
Endrin	mg/kg	NT	NT		0.000E+00		
gamma-Chlordane	mg/kg	NT	NT		0.000E+00		
Heptachlor	mg/kg	NT	NT		0.000E+00		
Heptachlor Epoxide	mg/kg	NT	NT		0.000E+00		
Lindane	mg/kg	NA	1.000E-03	mg/kg	1.000E-03	Max Det	
Methoxychlor	mg/kg	NT	NT		0.000E+00		
Bis(2-Ethylhexyl)phthalate	mg/kg	NT	NT		0.000E+00		
M-Nitroaniline	mg/kg	NT	NT		0.000E+00		
Pentachlorophenol	mg/kg	ND	ND		0.000E+00	No Detected Values	
Pyridine	mg/kg	ND	ND		0.000E+00	No Detected Values	
Hexachlorobenzene	mg/kg	NT	NT		0.000E+00		

Key:

EPC= Exposure Point Concentration

Max = Maximum Detected

NA = Not applicable; sample number less than 5

ND = All results were non-detect. Not included in risk calculations.

NT = Not tested for or results not indicated in historical report. Not included in risk calculations.

UCL = Upper Confidence Limit

TABLE B-4

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Dungeness Crab - Whole
Exposure Medium: Dungeness Crab - Whole[1]

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Aluminum	mg/kg	NT	NT		0.000E+00		
Antimony	mg/kg	NT	NT		0.000E+00		
Arsenic (Inorganic)	mg/kg	NA	6.050E-02	mg/kg	6.050E-02	Max Det	
Barium	mg/kg	NT	NT		0.000E+00		
Cadmium	mg/kg	NA	9.255E-01	mg/kg	9.255E-01	Max Det	
Cobalt	mg/kg	NT	NT		0.000E+00		
Copper	mg/kg	NA	2.895E+01	mg/kg	2.895E+01	Max Det	
Iron	mg/kg	NT	NT		0.000E+00		
Lead	mg/kg	NT	NT		0.000E+00		
Manganese	mg/kg	NT	NT		0.000E+00		
Mercury	mg/kg	NT	NT		0.000E+00		
Nickel	mg/kg	NT	NT		0.000E+00		
Selenium	mg/kg	NA	1.375E+00	mg/kg	1.375E+00	Max Det	
Silver	mg/kg	NT	NT		0.000E+00		
Vanadium	mg/kg	NT	NT		0.000E+00		
Zinc	mg/kg	NA	4.355E+01	mg/kg	4.355E+01	Max Det	
Tributyltin	mg/kg	NT	NT		0.000E+00		
Tributyltin oxide	mg/kg	NT	NT		0.000E+00		
Methylmercury	mg/kg	NA	1.300E-01	mg/kg	1.300E-01	Max Det	
Tetraethyl lead	mg/kg	NA	1.700E-02	mg/kg	1.700E-02	Max Det	
PCB, Sum of Aroclors, ND0	mg/kg	NA	2.775E-01	mg/kg	2.775E-01	Max Det	
PCB, Sum of Aroclors, ND05	mg/kg	NA	2.782E-01	mg/kg	2.782E-01	Max Det	
PCB TEQ, ND0	mg/kg	NT	NT		0.000E+00		
PCB TEQ, ND05	mg/kg	NT	NT		0.000E+00		
PCB, Sum of Congeners	mg/kg	1.266E+00	1.490E+00	mg/kg	1.266E+00	95% Student's-t UCL	
1-Methylnaphthalene	mg/kg	NT	NT		0.000E+00		
2-Methylnaphthalene	mg/kg	NA	5.600E-04	mg/kg	5.600E-04	Max Det	
Acenaphthene	mg/kg	NA	1.825E-04	mg/kg	1.825E-04	Max Det	
Acenaphthylene	mg/kg	NA	1.325E-04	mg/kg	1.325E-04	Max Det	
Anthracene	mg/kg	NA	3.275E-04	mg/kg	3.275E-04	Max Det	
Benzo(ghi)perylene	mg/kg	NA	2.350E-04	mg/kg	2.350E-04	Max Det	
cPAHs, ND0	mg/kg	NA	1.018E-03	mg/kg	1.018E-03	Max Det	
cPAHs, ND05	mg/kg	NA	2.788E-03	mg/kg	2.788E-03	Max Det	
Fluoranthene	mg/kg	NA	6.025E-04	mg/kg	6.025E-04	Max Det	
Fluorene	mg/kg	NA	3.975E-04	mg/kg	3.975E-04	Max Det	
Naphthalene	mg/kg	NA	6.300E-04	mg/kg	6.300E-04	Max Det	
Phenanthrene	mg/kg	NA	4.800E-04	mg/kg	4.800E-04	Max Det	
Pyrene	mg/kg	NA	5.925E-04	mg/kg	5.925E-04	Max Det	
2,3,7,8-TCDD TEQ, ND0	mg/kg	6.404E-06	9.754E-06	mg/kg	6.404E-06	95% Student's-t UCL	
2,3,7,8-TCDD TEQ, ND05	mg/kg	6.431E-06	9.754E-06	mg/kg	6.431E-06	95% Student's-t UCL	

TABLE B-4

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

4,4'-DDD	mg/kg	NA	4.900E-04	mg/kg	0.000E+00	Max Det	
4,4'-DDE	mg/kg	NA	3.670E-03	mg/kg	3.670E-03	Max Det	
4,4'-DDT	mg/kg	NA	3.103E-02	mg/kg	3.103E-02	Max Det	
Aldrin	mg/kg	NT	NT		0.000E+00		
Alpha-BHC	mg/kg	NA	7.100E-04	mg/kg	7.100E-04	Max Det	
Beta-BHC	mg/kg	NA	7.950E-04	mg/kg	7.950E-04	Max Det	
Delta-BHC	mg/kg	NA	1.278E-03	mg/kg	1.278E-03	Max Det	
Dieldrin	mg/kg	NT	NT		0.000E+00		
Endosulfan I	mg/kg	NT	NT		0.000E+00		
Endosulfan II	mg/kg	NT	NT		0.000E+00		
Endrin	mg/kg	NT	NT		0.000E+00		
gamma-Chlordane	mg/kg	NT	NT		0.000E+00		
Heptachlor	mg/kg	NT	NT		0.000E+00		
Heptachlor Epoxide	mg/kg	NT	NT		0.000E+00		
Lindane	mg/kg	NA	8.225E-04	mg/kg	8.225E-04	Max Det	
Methoxychlor	mg/kg	NT	NT		0.000E+00		
Bis(2-Ethylhexyl)phthalate	mg/kg	NT	NT		0.000E+00		
M-Nitroaniline	mg/kg	NT	NT		0.000E+00		
Pentachlorophenol	mg/kg	NA	9.100E-02	mg/kg	9.100E-02	Max Det	
Pyridine	mg/kg	NA	1.800E-02	mg/kg	1.800E-02	Max Det	
Hexachlorobenzene	mg/kg	NT	NT		0.000E+00		

Key:

EPC= Exposure Point Concentration

Max = Maximum Detected

NA = Not applicable; sample number less than 5

ND = All results were non-detect. Not included in risk calculations.

NT = Not tested for or results not indicated in historical report. Not included in risk calculations.

UCL = Upper Confidence Limit

Note:

1 - Whole crab concentrations are calculated based on the assumption that the whole body composition of the crab is 75% muscle and 25% hepatopancreas.

TABLE B-5

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Geoduck
Exposure Medium: Geoduck

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Aluminum	mg/kg	NA	9.230E+01	mg/kg	9.230E+01	Max	Max
Antimony	mg/kg	NA	7.700E-03	mg/kg	0.000E+00	Max	Max
Arsenic (Inorganic)	mg/kg	NA	1.410E+00	mg/kg	1.410E+00	Max	Max
Barium	mg/kg	NA	6.820E-01	mg/kg	6.820E-01	Max	Max
Cadmium	mg/kg	NA	4.800E-01	mg/kg	4.800E-01	Max	Max
Cobalt	mg/kg	NA	5.530E-01	mg/kg	5.530E-01	Max	Max
Copper	mg/kg	NA	7.430E+00	mg/kg	7.430E+00	Max	Max
Iron	mg/kg	NA	9.110E+02	mg/kg	9.110E+02	Max	Max
Lead	mg/kg	NA	1.050E+00	mg/kg	1.050E+00	Max	Max
Manganese	mg/kg	NA	2.990E+01	mg/kg	2.990E+01	Max	Max
Mercury	mg/kg	NA	8.200E-02	mg/kg	8.200E-02	Max	Max
Nickel	mg/kg	NA	8.600E-01	mg/kg	8.600E-01	Max	Max
Selenium	mg/kg	NA	8.240E-01	mg/kg	8.240E-01	Max	Max
Silver	mg/kg	NA	9.400E-01	mg/kg	9.400E-01	Max	Max
Vanadium	mg/kg	NA	1.580E+00	mg/kg	1.580E+00	Max	Max
Zinc	mg/kg	NA	2.420E+01	mg/kg	2.420E+01	Max	Max
Tributyltin	mg/kg	NT	NT		0.000E+00		
Tributyltin oxide	mg/kg	NT	NT		0.000E+00		
Methyl mercury	mg/kg	NA	4.000E-02	mg/kg	4.000E-02	Max	Max
Tetraethyl lead	mg/kg	NA	9.900E-01	mg/kg	9.900E-01	Max	Max
PCB, Sum of Aroclors, ND0	mg/kg	NA	1.030E-02	mg/kg	1.030E-02	Max	Max
PCB, Sum of Aroclors, ND05	mg/kg	NA	1.590E-02	mg/kg	1.590E-02	Max	Max
PCB TEQ, ND0	mg/kg	NA	4.316E-08	mg/kg	4.316E-08	Max	Max
PCB TEQ, ND05	mg/kg	NA	6.105E-08	mg/kg	6.105E-08	Max	Max
1-Methylnaphthalene	mg/kg	ND	ND		0.000E+00	No Detected Values	
2-Methylnaphthalene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Acenaphthene	mg/kg	NA	1.700E-04	mg/kg	1.700E-04	Max	Max
Acenaphthylene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Anthracene	mg/kg	NA	2.100E-04	mg/kg	2.100E-04	Max	Max
Benzo(ghi)perylene	mg/kg	NA	3.400E-04	mg/kg	3.400E-04	Max	
cPAHs, ND0	mg/kg	NA	7.670E-04	mg/kg	7.670E-04	Max	Max
cPAHs, ND05	mg/kg	NA	7.745E-04	mg/kg	7.745E-04	Max	Max
Fluoranthene	mg/kg	NA	1.500E-03	mg/kg	1.500E-03	Max	Max
Fluorene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Naphthalene	mg/kg	NA	6.700E-04	mg/kg	6.700E-04	Max	Max
Phenanthrene	mg/kg	NA	1.000E-03	mg/kg	1.000E-03	Max	Max
Pyrene	mg/kg	NA	1.200E-03	mg/kg	1.200E-03	Max	Max
2,3,7,8-TCDD TEQ, ND0	mg/kg	NA	1.094E-07	mg/kg	1.094E-07	Max	Max
2,3,7,8-TCDD TEQ, ND05	mg/kg	NA	1.421E-06	mg/kg	1.421E-06	Max	Max
4,4'-DDD	mg/kg	ND	ND		0.000E+00	No Detected Values	

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
4,4'-DDE	mg/kg	NA	1.600E-03	mg/kg	1.600E-03	Max	Max
4,4'-DDT	mg/kg	NA	1.700E-03	mg/kg	1.700E-03	Max	Max
Aldrin	mg/kg	ND	ND		0.000E+00	No Detected Values	
Alpha-BHC	mg/kg	NA	3.800E-02	mg/kg	3.800E-02	Max	Max
Beta-BHC	mg/kg	NA	1.500E-02	mg/kg	1.500E-02	Max	Max
Delta-BHC	mg/kg	NA	1.600E-03	mg/kg	1.600E-03	Max	Max
Dieldrin	mg/kg	ND	ND		0.000E+00	No Detected Values	
Endosulfan I	mg/kg	ND	ND		0.000E+00	No Detected Values	
Endosulfan II	mg/kg	ND	ND		0.000E+00	No Detected Values	
Endrin	mg/kg	ND	ND		0.000E+00	No Detected Values	
gamma-Chlordane	mg/kg	ND	ND		0.000E+00	No Detected Values	
Heptachlor	mg/kg	ND	ND		0.000E+00	No Detected Values	
Heptachlor Epoxide	mg/kg	ND	ND		0.000E+00	No Detected Values	
Lindane	mg/kg	NA	4.000E-03	mg/kg	4.000E-03	Max	Max
Methoxychlor	mg/kg	ND	ND		0.000E+00	No Detected Values	
Bis(2-Ethylhexyl)phthalate	mg/kg	ND	ND		0.000E+00	No Detected Values	
Dibenzofuran	mg/kg	ND	ND		0.000E+00	No Detected Values	
Pentachlorophenol	mg/kg	ND	ND		0.000E+00	No Detected Values	
Pyridine	mg/kg	NA	4.090E-01	mg/kg	4.090E-01	Max	Max
Hexachlorobenzene	mg/kg	NA	6.200E-04	mg/kg	6.200E-04	Max	Max

Key:

EPC= Exposure Point Concentration

Max = Maximum Detected

NA = Not applicable; sample number less than 5

ND = All results were non-detect. Not included in risk calculations.

NT = Not tested for or results not indicated in historical report. Not included in risk calculations.

UCL = Upper Confidence Limit

TABLE B-6

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Horse Clam - Edible Tissue
Exposure Medium: Horse Clam - Edible Tissue

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Aluminum	mg/kg	NT	NT		0.000E+00		
Antimony	mg/kg	NT	NT		0.000E+00		
Arsenic (Inorganic)	mg/kg	NT	NT		0.000E+00		
Barium	mg/kg	NT	NT		0.000E+00		
Cadmium	mg/kg	NT	NT		0.000E+00		
Cobalt	mg/kg	NT	NT		0.000E+00		
Copper	mg/kg	NT	NT		0.000E+00		
Iron	mg/kg	NT	NT		0.000E+00		
Lead	mg/kg	NT	NT		0.000E+00		
Manganese	mg/kg	NT	NT		0.000E+00		
Mercury	mg/kg	NT	NT		0.000E+00		
Nickel	mg/kg	NT	NT		0.000E+00		
Selenium	mg/kg	NT	NT		0.000E+00		
Silver	mg/kg	NT	NT		0.000E+00		
Vanadium	mg/kg	NT	NT		0.000E+00		
Zinc	mg/kg	NT	NT		0.000E+00		
Tributyltin	mg/kg	NT	NT		0.000E+00		
Tributyltin oxide	mg/kg	NT	NT		0.000E+00		
Methyl mercury	mg/kg	NT	NT		0.000E+00		
Tetraethyl lead	mg/kg	NT	NT		0.000E+00		
PCB, Sum of Aroclors, ND0	mg/kg	NT	NT		0.000E+00		
PCB, Sum of Aroclors, ND05	mg/kg	NT	NT		0.000E+00		
PCB TEQ, ND0	mg/kg	NT	NT		0.000E+00		
PCB TEQ, ND05	mg/kg	NT	NT		0.000E+00		
PCB, Sum of Congeners	mg/kg	2.370E-03	3.740E-03	mg/kg	2.370E-03	95% Student's-t UCL	
1-Methylnaphthalene	mg/kg	NT	NT		0.000E+00		
2-Methylnaphthalene	mg/kg	NT	NT		0.000E+00		
Acenaphthene	mg/kg	NT	NT		0.000E+00		
Acenaphthylene	mg/kg	NT	NT		0.000E+00		
Anthracene	mg/kg	NT	NT		0.000E+00		
Benzo(ghi)perylene	mg/kg	NT	NT		0.000E+00		
cPAHs, ND0	mg/kg	NT	NT		0.000E+00		
cPAHs, ND05	mg/kg	NT	NT		0.000E+00		
Fluoranthene	mg/kg	NT	NT		0.000E+00		
Fluorene	mg/kg	NT	NT		0.000E+00		
Naphthalene	mg/kg	NT	NT		0.000E+00		
Phenanthrene	mg/kg	NT	NT		0.000E+00		
Pyrene	mg/kg	NT	NT		0.000E+00		
2,3,7,8-TCDD TEQ, ND0	mg/kg	2.452E-09	6.000E-09	mg/kg	2.452E-09	95% KM (t) UCL	
2,3,7,8-TCDD TEQ, ND05	mg/kg	3.850E-08	6.700E-08	mg/kg	3.850E-08	95% Student's-t UCL	
4,4'-DDD	mg/kg	NT	NT		0.000E+00		
4,4'-DDE	mg/kg	NT	NT		0.000E+00		

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
4,4'-DDT	mg/kg	NT	NT		0.000E+00		
Aldrin	mg/kg	NT	NT		0.000E+00		
Alpha-BHC	mg/kg	NT	NT		0.000E+00		
Beta-BHC	mg/kg	NT	NT		0.000E+00		
Delta-BHC	mg/kg	NT	NT		0.000E+00		
Dieldrin	mg/kg	NT	NT		0.000E+00		
Endosulfan I	mg/kg	NT	NT		0.000E+00		
Endosulfan II	mg/kg	NT	NT		0.000E+00		
Endrin	mg/kg	NT	NT		0.000E+00		
gamma-Chlordane	mg/kg	NT	NT		0.000E+00		
Heptachlor	mg/kg	NT	NT		0.000E+00		
Heptachlor Epoxide	mg/kg	NT	NT		0.000E+00		
Lindane	mg/kg	NT	NT		0.000E+00		
Methoxychlor	mg/kg	NT	NT		0.000E+00		
Bis(2-Ethylhexyl)phthalate	mg/kg	NT	NT		0.000E+00		
M-Nitroaniline	mg/kg	NT	NT		0.000E+00		
Pentachlorophenol	mg/kg	NT	NT		0.000E+00		
Pyridine	mg/kg	NT	NT		0.000E+00		
Hexachlorobenzene	mg/kg	NT	NT		0.000E+00		

Key:

EPC= Exposure Point Concentration

Max = Maximum Detected

NA = Not applicable; sample number less than 5

ND = All results were non-detect. Not included in risk calculations.

NT = Not tested for or results not indicated in historical report. Not included in risk calculations.

UCL = Upper Confidence Limit

TABLE B-7

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Horse Clam - Whole
Exposure Medium: Horse Clam - Whole[1]

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Aluminum	mg/kg	NT	NT		0.000E+00		
Antimony	mg/kg	NA	1.930E-02	mg/kg	1.930E-02	95% KM (t) UCL	
Arsenic (Inorganic)	mg/kg	7.768E-01	1.350E+00	mg/kg	7.768E-01	95% Student's-t UCL	
Barium	mg/kg	1.965E+00	3.000E+00	mg/kg	1.965E+00	95% KM (t) UCL	
Cadmium	mg/kg	2.610E-01	3.500E-01	mg/kg	2.610E-01	95% Student's-t UCL	
Cobalt	mg/kg	NT	NT		0.000E+00		
Copper	mg/kg	1.770E+00	2.500E+00	mg/kg	1.770E+00	95% Student's-t UCL	
Iron	mg/kg	NT	NT		0.000E+00		
Lead	mg/kg	7.976E-01	1.000E+00	mg/kg	7.976E-01	95% KM (t) UCL	
Manganese	mg/kg	NT	NT		0.000E+00		
Mercury	mg/kg	2.147E-02	2.700E-02	mg/kg	2.147E-02	95% KM (t) UCL	
Nickel	mg/kg	NT	NT		0.000E+00		
Selenium	mg/kg	9.964E-01	1.900E+00	mg/kg	9.964E-01	95% Approximate Gamma UCL	
Silver	mg/kg	8.581E-01	1.200E+00	mg/kg	8.581E-01	95% KM (t) UCL	
Vanadium	mg/kg	NT	NT		0.000E+00		
Zinc	mg/kg	9.642E+00	1.200E+01	mg/kg	9.642E+00	95% Student's-t UCL	
Tributyltin	mg/kg	NT	NT		0.000E+00		
Tributyltin oxide	mg/kg	NT	NT		0.000E+00		
Methyl mercury	mg/kg	1.000E-02	1.000E-02	mg/kg	1.000E-02	Max Detected Value	
Tetraethyl lead	mg/kg	1.999E+00	2.910E+00	mg/kg	1.999E+00	95% Approximate Gamma UCL	
PCB, Sum of Aroclors, ND0	mg/kg	2.970E-02	3.600E-02	mg/kg	2.970E-02	95% KM (t) UCL	
PCB, Sum of Aroclors, ND05	mg/kg	3.070E-02	3.695E-02	mg/kg	3.070E-02	95% KM (t) UCL	
PCB TEQ, ND0	mg/kg	1.820E-07	2.810E-07	mg/kg	1.820E-07	95% Chebyshev UCL	
PCB TEQ, ND05	mg/kg	8.230E-07	1.410E-06	mg/kg	8.230E-07	95% Chebyshev UCL	
PCB, Sum of Congeners	mg/kg	3.365E-02	3.867E-02	mg/kg	3.365E-02	95% Student's-t UCL	
1-Methylnaphthalene	mg/kg	ND	ND		0.000E+00	No Detected Values	
2-Methylnaphthalene	mg/kg	3.600E-02	8.230E-02	mg/kg	3.600E-02	97.5% KM UCL	
Acenaphthene	mg/kg	2.594E-03	3.500E-03	mg/kg	2.594E-03	95% KM (t) UCL	
Acenaphthylene	mg/kg	2.290E-03	6.620E-03	mg/kg	2.290E-03	95% KM (t) UCL	
Anthracene	mg/kg	1.170E-02	2.530E-02	mg/kg	1.170E-02	97.5% KM UCL	
Benzo(ghi)perylene	mg/kg	1.250E-03	4.740E-03	mg/kg	1.250E-03	95% KM (t) UCL	
cPAHs, ND0	mg/kg	9.260E-03	2.550E-03	mg/kg	9.260E-03	95% Chebyshev UCL	
cPAHs, ND05	mg/kg	9.260E-03	2.550E-03	mg/kg	9.260E-03	95% Chebyshev UCL	
Fluoranthene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Fluorene	mg/kg	1.860E-02	5.500E-02	mg/kg	1.860E-02	95% Chebyshev UCL	
Naphthalene	mg/kg	1.879E-02	4.170E-02	mg/kg	1.879E-02	95% KM (t) UCL	
Phenanthrene	mg/kg	1.501E-02	2.400E-02	mg/kg	1.501E-02	95% KM (t) UCL	
Pyrene	mg/kg	2.105E-02	3.600E-02	mg/kg	2.105E-02	95% KM (t) UCL	
2,3,7,8-TCDD TEQ, ND0	mg/kg	1.130E-07	2.810E-07	mg/kg	1.130E-07	95% Chebyshev UCL	
2,3,7,8-TCDD TEQ, ND05	mg/kg	1.248E-06	4.000E-07	mg/kg	1.248E-06	95% Student's-t UCL	
4,4'-DDD	mg/kg	1.230E-03	1.600E-03	mg/kg	1.230E-03	95% KM (t) UCL	
4,4'-DDE	mg/kg	4.998E-04	8.700E-04	mg/kg	4.998E-04	95% KM (t) UCL	

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
4,4'-DDT	mg/kg	3.000E-03	5.100E-03	mg/kg	3.000E-03	95% KM (t) UCL	
Aldrin	mg/kg	ND	ND		0.000E+00	No Detected Values	
Alpha-BHC	mg/kg	4.658E-04	6.300E-04	mg/kg	4.658E-04	95% KM (t) UCL	
Beta-BHC	mg/kg	4.205E-04	4.500E-04	mg/kg	4.205E-04	95% KM (t) UCL	
Delta-BHC	mg/kg	ND	ND		0.000E+00	No Detected Values	
Dieldrin	mg/kg	ND	ND		0.000E+00	No Detected Values	
Endosulfan I	mg/kg	ND	ND		0.000E+00	No Detected Values	
Endosulfan II	mg/kg	ND	ND		0.000E+00	No Detected Values	
Endrin	mg/kg	ND	ND		0.000E+00	No Detected Values	
gamma-Chlordane	mg/kg	4.200E-04	4.200E-04	mg/kg	4.200E-04	Max Detected Conc.	Only 1 detected value
Heptachlor	mg/kg	ND	ND		0.000E+00	No Detected Values	
Heptachlor Epoxide	mg/kg	ND	ND		0.000E+00	No Detected Values	
Lindane	mg/kg	1.330E-03	2.000E-03	mg/kg	1.330E-03	95% KM (t) UCL	
Methoxychlor	mg/kg	ND	ND		0.000E+00	No Detected Values	
Bis(2-Ethylhexyl)phthalate	mg/kg	ND	ND		0.000E+00	No Detected Values	
M-Nitroaniline	mg/kg	ND	ND		0.000E+00	No Detected Values	
Pentachlorophenol	mg/kg	ND	ND		0.000E+00	No Detected Values	
Pyridine	mg/kg	ND	ND		0.000E+00	No Detected Values	
Hexachlorobenzene	mg/kg	ND	ND		0.000E+00	No Detected Values	

Key:

EPC= Exposure Point Concentration

Max = Maximum Detected

NA = Not applicable; sample number less than 5

ND = All results were non-detect. Not included in risk calculations.

NT = Not tested for or results not indicated in historical report. Not included in risk calculations.

UCL = Upper Confidence Limit

Note:

1 - For PCB, Sum of Congeners and 2,3,7,8-TCDD TEQ (ND0 and ND05) whole tissue concentrations are calculated based on the assumption that visceral tissue composition is 56% of the whole organism and edible tissue composition is 44%.

TABLE B-8

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Ling Cod - Fillet
Exposure Medium: Ling Cod - Fillet

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Aluminum	mg/kg	NT	NT		0.000E+00		
Antimony	mg/kg	ND	ND		0.000E+00	No Detected Values	
Arsenic (Total)	mg/kg	NA	7.700E-01	mg/kg	7.700E-01	Max	Max
Barium	mg/kg	ND	ND		0.000E+00	No Detected Values	
Cadmium	mg/kg	ND	ND		0.000E+00	No Detected Values	
Cobalt	mg/kg	NT	NT		0.000E+00		
Copper	mg/kg	NA	5.500E-01	mg/kg	5.500E-01	Max	Max
Iron	mg/kg	NT	NT		0.000E+00		
Lead	mg/kg	ND	ND		0.000E+00	No Detected Values	
Manganese	mg/kg	NT	NT		0.000E+00		
Mercury	mg/kg	NA	9.700E-02	mg/kg	9.700E-02	Max	Max
Nickel	mg/kg	NA	7.400E-02	mg/kg	7.400E-02	Max	Max
Selenium	mg/kg	NT	NT		0.000E+00		
Silver	mg/kg	ND	ND		0.000E+00	No Detected Values	
Vanadium	mg/kg	NT	NT		0.000E+00		
Zinc	mg/kg	NA	6.300E+00	mg/kg	6.300E+00	Max	Max
Tributyltin	mg/kg	NT	NT		0.000E+00		
Tributyltin oxide	mg/kg	NT	NT		0.000E+00		
Methyl mercury	mg/kg	NT	NT		0.000E+00		
Tetraethyl lead	mg/kg	NT	NT		0.000E+00		
PCB, Sum of Aroclors, ND0	mg/kg	NT	NT		0.000E+00	No Detected Values	
PCB, Sum of Aroclors, ND05	mg/kg	NT	NT		0.000E+00	No Detected Values	
PCB TEQ, ND0	mg/kg	NA	1.140E-07	mg/kg	1.140E-07	Max	Max
PCB TEQ, ND05	mg/kg	NA	1.237E-07	mg/kg	1.237E-07	Max	Max
1-Methylnaphthalene	mg/kg	ND	ND		0.000E+00	No Detected Values	
2-Methylnaphthalene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Acenaphthene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Acenaphthylene	mg/kg	NA	8.800E-05		8.800E-05	Max	
Anthracene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Benzo(ghi)perylene	mg/kg	NA	5.800E-05		5.800E-05	Max	
cPAHs, ND0	mg/kg	NA	2.570E-05		2.570E-05	Max	
cPAHs, ND05	mg/kg	NA	2.798E-05		2.798E-05	Max	
Fluoranthene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Fluorene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Naphthalene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Phenanthrene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Pyrene	mg/kg	ND	ND		0.000E+00	No Detected Values	
2,3,7,8-TCDD TEQ, ND0	mg/kg	NA	1.963E-08	mg/kg	1.963E-08	Max	Max
2,3,7,8-TCDD TEQ, ND05	mg/kg	NA	9.821E-08	mg/kg	9.821E-08	Max	Max
4,4'-DDD	mg/kg	NT	NT		0.000E+00		

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
4,4'-DDE	mg/kg	NT	NT		0.000E+00		
4,4'-DDT	mg/kg	NT	NT		0.000E+00		
Aldrin	mg/kg	NT	NT		0.000E+00		
Alpha-BHC	mg/kg	NT	NT		0.000E+00		
Beta-BHC	mg/kg	NT	NT		0.000E+00		
Delta-BHC	mg/kg	NT	NT		0.000E+00		
Dieldrin	mg/kg	NT	NT		0.000E+00		
Endosulfan I	mg/kg	NT	NT		0.000E+00		
Endosulfan II	mg/kg	NT	NT		0.000E+00		
Endrin	mg/kg	NT	NT		0.000E+00		
gamma-Chlordane	mg/kg	NT	NT		0.000E+00		
Heptachlor	mg/kg	NT	NT		0.000E+00		
Heptachlor Epoxide	mg/kg	NT	NT		0.000E+00		
Lindane	mg/kg	NT	NT		0.000E+00		
Methoxychlor	mg/kg	NT	NT		0.000E+00		
Bis(2-Ethylhexyl)phthalate	mg/kg	ND	ND		0.000E+00	No Detected Values	
Dibenzofuran	mg/kg	ND	ND		0.000E+00	No Detected Values	
Pentachlorophenol	mg/kg	ND	ND		0.000E+00	No Detected Values	
Pyridine	mg/kg	NT	NT		0.000E+00		
Hexachlorobenzene	mg/kg	ND	ND		0.000E+00	No Detected Values	

Key:

EPC= Exposure Point Concentration

Max = Maximum Detected

NA = Not applicable; sample number less than 5

ND = All results were non-detect. Not included in risk calculations.

NT = Not tested for or results not indicated in historical report. Not included in risk calculations.

UCL = Upper Confidence Limit

TABLE B-9

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Rock Sole - Fillet
Exposure Medium: Rock Sole - Fillet

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
Aluminum	mg/kg	NT	NT		0.000E+00		
Antimony	mg/kg	NT	NT		0.000E+00		
Arsenic (Inorganic)	mg/kg	NA	5.000E-03	mg/kg	5.000E-03	Max	Max
Barium	mg/kg	NT	NT		0.000E+00		
Cadmium	mg/kg	NA	1.300E-02	mg/kg	1.300E-02	Max	Max
Cobalt	mg/kg	NT	NT		0.000E+00		
Copper	mg/kg	NA	6.100E-01	mg/kg	6.100E-01	Max	Max
Iron	mg/kg	NT	NT		0.000E+00		
Lead	mg/kg	NT	NT		0.000E+00		
Manganese	mg/kg	NT	NT		0.000E+00		
Mercury	mg/kg	NT	NT		0.000E+00		
Nickel	mg/kg	NT	NT		0.000E+00		
Selenium	mg/kg	NA	4.000E-01	mg/kg	4.000E-01	Max	Max
Silver	mg/kg	NT	NT		0.000E+00		
Vanadium	mg/kg	NT	NT		0.000E+00		
Zinc	mg/kg	NA	1.280E+01	mg/kg	1.280E+01	Max	Max
Tributyltin	mg/kg	NT	NT		0.000E+00		
Tributyltin oxide	mg/kg	NT	NT		0.000E+00		
Methyl mercury	mg/kg	NA	2.000E-02	mg/kg	2.000E-02	Max	Max
Tetraethyl lead	mg/kg	NA	1.500E-01	mg/kg	1.500E-01	Max	Max
PCB, Sum of Aroclors, ND0	mg/kg	NA	1.310E-02	mg/kg	1.310E-02	Max	Max
PCB, Sum of Aroclors, ND05	mg/kg	NA	1.405E-02	mg/kg	1.405E-02	Max	Max
PCB TEQ, ND0	mg/kg	NT	NT		0.000E+00		
PCB TEQ, ND05	mg/kg	NT	NT		0.000E+00		
1-Methylnaphthalene	mg/kg	NT	NT		0.000E+00		
2-Methylnaphthalene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Acenaphthene	mg/kg	NA	2.400E-04	mg/kg	2.400E-04	Max	Max
Acenaphthylene	mg/kg	ND	ND		0.000E+00		
Anthracene	mg/kg	NA	1.500E-04	mg/kg	1.500E-04	Max	Max
Benzo(ghi)perylene	mg/kg	ND	ND		0.000E+00	No Detected Values	
cPAHs, ND0	mg/kg	ND	ND		0.000E+00	No Detected Values	
cPAHs, ND05	mg/kg	ND	ND		0.000E+00	No Detected Values	
Fluoranthene	mg/kg	NA	4.200E-04	mg/kg	4.200E-04	Max	Max
Fluorene	mg/kg	ND	ND		0.000E+00	No Detected Values	
Naphthalene	mg/kg	NA	6.900E-04	mg/kg	6.900E-04	Max	Max
Phenanthrene	mg/kg	NA	6.800E-04	mg/kg	6.800E-04	Max	Max
Pyrene	mg/kg	ND	ND		0.000E+00		
2,3,7,8-TCDD TEQ, ND0	mg/kg	NA	1.017E-09	mg/kg	1.017E-09	Max	Max
2,3,7,8-TCDD TEQ, ND05	mg/kg	NA	2.731E-07	mg/kg	2.731E-07	Max	Max
4,4'-DDD	mg/kg	ND	ND		0.000E+00	No Detected Values	

Chemical of Potential Concern	Units	95% UCL of Normal Data	Maximum Detected Concentration	EPC Units	Reasonable Maximum Exposure		
					Medium EPC Value	Medium EPC Statistic	Medium EPC Rationale
4,4'-DDE	mg/kg	NA	1.000E-03	mg/kg	1.000E-03	Max	Max
4,4'-DDT	mg/kg	NA	1.600E-03	mg/kg	1.600E-03	Max	Max
Aldrin	mg/kg	NT	NT		0.000E+00		
Alpha-BHC	mg/kg	NA	1.100E-03	mg/kg	1.100E-03	Max	Max
Beta-BHC	mg/kg	NA	1.000E-03	mg/kg	1.000E-03	Max	Max
Delta-BHC	mg/kg	NA	9.900E-04	mg/kg	9.900E-04	Max	Max
Dieldrin	mg/kg	NT	NT		0.000E+00		
Endosulfan I	mg/kg	NT	NT		0.000E+00		
Endosulfan II	mg/kg	NT	NT		0.000E+00		
Endrin	mg/kg	NT	NT		0.000E+00		
gamma-Chlordane	mg/kg	NT	NT		0.000E+00		
Heptachlor	mg/kg	NT	NT		0.000E+00		
Heptachlor Epoxide	mg/kg	NT	NT		0.000E+00		
Lindane	mg/kg	NA	7.000E-04	mg/kg	7.000E-04	Max	Max
Methoxychlor	mg/kg	NT	NT		0.000E+00		
Bis(2-Ethylhexyl)phthalate	mg/kg	NT	NT		0.000E+00		
Dibenzofuran	mg/kg	NT	NT		0.000E+00		
Pentachlorophenol	mg/kg	ND	ND		0.000E+00	No Detected Values	
Pyridine	mg/kg	ND	ND		0.000E+00	No Detected Values	
Hexachlorobenzene	mg/kg	NT	NT		0.000E+00		

Key:

EPC= Exposure Point Concentration

Max = Maximum Detected

NA = Not applicable; sample number less than 5

ND = All results were non-detect. Not included in risk calculations.

NT = Not tested for or results not indicated in historical report. Not included in risk calculations.

UCL = Upper Confidence Limit

Attachment C – Human Health Exposure Parameters and Risk Characterization Tables

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Table C-1
Values Used For Calculating Exposure
Human Health Risk Assessment - Adult Subsistence Fisher
Port Angeles Harbor, Washington

Scenario Timeframe: Current/Future
Exposure Medium: Sediment, Fish/Shellfish
Exposure Route: Oral, Dermal
Receptor Population: Subsistence Fisher
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Reference	CT Value	CT Reference	General Intake Equation/ Model Name
Ingestion - Sediment	CDI_{sed}	Chronic Daily Intake of Chemical - sediment	mg/kg-d	--	--	--	--	CDIsed = EPCsed * IRsed * EFsed * EDsed * CF / (BW * AT)
	EPC_{sed}	Exposure Point Concentration - sediment	mg/kg	95% UCL	--	95% UCL	--	
	$IR_{sed - a}$	Ingestion Rate - sediment, adult	g/d	0.1	US EPA 1991	0.1	US EPA 1991	
	$EF_{sed - a}$	Exposure Frequency - sediment, adult	d/y	104	NOAA 2009	104	NOAA 2009	
	$ED_{sed -a}$	Exposure Duration - sediment, adult	y	70	LEKT	70	LEKT	
	BW_a	Body Weight, adult	kg	79	LEKT	79	LEKT	
	AT_c	Averaging Time - cancer	days	25,550	LEKT	25,550	LEKT	
	AT_{nc}	Averaging Time - non-cancer	days	25,550	LEKT	25,550	LEKT	
	CF_{sed}	Conversion Factor - sediment	kg/g	0.001	--	0.001	--	
Ingestion - Fish and Shellfish	CDI_{fish}	Chronic Daily Intake of Chemical - fish	mg/kg-d	--	--	--	--	CDIfish = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)
	EPC_{fish}	Exposure Point Concentration - fish	mg/kg	95% UCL	--	95% UCL	--	
	$IR_{fish - a}$	Ingestion Rate - fish, adult	g/d	583	LEKT	583	LEKT	
	$IR_{pelagic-a}$	Ingestion Rate - pelagic fish, adult	g/d	56	LEKT	56	LEKT	
	$IR_{bottom-a}$	Ingestion Rate - bottom fish, adult	g/d	29	LEKT	29	LEKT	
	$IR_{shellfish-a}$	Ingestion Rate - shellfish, adult[1]	g/d	498	LEKT	498	LEKT	
	$EF_{fish - a}$	Exposure Frequency - fish, adult	d/y	365	LEKT	365	LEKT	
	$ED_{fish - a}$	Exposure Duration - fish, adult	y	70	LEKT	70	LEKT	
	BW_a	Body Weight, Adult	kg	79	LEKT	79	LEKT	
	AT_c	Averaging Time - cancer	days	25,550	LEKT	25,550	LEKT	
	AT_{nc}	Averaging Time - non-cancer	days	25,550	LEKT	25,550	LEKT	
	CF_{fish}	Conversion Factor - fish	kg/g	0.001	--	0.001	--	
	FIfish	Fractional Intake from contaminated source - fish	unitless	1	LEKT	0.5	MTCA	
Dermal - Sediment	DAD	Dermally Absorbed Dose	mg/kg-d	--	--	--	--	DAD = DAevent * EV * ED * EF * SA / (BW * AT)
	DA_{event}	Absorbed Dose Per Event	mg/cm^2-event	--	--	--	--	DAevent = EPCsed * CF * AF * ABSdermal
	SA_a	Surface Area, adult	cm^2	6,125.5	US EPA 1997	6,125.5	US EPA 1997	
	Ev_a	Event Frequency, adult	events/d	1	US EPA 2004	1	US EPA 2004	
	$EF_{sed - a}$	Exposure Frequency - sediment, adult	d/y	104	NOAA 2009	104	NOAA 2009	
	$ED_{sed -a}$	Exposure Duration - sediment, adult	y	70	LEKT	70	LEKT	
	BW_a	Body Weight, adult	kg	79	LEKT	79	LEKT	
	AT_c	Averaging Time - cancer	days	25,550	LEKT	25,550	LEKT	
	AT_{nc}	Averaging Time - non-cancer	days	25,550	LEKT	25,550	LEKT	

Table C-1
Values Used For Calculating Exposure
Human Health Risk Assessment - Adult Subsistence Fisher
Port Angeles Harbor, Washington

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Reference	CT Value	CT Reference	General Intake Equation/ Model Name
	EPC_{sed}	Exposure Point Concentration - sediment	unitless	95% UCL	--	95% UCL	--	
	AF	Soil-to-skin Adherence Factor	mg/cm^2-event	0.6	US EPA 2004	0.1	US EPA 2004	
	ABS_{dermal}	Dermal Absorption Fraction	Unitless	Chem.-specific	US EPA 2004	Chem.-specific	US EPA 2004	
	CF_{sed}	Conversion Factor - sediment	mg/kg	0.000001	--	0.000001	--	

Notes:

1 - Shellfish ingestion rate will be divided by 30% Dungeness crab, 30% Horse clam, 30% geoduck and 10% shrimp.

Sources:

LEKT = LEKT recommendations presented in Ecology 2008a. Site-Specific Proposal for Modifying the Default MTCA Fish Consumption Exposure Parameters: Questions and Background Information. Prepared for MTCA Science Advisory Board.

MTCA = Ecology 2007. Model Toxics Control Act Chapter 70.105D RCW [Amended 2007] and Cleanup Regulation Chapter 173-340 WAC [Amended November 2007], Revised 2007.

NOAA 2009 = NOAA Tides and Currents. http://tidesandcurrents.noaa.gov/index.shtml. Accessed January 2009.

US EPA 1991 = Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim.

US EPA 1997 = Exposure Factors Handbook - Volume 1. General Factors. U.S. Environmental Protection Agency, National Center for Environmental Assessment.

US EPA 2004 = Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment). Final.

Table C-2
Values Used For Calculating Exposure
Human Health Risk Assessment - Child Subsistence Fisher
Port Angeles Harbor, Washington

Scenario Timeframe: Current/Future
Exposure Medium: Sediment, Fish/Shellfish
Exposure Route: Oral, Dermal
Receptor Population: Subsistence Fisher
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Reference	CT Value	CT Reference	General Intake Equation/ Model Name
Ingestion - Sediment	CDI_{sed}	Chronic Daily Intake of Chemical - sediment	mg/kg-d	--	--	--	--	CDIsed = EPCsed * IRsed * EFsed * EDsed * CF / (BW * AT)
	EPC_{sed}	Exposure Point Concentration - sediment	mg/kg	95% UCL	--	95% UCL	--	
	$IR_{sed - c}$	Ingestion Rate - sediment, child	g/d	0.2	US EPA 1991	0.2	US EPA 1991	
	$EF_{sed - c}$	Exposure Frequency - sediment, child	d/y	104	NOAA 2009	104	NOAA 2009	
	$ED_{sed - c}$	Exposure Duration - sediment, child	y	6	MTCA	6	MTCA	
	BW_c	Body Weight, child	kg	16	MTCA	16	MTCA	
	AT_c	Averaging Time - cancer	days	25,550	LEKT	25,550	LEKT	
	AT_{nc}	Averaging Time - non-cancer	days	2,190	MTCA	2,190	MTCA	
	CF_{sed}	Conversion Factor - sediment	kg/g	0.001	--	0.001	--	
Ingestion - Fish and Shellfish	CDI_{fish}	Chronic Daily Intake of Chemical - fish	mg/kg-d	--	--	--	--	CDIfish = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)
	EPC_{fish}	Exposure Point Concentration - fish	mg/kg	95% UCL	--	95% UCL	--	
	$IR_{fish - c}$	Ingestion Rate - fish, child	g/d	233	US EPA 2007	233	US EPA 2007	
	$IR_{pelagic-c}$	Ingestion Rate - pelagic fish, child	g/d	22	US EPA 2007	22	US EPA 2007	
	$IR_{bottom-c}$	Ingestion Rate - bottom fish, child	g/d	12	US EPA 2007	12	US EPA 2007	
	$IR_{shellfish-c}$	Ingestion Rate - shellfish, child[1]	g/d	199	US EPA 2007	199	US EPA 2007	
	$EF_{fish - c}$	Exposure Frequency - fish, child	d/y	365	LEKT	365	LEKT	
	$ED_{fish - c}$	Exposure Duration - fish, child	y	6	MTCA	6	MTCA	
	BW_c	Body Weight, child	kg	16	MTCA	16	MTCA	
	AT_c	Averaging Time - cancer	days	25,550	LEKT	25,550	LEKT	
	AT_{nc}	Averaging Time - non-cancer	days	2,190	MTCA	2,190	MTCA	
	CF_{fish}	Conversion Factor - fish	kg/g	0.001	--	0.001	--	
	FIfish	Fractional Intake from contaminated source - fish	unitless	1	LEKT	0.5	MTCA	
Dermal - Sediment	DAD	Dermally Absorbed Dose	mg/kg-d	--	--	--	--	DAD = DAevent * EV * ED * EF * SA / (BW * AT)
	DA_{event}	Absorbed Dose Per Event	mg/cm^2-event	--	--	--	--	DAevent = EPCsed * CF * AF * ABSdermal
	SA_c	Surface Area, child	cm^2	2,800	US EPA 2004	2,800	US EPA 2004	
	EV_c	Event Frequency, child	events/d	1	US EPA 2004	1	US EPA 2004	
	$EF_{sed - c}$	Exposure Frequency - sediment, child	d/y	104	NOAA 2009	104	NOAA 2009	
	$ED_{sed - c}$	Exposure Duration - sediment, child	y	6	MTCA	6	MTCA	
	BW_c	Body Weight, child	kg	16	MTCA	16	MTCA	
	AT_c	Averaging Time - cancer	days	25,550	LEKT	25,550	LEKT	
	AT_{nc}	Averaging Time - non-cancer	days	2,190	MTCA	2,190	MTCA	

Table C-2
Values Used For Calculating Exposure
Human Health Risk Assessment - Child Subsistence Fisher
Port Angeles Harbor, Washington

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Reference	CT Value	CT Reference	General Intake Equation/ Model Name
	EPC_{sed}	Exposure Point Concentration - sediment	unitless	95% UCL	--	95% UCL	--	
	AF	Soil-to-skin Adherence Factor	mg/cm^2-event	3.3	US EPA 2004	0.2	US EPA 2004	
	ABS_{dermal}	Dermal Absorption Fraction	Unitless	Chem.-specific	US EPA 2004	Chem.-specific	US EPA 2004	
	CF_{sed}	Conversion Factor - sediment	mg/kg	0.000001	--	0.000001	--	

Notes:

1 - Shellfish ingestion rate will be divided by 30% Dungeness crab, 30% Horse clam, 30% geoduck and 10% shrimp.

Sources:

LEKT = LEKT recommendations presented in Ecology 2008a. Site-Specific Proposal for Modifying the Default MTCA Fish Consumption Exposure Parameters: Questions and Background Information. Prepared for MTCA Science Advisory Board.

MTCA = Ecology 2007. Model Toxics Control Act Chapter 70.105D RCW [Amended 2007] and Cleanup Regulation Chapter 173-340 WAC [Amended November 2007], Revised 2007.

NOAA 2009 = NOAA Tides and Currents. http://tidesandcurrents.noaa.gov/index.shtml. Accessed January 2009.

US EPA 1991 = Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim.

US EPA 2004 = Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment). Final.

US EPA 2007 = Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-based Decision-making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia

Table C-3
Values Used For Calculating Exposure
Human Health Risk Assessment - Adult Recreational Fisher
Port Angeles Harbor, Washington

Scenario Timeframe: Current/Future
Exposure Medium: Sediment, Fish/Shellfish
Exposure Route: Oral, Dermal
Receptor Population: Recreational Fisher
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Reference	CT Value	CT Reference	General Intake Equation/ Model Name
Ingestion - Sediment	CDI_{sed}	Chronic Daily Intake of Chemical - sediment	mg/kg-d	--	--	--	--	CDIsed = EPCsed * IRsed * EFsed * EDsed * CF / (BW * AT)
	EPC_{sed}	Exposure Point Concentration - sediment	mg/kg	95% UCL	--	95% UCL	--	
	$IR_{sed - a}$	Ingestion Rate - sediment, adult	g/d	0.1	US EPA 1991	0.1	US EPA 1991	
	$EF_{sed - a}$	Exposure Frequency - sediment, adult	d/y	53	KC 1999	37	KC 1999	
	$ED_{sed -a}$	Exposure Duration - sediment, adult	y	30	MTCA	30	MTCA	
	BW_a	Body Weight, adult	kg	70	MTCA	70	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	10,950	MTCA	10,950	MTCA	
	CF_{sed}	Conversion Factor - sediment	kg/g	0.001	--	0.001	--	
Ingestion - Fish and Shellfish	CDI_{fish}	Chronic Daily Intake of Chemical - fish	mg/kg-d	--	--	--	--	CDIfish = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)
	EPC_{fish}	Exposure Point Concentration - fish	mg/kg	95% UCL	--	95% UCL	--	
	$IR_{fish - a}$	Ingestion Rate - fish, adult	g/d	76.5	US EPA 1997	54.0	MTCA	
	$IR_{pelagic-a}$	Ingestion Rate - pelagic fish, adult	g/d	7.3	LEKT	5.2	LEKT	
	$IR_{bottom-a}$	Ingestion Rate - bottom fish, adult	g/d	3.8	LEKT	2.7	LEKT	
	$IR_{shellfish-a}$	Ingestion Rate - shellfish, adult[1]	g/d	65.3	LEKT	46.1	LEKT	
	$EF_{fish - a}$	Exposure Frequency - fish, adult	d/y	365	LEKT	365	MTCA	
	$ED_{fish - a}$	Exposure Duration - fish, adult	y	30	MTCA	30	MTCA	
	BW_a	Body Weight, Adult	kg	70	MTCA	70	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	10,950	MTCA	10,950	MTCA	
	CF_{fish}	Conversion Factor - fish	kg/g	0.001	--	0.001	--	
	FIfish	Fractional Intake from contaminated source - fish	unitless	0.5	MTCA	0.5	MTCA	
Dermal - Sediment	DAD	Dermally Absorbed Dose	mg/kg-d	--	--	--	--	DAD = DAevent * EV * ED * EF * SA / (BW * AT)
	DA_{event}	Absorbed Dose Per Event	mg/cm^2-event	--	--	--	--	DAevent = EPCsed * CF * AF * ABSdermal
	SA_a	Surface Area, adult	cm^2	6,125.5	US EPA 1997	6,125.5	US EPA 1997	
	Ev_a	Event Frequency, adult	events/d	1	US EPA 2004	1	US EPA 2004	
	$EF_{sed - a}$	Exposure Frequency - sediment, adult	d/y	53	KC 1999	37	KC 1999	
	$ED_{sed -a}$	Exposure Duration - sediment, adult	y	30	MTCA	30	MTCA	
	BW_a	Body Weight, adult	kg	70	MTCA	70	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	10,950	MTCA	10,950	MTCA	

Table C-3
Values Used For Calculating Exposure
Human Health Risk Assessment - Adult Recreational Fisher
Port Angeles Harbor, Washington

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Reference	CT Value	CT Reference	General Intake Equation/ Model Name
	EPC_{sed}	Exposure Point Concentration - sediment	unitless	95% UCL	--	95% UCL	--	
	AF	Soil-to-skin Adherence Factor	mg/cm^2-event	0.6	US EPA 2004	0.1	US EPA 2004	
	ABS_{dermal}	Dermal Absorption Fraction	Unitless	Chem.-specific	US EPA 2004	Chem.-specific	US EPA 2004	
	CF_{sed}	Conversion Factor - sediment	mg/kg	0.000001	--	0.000001	--	

Notes:

1 - Shellfish ingestion rate will be divided by 30% Dungeness crab, 30% Horse clam, 30% geoduck and 10% shrimp.

Sources:

KC 1999 = King County combined sewer overflow water quality assessment for the Duwamish River and Elliott Bay. Vol 1, Appendix B2: human health risk assessment.

LEKT = LEKT recommendations presented in Ecology 2008a. Site-Specific Proposal for Modifying the Default MTCA Fish Consumption Exposure Parameters: Questions and Background Information. Prepared for MTCA Science Advisory Board.

MTCA = Ecology 2007. Model Toxics Control Act Chapter 70.105D RCW [Amended 2007] and Cleanup Regulation Chapter 173-340 WAC [Amended November 2007], Revised 2007.

US EPA 1991 = Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim.

US EPA 1997 = Exposure Factors Handbook - Volume 1. General Factors. U.S. Environmental Protection Agency, National Center for Environmental Assessment.

US EPA 2004 = Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment). Final.

Table C-4
Values Used For Calculating Exposure
Human Health Risk Assessment - Child Recreational Fisher
Port Angeles Harbor, Washington

Scenario Timeframe: Current/Future
Exposure Medium: Sediment, Fish/Shellfish
Exposure Route: Oral, Dermal
Receptor Population: Recreational Fisher
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Reference	CT Value	CT Reference	General Intake Equation/ Model Name
Ingestion - Sediment	CDI_{sed}	Chronic Daily Intake of Chemical - sediment	mg/kg-d	--	--	--	--	CDIsed = EPCsed * IRsed * EFsed * EDsed * CF / (BW * AT)
	EPC_{sed}	Exposure Point Concentration - sediment	mg/kg	95% UCL	--	95% UCL	--	
	IR_{sed-c}	Ingestion Rate - sediment, child	g/d	0.2	MTCA	0.2	MTCA	
	EF_{sed-c}	Exposure Frequency - sediment, child	d/y	65	Parametrix 2003	10	Parametrix 2003	
	ED_{sed-c}	Exposure Duration - sediment, child	y	6	MTCA	6	MTCA	
	BW_c	Body Weight, child	kg	16	MTCA	16	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	2,190	MTCA	2,190	MTCA	
	CF_{sed}	Conversion Factor - sediment	kg/g	0.001	--	0.001	--	
Ingestion - Fish and Shellfish	CDI_{fish}	Chronic Daily Intake of Chemical - fish	mg/kg-d	--	--	--	--	CDIfish = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)
	EPC_{fish}	Exposure Point Concentration - fish	mg/kg	95% UCL	--	95% UCL	--	
	IR_{fish-c}	Ingestion Rate - fish, child	g/d	30.6	US EPA 2007	21.6	US EPA 2007	
	$IR_{pelagic-c}$	Ingestion Rate - pelagic fish, child	g/d	2.9	LEKT	2.1	LEKT	
	$IR_{bottom-c}$	Ingestion Rate - bottom fish, child	g/d	1.5	LEKT	1.1	LEKT	
	$IR_{shellfish-c}$	Ingestion Rate - shellfish, child[1]	g/d	26.1	LEKT	18.4	LEKT	
	EF_{fish-c}	Exposure Frequency - fish, child	d/y	365	LEKT	365	LEKT	
	ED_{fish-c}	Exposure Duration - fish, child	y	6	MTCA	6	MTCA	
	BW_c	Body Weight, child	kg	16	MTCA	16	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	2,190	MTCA	2,190	MTCA	
	CF_{fish}	Conversion Factor - fish	kg/g	0.001	--	0.001	--	
	FIfish	Fractional Intake from contaminated source - fish	unitless	0.5	MTCA	0.5	MTCA	
Dermal - Sediment	DAD	Dermally Absorbed Dose	mg/kg-d	--	--	--	--	DAD = DAevent * EV * ED * EF * SA / (BW * AT)
	DA_{event}	Absorbed Dose Per Event	mg/cm^2-event	--	--	--	--	DAevent = EPCsed * CF * AF * ABSdermal
	SA_c	Surface Area, child	cm^2	2,800	US EPA 2004	2,800	US EPA 2004	
	EV_c	Event Frequency, child	events/d	1	US EPA 2004	1	US EPA 2004	
	EF_{sed-c}	Exposure Frequency - sediment, child	d/y	65	Parametrix 2003	10	Parametrix 2003	
	ED_{sed-c}	Exposure Duration - sediment, child	y	6	MTCA	6	MTCA	
	BW_c	Body Weight, child	kg	16	MTCA	16	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	2,190	MTCA	2,190	MTCA	

Table C-4
Values Used For Calculating Exposure
Human Health Risk Assessment - Child Recreational Fisher
Port Angeles Harbor, Washington

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Reference	CT Value	CT Reference	General Intake Equation/ Model Name
	EPC_{sed}	Exposure Point Concentration - sediment	unitless	95% UCL	--	95% UCL	--	
	AF	Soil-to-skin Adherence Factor	mg/cm^2-event	3.3	US EPA 2004	0.2	US EPA 2004	
	ABS_{dermal}	Dermal Absorption Fraction	Unitless	Chem.-specific	US EPA 2004	Chem.-specific	US EPA 2004	
	CF_{sed}	Conversion Factor - sediment	mg/kg	0.000001	--	0.000001	--	

Notes:

1 - Shellfish ingestion rate will be divided by 30% Dungeness crab, 30% Horse clam, 30% geoduck and 10% shrimp.

Sources:

LEKT = LEKT recommendations presented in Ecology 2008a. Site-Specific Proposal for Modifying the Default MTCA Fish Consumption Exposure Parameters: Questions and Background Information. Prepared for MTCA Science Advisory Board.

MTCA = Ecology 2007. Model Toxics Control Act Chapter 70.105D RCW [Amended 2007] and Cleanup Regulation Chapter 173-340 WAC [Amended November 2007], Revised 2007.

Parametrix 2003 = Results of a human use survey for shoreline areas of Lake Union, Lake Washington, and Lake Sammamish. Sammamish-Washington Analysis and Modeling Program.

US EPA 2004 = Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment). Final.

US EPA 2007 = Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-based Decision-making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia

Table C-5
Values Used For Calculating Exposure
Human Health Risk Assessment - Adult Residential User
Port Angeles Harbor, Washington

Scenario Timeframe: Current/Future
Exposure Medium: Sediment
Exposure Route: Oral, Dermal
Receptor Population: Residential User
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	Value	Reference	General Intake Equation/ Model Name
Ingestion - Sediment	CDI_{sed}	Chronic Daily Intake of Chemical - sediment	mg/kg-d	--	--	CDIsed = EPCsed * IRsed * EFsed * EDsed * CF / (BW * AT)
	EPC_{sed}	Exposure Point Concentration - sediment	mg/kg	95% UCL	--	
	IR_{sed-a}	Ingestion Rate - sediment, adult	g/d	0.1	US EPA 1991	
	EF_{sed-a}	Exposure Frequency - sediment, adult	d/y	50	Parametrix 2003	
	ED_{sed-a}	Exposure Duration - sediment, adult	y	30	MTCA	
	BW_a	Body Weight, adult	kg	70	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	10,950	MTCA	
	CF_{sed}	Conversion Factor - sediment	kg/g	0.001	--	
Dermal - Sediment	DAD	Dermally Absorbed Dose	mg/kg-d	--	--	DAD = DAevent * EV * ED * EF * SA / (BW * AT)
	DA_{event}	Absorbed Dose Per Event	mg/cm^2-event	--	--	DAevent = EPCsed * CF * AF * ABSdermal
	SA_a	Surface Area, adult	cm^2	6,125.5	US EPA 1997	
	Ev_a	Event Frequency, adult	events/d	1	US EPA 2004	
	EF_{sed-a}	Exposure Frequency - sediment, adult	d/y	50	Parametrix 2003	
	ED_{sed-a}	Exposure Duration - sediment, adult	y	30	MTCA	
	BW_a	Body Weight, adult	kg	70	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	10,950	MTCA	
	EPC_{sed}	Exposure Point Concentration - sediment	unitless	95% UCL	--	
	AF	Soil-to-skin Adherence Factor	mg/cm^2-event	0.6	US EPA 2004	
	ABS_{dermal}	Dermal Absorption Fraction	Unitless	Chem.-specific	US EPA 2004	
	CF_{sed}	Conversion Factor - sediment	mg/kg	0.000001	--	

Sources:

MTCA = Ecology 2007. Model Toxics Control Act Chapter 70.105D RCW [Amended 2007] and Cleanup Regulation Chapter 173-340 WAC [Amended November 2007], Revised 2007.

Parametrix 2003 = Results of a human use survey for shoreline areas of Lake Union, Lake Washington, and Lake Sammamish. Sammamish-Washington Analysis and Modeling Program.

US EPA 1991 = Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim.

US EPA 1997 = Exposure Factors Handbook - Volume 1. General Factors. U.S. Environmental Protection Agency, National Center for Environmental Assessment.

US EPA 2004 = Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment). Final.

Table C-6
Values Used For Calculating Exposure
Human Health Risk Assessment - Child Residential User
Port Angeles Harbor, Washington

Scenario Timeframe: Current/Future
Exposure Medium: Sediment
Exposure Route: Oral, Dermal
Receptor Population: Residential User
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	Value	Reference	General Intake Equation/ Model Name
Ingestion - Sediment	CDI_{sed}	Chronic Daily Intake of Chemical - sediment	mg/kg-d	--	--	CDIsed = EPCsed * IRsed * EFsed * EDsed * CF / (BW * AT)
	EPC_{sed}	Exposure Point Concentration - sediment	mg/kg	95% UCL	--	
	$IR_{sed - c}$	Ingestion Rate - sediment, child	g/d	0.2	MTCA	
	$EF_{sed - c}$	Exposure Frequency - sediment, child	d/y	65	Parametrix 2003	
	$ED_{sed -c}$	Exposure Duration - sediment, child	y	6	MTCA	
	BW_c	Body Weight, child	kg	16	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	2,190	MTCA	
	CF_{sed}	Conversion Factor - sediment	kg/g	0.001	--	
Dermal - Sediment	DAD	Dermally Absorbed Dose	mg/kg-d	--	--	DAD = DAevent * EV * ED * EF * SA / (BW * AT)
	DA_{event}	Absorbed Dose Per Event	mg/cm^2-event	--	--	DAevent = EPCsed * CF * AF * ABSdermal
	SA_c	Surface Area, child	cm^2	2,800	US EPA 2004	
	EV_c	Event Frequency, child	events/d	1	US EPA 2004	
	$EF_{sed - c}$	Exposure Frequency - sediment, child	d/y	65	Parametrix 2003	
	$ED_{sed -c}$	Exposure Duration - sediment, child	y	6	MTCA	
	BW_c	Body Weight, child	kg	16	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	2,190	MTCA	
	EPC_{sed}	Exposure Point Concentration - sediment	unitless	95% UCL	--	
	AF	Soil-to-skin Adherence Factor	mg/cm^2-event	3.3	US EPA 2004	
	ABS_{dermal}	Dermal Absorption Fraction	Unitless	Chem.-specific	US EPA 2004	
	CF_{sed}	Conversion Factor - sediment	mg/kg	0.000001	--	

Sources:

MTCA = Ecology 2007. Model Toxics Control Act Chapter 70.105D RCW [Amended 2007] and Cleanup Regulation Chapter 173-340 WAC [Amended November 2007], Revised 2007.

Parametrix 2003 = Results of a human use survey for shoreline areas of Lake Union, Lake Washington, and Lake Sammamish. Sammamish-Washington Analysis and Modeling Program.

US EPA 1997 = Exposure Factors Handbook - Volume 1. General Factors. U.S. Environmental Protection Agency, National Center for Environmental Assessment.

US EPA 2004 = Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment). Final.

Table C-7
Values Used For Calculating Exposure
Human Health Risk Assessment - Adult Recreational User
Port Angeles Harbor, Washington

Scenario Timeframe: Current/Future
Exposure Medium: Sediment
Exposure Route: Oral, Dermal
Receptor Population: Recreational User
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	Value	Reference	General Intake Equation/ Model Name
Ingestion - Sediment	CDI_{sed}	Chronic Daily Intake of Chemical - sediment	mg/kg-d	--	--	CDIsed = EPCsed * IRsed * EFsed * EDsed * CF / (BW * AT)
	EPC_{sed}	Exposure Point Concentration - sediment	mg/kg	95% UCL	--	
	$IR_{sed - a}$	Ingestion Rate - sediment, adult	g/d	0.1	US EPA 1991	
	$EF_{sed - a}$	Exposure Frequency - sediment, adult	d/y	6	Parametrix 2003	
	$ED_{sed -a}$	Exposure Duration - sediment, adult	y	30	MTCA	
	BW_a	Body Weight, adult	kg	70	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	10,950	MTCA	
	CF_{sed}	Conversion Factor - sediment	kg/g	0.001	--	
Dermal - Sediment	DAD	Dermally Absorbed Dose	mg/kg-d	--	--	DAD = DAevent * EV * ED * EF * SA / (BW * AT)
	DA_{event}	Absorbed Dose Per Event	mg/cm^2-event	--	--	DAevent = EPCsed * CF * AF * ABSdermal
	SA_a	Surface Area, adult	cm^2	6,125.5	US EPA 1997	
	Ev_a	Event Frequency, adult	events/d	1	US EPA 2004	
	$EF_{sed - a}$	Exposure Frequency - sediment, adult	d/y	6	Parametrix 2003	
	$ED_{sed -a}$	Exposure Duration - sediment, adult	y	30	MTCA	
	BW_a	Body Weight, adult	kg	70	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	10,950	MTCA	
	EPC_{sed}	Exposure Point Concentration - sediment	unitless	95% UCL	--	
	AF	Soil-to-skin Adherence Factor	mg/cm^2-event	0.6	US EPA 2004	
	ABS_{dermal}	Dermal Absorption Fraction	Unitless	Chem.-specific	US EPA 2004	
	CF_{sed}	Conversion Factor - sediment	mg/kg	0.000001	--	

Sources:

MTCA = Ecology 2007. Model Toxics Control Act Chapter 70.105D RCW [Amended 2007] and Cleanup Regulation Chapter 173-340 WAC [Amended November 2007], Revised 2007.

Parametrix 2003 = Results of a human use survey for shoreline areas of Lake Union, Lake Washington, and Lake Sammamish. Sammamish-Washington Analysis and Modeling Program.

US EPA 1991 = Risk Assessment Guidance for Superfund (RAGS): Volume 1 – Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals), Interim.

US EPA 1997 = Exposure Factors Handbook - Volume 1. General Factors. U.S. Environmental Protection Agency, National Center for Environmental Assessment.

US EPA 2004 = Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment). Final.

Table C-8
Values Used For Calculating Exposure
Human Health Risk Assessment - Child Recreational User
Port Angeles Harbor, Washington

Scenario Timeframe: Current/Future
Exposure Medium: Sediment
Exposure Route: Oral, Dermal
Receptor Population: Recreational User
Receptor Age: Child

Exposure Route	Parameter Code	Parameter Definition	Units	Value	Reference	General Intake Equation/ Model Name
Ingestion - Sediment	CDI_{sed}	Chronic Daily Intake of Chemical - sediment	mg/kg-d	--	--	CDIsed = EPCsed * IRsed * EFsed * EDsed * CF / (BW * AT)
	EPC_{sed}	Exposure Point Concentration - sediment	mg/kg	95% UCL	--	
	$IR_{sed - c}$	Ingestion Rate - sediment, child	g/d	0.2	MTCA	
	$EF_{sed - c}$	Exposure Frequency - sediment, child	d/y	10	Parametrix 2003	
	$ED_{sed -c}$	Exposure Duration - sediment, child	y	6	MTCA	
	BW_c	Body Weight, child	kg	16	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	2,190	MTCA	
	CF_{sed}	Conversion Factor - sediment	kg/g	0.001	--	
Dermal - Sediment	DAD	Dermally Absorbed Dose	mg/kg-d	--	--	DAD = DAevent * EV * ED * EF * SA / (BW * AT)
	DA_{event}	Absorbed Dose Per Event	mg/cm^2-event	--	--	DAevent = EPCsed * CF * AF * ABSdermal
	SA_c	Surface Area, child	cm^2	2,800	US EPA 2004	
	EV_c	Event Frequency, child	events/d	1	US EPA 2004	
	$EF_{sed - c}$	Exposure Frequency - sediment, child	d/y	10	Parametrix 2003	
	$ED_{sed -c}$	Exposure Duration - sediment, child	y	6	MTCA	
	BW_c	Body Weight, child	kg	16	MTCA	
	AT_c	Averaging Time - cancer	days	27,375	MTCA	
	AT_{nc}	Averaging Time - non-cancer	days	2,190	MTCA	
	EPC_{sed}	Exposure Point Concentration - sediment	unitless	95% UCL	--	
	AF	Soil-to-skin Adherence Factor	mg/cm^2-event	3.3	US EPA 2004	
	ABS_{dermal}	Dermal Absorption Fraction	Unitless	Chem.-specific	US EPA 2004	
	CF_{sed}	Conversion Factor - sediment	mg/kg	0.000001	--	

Sources:

MTCA = Ecology 2007. Model Toxics Control Act Chapter 70.105D RCW [Amended 2007] and Cleanup Regulation Chapter 173-340 WAC [Amended November 2007], Revised 2007.

Parametrix 2003 = Results of a human use survey for shoreline areas of Lake Union, Lake Washington, and Lake Sammamish. Sammamish-Washington Analysis and Modeling Program.

US EPA 1997 = Exposure Factors Handbook - Volume 1. General Factors. U.S. Environmental Protection Agency, National Center for Environmental Assessment.

US EPA 2004 = Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E: Supplemental Guidance for Dermal Risk Assessment). Final.

Table C-9
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	2.35E-06	mg/kg-d	1.5E+00	(mg/kg-d)-1	**3.5E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.21E-08	mg/kg-d	2.9E-02	(mg/kg-d)-1	3.5E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	7.63E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	5.82E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	2.46E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	2.54E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	5.1E-08
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	1.36E-11	mg/kg-d	1.5E+05	(mg/kg-d)-1	**2.0E-06**
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	3.74E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.24E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	3.37E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	3.51E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	3.18E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	2.61E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.21E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	1.9E-08
							Risk				5.6E-06
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	2.91E-06	mg/kg-d	1.5E+00	(mg/kg-d)-1	**4.4E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.48E-08	mg/kg-d	2.9E-02	(mg/kg-d)-1	1.9E-09
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.10E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.13E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.32E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	1.47E-07	mg/kg-d	2.0E+00	(mg/kg-d)-1	2.9E-07
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	1.68E-11	mg/kg-d	2.5E+05	(mg/kg-d)-1	**4.2E-06**

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.54E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	5.12E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.39E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.45E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.31E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.08E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.98E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	8.0E-08
							Risk				8.9E-06

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Aluminum	NA	NA	NA	NA	NA	1.89E-01	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Antimony	NA	NA	NA	NA	NA	3.96E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	4.68E-03	mg/kg-d	1.5E+00	(mg/kg-d)-1	**7.0E-03**
	Barium	NA	NA	NA	NA	NA	5.43E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cadmium	NA	NA	NA	NA	NA	3.45E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cobalt	NA	NA	NA	NA	NA	1.13E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Copper	NA	NA	NA	NA	NA	8.24E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Iron	NA	NA	NA	NA	NA	1.87E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Lead	NA	NA	NA	NA	NA	6.35E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Manganese	NA	NA	NA	NA	NA	6.13E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Nickel	NA	NA	NA	NA	NA	1.82E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Selenium	NA	NA	NA	NA	NA	6.71E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Silver	NA	NA	NA	NA	NA	3.69E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Vanadium	NA	NA	NA	NA	NA	3.24E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Zinc	NA	NA	NA	NA	NA	1.77E-01	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Methyl mercury	NA	NA	NA	NA	NA	5.58E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	6.61E-04	mg/kg-d	2.0E+00	(mg/kg-d)-1	**1.3E-03**
	PCB TEQ, ND0	NA	NA	NA	NA	NA	5.49E-10	mg/kg-d	1.5E+05	(mg/kg-d)-1	**8.2E-05**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.9E-02	(mg/kg-d)-1	0.0E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	7.62E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthene	NA	NA	NA	NA	NA	9.39E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthylene	NA	NA	NA	NA	NA	5.41E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Anthracene	NA	NA	NA	NA	NA	2.54E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	3.79E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	cPAHs, ND0	NA	NA	NA	NA	NA	3.81E-05	mg/kg-d	7.3E+00	(mg/kg-d)-1	**2.8E-04**
	Fluoranthene	NA	NA	NA	NA	NA	6.31E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Fluorene	NA	NA	NA	NA	NA	3.95E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Naphthalene	NA	NA	NA	NA	NA	4.50E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	NA	NA	NA	NA	NA	3.63E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pyrene	NA	NA	NA	NA	NA	4.80E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	1.36E-08	mg/kg-d	1.5E+05	(mg/kg-d)-1	**2.0E-03**
	4,4'-DDD	NA	NA	NA	NA	NA	2.52E-06	mg/kg-d	2.4E-01	(mg/kg-d)-1	6.1E-07
	4,4'-DDE	NA	NA	NA	NA	NA	1.22E-05	mg/kg-d	3.4E-01	(mg/kg-d)-1	**4.2E-06**
	4,4'-DDT	NA	NA	NA	NA	NA	7.48E-05	mg/kg-d	3.4E-01	(mg/kg-d)-1	**2.5E-05**
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.7E+01	(mg/kg-d)-1	0.0E+00
	Alpha-BHC	NA	NA	NA	NA	NA	8.12E-05	mg/kg-d	6.3E+00	(mg/kg-d)-1	**5.1E-04**
	Beta-BHC	NA	NA	NA	NA	NA	3.77E-05	mg/kg-d	1.8E+00	(mg/kg-d)-1	**6.8E-05**
	Delta-BHC	NA	NA	NA	NA	NA	6.30E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.6E+01	(mg/kg-d)-1	0.0E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	8.61E-07	mg/kg-d	3.5E-01	(mg/kg-d)-1	3.0E-07
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	4.5E+00	(mg/kg-d)-1	0.0E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	9.1E+00	(mg/kg-d)-1	0.0E+00
	Lindane	NA	NA	NA	NA	NA	1.29E-05	mg/kg-d	1.1E+00	(mg/kg-d)-1	**1.4E-05**
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.4E-02	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	1.87E-04	mg/kg-d	1.2E-01	(mg/kg-d)-1	**2.2E-05**
	Pyridine	NA	NA	NA	NA	NA	2.37E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	NA	NA	NA	NA	NA	2.81E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	4.5E-08
							Risk (PCBs as congeners)				**1.0E-02**
							Risk (PCBs as Aroclors)				**1.1E-02**

Total Cancer Risk - All Pathways (2)	*1E-02*
Total Cancer Risk - All Pathways (3)	*1E-02*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Risk includes PCBs as congeners for tissue.

(3) - Risk includes PCBs as Aroclors for tissue.

Table C-10
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	2.35E-06	mg/kg-d	1.5E+00	(mg/kg-d)-1	**3.5E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.21E-08	mg/kg-d	2.9E-02	(mg/kg-d)-1	3.5E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	7.63E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	5.82E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	2.46E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	2.54E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	5.1E-08
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	1.36E-11	mg/kg-d	1.5E+05	(mg/kg-d)-1	**2.0E-06**
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	3.74E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.24E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	3.37E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	3.51E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	3.18E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	2.61E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.21E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	1.9E-08
							Risk				5.6E-06
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	3.18E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	4.8E-07
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	7.10E-09	mg/kg-d	2.9E-02	(mg/kg-d)-1	2.1E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.49E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.43E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.45E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	1.61E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	3.2E-08
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	1.85E-12	mg/kg-d	2.5E+05	(mg/kg-d)-1	4.6E-07

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.69E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	5.62E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.53E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.59E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.44E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.18E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	5.46E-09	mg/kg-d	1.6E+00	(mg/kg-d)-1	8.7E-09
							Risk				9.8E-07

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Aluminum	NA	NA	NA	NA	NA	9.46E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Antimony	NA	NA	NA	NA	NA	1.98E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	2.34E-03	mg/kg-d	1.5E+00	(mg/kg-d)-1	**3.5E-03**
	Barium	NA	NA	NA	NA	NA	2.71E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cadmium	NA	NA	NA	NA	NA	1.72E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cobalt	NA	NA	NA	NA	NA	5.67E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Copper	NA	NA	NA	NA	NA	4.12E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Iron	NA	NA	NA	NA	NA	9.34E-01	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Lead	NA	NA	NA	NA	NA	3.18E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Manganese	NA	NA	NA	NA	NA	3.07E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Nickel	NA	NA	NA	NA	NA	9.10E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Selenium	NA	NA	NA	NA	NA	3.36E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Silver	NA	NA	NA	NA	NA	1.84E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Vanadium	NA	NA	NA	NA	NA	1.62E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Zinc	NA	NA	NA	NA	NA	8.86E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Methyl mercury	NA	NA	NA	NA	NA	2.79E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	3.30E-04	mg/kg-d	2.0E+00	(mg/kg-d)-1	**6.6E-04**
	PCB TEQ, ND0	NA	NA	NA	NA	NA	2.75E-10	mg/kg-d	1.5E+05	(mg/kg-d)-1	**4.1E-05**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.9E-02	(mg/kg-d)-1	0.0E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	3.81E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthene	NA	NA	NA	NA	NA	4.70E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthylene	NA	NA	NA	NA	NA	2.70E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Anthracene	NA	NA	NA	NA	NA	1.27E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	1.89E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	cPAHs, ND0	NA	NA	NA	NA	NA	1.91E-05	mg/kg-d	7.3E+00	(mg/kg-d)-1	**1.4E-04**
	Fluoranthene	NA	NA	NA	NA	NA	3.16E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Fluorene	NA	NA	NA	NA	NA	1.97E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Naphthalene	NA	NA	NA	NA	NA	2.25E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	NA	NA	NA	NA	NA	1.81E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pyrene	NA	NA	NA	NA	NA	2.40E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	6.80E-09	mg/kg-d	1.5E+05	(mg/kg-d)-1	**1.0E-03**
	4,4'-DDD	NA	NA	NA	NA	NA	1.26E-06	mg/kg-d	2.4E-01	(mg/kg-d)-1	3.0E-07
	4,4'-DDE	NA	NA	NA	NA	NA	6.12E-06	mg/kg-d	3.4E-01	(mg/kg-d)-1	**2.1E-06**
	4,4'-DDT	NA	NA	NA	NA	NA	3.74E-05	mg/kg-d	3.4E-01	(mg/kg-d)-1	**1.3E-05**
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.7E+01	(mg/kg-d)-1	0.0E+00
	Alpha-BHC	NA	NA	NA	NA	NA	4.06E-05	mg/kg-d	6.3E+00	(mg/kg-d)-1	**2.6E-04**
	Beta-BHC	NA	NA	NA	NA	NA	1.89E-05	mg/kg-d	1.8E+00	(mg/kg-d)-1	**3.4E-05**
	Delta-BHC	NA	NA	NA	NA	NA	3.15E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.6E+01	(mg/kg-d)-1	0.0E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	4.31E-07	mg/kg-d	3.5E-01	(mg/kg-d)-1	1.5E-07
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	4.5E+00	(mg/kg-d)-1	0.0E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	9.1E+00	(mg/kg-d)-1	0.0E+00
	Lindane	NA	NA	NA	NA	NA	6.45E-06	mg/kg-d	1.1E+00	(mg/kg-d)-1	**7.1E-06**
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.4E-02	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	9.33E-05	mg/kg-d	1.2E-01	(mg/kg-d)-1	**1.1E-05**
	Pyridine	NA	NA	NA	NA	NA	2.37E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	NA	NA	NA	NA	NA	2.81E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	4.5E-08
							Risk (PCBs as congeners)				**5.0E-03**
							Risk (PCBs as Aroclors)				**5.7E-03**

Total Cancer Risk - All Pathways (2)	*5E-03*
Total Cancer Risk - All Pathways (3)	*6E-03*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Risk includes PCBs as congeners for tissue.

(3) - Risk includes PCBs as Aroclors for tissue.

Table C-11
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	9.03E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	**1.4E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.64E-09	mg/kg-d	2.9E-02	(mg/kg-d)-1	1.3E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.94E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.24E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	9.46E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	9.78E-09	mg/kg-d	2.0E+00	(mg/kg-d)-1	2.0E-08
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	5.23E-12	mg/kg-d	1.5E+05	(mg/kg-d)-1	7.8E-07
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.44E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.78E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.30E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.35E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.23E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.00E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.64E-09	mg/kg-d	1.6E+00	(mg/kg-d)-1	7.4E-09
							Risk				2.2E-06
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.18E-06	mg/kg-d	1.5E+00	(mg/kg-d)-1	1.8E-06
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.63E-08	mg/kg-d	2.9E-02	(mg/kg-d)-1	7.6E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.67E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.27E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.37E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	5.97E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	1.2E-07
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	6.85E-12	mg/kg-d	2.5E+05	(mg/kg-d)-1	**1.7E-06**

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	6.28E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.08E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.66E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.89E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	5.35E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	4.38E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.03E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	3.2E-08
							Risk				3.6E-06

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Aluminum	NA	NA	NA	NA	NA	5.93E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Antimony	NA	NA	NA	NA	NA	1.24E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	1.43E-04	mg/kg-d	1.5E+00	(mg/kg-d)-1	**2.2E-04**
	Barium	NA	NA	NA	NA	NA	1.70E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cadmium	NA	NA	NA	NA	NA	4.96E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cobalt	NA	NA	NA	NA	NA	3.56E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Copper	NA	NA	NA	NA	NA	1.09E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Iron	NA	NA	NA	NA	NA	5.86E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Lead	NA	NA	NA	NA	NA	1.99E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Manganese	NA	NA	NA	NA	NA	1.92E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Nickel	NA	NA	NA	NA	NA	5.71E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Selenium	NA	NA	NA	NA	NA	1.80E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Silver	NA	NA	NA	NA	NA	1.16E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Vanadium	NA	NA	NA	NA	NA	1.02E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Zinc	NA	NA	NA	NA	NA	5.99E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Methyl mercury	NA	NA	NA	NA	NA	1.75E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	6.10E-06	mg/kg-d	2.0E+00	(mg/kg-d)-1	**1.2E-05**
	PCB TEQ, ND0	NA	NA	NA	NA	NA	1.72E-11	mg/kg-d	1.5E+05	(mg/kg-d)-1	**2.6E-06**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.9E-02	(mg/kg-d)-1	0.0E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	2.35E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthene	NA	NA	NA	NA	NA	2.84E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthylene	NA	NA	NA	NA	NA	1.61E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Anthracene	NA	NA	NA	NA	NA	7.75E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	1.04E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	cPAHs, ND0	NA	NA	NA	NA	NA	1.50E-06	mg/kg-d	7.3E+00	(mg/kg-d)-1	**1.1E-05**
	Fluoranthene	NA	NA	NA	NA	NA	1.60E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Fluorene	NA	NA	NA	NA	NA	1.21E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Naphthalene	NA	NA	NA	NA	NA	1.37E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	NA	NA	NA	NA	NA	1.12E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pyrene	NA	NA	NA	NA	NA	1.47E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	2.81E-11	mg/kg-d	1.5E+05	(mg/kg-d)-1	**4.2E-06**
	4,4'-DDD	NA	NA	NA	NA	NA	7.91E-08	mg/kg-d	2.4E-01	(mg/kg-d)-1	1.9E-08
	4,4'-DDE	NA	NA	NA	NA	NA	1.99E-07	mg/kg-d	3.4E-01	(mg/kg-d)-1	6.8E-08
	4,4'-DDT	NA	NA	NA	NA	NA	6.52E-07	mg/kg-d	3.4E-01	(mg/kg-d)-1	2.2E-07
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.7E+01	(mg/kg-d)-1	0.0E+00
	Alpha-BHC	NA	NA	NA	NA	NA	2.50E-06	mg/kg-d	6.3E+00	(mg/kg-d)-1	**1.6E-05**
	Beta-BHC	NA	NA	NA	NA	NA	1.13E-06	mg/kg-d	1.8E+00	(mg/kg-d)-1	**2.0E-06**
	Delta-BHC	NA	NA	NA	NA	NA	1.79E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.6E+01	(mg/kg-d)-1	0.0E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	2.70E-08	mg/kg-d	3.5E-01	(mg/kg-d)-1	9.5E-09
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	4.5E+00	(mg/kg-d)-1	0.0E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	9.1E+00	(mg/kg-d)-1	0.0E+00
	Lindane	NA	NA	NA	NA	NA	4.16E-07	mg/kg-d	1.1E+00	(mg/kg-d)-1	4.6E-07
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.4E-02	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.2E-01	(mg/kg-d)-1	0.0E+00
	Pyridine	NA	NA	NA	NA	NA	2.37E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	NA	NA	NA	NA	NA	2.81E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	4.5E-08
							Risk (PCBs as congeners)				**2.5E-04**
							Risk (PCBs as Aroclors)				**2.6E-04**

Total Cancer Risk - All Pathways (2)	*3E-04*
Total Cancer Risk - All Pathways (3)	*3E-04*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Risk includes PCBs as congeners for tissue.

(3) - Risk includes PCBs as Aroclors for tissue.

Table C-12
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	2.72E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	4.1E-07
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.40E-09	mg/kg-d	2.9E-02	(mg/kg-d)-1	4.1E-11
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	8.86E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	6.76E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	2.85E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	2.95E-09	mg/kg-d	2.0E+00	(mg/kg-d)-1	5.9E-09
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	1.58E-12	mg/kg-d	1.5E+05	(mg/kg-d)-1	2.4E-07
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	4.34E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.44E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	3.92E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	4.07E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	3.70E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	3.03E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.40E-09	mg/kg-d	1.6E+00	(mg/kg-d)-1	2.2E-09
							Risk				6.5E-07
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	3.99E-08	mg/kg-d	1.5E+00	(mg/kg-d)-1	6.0E-08
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	8.91E-10	mg/kg-d	2.9E-02	(mg/kg-d)-1	2.6E-11
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	5.63E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	4.30E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.81E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	2.02E-09	mg/kg-d	2.0E+00	(mg/kg-d)-1	4.0E-09
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	2.31E-13	mg/kg-d	2.5E+05	(mg/kg-d)-1	5.8E-08

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.12E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	7.04E-12	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.91E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.99E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.81E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.48E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.85E-10	mg/kg-d	1.6E+00	(mg/kg-d)-1	1.1E-09
							Risk				1.2E-07

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Aluminum	NA	NA	NA	NA	NA	4.18E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Antimony	NA	NA	NA	NA	NA	8.74E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	1.01E-04	mg/kg-d	1.5E+00	(mg/kg-d)-1	**1.5E-04**
	Barium	NA	NA	NA	NA	NA	1.20E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cadmium	NA	NA	NA	NA	NA	3.50E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cobalt	NA	NA	NA	NA	NA	2.50E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Copper	NA	NA	NA	NA	NA	7.67E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Iron	NA	NA	NA	NA	NA	4.13E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Lead	NA	NA	NA	NA	NA	1.40E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Manganese	NA	NA	NA	NA	NA	1.35E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Nickel	NA	NA	NA	NA	NA	4.02E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Selenium	NA	NA	NA	NA	NA	1.27E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Silver	NA	NA	NA	NA	NA	8.14E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Vanadium	NA	NA	NA	NA	NA	7.16E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Zinc	NA	NA	NA	NA	NA	4.22E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Methyl mercury	NA	NA	NA	NA	NA	1.24E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	4.30E-06	mg/kg-d	2.0E+00	(mg/kg-d)-1	**8.6E-06**
	PCB TEQ, ND0	NA	NA	NA	NA	NA	1.22E-11	mg/kg-d	1.5E+05	(mg/kg-d)-1	**1.8E-06**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.9E-02	(mg/kg-d)-1	0.0E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	1.66E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthene	NA	NA	NA	NA	NA	2.02E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthylene	NA	NA	NA	NA	NA	1.14E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Anthracene	NA	NA	NA	NA	NA	5.46E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	7.30E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	cPAHs, ND0	NA	NA	NA	NA	NA	1.05E-06	mg/kg-d	7.3E+00	(mg/kg-d)-1	**7.7E-06**
	Fluoranthene	NA	NA	NA	NA	NA	1.14E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Fluorene	NA	NA	NA	NA	NA	8.54E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Naphthalene	NA	NA	NA	NA	NA	9.68E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	NA	NA	NA	NA	NA	7.92E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pyrene	NA	NA	NA	NA	NA	1.03E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	1.98E-11	mg/kg-d	1.5E+05	(mg/kg-d)-1	**3.0E-06**
	4,4'-DDD	NA	NA	NA	NA	NA	5.57E-08	mg/kg-d	2.4E-01	(mg/kg-d)-1	1.3E-08
	4,4'-DDE	NA	NA	NA	NA	NA	1.40E-07	mg/kg-d	3.4E-01	(mg/kg-d)-1	4.8E-08
	4,4'-DDT	NA	NA	NA	NA	NA	4.60E-07	mg/kg-d	3.4E-01	(mg/kg-d)-1	1.6E-07
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.7E+01	(mg/kg-d)-1	0.0E+00
	Alpha-BHC	NA	NA	NA	NA	NA	1.76E-06	mg/kg-d	6.3E+00	(mg/kg-d)-1	**1.1E-05**
	Beta-BHC	NA	NA	NA	NA	NA	8.00E-07	mg/kg-d	1.8E+00	(mg/kg-d)-1	**1.4E-06**
	Delta-BHC	NA	NA	NA	NA	NA	1.27E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.6E+01	(mg/kg-d)-1	0.0E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	1.90E-08	mg/kg-d	3.5E-01	(mg/kg-d)-1	6.7E-09
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	4.5E+00	(mg/kg-d)-1	0.0E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	9.1E+00	(mg/kg-d)-1	0.0E+00
	Lindane	NA	NA	NA	NA	NA	2.93E-07	mg/kg-d	1.1E+00	(mg/kg-d)-1	3.2E-07
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.4E-02	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.2E-01	(mg/kg-d)-1	0.0E+00
	Pyridine	NA	NA	NA	NA	NA	2.37E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	NA	NA	NA	NA	NA	2.81E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	4.5E-08
							Risk (PCBs as congeners)				**1.8E-04**
							Risk (PCBs as Aroclors)				**1.8E-04**

Total Cancer Risk - All Pathways (2)	*2E-04*
Total Cancer Risk - All Pathways (3)	*2E-04*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Risk includes PCBs as congeners for tissue.

(3) - Risk includes PCBs as Aroclors for tissue.

Table C-13
CALCULATION OF CANCER RISKS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Residential User
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	8.89E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	**1.3E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.57E-09	mg/kg-d	2.9E-02	(mg/kg-d)-1	1.3E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.89E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.21E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	9.32E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	9.63E-09	mg/kg-d	2.0E+00	(mg/kg-d)-1	1.9E-08
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	5.15E-12	mg/kg-d	1.5E+05	(mg/kg-d)-1	7.7E-07
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.42E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.70E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.28E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.33E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.21E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	9.89E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.57E-09	mg/kg-d	1.6E+00	(mg/kg-d)-1	7.3E-09
							Risk				2.1E-06
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.17E-06	mg/kg-d	1.5E+00	(mg/kg-d)-1	**1.7E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.60E-08	mg/kg-d	2.9E-02	(mg/kg-d)-1	7.5E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.65E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.26E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.30E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	5.90E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	1.2E-07
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	6.76E-12	mg/kg-d	2.5E+05	(mg/kg-d)-1	**1.7E-06**

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	6.20E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.06E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.59E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.81E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	5.28E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	4.33E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.00E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	3.2E-08
							Risk				3.6E-06

Total Cancer Risk - All Pathways	*6E-06*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

Table C-14
CALCULATION OF CANCER RISKS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational User
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.29E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	1.9E-07
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.63E-10	mg/kg-d	2.9E-02	(mg/kg-d)-1	1.9E-11
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.20E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.20E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.35E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	1.40E-09	mg/kg-d	2.0E+00	(mg/kg-d)-1	2.8E-09
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	7.47E-13	mg/kg-d	1.5E+05	(mg/kg-d)-1	1.1E-07
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.06E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	6.82E-12	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.85E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.93E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.75E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.43E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.63E-10	mg/kg-d	1.6E+00	(mg/kg-d)-1	1.1E-09
							Risk				3.1E-07
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.71E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	2.6E-07
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.81E-09	mg/kg-d	2.9E-02	(mg/kg-d)-1	1.1E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.41E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.84E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	7.76E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	8.63E-09	mg/kg-d	2.0E+00	(mg/kg-d)-1	1.7E-08
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	9.90E-13	mg/kg-d	2.5E+05	(mg/kg-d)-1	2.5E-07

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	9.08E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	3.01E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	8.19E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	8.51E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	7.73E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	6.34E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.93E-09	mg/kg-d	1.6E+00	(mg/kg-d)-1	4.7E-09
							Risk				5.3E-07

Total Cancer Risk - All Pathways	*8E-07*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

Table C-15
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	2.35E-06	mg/kg-d	1.5E+00	(mg/kg-d)-1	**3.5E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.21E-08	mg/kg-d	2.9E-02	(mg/kg-d)-1	3.5E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	7.63E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	5.82E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	2.46E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	2.72E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	5.4E-08
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	1.04E-11	mg/kg-d	1.5E+05	(mg/kg-d)-1	**1.6E-06**
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	3.74E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.24E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	3.37E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	3.51E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	3.18E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	2.61E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.21E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	1.9E-08
							Risk				5.2E-06
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	2.91E-06	mg/kg-d	1.5E+00	(mg/kg-d)-1	**4.4E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.48E-08	mg/kg-d	2.9E-02	(mg/kg-d)-1	1.9E-09
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.10E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.13E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.32E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.57E-07	mg/kg-d	2.0E+00	(mg/kg-d)-1	3.1E-07
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	1.29E-11	mg/kg-d	2.5E+05	(mg/kg-d)-1	**3.2E-06**

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.54E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	5.12E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.39E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.45E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.31E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.08E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.98E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	8.0E-08
							Risk				8.0E-06

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Aluminum	NA	NA	NA	NA	NA	1.89E-01	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Antimony	NA	NA	NA	NA	NA	3.96E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	4.68E-03	mg/kg-d	1.5E+00	(mg/kg-d)-1	**7.0E-03**
	Barium	NA	NA	NA	NA	NA	5.43E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cadmium	NA	NA	NA	NA	NA	3.45E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cobalt	NA	NA	NA	NA	NA	1.13E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Copper	NA	NA	NA	NA	NA	8.24E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Iron	NA	NA	NA	NA	NA	1.87E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Lead	NA	NA	NA	NA	NA	6.35E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Manganese	NA	NA	NA	NA	NA	6.13E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Nickel	NA	NA	NA	NA	NA	1.82E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Selenium	NA	NA	NA	NA	NA	6.71E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Silver	NA	NA	NA	NA	NA	3.69E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Vanadium	NA	NA	NA	NA	NA	3.24E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Zinc	NA	NA	NA	NA	NA	1.77E-01	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Methyl mercury	NA	NA	NA	NA	NA	5.58E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	6.78E-04	mg/kg-d	2.0E+00	(mg/kg-d)-1	**1.4E-03**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	1.91E-09	mg/kg-d	1.5E+05	(mg/kg-d)-1	**2.9E-04**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.9E-02	(mg/kg-d)-1	0.0E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	7.62E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthene	NA	NA	NA	NA	NA	9.39E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthylene	NA	NA	NA	NA	NA	5.41E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Anthracene	NA	NA	NA	NA	NA	2.54E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	3.79E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	cPAHs, ND05	NA	NA	NA	NA	NA	4.45E-05	mg/kg-d	7.3E+00	(mg/kg-d)-1	**3.2E-04**
	Fluoranthene	NA	NA	NA	NA	NA	6.31E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Fluorene	NA	NA	NA	NA	NA	3.95E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Naphthalene	NA	NA	NA	NA	NA	4.50E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	NA	NA	NA	NA	NA	3.63E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pyrene	NA	NA	NA	NA	NA	4.80E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	1.90E-08	mg/kg-d	1.5E+05	(mg/kg-d)-1	**2.8E-03**
	4,4'-DDD	NA	NA	NA	NA	NA	2.52E-06	mg/kg-d	2.4E-01	(mg/kg-d)-1	6.1E-07
	4,4'-DDE	NA	NA	NA	NA	NA	1.22E-05	mg/kg-d	3.4E-01	(mg/kg-d)-1	**4.2E-06**
	4,4'-DDT	NA	NA	NA	NA	NA	7.48E-05	mg/kg-d	3.4E-01	(mg/kg-d)-1	**2.5E-05**
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.7E+01	(mg/kg-d)-1	0.0E+00
	Alpha-BHC	NA	NA	NA	NA	NA	8.12E-05	mg/kg-d	6.3E+00	(mg/kg-d)-1	**5.1E-04**
	Beta-BHC	NA	NA	NA	NA	NA	3.77E-05	mg/kg-d	1.8E+00	(mg/kg-d)-1	**6.8E-05**
	Delta-BHC	NA	NA	NA	NA	NA	6.30E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.6E+01	(mg/kg-d)-1	0.0E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	8.61E-07	mg/kg-d	3.5E-01	(mg/kg-d)-1	3.0E-07
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	4.5E+00	(mg/kg-d)-1	0.0E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	9.1E+00	(mg/kg-d)-1	0.0E+00
	Lindane	NA	NA	NA	NA	NA	1.29E-05	mg/kg-d	1.1E+00	(mg/kg-d)-1	**1.4E-05**
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.4E-02	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	1.87E-04	mg/kg-d	1.2E-01	(mg/kg-d)-1	**2.2E-05**
	Pyridine	NA	NA	NA	NA	NA	1.07E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.27E-06	mg/kg-d	1.6E+00	(mg/kg-d)-1	**2.0E-06**
							Risk (including PCBs as congeners)				**1.1E-02**
							Risk (including PCBs as Aroclors)				**1.2E-02**

Total Cancer Risk - All Pathways (2)	*1E-02*
Total Cancer Risk - All Pathways (3)	*1E-02*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Risk includes PCBs as congeners for tissue.

(3) - Risk includes PCBs as Aroclors for tissue.

Table C-16
CALCULATION OF CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	9.03E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	**1.4E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.64E-09	mg/kg-d	2.9E-02	(mg/kg-d)-1	1.3E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.94E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.24E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	9.46E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.05E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	2.1E-08
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	4.01E-12	mg/kg-d	1.5E+05	(mg/kg-d)-1	6.0E-07
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.44E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.78E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.30E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.35E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.23E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.00E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.64E-09	mg/kg-d	1.6E+00	(mg/kg-d)-1	7.4E-09
							Risk				2.0E-06
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.18E-06	mg/kg-d	1.5E+00	(mg/kg-d)-1	1.8E-06
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.63E-08	mg/kg-d	2.9E-02	(mg/kg-d)-1	7.6E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.67E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.27E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.37E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	6.39E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	1.3E-07
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	5.25E-12	mg/kg-d	2.5E+05	(mg/kg-d)-1	**1.3E-06**

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	6.28E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.08E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.66E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.89E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	5.35E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	4.38E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.03E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	3.2E-08
							Risk				3.2E-06

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Aluminum	NA	NA	NA	NA	NA	5.93E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Antimony	NA	NA	NA	NA	NA	1.24E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	1.43E-04	mg/kg-d	1.5E+00	(mg/kg-d)-1	**2.2E-04**
	Barium	NA	NA	NA	NA	NA	1.70E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cadmium	NA	NA	NA	NA	NA	4.96E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cobalt	NA	NA	NA	NA	NA	3.56E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Copper	NA	NA	NA	NA	NA	1.09E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Iron	NA	NA	NA	NA	NA	5.86E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Lead	NA	NA	NA	NA	NA	1.99E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Manganese	NA	NA	NA	NA	NA	1.92E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Nickel	NA	NA	NA	NA	NA	5.71E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Selenium	NA	NA	NA	NA	NA	1.80E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Silver	NA	NA	NA	NA	NA	1.16E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Vanadium	NA	NA	NA	NA	NA	1.02E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Zinc	NA	NA	NA	NA	NA	5.99E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Methyl mercury	NA	NA	NA	NA	NA	1.75E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	6.64E-06	mg/kg-d	2.0E+00	(mg/kg-d)-1	**1.3E-05**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	5.98E-11	mg/kg-d	1.5E+05	(mg/kg-d)-1	**9.0E-06**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.9E-02	(mg/kg-d)-1	0.0E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	2.35E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthene	NA	NA	NA	NA	NA	2.84E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthylene	NA	NA	NA	NA	NA	1.61E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Anthracene	NA	NA	NA	NA	NA	7.75E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	1.04E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	cPAHs, ND05	NA	NA	NA	NA	NA	1.51E-06	mg/kg-d	7.3E+00	(mg/kg-d)-1	**1.1E-05**
	Fluoranthene	NA	NA	NA	NA	NA	1.60E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Fluorene	NA	NA	NA	NA	NA	1.21E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Naphthalene	NA	NA	NA	NA	NA	1.37E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	NA	NA	NA	NA	NA	1.12E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pyrene	NA	NA	NA	NA	NA	1.47E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	1.27E-10	mg/kg-d	1.5E+05	(mg/kg-d)-1	**1.9E-05**
	4,4'-DDD	NA	NA	NA	NA	NA	7.91E-08	mg/kg-d	2.4E-01	(mg/kg-d)-1	1.9E-08
	4,4'-DDE	NA	NA	NA	NA	NA	1.99E-07	mg/kg-d	3.4E-01	(mg/kg-d)-1	6.8E-08
	4,4'-DDT	NA	NA	NA	NA	NA	6.52E-07	mg/kg-d	3.4E-01	(mg/kg-d)-1	2.2E-07
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.7E+01	(mg/kg-d)-1	0.0E+00
	Alpha-BHC	NA	NA	NA	NA	NA	2.50E-06	mg/kg-d	6.3E+00	(mg/kg-d)-1	**1.6E-05**
	Beta-BHC	NA	NA	NA	NA	NA	1.13E-06	mg/kg-d	1.8E+00	(mg/kg-d)-1	**2.0E-06**
	Delta-BHC	NA	NA	NA	NA	NA	1.79E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.6E+01	(mg/kg-d)-1	0.0E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	2.70E-08	mg/kg-d	3.5E-01	(mg/kg-d)-1	9.5E-09
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	4.5E+00	(mg/kg-d)-1	0.0E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	9.1E+00	(mg/kg-d)-1	0.0E+00
	Lindane	NA	NA	NA	NA	NA	4.16E-07	mg/kg-d	1.1E+00	(mg/kg-d)-1	4.6E-07
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.4E-02	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.2E-01	(mg/kg-d)-1	0.0E+00
	Pyridine	NA	NA	NA	NA	NA	1.07E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.27E-06	mg/kg-d	1.6E+00	(mg/kg-d)-1	**2.0E-06**
							Risk (including PCBs as congeners)				**2.7E-04**
							Risk (including PCBs as Aroclors)				**2.8E-04**

Total Cancer Risk - All Pathways (2)	*3E-04*
Total Cancer Risk - All Pathways (3)	*3E-04*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Risk includes PCBs as congeners for tissue.

(3) - Risk includes PCBs as Aroclors for tissue.

Table C-17
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	2.35E-06	mg/kg-d	1.5E+00	(mg/kg-d)-1	**3.5E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.21E-08	mg/kg-d	2.9E-02	(mg/kg-d)-1	3.5E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	7.63E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	5.82E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	2.46E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	2.72E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	5.4E-08
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	1.04E-11	mg/kg-d	1.5E+05	(mg/kg-d)-1	**1.6E-06**
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	3.74E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.24E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	3.37E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	3.51E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	3.18E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	2.61E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.21E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	1.9E-08
							Risk				5.2E-06
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	3.18E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	4.8E-07
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	7.10E-09	mg/kg-d	2.9E-02	(mg/kg-d)-1	2.1E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.49E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.43E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.45E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.72E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	3.4E-08
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	1.41E-12	mg/kg-d	2.5E+05	(mg/kg-d)-1	3.5E-07

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.69E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	5.62E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.53E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.59E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.44E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.18E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	5.46E-09	mg/kg-d	1.6E+00	(mg/kg-d)-1	8.7E-09
							Risk				8.7E-07

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Aluminum	NA	NA	NA	NA	NA	9.46E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Antimony	NA	NA	NA	NA	NA	1.98E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	2.34E-03	mg/kg-d	1.5E+00	(mg/kg-d)-1	**3.5E-03**
	Barium	NA	NA	NA	NA	NA	2.71E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cadmium	NA	NA	NA	NA	NA	1.72E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cobalt	NA	NA	NA	NA	NA	5.67E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Copper	NA	NA	NA	NA	NA	4.12E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Iron	NA	NA	NA	NA	NA	9.34E-01	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Lead	NA	NA	NA	NA	NA	3.18E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Manganese	NA	NA	NA	NA	NA	3.07E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Nickel	NA	NA	NA	NA	NA	9.10E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Selenium	NA	NA	NA	NA	NA	3.36E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Silver	NA	NA	NA	NA	NA	1.84E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Vanadium	NA	NA	NA	NA	NA	1.62E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Zinc	NA	NA	NA	NA	NA	8.86E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Methyl mercury	NA	NA	NA	NA	NA	2.79E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	3.39E-04	mg/kg-d	2.0E+00	(mg/kg-d)-1	**6.8E-04**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	9.54E-10	mg/kg-d	1.5E+05	(mg/kg-d)-1	**1.4E-04**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.9E-02	(mg/kg-d)-1	0.0E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	3.81E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthene	NA	NA	NA	NA	NA	4.70E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthylene	NA	NA	NA	NA	NA	2.70E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Anthracene	NA	NA	NA	NA	NA	1.27E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	1.89E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	cPAHs, ND05	NA	NA	NA	NA	NA	2.23E-05	mg/kg-d	7.3E+00	(mg/kg-d)-1	**1.6E-04**
	Fluoranthene	NA	NA	NA	NA	NA	3.16E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Fluorene	NA	NA	NA	NA	NA	1.97E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Naphthalene	NA	NA	NA	NA	NA	2.25E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	NA	NA	NA	NA	NA	1.81E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pyrene	NA	NA	NA	NA	NA	2.40E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	9.50E-09	mg/kg-d	1.5E+05	(mg/kg-d)-1	**1.4E-03**
	4,4'-DDD	NA	NA	NA	NA	NA	1.26E-06	mg/kg-d	2.4E-01	(mg/kg-d)-1	3.0E-07
	4,4'-DDE	NA	NA	NA	NA	NA	6.12E-06	mg/kg-d	3.4E-01	(mg/kg-d)-1	**2.1E-06**
	4,4'-DDT	NA	NA	NA	NA	NA	3.74E-05	mg/kg-d	3.4E-01	(mg/kg-d)-1	**1.3E-05**
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.7E+01	(mg/kg-d)-1	0.0E+00
	Alpha-BHC	NA	NA	NA	NA	NA	4.06E-05	mg/kg-d	6.3E+00	(mg/kg-d)-1	**2.6E-04**
	Beta-BHC	NA	NA	NA	NA	NA	1.89E-05	mg/kg-d	1.8E+00	(mg/kg-d)-1	**3.4E-05**
	Delta-BHC	NA	NA	NA	NA	NA	3.15E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.6E+01	(mg/kg-d)-1	0.0E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	4.31E-07	mg/kg-d	3.5E-01	(mg/kg-d)-1	1.5E-07
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	4.5E+00	(mg/kg-d)-1	0.0E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	9.1E+00	(mg/kg-d)-1	0.0E+00
	Lindane	NA	NA	NA	NA	NA	6.45E-06	mg/kg-d	1.1E+00	(mg/kg-d)-1	**7.1E-06**
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.4E-02	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	9.33E-05	mg/kg-d	1.2E-01	(mg/kg-d)-1	**1.1E-05**
	Pyridine	NA	NA	NA	NA	NA	1.07E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.27E-06	mg/kg-d	1.6E+00	(mg/kg-d)-1	**2.0E-06**
							Risk (including PCBs as congeners)				**5.6E-03**
							Risk (including PCBs as Aroclors)				**6.1E-03**

Total Cancer Risk - All Pathways [(2)]	*6E-03*
Total Cancer Risk - All Pathways [(3)]	*6E-03*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Risk includes PCBs as congeners for tissue.

(3) - Risk includes PCBs as Aroclors for tissue.

Table C-18
CALCULATION OF CANCER RISKS
CENTRAL TENDENCY
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	2.72E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	4.1E-07
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.40E-09	mg/kg-d	2.9E-02	(mg/kg-d)-1	4.1E-11
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	8.86E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	6.76E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	2.85E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	3.15E-09	mg/kg-d	2.0E+00	(mg/kg-d)-1	6.3E-09
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	1.21E-12	mg/kg-d	1.5E+05	(mg/kg-d)-1	1.8E-07
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	4.34E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.44E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	3.92E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	4.07E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	3.70E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	3.03E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.40E-09	mg/kg-d	1.6E+00	(mg/kg-d)-1	2.2E-09
							Risk				6.0E-07
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	3.99E-08	mg/kg-d	1.5E+00	(mg/kg-d)-1	6.0E-08
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	8.91E-10	mg/kg-d	2.9E-02	(mg/kg-d)-1	2.6E-11
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	5.63E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	4.30E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.81E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	2.16E-09	mg/kg-d	2.0E+00	(mg/kg-d)-1	4.3E-09
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	1.77E-13	mg/kg-d	2.5E+05	(mg/kg-d)-1	4.4E-08

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.12E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	7.04E-12	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.91E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.99E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.81E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.48E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.85E-10	mg/kg-d	1.6E+00	(mg/kg-d)-1	1.1E-09
							Risk				1.1E-07

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Aluminum	NA	NA	NA	NA	NA	4.18E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Antimony	NA	NA	NA	NA	NA	8.74E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	1.01E-04	mg/kg-d	1.5E+00	(mg/kg-d)-1	**1.5E-04**
	Barium	NA	NA	NA	NA	NA	1.20E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cadmium	NA	NA	NA	NA	NA	3.50E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Cobalt	NA	NA	NA	NA	NA	2.50E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Copper	NA	NA	NA	NA	NA	7.67E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Iron	NA	NA	NA	NA	NA	4.13E-02	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Lead	NA	NA	NA	NA	NA	1.40E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Manganese	NA	NA	NA	NA	NA	1.35E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Nickel	NA	NA	NA	NA	NA	4.02E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Selenium	NA	NA	NA	NA	NA	1.27E-04	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Silver	NA	NA	NA	NA	NA	8.14E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Vanadium	NA	NA	NA	NA	NA	7.16E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Zinc	NA	NA	NA	NA	NA	4.22E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Methyl mercury	NA	NA	NA	NA	NA	1.24E-05	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	4.68E-06	mg/kg-d	2.0E+00	(mg/kg-d)-1	**9.4E-06**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	4.22E-11	mg/kg-d	1.5E+05	(mg/kg-d)-1	**6.3E-06**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.9E-02	(mg/kg-d)-1	0.0E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	1.66E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthene	NA	NA	NA	NA	NA	2.02E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Acenaphthylene	NA	NA	NA	NA	NA	1.14E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Anthracene	NA	NA	NA	NA	NA	5.46E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	7.30E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	cPAHs, ND05	NA	NA	NA	NA	NA	1.06E-06	mg/kg-d	7.3E+00	(mg/kg-d)-1	**7.8E-06**
	Fluoranthene	NA	NA	NA	NA	NA	1.14E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Fluorene	NA	NA	NA	NA	NA	8.54E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Naphthalene	NA	NA	NA	NA	NA	9.68E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	NA	NA	NA	NA	NA	7.92E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pyrene	NA	NA	NA	NA	NA	1.03E-06	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	8.93E-11	mg/kg-d	1.5E+05	(mg/kg-d)-1	**1.3E-05**
	4,4'-DDD	NA	NA	NA	NA	NA	5.57E-08	mg/kg-d	2.4E-01	(mg/kg-d)-1	1.3E-08
	4,4'-DDE	NA	NA	NA	NA	NA	1.40E-07	mg/kg-d	3.4E-01	(mg/kg-d)-1	4.8E-08
	4,4'-DDT	NA	NA	NA	NA	NA	4.60E-07	mg/kg-d	3.4E-01	(mg/kg-d)-1	1.6E-07
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.7E+01	(mg/kg-d)-1	0.0E+00
	Alpha-BHC	NA	NA	NA	NA	NA	1.76E-06	mg/kg-d	6.3E+00	(mg/kg-d)-1	**1.1E-05**
	Beta-BHC	NA	NA	NA	NA	NA	8.00E-07	mg/kg-d	1.8E+00	(mg/kg-d)-1	**1.4E-06**
	Delta-BHC	NA	NA	NA	NA	NA	1.27E-07	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.6E+01	(mg/kg-d)-1	0.0E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	1.90E-08	mg/kg-d	3.5E-01	(mg/kg-d)-1	6.7E-09
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	4.5E+00	(mg/kg-d)-1	0.0E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	9.1E+00	(mg/kg-d)-1	0.0E+00
	Lindane	NA	NA	NA	NA	NA	2.93E-07	mg/kg-d	1.1E+00	(mg/kg-d)-1	3.2E-07
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.4E-02	(mg/kg-d)-1	0.0E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer) (1)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.2E-01	(mg/kg-d)-1	0.0E+00
	Pyridine	NA	NA	NA	NA	NA	1.07E-03	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.27E-06	mg/kg-d	1.6E+00	(mg/kg-d)-1	**2.0E-06**
							Risk (including PCBs as congeners)				**1.9E-04**
							Risk (including PCBs as Aroclors)				**2.0E-04**

Total Cancer Risk - All Pathways (2)	*2E-04*
Total Cancer Risk - All Pathways (3)	*2E-04*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Risk includes PCBs as congeners for tissue.

(3) - Risk includes PCBs as Aroclors for tissue.

Table C-19
CALCULATION OF CANCER RISKS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Residential User
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	8.89E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	**1.3E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.57E-09	mg/kg-d	2.9E-02	(mg/kg-d)-1	1.3E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.89E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.21E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	9.32E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.03E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	2.1E-08
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	3.95E-12	mg/kg-d	1.5E+05	(mg/kg-d)-1	5.9E-07
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.42E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.70E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.28E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.33E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.21E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	9.89E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.57E-09	mg/kg-d	1.6E+00	(mg/kg-d)-1	7.3E-09
							Risk				2.0E-06
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.17E-06	mg/kg-d	1.5E+00	(mg/kg-d)-1	**1.7E-06**
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.60E-08	mg/kg-d	2.9E-02	(mg/kg-d)-1	7.5E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.65E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.26E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.30E-08	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	6.30E-08	mg/kg-d	2.0E+00	(mg/kg-d)-1	1.3E-07
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	5.18E-12	mg/kg-d	2.5E+05	(mg/kg-d)-1	**1.3E-06**

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	6.20E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.06E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.59E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.81E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	5.28E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	4.33E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.00E-08	mg/kg-d	1.6E+00	(mg/kg-d)-1	3.2E-08
							Risk				3.2E-06

Total Cancer Risk - All Pathways	*5E-06*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

Table C-20
CALCULATION OF CANCER RISKS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational User
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation	Intake (Cancer)	Intake (Cancer) Units	Slope Factor	Slope Factor Units	Cancer Risk
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.29E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	1.9E-07
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.63E-10	mg/kg-d	2.9E-02	(mg/kg-d)-1	1.9E-11
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.20E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.20E-10	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.35E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.49E-09	mg/kg-d	2.0E+00	(mg/kg-d)-1	3.0E-09
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	5.73E-13	mg/kg-d	1.5E+05	(mg/kg-d)-1	8.6E-08
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.06E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	6.82E-12	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.85E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.93E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.75E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.43E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.63E-10	mg/kg-d	1.6E+00	(mg/kg-d)-1	1.1E-09
							Risk				2.8E-07
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.71E-07	mg/kg-d	1.5E+00	(mg/kg-d)-1	2.6E-07
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.81E-09	mg/kg-d	2.9E-02	(mg/kg-d)-1	1.1E-10
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.41E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.84E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	7.76E-09	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	9.23E-09	mg/kg-d	2.0E+00	(mg/kg-d)-1	1.8E-08
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	7.59E-13	mg/kg-d	2.5E+05	(mg/kg-d)-1	1.9E-07

	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	9.08E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	3.01E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	8.19E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	8.51E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	7.73E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	6.34E-11	mg/kg-d	0.0E+00	(mg/kg-d)-1	0.0E+00
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.93E-09	mg/kg-d	1.6E+00	(mg/kg-d)-1	4.7E-09
							Risk				4.7E-07

Total Cancer Risk - All Pathways	*8E-07*

Bolded text indicates cancer risk for individual compound exceeds 1 x 10-6.

Table C-21
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.33E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.004439882
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.85E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.78969E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.34E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.22548E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.31E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.10246E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.40E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.65268E-08
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	1.44E-08	mg/kg-d	2.0E-05	mg/kg-d		0.000721346
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	7.72E-12	mg/kg-d	1.0E-09	mg/kg-d		0.007718398
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.12E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	7.05E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.17423E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.92E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.19195E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.99E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.31921E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.81E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	6.02588E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.48E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.9405E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.85E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.56598E-06
							Hazard Index					1.3E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.47E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.00489537
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.27E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	4.67741E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.07E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	3.45225E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.58E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	5.26742E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	6.67E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.223E-07
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	7.42E-08	mg/kg-d	2.0E-05	mg/kg-d		0.003711626
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	8.51E-12	mg/kg-d	6.0E-10	mg/kg-d		0.014183714
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	7.81E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.59E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	4.31565E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	7.04E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.17314E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	7.32E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.21991E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	6.64E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.21469E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	5.45E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.81578E-06

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.52E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	3.14825E-05
							Hazard Index					2.3E-02

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	1.75E-01	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	1.75E-01
	Antimony	NA	NA	NA	NA	NA	3.65E-05	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	9.12E-02
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	4.31E-03	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**1.44E+01**
	Barium	NA	NA	NA	NA	NA	5.01E-03	mg/kg-d	2.0E-01	mg/kg-d	Kidney	2.50E-02
	Cadmium	NA	NA	NA	NA	NA	3.18E-03	mg/kg-d	1.0E-03	mg/kg-d	Kidney	**3.18E+00**
	Cobalt	NA	NA	NA	NA	NA	1.05E-03	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	**3.49E+00**
	Copper	NA	NA	NA	NA	NA	7.60E-02	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	**1.90E+00**
	Iron	NA	NA	NA	NA	NA	1.72E+00	mg/kg-d	7.0E-01	mg/kg-d		**2.46E+00**
	Lead	NA	NA	NA	NA	NA	5.86E-03	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	5.65E-02	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	4.04E-01
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	1.68E-03	mg/kg-d	2.0E-02	mg/kg-d		8.39E-02
	Selenium	NA	NA	NA	NA	NA	6.19E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	**1.24E+00**
	Silver	NA	NA	NA	NA	NA	3.40E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	6.80E-01
	Vanadium	NA	NA	NA	NA	NA	2.99E-03	mg/kg-d	5.0E-03	mg/kg-d	Kidney	5.98E-01
	Zinc	NA	NA	NA	NA	NA	1.63E-01	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	5.45E-01
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	5.15E-04	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	**5.15E+00**
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	6.10E-04	mg/kg-d	2.0E-05	mg/kg-d		**3.05E+01**
	PCB TEQ, ND0	NA	NA	NA	NA	NA	5.07E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmental	5.07E-01
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	7.03E-05	mg/kg-d	4.0E-03	mg/kg-d	Lung	1.76E-02
	Acenaphthene	NA	NA	NA	NA	NA	8.69E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.45E-04
	Acenaphthylene	NA	NA	NA	NA	NA	4.99E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	8.32E-05
	Anthracene	NA	NA	NA	NA	NA	2.34E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	7.80E-05
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	3.49E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.16E-04
	cPAHs, ND0	NA	NA	NA	NA	NA	2.09E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	5.83E-06	mg/kg-d	4.0E-02	mg/kg-d	Liver	1.46E-04
	Fluorene	NA	NA	NA	NA	NA	3.64E-05	mg/kg-d	4.0E-02	mg/kg-d	Blood	9.10E-04
	Naphthalene	NA	NA	NA	NA	NA	4.15E-05	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	2.08E-03
	Phenanthrene	NA	NA	NA	NA	NA	3.34E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.11E-04
	Pyrene	NA	NA	NA	NA	NA	4.43E-05	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.48E-03
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	1.25E-08	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**1.25E+01**
	4,4'-DDD	NA	NA	NA	NA	NA	2.33E-06	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	1.13E-05	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	6.90E-05	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.38E-01
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	7.49E-05	mg/kg-d	8.0E-03	mg/kg-d	Liver	9.36E-03
	Beta-BHC	NA	NA	NA	NA	NA	3.48E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	5.81E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	7.94E-07	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.59E-03
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	1.19E-05	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	3.96E-02
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Pentachlorophenol	NA	NA	NA	NA	NA	1.72E-04	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	5.74E-03
	Pyridine	NA	NA	NA	NA	NA	9.84E-04	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.84E-01
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.17E-06	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmenta l	1.47E-03
							Hazard Index (including PCBs as congeners)					**4.9E+01**
							Hazard Index (including PCBs as Aroclors)					**7.9E+01**

Total HI - All Pathways (2)	**4.9E+01**
Total HI - All Pathways (3)	**7.9E+01**
HI Segregated By Target Organ (PCBs as Aroclors only)	
Cardiovascular	**1.4E+01**
Developmental	**4.8E+01**
Endocrine System	*5.7E-03*
GI Tract	**1.9E+00**
Hematologic System	**4.0E+00**
Immune System	*4.0E-02*
Kidney	**3.9E+00**
Liver	**1.2E+00**
Lungs	*1.8E-02*
Nervous System	**5.7E+00**
Reproductive System	*0.0E+00*
Skin	**1.6E+01**
Whole Body	*9.1E-02*
Not Classified	**3.3E+01**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Hi includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-22
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.33E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.004439882
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.85E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.78969E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.34E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.22548E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.31E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.10246E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.40E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.65268E-08
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	1.44E-08	mg/kg-d	2.0E-05	mg/kg-d		0.000721346
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	7.72E-12	mg/kg-d	1.0E-09	mg/kg-d		0.007718398
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.12E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	7.05E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.17423E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.92E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.19195E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.99E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.31921E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.81E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	6.02588E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.48E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.9405E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.85E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.56598E-06
							Hazard Index					1.3E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	2.45E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.000815895
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	5.46E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	7.79568E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	3.45E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	5.75376E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.63E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	8.77903E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.11E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	3.705E-08
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	1.24E-08	mg/kg-d	2.0E-05	mg/kg-d		0.000618604
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	1.42E-12	mg/kg-d	6.0E-10	mg/kg-d		0.002363952
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.30E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.32E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.19275E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.17E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.95523E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.22E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.03318E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.11E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.69115E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	9.08E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.0263E-07

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.20E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	5.24709E-06
							Hazard Index					3.8E-03

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	8.73E-02	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	8.73E-02
	Antimony	NA	NA	NA	NA	NA	1.82E-05	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	4.56E-02
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	2.16E-03	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**7.19E+00**
	Barium	NA	NA	NA	NA	NA	2.50E-03	mg/kg-d	2.0E-01	mg/kg-d	Kidney	1.25E-02
	Cadmium	NA	NA	NA	NA	NA	1.59E-03	mg/kg-d	1.0E-03	mg/kg-d	Kidney	**1.59E+00**
	Cobalt	NA	NA	NA	NA	NA	5.23E-04	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	**1.74E+00**
	Copper	NA	NA	NA	NA	NA	3.80E-02	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	9.50E-01
	Iron	NA	NA	NA	NA	NA	8.61E-01	mg/kg-d	7.0E-01	mg/kg-d		**1.23E+00**
	Lead	NA	NA	NA	NA	NA	2.93E-03	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	2.83E-02	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	2.02E-01
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	8.39E-04	mg/kg-d	2.0E-02	mg/kg-d		4.20E-02
	Selenium	NA	NA	NA	NA	NA	3.09E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	6.19E-01
	Silver	NA	NA	NA	NA	NA	1.70E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	3.40E-01
	Vanadium	NA	NA	NA	NA	NA	1.49E-03	mg/kg-d	5.0E-03	mg/kg-d	Kidney	2.99E-01
	Zinc	NA	NA	NA	NA	NA	8.17E-02	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	2.72E-01
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	2.57E-04	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	**2.57E+00**
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	3.05E-04	mg/kg-d	2.0E-05	mg/kg-d		**1.52E+01**
	PCB TEQ, ND0	NA	NA	NA	NA	NA	2.53E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmental	2.53E-01
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	3.51E-05	mg/kg-d	4.0E-03	mg/kg-d	Lung	8.78E-03
	Acenaphthene	NA	NA	NA	NA	NA	4.34E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.24E-05
	Acenaphthylene	NA	NA	NA	NA	NA	2.50E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.16E-05
	Anthracene	NA	NA	NA	NA	NA	1.17E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	3.90E-05
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	1.75E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	5.82E-05
	cPAHs, ND0	NA	NA	NA	NA	NA	1.05E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	2.92E-06	mg/kg-d	4.0E-02	mg/kg-d	Liver	7.29E-05
	Fluorene	NA	NA	NA	NA	NA	1.82E-05	mg/kg-d	4.0E-02	mg/kg-d	Blood	4.55E-04
	Naphthalene	NA	NA	NA	NA	NA	2.08E-05	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	1.04E-03
	Phenanthrene	NA	NA	NA	NA	NA	1.67E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	5.57E-05
	Pyrene	NA	NA	NA	NA	NA	2.21E-05	mg/kg-d	3.0E-02	mg/kg-d	Kidney	7.38E-04
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	6.27E-09	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**6.27E+00**
	4,4'-DDD	NA	NA	NA	NA	NA	1.16E-06	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	5.64E-06	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	3.45E-05	mg/kg-d	5.0E-04	mg/kg-d	Liver	6.90E-02
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	3.74E-05	mg/kg-d	8.0E-03	mg/kg-d	Liver	4.68E-03
	Beta-BHC	NA	NA	NA	NA	NA	1.74E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	2.90E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	3.97E-07	mg/kg-d	5.0E-04	mg/kg-d	Liver	7.94E-04
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	5.95E-06	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	1.98E-02
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Pentachlorophenol	NA	NA	NA	NA	NA	8.60E-05	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	2.87E-03
	Pyridine	NA	NA	NA	NA	NA	9.84E-04	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.84E-01
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.17E-06	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmenta l	1.47E-03
							Hazard Index (including PCBs as congeners)					**2.5E+01**
							Hazard Index (including PCBs as Aroclors)					**4.0E+01**

Total HI - All Pathways (2)		**2.5E+01**
Total HI - All Pathways (3)		**4.0E+01**
HI Segregated By Target Organ (PCBs as Aroclors only)		
	Cardiovascular	**7.2E+00**
	Developmental	**2.4E+01**
	Endocrine System	*2.9E-03*
	GI Tract	*9.5E-01*
	Hematologic System	**2.0E+00**
	Immune System	*2.0E-02*
	Kidney	**1.9E+00**
	Liver	**1.1E+00**
	Lungs	*8.8E-03*
	Nervous System	**2.9E+00**
	Reproductive System	*0.0E+00*
	Skin	**8.2E+00**
	Whole Body	*4.6E-02*
	Not Classified	**1.6E+01**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Hi includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-23
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.32E-05	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.043843836
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.77E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.66732E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.28E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.13516E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.27E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.08868E-06
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.38E-07	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.59452E-07
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	1.42E-07	mg/kg-d	2.0E-05	mg/kg-d		0.007123288
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	7.62E-11	mg/kg-d	1.0E-09	mg/kg-d		0.076219178
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.10E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	6.96E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.15955E-07
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.89E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.15205E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.97E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.27772E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.79E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	5.95056E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.46E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.87874E-06
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.77E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.4589E-05
							Hazard Index					1.3E-01
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.82E-05	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.060767556
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.06E-07	mg/kg-d	7.0E-02	mg/kg-d	Lung	5.80619E-06
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.57E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.28538E-06
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.96E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	6.53859E-06
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	8.28E-07	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.75947E-06
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	9.21E-07	mg/kg-d	2.0E-05	mg/kg-d		0.046073425
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	1.06E-10	mg/kg-d	6.0E-10	mg/kg-d		0.176066301
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	9.69E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	3.21E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	5.35713E-07
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	8.74E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.45625E-06
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	9.09E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.51431E-06
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	8.25E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.74916E-05
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	6.76E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.25398E-05

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.13E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmenta l	0.000390801
							Hazard Index					2.8E-01

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	3.46E-01	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	3.46E-01
	Antimony	NA	NA	NA	NA	NA	7.24E-05	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	1.81E-01
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	8.55E-03	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascula r, Skin	**2.85E+01**
	Barium	NA	NA	NA	NA	NA	9.93E-03	mg/kg-d	2.0E-01	mg/kg-d	Kidney	4.96E-02
	Cadmium	NA	NA	NA	NA	NA	6.31E-03	mg/kg-d	1.0E-03	mg/kg-d	Kidney	**6.31E+00**
	Cobalt	NA	NA	NA	NA	NA	2.07E-03	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	**6.91E+00**
	Copper	NA	NA	NA	NA	NA	1.50E-01	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	**3.76E+00**
	Iron	NA	NA	NA	NA	NA	3.42E+00	mg/kg-d	7.0E-01	mg/kg-d		**4.88E+00**
	Lead	NA	NA	NA	NA	NA	1.16E-02	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	1.12E-01	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	8.01E-01
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	3.33E-03	mg/kg-d	2.0E-02	mg/kg-d		1.66E-01
	Selenium	NA	NA	NA	NA	NA	1.23E-02	mg/kg-d	5.0E-03	mg/kg-d	Skin	**2.46E+00**
	Silver	NA	NA	NA	NA	NA	6.74E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	**1.35E+00**
	Vanadium	NA	NA	NA	NA	NA	5.93E-03	mg/kg-d	5.0E-03	mg/kg-d	Kidney	**1.19E+00**
	Zinc	NA	NA	NA	NA	NA	3.23E-01	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	**1.08E+00**
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	1.02E-03	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmenta l	**1.02E+01**
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	1.21E-03	mg/kg-d	2.0E-05	mg/kg-d		**6.04E+01**
	PCB TEQ, ND0	NA	NA	NA	NA	NA	1.00E-09	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**1.00E+00**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	1.39E-04	mg/kg-d	4.0E-03	mg/kg-d	Lung	3.48E-02
	Acenaphthene	NA	NA	NA	NA	NA	1.69E-05	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.82E-04
	Acenaphthylene	NA	NA	NA	NA	NA	9.86E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.64E-04
	Anthracene	NA	NA	NA	NA	NA	4.64E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.55E-04
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	6.92E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	2.31E-04
	cPAHs, ND0	NA	NA	NA	NA	NA	4.15E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	1.14E-05	mg/kg-d	4.0E-02	mg/kg-d	Liver	2.85E-04
	Fluorene	NA	NA	NA	NA	NA	7.22E-05	mg/kg-d	4.0E-02	mg/kg-d	Blood	1.80E-03
	Naphthalene	NA	NA	NA	NA	NA	8.20E-05	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	4.10E-03
	Phenanthrene	NA	NA	NA	NA	NA	6.61E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.20E-04
	Pyrene	NA	NA	NA	NA	NA	8.77E-05	mg/kg-d	3.0E-02	mg/kg-d	Kidney	2.92E-03
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	2.49E-08	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**2.49E+01**
	4,4'-DDD	NA	NA	NA	NA	NA	4.61E-06	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	2.24E-05	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	1.37E-04	mg/kg-d	5.0E-04	mg/kg-d	Liver	2.73E-01
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	1.48E-04	mg/kg-d	8.0E-03	mg/kg-d	Liver	1.86E-02
	Beta-BHC	NA	NA	NA	NA	NA	6.87E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	1.15E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	1.58E-06	mg/kg-d	5.0E-04	mg/kg-d	Liver	3.15E-03
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	2.36E-05	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	7.87E-02
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Pentachlorophenol	NA	NA	NA	NA	NA	3.41E-04	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	1.14E-02
	Pyridine	NA	NA	NA	NA	NA	9.84E-04	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.84E-01
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.17E-06	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmenta l	1.47E-03
							Hazard Index (including PCBs as congeners)					**9.5E+01**
							Hazard Index (including PCBs as Aroclors)					**1.5E+02**

Total HI - All Pathways [(2)]	**9.6E+01**
Total HI - All Pathways [(3)]	**1.6E+02**
HI Segregated By Target Organ (PCBs as Aroclors only)	
Cardiovascular	**2.9E+01**
Developmental	**9.5E+01**
Endocrine System	*1.1E-02*
GI Tract	**3.8E+00**
Hematologic System	**8.0E+00**
Immune System	*7.9E-02*
Kidney	**7.6E+00**
Liver	**1.4E+00**
Lungs	*3.5E-02*
Nervous System	**1.1E+01**
Reproductive System	*0.0E+00*
Skin	**3.2E+01**
Whole Body	*1.8E-01*
Not Classified	**6.6E+01**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Hi includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-24
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.32E-05	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.043843836
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.77E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.66732E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.28E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.13516E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.27E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.08868E-06
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.38E-07	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.59452E-07
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	1.42E-07	mg/kg-d	2.0E-05	mg/kg-d		0.007123288
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	7.62E-11	mg/kg-d	1.0E-09	mg/kg-d		0.076219178
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.10E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	6.96E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.15955E-07
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.89E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.15205E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.97E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.27772E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.79E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	5.95056E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.46E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.87874E-06
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.77E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.4589E-05
							Hazard Index					1.3E-01
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.10E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.003682882
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.46E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.5189E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.56E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.5972E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.19E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	3.96278E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.02E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.67241E-07
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	5.58E-08	mg/kg-d	2.0E-05	mg/kg-d		0.002792329
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	6.40E-12	mg/kg-d	6.0E-10	mg/kg-d		0.010670685
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	5.87E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.95E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.24675E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.30E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	8.82575E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.51E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	9.17762E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	5.00E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.66616E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	4.10E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.36605E-06

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.89E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	2.36849E-05
							Hazard Index					1.7E-02

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	1.73E-01	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	1.73E-01
	Antimony	NA	NA	NA	NA	NA	3.62E-05	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	9.05E-02
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	4.27E-03	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**1.42E+01**
	Barium	NA	NA	NA	NA	NA	4.96E-03	mg/kg-d	2.0E-01	mg/kg-d	Kidney	2.48E-02
	Cadmium	NA	NA	NA	NA	NA	3.15E-03	mg/kg-d	1.0E-03	mg/kg-d	Kidney	**3.15E+00**
	Cobalt	NA	NA	NA	NA	NA	1.04E-03	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	**3.46E+00**
	Copper	NA	NA	NA	NA	NA	7.52E-02	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	**1.88E+00**
	Iron	NA	NA	NA	NA	NA	1.71E+00	mg/kg-d	7.0E-01	mg/kg-d		**2.44E+00**
	Lead	NA	NA	NA	NA	NA	5.81E-03	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	5.61E-02	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	4.00E-01
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	1.66E-03	mg/kg-d	2.0E-02	mg/kg-d		8.32E-02
	Selenium	NA	NA	NA	NA	NA	6.14E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	**1.23E+00**
	Silver	NA	NA	NA	NA	NA	3.37E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	6.74E-01
	Vanadium	NA	NA	NA	NA	NA	2.96E-03	mg/kg-d	5.0E-03	mg/kg-d	Kidney	5.93E-01
	Zinc	NA	NA	NA	NA	NA	1.62E-01	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	5.39E-01
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	5.08E-04	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	**5.08E+00**
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	6.04E-04	mg/kg-d	2.0E-05	mg/kg-d		**3.02E+01**
	PCB TEQ, ND0	NA	NA	NA	NA	NA	5.01E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmental	5.01E-01
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	6.96E-05	mg/kg-d	4.0E-03	mg/kg-d	Lung	1.74E-02
	Acenaphthene	NA	NA	NA	NA	NA	8.46E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.41E-04
	Acenaphthylene	NA	NA	NA	NA	NA	4.93E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	8.22E-05
	Anthracene	NA	NA	NA	NA	NA	2.32E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	7.73E-05
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	3.46E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.15E-04
	cPAHs, ND0	NA	NA	NA	NA	NA	2.08E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	5.70E-06	mg/kg-d	4.0E-02	mg/kg-d	Liver	1.43E-04
	Fluorene	NA	NA	NA	NA	NA	3.61E-05	mg/kg-d	4.0E-02	mg/kg-d	Blood	9.02E-04
	Naphthalene	NA	NA	NA	NA	NA	4.10E-05	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	2.05E-03
	Phenanthrene	NA	NA	NA	NA	NA	3.31E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.10E-04
	Pyrene	NA	NA	NA	NA	NA	4.38E-05	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.46E-03
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	1.24E-08	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**1.24E+01**
	4,4'-DDD	NA	NA	NA	NA	NA	2.31E-06	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	1.12E-05	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	6.84E-05	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.37E-01
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	7.42E-05	mg/kg-d	8.0E-03	mg/kg-d	Liver	9.28E-03
	Beta-BHC	NA	NA	NA	NA	NA	3.43E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	5.77E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	7.88E-07	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.58E-03
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	1.18E-05	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	3.93E-02
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Pentachlorophenol	NA	NA	NA	NA	NA	1.71E-04	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	5.69E-03
	Pyridine	NA	NA	NA	NA	NA	9.84E-04	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.84E-01
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.17E-06	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmenta l	1.47E-03
							Hazard Index (including PCBs as congeners)					**4.8E+01**
							Hazard Index (including PCBs as Aroclors)					**7.8E+01**

Total HI - All Pathways [(2)]	**4.8E+01**
Total HI - All Pathways [(3)]	**7.8E+01**
HI Segregated By Target Organ (PCBs as Aroclors only)	
Cardiovascular	**1.4E+01**
Developmental	**4.8E+01**
Endocrine System	*5.7E-03*
GI Tract	**1.9E+00**
Hematologic System	**4.0E+00**
Immune System	*3.9E-02*
Kidney	**3.8E+00**
Liver	**1.2E+00**
Lungs	*1.7E-02*
Nervous System	**5.7E+00**
Reproductive System	*0.0E+00*
Skin	**1.6E+01**
Whole Body	*9.0E-02*
Not Classified	**3.3E+01**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Hi includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-25
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	7.66E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.002553542
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.94E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	5.63042E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.49E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.15564E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.90E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	6.34064E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	8.03E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.67593E-08
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	8.30E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000414873
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	4.44E-12	mg/kg-d	1.0E-09	mg/kg-d		0.004439139
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.22E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.05E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	6.75344E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.10E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.83581E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.15E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.909E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.04E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.46571E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	8.52E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.84146E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.94E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	4.92661E-06
							Hazard Index					7.4E-03
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	8.45E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.00281551
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.88E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	2.69015E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.19E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.98552E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	9.09E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	3.02949E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	3.84E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.27853E-07
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	4.27E-08	mg/kg-d	2.0E-05	mg/kg-d		0.002134695
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	4.89E-12	mg/kg-d	6.0E-10	mg/kg-d		0.008157584
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	4.49E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.49E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.48209E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	4.05E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	6.74716E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	4.21E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.01616E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	3.82E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.27375E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	3.13E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.04432E-06

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.45E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.81068E-05
							Hazard Index					1.3E-02

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	1.29E-02	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	1.29E-02
	Antimony	NA	NA	NA	NA	NA	2.70E-06	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	6.76E-03
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	3.12E-04	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**1.04E+00**
	Barium	NA	NA	NA	NA	NA	3.71E-04	mg/kg-d	2.0E-01	mg/kg-d	Kidney	1.85E-03
	Cadmium	NA	NA	NA	NA	NA	1.08E-04	mg/kg-d	1.0E-03	mg/kg-d	Kidney	1.08E-01
	Cobalt	NA	NA	NA	NA	NA	7.74E-05	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	2.58E-01
	Copper	NA	NA	NA	NA	NA	2.36E-03	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	5.90E-02
	Iron	NA	NA	NA	NA	NA	1.28E-01	mg/kg-d	7.0E-01	mg/kg-d		1.82E-01
	Lead	NA	NA	NA	NA	NA	4.34E-04	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	4.19E-03	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	2.99E-02
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	1.24E-04	mg/kg-d	2.0E-02	mg/kg-d		6.21E-03
	Selenium	NA	NA	NA	NA	NA	3.92E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	7.83E-02
	Silver	NA	NA	NA	NA	NA	2.52E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	5.03E-02
	Vanadium	NA	NA	NA	NA	NA	2.21E-04	mg/kg-d	5.0E-03	mg/kg-d	Kidney	4.42E-02
	Zinc	NA	NA	NA	NA	NA	1.30E-02	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	4.34E-02
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	3.81E-05	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	3.81E-01
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	1.33E-05	mg/kg-d	2.0E-05	mg/kg-d		6.64E-01
	PCB TEQ, ND0	NA	NA	NA	NA	NA	3.14E-11	mg/kg-d	1.0E-09	mg/kg-d	Developmental	3.14E-02
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	5.12E-06	mg/kg-d	4.0E-03	mg/kg-d	Lung	1.28E-03
	Acenaphthene	NA	NA	NA	NA	NA	6.16E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.03E-05
	Acenaphthylene	NA	NA	NA	NA	NA	3.51E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	5.85E-06
	Anthracene	NA	NA	NA	NA	NA	1.69E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	5.62E-06
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	2.26E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	7.52E-06
	cPAHs, ND0	NA	NA	NA	NA	NA	1.41E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	3.47E-07	mg/kg-d	4.0E-02	mg/kg-d	Liver	8.67E-06
	Fluorene	NA	NA	NA	NA	NA	2.64E-06	mg/kg-d	4.0E-02	mg/kg-d	Blood	6.60E-05
	Naphthalene	NA	NA	NA	NA	NA	2.98E-06	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	1.49E-04
	Phenanthrene	NA	NA	NA	NA	NA	2.44E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	8.14E-06
	Pyrene	NA	NA	NA	NA	NA	3.19E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.06E-04
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	7.66E-11	mg/kg-d	1.0E-09	mg/kg-d	Developmental	7.66E-02
	4,4'-DDD	NA	NA	NA	NA	NA	1.72E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	4.33E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	1.42E-06	mg/kg-d	5.0E-04	mg/kg-d	Liver	2.84E-03
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	5.44E-06	mg/kg-d	8.0E-03	mg/kg-d	Liver	6.81E-04
	Beta-BHC	NA	NA	NA	NA	NA	2.46E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	3.91E-07	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	5.88E-08	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.18E-04
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	9.05E-07	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	3.02E-03
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	0.00E+00
	Pyridine	NA	NA	NA	NA	NA	9.84E-04	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.84E-01
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.17E-06	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmenta l	1.47E-03
							Hazard Index (including PCBs as congeners)					**3.4E+00**
							Hazard Index (including PCBs as Aroclors)					**4.0E+00**

Total HI - All Pathways (2)		**3.4E+00**
Total HI - All Pathways (3)		**4.1E+00**
HI Segregated By Target Organ (PCBs as Aroclors only)		
	Cardiovascular	**1.0E+00**
	Developmental	**1.1E+00**
	Endocrine System	*0.0E+00*
	GI Tract	*5.9E-02*
	Hematologic System	*3.0E-01*
	Immune System	*3.0E-03*
	Kidney	*1.6E-01*
	Liver	*9.9E-01*
	Lungs	*1.3E-03*
	Nervous System	*4.2E-01*
	Reproductive System	*0.0E+00*
	Skin	**1.2E+00**
	Whole Body	*6.8E-03*
	Not Classified	*8.6E-01*

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Hi includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-26
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	5.35E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.001782661
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.75E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.93067E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.74E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.90111E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.33E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	4.42648E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.60E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.8681E-08
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	5.79E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000289628
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	3.10E-12	mg/kg-d	1.0E-09	mg/kg-d		0.003099022
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	8.53E-11	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.83E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	4.71466E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	7.69E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.2816E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	8.00E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.3327E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	7.26E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.41946E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	5.95E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.98366E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.75E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	3.43933E-06
							Hazard Index					5.2E-03
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	9.83E-08	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.000327591
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.19E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.13005E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.39E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.3102E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.06E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	3.52488E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	4.46E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.4876E-08
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	4.97E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000248376
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	5.69E-13	mg/kg-d	6.0E-10	mg/kg-d		0.000949153
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	5.22E-11	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.73E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.88797E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	4.71E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.85047E-09
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	4.90E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	8.16345E-09
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	4.45E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.48204E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	3.65E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.21509E-07

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.69E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	2.10676E-06
							Hazard Index					1.5E-03

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	9.10E-03	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	9.10E-03
	Antimony	NA	NA	NA	NA	NA	1.90E-06	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	4.76E-03
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	2.20E-04	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	7.33E-01
	Barium	NA	NA	NA	NA	NA	2.61E-04	mg/kg-d	2.0E-01	mg/kg-d	Kidney	1.30E-03
	Cadmium	NA	NA	NA	NA	NA	7.61E-05	mg/kg-d	1.0E-03	mg/kg-d	Kidney	7.61E-02
	Cobalt	NA	NA	NA	NA	NA	5.45E-05	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	1.82E-01
	Copper	NA	NA	NA	NA	NA	1.67E-03	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	4.17E-02
	Iron	NA	NA	NA	NA	NA	8.98E-02	mg/kg-d	7.0E-01	mg/kg-d		1.28E-01
	Lead	NA	NA	NA	NA	NA	3.05E-04	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	2.95E-03	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	2.11E-02
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	8.75E-05	mg/kg-d	2.0E-02	mg/kg-d		4.38E-03
	Selenium	NA	NA	NA	NA	NA	2.76E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	5.52E-02
	Silver	NA	NA	NA	NA	NA	1.77E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	3.54E-02
	Vanadium	NA	NA	NA	NA	NA	1.56E-04	mg/kg-d	5.0E-03	mg/kg-d	Kidney	3.11E-02
	Zinc	NA	NA	NA	NA	NA	9.19E-03	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	3.06E-02
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	2.69E-05	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	2.69E-01
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	9.36E-06	mg/kg-d	2.0E-05	mg/kg-d		4.68E-01
	PCB TEQ, ND0	NA	NA	NA	NA	NA	2.64E-11	mg/kg-d	1.0E-09	mg/kg-d	Developmental	2.64E-02
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	3.61E-06	mg/kg-d	4.0E-03	mg/kg-d	Lung	9.02E-04
	Acenaphthene	NA	NA	NA	NA	NA	4.38E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.30E-06
	Acenaphthylene	NA	NA	NA	NA	NA	2.47E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.12E-06
	Anthracene	NA	NA	NA	NA	NA	1.19E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	3.96E-06
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	1.59E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	5.30E-06
	cPAHs, ND0	NA	NA	NA	NA	NA	9.91E-07	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	2.47E-07	mg/kg-d	4.0E-02	mg/kg-d	Liver	6.17E-06
	Fluorene	NA	NA	NA	NA	NA	1.86E-06	mg/kg-d	4.0E-02	mg/kg-d	Blood	4.65E-05
	Naphthalene	NA	NA	NA	NA	NA	2.11E-06	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	1.05E-04
	Phenanthrene	NA	NA	NA	NA	NA	1.72E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	5.74E-06
	Pyrene	NA	NA	NA	NA	NA	2.25E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	7.50E-05
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	4.30E-11	mg/kg-d	1.0E-09	mg/kg-d	Developmental	4.30E-02
	4,4'-DDD	NA	NA	NA	NA	NA	1.21E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	3.05E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	1.00E-06	mg/kg-d	5.0E-04	mg/kg-d	Liver	2.00E-03
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	3.83E-06	mg/kg-d	8.0E-03	mg/kg-d	Liver	4.79E-04
	Beta-BHC	NA	NA	NA	NA	NA	1.74E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	2.75E-07	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	4.14E-08	mg/kg-d	5.0E-04	mg/kg-d	Liver	8.28E-05
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	6.37E-07	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	2.12E-03
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	0.00E+00
	Pyridine	NA	NA	NA	NA	NA	9.84E-04	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.84E-01
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.17E-06	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmenta l	1.47E-03
							Hazard Index (including PCBs as congeners)					**2.7E+00**
							Hazard Index (including PCBs as Aroclors)					**3.1E+00**

Total HI - All Pathways (2)	**2.7E+00**
Total HI - All Pathways (3)	**3.1E+00**
HI Segregated By Target Organ (PCBs as Aroclors only)	
Cardiovascular	*7.4E-01*
Developmental	*7.8E-01*
Endocrine System	*0.0E+00*
GI Tract	*4.2E-02*
Hematologic System	*2.1E-01*
Immune System	*2.1E-03*
Kidney	*1.1E-01*
Liver	*9.9E-01*
Lungs	*9.0E-04*
Nervous System	*3.0E-01*
Reproductive System	*0.0E+00*
Skin	*8.3E-01*
Whole Body	*4.8E-03*
Not Classified	*6.0E-01*

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Hi includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-27
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	8.22E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.027402397
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.23E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	6.04207E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.68E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.45947E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.04E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	6.80422E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	8.61E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.87158E-07
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	8.90E-08	mg/kg-d	2.0E-05	mg/kg-d		0.004452055
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	4.76E-11	mg/kg-d	1.0E-09	mg/kg-d		0.047636986
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.31E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.35E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.2472E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.18E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.97003E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.23E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.04858E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.12E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.7191E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	9.15E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.04921E-06
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.23E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	5.28682E-05
							Hazard Index					8.0E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.14E-05	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.037979723
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.54E-07	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.62887E-06
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.61E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.67836E-06
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.23E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	4.08662E-06
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.17E-07	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.72467E-06
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	5.76E-07	mg/kg-d	2.0E-05	mg/kg-d		0.02879589
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	6.60E-11	mg/kg-d	6.0E-10	mg/kg-d		0.110041438
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	6.06E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.01E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.34821E-07
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.46E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	9.10156E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.68E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	9.46442E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	5.15E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.71822E-05
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	4.23E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.40874E-05

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.95E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	0.000244251
							Hazard Index					1.8E-01

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	2.25E-02	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	2.25E-02
	Antimony	NA	NA	NA	NA	NA	4.70E-06	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	1.18E-02
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	5.44E-04	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**1.81E+00**
	Barium	NA	NA	NA	NA	NA	6.45E-04	mg/kg-d	2.0E-01	mg/kg-d	Kidney	3.23E-03
	Cadmium	NA	NA	NA	NA	NA	1.88E-04	mg/kg-d	1.0E-03	mg/kg-d	Kidney	1.88E-01
	Cobalt	NA	NA	NA	NA	NA	1.35E-04	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	4.49E-01
	Copper	NA	NA	NA	NA	NA	4.13E-03	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	1.03E-01
	Iron	NA	NA	NA	NA	NA	2.22E-01	mg/kg-d	7.0E-01	mg/kg-d		3.17E-01
	Lead	NA	NA	NA	NA	NA	7.55E-04	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	7.29E-03	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	5.21E-02
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	2.16E-04	mg/kg-d	2.0E-02	mg/kg-d		1.08E-02
	Selenium	NA	NA	NA	NA	NA	6.82E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	1.36E-01
	Silver	NA	NA	NA	NA	NA	4.38E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	8.77E-02
	Vanadium	NA	NA	NA	NA	NA	3.85E-04	mg/kg-d	5.0E-03	mg/kg-d	Kidney	7.70E-02
	Zinc	NA	NA	NA	NA	NA	2.27E-02	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	7.57E-02
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	6.64E-05	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	6.64E-01
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	2.31E-05	mg/kg-d	2.0E-05	mg/kg-d		**1.16E+00**
	PCB TEQ, ND0	NA	NA	NA	NA	NA	6.52E-11	mg/kg-d	1.0E-09	mg/kg-d	Developmenta l	6.52E-02
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	8.93E-06	mg/kg-d	4.0E-03	mg/kg-d	Lung	2.23E-03
	Acenaphthene	NA	NA	NA	NA	NA	1.09E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.82E-05
	Acenaphthylene	NA	NA	NA	NA	NA	6.13E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.02E-05
	Anthracene	NA	NA	NA	NA	NA	2.94E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	9.79E-06
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	3.93E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.31E-05
	cPAHs, ND0	NA	NA	NA	NA	NA	2.45E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	6.13E-07	mg/kg-d	4.0E-02	mg/kg-d	Liver	1.53E-05
	Fluorene	NA	NA	NA	NA	NA	4.60E-06	mg/kg-d	4.0E-02	mg/kg-d	Blood	1.15E-04
	Naphthalene	NA	NA	NA	NA	NA	5.21E-06	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	2.61E-04
	Phenanthrene	NA	NA	NA	NA	NA	4.26E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.42E-05
	Pyrene	NA	NA	NA	NA	NA	5.57E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.86E-04
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	1.06E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmenta l	1.06E-01
	4,4'-DDD	NA	NA	NA	NA	NA	3.00E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	7.54E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	2.48E-06	mg/kg-d	5.0E-04	mg/kg-d	Liver	4.95E-03
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	9.48E-06	mg/kg-d	8.0E-03	mg/kg-d	Liver	1.19E-03
	Beta-BHC	NA	NA	NA	NA	NA	4.31E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	6.80E-07	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	1.02E-07	mg/kg-d	5.0E-04	mg/kg-d	Liver	2.05E-04
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	1.58E-06	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	5.25E-03
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	0.00E+00
	Pyridine	NA	NA	NA	NA	NA	9.84E-04	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.84E-01
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.17E-06	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.47E-03
							Hazard Index (including PCBs as congeners)					**5.2E+00**
							Hazard Index (including PCBs as Aroclors)					**6.3E+00**

Total HI - All Pathways [(2)]	**5.4E+00**
Total HI - All Pathways [(3)]	**6.5E+00**
HI Segregated By Target Organ (PCBs as Aroclors only)	
Cardiovascular	**1.9E+00**
Developmental	**1.9E+00**
Endocrine System	*0.0E+00*
GI Tract	*1.0E-01*
Hematologic System	*5.3E-01*
Immune System	*5.3E-03*
Kidney	*2.7E-01*
Liver	*1.0E+00*
Lungs	*2.2E-03*
Nervous System	*7.4E-01*
Reproductive System	*0.0E+00*
Skin	**2.1E+00**
Whole Body	*1.2E-02*
Not Classified	**1.7E+00**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Hi includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-28
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.26E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.004215753
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.51E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.2955E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.12E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	6.86073E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.14E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.0468E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.33E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.41781E-08
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	1.37E-08	mg/kg-d	2.0E-05	mg/kg-d		0.000684932
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	7.33E-12	mg/kg-d	1.0E-09	mg/kg-d		0.007328767
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.02E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	6.69E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.11495E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.82E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.03082E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.89E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.15166E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.72E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	5.72169E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.41E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.6911E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.51E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.13356E-06
							Hazard Index					1.2E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.06E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.000354123
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.37E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.38356E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.50E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.49731E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.14E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	3.81037E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	4.82E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.60808E-08
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	5.37E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000268493
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	6.16E-13	mg/kg-d	6.0E-10	mg/kg-d		0.001026027
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	5.65E-11	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.87E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.12187E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.09E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	8.4863E-09
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.29E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	8.82463E-09
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	4.81E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.60207E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	3.94E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.31351E-07

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.82E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	2.2774E-06
							Hazard Index					1.7E-03

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	1.59E-02	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	1.59E-02
	Antimony	NA	NA	NA	NA	NA	3.32E-06	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	8.29E-03
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	3.84E-04	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**1.28E+00**
	Barium	NA	NA	NA	NA	NA	4.55E-04	mg/kg-d	2.0E-01	mg/kg-d	Kidney	2.27E-03
	Cadmium	NA	NA	NA	NA	NA	1.33E-04	mg/kg-d	1.0E-03	mg/kg-d	Kidney	1.33E-01
	Cobalt	NA	NA	NA	NA	NA	9.50E-05	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	3.17E-01
	Copper	NA	NA	NA	NA	NA	2.91E-03	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	7.28E-02
	Iron	NA	NA	NA	NA	NA	1.57E-01	mg/kg-d	7.0E-01	mg/kg-d		2.24E-01
	Lead	NA	NA	NA	NA	NA	5.33E-04	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	5.14E-03	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	3.67E-02
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	1.53E-04	mg/kg-d	2.0E-02	mg/kg-d		7.63E-03
	Selenium	NA	NA	NA	NA	NA	4.81E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	9.63E-02
	Silver	NA	NA	NA	NA	NA	3.09E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	6.18E-02
	Vanadium	NA	NA	NA	NA	NA	2.72E-04	mg/kg-d	5.0E-03	mg/kg-d	Kidney	5.43E-02
	Zinc	NA	NA	NA	NA	NA	1.60E-02	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	5.35E-02
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	4.70E-05	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	4.70E-01
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB, Sum of Aroclors, ND0	NA	NA	NA	NA	NA	1.63E-05	mg/kg-d	2.0E-05	mg/kg-d		8.16E-01
	PCB TEQ, ND0	NA	NA	NA	NA	NA	4.62E-11	mg/kg-d	1.0E-09	mg/kg-d	Developmenta l	4.62E-02
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	6.29E-06	mg/kg-d	4.0E-03	mg/kg-d	Lung	1.57E-03
	Acenaphthene	NA	NA	NA	NA	NA	7.68E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.28E-05
	Acenaphthylene	NA	NA	NA	NA	NA	4.32E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.20E-06
	Anthracene	NA	NA	NA	NA	NA	2.07E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	6.90E-06
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	2.77E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	9.24E-06
	cPAHs, ND0	NA	NA	NA	NA	NA	1.73E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	4.33E-07	mg/kg-d	4.0E-02	mg/kg-d	Liver	1.08E-05
	Fluorene	NA	NA	NA	NA	NA	3.24E-06	mg/kg-d	4.0E-02	mg/kg-d	Blood	8.11E-05
	Naphthalene	NA	NA	NA	NA	NA	3.68E-06	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	1.84E-04
	Phenanthrene	NA	NA	NA	NA	NA	3.01E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.00E-05
	Pyrene	NA	NA	NA	NA	NA	3.93E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.31E-04
	2,3,7,8-TCDD TEQ, ND0	NA	NA	NA	NA	NA	7.51E-11	mg/kg-d	1.0E-09	mg/kg-d	Developmenta l	7.51E-02
	4,4'-DDD	NA	NA	NA	NA	NA	2.11E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	5.33E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	1.75E-06	mg/kg-d	5.0E-04	mg/kg-d	Liver	3.50E-03
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	6.69E-06	mg/kg-d	8.0E-03	mg/kg-d	Liver	8.36E-04
	Beta-BHC	NA	NA	NA	NA	NA	3.04E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	4.81E-07	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	7.22E-08	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.44E-04
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	1.11E-06	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	3.71E-03
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	0.00E+00
	Pyridine	NA	NA	NA	NA	NA	9.84E-04	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.84E-01
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.17E-06	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.47E-03
							Hazard Index (including PCBs as congeners)					**3.9E+00**
							Hazard Index (including PCBs as Aroclors)					**4.7E+00**

Total HI - All Pathways (2)	**4.0E+00**
Total HI - All Pathways (3)	**4.7E+00**
HI Segregated By Target Organ (PCBs as Aroclors only)	
Cardiovascular	**1.3E+00**
Developmental	**1.4E+00**
Endocrine System	*0.0E+00*
GI Tract	*7.3E-02*
Hematologic System	*3.7E-01*
Immune System	*3.7E-03*
Kidney	*1.9E-01*
Liver	*9.9E-01*
Lungs	*1.6E-03*
Nervous System	*5.2E-01*
Reproductive System	*0.0E+00*
Skin	**1.4E+00**
Whole Body	*8.3E-03*
Not Classified	**1.0E+00**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - Hi includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-29
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Residential User
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	7.23E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.002409002
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.72E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	5.31171E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.35E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	3.92042E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.79E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	5.98174E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	7.57E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.52446E-08
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	7.83E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000391389
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	4.19E-12	mg/kg-d	1.0E-09	mg/kg-d		0.004187867
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.15E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	3.82E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	6.37117E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.04E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.7319E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.08E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.80095E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	9.81E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.26954E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	8.04E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.68063E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.72E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	4.64775E-06
							Hazard Index					7.0E-03
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	7.97E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.002656141
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.78E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	2.53788E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.12E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.87313E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	8.57E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	2.85801E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	3.62E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.20616E-07
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	4.03E-08	mg/kg-d	2.0E-05	mg/kg-d		0.002013863

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	4.62E-12	mg/kg-d	6.0E-10	mg/kg-d		0.007695834
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	4.24E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.40E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.3416E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	3.82E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	6.36525E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	3.97E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	6.61902E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	3.60E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.20165E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	2.96E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	9.85211E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.37E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.70819E-05
							Hazard Index					1.2E-02

Total HI - All Pathways	*1.9E-02*
HI Segregated By Target Organ	
Cardiovascular	*5.1E-03*
Developmental	*2.2E-05*
Endocrine System	*0.0E+00*
GI Tract	*0.0E+00*
Hematologic System	*0.0E+00*
Immune System	*0.0E+00*
Kidney	*3.5E-07*
Liver	*2.5E-05*
Lungs	*3.1E-07*
Nervous System	*0.0E+00*
Reproductive System	*0.0E+00*
Skin	*5.1E-03*
Whole Body	*0.0E+00*
Not Classified	*1.4E-02*

Bolded text indicates HI exceeds 1.0.

Table C-30
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Residential User
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	8.22E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.027402397
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.23E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	6.04207E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.68E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.45947E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.04E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	6.80422E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	8.61E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.87158E-07
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	8.90E-08	mg/kg-d	2.0E-05	mg/kg-d		0.004452055
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	4.76E-11	mg/kg-d	1.0E-09	mg/kg-d		0.047636986
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.31E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.35E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.2472E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.18E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.97003E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.23E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.04858E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.12E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.7191E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	9.15E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.04921E-06
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.23E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	5.28682E-05
							Hazard Index					8.0E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.14E-05	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.037979723
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.54E-07	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.62887E-06
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.61E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.67836E-06
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.23E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	4.08662E-06
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.17E-07	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.72467E-06
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	5.76E-07	mg/kg-d	2.0E-05	mg/kg-d		0.02879589

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	6.60E-11	mg/kg-d	6.0E-10	mg/kg-d		0.110041438
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	6.06E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.01E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.34821E-07
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.46E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	9.10156E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.68E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	9.46442E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	5.15E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.71822E-05
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	4.23E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.40874E-05
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.95E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	0.000244251
							Hazard Index					1.8E-01

Total HI - All Pathways	*2.6E-01*
HI Segregated By Target Organ	
Cardiovascular	*6.5E-02*
Developmental	*3.0E-04*
Endocrine System	*0.0E+00*
GI Tract	*0.0E+00*
Hematologic System	*0.0E+00*
Immune System	*0.0E+00*
Kidney	*4.8E-06*
Liver	*3.4E-04*
Lungs	*4.2E-06*
Nervous System	*0.0E+00*
Reproductive System	*0.0E+00*
Skin	*6.5E-02*
Whole Body	*0.0E+00*
Not Classified	*1.9E-01*

Bolded text indicates HI exceeds 1.0.

Table C-31
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational User
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	8.67E-08	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.00028908
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.46E-10	mg/kg-d	7.0E-02	mg/kg-d	Lung	6.37406E-09
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.82E-10	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.7045E-09
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.15E-10	mg/kg-d	3.0E-02	mg/kg-d	Kidney	7.17808E-09
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	9.09E-10	mg/kg-d	3.0E-01	mg/kg-d	Liver	3.02935E-09
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	9.39E-10	mg/kg-d	2.0E-05	mg/kg-d		4.69667E-05
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	5.03E-13	mg/kg-d	1.0E-09	mg/kg-d		0.000502544
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.38E-11	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.59E-12	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.6454E-10
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.25E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.07828E-09
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.30E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.16114E-09
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.18E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.92344E-08
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	9.65E-12	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.21675E-08
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.46E-10	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	5.5773E-07
							Hazard Index					8.4E-04
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	9.56E-08	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.000318737
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.13E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.04545E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.35E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.24776E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.03E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	3.42961E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	4.34E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.44739E-08
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	4.83E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000241664

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	5.54E-13	mg/kg-d	6.0E-10	mg/kg-d		0.0009235
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	5.08E-11	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.69E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.80991E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	4.58E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.63829E-09
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	4.77E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.94282E-09
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	4.33E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.44198E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	3.55E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.18225E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.64E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	2.04982E-06
							Hazard Index					1.5E-03

Total HI - All Pathways	*2.3E-03*
HI Segregated By Target Organ	
Cardiovascular	*6.1E-04*
Developmental	*2.6E-06*
Endocrine System	*0.0E+00*
GI Tract	*0.0E+00*
Hematologic System	*0.0E+00*
Immune System	*0.0E+00*
Kidney	*4.1E-08*
Liver	*3.0E-06*
Lungs	*3.7E-08*
Nervous System	*0.0E+00*
Reproductive System	*0.0E+00*
Skin	*6.1E-04*
Whole Body	*0.0E+00*
Not Classified	*1.7E-03*

Bolded text indicates HI exceeds 1.0.

Table C-32
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational User
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.26E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.004215753
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.51E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.2955E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.12E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	6.86073E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.14E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.0468E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.33E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.41781E-08
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	1.37E-08	mg/kg-d	2.0E-05	mg/kg-d		0.000684932
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	7.33E-12	mg/kg-d	1.0E-09	mg/kg-d		0.007328767
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.02E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	6.69E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.11495E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.82E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.03082E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.89E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.15166E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.72E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	5.72169E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.41E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.6911E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.51E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.13356E-06
							Hazard Index					1.2E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.75E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.005843034
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.91E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	5.58288E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.47E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.12055E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.89E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	6.2871E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	7.96E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.65334E-07
	PCB, Sum of Aroclors, ND0	4.00E-02	mg/kg	4.00E-02	mg/kg	4.00E-02	8.86E-08	mg/kg-d	2.0E-05	mg/kg-d		0.004430137

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
	2,3,7,8-TCDD TEQ, ND0	2.14E-05	mg/kg	2.14E-05	mg/kg	2.14E-05	1.02E-11	mg/kg-d	6.0E-10	mg/kg-d		0.016929452
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	9.32E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	3.09E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	5.15109E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	8.40E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.40024E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	8.74E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.45606E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	7.93E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.64342E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	6.50E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.16729E-06
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.01E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	3.75771E-05
							Hazard Index					2.7E-02

Total HI - All Pathways		*3.9E-02*
HI Segregated By Target Organ		
	Cardiovascular	*1.0E-02*
	Developmental	*4.6E-05*
	Endocrine System	*0.0E+00*
	GI Tract	*0.0E+00*
	Hematologic System	*0.0E+00*
	Immune System	*0.0E+00*
	Kidney	*7.3E-07*
	Liver	*5.3E-05*
	Lungs	*6.5E-07*
	Nervous System	*0.0E+00*
	Reproductive System	*0.0E+00*
	Skin	*1.0E-02*
	Whole Body	*0.0E+00*
	Not Classified	*2.9E-02*

Bolded text indicates HI exceeds 1.0.

Table C-33
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.33E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.004439882
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.85E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.78969E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.34E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.22548E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.31E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.10246E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.40E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.65268E-08
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.54E-08	mg/kg-d	2.0E-05	mg/kg-d		0.000771299
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	5.92E-12	mg/kg-d	1.0E-09	mg/kg-d		0.005915034
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.12E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	7.05E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.17423E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.92E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.19195E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.99E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.31921E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.81E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	6.02588E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.48E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.9405E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.85E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.56598E-06
							Hazard Index					1.1E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.47E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.00489537
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.27E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	4.67741E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.07E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	3.45225E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.58E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	5.26742E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	6.67E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.223E-07
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	7.94E-08	mg/kg-d	2.0E-05	mg/kg-d		0.003968656
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	6.52E-12	mg/kg-d	6.0E-10	mg/kg-d		0.010869762
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	7.81E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.59E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	4.31565E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	7.04E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.17314E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	7.32E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.21991E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	6.64E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.21469E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	5.45E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.81578E-06

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.52E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	3.14825E-05
							Hazard Index					2.0E-02

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	1.75E-01	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	1.75E-01
	Antimony	NA	NA	NA	NA	NA	3.65E-05	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	9.12E-02
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	4.31E-03	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**1.44E+01**
	Barium	NA	NA	NA	NA	NA	5.01E-03	mg/kg-d	2.0E-01	mg/kg-d	Kidney	2.50E-02
	Cadmium	NA	NA	NA	NA	NA	3.18E-03	mg/kg-d	1.0E-03	mg/kg-d	Kidney	**3.18E+00**
	Cobalt	NA	NA	NA	NA	NA	1.05E-03	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	**3.49E+00**
	Copper	NA	NA	NA	NA	NA	7.60E-02	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	**1.90E+00**
	Iron	NA	NA	NA	NA	NA	1.72E+00	mg/kg-d	7.0E-01	mg/kg-d		**2.46E+00**
	Lead	NA	NA	NA	NA	NA	5.86E-03	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	5.65E-02	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	4.04E-01
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	1.68E-03	mg/kg-d	2.0E-02	mg/kg-d		8.39E-02
	Selenium	NA	NA	NA	NA	NA	6.19E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	**1.24E+00**
	Silver	NA	NA	NA	NA	NA	3.40E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	6.80E-01
	Vanadium	NA	NA	NA	NA	NA	2.99E-03	mg/kg-d	5.0E-03	mg/kg-d	Kidney	5.98E-01
	Zinc	NA	NA	NA	NA	NA	1.63E-01	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	5.45E-01
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	5.15E-04	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	**5.15E+00**
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	6.25E-04	mg/kg-d	2.0E-05	mg/kg-d	Developmental	**3.13E+01**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	1.76E-09	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**1.76E+00**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	7.03E-05	mg/kg-d	4.0E-03	mg/kg-d	Lung	1.76E-02
	Acenaphthene	NA	NA	NA	NA	NA	8.69E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.45E-04
	Acenaphthylene	NA	NA	NA	NA	NA	4.99E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	8.32E-05
	Anthracene	NA	NA	NA	NA	NA	2.34E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	7.80E-05
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	3.49E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.16E-04
	cPAHs, ND05	NA	NA	NA	NA	NA	2.44E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	5.83E-06	mg/kg-d	4.0E-02	mg/kg-d	Liver	1.46E-04
	Fluorene	NA	NA	NA	NA	NA	3.64E-05	mg/kg-d	4.0E-02	mg/kg-d	Blood	9.10E-04
	Naphthalene	NA	NA	NA	NA	NA	4.15E-05	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	2.08E-03
	Phenanthrene	NA	NA	NA	NA	NA	3.34E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.11E-04
	Pyrene	NA	NA	NA	NA	NA	4.43E-05	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.48E-03
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	1.75E-08	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**1.75E+01**
	4,4'-DDD	NA	NA	NA	NA	NA	2.33E-06	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	1.13E-05	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	6.90E-05	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.38E-01
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	7.49E-05	mg/kg-d	8.0E-03	mg/kg-d	Liver	9.36E-03
	Beta-BHC	NA	NA	NA	NA	NA	3.48E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	5.81E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	7.94E-07	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.59E-03
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	1.19E-05	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	3.96E-02
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	1.72E-04	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	5.74E-03
	Pyridine	NA	NA	NA	NA	NA	9.00E-05	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.00E-02

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.07E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.33E-04
							Hazard Index (including PCBs as congeners)					**5.4E+01**
							Hazard Index (including PCBs as Aroclors)					**8.3E+01**

Total HI - All Pathways (2)		**5.4E+01**
Total HI - All Pathways (3)		**8.3E+01**
HI Segregated By Target Organ (PCBs as Aroclors only)		
	Cardiovascular	**1.4E+01**
	Developmental	**5.4E+01**
	Endocrine System	*5.7E-03*
	GI Tract	**1.9E+00**
	Hematologic System	**4.0E+00**
	Immune System	*4.0E-02*
	Kidney	**3.9E+00**
	Liver	*2.9E-01*
	Lungs	*1.8E-02*
	Nervous System	**5.7E+00**
	Reproductive System	*0.0E+00*
	Skin	**1.6E+01**
	Whole Body	*9.1E-02*
	Not Classified	**3.4E+01**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - HI includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-34
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.33E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.004439882
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.85E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.78969E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.34E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.22548E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.31E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.10246E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.40E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.65268E-08
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.54E-08	mg/kg-d	2.0E-05	mg/kg-d		0.000771299
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	5.92E-12	mg/kg-d	1.0E-09	mg/kg-d		0.005915034
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.12E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	7.05E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.17423E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.92E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.19195E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.99E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.31921E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.81E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	6.02588E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.48E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.9405E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.85E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.56598E-06
							Hazard Index					1.1E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	2.45E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.000815895
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	5.46E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	7.79568E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	3.45E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	5.75376E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.63E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	8.77903E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.11E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	3.705E-08
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.32E-08	mg/kg-d	2.0E-05	mg/kg-d		0.000661443
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	1.09E-12	mg/kg-d	6.0E-10	mg/kg-d		0.001811627
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.30E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.32E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.19275E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.17E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.95523E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.22E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.03318E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.11E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.69115E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	9.08E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.0263E-07

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.20E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	5.24709E-06
							Hazard Index					3.3E-03

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	8.73E-02	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	8.73E-02
	Antimony	NA	NA	NA	NA	NA	1.82E-05	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	4.56E-02
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	2.16E-03	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**7.19E+00**
	Barium	NA	NA	NA	NA	NA	2.50E-03	mg/kg-d	2.0E-01	mg/kg-d	Kidney	1.25E-02
	Cadmium	NA	NA	NA	NA	NA	1.59E-03	mg/kg-d	1.0E-03	mg/kg-d	Kidney	**1.59E+00**
	Cobalt	NA	NA	NA	NA	NA	5.23E-04	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	**1.74E+00**
	Copper	NA	NA	NA	NA	NA	3.80E-02	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	9.50E-01
	Iron	NA	NA	NA	NA	NA	8.61E-01	mg/kg-d	7.0E-01	mg/kg-d		**1.23E+00**
	Lead	NA	NA	NA	NA	NA	2.93E-03	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	2.83E-02	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	2.02E-01
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	8.39E-04	mg/kg-d	2.0E-02	mg/kg-d		4.20E-02
	Selenium	NA	NA	NA	NA	NA	3.09E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	6.19E-01
	Silver	NA	NA	NA	NA	NA	1.70E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	3.40E-01
	Vanadium	NA	NA	NA	NA	NA	1.49E-03	mg/kg-d	5.0E-03	mg/kg-d	Kidney	2.99E-01
	Zinc	NA	NA	NA	NA	NA	8.17E-02	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	2.72E-01
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	2.57E-04	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	**2.57E+00**
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	3.13E-04	mg/kg-d	2.0E-05	mg/kg-d	Developmental	**1.56E+01**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	8.80E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmental	8.80E-01
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	3.51E-05	mg/kg-d	4.0E-03	mg/kg-d	Lung	8.78E-03
	Acenaphthene	NA	NA	NA	NA	NA	4.34E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.24E-05
	Acenaphthylene	NA	NA	NA	NA	NA	2.50E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.16E-05
	Anthracene	NA	NA	NA	NA	NA	1.17E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	3.90E-05
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	1.75E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	5.82E-05
	cPAHs, ND05	NA	NA	NA	NA	NA	1.22E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	2.92E-06	mg/kg-d	4.0E-02	mg/kg-d	Liver	7.29E-05
	Fluorene	NA	NA	NA	NA	NA	1.82E-05	mg/kg-d	4.0E-02	mg/kg-d	Blood	4.55E-04
	Naphthalene	NA	NA	NA	NA	NA	2.08E-05	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	1.04E-03
	Phenanthrene	NA	NA	NA	NA	NA	1.67E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	5.57E-05
	Pyrene	NA	NA	NA	NA	NA	2.21E-05	mg/kg-d	3.0E-02	mg/kg-d	Kidney	7.38E-04
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	8.76E-09	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**8.76E+00**
	4,4'-DDD	NA	NA	NA	NA	NA	1.16E-06	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	5.64E-06	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	3.45E-05	mg/kg-d	5.0E-04	mg/kg-d	Liver	6.90E-02
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	3.74E-05	mg/kg-d	8.0E-03	mg/kg-d	Liver	4.68E-03
	Beta-BHC	NA	NA	NA	NA	NA	1.74E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	2.90E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	3.97E-07	mg/kg-d	5.0E-04	mg/kg-d	Liver	7.94E-04
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	5.95E-06	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	1.98E-02
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	8.60E-05	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	2.87E-03
	Pyridine	NA	NA	NA	NA	NA	9.00E-05	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.00E-02

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.07E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.33E-04
							Hazard Index (including PCBs as congeners)					**2.7E+01**
							Hazard Index (including PCBs as Aroclors)					**4.2E+01**

Total HI - All Pathways (2)		**2.7E+01**
Total HI - All Pathways (3)		**4.2E+01**
HI Segregated By Target Organ (PCBs as Aroclors only)		
	Cardiovascular	**7.2E+00**
	Developmental	**2.7E+01**
	Endocrine System	*2.9E-03*
	GI Tract	*9.5E-01*
	Hematologic System	**2.0E+00**
	Immune System	*2.0E-02*
	Kidney	**1.9E+00**
	Liver	*1.9E-01*
	Lungs	*8.8E-03*
	Nervous System	**2.9E+00**
	Reproductive System	*0.0E+00*
	Skin	**8.2E+00**
	Whole Body	*4.6E-02*
	Not Classified	**1.7E+01**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - HI includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-35
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.32E-05	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.043843836
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.77E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.66732E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.28E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.13516E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.27E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.08868E-06
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.38E-07	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.59452E-07
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.52E-07	mg/kg-d	2.0E-05	mg/kg-d		0.007616575
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	5.84E-11	mg/kg-d	1.0E-09	mg/kg-d		0.058410959
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.10E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	6.96E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.15955E-07
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.89E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.15205E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.97E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.27772E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.79E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	5.95056E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.46E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.87874E-06
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.77E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.4589E-05
							Hazard Index					1.1E-01
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.82E-05	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.060767556
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.06E-07	mg/kg-d	7.0E-02	mg/kg-d	Lung	5.80619E-06
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.57E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.28538E-06
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.96E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	6.53859E-06
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	8.28E-07	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.75947E-06
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	9.85E-07	mg/kg-d	2.0E-05	mg/kg-d		0.049264009
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	8.10E-11	mg/kg-d	6.0E-10	mg/kg-d		0.134929315
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	9.69E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	3.21E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	5.35713E-07
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	8.74E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.45625E-06
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	9.09E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.51431E-06
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	8.25E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.74916E-05
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	6.76E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.25398E-05

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.13E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	0.000390801
							Hazard Index					2.5E-01

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	3.46E-01	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	3.46E-01
	Antimony	NA	NA	NA	NA	NA	7.24E-05	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	1.81E-01
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	8.55E-03	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**2.85E+01**
	Barium	NA	NA	NA	NA	NA	9.93E-03	mg/kg-d	2.0E-01	mg/kg-d	Kidney	4.96E-02
	Cadmium	NA	NA	NA	NA	NA	6.31E-03	mg/kg-d	1.0E-03	mg/kg-d	Kidney	**6.31E+00**
	Cobalt	NA	NA	NA	NA	NA	2.07E-03	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	**6.91E+00**
	Copper	NA	NA	NA	NA	NA	1.50E-01	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	**3.76E+00**
	Iron	NA	NA	NA	NA	NA	3.42E+00	mg/kg-d	7.0E-01	mg/kg-d		**4.88E+00**
	Lead	NA	NA	NA	NA	NA	1.16E-02	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	1.12E-01	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	8.01E-01
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	3.33E-03	mg/kg-d	2.0E-02	mg/kg-d		1.66E-01
	Selenium	NA	NA	NA	NA	NA	1.23E-02	mg/kg-d	5.0E-03	mg/kg-d	Skin	**2.46E+00**
	Silver	NA	NA	NA	NA	NA	6.74E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	**1.35E+00**
	Vanadium	NA	NA	NA	NA	NA	5.93E-03	mg/kg-d	5.0E-03	mg/kg-d	Kidney	**1.19E+00**
	Zinc	NA	NA	NA	NA	NA	3.23E-01	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	**1.08E+00**
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	1.02E-03	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	**1.02E+01**
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	1.24E-03	mg/kg-d	2.0E-05	mg/kg-d	Developmental	**6.20E+01**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	3.49E-09	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**3.49E+00**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	1.39E-04	mg/kg-d	4.0E-03	mg/kg-d	Lung	3.48E-02
	Acenaphthene	NA	NA	NA	NA	NA	1.69E-05	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.82E-04
	Acenaphthylene	NA	NA	NA	NA	NA	9.86E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.64E-04
	Anthracene	NA	NA	NA	NA	NA	4.64E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.55E-04
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	6.92E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	2.31E-04
	cPAHs, ND05	NA	NA	NA	NA	NA	4.85E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	1.14E-05	mg/kg-d	4.0E-02	mg/kg-d	Liver	2.85E-04
	Fluorene	NA	NA	NA	NA	NA	7.22E-05	mg/kg-d	4.0E-02	mg/kg-d	Blood	1.80E-03
	Naphthalene	NA	NA	NA	NA	NA	8.20E-05	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	4.10E-03
	Phenanthrene	NA	NA	NA	NA	NA	6.61E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.20E-04
	Pyrene	NA	NA	NA	NA	NA	8.77E-05	mg/kg-d	3.0E-02	mg/kg-d	Kidney	2.92E-03
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	3.47E-08	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**3.47E+01**
	4,4'-DDD	NA	NA	NA	NA	NA	4.61E-06	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	2.24E-05	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	1.37E-04	mg/kg-d	5.0E-04	mg/kg-d	Liver	2.73E-01
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	1.48E-04	mg/kg-d	8.0E-03	mg/kg-d	Liver	1.86E-02
	Beta-BHC	NA	NA	NA	NA	NA	6.87E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	1.15E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	1.58E-06	mg/kg-d	5.0E-04	mg/kg-d	Liver	3.15E-03
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	2.36E-05	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	7.87E-02
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	3.41E-04	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	1.14E-02
	Pyridine	NA	NA	NA	NA	NA	9.00E-05	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.00E-02

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.07E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.33E-04
							Hazard Index (including PCBs as congeners)					**1.1E+02**
							Hazard Index (including PCBs as Aroclors)					**1.7E+02**

Total HI - All Pathways [(2)]	**1.1E+02**
Total HI - All Pathways [(3)]	**1.7E+02**
HI Segregated By Target Organ (PCBs as Aroclors only)	
Cardiovascular	**2.9E+01**
Developmental	**1.1E+02**
Endocrine System	*1.1E-02*
GI Tract	**3.8E+00**
Hematologic System	**8.0E+00**
Immune System	*7.9E-02*
Kidney	**7.6E+00**
Liver	*4.8E-01*
Lungs	*3.5E-02*
Nervous System	**1.1E+01**
Reproductive System	*0.0E+00*
Skin	**3.2E+01**
Whole Body	*1.8E-01*
Not Classified	**6.7E+01**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - HI includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-36
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.32E-05	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.043843836
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.77E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.66732E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.28E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.13516E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.27E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.08868E-06
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.38E-07	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.59452E-07
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.52E-07	mg/kg-d	2.0E-05	mg/kg-d		0.007616575
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	5.84E-11	mg/kg-d	1.0E-09	mg/kg-d		0.058410959
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.10E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	6.96E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.15955E-07
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.89E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.15205E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.97E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.27772E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.79E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	5.95056E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.46E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.87874E-06
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.77E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.4589E-05
							Hazard Index					1.1E-01
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.10E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.003682882
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.46E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.5189E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.56E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.5972E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.19E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	3.96278E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.02E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.67241E-07
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	5.97E-08	mg/kg-d	2.0E-05	mg/kg-d		0.002985698
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	4.91E-12	mg/kg-d	6.0E-10	mg/kg-d		0.008177534
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	5.87E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.95E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.24675E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.30E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	8.82575E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.51E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	9.17762E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	5.00E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.66616E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	4.10E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.36605E-06

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.89E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	2.36849E-05
							Hazard Index					1.5E-02

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	1.73E-01	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	1.73E-01
	Antimony	NA	NA	NA	NA	NA	3.62E-05	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	9.05E-02
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	4.27E-03	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**1.42E+01**
	Barium	NA	NA	NA	NA	NA	4.96E-03	mg/kg-d	2.0E-01	mg/kg-d	Kidney	2.48E-02
	Cadmium	NA	NA	NA	NA	NA	3.15E-03	mg/kg-d	1.0E-03	mg/kg-d	Kidney	**3.15E+00**
	Cobalt	NA	NA	NA	NA	NA	1.04E-03	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	**3.46E+00**
	Copper	NA	NA	NA	NA	NA	7.52E-02	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	**1.88E+00**
	Iron	NA	NA	NA	NA	NA	1.71E+00	mg/kg-d	7.0E-01	mg/kg-d		**2.44E+00**
	Lead	NA	NA	NA	NA	NA	5.81E-03	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	5.61E-02	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	4.00E-01
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	1.66E-03	mg/kg-d	2.0E-02	mg/kg-d		8.32E-02
	Selenium	NA	NA	NA	NA	NA	6.14E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	**1.23E+00**
	Silver	NA	NA	NA	NA	NA	3.37E-03	mg/kg-d	5.0E-03	mg/kg-d	Skin	6.74E-01
	Vanadium	NA	NA	NA	NA	NA	2.96E-03	mg/kg-d	5.0E-03	mg/kg-d	Kidney	5.93E-01
	Zinc	NA	NA	NA	NA	NA	1.62E-01	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	5.39E-01
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	5.08E-04	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	**5.08E+00**
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	6.20E-04	mg/kg-d	2.0E-05	mg/kg-d	Developmental	**3.10E+01**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	1.74E-09	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**1.74E+00**
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	6.96E-05	mg/kg-d	4.0E-03	mg/kg-d	Lung	1.74E-02
	Acenaphthene	NA	NA	NA	NA	NA	8.46E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.41E-04
	Acenaphthylene	NA	NA	NA	NA	NA	4.93E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	8.22E-05
	Anthracene	NA	NA	NA	NA	NA	2.32E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	7.73E-05
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	3.46E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.15E-04
	cPAHs, ND05	NA	NA	NA	NA	NA	2.42E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	5.70E-06	mg/kg-d	4.0E-02	mg/kg-d	Liver	1.43E-04
	Fluorene	NA	NA	NA	NA	NA	3.61E-05	mg/kg-d	4.0E-02	mg/kg-d	Blood	9.02E-04
	Naphthalene	NA	NA	NA	NA	NA	4.10E-05	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	2.05E-03
	Phenanthrene	NA	NA	NA	NA	NA	3.31E-05	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.10E-04
	Pyrene	NA	NA	NA	NA	NA	4.38E-05	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.46E-03
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	1.74E-08	mg/kg-d	1.0E-09	mg/kg-d	Developmental	**1.74E+01**
	4,4'-DDD	NA	NA	NA	NA	NA	2.31E-06	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	1.12E-05	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	6.84E-05	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.37E-01
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	7.42E-05	mg/kg-d	8.0E-03	mg/kg-d	Liver	9.28E-03
	Beta-BHC	NA	NA	NA	NA	NA	3.43E-05	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	5.77E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	7.88E-07	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.58E-03
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	1.18E-05	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	3.93E-02
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	1.71E-04	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	5.69E-03
	Pyridine	NA	NA	NA	NA	NA	9.00E-05	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.00E-02

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.07E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.33E-04
							Hazard Index (including PCBs as congeners)					**5.3E+01**
							Hazard Index (including PCBs as Aroclors)					**8.3E+01**

Total HI - All Pathways (2)		**5.4E+01**
Total HI - All Pathways (3)		**8.3E+01**
HI Segregated By Target Organ (PCBs as Aroclors only)		
	Cardiovascular	**1.4E+01**
	Developmental	**5.3E+01**
	Endocrine System	*5.7E-03*
	GI Tract	**1.9E+00**
	Hematologic System	**4.0E+00**
	Immune System	*3.9E-02*
	Kidney	**3.8E+00**
	Liver	*2.8E-01*
	Lungs	*1.7E-02*
	Nervous System	**5.7E+00**
	Reproductive System	*0.0E+00*
	Skin	**1.6E+01**
	Whole Body	*9.0E-02*
	Not Classified	**3.4E+01**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - HI includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-37
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	7.66E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.002553542
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.94E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	5.63042E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.49E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.15564E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.90E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	6.34064E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	8.03E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.67593E-08
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	8.87E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000443603
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	3.40E-12	mg/kg-d	1.0E-09	mg/kg-d		0.003401957
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.22E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.05E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	6.75344E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.10E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.83581E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.15E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.909E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.04E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.46571E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	8.52E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.84146E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.94E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	4.92661E-06
							Hazard Index					6.4E-03
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	8.45E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.00281551
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.88E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	2.69015E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.19E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.98552E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	9.09E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	3.02949E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	3.84E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.27853E-07
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	4.57E-08	mg/kg-d	2.0E-05	mg/kg-d		0.002282522
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	3.75E-12	mg/kg-d	6.0E-10	mg/kg-d		0.006251606
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	4.49E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.49E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.48209E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	4.05E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	6.74716E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	4.21E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.01616E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	3.82E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.27375E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	3.13E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.04432E-06

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.45E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.81068E-05
							Hazard Index					1.1E-02

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	1.29E-02	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	1.29E-02
	Antimony	NA	NA	NA	NA	NA	2.70E-06	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	6.76E-03
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	3.12E-04	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**1.04E+00**
	Barium	NA	NA	NA	NA	NA	3.71E-04	mg/kg-d	2.0E-01	mg/kg-d	Kidney	1.85E-03
	Cadmium	NA	NA	NA	NA	NA	1.08E-04	mg/kg-d	1.0E-03	mg/kg-d	Kidney	1.08E-01
	Cobalt	NA	NA	NA	NA	NA	7.74E-05	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	2.58E-01
	Copper	NA	NA	NA	NA	NA	2.36E-03	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	5.90E-02
	Iron	NA	NA	NA	NA	NA	1.28E-01	mg/kg-d	7.0E-01	mg/kg-d		1.82E-01
	Lead	NA	NA	NA	NA	NA	4.34E-04	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	4.19E-03	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	2.99E-02
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	1.24E-04	mg/kg-d	2.0E-02	mg/kg-d		6.21E-03
	Selenium	NA	NA	NA	NA	NA	3.92E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	7.83E-02
	Silver	NA	NA	NA	NA	NA	2.52E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	5.03E-02
	Vanadium	NA	NA	NA	NA	NA	2.21E-04	mg/kg-d	5.0E-03	mg/kg-d	Kidney	4.42E-02
	Zinc	NA	NA	NA	NA	NA	1.30E-02	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	4.34E-02
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	3.81E-05	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	3.81E-01
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	1.44E-05	mg/kg-d	2.0E-05	mg/kg-d	Developmental	7.22E-01

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	1.22E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmental	1.22E-01
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	5.12E-06	mg/kg-d	4.0E-03	mg/kg-d	Lung	1.28E-03
	Acenaphthene	NA	NA	NA	NA	NA	6.16E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.03E-05
	Acenaphthylene	NA	NA	NA	NA	NA	3.51E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	5.85E-06
	Anthracene	NA	NA	NA	NA	NA	1.69E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	5.62E-06
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	2.26E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	7.52E-06
	cPAHs, ND05	NA	NA	NA	NA	NA	1.42E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	3.47E-07	mg/kg-d	4.0E-02	mg/kg-d	Liver	8.67E-06
	Fluorene	NA	NA	NA	NA	NA	2.64E-06	mg/kg-d	4.0E-02	mg/kg-d	Blood	6.60E-05
	Naphthalene	NA	NA	NA	NA	NA	2.98E-06	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	1.49E-04
	Phenanthrene	NA	NA	NA	NA	NA	2.44E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	8.14E-06
	Pyrene	NA	NA	NA	NA	NA	3.19E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.06E-04
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	4.45E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmental	4.45E-01
	4,4'-DDD	NA	NA	NA	NA	NA	1.72E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	4.33E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	1.42E-06	mg/kg-d	5.0E-04	mg/kg-d	Liver	2.84E-03
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	5.44E-06	mg/kg-d	8.0E-03	mg/kg-d	Liver	6.81E-04
	Beta-BHC	NA	NA	NA	NA	NA	2.46E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	3.91E-07	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	5.88E-08	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.18E-04
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	9.05E-07	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	3.02E-03
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	0.00E+00
	Pyridine	NA	NA	NA	NA	NA	9.00E-05	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.00E-02

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.07E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.33E-04
							Hazard Index (including PCBs as congeners)					**3.0E+00**
							Hazard Index (including PCBs as Aroclors)					**3.6E+00**

Total HI - All Pathways (2)		**3.0E+00**
Total HI - All Pathways (3)		**3.6E+00**
HI Segregated By Target Organ (PCBs as Aroclors only)		
	Cardiovascular	**1.0E+00**
	Developmental	**1.5E+00**
	Endocrine System	*0.0E+00*
	GI Tract	*5.9E-02*
	Hematologic System	*3.0E-01*
	Immune System	*3.0E-03*
	Kidney	*1.6E-01*
	Liver	*9.7E-02*
	Lungs	*1.3E-03*
	Nervous System	*4.2E-01*
	Reproductive System	*0.0E+00*
	Skin	**1.2E+00**
	Whole Body	*6.8E-03*
	Not Classified	*9.2E-01*

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - HI includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-38
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	5.35E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.001782661
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.75E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.93067E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.74E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.90111E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.33E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	4.42648E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.60E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.8681E-08
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	6.19E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000309685
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	2.37E-12	mg/kg-d	1.0E-09	mg/kg-d		0.002374951
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	8.53E-11	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.83E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	4.71466E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	7.69E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.2816E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	8.00E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.3327E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	7.26E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.41946E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	5.95E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.98366E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.75E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	3.43933E-06
							Hazard Index					4.5E-03
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	9.83E-08	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.000327591
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.19E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.13005E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.39E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.3102E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.06E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	3.52488E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	4.46E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.4876E-08
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	5.31E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000265577
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	4.36E-13	mg/kg-d	6.0E-10	mg/kg-d		0.000727388
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	5.22E-11	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.73E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.88797E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	4.71E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.85047E-09
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	4.90E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	8.16345E-09
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	4.45E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.48204E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	3.65E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.21509E-07

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.69E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	2.10676E-06
							Hazard Index					1.3E-03

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	9.10E-03	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	9.10E-03
	Antimony	NA	NA	NA	NA	NA	1.90E-06	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	4.76E-03
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	2.20E-04	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	7.33E-01
	Barium	NA	NA	NA	NA	NA	2.61E-04	mg/kg-d	2.0E-01	mg/kg-d	Kidney	1.30E-03
	Cadmium	NA	NA	NA	NA	NA	7.61E-05	mg/kg-d	1.0E-03	mg/kg-d	Kidney	7.61E-02
	Cobalt	NA	NA	NA	NA	NA	5.45E-05	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	1.82E-01
	Copper	NA	NA	NA	NA	NA	1.67E-03	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	4.17E-02
	Iron	NA	NA	NA	NA	NA	8.98E-02	mg/kg-d	7.0E-01	mg/kg-d		1.28E-01
	Lead	NA	NA	NA	NA	NA	3.05E-04	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	2.95E-03	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	2.11E-02
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	8.75E-05	mg/kg-d	2.0E-02	mg/kg-d		4.38E-03
	Selenium	NA	NA	NA	NA	NA	2.76E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	5.52E-02
	Silver	NA	NA	NA	NA	NA	1.77E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	3.54E-02
	Vanadium	NA	NA	NA	NA	NA	1.56E-04	mg/kg-d	5.0E-03	mg/kg-d	Kidney	3.11E-02
	Zinc	NA	NA	NA	NA	NA	9.19E-03	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	3.06E-02
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	2.69E-05	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	2.69E-01
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	1.02E-05	mg/kg-d	2.0E-05	mg/kg-d	Developmental	5.09E-01

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	9.17E-11	mg/kg-d	1.0E-09	mg/kg-d	Developmental	9.17E-02
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	3.61E-06	mg/kg-d	4.0E-03	mg/kg-d	Lung	9.02E-04
	Acenaphthene	NA	NA	NA	NA	NA	4.38E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.30E-06
	Acenaphthylene	NA	NA	NA	NA	NA	2.47E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.12E-06
	Anthracene	NA	NA	NA	NA	NA	1.19E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	3.96E-06
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	1.59E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	5.30E-06
	cPAHs, ND05	NA	NA	NA	NA	NA	1.00E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	2.47E-07	mg/kg-d	4.0E-02	mg/kg-d	Liver	6.17E-06
	Fluorene	NA	NA	NA	NA	NA	1.86E-06	mg/kg-d	4.0E-02	mg/kg-d	Blood	4.65E-05
	Naphthalene	NA	NA	NA	NA	NA	2.11E-06	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	1.05E-04
	Phenanthrene	NA	NA	NA	NA	NA	1.72E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	5.74E-06
	Pyrene	NA	NA	NA	NA	NA	2.25E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	7.50E-05
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	1.94E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmental	1.94E-01
	4,4'-DDD	NA	NA	NA	NA	NA	1.21E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	3.05E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	1.00E-06	mg/kg-d	5.0E-04	mg/kg-d	Liver	2.00E-03
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	3.83E-06	mg/kg-d	8.0E-03	mg/kg-d	Liver	4.79E-04
	Beta-BHC	NA	NA	NA	NA	NA	1.74E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	2.75E-07	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	4.14E-08	mg/kg-d	5.0E-04	mg/kg-d	Liver	8.28E-05
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	6.37E-07	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	2.12E-03
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	0.00E+00
	Pyridine	NA	NA	NA	NA	NA	9.00E-05	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.00E-02

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.07E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.33E-04
							Hazard Index (including PCBs as congeners)					**2.0E+00**
							Hazard Index (including PCBs as Aroclors)					**2.4E+00**

Total HI - All Pathways (2)	**2.0E+00**
Total HI - All Pathways (3)	**2.4E+00**
HI Segregated By Target Organ (PCBs as Aroclors only)	
Cardiovascular	*7.4E-01*
Developmental	*9.7E-01*
Endocrine System	*0.0E+00*
GI Tract	*4.2E-02*
Hematologic System	*2.1E-01*
Immune System	*2.1E-03*
Kidney	*1.1E-01*
Liver	*9.5E-02*
Lungs	*9.0E-04*
Nervous System	*3.0E-01*
Reproductive System	*0.0E+00*
Skin	*8.3E-01*
Whole Body	*4.8E-03*
Not Classified	*6.5E-01*

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - HI includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-39
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	8.22E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.027402397
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.23E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	6.04207E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.68E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.45947E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.04E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	6.80422E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	8.61E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.87158E-07
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	9.52E-08	mg/kg-d	2.0E-05	mg/kg-d		0.00476036
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	3.65E-11	mg/kg-d	1.0E-09	mg/kg-d		0.036506849
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.31E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.35E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.2472E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.18E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.97003E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.23E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.04858E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.12E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.7191E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	9.15E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.04921E-06
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.23E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	5.28682E-05
							Hazard Index					6.9E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.14E-05	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.037979723
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.54E-07	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.62887E-06
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.61E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.67836E-06
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.23E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	4.08662E-06
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.17E-07	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.72467E-06
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	6.16E-07	mg/kg-d	2.0E-05	mg/kg-d		0.030790006
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	5.06E-11	mg/kg-d	6.0E-10	mg/kg-d		0.084330822
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	6.06E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.01E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.34821E-07
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.46E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	9.10156E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.68E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	9.46442E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	5.15E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.71822E-05
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	4.23E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.40874E-05

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.95E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	0.000244251
							Hazard Index					1.5E-01

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	2.25E-02	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	2.25E-02
	Antimony	NA	NA	NA	NA	NA	4.70E-06	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	1.18E-02
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	5.44E-04	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**1.81E+00**
	Barium	NA	NA	NA	NA	NA	6.45E-04	mg/kg-d	2.0E-01	mg/kg-d	Kidney	3.23E-03
	Cadmium	NA	NA	NA	NA	NA	1.88E-04	mg/kg-d	1.0E-03	mg/kg-d	Kidney	1.88E-01
	Cobalt	NA	NA	NA	NA	NA	1.35E-04	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	4.49E-01
	Copper	NA	NA	NA	NA	NA	4.13E-03	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	1.03E-01
	Iron	NA	NA	NA	NA	NA	2.22E-01	mg/kg-d	7.0E-01	mg/kg-d		3.17E-01
	Lead	NA	NA	NA	NA	NA	7.55E-04	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	7.29E-03	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	5.21E-02
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	2.16E-04	mg/kg-d	2.0E-02	mg/kg-d		1.08E-02
	Selenium	NA	NA	NA	NA	NA	6.82E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	1.36E-01
	Silver	NA	NA	NA	NA	NA	4.38E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	8.77E-02
	Vanadium	NA	NA	NA	NA	NA	3.85E-04	mg/kg-d	5.0E-03	mg/kg-d	Kidney	7.70E-02
	Zinc	NA	NA	NA	NA	NA	2.27E-02	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	7.57E-02
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	6.64E-05	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	6.64E-01
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	2.52E-05	mg/kg-d	2.0E-05	mg/kg-d	Developmental	**1.26E+00**

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	2.27E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmental	2.27E-01
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	8.93E-06	mg/kg-d	4.0E-03	mg/kg-d	Lung	2.23E-03
	Acenaphthene	NA	NA	NA	NA	NA	1.09E-06	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.82E-05
	Acenaphthylene	NA	NA	NA	NA	NA	6.13E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.02E-05
	Anthracene	NA	NA	NA	NA	NA	2.94E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	9.79E-06
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	3.93E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.31E-05
	cPAHs, ND05	NA	NA	NA	NA	NA	2.47E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	6.13E-07	mg/kg-d	4.0E-02	mg/kg-d	Liver	1.53E-05
	Fluorene	NA	NA	NA	NA	NA	4.60E-06	mg/kg-d	4.0E-02	mg/kg-d	Blood	1.15E-04
	Naphthalene	NA	NA	NA	NA	NA	5.21E-06	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	2.61E-04
	Phenanthrene	NA	NA	NA	NA	NA	4.26E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.42E-05
	Pyrene	NA	NA	NA	NA	NA	5.57E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.86E-04
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	4.80E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmental	4.80E-01
	4,4'-DDD	NA	NA	NA	NA	NA	3.00E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	7.54E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	2.48E-06	mg/kg-d	5.0E-04	mg/kg-d	Liver	4.95E-03
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	9.48E-06	mg/kg-d	8.0E-03	mg/kg-d	Liver	1.19E-03
	Beta-BHC	NA	NA	NA	NA	NA	4.31E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	6.80E-07	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	1.02E-07	mg/kg-d	5.0E-04	mg/kg-d	Liver	2.05E-04
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	1.58E-06	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	5.25E-03
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	0.00E+00
	Pyridine	NA	NA	NA	NA	NA	9.00E-05	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.00E-02

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.07E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.33E-04
							Hazard Index (including PCBs as congeners)					**4.8E+00**
							Hazard Index (including PCBs as Aroclors)					**5.9E+00**

Total HI - All Pathways (2)	**5.0E+00**
Total HI - All Pathways (3)	**6.1E+00**
HI Segregated By Target Organ (PCBs as Aroclors only)	
Cardiovascular	**1.9E+00**
Developmental	**2.4E+00**
Endocrine System	*0.0E+00*
GI Tract	*1.0E-01*
Hematologic System	*5.3E-01*
Immune System	*5.3E-03*
Kidney	*2.7E-01*
Liver	*1.0E-01*
Lungs	*2.2E-03*
Nervous System	*7.4E-01*
Reproductive System	*0.0E+00*
Skin	**2.1E+00**
Whole Body	*1.2E-02*
Not Classified	**1.7E+00**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - HI includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-40
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.26E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.004215753
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.51E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.2955E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.12E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	6.86073E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.14E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.0468E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.33E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.41781E-08
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.46E-08	mg/kg-d	2.0E-05	mg/kg-d		0.000732363
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	5.62E-12	mg/kg-d	1.0E-09	mg/kg-d		0.005616438
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.02E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	6.69E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.11495E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.82E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.03082E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.89E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.15166E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.72E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	5.72169E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.41E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.6911E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.51E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.13356E-06
							Hazard Index					1.1E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.06E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.000354123
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.37E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.38356E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.50E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.49731E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.14E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	3.81037E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	4.82E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.60808E-08
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	5.74E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000287086
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	4.72E-13	mg/kg-d	6.0E-10	mg/kg-d		0.000786301
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	5.65E-11	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.87E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.12187E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.09E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	8.4863E-09
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.29E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	8.82463E-09
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	4.81E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.60207E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	3.94E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.31351E-07

	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.82E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	2.2774E-06
							Hazard Index					1.4E-03

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
Ingestion	Aluminum	NA	NA	NA	NA	NA	1.59E-02	mg/kg-d	1.0E+00	mg/kg-d	Nervous System	1.59E-02
	Antimony	NA	NA	NA	NA	NA	3.32E-06	mg/kg-d	4.0E-04	mg/kg-d	Whole Body	8.29E-03
	Arsenic (Inorganic)	NA	NA	NA	NA	NA	3.84E-04	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	**1.28E+00**
	Barium	NA	NA	NA	NA	NA	4.55E-04	mg/kg-d	2.0E-01	mg/kg-d	Kidney	2.27E-03
	Cadmium	NA	NA	NA	NA	NA	1.33E-04	mg/kg-d	1.0E-03	mg/kg-d	Kidney	1.33E-01
	Cobalt	NA	NA	NA	NA	NA	9.50E-05	mg/kg-d	3.0E-04	mg/kg-d	Hematologic System	3.17E-01
	Copper	NA	NA	NA	NA	NA	2.91E-03	mg/kg-d	4.0E-02	mg/kg-d	GI Tract	7.28E-02
	Iron	NA	NA	NA	NA	NA	1.57E-01	mg/kg-d	7.0E-01	mg/kg-d		2.24E-01
	Lead	NA	NA	NA	NA	NA	5.33E-04	mg/kg-d	0.0E+00	mg/kg-d		
	Manganese	NA	NA	NA	NA	NA	5.14E-03	mg/kg-d	1.4E-01	mg/kg-d	Nervous System	3.67E-02
	Mercury	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System, Nervous System, Kidney	0.00E+00
	Nickel	NA	NA	NA	NA	NA	1.53E-04	mg/kg-d	2.0E-02	mg/kg-d		7.63E-03
	Selenium	NA	NA	NA	NA	NA	4.81E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	9.63E-02
	Silver	NA	NA	NA	NA	NA	3.09E-04	mg/kg-d	5.0E-03	mg/kg-d	Skin	6.18E-02
	Vanadium	NA	NA	NA	NA	NA	2.72E-04	mg/kg-d	5.0E-03	mg/kg-d	Kidney	5.43E-02
	Zinc	NA	NA	NA	NA	NA	1.60E-02	mg/kg-d	3.0E-01	mg/kg-d	Hematologic System	5.35E-02
	Tributyltin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Tributyltin oxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Immune System	0.00E+00
	Methyl mercury	NA	NA	NA	NA	NA	4.70E-05	mg/kg-d	1.0E-04	mg/kg-d	Nervous System, Developmental	4.70E-01
	Tetraethyl lead	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.0E-07	mg/kg-d	Liver	0.00E+00
	PCB, Sum of Aroclors, ND05	NA	NA	NA	NA	NA	1.78E-05	mg/kg-d	2.0E-05	mg/kg-d	Developmental	8.89E-01

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	PCB TEQ, ND05	NA	NA	NA	NA	NA	1.60E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmental	1.60E-01
	1-Methylnaphthalene	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	7.0E-02	mg/kg-d	Lung	0.00E+00
	2-Methylnaphthalene	NA	NA	NA	NA	NA	6.29E-06	mg/kg-d	4.0E-03	mg/kg-d	Lung	1.57E-03
	Acenaphthene	NA	NA	NA	NA	NA	7.68E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.28E-05
	Acenaphthylene	NA	NA	NA	NA	NA	4.32E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	7.20E-06
	Anthracene	NA	NA	NA	NA	NA	2.07E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	6.90E-06
	Benzo(ghi)perylene	NA	NA	NA	NA	NA	2.77E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	9.24E-06
	cPAHs, ND05	NA	NA	NA	NA	NA	1.74E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Fluoranthene	NA	NA	NA	NA	NA	4.33E-07	mg/kg-d	4.0E-02	mg/kg-d	Liver	1.08E-05
	Fluorene	NA	NA	NA	NA	NA	3.24E-06	mg/kg-d	4.0E-02	mg/kg-d	Blood	8.11E-05
	Naphthalene	NA	NA	NA	NA	NA	3.68E-06	mg/kg-d	2.0E-02	mg/kg-d	Nervous System	1.84E-04
	Phenanthrene	NA	NA	NA	NA	NA	3.01E-06	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.00E-05
	Pyrene	NA	NA	NA	NA	NA	3.93E-06	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.31E-04
	2,3,7,8-TCDD TEQ, ND05	NA	NA	NA	NA	NA	3.39E-10	mg/kg-d	1.0E-09	mg/kg-d	Developmental	3.39E-01
	4,4'-DDD	NA	NA	NA	NA	NA	2.11E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDE	NA	NA	NA	NA	NA	5.33E-07	mg/kg-d	0.0E+00	mg/kg-d		
	4,4'-DDT	NA	NA	NA	NA	NA	1.75E-06	mg/kg-d	5.0E-04	mg/kg-d	Liver	3.50E-03
	Aldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-05	mg/kg-d	Liver	0.00E+00
	Alpha-BHC	NA	NA	NA	NA	NA	6.69E-06	mg/kg-d	8.0E-03	mg/kg-d	Liver	8.36E-04
	Beta-BHC	NA	NA	NA	NA	NA	3.04E-06	mg/kg-d	0.0E+00	mg/kg-d		
	Delta-BHC	NA	NA	NA	NA	NA	4.81E-07	mg/kg-d	0.0E+00	mg/kg-d		
	Dieldrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-05	mg/kg-d	Liver	0.00E+00
	Endosulfan I	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endosulfan II	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	6.0E-03	mg/kg-d	Liver	0.00E+00
	Endrin	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-04	mg/kg-d	Liver, Nervous System	0.00E+00
	gamma-Chlordane	NA	NA	NA	NA	NA	7.22E-08	mg/kg-d	5.0E-04	mg/kg-d	Liver	1.44E-04
	Heptachlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-04	mg/kg-d	Liver, Immune System	0.00E+00
	Heptachlor Epoxide	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	1.3E-05	mg/kg-d	Liver	0.00E+00
	Lindane	NA	NA	NA	NA	NA	1.11E-06	mg/kg-d	3.0E-04	mg/kg-d	Liver, Kidney, Immune System	3.71E-03
	Methoxychlor	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	5.0E-03	mg/kg-d	Reproductive System	0.00E+00
	Bis(2-Ethylhexyl)phthalate	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-02	mg/kg-d	Reproductive System	0.00E+00
	Dibenzofuran	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	2.0E-03	mg/kg-d	Kidney	0.00E+00
	Pentachlorophenol	NA	NA	NA	NA	NA	0.00E+00	mg/kg-d	3.0E-02	mg/kg-d	Liver, Kidney, Endocrine System	0.00E+00
	Pyridine	NA	NA	NA	NA	NA	9.00E-05	mg/kg-d	1.0E-03	mg/kg-d	Liver	9.00E-02

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer) (1)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Reference Concentration	**Hazard Quotient**
	Hexachlorobenzene	NA	NA	NA	NA	NA	1.07E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.33E-04
							Hazard Index (including PCBs as congeners)					**3.4E+00**
							Hazard Index (including PCBs as Aroclors)					**4.2E+00**

Total HI - All Pathways (2)		**3.4E+00**
Total HI - All Pathways (3)		**4.2E+00**
HI Segregated By Target Organ (PCBs as Aroclors only)		
	Cardiovascular	**1.3E+00**
	Developmental	**1.7E+00**
	Endocrine System	*0.0E+00*
	GI Tract	*7.3E-02*
	Hematologic System	*3.7E-01*
	Immune System	*3.7E-03*
	Kidney	*1.9E-01*
	Liver	*9.8E-02*
	Lungs	*1.6E-03*
	Nervous System	*5.2E-01*
	Reproductive System	*0.0E+00*
	Skin	**1.4E+00**
	Whole Body	*8.3E-03*
	Not Classified	**1.1E+00**

Bolded text indicates HI exceeds 1.0.

(1) - Intake calculated in Tables C-45 through C-56.

(2) - HI includes PCBs as congeners for tissue.

(3) - HI includes PCBs as Aroclors for tissue.

Table C-41
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Residential User
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	7.23E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.002409002
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.72E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	5.31171E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.35E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	3.92042E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.79E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	5.98174E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	7.57E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.52446E-08
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	8.37E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000418493
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	3.21E-12	mg/kg-d	1.0E-09	mg/kg-d		0.003209393
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.15E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	3.82E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	6.37117E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.04E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.7319E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.08E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.80095E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	9.81E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.26954E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	8.04E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.68063E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.72E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	4.64775E-06
							Hazard Index					6.0E-03
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	7.97E-07	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.002656141
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.78E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	2.53788E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.12E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	1.87313E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	8.57E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	2.85801E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	3.62E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.20616E-07
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	4.31E-08	mg/kg-d	2.0E-05	mg/kg-d		0.002153323

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	3.54E-12	mg/kg-d	6.0E-10	mg/kg-d		0.005897742
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	4.24E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.40E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.3416E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	3.82E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	6.36525E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	3.97E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	6.61902E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	3.60E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.20165E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	2.96E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	9.85211E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.37E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	1.70819E-05
							Hazard Index					1.1E-02

Total HI - All Pathways	*1.7E-02*
HI Segregated By Target Organ	
Cardiovascular	*5.1E-03*
Developmental	*2.2E-05*
Endocrine System	*0.0E+00*
GI Tract	*0.0E+00*
Hematologic System	*0.0E+00*
Immune System	*0.0E+00*
Kidney	*3.5E-07*
Liver	*2.5E-05*
Lungs	*3.1E-07*
Reproductive System	*0.0E+00*
Skin	*5.1E-03*
Whole Body	*0.0E+00*
Not Classified	*1.2E-02*

Bolded text indicates HI exceeds 1.0.

Table C-42
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Residential User
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	8.22E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.027402397
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.23E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	6.04207E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.68E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.45947E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.04E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	6.80422E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	8.61E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.87158E-07
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	9.52E-08	mg/kg-d	2.0E-05	mg/kg-d		0.00476036
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	3.65E-11	mg/kg-d	1.0E-09	mg/kg-d		0.036506849
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.31E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.35E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.2472E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.18E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.97003E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.23E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.04858E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.12E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.7191E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	9.15E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.04921E-06
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.23E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	5.28682E-05
							Hazard Index					6.9E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.14E-05	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.037979723
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.54E-07	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.62887E-06
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.61E-07	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.67836E-06
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.23E-07	mg/kg-d	3.0E-02	mg/kg-d	Kidney	4.08662E-06
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	5.17E-07	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.72467E-06
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	6.16E-07	mg/kg-d	2.0E-05	mg/kg-d		0.030790006

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	5.06E-11	mg/kg-d	6.0E-10	mg/kg-d		0.084330822
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	6.06E-09	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	2.01E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.34821E-07
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	5.46E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	9.10156E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	5.68E-09	mg/kg-d	6.0E-03	mg/kg-d	Liver	9.46442E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	5.15E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.71822E-05
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	4.23E-09	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.40874E-05
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.95E-07	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	0.000244251
							Hazard Index					1.5E-01

Total HI - All Pathways	*2.2E-01*
HI Segregated By Target Organ	
Cardiovascular	*6.5E-02*
Developmental	*3.0E-04*
Endocrine System	*0.0E+00*
GI Tract	*0.0E+00*
Hematologic System	*0.0E+00*
Immune System	*0.0E+00*
Kidney	*4.8E-06*
Liver	*3.4E-04*
Lungs	*4.2E-06*
Reproductive System	*0.0E+00*
Skin	*6.5E-02*
Whole Body	*0.0E+00*
Not Classified	*1.6E-01*

Bolded text indicates HI exceeds 1.0.

Table C-43
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational User
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	8.67E-08	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.00028908
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.46E-10	mg/kg-d	7.0E-02	mg/kg-d	Lung	6.37406E-09
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.82E-10	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.7045E-09
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	2.15E-10	mg/kg-d	3.0E-02	mg/kg-d	Kidney	7.17808E-09
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	9.09E-10	mg/kg-d	3.0E-01	mg/kg-d	Liver	3.02935E-09
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.00E-09	mg/kg-d	2.0E-05	mg/kg-d		5.02192E-05
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	3.85E-13	mg/kg-d	1.0E-09	mg/kg-d		0.000385127
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	1.38E-11	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	4.59E-12	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.6454E-10
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.25E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.07828E-09
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.30E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.16114E-09
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.18E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.92344E-08
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	9.65E-12	mg/kg-d	3.0E-04	mg/kg-d	Liver	3.21675E-08
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	4.46E-10	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	5.5773E-07
							Hazard Index					7.3E-04
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	9.56E-08	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.000318737
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	2.13E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	3.04545E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	1.35E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	2.24776E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.03E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	3.42961E-08
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	4.34E-09	mg/kg-d	3.0E-01	mg/kg-d	Liver	1.44739E-08
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	5.17E-09	mg/kg-d	2.0E-05	mg/kg-d		0.000258399

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	4.25E-13	mg/kg-d	6.0E-10	mg/kg-d		0.000707729
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	5.08E-11	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	1.69E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	2.80991E-09
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	4.58E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.63829E-09
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	4.77E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	7.94282E-09
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	4.33E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.44198E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	3.55E-11	mg/kg-d	3.0E-04	mg/kg-d	Liver	1.18225E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	1.64E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	2.04982E-06
							Hazard Index					1.3E-03

Total HI - All Pathways	*2.0E-03*
HI Segregated By Target Organ	
Cardiovascular	*6.1E-04*
Developmental	*2.6E-06*
Endocrine System	*0.0E+00*
GI Tract	*0.0E+00*
Hematologic System	*0.0E+00*
Immune System	*0.0E+00*
Kidney	*4.1E-08*
Liver	*3.0E-06*
Lungs	*3.7E-08*
Reproductive System	*0.0E+00*
Skin	*6.1E-04*
Whole Body	*0.0E+00*
Not Classified	*1.4E-03*

Bolded text indicates HI exceeds 1.0.

Table C-44
CALCULATION OF NON-CANCER HAZARDS
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Beach/Intertidal Sediment
Exposure Medium: Beach/Intertidal Sediment
Exposure Point: On-Site
Receptor Population: Recreational User
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
Ingestion	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.26E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.004215753
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.51E-09	mg/kg-d	7.0E-02	mg/kg-d	Lung	9.2955E-08
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	4.12E-09	mg/kg-d	6.0E-02	mg/kg-d	Liver	6.86073E-08
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	3.14E-09	mg/kg-d	3.0E-02	mg/kg-d	Kidney	1.0468E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	1.33E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	4.41781E-08
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	1.46E-08	mg/kg-d	2.0E-05	mg/kg-d		0.000732363
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	5.62E-12	mg/kg-d	1.0E-09	mg/kg-d		0.005616438
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	2.02E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	6.69E-11	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.11495E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	1.82E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.03082E-08
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	1.89E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	3.15166E-08
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	1.72E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	5.72169E-07
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	1.41E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	4.6911E-07
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	6.51E-09	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	8.13356E-06
							Hazard Index					1.1E-02
Dermal	Arsenic	3.69E+00	mg/kg	3.69E+00	mg/kg	3.69E+00	1.75E-06	mg/kg-d	3.0E-04	mg/kg-d	Cardiovascular, Skin	0.005843034
	1-Methylnaphthalene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.91E-08	mg/kg-d	7.0E-02	mg/kg-d	Lung	5.58288E-07
	Acenaphthylene	1.20E-02	mg/kg	1.20E-02	mg/kg	1.20E-02	2.47E-08	mg/kg-d	6.0E-02	mg/kg-d	Liver	4.12055E-07
	Benzo(ghi)perylene	9.17E-03	mg/kg	9.17E-03	mg/kg	9.17E-03	1.89E-08	mg/kg-d	3.0E-02	mg/kg-d	Kidney	6.2871E-07
	Phenanthrene	3.87E-02	mg/kg	3.87E-02	mg/kg	3.87E-02	7.96E-08	mg/kg-d	3.0E-01	mg/kg-d	Liver	2.65334E-07
	PCB, Sum of Aroclors, ND05	4.28E-02	mg/kg	4.28E-02	mg/kg	4.28E-02	9.47E-08	mg/kg-d	2.0E-05	mg/kg-d		0.004736924

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Chronic Reference Dose	Reference Dose Units	Target Organ	Hazard Quotient
	2,3,7,8-TCDD TEQ, ND05	1.64E-05	mg/kg	1.64E-05	mg/kg	1.64E-05	7.78E-12	mg/kg-d	6.0E-10	mg/kg-d		0.012973973
	Delta-BHC	5.89E-04	mg/kg	5.89E-04	mg/kg	5.89E-04	9.32E-10	mg/kg-d	0.0E+00	mg/kg-d		
	Endosulfan I	1.95E-04	mg/kg	1.95E-04	mg/kg	1.95E-04	3.09E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	5.15109E-08
	Endosulfan II	5.31E-04	mg/kg	5.31E-04	mg/kg	5.31E-04	8.40E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.40024E-07
	Endosulfan Sulfate	5.52E-04	mg/kg	5.52E-04	mg/kg	5.52E-04	8.74E-10	mg/kg-d	6.0E-03	mg/kg-d	Liver	1.45606E-07
	Endrin Aldehyde	5.01E-04	mg/kg	5.01E-04	mg/kg	5.01E-04	7.93E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.64342E-06
	Endrin Ketone	4.11E-04	mg/kg	4.11E-04	mg/kg	4.11E-04	6.50E-10	mg/kg-d	3.0E-04	mg/kg-d	Liver	2.16729E-06
	Hexachlorobenzene	1.90E-02	mg/kg	1.90E-02	mg/kg	1.90E-02	3.01E-08	mg/kg-d	8.0E-04	mg/kg-d	Liver, Developmental	3.75771E-05
							Hazard Index					2.4E-02

Total HI - All Pathways	*3.4E-02*
HI Segregated By Target Organ	
Cardiovascular	*1.0E-02*
Developmental	*4.6E-05*
Endocrine System	*0.0E+00*
GI Tract	*0.0E+00*
Hematologic System	*0.0E+00*
Immune System	*0.0E+00*
Kidney	*7.3E-07*
Liver	*5.3E-05*
Lungs	*6.5E-07*
Reproductive System	*0.0E+00*
Skin	*1.0E-02*
Whole Body	*0.0E+00*
Not Classified	*2.4E-02*

Bolded text indicates HI exceeds 1.0.

Table C-45
CALCULATION OF FISH INTAKE
ADULT SUBSISTENCE FISHER (RME) - NONCANCER
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	1.7E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E-01	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	3.6E-05	0.0E+00	0.0E+00	3.6E-05	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	5.5E-05	5.0E-03	1.8E-06	6.1E-02	1.1E-04	1.4E+00	2.7E-03	7.8E-01	1.5E-03	9.0E-03	5.7E-06	4.3E-03	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	1.3E-03	2.0E+00	3.7E-03	0.0E+00	0.0E+00	5.0E-03	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	4.8E-06	9.3E-01	1.8E-03	4.8E-01	9.1E-04	2.6E-01	4.9E-04	4.0E-02	2.5E-05	3.2E-03	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	1.0E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-03	mg/kg-d
	Copper	5.5E-01	3.9E-04	6.1E-01	2.2E-04	2.9E+01	5.5E-02	7.4E+00	1.4E-02	1.8E+00	3.3E-03	5.1E+00	3.2E-03	7.6E-02	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	1.7E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E+00	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	5.5E-05	1.7E-02	3.2E-05	1.1E+00	2.0E-03	2.0E+00	3.8E-03	7.0E-03	4.4E-06	5.9E-03	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	5.7E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.7E-02	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00	mg/kg-d
	Nickel	7.4E-02	5.2E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	1.6E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E-03	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	1.5E-04	1.4E+00	2.6E-03	8.2E-01	1.6E-03	1.0E+00	1.9E-03	0.0E+00	0.0E+00	6.2E-03	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	1.8E-03	8.6E-01	1.6E-03	0.0E+00	0.0E+00	3.4E-03	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	3.0E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E-03	mg/kg-d
	Zinc	6.3E+00	4.5E-03	1.3E+01	4.7E-03	4.4E+01	8.2E-02	2.4E+01	4.6E-02	9.6E+00	1.8E-02	1.3E+01	7.9E-03	1.6E-01	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Methyl mercury	9.7E-02	6.9E-05	2.0E-02	7.3E-06	1.3E-01	2.5E-04	8.2E-02	1.6E-04	1.0E-02	1.9E-05	3.0E-02	1.9E-05	5.1E-04	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	4.8E-06	2.8E-01	5.2E-04	1.0E-02	1.9E-05	3.0E-02	5.6E-05	6.9E-03	4.3E-06	6.1E-04	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	5.2E-06	2.8E-01	5.3E-04	1.6E-02	3.0E-05	3.1E-02	5.8E-05	8.8E-03	5.5E-06	6.3E-04	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+00	2.4E-03	0.0E+00	0.0E+00	3.4E-02	6.4E-05	0.0E+00	0.0E+00	2.5E-03	mg/kg-d
	PCB TEQ, ND0	1.1E-07	8.1E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	8.2E-11	1.8E-07	3.4E-10	0.0E+00	0.0E+00	5.1E-10	mg/kg-d
	PCB TEQ, ND05	1.2E-07	8.8E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	1.2E-10	8.2E-07	1.6E-09	0.0E+00	0.0E+00	1.8E-09	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.6E-04	1.1E-06	0.0E+00	0.0E+00	3.6E-02	6.8E-05	1.8E-03	1.1E-06	7.0E-05	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	8.8E-08	1.8E-04	3.5E-07	1.7E-04	3.2E-07	2.6E-03	4.9E-06	4.8E-03	3.0E-06	8.7E-06	mg/kg-d
	Acenaphthylene	8.8E-05	6.2E-08	0.0E+00	0.0E+00	1.3E-04	2.5E-07	0.0E+00	0.0E+00	2.3E-03	4.3E-06	5.5E-04	3.5E-07	5.0E-06	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	5.5E-08	3.3E-04	6.2E-07	2.1E-04	4.0E-07	1.2E-02	2.2E-05	3.2E-04	2.0E-07	2.3E-05	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	4.1E-08	0.0E+00	0.0E+00	2.4E-04	4.4E-07	3.4E-04	6.4E-07	1.3E-03	2.4E-06	0.0E+00	0.0E+00	3.5E-06	mg/kg-d
	cPAHs, ND0	2.6E-05	1.8E-08	0.0E+00	0.0E+00	1.0E-03	1.9E-06	7.7E-04	1.5E-06	9.3E-03	1.8E-05	4.9E-05	3.1E-08	2.1E-05	mg/kg-d
	cPAHs, ND05	2.8E-05	2.0E-08	0.0E+00	0.0E+00	2.8E-03	5.3E-06	7.7E-04	1.5E-06	9.3E-03	1.8E-05	2.8E-04	1.8E-07	2.4E-05	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	1.5E-07	6.0E-04	1.1E-06	1.5E-03	2.8E-06	0.0E+00	0.0E+00	2.7E-03	1.7E-06	5.8E-06	mg/kg-d

C-45
Calculation of Fish Intake
Adult Subsistence Fisher (RME) -Noncancer
Port Angeles Harbor - Marine Sediment Investigation

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-04	7.5E-07	0.0E+00	0.0E+00	1.9E-02	3.5E-05	7.7E-04	4.9E-07	3.6E-05	mg/kg-d
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	2.5E-07	6.3E-04	1.2E-06	6.7E-04	1.3E-06	1.9E-02	3.6E-05	5.2E-03	3.3E-06	4.2E-05	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	2.5E-07	4.8E-04	9.1E-07	1.0E-03	1.9E-06	1.5E-02	2.8E-05	3.2E-03	2.0E-06	3.3E-05	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.9E-04	1.1E-06	1.2E-03	2.3E-06	2.1E-02	4.0E-05	1.7E-03	1.1E-06	4.4E-05	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	1.4E-11	1.0E-09	3.7E-13	6.4E-06	1.2E-08	1.1E-07	2.1E-10	1.1E-07	2.1E-10	1.4E-09	8.9E-13	1.3E-08	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	7.0E-11	2.7E-07	1.0E-10	6.4E-06	1.2E-08	1.4E-06	2.7E-09	1.2E-06	2.4E-09	2.2E-07	1.4E-10	1.8E-08	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	2.3E-06	0.0E+00	0.0E+00	2.3E-06	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	3.7E-07	3.7E-03	6.9E-06	1.6E-03	3.0E-06	5.0E-04	9.5E-07	0.0E+00	0.0E+00	1.1E-05	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	5.9E-07	3.1E-02	5.9E-05	1.7E-03	3.2E-06	3.0E-03	5.7E-06	1.3E-03	8.2E-07	6.9E-05	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	4.0E-07	7.1E-04	1.3E-06	3.8E-02	7.2E-05	4.7E-04	8.8E-07	6.4E-04	4.0E-07	7.5E-05	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	3.7E-07	8.0E-04	1.5E-06	1.5E-02	2.8E-05	4.2E-04	8.0E-07	6.0E-03	3.8E-06	3.5E-05	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	3.6E-07	1.3E-03	2.4E-06	1.6E-03	3.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.8E-06	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	7.9E-07	0.0E+00	0.0E+00	7.9E-07	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	2.6E-07	8.2E-04	1.6E-06	4.0E-03	7.6E-06	1.3E-03	2.5E-06	0.0E+00	0.0E+00	1.2E-05	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E-02	1.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E-04	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	3.4E-05	4.1E-01	7.7E-04	0.0E+00	0.0E+00	2.8E-01	1.8E-04	9.8E-04	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	1.2E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-06	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

Table C-46

CALCULATION OF FISH INTAKE

ADULT SUBSISTENCE FISHER (CT) - NONCANCER

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	8.7E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.7E-02	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	1.8E-05	0.0E+00	0.0E+00	1.8E-05	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	2.7E-05	5.0E-03	9.2E-07	6.1E-02	5.7E-05	1.4E+00	1.3E-03	7.8E-01	7.3E-04	9.0E-03	2.8E-06	2.2E-03	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	6.4E-04	2.0E+00	1.9E-03	0.0E+00	0.0E+00	2.5E-03	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	2.4E-06	9.3E-01	8.8E-04	4.8E-01	4.5E-04	2.6E-01	2.5E-04	4.0E-02	1.3E-05	1.6E-03	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	5.2E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.2E-04	mg/kg-d
	Copper	5.5E-01	1.9E-04	6.1E-01	1.1E-04	2.9E+01	2.7E-02	7.4E+00	7.0E-03	1.8E+00	1.7E-03	5.1E+00	1.6E-03	3.8E-02	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	8.6E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	2.8E-05	1.7E-02	1.6E-05	1.1E+00	9.9E-04	2.0E+00	1.9E-03	7.0E-03	2.2E-06	2.9E-03	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	2.8E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.8E-02	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00	mg/kg-d
	Nickel	7.4E-02	2.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	8.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.4E-04	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	7.3E-05	1.4E+00	1.3E-03	8.2E-01	7.8E-04	1.0E+00	9.4E-04	0.0E+00	0.0E+00	3.1E-03	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	8.9E-04	8.6E-01	8.1E-04	0.0E+00	0.0E+00	1.7E-03	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	1.5E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.5E-03	mg/kg-d
	Zinc	6.3E+00	2.2E-03	1.3E+01	2.3E-03	4.4E+01	4.1E-02	2.4E+01	2.3E-02	9.6E+00	9.1E-03	1.3E+01	4.0E-03	8.2E-02	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Methyl mercury	9.7E-02	3.4E-05	2.0E-02	3.7E-06	1.3E-01	1.2E-04	8.2E-02	7.8E-05	1.0E-02	9.5E-06	3.0E-02	9.5E-06	2.6E-04	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	2.4E-06	2.8E-01	2.6E-04	1.0E-02	9.7E-06	3.0E-02	2.8E-05	6.9E-03	2.2E-06	3.0E-04	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	2.6E-06	2.8E-01	2.6E-04	1.6E-02	1.5E-05	3.1E-02	2.9E-05	8.8E-03	2.8E-06	3.1E-04	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+00	1.2E-03	0.0E+00	0.0E+00	3.4E-02	3.2E-05	0.0E+00	0.0E+00	1.2E-03	mg/kg-d
	PCB TEQ, ND0	1.1E-07	4.0E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	4.1E-11	1.8E-07	1.7E-10	0.0E+00	0.0E+00	2.5E-10	mg/kg-d
	PCB TEQ, ND05	1.2E-07	4.4E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	5.8E-11	8.2E-07	7.8E-10	0.0E+00	0.0E+00	8.8E-10	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.6E-04	5.3E-07	0.0E+00	0.0E+00	3.6E-02	3.4E-05	1.8E-03	5.7E-07	3.5E-05	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	4.4E-08	1.8E-04	1.7E-07	1.7E-04	1.6E-07	2.6E-03	2.5E-06	4.8E-03	1.5E-06	4.3E-06	mg/kg-d
	Acenaphthylene	8.8E-05	3.1E-08	0.0E+00	0.0E+00	1.3E-04	1.3E-07	0.0E+00	0.0E+00	2.3E-03	2.2E-06	5.5E-04	1.7E-07	2.5E-06	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	2.8E-08	3.3E-04	3.1E-07	2.1E-04	2.0E-07	1.2E-02	1.1E-05	3.2E-04	1.0E-07	1.2E-05	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	2.1E-08	0.0E+00	0.0E+00	2.4E-04	2.2E-07	3.4E-04	3.2E-07	1.3E-03	1.2E-06	0.0E+00	0.0E+00	1.7E-06	mg/kg-d
	cPAHs, ND0	2.6E-05	9.1E-09	0.0E+00	0.0E+00	1.0E-03	9.6E-07	7.7E-04	7.3E-07	9.3E-03	8.8E-06	4.9E-05	1.5E-08	1.0E-05	mg/kg-d
	cPAHs, ND05	2.8E-05	9.9E-09	0.0E+00	0.0E+00	2.8E-03	2.6E-06	7.7E-04	7.3E-07	9.3E-03	8.8E-06	2.8E-04	8.9E-08	1.2E-05	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	7.7E-08	6.0E-04	5.7E-07	1.5E-03	1.4E-06	0.0E+00	0.0E+00	2.7E-03	8.5E-07	2.9E-06	mg/kg-d
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-04	3.8E-07	0.0E+00	0.0E+00	1.9E-02	1.8E-05	7.7E-04	2.4E-07	1.8E-05	mg/kg-d

C-46
Calculation of Fish Intake
Adult Subsistence Fisher (CT) -Noncancer
Port Angeles Harbor - Marine Sediment Investigation

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	1.3E-07	6.3E-04	6.0E-07	6.7E-04	6.3E-07	1.9E-02	1.8E-05	5.2E-03	1.6E-06	2.1E-05	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	1.2E-07	4.8E-04	4.5E-07	1.0E-03	9.5E-07	1.5E-02	1.4E-05	3.2E-03	1.0E-06	1.7E-05	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.9E-04	5.6E-07	1.2E-03	1.1E-06	2.1E-02	2.0E-05	1.7E-03	5.4E-07	2.2E-05	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	7.0E-12	1.0E-09	1.9E-13	6.4E-06	6.1E-09	1.1E-07	1.0E-10	1.1E-07	1.1E-10	1.4E-09	4.5E-13	6.3E-09	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	3.5E-11	2.7E-07	5.0E-11	6.4E-06	6.1E-09	1.4E-06	1.3E-09	1.2E-06	1.2E-09	2.2E-07	7.1E-11	8.8E-09	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	1.2E-06	0.0E+00	0.0E+00	1.2E-06	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	1.8E-07	3.7E-03	3.5E-06	1.6E-03	1.5E-06	5.0E-04	4.7E-07	0.0E+00	0.0E+00	5.6E-06	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	2.9E-07	3.1E-02	2.9E-05	1.7E-03	1.6E-06	3.0E-03	2.8E-06	1.3E-03	4.1E-07	3.4E-05	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	2.0E-07	7.1E-04	6.7E-07	3.8E-02	3.6E-05	4.7E-04	4.4E-07	6.4E-04	2.0E-07	3.7E-05	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	1.8E-07	8.0E-04	7.5E-07	1.5E-02	1.4E-05	4.2E-04	4.0E-07	6.0E-03	1.9E-06	1.7E-05	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	1.8E-07	1.3E-03	1.2E-06	1.6E-03	1.5E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.9E-06	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	4.0E-07	0.0E+00	0.0E+00	4.0E-07	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	1.3E-07	8.2E-04	7.8E-07	4.0E-03	3.8E-06	1.3E-03	1.3E-06	0.0E+00	0.0E+00	5.9E-06	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E-02	8.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-05	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	1.7E-05	4.1E-01	3.9E-04	0.0E+00	0.0E+00	2.8E-01	8.8E-05	4.9E-04	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	5.9E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.9E-07	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

C-47
Calculation of Fish Intake
Child Subsistence Fisher (RME) -Noncancer
Port Angeles Harbor - Marine Sediment Investigation

Table C-47
CALCULATION OF FISH INTAKE
CHILD SUBSISTENCE FISHER (RME) - NONCANCER
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	3.5E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.5E-01	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	7.2E-05	0.0E+00	0.0E+00	7E-05	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	1.1E-04	5.0E-03	3.8E-06	6.1E-02	2.3E-04	1.4E+00	5.3E-03	7.8E-01	2.9E-03	9.0E-03	1.1E-05	9E-03	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	2.6E-03	2.0E+00	7.4E-03	0.0E+00	0.0E+00	1E-02	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	9.8E-06	9.3E-01	3.5E-03	4.8E-01	1.8E-03	2.6E-01	9.8E-04	4.0E-02	4.8E-05	6E-03	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	2.1E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-03	mg/kg-d
	Copper	5.5E-01	7.6E-04	6.1E-01	4.6E-04	2.9E+01	1.1E-01	7.4E+00	2.8E-02	1.8E+00	6.6E-03	5.1E+00	6.1E-03	2E-01	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	3.4E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E+00	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	1.1E-04	1.7E-02	6.4E-05	1.1E+00	3.9E-03	2E+00	7.5E-03	7.0E-03	8.3E-06	1E-02	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	1.1E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-01	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	Nickel	7.4E-02	1.0E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	3.2E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E-03	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	3.0E-04	1.4E+00	5.2E-03	8.2E-01	3.1E-03	1.0E+00	3.7E-03	0.0E+00	0.0E+00	1E-02	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	3.5E-03	8.6E-01	3.2E-03	0.0E+00	0.0E+00	7E-03	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	5.9E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6E-03	mg/kg-d
	Zinc	6.3E+00	8.7E-03	1.3E+01	9.6E-03	4.4E+01	1.6E-01	2.4E+01	9.1E-02	9.6E+00	3.6E-02	1.3E+01	1.5E-02	3E-01	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Methyl mercury	9.7E-02	1.3E-04	2.0E-02	1.5E-05	1.3E-01	4.9E-04	8.2E-02	3.1E-04	1.0E-02	3.8E-05	3.0E-02	3.6E-05	1E-03	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	9.8E-06	2.8E-01	1.0E-03	1.0E-02	3.9E-05	3.0E-02	1.1E-04	6.9E-03	8.2E-06	1E-03	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	1.1E-05	2.8E-01	1.0E-03	1.6E-02	6.0E-05	3.1E-02	1.2E-04	8.8E-03	1.0E-05	1E-03	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+00	4.7E-03	0.0E+00	0.0E+00	3.4E-02	1.3E-04	0.0E+00	0.0E+00	5E-03	mg/kg-d
	PCB TEQ, ND0	1.1E-07	1.6E-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	1.6E-10	1.8E-07	6.8E-10	0.0E+00	0.0E+00	1E-09	mg/kg-d
	PCB TEQ, ND05	1.2E-07	1.7E-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	2.3E-10	8.2E-07	3.1E-09	0.0E+00	0.0E+00	3E-09	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.6E-04	2.1E-06	0.0E+00	0.0E+00	3.6E-02	1.4E-04	1.8E-03	2.1E-06	1E-04	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	1.8E-07	1.8E-04	6.8E-07	1.7E-04	6.4E-07	2.6E-03	9.7E-06	4.8E-03	5.7E-06	2E-05	mg/kg-d
	Acenaphthylene	8.8E-05	1.2E-07	0.0E+00	0.0E+00	1.3E-04	5.0E-07	0.0E+00	0.0E+00	2.3E-03	8.6E-06	5.5E-04	6.5E-07	1E-05	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	1.1E-07	3.3E-04	1.2E-06	2.1E-04	7.9E-07	1.2E-02	4.4E-05	3.2E-04	3.8E-07	5E-05	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	8.0E-08	0.0E+00	0.0E+00	2.4E-04	8.8E-07	3.4E-04	1.3E-06	1.3E-03	4.7E-06	0.0E+00	0.0E+00	7E-06	mg/kg-d
	cPAHs, ND0	2.6E-05	3.5E-08	0.0E+00	0.0E+00	1.0E-03	3.8E-06	7.7E-04	2.9E-06	9.3E-03	3.5E-05	4.9E-05	5.8E-08	4E-05	mg/kg-d
	cPAHs, ND05	2.8E-05	3.8E-08	0.0E+00	0.0E+00	2.8E-03	1.0E-05	7.7E-04	2.9E-06	9.3E-03	3.5E-05	2.8E-04	3.3E-07	5E-05	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	3.2E-07	6.0E-04	2.3E-06	1.5E-03	5.6E-06	0.0E+00	0.0E+00	2.7E-03	3.2E-06	1E-05	mg/kg-d
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-04	1.5E-06	0.0E+00	0.0E+00	1.9E-02	7.0E-05	7.7E-04	9.1E-07	7E-05	mg/kg-d

C-47
Calculation of Fish Intake
Child Subsistence Fisher (RME) -Noncancer
Port Angeles Harbor - Marine Sediment Investigation

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	5.2E-07	6.3E-04	2.4E-06	6.7E-04	2.5E-06	1.9E-02	7.0E-05	5.2E-03	6.2E-06	8E-05	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	5.1E-07	4.8E-04	1.8E-06	1.0E-03	3.8E-06	1.5E-02	5.6E-05	3.2E-03	3.8E-06	7E-05	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.9E-04	2.2E-06	1.2E-03	4.5E-06	2.1E-02	7.9E-05	1.7E-03	2.0E-06	9E-05	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	2.7E-11	1.0E-09	7.6E-13	6.4E-06	2.4E-08	1.1E-07	4.1E-10	1.1E-07	4.2E-10	1.4E-09	1.7E-12	2E-08	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	1.4E-10	2.7E-07	2.0E-10	6.4E-06	2.4E-08	1.4E-06	5.3E-09	1.2E-06	4.7E-09	2.2E-07	2.7E-10	3E-08	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	4.6E-06	0.0E+00	0.0E+00	5E-06	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	7.5E-07	3.7E-03	1.4E-05	1.6E-03	6.0E-06	5.0E-04	1.9E-06	0.0E+00	0.0E+00	2E-05	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	1.2E-06	3.1E-02	1.2E-04	1.7E-03	6.4E-06	3.0E-03	1.1E-05	1.3E-03	1.5E-06	1E-04	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	8.3E-07	7.1E-04	2.7E-06	3.8E-02	1.4E-04	4.7E-04	1.7E-06	6.4E-04	7.6E-07	1E-04	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	7.5E-07	8.0E-04	3.0E-06	1.5E-02	5.6E-05	4.2E-04	1.6E-06	6.0E-03	7.1E-06	7E-05	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	7.4E-07	1.3E-03	4.8E-06	1.6E-03	6.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-05	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	1.6E-06	0.0E+00	0.0E+00	2E-06	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	5.3E-07	8.2E-04	3.1E-06	4.0E-03	1.5E-05	1.3E-03	5.0E-06	0.0E+00	0.0E+00	2E-05	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E-02	3.4E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E-04	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	6.8E-05	4.1E-01	1.5E-03	0.0E+00	0.0E+00	2.8E-01	3.3E-04	2E-03	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	2.3E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-06	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

C-48
Calculation of Fish Intake
Child Subsistence Fisher (CT) -Noncancer
Port Angeles Harbor - Marine Sediment Investigation

Table C-48
CALCULATION OF FISH INTAKE
CHILD SUBSISTENCE FISHER (CT) - NONCANCER
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	1.7E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.7E-01	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	3.6E-05	0.0E+00	0.0E+00	4E-05	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	5.3E-05	5.0E-03	1.9E-06	6.1E-02	1.1E-04	1.4E+00	2.6E-03	7.8E-01	1.5E-03	9.0E-03	5.3E-06	4E-03	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	1.3E-03	2.0E+00	3.7E-03	0.0E+00	0.0E+00	5E-03	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	4.9E-06	9.3E-01	1.7E-03	4.8E-01	9.0E-04	2.6E-01	4.9E-04	4.0E-02	2.4E-05	3E-03	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	1.0E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-03	mg/kg-d
	Copper	5.5E-01	3.8E-04	6.1E-01	2.3E-04	2.9E+01	5.4E-02	7.4E+00	1.4E-02	1.8E+00	3.3E-03	5.1E+00	3.1E-03	8E-02	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	1.7E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E+00	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	5.6E-05	1.7E-02	3.2E-05	1.1E+00	2.0E-03	2E+00	3.7E-03	7.0E-03	4.2E-06	6E-03	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	5.6E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6E-02	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	Nickel	7.4E-02	5.1E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	1.6E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-03	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	1.5E-04	1.4E+00	2.6E-03	8.2E-01	1.5E-03	1.0E+00	1.9E-03	0.0E+00	0.0E+00	6E-03	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	1.8E-03	8.6E-01	1.6E-03	0.0E+00	0.0E+00	3E-03	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	3.0E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E-03	mg/kg-d
	Zinc	6.3E+00	4.3E-03	1.3E+01	4.8E-03	4.4E+01	8.2E-02	2.4E+01	4.5E-02	9.6E+00	1.8E-02	1.3E+01	7.5E-03	2E-01	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Methyl mercury	9.7E-02	6.7E-05	2.0E-02	7.5E-06	1.3E-01	2.4E-04	8.2E-02	1.5E-04	1.0E-02	1.9E-05	3.0E-02	1.8E-05	5E-04	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	4.9E-06	2.8E-01	5.2E-04	1.0E-02	1.9E-05	3.0E-02	5.6E-05	6.9E-03	4.1E-06	6E-04	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	5.3E-06	2.8E-01	5.2E-04	1.6E-02	3.0E-05	3.1E-02	5.8E-05	8.8E-03	5.2E-06	6E-04	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+00	2.4E-03	0.0E+00	0.0E+00	3.4E-02	6.3E-05	0.0E+00	0.0E+00	2E-03	mg/kg-d
	PCB TEQ, ND0	1.1E-07	7.8E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	8.1E-11	1.8E-07	3.4E-10	0.0E+00	0.0E+00	5E-10	mg/kg-d
	PCB TEQ, ND05	1.2E-07	8.5E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	1.1E-10	8.2E-07	1.5E-09	0.0E+00	0.0E+00	2E-09	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.6E-04	1.1E-06	0.0E+00	0.0E+00	3.6E-02	6.8E-05	1.8E-03	1.1E-06	7E-05	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	9.0E-08	1.8E-04	3.4E-07	1.7E-04	3.2E-07	2.6E-03	4.9E-06	4.8E-03	2.9E-06	8E-06	mg/kg-d
	Acenaphthylene	8.8E-05	6.1E-08	0.0E+00	0.0E+00	1.3E-04	2.5E-07	0.0E+00	0.0E+00	2.3E-03	4.3E-06	5.5E-04	3.3E-07	5E-06	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	5.6E-08	3.3E-04	6.1E-07	2.1E-04	3.9E-07	1.2E-02	2.2E-05	3.2E-04	1.9E-07	2E-05	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	4.0E-08	0.0E+00	0.0E+00	2.4E-04	4.4E-07	3.4E-04	6.4E-07	1.3E-03	2.3E-06	0.0E+00	0.0E+00	3E-06	mg/kg-d
	cPAHs, ND0	2.6E-05	1.8E-08	0.0E+00	0.0E+00	1.0E-03	1.9E-06	7.7E-04	1.4E-06	9.3E-03	1.7E-05	4.9E-05	2.9E-08	2E-05	mg/kg-d
	cPAHs, ND05	2.8E-05	1.9E-08	0.0E+00	0.0E+00	2.8E-03	5.2E-06	7.7E-04	1.5E-06	9.3E-03	1.7E-05	2.8E-04	1.7E-07	2E-05	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	1.6E-07	6.0E-04	1.1E-06	1.5E-03	2.8E-06	0.0E+00	0.0E+00	2.7E-03	1.6E-06	6E-06	mg/kg-d

C-48
Calculation of Fish Intake
Child Subsistence Fisher (CT) -Noncancer
Port Angeles Harbor - Marine Sediment Investigation

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-04	7.5E-07	0.0E+00	0.0E+00	1.9E-02	3.5E-05	7.7E-04	4.6E-07	4E-05	mg/kg-d
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	2.6E-07	6.3E-04	1.2E-06	6.7E-04	1.3E-06	1.9E-02	3.5E-05	5.2E-03	3.1E-06	4E-05	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	2.6E-07	4.8E-04	9.0E-07	1.0E-03	1.9E-06	1.5E-02	2.8E-05	3.2E-03	1.9E-06	3E-05	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.9E-04	1.1E-06	1.2E-03	2.3E-06	2.1E-02	3.9E-05	1.7E-03	1.0E-06	4E-05	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	1.3E-11	1.0E-09	3.8E-13	6.4E-06	1.2E-08	1.1E-07	2.1E-10	1.1E-07	2.1E-10	1.4E-09	8.4E-13	1E-08	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	6.8E-11	2.7E-07	1.0E-10	6.4E-06	1.2E-08	1.4E-06	2.7E-09	1.2E-06	2.3E-09	2.2E-07	1.3E-10	2E-08	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	2.3E-06	0.0E+00	0.0E+00	2E-06	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	3.8E-07	3.7E-03	6.9E-06	1.6E-03	3.0E-06	5.0E-04	9.4E-07	0.0E+00	0.0E+00	1E-05	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	6.0E-07	3.1E-02	5.8E-05	1.7E-03	3.2E-06	3.0E-03	5.6E-06	1.3E-03	7.7E-07	7E-05	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	4.1E-07	7.1E-04	1.3E-06	3.8E-02	7.1E-05	4.7E-04	8.7E-07	6.4E-04	3.8E-07	7E-05	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	3.8E-07	8.0E-04	1.5E-06	1.5E-02	2.8E-05	4.2E-04	7.9E-07	6.0E-03	3.6E-06	3E-05	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	3.7E-07	1.3E-03	2.4E-06	1.6E-03	3.0E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6E-06	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	7.9E-07	0.0E+00	0.0E+00	8E-07	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	2.6E-07	8.2E-04	1.5E-06	4.0E-03	7.5E-06	1.3E-03	2.5E-06	0.0E+00	0.0E+00	1E-05	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E-02	1.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-04	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	3.4E-05	4.1E-01	7.7E-04	0.0E+00	0.0E+00	2.8E-01	1.7E-04	1E-03	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	1.2E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-06	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

Table C-49

CALCULATION OF FISH INTAKE

ADULT/CHILD SUBSISTENCE FISHER (RME) - CANCER

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (RME)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	1.9E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-01	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	4.0E-05	0.0E+00	0.0E+00	4E-05	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	5.9E-05	5.0E-03	2.0E-06	6.1E-02	1.2E-04	1.4E+00	2.9E-03	7.8E-01	1.6E-03	9.0E-03	6.1E-06	5E-03	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	1.4E-03	2.0E+00	4.0E-03	0.0E+00	0.0E+00	5E-03	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	5.2E-06	9.3E-01	1.9E-03	4.8E-01	9.8E-04	2.6E-01	5.4E-04	4.0E-02	2.7E-05	3E-03	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	1.1E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-03	mg/kg-d
	Copper	5.5E-01	4.2E-04	6.1E-01	2.4E-04	2.9E+01	5.9E-02	7.4E+00	1.5E-02	1.8E+00	3.6E-03	5.1E+00	3.5E-03	8E-02	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	1.9E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E+00	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	6.0E-05	1.7E-02	3.5E-05	1.1E+00	2.2E-03	2E+00	4.1E-03	7.0E-03	4.7E-06	6E-03	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	6.1E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6E-02	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	Nickel	7.4E-02	5.7E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	1.8E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-03	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	1.6E-04	1.4E+00	2.8E-03	8.2E-01	1.7E-03	1.0E+00	2.0E-03	0.0E+00	0.0E+00	7E-03	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	1.9E-03	8.6E-01	1.8E-03	0.0E+00	0.0E+00	4E-03	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	3.2E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E-03	mg/kg-d
	Zinc	6.3E+00	4.8E-03	1.3E+01	5.1E-03	4.4E+01	8.9E-02	2.4E+01	5.0E-02	9.6E+00	2.0E-02	1.3E+01	8.5E-03	2E-01	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Methyl mercury	9.7E-02	7.4E-05	2.0E-02	8.0E-06	1.3E-01	2.7E-04	8.2E-02	1.7E-04	1.0E-02	2.1E-05	3.0E-02	2.0E-05	6E-04	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	5.2E-06	2.8E-01	5.7E-04	1.0E-02	2.1E-05	3.0E-02	6.1E-05	6.9E-03	4.7E-06	7E-04	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	5.6E-06	2.8E-01	5.7E-04	1.6E-02	3.3E-05	3.1E-02	6.3E-05	8.8E-03	6.0E-06	7E-04	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+00	2.6E-03	0.0E+00	0.0E+00	3.4E-02	6.9E-05	0.0E+00	0.0E+00	3E-03	mg/kg-d
	PCB TEQ, ND0	1.1E-07	8.7E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	8.8E-11	1.8E-07	3.7E-10	0.0E+00	0.0E+00	5E-10	mg/kg-d
	PCB TEQ, ND05	1.2E-07	9.5E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	1.3E-10	8.2E-07	1.7E-09	0.0E+00	0.0E+00	2E-09	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.6E-04	1.1E-06	0.0E+00	0.0E+00	3.6E-02	7.4E-05	1.8E-03	1.2E-06	8E-05	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	9.6E-08	1.8E-04	3.7E-07	1.7E-04	3.5E-07	2.6E-03	5.3E-06	4.8E-03	3.3E-06	9E-06	mg/kg-d
	Acenaphthylene	8.8E-05	6.7E-08	0.0E+00	0.0E+00	1.3E-04	2.7E-07	0.0E+00	0.0E+00	2.3E-03	4.7E-06	5.5E-04	3.7E-07	5E-06	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	6.0E-08	3.3E-04	6.7E-07	2.1E-04	4.3E-07	1.2E-02	2.4E-05	3.2E-04	2.2E-07	3E-05	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	4.4E-08	0.0E+00	0.0E+00	2.4E-04	4.8E-07	3.4E-04	7.0E-07	1.3E-03	2.6E-06	0.0E+00	0.0E+00	4E-06	mg/kg-d
	cPAHs, ND0	2.6E-05	3.3E-08	0.0E+00	0.0E+00	1.0E-03	3.5E-06	7.7E-04	2.6E-06	9.3E-03	3.2E-05	4.9E-05	5.4E-08	4E-05	mg/kg-d
	cPAHs, ND05	2.8E-05	3.6E-08	0.0E+00	0.0E+00	2.8E-03	9.6E-06	7.7E-04	2.7E-06	9.3E-03	3.2E-05	2.8E-04	3.1E-07	4E-05	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	1.7E-07	6.0E-04	1.2E-06	1.5E-03	3.1E-06	0.0E+00	0.0E+00	2.7E-03	1.8E-06	6E-06	mg/kg-d

C-49
Calculation of Fish Intake
Adult/Child Subsistence Fisher (RME) -Cancer
Port Angeles Harbor - Marine Sediment Investigation

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-04	8.2E-07	0.0E+00	0.0E+00	1.9E-02	3.8E-05	7.7E-04	5.2E-07	4E-05	mg/kg-d
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	2.8E-07	6.3E-04	1.3E-06	6.7E-04	1.4E-06	1.9E-02	3.9E-05	5.2E-03	3.5E-06	4E-05	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	2.7E-07	4.8E-04	9.8E-07	1.0E-03	2.1E-06	1.5E-02	3.1E-05	3.2E-03	2.2E-06	4E-05	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.9E-04	1.2E-06	1.2E-03	2.5E-06	2.1E-02	4.3E-05	1.7E-03	1.2E-06	5E-05	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	1.5E-11	1.0E-09	4.1E-13	6.4E-06	1.3E-08	1.1E-07	2.2E-10	1.1E-07	2.3E-10	1.4E-09	9.6E-13	1E-08	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	7.5E-11	2.7E-07	1.1E-10	6.4E-06	1.3E-08	1.4E-06	2.9E-09	1.2E-06	2.6E-09	2.2E-07	1.5E-10	2E-08	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	2.5E-06	0.0E+00	0.0E+00	3E-06	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	4.0E-07	3.7E-03	7.5E-06	1.6E-03	3.3E-06	5.0E-04	1.0E-06	0.0E+00	0.0E+00	1E-05	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	6.4E-07	3.1E-02	6.4E-05	1.7E-03	3.5E-06	3.0E-03	6.2E-06	1.3E-03	8.8E-07	7E-05	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	4.4E-07	7.1E-04	1.5E-06	3.8E-02	7.8E-05	4.7E-04	9.6E-07	6.4E-04	4.3E-07	8E-05	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	4.0E-07	8.0E-04	1.6E-06	1.5E-02	3.1E-05	4.2E-04	8.6E-07	6.0E-03	4.1E-06	4E-05	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	4.0E-07	1.3E-03	2.6E-06	1.6E-03	3.3E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6E-06	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	8.6E-07	0.0E+00	0.0E+00	9E-07	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	2.8E-07	8.2E-04	1.7E-06	4.0E-03	8.2E-06	1.3E-03	2.7E-06	0.0E+00	0.0E+00	1E-05	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E-02	1.9E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-04	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	3.7E-05	4.1E-01	8.4E-04	0.0E+00	0.0E+00	2.8E-01	1.9E-04	1E-03	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	1.3E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-06	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

Table C-50

CALCULATION OF FISH INTAKE

ADULT/CHILD SUBSISTENCE FISHER (CT) - CANCER

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Subsistence Fisher (CT)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	9.5E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.5E-02	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	2.0E-05	0.0E+00	0.0E+00	2E-05	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	2.9E-05	5.0E-03	1.0E-06	6.1E-02	6.2E-05	1.4E+00	1.4E-03	7.8E-01	8.0E-04	9.0E-03	3.1E-06	2E-03	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	7.0E-04	2.0E+00	2.0E-03	0.0E+00	0.0E+00	3E-03	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	2.6E-06	9.3E-01	9.5E-04	4.8E-01	4.9E-04	2.6E-01	2.7E-04	4.0E-02	1.4E-05	2E-03	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	5.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6E-04	mg/kg-d
	Copper	5.5E-01	2.1E-04	6.1E-01	1.2E-04	2.9E+01	3.0E-02	7.4E+00	7.6E-03	1.8E+00	1.8E-03	5.1E+00	1.7E-03	4E-02	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	9.3E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9E-01	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	3.0E-05	1.7E-02	1.7E-05	1.1E+00	1.1E-03	2E+00	2.0E-03	7.0E-03	2.4E-06	3E-03	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	3.1E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E-02	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	Nickel	7.4E-02	2.8E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	8.8E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9E-04	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	8.0E-05	1.4E+00	1.4E-03	8.2E-01	8.4E-04	1.0E+00	1.0E-03	0.0E+00	0.0E+00	3E-03	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	9.6E-04	8.6E-01	8.8E-04	0.0E+00	0.0E+00	2E-03	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	1.6E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-03	mg/kg-d
	Zinc	6.3E+00	2.4E-03	1.3E+01	2.6E-03	4.4E+01	4.5E-02	2.4E+01	2.5E-02	9.6E+00	9.9E-03	1.3E+01	4.3E-03	9E-02	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Methyl mercury	9.7E-02	3.7E-05	2.0E-02	4.0E-06	1.3E-01	1.3E-04	8.2E-02	8.4E-05	1.0E-02	1.0E-05	3.0E-02	1.0E-05	3E-04	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	2.6E-06	2.8E-01	2.8E-04	1.0E-02	1.1E-05	3.0E-02	3.0E-05	6.9E-03	2.3E-06	3E-04	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	2.8E-06	2.8E-01	2.9E-04	1.6E-02	1.6E-05	3.1E-02	3.1E-05	8.8E-03	3.0E-06	3E-04	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E+00	1.3E-03	0.0E+00	0.0E+00	3.4E-02	3.4E-05	0.0E+00	0.0E+00	1E-03	mg/kg-d
	PCB TEQ, ND0	1.1E-07	4.4E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	4.4E-11	1.8E-07	1.9E-10	0.0E+00	0.0E+00	3E-10	mg/kg-d
	PCB TEQ, ND05	1.2E-07	4.7E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	6.3E-11	8.2E-07	8.4E-10	0.0E+00	0.0E+00	1E-09	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.6E-04	5.7E-07	0.0E+00	0.0E+00	3.6E-02	3.7E-05	1.8E-03	6.1E-07	4E-05	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	4.8E-08	1.8E-04	1.9E-07	1.7E-04	1.7E-07	2.6E-03	2.7E-06	4.8E-03	1.6E-06	5E-06	mg/kg-d
	Acenaphthylene	8.8E-05	3.4E-08	0.0E+00	0.0E+00	1.3E-04	1.4E-07	0.0E+00	0.0E+00	2.3E-03	2.3E-06	5.5E-04	1.9E-07	3E-06	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	3.0E-08	3.3E-04	3.4E-07	2.1E-04	2.2E-07	1.2E-02	1.2E-05	3.2E-04	1.1E-07	1E-05	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	2.2E-08	0.0E+00	0.0E+00	2.4E-04	2.4E-07	3.4E-04	3.5E-07	1.3E-03	1.3E-06	0.0E+00	0.0E+00	2E-06	mg/kg-d
	cPAHs, ND0	2.6E-05	1.6E-08	0.0E+00	0.0E+00	1.0E-03	1.8E-06	7.7E-04	1.3E-06	9.3E-03	1.6E-05	4.9E-05	2.7E-08	2E-05	mg/kg-d
	cPAHs, ND05	2.8E-05	1.8E-08	0.0E+00	0.0E+00	2.8E-03	4.8E-06	7.7E-04	1.3E-06	9.3E-03	1.6E-05	2.8E-04	1.6E-07	2E-05	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	8.4E-08	6.0E-04	6.2E-07	1.5E-03	1.5E-06	0.0E+00	0.0E+00	2.7E-03	9.2E-07	3E-06	mg/kg-d

C-50
Calculation of Fish Intake
Adult/Child Subsistence Fisher (CT) -Cancer
Port Angeles Harbor - Marine Sediment Investigation

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-04	4.1E-07	0.0E+00	0.0E+00	1.9E-02	1.9E-05	7.7E-04	2.6E-07	2E-05	mg/kg-d
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	1.4E-07	6.3E-04	6.5E-07	6.7E-04	6.9E-07	1.9E-02	1.9E-05	5.2E-03	1.8E-06	2E-05	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	1.4E-07	4.8E-04	4.9E-07	1.0E-03	1.0E-06	1.5E-02	1.5E-05	3.2E-03	1.1E-06	2E-05	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.9E-04	6.1E-07	1.2E-03	1.2E-06	2.1E-02	2.2E-05	1.7E-03	5.8E-07	2E-05	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	7.5E-12	1.0E-09	2.0E-13	6.4E-06	6.6E-09	1.1E-07	1.1E-10	1.1E-07	1.2E-10	1.4E-09	4.8E-13	7E-09	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	3.8E-11	2.7E-07	5.5E-11	6.4E-06	6.6E-09	1.4E-06	1.5E-09	1.2E-06	1.3E-09	2.2E-07	7.6E-11	9E-09	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	1.3E-06	0.0E+00	0.0E+00	1E-06	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	2.0E-07	3.7E-03	3.8E-06	1.6E-03	1.6E-06	5.0E-04	5.1E-07	0.0E+00	0.0E+00	6E-06	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	3.2E-07	3.1E-02	3.2E-05	1.7E-03	1.7E-06	3.0E-03	3.1E-06	1.3E-03	4.4E-07	4E-05	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	2.2E-07	7.1E-04	7.3E-07	3.8E-02	3.9E-05	4.7E-04	4.8E-07	6.4E-04	2.2E-07	4E-05	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	2.0E-07	8.0E-04	8.2E-07	1.5E-02	1.5E-05	4.2E-04	4.3E-07	6.0E-03	2.0E-06	2E-05	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	2.0E-07	1.3E-03	1.3E-06	1.6E-03	1.6E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E-06	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	4.3E-07	0.0E+00	0.0E+00	4E-07	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	1.4E-07	8.2E-04	8.4E-07	4.0E-03	4.1E-06	1.3E-03	1.4E-06	0.0E+00	0.0E+00	6E-06	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E-02	9.3E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9E-05	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	1.8E-05	4.1E-01	4.2E-04	0.0E+00	0.0E+00	2.8E-01	9.5E-05	5E-04	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	6.4E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6E-07	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

Table C-51

CALCULATION OF FISH INTAKE

ADULT RECREATIONAL FISHER (RME) - NONCANCER

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	1.3E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.3E-02	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	2.7E-06	0.0E+00	0.0E+00	3E-06	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	4.0E-06	5.0E-03	1.4E-07	1.1E-02	1.5E-06	1.4E+00	2.0E-04	7.8E-01	1.1E-04	9.0E-03	4.2E-07	3E-04	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	9.5E-05	2.0E+00	2.8E-04	0.0E+00	0.0E+00	4E-04	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	3.5E-07	1.5E-02	2.1E-06	4.8E-01	6.7E-05	2.6E-01	3.7E-05	4.0E-02	1.9E-06	1E-04	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	7.7E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8E-05	mg/kg-d
	Copper	5.5E-01	2.9E-05	6.1E-01	1.7E-05	5.6E+00	7.9E-04	7.4E+00	1.0E-03	1.8E+00	2.5E-04	5.1E+00	2.4E-04	2E-03	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	1.3E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-01	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	4.1E-06	1.7E-02	2.4E-06	1.1E+00	1.5E-04	2E+00	2.8E-04	7.0E-03	3.3E-07	4E-04	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	4.2E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4E-03	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	Nickel	7.4E-02	3.9E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	1.2E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-04	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	1.1E-05	9.0E-01	1.3E-04	8.2E-01	1.2E-04	1.0E+00	1.4E-04	0.0E+00	0.0E+00	4E-04	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	1.3E-04	8.6E-01	1.2E-04	0.0E+00	0.0E+00	3E-04	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	2.2E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-04	mg/kg-d
	Zinc	6.3E+00	3.3E-04	1.3E+01	3.5E-04	5.0E+01	7.0E-03	2.4E+01	3.4E-03	9.6E+00	1.3E-03	1.3E+01	5.9E-04	1E-02	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Methyl mercury	9.7E-02	5.1E-06	2.0E-02	5.4E-07	1.3E-01	1.8E-05	8.2E-02	1.1E-05	1.0E-02	1.4E-06	3.0E-02	1.4E-06	4E-05	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	3.6E-07	5.0E-02	7.0E-06	1.0E-02	1.4E-06	3.0E-02	4.2E-06	6.9E-03	3.2E-07	1E-05	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	3.8E-07	5.1E-02	7.1E-06	1.6E-02	2.2E-06	3.1E-02	4.3E-06	8.8E-03	4.1E-07	1E-05	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-01	1.4E-05	0.0E+00	2.4E-03	3.4E-02	4.7E-06	0.0E+00	0.0E+00	2E-03	mg/kg-d
	PCB TEQ, ND0	1.1E-07	5.9E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	0.0E+00	1.8E-07	2.5E-11	0.0E+00	0.0E+00	3E-11	mg/kg-d
	PCB TEQ, ND05	1.2E-07	6.4E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	0.0E+00	8.2E-07	1.2E-10	0.0E+00	0.0E+00	1E-10	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E-02	5.0E-06	1.8E-03	8.4E-08	5E-06	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	6.5E-09	0.0E+00	0.0E+00	1.7E-04	2.4E-08	2.6E-03	3.6E-07	4.8E-03	2.2E-07	6E-07	mg/kg-d
	Acenaphthylene	8.8E-05	4.6E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E-03	3.2E-07	5.5E-04	2.6E-08	4E-07	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	4.1E-09	0.0E+00	0.0E+00	2.1E-04	2.9E-08	1.2E-02	1.6E-06	3.2E-04	1.5E-08	2E-06	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	3.0E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-04	4.8E-08	1.3E-03	1.8E-07	0.0E+00	0.0E+00	2E-07	mg/kg-d
	cPAHs, ND0	2.6E-05	1.3E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	1.1E-07	9.3E-03	1.3E-06	4.9E-05	2.3E-09	1E-06	mg/kg-d
	cPAHs, ND05	2.8E-05	1.5E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	1.1E-07	9.3E-03	1.3E-06	2.8E-04	1.3E-08	1E-06	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	1.1E-08	0.0E+00	0.0E+00	1.5E-03	2.1E-07	0.0E+00	0.0E+00	2.7E-03	1.3E-07	3E-07	mg/kg-d

C-51
Calculation of Fish Intake
Adult Recreational Fisher (RME) -Noncancer
Port Angeles Harbor - Marine Sediment Investigation

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	2.6E-06	7.7E-04	3.6E-08	3E-06	mg/kg-d
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	1.9E-08	0.0E+00	0.0E+00	6.7E-04	9.4E-08	1.9E-02	2.6E-06	5.2E-03	2.4E-07	3E-06	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	1.8E-08	2.4E-04	3.4E-08	1.0E-03	1.4E-07	1.5E-02	2.1E-06	3.2E-03	1.5E-07	2E-06	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	1.7E-07	2.1E-02	2.9E-06	1.7E-03	7.9E-08	3E-06	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	1.0E-12	1.0E-09	2.8E-14	3.2E-07	4.4E-11	1.1E-07	1.5E-11	1.1E-07	1.6E-11	1.4E-09	6.6E-14	8E-11	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	5.1E-12	2.7E-07	7.4E-12	3.4E-07	4.8E-11	1.4E-06	2.0E-10	1.2E-06	1.7E-10	2.2E-07	1.0E-11	4E-10	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	1.7E-07	0.0E+00	0.0E+00	2E-07	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	2.7E-08	8.0E-04	1.1E-07	1.6E-03	2.2E-07	5.0E-04	7.0E-08	0.0E+00	0.0E+00	4E-07	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	4.3E-08	4.7E-03	6.6E-07	1.7E-03	2.4E-07	3.0E-03	4.2E-07	1.3E-03	6.0E-08	1E-06	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	3.0E-08	0.0E+00	0.0E+00	3.8E-02	5.3E-06	4.7E-04	6.5E-08	6.4E-04	3.0E-08	5E-06	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	2.7E-08	0.0E+00	0.0E+00	1.5E-02	2.1E-06	4.2E-04	5.9E-08	6.0E-03	2.8E-07	2E-06	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	2.7E-08	1.0E-03	1.4E-07	1.6E-03	2.2E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4E-07	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	5.9E-08	0.0E+00	0.0E+00	6E-08	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	1.9E-08	1.0E-03	1.4E-07	4.0E-03	5.6E-07	1.3E-03	1.9E-07	0.0E+00	0.0E+00	9E-07	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	2.5E-06	4.1E-01	5.7E-05	0.0E+00	0.0E+00	2.8E-01	1.3E-05	7E-05	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	8.7E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9E-08	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

C-52
Calculation of Fish Intake
Adult Recreational Fisher (CT) -Noncancer
Port Angeles Harbor - Marine Sediment Investigation

Table C-52
CALCULATION OF FISH INTAKE
ADULT RECREATIONAL FISHER (CT) - NONCANCER
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	9.1E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E-03	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	1.9E-06	0.0E+00	0.0E+00	2E-06	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	2.9E-06	5.0E-03	9.6E-08	1.1E-02	1.1E-06	1.4E+00	1.4E-04	7.8E-01	7.7E-05	9.0E-03	3.0E-07	2E-04	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	6.7E-05	2.0E+00	1.9E-04	0.0E+00	0.0E+00	3E-04	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	2.5E-07	1.5E-02	1.5E-06	4.8E-01	4.7E-05	2.6E-01	2.6E-05	4.0E-02	1.3E-06	8E-05	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	5.5E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5E-05	mg/kg-d
	Copper	5.5E-01	2.0E-05	6.1E-01	1.2E-05	5.6E+00	5.6E-04	7.4E+00	7.3E-04	1.8E+00	1.7E-04	5.1E+00	1.7E-04	2E-03	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	9.0E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9E-02	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	2.9E-06	1.7E-02	1.7E-06	1.1E+00	1.0E-04	2E+00	2.0E-04	7.0E-03	2.4E-07	3E-04	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	2.9E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E-03	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	Nickel	7.4E-02	2.7E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	8.5E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9E-05	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	7.7E-06	9.0E-01	8.9E-05	8.2E-01	8.1E-05	1.0E+00	9.8E-05	0.0E+00	0.0E+00	3E-04	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	9.3E-05	8.6E-01	8.5E-05	0.0E+00	0.0E+00	2E-04	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	1.6E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-04	mg/kg-d
	Zinc	6.3E+00	2.3E-04	1.3E+01	2.5E-04	5.0E+01	4.9E-03	2.4E+01	2.4E-03	9.6E+00	9.5E-04	1.3E+01	4.2E-04	9E-03	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Methyl mercury	9.7E-02	3.6E-06	2.0E-02	3.9E-07	1.3E-01	1.3E-05	8.2E-02	8.1E-06	1.0E-02	9.9E-07	3.0E-02	1.0E-06	3E-05	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	2.5E-07	5.0E-02	4.9E-06	1.0E-02	1.0E-06	3.0E-02	2.9E-06	6.9E-03	2.3E-07	9E-06	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	2.7E-07	5.1E-02	5.0E-06	1.6E-02	1.6E-06	3.1E-02	3.0E-06	8.8E-03	3.0E-07	1E-05	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-01	9.9E-06	0.0E+00	0.0E+00	2.4E-03	2.3E-07	0.0E+00	0.0E+00	1E-05	mg/kg-d
	PCB TEQ, ND0	1.1E-07	4.2E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	4.3E-12	1.8E-07	1.8E-11	0.0E+00	0.0E+00	3E-11	mg/kg-d
	PCB TEQ, ND05	1.2E-07	4.6E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	6.0E-12	8.2E-07	8.1E-11	0.0E+00	0.0E+00	9E-11	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E-02	3.5E-06	1.8E-03	6.0E-08	4E-06	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	4.6E-09	0.0E+00	0.0E+00	1.7E-04	1.7E-08	2.6E-03	2.6E-07	4.8E-03	1.6E-07	4E-07	mg/kg-d
	Acenaphthylene	8.8E-05	3.3E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E-03	2.3E-07	5.5E-04	1.8E-08	2E-07	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	2.9E-09	0.0E+00	0.0E+00	2.1E-04	2.1E-08	1.2E-02	1.2E-06	3.2E-04	1.1E-08	1E-06	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	2.2E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-04	3.4E-08	1.3E-03	1.2E-07	0.0E+00	0.0E+00	2E-07	mg/kg-d
	cPAHs, ND0	2.6E-05	9.5E-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	7.6E-08	9.3E-03	9.1E-07	4.9E-05	1.6E-09	1E-06	mg/kg-d
	cPAHs, ND05	2.8E-05	1.0E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	7.6E-08	9.3E-03	9.1E-07	2.8E-04	9.4E-09	1E-06	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	8.1E-09	0.0E+00	0.0E+00	1.5E-03	1.5E-07	0.0E+00	0.0E+00	2.7E-03	9.1E-08	2E-07	mg/kg-d

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Calculation of Fish Intake
Adult Recreational Fisher (CT) -Noncancer
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Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	1.8E-06	7.7E-04	2.6E-08	2E-06	mg/kg-d
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	1.3E-08	0.0E+00	0.0E+00	6.7E-04	6.6E-08	1.9E-02	1.9E-06	5.2E-03	1.7E-07	2E-06	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	1.3E-08	2.4E-04	2.4E-08	1.0E-03	9.9E-08	1.5E-02	1.5E-06	3.2E-03	1.1E-07	2E-06	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	1.2E-07	2.1E-02	2.1E-06	1.7E-03	5.7E-08	2E-06	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	7.3E-13	1.0E-09	2.0E-14	3.2E-07	3.1E-11	1.1E-07	1.1E-11	2.5E-09	2.4E-13	1.4E-09	4.8E-14	4E-11	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	3.6E-12	2.7E-07	5.3E-12	3.4E-07	3.4E-11	1.4E-06	1.4E-10	3.8E-08	3.8E-12	2.2E-07	7.5E-12	2E-10	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	1.2E-07	0.0E+00	0.0E+00	1E-07	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	1.9E-08	8.0E-04	7.9E-08	1.6E-03	1.6E-07	5.0E-04	4.9E-08	0.0E+00	0.0E+00	3E-07	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	3.1E-08	4.7E-03	4.6E-07	1.7E-03	1.7E-07	3.0E-03	3.0E-07	1.3E-03	4.4E-08	1E-06	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	2.1E-08	0.0E+00	0.0E+00	3.8E-02	3.7E-06	4.7E-04	4.6E-08	6.4E-04	2.1E-08	4E-06	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	1.9E-08	0.0E+00	0.0E+00	1.5E-02	1.5E-06	4.2E-04	4.1E-08	6.0E-03	2.0E-07	2E-06	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	1.9E-08	1.0E-03	9.9E-08	1.6E-03	1.6E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E-07	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	4.1E-08	0.0E+00	0.0E+00	4E-08	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	1.4E-08	1.0E-03	9.9E-08	4.0E-03	3.9E-07	1.3E-03	1.3E-07	0.0E+00	0.0E+00	6E-07	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	1.8E-06	4.1E-01	4.0E-05	0.0E+00	0.0E+00	2.8E-01	9.4E-06	5E-05	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	6.1E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6E-08	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

Table C-53
CALCULATION OF FISH INTAKE
CHILD RECREATIONAL FISHER (RME) - NONCANCER
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	2.2E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E-02	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	4.7E-06	0.0E+00	0.0E+00	5E-06	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	7.0E-06	5.0E-03	2.3E-07	1.1E-02	2.7E-06	1.4E+00	3.4E-04	7.8E-01	1.9E-04	9.0E-03	7.6E-07	5E-04	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	1.7E-04	2.0E+00	4.8E-04	0.0E+00	0.0E+00	6E-04	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	6.1E-07	1.5E-02	3.7E-06	4.8E-01	1.2E-04	2.6E-01	6.4E-05	4.0E-02	3.4E-06	2E-04	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	1.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-04	mg/kg-d
	Copper	5.5E-01	5.0E-05	6.1E-01	2.9E-05	5.6E+00	1.4E-03	7.4E+00	1.8E-03	1.8E+00	4.3E-04	5.1E+00	4.3E-04	4E-03	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	2.2E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-01	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	7.0E-06	1.7E-02	4.1E-06	1.1E+00	2.6E-04	2E+00	4.9E-04	7.0E-03	5.9E-07	8E-04	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	7.3E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7E-03	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	Nickel	7.4E-02	6.7E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	2.1E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-04	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	1.9E-05	9.0E-01	2.2E-04	8.2E-01	2.0E-04	1.0E+00	2.4E-04	0.0E+00	0.0E+00	7E-04	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	2.3E-04	8.6E-01	2.1E-04	0.0E+00	0.0E+00	4E-04	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	3.9E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4E-04	mg/kg-d
	Zinc	6.3E+00	5.7E-04	1.3E+01	6.0E-04	5.0E+01	1.2E-02	2.4E+01	5.9E-03	9.6E+00	2.4E-03	1.3E+01	1.1E-03	2E-02	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Methyl mercury	9.7E-02	8.8E-06	2.0E-02	9.4E-07	1.3E-01	3.2E-05	8.2E-02	2.0E-05	1.0E-02	2.4E-06	3.0E-02	2.5E-06	7E-05	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	6.1E-07	5.0E-02	1.2E-05	1.0E-02	2.5E-06	3.0E-02	7.2E-06	6.9E-03	5.8E-07	2E-05	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	6.6E-07	5.1E-02	1.2E-05	1.6E-02	3.9E-06	3.1E-02	7.5E-06	8.8E-03	7.4E-07	3E-05	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-01	2.5E-05	0.0E+00	0.0E+00	2.4E-03	5.8E-07	0.0E+00	0.0E+00	3E-05	mg/kg-d
	PCB TEQ, ND0	1.1E-07	1.0E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	1.1E-11	1.8E-07	4.4E-11	0.0E+00	0.0E+00	7E-11	mg/kg-d
	PCB TEQ, ND05	1.2E-07	1.1E-11	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	1.5E-11	8.2E-07	2.0E-10	0.0E+00	0.0E+00	2E-10	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E-02	8.8E-06	1.8E-03	1.5E-07	9E-06	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	1.1E-08	0.0E+00	0.0E+00	1.7E-04	4.1E-08	2.6E-03	6.3E-07	4.8E-03	4.1E-07	1E-06	mg/kg-d
	Acenaphthylene	8.8E-05	8.0E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E-03	5.6E-07	5.5E-04	4.6E-08	6E-07	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	7.0E-09	0.0E+00	0.0E+00	2.1E-04	5.1E-08	1.2E-02	2.9E-06	3.2E-04	2.7E-08	3E-06	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	5.3E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-04	8.3E-08	1.3E-03	3.0E-07	0.0E+00	0.0E+00	4E-07	mg/kg-d
	cPAHs, ND0	2.6E-05	2.3E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	1.9E-07	9.3E-03	2.3E-06	4.9E-05	4.1E-09	2E-06	mg/kg-d
	cPAHs, ND05	2.8E-05	2.5E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	1.9E-07	9.3E-03	2.3E-06	2.8E-04	2.4E-08	2E-06	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	2.0E-08	0.0E+00	0.0E+00	1.5E-03	3.7E-07	0.0E+00	0.0E+00	2.7E-03	2.3E-07	6E-07	mg/kg-d

C-53

Calculation of Fish Intake Child Recreational Fisher (RME) -Noncancer

Port Angeles Harbor - Marine Sediment Investigation

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	4.5E-06	7.7E-04	6.5E-08	5E-06	mg/kg-d
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	3.2E-08	0.0E+00	0.0E+00	6.7E-04	1.6E-07	1.9E-02	4.6E-06	5.2E-03	4.4E-07	5E-06	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	3.2E-08	2.4E-04	5.9E-08	1.0E-03	2.4E-07	1.5E-02	3.7E-06	3.2E-03	2.7E-07	4E-06	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	2.9E-07	2.1E-02	5.1E-06	1.7E-03	1.4E-07	6E-06	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	1.8E-12	1.0E-09	4.8E-14	3.2E-07	7.7E-11	1.1E-07	2.7E-11	2.5E-09	6.0E-13	1.4E-09	1.2E-13	1E-10	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	8.9E-12	2.7E-07	1.3E-11	3.4E-07	8.4E-11	1.4E-06	3.5E-10	3.8E-08	9.4E-12	2.2E-07	1.9E-11	5E-10	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	3.0E-07	0.0E+00	0.0E+00	3E-07	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	4.7E-08	8.0E-04	2.0E-07	1.6E-03	3.9E-07	5.0E-04	1.2E-07	0.0E+00	0.0E+00	8E-07	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	7.5E-08	4.7E-03	1.1E-06	1.7E-03	4.1E-07	3.0E-03	7.3E-07	1.3E-03	1.1E-07	2E-06	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	5.2E-08	0.0E+00	0.0E+00	3.8E-02	9.3E-06	4.7E-04	1.1E-07	6.4E-04	5.4E-08	9E-06	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	4.7E-08	0.0E+00	0.0E+00	1.5E-02	3.7E-06	4.2E-04	1.0E-07	6.0E-03	5.1E-07	4E-06	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	4.6E-08	1.0E-03	2.4E-07	1.6E-03	3.9E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7E-07	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	1.0E-07	0.0E+00	0.0E+00	1E-07	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	3.3E-08	1.0E-03	2.4E-07	4.0E-03	9.8E-07	1.3E-03	3.2E-07	0.0E+00	0.0E+00	2E-06	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	4.4E-06	4.1E-01	1.0E-04	0.0E+00	0.0E+00	2.8E-01	2.4E-05	1E-04	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	1.5E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-07	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

Table C-54

CALCULATION OF FISH INTAKE

CHILD RECREATIONAL FISHER (CT) - NONCANCER

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Child

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	1.6E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E-02	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	3.3E-06	0.0E+00	0.0E+00	3E-06	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	5.1E-06	5.0E-03	1.7E-07	1.1E-02	1.9E-06	1.4E+00	2.4E-04	7.8E-01	1.3E-04	9.0E-03	5.3E-07	4E-04	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	1.2E-04	2.0E+00	3.4E-04	0.0E+00	0.0E+00	5E-04	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	4.5E-07	1.5E-02	2.6E-06	4.8E-01	8.3E-05	2.6E-01	4.5E-05	4.0E-02	2.4E-06	1E-04	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	9.5E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-04	mg/kg-d
	Copper	5.5E-01	3.6E-05	6.1E-01	2.1E-05	5.6E+00	9.7E-04	7.4E+00	1.3E-03	1.8E+00	3.0E-04	5.1E+00	3.1E-04	3E-03	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	1.6E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-01	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	5.2E-06	1.7E-02	2.9E-06	1.1E+00	1.8E-04	2E+00	3.4E-04	7.0E-03	4.2E-07	5E-04	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	5.1E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5E-03	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	Nickel	7.4E-02	4.9E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	1.5E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-04	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	1.4E-05	9.0E-01	1.5E-04	8.2E-01	1.4E-04	1.0E+00	1.7E-04	0.0E+00	0.0E+00	5E-04	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	1.6E-04	8.6E-01	1.5E-04	0.0E+00	0.0E+00	3E-04	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	2.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E-04	mg/kg-d
	Zinc	6.3E+00	4.1E-04	1.3E+01	4.4E-04	5.0E+01	8.6E-03	2.4E+01	4.2E-03	9.6E+00	1.7E-03	1.3E+01	7.5E-04	2E-02	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Methyl mercury	9.7E-02	6.4E-06	2.0E-02	6.9E-07	1.3E-01	2.2E-05	8.2E-02	1.4E-05	1.0E-02	1.7E-06	3.0E-02	1.8E-06	5E-05	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	4.5E-07	5.0E-02	8.6E-06	1.0E-02	1.8E-06	3.0E-02	5.1E-06	6.9E-03	4.1E-07	2E-05	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	4.8E-07	5.1E-02	8.8E-06	1.6E-02	2.7E-06	3.1E-02	5.3E-06	8.8E-03	5.2E-07	2E-05	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-01	1.7E-05	0.0E+00	0.0E+00	2.4E-03	4.1E-07	0.0E+00	0.0E+00	2E-05	mg/kg-d
	PCB TEQ, ND0	1.1E-07	7.5E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	7.4E-12	1.8E-07	3.1E-11	0.0E+00	0.0E+00	5E-11	mg/kg-d
	PCB TEQ, ND05	1.2E-07	8.1E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	1.0E-11	8.2E-07	1.4E-10	0.0E+00	0.0E+00	2E-10	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E-02	6.2E-06	1.8E-03	1.1E-07	6E-06	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	8.3E-09	0.0E+00	0.0E+00	1.7E-04	2.9E-08	2.6E-03	4.5E-07	4.8E-03	2.9E-07	8E-07	mg/kg-d
	Acenaphthylene	8.8E-05	5.8E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E-03	3.9E-07	5.5E-04	3.3E-08	4E-07	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	5.2E-09	0.0E+00	0.0E+00	2.1E-04	3.6E-08	1.2E-02	2.0E-06	3.2E-04	1.9E-08	2E-06	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	3.8E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-04	5.8E-08	1.3E-03	2.1E-07	0.0E+00	0.0E+00	3E-07	mg/kg-d
	cPAHs, ND0	2.6E-05	1.7E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	1.3E-07	9.3E-03	1.6E-06	4.9E-05	2.9E-09	2E-06	mg/kg-d
	cPAHs, ND05	2.8E-05	1.8E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	1.3E-07	9.3E-03	1.6E-06	2.8E-04	1.7E-08	2E-06	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	1.4E-08	0.0E+00	0.0E+00	1.5E-03	2.6E-07	0.0E+00	0.0E+00	2.7E-03	1.6E-07	4E-07	mg/kg-d

C-54
Calculation of Fish Intake
Child Recreational Fisher (CT) -Noncancer
Port Angeles Harbor - Marine Sediment Investigation

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	3.2E-06	7.7E-04	4.6E-08	3E-06	mg/kg-d
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	2.4E-08	0.0E+00	0.0E+00	6.7E-04	1.2E-07	1.9E-02	3.2E-06	5.2E-03	3.1E-07	4E-06	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	2.3E-08	2.4E-04	4.1E-08	1.0E-03	1.7E-07	1.5E-02	2.6E-06	3.2E-03	1.9E-07	3E-06	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	2.1E-07	2.1E-02	3.6E-06	1.7E-03	1.0E-07	4E-06	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	1.3E-12	1.0E-09	3.5E-14	3.2E-07	5.4E-11	1.1E-07	1.9E-11	2.5E-09	4.2E-13	1.4E-09	8.4E-14	8E-11	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	6.4E-12	2.7E-07	9.4E-12	3.4E-07	5.9E-11	1.4E-06	2.4E-10	3.8E-08	6.6E-12	2.2E-07	1.3E-11	3E-10	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	2.1E-07	0.0E+00	0.0E+00	2E-07	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	3.4E-08	8.0E-04	1.4E-07	1.6E-03	2.8E-07	5.0E-04	8.6E-08	0.0E+00	0.0E+00	5E-07	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	5.5E-08	4.7E-03	8.1E-07	1.7E-03	2.9E-07	3.0E-03	5.2E-07	1.3E-03	7.7E-08	2E-06	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	3.8E-08	0.0E+00	0.0E+00	3.8E-02	6.5E-06	4.7E-04	8.0E-08	6.4E-04	3.8E-08	7E-06	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	3.4E-08	0.0E+00	0.0E+00	1.5E-02	2.6E-06	4.2E-04	7.2E-08	6.0E-03	3.6E-07	3E-06	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	3.4E-08	1.0E-03	1.7E-07	1.6E-03	2.8E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5E-07	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	7.2E-08	0.0E+00	0.0E+00	7E-08	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	2.4E-08	1.0E-03	1.7E-07	4.0E-03	6.9E-07	1.3E-03	2.3E-07	0.0E+00	0.0E+00	1E-06	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	3.1E-06	4.1E-01	7.0E-05	0.0E+00	0.0E+00	2.8E-01	1.7E-05	9E-05	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	1.1E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-07	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

C-55
Calculation of Fish Intake
Adult/Child Recreational Fisher (RME) -Cancer
Port Angeles Harbor - Marine Sediment Investigation

Table C-55

CALCULATION OF FISH INTAKE

ADULT/CHILD RECREATIONAL FISHER (RME) - CANCER

PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (RME)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	5.9E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.9E-03	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	1.2E-06	0.0E+00	0.0E+00	1E-06	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	1.8E-06	5.0E-03	6.2E-08	1.1E-02	7.1E-07	1.4E+00	9.1E-05	7.8E-01	5.0E-05	9.0E-03	1.9E-07	1E-04	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	4.4E-05	2.0E+00	1.3E-04	0.0E+00	0.0E+00	2E-04	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	1.6E-07	1.5E-02	9.6E-07	4.8E-01	3.1E-05	2.6E-01	1.7E-05	4.0E-02	8.6E-07	5E-05	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	3.6E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4E-05	mg/kg-d
	Copper	5.5E-01	1.3E-05	6.1E-01	7.6E-06	5.6E+00	3.6E-04	7.4E+00	4.8E-04	1.8E+00	1.1E-04	5.1E+00	1.1E-04	1E-03	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	5.9E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6E-02	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	1.9E-06	1.7E-02	1.1E-06	1.1E+00	6.8E-05	2E+00	1.3E-04	7.0E-03	1.5E-07	2E-04	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	1.9E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-03	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	Nickel	7.4E-02	1.8E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	5.5E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6E-05	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	5.0E-06	9.0E-01	5.8E-05	8.2E-01	5.3E-05	1.0E+00	6.4E-05	0.0E+00	0.0E+00	2E-04	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	6.0E-05	8.6E-01	5.5E-05	0.0E+00	0.0E+00	1E-04	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	1.0E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-04	mg/kg-d
	Zinc	6.3E+00	1.5E-04	1.3E+01	1.6E-04	5.0E+01	3.2E-03	2.4E+01	1.6E-03	9.6E+00	6.2E-04	1.3E+01	2.7E-04	6E-03	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Methyl mercury	9.7E-02	2.3E-06	2.0E-02	2.5E-07	1.3E-01	8.4E-06	8.2E-02	5.3E-06	1.0E-02	6.4E-07	3.0E-02	6.5E-07	2E-05	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	1.6E-07	5.0E-02	3.2E-06	1.0E-02	6.6E-07	3.0E-02	1.9E-06	6.9E-03	1.5E-07	6E-06	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	1.7E-07	5.1E-02	3.3E-06	1.6E-02	1.0E-06	3.1E-02	2.0E-06	8.8E-03	1.9E-07	7E-06	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-01	6.5E-06	0.0E+00	0.0E+00	2.4E-03	1.5E-07	0.0E+00	0.0E+00	7E-06	mg/kg-d
	PCB TEQ, ND0	1.1E-07	2.7E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	2.8E-12	1.8E-07	1.2E-11	0.0E+00	0.0E+00	2E-11	mg/kg-d
	PCB TEQ, ND05	1.2E-07	3.0E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	3.9E-12	8.2E-07	5.3E-11	0.0E+00	0.0E+00	6E-11	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E-02	2.3E-06	1.8E-03	3.9E-08	2E-06	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	3.0E-09	0.0E+00	0.0E+00	1.7E-04	1.1E-08	2.6E-03	1.7E-07	4.8E-03	1.0E-07	3E-07	mg/kg-d
	Acenaphthylene	8.8E-05	2.1E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E-03	1.5E-07	5.5E-04	1.2E-08	2E-07	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	1.9E-09	0.0E+00	0.0E+00	2.1E-04	1.4E-08	1.2E-02	7.5E-07	3.2E-04	6.9E-09	8E-07	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	1.4E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-04	2.2E-08	1.3E-03	8.0E-08	0.0E+00	0.0E+00	1E-07	mg/kg-d
	cPAHs, ND0	2.6E-05	1.4E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	1.1E-07	9.3E-03	1.4E-06	4.9E-05	2.5E-09	1E-06	mg/kg-d
	cPAHs, ND05	2.8E-05	1.5E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	1.2E-07	9.3E-03	1.4E-06	2.8E-04	1.4E-08	2E-06	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	5.2E-09	0.0E+00	0.0E+00	1.5E-03	9.6E-08	0.0E+00	0.0E+00	2.7E-03	5.8E-08	2E-07	mg/kg-d

C-55
Calculation of Fish Intake
Adult/Child Recreational Fisher (RME) -Cancer
Port Angeles Harbor - Marine Sediment Investigation

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	1.2E-06	7.7E-04	1.7E-08	1E-06	mg/kg-d
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	8.6E-09	0.0E+00	0.0E+00	6.7E-04	4.3E-08	1.9E-02	1.2E-06	5.2E-03	1.1E-07	1E-06	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	8.5E-09	2.4E-04	1.5E-08	1.0E-03	6.4E-08	1.5E-02	9.7E-07	3.2E-03	6.9E-08	1E-06	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	7.7E-08	2.1E-02	1.4E-06	1.7E-03	3.7E-08	1E-06	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	4.7E-13	1.0E-09	1.3E-14	3.2E-07	2.0E-11	1.1E-07	7.0E-12	2.5E-09	1.6E-13	1.4E-09	3.1E-14	3E-11	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	2.4E-12	2.7E-07	3.4E-12	3.4E-07	2.2E-11	1.4E-06	9.1E-11	3.8E-08	2.5E-12	2.2E-07	4.8E-12	1E-10	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	7.9E-08	0.0E+00	0.0E+00	8E-08	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	1.2E-08	8.0E-04	5.1E-08	1.6E-03	1.0E-07	5.0E-04	3.2E-08	0.0E+00	0.0E+00	2E-07	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	2.0E-08	4.7E-03	3.0E-07	1.7E-03	1.1E-07	3.0E-03	1.9E-07	1.3E-03	2.8E-08	7E-07	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	1.4E-08	0.0E+00	0.0E+00	3.8E-02	2.4E-06	4.7E-04	3.0E-08	6.4E-04	1.4E-08	3E-06	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	1.2E-08	0.0E+00	0.0E+00	1.5E-02	9.6E-07	4.2E-04	2.7E-08	6.0E-03	1.3E-07	1E-06	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	1.2E-08	1.0E-03	6.4E-08	1.6E-03	1.0E-07	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2E-07	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	2.7E-08	0.0E+00	0.0E+00	3E-08	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	8.7E-09	1.0E-03	6.4E-08	4.0E-03	2.6E-07	1.3E-03	8.6E-08	0.0E+00	0.0E+00	4E-07	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	1.2E-06	4.1E-01	2.6E-05	0.0E+00	0.0E+00	2.8E-01	6.1E-06	3E-05	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	4.0E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4E-08	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

C-56
Calculation of Fish Intake
Adult/Child Recreational Fisher (CT) -Cancer
Port Angeles Harbor - Marine Sediment Investigation

Table C-56
CALCULATION OF FISH INTAKE
ADULT/CHILD RECREATIONAL FISHER (CT) - CANCER
PORT ANGELES HARBOR - MARINE SEDIMENT INVESTIGATION

Scenario Timeframe: Current/Future
Medium: Fish and Shellfish
Exposure Medium: Tissue
Exposure Point: On-Site
Receptor Population: Recreational Fisher (CT)
Receptor Age: Adult/Child

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
Ingestion	Aluminum	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.2E+01	4.2E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-03	mg/kg-d
	Antimony	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	8.7E-07	0.0E+00	0.0E+00	9E-07	mg/kg-d
	Arsenic (Inorganic)	7.7E-02	1.3E-06	5.0E-03	4.5E-08	1.1E-02	5.0E-07	1.4E+00	6.4E-05	7.8E-01	3.5E-05	9.0E-03	1.4E-07	1E-04	mg/kg-d
	Barium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.8E-01	3.1E-05	2.0E+00	8.9E-05	0.0E+00	0.0E+00	1E-04	mg/kg-d
	Cadmium	0.0E+00	0.0E+00	1.3E-02	1.2E-07	1.5E-02	6.8E-07	4.8E-01	2.2E-05	2.6E-01	1.2E-05	4.0E-02	6.2E-07	3E-05	mg/kg-d
	Cobalt	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	5.5E-01	2.5E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E-05	mg/kg-d
	Copper	5.5E-01	9.4E-06	6.1E-01	5.4E-06	5.6E+00	2.6E-04	7.4E+00	3.4E-04	1.8E+00	8.0E-05	5.1E+00	8.0E-05	8E-04	mg/kg-d
	Iron	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.1E+02	4.1E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4E-02	mg/kg-d
	Lead	0.0E+00	0.0E+00	1.5E-01	1.3E-06	1.7E-02	7.7E-07	1.1E+00	4.8E-05	2E+00	9.1E-05	7.0E-03	1.1E-07	1E-04	mg/kg-d
	Manganese	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.0E+01	1.4E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-03	mg/kg-d
	Mercury		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	Nickel	7.4E-02	1.3E-06	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.6E-01	3.9E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4E-05	mg/kg-d
	Selenium	0.0E+00	0.0E+00	4.0E-01	3.6E-06	9.0E-01	4.1E-05	8.2E-01	3.7E-05	1.0E+00	4.5E-05	0.0E+00	0.0E+00	1E-04	mg/kg-d
	Silver	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	9.4E-01	4.3E-05	8.6E-01	3.9E-05	0.0E+00	0.0E+00	8E-05	mg/kg-d
	Vanadium	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.6E+00	7.2E-05	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7E-05	mg/kg-d
	Zinc	6.3E+00	1.1E-04	1.3E+01	1.1E-04	5.0E+01	2.3E-03	2.4E+01	1.1E-03	9.6E+00	4.4E-04	1.3E+01	2.0E-04	4E-03	mg/kg-d
	Tributyltin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Tributyltin oxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Methyl mercury	9.7E-02	1.7E-06	2.0E-02	1.8E-07	1.3E-01	5.9E-06	8.2E-02	3.7E-06	1.0E-02	4.5E-07	3.0E-02	4.6E-07	1E-05	mg/kg-d
	Tetraethyl lead		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0E+00	mg/kg-d
	PCB, Sum of Aroclors, ND0	0.0E+00	0.0E+00	1.3E-02	1.2E-07	5.0E-02	2.3E-06	1.0E-02	4.7E-07	3.0E-02	1.3E-06	6.9E-03	1.1E-07	4E-06	mg/kg-d
	PCB, Sum of Aroclors, ND05	0.0E+00	0.0E+00	1.4E-02	1.3E-07	5.1E-02	2.3E-06	1.6E-02	7.2E-07	3.1E-02	1.4E-06	8.8E-03	1.4E-07	5E-06	mg/kg-d
	PCB, Sum of Congeners	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-01	4.6E-06	0.0E+00	0.0E+00	2.4E-03	1.1E-07	0.0E+00	0.0E+00	5E-06	mg/kg-d
	PCB TEQ, ND0	1.1E-07	2.0E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-08	2.0E-12	1.8E-07	8.2E-12	0.0E+00	0.0E+00	1E-11	mg/kg-d
	PCB TEQ, ND05	1.2E-07	2.1E-12	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.1E-08	2.8E-12	8.2E-07	3.7E-11	0.0E+00	0.0E+00	4E-11	mg/kg-d
	1-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	2-Methylnaphthalene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.6E-02	1.6E-06	1.8E-03	2.8E-08	2E-06	mg/kg-d
	Acenaphthene	0.0E+00	0.0E+00	2.4E-04	2.1E-09	0.0E+00	0.0E+00	1.7E-04	7.7E-09	2.6E-03	1.2E-07	4.8E-03	7.4E-08	2E-07	mg/kg-d
	Acenaphthylene	8.8E-05	1.5E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.3E-03	1.0E-07	5.5E-04	8.5E-09	1E-07	mg/kg-d
	Anthracene	0.0E+00	0.0E+00	1.5E-04	1.3E-09	0.0E+00	0.0E+00	2.1E-04	9.5E-09	1.2E-02	5.3E-07	3.2E-04	5.0E-09	5E-07	mg/kg-d
	Benzo(ghi)perylene	5.8E-05	9.9E-10	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.4E-04	1.5E-08	1.3E-03	5.7E-08	0.0E+00	0.0E+00	7E-08	mg/kg-d
	cPAHs, ND0	2.6E-05	1.0E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	8.0E-08	9.3E-03	9.7E-07	4.9E-05	1.7E-09	1E-06	mg/kg-d
	cPAHs, ND05	2.8E-05	1.1E-09	0.0E+00	0.0E+00	0.0E+00	0.0E+00	7.7E-04	8.1E-08	9.3E-03	9.7E-07	2.8E-04	1.0E-08	1E-06	mg/kg-d
	Fluoranthene	0.0E+00	0.0E+00	4.2E-04	3.7E-09	0.0E+00	0.0E+00	1.5E-03	6.8E-08	0.0E+00	0.0E+00	2.7E-03	4.2E-08	1E-07	mg/kg-d

C-56

Calculation of Fish Intake

Adult/Child Recreational Fisher (CT) -Cancer

Port Angeles Harbor - Marine Sediment Investigation

Exposure Route	Chemical of Potential Concern	Pelagic EPC Value (mg/kg)	Pelagic Intake (mg/kg-d)	Bottom Fish EPC Value (mg/kg)	Bottom Fish Intake (mg/kg-d)	Dungeness Crab - Muscle EPC Value (mg/kg)	Dungeness Crab Intake (mg/kg-d)	Geoduck EPC Value (mg/kg)	Geoduck Intake (mg/kg-d)	Horse Clam Edible EPC Value (mg/kg)	Horse Clam Intake (mg/kg-d)	Shrimp EPC Value (mg/kg)	Shrimp Intake (mg/kg-d)	Total Intake (Non-Cancer)	Intake (Non-Cancer) Units (1)
	Fluorene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.9E-02	8.4E-07	7.7E-04	1.2E-08	9E-07	mg/kg-d
	Naphthalene	0.0E+00	0.0E+00	6.9E-04	6.2E-09	0.0E+00	0.0E+00	6.7E-04	3.0E-08	1.9E-02	8.5E-07	5.2E-03	8.1E-08	1E-06	mg/kg-d
	Phenanthrene	0.0E+00	0.0E+00	6.8E-04	6.1E-09	2.4E-04	1.1E-08	1.0E-03	4.5E-08	1.5E-02	6.8E-07	3.2E-03	5.0E-08	8E-07	mg/kg-d
	Pyrene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	5.4E-08	2.1E-02	9.5E-07	1.7E-03	2.6E-08	1E-06	mg/kg-d
	2,3,7,8-TCDD TEQ, ND0	2.0E-08	3.4E-13	1.0E-09	9.1E-15	3.2E-07	1.4E-11	1.1E-07	5.0E-12	2.5E-09	1.1E-13	1.4E-09	2.2E-14	2E-11	mg/kg-d
	2,3,7,8-TCDD TEQ, ND05	9.8E-08	1.7E-12	2.7E-07	2.4E-12	3.4E-07	1.6E-11	1.4E-06	6.4E-11	3.8E-08	1.7E-12	2.2E-07	3.5E-12	9E-11	mg/kg-d
	4,4'-DDD	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.2E-03	5.6E-08	0.0E+00	0.0E+00	6E-08	mg/kg-d
	4,4'-DDE	0.0E+00	0.0E+00	1.0E-03	8.9E-09	8.0E-04	3.6E-08	1.6E-03	7.2E-08	5.0E-04	2.3E-08	0.0E+00	0.0E+00	1E-07	mg/kg-d
	4,4'-DDT	0.0E+00	0.0E+00	1.6E-03	1.4E-08	4.7E-03	2.1E-07	1.7E-03	7.7E-08	3.0E-03	1.4E-07	1.3E-03	2.0E-08	5E-07	mg/kg-d
	Aldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Alpha-BHC	0.0E+00	0.0E+00	1.1E-03	9.8E-09	0.0E+00	0.0E+00	3.8E-02	1.7E-06	4.7E-04	2.1E-08	6.4E-04	9.9E-09	2E-06	mg/kg-d
	Beta-BHC	0.0E+00	0.0E+00	1.0E-03	8.9E-09	0.0E+00	0.0E+00	1.5E-02	6.8E-07	4.2E-04	1.9E-08	6.0E-03	9.3E-08	8E-07	mg/kg-d
	Delta-BHC	0.0E+00	0.0E+00	9.9E-04	8.8E-09	1.0E-03	4.5E-08	1.6E-03	7.2E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1E-07	mg/kg-d
	Dieldrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan I	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endosulfan II	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Endrin	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	gamma-Chlordane	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.2E-04	1.9E-08	0.0E+00	0.0E+00	2E-08	mg/kg-d
	Heptachlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Heptachlor Epoxide	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Lindane	0.0E+00	0.0E+00	7.0E-04	6.2E-09	1.0E-03	4.5E-08	4.0E-03	1.8E-07	1.3E-03	6.0E-08	0.0E+00	0.0E+00	3E-07	mg/kg-d
	Methoxychlor	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Bis(2-Ethylhexyl)phthalate	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Dibenzofuran	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pentachlorophenol	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0E+00	mg/kg-d
	Pyridine	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E-02	8.2E-07	4.1E-01	1.9E-05	0.0E+00	0.0E+00	2.8E-01	4.3E-06	2E-05	mg/kg-d
	Hexachlorobenzene	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.2E-04	2.8E-08	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3E-08	mg/kg-d

Notes:

1 - Total Intake = Pelagic Intake + Bottom Fish Intake + Dungeness Crab Intake + Geoduck Intake + Horse Clam Intake + Coonstrip Shrimp Intake

Intake per fish/shellfish type = EPCfish * IRfish * Effish * EDfish * FIfish * CF / (BW x AT)

Attachment D – Human Health Toxicity Narratives

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HEALTH EFFECTS SUMMARIES

This appendix contains health effects summaries for chemicals of potential concern at Port Angeles Harbor. These summaries provide information on the occurrence and behavior of the IHSs in the environment, potential exposure mechanisms, and adverse health effects that could result from exposure, and the basis and reliability of the quantitative toxicity values used in the risk assessment. Information in each summary is drawn largely from the Public Health statement in the Toxicological Profile or Fact Sheet for the chemical, prepared by the Agency for Toxic Substances and Disease Registry (ATSDR) and the United States Environmental Protection Agency (U.S. EPA) Integrated Risk Information System (IRIS) profiles, unless otherwise noted.

Aldrin
See Dieldrin.

Aluminum

Aluminum is a silver-white flexible metal with a vast number of uses. It is poorly absorbed and efficiently eliminated; however, when absorption does occur, aluminum is distributed mainly in bone, liver, testes, kidneys, and brain.

Aluminum is a naturally occurring metal that is found in the earth in combination with other elements. Aluminum is used in cooking utensils, appliances, and building materials. In combination with other substances, aluminum is an ingredient in such everyday items as antacids and antiperspirants.

Limited amounts of aluminum can be found in natural waters, drinking water, and air. It makes up approximately 8 percent of the earth's crust; however, higher concentrations may exist in soil surrounding waste sites associated with industries such as coal combustion and aluminum mining and smelting.

Oral doses of aluminum have been shown to induce neurobehavioral effects in adult mice and in developing offspring. Developmental effects (neurobehavioral deficits, decreased body weight, and possibly skeletal abnormalities) in the offspring of mice were identified as the most sensitive toxicity endpoint. A provisional oral reference dose (RfD) for aluminum of 1 mg/kg-day is derived by applying to the lowest observed adverse effect level (LOAEL) a total uncertainty factor (UF) of 100 to account for use of a LOAEL rather than a no observed adverse effect level (NOAEL), interspecies extrapolation, and human population variability. Confidence in the RfD is low because of limitations in the database. The RfD is based on conservative data (i.e., ingestion of soluble aluminum compounds).

Very little aluminum enters the body through the skin or the lungs, and the small amount that might enter the bloodstream through the stomach is quickly eliminated. Some people may get skin rashes from aluminum in antiperspirants, and factory workers who breathe in large amounts of aluminum dust can have lung problems such as coughing or changes that show up in chest x-rays. Because it is minimally absorbed through the gastrointestinal tract (GI), aluminum has long been regarded as nontoxic. Human and animal studies have shown that elevated levels of aluminum in the body may be toxic to the central nervous, skeletal, and hematological systems; however, these effects have been observed mainly under conditions in which the GI tract has been bypassed (e.g., intravenously).

Source: ATSDR 1999.

Antimony
Antimony is a naturally occurring element that can be found at very low levels in air, soil, food, and water. Much of the antimony in the environment is bound tightly to dust, soil, and rocks. Antimony is used industrially in metal alloys and for producing fireproofing chemicals, ceramics, glassware, and pigments. It also has been used medicinally as an antiparasitic agent.

Antimony can enter the body by absorption from the gastrointestinal tract following ingestion of food or water containing it, or by absorption from the lungs after inhalation. People may be exposed to high levels of antimony in dust if they live near antimony mines or processing companies. Ingestion of high doses of antimony can result in burning stomach pains, colic, nausea, and vomiting. Long-term occupational inhalation exposure has been shown to cause heart problems, stomach ulcers, and irritation of the lungs, eyes, and skin. It is not known whether antimony can enter the body through the skin. Antimony can have beneficial effects when used for medical reasons. It has been used as a medicine to treat people infected with parasites.

The critical or most sensitive noncarcinogenic effects of antimony exposure, based on chronic oral exposure of rats to antimony, are shortened life span, reduced blood glucose levels, and altered cholesterol levels. The oral RfD for antimony, 4×10^{-4} mg/kg-day, is based on a chronic oral bioassay in which 5 part per million (ppm) of potassium antimony tartrate was administered to rats in their drinking water. Confidence in the principal study is considered low because only one species and one dose level were used; a "no observed adverse effects level" (NOAEL) was not determined; and gross pathology and histopathology were not well described. Confidence in the database, and consequently the RfD, is low due to lack of adequate oral exposure investigations.

Existing data suggest that antimony may be an animal carcinogen; however, the data are not sufficient to justify a quantitative cancer potency estimate at this time. In laboratory rats, inhalation of antimony dust can increase the risk of lung cancer. However, there is no evidence of increased risk of cancer to animals from eating food or drinking water containing antimony. It is not known whether antimony can cause cancer in humans. Antimony has not yet received a weight-of-evidence classification from the U.S. EPA.

Source: ATSDR 1995; U.S. EPA 1991.

Arsenic

Arsenic, a naturally occurring element, is present at low levels in soil, water, and air. It is usually found in combination with one or more elements such as oxygen, chlorine, or sulfur; these compounds are called inorganic arsenic. Arsenic is also found in plants, animals, fish, and shellfish, usually in combination with carbon and hydrogen; these compounds, called organic arsenic, are generally less toxic than inorganic arsenic. Arsenic is widely distributed in the environment from natural sources, but higher concentrations have been found to occur in association with chemical waste, smelting of copper and other metals, fossil fuel combustion, and pesticide use. The primary use of arsenic is as a wood preservative, but it is also used to make insect and weed killers and pharmaceuticals.

Arsenic does not break down in the environment, but it can change from one form to another. Most arsenic compounds are soluble in water but do not evaporate. Arsenic can be released into the air when minerals containing arsenic are processed or smelted, or when materials containing arsenic are burned. Airborne particles containing arsenic can settle on the ground, surface water, and plants. Fish and shellfish accumulate arsenic in their tissues, but most of the arsenic in fish is the less- toxic organic arsenic.

Most people are routinely exposed to low levels of arsenic because it is naturally occurring and low levels are present in food, water, soil, and air. Workers in several industries (nonferrous smelting, wood preservation, arsenical pharmaceutical production, and production and application of arsenical pesticides) may be exposed to significantly higher levels. Higher exposures also can result from breathing sawdust or smoke from wood treated with arsenic.

Ingestion of food or water with high levels of inorganic arsenic (60 mg/kg in food or 60 mg/L in water) can be fatal. Chronic arsenic overexposure may cause many health effects, including body weight changes, changes in the blood, and liver and kidney damage. Arsenic damages many tissues, including nerves, stomach, intestines, liver, kidneys, and skin. Breathing high levels can irritate the throat and lungs. Lower levels of exposure to inorganic arsenic may cause nausea, vomiting, and diarrhea; decreased production of red and white blood cells; abnormal heart rhythm; blood vessel damage; and a "pins and needles" sensation in the hands and feet. Long-term exposure to inorganic arsenic may lead to a darkening of the skin (hyperpigmentation), and the appearance of small "corns" or "warts" (keratosis) on the palms, soles, and torso. Direct skin contact may cause redness and swelling.

The critical or most sensitive effects of arsenic exposure, based on chronic oral exposure to humans, are hyperpigmentation of the skin, keratosis, and possible vascular complications. The oral RfD for arsenic, 3×10^{-4} mg/kg-day, is based on chronic human exposure to elevated levels of inorganic arsenic in drinking water. The principal study upon which the reference dose is based included more than 40,000 individuals, and there are a number of supporting studies. Confidence in the principal study is considered medium. An extremely large number of people were included in the study, but the doses were not well-characterized and other contaminants were present. The supporting human toxicity database is extensive but somewhat flawed. Problems exist with all of the epidemiological studies; however, the database does support the choice of a NOAEL. Confidence in the database as a whole and in the RfD is considered medium.

Arsenic is classified as a Group A human carcinogen by U.S. EPA. Epidemiologic studies and case reports have shown that ingesting inorganic arsenic increases the risk of cancer of the skin, lungs, bladder, and kidneys. Breathing inorganic arsenic increases the risk of lung cancer.

An oral slope factor and inhalation unit risk has been derived for inorganic arsenic. The oral slope factor of 1.5 $(mg/kg\text{-}day)^{-1}$, which is based on increased incidence of skin cancer in humans who consumed drinking water with high arsenic concentrations, was derived from the same principal study as the oral RfD. Although the study included a large number of people, uncertainties about the dosages of arsenic led the U.S. EPA administrator to conclude that the slope factor estimates based on that study could be modified downward by as much as an order of magnitude relative to estimates for most other carcinogens.

The inhalation unit risk, 0.0043 $(\mu g/m^3)^{-1}$, is derived from observations of increased lung cancer mortality in occupationally exposed males. Data from several studies were combined to obtain the final unit risk estimates. Overall, a large study population was observed. Exposure assessments included both work place air and urinary arsenic measurements. The unit risk estimated from the individual studies that were combined to obtain the final estimate all fell within a factor of 6 of one another. All of these factors lead to medium confidence in the final inhalation unit risk estimate.

Source: ATSDR 2005; U.S. EPA 1995.

Barium

Barium is a silvery-white metal which exists in nature only in ores containing mixtures of elements. It combines with other chemicals such as sulfur or carbon and oxygen to form barium compounds.

Barium compounds are used by the oil and gas industries to make drilling muds. Drilling muds make it easier to drill through rock by keeping the drill bit lubricated. They are also used to make paint, bricks, ceramics, glass, and rubber.

The health effects of the different barium compounds depend on how well the compound dissolves in water or in the stomach contents. Barium compounds that do not dissolve well, such as barium sulfate, are not generally harmful.

Barium has been found to potentially cause gastrointestinal disturbances and muscular weakness when people are exposed to it at levels above the U.S. EPA drinking water standards for relatively short periods of time. Some people who eat or drink amounts of barium above background levels found in food and water for a short period may experience vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness. Eating or drinking very large amounts of barium compounds that easily dissolve can cause changes in heart rhythm or paralysis and possibly death. Animals that drank barium over long periods had damage to the kidneys, decreases in body weight, and some died.

The Department of Health and Human Services (DHHS) and the International Agency for Research on Cancer (IARC) have not classified barium as to its carcinogenicity. The U.S. EPA has determined that barium is not likely to be carcinogenic to humans following ingestion and that there is insufficient information to determine whether it will be carcinogenic to humans following inhalation exposure.

Source: ATSDR 2007.

Bis(2-ethylhexyl)phthalate or Di(2-ethylhexyl)phthalate (DEHP)

Di(2-ethylhexyl) phthlate (DEHP) is a manufactured chemical that is commonly added to plastics to make them flexible. DEHP is a colorless liquid with almost no odor.

DEHP is present in plastic products such as wall coverings, tablecloths, floor tiles, furniture upholstery, shower curtains, garden hoses, swimming pool liners, rainwear, baby pants, dolls, some toys, shoes, automobile upholstery and tops, packaging film and sheets, sheathing for wire and cable, medical tubing, and blood storage bags.

At the levels found in the environment, DEHP is not expected to cause harmful health effects in humans. Most of what we know about the health effects of DEHP comes from studies of rats and mice given high amounts of DEHP.

Harmful effects in animals generally occurred only with high amounts of DEHP or with prolonged exposures. Moreover, absorption and breakdown of DEHP in humans is different than in rats or mice, so the effects seen in rats and mice may not occur in humans.

Rats that breathed DEHP in the air showed no serious harmful effects. Their lifespan and ability to reproduce were not affected.

Although there is no direct evidence that exposure of people to DEHP adversely affects reproduction or development, studies with laboratory rodents clearly show that exposure to DEHP can cause adverse effects on development and reproduction. Potentially high exposures of fetuses and infants to DEHP may lead to adverse effects on the developing male reproductive tract. Brief oral exposure to very high levels of DEHP damaged sperm in mice. Although the effect reversed when exposure ceased, sexual maturity was delayed in the animals.

High amounts of DEHP damaged the liver of rats and mice. Whether or not DEHP contributes to human kidney damage is unclear.

Skin contact with products containing DEHP will probably cause no harmful effects because it cannot be taken up easily through the skin.

The Department of Health and Human Services (DHHS) has determined that DEHP may reasonably be anticipated to be a human carcinogen. The EPA has determined that DEHP is a probable human carcinogen. These determinations were based entirely on liver cancer in rats and mice. The International Agency for Research on Cancer (IARC) has stated that DEHP cannot be classified as to its carcinogenicity to humans.

Source: ATSDR 2002. NTP 2006.

Cadmium

Cadmium is a naturally occurring element present in trace amounts in the earth's crust. It is usually found as a mineral combined with other elements such as oxygen (cadmium oxide), chlorine (cadmium chloride), or sulfur (cadmium sulfate, cadmium sulfide). Because cadmium does not corrode easily, it has several industrial applications, including metal plating and the manufacture of pigments, batteries, and plastics.

Cadmium enters the air from mining and industrial processes, and from the burning of coal and household wastes, eventually depositing on land and water surfaces. It also can be released to water and soil by waste disposal processes and spills or leaks at hazardous waste sites. Cadmium can bind to soil particles; however, some cadmium dissolves in water. Cadmium does not break down in the environment, but can change from one form to another. Plants and animals take up cadmium from the environment, and cadmium accumulates in body tissues even as a result of prolonged exposure to low levels. Humans are exposed to small quantities of cadmium because it is widely distributed in air, water, soil, and food. Cadmium can enter the body by absorption from the stomach or intestines after ingestion of food or water containing cadmium, or by absorption from the lungs after inhalation of cadmium-containing dust, mists, or fumes. Food and cigarette smoke are probably the largest sources of cadmium exposure for the general public. Very little cadmium enters the body through the skin.

Cadmium can cause a number of adverse health effects. Ingestion of very high levels of cadmium causes severe irritation to the stomach, leading to vomiting and diarrhea. Breathing high levels of cadmium severely damages the lungs and can cause death. There is very strong evidence that long-term exposure to lower levels of cadmium in air, food, or water leads to a build up of cadmium in the kidneys and possible kidney disease. Long-term human exposure by the inhalation route may cause kidney damage and lung disease such as emphysema.

Studies of animals given cadmium in food or water indicate that high blood pressure, iron-poor blood, liver disease, and nerve or brain damage may result. It is not known if humans get any of these diseases from eating or drinking cadmium. Skin contact with cadmium is not known to cause health effects in humans or animals.

The most sensitive or critical effect of cadmium exposure is abnormal kidney function as indicated by significant proteinuria. Oral RfDs (5×10^{-4} mg/kg-day [water] and 1×10^{-3} mg/kg-day [food]) have been derived for cadmium based on a toxicokinetic model that predicts NOAELs for chronic cadmium exposure in water (5×10^{-3} mg/kg-day) and food (0.01 mg/kg-day). An UF of 10 was applied to each NOAEL to obtain the RfDs. The toxicokinetic model was used to identify the level of chronic human oral exposure that results in a concentration of 200 µg cadmium/gm human renal cortex (wet), the highest renal level not associated with significant proteinuria. Confidence in the RfDs is high because the NOAEL reflects data obtained from many studies on cadmium toxicity in both humans and animals. These data also permit calculation of pharmacokinetic parameters of cadmium absorption, distribution, metabolism, and elimination. Taken together, this information gives a high level of confidence in the database and, as a result, a high level of confidence in each of the RfDs.

Studies of humans or animals have not demonstrated increased cancer rates from ingestion of cadmium. However, there is evidence that long-term inhalation of cadmium by workers may be associated with an increased risk of lung cancer. Laboratory rats that inhaled cadmium also have shown increased cancer rates. U.S. EPA classifies cadmium as a Group B1, probable human carcinogen, based on the occupational studies. The inhalation unit risk, 0.0018 ($\mu g/m^{3)}$-1, is based on increased incidence of cancer from lung, tracheal, and bronchial cancers among occupationally exposed males (for example, a 2-fold excess risk of lung cancer observed in cadmium smelter workers). The cohort consisted of 602 white males who had been employed in production work for a minimum of 6 months during the years 1940-1969. An excess lung cancer risk also was observed in three other occupational studies; however, those studies were compromised by the presence of other carcinogens (e.g., arsenic, smoking) or by a small population. Although the inhalation unit risk for cadmium in one animal study was higher (i.e., more conservative) than that used to derive the unit risk, the use of available human data was considered to be more reliable because of species response variations and differences in the forms of cadmium used in the animal studies.

Source: ATSDR 1999; U.S. EPA 1991.

Chlordane (Reference for gamma-Chlordane)

Chlordane is a manufactured chemical that was used as a pesticide in the United States from 1948 to 1988. Technical chlordane is not a single chemical, but is actually a mixture of alpha and gamma isomers of chlordane mixed with many related chemicals. It doesn't occur naturally in the environment. It is a thick liquid whose color ranges from colorless to amber. Chlordane has a mild, irritating smell.

Until 1983, chlordane was used as a pesticide on crops like corn and citrus and on home lawns and gardens. Because of concern about damage to the environment and harm to human health, the U.S. EPA banned all uses of chlordane in 1983 except to control termites. In 1988, U.S. EPA banned all uses.

Chlordane adheres strongly to soil particles at the surface and is not likely to enter groundwater. Chlordane doesn't dissolve easily in water. Most chlordane leaves soil by evaporation to the air. It breaks down very slowly. It builds up in the tissues of fish, birds, and mammals.

Chlordane affects the nervous system, the digestive system, and the liver in people and animals. Headaches, irritability, confusion, weakness, vision problems, vomiting, stomach cramps, diarrhea, and jaundice have occurred in people who breathed air containing high concentrations of chlordane or accidentally swallowed small amounts of chlordane. Large amounts of chlordane taken by mouth can cause convulsions and death in people.

Long-term exposure caused harmful effects in the liver of test animals. It is not known whether chlordane affects the ability of people to have children or whether it causes birth defects. Animals exposed before birth or while nursing developed behavioral effects later.

The chronic oral reference dose of 5×10^{-4} mg/kg-d is based on a chronic toxicity test in mice. Statistically significant increased incidences over controls were found for hepatocellular swelling (hypertrophy) in 5- and 12.5-ppm males and females, and hepatic fatty degeneration was observed in 12.5-ppm males and 5- and 12.5-ppm females. Hepatic necrosis was noted in males only. An UF of 300 was applied to the NOAEL derived from the principal study: 10 for consideration of intraspecies variation, 10 for consideration of interspecies extrapolation, and 3 for lack of any reproductive studies. The overall confidence for this RfD assessment is medium.

The chronic inhalation reference concentration of 7×10^{-4} mg/m^3 is based on a comparative inhalation toxicity of technical chlordane in rats and monkeys. At the end of the exposure period, increased liver weights ($p < 0.01$) were observed for male and female rats exposed to 10 mg/m^3 at weeks 9 and 14. Analysis of blood chemistry results gave indications of hepatic functional alteration, but only among rats exposed to the highest concentration. An UF of 1000 was applied to the NOAEL: 10 for subchronic to chronic extrapolation; 10 for consideration of intraspecies variation. Partial UFs are used for interspecies extrapolation (which already has been addressed partially) and for database deficiencies (lack of any reproductive studies). The overall confidence in this RfC assessment is low.

U.S. EPA classifies chlordane as a Group B2, probable human carcinogen - based on sufficient evidence of carcinogenicity in animals.

Source: ATSDR 1995; U.S. EPA 1998.

4-Chloroaniline

4-Chloroaniline (PCA) is a colorless to slightly amber-colored crystalline solid with a mild aromatic odor. The chemical is soluble in water and in common organic solvents. PCA is used as an intermediate in the production of a number of products, including agricultural chemicals, azo dyes and pigments, cosmetics, and pharmaceutical products.

In humans, hemoglobin adducts are detectable as early as 30 min after accidental exposure, with a maximum level at 3 hr. Slow acetylating individuals have a higher potency to form hemoglobin adducts compared with fast acetylators. Excretion in humans occurs primarily via the urine, with PCA and its conjugates appearing as early as 30 min after exposure. Excretion takes place mainly during the first 24 h and is almost complete within 72 h. Data on occupational exposure of humans to PCA are mostly from a few older reports of severe intoxications after accidental exposure to PCA during production. Symptoms include increased methemoglobin and sulfhemoglobin levels, cyanosis, the development of anemia, and changes due to anoxia. PCA has a strong tendency to form hemoglobin adducts, and their determination can be used in biomonitoring of employees exposed to 4-chloroaniline in the workplace. There are reports of severe methemoglobinemia in neonates from neonatal intensive care units in two countries where premature babies were exposed to PCA as a breakdown product of chlorohexidine; the chlorohexidine, which had been inadvertently used in the humidifying fluid, broke down to PCA upon heating in a new type of incubator. Three neonates in one report (14.5-43.5% methemoglobin) and 33 of 415 neonates in another report (6.5-45.5% methemoglobin during the 8-month screening period) were found to be methemoglobin positive. A prospective clinical study showed that immaturity, severe illness, time exposed to PCA, and low concentrations of NADH reductase probably contributed to the condition.

Source: HSDB 2009 (accessed).

Cobalt

Cobalt is a naturally occurring element found in rocks, soil, water, plants, and animals. Cobalt is used to produce alloys used in the manufacture of aircraft engines, magnets, grinding and cutting tools, artificial hip and knee joints. Cobalt compounds are also used to color glass, ceramics and paints, and used as a drier for porcelain enamel and paints.

Radioactive cobalt is used for commercial and medical purposes. ^{60}Co (read as cobalt sixty) is used for sterilizing medical equipment and consumer products, radiation therapy for treating cancer patients, manufacturing plastics, and irradiating food. ^{57}Co is used in medical and scientific research. It takes about 5.27 years for half of ^{60}Co to give off its radiation and about 272 days for ^{57}Co; this is called the half-life.

Cobalt can benefit or harm human health. Cobalt is beneficial for humans because it is part of vitamin B12.

Exposure to high levels of cobalt can result in lung and heart effects and dermatitis. Liver and kidney effects have also been observed in animals exposed to high levels of cobalt.

Exposure to large amounts of radiation from radioactive cobalt can damage cells in your body from the radiation. You might also experience acute radiation syndrome that includes nausea, vomiting, diarrhea, bleeding, coma, and even death. This would be a rare event.

Nonradioactive cobalt has not been found to cause cancer in humans or animals following exposure in food or water. Cancer has been shown, however, in animals that breathed cobalt or when cobalt was placed directly into the muscle or under the skin. Based on the laboratory animal data, the International Agency for Research on Cancer (IARC) has determined that cobalt and cobalt compounds are possibly carcinogenic to humans.

Source: ATSDR 2004.

Copper
Copper is a naturally occurring element that is used to make electrical wiring and water pipes and as a component of alloys such as bronze and brass. Copper compounds are used as fungicides to prevent plant disease, in water treatment, and in wood, leather, and fabric preservatives.

Copper may enter the body by breathing air, drinking water, or eating food containing copper, and by skin contact with soil, water, and other copper-containing substances. Copper is an essential element at low-dose levels but may induce toxic effects at high-dose levels. The critical or most sensitive effect is gastrointestinal irritation. The National Academy of Science has recommended 2 to 3 mg/day of copper as a safe and adequate daily intake. Long-term overexposure to copper dust can irritate the nose, mouth, and eyes and cause headaches, dizziness, nausea, and diarrhea. Ingestion of high concentrations of copper can cause vomiting, diarrhea, stomach cramps, and nausea. Very young children are particularly sensitive to ingested copper. Liver and kidney damage and possibly death may result from long-term exposure.

In general, the seriousness of health effects of copper increase as the level and duration of exposure increases. Copper is not known to cause cancer or birth defects.

U.S. EPA assigns a Group D classification to chlordane for carcinogenicity meaning is not classified as a carcinogen. This classification is based no human data, inadequate animal data from assays of copper compounds, and equivocal mutagenicity data.

Source: ATSDR 2004; U.S. EPA 1988.

4,4'-DDD, 4,4'-DDE, 4,4'-DDT

DDT (dichlorodiphenyltrichloroethane) is a pesticide once widely used to control insects in agriculture and insects that carry diseases such as malaria. DDT is a white, crystalline solid with no odor or taste. Its use in the U.S. was banned in 1972 because of damage to wildlife, but is still used in some countries.

DDE (dichlorodiphenyldichloroethylene) and DDD (dichlorodiphenyldichloroethane) are chemicals similar to DDT that contaminate commercial DDT preparations. DDE has no commercial use. DDD was also used to kill pests, but its use has also been banned. One form of DDD has been used medically to treat cancer of the adrenal gland.

DDT affects the nervous system. People who accidentally swallowed large amounts of DDT became excitable and had tremors and seizures. These effects went away after the exposure stopped. No effects were seen in people who took small daily doses of DDT by capsule for 18 months.

A study in humans showed that women who had high amounts of a form of DDE in their breast milk were unable to breast feed their babies for as long as women who had little

DDE in the breast milk. Another study in humans showed that women who had high amounts of DDE in breast milk had an increased chance of having premature babies.

In animals, short-term exposure to large amounts of DDT in food affected the nervous system, while long-term exposure to smaller amounts affected the liver. Also in animals, short-term oral exposure to small amounts of DDT or its breakdown products may also have harmful effects on reproduction.

Studies in DDT-exposed workers did not show increases in cancer. Studies in animals given DDT with the food have shown that DDT can cause liver cancer.

The Department of Health and Human Services (DHHS) determined that DDT may reasonable be anticipated to be a human carcinogen. The International Agency for Research on Cancer (IARC) determined that DDT may possibly cause cancer in humans. The U.S. EPA determined that DDT, DDE, and DDD are probable human carcinogens.

Source: ATSDR 2002.

Dibenzofuran

Exposure to dibenzofuran may occur from inhalation of contaminated air, or ingesting contaminated drinking water or food. No information is available on the acute (short-term), chronic (long-term), reproductive, developmental, and carcinogenic effects of dibenzofuran in humans or animals. Health effects information is available on the polychlorinated dibenzofurans; however, U.S. EPA has noted that the biological activity of various chlorinated dibenzofurans varies greatly, thus, risk assessment by analogy to any of these more widely studied compounds would not be recommended. EPA has classified dibenzofuran as a Group D, not classifiable as to human carcinogenicity.

Source: U.S. EPA Hazard Summary (http://www.epa.gov/ttn/atw/hlthef/di-furan.html) 2000.

3,3'-Dichlorobenzidine

3,3'-Dichlorobenzidine is a gray-to-purple colored crystalline solid. It changes from a solid to a gas very slowly.

3,3'-Dichlorobenzidine salt is the major form in actual use. It is a stable, off-white colored crystalline solid that does not evaporate. Neither 3,3'-dichlorobenzidine nor its salt are found naturally in the environment. They are manufactured for pigments for printing inks, textiles, plastics and enamels, paint, leather, and rubber.

The salt form of 3,3'-dichlorobenzidine may have caused sore throat, respiratory infections, stomach upset, headache, dizziness, caustic burns, and dermatitis (an inflammation of the skin) in workers exposed to the chemical. However, with the exception of dermatitis, it is not certain that 3,3'-dichlorobenzidine caused these effects because the workers were exposed to other chemicals at the same time.

Studies show that 3,3'-dichlorobenzidine caused cancer of the liver, skin, breast, bladder, and tissues that form blood (leukemia) and other organs in laboratory animals that ate it in their food. Studies in people are inconclusive.

The Department of Health and Human Services (DHHS) has determined that 3,3'-dichlorobenzidine and its salt form may reasonably be expected to be a carcinogen.

Source: ATSDR 1999.

Dieldrin/Aldrin

Aldrin and dieldrin are insecticides with similar chemical structures. They are discussed together in this fact sheet because aldrin quickly breaks down to dieldrin in the body and in the environment. Pure aldrin and dieldrin are white powders with a mild chemical odor. The less pure commercial powders have a tan color. Neither substance occurs naturally in the environment.

From the 1950s until 1970, dieldrin was widely used pesticides for crops like corn and cotton. Because of concerns about damage to the environment and potentially to human health, U.S. EPA banned all uses of dieldrin in 1974, except to control termites. In 1987, U.S. EPA banned all uses.

Sunlight and bacteria change aldrin to dieldrin so dieldrin is found most often in the environment. Dieldrin binds tightly to soil and slowly evaporate to the air. Dieldrin in soil and water breaks down very slowly. Plants take in and store aldrin and dieldrin from the soil. Aldrin rapidly changes to dieldrin in plants and animals. Dieldrin is stored in the fat and leaves the body very slowly.

People who intentionally or accidentally ingested large amounts of aldrin or dieldrin suffered convulsions and some died. Health effects may also occur after a longer period of exposure to smaller amounts because these chemicals build up in the body.

Some workers exposed to moderate levels in the air for a long time had headaches, dizziness, irritability, vomiting, and uncontrolled muscle movements. Workers removed from the source of exposure rapidly recovered from most of these effects.

Animals exposed to high amounts of aldrin or dieldrin also had nervous system effects. In animals, oral exposure to lower levels for a long period also affected the liver and decreased their ability to fight infections. We do not know whether aldrin or dieldrin affect the ability of people to fight disease.

Studies in animals have given conflicting results about whether aldrin and dieldrin affect reproduction in male animals and whether these chemicals may damage the sperm. We do not know whether aldrin or dieldrin affect reproduction in humans.

The oral reference dose of 5×10^{-5} mg/kg-d is based on a two-year oral exposure study of rats and dogs. At the end of 2 years, females fed 1.0 and 10.0 ppm (0.05 and 0.5 mg/kg/day) had increased liver weights and liver-to- body weight ratios. Histopathological examinations revealed liver parenchymal cell changes including focal proliferation and focal hyperplasia. These hepatic lesions were considered to be characteristic of exposure to an organochlorine insecticide. An UF of 100 was applied to allow for uncertainty in the extrapolation of dose levels from laboratory animals to humans and uncertainty in the threshold for sensitive humans. The principal study is an older study for which detailed data are not available and in which a wide range of doses was tested. The chronic toxicity evaluation is relatively complete and supports the critical effect, if not the magnitude of effects. Reproductive studies are lacking. The RfD is given a medium confidence rating because of the support for the critical effect from other dieldrin studies, and from studies on organochlorine insecticides in general.

There is no conclusive evidence that aldrin or dieldrin cause cancer in humans. Aldrin and dieldrin have shown to cause liver cancer in mice. The U.S. EPA has determined that dieldrin is a class B2; probable human carcinogen.

Source: ATSDR 2002; U.S. EPA 1988.

Endrin (Reference for Endrin Aldehyde and Endrin Ketone)

Endrin is a solid, white, almost odorless substance that was used as a pesticide to control insects, rodents, and birds. Endrin has not been produced or sold for general use in the United States since 1986.

Little is known about the properties of endrin aldehyde (an impurity and breakdown product of endrin) or endrin ketone (a product of endrin when it is exposed to light).

Exposure to endrin can cause various harmful effects including death and severe central nervous system (brain and spinal cord) injury. Swallowing large amounts of endrin may cause convulsions and kill you in a few minutes or hours.

Symptoms that may result from endrin poisoning are headaches, dizziness, nervousness, confusion, nausea, vomiting, and convulsions.

No long-term health effects have been noted in workers who have been exposed to endrin by breathing or touching it.

Studies in animals confirm that endrin's main target is the nervous system.

Birth defects, especially abnormal bone formation, have been seen in some animal studies.

In studies using rats, mice, and dogs, endrin did not produce cancer. However, most of these studies did not accurately evaluate the ability of endrin to cause cancer.

No significant excess of cancer has been found in exposed factory workers.

The EPA has determined that endrin is not classifiable as to its human carcinogenicity because there is not enough information to allow classification.

Source: ATSDR 1997.

Endosulfan (Reference for Endosulfan I, Endosulfan II, and Endosulfan Sulfate)

Endosulfan affects the central nervous system and prevents it from working properly. Hyperactivity, nausea, dizziness, headache, or convulsions have been observed in adults exposed to high doses. Severe poisoning may result in death.

Studies of the effects of endosulfan on animals suggest that long-term exposure to endosulfan can also damage the kidneys, testes, and liver and may possibly affect the body's ability to fight infection. However, it is not known if these effects also occur in humans.

High levels of toluene may affect your kidneys.

We do not know if endosulfan can cause cancer in humans. Studies in animals have provided inconclusive results.

Endosulfan is a pesticide. It is a cream- to brown-colored solid that may appear in the form of crystals or flakes. It has a smell like turpentine, but does not burn. It does not occur naturally in the environment.

Endosulfan is used to control insects on food and non-food crops and also as a wood preservative.

Source: ATSDR 2001.

Dioxins/Furans

Dioxins and furans are two classes of chemicals that are structurally similar in that they both contain two carbon ring structures. They also exhibit similar chemical and physical properties. There are 210 unique dioxin/furan compounds, each called a “congener” (75 dioxin and 135 furan congeners), which differ from each other in the number of chlorine atoms attached to the carbon rings and in the position of the chlorine atoms. Dioxin/furan congeners can have one to eight chlorine atoms, resulting in eight different groups of congeners.

Dioxins are of concern to environmental and public health agencies because they are toxic to multiple human organs and systems. They also are persistent, accumulating and lasting in the body for years. While there are differences in toxicity among all the dioxin/furan congeners, animal studies have shown that there is a subset of 17 congeners that are considered the most toxic. Each of these congeners contains chlorine atoms located in the 2, 3, 7, and 8 positions of the carbon ring structures. The congener considered by EPA and the World Health Organization (WHO) to be the most toxic is 2,3,7,8-TCDD. The toxicity of each of the 17 congeners is described relative to the toxicity of 2,3,7,8-TCDD due to its toxicity and because it is the most studied congener.

Short-term exposure to high levels of dioxins/furans can cause skin lesions (e.g., chloracne) and impaired liver function. However, it is unlikely that most people will contact high levels that cause acute health effects. Long-term, or chronic, exposure to low levels of dioxins/furans has been shown to result in adverse effects on the immune system, liver function, the endocrine system, and reproductive functions. These effects have been documented in humans accidentally exposed to dioxins/furans and in results from controlled animal studies.

Studies in animals have shown that chronic exposure to dioxins/furans causes multiple forms of cancer and human studies demonstrate an association between exposure to dioxins/furans and increased cancer mortality. Based on the animal study results and some studies of accidental exposures to humans, WHO classified 2,3,7,8-TCDD as a "known human carcinogen" in 1997 (IARC 1997).

There is much debate among scientists regarding the cancer potency of 2,3,7,8-TCDD, and a quantitative assessment of toxicity by EPA is on-going (EPA 2003)[1]. Although EPA published revised estimates of cancer potency in 2003, Ecology (2007) and many other state and federal agencies continue to use EPA's provisional value of 150,000 per mg/kg-day published in the 1997 *Health Effects Assessment Summary Tables*.

Source: Ecology. 1997. Evaluating the toxicity and assessing the carcinogenic risk of environmental mixtures using toxicity equivalency factors.

EPA. 2003. Exposure and human health reassessment of 2,3,7,8-TCDD and related compounds. Part III: Integrated summary and risk characterization for 2,3,7,8-TCDD and related compounds. NAS Review Draft. National Center for Environmental Assessment, Research and Development, U.S. Environmental Protection Agency. Washington D.C.

IARC (International Agency for Research on Cancer). 1997. IARC monographs on the evaluation of carcinogenic risks to humans. Vol. 69. Polychlorinated dibenzo-para-dioxins and polychlorinated dibenzofurans. Lyon, France.

Heptachlor/Heptachlor Expoxide

Heptachlor is a manufactured chemical and doesn't occur naturally. Pure heptachlor is a white powder that smells like camphor (mothballs). The less pure grade is tan. Trade names include Heptagran®, Basaklor®, Drinox®, Soleptax®, Termide®, Gold Crest H-60®, and Velsicol 104®.

Heptachlor was used extensively in the past for killing insects in homes, buildings, and on food crops. These uses stopped in 1988. Currently it can only be used for fire ant control in underground power transformers.

Heptachlor epoxide is also a white powder. Bacteria and animals break down heptachlor to form heptachlor epoxide. The epoxide is more likely to be found in the environment than heptachlor.

[1] In May 2009, EPA stated that the reassessment of dioxin toxicity will be published by the end of 2010. The reassessment will incorporate results of more recent studies on the mechanisms of toxicity and estimates of cancer potency.

There is no reliable information on health effects in humans. Liver damage, excitability, and decreases in fertility have been observed in animals ingesting heptachlor. The effects are worse when the exposure levels were high or when exposure lasted many weeks.

Although there is very little information on heptachlor epoxide, it is likely that similar effects would also occur after exposure to this compound.

Lifetime exposure to heptachlor resulted in liver tumors in animals. The International Agency for Research on Cancer (IARC) and the EPA have classified heptachlor as a possible human carcinogen. EPA also considers heptachlor epoxide as a possible human carcinogen.

Source: ATSDR 2007.

Hexachlorobenzene

Hexachlorobenzene was widely used as a pesticide to protect the seeds of onions and sorghum, wheat, and other grains against fungus until 1965. It was also used to make fireworks, ammunition, and synthetic rubber. Currently, there are no commercial uses of hexachlorobenzene in the United States.

Hexachlorobenzene is a white crystalline solid that is not very soluble in water. It does not occur naturally in the environment. It is formed as a by-product while making other chemicals, in the waste streams of chloralkali and wood-preserving plants, and when burning municipal waste.

A study of people in Turkey who ate bread accidentally contaminated with hexachlorobenzene showed that the young children of mothers who it ate it or young children who ate it themselves can have lower survival rates. Nursing infants can be exposed to hexachlorobenzene through breast milk if their mothers have been exposed. Unborn children may also be affected if their mother has been exposed.

The people in Turkey who ate the contaminated bread suffered from a liver disease called porphyria cutanea tarda. This disease can cause red-colored urine, skin sores, change in skin color, arthritis, and problems of the liver, nervous system, and stomach.

Studies in animals show that eating hexachlorobenzene for a long time can damage the liver, thyroid, nervous system, bones, kidneys, blood, and immune and endocrine systems.

The immune system of rats that breathed hexachlorobenzene for a few weeks was harmed.

The U.S. Department of Health and Human Services (DHHS) has determined that hexachlorobenzene may reasonably be expected to be a carcinogen.

Animals that ate hexachlorobenzene for months or years developed cancer of the liver, kidneys, and thyroid. There is no strong evidence that it causes cancer in people.

A factory worker who breathed air for several years that contained many chemicals, but mostly hexachlorobenzene, developed liver cancer. However, because the factory worker breathed other chemicals at the same time that could cause cancer, it is not known if the liver cancer was caused by hexachlorobenzene alone or by a mixture of chemicals.

Source: ATSDR 2002.

Iron

Iron is a naturally occurring metallic element. It is commonly used to produce steel, special-purpose alloys with magnetic properties, and heat, corrosion and electrical resistances. In combination with other substances, iron is used to make pigments, polishing compounds, catalysts, feeds, disinfectants, and sewage and industrial wastewater treatment chemicals.

Iron is an essential nutrient; required for maintenance of good health. Available data indicate that to protect against the adverse health effects associated with iron deficiency, the RDA (recommended dietary allowance) should be at least 30 mg/day for pregnant women. If ingested in larger quantities iron can be toxic, causing effects such as irritability, seizures, abdominal pain, vomiting, diarrhea, lethargy, and coma. However, apart from accidental or deliberate poisoning, ingestion of sufficient iron to cause these effects is unlikely in most individuals.
Approximately 0.01% of the body burden of iron is excreted daily and the elimination half-time of iron from the body is 10 to 20 years. Humans do not have a mechanism to increase the excretion of absorbed iron in response to elevated body levels. Chronic ingestion of high levels of iron causes an increase in tissue iron levels. During iron overload, excess iron is stored in the liver and other organs. Massive iron overload can lead to liver cirrhosis and damage to other organs including the heart, endocrine glands, and pancreas.

A provisional oral RfD has been developed for iron based on typical dietary intake. The average intakes of iron, which range from 0.15 to 0.27 mg/kg-day do not cause iron overload, yet are sufficient to protect against iron deficiency. Dividing the NOAEL of 0.27 mg/kg-day by an UF of 1 yields a provisional chronic oral RfD of 0.3 mg/kg-day. While confidence in the critical study is high, overall confidence in the overall database is medium because the data are insufficient to determine the chronic dose level that is associated with adverse effects in health individuals. This RfD may not be protective of people with disorders of iron metabolism and could be conservative if applied to forms of iron with low bioavailability.

There is no evidence that iron can cause cancer. Iron has not been assigned a carcinogenicity weight-of-evidence classification by U.S. EPA.

Source: U.S. EPA 1999.

Lead

Lead is a naturally occurring metal that is used in the manufacture of storage batteries and the production of ammunition and miscellaneous metal products (e.g., sheet lead, solder, and pipes). Other uses for lead are in the manufacturing of lead compounds including gasoline additives and pigments. In recent years, the quantity of lead used in paints, gasoline additives, ammunition, and solder has been reduced because of lead's toxic effects.

Lead can enter the body via ingestion and inhalation. Although it may also enter the body through the skin, dermal absorption of inorganic lead compounds is less significant than absorption through other routes. Children appear to be the segment of the population at greatest risk from toxic effects of lead. Children absorb about 50% of ingested lead while adults absorb only 5% to 15%. Initially, lead travels in the blood to the soft tissues (heart, liver, kidney, brain, etc.), then it is gradually sequestered in the bones and teeth. Children retain a larger fraction of the absorbed lead, about 57%, in the blood and soft tissue compartments, whereas in adults roughly 95% of the total body burden of lead is found in bones and teeth.

The most serious effects associated with markedly elevated blood lead levels include neurotoxic effects such as irreversible brain damage. Health effects are the same for inhaled and ingested lead. At blood lead levels of 40 to 100 micrograms per deciliter (µg/dL), children have exhibited nerve damage, permanent mental retardation, colic, anemia, brain damage, and death. Chronic kidney disease is also evident at these levels. For most adults, such damage does not occur until blood lead levels exceed 100 to 120 µg/dL. At these levels, damage to the male reproductive system; miscarriages; anemia; severe digestive system symptoms; decreased reaction time; weakness in fingers, wrists, or ankles; and some increased risk of heart and circulatory system disease may be exhibited.

Developmental effects in children have been identified as the most sensitive or critical effects of lead exposure. IQ, hearing, and growth deficits have been reported in children with blood lead levels of 10 µg/dL. The Center for Disease Control (CDC) regards 10 µg/dL as a level of concern for blood lead based on the evidence of adverse health effects at that level and above. U.S. EPA has adopted the 10 µg/dL blood lead level as a target to assist in evaluating progress in reducing lead exposure. This level is not considered to be a threshold for adverse health effects; rather, it is a benchmark that is subject to revision. U.S. EPA recognizes that there may be a small but finite risk of health effects at lower levels.

None of the epidemiology studies conducted to explore the relationship between lead exposure and increased cancer risk found any relationship. However, animal studies have shown increased kidney cancer and central nervous system (CNS) cancer in rats and mice. The U.S. EPA has classified lead as a Group B2 probable human carcinogen.

U.S. EPA currently provides neither a RfD for evaluating noncarcinogenic effects nor a SF for evaluating possible carcinogenic effects of lead exposure. The absence of toxicological values reflects the scientific community's inability to agree on the threshold dose for lead's noncarcinogenic effects or to satisfactorily estimate its carcinogenic potential, despite a rather large body of scientific literature on its toxic effects.

Source: ATSDR 2007, U.S. EPA 1988.

Lindane and other Hexachlorocyclohexanes

Hexachlorocyclohexane (HCH; also known as BHC) is a manufactured chemical that exists in eight chemical forms called isomers. One of these forms, gamma-HCH (or γ-HCH, commonly called lindane) is produced and used as an insecticide on fruit, vegetables, and forest crops. It is a white solid that may evaporate into the air as a colorless vapor with a slightly musty odor. It is also available as a prescription (lotion, cream, or shampoo) to treat head and body lice, and scabies. Lindane has not been produced in the United States since 1976, but is imported for insecticide use.

Technical-grade HCH was used as an insecticide in the United States and typically contained 10-15% γ-HCH as well as the alpha (α), beta (β), delta (δ), and epsilon (ε) forms of HCH. Virtually all the insecticidal properties resided in γ-HCH. Technical-grade HCH has not been produced or used in the United States in over 20 years.

Some people who breathed contaminated workplace air during manufacturing of pesticides, including γ-HCH, had blood disorders, dizziness, headaches, and changes in the levels of sex hormones. Some people who swallowed large amounts had seizures and sometimes died.

Animals fed γ- and α-HCH have had convulsions, and animals fed β-HCH have become comatose. All isomers can produce liver and kidney effects. Reduced ability to fight infection was reported in animals fed γ-HCH, and injury to the ovaries and testes was reported in animals given γ-HCH or β-HCH.

Long-term oral administration of α-HCH, β-HCH, γ-HCH, or technical-grade HCH to laboratory rodents produced liver cancer. The Department of Health and Human Services (DHHS) has determined that HCH (all isomers) may reasonably be anticipated to cause cancer in humans. The International Agency for Research on Cancer (IARC) has classified HCH (all isomers) as possibly carcinogenic to humans. The EPA has determined that there is suggestive evidence that lindane (γ-HCH) is carcinogenic, but the evidence is not sufficient to assess its human carcinogenic potential. The EPA has additionally classified technical HCH and α-HCH as probable human carcinogens, β-HCH as a possible human carcinogen, and δ- and ε-HCH as not classifiable as to human carcinogenicity.

Source: ATSDR 2005.

Manganese
Manganese, a naturally occurring element, is usually found combined with other elements such as oxygen, sulfur, and chlorine. Manganese is used in the steel industry; metallurgical processing; the production of dry cell batteries; as a component of some ceramics, pesticides, and fertilizers; and in nutritional supplements. Manganese is an essential element for humans and is a cofactor for a number of enzymatic reactions. The United States National Research Council recommends a provisional daily dietary intake of manganese of 2.0 to 5.0 gram for adults.

Manganese enters the air primarily through the burning of fossil fuels and emissions from factories where metallic manganese is produced from ores. It can be released to water and soil from factories or spills and leaks at hazardous waste sites. Some manganese compounds are soluble in water, and low levels of these compounds are normally present in lakes, streams, and the ocean. Manganese does not break down in the environment, but can change from one form to another.

Because manganese occurs naturally in the environment, humans are exposed to low levels of manganese in water, air, soil, and food. Food is the primary source of manganese for most people. There are few reports of negative health effects in humans exposed to manganese in drinking water or food. Laboratory studies of animals exposed to manganese in water or food have demonstrated adverse health effects, including changes in brain chemical levels, low birth weights in rats when mothers were exposed during pregnancy, slower than usual testes development, decreased body weight gain, and weakness and muscle rigidity in monkeys.

Inhalation of manganese dust at mining or ore processing plants and inhalation of welding fumes may be significant sources of occupational exposure. Following inhalation of manganese dust, absorption into the bloodstream occurs only if particles are sufficiently small to be able to penetrate deeply into the lungs. Long-term inhalation of manganese dust may result in a neurological disorder characterized by irritability, difficulty in walking, and speech disturbances. Impotence and loss of libido also have been reported in men exposed to high levels of manganese in air. Short-term inhalation exposure has been associated with respiratory disease.

Several studies were used to derive the oral RfD for dietary manganese, 1.4E-01 mg/kg-day. While those studies report average levels of manganese in various diets, no quantitative information is available to indicate toxic levels of manganese in the diet. Because humans maintain homeostatic control of manganese uptake and elimination, there is a wide range of dietary intakes considered to be safe. The determination of a single acceptable intake of manganese in the diet does not reflect the considerable variability in its absorption and elimination by humans, which are influenced by both environmental and biological factors. Confidence in the database and in the dietary RfD for manganese is medium.

For assessments of exposure to manganese is soil or drinking water, U.S. EPA recommends that the oral RfD should be adjusted by subtracting the amount of manganese that would be consumed in a normal diet (assuming 5 mg/day for a 70 kg adult, or 0.071 mg/kg-day) and dividing by an UF of 3. The resulting oral RfD for soil or water is 2.4×10^{-2} mg/kg-day. Region 3 (U.S. EPA 2006) does not conduct this non-standard adjustment to the oral RfD and therefore was not used in this risk assessment.

The inhalation RfC for manganese, 0.00005 mg/m^3, is based on a study in which impairment of neurobehavioral function in occupationally exposed individuals was identified as the critical effect. The principal study included 92 male workers exposed to manganese dioxide dust in a Belgian alkaline battery plant for an average of 5.3 years (range: 0.2 to 17.7 years) and a control group of 101 male workers. Confidence in the study and the database is considered medium. The principal study did not identify a NOAEL for neurobehavioral effects, nor did it measure particle size directly or provide information on particle size distribution. These limitations are mitigated by the fact that the principal study found similar indications of neurobehavioral dysfunction, and these findings were consistent with the results of other human studies. In all of the principal and supporting studies, the exposure duration was relatively limited and the workers were relatively young. These temporal limitations raise concerns that longer exposure durations and/or interactions with aging might result in the detection of effects at lower concentrations. There also is insufficient information on the developmental and reproductive effects of manganese inhalation. Medium confidence in the inhalation RfC follows medium confidence in the principal studies and the database.

There are no human carcinogenicity data for manganese exposure. The data from some animal studies have shown increases in tumors in a small number of animals at high doses of manganese, but the data are inadequate to judge whether manganese can cause cancer. The U.S. EPA has placed manganese in Group D (not classifiable as to human carcinogenicity).

Source: ATSDR 2001; U.S. EPA 1988; U.S. EPA 2006.

Mercury and Methyl Mercury

Mercury is a naturally occurring element that exists in three oxidation states—metallic mercury (Hg), mercurous mercury (Hg^{1+}), and mercuric mercury (Hg^{2+})—and a variety of chemical forms. Mercury is used in a variety of manufactured products, including thermometers, barometers, batteries, mercury lamps, and paint, and as a catalyst in the manufacture of chlorine, caustic soda, and other chemicals. Man-made sources of mercury in the environment include mercury mining and smelting operations, industrial processes that use mercury, fossil fuel combustion, and waste disposal.

The most important forms of mercury with respect to human exposure are methyl mercury, mercuric mercury, and elemental mercury. Elemental mercury, the principal form in the atmosphere, can be transported long distances, eventually depositing on land and in surface waters. In soils and surface waters, mercury can exist in the mercuric and mercurous states as complex ions with varying water solubilities. Inorganic forms tend to sorb to soil and sediment particles and are relatively immobile; however, chemical and biological processes can convert sorbed mercury to more mobile forms, including elemental mercury and volatile organic forms. The most common organic form, methyl mercury, is relatively mobile, and it quickly enters the aquatic food chain and bioaccumulates in aquatic organisms.

Non-occupational exposure to inorganic mercury and methyl mercury compounds occurs primarily through ingestion, with the major source of human exposure to methyl mercury occurring through the consumption of fish and shellfish. Mercury also can enter the body readily through inhalation of mercury vapor, which is the principal route of occupational exposure.

The form of mercury determines its distribution in the body and its health effects. Metallic mercury and organic mercury distribute primarily to the kidneys; however, they also can readily cross the blood-brain and placental barriers. Long-term exposure to these forms of mercury can permanently damage the brain, kidneys, and developing fetus. Inorganic mercuric compounds also are distributed primarily to the kidneys, similar to metallic mercury; however, the amount that crosses the blood-brain and placental barriers is much lower.

The nervous system appears to be the most sensitive target of low-level exposure to metallic and organic mercury. CNS effects associated with chronic inhalation of mercury vapors or chronic ingestion of methyl mercury include tremors, memory loss, impaired vision, and irritability. Prenatal exposure to methyl mercury via maternal ingestion can cause neurological effects in the children ranging from slowed mental and coordination development at low exposure levels to severe, irreversible brain damage from mercury poisoning. The most sensitive target of exposure to inorganic mercury salts appears to be the kidneys, though brain effects also have been reported.

A chronic oral RfD of 3×10^{-4} has been established for mercuric chloride and other soluble salts based on rat subchronic feeding and subcutaneous studies that reported autoimmune effects. An UF of 1000 was applied to the LOAEL, 10 to convert to and expected NOAEL, 10 for the use of subchronic studies, and 10 for both animal-to-human extrapolation and protection of sensitive human subpopulations. While no one study was considered adequate, based on the weight of evidence from available studies and the entirety of the data base, confidence in this oral RfD is high.

The oral RfD for methylmercury, 1×10^{-4} mg/kg-day, is based on neurologic abnormalities observed in human infants whose mothers ingested methylmercury in their diet. An UF of 10 was applied to the NOAEL to account for variability in the human population and for the lack of a two-generation reproductive study and lack of data for the effect of exposure duration on longer-term effects. Confidence in the RfD is medium.

The inhalation RfC, 0.0003 mg/m^3, which is specifically for elemental mercury, is derived from a human inhalation study in which neurotoxicity was identified as the critical effect. A NOAEL of 0.009 mg/m^3 was identified in the critical study and an UF of 30 was applied.

Mercuric chloride and methylmercury have been classified by U.S. EPA as Group C possible human carcinogens; however, SFs have not been derived for these chemicals. Inorganic mercury has not been found to be carcinogenic in animals or humans and has been placed in Group D, not classifiable as to human carcinogenicity, by the U.S. EPA.

Source: ATSDR 1999; U.S. EPA 2005.

Methoxychlor

Methoxychlor is a manufactured chemical that does not occur naturally in the environment. Pure methoxychlor is a pale-yellow powder with a slight fruity or musty odor.

Methoxychlor is used as an insecticide against flies, mosquitoes, cockroaches, chiggers, and a wide variety of other insects. It is used on agricultural crops and livestock, and in animal feed, barns, grain storage bins, home garden, and on pets.

Methoxychlor is also known as DMDT, Marlate®, or Metox®.

There is very little information on how methoxychlor can affect people's health. Animals exposed to very high amounts of methoxychlor suffered tremors and convulsions and seizures. Because methoxychlor is broken down quickly in the body, you are not likely to experience these effects unless you are exposed to very high levels.

Animal studies show that exposure to methoxychlor in food or water harms the ovaries, uterus, and mating cycle in females, and the testes and prostate in males. Fertility is decreased in both male and female animals. These effects can occur both in adult and in developing animals and could also occur following inhalation or skin contact. These effects are caused by a breakdown product of methoxychlor which acts as a natural sex hormone. These effects have not been reported in humans, but they could happen.

Most of the information available from human and animal studies suggests that methoxychlor does not cause cancer. The International Agency for Research on Cancer (IARC) and the EPA have determined that methoxychlor is not classifiable as to its carcinogenicity to humans.

Source: ATSDR 2002.

Nickel

Nickel is a naturally occurring metal found in small quantities in the earth's crust. Nickel is used industrially in making various steels and alloys and in electroplating. Exposure to nickel and nickel compounds may occur through inhalation of dust and particles, ingestion of food and drinking water containing nickel, and by absorption through the skin. Nickel has been shown to be essential nutrients for some species of animals and may be essential to humans.

Inhalation exposure to high levels of nickel and nickel compounds may have adverse effects on the lungs. Exposure by oral and inhalation routes may also affect the immune system, kidneys, and blood. Inhalation of nickel at concentrations greater than 0.001 mg/m^3 in air may cause immune system depression, lung irritation, and pulmonary disease. Death may result from inhalation of concentrations greater than 0.1 mg/m^3.

An oral RfD for soluble salts of nickel, 0.02 mg/kg-day, is based on decreased organ and body weights in rats who ingested nickel in their diet. The NOAEL of 5 mg/kg-day was multiplied by an UF of 300 to account for interspecies extrapolation, protection of sensitive populations, and inadequacies in the reproductive studies. Confidence in the oral RfD is medium.

Inhalation of nickel refinery dust has caused cancer of the lung, nasal cavity, and voice box in humans. Nickel refinery dust and nickel subsulfide have been classified as Group A human carcinogens. It is not known if other nickel compounds are carcinogenic.

Source: ATSDR 2005; U.S. EPA 1987; U.S. EPA 1987.

M-Nitroaniline

3-Nitrobenzenamine is non-volatile stable solid. This chemical is used as raw material for dyestuff in closed system. This chemical is stable in neutral, acidic or alkaline solutions, and is classified as "not readily biodegradable" and "low bioaccumulation potential". The fact that the chemical is moderately toxic to daphnids, slightly toxic to fish and algae, implies the environmental risk presumably to be low. The chemical showed genotoxic effects in bacterial test, non-bacterial test in vitro and micronucleus test, and LOAEL for repeated dose toxicity was 15 mg/kg/day and NOAEL for reproductive toxicity was 50 mg/kg/day in male rats and 5 mg/kg/day in female rats.

Source: Internal Programme on Chemical Safety, Screening Information Data Set (SIDS) for High Production Volume Chemicals (access 2009).

Pentachlorophenol

Pentachlorophenol is a manufactured chemical that does not occur naturally. Pure pentachlorophenol exists as colorless crystals. Impure pentachlorophenol (the form usually found at hazardous waste sites) is dark gray to brown and exists as dust, beads, or flakes. Humans are usually exposed to impure pentachlorophenol (also called technical grade pentachlorophenol).

Pentachlorophenol was widely used as a pesticide and wood preservative. Since 1984, the purchase and use of pentachlorophenol has been restricted to certified applicators. It is no longer available to the general public. It is still used industrially as a wood preservative for utility poles, railroad ties, and wharf pilings.

Studies in workers show that exposure to high levels of pentachlorophenol can cause the cells in the body to produce excess heat. When this occurs, a person may experience a very high fever, profuse sweating, and difficulty breathing. The body temperature can increase to dangerous levels, causing injury to various organs and tissues, and even death.

Liver effects and damage to the immune system have also been observed in humans exposed to high levels of pentachlorophenol for a long time. Damage to the thyroid and reproductive system has been observed in laboratory animals exposed to high doses of pentachlorophenol. Some of the harmful effects of pentachlorophenol are caused by the other chemicals present in technical grade pentachlorophenol.

Some studies have found an increase in cancer risk in workers exposed to high levels of technical grade pentachlorophenol for a long time, but other studies have not found this. Increases in liver, adrenal gland, and nasal tumors have been found in laboratory animals exposed to high doses of pentachlorophenol.

The EPA has determined that pentachlorophenol is a probable human carcinogen and the International Agency for Cancer Research (IARC) considers it possibly carcinogenic to humans.

Source: ATSDR 2001.

Polychlorinated Biphenyls (PCBs)
PCBs are a group of man-made chemicals composed of 209 individual compounds. They have been used widely in coolants, lubricants, and dielectric materials in transformers, capacitors, and other electrical equipment because of their insulating and flame-resistant properties. The industrial manufacture of PCBs in the United States was stopped in 1977 in response to the discovery that PCBs could accumulate and persist in the environment and might cause adverse health effects. Although PCBs are no longer manufactured in the United States, people can be exposed to PCBs spilled or leaked from older transformers, capacitors, and other kinds of equipment and to low levels of PCBs which are widespread throughout the environment. PCBs bind tightly to soils, and can be found in high concentrations in some freshwater and marine sediments. Some freshwater fish have bioconcentrated PCBs, and eating fish from contaminated areas may be a potentially significant source of human exposure.

PCBs can enter the body when fish, other foods, or water containing PCBs are ingested, when air that contains PCBs is breathed, or when skin comes in contact with PCBs. Skin irritations characterized by acne-like lesions and rashes and liver effects were the only significant adverse health effects reported in PCB-exposed workers. Epidemiological studies of workers occupationally exposed to PCBs thus far have not found any conclusive evidence of an increased incidence of cancer in these groups.

Aroclor 1254 has an oral reference dose of 2 x 10-5 mg/kg-d based on monkey clinical and immunologic studies. A 10-fold US is applied to account for sensitive individuals. A factor of 3 is applied to extrapolation from rhesus monkeys to humans. A full 10-fold factor for interspecies extrapolation is not considered necessary because of similarities in toxic responses and metabolism of PCBs between monkeys and humans and the general physiologic similarity between these species. A partial factor is applied for the use of a minimal LOAEL since the changes in the periocular tissues and nail bed see at the 0.05 mg/kg-day are not considered to be of marked severity. The duration of the critical study continued for approximately 25% of the lifespan of rhesus monkeys so that a reduced factor was used for extrapolation from subchronic exposure to a chronic RfD. The immunologic and clinical changes that were observed did not appear to be dependent upon duration which further justifies using a factor of 3 rather than 10 for extrapolation from subchronic to chronic, lifetime exposure. The total UF is 300.

Effects of PCBs in experimentally exposed animals include liver damage, skin irritations, death, low birth weights, and other reproductive effects. Some strains of rats and mice that were fed PCB mixtures throughout their lives showed increased incidence of cancer of the liver and other organs. Based on these animal studies, the U.S. EPA has classified PCBs as Group B2 probable human carcinogen.

Source: ATSDR 2001; U.S. EPA 1994; U.S. EPA 1989.

Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs contain only carbon and hydrogen and consist of two or more fused benzene rings in linear, angular, or cluster arrangements. PAHs are formed during the incomplete burning of fossil fuel, garbage, or any organic matter. PAHs produced by burning may be carried into the air on dust particles and distributed into water and soil. In general, PAHs do not evaporate easily, and do not dissolve in water.

Exposure to PAHs may occur by inhaling airborne particles, drinking water, or accidentally ingesting soil or dust containing PAHs. In addition, smoking tobacco or eating charcoal-broiled food are common routes of exposure to PAHs.

Some PAHs are known carcinogens, and potential health effects caused by PAHs are usually discussed in terms of an individual PAH compound's carcinogenic or noncarcinogenic effects. Little attention has been paid to non-cancer effects of PAHs. Rapidly growing tissues, such as the intestinal lining, bone marrow, lymphoid organs, blood cells, and testes seem to be especially susceptible targets to non-cancer effects. Exposure to benzo(a)pyrene (B(a)P) and other carcinogenic PAHs can cause cancer at the point of exposure. When exposed to high levels of B(a)P in air, animal develop lung tumors; when exposed via the dietary route, they develop stomach tumors; and when B(a)P is painted on skin, animals develop skin tumors. B(a)P and six other PAHs have been classified by U.S. EPA as Group B2 probable human carcinogens. The other Group B2 carcinogenic PAHs are: benzo(a)anthracene, benzo)b)fluoranthene, benzo(k) fluoranthene, chrysene, dibenzo(a,h) anthracene, and indeno(1,2,3-cd)pyrene.. Only B(a)P has been assigned a slope factor (SF) by U.S. EPA.

The oral SF for B(a)P, 7.3 $(mg/kg\text{-}day)^{-1}$ is based on the geometric mean of four slope factors derived using differing modeling procedures from two different studies of mice and rats in which increased incidences of cancer of the forestomach were caused by dietary exposures. The range of slope factors calculated was 4.5 to 11.7 $(mg/kg\text{-}day)^{-1}$. The data used are considered to be less than optimal, but acceptable.

In the past, other group B2 carcinogenic PAHs were assumed to be equipotent to B(a)P; however, it has been shown in animal studies that some are less carcinogenic than B(a)P. U.S. EPA has adopted relative potency factors (RPFs) that account for differences in the carcinogenic potencies of individual PAHs relative to that of B(a)P (U.S. EPA 1993c). In this risk assessment, the SF for each carcinogenic PAH has been estimated by multiplying the SF for B(a)P by the compound-specific RPF.

It is not really appropriate to use the oral SF for B(a)P or the other carcinogenic PAHs to evaluate carcinogenic risks from dermal contact, because B(a)P exposure is associated with cancer at the point of contact. Nevertheless, rather than eliminating the dermal route and possibly underestimating the total cancer risks, the oral SFs were extrapolated to estimate risks from dermal exposure in this assessment.

Source: ATSDR 1996; U.S. EPA 1987.

Pyridine

Pyridine is a colorless liquid with an unpleasant smell. It can be made from crude coal tar or from other chemicals.

Pyridine is used to dissolve other substances. It is also used to make many different products such as medicines, vitamins, food flavorings, paints, dyes, rubber products, adhesives, insecticides, and herbicides. Pyridine can also be formed from the breakdown of many natural materials in the environment.

Very little information is available on the health effects of pyridine. Animal studies and some limited case reports in people have noted liver damage from exposure to pyridine.

Two patients with epilepsy had damage to the liver and kidneys after ingesting some pyridine. We do not know if the pyridine caused these effects because the patients were taking several other medications at the same time. Harmful effects to the liver were also seen in rats and mice that were given pyridine for three months.

Headaches, giddiness, a desire to sleep, quickening of the pulse, and rapid breathing occurred in adults who breathed an unknown amount of pyridine for an unknown length of time.

Mild skin irritation and eye irritation were seen in rabbits when pyridine was placed on their skin or in their eyes.

We do not know whether pyridine affects the ability of men and women to have children or whether it causes birth defects.

The Department of Health and Human Services, the International Agency for Research on Cancer, and the Environmental Protection Agency (EPA) have not classified pyridine as to its human carcinogenicity.

No studies are available in people or animals on the carcinogenic effects of pyridine.

Source: ATSDR 1995.

Resin Compounds
Resin compounds include retene, guaiacol, chlorinated guaiacols, and resin acids. Wood resins or resin acids are plant derived chemicals found in association with wood debris, hardwood tar, and pulp and paper mill processes. Resin acids are a component of most softwoods and are usually released from wood chips during the pulping process. Their acute toxicity towards fish and other aquatic life has been shown in previous studies. Resin acids may account for as much as 70% of the toxicity of effluents (Li et. al. 1996). Guaiacols can be absorbed through the skin and appears to be about one third as toxic as phenol and have pharmacological properties similar to phenol (HSDB 2009).

Selenium
Selenium is a naturally occurring mineral element that is distributed widely in nature in most rocks and soils. In its pure form, it exists as metallic gray to black hexagonal crystals, but in nature it is usually combined with sulfide or with silver, copper, lead, and nickel minerals. Most processed selenium is used in the electronics industry, but it is also used: as a nutritional supplement; in the glass industry; as a component of pigments in plastics, paints, enamels, inks, and rubber; in the preparation of pharmaceuticals; as a nutritional feed additive for poultry and livestock; in pesticide formulations; in rubber production; as an ingredient in antidandruff shampoos; and as a constituent of fungicides.

Selenium has both beneficial and harmful effects. Low doses of selenium are needed to maintain good health. However, exposure to high levels can cause adverse health effects. Short-term oral exposure to high concentrations of selenium may cause nausea, vomiting, and diarrhea. Chronic oral exposure to high concentrations of selenium compounds can produce a disease called selenosis. The major signs of selenosis are hair loss, nail brittleness, and neurological abnormalities (such as numbness and other odd sensations in the extremities).

Brief exposures to high levels of elemental selenium or selenium dioxide in air can result in respiratory tract irritation, bronchitis, difficulty breathing, and stomach pains. Longer-term exposure to either of these air-borne forms can cause respiratory irritation, bronchial spasms, and coughing. Levels of these forms of selenium that would be necessary to produce such effects are normally not seen outside of the workplace.

Animal studies have shown that very high amounts of selenium can affect sperm production and the female reproductive cycle. We do not know if similar effects would occur in humans.

Studies of laboratory animals and people show that most selenium compounds probably do not cause cancer. In fact, studies in humans suggest that lower-than-normal selenium levels in the diet might increase the risk of cancer.

The International Agency for Research on Cancer (IARC) has determined that selenium and selenium compounds are not classifiable as to their carcinogenicity to humans.

The U.S. EPA has determined that one specific form of selenium, selenium sulfide, is a probable human carcinogen. Selenium sulfide is not present in foods and is a very different chemical from the organic and inorganic selenium compounds found in foods and in the environment.

Source: ATSDR 2003.

Silver

Silver is a soft metal that occurs naturally in pure form and in ores. Silver com-pounds have been used industrially in the manufacture of photographic film, indelible inks, and medications. Photographic materials are the major source of silver released to the environment.

In general, silver in the environment binds to minerals in soil. However, silver can convert to forms that dissolve in water. Most people are exposed daily to very low levels of silver in food and water. It is less likely for the general public to be exposed to silver in air.

Most of the information about health effects caused by human exposure to silver is based on exposure to very high concentrations of silver in medications or the work place, such as chemical manufacturing facilities. Long-term oral or inhalation exposure to silver compounds can cause a gray or blue-gray color in some areas of skin or other body tissues. This condition, called argyria, is permanent but thought to be only a "cosmetic" problem.

Argyria is the critical or most sensitive health effect of exposure to silver. Other health effects seen in humans include minor allergic reactions from dermal exposure to silver and irritation of the throat, lungs, and stomach after exposure to dust containing high levels of silver compounds.

Studies of long-term exposure of laboratory animals to silver have demonstrated reduced activity, decreased weight gain, and enlarged hearts. It is not known whether similar effects could occur in humans, although some occupational studies in humans suggest silver can cause kidney problems.

The oral reference dose for silver is 5×10^{-3} mg/kg-d based on an 1935 clinical spectroscopy study that showed seventy cases of generalized argyrosis following organic and colloidal silver medication. Argyria, is a medically benign but permanent bluish-gray discoloration of the skin. Argyria results from the deposition of silver in the dermis and also from silver-induced production of melanin. Although silver has been shown to be uniformly deposited in exposed and unexposed areas, the increased pigmentation becomes more pronounced in areas exposed to sunlight due to photoactivated reduction of the metal. Although the deposition of silver is permanent, it is not associated with any adverse health effects. No pathologic changes or inflammatory reactions have been shown to result from silver deposition. Silver compounds have been employed for medical uses for centuries. In the nineteenth and early twentieth centuries, silver arsphenamine was used in the treatment of syphillis; more recently it has been used as an astringent in topical preparations. While argyria occurred more commonly before the development of antibiotics, it is now a rare occurrence. An UF of 3 is applied to account for minimal effects in a subpopulation which has exhibited an increased propensity for the development of argyria. The critical effect observed is a cosmetic effect, with no associated adverse health effects. Also, the critical study reports on only 1 individual who developed argyria following an i.v. dose of 1 g silver (4 g silver arsphenamine). Other individuals did not respond until levels five times higher were administered. No UF for less than chronic to chronic duration is needed because the dose has been apportioned over a lifetime of 70 years.

Silver is not classified as to its human carcinogenicity and therefore is a Class D compound. In animals, local sarcomas have been induced after implantation of foils and discs of silver. However, the interpretation of these findings has been questioned due to the phenomenon of solid-state carcinogenesis in which even insoluble solids such as plastic have been shown to result in local fibrosarcomas

Source: ATSDR 1996; U.S. EPA 1987.

Tin including Tributyltin and Tributyltin Oxide

Tin is a natural element in the earth's crust. It is a soft, white, silvery metal that does not dissolve in water. It is present in brass, bronze, pewter, and some soldering materials. Tin metal is used to line cans for food, beverages, and aerosols.

Tin can combine with other chemicals to form compounds. Combinations with chemicals like chlorine, sulfur, or oxygen are called inorganic tin compounds (i.e., stannous chloride, stannous sulfide, stannic oxide). These are used in toothpaste, perfumes, soaps, food additives and dyes. Tin also can combine with carbon to form organotin compounds (i.e., dibutyltin, tributyltin, triphenyltin). These compounds are used to make plastics, food packages, plastic pipes, pesticides, paints, and pest repellents.

Tin metal, and inorganic and organic tin compounds can be found in the air, water, and soil near places where they are naturally present in the rocks, or where they are mined, manufactured, or used.

Metallic tin is not very toxic due to its poor gastrointestinal absorption. Human and animal studies show that ingestion of large amounts of inorganic tin compounds can cause stomachache, anemia, and liver and kidney problems.

Breathing or swallowing, or skin contact with some organotins, such as trimethyltin and triethyltin compounds, can interfere with the way the brain and nervous system work. In severe cases, it can cause death.

Some organotin compounds, such as dibutyltins and tributyltins, have been shown to affect the immune system in animals, but this has not been examined in people. Studies in animals also have shown that some organotins, such as dibutyltins, tributyltins, and triphenyltins can affect the reproductive system. This, also, has not been examined in people.

Inorganic or organic tin compounds placed on the skin or in the eyes can produce skin and eye irritation.

There is no evidence that tin or tin compounds cause cancer in humans. Studies in animals have not shown evidence of carcinogenicity for inorganic tin. A study in rats and another in mice showed that a specific organotin, triphenyltin hydroxide, can produce cancer in animals after long-term oral administration.

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA has not classified metallic tin or inorganic tin compounds for carcinogenicity. The EPA has determined that a specific organotin, tributyltin oxide, is not classifiable as to human carcinogenicity.

Source: ATSDR 2005.

Vanadium

Vanadium is a naturally occurring gray metal. In the environment, vanadium is usually combined with elements such as oxygen and sulfur. Vanadium compounds, primarily vanadium pentoxide, are used extensively in industry. The largest industrial use of vanadium oxide is in steel manufacturing, but vanadium compounds also are used in plastic, rubber, ceramic, and other chemical manufacturing.

Burning of fuel oil is the largest source of vanadium releases to the atmosphere, which are generally in the form of vanadium oxides. Deposition of atmospheric vanadium is an important source of vanadium in soil and water; however, natural releases from weathering of rocks and soil erosion are far greater than anthropogenic sources to the atmosphere. Vanadium is not generally very soluble in water, but it can be carried with small particles in surface water and groundwater.

Because vanadium occurs naturally, people are likely to be exposed to low concentrations of vanadium in food and drinking water. People can be exposed to vanadium in air near industries that use vanadium, waste disposal areas of these industries, or downwind of fuel oil or coal burning areas. Most inhaled or ingested vanadium is not absorbed from the respiratory or digestive tract. Only a small amount is absorbed into the bloodstream, and most of that leaves the body quickly in the urine. Vanadium is not believed to be absorbed through skin. Humans exposed to large amounts of vanadium in air have experienced coughs, and eye and throat irritation. However, these effects stop soon after exposure ceases.

Long-term oral exposure of rats to vanadium causes minor cell changes in the kidney and lungs. Female rats exposed to vanadium have offspring of decreased body weights. It is unknown whether humans experience effects similar to vanadium-exposed rats. The oral RfD for vanadium is currently under review by the U.S. EPA. The provisional oral RfD for vanadium, 0.001 mg/kg-day, is based on a study in which rats were administered vanadium in their drinking water.

There have been no specific studies of the carcinogenicity of vanadium. No increased incidence of cancer has been noticed in studies of long-term oral exposure of rats, but these studies are less sensitive than specific cancer studies. Vanadium has not yet received a weight-of-evidence classification from the U.S. EPA.

Source: ATSDR 1995.

Zinc

Zinc is a naturally occurring element that can be found in a variety of compounds. Zinc has many industrial uses, including the production of galvanized steel and the manufacture of zinc-containing alloys such as brass. Zinc is an essential nutrient, and an inadequate amount of zinc in the diet will lead to adverse health effects such as loss of appetite, decreased sense of taste and smell, slow wound healing, and skin sores.

Although zinc occurs naturally, releases from anthropogenic sources are greater than from natural sources. The primary sources are releases from mining and metallurgical operations and the use of commercial products containing zinc, such as fertilizers. The mobility of zinc in soil depends on its chemical form and on soil properties, which affect zinc adsorption. Mobility is greater at lower pH under oxidizing conditions in soils with low cation exchange capacity and high organic content. Migration to groundwater is usually slow; however, the rate would be faster under favorable soil conditions or if zinc was applied in a soluble form or with corrosive substances (such as mine tailings).

People are exposed to low concentrations of zinc in air, water, soil, and food. Sources of zinc exposure include drinking water containing elevated levels of zinc and breathing air containing elevated levels of zinc from galvanizing, smelting, welding, or brass foundry operations. Drinking water is thought to be the most significant exposure route to zinc at hazardous waste sites.

The oral RfD for zinc, 0.3 mg/kg-day, is based on decreased erythrocyte superoxide dismutase (a blood enzyme) activity in a 10-week study of 18 healthy women who were given zinc as a dietary supplement. By 10 weeks, the blood enzyme activity had decreased to 53% of pretreatment levels. The principal study is supported by several other studies that indicate that zinc supplementation can alter copper balance. The level of confidence in the studies is medium. The clinical studies were well-conducted, with many biochemical parameters investigated; however, only a small number of subjects were tested. The confidence in the overall data base is medium because these studies were all of short duration.

Source: ATSDR 2005; U.S. EPA 2005.

Attachment E – Ecological Risk Assessment Screening Tables

This attachment presents the screening tables used to select indicator hazardous substances (IHSs) for the ecological risk assessment (ERA). Eleven tables are included:

- Intertidal and subtidal sediments combined
- Intertidal sediment only
- Bull kelp (*Nereocystis luetkeana*; blades)
- Eel grass (*Zostera spp*.; leaves)
- Coonstripe shrimp (*Pandalus danae*; whole organism)
- Dungeness crab (*Cancer magister*; hepatopanceas)
- Dungeness crab muscle
- Geoduck (*Panope abrup*; whole organism)
- Horse clam (*Tresus capax*; whole organism)
- Lingcod (*Ophiodon elongatus*; whole organism)
- Rock sole (*Pleuronectes bilineatus;* whole organism).

The IHSs selection process is described in Section 4.2.3 of the ERA. One element of the screening process was a comparison of samples from Port Angeles Harbor with reference (Dungeness Bay). Table 3-3 in the risk assessment report lists the reference sample types used for comparison with samples from Port Angeles Harbor. Unfortunately, every sample type collected from Port Angeles Harbor was not also collected from Dungeness Bay. For example, lingcod were collected from Port Angels Harbor, but not from Dungeness Bay. In such cases, a suitable surrogate reference sample type was used for comparison. In this case, lingcod data from Port Angels Harbor were compared with reference data for rock sole (see Table 3-3).

During the screening process, hepatopancreas and muscle tissue data for Dungeness crab were screened separately for IHSs (see Tables E-6 and E-7, respectively). This approach is considered conservative because the elevated concentrations or organic contaminants present in the lipid-rich hepatopancreas were not "diluted" by comparatively lower concentrations in muscle. However, when calculating exposure point concentrations for Dungeness crab for use in the wildlife risk evaluation, we estimated whole-body Dungeness crab concentrations as described in Section 4.6.1.3 of the ERA and Attachment G, assuming that wildlife that feed on crabs would consume both muscle and hepatopancreas.

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Table E-1. Sediment (Intertidal and Subtidal) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Toxicity Value	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
Anions	18496-25-8	Sulfide	200	194	97.0%	5	7130	mg/kg	7130	408	80	45	138	YES	ASL; >Bkg
General Chem	7664-41-7	Ammonia	56	56	100.0%	--	641	mg/kg	641	--	--	340	1	YES	ASL; Bkg na/nd
General Chem	AmmoniaN	Ammonia (NH3) as Nitrogen (N)	123	123	100.0%	--	403	mg/kg	403	25.4	32	340	1	YES	ASL; >Bkg
General Chem	TOC	Total Organic Carbon	353	353	100.0%	--	78.5	%	78.5	--	--	--	--	NO	NUT
General Chem	Wood_Debris	Volume Fraction Woody Debris	4	4	100.0%	--	15	%	15	--	--	--	--	YES	NSL; Bkg na/nd
Guaiacols	57057-83-7	3,4,5-Trichloroguaiacol (Ac)	207	1	0.5%	2.1	0.019	mg/kg	2.1	--	--	--	--	NO	IFD
Guaiacols	60712-44-9	3,4,6-Trichloroguaiacol (Ac)	153	2	1.3%	0.12	0.02	mg/kg	0.12	--	--	--	--	NO	IFD
Guaiacols	77102-94-4	3,4-Dicloroguaiacol	153	2	1.3%	0.12	0.02	mg/kg	0.12	--	--	--	--	NO	IFD
Guaiacols	2668-24-8	4,5,6 Trichloroguaiacol	153	1	0.7%	0.12	0.019	mg/kg	0.12	--	--	--	--	NO	IFD
Guaiacols	2460-49-3	4,5-Dichloroguaiacol	153	1	0.7%	0.12	0.019	mg/kg	0.12	--	--	--	--	NO	IFD
Guaiacols	16766-31-7	4,6-Dichloroguaiacol	153	2	1.3%	0.12	0.02	mg/kg	0.12	--	--	--	--	NO	IFD
Guaiacols	16766-30-6	4-Chloroguaiacol	153	2	1.3%	0.12	0.02	mg/kg	0.12	--	--	--	--	NO	IFD
Guaiacols	90-05-1	Guaiacol (2-Methoxyphenol)	153	2	1.3%	0.12	0.026	mg/kg	0.12	--	--	0.58	0	NO	IFD
Guaiacols	2539-17-5	Tetrachloroguaiacol	207	1	0.5%	2.1	0.019	mg/kg	2.1	--	--	--	--	NO	IFD
Metals	7429-90-5	Aluminum	68	68	100.0%	--	24100	mg/kg	24100	22400	2	58030	0	NO	BSL
Metals	7440-36-0	Antimony	236	82	34.7%	2.4	9.9	mg/kg	9.9	0.2	65	2	1	YES	ASL; >Bkg
Metals	7440-38-2	Arsenic	308	295	95.8%	20	69	mg/kg	69	7.1	88	57	2	YES	ASL; >Bkg
Metals	7440-39-3	Barium	236	236	100.0%	--	53	mg/kg	53	45.6	8	48	5	YES	ASL; >Bkg
Metals	7440-41-7	Beryllium	68	11	16.2%	0.81	2.6	mg/kg	2.6	0.46	3	0.36	7	YES	ASL; >Bkg
Metals	7440-43-9	Cadmium	308	288	93.5%	1.6	5610	mg/kg	5610	2.1	35	5.1	10	YES	ASL; >Bkg
Metals	7440-47-3	Chromium	265	265	100.0%	--	54.1	mg/kg	54.1	47.5	3	260	0	NO	BSL
Metals	7440-48-4	Cobalt	68	68	100.0%	--	909	mg/kg	909	11.5	6	--	--	YES	NSL; >Bkg
Metals	7440-50-8	Copper	308	308	100.0%	--	28700	mg/kg	28700	36	71	390	2	YES	ASL; >Bkg
Metals	7439-89-6	Iron	68	68	100.0%	--	220000	mg/kg	220000	33300	7	37000	3	YES	ASL; >Bkg
Metals	7439-92-1	Lead	290	290	100.0%	--	10500	mg/kg	10500	8.3	135	450	1	YES	ASL; >Bkg
Metals	7439-96-5	Manganese	68	67	98.5%	0.15	420	mg/kg	420	284	10	480	0	NO	BSL
Metals	7439-97-6	Mercury	317	291	91.8%	0.16	8.9	mg/kg	8.9	0.13	97	0.41	30	YES	ASL; >Bkg
Metals	7440-02-0	Nickel	236	236	100.0%	--	62	mg/kg	62	45.3	6	28	81	YES	ASL; >Bkg
Metals	7782-49-2	Selenium	122	53	43.4%	78	3.8	mg/kg	78	--	--	1	13	YES	ASL; Bkg na/nd
Metals	7440-22-4	Silver	265	204	77.0%	1.26	1.2	mg/kg	1.26	0.433	6	6.1	0	NO	BSL
Metals	7440-28-0	Thallium	68	30	44.1%	2.4	3.4	mg/kg	3.4	--	--	--	--	YES	NSL; Bkg na/nd
Metals	7440-62-2	Vanadium	68	68	100.0%	--	87.5	mg/kg	87.5	67.9	8	--	--	YES	NSL; >Bkg
Metals	7440-66-6	Zinc	309	309	100.0%	--	2010	mg/kg	2010	88.7	61	410	9	YES	ASL; >Bkg
Organic Acids	65310-45-4	12-Chlorodehydroabietic Acid	181	6	3.3%	2.1	0.77	mg/kg	2.1	--	--	--	--	NO	IFD
Organic Acids	65281-76-7	14-Chlorodehydroabietic Acid	181	2	1.1%	2.1	0.29	mg/kg	2.1	--	--	--	--	NO	IFD
Organic Acids	1740-19-8	1-Phenanthrenecarboxylic acid, 1,2,3,4,4a,9,10,10a	127	82	64.6%	0.5	46	mg/kg	46	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	5829-48-1	9,10-Dichlorostearic acid	127	1	0.8%	0.5	0.096	mg/kg	0.5	--	--	--	--	NO	IFD
Organic Acids	514-10-3	Abietic Acid	179	103	57.5%	0.79	110	mg/kg	110	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	65-85-0	Benzoic Acid	265	23	8.7%	6.7	0.354	mg/kg	6.7	--	--	0.65	0	YES	ASL; Bkg na/nd
Organic Acids	1740-19-3	Dehydroabietic Acid	54	35	64.8%	0.52	20	mg/kg	20	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	57055-39-7	Dichlorodehydroabietic Acid	180	1	0.6%	2.1	0.096	mg/kg	2.1	--	--	--	--	NO	IFD
Organic Acids	31135-63-4	Dichlorostearic acid	54	0	0.0%	2.1	--	mg/kg	2.1	--	--	--	--	NO	IFD
Organic Acids	5835-26-7	Isopimaric Acid	181	32	17.7%	2.1	8.1	mg/kg	8.1	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	60-33-3	Linoleic Acid	54	7	13.0%	2.1	7.6	mg/kg	7.6	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	463-40-1	Linolenic Acid	127	6	4.7%	0.5	1.4	mg/kg	1.4	--	--	--	--	NO	IFD
Organic Acids	471-77-2	Neoabietic Acid	80	6	7.5%	0.5	3.1	mg/kg	3.1	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	112-80-1	Oleic Acid	127	37	29.1%	0.5	2.3	mg/kg	2.3	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	Oleic-Linol-Mix	Oleic-Linolenic Acid Mixture	54	40	74.1%	1.1	12	mg/kg	12	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	1945-53-5	Palustric Acid	89	7	7.9%	0.5	1.9	mg/kg	1.9	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	127-27-5	Pimaric Acid	181	5	2.8%	2.1	0.54	mg/kg	2.1	--	--	--	--	NO	IFD
Organic Acids	471-74-9	Sandaracopimaric Acid	127	11	8.7%	0.5	7.5	mg/kg	7.5	--	--	--	--	YES	NSL; Bkg na/nd
Organometalics	78763-54-9	Butyltin	17	0	0.0%	0.0041	--	mg/kg	0.0041	--	--	--	--	NO	IFD
Organometalics	1002-53-5	Dibutyltin	12	0	0.0%	0.0032	--	mg/kg	0.0032	--	--	--	--	NO	IFD
Organometalics	14488-53-0	Dibutyltin ion	5	1	20.0%	0.0056	0.0055	mg/kg	0.0056	--	--	--	--	YES	NSL; Bkg na/nd
Organometalics	688-73-3	Tributyltin	12	6	50.0%	0.0018	0.012	mg/kg	0.012	--	--	0.073	0	YES	log Kow > 3.5
Organometalics	36643-28-4	Tributyltin ion	5	3	60.0%	0.0038	0.04	mg/kg	0.04	--	--	0.073	0	YES	log Kow > 3.5
PAH Totals	HPAH0	High MW PAHs ND=0	301	158	52.5%	6.234	28.361	mg/kg	28.361	0.0430	139	9.6	2	YES	ASL; >Bkg
PAH Totals	HPAH05	High MW PAHs ND=0.5	301	158	52.5%	6.525	28.361	mg/kg	28.361	0.1262	125	9.6	2	YES	ASL; >Bkg
PAH Totals	LPAH0	Low MW PAHs ND=0	291	163	56.0%	1.55	25.71	mg/kg	25.71	0.0247	143	3.7	4	YES	ASL; >Bkg
PAH Totals	LPAH05	Low MW PAHs ND=0.5	291	163	56.0%	1.756	25.71	mg/kg	25.71	0.10005	121	3.7	4	YES	ASL; >Bkg
PAH Totals	TotPAH0	Total PAHs ND=0	301	182	60.5%	16.95	43.18	mg/kg	43.18	0.0677	159	--	--	YES	NSL; >Bkg
PAH Totals	TotPAH05	Total PAHs ND=0.5	301	182	60.5%	17	43.18	mg/kg	43.18	0.22625	137	--	--	YES	NSL; >Bkg
PAHs	90-12-0	1-Methylnaphthalene	232	51	22.0%	0.254	1.9	mg/kg	1.9	--	--	0.052	11	YES	ASL; Bkg na/nd
PAHs	91-57-6	2-Methylnaphthalene	291	143	49.1%	0.254	3	mg/kg	3	--	--	0.38	3	YES	ASL; Bkg na/nd
PAHs	9HCarb	9H-Carbazole	67	9	13.4%	0.132	0.628	mg/kg	0.628	--	--	--	--	YES	NSL; Bkg na/nd
PAHs	9HFluor	9H-Fluorene	67	42	62.7%	0.254	1.18	mg/kg	1.18	--	--	--	--	YES	NSL; Bkg na/nd

Table E-1. Sediment (Intertidal and Subtidal) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Toxicity Value	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PAHs	83-32-9	Acenaphthene	291	121	41.6%	0.254	4.9	mg/kg	4.9	--	--	0.16	5	YES	ASL; Bkg na/nd
PAHs	208-96-8	Acenaphthylene	291	121	41.6%	0.254	7.934	mg/kg	7.934	--	--	0.66	1	YES	ASL; Bkg na/nd
PAHs	120-12-7	Anthracene	290	176	60.7%	0.0489	1.5	mg/kg	1.5	--	--	2.2	0	YES	log Kow > 3.5
PAHs	56-55-3	Benz[a]anthracene	289	194	67.1%	0.131	1.39	mg/kg	1.39	--	--	1.1	1	YES	ASL; Bkg na/nd
PAHs	50-32-8	Benzo(a)pyrene	290	189	65.2%	0.0489	1.14	mg/kg	1.14	--	--	0.99	1	YES	ASL; Bkg na/nd
PAHs	205-99-2	Benzo(b)fluoranthene	289	198	68.5%	0.056	1.88	mg/kg	1.88	--	--	--	--	YES	NSL; Bkg na/nd
PAHs	191-24-2	Benzo(ghi)perylene	292	148	50.7%	0.254	0.506	mg/kg	0.506	--	--	0.31	1	YES	ASL; Bkg na/nd
PAHs	207-08-9	Benzo(k)fluoranthene	291	179	61.5%	0.07	0.754	mg/kg	0.754	--	--	--	--	YES	NSL; Bkg na/nd
PAHs	BnzFluor-bkj	Benzofluoranthenes, Total (b+k+j)	45	45	100.0%	--	1.17	mg/kg	1.17	--	--	2.3	0	YES	log Kow > 3.5
PAHs	218-01-9	Chrysene	288	206	71.5%	0.0859	2.21	mg/kg	2.21	--	--	1.1	5	YES	ASL; Bkg na/nd
PAHs	53-70-3	Dibenzo(a,h)anthracene	301	72	23.9%	0.254	0.142	mg/kg	0.254	--	--	0.12	1	YES	ASL; Bkg na/nd
PAHs	132-64-9	Dibenzofuran	263	115	43.7%	0.254	2.7	mg/kg	2.7	--	--	0.15	8	YES	ASL; Bkg na/nd
PAHs	206-44-0	Fluoranthene	287	236	82.2%	0.047	15	mg/kg	15	--	--	1.6	5	YES	ASL; Bkg na/nd
PAHs	86-73-7	Fluorene	224	117	52.2%	0.12	4.1	mg/kg	4.1	0.0211	208	0.23	3	YES	ASL; >Bkg
PAHs	193-39-5	Indeno(1,2,3-cd)pyrene	290	138	47.6%	0.254	0.499	mg/kg	0.499	--	--	0.34	1	YES	ASL; Bkg na/nd
PAHs	91-20-3	Naphthalene	289	178	61.6%	0.254	6.3	mg/kg	6.3	--	--	0.99	3	YES	ASL; Bkg na/nd
PAHs	85-01-8	Phenanthrene	289	229	79.2%	0.019	11.8	mg/kg	11.8	0.016	211	1	3	YES	ASL; >Bkg
PAHs	129-00-0	Pyrene	287	232	80.8%	0.046	8.39	mg/kg	8.39	0.0215	207	10	0	NO	BSL
PBDEs	101-55-3	4-Bromophenyl phenyl ether	165	2	1.2%	0.057	0.02	mg/kg	0.057	--	--	--	--	NO	IFD
PCB Aroclors	12674-11-2	PCB-aroclor 1016	157	0	0.0%	0.039	--	mg/kg	0.039	--	--	--	--	NO	IFD
PCB Aroclors	11104-28-2	PCB-aroclor 1221	157	0	0.0%	0.04	--	mg/kg	0.04	--	--	--	--	NO	IFD
PCB Aroclors	11141-16-5	PCB-aroclor 1232	157	0	0.0%	0.039	--	mg/kg	0.039	--	--	--	--	NO	IFD
PCB Aroclors	53469-21-9	PCB-aroclor 1242	277	10	3.6%	0.074	0.096	mg/kg	0.096	--	--	--	--	NO	IFD
PCB Aroclors	12672-29-6	PCB-aroclor 1248	157	0	0.0%	0.039	--	mg/kg	0.039	--	--	--	--	NO	IFD
PCB Aroclors	11097-69-1	PCB-aroclor 1254	277	33	11.9%	0.074	0.64	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
PCB Aroclors	11096-82-5	PCB-aroclor 1260	277	77	27.8%	0.074	0.41	mg/kg	0.41	--	--	--	--	YES	NSL; Bkg na/nd
PCB Aroclors	11100-14-4	PCB-aroclor 1268	8	1	12.5%	0.003	0.25	mg/kg	0.25	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	2051-60-7	PCB-001	8	0	0.0%	0.016	--	mg/kg	0.016	--	--	--	--	NO	IFD
PCB Congeners	16605-91-7	PCB-005	8	0	0.0%	0.0016	--	mg/kg	0.0016	--	--	--	--	NO	IFD
PCB Congeners	34883-43-7	PCB-008	7	0	0.0%	0.0022	--	mg/kg	0.0022	--	--	--	--	NO	IFD
PCB Congeners	37680-65-2	PCB-018	15	3	20.0%	0.0016	0.00081	mg/kg	0.0016	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	7012-37-5	PCB-028	7	6	85.7%	0.00036	0.0018	mg/kg	0.0018	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	16606-02-3	PCB-031	8	3	37.5%	0.0016	0.0011	mg/kg	0.0016	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	41464-39-5	PCB-044	15	10	66.7%	0.00042	0.0018	mg/kg	0.0018	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	35693-99-3	PCB-052	15	12	80.0%	0.00085	0.0027	mg/kg	0.0027	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	33025-41-1	PCB-060	7	0	0.0%	0.003	--	mg/kg	0.003	--	--	--	--	NO	IFD
PCB Congeners	32598-10-0	PCB-066	15	10	66.7%	0.0011	0.002	mg/kg	0.002	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	32598-13-3	PCB-077	7	0	0.0%	0.0014	--	mg/kg	0.0014	--	--	--	--	NO	IFD
PCB Congeners	70362-50-4	PCB-081	7	1	14.3%	0.0043	0.0011	mg/kg	0.0043	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	38380-02-8	PCB-087	15	7	46.7%	0.0013	0.0029	mg/kg	0.0029	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	68194-07-0	PCB-090	7	0	0.0%	0.0038	--	mg/kg	0.0038	--	--	--	--	NO	IFD
PCB Congeners	37680-73-2	PCB-101	15	13	86.7%	0.00009	0.0042	mg/kg	0.0042	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	32598-14-4	PCB-105	7	6	85.7%	0.00056	0.0017	mg/kg	0.0017	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	38380-03-9	PCB-110	8	6	75.0%	0.000088	0.0031	mg/kg	0.0031	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	74472-37-0	PCB-114	7	0	0.0%	0.00033	--	mg/kg	0.00033	--	--	--	--	NO	IFD
PCB Congeners	31508-00-6	PCB-118	7	6	85.7%	0.00056	0.004	mg/kg	0.004	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	65510-44-3	PCB-123	7	0	0.0%	0.0014	--	mg/kg	0.0014	--	--	--	--	NO	IFD
PCB Congeners	57465-28-8	PCB-126	7	0	0.0%	0.0015	--	mg/kg	0.0015	--	--	--	--	NO	IFD
PCB Congeners	38380-07-3	PCB-128	7	5	71.4%	0.0006	0.0015	mg/kg	0.0015	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	35065-28-2	PCB-138	15	13	86.7%	0.000093	0.0054	mg/kg	0.0054	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	52712-04-6	PCB-141	8	3	37.5%	0.00031	0.00085	mg/kg	0.00085	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	52663-63-5	PCB-151	8	4	50.0%	0.00025	0.00069	mg/kg	0.00069	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	35065-27-1	PCB-153	15	11	73.3%	0.00077	0.0054	mg/kg	0.0054	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	38380-08-4	PCB-156	7	5	71.4%	0.00033	0.0011	mg/kg	0.0011	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	69782-90-7	PCB-157	7	0	0.0%	0.0006	--	mg/kg	0.0006	--	--	--	--	NO	IFD
PCB Congeners	74472-42-7	PCB-158	7	2	28.6%	0.00073	0.00077	mg/kg	0.00077	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	41411-63-6	PCB-166	7	0	0.0%	0.0016	--	mg/kg	0.0016	--	--	--	--	NO	IFD
PCB Congeners	52663-72-6	PCB-167	7	0	0.0%	0.0012	--	mg/kg	0.0012	--	--	--	--	NO	IFD
PCB Congeners	32774-16-6	PCB-169	7	0	0.0%	0.00065	--	mg/kg	0.00065	--	--	--	--	NO	IFD
PCB Congeners	35065-30-6	PCB-170	15	8	53.3%	0.00069	0.0018	mg/kg	0.0018	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	35065-29-3	PCB-180	15	12	80.0%	0.00024	0.0032	mg/kg	0.0032	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	52663-69-1	PCB-183	15	4	26.7%	0.00057	0.0012	mg/kg	0.0012	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	74472-48-3	PCB-184	7	1	14.3%	0.0014	0.00088	mg/kg	0.0014	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	52663-68-0	PCB-187	15	7	46.7%	0.0012	0.0017	mg/kg	0.0017	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	39635-31-9	PCB-189	7	0	0.0%	0.0014	--	mg/kg	0.0014	--	--	--	--	NO	IFD
PCB Congeners	52663-78-2	PCB-195	7	2	28.6%	0.00077	0.00082	mg/kg	0.00082	--	--	--	--	YES	NSL; Bkg na/nd

Table E-1. Sediment (Intertidal and Subtidal) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Toxicity Value	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PCB Congeners	40186-72-9	PCB-206	15	1	6.7%	0.00094	0.00027	mg/kg	0.00094	--	--	--	--	YES	NSL; Bkg na/nd
PCB Congeners	2051-24-3	PCB-209	7	1	14.3%	0.00089	0.00027	mg/kg	0.00089	--	--	--	--	YES	NSL; Bkg na/nd
PCB Totals	1336-36-3	PCB	53	53	100.0%	--	0.64	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
PCB Totals	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	277	97	35.0%	0	0.64	mg/kg	0.64	--	--	0.12	22	YES	ASL; Bkg na/nd
PCB Totals	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	277	97	35.0%	0.111	0.6414	mg/kg	0.6414	--	--	0.12	25	YES	ASL; Bkg na/nd
PCB Totals	PCB-Tot-Cong	PCB, Sum of Congeners	65	65	100.0%	--	2.93	mg/kg	2.93	0.0012	65	0.12	15	YES	ASL; >Bkg
PCB Totals	PCB-TOT-CON-TOC	PCB, Sum of Congeners, per gram TOC	65	65	100.0%	--	43.02	mg/kg	43.02	0.106	65	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	272	272	100.0%	--	1.21E-04	mg/kg	1.21E-04	5.20E-08	268	0.1	0	YES	log Kow > 3.5
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	272	272	100.0%	--	1.49E-04	mg/kg	1.49E-04	8.75E-07	209	0.1	0	YES	log Kow > 3.5
PCDD/PCDF Totals	37871-00-4	Total HpCDD	216	216	100.0%	--	9.91E-03	mg/kg	9.91E-03	1.94E-05	172	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	38998-75-3	Total HpCDF	216	208	96.3%	3.20E-06	4.86E-03	mg/kg	4.86E-03	4.25E-06	172	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	34465-46-8	Total HxCDD	216	212	98.1%	2.30E-06	1.41E-03	mg/kg	1.41E-03	1.07E-05	160	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	55684-94-1	Total HxCDF	215	198	92.1%	3.70E-06	1.37E-03	mg/kg	1.37E-03	2.46E-06	164	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	36088-22-9	Total PeCDD	216	209	96.8%	3.10E-06	2.21E-03	mg/kg	2.21E-03	2.96E-06	179	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	30402-15-4	Total PeCDF	216	203	94.0%	3.50E-06	3.69E-04	mg/kg	3.69E-04	2.60E-06	164	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	41903-57-5	Total TCDD	216	212	98.1%	7.50E-07	3.88E-03	mg/kg	3.88E-03	2.62E-06	185	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	30402-14-3	Total TCDF	96	91	94.8%	4.20E-07	4.51E-04	mg/kg	4.51E-04	1.10E-06	85	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	55722-27-5	TOTAL TETRA_FURANS	141	138	97.9%	5.83E-07	2.53E-04	mg/kg	2.53E-04	4.73E-06	106	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	35822-46-9	1,2,3,4,6,7,8-HpCDD	216	211	97.7%	2.70E-05	5.09E-03	mg/kg	5.09E-03	8.06E-06	167	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	67562-39-4	1,2,3,4,6,7,8-HpCDF	216	195	90.3%	3.20E-06	1.43E-03	mg/kg	1.43E-03	1.82E-06	166	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	55673-89-7	1,2,3,4,7,8,9-HpCDF	195	153	78.5%	6.22E-06	3.67E-05	mg/kg	3.67E-05	1.11E-07	131	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	39227-28-6	1,2,3,4,7,8-HxCDD	216	180	83.3%	4.70E-06	2.75E-05	mg/kg	2.75E-05	1.91E-07	148	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	70648-26-9	1,2,3,4,7,8-HxCDF	195	168	86.2%	7.75E-07	3.73E-05	mg/kg	3.73E-05	2.24E-07	145	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	57653-85-7	1,2,3,6,7,8-HxCDD	216	203	94.0%	4.00E-06	1.91E-04	mg/kg	1.91E-04	1.01E-06	145	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	57117-44-9	1,2,3,6,7,8-HxCDF	196	175	89.3%	7.98E-07	1.65E-05	mg/kg	1.65E-05	1.28E-07	148	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	19408-74-3	1,2,3,7,8,9-HxCDD	216	195	90.3%	3.30E-06	4.28E-05	mg/kg	4.28E-05	8.20E-07	140	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	72918-21-9	1,2,3,7,8,9-HxCDF	195	116	59.5%	1.32E-06	2.11E-05	mg/kg	2.11E-05	--	--	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	40321-76-4	1,2,3,7,8-PeCDD	216	184	85.2%	3.30E-06	2.52E-05	mg/kg	2.52E-05	2.36E-07	144	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	57117-41-6	1,2,3,7,8-PeCDF	196	172	87.8%	5.36E-07	1.93E-05	mg/kg	1.93E-05	1.06E-07	152	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	60851-34-5	2,3,4,6,7,8-HxCDF	196	167	85.2%	1.12E-06	1.59E-05	mg/kg	1.59E-05	1.25E-07	143	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	57117-31-4	2,3,4,7,8-PeCDF	196	180	91.8%	5.36E-07	2.24E-05	mg/kg	2.24E-05	1.88E-07	152	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	1746-01-6	2,3,7,8-TCDD	216	184	85.2%	7.50E-07	4.43E-05	mg/kg	4.43E-05	1.16E-07	148	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	51207-31-9	2,3,7,8-TCDF	209	195	93.3%	8.70E-07	2.86E-05	mg/kg	2.86E-05	7.79E-07	136	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	3268-87-9	OCDD	216	215	99.5%	5.40E-05	3.12E-02	mg/kg	3.12E-02	5.37E-05	169	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	39001-02-0	OCDF	216	194	89.8%	9.50E-06	5.42E-03	mg/kg	5.42E-03	3.02E-06	170	--	--	YES	NSL; >Bkg
Pesticides	72-54-8	4,4'-DDD	192	62	32.3%	0.0074	0.065	mg/kg	0.065	--	--	0.016	2	YES	ASL; Bkg na/nd
Pesticides	72-55-9	4,4'-DDE	127	35	27.6%	0.0071	0.014	mg/kg	0.014	--	--	0.009	1	YES	ASL; Bkg na/nd
Pesticides	50-29-3	4,4'-DDT	125	58	46.4%	0.006	0.11	mg/kg	0.11	--	--	0.0039	23	YES	ASL; Bkg na/nd
Pesticides	309-00-2	Aldrin	73	23	31.5%	0.00025	0.0019	mg/kg	0.0019	0.0049	0	0.00044	14	NO	ASL; <Bkg
Pesticides	319-84-6	Alpha-BHC	126	29	23.0%	0.0011	0.003	mg/kg	0.003	0.0015	2	0.0003	25	YES	ASL; >Bkg
Pesticides	319-85-7	Beta-BHC	127	36	28.3%	0.0084	0.04	mg/kg	0.04	0.0022	5	0.0002	35	YES	ASL; >Bkg
Pesticides	5103-71-9	cis-Chlordane	73	29	39.7%	0.00025	0.022	mg/kg	0.022	0.00066	7	--	--	YES	NSL; >Bkg
Pesticides	319-86-8	Delta-BHC	127	19	15.0%	0.0047	0.0026	mg/kg	0.0047	--	--	0.13	0	YES	log Kow > 3.5
Pesticides	60-57-1	Dieldrin	73	10	13.7%	0.00052	0.0093	mg/kg	0.0093	--	--	0.00002	10	YES	ASL; Bkg na/nd
Pesticides	959-98-8	Endosulfan I	73	7	9.6%	0.00028	0.0029	mg/kg	0.0029	--	--	0.0029	0	YES	log Kow > 3.5
Pesticides	33213-65-9	Endosulfan II	73	17	23.3%	0.0042	0.0049	mg/kg	0.0049	--	--	0.014	0	YES	log Kow > 3.5
Pesticides	1031-07-8	Endosulfan Sulfate	73	15	20.5%	0.00072	0.013	mg/kg	0.013	--	--	--	--	YES	NSL; Bkg na/nd
Pesticides	72-20-8	Endrin	73	9	12.3%	0.001	0.0036	mg/kg	0.0036	--	--	0.00002	9	YES	ASL; Bkg na/nd
Pesticides	7421-93-4	Endrin Aldehyde	73	17	23.3%	0.0006	0.0025	mg/kg	0.0025	--	--	--	--	YES	NSL; Bkg na/nd
Pesticides	53494-70-5	Endrin Ketone	73	7	9.6%	0.0006	0.0011	mg/kg	0.0011	--	--	--	--	YES	NSL; Bkg na/nd
Pesticides	5566-34-7	gamma-Chlordane	73	28	38.4%	0.00025	0.0085	mg/kg	0.0085	0.00074	16	0.00002	28	YES	ASL; >Bkg
Pesticides	76-44-8	Heptachlor	73	16	21.9%	0.00032	0.0016	mg/kg	0.0016	--	--	0.00004	16	YES	ASL; Bkg na/nd
Pesticides	1024-57-3	Heptachlor Epoxide	73	32	43.8%	0.0012	0.007	mg/kg	0.007	0.00088	13	0.001	8	YES	ASL; >Bkg
Pesticides	58-89-9	Lindane	127	25	19.7%	0.0085	0.0084	mg/kg	0.0085	0.0041	1	0.0003	18	YES	ASL; >Bkg
Pesticides	72-43-5	Methoxychlor	73	5	6.8%	0.0032	0.0057	mg/kg	0.0057	--	--	0.006	0	YES	log Kow > 3.5
Pesticides	8001-35-2	Toxaphene	73	3	4.1%	0.024	0.043	mg/kg	0.043	--	--	0.000002	3	NO	IFD
Petrol Prod	68476-34-6	#2 Diesel	117	98	83.8%	31	1300	mg/kg	1300	12	77	200	10	YES	ASL; >Bkg
Petrol Prod	86290-81-5	Gasoline	117	0	0.0%	20	--	mg/kg	20	--	--	--	--	NO	IFD
Petrol Prod	PHCMOT	Motor Oil	117	96	82.1%	8.5	3100	mg/kg	3100	10	90	200	35	YES	ASL; >Bkg
SVOCs	120-82-1	1,2,4-Trichlorobenzene	198	2	1.0%	0.11	0.02	mg/kg	0.11	--	--	--	--	NO	IFD
SVOCs	95-95-4	2,4,5-Trichlorophenol	165	2	1.2%	0.26	0.098	mg/kg	0.26	--	--	0.003	2	NO	IFD
SVOCs	88-06-2	2,4,6-Trichlorophenol	232	3	1.3%	0.593	0.098	mg/kg	0.593	--	--	0.006	3	NO	IFD
SVOCs	120-83-2	2,4-Dichlorophenol	165	2	1.2%	0.24	0.098	mg/kg	0.24	--	--	0.005	2	NO	IFD
SVOCs	105-67-9	2,4-Dimethylphenol	221	6	2.7%	0.087	0.099	mg/kg	0.099	--	--	0.029	2	NO	IFD
SVOCs	51-28-5	2,4-Dinitrophenol	165	2	1.2%	0.65	0.2	mg/kg	0.65	--	--	--	--	NO	IFD
SVOCs	121-14-2	2,4-Dinitrotoluene	165	2	1.2%	0.23	0.098	mg/kg	0.23	--	--	--	--	NO	IFD

Table E-1. Sediment (Intertidal and Subtidal) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Toxicity Value	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
SVOCs	606-20-2	2,6-Dinitrotoluene	165	2	1.2%	0.32	0.098	mg/kg	0.32	--	--	--	--	NO	IFD
SVOCs	91-58-7	2-Chloronaphthalene	165	2	1.2%	0.047	0.02	mg/kg	0.047	--	--	--	--	NO	IFD
SVOCs	95-57-8	2-Chlorophenol	165	2	1.2%	0.044	0.02	mg/kg	0.044	--	--	0.008	2	NO	IFD
SVOCs	88-74-4	2-Nitroaniline	165	2	1.2%	0.25	0.098	mg/kg	0.25	--	--	--	--	NO	IFD
SVOCs	88-75-5	2-Nitrophenol	165	2	1.2%	0.23	0.098	mg/kg	0.23	--	--	--	--	NO	IFD
SVOCs	91-94-1	3,3'-Dichlorobenzidine	137	1	0.7%	0.29	0.098	mg/kg	0.29	--	--	--	--	NO	IFD
SVOCs	534-52-1	4,6-Dinitro-2-Methylphenol	165	2	1.2%	0.5	0.2	mg/kg	0.5	--	--	--	--	NO	IFD
SVOCs	59-50-7	4-Chloro-3-Methylphenol	165	2	1.2%	0.099	0.098	mg/kg	0.099	--	--	--	--	NO	IFD
SVOCs	106-47-8	4-Chloroaniline	120	1	0.8%	0.59	0.098	mg/kg	0.59	--	--	--	--	NO	IFD
SVOCs	7005-72-3	4-Chlorophenyl-Phenylether	165	2	1.2%	0.05	0.02	mg/kg	0.05	--	--	--	--	NO	IFD
SVOCs	100-01-6	4-Nitroaniline	164	2	1.2%	0.3	0.098	mg/kg	0.3	--	--	--	--	NO	IFD
SVOCs	100-02-7	4-Nitrophenol	165	2	1.2%	0.39	0.098	mg/kg	0.39	--	--	--	--	NO	IFD
SVOCs	100-51-6	Benzyl Alcohol	158	4	2.5%	0.086	0.047	mg/kg	0.086	--	--	0.057	0	NO	IFD
SVOCs	117-81-7	Bis(2-Ethylhexyl) Phthalate	196	94	48.0%	0.18	2.8	mg/kg	2.8	--	--	0.47	2	YES	ASL; Bkg na/nd
SVOCs	85-68-7	Butyl benzyl phthalate	212	17	8.0%	0.11	0.67	mg/kg	0.67	--	--	0.049	5	YES	ASL; Bkg na/nd
SVOCs	86-74-8	Carbazole	165	48	29.1%	0.039	0.81	mg/kg	0.81	--	--	0.97	0	NO	BSL
SVOCs	84-74-2	Dibutyl phthalate	210	20	9.5%	0.23	0.04	mg/kg	0.23	--	--	2.2	0	YES	log Kow > 3.5
SVOCs	84-66-2	Diethyl phthalate	212	23	10.8%	0.25	0.093	mg/kg	0.25	--	--	0.61	0	NO	BSL
SVOCs	131-11-3	Dimethyl phthalate	212	7	3.3%	0.13	0.026	mg/kg	0.13	--	--	0.53	0	NO	IFD
SVOCs	117-84-0	Di-N-Octyl Phthalate	212	6	2.8%	0.084	0.088	mg/kg	0.088	--	--	0.58	0	NO	IFD
SVOCs	118-74-1	Hexachlorobenzene	198	2	1.0%	0.15	0.02	mg/kg	0.15	--	--	0.0038	2	NO	IFD
SVOCs	118-74-1	Hexachlorobenzene	198	2	1.0%	0.15	0.02	mg/kg	0.15	--	--	0.022	2	NO	IFD
SVOCs	87-68-3	Hexachlorobutadiene	198	2	1.0%	0.098	0.02	mg/kg	0.098	--	--	0.039	0	NO	IFD
SVOCs	77-47-4	Hexachlorocyclopentadiene	161	2	1.2%	0.26	0.098	mg/kg	0.26	--	--	0.007	6	NO	IFD
SVOCs	78-59-1	Isophorone	165	2	1.2%	0.049	0.02	mg/kg	0.049	--	--	2.4	0	NO	IFD
SVOCs	99-09-2	m-Nitroaniline	146	1	0.7%	0.45	0.098	mg/kg	0.45	--	--	--	--	NO	IFD
SVOCs	98-95-3	Nitrobenzene	165	3	1.8%	0.052	0.02	mg/kg	0.052	--	--	1.65	0	NO	IFD
SVOCs	621-64-7	N-Nitrosodi-n-propylamine	164	2	1.2%	0.21	0.098	mg/kg	0.21	--	--	--	--	NO	IFD
SVOCs	86-30-6	N-Nitrosodiphenylamine	198	3	1.5%	0.16	0.02	mg/kg	0.16	--	--	0.11	0	NO	IFD
SVOCs	95-48-7	o-Cresol	220	5	2.3%	0.24	0.04	mg/kg	0.24	--	--	0.063	0	NO	IFD
SVOCs	106-44-5	p-Cresol	276	150	54.3%	0.283	41	mg/kg	41	0.049	96	0.67	7	YES	ASL; >Bkg
SVOCs	87-86-5	Pentachlorophenol	221	4	1.8%	0.6	0.098	mg/kg	0.6	--	--	0.36	0	NO	IFD
SVOCs	108-95-2	Phenol	272	134	49.3%	0.297	0.76	mg/kg	0.76	0.12	24	0.42	3	YES	ASL; >Bkg
SVOCs	110-86-1	Pyridine	55	1	1.8%	0.21	0.0042	mg/kg	0.21	--	--	--	--	NO	IFD
SVOCs	483-65-8	Retene	233	141	60.5%	0.244	630	mg/kg	630	--	--	1.2	14	YES	ASL; Bkg na/nd
VOCs	95-50-1	1,2-Dichlorobenzene	198	3	1.5%	0.091	0.02	mg/kg	0.091	--	--	--	--	NO	IFD
VOCs	541-73-1	1,3-Dichlorobenzene	165	2	1.2%	0.044	0.02	mg/kg	0.044	--	--	--	--	NO	IFD
VOCs	106-46-7	1,4-Dichlorobenzene	198	8	4.0%	0.14	0.03	mg/kg	0.14	--	--	0.031	0	NO	IFD
VOCs	108-60-1	2,2'-Oxybis[1-chloropropane]	165	2	1.2%	0.047	0.02	mg/kg	0.047	--	--	--	--	NO	IFD
VOCs	78-93-3	2-Butanone	67	1	1.5%	0.0336	0.0211	mg/kg	0.0336	--	--	--	--	NO	IFD
VOCs	67-64-1	Acetone	67	3	4.5%	0.0418	0.109	mg/kg	0.109	--	--	--	--	NO	IFD
VOCs	111-91-1	Bis(2-Chloroethoxy)Methane	165	2	1.2%	0.052	0.02	mg/kg	0.052	--	--	--	--	NO	IFD
VOCs	111-44-4	Bis(2-Chloroethyl)Ether	165	2	1.2%	0.044	0.02	mg/kg	0.044	--	--	--	--	NO	IFD
VOCs	75-15-0	Carbon Disulfide	67	1	1.5%	0.0336	0.0384	mg/kg	0.0384	--	--	--	--	NO	IFD
VOCs	67-72-1	Hexachloroethane	165	2	1.2%	0.042	0.02	mg/kg	0.042	--	--	0.14	0	NO	IFD
VOCs	75-09-2	Methylene Chloride	67	1	1.5%	0.0336	0.0122	mg/kg	0.0336	--	--	--	--	NO	IFD
VOCs	108-88-3	Toluene	67	1	1.5%	0.0336	0.018	mg/kg	0.0336	--	--	--	--	NO	IFD

Notes: (1) Maximum detected concentration or highest detection limit, whichever is greater.
(2) Dungeness Bay.
(3) Screening toxicity value (for marine benthic life) from Table 4-1.
(4) Rationale codes:
- for selection: ASL; >Bkg = above screening level; greater than background.
ASL; Bkg na = above screening level; background not available.
log Kow >3.5 = logarithm of octanol-water partition coefficient greater than 3.5.
NSL; Bkg na/nd = no screening level; background not available/not detected
NSL; >Bkg = no screening level; greater than background
- for exclusion: BSL = below screening level
IFD = infrequently (less than 5%) detected
NSL; <Bkg = no screening level (NSL); less than background
NUT = essential nutrient

Key: -- (double dash) = not available or not applicable
CAS = Chemical Abstract Service
IHS = indicator hazardous substance
na = not applicable or not available
ND = not detected
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCDD = polychlorinated dibenzo dioxins
PCDF = polychlorinated dibenzo furans
SVOC = semivolitile organic compound
TEQ = toxic equivalent
VOC = volatile organic compound

Table E-2. Intertidal Sediment Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Toxicity Value	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
Anions	18496-25-8	Sulfide	17	13	76.5%	0.00951	1220	mg/kg	1220	408	4	45	9	YES	ASL; > Bkg
General Chem	7664-41-7	Ammonia	5	5	100.0%	--	21.3	mg/kg	21.3	--	--	340	0	NO	BSL
General Chem	AmmoniaN	Ammonia (NH3) as Nitrogen (N)	11	11	100.0%	--	38.4	mg/kg	38.4	25.4	1	340	0	NO	BSL
General Chem	TOC	Total Organic Carbon	28	28	100.0%	--	24.6	%	24.6	--	--	--	--	NO	NUT
Guaiacols	57057-83-7	3,4,5-Trichloroguaiacol (Ac)	23	1	4.3%	0.64	0.019	mg/kg	0.64	--	--	--	--	NO	IFD
Guaiacols	60712-44-9	3,4,6-Trichloroguaiacol (Ac)	18	2	11.1%	0.02	0.02	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
Guaiacols	77102-94-4	3,4-Dicloroguaiacol	18	2	11.1%	0.02	0.02	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
Guaiacols	2668-24-8	4,5,6 Trichloroguaiacol	18	1	5.6%	0.02	0.019	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
Guaiacols	2460-49-3	4,5-Dichloroguaiacol	18	1	5.6%	0.02	0.019	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
Guaiacols	16766-31-7	4,6-Dichloroguaiacol	18	2	11.1%	0.02	0.02	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
Guaiacols	16766-30-6	4-Chloroguaiacol	18	2	11.1%	0.02	0.02	mg/kg	0.02	--	--	--	--	YES	NSL; Bkg na/nd
Guaiacols	90-05-1	Guaiacol (2-Methoxyphenol)	18	1	5.6%	0.02	0.019	mg/kg	0.02	--	--	0.58	0	NO	BSL
Guaiacols	2539-17-5	Tetrachloroguaiacol	23	1	4.3%	0.64	0.019	mg/kg	0.64	--	--	--	--	NO	IFD
Metals	7440-36-0	Antimony	21	10	47.6%	0.240	0.590	mg/kg	0.590	0.200	4	2	0	NO	BSL
Metals	7440-38-2	Arsenic	26	26	100.0%	--	9.9	mg/kg	9.9	7.1	1	57	0	NO	BSL
Metals	7440-39-3	Barium	21	21	100.0%	--	53	mg/kg	53	45.6	1	48	1	YES	ASL; > Bkg
Metals	7440-43-9	Cadmium	26	18	69.2%	0.00052	5.9	mg/kg	5.9	2.1	1	5.1	1	YES	ASL; > Bkg
Metals	7440-47-3	Chromium	21	21	100.0%	--	40	mg/kg	40	47.5	0	260	0	NO	BSL
Metals	7440-50-8	Copper	26	26	100.0%	--	61	mg/kg	61	36	3	390	0	NO	BSL
Metals	7439-92-1	Lead	26	26	100.0%	--	84.5	mg/kg	84.5	8.3	4	450	0	NO	BSL
Metals	7439-97-6	Mercury	28	23	82.1%	0.01	0.59	mg/kg	0.59	0.13	5	0.41	3	YES	ASL; > Bkg
Metals	7440-02-0	Nickel	21	21	100.0%	--	62	mg/kg	62	45	1	28	7	YES	ASL; > Bkg
Metals	7782-49-2	Selenium	5	3	60.0%	0.2	0.6	mg/kg	0.6	--	--	1	0	NO	BSL
Metals	7440-22-4	Silver	21	21	100.0%	--	0.18	mg/kg	0.18	0.433	0	6.1	0	NO	BSL
Metals	7440-66-6	Zinc	26	26	100.0%	--	320	mg/kg	320	88.7	1	410	0	NO	BSL
Organic Acids	65310-45-4	12-Chlorodehydroabietic Acid	15	1	6.7%	0.64	0.096	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	65281-76-7	14-Chlorodehydroabietic Acid	15	1	6.7%	0.64	0.096	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	1740-19-8	1-Phenanthrenecarboxylic acid, 1,2,3,4,4a,9,10,10a	10	5	50.0%	0.29	5	mg/kg	5	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	5829-48-1	9,10-Dichlorostearic acid	10	1	10.0%	0.5	0.096	mg/kg	0.5	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	514-10-3	Abietic Acid	15	9	60.0%	0.37	4.8	mg/kg	4.8	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	65-85-0	Benzoic Acid	29	3	10.3%	1.9	0.26	mg/kg	1.9	--	--	0.65	0	YES	ASL; Bkg na/nd
Organic Acids	1740-19-3	Dehydroabietic Acid	5	4	80.0%	0.35	3.2	mg/kg	3.2	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	57055-39-7	Dichlorodehydroabietic Acid	15	1	6.7%	0.64	0.096	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	31135-63-4	Dichlorostearic acid	5	0	0.0%	0.64	--	mg/kg	0.64	--	--	--	--	NO	IFD
Organic Acids	5835-26-7	Isopimaric Acid	15	2	13.3%	0.64	1.4	mg/kg	1.4	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	60-33-3	Linoleic Acid	5	1	20.0%	0.64	0.79	mg/kg	0.79	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	463-40-1	Linolenic Acid	10	1	10.0%	0.5	0.096	mg/kg	0.5	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	471-77-2	Neoabietic Acid	5	1	20.0%	0.5	0.68	mg/kg	0.68	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	112-80-1	Oleic Acid	10	1	10.0%	0.5	0.096	mg/kg	0.5	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	Oleic-Linol-Mix	Oleic-Linolenic Acid Mixture	5	2	40.0%	0.41	0.97	mg/kg	0.97	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	1945-53-5	Palustric Acid	10	2	20.0%	0.5	0.64	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	127-27-5	Pimaric Acid	15	1	6.7%	0.64	0.096	mg/kg	0.64	--	--	--	--	YES	NSL; Bkg na/nd
Organic Acids	471-74-9	Sandaracopimaric Acid	10	1	10.0%	0.5	0.096	mg/kg	0.5	--	--	--	--	YES	NSL; Bkg na/nd
PAH Totals	HPAH0	High MW PAHs ND=0	29	15	51.7%	1.016	1.1811	mg/kg	1.1811	0.043	11	9.6	0	YES	log Kow > 3.5
PAH Totals	HPAH05	High MW PAHs ND=0.5	29	15	51.7%	1.02025	1.1811	mg/kg	1.1811	0.1262	6	9.6	0	YES	log Kow > 3.5
PAH Totals	LPAH0	Low MW PAHs ND=0	27	13	48.1%	0.068	0.3973	mg/kg	0.3973	0.0247	6	3.7	0	YES	log Kow > 3.5
PAH Totals	LPAH05	Low MW PAHs ND=0.5	27	13	48.1%	0.0845	0.3973	mg/kg	0.3973	0.10005	4	3.7	0	YES	log Kow > 3.5
PAH Totals	TotPAH0	Total PAHs ND=0	29	17	58.6%	0.126	1.6024	mg/kg	1.6024	0.0677	11	--	--	YES	NSL; >Bkg
PAH Totals	TotPAH05	Total PAHs ND=0.5	29	17	58.6%	0.18125	1.6024	mg/kg	1.6024	0.22625	5	--	--	YES	NSL; >Bkg
PAHs	90-12-0	1-Methylnaphthalene	24	2	8.3%	0.019	0.019	mg/kg	0.019	--	--	0.052	0	YES	log Kow > 3.5
PAHs	91-57-6	2-Methylnaphthalene	27	5	18.5%	0.019	0.024	mg/kg	0.024	--	--	0.38	0	YES	log Kow > 3.5
PAHs	83-32-9	Acenaphthene	27	6	22.2%	0.019	0.034	mg/kg	0.034	--	--	0.16	0	YES	log Kow > 3.5
PAHs	208-96-8	Acenaphthylene	27	6	22.2%	0.019	0.019	mg/kg	0.019	--	--	0.66	0	YES	log Kow > 3.5
PAHs	120-12-7	Anthracene	27	6	22.2%	0.019	0.043	mg/kg	0.043	--	--	2.2	0	YES	log Kow > 3.5
PAHs	56-55-3	Benz[a]anthracene	27	10	37.0%	0.019	0.089	mg/kg	0.089	--	--	1.1	0	YES	log Kow > 3.5
PAHs	50-32-8	Benzo(a)pyrene	27	9	33.3%	0.019	0.094	mg/kg	0.094	--	--	0.99	0	YES	log Kow > 3.5
PAHs	205-99-2	Benzo(b)fluoranthene	27	10	37.0%	0.019	0.12	mg/kg	0.12	--	--	--	--	YES	NSL; Bkg na/nd
PAHs	191-24-2	Benzo(ghi)perylene	28	7	25.0%	0.041	0.033	mg/kg	0.041	--	--	0.31	0	NO	BSL
PAHs	207-08-9	Benzo(k)fluoranthene	27	9	33.3%	0.019	0.13	mg/kg	0.13	--	--	--	--	YES	NSL; Bkg na/nd
PAHs	BnzFluor-bkj	Benzofluoranthenes, Total (b+k+j)	3	3	100.0%	--	0.113	mg/kg	0.113	--	--	2.3	0	YES	log Kow > 3.5
PAHs	218-01-9	Chrysene	27	12	44.4%	0.019	0.14	mg/kg	0.14	--	--	1.1	0	YES	log Kow > 3.5
PAHs	53-70-3	Dibenzo(a,h)anthracene	29	4	13.8%	0.043	0.019	mg/kg	0.043	--	--	0.12	0	YES	log Kow > 3.5
PAHs	132-64-9	Dibenzofuran	27	5	18.5%	0.019	0.041	mg/kg	0.041	--	--	0.15	0	YES	log Kow > 3.5
PAHs	206-44-0	Fluoranthene	27	17	63.0%	0.019	0.41	mg/kg	0.41	0.0211	11	1.6	0	YES	log Kow > 3.5
PAHs	86-73-7	Fluorene	27	6	22.2%	0.019	0.039	mg/kg	0.039	--	--	0.23	0	YES	log Kow > 3.5
PAHs	193-39-5	Indeno(1,2,3-cd)pyrene	27	6	22.2%	0.019	0.03	mg/kg	0.03	--	--	0.34	0	YES	log Kow > 3.5

Table E-2. Intertidal Sediment Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Toxicity Value	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PAHs	91-20-3	Naphthalene	27	9	33.3%	0.019	0.095	mg/kg	0.095	--	--	0.99	0	NO	BSL
PAHs	85-01-8	Phenanthrene	27	14	51.9%	0.019	0.18	mg/kg	0.18	0.016	12	1	0	YES	log Kow > 3.5
PAHs	129-00-0	Pyrene	27	18	66.7%	0.019	0.29	mg/kg	0.29	0.0215	12	10	0	YES	log Kow > 3.5
PBDEs	101-55-3	4-Bromophenyl phenyl ether	24	1	4.2%	0.019	0.019	mg/kg	0.019	--	--	--	--	NO	IFD
PCB Aroclors	12674-11-2	PCB-aroclor 1016	21	0	0.0%	0.027	--	mg/kg	0.027	--	--	--	--	NO	IFD
PCB Aroclors	11104-28-2	PCB-aroclor 1221	21	0	0.0%	0.027	--	mg/kg	0.027	--	--	--	--	NO	IFD
PCB Aroclors	11141-16-5	PCB-aroclor 1232	21	0	0.0%	0.027	--	mg/kg	0.027	--	--	--	--	NO	IFD
PCB Aroclors	53469-21-9	PCB-aroclor 1242	26	0	0.0%	0.027	--	mg/kg	0.027	--	--	--	--	NO	IFD
PCB Aroclors	12672-29-6	PCB-aroclor 1248	21	0	0.0%	0.027	--	mg/kg	0.027	--	--	--	--	NO	IFD
PCB Aroclors	11097-69-1	PCB-aroclor 1254	26	0	0.0%	0.007	--	mg/kg	0.007	--	--	--	--	NO	IFD
PCB Aroclors	11096-82-5	PCB-aroclor 1260	26	7	27.0%	0.0015	0.23	mg/kg	0.23	--	--	--	--	YES	NSL; Bkg na/nd
PCB Aroclors	11100-14-4	PCB-aroclor 1268	3	0	0.0%	0.0017	--	mg/kg	0.0017	--	--	--	--	NO	IFD
PCB Totals	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	26	5	19.2%	0	0.23	mg/kg	0.23	--	--	0.12	2	YES	ASL; Bkg na/nd
PCB Totals	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	26	5	19.2%	0.0805	0.2316	mg/kg	0.2316	--	--	0.12	2	YES	ASL; Bkg na/nd
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins/Furans as 2,3,7,8-TCDD TEQs ND=0	27	27	100.0%	--	9.41E-05	mg/kg	9.41E-05	5.20E-08	25	0.1	0	YES	log Kow > 3.5
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins/Furans as 2,3,7,8-TCDD TEQs ND=0.5	27	27	100.0%	--	9.41E-05	mg/kg	9.41E-05	8.75E-07	8	0.1	0	YES	log Kow > 3.5
PCDD/PCDF Totals	37871-00-4	Total HpCDD	27	27	100.0%	--	2.91E-03	mg/kg	2.91E-03	1.94E-05	9	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	38998-75-3	Total HpCDF	27	22	81.5%	7.29E-07	7.51E-04	mg/kg	7.51E-04	4.25E-06	9	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	34465-46-8	Total HxCDD	27	25	92.6%	3.93E-07	5.74E-04	mg/kg	5.74E-04	1.07E-05	8	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	55684-94-1	Total HxCDF	27	20	74.1%	3.45E-07	3.96E-04	mg/kg	3.96E-04	2.46E-06	11	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	36088-22-9	Total PeCDD	27	25	92.6%	1.89E-07	2.49E-04	mg/kg	2.49E-04	2.96E-06	15	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	30402-15-4	Total PeCDF	27	23	85.2%	1.29E-07	1.83E-04	mg/kg	1.83E-04	2.60E-06	11	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	41903-57-5	Total TCDD	27	26	96.3%	8.90E-08	3.04E-04	mg/kg	3.04E-04	2.62E-06	15	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	30402-14-3	Total TCDF	6	4	66.7%	1.14E-07	1.11E-04	mg/kg	1.11E-04	1.10E-06	4	--	--	YES	NSL; >Bkg
PCDD/PCDF Totals	55722-27-5	TOTAL TETRA_FURANS	21	18	85.7%	5.83E-07	2.03E-04	mg/kg	2.03E-04	4.73E-06	8	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	35822-46-9	1,2,3,4,6,7,8-HpCDD	27	25	93.0%	1.24E-06	1.02E-03	mg/kg	1.02E-03	8.06E-06	8	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	67562-39-4	1,2,3,4,6,7,8-HpCDF	27	19	70.0%	1.10E-07	2.78E-04	mg/kg	2.78E-04	1.82E-06	9	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	55673-89-7	1,2,3,4,7,8,9-HpCDF	26	10	38.0%	4.98E-07	1.10E-05	mg/kg	1.10E-05	1.11E-07	6	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	39227-28-6	1,2,3,4,7,8-HxCDD	27	22	81.5%	4.00E-07	1.76E-05	mg/kg	1.76E-05	1.91E-07	10	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	70648-26-9	1,2,3,4,7,8-HxCDF	27	14	51.9%	5.92E-07	2.17E-05	mg/kg	2.17E-05	2.24E-07	10	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	57653-85-7	1,2,3,6,7,8-HxCDD	27	25	92.6%	4.31E-07	7.61E-05	mg/kg	7.61E-05	1.01E-06	7	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	57117-44-9	1,2,3,6,7,8-HxCDF	27	17	63.0%	5.36E-07	1.05E-05	mg/kg	1.05E-05	1.28E-07	10	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	19408-74-3	1,2,3,7,8,9-HxCDD	27	25	92.6%	3.93E-07	3.85E-05	mg/kg	3.85E-05	8.20E-07	8	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	72918-21-9	1,2,3,7,8,9-HxCDF	26	6	23.1%	1.32E-06	9.66E-07	mg/kg	1.32E-06	--	--	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	40321-76-4	1,2,3,7,8-PeCDD	27	25	92.6%	1.89E-07	1.44E-05	mg/kg	1.44E-05	2.36E-07	10	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	57117-41-6	1,2,3,7,8-PeCDF	27	17	63.0%	5.36E-07	8.52E-06	mg/kg	8.52E-06	1.06E-07	13	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	60851-34-5	2,3,4,6,7,8-HxCDF	27	17	63.0%	5.65E-07	1.14E-05	mg/kg	1.14E-05	1.25E-07	11	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	57117-31-4	2,3,4,7,8-PeCDF	27	22	81.5%	5.36E-07	1.43E-05	mg/kg	1.43E-05	1.88E-07	13	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	1746-01-6	2,3,7,8-TCDD	27	25	92.6%	9.10E-08	4.43E-05	mg/kg	4.43E-05	1.16E-07	13	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	51207-31-9	2,3,7,8-TCDF	25	19	76.0%	1.14E-07	2.47E-05	mg/kg	2.47E-05	7.79E-07	6	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	3268-87-9	OCDD	27	27	100.0%	--	8.78E-03	mg/kg	8.78E-03	5.37E-05	9	--	--	YES	NSL; >Bkg
PCDDs/PCDFs	39001-02-0	OCDF	27	18	66.7%	3.63E-06	9.41E-04	mg/kg	9.41E-04	3.02E-06	8	--	--	YES	NSL; >Bkg
Pesticides	72-54-8	4,4'-DDD	26	10	38.5%	0.00032	0.027	mg/kg	0.027	--	--	0.016	1	YES	ASL; Bkg na/nd
Pesticides	72-55-9	4,4'-DDE	26	7	26.9%	0.0018	0.0058	mg/kg	0.0058	--	--	0.009	0	YES	log Kow > 3.5
Pesticides	50-29-3	4,4'-DDT	26	9	34.6%	0.00032	0.017	mg/kg	0.017	--	--	0.0039	3	YES	ASL; Bkg na/nd
Pesticides	309-00-2	Aldrin	21	12	57.1%	0.00013	0.0019	mg/kg	0.0019	0.0049	0	0.00044	4	NO	ASL; <Bkg
Pesticides	319-84-6	Alpha-BHC	26	3	12.0%	0.0011	0.00077	mg/kg	0.0011	0.0015	0	0.0003	3	NO	ASL; <Bkg
Pesticides	319-85-7	Beta-BHC	26	3	12.0%	1.80E-03	4.50E-03	mg/kg	4.50E-03	0.0022	1	0.0002	3	YES	ASL
Pesticides	5103-71-9	cis-Chlordane	21	7	48.0%	5.60E-04	3.20E-04	mg/kg	5.60E-04	0.00066	0	--	--	NO	NSL; <Bkg
Pesticides	319-86-8	Delta-BHC	26	10	38.0%	3.70E-03	2.80E-03	mg/kg	3.70E-03	--	--	0.13	0	YES	log Kow > 3.5
Pesticides	60-57-1	Dieldrin	21	3	29.0%	1.00E-03	0.0012	mg/kg	0.0012	--	--	0.00002	3	YES	ASL; Bkg na/nd
Pesticides	959-98-8	Endosulfan I	21	3	14.3%	0.00014	0.00051	mg/kg	0.00051	--	--	0.0029	0	YES	log Kow > 3.5
Pesticides	33213-65-9	Endosulfan II	21	4	19.0%	3.90E-03	1.60E-03	mg/kg	1.60E-03	--	--	0.014	0	YES	log Kow > 3.5
Pesticides	1031-07-8	Endosulfan Sulfate	21	5	23.8%	0.00041	0.0015	mg/kg	0.0015	--	--	--	--	YES	NSL; Bkg na/nd
Pesticides	72-20-8	Endrin	21	2	10.0%	2.00E-03	6.60E-04	mg/kg	2.00E-03	--	--	0.00002	0	YES	log Kow > 3.5
Pesticides	7421-93-4	Endrin Aldehyde	21	10	47.6%	0.0003	0.0011	mg/kg	0.0011	--	--	--	--	YES	NSL; Bkg na/nd
Pesticides	53494-70-5	Endrin Ketone	21	5	23.8%	0.0003	0.0011	mg/kg	0.0011	--	--	--	--	YES	NSL; Bkg na/nd
Pesticides	5566-34-7	gamma-Chlordane	21	5	24.0%	6.00E-04	6.00E-04	mg/kg	0.0006	0.00074	0	0.00002	5	NO	ASL; <Bkg
Pesticides	76-44-8	Heptachlor	21	5	24.0%	6.30E-04	4.90E-04	mg/kg	6.30E-04	--	--	0.00004	5	YES	ASL; Bkg na/nd
Pesticides	1024-57-3	Heptachlor Epoxide	21	8	38.0%	9.80E-04	1.80E-03	mg/kg	1.80E-03	0.00088	3	0.001	2	YES	ASL
Pesticides	58-89-9	Lindane	26	7	27.0%	5.40E-04	0.0022	mg/kg	0.0022	0.0041	0	0.0003	5	NO	ASL; <Bkg
Pesticides	72-43-5	Methoxychlor	21	4	19.0%	0.0016	0.0057	mg/kg	0.0057	--	--	0.006	0	YES	log Kow > 3.5
Pesticides	8001-35-2	Toxaphene	21	3	14.3%	0.012	0.043	mg/kg	0.043	--	--	0.000002	3	YES	ASL; Bkg na/nd
Petrol Prod	68476-34-6	#2 Diesel	21	10	48.0%	17	110	mg/kg	110	12	9	200	0	NO	BSL
Petrol Prod	86290-81-5	Gasoline	21	0	0.0%	20	--	mg/kg	20	--	--	--	--	NO	IFD
Petrol Prod	PHCMOT	Motor Oil	21	12	57.1%	7.2	370	mg/kg	370	10	12	200	3	YES	ASL; >Bkg

Table E-2. Intertidal Sediment Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	Screening Toxicity Value (3)	Number of Detected Observations Above Toxicity Value	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
SVOCs	120-82-1	1,2,4-Trichlorobenzene	29	1	3.4%	0.029	0.019	mg/kg	0.029	--	--	--	--	NO	IFD
SVOCs	95-95-4	2,4,5-Trichlorophenol	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	0.003	1	NO	IFD
SVOCs	88-06-2	2,4,6-Trichlorophenol	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	0.006	1	NO	IFD
SVOCs	120-83-2	2,4-Dichlorophenol	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	0.005	1	NO	IFD
SVOCs	105-67-9	2,4-Dimethylphenol	29	1	3.4%	0.019	0.019	mg/kg	0.019	--	--	0.029	0	NO	IFD
SVOCs	51-28-5	2,4-Dinitrophenol	24	1	4.2%	0.19	0.19	mg/kg	0.19	--	--	--	--	NO	IFD
SVOCs	121-14-2	2,4-Dinitrotoluene	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
SVOCs	606-20-2	2,6-Dinitrotoluene	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
SVOCs	91-58-7	2-Chloronaphthalene	24	1	4.2%	0.019	0.019	mg/kg	0.019	--	--	--	--	NO	IFD
SVOCs	95-57-8	2-Chlorophenol	24	1	4.2%	0.019	0.019	mg/kg	0.019	--	--	0.008	1	NO	IFD
SVOCs	88-74-4	2-Nitroaniline	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
SVOCs	88-75-5	2-Nitrophenol	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
SVOCs	91-94-1	3,3'-Dichlorobenzidine	20	0	0.0%	0.099	--	mg/kg	0.099	--	--	--	--	NO	IFD
SVOCs	534-52-1	4,6-Dinitro-2-Methylphenol	24	1	4.2%	0.19	0.19	mg/kg	0.19	--	--	--	--	NO	IFD
SVOCs	59-50-7	4-Chloro-3-Methylphenol	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
SVOCs	106-47-8	4-Chloroaniline	21	0	0.0%	0.098	--	mg/kg	0.098	--	--	--	--	NO	IFD
SVOCs	7005-72-3	4-Chlorophenyl-Phenylether	24	1	4.2%	0.019	0.019	mg/kg	0.019	--	--	--	--	NO	IFD
SVOCs	100-01-6	4-Nitroaniline	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
SVOCs	100-02-7	4-Nitrophenol	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
SVOCs	100-51-6	Benzyl Alcohol	19	0	0.0%	0.02	--	mg/kg	0.02	--	--	0.057	0	NO	IFD
SVOCs	117-81-7	Bis(2-Ethylhexyl) Phthalate	27	9	33.3%	0.019	0.13	mg/kg	0.13	--	--	0.47	0	YES	log Kow > 3.5
SVOCs	85-68-7	Butyl benzyl phthalate	29	2	6.9%	0.029	0.073	mg/kg	0.073	--	--	0.049	1	YES	ASL; Bkg na/nd
SVOCs	86-74-8	Carbazole	24	2	8.3%	0.019	0.019	mg/kg	0.019	--	--	0.97	0	NO	BSL
SVOCs	84-74-2	Dibutyl phthalate	29	1	3.4%	0.051	0.019	mg/kg	0.051	--	--	2.2	0	NO	IFD
SVOCs	84-66-2	Diethyl phthalate	29	2	6.9%	0.068	0.019	mg/kg	0.068	--	--	0.61	0	NO	BSL
SVOCs	131-11-3	Dimethyl phthalate	29	1	3.4%	0.035	0.019	mg/kg	0.035	--	--	0.53	0	NO	IFD
SVOCs	117-84-0	Di-N-Octyl Phthalate	29	1	3.4%	0.024	0.019	mg/kg	0.024	--	--	0.58	0	NO	IFD
SVOCs	118-74-1	Hexachlorobenzene	29	1	3.4%	0.041	0.019	mg/kg	0.041	--	--	0.0038	1	NO	IFD
SVOCs	118-74-1	Hexachlorobenzene	29	1	3.4%	0.041	0.019	mg/kg	0.041	--	--	0.022	1	NO	IFD
SVOCs	87-68-3	Hexachlorobutadiene	29	1	3.4%	0.028	0.019	mg/kg	0.028	--	--	0.039	0	NO	IFD
SVOCs	77-47-4	Hexachlorocyclopentadiene	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	0.007	1	NO	IFD
SVOCs	78-59-1	Isophorone	24	1	4.2%	0.019	0.019	mg/kg	0.019	--	--	2.4	0	NO	IFD
SVOCs	99-09-2	m-Nitroaniline	22	0	0.0%	0.097	--	mg/kg	0.097	--	--	--	--	NO	IFD
SVOCs	98-95-3	Nitrobenzene	24	1	4.2%	0.019	0.019	mg/kg	0.019	--	--	1.65	0	NO	IFD
SVOCs	621-64-7	N-Nitrosodi-n-propylamine	24	1	4.2%	0.097	0.097	mg/kg	0.097	--	--	--	--	NO	IFD
SVOCs	86-30-6	N-Nitrosodiphenylamine	29	1	3.4%	0.043	0.019	mg/kg	0.043	--	--	0.11	0	NO	IFD
SVOCs	95-48-7	o-Cresol	29	1	3.4%	0.066	0.019	mg/kg	0.066	--	--	0.063	0	NO	IFD
SVOCs	106-44-5	p-Cresol	27	6	22.2%	0.019	0.37	mg/kg	0.37	0.049	2	0.67	0	NO	BSL
SVOCs	87-86-5	Pentachlorophenol	29	2	6.9%	0.17	0.097	mg/kg	0.17	--	--	0.36	0	YES	log Kow > 3.5
SVOCs	108-95-2	Phenol	27	9	33.3%	0.028	0.11	mg/kg	0.11	0.12	0	0.42	0	NO	BSL
SVOCs	110-86-1	Pyridine	5	0	0.0%	0.058	--	mg/kg	0.058	--	--	--	--	NO	IFD
SVOCs	483-65-8	Retene	24	6	25.0%	0.019	0.2	mg/kg	0.2	--	--	1.2	0	YES	log Kow > 3.5
VOCs	95-50-1	1,2-Dichlorobenzene	29	1	3.4%	0.026	0.019	mg/kg	0.026	--	--	--	--	NO	IFD
VOCs	541-73-1	1,3-Dichlorobenzene	24	1	4.2%	0.019	0.019	mg/kg	0.019	--	--	--	--	NO	IFD
VOCs	106-46-7	1,4-Dichlorobenzene	29	1	3.4%	0.037	0.019	mg/kg	0.037	--	--	0.031	0	NO	IFD
VOCs	108-60-1	2,2'-Oxybis[1-chloropropane]	24	1	4.2%	0.019	0.019	mg/kg	0.019	--	--	--	--	NO	IFD
VOCs	111-91-1	Bis(2-Chloroethoxy)Methane	24	1	4.2%	0.019	0.019	mg/kg	0.019	--	--	--	--	NO	IFD
VOCs	111-44-4	Bis(2-Chloroethyl)Ether	24	1	4.2%	0.019	0.019	mg/kg	0.019	--	--	--	--	NO	IFD
VOCs	67-72-1	Hexachloroethane	24	1	4.2%	0.019	0.019	mg/kg	0.019	--	--	0.14	0	NO	IFD

Notes:
(1) Maximum detected concentration or highest detection limit, whichever is greater.
(2) Dungeness Bay.
(3) Screening toxicity value (for marine benthic life) from Table 4-1.
(4) Rationale codes:
- for selection: ASL; >Bkg = above screening level; greater than background.
  ASL; Bkg na = above screening level; background not available.
  log Kow >3.5 = logarithm of octanol-water partition coefficient greater than 3.5.
  NSL; Bkg na/nd = no screening level; background not available/not detected
  NSL; >Bkg = no screening level; greater than background
- for exclusion: BSL = below screening level
  IFD = infrequently (less than 5%) detected
  NSL; <Bkg = no screening level (NSL); less than background
  NUT = essential nutrient

Key:
-- (double dash) = not available or not applicable
CAS = Chemical Abstract Service
IHS = indicator hazardous substance
na = not applicable or not available
ND = not detected
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCDD = polychlorinated dibenzo dioxins
PCDF = polychlorinated dibenzo furans
SVOC = semivolitile organic compound
TEQ = toxic equivalent
VOC = volatile organic compound

Table E-3. Bull Kelp Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
Metals	7440-36-0	Antimony	1	0	0.0%	0.001	--	mg/kg	0.001	-	-	NO	IFD
Metals	7440-38-2	Arsenic	1	1	100.0%	--	6	mg/kg	6	-	-	YES	NSL; Bkg na/nd
Metals	7440-39-3	Barium	1	1	100.0%	--	0.97	mg/kg	0.97	-	-	YES	NSL; Bkg na/nd
Metals	7440-43-9	Cadmium	1	1	100.0%	--	0.18	mg/kg	0.18	-	-	YES	NSL; Bkg na/nd
Metals	7440-47-3	Chromium	1	1	100.0%	--	0.078	mg/kg	0.078	-	-	YES	NSL; Bkg na/nd
Metals	7440-50-8	Copper	1	1	100.0%	--	0.3	mg/kg	0.3	-	-	YES	NSL; Bkg na/nd
Metals	7439-92-1	Lead	1	0	0.0%	0.091	--	mg/kg	0.091	-	-	NO	IFD
Metals	7439-97-6	Mercury	1	1	100.0%	--	0.011	mg/kg	0.011	-	-	YES	NSL; Bkg na/nd
Metals	7440-02-0	Nickel	1	1	100.0%	--	0.11	mg/kg	0.11	-	-	YES	NSL; Bkg na/nd
Metals	7440-22-4	Silver	1	1	100.0%	--	0.0069	mg/kg	0.0069	-	-	YES	NSL; Bkg na/nd
Metals	7440-66-6	Zinc	1	1	100.0%	--	2.9	mg/kg	2.9	-	-	YES	NSL; Bkg na/nd
Organic Acids	65-85-0	Benzoic Acid	1	0	0.0%	19	--	mg/kg	19	-	-	NO	IFD
PAH Totals	HPAH0	High MW PAHs ND=0	1	1	100%	--	0.0095	mg/kg	0.0095	-	-	YES	NSL; Bkg na/nd
PAH Totals	HPAH05	High MW PAHs ND=0.5	1	1	100%	--	0.0095	mg/kg	0.0095	-	-	YES	NSL; Bkg na/nd
PAH Totals	LPAH0	Low MW PAHs ND=0	1	1	100%	--	0.0025	mg/kg	0.0025	-	-	YES	NSL; Bkg na/nd
PAH Totals	LPAH05	Low MW PAHs ND=0.5	1	1	100%	--	0.0032	mg/kg	0.0032	-	-	YES	NSL; Bkg na/nd
PAHs	832-69-9	1-Methylphenanthrene	1	1	100%	--	0.000309	mg/kg	0.000309	-	-	YES	NSL; Bkg na/nd
PAHs	2245-38-7	2,3,5-Trimethylnaphthalene	1	0	0.0%	0.000244	--	mg/kg	0.000244	-	-	NO	IFD
PAHs	581-42-0	2,6-Dimethylnaphthalene	1	1	100%	--	0.000315	mg/kg	0.000315	-	-	YES	NSL; Bkg na/nd
PAHs	91-57-6	2-Methylnaphthalene	1	0	0.0%	0.000403	--	mg/kg	0.000403	-	-	NO	IFD
PAHs	83-32-9	Acenaphthene	1	1	100%	--	0.000152	mg/kg	0.000152	-	-	YES	NSL; Bkg na/nd
PAHs	208-96-8	Acenaphthylene	1	1	100.0%	--	0.00009	mg/kg	0.00009	-	-	YES	NSL; Bkg na/nd
PAHs	120-12-7	Anthracene	1	1	100%	--	0.000532	mg/kg	0.000532	-	-	YES	NSL; Bkg na/nd
PAHs	56-55-3	Benz[a]anthracene	1	1	100%	--	0.000918	mg/kg	0.000918	-	-	YES	NSL; Bkg na/nd
PAHs	50-32-8	Benzo[a]pyrene	1	1	100%	--	0.00067	mg/kg	0.00067	-	-	YES	NSL; Bkg na/nd
PAHs	BnzFluor-bkj	Benzo[b/j/k]fluoranthene	1	1	100%	--	0.000995	mg/kg	0.000995	-	-	YES	NSL; Bkg na/nd
PAHs	205-99-2	Benzo[b]fluoranthene	1	1	100%	--	0.000397	mg/kg	0.000397	-	-	YES	NSL; Bkg na/nd
PAHs	192-97-2	Benzo[e]pyrene	1	1	100.0%	--	0.0004	mg/kg	0.0004	-	-	YES	NSL; Bkg na/nd
PAHs	191-24-2	Benzo[ghi]perylene	1	1	100%	--	0.000265	mg/kg	0.000265	-	-	YES	NSL; Bkg na/nd
PAHs	BnzFluor-jk	Benzo[j,k]fluoranthenes	1	1	100%	--	0.000597	mg/kg	0.000597	-	-	YES	NSL; Bkg na/nd
PAHs	218-01-9	Chrysene	1	1	100%	--	0.00104	mg/kg	0.00104	-	-	YES	NSL; Bkg na/nd
PAHs	53-70-3	Dibenz[a,h]anthracene	1	0	0.0%	0.000101	--	mg/kg	0.000101	-	-	NO	IFD
PAHs	132-65-0	Dibenzothiophene	1	0	0.0%	0.000128	--	mg/kg	0.000128	-	-	NO	IFD
PAHs	206-44-0	Fluoranthene	1	1	100%	--	0.00223	mg/kg	0.00223	-	-	YES	NSL; Bkg na/nd
PAHs	86-73-7	Fluorene	1	1	1--%	--	0.000166	mg/kg	0.000166	-	-	YES	NSL; Bkg na/nd
PAHs	193-39-5	Indeno[1,2,3-cd]pyrene	1	1	100%	--	0.000284	mg/kg	0.000284	-	-	YES	NSL; Bkg na/nd
PAHs	91-20-3	Naphthalene	1	1	100%	--	0.000918	mg/kg	0.000918	-	-	YES	NSL; Bkg na/nd
PAHs	198-55-0	Perylene	1	1	100%	--	0.000213	mg/kg	0.000213	-	-	YES	NSL; Bkg na/nd
PAHs	85-01-8	Phenanthrene	1	1	100%	--	0.00216	mg/kg	0.00216	-	-	YES	NSL; Bkg na/nd
PAHs	129-00-0	Pyrene	1	1	100%	--	0.00246	mg/kg	0.00246	-	-	YES	NSL; Bkg na/nd
PBDEs	101-55-3	4-Bromophenyl phenyl ether	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
PCB Aroclor	12674-11-2	PCB-aroclor 1016	1	0	0.0%	0.003	--	mg/kg	0.003	-	-	NO	IFD
PCB Aroclor	11104-28-2	PCB-aroclor 1221	1	0	0.0%	0.0076	--	mg/kg	0.0076	-	-	NO	IFD
PCB Aroclor	11141-16-5	PCB-aroclor 1232	1	0	0.0%	0.0067	--	mg/kg	0.0067	-	-	NO	IFD
PCB Aroclor	53469-21-9	PCB-aroclor 1242	1	0	0.0%	0.002	--	mg/kg	0.002	-	-	NO	IFD
PCB Aroclor	12672-29-6	PCB-aroclor 1248	1	0	0.0%	0.0012	--	mg/kg	0.0012	-	-	NO	IFD
PCB Aroclor	11097-69-1	PCB-aroclor 1254	1	0	0.0%	0.002	--	mg/kg	0.002	-	-	NO	IFD
PCB Aroclor	11096-82-5	PCB-aroclor 1260	1	0	0.0%	0.0029	--	mg/kg	0.0029	-	-	NO	IFD
PCB Aroclor	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND=0	1	0	0.0%	0	--	mg/kg	0	-	-	NO	IFD
PCB Aroclor	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND=0.5	1	0	0.0%	0.0127	--	mg/kg	0.0127	-	-	NO	IFD
PCB Congeners	32598-13-3	PCB-077	1	0	0.0%	4.19E-08	--	mg/kg	4.19E-08	-	-	NO	IFD
PCB Congeners	70362-50-4	PCB-081	1	0	0.0%	4.45E-08	--	mg/kg	4.45E-08	-	-	NO	IFD
PCB Congeners	32598-14-4	PCB-105	1	1	100.0%	--	7.15E-07	mg/kg	7.15E-07	-	-	YES	NSL; Bkg na/nd
PCB Congeners	74472-37-0	PCB-114	1	0	0.0%	3.27E-08	--	mg/kg	3.27E-08	-	-	NO	IFD
PCB Congeners	31508-00-6	PCB-118	1	1	100.0%	--	1.84E-06	mg/kg	1.84E-06	-	-	YES	NSL; Bkg na/nd
PCB Congeners	65510-44-3	PCB-123	1	0	0.0%	3.39E-08	--	mg/kg	3.39E-08	-	-	NO	IFD
PCB Congeners	57465-28-8	PCB-126	1	0	0.0%	3.39E-08	--	mg/kg	3.39E-08	-	-	NO	IFD
PCB Congeners	52663-72-6	PCB-167	1	0	0.0%	1.66E-08	--	mg/kg	1.66E-08	-	-	NO	IFD
PCB Congeners	32774-16-6	PCB-169	1	0	0.0%	1.77E-08	--	mg/kg	1.77E-08	-	-	NO	IFD
PCB Congeners	39635-31-9	PCB-189	1	0	0.0%	1.48E-08	--	mg/kg	1.48E-08	-	-	NO	IFD

Table E-3. Bull Kelp Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	1	1	100.0%	--	1.20E-09	mg/kg	1.20E-09	-	-	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	1	1	100.0%	--	1.02E-07	mg/kg	1.02E-07	-	-	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	37871-00-4	Total HpCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDD/PCDF Totals	38998-75-3	Total HpCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDD/PCDF Totals	34465-46-8	Total HxCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDD/PCDF Totals	55684-94-1	Total HxCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDD/PCDF Totals	36088-22-9	Total PeCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDD/PCDF Totals	30402-15-4	Total PeCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDD/PCDF Totals	41903-57-5	Total TCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	35822-46-9	1,2,3,4,6,7,8-HpCDD	1	0	0.0%	1.26E-06	--	mg/kg	1.26E-06	-	-	NO	IFD
PCDDs/PCDFs	67562-39-4	1,2,3,4,6,7,8-HpCDF	1	1	100.0%	--	5.80E-08	mg/kg	5.80E-08	-	-	YES	NSL; Bkg na/nd
PCDDs/PCDFs	55673-89-7	1,2,3,4,7,8,9-HpCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	39227-28-6	1,2,3,4,7,8-HxCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	70648-26-9	1,2,3,4,7,8-HxCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	57653-85-7	1,2,3,6,7,8-HxCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	57117-44-9	1,2,3,6,7,8-HxCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	19408-74-3	1,2,3,7,8,9-HxCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	72918-21-9	1,2,3,7,8,9-HxCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	40321-76-4	1,2,3,7,8-PeCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	57117-41-6	1,2,3,7,8-PeCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	60851-34-5	2,3,4,6,7,8-HxCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	57117-31-4	2,3,4,7,8-PeCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	1746-01-6	2,3,7,8-TCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	51207-31-9	2,3,7,8-TCDF	1	0	0.0%	3.39E-07	--	mg/kg	3.39E-07	-	-	NO	IFD
PCDDs/PCDFs	3268-87-9	OCDD	1	1	100.0%	--	1.55E-06	mg/kg	1.55E-06	-	-	YES	NSL; Bkg na/nd
PCDDs/PCDFs	39001-02-0	OCDF	1	1	100.0%	--	1.08E-07	mg/kg	1.08E-07	-	-	YES	NSL; Bkg na/nd
SVOCs	120-82-1	1,2,4-Trichlorobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	95-95-4	2,4,5-Trichlorophenol	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	88-06-2	2,4,6-Trichlorophenol	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	120-83-2	2,4-Dichlorophenol	1	0	0.0%	5.8	--	mg/kg	5.8	-	-	NO	IFD
SVOCs	105-67-9	2,4-Dimethylphenol	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	51-28-5	2,4-Dinitrophenol	1	0	0.0%	19	--	mg/kg	19	-	-	NO	IFD
SVOCs	121-14-2	2,4-Dinitrotoluene	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	606-20-2	2,6-Dinitrotoluene	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	91-58-7	2-Chloronaphthalene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	95-57-8	2-Chlorophenol	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	88-74-4	2-Nitroaniline	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	88-75-5	2-Nitrophenol	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	91-94-1	3,3'-Dichlorobenzidine	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	534-52-1	4,6-Dinitro-2-Methylphenol	1	0	0.0%	5.2	--	mg/kg	5.2	-	-	NO	IFD
SVOCs	59-50-7	4-Chloro-3-Methylphenol	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	106-47-8	4-Chloroaniline	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	7005-72-3	4-Chlorophenyl-Phenylether	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	100-01-6	4-Nitroaniline	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	100-02-7	4-Nitrophenol	1	0	0.0%	0.56	--	mg/kg	0.56	-	-	NO	IFD
SVOCs	100-51-6	Benzyl Alcohol	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	117-81-7	Bis(2-Ethylhexyl) Phthalate	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	85-68-7	Butyl benzyl phthalate	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	86-74-8	Carbazole	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	132-64-9	Dibenzofuran	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	84-74-2	Dibutyl phthalate	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	84-66-2	Diethyl phthalate	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	131-11-3	Dimethyl phthalate	1	0	0.0%	0.33	--	mg/kg	0.33	-	-	NO	IFD
SVOCs	117-84-0	Di-N-Octyl Phthalate	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	118-74-1	Hexachlorobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	87-68-3	Hexachlorobutadiene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	77-47-4	Hexachlorocyclopentadiene	1	0	0.0%	2.5	--	mg/kg	2.5	-	-	NO	IFD
SVOCs	78-59-1	Isophorone	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	99-09-2	m-Nitroaniline	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	98-95-3	Nitrobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD

Table E-3. Bull Kelp Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
SVOCs	621-64-7	N-Nitrosodi-n-propylamine	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	86-30-6	N-Nitrosodiphenylamine	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	95-48-7	o-Cresol	1	0	0.0%	0.56	--	mg/kg	0.56	-	-	NO	IFD
SVOCs	106-44-5	p-Cresol	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	87-86-5	Pentachlorophenol	1	0	0.0%	9.6	--	mg/kg	9.6	-	-	NO	IFD
SVOCs	108-95-2	Phenol	1	0	0.0%	0.62	--	mg/kg	0.62	-	-	NO	IFD
VOCs	95-50-1	1,2-Dichlorobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	541-73-1	1,3-Dichlorobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	106-46-7	1,4-Dichlorobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	108-60-1	2,2'-Oxybis[1-chloropropane]	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	111-91-1	Bis(2-Chloroethoxy)Methane	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	111-44-4	Bis(2-Chloroethyl)Ether	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	67-72-1	Hexachloroethane	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD

Notes:
(1) Maximum detected concentration or highest detection limit, whichever is greater.
(2) Dungeness Bay.
(3) Screening toxicity value (for marine benthic life) from Table 4-1.
(4) Rationale codes:
- for selection: ASL = above screening level
  ASL; Bkg na = above screening level; background not available.
  log Kow >3.5 = logarithm of octanol-water partition coefficient greater than 3.5.
  NSL; Bkg na/nd = no screening level; background not available/not detected
  NSL; >Bkg = no screening level; greater than background
- for exclusion: BSL = below screening level
  IFD = infrequently (less than 5%) detected
  NSL; <Bkg = no screening level (NSL); less than background
  NUT = essential nutrient

Key:
-- (double dash) = not available or not applicable
CAS = Chemical Abstract Service
IHS = indicator hazardous substance
na = not applicable or not available
ND = not detected
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCDD = polychlorinated dibenzo dioxins
PCDF = polychlorinated dibenzo furans
SVOC = semivolitile organic compound
TEQ = toxic equivalent
VOC = volatile organic compound

Table E-4. Eelgrass Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
Metals	7440-36-0	Antimony	1	1	100.0%	--	0.057	mg/kg	0.057	-	-	YES	NSL; Bkg na/nd
Metals	7440-38-2	Arsenic	1	1	100.0%	--	0.72	mg/kg	0.72	-	-	YES	NSL; Bkg na/nd
Metals	7440-39-3	Barium	1	1	100.0%	--	1.2	mg/kg	1.2	-	-	YES	NSL; Bkg na/nd
Metals	7440-43-9	Cadmium	1	1	100.0%	--	0.79	mg/kg	0.79	-	-	YES	NSL; Bkg na/nd
Metals	7440-47-3	Chromium	1	1	100.0%	--	0.32	mg/kg	0.32	-	-	YES	NSL; Bkg na/nd
Metals	7440-50-8	Copper	1	1	100.0%	--	1	mg/kg	1	-	-	YES	NSL; Bkg na/nd
Metals	7439-92-1	Lead	1	0	0.0%	0.09	--	mg/kg	0.09	-	-	NO	IFD
Metals	7439-97-6	Mercury	1	1	100.0%	--	0.021	mg/kg	0.021	-	-	YES	NSL; Bkg na/nd
Metals	7440-02-0	Nickel	1	1	100.0%	--	0.75	mg/kg	0.75	-	-	YES	NSL; Bkg na/nd
Metals	7440-22-4	Silver	1	0	0.0%	0.0091	--	mg/kg	0.0091	-	-	NO	IFD
Metals	7440-66-6	Zinc	1	1	100.0%	--	7.6	mg/kg	7.6	-	-	YES	NSL; Bkg na/nd
Organic Acids	65-85-0	Benzoic Acid	1	0	0.0%	19	--	mg/kg	19	-	-	NO	IFD
PAH Totals	HPAH0	High MW PAHs ND=0	1	1	100.0%	--	0.0161	mg/kg	0.0161	-	-	YES	NSL; Bkg na/nd
PAH Totals	HPAH05	High MW PAHs ND=0.5	1	1	100.0%	--	0.0162	mg/kg	0.0162	-	-	YES	NSL; Bkg na/nd
PAH Totals	LPAH0	Low MW PAHs ND=0	1	1	100.0%	--	0.0030	mg/kg	0.0030	-	-	YES	NSL; Bkg na/nd
PAH Totals	LPAH05	Low MW PAHs ND=0.5	1	1	100.0%	--	0.0042	mg/kg	0.0042	-	-	YES	NSL; Bkg na/nd
PAHs	832-69-9	1-Methylphenanthrene	1	1	100.0%	--	0.00133	mg/kg	0.00133	-	-	YES	NSL; Bkg na/nd
PAHs	2245-38-7	2,3,5-Trimethylnaphthalene	1	1	100.0%	--	0.000895	mg/kg	0.000895	-	-	YES	NSL; Bkg na/nd
PAHs	581-42-0	2,6-Dimethylnaphthalene	1	1	100.0%	--	0.00373	mg/kg	0.00373	-	-	YES	NSL; Bkg na/nd
PAHs	91-57-6	2-Methylnaphthalene	1	0	0.0%	0.00105	--	mg/kg	0.00105	-	-	NO	IFD
PAHs	83-32-9	Acenaphthene	1	0	0.0%	0.000119	--	mg/kg	0.000119	-	-	NO	IFD
PAHs	208-96-8	Acenaphthylene	1	1	100.0%		0.000232	mg/kg	0.000232	-	-	YES	NSL; Bkg na/nd
PAHs	120-12-7	Anthracene	1	0	0.0%	0.000668	--	mg/kg	0.000668	-	-	NO	IFD
PAHs	56-55-3	Benz[a]anthracene	1	1	100.0%	--	0.00114	mg/kg	0.00114	-	-	YES	NSL; Bkg na/nd
PAHs	50-32-8	Benzo[a]pyrene	1	1	100.0%	--	0.000823	mg/kg	0.000823	-	-	YES	NSL; Bkg na/nd
PAHs	BnzFluor-bkj	Benzo[b/j/k]fluoranthene	1	1	100.0%	--	0.00254	mg/kg	0.00254	-	-	YES	NSL; Bkg na/nd
PAHs	205-99-2	Benzo[b]fluoranthene	1	1	100.0%	--	0.00133	mg/kg	0.00133	-	-	YES	NSL; Bkg na/nd
PAHs	192-97-2	Benzo[e]pyrene	1	1	100.0%	--	0.000893	mg/kg	0.000893	-	-	YES	NSL; Bkg na/nd
PAHs	191-24-2	Benzo[ghi]perylene	1	1	100.0%	--	0.000719	mg/kg	0.000719	-	-	YES	NSL; Bkg na/nd
PAHs	BnzFluor-jk	Benzo[j,k]fluoranthenes	1	1	100.0%	--	0.00121	mg/kg	0.00121	-	-	YES	NSL; Bkg na/nd
PAHs	218-01-9	Chrysene	1	1	100.0%	--	0.00205	mg/kg	0.00205	-	-	YES	NSL; Bkg na/nd
PAHs	53-70-3	Dibenz[a,h]anthracene	1	0	0.0%	0.000203	--	mg/kg	0.000203	-	-	NO	IFD
PAHs	132-65-0	Dibenzothiophene	1	1	100.0%	--	0.000169	mg/kg	0.000169	-	-	YES	NSL; Bkg na/nd
PAHs	206-44-0	Fluoranthene	1	1	100.0%	--	0.00387	mg/kg	0.00387	-	-	YES	NSL; Bkg na/nd
PAHs	86-73-7	Fluorene	1	1	100.0%	--	0.000359	mg/kg	0.000359	-	-	YES	NSL; Bkg na/nd
PAHs	193-39-5	Indeno[1,2,3-cd]pyrene	1	1	100.0%	--	0.000681	mg/kg	0.000681	-	-	YES	NSL; Bkg na/nd
PAHs	91-20-3	Naphthalene	1	0	0.0%	0.00168	--	mg/kg	0.00168	-	-	NO	IFD
PAHs	198-55-0	Perylene	1	1	100.0%	--	0.000992	mg/kg	0.000992	-	-	YES	NSL; Bkg na/nd
PAHs	85-01-8	Phenanthrene	1	1	100.0%	--	0.00265	mg/kg	0.00265	-	-	YES	NSL; Bkg na/nd
PAHs	129-00-0	Pyrene	1	1	100.0%	--	0.00307	mg/kg	0.00307	-	-	YES	NSL; Bkg na/nd
PBDEs	101-55-3	4-Bromophenyl phenyl ether	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
PCB Aroclor	12674-11-2	PCB-aroclor 1016	1	0	0.0%	0.0032	--	mg/kg	0.0032	-	-	NO	IFD
PCB Aroclor	11104-28-2	PCB-aroclor 1221	1	0	0.0%	0.008	--	mg/kg	0.008	-	-	NO	IFD
PCB Aroclor	11141-16-5	PCB-aroclor 1232	1	0	0.0%	0.007	--	mg/kg	0.007	-	-	NO	IFD
PCB Aroclor	53469-21-9	PCB-aroclor 1242	1	0	0.0%	0.0021	--	mg/kg	0.0021	-	-	NO	IFD
PCB Aroclor	12672-29-6	PCB-aroclor 1248	1	0	0.0%	0.0013	--	mg/kg	0.0013	-	-	NO	IFD
PCB Aroclor	11097-69-1	PCB-aroclor 1254	1	0	0.0%	0.0021	--	mg/kg	0.0021	-	-	NO	IFD
PCB Aroclor	11096-82-5	PCB-aroclor 1260	1	0	0.0%	0.003	--	mg/kg	0.003	-	-	NO	IFD
PCB Aroclor	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND=0	1	0	0.0%	0	--	mg/kg	0	-	-	NO	IFD
PCB Aroclor	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND=0.5	1	0	0.0%	0.0134	--	mg/kg	0.0134	-	-	NO	IFD
PCB Congeners	32598-13-3	PCB-077	1	1	100.0%	--	2.88E-07	mg/kg	2.88E-07	-	-	YES	NSL; Bkg na/nd
PCB Congeners	70362-50-4	PCB-081	1	0	0.0%	7.46E-08	--	mg/kg	7.46E-08	-	-	NO	IFD
PCB Congeners	32598-14-4	PCB-105	1	1	100.0%	--	2.27E-06	mg/kg	2.27E-06	-	-	YES	NSL; Bkg na/nd
PCB Congeners	74472-37-0	PCB-114	1	0	0.0%	7.98E-08	--	mg/kg	7.98E-08	-	-	NO	IFD
PCB Congeners	31508-00-6	PCB-118	1	1	100.0%	--	6.45E-06	mg/kg	6.45E-06	-	-	YES	NSL; Bkg na/nd
PCB Congeners	65510-44-3	PCB-123	1	0	0.0%	7.73E-08	--	mg/kg	7.73E-08	-	-	NO	IFD
PCB Congeners	57465-28-8	PCB-126	1	0	0.0%	8.04E-08	--	mg/kg	8.04E-08	-	-	NO	IFD
PCB Congeners	38380-08-4	PCB-156	1	1	100.0%	--	1.36E-06	mg/kg	1.36E-06	-	-	YES	NSL; Bkg na/nd
PCB Congeners	52663-72-6	PCB-167	1	1	100.0%	--	5.42E-07	mg/kg	5.42E-07	-	-	YES	NSL; Bkg na/nd
PCB Congeners	32774-16-6	PCB-169	1	0	0.0%	3.98E-08	--	mg/kg	3.98E-08	-	-	NO	IFD
PCB Congeners	39635-31-9	PCB-189	1	1	100.0%	--	1.07E-07	mg/kg	1.07E-07	-	-	YES	NSL; Bkg na/nd

Table E-4. Eelgrass Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	1	1	100.0%	--	6.66E-08	mg/kg	6.66E-08	-	-	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	1	1	100.0%	--	1.28E-07	mg/kg	1.28E-07	-	-	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	37871-00-4	Total HpCDD	1	1	100.0%	--	2.62E-06	mg/kg	2.62E-06	-	-	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	38998-75-3	Total HpCDF	1	1	100.0%	--	3.35E-07	mg/kg	3.35E-07	-	-	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	34465-46-8	Total HxCDD	1	1	100.0%	--	5.20E-08	mg/kg	5.20E-08	-	-	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	55684-94-1	Total HxCDF	1	1	100.0%	--	6.70E-08	mg/kg	6.70E-08	-	-	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	36088-22-9	Total PeCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDD/PCDF Totals	30402-15-4	Total PeCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDD/PCDF Totals	41903-57-5	Total TCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDD/PCDF Totals	55722-27-5	TOTAL TETRA_FURANS	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	35822-46-9	1,2,3,4,6,7,8-HpCDD	1	1	100.0%	--	7.67E-07	mg/kg	7.67E-07	-	-	YES	NSL; Bkg na/nd
PCDDs/PCDFs	67562-39-4	1,2,3,4,6,7,8-HpCDF	1	1	100.0%	--	1.27E-07	mg/kg	1.27E-07	-	-	YES	NSL; Bkg na/nd
PCDDs/PCDFs	55673-89-7	1,2,3,4,7,8,9-HpCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	39227-28-6	1,2,3,4,7,8-HxCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	70648-26-9	1,2,3,4,7,8-HxCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	57653-85-7	1,2,3,6,7,8-HxCDD	1	1	100.0%	--	5.20E-08	mg/kg	5.20E-08	-	-	YES	NSL; Bkg na/nd
PCDDs/PCDFs	57117-44-9	1,2,3,6,7,8-HxCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	19408-74-3	1,2,3,7,8,9-HxCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	72918-21-9	1,2,3,7,8,9-HxCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	40321-76-4	1,2,3,7,8-PeCDD	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	57117-41-6	1,2,3,7,8-PeCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	60851-34-5	2,3,4,6,7,8-HxCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	57117-31-4	2,3,4,7,8-PeCDF	1	0	0.0%	4.95E-08	--	mg/kg	4.95E-08	-	-	NO	IFD
PCDDs/PCDFs	1746-01-6	2,3,7,8-TCDD	1	1	100.0%	--	5.00E-08	mg/kg	5.00E-08	-	-	YES	NSL; Bkg na/nd
PCDDs/PCDFs	51207-31-9	2,3,7,8-TCDF	1	0	0.0%	1.82E-07	--	mg/kg	1.82E-07	-	-	NO	IFD
PCDDs/PCDFs	3268-87-9	OCDD	1	1	100.0%	--	6.60E-06	mg/kg	6.60E-06	-	-	YES	NSL; Bkg na/nd
PCDDs/PCDFs	39001-02-0	OCDF	1	1	100.0%	--	3.24E-07	mg/kg	3.24E-07	-	-	YES	NSL; Bkg na/nd
SVOCs	120-82-1	1,2,4-Trichlorobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	95-95-4	2,4,5-Trichlorophenol	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	88-06-2	2,4,6-Trichlorophenol	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	120-83-2	2,4-Dichlorophenol	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	105-67-9	2,4-Dimethylphenol	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	51-28-5	2,4-Dinitrophenol	1	0	0.0%	19	--	mg/kg	19	-	-	NO	IFD
SVOCs	121-14-2	2,4-Dinitrotoluene	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	606-20-2	2,6-Dinitrotoluene	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	91-58-7	2-Chloronaphthalene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	95-57-8	2-Chlorophenol	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	88-74-4	2-Nitroaniline	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	88-75-5	2-Nitrophenol	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	91-94-1	3,3'-Dichlorobenzidine	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	534-52-1	4,6-Dinitro-2-Methylphenol	1	0	0.0%	19	--	mg/kg	19	-	-	NO	IFD
SVOCs	59-50-7	4-Chloro-3-Methylphenol	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	106-47-8	4-Chloroaniline	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	7005-72-3	4-Chlorophenyl-Phenylether	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	100-01-6	4-Nitroaniline	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	100-02-7	4-Nitrophenol	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	100-51-6	Benzyl Alcohol	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	117-81-7	Bis(2-Ethylhexyl) Phthalate	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	85-68-7	Butyl benzyl phthalate	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	86-74-8	Carbazole	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	132-64-9	Dibenzofuran	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	84-74-2	Dibutyl phthalate	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	84-66-2	Diethyl phthalate	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	131-11-3	Dimethyl phthalate	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	117-84-0	Di-N-Octyl Phthalate	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	118-74-1	Hexachlorobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	87-68-3	Hexachlorobutadiene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	77-47-4	Hexachlorocyclopentadiene	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	78-59-1	Isophorone	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	99-09-2	m-Nitroaniline	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	98-95-3	Nitrobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD

Table E-4. Eelgrass Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
SVOCs	621-64-7	N-Nitrosodi-n-propylamine	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	86-30-6	N-Nitrosodiphenylamine	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	95-48-7	o-Cresol	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	106-44-5	p-Cresol	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
SVOCs	87-86-5	Pentachlorophenol	1	0	0.0%	9.7	--	mg/kg	9.7	-	-	NO	IFD
SVOCs	108-95-2	Phenol	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	95-50-1	1,2-Dichlorobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	541-73-1	1,3-Dichlorobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	106-46-7	1,4-Dichlorobenzene	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	108-60-1	2,2'-Oxybis[1-chloropropane]	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	111-91-1	Bis(2-Chloroethoxy)Methane	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	111-44-4	Bis(2-Chloroethyl)Ether	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD
VOCs	67-72-1	Hexachloroethane	1	0	0.0%	1.9	--	mg/kg	1.9	-	-	NO	IFD

Notes:
(1) Maximum detected concentration or highest detection limit, whichever is greater.
(2) Dungeness Bay.
(3) Screening toxicity value (for marine benthic life) from Table 4-1.
(4) Rationale codes:
- for selection: ASL = above screening level
  ASL; Bkg na = above screening level; background not available.
  log Kow >3.5 = logarithm of octanol-water partition coefficient greater than 3.5.
  NSL; Bkg na/nd = no screening level; background not available/not detected
  NSL; >Bkg = no screening level; greater than background
- for exclusion: BSL = below screening level
  IFD = infrequently (less than 5%) detected
  NSL; <Bkg = no screening level (NSL); less than background
  NUT = essential nutrient

Key:
-- (double dash) = not available or not applicable
CAS = Chemical Abstract Service
IHS = indicator hazardous substance
na = not applicable or not available
ND = not detected
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCDD = polychlorinated dibenzo dioxins
PCDF = polychlorinated dibenzo furans
SVOC = semivolitile organic compound
TEQ = toxic equivalent
VOC = volatile organic compound

Table E-5. Coonstripe Shrimp Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
General Chem	LIPIDS	Lipids	3	3	100.0%	--	0.85	%	0.85	--	--	NO	CON
General Chem	TS	Total Solids	3	3	100.0%	--	23.7	%	23.7	--	--	NO	CON
Metals	7440-38-2	Arsenic	3	3	100.0%	--	8.48	mg/kg	8.48	12.9	0	NO	NSL; <Bkg
Metals	7440-38-2-Inorg	Arsenic, Inorganic	3	3	100.0%	--	0.009	mg/kg	0.009	0.012	0	NO	NSL; <Bkg
Metals	7440-43-9	Cadmium	3	3	100.0%	--	0.04	mg/kg	0.04	0.04	0	NO	NSL; <Bkg
Metals	7440-50-8	Copper	3	3	100.0%	--	5.14	mg/kg	5.14	5.19	0	NO	NSL; <Bkg
Metals	7782-49-2	Selenium	3	0	0.0%	0.2	--	mg/kg	0.2	--	--	NO	IFD
Metals	7440-66-6	Zinc	3	3	100.0%	--	12.6	mg/kg	12.6	11.2	3	YES	NSL; >Bkg
Organometalics	22967-92-6	Methylmercury(1+)	3	3	100.0%	--	0.03	mg/kg	0.03	0.05	0	NO	NSL; <Bkg
Organometalics	78-00-2	Tetraethyl Lead	3	3	100.0%	--	0.007	mg/kg	0.007	0.004	3	YES	NSL; >Bkg
PAH Totals	HPAH	High MW PAHs	3	3	100.0%	--	0.0000047	mg/kg	0.0000047	--	--	YES	NSL; Bkg na/nd
PAH Totals	HPAH0	High MW PAHs ND=0	3	3	100.0%	--	0.0047203	mg/kg	0.0047203	--	--	YES	NSL; Bkg na/nd
PAH Totals	HPAH05	High MW PAHs ND=0.5	3	3	100.0%	--	0.005336	mg/kg	0.005336	--	--	YES	NSL; Bkg na/nd
PAH Totals	LPAH	Low MW PAHs	3	3	100.0%	--	0.0000146	mg/kg	0.0000146	0.0000011	3	YES	NSL; >Bkg
PAH Totals	LPAH0	Low MW PAHs ND=0	3	3	100.0%	--	0.01387	mg/kg	0.01387	0.00105	3	YES	NSL; >Bkg
PAH Totals	LPAH05	Low MW PAHs ND=0.5	3	3	100.0%	--	0.01387	mg/kg	0.01387	0.00121	3	YES	NSL; >Bkg
PAH Totals	TotPAH0	Total PAHs ND=0	3	3	100.0%	--	0.0000485	mg/kg	0.0000485	--	--	YES	NSL; Bkg na/nd
PAH Totals	TotPAH05	Total PAHs ND=0.5	3	3	100.0%	--	0.000281	mg/kg	0.000281	--	--	YES	NSL; Bkg na/nd
PAHs	91-57-6	2-Methylnaphthalene	3	3	100.0%	--	0.0018	mg/kg	0.0018	--	--	YES	NSL; Bkg na/nd
PAHs	83-32-9	Acenaphthene	3	3	100.0%	--	0.0048	mg/kg	0.0048	--	--	YES	NSL; Bkg na/nd
PAHs	208-96-8	Acenaphthylene	3	3	100.0%	--	0.00055	mg/kg	0.00055	--	--	YES	NSL; Bkg na/nd
PAHs	120-12-7	Anthracene	3	3	100.0%	--	0.00032	mg/kg	0.00032	--	--	YES	NSL; Bkg na/nd
PAHs	56-55-3	Benz[a]anthracene	3	1	33.3%	0.00017	0.00043	mg/kg	0.00043	--	--	YES	NSL; Bkg na/nd
PAHs	50-32-8	Benzo(a)pyrene	3	0	0.0%	0.0001	--	mg/kg	0.0001	--	--	NO	IFD
PAHs	205-99-2	Benzo(b)fluoranthene	3	1	33.3%	0.00315	0.00032	mg/kg	0.00315	--	--	YES	NSL; Bkg na/nd
PAHs	191-24-2	Benzo(ghi)perylene	3	0	0.0%	0.0002	--	mg/kg	0.0002	--	--	NO	IFD
PAHs	207-08-9	Benzo(k)fluoranthene	3	0	0.0%	0.00017	--	mg/kg	0.00017	--	--	NO	IFD
PAHs	BnzFluor-bkj	Benzofluoranthenes, Total (b+k+j)	3	1	33.3%	0.000002	0.0000003	mg/kg	0.000002	--	--	YES	NSL; Bkg na/nd
PAHs	218-01-9	Chrysene	3	2	66.7%	0.00017	0.00055	mg/kg	0.00055	--	--	YES	NSL; Bkg na/nd
PAHs	53-70-3	Dibenzo(a,h)anthracene	3	0	0.0%	0.00015	--	mg/kg	0.00015	--	--	NO	IFD
PAHs	206-44-0	Fluoranthene	3	3	100.0%	--	0.0027	mg/kg	0.0027	--	--	YES	NSL; Bkg na/nd
PAHs	193-39-5	Indeno(1,2,3-cd)pyrene	3	0	0.0%	0.00018	--	mg/kg	0.00018	--	--	NO	IFD
PAHs	91-20-3	Naphthalene	3	3	100.0%	--	0.0052	mg/kg	0.0052	0.00078	3	YES	NSL; >Bkg
PAHs	85-01-8	Phenanthrene	3	3	100.0%	--	0.0032	mg/kg	0.0032	0.00031	3	YES	NSL; >Bkg
PAHs	129-00-0	Pyrene	3	3	100.0%	--	0.0017	mg/kg	0.0017	--	--	YES	NSL; Bkg na/nd
PCB Aroclors	53469-21-9	PCB-aroclor 1242	3	0	0.0%	0.0019	--	mg/kg	0.0019	--	--	NO	IFD
PCB Aroclors	11097-69-1	PCB-aroclor 1254	3	0	0.0%	0.0019	--	mg/kg	0.0019	--	--	NO	IFD
PCB Aroclors	11096-82-5	PCB-aroclor 1260	3	3	100.0%	--	0.0069	mg/kg	0.0069	--	--	YES	NSL; Bkg na/nd
PCB Totals	1336-36-3	PCB	3	0	0.0%	0.017	--	mg/kg	0.017	--	--	NO	IFD
PCB Totals	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	3	3	100.0%	--	0.0069	mg/kg	0.0069	--	--	YES	NSL; Bkg na/nd
PCB Totals	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	3	3	100.0%	--	0.0088	mg/kg	0.0088	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	3	3	100.0%	--	1.4E-09	mg/kg	1.4E-09	4.0E-10	2	YES	NSL; >Bkg
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	3	3	100.0%	--	2.4E-07	mg/kg	2.4E-07	3.4E-07	0	NO	NSL; <Bkg
PCDD/PCDF Totals	37871-00-4	Total HpCDD	3	2	66.7%	7.2E-07	1.1E-06	mg/kg	1.1E-06	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	38998-75-3	Total HpCDF	3	0	0.0%	2.3E-07	--	mg/kg	2.3E-07	--	--	NO	IFD
PCDD/PCDF Totals	34465-46-8	Total HxCDD	3	0	0.0%	2.1E-07	--	mg/kg	2.1E-07	--	--	NO	IFD
PCDD/PCDF Totals	55684-94-1	Total HxCDF	3	0	0.0%	1.7E-07	--	mg/kg	1.7E-07	--	--	NO	IFD
PCDD/PCDF Totals	36088-22-9	Total PeCDD	3	0	0.0%	1.8E-07	--	mg/kg	1.8E-07	--	--	NO	IFD
PCDD/PCDF Totals	30402-15-4	Total PeCDF	3	0	0.0%	1.1E-07	--	mg/kg	1.1E-07	--	--	NO	IFD
PCDD/PCDF Totals	41903-57-5	Total TCDD	3	0	0.0%	1.1E-07	--	mg/kg	1.1E-07	--	--	NO	IFD
PCDD/PCDF Totals	30402-14-3	Total TCDF	3	0	0.0%	1.3E-07	--	mg/kg	1.3E-07	--	--	NO	IFD
PCDDs/PCDFs	35822-46-9	1,2,3,4,6,7,8-HpCDD	3	0	0.0%	7.2E-07	--	mg/kg	7.2E-07	--	--	NO	IFD
PCDDs/PCDFs	67562-39-4	1,2,3,4,6,7,8-HpCDF	3	0	0.0%	2.3E-07	--	mg/kg	2.3E-07	--	--	NO	IFD
PCDDs/PCDFs	55673-89-7	1,2,3,4,7,8,9-HpCDF	3	0	0.0%	4.0E-07	--	mg/kg	4.0E-07	--	--	NO	IFD
PCDDs/PCDFs	39227-28-6	1,2,3,4,7,8-HxCDD	3	0	0.0%	1.9E-07	--	mg/kg	1.9E-07	--	--	NO	IFD
PCDDs/PCDFs	70648-26-9	1,2,3,4,7,8-HxCDF	3	0	0.0%	1.7E-07	--	mg/kg	1.7E-07	--	--	NO	IFD
PCDDs/PCDFs	57653-85-7	1,2,3,6,7,8-HxCDD	3	0	0.0%	2.1E-07	--	mg/kg	2.1E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-44-9	1,2,3,6,7,8-HxCDF	3	0	0.0%	1.7E-07	--	mg/kg	1.7E-07	--	--	NO	IFD
PCDDs/PCDFs	19408-74-3	1,2,3,7,8,9-HxCDD	3	0	0.0%	2.0E-07	--	mg/kg	2.0E-07	--	--	NO	IFD
PCDDs/PCDFs	72918-21-9	1,2,3,7,8,9-HxCDF	3	0	0.0%	2.5E-07	--	mg/kg	2.5E-07	--	--	NO	IFD

Table E-5. Coonstripe Shrimp Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PCDDs/PCDFs	40321-76-4	1,2,3,7,8-PeCDD	3	0	0.0%	1.8E-07	--	mg/kg	1.8E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-41-6	1,2,3,7,8-PeCDF	3	0	0.0%	1.2E-07	--	mg/kg	1.2E-07	--	--	NO	IFD
PCDDs/PCDFs	60851-34-5	2,3,4,6,7,8-HxCDF	3	0	0.0%	1.9E-07	--	mg/kg	1.9E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-31-4	2,3,4,7,8-PeCDF	3	0	0.0%	1.1E-07	--	mg/kg	1.1E-07	--	--	NO	IFD
PCDDs/PCDFs	1746-01-6	2,3,7,8-TCDD	3	0	0.0%	1.1E-07	--	mg/kg	1.1E-07	--	--	NO	IFD
PCDDs/PCDFs	51207-31-9	2,3,7,8-TCDF	3	0	0.0%	1.3E-07	--	mg/kg	1.3E-07	--	--	NO	IFD
PCDDs/PCDFs	3268-87-9	OCDD	3	3	100.0%	--	2.7E-06	mg/kg	2.7E-06	1.4E-06	2	YES	NSL; >Bkg
PCDDs/PCDFs	39001-02-0	OCDF	3	2	66.7%	5.2E-07	2.0E-06	mg/kg	2.0E-06	1.1E-06	1	YES	NSL; >Bkg
Pesticides	72-54-8	4,4'-DDD	3	0	0.0%	0.00032	--	mg/kg	0.00032	--	--	NO	IFD
Pesticides	72-55-9	4,4'-DDE	3	0	0.0%	0.00033	--	mg/kg	0.00033	--	--	NO	IFD
Pesticides	50-29-3	4,4'-DDT	3	3	100.0%	--	0.0013	mg/kg	0.0013	--	--	YES	NSL; Bkg na/nd
Pesticides	319-84-6	Alpha-BHC	3	3	100.0%	--	0.00064	mg/kg	0.00064	0.00071	0	NO	NSL; <Bkg
Pesticides	319-85-7	Beta-BHC	3	1	33.3%	0.002	0.006	mg/kg	0.006	--	--	YES	NSL; Bkg na/nd
Pesticides	319-86-8	Delta-BHC	3	0	0.0%	0.00031	--	mg/kg	0.00031	--	--	NO	IFD
Pesticides	58-89-9	Lindane	3	0	0.0%	0.0002	--	mg/kg	0.0002	--	--	NO	IFD
SVOCs	87-86-5	Pentachlorophenol	3	0	0.0%	0.091	--	mg/kg	0.091	--	--	NO	IFD
SVOCs	110-86-1	Pyridine	3	3	100.0%	--	0.28	mg/kg	0.28	0.18	2	YES	NSL; >Bkg

Notes:
(1) Maximum detected concentration or highest detection limit, whichever is greater.
(2) Dungeness Bay.
(3) Screening toxicity value (for marine benthic life) from Table 4-1.
(4) Rationale codes:
- for selection: ASL = above screening level
  ASL; Bkg na = above screening level; background not available.
  CON = conventional parameter used for data interpretation and evaluation.
  log Kow >3.5 = logarithm of octanol-water partition coefficient greater than 3.5.
  NSL; Bkg na/nd = no screening level; background not available/not detected
  NSL; >Bkg = no screening level; greater than background
- for exclusion: BSL = below screening level
  IFD = infrequently (less than 5%) detected
  NSL; <Bkg = no screening level (NSL); less than background
  NUT = essential nutrient

Key:
-- (double dash) = not available or not applicable
CAS = Chemical Abstract Service
IHS = indicator hazardous substance
na = not applicable or not available
ND = not detected
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCDD = polychlorinated dibenzo dioxins
PCDF = polychlorinated dibenzo furans
SVOC = semivolitile organic compound
TEQ = toxic equivalent
VOC = volatile organic compound

Table E-6. Dungeness Crab Hepatopancreas Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
General Chem	LIPIDS	Lipids	3	3	100.0%	--	5.7	%	5.7	--	--	NO	CON
General Chem	TS	Total Solids	3	3	100.0%	--	21.9	%	21.9	--	--	NO	CON
Metals	7440-38-2	Arsenic	3	3	100.0%	--	14.5	mg/kg	14.5	13.2	3	YES	NSL; >Bkg
Metals	7440-38-2-Inorg	Arsenic, Inorganic	3	3	100.0%	--	0.23	mg/kg	0.23	0.65	0	NO	NSL; <Bkg
Metals	7440-43-9	Cadmium	3	3	100.0%	--	3.66	mg/kg	3.66	1.46	3	YES	NSL; >Bkg
Metals	7440-50-8	Copper	3	3	100.0%	--	99.8	mg/kg	99.8	54.9	3	YES	NSL; >Bkg
Metals	7782-49-2	Selenium	3	3	100.0%	--	2.8	mg/kg	2.8	2	3	YES	NSL; >Bkg
Metals	7440-66-6	Zinc	3	3	100.0%	--	25.3	mg/kg	25.3	22.6	2	YES	NSL; >Bkg
Organometalics	22967-92-6	Methylmercury(1+)	3	3	100.0%	--	0.22	mg/kg	0.22	0.1	3	YES	NSL; >Bkg
Organometalics	78-00-2	Tetraethyl Lead	3	3	100.0%	--	0.05	mg/kg	0.05	0.03	3	YES	NSL; >Bkg
PAH Totals	HPAH	High MW PAHs	3	1	33.3%	0.0000004	0.0000057	mg/kg	0.0000057	--	--	YES	NSL; Bkg na/nd
PAH Totals	HPAH0	High MW PAHs ND=0	3	1	33.3%	0	0.0056807	mg/kg	0.0056807	--	--	YES	NSL; Bkg na/nd
PAH Totals	HPAH05	High MW PAHs ND=0.5	3	1	33.3%	0.001026	0.0057307	mg/kg	0.0057307	--	--	YES	NSL; Bkg na/nd
PAH Totals	LPAH	Low MW PAHs	3	3	100.0%	--	0.0000045	mg/kg	0.0000045	0.0000067	0	NO	NSL; <Bkg
PAH Totals	LPAH0	Low MW PAHs ND=0	3	3	100.0%	--	0.00368	mg/kg	0.00368	0.0067	0	NO	NSL; <Bkg
PAH Totals	LPAH05	Low MW PAHs ND=0.5	3	3	100.0%	--	0.00368	mg/kg	0.00368	0.00686	0	NO	NSL; <Bkg
PAH Totals	TotPAH0	Total PAHs ND=0	3	1	33.3%	0	0.0002246	mg/kg	0.0002246	--	--	YES	NSL; Bkg na/nd
PAH Totals	TotPAH05	Total PAHs ND=0.5	3	1	33.3%	0.00009185	0.0002746	mg/kg	0.0002746	--	--	YES	NSL; Bkg na/nd
PAHs	91-57-6	2-Methylnaphthalene	3	0	0.0%	0.00056	--	mg/kg	0.00056	0.00074	0	NO	IFD
PAHs	83-32-9	Acenaphthene	3	2	66.7%	0.00008	0.00049	mg/kg	0.00049	0.00017	2	YES	NSL; >Bkg
PAHs	208-96-8	Acenaphthylene	3	2	66.7%	0.00012	0.00017	mg/kg	0.00017	--	--	YES	NSL; Bkg na/nd
PAHs	120-12-7	Anthracene	3	3	100.0%	--	0.00095	mg/kg	0.00095	0.0017	0	NO	NSL; <Bkg
PAHs	56-55-3	Benz[a]anthracene	3	1	33.3%	0.00017	0.00073	mg/kg	0.00073	--	--	YES	NSL; Bkg na/nd
PAHs	50-32-8	Benzo(a)pyrene	3	0	0.0%	0.0001	--	mg/kg	0.0001	--	--	NO	IFD
PAHs	205-99-2	Benzo(b)fluoranthene	3	1	33.3%	0.00015	0.00038	mg/kg	0.00038	--	--	YES	NSL; Bkg na/nd
PAHs	191-24-2	Benzo(ghi)perylene	3	1	33.3%	0.0002	0.00034	mg/kg	0.00034	--	--	YES	NSL; Bkg na/nd
PAHs	207-08-9	Benzo(k)fluoranthene	3	1	33.3%	0.00017	0.00035	mg/kg	0.00035	--	--	YES	NSL; Bkg na/nd
PAHs	BnzFluor-bkj	Benzofluoranthenes, Total (b+k+j)	3	1	33.3%	0.000002	0.0000007	mg/kg	0.000002	--	--	YES	NSL; Bkg na/nd
PAHs	218-01-9	Chrysene	3	1	33.3%	0.00017	0.00066	mg/kg	0.00066	--	--	YES	NSL; Bkg na/nd
PAHs	53-70-3	Dibenzo(a,h)anthracene	3	1	33.3%	0.00015	0.00039	mg/kg	0.00039	--	--	YES	NSL; Bkg na/nd
PAHs	206-44-0	Fluoranthene	3	1	33.3%	0.00037	0.0013	mg/kg	0.0013	--	--	YES	NSL; Bkg na/nd
PAHs	193-39-5	Indeno(1,2,3-cd)pyrene	3	1	33.3%	0.00018	0.00033	mg/kg	0.00033	--	--	YES	NSL; Bkg na/nd
PAHs	91-20-3	Naphthalene	3	3	100.0%	--	0.00087	mg/kg	0.00087	0.001	0	NO	NSL; <Bkg
PAHs	85-01-8	Phenanthrene	3	3	100.0%	--	0.0012	mg/kg	0.0012	0.0057	0	NO	NSL; <Bkg
PAHs	129-00-0	Pyrene	3	1	33.3%	0.00039	0.0012	mg/kg	0.0012	--	--	YES	NSL; Bkg na/nd
PCB Aroclors	53469-21-9	PCB-aroclor 1242	3	0	0.0%	0.0038	--	mg/kg	0.0038	--	--	NO	IFD
PCB Aroclors	11097-69-1	PCB-aroclor 1254	3	3	100.0%	--	0.23	mg/kg	0.23	0.011	3	YES	NSL; >Bkg
PCB Aroclors	11096-82-5	PCB-aroclor 1260	3	3	100.0%	--	0.73	mg/kg	0.73	0.017	3	YES	NSL; >Bkg
PC B Congeners	32598-13-3	PCB-077	8	8	100.0%	--	6.66E-04	mg/kg	6.66E-04	4.37E-05	8	YES	NSL; >Bkg
PC B Congeners	70362-50-4	PCB-081	8	6	75.0%	2.74E-05	4.86E-05	mg/kg	4.86E-05	1.01E-06	6	YES	NSL; >Bkg
PC B Congeners	32598-14-4	PCB-105	8	8	100.0%	--	2.89E-02	mg/kg	2.89E-02	6.82E-04	8	YES	NSL; >Bkg
PC B Congeners	74472-37-0	PCB-114	8	8	100.0%	--	2.96E-03	mg/kg	2.96E-03	3.75E-05	8	YES	NSL; >Bkg
PC B Congeners	31508-00-6	PCB-118	8	8	100.0%	--	8.32E-02	mg/kg	8.32E-02	1.60E-03	8	YES	NSL; >Bkg
PC B Congeners	65510-44-3	PCB-123	8	8	100.0%	--	9.37E-04	mg/kg	9.37E-04	3.20E-05	8	YES	NSL; >Bkg
PC B Congeners	57465-28-8	PCB-126	8	8	100.0%	--	4.39E-04	mg/kg	4.39E-04	6.80E-06	8	YES	NSL; >Bkg
PC B Congeners	38380-08-4/69782-90-7	PCB-156/157	8	8	100.0%	--	5.28E-02	mg/kg	5.28E-02	2.65E-04	8	YES	NSL; >Bkg
PC B Congeners	52663-72-6	PCB-167	8	8	100.0%	--	2.82E-02	mg/kg	2.82E-02	1.46E-04	8	YES	NSL; >Bkg
PC B Congeners	32774-16-6	PCB-169	8	1	12.5%	4.85E-05	1.52E-03	mg/kg	1.52E-03	2.66E-06	1	YES	NSL; >Bkg
PC B Congeners	39635-31-9	PCB-189	8	8	100.0%	--	1.76E-02	mg/kg	1.76E-02	3.39E-05	8	YES	NSL; >Bkg
PC B Congeners	PCB TEQ ND0	PCB Congeners, mammalian TEQ (ND=0)	8	8	100.0%	--	9.09E-05	mg/kg	9.09E-05	7.46E-07	8	YES	NSL; >Bkg
PC B Congeners	PCB TEQ ND05	PCB Congeners, mammalian TEQ (ND=0.5)	8	8	100.0%	--	9.09E-05	mg/kg	9.09E-05	7.92E-07	8	YES	NSL; >Bkg
PC B Congeners	PCB TEQ ND0 avian	PCB Congeners, avian TEQ (ND=0)	8	8	100.0%	--	8.34E-05	mg/kg	8.34E-05	2.28E-06	8	YES	NSL; >Bkg
PC B Congeners	PCB TEQ ND05 avian	PCB Congeners, avian TEQ (ND=0.5)	8	8	100.0%	--	8.48E-05	mg/kg	8.48E-05	2.72E-06	8	YES	NSL; >Bkg
PCB Totals	1336-36-3	PCB	3	3	100.0%	--	0.96	mg/kg	0.96	0.033	3	YES	NSL; >Bkg
PCB Totals	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	3	3	100.0%	--	0.96	mg/kg	0.96	0.028	3	YES	NSL; >Bkg
PCB Totals	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	3	3	100.0%	--	0.960095	mg/kg	0.960095	0.02895	3	YES	NSL; >Bkg
PCB Totals	PCB-Tot-Cong	PCB, Sum of Congeners	8	8	100.0%	--	5.79952	mg/kg	5.79952	0.04945	8	YES	NSL; >Bkg
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	11	11	100.0%	--	3.8E-05	mg/kg	3.8E-05	1.2E-06	9	YES	NSL; >Bkg
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	11	11	100.0%	--	3.8E-05	mg/kg	3.8E-05	1.2E-06	9	YES	NSL; >Bkg
PCDD/PCDF Totals	37871-00-4	Total HpCDD	3	3	100.0%	--	5.9E-06	mg/kg	5.9E-06	1.2E-06	2	YES	NSL; >Bkg
PCDD/PCDF Totals	38998-75-3	Total HpCDF	3	2	66.7%	1.6E-07	8.8E-07	mg/kg	8.8E-07	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	34465-46-8	Total HxCDD	3	2	66.7%	1.7E-07	8.3E-06	mg/kg	8.3E-06	1.8E-06	2	YES	NSL; >Bkg
PCDD/PCDF Totals	55684-94-1	Total HxCDF	3	2	66.7%	9.0E-08	6.1E-06	mg/kg	6.1E-06	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	36088-22-9	Total PeCDD	3	1	33.3%	1.2E-07	3.5E-06	mg/kg	3.5E-06	3.4E-07	1	YES	NSL; >Bkg
PCDD/PCDF Totals	30402-15-4	Total PeCDF	3	3	100.0%	--	1.7E-05	mg/kg	1.7E-05	1.2E-06	3	YES	NSL; >Bkg

Table E-6. Dungeness Crab Hepatopancreas Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PCDD/PCDF Totals	41903-57-5	Total TCDD	3	1	33.3%	7.0E-08	1.7E-06	mg/kg	1.7E-06	5.9E-07	1	YES	NSL; >Bkg
PCDD/PCDF Totals	30402-14-3	Total TCDF	3	3	100.0%	--	1.6E-05	mg/kg	1.6E-05	3.0E-06	2	YES	NSL; >Bkg
PCDDs/PCDFs	35822-46-9	1,2,3,4,6,7,8-HpCDD	3	3	100.0%	--	2.8E-06	mg/kg	2.8E-06	7.6E-07	2	YES	NSL; >Bkg
PCDDs/PCDFs	67562-39-4	1,2,3,4,6,7,8-HpCDF	3	2	66.7%	1.6E-07	8.8E-07	mg/kg	8.8E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	55673-89-7	1,2,3,4,7,8,9-HpCDF	3	0	0.0%	3.7E-07	--	mg/kg	3.7E-07	--	--	NO	IFD
PCDDs/PCDFs	39227-28-6	1,2,3,4,7,8-HxCDD	3	1	33.3%	1.6E-07	5.3E-07	mg/kg	5.3E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	70648-26-9	1,2,3,4,7,8-HxCDF	3	1	33.3%	1.9E-07	7.6E-07	mg/kg	7.6E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	57653-85-7	1,2,3,6,7,8-HxCDD	3	3	100.0%	--	2.7E-06	mg/kg	2.7E-06	6.8E-07	3	YES	NSL; >Bkg
PCDDs/PCDFs	57117-44-9	1,2,3,6,7,8-HxCDF	3	1	33.3%	1.9E-07	3.7E-07	mg/kg	3.7E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	19408-74-3	1,2,3,7,8,9-HxCDD	3	1	33.3%	1.6E-07	6.3E-07	mg/kg	6.3E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	72918-21-9	1,2,3,7,8,9-HxCDF	3	0	0.0%	3.3E-07	--	mg/kg	3.3E-07	--	--	NO	IFD
PCDDs/PCDFs	40321-76-4	1,2,3,7,8-PeCDD	3	1	33.3%	1.2E-07	1.2E-06	mg/kg	1.2E-06	3.4E-07	1	YES	NSL; >Bkg
PCDDs/PCDFs	57117-41-6	1,2,3,7,8-PeCDF	3	1	33.3%	1.4E-07	7.2E-07	mg/kg	7.2E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	60851-34-5	2,3,4,6,7,8-HxCDF	3	0	0.0%	2.2E-07	--	mg/kg	2.2E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-31-4	2,3,4,7,8-PeCDF	3	2	66.7%	1.3E-07	2.0E-06	mg/kg	2.0E-06	3.6E-07	1	YES	NSL; >Bkg
PCDDs/PCDFs	1746-01-6	2,3,7,8-TCDD	3	1	33.3%	7.0E-08	5.0E-07	mg/kg	5.0E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	51207-31-9	2,3,7,8-TCDF	3	2	66.7%	3.0E-07	1.9E-06	mg/kg	1.9E-06	6.9E-07	2	YES	NSL; >Bkg
PCDDs/PCDFs	3268-87-9	OCDD	3	0	0.0%	9.4E-07	--	mg/kg	9.4E-07	1.3E-06	0	NO	IFD
PCDDs/PCDFs	39001-02-0	OCDF	3	0	0.0%	1.1E-06	--	mg/kg	1.1E-06	--	--	NO	IFD
Pesticides	72-54-8	4,4'-DDD	3	0	0.0%	0.001	--	mg/kg	0.001	--	--	NO	IFD
Pesticides	72-55-9	4,4'-DDE	3	3	100.0%	--	0.013	mg/kg	0.013	0.014	0	NO	NSL; <Bkg
Pesticides	50-29-3	4,4'-DDT	3	3	100.0%	--	0.11	mg/kg	0.11	0.0049	3	YES	NSL; >Bkg
Pesticides	319-84-6	Alpha-BHC	3	3	100.0%	--	0.002	mg/kg	0.002	0.0018	1	YES	NSL; >Bkg
Pesticides	319-85-7	Beta-BHC	3	3	100.0%	--	0.0021	mg/kg	0.0021	0.0034	0	NO	NSL; <Bkg
Pesticides	319-86-8	Delta-BHC	3	1	33.3%	0.00035	0.00082	mg/kg	0.00082	0.00062	1	YES	NSL; >Bkg
Pesticides	58-89-9	Lindane	3	0	0.0%	0.00029	--	mg/kg	0.00029	0.0025	0	NO	IFD
SVOCs	87-86-5	Pentachlorophenol	3	0	0.0%	0.091	--	mg/kg	0.091	--	--	NO	IFD
SVOCs	110-86-1	Pyridine	3	0	0.0%	0.018	--	mg/kg	0.018	--	--	NO	IFD

Notes: (1) Maximum detected concentration or highest detection limit, whichever is greater.
(2) Dungeness Bay.
(3) Screening toxicity value (for marine benthic life) from Table 4-1.
(4) Rationale codes:
- for selection: ASL = above screening level
ASL; Bkg na = above screening level; background not available.
CON = conventional parameter used for data interpretation and evaluation.
log Kow >3.5 = logarithm of octanol-water partition coefficient greater than 3.5.
NSL; Bkg na/nd = no screening level; background not available/not detected
NSL; >Bkg = no screening level; greater than background
- for exclusion: BSL = below screening level
IFD = infrequently (less than 5%) detected
NSL; <Bkg = no screening level (NSL); less than background
NUT = essential nutrient

Key: -- (double dash) = not available or not applicable
CAS = Chemical Abstract Service
IHS = indicator hazardous substance
na = not applicable or not available
ND = not detected
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCDD = polychlorinated dibenzo dioxins
PCDF = polychlorinated dibenzo furans
SVOC = semivolitile organic compound
TEQ = toxic equivalent
VOC = volatile organic compound

Table E-7. Dungeness Crab Muscle Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
General Chem	LIPIDS	Lipids	3	3	100.0%	--	0.81	%	0.81	--	--	NO	CON
General Chem	TS	Total Solids	3	3	100.0%	--	20.2	%	20.2	--	--	NO	CON
Metals	7440-38-2	Arsenic	3	3	100.0%	--	12.8	mg/kg	12.8	10.4	3	YES	NSL; >Bkg
Metals	7440-38-2-Inorg	Arsenic, Inorganic	3	2	66.7%	0.004	0.011	mg/kg	0.011	0.01	1	YES	NSL; >Bkg
Metals	7440-43-9	Cadmium	3	3	100.0%	--	0.015	mg/kg	0.015	0.013	3	YES	NSL; >Bkg
Metals	7440-50-8	Copper	3	3	100.0%	--	5.64	mg/kg	5.64	5.09	2	YES	NSL; >Bkg
Metals	7782-49-2	Selenium	3	3	100.0%	--	0.9	mg/kg	0.9	0.7	2	YES	NSL; >Bkg
Metals	7440-66-6	Zinc	3	3	100.0%	--	50.2	mg/kg	50.2	41.7	3	YES	NSL; >Bkg
Organometalics	22967-92-6	Methylmercury(1+)	3	3	100.0%	--	0.11	mg/kg	0.11	0.09	2	YES	NSL; >Bkg
Organometalics	78-00-2	Tetraethyl Lead	3	3	100.0%	--	0.006	mg/kg	0.006	0.007	0	NO	NSL; <Bkg
PAH Totals	HPAH	High MW PAHs	3	0	0.0%	0.0000004	--	mg/kg	0.0000004	--	--	NO	IFD
PAH Totals	HPAH0	High MW PAHs ND=0	3	0	0.0%	0	--	mg/kg	0	--	--	NO	IFD
PAH Totals	HPAH05	High MW PAHs ND=0.5	3	0	0.0%	0.0010251	--	mg/kg	0.0010251	--	--	NO	IFD
PAH Totals	LPAH	Low MW PAHs	3	2	66.7%	0.0000006	0.0000002	mg/kg	0.0000006	0.0000002	0	YES	NSL; >Bkg
PAH Totals	LPAH0	Low MW PAHs ND=0	3	2	66.7%	0	0.00024	mg/kg	0.00024	0.0002	2	YES	NSL; >Bkg
PAH Totals	LPAH05	Low MW PAHs ND=0.5	3	2	66.7%	0.00053	0.000675	mg/kg	0.000675	0.000635	2	YES	NSL; >Bkg
PAH Totals	TotPAH0	Total PAHs ND=0	3	0	0.0%	0	--	mg/kg	0	--	--	NO	IFD
PAH Totals	TotPAH05	Total PAHs ND=0.5	3	0	0.0%	0.00009185	--	mg/kg	0.00009185	--	--	NO	IFD
PAHs	91-57-6	2-Methylnaphthalene	3	0	0.0%	0.00056	--	mg/kg	0.00056	--	--	NO	IFD
PAHs	83-32-9	Acenaphthene	3	0	0.0%	0.00008	--	mg/kg	0.00008	--	--	NO	IFD
PAHs	208-96-8	Acenaphthylene	3	0	0.0%	0.00012	--	mg/kg	0.00012	--	--	NO	IFD
PAHs	120-12-7	Anthracene	3	0	0.0%	0.00012	--	mg/kg	0.00012	--	--	NO	IFD
PAHs	56-55-3	Benz[a]anthracene	3	0	0.0%	0.00017	--	mg/kg	0.00017	--	--	NO	IFD
PAHs	50-32-8	Benzo(a)pyrene	3	0	0.0%	0.0001	--	mg/kg	0.0001	--	--	NO	IFD
PAHs	205-99-2	Benzo(b)fluoranthene	3	0	0.0%	0.00015	--	mg/kg	0.00015	--	--	NO	IFD
PAHs	191-24-2	Benzo(ghi)perylene	3	0	0.0%	0.0002	--	mg/kg	0.0002	--	--	NO	IFD
PAHs	207-08-9	Benzo(k)fluoranthene	3	0	0.0%	0.00017	--	mg/kg	0.00017	--	--	NO	IFD
PAHs	BnzFluor-bkj	Benzofluoranthenes, Total (b+k+j)	3	0	0.0%	0.0000002	--	mg/kg	0.0000002	--	--	NO	IFD
PAHs	218-01-9	Chrysene	3	0	0.0%	0.00017	--	mg/kg	0.00017	--	--	NO	IFD
PAHs	53-70-3	Dibenzo(a,h)anthracene	3	0	0.0%	0.00015	--	mg/kg	0.00015	--	--	NO	IFD
PAHs	206-44-0	Fluoranthene	3	0	0.0%	0.00037	--	mg/kg	0.00037	--	--	NO	IFD
PAHs	193-39-5	Indeno(1,2,3-cd)pyrene	3	0	0.0%	0.00018	--	mg/kg	0.00018	--	--	NO	IFD
PAHs	91-20-3	Naphthalene	3	0	0.0%	0.00055	--	mg/kg	0.00055	--	--	NO	IFD
PAHs	85-01-8	Phenanthrene	3	2	66.7%	0.00019	0.00024	mg/kg	0.00024	0.0002	2	YES	NSL; >Bkg
PAHs	129-00-0	Pyrene	3	0	0.0%	0.00039	--	mg/kg	0.00039	--	--	NO	IFD
PCB Aroclors	53469-21-9	PCB-aroclor 1242	3	0	0.0%	0.0019	--	mg/kg	0.0019	--	--	NO	IFD
PCB Aroclors	11097-69-1	PCB-aroclor 1254	3	3	100.0%	--	0.015	mg/kg	0.015	0.013	1	YES	NSL; >Bkg
PCB Aroclors	11096-82-5	PCB-aroclor 1260	3	3	100.0%	--	0.035	mg/kg	0.035	0.014	1	YES	NSL; >Bkg
PC B Congeners	32598-13-3	PCB-077	8	8	100.0%	--	2.10E-05	mg/kg	2.10E-05	2.77E-06	8	YES	NSL; >Bkg
PC B Congeners	70362-50-4	PCB-081	8	8	100.0%	--	9.87E-07	mg/kg	9.87E-07	1.81E-07	8	YES	NSL; >Bkg
PC B Congeners	32598-14-4	PCB-105	8	8	100.0%	--	6.70E-04	mg/kg	6.70E-04	4.26E-05	8	YES	NSL; >Bkg
PC B Congeners	74472-37-0	PCB-114	8	8	100.0%	--	5.97E-05	mg/kg	5.97E-05	2.18E-06	8	YES	NSL; >Bkg
PC B Congeners	31508-00-6	PCB-118	8	8	100.0%	--	2.06E-03	mg/kg	2.06E-03	1.08E-04	8	YES	NSL; >Bkg
PC B Congeners	65510-44-3	PCB-123	8	8	100.0%	--	1.92E-05	mg/kg	1.92E-05	1.51E-06	8	YES	NSL; >Bkg
PC B Congeners	57465-28-8	PCB-126	8	8	100.0%	--	6.09E-06	mg/kg	6.09E-06	3.17E-07	8	YES	NSL; >Bkg
PC B Congeners	38380-08-4/69782-90-7	PCB-156/157	8	8	100.0%	--	1.10E-03	mg/kg	1.10E-03	1.29E-05	8	YES	NSL; >Bkg
PC B Congeners	52663-72-6	PCB-167	8	8	100.0%	--	4.73E-04	mg/kg	4.73E-04	5.88E-06	8	YES	NSL; >Bkg
PC B Congeners	32774-16-6	PCB-169	8	0	0.0%	1.18E-06	--	mg/kg	1.18E-06	4.32E-07	--	NO	IFD
PC B Congeners	39635-31-9	PCB-189	8	8	100.0%	--	2.58E-04	mg/kg	2.58E-04	9.23E-07	8	YES	NSL; >Bkg
PC B Congeners	PCB TEQ ND0	PCB Congeners, mammalian TEQ (ND=0)	8	8	100.0%	--	7.51E-07	mg/kg	7.51E-07	4.80E-08	8	YES	NSL; >Bkg
PC B Congeners	PCB TEQ ND05	PCB Congeners, mammalian TEQ (ND=0.5)	8	8	100.0%	--	7.68E-07	mg/kg	7.68E-07	4.80E-08	8	YES	NSL; >Bkg
PC B Congeners	PCB TEQ ND0 avian	PCB Congeners, avian TEQ (ND=0)	8	8	100.0%	--	1.97E-06	mg/kg	1.97E-06	1.88E-07	8	YES	NSL; >Bkg
PC B Congeners	PCB TEQ ND05 avian	PCB Congeners, avian TEQ (ND=0.5)	8	8	100.0%	--	1.97E-06	mg/kg	1.97E-06	1.88E-07	8	YES	NSL; >Bkg
PCB Totals	1336-36-3	PCB	3	1	33.3%	0.017	0.05	mg/kg	0.05	0.028	1	YES	NSL; >Bkg
PCB Totals	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	3	3	100.0%	--	0.05	mg/kg	0.05	0.027	1	YES	NSL; >Bkg
PCB Totals	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	3	3	100.0%	--	0.05095	mg/kg	0.05095	0.02795	1	YES	NSL; >Bkg
PCB Totals	PCB-Tot-Cong	PCB, Sum of Congeners	8	8	100.0%	--	0.17881	mg/kg	0.17881	0.00192	8	YES	NSL; >Bkg

Table E-7. Dungeness Crab Muscle Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	11	8	72.7%	0	6.50E-07	mg/kg	6.50E-07	2.00E-08	8	YES	NSL; >Bkg
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	11	8	72.7%	2.96E-07	6.56E-07	mg/kg	6.56E-07	1.78E-08	8	YES	NSL; >Bkg
PCDD/PCDF Totals	37871-00-4	Total HpCDD	3	0	0.0%	2.70E-07	--	mg/kg	2.70E-07	--	--	NO	IFD
PCDD/PCDF Totals	38998-75-3	Total HpCDF	3	0	0.0%	1.90E-07	--	mg/kg	1.90E-07	--	--	NO	IFD
PCDD/PCDF Totals	34465-46-8	Total HxCDD	3	0	0.0%	2.10E-07	--	mg/kg	2.10E-07	--	--	NO	IFD
PCDD/PCDF Totals	55684-94-1	Total HxCDF	3	0	0.0%	1.20E-07	--	mg/kg	1.20E-07	--	--	NO	IFD
PCDD/PCDF Totals	36088-22-9	Total PeCDD	3	0	0.0%	2.00E-07	--	mg/kg	2.00E-07	--	--	NO	IFD
PCDD/PCDF Totals	30402-15-4	Total PeCDF	3	0	0.0%	1.30E-07	--	mg/kg	1.30E-07	--	--	NO	IFD
PCDD/PCDF Totals	41903-57-5	Total TCDD	3	0	0.0%	2.10E-07	--	mg/kg	2.10E-07	--	--	NO	IFD
PCDD/PCDF Totals	30402-14-3	Total TCDF	3	0	0.0%	1.70E-07	--	mg/kg	1.70E-07	--	--	NO	IFD
PCDDs/PCDFs	35822-46-9	1,2,3,4,6,7,8-HpCDD	3	0	0.0%	2.70E-07	--	mg/kg	2.70E-07	--	--	NO	IFD
PCDDs/PCDFs	67562-39-4	1,2,3,4,6,7,8-HpCDF	3	0	0.0%	1.90E-07	--	mg/kg	1.90E-07	--	--	NO	IFD
PCDDs/PCDFs	55673-89-7	1,2,3,4,7,8,9-HpCDF	3	0	0.0%	3.00E-07	--	mg/kg	3.00E-07	--	--	NO	IFD
PCDDs/PCDFs	39227-28-6	1,2,3,4,7,8-HxCDD	3	0	0.0%	1.90E-07	--	mg/kg	1.90E-07	--	--	NO	IFD
PCDDs/PCDFs	70648-26-9	1,2,3,4,7,8-HxCDF	3	0	0.0%	1.20E-07	--	mg/kg	1.20E-07	--	--	NO	IFD
PCDDs/PCDFs	57653-85-7	1,2,3,6,7,8-HxCDD	3	0	0.0%	2.10E-07	--	mg/kg	2.10E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-44-9	1,2,3,6,7,8-HxCDF	3	0	0.0%	1.20E-07	--	mg/kg	1.20E-07	--	--	NO	IFD
PCDDs/PCDFs	19408-74-3	1,2,3,7,8,9-HxCDD	3	0	0.0%	1.90E-07	--	mg/kg	1.90E-07	--	--	NO	IFD
PCDDs/PCDFs	72918-21-9	1,2,3,7,8,9-HxCDF	3	0	0.0%	1.70E-07	--	mg/kg	1.70E-07	--	--	NO	IFD
PCDDs/PCDFs	40321-76-4	1,2,3,7,8-PeCDD	3	0	0.0%	2.00E-07	--	mg/kg	2.00E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-41-6	1,2,3,7,8-PeCDF	3	0	0.0%	1.60E-07	--	mg/kg	1.60E-07	--	--	NO	IFD
PCDDs/PCDFs	60851-34-5	2,3,4,6,7,8-HxCDF	3	0	0.0%	1.40E-07	--	mg/kg	1.40E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-31-4	2,3,4,7,8-PeCDF	3	0	0.0%	1.30E-07	--	mg/kg	1.30E-07	--	--	NO	IFD
PCDDs/PCDFs	1746-01-6	2,3,7,8-TCDD	3	0	0.0%	2.10E-07	--	mg/kg	2.10E-07	--	--	NO	IFD
PCDDs/PCDFs	51207-31-9	2,3,7,8-TCDF	3	0	0.0%	1.70E-07	--	mg/kg	1.70E-07	--	--	NO	IFD
PCDDs/PCDFs	3268-87-9	OCDD	3	0	0.0%	3.80E-07	--	mg/kg	3.80E-07	--	--	NO	IFD
PCDDs/PCDFs	39001-02-0	OCDF	3	0	0.0%	5.50E-07	--	mg/kg	5.50E-07	--	--	NO	IFD
Pesticides	72-54-8	4,4'-DDD	3	0	0.0%	0.00032	--	mg/kg	0.00032	--	--	NO	IFD
Pesticides	72-55-9	4,4'-DDE	3	2	66.7%	0.00033	0.0008	mg/kg	0.0008	0.014	0	NO	NSL; <Bkg
Pesticides	50-29-3	4,4'-DDT	3	1	33.3%	0.001	0.0047	mg/kg	0.0047	0.005	0	NO	NSL; <Bkg
Pesticides	319-84-6	Alpha-BHC	3	0	0.0%	0.00028	--	mg/kg	0.00028	0.0016	0	NO	IFD
Pesticides	319-85-7	Beta-BHC	3	0	0.0%	0.00036	--	mg/kg	0.00036	0.0037	0	NO	IFD
Pesticides	319-86-8	Delta-BHC	3	2	66.7%	0.0016	0.001	mg/kg	0.0016	--	--	YES	NSL; Bkg na/nd
Pesticides	58-89-9	Lindane	3	2	66.7%	0.001	0.001	mg/kg	0.001	0.0017	0	NO	NSL; <Bkg
SVOCs	87-86-5	Pentachlorophenol	3	0	0.0%	0.091	--	mg/kg	0.091	--	--	NO	IFD
SVOCs	110-86-1	Pyridine	3	0	0.0%	0.018	--	mg/kg	0.018	--	--	NO	IFD

Notes: (1) Maximum detected concentration or highest detection limit, whichever is greater.
(2) Dungeness Bay.
(3) Screening toxicity value (for marine benthic life) from Table 4-1.
(4) Rationale codes:
- for selection: ASL = above screening level
ASL; Bkg na = above screening level; background not available.
CON = conventional parameter used for data interpretation and evaluation.
log Kow >3.5 = logarithm of octanol-water partition coefficient greater than 3.5.
NSL; Bkg na/nd = no screening level; background not available/not detected
NSL; >Bkg = no screening level; greater than background
- for exclusion: BSL = below screening level
IFD = infrequently (less than 5%) detected
NSL; <Bkg = no screening level (NSL); less than background
NUT = essential nutrient

Key: -- (double dash) = not available or not applicable
CAS = Chemical Abstract Service
IHS = indicator hazardous substance
na = not applicable or not available
ND = not detected
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCDD = polychlorinated dibenzo dioxins
PCDF = polychlorinated dibenzo furans
SVOC = semivolitile organic compound
TEQ = toxic equivalent
VOC = volatile organic compound

Table E-8. Geoduck (Whole Organism without Shell) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
General Chem	LIPIDS	Lipids	4	4	100.0%	--	0.94	%	0.94	--	--	NO	CON
General Chem	TS	Total Solids	3	3	100.0%	--	22.5	%	22.5	--	--	NO	CON
Metals	7429-90-5	Aluminum	3	3	100.0%	--	92.3	mg/kg	92.3	--	--	NO	NAB
Metals	7440-36-0	Antimony	5	1	20.0%	0.05	0.0077	mg/kg	0.05	--	--	YES	NSL; Bkg na/nd
Metals	7440-38-2	Arsenic	7	7	100.0%	--	5.25	mg/kg	5.25	4.21	3	YES	NSL; >Bkg
Metals	7440-38-2-Inorg	Arsenic, Inorganic	3	3	100.0%	--	1.41	mg/kg	1.41	0.4	3	YES	NSL; >Bkg
Metals	7440-39-3	Barium	4	4	100.0%	--	0.682	mg/kg	0.682	0.996	0	NO	NSL; <Bkg
Metals	7440-41-7	Beryllium	3	1	33.3%	0.004	0.0056	mg/kg	0.0056	--	--	YES	NSL; Bkg na/nd
Metals	7440-43-9	Cadmium	7	7	100.0%	--	0.48	mg/kg	0.48	0.3	3	YES	NSL; >Bkg
Metals	7440-70-2	Calcium	3	3	100.0%	--	1500	mg/kg	1500	--	--	NO	NUT
Metals	7440-47-3	Chromium	4	4	100.0%	--	0.49	mg/kg	0.49	0.43	2	YES	NSL; >Bkg
Metals	7440-48-4	Cobalt	3	3	100.0%	--	0.553	mg/kg	0.553	--	--	YES	NSL; Bkg na/nd
Metals	7440-50-8	Copper	7	7	100.0%	--	7.43	mg/kg	7.43	2.6	5	YES	NSL; >Bkg
Metals	7439-89-6	Iron	3	3	100.0%	--	911	mg/kg	911	--	--	NO	NUT
Metals	7439-92-1	Lead	4	4	100.0%	--	1.05	mg/kg	1.05	1.04	1	YES	NSL; >Bkg
Metals	7439-95-4	Magnesium	3	3	100.0%	--	714	mg/kg	714	--	--	NO	NUT
Metals	7439-96-5	Manganese	3	3	100.0%	--	29.9	mg/kg	29.9	--	--	YES	NSL; Bkg na/nd
Metals	7439-97-6	Mercury	4	3	75.0%	0.05	0.082	mg/kg	0.082	--	--	YES	NSL; Bkg na/nd
Metals	7440-02-0	Nickel	5	5	100.0%	--	0.86	mg/kg	0.86	--	--	YES	NSL; Bkg na/nd
Metals	7440-09-7	Potassium	3	3	100.0%	--	2820	mg/kg	2820	--	--	NO	NUT
Metals	7782-49-2	Selenium	6	6	100.0%	--	0.824	mg/kg	0.824	0.943	0	NO	NSL; <Bkg
Metals	7440-22-4	Silver	4	4	100.0%	--	0.94	mg/kg	0.94	0.739	1	YES	NSL; >Bkg
Metals	7440-23-5	Sodium	3	3	100.0%	--	4210	mg/kg	4210	--	--	NO	NUT
Metals	7440-62-2	Vanadium	3	3	100.0%	--	1.58	mg/kg	1.58	--	--	YES	NSL; Bkg na/nd
Metals	7440-66-6	Zinc	7	7	100.0%	--	24.2	mg/kg	24.2	54.1	0	NO	NSL; <Bkg
Organic Acids	65-85-0	Benzoic Acid	4	0	0.0%	4.9	--	mg/kg	4.9	--	--	NO	IFD
Organometalics	22967-92-6	Methylmercury(1+)	3	3	100.0%	--	0.04	mg/kg	0.04	0.03	1	YES	NSL; >Bkg
Organometalics	78-00-2	Tetraethyl Lead	3	3	100.0%	--	0.99	mg/kg	0.99	0.29	3	YES	NSL; >Bkg
PAH Totals	HPAH0	High MW PAHs ND=0	4	3	75.0%	7.30E-04	7.65E-03	mg/kg	7.65E-03	2.45E-03	3	YES	NSL; >Bkg
PAH Totals	HPAH05	High MW PAHs ND=0.5	4	3	75.0%	1.57E-03	7.73E-03	mg/kg	7.73E-03	2.84E-03	3	YES	NSL; >Bkg
PAH Totals	LPAH0	Low MW PAHs ND=0	4	4	100.0%	--	0.0024	mg/kg	0.0040	0.0018	2	YES	NSL; >Bkg
PAH Totals	LPAH05	Low MW PAHs ND=0.5	4	4	100.0%	--	0.0031	mg/kg	0.0043	0.0022	2	YES	NSL; >Bkg
PAHs	832-69-9	1-Methylphenanthrene	1	0	0.0%	7.22E-04	--	mg/kg	7.22E-04	--	--	NO	IFD
PAHs	2245-38-7	2,3,5-Trimethylnaphthalene	1	0	0.0%	9.94E-05	--	mg/kg	9.94E-05	--	--	NO	IFD
PAHs	581-42-0	2,6-Dimethylnaphthalene	1	0	0.0%	2.52E-04	--	mg/kg	2.52E-04	1.36E-04	0	NO	IFD
PAHs	91-57-6	2-Methylnaphthalene	4	0	0.0%	5.60E-04	--	mg/kg	5.60E-04	5.70E-04	0	NO	IFD
PAHs	83-32-9	Acenaphthene	4	3	75.0%	8.00E-05	2.30E-04	mg/kg	2.30E-04	2.40E-04	0	NO	NSL; <Bkg
PAHs	208-96-8	Acenaphthylene	4	2	50.0%	5.00E-01	0.000227	mg/kg	5.00E-01	--	--	YES	NSL; Bkg na/nd
PAHs	120-12-7	Anthracene	4	1	25.0%	1.60E-01	2.10E-04	mg/kg	1.60E-01	3.00E-04	1	YES	NSL; >Bkg
PAHs	56-55-3	Benz(a)anthracene	4	2	50.0%	1.70E-04	1.30E-03	mg/kg	1.30E-03	4.90E-04	2	YES	NSL; >Bkg
PAHs	50-32-8	Benzo(a)pyrene	4	3	75.0%	4.90E-01	4.60E-04	mg/kg	4.90E-01	1.00E-04	2	YES	NSL; >Bkg
PAHs	205-99-2	Benzo(b)fluoranthene	4	3	75.0%	1.50E-04	9.10E-04	mg/kg	9.10E-04	1.07E-04	3	YES	NSL; >Bkg
PAHs	192-97-2	Benzo(e)pyrene	1	1	100.0%	--	6.77E-04	mg/kg	6.77E-04	--	--	YES	NSL; Bkg na/nd
PAHs	191-24-2	Benzo(ghi)perylene	4	3	75.0%	4.90E-01	3.40E-04	mg/kg	4.90E-01	--	--	YES	NSL; Bkg na/nd
PAHs	207-08-9	Benzo(k)fluoranthene	3	1	33.3%	1.70E-04	3.20E-04	mg/kg	3.20E-04	--	--	YES	NSL; Bkg na/nd
PAHs	BnzFluor-bkj	Benzofluoranthenes, Total (b+k+j)	4	3	75.0%	2.00E-07	1.43E-03	mg/kg	1.43E-03	1.07E-04	1	YES	NSL; >Bkg
PAHs	BnzFluor-jk	Benzofluoranthenes, Total (j+k)	1	1	100.0%	--	6.90E-04	mg/kg	6.90E-04	--	--	YES	NSL; Bkg na/nd
PAHs	218-01-9	Chrysene	4	3	75.0%	1.70E-04	1.20E-03	mg/kg	1.20E-03	3.80E-04	3	YES	NSL; >Bkg
PAHs	53-70-3	Dibenzo(a,h)anthracene	4	0	0.0%	1.50E-04	--	mg/kg	1.50E-04	--	--	NO	IFD
PAHs	132-65-0	Dibenzothiophene	4	1	25.0%	5.00E-01	4.66E-04	mg/kg	5.00E-01	--	--	YES	NSL; Bkg na/nd
PAHs	206-44-0	Fluoranthene	4	4	100.0%	--	2.34E-03	mg/kg	2.34E-03	1.00E-03	3	YES	NSL; >Bkg
PAHs	86-73-7	Fluorene	4	2	50.0%	3.70E-04	4.54E-04	mg/kg	4.54E-04	1.18E-04	2	YES	NSL; >Bkg
PAHs	193-39-5	Indeno(1,2,3-cd)pyrene	4	2	50.0%	4.90E-01	4.20E-04	mg/kg	4.90E-01	2.20E-04	1	YES	NSL; >Bkg
PAHs	91-20-3	Naphthalene	4	2	50.0%	4.90E-01	6.70E-04	mg/kg	4.90E-01	8.50E-04	0	NO	NSL; <Bkg
PAHs	198-55-0	Perylene	1	1	100.0%	--	6.91E-04	mg/kg	6.91E-04	3.09E-04	1	YES	NSL; >Bkg
PAHs	85-01-8	Phenanthrene	4	4	100.0%	--	1.55E-03	mg/kg	1.55E-03	1.10E-03	1	YES	NSL; >Bkg

Table E-8. Geoduck (Whole Organism without Shell) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PAHs	129-00-0	Pyrene	4	3	75.0%	3.90E-04	1.32E-03	mg/kg	1.32E-03	5.40E-04	2	YES	NSL; >Bkg
PBDEs	101-55-3	4-Bromophenyl phenyl ether	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
PCB Aroclors	53469-21-9	PCB-aroclor 1242	3	0	0.0%	0.0019	--	mg/kg	0.0019	--	--	NO	IFD
PCB Aroclors	11097-69-1	PCB-aroclor 1254	6	2	33.3%	0.02	0.0074	mg/kg	0.02	0.0035	2	YES	NSL; >Bkg
PCB Aroclors	11096-82-5	PCB-aroclor 1260	6	5	83.3%	0.0019	0.0059	mg/kg	0.0059	--	--	YES	NSL; Bkg na/nd
PCB Congeners	32598-13-3	PCB-077	1	1	100.0%	--	1.65E-06	mg/kg	1.65E-06	9.93E-07	1	YES	NSL; >Bkg
PCB Congeners	70362-50-4	PCB-081	1	0	0.0%	3.41E-07	--	mg/kg	3.41E-07	--	--	NO	IFD
PCB Congeners	32598-14-4	PCB-105	1	1	100.0%	--	2.36E-05	mg/kg	2.36E-05	1.08E-05	1	YES	NSL; >Bkg
PCB Congeners	74472-37-0	PCB-114	1	1	100.0%	--	5.50E-06	mg/kg	5.50E-06	1.36E-06	1	YES	NSL; >Bkg
PCB Congeners	31508-00-6	PCB-118	1	1	100.0%	--	7.41E-05	mg/kg	7.41E-05	3.25E-05	1	YES	NSL; >Bkg
PCB Congeners	65510-44-3	PCB-123	1	1	100.0%	--	2.50E-06	mg/kg	2.50E-06	1.12E-06	1	YES	NSL; >Bkg
PCB Congeners	57465-28-8	PCB-126	1	1	100.0%	--	4.16E-07	mg/kg	4.16E-07	--	--	YES	NSL; Bkg na/nd
PCB Congeners	38380-08-4	PCB-156	1	1	100.0%	--	2.19E-05	mg/kg	2.19E-05	2.84E-06	1	YES	NSL; >Bkg
PCB Congeners	52663-72-6	PCB-167	1	1	100.0%	--	1.42E-05	mg/kg	1.42E-05	2.42E-06	1	YES	NSL; >Bkg
PCB Congeners	32774-16-6	PCB-169	1	0	0.0%	9.92E-07	--	mg/kg	9.92E-07	--	--	NO	IFD
PCB Congeners	39635-31-9	PCB-189	1	1	100.0%	--	3.35E-06	mg/kg	3.35E-06	1.08E-07	1	YES	NSL; >Bkg
PCB Totals	1336-36-3	PCB	3	0	0.0%	0.017	--	mg/kg	0.017	--	--	NO	IFD
PCB Totals	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	6	5	83.3%	0	0.0103	mg/kg	0.0103	0.0035	3	YES	NSL; >Bkg
PCB Totals	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	6	5	83.3%	0.00285	0.0159	mg/kg	0.0159	0.0054	5	YES	NSL; >Bkg
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins/Furans as 2,3,7,8-TCDD TEQ; ND=0	7	4	57.1%	0.00E+00	1.56E-07	mg/kg	1.56E-07	1.60E-08	4	YES	NSL; >Bkg
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins/Furans as 2,3,7,8-TCDD TEQ; ND=0.5	7	4	57.1%	4.36E-07	2.15E-07	mg/kg	4.36E-07	1.44E-06	0	NO	NSL; <Bkg
PCDD/PCDF Totals	37871-00-4	Total HpCDD	7	2	28.6%	1.00E-06	2.30E-06	mg/kg	2.30E-06	2.93E-07	2	YES	NSL; >Bkg
PCDD/PCDF Totals	38998-75-3	Total HpCDF	4	0	0.0%	3.20E-07	--	mg/kg	3.20E-07	--	--	NO	IFD
PCDD/PCDF Totals	34465-46-8	Total HxCDD	4	1	25.0%	3.60E-07	4.63E-07	mg/kg	4.63E-07	9.00E-08	1	YES	NSL; >Bkg
PCDD/PCDF Totals	55684-94-1	Total HxCDF	4	1	25.0%	2.10E-07	1.76E-07	mg/kg	2.10E-07	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	36088-22-9	Total PeCDD	4	1	25.0%	3.30E-07	1.43E-07	mg/kg	3.30E-07	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	30402-15-4	Total PeCDF	4	1	25.0%	2.00E-07	4.88E-08	mg/kg	2.00E-07	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	41903-57-5	Total TCDD	7	4	57.1%	2.30E-07	3.70E-07	mg/kg	3.70E-07	1.02E-07	4	YES	NSL; >Bkg
PCDD/PCDF Totals	30402-14-3	Total TCDF	6	3	50.0%	2.40E-07	1.10E-06	mg/kg	1.10E-06	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	55722-27-5	TOTAL TETRA_FURANS	1	1	100.0%	--	3.28E-07	mg/kg	3.28E-07	2.27E-07	1	YES	NSL; >Bkg
PCDDs/PCDFs	35822-46-9	1,2,3,4,6,7,8-HpCDD	4	1	25.0%	5.60E-07	4.97E-07	mg/kg	5.60E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	67562-39-4	1,2,3,4,6,7,8-HpCDF	4	0	0.0%	1.24E-06	--	mg/kg	1.24E-06	--	--	NO	IFD
PCDDs/PCDFs	55673-89-7	1,2,3,4,7,8,9-HpCDF	4	0	0.0%	5.40E-07	--	mg/kg	5.40E-07	--	--	NO	IFD
PCDDs/PCDFs	39227-28-6	1,2,3,4,7,8-HxCDD	4	0	0.0%	3.40E-07	--	mg/kg	3.40E-07	--	--	NO	IFD
PCDDs/PCDFs	70648-26-9	1,2,3,4,7,8-HxCDF	4	0	0.0%	2.10E-07	--	mg/kg	2.10E-07	--	--	NO	IFD
PCDDs/PCDFs	57653-85-7	1,2,3,6,7,8-HxCDD	4	1	25.0%	3.60E-07	1.08E-07	mg/kg	3.60E-07	5.40E-08	1	YES	NSL; >Bkg
PCDDs/PCDFs	57117-44-9	1,2,3,6,7,8-HxCDF	4	0	0.0%	2.10E-07	--	mg/kg	2.10E-07	--	--	NO	IFD
PCDDs/PCDFs	19408-74-3	1,2,3,7,8,9-HxCDD	4	1	25.0%	3.30E-07	5.30E-08	mg/kg	3.30E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	72918-21-9	1,2,3,7,8,9-HxCDF	4	0	0.0%	3.70E-07	--	mg/kg	3.70E-07	--	--	NO	IFD
PCDDs/PCDFs	40321-76-4	1,2,3,7,8-PeCDD	4	1	25.0%	3.30E-07	5.40E-08	mg/kg	3.30E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	57117-41-6	1,2,3,7,8-PeCDF	4	0	0.0%	2.20E-07	--	mg/kg	2.20E-07	--	--	NO	IFD
PCDDs/PCDFs	60851-34-5	2,3,4,6,7,8-HxCDF	4	0	0.0%	2.40E-07	--	mg/kg	2.40E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-31-4	2,3,4,7,8-PeCDF	4	1	25.0%	2.00E-07	8.00E-08	mg/kg	2.00E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	1746-01-6	2,3,7,8-TCDD	4	0	0.0%	2.30E-07	--	mg/kg	2.30E-07	--	--	NO	IFD
PCDDs/PCDFs	51207-31-9	2,3,7,8-TCDF	7	3	42.9%	4.80E-07	5.70E-07	mg/kg	5.70E-07	9.00E-08	3	YES	NSL; >Bkg
PCDDs/PCDFs	3268-87-9	OCDD	7	4	57.1%	1.24E-06	7.90E-06	mg/kg	7.90E-06	3.00E-06	4	YES	NSL; >Bkg
PCDDs/PCDFs	39001-02-0	OCDF	7	1	14.3%	2.67E-06	6.00E-05	mg/kg	6.00E-05	--	--	YES	NSL; Bkg na/nd
Pesticides	72-54-8	4,4'-DDD	4	0	0.0%	0.00032	--	mg/kg	0.00032	--	--	NO	IFD
Pesticides	72-55-9	4,4'-DDE	7	5	71.4%	0.00033	0.0016	mg/kg	0.0016	0.00084	2	YES	NSL; >Bkg
Pesticides	50-29-3	4,4'-DDT	4	3	75.0%	0.00025	0.0017	mg/kg	0.0017	0.0017	0	NO	NSL; <Bkg
Pesticides	309-00-2	Aldrin	1	0	0.0%	0.0001	--	mg/kg	0.0001	--	--	NO	IFD
Pesticides	319-84-6	Alpha-BHC	7	7	100.0%	--	0.038	mg/kg	0.038	0.033	1	YES	NSL; >Bkg
Pesticides	319-85-7	Beta-BHC	7	7	100.0%	--	0.015	mg/kg	0.015	0.013	1	YES	NSL; >Bkg
Pesticides	5103-71-9	cis-Chlordane	1	0	0.0%	0.00011	--	mg/kg	0.00011	--	--	NO	IFD
Pesticides	319-86-8	Delta-BHC	7	6	85.7%	0.00011	0.0016	mg/kg	0.0016	0.077	0	NO	NSL; <Bkg
Pesticides	60-57-1	Dieldrin	1	0	0.0%	0.00021	--	mg/kg	0.00021	--	--	NO	IFD

Table E-8. Geoduck (Whole Organism without Shell) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
Pesticides	959-98-8	Endosulfan I	1	0	0.0%	0.00011	--	mg/kg	0.00011	--	--	NO	IFD
Pesticides	33213-65-9	Endosulfan II	1	0	0.0%	0.00025	--	mg/kg	0.00025	--	--	NO	IFD
Pesticides	1031-07-8	Endosulfan Sulfate	1	0	0.0%	0.00032	--	mg/kg	0.00032	--	--	NO	IFD
Pesticides	72-20-8	Endrin	1	0	0.0%	0.0004	--	mg/kg	0.0004	--	--	NO	IFD
Pesticides	7421-93-4	Endrin Aldehyde	1	0	0.0%	0.00024	--	mg/kg	0.00024	--	--	NO	IFD
Pesticides	53494-70-5	Endrin Ketone	1	0	0.0%	0.00024	--	mg/kg	0.00024	--	--	NO	IFD
Pesticides	5566-34-7	gamma-Chlordane	1	0	0.0%	0.00011	--	mg/kg	0.00011	--	--	NO	IFD
Pesticides	76-44-8	Heptachlor	1	0	0.0%	0.00013	--	mg/kg	0.00013	--	--	NO	IFD
Pesticides	1024-57-3	Heptachlor Epoxide	1	0	0.0%	0.00012	--	mg/kg	0.00012	--	--	NO	IFD
Pesticides	58-89-9	Lindane	7	6	85.7%	0.00011	0.004	mg/kg	0.004	0.003	1	YES	NSL; >Bkg
Pesticides	72-43-5	Methoxychlor	1	0	0.0%	0.0013	--	mg/kg	0.0013	--	--	NO	IFD
Pesticides	8001-35-2	Toxaphene	1	0	0.0%	0.0094	--	mg/kg	0.0094	--	--	NO	IFD
SVOCs	120-82-1	1,2,4-Trichlorobenzene	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	95-95-4	2,4,5-Trichlorophenol	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	88-06-2	2,4,6-Trichlorophenol	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	120-83-2	2,4-Dichlorophenol	1	0	0.0%	1.5	--	mg/kg	1.5	--	--	NO	IFD
SVOCs	105-67-9	2,4-Dimethylphenol	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	51-28-5	2,4-Dinitrophenol	1	0	0.0%	4.9	--	mg/kg	4.9	--	--	NO	IFD
SVOCs	121-14-2	2,4-Dinitrotoluene	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	606-20-2	2,6-Dinitrotoluene	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	91-58-7	2-Chloronaphthalene	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	95-57-8	2-Chlorophenol	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	88-74-4	2-Nitroaniline	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	88-75-5	2-Nitrophenol	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	91-94-1	3,3'-Dichlorobenzidine	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	534-52-1	4,6-Dinitro-2-Methylphenol	1	0	0.0%	1.3	--	mg/kg	1.3	--	--	NO	IFD
SVOCs	59-50-7	4-Chloro-3-Methylphenol	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	106-47-8	4-Chloroaniline	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	7005-72-3	4-Chlorophenyl-Phenylether	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	100-01-6	4-Nitroaniline	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	100-02-7	4-Nitrophenol	1	0	0.0%	0.14	--	mg/kg	0.14	--	--	NO	IFD
SVOCs	100-51-6	Benzyl Alcohol	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	117-81-7	Bis(2-Ethylhexyl) Phthalate	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	85-68-7	Butyl benzyl phthalate	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	86-74-8	Carbazole	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	84-74-2	Dibutyl phthalate	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	84-66-2	Diethyl phthalate	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	131-11-3	Dimethyl phthalate	1	0	0.0%	0.083	--	mg/kg	0.083	--	--	NO	IFD
SVOCs	117-84-0	Di-N-Octyl Phthalate	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	118-74-1	Hexachlorobenzene	4	3	75.0%	0.49	0.00062	mg/kg	0.49	--	--	YES	NSL; Bkg na/nd
SVOCs	87-68-3	Hexachlorobutadiene	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	77-47-4	Hexachlorocyclopentadiene	1	0	0.0%	0.64	--	mg/kg	0.64	--	--	NO	IFD
SVOCs	78-59-1	Isophorone	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	99-09-2	m-Nitroaniline	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	98-95-3	Nitrobenzene	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	621-64-7	N-Nitrosodi-n-propylamine	1	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	86-30-6	N-Nitrosodiphenylamine	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	95-48-7	o-Cresol	1	0	0.0%	0.14	--	mg/kg	0.14	--	--	NO	IFD
SVOCs	106-44-5	p-Cresol	4	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
SVOCs	87-86-5	Pentachlorophenol	7	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	108-95-2	Phenol	4	0	0.0%	0.16	--	mg/kg	0.16	--	--	NO	IFD
SVOCs	110-86-1	Pyridine	6	3	50.0%	0.018	0.409	mg/kg	0.409	--	--	YES	NSL; Bkg na/nd
VOCs	95-50-1	1,2-Dichlorobenzene	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
VOCs	541-73-1	1,3-Dichlorobenzene	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
VOCs	106-46-7	1,4-Dichlorobenzene	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
VOCs	108-60-1	2,2'-Oxybis[1-chloropropane]	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD

Table E-8. Geoduck (Whole Organism without Shell) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
VOCs	111-91-1	Bis(2-Chloroethoxy)Methane	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
VOCs	111-44-4	Bis(2-Chloroethyl)Ether	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD
VOCs	67-72-1	Hexachloroethane	1	0	0.0%	0.49	--	mg/kg	0.49	--	--	NO	IFD

Notes: (1) Maximum detected concentration or highest detection limit, whichever is greater.
(2) Dungeness Bay.
(3) Screening toxicity value (for marine benthic life) from Table 4-1.
(4) Rationale codes:
- for selection: ASL = above screening level
ASL; Bkg na = above screening level; background not available.
CON = conventional parameter used for data interpretation and evaluation.
log Kow >3.5 = logarithm of octanol-water partition coefficient greater than 3.5.
NSL; Bkg na/nd = no screening level; background not available/not detected
NSL; >Bkg = no screening level; greater than background
- for exclusion: BSL = below screening level
IFD = infrequently (less than 5%) detected
NAB = naturally abundant element of low toxicity (Gough et al. 1979).
NSL; <Bkg = no screening level (NSL); less than background
NUT = essential nutrient

Key:
-- (double dash) = not available or not applicable
CAS = Chemical Abstract Service
IHS = indicator hazardous substance
na = not applicable or not available
ND = not detected
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCDD = polychlorinated dibenzo dioxins
PCDF = polychlorinated dibenzo furans
SVOC = semivolitile organic compound
TEQ = toxic equivalent
VOC = volatile organic compound

Table E-9. Horse Clam (Whole Organism without Shell) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
General Chem	LIPIDS	Lipids	13	13	100.0%	--	1.6	%	1.6	--	--	NO	CON
General Chem	TS	Total Solids	9	9	100.0%	--	25.2	%	25.2	--	--	NO	CON
Metals	7440-36-0	Antimony	8	2	25.0%	0.0011	0.021	mg/kg	0.021	0.006	2	YES	NSL: >Bkg
Metals	7440-38-2	Arsenic	17	17	100.0%	--	23.34	mg/kg	23.34	2.4	7	YES	NSL; >Bkg
Metals	7440-38-2-Inorg	Arsenic, Inorganic	9	9	100.0%	--	1.35	mg/kg	1.35	0.74	3	YES	NSL; >Bkg
Metals	7440-39-3	Barium	8	8	100.0%	--	3	mg/kg	3	1.1	4	YES	NSL; >Bkg
Metals	7440-43-9	Cadmium	17	17	100.0%	--	0.35	mg/kg	0.35	0.4	0	NO	NSL; <Bkg
Metals	7440-47-3	Chromium	8	8	100.0%	--	1.8	mg/kg	1.8	0.4	8	YES	NSL; >Bkg
Metals	7440-50-8	Copper	17	17	100.0%	--	2.5	mg/kg	2.5	3.8	0	NO	NSL; <Bkg
Metals	7439-92-1	Lead	8	4	50.0%	0.32	1	mg/kg	1	0.22	4	YES	NSL; >Bkg
Metals	7439-97-6	Mercury	8	7	87.5%	0.0082	0.027	mg/kg	0.027	0.018	3	YES	NSL; >Bkg
Metals	7440-02-0	Nickel	8	8	100.0%	--	1.4	mg/kg	1.4	1.4	0	N0	NSL: <Bkg
Metals	7782-49-2	Selenium	9	9	100.0%	--	1.9	mg/kg	1.9	0.4	4	YES	NSL; >Bkg
Metals	7440-22-4	Silver	8	8	100.0%	--	1.2	mg/kg	1.2	2.2	0	NO	NSL; <Bkg
Metals	7440-66-6	Zinc	17	17	100.0%	--	12	mg/kg	12	12	0	NO	NSL; <Bkg
Organic Acids	65-85-0	Benzoic Acid	7	0	0.0%	20	--	mg/kg	20	--	--	NO	IFD
Organometalics	22967-92-6	Methylmercury(1+)	9	9	100.0%	--	0.01	mg/kg	0.01	0.01	0	NO	NSL; <Bkg
Organometalics	78-00-2	Tetraethyl Lead	9	9	100.0%	--	2.91	mg/kg	2.91	0.17	7	YES	NSL; >Bkg
PAH Totals	HPAH0	High MW PAHs ND=0	17	15	88.2%	0.068	0.276	mg/kg	0.276	0.0008	15	YES	NSL; >Bkg
PAH Totals	HPAH05	High MW PAHs ND=0.5	17	15	88.2%	0.068	0.276	mg/kg	0.276	0.0012	15	YES	NSL; >Bkg
PAH Totals	LPAH0	Low MW PAHs ND=0	17	17	100.0%	--	0.201	mg/kg	0.201	0.0020	17	YES	NSL; >Bkg
PAH Totals	LPAH05	Low MW PAHs ND=0.5	17	17	100.0%	--	0.201	mg/kg	0.201	0.0023	17	YES	NSL; >Bkg
PAHs	832-69-9	1-Methylphenanthrene	8	7	88.0%	3.55E-04	1.33E-02	mg/kg	1.33E-02	0.000116	6	YES	NSL; >Bkg
PAHs	2245-38-7	2,3,5-Trimethylnaphthalene	8	3	37.5%	4.21E-04	6.04E-03	mg/kg	6.04E-03	--	--	YES	NSL; Bkg na/nd
PAHs	581-42-0	2,6-Dimethylnaphthalene	8	7	87.5%	8.87E-04	1.79E-02	mg/kg	1.79E-02	0.000211	7	YES	NSL; >Bkg
PAHs	91-57-6	2-Methylnaphthalene	17	8	47.0%	2.40E+00	1.40E-03	mg/kg	2.40E+00	0.00061	8	YES	NSL; >Bkg
PAHs	83-32-9	Acenaphthene	17	17	100.0%	--	9.43E-02	mg/kg	9.43E-02	0.00021	17	YES	NSL; >Bkg
PAHs	208-96-8	Acenaphthylene	17	10	59.0%	2.00E+00	3.50E-04	mg/kg	2.00E+00	0.000044	10	YES	NSL; >Bkg
PAHs	120-12-7	Anthracene	17	5	29.0%	2.00E+00	2.20E-03	mg/kg	2.00E+00	0.0003	5	YES	NSL; >Bkg
PAHs	56-55-3	Benz(a)anthracene	17	10	59.0%	2.40E+00	3.90E-03	mg/kg	2.40E+00	0.00095	10	YES	NLS; >Bkg
PAHs	50-32-8	Benzo(a)pyrene	17	9	53.0%	2.00E+00	1.40E-03	mg/kg	2.00E+00	0.000065	9	YES	NSL; >Bkg
PAHs	205-99-2	Benzo(b)fluoranthene	17	17	100.0%	--	2.58E-02	mg/kg	2.58E-02	0.000078	17	YES	NSL; >Bkg
PAHs	192-97-2	Benzo(e)pyrene	8	8	100.0%	--	3.48E-03	mg/kg	3.48E-03	0.000102	8	YES	NSL: >Bkg
PAHs	191-24-2	Benzo(ghi)perylene	17	11	65.0%	2.00E+00	9.30E-04	mg/kg	2.00E+00	0.00012	11	YES	NSL: >Bkg
PAHs	207-08-9	Benzo(k)fluoranthene	9	9	100.0%	--	0.039	mg/kg	0.039	--	--	YES	NSL; Bkg na/nd
PAHs	BnzFluor-bkj	Benzofluoranthenes, Total (b+k+j)	17	17	100.0%	--	5.32E-02	mg/kg	5.32E-02	0.000078	8	YES	NSL; >Bkg
PAHs	BnzFluor-jk	Benzofluoranthenes, Total (j+k)	8	8	100.0%	--	2.74E-02	mg/kg	2.74E-02	--	--	YES	NSL; Bkg na/nd
PAHs	218-01-9	Chrysene	17	17	100.0%	--	5.13E-02	mg/kg	5.13E-02	0.000265	17	YES	NSL; >Bkg
PAHs	53-70-3	Dibenzo(a,h)anthracene	17	7	41.0%	2.00E+00	4.60E-04	mg/kg	2.00E+00	--	--	YES	NSL; Bkg na/nd
PAHs	132-65-0	Dibenzothiophene	8	8	100.0%	--	2.10E-04	mg/kg	2.10E-04	--	--	YES	NSL; Bkg na/nd
PAHs	206-44-0	Fluoranthene	17	17	100.0%	--	0.288000014	mg/kg	0.288000014	0.0012	17	YES	NSL; >Bkg
PAHs	86-73-7	Fluorene	17	10	59.0%	2.00E+00	4.40E-03	mg/kg	2.00E+00	0.000179	10	YES	NSL; >Bkg
PAHs	193-39-5	Indeno(1,2,3-cd)pyrene	17	13	76.5%	2.00E+00	9.80E-04	mg/kg	2.00E+00	0.00073	13	YES	NSL; >Bkg
PAHs	91-20-3	Naphthalene	17	1	6.0%	0.000434	4.17E-02	mg/kg	4.17E-02	0.00109	1	YES	NSL; >Bkg
PAHs	198-55-0	Perylene	8	8	100.0%	--	6.08E-03	mg/kg	6.08E-03	0.000407	8	YES	NSL; >Bkg
PAHs	85-01-8	Phenanthrene	17	17	100.0%	--	0.391000019	mg/kg	0.391000019	0.00095	17	YES	NSL; >Bkg
PAHs	129-00-0	Pyrene	17	17	100.0%	--	0.298000014	mg/kg	0.298000014	0.00059	17	YES	NSL; >Bkg
PBDEs	101-55-3	4-Bromophenyl phenyl ether	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
PCB Aroclors	53469-21-9	PCB-aroclor 1242	9	0	0.0%	0.0019	--	mg/kg	0.0019	--	--	NO	IFD
PCB Aroclors	11097-69-1	PCB-aroclor 1254	9	9	100.0%	--	0.017	mg/kg	0.017	--	--	YES	NSL; Bkg na/nd
PCB Aroclors	11096-82-5	PCB-aroclor 1260	9	9	100.0%	--	0.023	mg/kg	0.023	--	--	YES	NSL; Bkg na/nd
PCB Congeners	32598-13-3	PCB-077	18	18	100.0%	--	7.64E-06	mg/kg	7.64E-06	1.91E-06	14	YES	NSL; >Bkg
PCB Congeners	70362-50-4	PCB-081	18	0	0.0%	8.07E-07	--	mg/kg	8.07E-07	4.05E-07	0	NO	IFD
PCB Congeners	32598-14-4	PCB-105	18	18	100.0%	--	1.63E-04	mg/kg	1.63E-04	1.40E-05	18	YES	NSL; >Bkg
PCB Congeners	74472-37-0	PCB-114	18	18	100.0%	--	6.67E-06	mg/kg	6.67E-06	7.36E-07	17	YES	NSL; >Bkg
PCB Congeners	31508-00-6	PCB-118	18	18	100.0%	--	4.62E-04	mg/kg	4.62E-04	4.48E-05	17	YES	NSL; >Bkg
PCB Congeners	65510-44-3	PCB-123	18	18	100.0%	--	6.71E-06	mg/kg	6.71E-06	9.86E-07	17	YES	NSL; >Bkg
PCB Congeners	57465-28-8	PCB-126	18	6	33.3%	8.08E-07	2.21E-06	mg/kg	2.21E-06	1.11E-07	6	YES	NSL; >Bkg
PCB Congeners	38380-08-4	PCB-156	8	8	100.0%	--	0.0000495	mg/kg	4.95E-05	2.71E-06	8	YES	NSL; >Bkg
PCB Congeners	PCB-156/157	PCB-156/157	10	10	100.0%	--	7.18E-05	mg/kg	7.18E-05	2.13E-06	10	YES	NSL; >Bkg
PCB Congeners	52663-72-6	PCB-167	18	18	100.0%	--	8.78E-05	mg/kg	8.78E-05	2.33E-06	18	YES	NSL; >Bkg
PCB Congeners	32774-16-6	PCB-169	18	6	33.3%	2.96E-06	1.17E-05	mg/kg	1.17E-05	--	--	YES	NSL; Bkg na/nd
PCB Congeners	39635-31-9	PCB-189	18	18	100.0%	--	0.0000114	mg/kg	1.14E-05	2.69E-07	18	YES	NSL; >Bkg
PCB Totals	PCB-TBi-TEQ0	PCB Congeners, Total Bird TEQs, ND=0	18	18	100.0%	--	5.51E-07	mg/kg	5.51E-07	9.78E-08	14	YES	NSL; >Bkg
PCB Totals	PCB-TBi-TEQ05	PCB Congeners, Total Bird TEQs, ND=0.5	18	18	100.0%	--	5.72E-07	mg/kg	5.72E-07	1.33E-07	14	YES	NSL; >Bkg

Table E-9. Horse Clam (Whole Organism without Shell) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PCB Totals	PCB-THu-TEQ0	PCB Congeners, Total Human TEQs, ND=0	18	18	100.0%	--	5.33E-07	mg/kg	5.33E-07	2.20E-09	17	YES	NSL; >Bkg
PCB Totals	PCB-THu-TEQ05	PCB Congeners, Total Human TEQs, ND=0.5	18	18	100.0%	--	5.35E-07	mg/kg	5.35E-07	2.66E-08	14	YES	NSL; >Bkg
PCB Totals	1336-36-3	PCB	9	9	100.0%	--	0.036	mg/kg	0.036	--	--	YES	NSL; Bkg na/nd
PCB Totals	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	9	9	100.0%	--	0.036	mg/kg	0.036	--	--	YES	NSL; Bkg na/nd
PCB Totals	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	9	9	100.0%	--	0.03695	mg/kg	0.03695	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	27	25	92.6%	0.00E+00	4.11E-07	mg/kg	4.11E-07	2.32E-08	15	YES	NSL; >Bkg
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	27	25	92.6%	4.00E-07	4.72E-07	mg/kg	4.72E-07	1.43E-06	0	NO	NSL; <Bkg
PCDD/PCDF Totals	37871-00-4	Total HpCDD	17	10	58.8%	6.70E-07	3.08E-05	mg/kg	3.08E-05	2.77E-07	10	YES	NSL; >Bkg
PCDD/PCDF Totals	38998-75-3	Total HpCDF	17	6	35.3%	2.50E-07	1.18E-06	mg/kg	1.18E-06	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	34465-46-8	Total HxCDD	17	6	35.3%	2.20E-07	2.55E-06	mg/kg	2.55E-06	6.90E-08	6	YES	NSL; >Bkg
PCDD/PCDF Totals	55684-94-1	Total HxCDF	17	7	41.2%	1.70E-07	8.36E-07	mg/kg	8.36E-07	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	36088-22-9	Total PeCDD	17	4	23.5%	2.70E-07	2.73E-07	mg/kg	2.73E-07	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	30402-15-4	Total PeCDF	17	7	41.2%	1.60E-07	4.18E-07	mg/kg	4.18E-07	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	41903-57-5	Total TCDD	17	6	35.3%	2.10E-07	4.77E-07	mg/kg	4.77E-07	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	30402-14-3	Total TCDF	9	0	0.0%	2.20E-07	--	mg/kg	2.20E-07	--	--	NO	IFD
PCDD/PCDF Totals	55722-27-5	TOTAL TETRA_FURANS	8	5	62.5%	4.86E-08	6.62E-07	mg/kg	6.62E-07	5.10E-08	5	YES	NSL; >Bkg
PCDDs/PCDFs	35822-46-9	1,2,3,4,6,7,8-HpCDD	17	9	52.9%	6.70E-07	5.87E-06	mg/kg	5.87E-06	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	67562-39-4	1,2,3,4,6,7,8-HpCDF	17	6	35.3%	2.50E-05	3.90E-07	mg/kg	2.50E-05	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	55673-89-7	1,2,3,4,7,8,9-HpCDF	17	0	0.0%	4.70E-07	--	mg/kg	4.70E-07	--	--	NO	IFD
PCDDs/PCDFs	39227-28-6	1,2,3,4,7,8-HxCDD	17	1	5.9%	2.00E-07	6.50E-08	mg/kg	2.00E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	70648-26-9	1,2,3,4,7,8-HxCDF	17	2	11.8%	1.70E-07	6.70E-08	mg/kg	1.70E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	57653-85-7	1,2,3,6,7,8-HxCDD	17	6	35.3%	2.20E-07	3.25E-07	mg/kg	3.25E-07	5.30E-08	6	YES	NSL; >Bkg
PCDDs/PCDFs	57117-44-9	1,2,3,6,7,8-HxCDF	17	0	0.0%	1.70E-07	--	mg/kg	1.70E-07	--	--	NO	IFD
PCDDs/PCDFs	19408-74-3	1,2,3,7,8,9-HxCDD	17	4	23.5%	2.10E-07	1.30E-07	mg/kg	2.10E-07	5.10E-08	3	YES	NSL; >Bkg
PCDDs/PCDFs	72918-21-9	1,2,3,7,8,9-HxCDF	17	0	0.0%	2.40E-07	--	mg/kg	2.40E-07	--	--	NO	IFD
PCDDs/PCDFs	40321-76-4	1,2,3,7,8-PeCDD	17	1	5.9%	2.70E-07	6.10E-08	mg/kg	2.70E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	57117-41-6	1,2,3,7,8-PeCDF	17	0	0.0%	2.00E-07	--	mg/kg	2.00E-07	--	--	NO	IFD
PCDDs/PCDFs	60851-34-5	2,3,4,6,7,8-HxCDF	17	0	0.0%	1.90E-07	--	mg/kg	1.90E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-31-4	2,3,4,7,8-PeCDF	17	4	23.5%	1.60E-07	8.40E-08	mg/kg	1.60E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	1746-01-6	2,3,7,8-TCDD	17	3	17.6%	2.10E-07	6.30E-08	mg/kg	2.10E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	51207-31-9	2,3,7,8-TCDF	17	1	5.9%	2.20E-07	4.90E-08	mg/kg	2.20E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	3268-87-9	OCDD	17	15	88.2%	7.70E-07	5.69E-05	mg/kg	5.69E-05	2.78E-06	6	YES	NSL; >Bkg
PCDDs/PCDFs	39001-02-0	OCDF	17	7	41.2%	5.37E-07	6.88E-07	mg/kg	6.88E-07	--	--	YES	NSL; Bkg na/nd
Pesticides	72-54-8	4,4'-DDD	13	2	15.4%	0.00032	0.0016	mg/kg	0.0016	--	--	YES	NSL; Bkg na/nd
Pesticides	72-55-9	4,4'-DDE	13	3	23.1%	0.00033	0.00087	mg/kg	0.00087	--	--	YES	NSL; Bkg na/nd
Pesticides	50-29-3	4,4'-DDT	13	8	61.5%	0.0025	0.0051	mg/kg	0.0051	--	--	YES	NSL; Bkg na/nd
Pesticides	309-00-2	Aldrin	4	0	0.0%	0.0001	--	mg/kg	0.0001	--	--	NO	IFD
Pesticides	319-84-6	Alpha-BHC	13	3	23.1%	0.00088	0.00063	mg/kg	0.00088	--	--	YES	NSL; Bkg na/nd
Pesticides	319-85-7	Beta-BHC	13	2	15.4%	0.00036	0.00045	mg/kg	0.00045	--	--	YES	NSL; Bkg na/nd
Pesticides	5103-71-9	cis-Chlordane	4	0	0.0%	0.00011	--	mg/kg	0.00011	--	--	NO	IFD
Pesticides	319-86-8	Delta-BHC	13	0	0.0%	0.00031	--	mg/kg	0.00031	--	--	NO	IFD
Pesticides	60-57-1	Dieldrin	4	0	0.0%	0.00021	--	mg/kg	0.00021	--	--	NO	IFD
Pesticides	959-98-8	Endosulfan I	4	0	0.0%	0.00011	--	mg/kg	0.00011	--	--	NO	IFD
Pesticides	33213-65-9	Endosulfan II	4	0	0.0%	0.00025	--	mg/kg	0.00025	--	--	NO	IFD
Pesticides	1031-07-8	Endosulfan Sulfate	4	0	0.0%	0.00033	--	mg/kg	0.00033	--	--	NO	IFD
Pesticides	72-20-8	Endrin	4	0	0.0%	0.0004	--	mg/kg	0.0004	--	--	NO	IFD
Pesticides	7421-93-4	Endrin Aldehyde	4	0	0.0%	0.00024	--	mg/kg	0.00024	--	--	NO	IFD
Pesticides	53494-70-5	Endrin Ketone	4	0	0.0%	0.00024	--	mg/kg	0.00024	--	--	NO	IFD
Pesticides	5566-34-7	gamma-Chlordane	4	1	25.0%	0.00011	0.00042	mg/kg	0.00042	--	--	YES	NSL; Bkg na/nd
Pesticides	76-44-8	Heptachlor	4	0	0.0%	0.00093	--	mg/kg	0.00093	--	--	NO	IFD
Pesticides	1024-57-3	Heptachlor Epoxide	4	0	0.0%	0.00012	--	mg/kg	0.00012	--	--	NO	IFD
Pesticides	58-89-9	Lindane	13	3	23.1%	0.001	0.002	mg/kg	0.002	0.00037	3	YES	NSL; >Bkg
Pesticides	72-43-5	Methoxychlor	4	0	0.0%	0.0013	--	mg/kg	0.0013	--	--	NO	IFD
Pesticides	8001-35-2	Toxaphene	4	0	0.0%	0.0095	--	mg/kg	0.0095	--	--	NO	IFD
SVOCs	120-82-1	1,2,4-Trichlorobenzene	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	95-95-4	2,4,5-Trichlorophenol	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	88-06-2	2,4,6-Trichlorophenol	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	120-83-2	2,4-Dichlorophenol	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	105-67-9	2,4-Dimethylphenol	8	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	51-28-5	2,4-Dinitrophenol	8	0	0.0%	20	--	mg/kg	20	--	--	NO	IFD
SVOCs	121-14-2	2,4-Dinitrotoluene	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	606-20-2	2,6-Dinitrotoluene	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	91-58-7	2-Chloronaphthalene	8	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	95-57-8	2-Chlorophenol	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	88-74-4	2-Nitroaniline	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD

Table E-9. Horse Clam (Whole Organism without Shell) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
SVOCs	88-75-5	2-Nitrophenol	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	91-94-1	3,3'-Dichlorobenzidine	7	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	534-52-1	4,6-Dinitro-2-Methylphenol	8	0	0.0%	20	--	mg/kg	20	--	--	NO	IFD
SVOCs	59-50-7	4-Chloro-3-Methylphenol	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	106-47-8	4-Chloroaniline	7	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	7005-72-3	4-Chlorophenyl-Phenylether	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	100-01-6	4-Nitroaniline	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	100-02-7	4-Nitrophenol	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	100-51-6	Benzyl Alcohol	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	117-81-7	Bis(2-Ethylhexyl) Phthalate	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	85-68-7	Butyl benzyl phthalate	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	86-74-8	Carbazole	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	132-64-9	Dibenzofuran	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	84-74-2	Dibutyl phthalate	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	84-66-2	Diethyl phthalate	8	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	131-11-3	Dimethyl phthalate	8	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	117-84-0	Di-N-Octyl Phthalate	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	118-74-1	Hexachlorobenzene	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	87-68-3	Hexachlorobutadiene	8	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD
SVOCs	77-47-4	Hexachlorocyclopentadiene	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	78-59-1	Isophorone	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	99-09-2	m-Nitroaniline	7	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	98-95-3	Nitrobenzene	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	621-64-7	N-Nitrosodi-n-propylamine	8	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	86-30-6	N-Nitrosodiphenylamine	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	95-48-7	o-Cresol	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	106-44-5	p-Cresol	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	87-86-5	Pentachlorophenol	17	0	0.0%	10	--	mg/kg	10	--	--	NO	IFD
SVOCs	108-95-2	Phenol	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	110-86-1	Pyridine	9	0	0.0%	0.018	--	mg/kg	0.018	--	--	NO	IFD
VOCs	95-50-1	1,2-Dichlorobenzene	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	541-73-1	1,3-Dichlorobenzene	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	106-46-7	1,4-Dichlorobenzene	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	108-60-1	2,2'-Oxybis[1-chloropropane]	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	111-91-1	Bis(2-Chloroethoxy)Methane	8	0	0.0%	4.7	--	mg/kg	4.7	--	--	NO	IFD
VOCs	111-44-4	Bis(2-Chloroethyl)Ether	8	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	67-72-1	Hexachloroethane	8	0	0.0%	2.4	--	mg/kg	2.4	--	--	NO	IFD

Notes: (1) Maximum detected concentration or highest detection limit, whichever is greater.
(2) Dungeness Bay.
(3) Screening toxicity value (for marine benthic life) from Table 4-1.
(4) Rationale codes:
- for selection: ASL = above screening level
ASL; Bkg na = above screening level; background not available.
CON = conventional parameter used for data interpretation and evaluation.
log Kow >3.5 = logarithm of octanol-water partition coefficient greater than 3.5.
NSL; Bkg na/nd = no screening level; background not available/not detected
NSL; >Bkg = no screening level; greater than background
- for exclusion: BSL = below screening level
IFD = infrequently (less than 5%) detected
NSL; <Bkg = no screening level (NSL); less than background
NUT = essential nutrient

Key: -- (double dash) = not available or not applicable
CAS = Chemical Abstract Service
IHS = indicator hazardous substance
na = not applicable or not available
ND = not detected
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCDD = polychlorinated dibenzo dioxins
PCDF = polychlorinated dibenzo furans
SVOC = semivolitile organic compound
TEQ = toxic equivalent
VOC = volatile organic compound

Table E-10. Ling Cod (Whole Organism) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
Metals	7440-36-0	Antimony	2	0	0.0%	0.00091	--	mg/kg	0.00091	--	--	NO	IFD
Metals	7440-38-2	Arsenic	2	2	100.0%	--	0.59	mg/kg	0.59	1.24	0	NO	NSL; <Bkg
Metals	7440-39-3	Barium	2	0	0.0%	0.083	--	mg/kg	0.083	--	--	NO	IFD
Metals	7440-43-9	Cadmium	2	0	0.0%	0.083	--	mg/kg	0.083	0.02	0	NO	IFD
Metals	7440-47-3	Chromium	2	2	100.0%	--	0.33	mg/kg	0.33	--	--	YES	NSL; Bkg na/nd
Metals	7440-50-8	Copper	2	2	100.0%	--	0.63	mg/kg	0.63	0.48	2	YES	NSL; >Bkg
Metals	7439-92-1	Lead	2	0	0.0%	0.083	--	mg/kg	0.083	--	--	NO	IFD
Metals	7439-97-6	Mercury	2	2	100.0%	--	0.22	mg/kg	0.22	--	--	YES	NSL; Bkg na/nd
Metals	7440-02-0	Nickel	2	2	100.0%	--	0.096	mg/kg	0.096	--	--	YES	NSL; Bkg na/nd
Metals	7440-22-4	Silver	2	0	0.0%	0.083	--	mg/kg	0.083	--	--	NO	IFD
Metals	7440-66-6	Zinc	2	2	100.0%	--	11	mg/kg	11	13.2	0	NO	NSL; <Bkg
Organic Acids	65-85-0	Benzoic Acid	2	0	0.0%	20	--	mg/kg	20	--	--	NO	IFD
PAH Totals	HPAH0	High MW PAHs ND=0	2	2	100.0%	--	0.000609	mg/kg	6.09E-04	--	--	YES	NSL; Bkg na/nd
PAH Totals	HPAH05	High MW PAHs ND=0.5	2	2	100.0%	--	0.00072865	mg/kg	7.29E-04	--	--	YES	NSL; Bkg na/nd
PAH Totals	LPAH0	Low MW PAHs ND=0	2	2	100.0%	--	0.000516	mg/kg	5.16E-04	1.53E-03	1	YES	NSL; >Bkg
PAH Totals	LPAH05	Low MW PAHs ND=0.5	2	2	100.0%	--	0.0013375	mg/kg	1.34E-03	1.65E-03	1	YES	NSL; >Bkg
PAHs	90-12-0	1-Methylnaphthalene	2	0	0.0%	9.97E-05	--	mg/kg	9.97E-05	--	--	NO	IFD
PAHs	2245-38-7	2,3,5-Trimethylnaphthalene	2	0	0.0%	1.45E-04	--	mg/kg	1.45E-04	--	--	NO	IFD
PAHs	581-42-0	2,6-Dimethylnaphthalene	2	2	100.0%	--	9.90E-05	mg/kg	9.90E-05	--	--	YES	NSL; Bkg na/nd
PAHs	91-57-6	2-Methylnaphthalene	2	0	0.0%	5.16E-04	--	mg/kg	5.16E-04	5.70E-04	0	NO	IFD
PAHs	83-32-9	Acenaphthene	2	2	100.0%	--	2.71E-04	mg/kg	2.71E-04	2.10E-04	1	YES	NSL; >Bkg
PAHs	208-96-8	Acenaphthylene	2	2	100.0%	--	0.000125	mg/kg	1.25E-04	--	--	YES	NSL; Bkg na/nd
PAHs	120-12-7	Anthracene	2	1	50.0%	--	1.98E-04	mg/kg	1.98E-04	--	--	YES	NSL; Bkg na/nd
PAHs	56-55-3	Benz[a]anthracene	2	2	100.0%	--	4.80E-05	mg/kg	4.80E-05	--	--	YES	NSL; Bkg na/nd
PAHs	50-32-8	Benzo(a)pyrene	2	2	100.0%	--	4.60E-05	mg/kg	4.60E-05	--	--	YES	NSL; Bkg na/nd
PAHs	BnzFluor-bkj	Benzo(b/j/k)fluoranthene	2	0	0.0%	1.68E-05	--	mg/kg	1.68E-05	--	--	NO	IFD
PAHs	205-99-2	Benzo(b)fluoranthene	2	1	50.0%	1.68E-05	0.000021	mg/kg	2.10E-05	--	--	YES	NSL; Bkg na/nd
PAHs	192-97-2	Benzo(e)pyrene	2	2	100.0%	--	4.50E-05	mg/kg	4.50E-05	--	--	YES	NSL; Bkg na/nd
PAHs	191-24-2	Benzo(ghi)perylene	2	0	0.0%	1.58E-04	--	mg/kg	1.58E-04	--	--	NO	IFD
PAHs	BnzFluor-jk	Benzo(j,k)fluoranthene	2	0	0.0%	3.60E-05	--	mg/kg	3.60E-05	--	--	NO	IFD
PAHs	218-01-9	Chrysene	2	2	100.0%	--	8.60E-05	mg/kg	8.60E-05	--	--	YES	NSL; Bkg na/nd
PAHs	53-70-3	Dibenzo(a,h)anthracene	2	0	0.0%	5.13E-05	--	mg/kg	5.13E-05	--	--	NO	IFD
PAHs	132-65-0	Dibenzothiophene	2	2	100.0%	--	4.90E-05	mg/kg	4.90E-05	--	--	YES	NSL; Bkg na/nd
PAHs	206-44-0	Fluoranthene	2	1	50.0%	--	2.55E-04	mg/kg	2.55E-04	--	--	YES	NSL; Bkg na/nd
PAHs	86-73-7	Fluorene	2	2	100.0%	--	0.000483	mg/kg	4.83E-04	--	--	YES	NSL; Bkg na/nd
PAHs	193-39-5	Indeno(1,2,3-cd)pyrene	2	1	50.0%	3.98E-05	0.000067	mg/kg	6.70E-05	--	--	YES	NSL; Bkg na/nd
PAHs	91-20-3	Naphthalene	2	2	100.0%	--	1.34E-03	mg/kg	1.34E-03	7.70E-04	2	YES	NSL; >Bkg
PAHs	198-55-0	Perylene	2	0	0.0%	2.64E-05	--	mg/kg	2.64E-05	--	--	NO	IFD
PAHs	85-01-8	Phenanthrene	2	0	0.0%	3.51E-04	--	mg/kg	3.51E-04	5.50E-04	--	NO	IFD
PAHs	129-00-0	Pyrene	2	0	0.0%	1.34E-04	--	mg/kg	1.34E-04	--	--	NO	IFD
PBDEs	101-55-3	4-Bromophenyl phenyl ether	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
PCB Aroclor	12674-11-2	PCB-aroclor 1016	2	0	0.0%	0.0032	--	mg/kg	0.0032	-	-	NO	IFD
PCB Aroclor	11104-28-2	PCB-aroclor 1221	2	0	0.0%	0.0079	--	mg/kg	0.0079	-	-	NO	IFD
PCB Aroclor	11141-16-5	PCB-aroclor 1232	2	0	0.0%	0.007	--	mg/kg	0.007	-	-	NO	IFD
PCB Aroclor	53469-21-9	PCB-aroclor 1242	2	0	0.0%	0.0021	--	mg/kg	0.0021	-	-	NO	IFD
PCB Aroclor	12672-29-6	PCB-aroclor 1248	2	0	0.0%	0.0013	--	mg/kg	0.0013	-	-	NO	IFD
PCB Aroclor	11097-69-1	PCB-aroclor 1254	2	0	0.0%	0.0021	--	mg/kg	0.0021	-	-	NO	IFD
PCB Aroclor	11096-82-5	PCB-aroclor 1260	2	2	100.0%	--	0.027	mg/kg	0.027	-	-	YES	NSL; Bkg na/nd
PCB Aroclor	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND=0	2	2	100.0%	--	0.027	mg/kg	0.027	-	-	YES	NSL; Bkg na/nd
PCB Aroclor	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND=0.5	2	2	100.0%	--	0.038	mg/kg	0.038	-	-	YES	NSL; Bkg na/nd
PCB Congeners	32598-13-3	PCB-077	2	2	100.0%	--	0.00000168	mg/kg	0.00000168	--	--	YES	NSL; Bkg na/nd
PCB Congeners	70362-50-4	PCB-081	2	0	0.0%	0.00000157	--	mg/kg	0.00000157	--	--	NO	IFD
PCB Congeners	32598-14-4	PCB-105	2	2	100.0%	--	0.0017	mg/kg	0.0017	--	--	YES	NSL; Bkg na/nd
PCB Congeners	74472-37-0	PCB-114	2	2	100.0%	--	0.000118	mg/kg	0.000118	--	--	YES	NSL; Bkg na/nd
PCB Congeners	31508-00-6	PCB-118	2	2	100.0%	--	0.00551	mg/kg	0.00551	--	--	YES	NSL; Bkg na/nd
PCB Congeners	65510-44-3	PCB-123	2	2	100.0%	--	0.0000178	mg/kg	0.0000178	--	--	YES	NSL; Bkg na/nd
PCB Congeners	57465-28-8	PCB-126	2	2	100.0%	--	0.00000341	mg/kg	0.00000341	--	--	YES	NSL; Bkg na/nd
PCB Congeners	38380-08-4	PCB-156	2	2	100.0%	--	0.00136	mg/kg	0.00136	--	--	YES	NSL; Bkg na/nd
PCB Congeners	52663-72-6	PCB-167	2	2	100.0%	--	0.000319	mg/kg	0.000319	--	--	YES	NSL; Bkg na/nd
PCB Congeners	32774-16-6	PCB-169	2	0	0.0%	0.00000541	--	mg/kg	0.00000541	--	--	NO	IFD
PCB Congeners	39635-31-9	PCB-189	2	2	100.0%	--	0.0000836	mg/kg	0.0000836	--	--	YES	NSL; Bkg na/nd

Table E-10. Ling Cod (Whole Organism) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	2	2	100.0%	--	7.12E-07	mg/kg	7.12E-07	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	2	2	100.0%	--	8.40E-07	mg/kg	8.40E-07	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	37871-00-4	Total HpCDD	2	1	50.0%	4.82E-08	9.42E-08	mg/kg	9.42E-08	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	38998-75-3	Total HpCDF	2	1	50.0%	4.82E-08	6.74E-08	mg/kg	6.74E-08	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	34465-46-8	Total HxCDD	2	2	100.0%	--	1.67E-07	mg/kg	1.67E-07	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	55684-94-1	Total HxCDF	2	0	0.0%	4.88E-08	--	mg/kg	4.88E-08	--	--	NO	IFD
PCDD/PCDF Totals	36088-22-9	Total PeCDD	2	0	0.0%	4.88E-08	--	mg/kg	4.88E-08	--	--	NO	IFD
PCDD/PCDF Totals	30402-15-4	Total PeCDF	2	1	50.0%	4.82E-08	7.60E-08	mg/kg	7.60E-08	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	41903-57-5	Total TCDD	2	1	50.0%	4.82E-08	7.30E-08	mg/kg	7.30E-08	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	55722-27-5	TOTAL TETRA_FURANS	2	2	100.0%	--	4.34E-07	mg/kg	4.34E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	35822-46-9	1,2,3,4,6,7,8-HpCDD	2	0	0.0%	1.25E-06	--	mg/kg	1.25E-06	--	--	NO	IFD
PCDDs/PCDFs	67562-39-4	1,2,3,4,6,7,8-HpCDF	2	0	0.0%	6.74E-08	--	mg/kg	6.74E-08	--	--	NO	IFD
PCDDs/PCDFs	55673-89-7	1,2,3,4,7,8,9-HpCDF	2	0	0.0%	6.74E-08	--	mg/kg	6.74E-08	--	--	NO	IFD
PCDDs/PCDFs	39227-28-6	1,2,3,4,7,8-HxCDD	2	0	0.0%	5.40E-08	--	mg/kg	5.40E-08	--	--	NO	IFD
PCDDs/PCDFs	70648-26-9	1,2,3,4,7,8-HxCDF	2	0	0.0%	4.88E-08	--	mg/kg	4.88E-08	--	--	NO	IFD
PCDDs/PCDFs	57653-85-7	1,2,3,6,7,8-HxCDD	2	2	100.0%	--	1.67E-07	mg/kg	1.67E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	57117-44-9	1,2,3,6,7,8-HxCDF	2	0	0.0%	4.88E-08	--	mg/kg	4.88E-08	--	--	NO	IFD
PCDDs/PCDFs	19408-74-3	1,2,3,7,8,9-HxCDD	2	0	0.0%	5.40E-08	--	mg/kg	5.40E-08	--	--	NO	IFD
PCDDs/PCDFs	72918-21-9	1,2,3,7,8,9-HxCDF	2	0	0.0%	4.88E-08	--	mg/kg	4.88E-08	--	--	NO	IFD
PCDDs/PCDFs	40321-76-4	1,2,3,7,8-PeCDD	2	0	0.0%	4.88E-08	--	mg/kg	4.88E-08	--	--	NO	IFD
PCDDs/PCDFs	57117-41-6	1,2,3,7,8-PeCDF	2	1	50.0%	4.82E-08	5.70E-08	mg/kg	5.70E-08	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	60851-34-5	2,3,4,6,7,8-HxCDF	2	0	0.0%	4.88E-08	--	mg/kg	4.88E-08	--	--	NO	IFD
PCDDs/PCDFs	57117-31-4	2,3,4,7,8-PeCDF	2	1	50.0%	4.82E-08	7.60E-08	mg/kg	7.60E-08	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	1746-01-6	2,3,7,8-TCDD	2	2	100.0%	--	6.50E-08	mg/kg	6.50E-08	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	51207-31-9	2,3,7,8-TCDF	1	1	100.0%	--	2.24E-07	mg/kg	2.24E-07	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	3268-87-9	OCDD	2	0	0.0%	2.70E-06	--	mg/kg	2.70E-06	--	--	NO	IFD
PCDDs/PCDFs	39001-02-0	OCDF	2	2	100.0%	--	9.60E-08	mg/kg	9.60E-08	--	--	YES	NSL; Bkg na/nd
SVOCs	120-82-1	1,2,4-Trichlorobenzene	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	95-95-4	2,4,5-Trichlorophenol	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	88-06-2	2,4,6-Trichlorophenol	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	120-83-2	2,4-Dichlorophenol	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	105-67-9	2,4-Dimethylphenol	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	51-28-5	2,4-Dinitrophenol	2	0	0.0%	20	--	mg/kg	20	--	--	NO	IFD
SVOCs	121-14-2	2,4-Dinitrotoluene	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	606-20-2	2,6-Dinitrotoluene	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	91-58-7	2-Chloronaphthalene	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	95-57-8	2-Chlorophenol	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	88-74-4	2-Nitroaniline	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	88-75-5	2-Nitrophenol	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	91-94-1	3,3'-Dichlorobenzidine	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	534-52-1	4,6-Dinitro-2-Methylphenol	2	0	0.0%	20	--	mg/kg	20	--	--	NO	IFD
SVOCs	59-50-7	4-Chloro-3-Methylphenol	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	106-47-8	4-Chloroaniline	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	7005-72-3	4-Chlorophenyl-Phenylether	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	100-01-6	4-Nitroaniline	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	100-02-7	4-Nitrophenol	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	100-51-6	Benzyl Alcohol	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	117-81-7	Bis(2-Ethylhexyl) Phthalate	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	85-68-7	Butyl benzyl phthalate	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	86-74-8	Carbazole	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	132-64-9	Dibenzofuran	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	84-74-2	Dibutyl phthalate	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	84-66-2	Diethyl phthalate	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	131-11-3	Dimethyl phthalate	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	117-84-0	Di-N-Octyl Phthalate	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	118-74-1	Hexachlorobenzene	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	87-68-3	Hexachlorobutadiene	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	77-47-4	Hexachlorocyclopentadiene	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	78-59-1	Isophorone	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	99-09-2	m-Nitroaniline	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	98-95-3	Nitrobenzene	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD

Table E-10. Ling Cod (Whole Organism) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
SVOCs	621-64-7	N-Nitrosodi-n-propylamine	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	86-30-6	N-Nitrosodiphenylamine	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	95-48-7	o-Cresol	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	106-44-5	p-Cresol	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
SVOCs	87-86-5	Pentachlorophenol	2	0	0.0%	9.8	--	mg/kg	9.8	--	--	NO	IFD
SVOCs	108-95-2	Phenol	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	95-50-1	1,2-Dichlorobenzene	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	541-73-1	1,3-Dichlorobenzene	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	106-46-7	1,4-Dichlorobenzene	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	108-60-1	2,2'-Oxybis[1-chloropropane]	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	111-91-1	Bis(2-Chloroethoxy)Methane	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	111-44-4	Bis(2-Chloroethyl)Ether	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD
VOCs	67-72-1	Hexachloroethane	2	0	0.0%	2	--	mg/kg	2	--	--	NO	IFD

Notes:
(1) Maximum detected concentration or highest detection limit, whichever is greater.
(2) Dungeness Bay.
(3) Screening toxicity value (for marine benthic life) from Table 4-1.
(4) Rationale codes:
- for selection: ASL = above screening level
  ASL; Bkg na = above screening level; background not available.
  CON = conventional parameter used for data interpretation and evaluation.
  log Kow >3.5 = logarithm of octanol-water partition coefficient greater than 3.5.
  NSL; Bkg na/nd = no screening level; background not available/not detected
  NSL; >Bkg = no screening level; greater than background
- for exclusion: BSL = below screening level
  IFD = infrequently (less than 5%) detected
  NSL; <Bkg = no screening level (NSL); less than background
  NUT = essential nutrient

Key:
-- (double dash) = not available or not applicable
CAS = Chemical Abstract Service
IHS = indicator hazardous substance
na = not applicable or not available
ND = not detected
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCDD = polychlorinated dibenzo dioxins
PCDF = polychlorinated dibenzo furans
SVOC = semivolitile organic compound
TEQ = toxic equivalent
VOC = volatile organic compound

Table E-11. Rock Sole (Whole Organism) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
General Chem	LIPIDS	Lipids	3	3	100.0%	--	0.54	%	0.54	--	--	NO	CON
General Chem	TS	Total Solids	3	3	100.0%	--	22.7	%	22.7	--	--	NO	CON
Metals	7440-38-2	Arsenic	3	3	100.0%	--	2.77	mg/kg	2.77	1.24	3	YES	NSL; >Bkg
Metals	7440-38-2-Inorg	Arsenic, Inorganic	3	3	100.0%	--	0.013	mg/kg	0.013	--	--	YES	NSL; Bkg na/nd
Metals	7440-43-9	Cadmium	3	2	66.7%	0.002	0.005	mg/kg	0.005	0.02	0	NO	NSL; <Bkg
Metals	7440-50-8	Copper	3	3	100.0%	--	0.24	mg/kg	0.24	0.48	0	NO	NSL; <Bkg
Metals	7782-49-2	Selenium	3	3	100.0%	--	0.4	mg/kg	0.4	--	--	YES	NSL; Bkg na/nd
Metals	7440-66-6	Zinc	3	3	100.0%	--	4.66	mg/kg	4.66	13.2	0	NO	NSL; <Bkg
Organometalics	22967-92-6	Methylmercury(1+)	3	3	100.0%	--	0.05	mg/kg	0.05	0.01	3	YES	NSL; >Bkg
Organometalics	78-00-2	Tetraethyl Lead	3	3	100.0%	--	0.007	mg/kg	0.007	0.02	0	NO	NSL; <Bkg
PAH Totals	HPAH	High MW PAHs	2	1	50.0%	0.0000004	0.0000004	mg/kg	0.0000004	--	--	YES	NSL; Bkg na/nd
PAH Totals	HPAH0	High MW PAHs ND=0	2	1	50.0%	0	0.00039	mg/kg	0.00039	--	--	YES	NSL; Bkg na/nd
PAH Totals	HPAH05	High MW PAHs ND=0.5	2	1	50.0%	0.001025085	0.001230085	mg/kg	0.001230085	--	--	YES	NSL; Bkg na/nd
PAH Totals	LPAH	Low MW PAHs	2	2	100.0%	--	0.000001	mg/kg	0.000001	0.0000015	0	NO	NSL; <Bkg
PAH Totals	LPAH0	Low MW PAHs ND=0	2	2	100.0%	--	0.00104	mg/kg	0.00104	0.00153	0	NO	NSL; <Bkg
PAH Totals	LPAH05	Low MW PAHs ND=0.5	2	2	100.0%	--	0.0012	mg/kg	0.0012	0.00165	0	NO	NSL; <Bkg
PAH Totals	TotPAH0	Total PAHs ND=0	2	0	0.0%	0	--	mg/kg	0	--	--	NO	IFD
PAH Totals	TotPAH05	Total PAHs ND=0.5	2	0	0.0%	0.00009185	--	mg/kg	0.00009185	--	--	NO	IFD
PAHs	91-57-6	2-Methylnaphthalene	2	0	0.0%	0.00056	--	mg/kg	0.00056	0.00057	0	NO	IFD
PAHs	83-32-9	Acenaphthene	2	0	0.0%	0.00008	--	mg/kg	0.00008	0.00021	0	NO	IFD
PAHs	208-96-8	Acenaphthylene	2	0	0.0%	0.00012	--	mg/kg	0.00012	--	--	NO	IFD
PAHs	120-12-7	Anthracene	2	0	0.0%	0.00012	--	mg/kg	0.00012	--	--	NO	IFD
PAHs	56-55-3	Benz[a]anthracene	2	0	0.0%	0.00017	--	mg/kg	0.00017	--	--	NO	IFD
PAHs	50-32-8	Benzo(a)pyrene	2	0	0.0%	0.0001	--	mg/kg	0.0001	--	--	NO	IFD
PAHs	205-99-2	Benzo(b)fluoranthene	2	0	0.0%	0.00015	--	mg/kg	0.00015	--	--	NO	IFD
PAHs	191-24-2	Benzo(ghi)perylene	2	0	0.0%	0.0002	--	mg/kg	0.0002	--	--	NO	IFD
PAHs	207-08-9	Benzo(k)fluoranthene	2	0	0.0%	0.00017	--	mg/kg	0.00017	--	--	NO	IFD
PAHs	BnzFluor-bkj	Benzofluoranthenes, Total (b+k+j)	2	0	0.0%	0.00000017	--	mg/kg	0.00000017	--	--	NO	IFD
PAHs	218-01-9	Chrysene	2	0	0.0%	0.00017	--	mg/kg	0.00017	--	--	NO	IFD
PAHs	53-70-3	Dibenzo(a,h)anthracene	2	0	0.0%	0.00015	--	mg/kg	0.00015	--	--	NO	IFD
PAHs	206-44-0	Fluoranthene	2	1	50.0%	0.00037	0.00039	mg/kg	0.00039	--	--	YES	NSL; Bkg na/nd
PAHs	193-39-5	Indeno(1,2,3-cd)pyrene	2	0	0.0%	0.00018	--	mg/kg	0.00018	--	--	NO	IFD
PAHs	91-20-3	Naphthalene	2	1	50.0%	0.00055	0.00057	mg/kg	0.00057	0.00077	0	NO	NSL; <Bkg
PAHs	85-01-8	Phenanthrene	2	2	100.0%	--	0.00047	mg/kg	0.00047	0.00055	0	NO	NSL; <Bkg
PAHs	129-00-0	Pyrene	2	0	0.0%	0.00039	--	mg/kg	0.00039	--	--	NO	IFD
PCB Aroclors	53469-21-9	PCB-aroclor 1242	2	0	0.0%	0.0019	--	mg/kg	0.0019	--	--	NO	IFD
PCB Aroclors	11097-69-1	PCB-aroclor 1254	2	0	0.0%	0.0019	--	mg/kg	0.0019	0.0028	0	NO	IFD
PCB Aroclors	11096-82-5	PCB-aroclor 1260	2	0	0.0%	0.0019	--	mg/kg	0.0019	0.0031	0	NO	IFD
PCB Totals	1336-36-3	PCB	2	0	0.0%	0.017	--	mg/kg	0.017	--	--	NO	IFD
PCB Totals	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	2	0	0.0%	0	--	mg/kg	0	0.0059	0	NO	IFD
PCB Totals	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	2	0	0.0%	0.00285	--	mg/kg	0.00285	0.00685	0	NO	IFD
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	3	1	33.3%	0	1.47E-09	mg/kg	1.47E-09	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	3	1	33.3%	1.01E-06	3.74E-07	mg/kg	1.01E-06	--	--	YES	NSL; Bkg na/nd
PCDD/PCDF Totals	37871-00-4	Total HpCDD	3	0	0.0%	1.96E-06	--	mg/kg	1.96E-06	--	--	NO	IFD
PCDD/PCDF Totals	38998-75-3	Total HpCDF	3	0	0.0%	1.03E-06	--	mg/kg	1.03E-06	--	--	NO	IFD
PCDD/PCDF Totals	34465-46-8	Total HxCDD	3	0	0.0%	9.50E-07	--	mg/kg	9.50E-07	--	--	NO	IFD
PCDD/PCDF Totals	55684-94-1	Total HxCDF	3	0	0.0%	4.60E-07	--	mg/kg	4.60E-07	--	--	NO	IFD
PCDD/PCDF Totals	36088-22-9	Total PeCDD	3	0	0.0%	7.40E-07	--	mg/kg	7.40E-07	--	--	NO	IFD
PCDD/PCDF Totals	30402-15-4	Total PeCDF	3	0	0.0%	4.70E-07	--	mg/kg	4.70E-07	--	--	NO	IFD
PCDD/PCDF Totals	41903-57-5	Total TCDD	3	0	0.0%	5.30E-07	--	mg/kg	5.30E-07	--	--	NO	IFD
PCDD/PCDF Totals	30402-14-3	Total TCDF	3	0	0.0%	5.80E-07	--	mg/kg	5.80E-07	--	--	NO	IFD
PCDDs/PCDFs	35822-46-9	1,2,3,4,6,7,8-HpCDD	3	0	0.0%	1.96E-06	--	mg/kg	1.96E-06	--	--	NO	IFD
PCDDs/PCDFs	67562-39-4	1,2,3,4,6,7,8-HpCDF	3	0	0.0%	1.03E-06	--	mg/kg	1.03E-06	--	--	NO	IFD
PCDDs/PCDFs	55673-89-7	1,2,3,4,7,8,9-HpCDF	3	0	0.0%	1.84E-06	--	mg/kg	1.84E-06	--	--	NO	IFD
PCDDs/PCDFs	39227-28-6	1,2,3,4,7,8-HxCDD	3	0	0.0%	8.70E-07	--	mg/kg	8.70E-07	--	--	NO	IFD
PCDDs/PCDFs	70648-26-9	1,2,3,4,7,8-HxCDF	3	0	0.0%	4.80E-07	--	mg/kg	4.80E-07	--	--	NO	IFD
PCDDs/PCDFs	57653-85-7	1,2,3,6,7,8-HxCDD	3	0	0.0%	9.50E-07	--	mg/kg	9.50E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-44-9	1,2,3,6,7,8-HxCDF	3	0	0.0%	4.60E-07	--	mg/kg	4.60E-07	--	--	NO	IFD
PCDDs/PCDFs	19408-74-3	1,2,3,7,8,9-HxCDD	3	0	0.0%	8.90E-07	--	mg/kg	8.90E-07	--	--	NO	IFD

Table E-11. Rock Sole (Whole Organism) Screening Results for the Ecological Risk Assessment, Port Angeles Harbor Marine Environment.

Analyte Group	CAS Number	Chemical Name	Number of Observations	Number of Detects	Detection Frequency	Maximum Nondetected Concentration	Maximum Detected Concentration	Units	Concentration Used for Screening (1)	Background Value (2)	Number of Detected Observations Above Background	IHS Flag (Y/N)	Rationale for Selection or Exclusion (4)
PCDDs/PCDFs	72918-21-9	1,2,3,7,8,9-HxCDF	3	0	0.0%	7.40E-07	--	mg/kg	7.40E-07	--	--	NO	IFD
PCDDs/PCDFs	40321-76-4	1,2,3,7,8-PeCDD	3	0	0.0%	7.40E-07	--	mg/kg	7.40E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-41-6	1,2,3,7,8-PeCDF	3	0	0.0%	5.30E-07	--	mg/kg	5.30E-07	--	--	NO	IFD
PCDDs/PCDFs	60851-34-5	2,3,4,6,7,8-HxCDF	3	0	0.0%	5.50E-07	--	mg/kg	5.50E-07	--	--	NO	IFD
PCDDs/PCDFs	57117-31-4	2,3,4,7,8-PeCDF	3	0	0.0%	4.70E-07	--	mg/kg	4.70E-07	--	--	NO	IFD
PCDDs/PCDFs	1746-01-6	2,3,7,8-TCDD	3	0	0.0%	5.30E-07	--	mg/kg	5.30E-07	--	--	NO	IFD
PCDDs/PCDFs	51207-31-9	2,3,7,8-TCDF	3	0	0.0%	5.80E-07	--	mg/kg	5.80E-07	--	--	NO	IFD
PCDDs/PCDFs	3268-87-9	OCDD	3	1	33.3%	2.61E-06	4.91E-06	mg/kg	4.91E-06	--	--	YES	NSL; Bkg na/nd
PCDDs/PCDFs	39001-02-0	OCDF	3	0	0.0%	2.46E-06	--	mg/kg	2.46E-06	--	--	NO	IFD
Pesticides	72-54-8	4,4'-DDD	2	0	0.0%	0.00032	--	mg/kg	0.00032	--	--	NO	IFD
Pesticides	72-55-9	4,4'-DDE	2	0	0.0%	0.00033	--	mg/kg	0.00033	0.0022	0	NO	IFD
Pesticides	50-29-3	4,4'-DDT	2	2	100.0%	--	0.00039	mg/kg	0.00039	0.001	0	NO	NSL; <Bkg
Pesticides	319-84-6	Alpha-BHC	2	0	0.0%	0.00028	--	mg/kg	0.00028	--	--	NO	IFD
Pesticides	319-85-7	Beta-BHC	2	0	0.0%	0.00036	--	mg/kg	0.00036	--	--	NO	IFD
Pesticides	319-86-8	Delta-BHC	2	0	0.0%	0.00031	--	mg/kg	0.00031	--	--	NO	IFD
Pesticides	58-89-9	Lindane	2	0	0.0%	0.0002	--	mg/kg	0.0002	--	--	NO	IFD
SVOCs	87-86-5	Pentachlorophenol	2	0	0.0%	0.091	--	mg/kg	0.091	--	--	NO	IFD
SVOCs	110-86-1	Pyridine	2	0	0.0%	0.018	--	mg/kg	0.018	--	--	NO	IFD

Notes:
(1) Maximum detected concentration or highest detection limit, whichever is greater.
(2) Dungeness Bay.
(3) Screening toxicity value (for marine benthic life) from Table 4-1.
(4) Rationale codes:
- for selection: ASL = above screening level
  ASL; Bkg na = above screening level; background not available.
  CON = conventional parameter used for data interpretation and evaluation.
  log Kow >3.5 = logarithm of octanol-water partition coefficient greater than 3.5.
  NSL; Bkg na/nd = no screening level; background not available/not detected
  NSL; >Bkg = no screening level; greater than background
- for exclusion: BSL = below screening level
  IFD = infrequently (less than 5%) detected
  NSL; <Bkg = no screening level (NSL); less than background
  NUT = essential nutrient

Key:
-- (double dash) = not available or not applicable
CAS = Chemical Abstract Service
IHS = indicator hazardous substance
na = not applicable or not available
ND = not detected
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PCDD = polychlorinated dibenzo dioxins
PCDF = polychlorinated dibenzo furans
SVOC = semivolitile organic compound
TEQ = toxic equivalent
VOC = volatile organic compound

Attachment F - Wildlife Exposure Parameter Supporting Information

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ATTACHMENT F

SUPPLEMENTAL INFORMATION ON WILDLIFE EXPOSURE FACTORS

INTRODUCTION

This appendix provides supplemental information regarding the sources and derivation of the wildlife exposure factors proposed for use in the Port Angeles Harbor ecological risk assessment. The following points are noteworthy:

- Food ingestion rates are presented on a wet-weight basis and sediment ingestion rates are presented on a dry-weight basis, consistent with the reporting basis for tissue samples (wet weight basis) and sediment samples (dry weight basis).

- When it was necessary to convert the food ingestion rate from a dry- to wet-weight basis or visa versa, the food moisture content assumptions provided in USEPA (1999, Table 5-1, footnote e) were used (i.e., 68% food moisture content for carnivores, 78% food moisture content for omnivores, and 88% food moisture content for herbivores).

- Sediment ingestion rates were calculated as in USEPA (1999, Table 5-1) as the product of the dry food ingestion rate and percent soil in diet.

- The wildlife receptors from the final risk assessment work plan for Port Angeles Harbor are bald eagle, brant, double-crested cormorant, greater scaup, harbor seal, and raccoon.

The supplemental information on exposure parameters for these receptors is organized below by receptor. The following abbreviations are used:

- BW = body weight
- DW = dry weight
- IR = ingestion rate
- kg = kilogram
- WW = wet weight

Values that will be used in the Port Angeles Harbor ecological risk assessment are underlined.

BALD EAGLE (*Haliaeetus leucocephalus*)

- Body weight of <u>5.35 kg</u> is mean female body weight of from Dunning (1993).

- Food ingestion rate was calculated using equation 3-3 from USEPA (1993) and assumption of 68% moisture content of food (fish), as shown below:

$$\text{IR-food (g DW/day)} = 0.648\text{BW}^{0.651}\text{ (g)} = 173.3\text{ g DW/day} = 0.173\text{ kg DW/day}$$
$$\text{IR-food (WW)} = 0.173\text{ kg DW/day} / (1\text{-\% moisture}/100) = 0.173\text{ kg DW/kg BW-day} / (1-0.68)$$
$$= \underline{0.54\text{ kg WW/day}}$$

- Sediment ingestion rate assumed to be 2% of IR-food (DW):

$$0.173\text{ kg DW/day} \times 0.02 = \underline{0.0035\text{ kg DW/day}}$$

BRANT (*Branta bernicla*)

- Body weight of <u>1.23 kg</u> is mean female body weight from Dunning (1993).

- Food ingestion rate calculated using equation 3-3 from USEPA (1993) and assumption of 88% moisture content of food (vegetation), as shown below:

$$\text{IR-food (g DW/day)} = 0.648\text{BW}^{0.651}\text{(g)} = 66.54 \text{ g DW/day} = 0.067 \text{ kg DW/day}$$
$$\text{IR-food (WW)} = 0.067 \text{ kg DW/day} / (1\text{-\% moisture}/100) = 0.067 \text{ kg DW/day} / (1-0.88)$$
$$= \underline{0.55 \text{ kg WW/day}}$$

- Sediment ingestion rate of 8.2% of IR-food (DW) assumed based on Beyer et al (1994) for Canada goose:

$$0.067 \text{ kg DW/day} \times 0.082 = \underline{0.0055 \text{ kg DW/day}}$$

DOUBLE-CRESTED CORMORANT (*Phalacrocorax auritus*)

- Body weight of <u>1.54 kg</u> is mean female body weight from Dunning (1993).

- Food ingestion rate calculated using equation 3-3 from USEPA (1993) and assumption of 68% moisture content of food (fish), as shown below:

$$\text{IR-food (g DW/day)} = 0.648\text{BW}^{0.651}\text{(g)} = 77.03 \text{ g DW/day} = 0.077 \text{ kg DW/day}$$
$$\text{IR-food (WW)} = 0.077 \text{ kg DW/day} / (1\text{-\% moisture}/100) = 0.077 \text{ kg DW/day} / (1-0.68)$$
$$= \underline{0.24 \text{ kg WW/day}}$$

- Sediment ingestion rate assumed to be 2% of IR-food (DW):

$$0.077 \text{ kg DW/day} \times 0.02 = \underline{0.0015 \text{ kg DW/day}}$$

GREATER SCAUP (*Aythya marila*)

- Body weight of <u>0.957 kg</u> is mean female body weight from Dunning (1993).

- Food ingestion rate calculated using equation 3-3 from USEPA (1993) and assumption of 78% moisture content of food (vegetation and invertebrates), as shown below:

$$\text{IR-food (g DW/day)} = 0.648\text{BW}^{0.651}\text{(g)} = 56.6 \text{ g DW/day} = 0.057 \text{ kg DW/day}$$
$$\text{IR-food (WW)} = 0.057 \text{ kg DW/day} / (1\text{-\% moisture}/100) = 0.057 \text{ kg DW/day} / (1-0.78)$$
$$= \underline{0.26 \text{ kg WW/day}}$$

- Sediment ingestion rate of 3.3% of IR-food (DW) assumed based on Beyer et al (1994) for mallard:

$$0.057 \text{ kg DW/day} \times 0.033 = \underline{0.0019 \text{ kg DW/day}}$$

HARBOR SEAL (*Phoca Vitulina)*

- Body weight of <u>77.5 kg</u> is midpoint of weigh range at sexual maturity from USEPA (1993).

- Food ingestion rate (WW) calculated using equation for free-living adults from USEPA (1993, page 2-277), as shown below:

$$\text{IR-food (kg WW/day)} = 0.089\text{BW}^{0.76}\text{(kg)} = \underline{2.43 \text{ kg WW/day}}$$

- Sediment ingestion rate of 2% of IR-food (DW) assumed.

$$\text{IR-food (DW)} = \text{IR-food WW} \times (1\text{-\%moisture}/100) = 2.43 \text{ kg WW/day} \times (1-0.68) = 0.78 \text{ kg DW/day}$$
$$\text{IR-sediment (DW)} = 0.78 \text{ kg DW/day} \times 0.02 = \underline{0.016 \text{ kg DW /day}}$$

RACCOON (*Procyon lotor*)

- Body weight of 5.8 kg is average of adult male and female body weights listed in USEPA (1993).

- Food ingestion rate calculated using equation 3-7 from USEPA (1993) and assumption of 68% moisture content of food (invertebrates and fish), as shown below:

$$\text{IR-food (g DW/day)} = 0.235\text{BW}^{0.822}\text{ (g)} = 291\text{ g DW/day} = 0.291\text{ kg DW/day}$$
$$\text{IR-food (WW)} = 0.291\text{kg DW/day} / (1\text{-\% moisture}/100) = 0.291\text{kg DW/day} / (1-0.68)$$
$$= \underline{0.91\text{ kg WW/day}}$$

- Sediment ingestion rate of 9.4% of IR-food (DW) assumed based on Beyer et al. (1994):

$$0.291\text{kg DW/day} \times 0.094 = \underline{0.027\text{ kg DW/day}}$$

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Attachment G – Exposure Point Concentrations for Selected Media for the Ecological Risk Assessment

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Attachment G – Exposure Point Concentrations for Selected Media for the Ecological Risk Assessment

This attachment presents exposure point concentrations (EPCs) for Dungeness crab and horse clam for use in the ecological risk assessment (ERA). Whole-body EPCs for Dungeness crab and horse clam, estimated as described below, were used in the ERA.

For Dungeness crab, whole-body EPCs were estimated from separate chemical analyses of hepatopancreas and muscle tissue, assuming that the average crab is 75% muscle and 25% hepatopancreas (see Section 3.3 for rationale). The hepatopancreas and muscle tissue data were taken from Malcolm Pirnie (2006, 2007, see Table 2-3). Because the number of observations was limited for most chemicals (n = 3), the maximum detected concentration or one-half of the maximum detection limit was used as the EPC. For dioxins/furans and dioxin-like PCB congeners, the sample size (11 and 8, respectively) was great enough for an upper confidence limit (UCL) on the average concentration to be calculated using ProUCL version 4 software (see Table G-1). The UCL was used as the EPC for these two chemical groups.

The horse clam database for Port Angeles Harbor is comprised of 17 true whole-body samples and 10 reconstituted whole-body samples (see Table 2-3). Reconstituted whole-body chemical concentrations were estimated based on separate chemical analysis of viscera and edible tissue, assuming that an average clam is 56% viscera and 44% edible tissue (see Section 3.3 for rationale). For most chemicals, ProUCL version 4 software was used to calculate a UCL because an adequate number of observations (8 to 27) was available (see Table G-2). When the number of observations was limited (less than 8), the maximum detected concentration was used as the EPC. When all observations were reported as “non-detect”, one-half of the maximum detection limit was used as the EPC.

Table G-1. Exposure Point Concentrations for Whole Body[a] Dungnesess Crab for the Port Angeles Harbor Ecological Risk Assessment.

Analyte Group	CAS Number	Chemical Name	Units	NObs	NDet	MaxDet	Arith_ Mean_ Det	UCL	UCL Units	EPC	Statistic	Rationale
Metals	7440-38-2	Arsenic	mg/kg	3	3	13.03	12.78	None	mg/kg	13.03	Max Det	No UCL stats available
Metals	7440-38-2-Inorg	Arsenic, Inorganic	mg/kg	3	3	0.0605	0.053	None	mg/kg	0.0605	Max Det	No UCL stats available
Metals	7440-43-9	Cadmium	mg/kg	3	3	0.926	0.762	None	mg/kg	0.926	Max Det	No UCL stats available
Metals	7440-50-8	Copper	mg/kg	3	3	28.95	22.45	None	mg/kg	28.95	Max Det	No UCL stats available
Metals	7782-49-2	Selenium	mg/kg	3	3	1.375	1.3	None	mg/kg	1.375	Max Det	No UCL stats available
Metals	7440-66-6	Zinc	mg/kg	3	3	43.55	41.2	None	mg/kg	43.55	Max Det	No UCL stats available
Organometalics	22967-92-6	Methylmercury(1+)	mg/kg	3	3	0.13	0.118	None	mg/kg	0.13	Max Det	No UCL stats available
Organometalics	78-00-2	Tetraethyl Lead	mg/kg	3	3	0.017	0.0148	None	mg/kg	0.017	Max Det	No UCL stats available
PAH Totals	HPAH0	High MW PAHs ND=0	mg/kg	3	1	0.00142	0.00142	None	mg/kg	0.00142	Max Det	No UCL stats available
PAH Totals	HPAH05	High MW PAHs ND=0.5	mg/kg	3	1	0.0022	0.0022	None	mg/kg	0.0022	Max Det	No UCL stats available
PAH Totals	LPAH0	Low MW PAHs ND=0	mg/kg	3	3	0.00122	9.35E-04	None	mg/kg	0.00122	Max Det	No UCL stats available
PAH Totals	LPAH05	Low MW PAHs ND=0.5	mg/kg	3	3	0.00169	0.00145	None	mg/kg	0.00169	Max Det	No UCL stats available
PCB Totals	1336-36-3	PCB	mg/kg	3	3	0.278	0.118	None	mg/kg	0.278	Max Det	No UCL stats available
PCB Totals	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	mg/kg	3	3	0.278	0.117	None	mg/kg	0.278	Max Det	No UCL stats available
PCB Totals	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	mg/kg	3	3	0.278	0.118	None	mg/kg	0.278	Max Det	No UCL stats available
PC B Congeners	PCB TEQ ND0	PCB Congeners, mammalian TEQ (ND=0)	mg/kg	8	8	2.30E-05	1.02E-05	1.41E-05	mg/kg	1.41E-05	95% Student's-t UCL	ProUCL recommendation
PC B Congeners	PCB TEQ ND05	PCB Congeners, mammalian TEQ (ND=0.5)	mg/kg	8	8	2.30E-05	1.03E-05	1.42E-05	mg/kg	1.42E-05	95% Student's-t UCL	ProUCL recommendation
PC B Congeners	PCB TEQ ND0 avian	PCB Congeners, avian TEQ (ND=0)	mg/kg	8	8	2.13E-05	1.65E-05	1.91E-05	mg/kg	1.91E-05	95% Student's-t UCL	ProUCL recommendation
PC B Congeners	PCB TEQ ND05 avian	PCB Congeners, avian TEQ (ND=0.5)	mg/kg	8	8	2.17E-05	1.65E-05	1.92E-05	mg/kg	1.92E-05	95% Student's-t UCL	ProUCL recommendation
PCB Totals	PCB-Tot-Cong	PCB, Sum of Congeners	mg/kg	8	8	1.49	1.029	1.2662673	mg/kg	1.2662673	95% Student's-t UCL	ProUCL recommendation
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins/Furans as 2,3,7,8-TCDD TEQs; ND=0	mg/kg	11	11	9.75E-06	4.62E-06	6.40E-06	mg/kg	6.40E-06	95% Student's-t UCL	ProUCL recommendation
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins/Furans as 2,3,7,8-TCDD TEQs; ND=0.5	mg/kg	11	11	9.75E-06	4.68E-06	6.43E-06	mg/kg	6.43E-06	95% Student's-t UCL	ProUCL recommendation
Pesticides		4,4'-DDD	mg/kg	3	0	None	None	None	mg/kg	2.45E-04	max ND/2	No UCL stats available
Pesticides	72-55-9	4,4'-DDE	mg/kg	3	3	0.00367	0.00313	None	mg/kg	0.00367	Max Det	No UCL stats available
Pesticides	50-29-3	4,4'-DDT	mg/kg	3	3	0.031	0.0132	None	mg/kg	0.031	Max Det	No UCL stats available
Pesticides	319-84-6	Alpha-BHC	mg/kg	3	3	7.10E-04	6.43E-04	None	mg/kg	7.10E-04	Max Det	No UCL stats available
Pesticides	319-85-7	Beta-BHC	mg/kg	3	3	7.95E-04	7.62E-04	None	mg/kg	7.95E-04	Max Det	No UCL stats available
Pesticides	319-86-8	Delta-BHC	mg/kg	3	1	9.55E-04	8.96E-04	None	mg/kg	9.55E-04	Max Det	No UCL stats available
Pesticides	58-89-9	Lindane	mg/kg	3	0	None	None	None	mg/kg	4.12E-04	max ND/2	No UCL stats available
SVOCs	87-86-5	Pentachlorophenol	mg/kg	3	0	None	None	None	mg/kg	0.0455	max ND/2	No UCL stats available
SVOCs	110-86-1	Pyridine	mg/kg	3	0	None	None	None	mg/kg	0.009	max ND/2	No UCL stats available

Key:
BHC = benzene hexachloride
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPC = exposure point concentration
HPAH = high molecular weight PAHs
KM (t) UCL = UCL based on Kaplan-Meier estimate using standard normal distribution cutoff value
KM (Chebyshev) UCL = UCL based on Kaplan-Meier estimate using Chebyshev inequality
KM (BCA) UCL = UCL based on Kaplan-Meier estimate using bias-corrected accelerated bootstrap method cutoff value
LPAH = low molecular weight PAHs
na = not analyzed or not applicable
ND = non-detect
TCDD = tetrachlorodibenzo-p- dioxin
TEQ = toxic equivalent
UCL = upper confidence limit

Notes:
a = Whole-body concentrations were estimated from separate chemical analyses of hepatopancreas and muscle tissue, assuming that an average crab was 75% muscle and 25% hepatopancreas (see Section 3.3).

Table G-2. Exposure Point Concentrations for Whole Body[a] Horse Clam for the Port Angeles Harbor Ecological Risk Assessment.

Analyte Group	CAS Number	Chemical Name	Units	NObs	NDet	MaxDet	Arith_ Mean_ Det	UCL	UCL Units	EPC	Statistic	Rationale
Metals	7440-36-0	Antimony	mg/kg	8	2	0.021	0.0195	0.019315	mg/kg	0.019315	95% KM (t) UCL	ProUCL recommendation
Metals	7440-38-2	Arsenic	mg/kg	17	16	23.34	3.6105882	9.139676	mg/kg	9.139676	95% Chebyshev (Mean, Sd) UCL	ProUCL recommendation
Metals	7440-38-2-Inorg	Arsenic, Inorganic	mg/kg	9	9	1.35	0.5344444	0.7768228	mg/kg	0.7768228	95% Student's-t UCL	ProUCL recommendation
Metals	7440-39-3	Barium	mg/kg	8	8	3	1.34125	1.9650593	mg/kg	1.9650593	95% KM (t) UCL	ProUCL recommendation
Metals	7440-43-9	Cadmium	mg/kg	17	17	0.35	0.2323529	0.2609754	mg/kg	0.2609754	95% Student's-t UCL	ProUCL recommendation
Metals	7440-47-3	Chromium	mg/kg	8	8	1.8	0.85625	1.4468847	mg/kg	1.4468847	95% KM (Chebyshev) UCL	ProUCL recommendation
Metals	7440-50-8	Copper	mg/kg	17	17	2.5	1.6088235	1.7698339	mg/kg	1.7698339	95% Student's-t UCL	ProUCL recommendation
Metals	7439-92-1	Lead	mg/kg	8	4	1	0.7925	0.7976454	mg/kg	0.7976454	95% KM (t) UCL	ProUCL recommendation
Metals	7439-97-6	Mercury	mg/kg	8	5	0.027	0.0187143	0.0214688	mg/kg	0.0214688	95% KM (t) UCL	ProUCL recommendation
Metals	7440-02-0	Nickel	mg/kg	8	8	1.4	1.0725	1.246353	mg/kg	1.246353	95% KM (t) UCL	ProUCL recommendation
Metals	7782-49-2	Selenium	mg/kg	9	9	1.9	0.6	0.9963759	mg/kg	0.9963759	95% Approximate Gamma UCL	ProUCL recommendation
Metals	7440-22-4	Silver	mg/kg	8	8	1.2	0.57125	0.8580957	mg/kg	0.8580957	95% KM (t) UCL	ProUCL recommendation
Metals	7440-66-6	Zinc	mg/kg	17	17	12	9.0270588	9.6419294	mg/kg	9.6419294	95% Student's-t UCL	ProUCL recommendation
Organometalics	22967-92-6	Methylmercury(1+)	mg/kg	9	9	0.01	0.01	0.01	mg/kg	0.01	Max Detected Value	No UCL statistics available
Organometalics	78-00-2	Tetraethyl Lead	mg/kg	9	9	2.91	0.89	1.9993555	mg/kg	1.9993555	95% Approximate Gamma UCL	ProUCL recommendation
PAH Totals	HPAH0	High MW PAHs ND=0	mg/kg	17	15	0.762	0.081	0.347	mg/kg	0.347	97.5% KM (Chebyshev) UCL	ProUCL recommendation
PAH Totals	HPAH05	High MW PAHs ND=0.5	mg/kg	17	15	0.762	0.082	0.347	mg/kg	0.347	97.5% KM (Chebyshev) UCL	ProUCL recommendation
PAH Totals	LPAH0	Low MW PAHs ND=0	mg/kg	17	17	0.638	0.052	0.282	mg/kg	0.282	97.5% KM (Chebyshev) UCL	ProUCL recommendation
PAH Totals	LPAH05	Low MW PAHs ND=0.5	mg/kg	17	17	0.638	0.052	0.282	mg/kg	0.282	97.5% KM (Chebyshev) UCL	ProUCL recommendation
PCB Congeners	PCB dioxin-like	PCB, TEQ for dioxin-like congeners; ND=0	mg/kg	18	18	5.33E-07	1.55E-07	3.37E-07	mg/kg	3.37E-07	95% KM (Chebyshev) UCL	ProUCL recommendation
PCB Congeners	PCB dioxin-like	PCB, TEQ for dioxin-like congeners; ND=0.5	mg/kg	18	18	5.35E-07	1.85E-07	3.57E-07	mg/kg	3.57E-07	95% KM (Chebyshev) UCL	ProUCL recommendation
PCB Congeners	PCB dioxin-like	PCB, TEQ for dioxin-like congeners; ND=0 avian	mg/kg	18	18	5.51E-07	3.07E-07	4.96E-07	mg/kg	4.96E-07	95% KM (Chebyshev) UCL	ProUCL recommendation
PCB Congeners	PCB dioxin-like	PCB, TEQ for dioxin-like congeners; ND=0.5 avian	mg/kg	18	18	5.72E-07	3.44E-07	5.35E-07	mg/kg	5.35E-07	95% KM (Chebyshev) UCL	ProUCL recommendation
PCB Totals	PCB-Tot-Aro ND0	PCB, Sum of Aroclors, ND0	mg/kg	9	9	0.036	0.0259	0.0297	mg/kg	0.0297	95% KM (t) UCL	ProUCL recommendation
PCB Totals	PCB-Tot-AroND05	PCB, Sum of Aroclors, ND05	mg/kg	9	9	0.03695	0.0269	0.0307	mg/kg	0.0307	95% KM (t) UCL	ProUCL recommendation
PCB Totals	PCB-Tot-Cong	PCB, Sum of Congeners	mg/kg	10	10	0.038674	3.00E-02	3.36E-02	mg/kg	3.36E-02	95% Student's-t UCL	ProUCL recommendation
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0	mg/kg	27	25	2.81E-07	4.51E-08	1.53E-07	mg/kg	1.53E-07	99% KM (Chebyshev) UCL	ProUCL recommendation
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5	mg/kg	27	25	3.49E-07	1.45E-07	2.19E-07	mg/kg	2.19E-07	99% KM (Chebyshev) UCL	ProUCL recommendation
PCDD/PCDF Totals	PCDD/PCDF-TEQ0	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0 (avian)	mg/kg	17	15	2.43E-07	4.29E-08	2.08E-07	mg/kg	2.08E-07	99% KM (Chebyshev) UCL	ProUCL recommendation
PCDD/PCDF Totals	PCDD/PCDF-TEQ05	Dioxins and Furans as 2,3,7,8-TCDD TEQs; ND=0.5 (avian)	mg/kg	17	15	4.96E-07	2.71E-07	3.18E-07	mg/kg	3.18E-07	95% KM (t) UCL	ProUCL recommendation
Pesticides	72-54-8	4,4'-DDD	mg/kg	13	2	0.0016	0.00135	0.00123	mg/kg	0.00123	95% KM (t) UCL	ProUCL recommendation
Pesticides	72-55-9	4,4'-DDE	mg/kg	13	3	0.00087	6.30E-04	5.00E-04	mg/kg	5.00E-04	95% KM (t) UCL	ProUCL recommendation
Pesticides	50-29-3	4,4'-DDT	mg/kg	13	7	0.0051	0.0029	0.003	mg/kg	0.003	95% KM (t) UCL	ProUCL recommendation
Pesticides	319-84-6	Alpha-BHC	mg/kg	13	3	0.00063	5.13E-04	4.66E-04	mg/kg	4.66E-04	95% KM (t) UCL	ProUCL recommendation
Pesticides	319-85-7	Beta-BHC	mg/kg	13	2	0.00045	4.30E-04	4.21E-04	mg/kg	4.21E-04	95% KM (t) UCL	ProUCL recommendation
Pesticides	5103-71-9	cis-Chlordane	mg/kg	4	0	None	None	None	mg/kg	None	None	No Detected Values
Pesticides	319-86-8	Delta-BHC	mg/kg	13	0	None	None	None	mg/kg	1.55E-04	max ND/2	No Detected Values
Pesticides	60-57-1	Dieldrin	mg/kg	4	0	None	None	None	mg/kg	1.00E-04	max ND/2	No Detected Values
Pesticides	959-98-8	Endosulfan I	mg/kg	4	0	None	None	None	mg/kg	5.50E-05	max ND/2	No Detected Values
Pesticides	33213-65-9	Endosulfan II	mg/kg	4	0	None	None	None	mg/kg	1.25E-04	max ND/2	No Detected Values
Pesticides	1031-07-8	Endosulfan Sulfate	mg/kg	4	0	None	None	None	mg/kg	1.65E-04	max ND/2	No Detected Values
Pesticides	72-20-8	Endrin	mg/kg	4	0	None	None	None	mg/kg	2.00E-04	max ND/2	No Detected Values
Pesticides	7421-93-4	Endrin Aldehyde	mg/kg	4	0	None	None	None	mg/kg	1.20E-04	max ND/2	No Detected Values
Pesticides	53494-70-5	Endrin Ketone	mg/kg	4	0	None	None	None	mg/kg	1.20E-04	max ND/2	No Detected Values
Pesticides	5566-34-7	gamma-Chlordane	mg/kg	4	1	0.00042	0.00042	0.00042	mg/kg	4.20E-04	Max Detected Conc.	Only 1 detected value
Pesticides	76-44-8	Heptachlor	mg/kg	4	0	None	None	None	mg/kg	4.65E-04	max ND/2	No Detected Values
Pesticides	1024-57-3	Heptachlor Epoxide	mg/kg	4	0	None	None	None	mg/kg	6.00E-05	max ND/2	No Detected Values
Pesticides	58-89-9	Lindane	mg/kg	13	3	0.002	0.00147	0.00133	mg/kg	1.33E-03	95% KM (t) UCL	ProUCL recommendation
Pesticides	72-43-5	Methoxychlor	mg/kg	4	0	None	None	None	mg/kg	6.50E-04	max ND/2	No Detected Values
Pesticides	8001-35-2	Toxaphene	mg/kg	4	0	None	None	None	mg/kg	4.75E-03	max ND/2	No Detected Values
SVOCs	85-68-7	Butyl benzyl phthalate	mg/kg	8	0	None	None	None	mg/kg	1	max ND/2	No Detected Values
SVOCs	118-74-1	Hexachlorobenzene	mg/kg	8	0	None	None	None	mg/kg	1	max ND/2	No Detected Values
SVOCs	106-44-5	p-Cresol	mg/kg	8	0	None	None	None	mg/kg	1	max ND/2	No Detected Values
SVOCs	87-86-5	Pentachlorophenol	mg/kg	17	0	None	None	None	mg/kg	5	max ND/2	No Detected Values
SVOCs	108-95-2	Phenol	mg/kg	8	0	None	None	None	mg/kg	1	max ND/2	No Detected Values
SVOCs	110-86-1	Pyridine	mg/kg	9	0	None	None	None	mg/kg	0.009	max ND/2	No Detected Values

Key:
BHC = benzene hexachloride
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPC = exposure point concentration
HPAH = high molecular weight PAHs
KM (t) UCL = UCL based on Kaplan-Meier estimate using standard normal distribution cutoff value
KM (Chebyshev) UCL = UCL based on Kaplan-Meier estimate using Chebyshev inequality
KM (BCA) UCL = UCL based on Kaplan-Meier estimate using bias-corrected accelerated bootstrap method cutoff value
LPAH = low molecular weight PAHs
na = not analyzed or not applicable
ND = non-detect
TCDD = tetrachlorodibenzo-p- dioxin
TEQ = toxic equivalent
UCL = upper confidence limit

Notes:
a = In some studies, viscera and edible tissue were analyzed separately (see Table 2-3). In these cases, whole-body concentrations were estimated assuming that an average clam was 56% viscera and 44% edible tissue (see Section 3.3).

Attachment H – Letter from LEKT Regarding Consumption Rates

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LOWER ELWHA KLALLAM TRIBE

ʔəʔɬx̣ʷə nəxʷsƛ̕ay̕əm "Strong People"

2851 Lower Elwha Road
Port Angeles WA 98363

(360) 452-8471
Fax: (360) 452-3428

March 13, 2009

To: Cynthia Erickson
Washington State Department of Ecology
Toxics Cleanup Program

In response to your request, we are providing a recommended allocation of fish and shellfish representing species consumed by the Lower Elwha Tribal members. This is intended to provide a basis for using tissue concentrations for fish and shellfish species sampled in Port Angeles Harbor to represent a reasonable maximum exposure to Lower Elwha Tribal members. The species-specific rates recommended below total to the consumption rate recommended by Ecology's Science Advisory Board, which we understand is being used for the risk assessment on the Rayonier and Port Angeles Harbor clean ups.

Total Consumption Rate: 583 grams per day

Shellfish: 498 grams per day

- Dungeness crab: 149.4 grams per day (30% of shellfish total)
- Geoduck: 149.4 grams per day (30% of shellfish total)
- Horse Clam: 149.4 grams per day (30% of shellfish total)
- Shrimp: 49.8 grams per day (10% of shellfish total)

Pelagic Fish: 56 grams per day

- Lingcod: 56 grams per day (100% of pelagic fish total)

Bottom Fish: 29 grams per day

- Rock sole: 14.5 grams per day (50% of bottom fish total)
- Starry flounder: 14.5 grams per day (50% of bottom fish total)

Sincerely:

Frances G. Charles

Frances Charles, Lower Elwha Tribal Chair

Attachment I – Lead Modeling Inputs and Outputs

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Table I-1. IEUBK Exposure Parameter Inputs

Media	Description of Exposure Variable	Units	Receptors			
			SF (RME)	SF (CT)	RF (RME)	RF (CT)
Air	Outdoor air lead concentration	ug/m3	0.1			
	Indoor air leaad concentration	% of outdoor air	30%			
	Time spent outdoors	hours/day	1, 2, 3, 4, 4, 4, 4			
	Ventilation rates	m3/day	2, 3, 5, 5, 5, 7, 7			
	Lung absorption	%	32.0			
Diet	Diet intake	ug/day	3.16, 2.60, 2.87, 2.74, 2.61, 2.74, 2.99			
	Alternative Diet Value - Lead in Fish[1]	ug Pb/g	**0.631**	**0.316**	**0.249**	**0.176**
	Alternative Diet Value - Percentage of Fish	% fish	**100%**	**100%**	**16%**	**12%**
	Bioavailability of lead in food	%	0.5			
Drinking Water	Lead concentration in drinking water	ug/L	4.0			
	Drinking water intake	L/day	0.20, 0.50, 0.52, 0.53, 0.55, 0.58, 0.59			
	Bioavailability of lead in water	%	0.5			
Soil/Dust	Soil lead level	ug/g	200.0			
	Indoor dust lead levels	% of soil levels	0.7			
	SoilDust Ingestion Weighting Factor	% soil	0.5			
	Amount of soil/dust ingested daily	g/day	0.085, 0.135, 0.135, 0.135, 0.100, 0.090, 0.085			
	Bioavailability of lead in soil and dust	%	30.0			
Other	Maternal blood lead at birth of child	ug/dL	**1.4**	**1.4**	**1.4**	**1.4**

Key:
CT = Central Tendancy
IEUBK = Integrated Exposure Uptake Biokinetic
RF = Recreation Fisher
RME = Reasonable Maximum Exposure
SF = Subsistence Fisher

Notes:
Bolded text indicates site-specific values. All other values are U.S. EPA default values.
1 - Values from Table I-2

Table I-2. IEUBK Fish Consumption

Receptor	Seafood	Child Ingestion Rate[1] (g/day)	Lead Average Concentration (mg Pb/kg)	Child Lead Intake (ug Pb/day)	Daily Dietary Lead Concentration @ Total IR g/day (ug Pb/g)	Equivalent Meat Concentration @ 93.5 g/day (ug Pb/g)[2]
Subsistence Fisher (RME)	Dungeness Crab	60	0.016	0.984	0.004	1.05E-02
	Horse Clam	60	0.431	25.8525	0.111	2.76E-01
	Geoduck	60	0.516	30.960	0.133	3.31E-01
	Shrimp	19	0.006	0.114	0.0005	1.22E-03
	Pelagic fish	22	0.047	1.034	0.0044	1.11E-02
	Bottom fish	12	0.005	0.060	0.0003	6.42E-04
	Total	***233***	***1.021***	***59.005***	***0.253***	***0.631***
Subsistence Fisher (CT)	Dungeness Crab	30	0.016	0.492	0.004	5.26E-03
	Horse Clam	30	0.431	12.92625	0.111	1.38E-01
	Geoduck	30	0.516	15.480	0.133	1.66E-01
	Shrimp	9.5	0.006	0.057	0.0005	6.10E-04
	Pelagic fish	11	0.047	0.517	0.0044	5.53E-03
	Bottom fish	6	0.005	0.030	0.0003	3.21E-04
	Total	***116.5***	***1.021***	***29.502***	***0.253***	***0.316***
Recreational Fisher (RME)	Dungeness Crab	3.9	0.006	0.0234	0.002	--
	Horse Clam	3.9	0.431	1.6804125	0.110	--
	Geoduck	3.9	0.516	2.012	0.132	--
	Shrimp	1.35	0.006	0.0081	0.001	--
	Pelagic fish	1.45	0.047	0.06815	0.004	--
	Bottom fish	0.75	0.005	0.004	0.000	--
	Total	***15.25***	***1.011***	***3.796***	***0.249***	***--***
Recreational Fisher (CT)	Dungeness Crab	2.75	0.006	0.0165	0.001	--
	Horse Clam	2.75	0.431	1.18490625	0.078	--
	Geoduck	2.75	0.516	1.419	0.093	--
	Shrimp	0.95	0.006	0.0057	0.000	--
	Pelagic fish	1.05	0.047	0.04935	0.003	--
	Bottom fish	0.55	0.005	0.003	0.000	--
	Total	***10.8***	***1.011***	***2.678***	***0.176***	***--***

Key:
CT = Central Tendancy
IEUBK = Integrated Exposure Uptake Biokinetic
IR = Ingestion Rate
Pb = Lead
RME = Reasonable Maximum Exposure

Notes:
1 - Ingestion rate (IR) is calcualted as the IR presented in Appendix C tables multiplied by the fractional intake.
2 - Lead dose is adjusted based on ratio of total IR to average meat IR used in IEUBK model (93.5 g/day).

Table I-3. ALM Parameter Inputs

Parameter Definition	Parameter Code	Units	Subsistence Fisher (RME) Input	Subsistence Fisher (CT) Input	Recreational Fisher (RME) Input	Recreational Fisher (CT) Input	Rationale
Baseline blood lead level	PbB0	ug/dL	1.4	1.4	1.4	1.4	Default for Western US
Biokinetic slope factor	BKSF	ug/dL per ug/d	0.4	0.4	0.4	0.4	Default
Soil lead concentration	Cs	ug/g	14.56	14.56	14.56	14.56	Average lead concentration in sediment
Soil/sediment ingestion rate	IRs	g/day	0.100	0.100	0.100	0.100	Site-specific
Exposure frequency for soil/sediment	EFs	days/year	104	104	53	37	Site-specific
Absorption fraction for soil	AFs	unitless	0.12	0.12	0.12	0.12	Default
Daily lead intake from fish and shellfish	IRf	g/day	1.47E-01	7.35E-02	9.54E-03	6.72E-03	See Table I-4
Exposure frequency for fish and shellfish	EFr	days/year	365	365	365	365	Site-specific
Absorption fraction for fish and shellfish	AFf	unitless	0.12	0.12	0.12	0.12	U.S. EPA 2009b
Averaging time	AT	days/year	365	365	365	365	Default

Table I-4. ALM Fish Consumption

Receptor	Seafood	Adult Ingestion Rate[1] (g/day)	Lead Average Concentration (mg Pb/kg)	Adult Lead Intake (ug Pb/day)
Subsistence Fisher (RME)	Dungeness Crab	149.4	0.016	2.45E+00
	Horse Clam	149.4	0.431	6.44E+01
	Geoduck	149.4	0.516	7.71E+01
	Shrimp	49.8	0.006	2.99E-01
	Pelagic fish	56	0.047	2.63E+00
	Bottom fish	29	0.005	1.45E-01
	Total	***583***	***1.021***	***1.47E+02***
Subsistence Fisher (CT)	Dungeness Crab	74.7	0.016	1.23E+00
	Horse Clam	74.7	0.431	3.22E+01
	Geoduck	74.7	0.516	3.85E+01
	Shrimp	24.9	0.006	1.49E-01
	Pelagic fish	28	0.047	1.32E+00
	Bottom fish	14.5	0.005	7.25E-02
	Total	***291.5***	***1.021***	***7.35E+01***
Recreational Fisher (RME)	Dungeness Crab	9.8	0.006	5.88E-02
	Horse Clam	9.8	0.431	4.22E+00
	Geoduck	9.8	0.516	5.06E+00
	Shrimp	3.25	0.006	1.95E-02
	Pelagic fish	3.65	0.047	1.72E-01
	Bottom fish	1.9	0.005	9.50E-03
	Total	***38.2***	***1.011***	***9.54E+00***
Recreational Fisher (CT)	Dungeness Crab	6.9	0.006	4.14E-02
	Horse Clam	6.9	0.431	2.97E+00
	Geoduck	6.9	0.516	3.56E+00
	Shrimp	2.35	0.006	1.41E-02
	Pelagic fish	2.6	0.047	1.22E-01
	Bottom fish	1.35	0.005	6.75E-03
	Total	***27***	***1.011***	***6.72E+00***

Key:
CT = Central Tendancy
IEUBK = Integrated Exposure Uptake Biokinetic
Pb = Lead
RME = Reasonable Maximum Exposure

Notes:
1 - Ingestion rate (IR) is calcualted as the IR presented in Appendix C tables multiplied by the fractional intake.

Table I-5 Adult Lead Model Results

Exposure Variable	Description of Exposure Variable	Units	Receptors			
			SF (RME)	SF (CT)	RF (RME)	RF (CT)
Cs	Soil lead concentration	ug/g or ppm	14.56	14.56	14.56	14.56
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	2.1	2.1	2.1	2.1
PbB_0	Baseline PbB	ug/dL	1.4	1.4	1.4	1.4
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	0.100	0.100	0.100
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	--	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	--	--
K_{SD}	Mass fraction of soil in dust	--	--	--	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	104	104	53	37
IR_f	Lead intake from locally caught fish and shellfish	ug/day	1.47E-01	7.35E-02	9.54E-03	6.72E-03
AF_f	Absorption fraction (fish))	--	0.12	0.12	0.12	0.12
EF_f	Exposure frequency (fish)	days/yr	365	365	365	365
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365	365	365	365
PbB_{adult}	**PbB of adults, geometric mean**	**ug/dL**	**1.4**	**1.4**	**1.4**	**1.4**
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adults	ug/dL	4.4	4.4	4.3	4.3
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	10.0	10.0	10.0	10.0
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**0.3%**	**0.3%**	**0.3%**	**0.3%**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

Key:
CT = Central Tendancy
RF = Recreation Fisher
RME = Reasonable Maximum Exposure
SF = Subsistence Fisher

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

Appendix H
Chemistry Data Validation Memoranda

(Included in its entirety on CD)

DATA VALIDATION SUMMARY MEMORANDA: PORT ANGELES HARBOR

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 14, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
BA01A	06/07/2008	Solid/Sediment	Analytical Resources, Inc.
BA02A	06/07/2008	Solid/Sediment	Analytical Resources, Inc.
EH01A	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
EH02A	06/07/2008	Solid/Sediment	Analytical Resources, Inc.
EH03A	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
EH04A	06/06/2008	Solid/Sediment	Analytical Resources, Inc.
FP01A	06/07/2008	Solid/Sediment	Analytical Resources, Inc.
FP02A	06/07/2008	Solid/Sediment	Analytical Resources, Inc.
FP03A	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
FT04B	06/07/2008	Solid/Sediment	Analytical Resources, Inc.
FT04C	06/07/2008	Solid/Sediment	Analytical Resources, Inc.
IE03A	06/07/2008	Solid/Sediment	Analytical Resources, Inc.
IE04A	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
IE05A	06/07/2008	Solid/Sediment	Analytical Resources, Inc.
IE06A	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
IE11A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE14A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
KP08B	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
KP08C	06/08/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
NA16	EPA160.3	19
NA16	EPA350.1M	11
NA16	EPA376.2	11
NA16	PLUMB81TC	19
NA16	PSDDA SW8270D	4
NA16	PSEP-PS	19
NA16	SW8270D	2

General Sample Information

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 14, 2008	Completed by: Bryan Kroon

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6°C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	No- KP08MS surrogate recovery values were low for all surrogates. The sample results were not qualified.
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	The analytes were qualified in the parent sample “JG” and “UJG” for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No- RPD Values were non-compliant for all compounds, results qualified “UJG” for non-detects in the parent sample.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	Yes
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD outliers. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ".

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits

Sample ID	Surrogate	Recovery	Limits	Validation Qual

Sample ID	Surrogate	Recovery	Limits	Validation Qual
KP08C MS	d5-Nitrobenzene	19.7%	29-87	UJG
KP08C MS	2-Fluorobiphenyl	22.0%	32-88	UJG
KP08C MS	d14-p-Terphenyl	22.5%	21-97	UJG
KP08C MS	d4-1,2-Dichlorobenzene	14.3%	25-82	UJG
KP08C MS	d5-Phenol	21.1%	29-85	UJG
KP08C MS	2-Fluorophenol	18.8%	10-114	UJG
KP08C MS	2,4,6-Tribromophenol	24.7%	25-103	UJG
KP08C MS	d4-2-Chlorophenol	20.7%	30-84	UJG

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	Recovery	RPD	Limits	Validation Qual
KP08C MS	Phenol	22.0%	87.0%	37-92	UJG
KP08C MS	Bis-(2-Chloroethyl) Ether	20.0%	87.3%	40-83	UJG
KP08C MS	2-Chlorophenol	20.3%	88.5%	42-80	UJG
KP08C MS	1,3-Dichlorobenzene	18.3%	90.3%	39-75	UJG
KP08C MS	1,4-Dichlorobenzene	18.5%	90.9%	40-75	UJG
KP08C MS	Benzyl Alcohol	17.1%	87.4%	25-90	UJG
KP08C MS	1,2-Dichlorobenzene	19.4%	88.1%	40-76	UJG
KP08C MS	2-Methylphenol	20.9%	92.1%	40-86	UJG
KP08C MS	2,2'-Oxybis(1-chloropropane)	19.3%	88.2%	26-100	UJG
KP08C MS	4-Methylphenol	21.4%	87.0%	40-92	UJG
KP08C MS	n-Nitroso-di-n-Propylamine	0%	0%	29-95	REJ
KP08C MS	Hexachloroethane	13.4%	104.0%	37-73	UJG
KP08C MS	Nitrobenzene	21.0%	88.6%	37-85	UJG
KP08C MS	Isophorone	23.9%	89.2%	42-91	UJG
KP08C MS	2-Nitrophenol	20.1%	92.7%	40-86	UJG
KP08C MS	2,4-Dimethylphenol	21.3%	89.8%	23-85	UJG
KP08C MS	Benzoic Acid	14.0%	84.3%	29-104	UJG
KP08C MS	bis(2-Chloroethoxy) Methane	21.0%	88.2%	40-87	UJG
KP08C MS	2,4-Dichlorophenol	21.3%	91.9%	42-88	UJG
KP08C MS	1,2,4-Trichlorobenzene	19.9%	90.9%	40-81	UJG
KP08C MS	Naphthalene	18.6%	93.3%	41-80	UJG
KP08C MS	4-Chloroaniline	15.7%	67.0%	14-80	UJG
KP08C MS	Hexachlorobutadiene	19.9%	89.5%	37-85	UJG
KP08C MS	4-Chloro-3-methylphenol	23.3%	92.2%	40-94	UJG
KP08C MS	2-Methylnaphthalene	18.7%	9510.0%	44-82	UJG
KP08C MS	Hexachlorocyclopentadiene	0 %	0%	10-98	REJ
KP08C MS	2,4,6-Trichlorophenol	22.8%	92.1%	42-88	UJG
KP08C MS	2,4,5-Trichlorophenol	23.7%	92.6%	41-89	UJG
KP08C MS	2-Chloronaphthalene	21.7%	90.5%	42-82	UJG
KP08C MS	2-Nitroaniline	22.4%	94.0%	35-101	UJG
KP08C MS	Dimethylphthalate	25.9%	86.0%	44-91	UJG
KP08C MS	Acenaphthylene	23.5%	88.9%	44-84	UJG
KP08C MS	3-Nitroaniline	24.3%	80.5%	25-93	UJG

Sample ID	Analyte	Recovery	RPD	Limits	Validation Qual
KP08C MS	Acenaphthene	22.2%	91.0%	42-85	UJG
KP08C MS	2,4-Dinitrophenol	15.2%	117.0%	10-179	UJG
KP08C MS	4-Nitrophenol	25.6%	101.0%	26-97	UJG
KP08C MS	Dibenzofuran	24.0%	87.5%	46-84	UJG
KP08C MS	2,6-Dinitrotoluene	24.3%	92.6%	42-97	UJG
KP08C MS	2,4-Dinitrotoluene	24.7%	96.6%	41-101	UJG
KP08C MS	Diethylphthalate	27.0%	88.6%	46-94	UJG
KP08C MS	4-Chlorophenyl-phenylether	24.7%	88.0%	44-87	UJG
KP08C MS	Fluorene	24.3%	89.5%	44-88	UJG
KP08C MS	4-Nitroaniline	0%	0%	24-89	REJ
KP08C MS	4,6-Dinitro-2-Methylphenol	18.9%	105.0%	22-128	UJG
KP08C MS	N-Nitrosodiphenylamine	37.8%	82.9%	40-111	UJG
KP08C MS	4-Bromophenyl-phenylether	26.2%	85.3%	43-91	UJG
KP08C MS	Hexachlorobenzene	25.7%	85.4%	42-90	UJG
KP08C MS	Pentachlorophenol	26.2%	93.9%	34-94	UJG
KP08C MS	Phenanthrene	27.0%	83.6%	45-90	UJG
KP08C MS	Carbazole	28.6%	84.7%	43-93	UJG
KP08C MS	Anthracene	26.5%	83.6%	42-87	UJG
KP08C MS	Di-n-Butylphthalate	30.7%	85.6%	48-99	UJG
KP08C MS	Fluoranthene	30.2%	83.2%	43-98	UJG
KP08C MS	Pyrene	23.2%	89.4%	39-99	UJG
KP08C MS	Butylbenzylphthalate	25.2%	92.8%	41-105	UJG
KP08C MS	3,3'-Dichlorobenzidine	25.5%	65.6%	14-84	UJG
KP08C MS	Benzo(a)anthracene	27.6%	86.2%	42-94	UJG
KP08C MS	bis(2-Ethylhexyl)phthalate	28.1%	88.8%	34-111	UJG
KP08C MS	Chrysene	28.3%	86.0%	45-92	UJG
KP08C MS	Di-n-Octyl phthalate	28.3%	84.2%	32-107	UJG
KP08C MS	Benzo(b)fluoranthene	29.7%	81.7%	43-105	UJG
KP08C MS	Benzo(k)fluoranthene	32.3%	81.2%	40-108	UJG
KP08C MS	Benzo(a)pyrene	28.3%	81.6%	41-95	UJG
KP08C MS	Indeno(1,2,3-cd)pyrene	21.0%	84.0%	28-101	UJG
KP08C MS	Dibenz(a,h)anthracene	22.5%	83.3%	32-104	UJG
KP08C MS	Benzo(g,h,i)perylene	17.5%	83.7%	18-106	UJG
KP08C MS	Guaiacol	20.5%	88.4%	30-160	UJG
KP08C MS	4,5-Dichloroguaiacol	23.3%	94.7%	30-160	UJG
KP08C MS	4,5,6-Trichloroguaiacol	26.5%	97.2%	30-160	UJG
KP08C MS	3,4,5-Trichloroguaiacol	27.8%	88.4%	30-160	UJG
KP08C MS	Tetrachloroguaiacol	29.3%	88.6%	30-160	UJG
KP08C MS	1-Methylnaphthalene	22.3%	88.7%	43-87	UJG
KP08C MS	4-Chloroguaiacol	22.1%	90.9%	30-160	UJG
KP08C MS	3,4-Dichloroguaiacol	23.7%	93.9%	30-160	UJG
KP08C MS	4,6-Dichloroguaiacol	24.9%	86.8%	30-160	UJG
KP08C MS	3,4,6-Trichloroguaiacol	23.9	97.0%	30-160	UJG

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.

NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 18, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
BL02B	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
BL02C	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
BL06A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
BL08A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE10A	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
IE12A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE13A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE15A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE16A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IH06B	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
IH06C	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
KP06A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
FT12A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
OH02A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
OH03A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
RF01A	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
RF02A	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
RF03A	06/10/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
NA77	EPA160.3	18
NA77	EPA376.2	18

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes. Note, at a later date sample OH01A was discovered to have the wrong sample Identification number. The sample was changed to FT12A.
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct?	Yes

General Sample Information	
Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	No, refer to Table 4.
Triplicate relative standard deviation within QC limits of < 20%?	No, sample results were qualified due to LCS outliers.
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	No, refer to Table 5.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
None

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination

None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	QC Limit	Validation Qual
LCS-080408	Sulfide	66.7%	80 - 120%	UJG or JG

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Sample ID	Analyte	LCS Recovery	QC Limit	Validation Qual
LCS-061408	Sulfide	75.2%	80 - 120%	UJG or JG

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.

K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 18, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
IE09A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IE16C	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
IH01A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IH02A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IH02B	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
IH02C	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
IH03A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IH04A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IH05A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IH06A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
KP05A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
MA02A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
MA05A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
MA06A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NB39	EPA160.3	14
NB39	EPA376.2	14

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and

	analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
None

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.

NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 18, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
BL02A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
BL03A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
BL04A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
FT06A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
FT11A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
IE05B	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
IE05C	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
IE07A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IE08A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
IE09B	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
IE16B	06/12/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NB43	EPA160.3	11
NB43	EPA376.2	11

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)

- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	No – Laboratory attributes to sample non-homogeneity, concurrent samples in batch NB39 were within limits. The sulfide result in sample IE16B was qualified as estimated, bias unknown "JK".
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
The sulfide result in sample IE16B was qualified as estimated, bias unknown "JK" based on duplicate outlier.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.

NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 19, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
BL02B	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
BL02C	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
BL05A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
BL07A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
BL08A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
FT06B	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
FT06C	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE10A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE12A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE13A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE15A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE16A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IH06B	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
KP02C	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
KP03C	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
RF02A	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
RF03A	06/10/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NB71	EPA160.3	16
NB71	EPA350.1M	5
NB71	Krone	3
NB71	PSDDA SW8270D	8
NB71	PSEP-PS	14
NB71	SW8270D	6
NB71	SW9060M	14

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 19, 2008	Completed by: Bryan Kroon

General Sample Information	
Did coolers arrive at lab between 2 and 6°C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. The analytes were qualified in the parent sample “JG” and “UJG” for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – 3,3’-Dichlorobenzidine, 3-Nitroaniline, and 4-Chloroaniline outside QC limits; the sample was qualified due to MS/MSD recovery.

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples "JG" and "UJG" for low LCS/LCSD recovery. If LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ".
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	No – Chrysene-d_{12} was high in sample BL02B associated results are flagged as estimated, biased low "UJG, JTG, or JG" in.
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol %RSD was high. Positive results for this compound qualified as estimated, biased unknown "UJK or JK". Non-detects not qualified.
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD and LCS/LCSD outliers. If MS/MSD or LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration. Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limits	Validation Qual
FT06C MS	Benzoic Acid	26.2%	35.5%	30.0%	14-80	UJG
FT06C MS	Benzyl Alcohol	27.4%	21.0%	26.3%	30-160	UJG
FT06C MS	4-Chloroaniline	21.8%	9.6%	77.7%	14-80	REJ
FT06C MS	3-Nitroaniline	39.5%	20.9%	61.5%	25-93	UJG
FT06C MS	3,3'-Dichlorobenzidine	11.3%	2.9%	118.0%	14-84	REJ

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	Lower Limit	Upper Limit	Validation Qual
LCS-062108	3,3'-Dichlorobenzidine	1.0%	14%	84%	REJ

Table 6 –Samples that were Reextracted

Sample ID	Method	Reason
BL02B	Resin Acids	Poor surrogate recovery
BL02C	Resin Acids	Poor surrogate recovery
IH06B	Resin Acids	Poor surrogate recovery
RF02A	Resin Acids	Poor surrogate recovery
RF03A	Resin Acids	Poor surrogate recovery

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .

NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 20, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
BL06A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
BL08B	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
BL08C	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
FT12A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
IH06B	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
IH06C	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
KP02B	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
KP02C	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
KP03B	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
KP03C	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
KP06A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
KP07A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
MA02B	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
MA02C	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
MA06A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
OH02A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
OH03A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
RF01A	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
RF03A	06/10/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NB97	EPA160.3	18
NB97	EPA350.1M	4
NB97	Krone	2
NB97	PSDDA SW8270D	10
NB97	PSEP-PS	18
NB97	SW8270D	10
NB97	SW9060M	18

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples "JG" and "UJG" for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ".
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples "JG" and "UJG".
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	Yes

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Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	No – 2,4-Dinitrophenol and Abietic Acid were outside QC limits. All associated samples were qualified as estimated, biased unknown (UJK, JTK, or JK).
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD outliers. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK, JTK, or JK), based on initial and continuing calibration. In sample KP03A, the isopimaric acid result was identified and quantitated based on the professional judgment of the analyst; the results were qualified as estimated biased unknown (JK). In sample OH02A, the isopimaric acid results were qualified as estimated biased high (UJL), due to sample matrix interferences.

Table 2 - List of Positive Results for Blank Samples

None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
KP03C MS	Hexachloroethane	38.4%	32.5%	16.6%	37 - 73%	35%	UJG
KP03C MS	4-Chloroaniline	12.0%	19.8%	49.1%	14 - 80%	35%	UJG
KP03C MS	Hexachlorocyclopentadiene	3.7%	0%	NC	10 - 98%	35%	REJ
KP03C MS	3-Nitroaniline	26.1%	36.7%	33.8%	25 - 93%	35%	UJG
KP03C MS	4-Nitroaniline	30.9%	45.3%	37.8%	24 - 89%	35%	UJG
KP03C MS	N-Nitrosodiphenylamine	88.8%	96.0%	7.8%	40 - 111%	35%	UJG
KP03C MS	Phenanthrene	63.1%	90.0%	35.1%	45 - 90%	35%	JG
KP03C MS	Carbazole	77.3%	121.0%	44.1%	43 - 93%	35%	JG
KP03C MS	Anthracene	61.2%	171.0%	94.6%	42 - 87%	35%	JG
KP03C MS	Fluoranthene	60.6%	146.0%	82.7%	43 - 98%	35%	JG
KP03C MS	Pyrene	56.2%	399.0%	150.6%	39 - 99%	35%	JG
KP03C MS	3,3'-Dichlorobenzidine	3.7%	8.6%	79.7%	14 - 84%	35%	REJ
KP03C MS	Benzo(a)anthracene	61.4%	263.0%	124.3%	42 - 94%	35%	JG
KP03C MS	Chrysene	59.8%	330.0%	138.6%	45 - 92%	35%	JG
KP03C MS	Benzo(b)fluoranthene	98.6%	432.0%	125.7%	43 - 105%	35%	JG
KP03C MS	Benzo(k)fluoranthene	62.7%	155.0%	84.8%	40 - 108%	35%	JG
KP03C MS	Benzo(a)pyrene	63.9%	211.0%	107.0%	41 - 95%	35%	JG
KP03C MS	Indeno(1,2,3-cd)pyrene	36.7%	58.3%	45.5%	28 - 101%	35%	UJG
KP03C MS	Benzo(g,h,i)perylene	28.7%	41.9%	37.4%	18 - 106%	35%	UJG
RF01A MS	Dibutyl Tin	14.7%	30.3%	70.0%	30 – 160%	35%	UJG

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code **Description**

B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
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The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
EI02A	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
EI07A	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
FT01A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
FT04A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
FT05A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
FT06A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
FT07A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
FT08A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
FT09A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
FT10A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
FT11A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
FT13A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
IE16B	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
IE16C	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
IH02B	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
IH02C	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
KP01A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
KP02A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
KP03A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
KP05A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
KP07A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
KP08A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
MA01A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
MA02B	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
MA04A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
OH01A-R	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
RL01A	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
RL02A	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
RL03A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 20, 2008	Completed by: Bryan Kroon

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
NC14	EPA160.3	27
NC14	EPA350.1M	5
NC14	EPA376.2	11
NC14	Krone	3
NC14	PSDDA SW8270D	7
NC14	PSEP-PS	16
NC14	SW8270D	7
NC14	SW9060M	16

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics (including organotins) by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 20, 2008	Completed by: Bryan Kroon

Semivolatile Organics (including organotins) by GCMS	
Description	**Notes and Qualifiers**
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. The analytes were qualified in the parent sample "JG" and "UJG" for low MS/MSD recovery.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – Several compounds were outside QC limits. The analytes were qualified in the parent sample "JG" and "UJG".
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples "JG" and "UJG" for low LCS/LCSD recovery. If LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ".
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	No, IS#6 was low in sample IH02B; associated sample results were flagged as estimated, biased high (UJL or JL). In sample MA02B, IS#5 was high; associated sample results were flagged as estimated biased low (UJG or JG).
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol was above the QC limit, samples results were qualified "UJK" in all samples.
Is continuing calibration for target compounds < 20%?	No – 2,4-dinitrophenol and benzyl alcohol were outside QC limits. All associated samples were qualified as estimated "JK" or "UJK".
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 20, 2008	Completed by: Bryan Kroon

General Analytical Methods	
Description	**Notes and Qualifiers**
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD or LCS/LCSD outliers. Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration. Sample IH02B and MA02B had IS outliers; associated results were qualified as estimated. In sample IH02B, the laboratory analyst tentatively identified isopimaric acid, based on his professional judgment. The isopimaric acid result was qualified as estimated, biased unknown (JK).

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
FT13A	4-Chloroaniline	8.2%	22.8%	18.3%	14 - 80%	35%	UJG
FT13A	3-Nitroaniline	32.1%	16.9%	62.2%	25 - 93%	35%	UJG
FT13A	3,3'-Dichlorobenzidine	11.8%	20.8%	55.2%	14 - 84%	35%	UJG
FT13A	Hexachloroethane	29.5%	38.3%	26.0%	30 - 160%	35%	UJG
FT13A	Hexachlorocylcopentadiene	19.4%	19.7%	1.4%	30 - 160%	35%	UJG

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	LCSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
LCS-062508	4-Chloroaniline	8.2%	22.8%	94.8%	14 - 80%	35%	REJ
LCS-062508	3-Nitroaniline	18.0%	41.6%	79.3%	25 - 93%	35%	UJG
LCS-062508	Butyl Tin	57.4%	26.9%	72.2%	30 - 160%	35%	UJG

Table 6 –Samples that were Reanalyzed

Sample ID	Method	Reason
IH02B	8270	Poor IS recovery, dilution results within QC control. Report original sample results.
MA02B	8270	Poor IS recovery, dilution results within QC control. Report original sample results.

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.

NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 21, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
FT11A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.
IE01B	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
IE01C	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
IE05B	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
IE05C	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
IE07A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IE08A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
IE09A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IE09B	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IE10A	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
IE12A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE12B	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
IE12C	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
IE13A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE14B	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
IE14C	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
IE15A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NC39	EPA160.3	17
NC39	EPA350.1M	17
NC39	EPA376.2	6
NC39	PSDDA SW8270D	9
NC39	PSEP-PS	12
NC39	SW8270D	9
NC39	SW9060M	12

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 21, 2008	Completed by: Bryan Kroon

General Sample Information	
Did coolers arrive at lab between 2 and 6°C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	NA, the MS/MSD sample was performed on a different work order.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	NA, the MS/MSD sample was performed on a different work order.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	Yes
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	No – In sample IE09B, IS #6 and IS#7 were below QC limits. Associated compounds were qualified estimated biased low "UJG, JTG, and JG".
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimate, biased low (UJG, JTG, or JG), based on IS recovery. Several compounds were identified and quantitated based on the professional judgment of the analyst; the results were qualified as estimated biased unknown (JK). The retene result in sample IE14B; and the 4-chloroguaiacol results in sample IE09B were qualified as not detected estimated biased high (UJL), due to sample matrix interferences.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed

Sample ID	Method	Reason
IE09B	8270	Poor IS recovery, report original analysis.
IE14B	8270	Possible sample carry-over; report original analysis.

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.

REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 25, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
ED04B	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
ED05A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
EE01A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
EE02A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
EE03A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
EE04A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
EE05A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
EI01A	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
EI02A	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
EI03A	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
EI04A	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
EI06A	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
EI07A	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
FT01A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
FT02A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
FT04A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
FT06A	06/12/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NC41	EPA160.3	17
NC41	EPA350.1M	10
NC41	EPA376.2	5
NC41	PSDDA SW8270D	15
NC41	PSEP-PS	16
NC41	SW8270D	1
NC41	SW9060M	16

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 25, 2008	Completed by: Bryan Kroon

General Sample Information	
Did coolers arrive at lab between 2 and 6°C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. The analytes were qualified in the parent sample “UJG” for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – Several compounds were outside QC limits. The analytes were qualified in the parent sample “UJG”.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	No- 3,3’-Dichlorobenzidine recovery was below QC limits. All analytes were qualified in associated samples “UJG” for low LCS/LCSD recovery.

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol was above the QC limit, samples results were qualified “UJK” in all samples.
Is continuing calibration for target compounds < 20%?	No – 2,4-Dinitrophenol was above the QC limit, samples results were qualified “UJK” in all samples.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides?	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD or LCS/LCSD outliers. Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration.

Table 2 - List of Positive Results for Blank Samples

None

Table 2A - List of Samples Qualified for Method Blank Contamination

None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
EI01A MS	Benzyl Alcohol	0%	0%	NC	14 - 80%	35%	REJ
EI01A MS	4-Chloroaniline	13.4%	10.3%	25.7%	14 - 80%	35%	UJG
EI01A MS	Hexachlorocyclopentadiene	21.0%	14.1%	39.1%	10 - 98%	35%	UJG
EI01A MS	2,4-Dinitrophenol	45.1%	29.2%	42.9%	10 - 179%	35%	UJG
EI01A MS	3,3'-Dichlorobenzidine	3.1%	1.7%	57.8%	14 - 84%	35%	REJ

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	Lower Limit	Upper Limit	Validation Qual
LCS-063008	3,3'-Dichlorobenzidine	13.3%	14%	84%	UJG

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.

JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 25, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
MD05A	06/21/2008	Solid/Sediment	Analytical Resources, Inc.
MD05B	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
MD05C	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
OH01A-R	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
RL01A	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
RL02A	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
WW01A	06/19/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NC44	EPA160.3	7
NC44	EPA350.1M	7
NC44	EPA376.2	4
NC44	PSDDA SW8270D	4
NC44	PSEP-PS	7
NC44	SW8270D	4
NC44	SW9060M	7

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples “UJG” for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – Several compounds were outside QC limits. The analytes were qualified in the parent sample “JG” and “UJG”.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	No – Benzyl alcohol was outside QC limits. Benzyl alcohol was qualified in associated samples “UJG” for low LCS/LCSD recovery.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol was above the QC limit, samples results were qualified “UJK” in all samples.
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 25, 2008	Completed by: Bryan Kroon

Description	Notes and Qualifiers
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	No – Sulfide had RSD greater than 20%. The sulfide result in sample WW01A was qualified estimate, biased unknown "JK".
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides?	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD or LCS/LCSD outliers. If MS/MSD or LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration. The sulfide result in sample WW01A was qualified estimate, biased unknown "JK" based on RSD outlier.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
MD05C MS	Benzyl Alcohol	0%	0%	NC	37% - 73%	35%	REJ
MD05C MS	Hexachloroethane	31.3%	32.0%	2.2%	37% - 73%	35%	UJG
MD05C MS	Hexachlorocyclopentadiene	5.5%	2.7%	68.3%	10 - 98%	35%	REJ
MD05C MS	4,6-Dinitro-2-Methylphenol	18.5%	27.5%	39.1%	22 - 128%	35%	UJG
MD05C MS	Pentachlorophenol	18.0%	18.3%	1.7%	34 - 94%	35%	UJG
MD05C MS	3,3'-Dichlorobenzidine	14.3%	10.0%	35.4%	14 - 84%	35%	UJG

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	Lower Limit	Upper Limit	Validation Qual
LCS-063008	Benzyl Alcohol	22.1%	25%	90%	UJG

Table 6 –Samples that were Reanalyzed

None

Key:

A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.

NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: August 27, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
EC02A	06/21/2008	Solid/Sediment	Analytical Resources, Inc.
EC03A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
EC04A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
EC05A	06/21/2008	Solid/Sediment	Analytical Resources, Inc.
ED01A	06/21/2008	Solid/Sediment	Analytical Resources, Inc.
ED01B	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
ED01C	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
ED02A	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
ED02B	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
ED02C	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
ED03A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
ED03B	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
ED03C	06/18/2008	Solid/Sediment	Analytical Resources, Inc.
ED04A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
ED04B	06/20/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NC45	EPA160.3	14
NC45	EPA350.1M	8
NC45	EPA376.2	8
NC45	PSDDA SW8270D	15
NC45	PSEP-PS	14
NC45	SW8270D	4
NC45	SW9060M	14

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes, one sample was missed in the original set of analysis. The sample was stored as an archived sample. The sample was removed from storage and

General Sample Information	
	analyzed, no action was tasken.
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	No- Sample ED04A had one surrogate out of QC limits, no qualification was necessary.
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples "JG" and "UJG" for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ".
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No- Three compounds were above 35% RPD qualified as estimated bias unknown "UJK or JK".
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: August 27, 2008	**Completed by: Bryan Kroon**

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	No – The IS#5 for samples ED03A, ED03B, and ED04A; and IS#7 for sample ED04A was above QC limits. Associated compounds were qualified estimated biased high “UJL, JTL, and JL”.
Is initial calibration for target compounds <20 % RSD or curve fit?	No- the 2,4-Dinitrophenol %RSD was outside QC limits. All associated samples were qualified as estimated “JTK” or “UJK”.
Is continuing calibration for target compounds < 20%?	No- 4,6-Dichloroguaiacol %RSD was outside QC limits. All associated samples were qualified as estimated “JTK” or “UJK”.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes – ED03A, ED03B, and ED04A were reanalyzed at dilution due to analytes being over calibration range. One result is reported for each.
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	No- TOC recovery was high results qualified “JL” in parent sample only.
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns

Sample results were qualified as estimated based on MS/MSD or LCS/LCSD outliers. If MS/MSD or LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”. Sample results were qualified as estimate, biased low (UJL, JTL, or JL), based on IS recovery. Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration. The di-n-butylphthalate result in sample ED03B was qualified as not detected estimated biased high (UJL), due to sample matrix interferences.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits

Sample ID	Surrogate	Recovery	Limits	Validation Qual
ED04A	2,4,6-Tribromophenol	108.0%	25-103	None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
ED01C MS	Bis-(2-Chloroethyl) Ether	47.6%	76.7%	46.8%	40 - 83%	35%	UJK
ED01C MS	Hexachloroethane	32.2%	48.7%	40.8%	37 - 73%	35%	UJG
ED01C MS	Hexachlorocyclopentadiene	4.4%	12.3%	94.6%	10 - 98%	35%	REJ
EC03A MS	Total Organic Carbon	125.2			75 - 125%		JL

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.

G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 16, 2008	Completed by: Brian Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
IE16A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IH01A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IH02A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IH03A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IH04A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IH05A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
IH06A	06/16/2008	Solid/Sediment	Analytical Resources, Inc.
KP01A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
KP02A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
KP03A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
KP04A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
KP06A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NC48	EPA160.3	12
NC48	EPA350.1M	11
NC48	Krone	1
NC48	PSDDA SW8270D	2
NC48	PSEP-PS	10
NC48	SW8270D	2
NC48	SW9060M	10

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment.	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 16, 2008	Completed by: Brian Kroon

General Sample Information	
MS/MSD samples – 1/20 samples, if requested.	
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	NA, the MS/MSD sample was performed on a different work order.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	NA, the MS/MSD sample was performed on a different work order.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	No- 3,3'-Dichlorobenzidine recovery was low qualified “UJG” in all samples.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No- 2,4-Dinitrophenol %RSD was above the QC limit, samples results were qualified “UJK” in all samples.
Is continuing calibration for target compounds < 20%?	No- 2,4-Dinitrophenol %RSD was above the QC limit, samples results were qualified “UJK” in all samples.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No

General Analytical Methods	
Description	**Notes and Qualifiers**

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on LCS/LCSD outliers. Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	Lower Limit	Upper Limit	Validation Qual
LCS-063008	3,3'-Dichlorobenzidine	13.3%	14%	84%	UJG

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.

UJK Analyte was not detected at or above the reported estimate with unknown bias.
UJL Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 3, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
CO01A	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
CO02A	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
CO03A	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
CO04A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
CO05A	06/20/2008	Solid/Sediment	Analytical Resources, Inc.
DO01A	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
DO02A	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
DO03A	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
DO04A	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
DO05A	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
EC01A	06/21/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NC49	EPA160.3	11
NC49	EPA350.1M	11
NC49	EPA376.2	11
NC49	PSDDA SW8270D	11
NC49	PSEP-PS	11
NC49	SW8270D	11
NC49	SW9060M	11

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 3, 2008	Completed by: Bryan Kroon

General Sample Information	
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes. The surrogate recovery values for the original extractions of DO04A and EC01A were low. The samples were reextracted; and the reextraction results are reported.
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)? If out and LCS is compliant, then J flag positive data in original sample due to matrix?	No – 3,3'-Dichlorobenzidine was out of QC limits. The analytes were qualified in the parent sample “JG” and “UJG”.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples “JG” and “UJG”.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	Yes. All guaiacol data qualified as estimated bias unknown “UJK or JK” in all samples due to compounds missing in the MS/MSD and LCS Spikes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol was above the QC limit, samples results were qualified “UJK” in all samples.
Is continuing calibration for target compounds < 20%?	No- Several compounds were outside QC limits. All associated samples were qualified as estimated “JK” or “UJK”.

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes – DO04A and EC01A were reextracted within hold time due to poor surrogate recovery; the reextraction results are reported.
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Qualifications based on MS/MSD recovery and RPD, missing spike compounds in MS/MSD and LCS, and initial and continuing calibrations.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits

Sample ID	Surrogate	Recovery	Limits	Validation Qual
DO03A	d4-1,2-Dichlorobenzene	14.2%	33-79	None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
CO04 MS	4-Chloroaniline	19.6%	28.0%	35.3%	14 - 80%	35%	UJK
CO04 MS	3,3'-Dichlorobenzidine	10.6%	17.6%	49.6%	14 - 84%	35%	UJG

Table 5 - List LCS Percent Recovery Values outside Control Limits

None

Table 6 –Samples that were Reanalyzed

Sample ID	Method	Reason	Action
EC01A	PSDDA8270	Surrogates out	Reanalysis results reported
DO04A	PSDDA8270	Surrogates out	Reanalysis results reported

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .

NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 8, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
KP07B	06/21/2008	Solid/Sediment	Analytical Resources, Inc.
KP07C	06/21/2008	Solid/Sediment	Analytical Resources, Inc.
LP01A	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
LP03A	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
LP04A	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
LP05A	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
MA01A	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
MA02A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
MA03A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
MA05A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
MD01A	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
MD02A	06/21/2008	Solid/Sediment	Analytical Resources, Inc.
MD03A	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
MD03B	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
MD03C	06/17/2008	Solid/Sediment	Analytical Resources, Inc.
MD04A	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
MD04B	06/22/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NC50	EPA160.3	17
NC50	EPA350.1M	14
NC50	EPA376.2	11
NC50	Krone	2
NC50	PSDDA SW8270D	13
NC50	PSEP-PS	17
NC50	SW8270D	13
NC50	SW9060M	17

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample	

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 8, 2008	Completed by: Bryan Kroon

General Sample Information	
Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6°C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	NA, the MS/MSD sample was performed on a different work order.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	NA, the MS/MSD sample was performed on a different work order.
LCS percent recovery values within Laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	No – Benzyl Alcohol recovery was below QC limits; results were qualified “UJG” in associated samples.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol was above the QC limit, samples results were qualified “UJK” in all samples.

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Is continuing calibration for target compounds < 20%?	No – Benzyl Alcohol, 2,4-Dinitrophenol, 4-Nitrophenol, and 4,6-Dichloroguaiacol were outside QC limits. All associated samples were qualified as estimated “JK” or “UJK”.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on LCS/LCSD outliers. If LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”. Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration. Several compounds were identified and quantitated based on the professional judgment of the analyst; the results were qualified as estimated biased unknown (JK).

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	Lower Limit	Upper Limit	Validation Qual
LCS-063008	Benzyl Alcohol	22.1%	25%	90%	UJG

Table 6 –Samples that were Reanalyzed
None

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.

NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 8, 2008	**Completed by: Bryan Kroon**

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
BL01A	06/19/2008	Solid/Sediment	Analytical Resources, Inc.
BL02A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
BL03A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
BL04A	06/13/2008	Solid/Sediment	Analytical Resources, Inc.
BL06A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
BL08A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NC54	EPA160.3	6
NC54	EPA350.1M	6
NC54	EPA376.2	1
NC54	Krone	4
NC54	PSDDA SW8270D	1
NC54	PSEP-PS	4
NC54	SW8270D	1
NC54	SW9060M	4

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes – Case Narrative for Volatiles, General Methods, and TBT not present.
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 8, 2008	Completed by: Bryan Kroon

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	NA, the MS/MSD sample was performed on a different work order.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	NA, the MS/MSD sample was performed on a different work order.
LCS percent recovery values within Laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol was above the QC limit, samples results were qualified "UJK" in all samples.
Is continuing calibration for target compounds < 20%?	No – 2,4-Dinitrophenol was above the QC limit, samples results were qualified "UJK" in associated samples.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U.

General Analytical Methods	
Description	**Notes and Qualifiers**
	Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	No – Sulfide had RSD greater than 20%. The sulfide result in sample BL01A was qualified estimate, biased unknown “JK”.
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration. The sulfide result in sample BL01A was qualified estimate, biased unknown “JK” based on RSD outlier.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated

ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 10, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
IE24TL	6/18/2008	Tissue	Analytical Resources, Inc.
IE21TL	6/18/2008	Tissue	Analytical Resources, Inc.
IE22TL	6/18/2008	Tissue	Analytical Resources, Inc.
IE23TL	6/18/2008	Tissue	Analytical Resources, Inc.
IE26TM	6/18/2008	Tissue	Analytical Resources, Inc.
EI08TH	6/18/2008	Tissue	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
ND44	SW8270D	6
ND44	Percent Lipids	6

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes. The laboratory was given the wrong sample identifications numbers. The laboratory received samples IE21TL through IE24TL and IE26TM as samples EI21TL through EI24TL and EI26TM. He samples umbers were corrected in the reviewed database.
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)? If out and LCS is compliant, then J flag positive data in original sample due to matrix?	NA, the MS/MSD were performed on another site sample.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	NA, the MS/MSD were performed on another site sample.
LCS percent recovery values within Laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – the 2,4-Dinitrophenol RSD value was greater than QC limit; all sample results were qualified "UJK".
Is continuing calibration for target compounds < 20%?	No – Benzyl Alcohol, 4-Nitrophenol, and Indeno (1,2,3-cd) pyrene were outside the QC limit. All associated samples were qualified "UJK".
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes – Samples were diluted due to complications with the high lipid content of the matrix.
For TICs are there any system related compounds that should not be reported?	No

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns

Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalysed and Diluted

Sample ID	Method	Reason	Dilution Factor
IE24TL	8270 D	Lipid Content in Matrix	2.00x
IE21TL	8270 D	Lipid Content in Matrix	2.00x
IE22TL	8270 D	Lipid Content in Matrix	2.00x
IE23TL	8270 D	Lipid Content in Matrix	2.00x
IE26TM	8270 D	Lipid Content in Matrix	2.00x
EI08TH	8270 D	Lipid Content in Matrix	2.00x

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.

JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 15, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
EC06TH	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
IE18TH	06/21/2008	Solid/Sediment	Analytical Resources, Inc.
IE20TH	06/21/2008	Solid/Sediment	Analytical Resources, Inc.
IE25TM	06/21/2008	Solid/Sediment	Analytical Resources, Inc.
MD06TH	06/22/2008	Solid/Sediment	Analytical Resources, Inc.
MD07TH	06/22/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
NE18	SW8270D	6
NE18	Lipids	6

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	No – Samples arrived at -0.3^{o}C
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. The analytes were qualified in the parent sample “JG” and “UJG” for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – Several compounds were outside QC limits. The analytes were qualified in the parent sample “JG” and “UJG”.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	Yes
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol was above the QC limit, samples results were qualified “UJK” in all samples.
Is continuing calibration for target compounds < 20%?	No – Benzyl Alcohol, 4-Nitrophenol, and Indeno (1,2,3-cd) pyrene were outside QC limits. All associated samples were qualified as estimated “JK” or “UJK”.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes – Samples were diluted due to complications with the high lipid content of the matrix.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns

Sample results were qualified as estimated based on LCS/LCSD outliers. If LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
EC06TH MS	2,4-Dimethylphenol	12.6%	24.2%	63.0%	30 - 160%	35%	UJG
EC06TH MS	Benzoic Acid	49.1%	4.1%	169.2%	30 - 160%	35%	REJ
EC06TH MS	4-Chloroaniline	0%	0%	NA	30 - 160%	35%	REJ
EC06TH MS	3-Nitroaniline	0%	0%	NA	30 - 160%	35%	REJ
EC06TH MS	4-Nitroaniline	21.8%	25.8%	16.8%	30 - 160%	35%	UJG
EC06TH MS	3,3'-Dichlorobenzidine	3.3%	6.9%	70.6%	30 - 160%	35%	REJ

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Diluted

Sample ID	Method	Reason	Dilution Factor
EC06TH	8270 D	Lipid Content in Matrix	2.00x
IE18TH	8270 D	Lipid Content in Matrix	2.00x
IE20TH	8270 D	Lipid Content in Matrix	2.00x
IE25TM	8270 D	Lipid Content in Matrix	2.00x
MD06TH	8270 D	Lipid Content in Matrix	2.00x
MD07TH	8270 D	Lipid Content in Matrix	2.00x

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code **Description**

B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 16, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
CO05B	07/15/2008	Solid/Sediment	Analytical Resources, Inc.
EC03B	07/16/2008	Solid/Sediment	Analytical Resources, Inc.
EC03C	07/16/2008	Solid/Sediment	Analytical Resources, Inc.
EC04B	07/16/2008	Solid/Sediment	Analytical Resources, Inc.
ED05B	07/16/2008	Solid/Sediment	Analytical Resources, Inc.
EE01B	07/16/2008	Solid/Sediment	Analytical Resources, Inc.
EE03B	07/16/2008	Solid/Sediment	Analytical Resources, Inc.
EE03C	07/16/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NG11	EPA160.3	8
NG11	EPA350.1M	1
NG11	EPA376.2	1
NG11	PSDDA SW8270D	8
NG11	SW8270	2
NG11	PSEP-PS	8
NG11	SW9060M	8

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	Yes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	No, one SVOC surrogate was out for EE03B, no action was taken.
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples “JG” and “UJG” for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – the data was qualified based on MS/MSD outliers.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	No – two compounds were outside QC limits. The analytes were qualified in associated samples as estimated.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol and 3,3’-Dichlorobenzidine were outside QC limits. All associated samples were qualified as estimated “UJK”.
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 16, 2008	Completed by: David Ikeda

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	No.
Triplicate relative standard deviation within QC limits of < 20%?	No, the TOC result above QC limits, sample result was flagged as estimated bias unknown "JK" in the associated samples.
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD or LCS/LCSD outliers. If MS/MSD or LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK or JK), based on the initial calibration. The TOC results were qualified as estimated bias unknown due to triplicate outlier. The bis(2-ethylhexyl)phthalate result in sample EC03C was qualified as not detected (U), due to method blank contamination. The n-nitrosodiphenylamine result in samples EC03B and EC03C were qualified as not detected estimated biased high (UJL), due to sample matrix interferences. One compound in samples EC03B and EC03C was identified and quantitated based on the professional judgment of the analyst; the results were qualified as estimated biased unknown (JK).

Table 2 - List of Positive Results for Blank Samples

Sample ID	Analyte	Result	Qual	Units	PQL
MB-072808	Bis (2-ethylhexyl)phthalate	37		µg/Kg	20

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
8270	EC03C	Bis (2-ethylhexyl)phthalate	120	U

Table 3 - List of Samples with Surrogates outside Control Limits

None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
EE03C MS	Di-n-octylphthalate	27.0%	31.3%	14.1%	32 - 107%	35%	UJG
CO05B MS	Palustric acid	0%	0%	NC	30 - 160%	35%	REJ
CO05B MS	Dehydroabietic acid	1.0%	34.8%	19.9	30 - 160%	35%	REJ
CO05B MS	Abietic acid	2.6%	15.6%	14.4%	30 - 160%	35%	REJ
CO05B MS	Neoabietic acid	6.3%	6.7%	5.8%	30 - 160%	35%	REJ
CO05B MS	14-Chlorodehydroabietic acid	20.8%	25.7%	21.1%	30 - 160%	35%	UJG
CO05B MS	12-Chlorodehydroabietic acid	14.2%	19.7%	19.5%	30 - 160%	35%	JG
CO05B MS	9,10 –Dichlorostearic acid	27.1%	35.2%	25.9%	30 - 160%	35%	UJG
CO05B MS	Linolenic acid	22.7%	20.6%	9.9	25 - 90%	35%	UJG
EC03C MS	TOC	135%	NA	NA	25 - 90%	35%	JG
EC03C MS	Sulfide	0%	NA	NA	75 - 125%	35%	JG

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	LCSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
LCSD-072808	Abietic acid	23.2%	21.8%	6.2%	30 - 160%	35%	JG
LCSD-072808	Neoabietic acid	54.8%	39.7%	32.0%	30 - 160%	35%	UJK

Table 6 –Samples that were Reanalyzed

Sample ID	Method	Reason
CO05B	SVOCs	Compound outside calibration range.
EC03B	SVOCs	Compound outside calibration range.
EC03C	SVOCs	Compound outside calibration range.
ED05B	SVOCs	Compound outside calibration range.

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.

JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 16, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
CO02B	07/17/2008	Solid/Sediment	Analytical Resources, Inc.
EE04B	07/17/2008	Solid/Sediment	Analytical Resources, Inc.
EE04C	07/17/2008	Solid/Sediment	Analytical Resources, Inc.
MD01B	07/17/2008	Solid/Sediment	Analytical Resources, Inc.
MD01C	07/17/2008	Solid/Sediment	Analytical Resources, Inc.
MD02B	07/17/2008	Solid/Sediment	Analytical Resources, Inc.
MD02C	07/17/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NG55	EPA160.3	7
NG55	EPA350.1M	3
NG55	EPA376.2	4
NG55	PSDDA SW8270D	7
NG55	SW8270	5
NG55	PSEP-PS	7
NG55	SW9060M	7

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples "JG" and "UJG" for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ".
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – the data was qualified based on MS/MSD outliers.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	No – One compound was outside QC limits. The analyte was qualified in associated samples as estimated biased low "JG" or "UJG".
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol and 3,3'-Dichlorobenzidine were outside QC limits. All associated samples were qualified as estimated "UJK".
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes, sample MD02B was reanalyzed for semivolatile compounds and resin compounds. Only one result per analyte was reported.
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD or LCS/LCSD outliers. If MS/MSD or LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial calibration. One compound was identified and quantitated based on the professional judgment of the analyst; the results were qualified as estimated biased unknown (JK).

Table 2 - List of Positive Results for Blank Samples

None

Table 2A - List of Samples Qualified for Method Blank Contamination

None

Table 3 - List of Samples with Surrogates outside Control Limits

None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
MD02C MS	Benzyl Alcohol	10.8%	2.2%	133%	25 - 90%	35%	REJ
MD02C MS	Palustric acid	14.0%	12.5%	10.9%	30 - 160%	35%	UJG
MD02C MS	Abietic acid	25.5%	13.5%	61.4%	30 - 160%	35%	REJ
MD02C MS	Neoabietic acid	2.6%	0%	NC	25 - 90%	35%	REJ

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	LCSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
LCS-072908	Abietic acid	23.2%	21.8%	6.2%	30 - 160%	35%	UJG

Table 6 –Samples that were Reanalyzed

Sample ID	Method	Reason
MD02B	SVOCs	Compound outside calibration range.
MD02B	Resin Acids	Compound outside calibration range.

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.

NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 16, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
CO03B	07/20/2008	Solid/Sediment	Analytical Resources, Inc.
CO04B	07/18/2008	Solid/Sediment	Analytical Resources, Inc.
LP05B	07/19/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NG54	EPA160.3	3
NC45	EPA350.1M	1
NG54	EPA376.2	1
NG54	PSDDA SW8270D	3
NG54	ResinCompounds, Guaiacols	3
NG54	PSEP-PS	3
NG54	SW9060M	3

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)

- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	Yes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes.
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples “JG” and “UJG” for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – the data was qualified based on MS/MSD outliers.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	No – two compounds were outside QC limits. The analytes were qualified in associated samples as estimated.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol and 3,3’-Dichlorobenzidine were outside QC limits. All associated samples were qualified as estimated “UJK”.
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 16, 2008	Completed by: David Ikeda

General Analytical Methods	
Description	**Notes and Qualifiers**
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Matrix spike samples were performed on samples from another work order.
Triplicate relative standard deviation within QC limits of < 20%?	Triplicate samples were performed on samples from another work order.
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD or LCS/LCSD outliers. If MS/MSD or LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”. Sample results were qualified as estimate, biased unknown (UJK or JK), based on the initial calibration. The bis(2-ethylhexyl)phthalate result in sample LP05B was qualified as not detected (U), due to method blank contamination. The nitrobenzene, 2,4-dimethylphenol, and 4-nitrophenol results in samples LP05B were qualified as not detected estimated biased high (UJL), due to sample matrix interferences. The benzyl alcohol result in samples LP05B was identified and quantitated based on the professional judgment of the analyst; the results were qualified as estimated biased unknown (JK).

Table 2 - List of Positive Results for Blank Samples

Sample ID	Analyte	Result	Qual	Units	PQL
MB-072808	Bis (2-ethylhexyl)phthalate	37		µg/Kg	20

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
8270	LP05B	Bis (2-ethylhexyl)phthalate	35	U

Table 3 - List of Samples with Surrogates outside Control Limits

None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
CO04B MS	Palustric acid	0%	0%	NC	30 - 160%	35%	REJ
CO04B MS	Abietic acid	1.2%	2.0%	NC	30 - 160%	35%	JG
CO04B MS	Neoabietic acid	6.6%	7.3%	NC	25 - 90%	35%	REJ
CO04B MS	14-Chlorodehydroabietic acid	23.8%	26.0%	21.1%	30 - 160%	35%	UJG

CO04B MS	12-Chlorodehydroabietic acid	23.8%	26.1%	19.5%	30 - 160%	35%	UJG

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	LCSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
LCSD-072808	Abietic acid	40.2%	24.1%	50.1%	30 - 160%	35%	JG
LCSD-072808	Neoabietic acid	54.8%	39.7%	32.0%	30 - 160%	35%	UJK or JK

Table 6 –Samples that were Reanalyzed

Sample ID	Method	Reason
LP05B	SVOCs	Compound outside calibration range.
LP05B	Resin Acids	Compound outside calibration range.

Key:

A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.

NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 10, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
E102B	07/18/2008	Solid/Sediment	Analytical Resources, Inc.
FT12B	07/18/2008	Solid/Sediment	Analytical Resources, Inc.
FT12C	07/18/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NG55	EPA160.3	3
NG55	EPA350.1M	1
NG55	EPA376.2	1
NG55	PSDDA SW8270D	3
NG55	PSEP-PS	3
NG55	SW9060M	3

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)

- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples "JG" and "UJG" for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ".
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No- RPD Values were outside QC limits for one compound; the result was qualified "UJG" for non-detects in the parent sample.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	Yes
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol and 3,3'-Dichlorobenzidine were outside QC limits. All associated samples were qualified as estimated "UJK".
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag	Samples results below the PQL are

General Analytical Methods	
Description	**Notes and Qualifiers**
data.	reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD outliers. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial calibration.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
E102B MS	Benzyl Alcohol	0%	0%	NC	25 - 90%	35%	REJ
E102B MS	4-Chloroaniline	11.5%	10.7%	7.2%	14 - 80%	35%	UJG
E102B MS	4-Nitroaniline	61.8%	28.9%	72.5%	24 - 89%	35%	UJK
E102B MS	3,3'-Dichlorobenzidine	0%	0%	NC	14 - 84%	35%	REG
E102B MS	4,5-Dichloroguaiacol	28.3%	39.3%	32.5%	30 - 160%	35%	UJG

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed

None

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL

U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles NH42
Date Completed: September 16, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
DO04B	7/22/2008	Solid/Sediment	Analytical Resources, Inc.
DO04C	7/22/2008	Solid/Sediment	Analytical Resources, Inc.
DO04D	7/22/2008	Solid/Sediment	Analytical Resources, Inc.
EE02B	7/21/2008	Solid/Sediment	Analytical Resources, Inc.
EE02C	7/21/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NH40	EPA160.3	5
NH40	EPA350.1M	3
NH40	EPA376.2	3
NH40	PSDDA SW8270D	5
NH40	PSEP - Grain size	5
NH40	SW8270D – Resin Acid	3
NH40	SW9060M	5

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	No, the samples arrive below 2 ^{o}C, no action was taken.
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples “JG” and “UJG” for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – the data was qualified based on MS/MSD outliers.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples “JG” and “UJG” for low LCS/LCSD recovery. If LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol and 3,3’-Dichlorobenzidine were above the QC limit, samples results were qualified “UJK” in all samples.
Is continuing calibration for target compounds < 20%?	No – dibenzo(a,h)anthracene, and benzo(g,h,i)perylene were outside QC limits. All associated samples were qualified as estimated “JTK” or “UJK”.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD or LCS/LCSD outliers. If MS/MSD or LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
EE02C MS	Benzyl Alcohol	0%	0%	NC	25 - 90%	35%	REJ
EE02C MS	4-Chloroanilne	15.0%	3.3%	40.8%	14 - 80%	35%	REJ
EE02C MS	3-Nitroaniline	35.2%	24.2%	37.1%	25 – 93%	35%	UJG
EE02C MS	3,3'-Dichlorobenzidine	19.9%	10.6%	60.8%	14 - 84%	35%	UJG
DO04D MS	Palustric acid	14.6%	16.0%	9.3%	30 - 160%	35%	UJG

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
DO04D MS	Abietic acid	18.6%	21.6%	15.2%	30 - 160%	35%	UJG
DO04D MS	Neoabietic acid	21.9%	33.9%	43.4%	25 - 90%	35%	UJG

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	LCSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
LCS-080408	Palustric acid	14.3%	16.7%	15.5%	30 - 160%	35%	UJG
LCS-080408	Neoabietic acid	2.9%	7.2%	83.8%	30 - 160%	35%	REJ

Table 6 –Samples that were Reanalyzed

None

Key:

A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .

NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles NH42
Date Completed: September 16, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
DO05B	7/22/2008	Solid/Sediment	Analytical Resources, Inc.
DO05C	7/22/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NH41	EPA160.3	2
NH41	EPA350.1M	2
NH41	EPA376.2	2
NH41	PSDDA SW8270D	2
NH41	PSEP - Grain size	2
NH41	SW8270D – Resin Acid	2
NH41	SW9060M	2

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6°C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)

- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	NA, the MS/MSD sample was performed on a different work order.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	NA, the MS/MSD sample was performed on a different work order.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples "JG" and "UJG" for low LCS/LCSD recovery. If LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ".
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol and 3,3'-Dichlorobenzidine were above the QC limit, samples results were qualified "UJK" in all samples.
Is continuing calibration for target compounds < 20%?	No – dibenzo(a,h)anthracene, and benzo(g,h,i)perylene were outside QC limits. All associated samples were qualified as estimated "JTK" or "UJK".
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles NH42
Date Completed: September 16, 2008	Completed by: David Ikeda

General Analytical Methods	
Description	**Notes and Qualifiers**
	not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on LCS/LCSD outliers. If LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”. Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	LCSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
LCS-080408	Palustric acid	14.3%	16.7%	15.5%	30 - 160%	35%	UJG
LCS-080408	Neoabietic acid	2.9%	7.2%	83.8%	30 - 160%	35%	REJ

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated

ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles NH42
Date Completed: September 16, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
LA01A	7/23/2008	Solid/Sediment	Analytical Resources, Inc.
LA02A	7/23/2008	Solid/Sediment	Analytical Resources, Inc.
LA02B	7/23/2008	Solid/Sediment	Analytical Resources, Inc.
LA02X	7/23/2008	Solid/Sediment	Analytical Resources, Inc.
LA03A	7/23/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NH43	EPA160.3	4
NH43	EPA350.1M	2
NH43	EPA376.2	4
NH43	PSDDA SW8270D	1
NH43	PSEP - Grain size	3
NH43	SW8270D – Resin Acid	1
NH43	SW9060M	3

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)

- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)?	NA, the MS/MSD sample was performed on a different work order.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	NA, the MS/MSD sample was performed on a different work order.
LCS percent recovery values within Laboratory QC criteria (see Table 5)?	No – Several compounds were outside QC limits. All analytes were qualified in associated samples "JG" and "UJG" for low LCS/LCSD recovery. If LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ".
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol and 3,3'-Dichlorobenzidine were above the QC limit, samples results were qualified "UJK" in all samples.
Is continuing calibration for target compounds < 20%?	No – dibenzo(a,h)anthracene, and benzo(g,h,i)perylene were outside QC limits. All associated samples were qualified as estimated "JTK" or "UJK".
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles NH42
Date Completed: September 16, 2008	Completed by: David Ikeda

General Analytical Methods	
Description	**Notes and Qualifiers**
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on LCS/LCSD outliers. If LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	LCSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
LCS-080408	Palustric acid	14.3%	16.7%	15.5%	30 - 160%	35%	UJG
LCS-080408	Neoabietic acid	2.9%	7.2%	83.8%	30 - 160%	35%	REJ

Table 6 –Samples that were Reanalyzed

Sample ID	Method	Reason
LA03A	8270 D	Poor surrogate recovery

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.

UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 16, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
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LA02B	7/23/2008	Solid/Sediment	Analytical Resources, Inc.
LA02X	7/23/2008	Solid/Sediment	Analytical Resources, Inc.
LA03A	7/23/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NH43	EPA160.3	4
NH43	EPA350.1M	3
NH43	EPA376.2	1
NH43	PSDDA SW8270D	4
NH43	PSEP - Grain size	2
NH43	SW8270D – Resin Acid	3
NH43	SW9060M	2

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)

- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	Yes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)? If out and LCS is compliant, then J flag positive data in original sample due to matrix?	No – Several compounds were outside QC limits. The analytes were qualified in the parent sample “JG” and “UJG” for low MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – 3-Nitroaniline was outside QC limits; the sample was qualified due to MS/MSD recovery.
LCS percent recovery values within Laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	No – Several compounds were outside QC limits. All analytes were qualified in associated samples “JG” and “UJG” for low LCS/LCSD recovery. If LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	No – 2,4-Dinitrophenol and 3,3’-Dichlorobenzidine were above the QC limit, samples results were qualified “UJK” in all samples.
Is continuing calibration for target compounds < 20%?	No – 2,4-dinitrophenol, 4-nitroaniline, 4,6-dinitro-2-methylphenol, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene were outside QC limits. All associated samples were qualified as estimated “JK” or “UJK”.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
For TICs are there any system related compounds that should not be reported?	No

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	Yes
Triplicate relative standard deviation within QC limits of < 20%?	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated based on MS/MSD and LCS/LCSD outliers. If MS/MSD or LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration. Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination.

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 8270	08-17521-NH43MB	MBLK	Phenol	31		µg/Kg	0.13	20

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
SW846 8270	LA03A	Phenol	28	U

Table 3 - List of Samples with Surrogates outside Control Limits

None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
LA02X MS	Benzyl Alcohol	0%	0%	NC	25 - 90%	35%	REJ
LA02X MS	4-Chloroaniline	0%	0%	NC	14 - 80%	35%	REJ
LA02X MS	3-Nitroaniline	12.0%	8.3%	72.5%	24 - 89%	35%	REJ
LA02X MS	4-Nitroaniline	25.3%	23.4%	72.5%	24 - 89%	35%	UJG
LA02X MS	3,3'-Dichlorobenzidine	0%	0%	NC	14 - 84%	35%	REJ
LA02B MS	Palustric acid	24.0%	10.9%	32.5%	30 - 160%	35%	UJG or JG
LA02B MS	Dehydroabietic acid	0%	20.4%	NC	30 - 160%	35%	JG
LA02B MS	Abietic acid	0%	0%	NC	30 - 160%	35%	JG
LA02B MS	Linolenic acid	0%	39.3%	59.6%	30 - 160%	35%	REJ

Table 5 - List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	LCSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
LCS-080408	Palustric acid	14.3%	16.7%	15.5%	30 - 160%	35%	UJG or JG
LCS-080408	Neoabietic acid	2.9%	7.2%	83.8%	30 - 160%	35%	REJ or JG

Table 6 –Samples that were Reanalyzed

Sample ID	Method	Reason
LA03A	8270 D	Poor surrogate recovery

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.

JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 10, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
MD08TG	7/12/2008	Tissue	Analytical Resources, Inc.
MD08TH	7/12/2008	Tissue	Analytical Resources, Inc.
MD09TH	7/12/2008	Tissue	Analytical Resources, Inc.
RF04TH	7/12/2008	Tissue	Analytical Resources, Inc.
RF05TH	7/12/2008	Tissue	Analytical Resources, Inc.
RF06TG	7/12/2008	Tissue	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
NI28	SW8270D	6
NI28	Percent Lipids	6

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes. The laboratory was given the wrong sample identifications numbers. The laboratory received samples IE21TL through IE24TL and IE26TM as samples EI21TL through EI24TL and EI26TM. He samples umbers were corrected in the reviewed database.
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	Yes
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)? If out and LCS is compliant, then J flag positive data in original sample due to matrix?	No – Several compounds were outside QC limits. No results were qualified due to MS/MSD outliers, since the analytes were diluted out.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within Laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes – Samples were diluted due to complications with the high lipid content of the matrix.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
None.

Table 2 - List of Positive Results for Blank Samples

Sample ID	Analyte	Result	Qual	Units	PQL
MB-	Diethylphthalate	150		μg/Kg	100

Sample ID	Analyte	Result	Qual	Units	PQL
072508					

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
MD08TG MS	n-Nitroso-di-n-propylamine	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	2-Nitrophenol	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	2,4-Dichlorophenol	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	4-Chloroaniline	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	4-Chloro-3-methylphenol	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	Hexachlorocyclopentadiene	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	2,4,6-Trichlorophenol	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	2,4,5-Trichlorophenol	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	2-Nitroaniline	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	3-Nitroaniline	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	2,4-Dinitrophenol	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	4-Nitrophenol	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	2,6-Ditrotoluene	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	2,4-Ditrotoluene	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	4-Nitroaniline	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	4,6-Dinitro-2-methylphenol	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	Pentachlorophenol	0%	0%	NC	30 - 160%	35%	REJ
MD08TG MS	3,3'-Dichlorobenzidine	0%	0%	NC	30 - 160%	35%	REJ

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalysed and Diluted

Sample ID	Method	Reason	Dilution Factor
MD08TG	8270 D	Lipid Content in Matrix	5
MD08TH	8270 D	Lipid Content in Matrix	5
MD09TH	8270 D	Lipid Content in Matrix	5
RF04TH	8270 D	Lipid Content in Matrix	5
RF05TH	8270 D	Lipid Content in Matrix	5
RF06TG	8270 D	Lipid Content in Matrix	5

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected

PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 18, 2008	Completed by: Bryan Kroon

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
BL02B	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
BL02C	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
BL06A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
BL08A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE10A	06/08/2008	Solid/Sediment	Analytical Resources, Inc.
IE12A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE13A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE15A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IE16A	06/09/2008	Solid/Sediment	Analytical Resources, Inc.
IH06B	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
IH06C	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
KP06A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
OH01A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
OH02A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
OH03A	06/11/2008	Solid/Sediment	Analytical Resources, Inc.
RF01A	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
RF02A	06/10/2008	Solid/Sediment	Analytical Resources, Inc.
RF03A	06/10/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
NL28	EPA160.3	18
NL28	EPA376.2	18

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required.	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 18, 2008	Completed by: Bryan Kroon

General Sample Information	
Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

General Analytical Methods	
Description	**Notes and Qualifiers**
Any compounds present in method blank as noted on Table 2?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD and triplicates per 20 samples (if applicable)?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125% or 65-135% for total sulfides?	No, refer to Table 4.
Triplicate relative standard deviation within QC limits of < 20%?	No, sample results were qualified due to LCS outliers.
LCS percent recovery values within QC criteria (see Table 5) of 80-120% or 65-135% for total sulfides? If the value is high with no positive values in the associated data; then no data qualification is required.	No, refer to Table 5.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110% or 85-115% for total sulfides.	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
None

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	QC Limit	Validation Qual
LCS-080408	Sulfide	66.7%	80 - 120%	UJG or JG

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Sample ID	Analyte	LCS Recovery	QC Limit	Validation Qual
LCS-061408	Sulfide	75.2%	80 - 120%	UJG or JG

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.

L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: December 10, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Work Order	Sample_Matrix	Laboratory
BA01A	6/07/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
BL06A	6/11/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
BL08A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
FT05A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
FT06A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
FT09A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
FT10A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
FT11A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE03A	6/07/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE04A	6/08/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE05A	6/07/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE06A	6/08/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE10A	6/08/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE11A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE13A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE14A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE15A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE16A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
KP05A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
KP08A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
MA04A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
MA06A	6/11/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
BL03A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
BL04A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
FT02A	6/17/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IE07A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IE08A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IE09A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IH01A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IH02A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IH03A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IH04A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Work Order	Sample_Matrix	Laboratory
IH05A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IH06A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
KP01A	6/17/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
KP02A	6/17/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
KP04A	6/17/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
MA01A	6/17/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
MA02A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
MA03A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
MA05A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
RL01A	6/18/2008	NV14	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NV13	PSDDA SW8270D	22
NV13	SW8270D – Resin Acid	19
NV13	Krone – Organotin	1
NV14	PSDDA SW8270D	19
NV14	SW8270D – Resin Acid	17
NV14	Krone – Organotin	4

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics (including Resin Acids and Organotin) by GCMS

Description	Notes and Qualifiers
Any compounds present in method, trip, and field blanks (see Table 2)?	No.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	No, the LCS surrogate for organotin was out. No action was taken since associate samples surrogate recovery values were within QC limits.
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	No, refer to Table 3.
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)? If out and LCS is compliant, then J flag positive data in original sample due to matrix?	No, several compounds were outside QC limits. Refer to Table 4.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No, several compounds were outside QC limits. Refer to Table 4.
LCS percent recovery values within Laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	No – Several compounds were outside QC limits. Refer to Table 5.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	No, Chrysene-d12 and Di-n-octylphthtalate-d4 in sample MA02A (SVOC) were above the QC limits. Associated sample results were qualified as estimated biased low (UJG).
Is initial calibration for target compounds <20 % RSD or curve fit?	No, benzoic acid and 4,6-dinitro-2-methylphenol were above the QC limit, samples results were qualified “UJK” in all samples that haven’t been qualified previously.
Is continuing calibration for target compounds < 20%?	No, benzyl alcohol, benzoic acid, hexachlorocyclopentadiene, 4,5-dichloroguaiacol, and 4,6-dichloroguaiacol were outside QC limits. All associated samples were qualified as estimated “JK” or “UJK” in all samples that haven’t been qualified previously.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated (JG or JL) based on MS/MSD and LCs/LCSD outliers. If MS/MSD or LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected “REJ”. Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration. In sample MA02A, SVOCs were qualified as estimated biased low (UJG) based on internal standard outliers. Positive sample results in IH03A (resin acid) were qualified as biased high (JL) due to a high surrogate recovery. The nitobenzene result in sample IH03A was qualified as not detected estimated biased high (UJL), due to sample matrix interferences. The 2-chlorophenol result in sample IH06A was qualified as not detected estimated biased high (UJL), due to sample matrix interferences. The phenol, bis(2-chloroethyl)ether, benzyl alcohol, 2-methylphenol, nitrobenzene, 2,4-dimethylphenol, 2-chlorophenol, di-n-butylphthtalte, fluoranthene, and chrysene results in sample MA02A were qualified as not detected estimated biased high (UJL), due to sample matrix interferences. The bis(2-chloroethyl)ether and 2-methylphenol results in sample MA04A were qualified as not detected estimated biased high (UJL), due to sample matrix interferences. The 2-methylphenol and 4-methylphenol result in samples IH03A was identified and quantitated based on the professional judgment of the analyst; the results were qualified as estimated biased unknown (JK).

Table 2 – List of Positive Results for Blank Samples

None

Table 2A – List of Samples Qualified for Method Blank Contamination

None

Table 3 – List of Samples with Surrogates outside Control Limits

Sample ID	Fraction	Surrogate	Recovery	Limits	Validation Qual
MA02A	SVOC	Terphenyl-d4	20.9	38-105%	None
IH03A	Resin Acid	o-Methylpodocarpic Acid	116%	28-120%	JL

Table 4 – List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
FT10A MS	Benzoic Acid	44.0%	77.4%	54.4%	29 – 104%	35%	UJG
FT10A MS	4-Chloroaniline	0%	0%	NC	14 – 80%	35%	REJ
FT10A MS	Hexachlorocyclopentadiene	21.3%	41.6%	63.9	25 – 93%	35%	UJG
FT10A MS	3-Nitroaniline	10.1%	0%	NC	25 – 93%	35%	REJ
FT10A MS	4-Nitrophenol	98.6%	83.4%	17.5%	26 – 97%	35%	REJ
FT10A MS	3,3’-Dichlorobenzidine	0%	0%	NC	14 – 84%	35%	REJ
FT10A MS	Indeno(1,2,3-cd)pyrene	53.0%	83.0%	43.4%	25 – 93%	35%	UJG or JG
FT10A MS	Dibenz(a,h)anthracene	54.4%	80.7%	38.2%	25 – 93%	35%	UJG
FT10A MS	Benzo(g,h,i)perylene	43.6%	79.1%	57.1%	26 – 97%	35%	UJG or JG
FT10A MS	4,5-Dichloroguaiacol	69.7%	105%	39.6	14 – 84%	35%	UJG
KP08A MS	4-Chloroaniline	0%	0%	NC	14 – 80%	35%	REJ
KP08A MS	3-Nitroaniline	0%	0%	NC	25 – 93%	35%	REJ
KP08A MS	3,3’-Dichlorobenzidine	0%	0%	NC	14 – 84%	35%	REJ
BL04A MS	4-Chloroaniline	4.3%	4.2%	1.0%	14 – 80%	35%	REJ
BL04A MS	3-Nitroaniline	23.3%	25.5%	9.6%	25 – 93%	35%	UJG
FT09A MS	Palustric acid	0%	0%	NC	30 – 160%	35%	REJ or JL

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
FT09A MS	Neoabietic acid	0%	0%	NC	30 – 160%	35%	REJ or JL
MA01A MS	Palustric acid	0%	0%	NC	30 – 160%	35%	REJ or JL
MA01A MS	Neoabietic acid	0%	0%	NC	30 – 160%	35%	REJ or JL

Table 5 – List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	LCSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
LCS-102408	Benzyl alcohol	21.6%	24.7%	15.5%	25 – 90%	35%	UJG
LCS-102508	Benzoic Acid	118.3%	NA	NA	29 – 104%	35%	None
LCS-102408	Abietic acid	136%	256%	61.2%	30 – 160%	35%	JL
LCS-102408	Neoabietic acid	9.2%	21.5%	80.1%	30 – 160%	35%	MS/MSD
LCS-102508	Neoabietic acid	20.4%	NA	NA	29 – 104%	35%	MS/MSD

Table 6 –Samples that were Reanalyzed

Sample ID	Method	Reason
IE07A	Resin Acid	IS out, Sample was reanalyzed and IS within QC limits.
IE08A	Resin Acid	IS out, Sample was reanalyzed and IS within QC limits.
IE09A	Resin Acid	IS out, Sample was reanalyzed and IS within QC limits.
IH03A	SVOC	IS out, Sample was reanalyzed and IS within QC limits.
IH03A	Resin Acid	Surrogate out. The extract was diluted and reanalyzed; the surrogate was still outside QC limits
IH04A	Resin Acid	Sample was diluted and reanalyzed.
IH06A	SVOC	Sample was diluted and reanalyzed.
MA02A	8270D	Surrogate out. The extract was diluted and reanalyzed; the surrogate was within QC limits
MA02A	8270D	IS out, Sample was reanalyzed and IS outside QC limits.
MA04A	Resin Acid	Sample was diluted and reanalyzed.

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.

E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: December 10, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Work Order	Sample_Matrix	Laboratory
BA01A	6/07/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
BL06A	6/11/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
BL08A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
FT05A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
FT06A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
FT09A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
FT10A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
FT11A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE03A	6/07/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE04A	6/08/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE05A	6/07/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE06A	6/08/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE10A	6/08/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE11A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE13A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE14A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE15A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
IE16A	6/09/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
KP05A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
KP08A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
MA04A	6/12/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
MA06A	6/11/2008	NV13	Solid/Sediment	Analytical Resources, Inc.
BL03A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
BL04A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
FT02A	6/17/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IE07A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IE08A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IE09A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IH01A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IH02A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IH03A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IH04A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Work Order	Sample_Matrix	Laboratory
IH05A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
IH06A	6/16/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
KP01A	6/17/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
KP02A	6/17/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
KP04A	6/17/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
MA01A	6/17/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
MA02A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
MA03A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
MA05A	6/13/2008	NV14	Solid/Sediment	Analytical Resources, Inc.
RL01A	6/18/2008	NV14	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NV13	PSDDA SW8270D	22
NV13	SW8270D – Resin Acid	19
NV13	Krone – Organotin	1
NV14	PSDDA SW8270D	19
NV14	SW8270D – Resin Acid	17
NV14	Krone – Organotin	4

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6°C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics (including Resin Acids and Organotin) by GCMS

Description	Notes and Qualifiers
Any compounds present in method, trip, and field blanks (see Table 2)?	No.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Not applicable.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	No, the LCS surrogate for organotin was out. No action was taken since associate samples surrogate recovery values were within QC limits.
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	No, refer to Table 3. No action was taken for the IH03A resin acid outlier, because the high sample results elevated the surrogate results.
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)? If out and LCS is compliant, then J flag positive data in original sample due to matrix?	No, several compounds were outside QC limits. Refer to Table 4.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No, several compounds were outside QC limits. Refer to Table 4.
LCS percent recovery values within Laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	No – Several compounds were outside QC limits. Refer to Table 5.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	No, Chrysene-d12 in sample IH03A (SVOC) and Chrysene-d12 and Di-n-octylphthtalate-d4 in sample MA02A (SVOC) were above the QC limits. Associated sample results were qualified as estimated biased low (UJG).
Is initial calibration for target compounds <20 % RSD or curve fit?	No, benzoic acid and 4,6-dinitro-2-methylphenol were above the QC limit, samples results were qualified "UJK" in all samples that haven't been qualified previously.
Is continuing calibration for target compounds < 20%?	No, benzyl alcohol, benzoic acid, hexachlorocyclopentadiene, 4,5-dichloroguaiacol, and 4,6-dichloroguaiacol were outside QC limits. All associated samples were qualified as estimated "JK" or "UJK" in all samples that haven't been qualified previously.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated (JG or JL) based on MS/MSD and LCS/LCSD outliers. If MS/MSD or LCS/LCSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration. In sample IH03A andMA02A, SVOCs were qualified as estimated biased low (UJG) based on internal standard outliers. The nitobenzene result in sample IH03A was qualified as not detected estimated biased high (UJL), due to sample matrix interferences. The 2-chlorophenol result in sample IH06A was qualified as not detected estimated biased high (UJL), due to sample matrix interferences. The phenol, bis(2-chloroethyl)ether, benzyl alcohol, 2-methylphenol, nitrobenzene, 2,4-dimethylphenol, 2-chlorophenol, di-n-butylphthtalte, fluoranthene, and chrysene results in sample MA02A were qualified as not detected estimated biased high (UJL), due to sample matrix interferences. The bis(2-chloroethyl)ether and 2-methylphenol results in sample MA04A were qualified as not detected estimated biased high (UJL), due to sample matrix interferences. The 2-methylphenol and 4-methylphenol result in samples IH03A was identified and quantitated based on the professional judgment of the analyst; the results were qualified as estimated biased unknown (JK).

Table 2 – List of Positive Results for Blank Samples

None

Table 2A – List of Samples Qualified for Method Blank Contamination

None

Table 3 – List of Samples with Surrogates outside Control Limits

Sample ID	Fraction	Surrogate	Recovery	Limits	Validation Qual
MA02A	SVOC	Terphenyl-d4	20.9	38-105%	None
IH03A	Resin Acid	o-Methylpodocarpic Acid	116%	19-114%	None
LCS-102208	Organotin	Tripentyl Tin Chloride	21.7%	30-160%	None

Table 4 – List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
FT10A MS	Benzoic Acid	44.0%	77.4%	54.4%	29 – 104%	35%	UJG
FT10A MS	4-Chloroaniline	0%	0%	NC	14 – 80%	35%	REJ
FT10A MS	Hexachlorocyclopentadiene	21.3%	41.6%	63.9	25 – 93%	35%	UJG
FT10A MS	3-Nitroaniline	10.1%	0%	NC	25 – 93%	35%	REJ
FT10A MS	3,3'-Dichlorobenzidine	0%	0%	NC	14 – 84%	35%	REJ
FT10A MS	Indeno(1,2,3-cd)pyrene	53.0%	83.0%	43.4%	25 – 93%	35%	UJG or JG
FT10A MS	Dibenz(a,h)anthracene	54.4%	80.7%	38.2%	25 – 93%	35%	UJG
FT10A MS	Benzo(g,h,i)perylene	43.6%	79.1%	57.1%	26 – 97%	35%	UJG or JG
FT10A MS	4,5-Dichloroguaiacol	69.7%	105%	39.6	14 – 84%	35%	UJG
KP08A MS	4-Chloroaniline	0%	0%	NC	14 – 80%	35%	REJ
KP08A MS	3-Nitroaniline	0%	0%	NC	25 – 93%	35%	REJ
KP08A MS	3,3'-Dichlorobenzidine	0%	0%	NC	14 – 84%	35%	REJ
BL04A MS	4-Chloroaniline	4.3%	4.2%	1.0%	14 – 80%	35%	REJ
BL04A MS	3-Nitroaniline	23.3%	25.5%	9.6%	25 – 93%	35%	UJG
FT09A MS	Palustric acid	0%	0%	NC	30 – 160%	35%	REJ or JL
FT09A MS	Neoabietic acid	0%	0%	NC	30 – 160%	35%	REJ or JL
MA01A MS	Palustric acid	0%	0%	NC	30 – 160%	35%	REJ or JL

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
MA01A MS	Neoabietic acid	0%	0%	NC	30 – 160%	35%	REJ or JL

Table 5 – List LCS Percent Recovery Values outside Control Limits

Sample ID	Analyte	LCS Recovery	LCSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
LCS-102408	Benzyl alcohol	21.6%	24.7%	15.5%	25 – 90%	35%	UJG
LCS-102508	Benzoic Acid	118.3%	NA	NA	29 – 104%	35%	None
LCS-102408	Abietic acid	136%	256%	61.2%	30 – 160%	35%	JL
LCS-102408	Neoabietic acid	9.2%	21.5%	80.1%	30 – 160%	35%	None
LCS-102508	Neoabietic acid	20.4%	NA	NA	29 – 104%	35%	None

Table 6 –Samples that were Reanalyzed

Sample ID	Method	Reason
IE07A	Resin Acid	IS out, Sample was reanalyzed and IS within QC limits. Diluted sample results were reported.
IE08A	Resin Acid	IS out, Sample was reanalyzed and IS within QC limits. Diluted sample results were reported.
IE09A	Resin Acid	IS out, Sample was reanalyzed and IS within QC limits. Diluted sample results were reported.
IH03A	SVOC	IS out, Sample was reanalyzed and IS within QC limits. Original results were reported.
IH03A	Resin Acid	Surrogate out. The extract was diluted and reanalyzed; the surrogate was still outside QC limits. Original and diluted results were reported.
IH04A	Resin Acid	Sample was diluted and reanalyzed. Original and diluted results were reported.
IH06A	SVOC	Sample was diluted and reanalyzed. Original and diluted results were reported.
MA02A	8270D	Surrogate out. The extract was diluted and reanalyzed; the surrogate was within QC limits. Original results were reported.
MA02A	8270D	IS out, Sample was reanalyzed and IS outside QC limits. Original results were reported.
MA04A	Resin Acid	Sample was diluted and reanalyzed. Original and diluted results were reported.

Key:
A = Analyte
NA = Not Analyzed
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.

E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: December 10, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
BL01A	6/19/2008	Solid/Sediment	Analytical Resources, Inc.
IE12A	6/09/2008	Solid/Sediment	Analytical Resources, Inc.
FT04B	6/07/2008	Solid/Sediment	Analytical Resources, Inc.
FT04C	6/07/2008	Solid/Sediment	Analytical Resources, Inc.

Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Result_Method_Code	CountOfSample_ID
NW05	PSDDA SW8270D	4
NW05	SW8270D – Resin Acid	3

Sample IE12A was originally requested to be analyzed for SVOC and resin acid. The laboratory contacted E&E by email about IE12A having insufficient sample volume for both SVOC and resin acid extraction. Based on limited sample volume, E&E determine that due to sediment management standards (SMS) the SVOC analysis was a higher priority and directed the laboratory to perform the SVOC analysis.

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations (See table below)?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)

- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Semivolatile Organics by GCMS	
Description	**Notes and Qualifiers**
Any compounds present in method, trip, and field blanks (see Table 2)?	No.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data. Qualification also applies to TICs.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits? All samples should be re-analyzed for VOCs? Samples should be re-analyzed if >1 BN and/or AP for SVOCs is out.	Yes
MS/MSD percent recovery values within laboratory QC criteria (see Table 4)? If out and LCS is compliant, then J flag positive data in original sample due to matrix?	No – Several compounds were outside QC limits. Positive sample results were qualified as estimated (JG or JL) based on MS/MSD recovery. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ".
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	No – Abietic acid was outside QC limits; the sample was qualified due to MS/MSD recovery.
LCS percent recovery values within Laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix (see Table 6)?	Yes.
Is initial calibration for target compounds <20 % RSD or curve fit?	No – Benzoic acid and 4,6-dinitro-2-methylphenol were above the QC limit, samples results were qualified "UJK" in all samples.
Is continuing calibration for target compounds < 20%?	No – Benzyl alcohol were outside QC limits. All associated samples were qualified as estimated "JK" or "UJK".
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
For TICs are there any system related compounds that should not be reported?	No

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns

Positive sample results were qualified as estimated (JG or JL) based on MS/MSD outliers. If MS/MSD percent recovery values were below 10%, then non-detect results were flagged as rejected "REJ". Sample results were qualified as estimate, biased unknown (UJK or JK), based on initial and continuing calibration.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Sample ID	Analyte	MS Recovery	MSD Recovery	RPD	QC Limit	RPD Limit	Validation Qual
FT04B MS	Palustric acid	0%	0%	NC	30 - 160%	35%	REJ or JL
FT04B MS	Dehydroabietic acid	167%	266%	30.4	30 - 160%	35%	JG
FT04B MS	Abietic acid	421%	948%	61.5	30 - 160%	35%	JG

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed

Sample ID	Method	Reason
BL01A	8270D – Resin Acid	Sample extract was diluted and reanalyzed.

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.

JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 14, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
IE24TL	6/23/2008	TISSUE	Axys Analytical
IE21TL	6/17/2008	TISSUE	Axys Analytical
IE22TL	6/19/2008	TISSUE	Axys Analytical
IE23TL	6/21/2008	TISSUE	Axys Analytical
IE26TM	6/25/2008	TISSUE	Axys Analytical
EI08TH	6/15/2008	TISSUE	Axys Analytical
IE20TH	6/26/2008	TISSUE	Axys Analytical
IE25TM	6/28/2008	TISSUE	Axys Analytical
MD06TH	6/30/2008	TISSUE	Axys Analytical
MD07TH	7/2/2008	TISSUE	Axys Analytical
EC06TH	6/22/2008	TISSUE	Axys Analytical
IE18TH	6/24/2008	TISSUE	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11297	1613B	4
L11298	1613B	2
L11299	1613B	6

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab less than 0^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3)

Dioxin/Furans by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see to Table 3 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted? For any sample re-analysis and dilutions is only one reportable result by flagged?	No.
Laboratory Duplicate Sample analyzed?	Yes. All relative percent difference values were within Laboratory QC limits.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG25645-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.077	J	EI08TH, IE21TL, IE22TL, IE23TL, IE24TL, IE26TM, EC06TH, IE18TH, IE20TH, IE25TM, MD07TH, and MD07TH.
	Total Heptachlorodibenzo-p-dioxin	0.077	J	
	Octachlorodibenzo-p-dioxin	0.214	J	

Table 3A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qualier

Method	Sample ID	Analyte	Result	Qualier
1613B	IE21TL	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.23	U
1613B	IE21TL	Octachlorodibenzo-p-dioxin	2.66	U
1613B	IE22TL	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.24	U
1613B	IE22TL	Octachlorodibenzo-p-dioxin	2.68	U
1613B	IE23TL	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.24	U
1613B	IE23TL	Octachlorodibenzo-p-dioxin	2.67	U
1613B	IE23TL	Total Heptachlorodibenzo-p-dioxin	0.0488	U
1613B	IE24TL	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.25	U
1613B	IE24TL	Octachlorodibenzo-p-dioxin	2.70	U
1613B	IE24TL	Total Heptachlorodibenzo-p-dioxin	0.0942	U
1613B	IE25TM	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.26	U
1613B	IE25TM	Total Heptachlorodibenzo-p-dioxin	0.0335	U

Data Validation Qualifiers:

Code	Description
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 20, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
IH06C	6/10/2008	SEDIMENT	Axys Analytical
KP02B	6/10/2008	SEDIMENT	Axys Analytical
KP03B	6/10/2008	SEDIMENT	Axys Analytical
KP07A	6/11/2008	SEDIMENT	Axys Analytical
KP08B	6/8/2008	SEDIMENT	Axys Analytical
MA02B	6/11/2008	SEDIMENT	Axys Analytical
MA02C	6/11/2008	SEDIMENT	Axys Analytical
OH01A	6/11/2008	SEDIMENT	Axys Analytical
OH02A	6/11/2008	SEDIMENT	Axys Analytical
OH03A	6/11/2008	SEDIMENT	Axys Analytical
RF01A	6/10/2008	SEDIMENT	Axys Analytical
RF02A	6/10/2008	SEDIMENT	Axys Analytical
RF03A	6/10/2008	SEDIMENT	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11304	1613B	13

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes. Some minor discrepancies were noted by the laboratory, these discrepancies were resolved with the sampling team.
Did coolers arrive at lab less than 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	No. Refer to Table 3 for outliers. Sample results were flagged as estimated biased low (UJL or JL).
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes.
Any holding time violations?	No - All samples were prepared and

	analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Samples Exceeding Temperature Requirements (Table 3);
- Method Blanks Results (Table 4);
- Sample Reanalysis (Table 5).

Dioxin/Furan by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see Table 4 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes. Refer to Table 5.
Laboratory Duplicate Sample analyzed?	Yes. All relative percent difference values were within Laboratory QC limits.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
All samples were received to the laboratory above the 6 degrees Celsius, sample results were qualified as estimated biased low (UJG or JG). Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 – List of Samples Exceeding Temperature Requirements

Sample ID	Analytical Fraction	Temperature	Qualifiers
IH06C	Dioxin/Furans	7 C	UJG or JG
KP02B	Dioxin/Furans	7 C	UJG or JG
KP03B	Dioxin/Furans	7 C	UJG or JG

KP07A	Dioxin/Furans	7 C	UJG or JG
KP08B	Dioxin/Furans	7 C	UJG or JG

Table 4 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG25640-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.026	J	IH06C, KP02B, KP03B, KP08B, MA02A, MA02C, FT12A, OH02A, OH03A, RF01A, RF02A, and RF03A.
	Octachlorodibenzo-p-dioxin	0.121	J	
	1,2,3,4,7,8-Hexachlorodibenzofuran	0.025	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.030	J	
	Octachlorodibenzofuran	0.032	J	
	Total Heptachlorodibenzofurans	0.030		
WG25754-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.073	J	KP07A
	Octachlorodibenzo-p-dioxin	0.173	J	
	2,3,4,7,8-Pentachlorodibenzofuran	0.052	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.079	J	
	Octachlorodibenzofuran	0.102	J	
	Total Heptachlorodibenzo-p-dioxins	0.073		
	Total Heptachlorodibenzofurans	0.079		

Table 4A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qualier
1613B	IH06C	1,2,3,4,7,8-Hexachlorodibenzofuran	0.588	U
1613B	IH06C	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.548	U
1613B	RF01A	Octachlorodibenzofuran	1.13	U
1613B	RF01A	Total Heptachlorodibenzofurans	0.119	U
1613B	RF02A	1,2,3,4,7,8-Hexachlorodibenzofuran	0.569	U
1613B	RF02A	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.53	U
1613B	RF02A	Octachlorodibenzofuran	1.15	U
1613B	RF02A	Total Heptachlorodibenzofurans	0.10	U

Table 5 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
IH06C	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported.
KP02B	Sample underwent additional cleanup, reanalyzed result was reported.
KP07A	Sample was reextracted due to QC issues.
MA02A	Sample required a dilution.
FT12A	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported.
RF01A	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported..

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.

EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 18, 2008	**Completed by: David Ikeda**

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
BL02A	6/13/2008	SEDIMENT	Axys Analytical
BL02B	6/8/2008	SEDIMENT	Axys Analytical
BL02C	6/8/2008	SEDIMENT	Axys Analytical
BL08B	6/11/2008	SEDIMENT	Axys Analytical
BL08C	6/11/2008	SEDIMENT	Axys Analytical
FT13A	6/11/2008	SEDIMENT	Axys Analytical
IE05B	6/13/2008	SEDIMENT	Axys Analytical
IE09B	6/13/2008	SEDIMENT	Axys Analytical
IE16B	6/12/2008	SEDIMENT	Axys Analytical
IH02B	6/12/2008	SEDIMENT	Axys Analytical
IH02C	6/12/2008	SEDIMENT	Axys Analytical
IH06B	6/10/2008	SEDIMENT	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11304	1613B	12

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes. Some minor discrepancies were noted by the laboratory, these discrepancies were resolved with the sampling team.
Did coolers arrive at lab less than 6°C and in good condition as indicated on COC and Cooler Receipt Form?	No. Refer to Table 3 for outliers. Sample results were flagged as estimated biased low (UJG or JG).
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes.
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Samples Exceeding Temperature Requirements (Table 3);
- Method Blanks Results (Table 4);
- Sample Reanalysis (Table 5).

Dioxin/Furan by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see Table 4 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	No. The percent recovery value for 1,2,3,4,6,7,8-heptachlorodibenzofuran for WG25979 was above the Laboratory QC limit, the associated sample result was qualified as estimated, biased high (JL).
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes. Refer to Table 5.
Laboratory Duplicate Sample analyzed?	Yes. All relative percent difference values were within Laboratory QC limits.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
All samples were received by the laboratory above the 6 degrees Celsius, sample results were qualified as estimated biased low (UJG or JG). The OPR percent recovery value for 1,2,3,4,6,7,8-heptachlorodibenzofuran for WG25979 was above the Laboratory QC limit, the associated sample result was qualified as estimated, biased high (JG). Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 – List of Samples Exceeding Temperature Requirements

Sample ID	Analytical Fraction	Temperature	Qualifiers
BL02A	Dioxin/Furans	8 C	UJG or JG
BL02B	Dioxin/Furans	8 C	UJG or JG
BL02C	Dioxin/Furans	8 C	UJG or JG
BL08B	Dioxin/Furans	8 C	UJG or JG
BL08C	Dioxin/Furans	8 C	UJG or JG
FT13A	Dioxin/Furans	7 C	UJG or JG
IE05B	Dioxin/Furans	7 C	UJG or JG
IE09B	Dioxin/Furans	7 C	UJG or JG
IE16B	Dioxin/Furans	7 C	UJG or JG
IH02B	Dioxin/Furans	7 C	UJG or JG
IH02C	Dioxin/Furans	7 C	UJG or JG
IH06B	Dioxin/Furans	7 C	UJG or JG

Table 4 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG25639-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.042	J	BL02A, BL02B, BL02C, BL08B, BL08C, FT13A, IE05B, IH02C, and IH06B.
	Octachlorodibenzo-p-dioxin	0.022	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.034	J	
	Octachlorodibenzofuran	0.062	J	
WG25640-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.026	J	IE09B and IH02B
	Octachlorodibenzo-p-dioxin	0.121	J	
	1,2,3,4,7,8-Hexachlorodibenzofuran	0.025	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.030	J	
	Octachlorodibenzofuran	0.032	J	
	Total Heptachlorodibenzofurans	0.030		
WG25979-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.03	J	IE16B
	Octachlorodibenzo-p-dioxin	0.098	J	
	1,2,3,4,7,8-Hexachlorodibenzofuran	0.026	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.034	J	
	Octachlorodibenzofuran	0.047	J	
	Total Heptachlorodibenzo-p-dioxins	0.03		

Table 4A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
1613B	IE16B	1,2,3,4,7,8-Hexachlorodibenzofuran	0.565	U

Table 5 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
BL02C	First column reanalyzed due to possible sample carryover, original results were reported. Second column reanalyzed due to instrument disruption, reanalyzed result was reported.
BL08B	Second column reanalyzed due to instrument disruption, reanalyzed result was reported.
BL08C	First column reanalyzed due to possible instrument interferences, reanalysis results were reported. Second column reanalyzed due to instrument disruption, reanalyzed result was reported.

FT13A	Second column reanalyzed due to instrument disruption, reanalyzed result was reported.
IE05B	Second column reanalyzed due to instrument disruption, reanalyzed result was reported.
IE09B	Samples reanalyzed due to additional cleanup, reanalyzed result reported.
IE16B	Samples reextracted and reanalyzed due to low surrogate recovery values, reanalyzed result reported.
IH02B	First column reanalyzed due to sample dilution, reanalysis results were reported. Samples reanalyzed due to additional cleanup, reanalyzed result reported.
IH02C	Second column reanalyzed due to instrument disruption, reanalyzed result was reported.
IH06B	First column reanalyzed due to sample dilution, reanalysis results were reported. Second column reanalyzed due to instrument disruption, reanalyzed result was reported.

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.

REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 25, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
CO04A	6/20/2008	SEDIMENT	Axys Analytical
DO01A	6/19/2008	SEDIMENT	Axys Analytical
DO02A	6/19/2008	SEDIMENT	Axys Analytical
DO03A	6/19/2008	SEDIMENT	Axys Analytical
DO04A	6/19/2008	SEDIMENT	Axys Analytical
DO05A	6/19/2008	SEDIMENT	Axys Analytical
EC03A	6/20/2008	SEDIMENT	Axys Analytical
ED01B	6/19/2008	SEDIMENT	Axys Analytical
ED01C	6/19/2008	SEDIMENT	Axys Analytical
ED02C	6/19/2008	SEDIMENT	Axys Analytical
ED03A	6/20/2008	SEDIMENT	Axys Analytical
ED04A	6/20/2008	SEDIMENT	Axys Analytical
ED05A	6/20/2008	SEDIMENT	Axys Analytical
EE01A	6/20/2008	SEDIMENT	Axys Analytical
EE02A	6/20/2008	SEDIMENT	Axys Analytical
EE03A	6/20/2008	SEDIMENT	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11334	1613B	16

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes. Some minor discrepancies were noted by the laboratory, these discrepancies were resolved with the sampling team.
Did coolers arrive at lab less than 6°C and in good condition as indicated on COC and Cooler Receipt Form?	Yes.
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 25, 2008	Completed by: David Ikeda

Case narrative present and complete?	Yes.
Any holding time violations ?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3);
- Sample Reanalysis (Table 4).

Dioxin/Furan by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks (see Table 3)?	Yes, see Table 3 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted (see Table 4)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
Laboratory Duplicate Sample analyzed?	Yes. All relative percent difference values were within Laboratory QC limits.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG25706-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.040	J	CO04A, ED01B, ED02C, ED3A, ED05A, EE01A, EE02A, and EE03A.
	Octachlorodibenzo-p-dioxin	0.286	J	
	1,2,3,4,7,8-Hexachlorodibenzofuran	0.026	J	

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.034	J	
	Octachlorodibenzofuran	0.066	J	
	Total Hexachlorodibenzofurans	0.026		
	Total Heptachlorodibenzofurans	0.034		
WG25706-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.030	J	DO02A, DO03A, DO04A, DO05A, EC03A, ED01C, and ED04A.
	Octachlorodibenzo-p-dioxin	0.053	J	
	Octachlorodibenzofuran	0.067	J	
WG25754-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.070	J	DO01A
	Octachlorodibenzo-p-dioxin	0.579	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.048	J	
	Octachlorodibenzofuran	0.129	J	
	Total Heptachlorodibenzo-p-dioxins	0.111		

Table 3A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
1613B	CO04A	1,2,3,4,7,8- Hexachlorodibenzofuran	0.578	U
1613B	EE01A	1,2,3,4,7,8- Hexachlorodibenzofuran	0.588	U
1613B	EE01A	1,2,3,4,6,7,8- Heptachlorodibenzofuran	0.548	U
1613B	EE01A	Total Hexachlorodibenzofurans	0.501	U
1613B	EE02A	1,2,3,4,7,8- Hexachlorodibenzofuran	0.592	U
1613B	EE03A	1,2,3,4,7,8- Hexachlorodibenzofuran	0.581	U

Table 4 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
IH06C	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported.
KP02B	Sample underwent additional cleanup, reanalyzed result was reported.
KP07A	Sample was reextracted due to QC issues.
MA02A	Sample required a dilution.
FT12A	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported.
RF01A	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported..

Data Validation Qualifiers:

Code	**Description**
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.

J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 25, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
EE04A	6/20/2008	SEDIMENT	Axys Analytical
EE05A	6/20/2008	SEDIMENT	Axys Analytical
EI04A	6/18/2008	SEDIMENT	Axys Analytical
EI07A	6/18/2008	SEDIMENT	Axys Analytical
IE01B	6/17/2008	SEDIMENT	Axys Analytical
KP01A	6/17/2008	SEDIMENT	Axys Analytical
KP03A	6/17/2008	SEDIMENT	Axys Analytical
KP04A	6/17/2008	SEDIMENT	Axys Analytical
KP07B	6/21/2008	SEDIMENT	Axys Analytical
MD03B	6/17/2008	SEDIMENT	Axys Analytical
MD03C	6/17/2008	SEDIMENT	Axys Analytical
MD04B	6/22/2008	SEDIMENT	Axys Analytical
MD05B	6/19/2008	SEDIMENT	Axys Analytical
MD05C	6/19/2008	SEDIMENT	Axys Analytical
OH01A-R	6/18/2008	SEDIMENT	Axys Analytical
WW01A	6/19/2008	SEDIMENT	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11334	1613B	16

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes. Some minor discrepancies were noted by the laboratory, these discrepancies were resolved with the sampling team.
Did coolers arrive at lab less than 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes.
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 25, 2008	Completed by: David Ikeda

Case narrative present and complete?	Yes.
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3);
- Sample Reanalysis (Table 4).

Dioxin/Furan by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks (see Table 3)?	Yes, see Table 3 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted (see Table 4)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
Laboratory Duplicate Sample analyzed?	Yes. All relative percent difference values were within Laboratory QC limits.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG25706-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.040	J	EE04A, EE05A, EI04A, EI07A, KP01A, KP07B,
	Octachlorodibenzo-p-dioxin	0.286	J	
	1,2,3,4,7,8-Hexachlorodibenzofuran	0.026	J	

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.034	J	MD03B, and MD04B.
	Octachlorodibenzofuran	0.066	J	
	Total Hexachlorodibenzofurans	0.026		
	Total Heptachlorodibenzofurans	0.034		
WG25707-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.030	J	IE01B, KP03A, KP04A, MD03C, MD05B, MD05C, OH01A-R, and WW01A.
	Octachlorodibenzo-p-dioxin	0.053	J	
	Octachlorodibenzofuran	0.067	J	

Table 4 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
EE05A	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported.
EI04A	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported.
EI07A	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported.
KP01A	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported.
KP07B	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported.
MD03B	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported.
MD04B	Sample was reanalyzed to meet QC requirements, reanalyzed result was reported.

Data Validation Qualifiers:

Code	**Description**
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an

	estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 29, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
CO01A	6/22/2008	SEDIMENT	Axys Analytical
CO02A	6/22/2008	SEDIMENT	Axys Analytical
CO03A	6/21/2008	SEDIMENT	Axys Analytical
EC01A	6/21/2008	SEDIMENT	Axys Analytical
EC02A	6/21/2008	SEDIMENT	Axys Analytical
EC04A	6/20/2008	SEDIMENT	Axys Analytical
EC05A	6/21/2008	SEDIMENT	Axys Analytical
ED01A	6/21/2008	SEDIMENT	Axys Analytical
ED02A	6/19/2008	SEDIMENT	Axys Analytical
ED02B	6/18/2008	SEDIMENT	Axys Analytical
ED03B	6/18/2008	SEDIMENT	Axys Analytical
ED03C	6/18/2008	SEDIMENT	Axys Analytical
ED04B	6/18/2008	SEDIMENT	Axys Analytical
EI02A	6/18/2008	SEDIMENT	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11346	1613B	14

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes. Some minor discrepancies were noted by the laboratory, these discrepancies were resolved with the sampling team.
Did coolers arrive at lab less than 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes.
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes.
Any holding time violations?	No - All samples were prepared and

	analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3);
- Sample Reanalysis (Table 4).

Dioxin/Furan by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see Table 3 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted (see Table 4)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
Laboratory Duplicate Sample analyzed?	Yes. All relative percent difference values were within Laboratory QC limits.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Two samples CO02A and ED01A had a lock mass interference in the total tetrachlorobenzo-p-dioxin; the total tetrachlorobenzo-p-dioxin results were flagged as estimated unknown bias (JG). Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG25778-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.098	J	CO01A, CO02A, CO03A, EC01A, EC04A, EC05A, ED01A, ED02A, ED02B, ED03B, and ED03C.
	Octachlorodibenzo-p-dioxin	0.986	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.037	J	
	Octachlorodibenzofuran	0.191	J	
	Total Heptachlorodibenzo-p-dioxins	0.164		

Method Blank ID	Analyte	Concentration	Qualifie r	Associated Samples
	Total Heptachlorodibenzofurans	0.142		
WG25779-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.070	J	ED04B and EI02A.
	Octachlorodibenzo-p-dioxin	0.579	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.048	J	
	Octachlorodibenzofuran	0.129	J	
	Total Heptachlorodibenzo-p-dioxins	0.111		
WG26010-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.025	J	EC02A.
	Octachlorodibenzo-p-dioxin	0.093	J	
	Octachlorodibenzofuran	0.042	J	

Table 3A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
1613B	EC01A	1,2,3,4,6,7,8- Heptachlorodibenzofuran	0.535	U
1613B	EC01A	Octachlorodibenzofuran	1.16	U
1613B	EC05A	1,2,3,4,6,7,8- Heptachlorodibenzofuran	0.535	U
1613B	EC05A	Octachlorodibenzofuran	1.16	U
1613B	EC02A	Octachlorodibenzofuran	1.20	U

Table 4 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
CO03A	Sample was reanalyzed to verify possible carryover, original analyzed result was reported.
EC02A	Sample was reextracted and reanalyzed to meet QC requirements, reextracted result was reported.
ED02B	Sample was reanalyzed to verify possible carryover, original analyzed result was reported.
ED03C	Sample was reanalyzed to verify possible carryover, original analyzed result was reported.
EI02A	Sample was reanalyzed to verify possible carryover, original analyzed result was reported.

Data Validation Qualifiers:

Code	**Description**
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.

JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 29, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
CO05A	6/20/2008	SEDIMENT	Axys Analytical
FT01A	6/17/2008	SEDIMENT	Axys Analytical
FT04A	6/17/2008	SEDIMENT	Axys Analytical
IE12B	6/20/2008	SEDIMENT	Axys Analytical
IE14B	6/20/2008	SEDIMENT	Axys Analytical
LP01A	6/22/2008	SEDIMENT	Axys Analytical
LP03A	6/22/2008	SEDIMENT	Axys Analytical
LP04A	6/22/2008	SEDIMENT	Axys Analytical
LP05A	6/22/2008	SEDIMENT	Axys Analytical
MD01A	6/22/2008	SEDIMENT	Axys Analytical
MD02A	6/21/2008	SEDIMENT	Axys Analytical
MD03A	6/21/2008	SEDIMENT	Axys Analytical
MD04A	6/22/2008	SEDIMENT	Axys Analytical
MD05A	6/21/2008	SEDIMENT	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11346	1613B	14

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes. Some minor discrepancies were noted by the laboratory, these discrepancies were resolved with the sampling team.
Did coolers arrive at lab less than 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes.
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes.

Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3);
- Sample Reanalysis (Table 4).

Dioxin/Furan by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see Table 3 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted (see Table 4)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
Laboratory Duplicate Sample analyzed?	Yes. All relative percent difference values were within Laboratory QC limits, except for 1,2,3,4,6,7,8-hexachlorodibenzo-p-dioxin. The sample result for 1,2,3,4,6,7,8-hexachlorodibenzo-p-dioxin in sample LP03A was qualified as estimated, biased unknown (JK).

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
The sample result for 1,2,3,4,6,7,8-hexachlorobenzo-p-dioxin in sample LP03A was qualified as estimated, biased unknown (JK) due to laboratory duplicate QC outlier. Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG25779-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.070	J	IE12B, IE14B, LP01A, LP03A, LP04A, LP05A,MD01A, MD02A, MD03A, MD04A, MD05A, CO05A, FT04A, and FT01A.
	Octachlorodibenzo-p-dioxin	0.579	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.048	J	
	Octachlorodibenzofuran	0.129	J	
	Total Heptachlorodibenzo-p-dioxins	0.111		

Table 4 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
IE12B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
IE14B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
LP01A	Sample was reanalyzed to verify possible carryover, reanalyzed results were reported.
LP04A	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
LP05A	Sample was diluted, and the diluted octachlorobenzo-p-dioxin result was reported.
MD01A	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
MD02A	Sample was reanalyzed due to QC outliers, reanalyzed results were reported. Sample was diluted, and the diluted octachlorobenzo-p-dioxin result was reported.
MD03A	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
MD04A	Sample was reanalyzed due to QC outliers, reanalyzed results were reported. Sample was diluted, and the diluted octachlorobenzo-p-dioxin result was reported.
FT04A	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
FT01	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.

NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 15, 2008	**Completed by: David Ikeda**

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
CO02B	7/17/2008	SEDIMENT	Axys Analytical
CO03B	7/20/2008	SEDIMENT	Axys Analytical
CO04B	7/18/2008	SEDIMENT	Axys Analytical
CO05B	7/15/2008	SEDIMENT	Axys Analytical
EC03B	7/16/2008	SEDIMENT	Axys Analytical
EC03C	7/16/2008	SEDIMENT	Axys Analytical
EC04B	7/16/2008	SEDIMENT	Axys Analytical
ED05B	7/16/2008	SEDIMENT	Axys Analytical
EE01B	7/16/2008	SEDIMENT	Axys Analytical
EE02B	7/21/2008	SEDIMENT	Axys Analytical
EE02C	7/21/2008	SEDIMENT	Axys Analytical
EE03B	7/16/2008	SEDIMENT	Axys Analytical
EE03C	7/16/2008	SEDIMENT	Axys Analytical
EE04B	7/17/2008	SEDIMENT	Axys Analytical
EE04C	7/17/2008	SEDIMENT	Axys Analytical
MD01B	7/17/2008	SEDIMENT	Axys Analytical
MD01C	7/17/2008	SEDIMENT	Axys Analytical
MD02B	7/17/2008	SEDIMENT	Axys Analytical
MD02C	7/17/2008	SEDIMENT	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11458	1613B	19

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	No. Some minor discrepancies were noted by the laboratory, these discrepancies were resolved with the sampling team.
Did coolers arrive at lab less than 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes.
Frequency of Field QC Samples Correct?	Yes.

General Sample Information	
Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	
Case narrative present and complete?	Yes.
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3);
- Sample Reanalysis (Table 4).

Dioxin/Furan by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see Table 3 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted (see Table 4)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
Laboratory Duplicate Sample analyzed?	Yes. All relative percent difference values were within Laboratory QC limits, except for 1,2,3,4,7,8,9-heptachlorodibenzofuran and octachlorodibenzofuran. The sample result for octachlorodibenzofuran in sample EE03B was qualified as estimated, biased unknown (JK). No action was taken for 1,2,3,4,7,8,9-heptachlorodibenzofuran, since the result was qualified as undetected (U) because of blank contamination.

Summary of Potential Impacts on Data Usability
Major Concerns

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 15, 2008	Completed by: David Ikeda

Summary of Potential Impacts on Data Usability
None
Minor Concerns
The sample result for octachlorodibenzofuran in sample EE03B was qualified as estimated, biased unknown (JG) due to laboratory duplicate QC outlier. Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. The sample result for 2,3,7,8-Tetrachlorodibenzo-p-dioxin in three samples, EE02B, EE03C, and MD02C were qualified as estimated, bias unknown (JK) since the sample result is an estimated maximum possible concentration. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG26109-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.064	J	CO02B, CO03B, CO04B, CO05B, EC03B, EC03C, EC04B, ED05B, EE01B, EE02B, EE02C, EE03B, EE03C, EE04B, EE04C, MD01B, MD01C, and MD02C.
	Octachlorodibenzo-p-dioxin	0.153	J	
	2,3,7,8-Tetachlorodibenzofuran	0.054	J	
	1,2,3,7,8-Pentachlorodibenzofuran	0.029	J	
	2,3,4,7,8-Pentachlorodibenzofuran	0.038	J	
	1,2,3,4,7,8-Hexachlorodibenzofuran	0.068	J	
	1,2,3,6,7,8-Hexachlorodibenzofuran	0.047	J	
	2,3,4,6,7,8-Hexachlorodibenzofuran	0.025	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.159	J	
	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.053	J	
	Octachlorodibenzofuran	0.216	J	
	Total Heptachlorodibenzo-p-dioxins	0.046		
	Total Tetachlorodibenzofurans	0.142		
	Total Pentachlorodibenzofurans	0.259		
	Total Hexachlorodibenzofurans	0.310		
	Total Heptachlorodibenzofurans	0.211		
WG26340-101	2,3,7,8-Tetachlorodibenzo-p-dioxin	0.029	J	MD02B
	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.031	J	
	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.038	J	
	Octachlorodibenzo-p-dioxin	0.192	J	
	1,2,3,4,7,8-Hexachlorodibenzofuran	0.033	J	
	1,2,3,6,7,8-Hexachlorodibenzofuran	0.032	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.030	J	
	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.073	J	
	Octachlorodibenzofuran	0.174	J	
	Total Hexachlorodibenzo-p-dioxins	0.031		
	Total Heptachlorodibenzo-p-dioxins	0.036		
	Total Pentachlorodibenzofurans	0.076		
	Total Hexachlorodibenzofurans	0.069		
	Total Heptachlorodibenzofurans	0.104		

Table 3A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
1613B	CO02B	1,2,3,4,7,8,9- Heptachlorodibenzofuran	0.516	U

Method	Sample ID	Analyte	Result	Qual
1613B	CO04B	2,3,7,8- Tetrachlorodibenzofuran	0.248	U
1613B	CO04B	1,2,3,7,8- Pentachlorodibenzofuran	0.517	U
1613B	CO04B	2,3,4,7,8- Pentachlorodibenzofuran	0.517	U
1613B	CO04B	1,2,3,4,7,8-Hexachlorodibenzofuran	0.554	U
1613B	CO04B	1,2,3,6,7,8-Hexachlorodibenzofuran	0.065	U
1613B	CO04B	2,3,4,6,7,8-Hexachlorodibenzofuran	0.545	U
1613B	CO04B	1,2,3,4,6,7,8- Heptachlorodibenzofuran	0.541	U
1613B	CO04B	1,2,3,4,7,8,9- Heptachlorodibenzofuran	0.517	U
1613B	CO04B	Octachlorodibenzofuran	1.12	U
1613B	CO04B	Total Pentachlorodibenzofurans	0.912	U
1613B	CO04B	Total Hexachlorodibenzofurans	1.02	U
1613B	EE01B	1,2,3,4,6,7,8- Heptachlorodibenzo-p-dioxin	0.506	U
1613B	EE01B	2,3,7,8- Tetrachlorodibenzofuran	0.11	U
1613B	EE01B	2,3,4,7,8- Pentachlorodibenzofuran	0.506	U
1613B	EE01B	1,2,3,4,7,8-Hexachlorodibenzofuran	0.543	U
1613B	EE01B	1,2,3,6,7,8-Hexachlorodibenzofuran	0.506	U
1613B	EE01B	1,2,3,4,6,7,8- Heptachlorodibenzofuran	0.506	U
1613B	EE01B	1,2,3,4,7,8,9- Heptachlorodibenzofuran	0.506	U
1613B	EE01B	Octachlorodibenzofuran	1.09	U
1613B	EE01B	Total Tetachlorodibenzofurans	0.135	U
1613B	EE01B	Total Pentachlorodibenzofurans	0.133	U
1613B	EE01B	Total Hexachlorodibenzofurans	0.16	U
1613B	EE01B	Total Heptachlorodibenzofurans	0.203	U
1613B	EE02B	1,2,3,4,7,8,9- Heptachlorodibenzofuran	0.498	U
1613B	EE02C	1,2,3,4,6,7,8- Heptachlorodibenzo-p-dioxin	0.536	U
1613B	EE02C	2,3,7,8- Tetrachlorodibenzofuran	0.12	U
1613B	EE02C	1,2,3,7,8- Pentachlorodibenzofuran	0.536	U
1613B	EE02C	2,3,4,7,8- Pentachlorodibenzofuran	0.536	U
1613B	EE02C	1,2,3,4,7,8-Hexachlorodibenzofuran	0.575	U
1613B	EE02C	1,2,3,6,7,8-Hexachlorodibenzofuran	0.536	U
1613B	EE02C	2,3,4,6,7,8-Hexachlorodibenzofuran	0.565	U
1613B	EE02C	1,2,3,4,6,7,8- Heptachlorodibenzofuran	0.536	U
1613B	EE02C	1,2,3,4,7,8,9- Heptachlorodibenzofuran	0.536	U
1613B	EE02C	Octachlorodibenzofuran	1.16	U
1613B	EE02C	Total Pentachlorodibenzofurans	0.121	U
1613B	EE02C	Total Hexachlorodibenzofurans	0.149	U
1613B	EE02C	Total Heptachlorodibenzofurans	0.256	U
1613B	EE03B	1,2,3,6,7,8-Hexachlorodibenzofuran	0.531	U
1613B	EE03C	1,2,3,4,7,8-Hexachlorodibenzofuran	0.520	U
1613B	EE03C	1,2,3,4,7,8,9- Heptachlorodibenzofuran	0.485	U
1613B	EE04B	1,2,3,7,8- Pentachlorodibenzofuran	0.532	U
1613B	EE04B	1,2,3,4,7,8-Hexachlorodibenzofuran	0.571	U

Method	Sample ID	Analyte	Result	Qual
1613B	EE04B	1,2,3,6,7,8-Hexachlorodibenzofuran	0.532	U
1613B	EE04B	2,3,4,6,7,8-Hexachlorodibenzofuran	0.561	U
1613B	EE04B	1,2,3,4,6,7,8- Heptachlorodibenzofuran	0.776	U
1613B	EE04B	1,2,3,4,7,8,9- Heptachlorodibenzofuran	0.532	U
1613B	EE04B	Total Hexachlorodibenzofurans	1.43	U
1613B	EE04C	2,3,7,8- Tetrachlorodibenzofuran	0.109	U
1613B	EE04C	1,2,3,7,8- Pentachlorodibenzofuran	0.501	U
1613B	EE04C	2,3,4,7,8- Pentachlorodibenzofuran	0.501	U
1613B	EE04C	1,2,3,4,7,8-Hexachlorodibenzofuran	0.538	U
1613B	EE04C	1,2,3,6,7,8-Hexachlorodibenzofuran	0.501	U
1613B	EE04C	1,2,3,4,6,7,8- Heptachlorodibenzofuran	0.501	U
1613B	EE04C	1,2,3,4,7,8,9- Heptachlorodibenzofuran	0.501	U
1613B	EE04C	Octachlorodibenzofuran	1.08	U
1613B	EE04C	Total Tetachlorodibenzofurans	0.23	U
1613B	EE04C	Total Pentachlorodibenzofurans	0.038	U
1613B	EE04C	Total Hexachlorodibenzofurans	0.082	U
1613B	EE04C	Total Heptachlorodibenzofurans	0.367	U
1613B	MD01C	2,3,7,8- Tetrachlorodibenzofuran	0.173	U
1613B	MD01C	1,2,3,7,8- Pentachlorodibenzofuran	0.487	U
1613B	MD01C	2,3,4,7,8- Pentachlorodibenzofuran	0.487	U
1613B	MD01C	1,2,3,4,7,8-Hexachlorodibenzofuran	0.522	U
1613B	MD01C	1,2,3,6,7,8-Hexachlorodibenzofuran	0.487	U
1613B	MD01C	2,3,4,6,7,8-Hexachlorodibenzofuran	0.513	U
1613B	MD01C	1,2,3,4,6,7,8- Heptachlorodibenzofuran	0.487	U
1613B	MD01C	1,2,3,4,7,8,9- Heptachlorodibenzofuran	0.487	U
1613B	MD01C	Octachlorodibenzofuran	1.05	U
1613B	MD01C	Total Pentachlorodibenzofurans	0.686	U
1613B	MD01C	Total Hexachlorodibenzofurans	0.53	U
1613B	MD01C	Total Heptachlorodibenzofurans	1.08	U
1613B	MD02C	1,2,3,4,7,8-Hexachlorodibenzofuran	0.496	U
1613B	MD02C	2,3,4,6,7,8-Hexachlorodibenzofuran	0.487	U
1613B	MD02C	1,2,3,4,6,7,8- Heptachlorodibenzofuran	0.771	U
1613B	MD02C	1,2,3,4,7,8,9- Heptachlorodibenzofuran	0.462	U
1613B	MD02C	Octachlorodibenzofuran	1.00	U

Table 4 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
CO02B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
CO03B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
CO04B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported. Extract underwent additional cleanup and reanalysis.
CO05B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
EC03B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.

EC03C	Sample was reanalyzed due to QC outliers, reanalyzed results were reported. Extract underwent additional cleanup and reanalysis.
EC04B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
ED05B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
EE01B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
EE02B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
EE02C	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
EE03B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported. Extract underwent additional cleanup and reanalysis.
EE03C	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
EE04B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
EE04C	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.
MD01B	Sample was reanalyzed due to QC outliers, reanalyzed results were reported. Extract underwent additional cleanup and reanalysis.
MD01C	Sample was reanalyzed due to QC outliers, reanalyzed results were reported. Extract underwent additional cleanup and reanalysis.
MD02B	Sample was reextracted due to QC outliers, reextraced results were reported. Extract underwent additional cleanup and reanalysis.
MD02C	Sample was reanalyzed due to QC outliers, reanalyzed results were reported.

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.

NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 14, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
RF04TH	7/12/2008	RF04TH	Axys Analytical
RF05TH	7/12/2008	RF05TH	Axys Analytical
RF06TG	7/12/2008	RF06TG	Axys Analytical
MD08TG	7/12/2008	MD08TG	Axys Analytical
MD08TH	7/12/2008	MD08TH	Axys Analytical
MD09TH	7/12/2008	MD09TH	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11431	1613B	3
L11432	1613B	3

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab less than 0^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3).
- Sample Reanalysis (Table 4).

Dioxin/Furans by HRMS	
Description	**Notes and Qualifiers**

Dioxin/Furans by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see to Table 3 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes. Refer to Table 4 for the list of samples.
Laboratory Duplicate Sample analyzed?	Yes. All relative percent difference values were within Laboratory QC limits.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG25933-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.086	J	RF04TH, RF05TH, RF06TH, MD08TG, MD08TH, and MD09TH.
	Octachlorodibenzo-p-dioxin	0.346	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.053	J	
	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.061	J	
	Octachlorodibenzodibenzofuran	0.133	J	
	Total Heptachlorodibenzofurans	0.114	J	

Table 3A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
1613B	MD08TG	1,2,3,4,6,7,8- Heptachlorodibenzofuran	1.24	U
1613B	MD08TG	Octachlorodibenzofuran	2.67	U
1613B	MD08TG	Total Heptachlorodibenzofurans	1.12	U
1613B	MD08TH	1,2,3,4,6,7,8- Heptachlorodibenzofuran	1.25	U

Method	Sample ID	Analyte	Result	Qual
1613B	MD08TH	Octachlorodibenzofuran	2.7	U
1613B	MD08TH	Total Heptachlorodibenzofurans	1.14	U
1613B	MD09TH	1,2,3,4,6,7,8- Heptachlorodibenzofuran	1.23	U
1613B	MD09TH	Octachlorodibenzofuran	2.64	U
1613B	MD09TH	Total Heptachlorodibenzofurans	1.11	U
1613B	RF04TH	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.27	U
1613B	RF04TH	Octachlorodibenzo-p-dioxin	2.74	U
1613B	RF04TH	Octachlorodibenzofuran	2.74	U
1613B	RF05TH	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.25	U
1613B	RF05TH	Octachlorodibenzo-p-dioxin	2.7	U
1613B	RF05TH	1,2,3,4,6,7,8- Heptachlorodibenzofuran	1.25	U
1613B	RF05TH	1,2,3,4,7,8,9- Heptachlorodibenzofuran	1.25	U
1613B	RF05TH	Octachlorodibenzofuran	2.7	U
1613B	RF06TG	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.2	U
1613B	RF06TG	Octachlorodibenzo-p-dioxin	2.59	U
1613B	RF06TG	Octachlorodibenzofuran	2.59	U

Table 4 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
RF04TH	Sample was reanalyzed due to QC outliers, the reanalyzed results were reported.
RF05TH	Sample was reanalyzed due to QC outliers, the reanalyzed results were reported.
RF06TH	Sample was reanalyzed due to QC outliers, the reanalyzed results were reported.
MD08TG	Sample was reanalyzed due to QC outliers, the reanalyzed results were reported.
MD08TH	Sample was reanalyzed due to QC outliers, the reanalyzed results were reported.
MD09TH	Sample was reanalyzed due to QC outliers, the reanalyzed results were reported.

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.

JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 15, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
DO04B	7/22/2008	SEDIMENT	Axys Analytical
DO04C	7/22/2008	SEDIMENT	Axys Analytical
DO04D	7/22/2008	SEDIMENT	Axys Analytical
DO05B	7/22/2008	SEDIMENT	Axys Analytical
DO05C	7/22/2008	SEDIMENT	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11487	1613B	5

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	No. Some minor discrepancies were noted by the laboratory, these discrepancies were resolved with the sampling team.
Did coolers arrive at lab less than 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes.
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes.
Case narrative present and complete?	Yes.
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3);
- Sample Reanalysis (Table 4).

Dioxin/Furan by HRMS

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 15, 2008	**Completed by: David Ikeda**

Description	Notes and Qualifiers
Any compounds present in method and field blanks?	Yes, see Table 3 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted (see Table 4)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
Laboratory Duplicate Sample analyzed?	No.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG26010-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.025	J	DO04C, DO04D, and DO05C.
	Octachlorodibenzo-p-dioxin	0.093	J	
	Octachlorodibenzofuran	0.042	J	
WG26174-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.035	J	DO04B and DO05B.
	Octachlorodibenzo-p-dioxin	0.215	J	
	2,3,4,7,8-Pentachlorodibenzofuran	0.026	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.031	J	
	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.043	J	
	Octachlorodibenzofuran	0.076	J	

Table 3A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
1613B	DO04D	Octachlorodibenzofuran	1.16	U
1613B	DO04D	1,2,3,4,7,8,9- Heptachlorodibenzofuran	0.538	U

Table 4 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
DO04B	Sample was reextracted due to extract losses, reextracted results were reported.
DO05B	Sample was reextracted due to extract losses, reextracted results were reported.

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 15, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
LA01A	7/23/2008	SEDIMENT	Axys Analytical
LA02B	7/23/2008	SEDIMENT	Axys Analytical
LA02C	7/23/2008	SEDIMENT	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11487	1613B	3

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	No. Some minor discrepancies were noted by the laboratory, these discrepancies were resolved with the sampling team.
Did coolers arrive at lab less than 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes.
Frequency of Field QC Samples Correct? Field Duplicate – Not required.	Yes.

Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	
Case narrative present and complete?	Yes.
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3);
- Sample Reanalysis (Table 4).

Dioxin/Furan by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see Table 3 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted (see Table 4)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
Laboratory Duplicate Sample analyzed?	Yes, percent relative difference values were within laboratory QC limits.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 15, 2008	Completed by: David Ikeda

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG26010-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.025	J	DO04C, DO04D, and DO05C.
	Octachlorodibenzo-p-dioxin	0.093	J	
	Octachlorodibenzofuran	0.042	J	

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.

JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: December 10, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
BL03A	6/13/2008	SEDIMENT	Axys Analytical
BL04A	6/13/2008	SEDIMENT	Axys Analytical
BL06A	6/11/2008	SEDIMENT	Axys Analytical
BL08A	6/09/2008	SEDIMENT	Axys Analytical
FT10A	6/12/2008	SEDIMENT	Axys Analytical
IE03A	6/07/2008	SEDIMENT	Axys Analytical
IE04A	6/08/2008	SEDIMENT	Axys Analytical
IE05A	6/07/2008	SEDIMENT	Axys Analytical
IE06A	6/08/2008	SEDIMENT	Axys Analytical
IE12A	6/09/2008	SEDIMENT	Axys Analytical
IE14A	6/00/2008	SEDIMENT	Axys Analytical
IE15A	6/09/2008	SEDIMENT	Axys Analytical
IH05A	6/16/2008	SEDIMENT	Axys Analytical
IH06A	6/16/2008	SEDIMENT	Axys Analytical
KP05A	6/12/2008	SEDIMENT	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11303	1613B	16

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes.
Did coolers arrive at lab less than 6°C and in good condition as indicated on COC and Cooler Receipt Form? Were samples archived properly?	No, refer to Table 3 for outliers. Sample results were flagged as estimated biased low (UJG or JG). Yes.
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required.	Yes.
Case narrative present and complete?	Yes.
Any holding time violations?	No - All samples were prepared and

	analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Samples Exceeding Temperature Requirements (Table 3);
- Method Blanks Results (Table 4);
- Sample Reanalysis (Table 5).
- Duplicate Sample Outliers (Table 6).

Dioxin/Furan by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see Table 4 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted (see Table 5)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
Laboratory Duplicate Sample analyzed?	Yes, several percent relative difference values were outside laboratory QC limits. Refer to Table 6.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Some of the samples were received by the laboratory above the 6 degrees Celsius, sample results were qualified as estimated biased low (UJG or JG). Several compounds in the duplicate sample analysis were outside laboratory QC limits, these compounds were flagged as estimated, bias unknown (JK) in the sample. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 – List of Samples Exceeding Temperature Requirements

Sample ID	Analytical Fraction	Temperature	Qualifiers
BL03A	Dioxin/Furans	8 C	UJG or JG
BL04A	Dioxin/Furans	8 C	UJG or JG

BL06A	Dioxin/Furans	8 C	UJG or JG
BL08A	Dioxin/Furans	8 C	UJG or JG
FT10A	Dioxin/Furans	8 C	UJG or JG
IE03A	Dioxin/Furans	7 C	UJG or JG
IE04A	Dioxin/Furans	7 C	UJG or JG
IE05A	Dioxin/Furans	7 C	UJG or JG
IE06A	Dioxin/Furans	7 C	UJG or JG
IE12A	Dioxin/Furans	7 C	UJG or JG
IE14A	Dioxin/Furans	7 C	UJG or JG
IE15A	Dioxin/Furans	7 C	UJG or JG
KP05A	Dioxin/Furans	7 C	UJG or JG

Table 4 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG26764-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.066	J	All samples.
	Octachlorodibenzo-p-dioxin	0.334	J	
	Octachlorodibenzofuran	0.050	J	

Table 5 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
IE12A	Sample was reanalyzed due to instrument disruption.
IE14A	Sample extract was diluted and reanalyzed.
IE15A	Sample extract was diluted and reanalyzed.

Table 4 - List Duplicate Sample RPD values outside Control Limits

Sample ID	Analyte	RPD	RPD Limit	Validation Qual
IH05A	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	31.1%	20%	JK
IH05A	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	27.0%	20%	JK
IH05A	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	32.4%	20%	JK
IH05A	Octachlorodibenzo-p-dioxin	34.5%	20%	JK
IH05A	1,2,3,7,8-Pentachlorodibenzofuran	40.6%	20%	JTK
IH05A	2,3,4,7,8-Pentachlorodibenzofuran	51.0%	20%	JK
IH05A	1,2,3,4,7,8-Hexachlorodibenzofuran	45.2%	20%	JK
IH05A	1,2,3,6,7,8-Hexachlorodibenzofuran	49.2%	20%	JK
IH05A	2,3,4,6,7,8-Hexachlorodibenzofuran	30.5%	20%	JK
IH05A	Octachlorodibenzofuran	32.4%	20%	JK

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.

JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: December 10, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Sample_ID	Collected Date	Sample_Matrix	Laboratory
BL01A	6/13/2008	SEDIMENT	Axys Analytical
IE07A	6/13/2008	SEDIMENT	Axys Analytical
IE09A	6/11/2008	SEDIMENT	Axys Analytical
IH01A	6/09/2008	SEDIMENT	Axys Analytical
IH02A	6/12/2008	SEDIMENT	Axys Analytical
IH03A	6/07/2008	SEDIMENT	Axys Analytical
IH04A	6/08/2008	SEDIMENT	Axys Analytical
KP02A	6/07/2008	SEDIMENT	Axys Analytical
LA02A	6/08/2008	SEDIMENT	Axys Analytical
LA03A	6/09/2008	SEDIMENT	Axys Analytical
MA01A	6/00/2008	SEDIMENT	Axys Analytical
MA02A	6/00/2008	SEDIMENT	Axys Analytical
MA03A	6/09/2008	SEDIMENT	Axys Analytical
MA04A	6/16/2008	SEDIMENT	Axys Analytical
MA05A	6/16/2008	SEDIMENT	Axys Analytical
RL01A	6/12/2008	SEDIMENT	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11303	1613B	4
L11349	1613B	2
L11352	1613B	8
L11388	1613B	2

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes.
Did coolers arrive at lab less than 6°C and in good condition as indicated on COC and Cooler Receipt Form? Were samples archived properly?	Yes.
Frequency of Field QC Samples Correct?	Yes.

General Sample Information	
Case narrative present and complete?	Yes.
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3);
- Sample Reanalysis (Table 4).

Dioxin/Furan by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see Table 3 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted (see Table 4)? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes.
Laboratory Duplicate Sample analyzed?	No.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG26764-101	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.030	J	All samples.

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.025	J	
	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.067	J	
	Octachlorodibenzo-p-dioxin	0.318	J	
	2,3,4,7,8-Pentachlorodibenzofuran	0.035	J	
	1,2,3,7,8,9-Hexachlorodibenzofuran	0.025	J	
	2,3,4,6,7,8-Hexachlorodibenzofuran	0.033	J	
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.043	J	
	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.036	J	
	Octachlorodibenzofuran	0.110	J	
	Total Hexachlorodibenzo-p-dioxin	0.035	J	
	Total Heptachlorodibenzo-p-dioxin	0.119	J	
	Total Heptachlorodibenzofuran	0.036	J	

Table 3A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
1613B	EE04A	1,2,3,4,7,8- Hexachlorodibenzofuran	0.568	U
1613B	EI04A	1,2,3,4,7,8- Hexachlorodibenzofuran	0.551	U
1613B	EI04A	1,2,3,4,6,7,8- Heptachlorodibenzofuran	0.514	U
1613B	EI07A	1,2,3,4,7,8- Hexachlorodibenzofuran	0.584	U
1613B	KP07B	1,2,3,4,7,8- Hexachlorodibenzofuran	0.580	U

Table 4 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
MA04A	Sample extract was diluted and reanalyzed.
IE09A	Sample extract was diluted and reanalyzed.
IH01A	Sample extract was diluted and reanalyzed.
IH02A	Sample extract was diluted and reanalyzed.
IH03A	Sample extract was diluted and reanalyzed.
IH04A	Sample extract was diluted and reanalyzed.
KP02A	Sample extract was diluted and reanalyzed.
LA02A	Sample extract was diluted and reanalyzed.
LA03A	Sample extract was diluted and reanalyzed.

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.

JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 14, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Client SampleID	Collected	MatrixID	LabID
EI08TH	6/15/2008	TISSUE	Axys Analytical
IE21TL	6/17/2008	TISSUE	Axys Analytical
IE22TL	6/19/2008	TISSUE	Axys Analytical
IE23TL	6/21/2008	TISSUE	Axys Analytical
IE24TL	6/23/2008	TISSUE	Axys Analytical
IE26TM	6/25/2008	TISSUE	Axys Analytical
EC06TH	6/22/2008	TISSUE	Axys Analytical
IE18TH	6/24/2008	TISSUE	Axys Analytical
IE20TH	6/26/2008	TISSUE	Axys Analytical
IE25TM	6/28/2008	TISSUE	Axys Analytical
MD06TH	6/30/2008	TISSUE	Axys Analytical
MD07TH	7/2/2008	TISSUE	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11297	1668A	4
L11298	1668A	2
L11299	1668A	6

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 14, 2008	Completed by: David Ikeda

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab less than 0^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. Trip Blank (for VOC and NWTPH-Gx) – One per shipment. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3).

PCB congeners by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see Table 3 for specific analytes.
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	Yes.
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: August 14, 2008	Completed by: David Ikeda

PCB congeners by HRMS	
Description	**Notes and Qualifiers**
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted? For any sample re-analysis and dilutions is only one reportable result by flagged?	No.
Laboratory Duplicate Sample analyzed?	Yes. All relative percent difference values were within Laboratory QC limits.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG25646-101	2,3,3',4,4'-Pentachlorobiphenyl	0.222	J	EI08TH, IE21TL, IE22TL, IE23TL, IE24TL, and IE26TM.
	2,3',4,4',5-Pentachlorobiphenyl	0.419	J	
	2,3,3',4,4',5-Hexachlorobiphenyl	0.203	J	
	2,3',4,4',5,5'-Hexachlorobiphenyl	0.046	J	
	3,3',4,4',5,5'-Hexachlorobiphenyl	0.028	J	
WG25709-101	3,3',4,4'-Tetachlorobiphenyl	0.058	J	EC06TH, IE18TH, IE20TH, IE25TH, MD07TH, and MD07TH.
	2,3,4,4',5-Pentachlorobiphenyl	0.136	J	
	2,3,4,4',5-Pentachlorobiphenyl	0.049	J	
	2,3',4,4',5-Pentachlorobiphenyl	0.218	J	
	2,3,3',4,4',5-Hexachlorobiphenyl	0.151	J	
	2,3',4,4',5,5'-Hexachlorobiphenyl	0.048	J	
	2,3,3',4,4',5,5'-Heptachlorobiphenyl	0.03	J	

Table 3A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
1668A	IE25TM	3,3',4,4'-Tetachlorobiphenyl	1.86	U
1668A	IE25TM	2,3',4,4',5,5'-Hexachlorobiphenyl	1.86	U
1668A	IE25TM	2,3,3',4,4',5,5'-Heptachlorobiphenyl	0.0148	U

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.

NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles Harbor
Date Completed: September 10, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Client SampleID	Collected	MatrixID	LabID
RF04TH	7/12/2008	TISSUE	Axys Analytical
RF05TH	7/12/2008	TISSUE	Axys Analytical
RF06TG	7/12/2008	TISSUE	Axys Analytical
MD08TG	7/12/2008	TISSUE	Axys Analytical
MD08TH	7/12/2008	TISSUE	Axys Analytical
MD09TH	7/12/2008	TISSUE	Axys Analytical

Table 2 Work Orders, Tests and Number of Samples included in this DUSR

Work Order	Analytical Method	Sample Count
L11431	1668A	3
L11432	1668A	3

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab less than 0^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 3).
- Sample Reanalysis (Table 4).

PCB congeners by HRMS	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, see Table 3 for specific analytes.

PCB congeners by HRMS	
Description	**Notes and Qualifiers**
For samples, if results are <5 times the blank or < 10 times blank for common laboratory contaminants then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one method blank and ongoing precision and recovery (OPR) with each batch?	Yes.
Initial precision and recovery (IPR) values are within QC limits?	Yes.
OPR recovery values are within laboratory QC limits?	Yes.
C-13 labeled isotope dilution internal standard recovery values for samples within QC limits?	No. In sample RF05TH, the cleanup standards 13C-labeled 111 and 178 PCBs were below QC limits. The sample results were qualified as estimated (UJG or JTG).
Instrument recovery internal standard values for samples within QC limits?	Yes.
Do internal standards areas and retention time meet criteria? If not was sample re-analyzed to establish matrix?	Yes.
Is initial calibration within Method QC limits?	Yes.
Is continuing calibration within Method QC limits?	Yes.
Were any samples re-analyzed or diluted? For any sample re-analysis and dilutions is only one reportable result by flagged?	Yes. See Table 4 for samples.
Laboratory Duplicate Sample analyzed?	Yes. All relative percent difference values were within Laboratory QC limits.

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
In sample RF05TH, the cleanup standards 13C-labeled PCBs were below QC limits; the sample results were qualified as estimated (UJG or JTG). Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results greater than MDL and less than PQL are flagged estimated (JT).

Table 3 - List of Positive Results for Blank Samples

Method Blank ID	Analyte	Concentration	Qualifier	Associated Samples
WG25934-101	2,3,3',4,4'-Pentachlorobiphenyl	0.279	J	RF05TH, RF06TH, MD08TG, MD08TH, and MD09TH.
	2,3,4,4',5-Pentachlorobiphenyl	0.045	J	
	2,3',4,4',5-Pentachlorobiphenyl	0.671	J	
	2,3,3',4,4',5-Hexachlorobiphenyl	0.151	J	
	2,3',4,4',5,5'-Hexachlorobiphenyl	0.080	J	
WG26253-101	2,3,3',4,4'-Pentachlorobiphenyl	0.199	J	RF04TH.
	2,3',4,4',5-Pentachlorobiphenyl	0.552	J	
	2,3,3',4,4',5-Hexachlorobiphenyl	0.117	J	
	2,3',4,4',5,5'-Hexachlorobiphenyl	0.073	J	

	2,3,3',4,4',5,5'-Heptachlorobiphenyl	0.072	J	

Table 3A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
1668A	RF04TH	2,3,3',4,4',5,5'-Heptachlorobiphenyl	1.93	U

Table 4 - List of Reanalyzed Samples

Sample ID	Reason for Reanalysis
RF04TH	Sample was reextracted due to QC outliers, the reextracted results were reported.

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.

REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 11, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10314-1	Solid	BA01A	580-10314-05	6/7/2008		None
580-10314-1	Solid	BA02A	580-10314-04	6/7/2008		None
580-10314-1	Solid	BL02B	580-10314-13	6/8/2008		None
580-10314-1	Solid	BL02C	580-10314-14	6/8/2008		None
580-10314-1	Solid	BL05A	580-10314-26	6/9/2008		None
580-10314-1	Solid	BL07A	580-10314-21	6/9/2008		None
580-10314-1	Solid	BL08A	580-10314-25	6/9/2008		None
580-10314-1	Solid	EH01A	580-10314-18	6/8/2008		None
580-10314-1	Solid	EH02A	580-10314-09	6/7/2008		None
580-10314-1	Solid	EH03A	580-10314-11	6/8/2008		None
580-10314-1	Solid	EH04A	580-10314-01	6/6/2008		None
580-10314-1	Solid	FP01A	580-10314-08	6/7/2008		None
580-10314-1	Solid	FP02A	580-10314-06	6/7/2008		None
580-10314-1	Solid	FP03A	580-10314-19	6/8/2008	MS/MSD	None
580-10314-1	Solid	FT04B	580-10314-07	6/7/2008		None
580-10314-1	Solid	FT04C	580-10314-02	6/7/2008		None
580-10314-1	Solid	FT06B	580-10314-30	6/9/2008		None
580-10314-1	Solid	FT06C	580-10314-27	6/9/2008	MS/MSD	None
580-10314-1	Solid	IE03A	580-10314-03	6/7/2008		None
580-10314-1	Solid	IE04A	580-10314-16	6/8/2008		None
580-10314-1	Solid	IE05A	580-10314-10	6/7/2008		None
580-10314-1	Solid	IE06A	580-10314-20	6/8/2008	MS/MSD	None
580-10314-1	Solid	IE11A	580-10314-31	6/9/2008		None
580-10314-1	Solid	IE12A	580-10314-29	6/9/2008		None
580-10314-1	Solid	IE13A	580-10314-28	6/9/2008		None
580-10314-1	Solid	IE14A	580-10314-24	6/9/2008		None
580-10314-1	Solid	IE15A	580-10314-22	6/9/2008	MS/MSD	None
580-10314-1	Solid	IE16A	580-10314-23	6/9/2008		None
580-10314-1	Solid	KP08B	580-10314-15	6/8/2008		None

580-10314-1	Solid	KP08C	580-10314-12	6/8/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10314-1	Solid	EPA 160.3	160.3 Modified	30	Sediment
580-10314-1	Solid	NWTPH-Dx	Semi-Volatile Petroleum Products by NWTPH-Dx	14	Sediment
580-10314-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	29	Sediment
580-10314-1	Solid	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	30	Sediment
580-10314-1	Solid	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	9	Sediment
580-10314-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	24	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	No, refer to Table 3. Samples result were qualified as estimated biased low (JG, JTG, or UJG) based on surrogate outliers.
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Acceptable.

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Any compounds present in method blank?	No.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%?	No, refer to Table 4. Data was not qualified, since the analyte was not detected in the sample and the percent recovery was above the QC limit.
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110%.	Yes

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted	Yes – Several analytes were detected

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
on Table 2?	in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Were elements recovered ≤30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples result were qualified as estimated biased low (JG, JTG, or UJG) based on pesticide surrogate outliers.

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Anal Type	Units	MDL	PQL
SW846 6020	MB 580-32949/1-A	MBLK	Barium	0.0045	J	A	mg/Kg	0.00065	0.20
SW846 6020	MB 580-32949/1-A	MBLK	Copper	0.032	J	A	mg/Kg	0.0011	0.20
SW846 6020	MB 580-32949/1-A	MBLK	Silver	0.0010	J	A	mg/Kg	0.00050	0.20
SW846 6020	MB 580-32949/1-A	MBLK	Zinc	1.2		A	mg/Kg	0.0091	0.50
SW846 6020	MB 580-32956/1-A	MBLK	Barium	0.0045	J	A	mg/Kg	0.00065	0.20
SW846 6020	MB 580-32956/1-A	MBLK	Copper	0.019	J	A	mg/Kg	0.0011	0.20

Method	Sample ID	Samp Type	Analyte	Result	Qual	Anal Type	Units	MDL	PQL
SW846 6020	MB 580-32956/1-A	MBLK	Lead	0.015	J	A	mg/Kg	0.0012	0.20
SW846 6020	MB 580-32956/1-A	MBLK	Silver	0.0010	J	A	mg/Kg	0.00050	0.20
SW846 6020	MB 580-32956/1-A	MBLK	Zinc	0.079	J	A	mg/Kg	0.0091	0.50

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8082	BL02B	Decachlorobiphenyl	45	50 - 150	JG, JTG, or UJG
SW846 8082	BL05A	Decachlorobiphenyl	28	50 – 150	JG, JTG, or UJG
SW846 8082	BL07A	Decachlorobiphenyl	34	50 – 150	JG, JTG, or UJG
SW846 8082	BL08A	Decachlorobiphenyl	36	50 – 150	JG, JTG, or UJG
SW846 8082	FP03A	Decachlorobiphenyl	36	50 – 150	JG, JTG, or UJG
SW846 8082	FT04B	Decachlorobiphenyl	45	50 – 150	JG, JTG, or UJG
SW846 8082	IE03A	Decachlorobiphenyl	31	50 – 150	JG, JTG, or UJG
SW846 8082	IE04A	Decachlorobiphenyl	35	50 – 150	JG, JTG, or UJG
SW846 8082	IE05A	Decachlorobiphenyl	37	50 – 150	JG, JTG, or UJG
SW846 8082	IE06A	Decachlorobiphenyl	41	50 – 150	JG, JTG, or UJG
SW846 8082	IE11A	Decachlorobiphenyl	21	50 – 150	JG, JTG, or UJG
SW846 8082	IE11A	Tetrachloro-m-xylene	43	45 - 155	JG, JTG, or UJG
SW846 8082	IE12A	Decachlorobiphenyl	22	50 – 150	JG, JTG, or UJG
SW846 8082	IE13A	Decachlorobiphenyl	35	50 – 150	JG, JTG, or UJG
SW846 8082	IE14A	Decachlorobiphenyl	25	50 – 150	JG, JTG, or UJG
SW846 8082	IE15A	Decachlorobiphenyl	32	50 – 150	JG, JTG, or UJG
SW846 8082	IE15A	Tetrachloro-m-xylene	42	50 – 150	JG, JTG, or UJG
SW846 8082	IE16A	Decachlorobiphenyl	42	50 – 150	JG, JTG, or UJG
SW846 8082	KP08B	Decachlorobiphenyl	46	50 – 150	JG, JTG, or UJG

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Method	Sample ID	Sample Type	Analyte	Orig. Result	Spike Amount	Rec.	Low Limit	High Limit	Sample Qual.
NWTPH NWTPH-Dx	FP03A	MS	#2 Diesel (C10-C24)	<11	897	127	70	125	None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.

REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 11, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10374-1	Solid	FT12A	580-10374-23	6/11/2008		None
580-10374-1	Solid	FT13A	580-10374-7	6/11/2008	MS/MSD	None
580-10374-1	Solid	IE16B	580-10374-9	6/12/2008		None
580-10374-1	Solid	IH02C	580-10374-10	6/12/2008		None
580-10374-1	Solid	IH06B	580-10374-11	6/10/2008		None
580-10374-1	Solid	IH06C	580-10374-12	6/10/2008	MS/MSD	None
580-10374-1	Solid	KP02B	580-10374-13	6/10/2008		None
580-10374-1	Solid	KP02C	580-10374-14	6/10/2008		None
580-10374-1	Solid	KP03B	580-10374-15	6/10/2008		None
580-10374-1	Solid	KP03C	580-10374-16	6/10/2008		None
580-10374-1	Solid	KP07A	580-10374-19	6/11/2008		None
580-10374-1	Solid	MA02B	580-10374-20	6/11/2008		None
580-10374-1	Solid	MA02C	580-10374-21	6/11/2008		None
580-10374-1	Solid	MA06A	580-10374-22	6/11/2008		None
580-10374-1	Solid	OH02A	580-10374-24	6/11/2008		None
580-10374-1	Solid	OH03A	580-10374-25	6/11/2008		None
580-10374-1	Solid	RF01A	580-10374-26	6/10/2008	MS/MSD	None
580-10374-1	Solid	RF02A	580-10374-27	6/10/2008		None
580-10374-1	Solid	RF03A	580-10374-28	6/10/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10374-1	Solid	EPA 160.3	160.3 Modified	19	Sediment
580-10374-1	Solid	NWTPH-Dx	Semi-Volatile Petroleum Products by NWTPH-Dx	15	Sediment
580-10374-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	17	Sediment
580-10374-1	Solid	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	19	Sediment

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 11, 2008	Completed by: David Ikeda

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10374-1	Solid	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	7	Sediment
580-10374-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	15	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	No, refer to Table 3. Samples result were qualified as estimated biased low (JG, JTG, or UJG) based on surrogate outliers.
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 11, 2008	Completed by: David Ikeda

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Several compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Any compounds present in method blank?	No.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%?	Yes.
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	No, associated samples were not qualified.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110%.	Yes

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 11, 2008	Completed by: David Ikeda

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Were elements recovered <u><</u>30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated biased low (JG, JTG, or UJG) based on pesticide surrogate outliers. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Anal Type	Units	MDL	PQL
SW846 6020	MB 580-33384/1-A	MBLK	Lead	0.0018	J	A	mg/Kg	0.0012	0.20
SW846 6020	MB 580-33384/1-A	MBLK	Silver	0.0013	J	A	mg/Kg	0.00050	0.20
SW846 6020	MB 580-33384/1-A	MBLK	Zinc	0.17		A	mg/Kg	0.0091	0.50

Table 2A - List of Samples Qualified for Method Blank Contamination

None

Table 3 - List of Samples with Surrogates outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8082	IE16B	Decachlorobiphenyl	46	50 - 150	JG, JTG, or UJG
SW846 8082	IH02C	Decachlorobiphenyl	46	50 – 150	JG, JTG, or UJG
SW846 8082	IH06B	Tetrachloro-m-xylene	43	45 - 155	JG, JTG, or UJG
SW846 8082	IH06B	Decachlorobiphenyl	40	50 – 150	JG, JTG, or UJG

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8082	KP02B	Decachlorobiphenyl	46	50 – 150	JG, JTG, or UJG
SW846 8082	KP07A	Decachlorobiphenyl	36	50 – 150	JG, JTG, or UJG
SW846 8082	MA02B	Decachlorobiphenyl	47	50 – 150	JG, JTG, or UJG
SW846 8082	MA02C	Tetrachloro-m-xylene	43	45 - 155	JG, JTG, or UJG
SW846 8082	MA02C	Decachlorobiphenyl	42	50 – 150	JG, JTG, or UJG
SW846 8082	OH02A	Decachlorobiphenyl	46	50 – 150	JG, JTG, or UJG
SW846 8082	RF03A	Decachlorobiphenyl	36	50 – 150	JG, JTG, or UJG

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits

Method	Sample ID	Analyte	LCS Recovery	QC Limit	Sample Qualification
SW846 8081	LCS 580-33096	Methoxychlor	156	46 - 154	None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.

JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: November 11, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10374-2	Solid	FT10A	580-10374-05	6/12/2008		None
580-10374-2	Solid	KP02C	580-10374-14	6/10/2008		None
580-10374-2	Solid	KP03C	580-10374-16	6/10/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10746-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	1	Sediment
580-10746-1	Solid	SW846 8081	Chlorinated Pesticides by Gas Chromatography	3	Sediment
580-10746-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	3	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6°C and in good condition as indicated on COC and Cooler Receipt Form? Where samples archived (frozen) properly?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Chlorinated Pesticides and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes, the laboratory analyzed a MS/MSD sample from another work order.
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	No, refer to Table 3. Samples results were qualified as estimated biased low (UJG) based on surrogate outliers.
MS/MSD percent recovery values within laboratory QC criteria?	Not Applicable.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Not Applicable.
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Yes

Metals by ICP	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Not Applicable.
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Not Applicable.
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is there one serial dilution per 20 samples? Are percent	Yes.

Metals by ICP	
Description	**Notes and Qualifiers**
difference values within laboratory QC criteria?	
Spot check ICS recoveries 80-120%.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	All are acceptable.
Spot check CCV 90-110%.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results that had surrogate outliers were qualified as estimated bias low (UJG).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 8081	MB 580-37035	MBLK	Endosulfan II	0.43	J	mg/Kg	0.26	2.0
SW846 6020	MB 580-37079	MBLK	Barium	0.0069	J	mg/Kg	0.00065	0.20
SW846 6020	MB 580-37079	MBLK	Cadmium	0.00055	J	mg/Kg	0.00051	0.20
SW846 6020	MB 580-37079	MBLK	Copper	0.021	J	mg/Kg	0.0011	0.20
SW846 6020	MB 580-37079	MBLK	Lead	0.0060	J	mg/Kg	0.0012	0.20
SW846 6020	MB 580-37079	MBLK	Silver	0.0026	J	mg/Kg	0.00050	0.20
SW846 6020	MB 580-37079	MBLK	Zinc	0.38	J	mg/Kg	0.0091	0.70

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
SW846 8081	FT10A	Endosulfan II	3.2	U
SW846 8081	KP02C	Endosulfan II	2.4	U
SW846 8081	KP03C	Endosulfan II	3.1	U

Table 3 - List of Samples with Surrogates outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8081	FT10A	Tetrachloro-m-xylene	32	49 – 123	UJG
SW846 8081	FT10A	Decachlorobiphenyl	26	40 - 158	UJG
SW846 8081	KP03C	Tetrachloro-m-xylene	33	49 – 123	UJG
SW846 8081	KP03C	Decachlorobiphenyl	31	40 - 158	UJG
SW846 8082	FT10A	Tetrachloro-m-xylene	29	45 - 155	UJG
SW846 8082	FT10A	Decachlorobiphenyl	35	60 - 125	UJG
SW846 8082	KP02C	Decachlorobiphenyl	56	60 - 125	UJG
SW846 8082	KP03C	Tetrachloro-m-xylene	24	45 - 155	UJG
SW846 8082	KP03C	Decachlorobiphenyl	34	60 - 125	UJG

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.

UJK Analyte was not detected at or above the reported estimate with unknown bias.
UJL Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 11, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10388-1	Solid	BL02A	580-10388-01	6/13/2008		None
580-10388-1	Solid	BL04A	580-10388-03	6/13/2008		None
580-10388-1	Solid	IE07A	580-10388-04	6/16/2008		None
580-10388-1	Solid	IE09A	580-10388-06	6/16/2008		None
580-10388-1	Solid	IE09B	580-10388-07	6/13/2008		None
580-10388-1	Solid	IH01A	580-10388-08	6/16/2008		None
580-10388-1	Solid	IH02A	580-10388-09	6/16/2008		None
580-10388-1	Solid	IH04A	580-10388-11	6/16/2008		None
580-10388-1	Solid	IH06A	580-10388-13	6/16/2008		None
580-10388-1	Solid	MA02A	580-10388-14	6/13/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10388-1	Solid	EPA 160.3	160.3 Modified	10	Sediment
580-10388-1	Solid	NWTPH-Dx	Semi-Volatile Petroleum Products by NWTPH-Dx	10	Sediment
580-10388-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	2	Sediment
580-10388-1	Solid	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	10	Sediment
580-10388-1	Solid	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	1	Sediment
580-10388-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	2	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? MS/MSD samples – 1/20 samples, if requested.	Yes

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General Sample Information	
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	No, refer to Table 3. Samples result were qualified as estimated biased low (JG, JTG, or UJG) based on surrogate outliers.
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	No, associated samples were not qualified.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Several compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Any compounds present in method blank?	No.

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	No, refer to Table 3. Samples result were qualified as estimated biased low (JG, JTG, or UJG) based on surrogate outliers.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%?	Yes.
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110%.	Yes

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

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Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated biased low (JG, JTG, or UJG) based on pesticide surrogate outliers. Several pesticide compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Anal Type	Units	MDL	PQL
SW846 6020	MB 580-33384/1-A	MBLK	Lead	0.0018	J	A	mg/Kg	0.0012	0.20
SW846 6020	MB 580-33384/1-A	MBLK	Silver	0.0013	J	A	mg/Kg	0.00050	0.20
SW846 6020	MB 580-33384/1-A	MBLK	Zinc	0.17		A	mg/Kg	0.0091	0.50

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8082	BL02A	Decachlorobiphenyl	41	50 - 150	JG, JTG, or UJG
SW846 8082	IE09B	Tetrachloro-m-xylene	44	45 - 155	JG, JTG, or UJG
SW846 8082	IE09B	Decachlorobiphenyl	45	50 – 150	JG, JTG, or UJG
NWTPH-Dx	IH01A	o-Terphenyl	47	50 – 150	JG, JTG, or UJG

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits

Method	Sample ID	Analyte	LCS Recovery	QC Limit	Sample Qualification
SW846 8081	LCS 580-33096	Methoxychlor	156	46 - 154	None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference

T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

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The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10388-2	Solid	BL04A	580-10388-03	6/13/2008	MS/MSD	None
580-10388-2	Solid	IH04A	580-10388-11	6/16/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10746-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	2	Sediment
580-10746-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	2	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form? Where samples archived (frozen) properly?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

PCBs by GC/ECD	
Description	**Notes and Qualifiers**

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PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes, the laboratory analyzed a MS/MSD sample from another work order.
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	No, refer to Table 3. Samples results were qualified as estimated biased low (UJG) based on surrogate outliers.
MS/MSD percent recovery values within laboratory QC criteria?	Not Applicable.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Not Applicable.
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Yes

Metals by ICP	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Not Applicable.
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Not Applicable.
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes.
Spot check ICS recoveries 80-120%.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.

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Metals by ICP	
Description	**Notes and Qualifiers**
Spot check ICV 90-110%.	All are acceptable.
Spot check CCV 90-110%.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results that had surrogate outliers were qualified as estimated bias low (UJG).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 6020	MB 580-37079	MBLK	Barium	0.0069	J	mg/Kg	0.00065	0.20
SW846 6020	MB 580-37079	MBLK	Cadmium	0.00055	J	mg/Kg	0.00051	0.20
SW846 6020	MB 580-37079	MBLK	Copper	0.021	J	mg/Kg	0.0011	0.20
SW846 6020	MB 580-37079	MBLK	Lead	0.0060	J	mg/Kg	0.0012	0.20
SW846 6020	MB 580-37079	MBLK	Silver	0.0026	J	mg/Kg	0.00050	0.20
SW846 6020	MB 580-37079	MBLK	Zinc	0.38	J	mg/Kg	0.0091	0.70

Table 3 - List of Samples with Surrogates outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8082	BL04A	Decachlorobiphenyl	51	60 - 125	UJG
SW846 8082	IH04A	Tetrachloro-m-xylene	44	45 - 155	None, within 1%.
SW846 8082	IH04A	Decachlorobiphenyl	54	60 - 125	UJG

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.

JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

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Date Completed: September 12, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10425-1	Solid	BL01A	580-10425-1	6/19/2008	MS/MSD	None
580-10425-1	Solid	BL03A	580-10425-2	6/13/2008		None
580-10425-1	Solid	BL06A	580-10425-3	6/11/2008		None
580-10425-1	Solid	BL08B	580-10425-4	6/11/2008		None
580-10425-1	Solid	BL08C	580-10425-5	6/11/2008		None
580-10425-1	Solid	CO01A	580-10425-6	6/22/2008		None
580-10425-1	Solid	CO02A	580-10425-7	6/22/2008		None
580-10425-1	Solid	CO03A	580-10425-8	6/22/2008		None
580-10425-1	Solid	CO04A	580-10425-9	6/20/2008		None
580-10425-1	Solid	CO05A	580-10425-10	6/20/2008		None
580-10425-1	Solid	DO01A	580-10425-11	6/19/2008		None
580-10425-1	Solid	DO02A	580-10425-12	6/19/2008		None
580-10425-1	Solid	DO03A	580-10425-13	6/19/2008		None
580-10425-1	Solid	DO04A	580-10425-14	6/19/2008		None
580-10425-1	Solid	DO05A	580-10425-15	6/19/2008		None
580-10425-1	Solid	EC01A	580-10425-16	6/21/2008		None
580-10425-1	Solid	EC02A	580-10425-17	6/21/2008		None
580-10425-1	Solid	EC03A	580-10425-18	6/20/2008	MD/MSD	None
580-10425-1	Solid	EC04A	580-10425-20	6/20/2008		None
580-10425-1	Solid	EC05A	580-10425-21	6/21/2008		None
580-10425-1	Solid	ED01A	580-10425-22	6/21/2008		None
580-10425-1	Solid	ED01B	580-10425-23	6/19/2008		None
580-10425-1	Solid	ED01C	580-10425-24	6/19/2008		None
580-10425-1	Solid	ED02A	580-10425-25	6/19/2008		None
580-10425-1	Solid	ED02B	580-10425-26	6/18/2008		None
580-10425-1	Solid	ED02C	580-10425-27	6/18/2008		None
580-10425-1	Solid	ED03A	580-10425-28	6/20/2008		None
580-10425-1	Solid	ED03B	580-10425-29	6/18/2008		None
580-10425-1	Solid	ED03C	580-10425-30	6/18/2008		None
580-10425-1	Solid	ED04A	580-10425-31	6/20/2008		None
580-10425-1	Solid	ED04B	580-10425-32	6/18/2008		None
580-10425-1	Solid	ED05A	580-10425-33	6/20/2008		None
580-10425-1	Solid	EE01A	580-10425-34	6/20/2008		None

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10425-1	Solid	EE02A	580-10425-35	6/20/2008		None
580-10425-1	Solid	EE03A	580-10425-36	6/20/2008		None
580-10425-1	Solid	EE04A	580-10425-37	6/20/2008		None
580-10425-1	Solid	EE05A	580-10425-38	6/20/2008	MS/MSD	None
580-10425-1	Solid	EI01A	580-10425-39	6/19/2008		None
580-10425-1	Solid	EI02A	580-10425-40	6/18/2008		None
580-10425-1	Solid	EI03A	580-10425-41	6/18/2008		None
580-10425-1	Solid	EI04A	580-10425-42	6/18/2008		None
580-10425-1	Solid	EI06A	580-10425-43	6/18/2008		None
580-10425-1	Solid	EI07A	580-10425-44	6/18/2008		None
580-10425-1	Solid	FT01A	580-10425-45	6/17/2008		None
580-10425-1	Solid	FT02A	580-10425-45	6/17/2008	MS/MSD	None
580-10425-1	Solid	FT04A	580-10425-46	6/17/2008		None
580-10425-1	Solid	FT06A	580-10425-48	6/12/2008		None
580-10425-1	Solid	FT11A	580-10425-49	6/12/2008		None
580-10425-1	Solid	IE01B	580-10425-50	6/17/2008		None
580-10425-1	Solid	IE01C	580-10425-51	6/17/2008		None
580-10425-1	Solid	IE05B	580-10425-52	6/13/2008		None
580-10425-1	Solid	IE05C	580-10425-53	6/13/2008		None
580-10425-1	Solid	IE08A	580-10425-55	6/13/2008		None
580-10425-1	Solid	IE10A	580-10425-57	6/8/2008		None
580-10425-1	Solid	IE12B	580-10425-58	6/20/2008		None
580-10425-1	Solid	IE12C	580-10425-59	6/20/2008		None
580-10425-1	Solid	IE14B	580-10425-60	6/20/2008		None
580-10425-1	Solid	IE14C	580-10425-61	6/20/2008		None
580-10425-1	Solid	IE16C	580-10425-62	6/12/2008		None
580-10425-1	Solid	IH02B	580-10425-65	6/12/2008		None
580-10425-1	Solid	IH03A	580-10425-66	6/16/2008		None
580-10425-1	Solid	IH05A	580-10425-67	6/16/2008		None
580-10425-1	Solid	KP01A	580-10425-69	6/17/2008		None
580-10425-1	Solid	KP02A	580-10425-70	6/17/2008		None
580-10425-1	Solid	KP03A	580-10425-71	6/17/2008		None
580-10425-1	Solid	KP04A	580-10425-72	6/17/2008		None
580-10425-1	Solid	KP05A	580-10425-73	6/12/2008		None
580-10425-1	Solid	KP06A	580-10425-74	6/11/2008		None
580-10425-1	Solid	KP07B	580-10425-75	6/21/2008		None
580-10425-1	Solid	KP07C	580-10425-76	6/21/2008		None
580-10425-1	Solid	KP08A	580-10425-77	6/12/2008		None
580-10425-1	Solid	LP01A	580-10425-78	6/22/2008		None
580-10425-1	Solid	LP03A	580-10425-79	6/22/2008		None
580-10425-1	Solid	LP04A	580-10425-80	6/22/2008	MS/MSD	None

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Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10425-1	Solid	LP05A	580-10425-81	6/22/2008		None
580-10425-1	Solid	MA01A	580-10425-82	6/17/2008		None
580-10425-1	Solid	MA03A	580-10425-84	6/13/2008		None
580-10425-1	Solid	MA04A	580-10425-85	6/12/2008		None
580-10425-1	Solid	MA05A	580-10425-86	6/13/2008		None
580-10425-1	Solid	MD01A	580-10425-87	6/22/2008		None
580-10425-1	Solid	MD02A	580-10425-88	6/21/2008		None
580-10425-1	Solid	MD03A	580-10425-89	6/22/2008		None
580-10425-1	Solid	MD03B	580-10425-90	6/17/2008		None
580-10425-1	Solid	MD03C	580-10425-91	6/17/2008		None
580-10425-1	Solid	MD04A	580-10425-92	6/22/2008		None
580-10425-1	Solid	MD04B	580-10425-93	6/22/2008		None
580-10425-1	Solid	MD05A	580-10425-94	6/21/2008		None
580-10425-1	Solid	MD05B	580-10425-95	6/19/2008		None
580-10425-1	Solid	MD05C	580-10425-96	6/19/2008		None
580-10425-1	Solid	OH01A-R	580-10425-97	6/18/2008		None
580-10425-1	Solid	RL01A	580-10425-98	6/18/2008		None
580-10425-1	Solid	RL02A	580-10425-99	6/18/2008		None
580-10425-1	Solid	RL03A	580-10425-100	6/12/2008		None
580-10425-1	Solid	WW01A	580-10425-101	6/19/2008	MS/MSD	None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10425-1	Solid	EPA 160.3	160.3 Modified	94	Sediment
580-10425-1	Solid	NWTPH-Dx	Semi-Volatile Petroleum Products by NWTPH-Dx	57	Sediment
580-10425-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	69	Sediment
580-10425-1	Solid	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	91	Sediment
580-10425-1	Solid	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	27	Sediment
580-10425-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	55	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes

General Sample Information	
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	No, refer to Table 3. Samples result were qualified as estimated biased low (JG, JTG, or UJG) based on surrogate outliers.
MS/MSD percent recovery values within laboratory QC criteria?	No, refer to Table 4. The sample results were qualified as estimated.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Several compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Any compounds present in method blank?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%?	No.
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110%.	Yes

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Were elements recovered ≤30%? If so, “REJ” flag associated NDs on Form 1’s.	No
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	No, associated samples were not qualified.
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated biased low (JG, JTG, or UJG) based on pesticide surrogate outliers. Sample results were qualified as estimated based on pesticide MS/MSD outliers. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK). Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination.

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Anal Type	Units	MDL	PQL
SW846 8081	MB 580-33448	MBLK	Aldrin	0.31	J	A	µg/Kg	0.11	1.0
SW846 8081	MB 580-33448	MBLK	beta-BHC	0.47	J	A	µg/Kg	0.13	1.0
SW846 8081	MB 580-33448	MBLK	delta-BHC	2.2		A	µg/Kg	0.12	1.0
SW846 8081	MB 580-33452	MBLK	alpha-BHC	0.26	J	A	µg/Kg	0.13	1.0
NWTPH	MB 580-33484	MBLK	#2 Diesel	6.7	J	A	mg/Kg	6.0	25
NWTPH	MB 580-33529	MBLK	#2 Diesel	7.4	J	A	mg/Kg	6.0	25
NWTPH	MB 580-33565	MBLK	#2 Diesel	9.0	J	A	mg/Kg	6.0	25
SW846 6020	MB 580-33583	MBLK	Barium	0.0010	J	A	mg/Kg	0.00065	0.20
SW846 6020	MB 580-33583	MBLK	Copper	0.0070	J	A	mg/Kg	0.0011	0.20
SW846 6020	MB 580-33597	MBLK	Barium	0.0010	J	A	mg/Kg	0.00065	0.20
SW846 6020	MB 580-33597	MBLK	Copper	0.010	J	A	mg/Kg	0.0011	0.20
SW846 6020	MB 580-33597	MBLK	Lead	0.0060	J	A	mg/Kg	0.0012	0.20
SW846 6020	MB 580-33609	MBLK	Barium	0.0015	J	A	mg/Kg	0.00065	0.20
SW846 6020	MB 580-33609	MBLK	Copper	0.0055	J	A	mg/Kg	0.0011	0.20
SW846 6020	MB 580-33609	MBLK	Lead	0.0025	J	A	mg/Kg	0.0012	0.20
SW846 6020	MB 580-33613	MBLK	Arsenic	0.0024	J	A	mg/Kg	0.0086	0.20
SW846 6020	MB 580-33613	MBLK	Barium	0.0020	J	A	mg/Kg	0.00065	0.20
SW846 6020	MB 580-33613	MBLK	Copper	0.0095	J	A	mg/Kg	0.0011	0.20
SW846 6020	MB 580-33613	MBLK	Lead	0.004	J	A	mg/Kg	0.0012	0.20

Method	Sample ID	Samp Type	Analyte	Result	Qual	Anal Type	Units	MDL	PQL
				0					

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
NWTPH	CO01A	#2 Diesel	27	U
SW846 8081	CO01A	alpha-BHC	1.1	U
NWTPH	CO03A	#2 Diesel	26	U
SW846 8081	CO04A	delta-BHC	1.1	U
SW846 8081	CO05A	delta-BHC	2.9	U
SW846 8081	CO05A	beta-BHC	1.3	U
SW846 8081	EC01A	delta-BHC	3.7	U
NWTPH	EC01A	#2 Diesel	29	U
SW846 8081	EC01A	Aldrin	1.1	U
SW846 8081	EC01A	beta-BHC	1.1	U
NWTPH	EC02A	#2 Diesel	27	U
SW846 8081	EC02A	alpha-BHC	1.1	U
SW846 8081	EC03A	alpha-BHC	1.4	U
SW846 8081	EC05A	alpha-BHC	1.1	U
NWTPH	EC05A	#2 Diesel	26	U
NWTPH	ED01A	#2 Diesel	38	U
NWTPH	ED02B	#2 Diesel	29	U
NWTPH	ED02C	#2 Diesel	29	U
SW846 8081	EE01A	delta-BHC	2.2	U
NWTPH	EE01A	#2 Diesel	27	U
SW846 8081	EE01A	Aldrin	1.1	U
SW846 8081	EE01A	beta-BHC	1.1	U
NWTPH	EE02A	#2 Diesel	30	U
SW846 8081	EE02A	beta-BHC	1.1	U
SW846 8081	EE03A	delta-BHC	3.4	U
NWTPH	EE03A	#2 Diesel	29	U
SW846 8081	EE04A	Aldrin	1	U
SW846 8081	EE05A	delta-BHC	2.6	U
SW846 8081	EE05A	beta-BHC	1	U
SW846 8081	EI01A	beta-BHC	1.2	U
SW846 8081	EI01A	delta-BHC	1.2	U
SW846 8081	EI02A	delta-BHC	4.2	U
SW846 8081	EI02A	beta-BHC	1.2	U
SW846 8081	EI03A	Aldrin	1.1	U
SW846 8081	EI03A	beta-BHC	1.1	U
SW846 8081	EI04A	beta-BHC	1.1	U
SW846 8081	EI06A	beta-BHC	1.2	U

Method	Sample ID	Analyte	Result	Qual
SW846 8081	EI07A	delta-BHC	7.3	U
SW846 8081	EI07A	beta-BHC	1.2	U
SW846 8081	FT01A	Aldrin	1.8	U
SW846 8081	FT04A	beta-BHC	1.4	U
NWTPH	IE08A	#2 Diesel	28	U
NWTPH	IH05A	#2 Diesel	34	U
NWTPH	KP01A	#2 Diesel	49	U
NWTPH	KP02A	#2 Diesel	52	U
NWTPH	KP03A	#2 Diesel	36	U
SW846 8081	KP04A	alpha-BHC	1.5	U
NWTPH	MD03B	#2 Diesel	33	U
NWTPH	MD04A	#2 Diesel	43	U
NWTPH	MD04B	#2 Diesel	20	U
NWTPH	MD05A	#2 Diesel	29	U

Table 3 - List of Samples with Surrogates outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8081	FT01A	Decachlorobiphenyl	37	40 - 158	JG, JTG, or UJG
SW846 8081	FT02A	Decachlorobipheny	38	40 - 158	JG, JTG, or UJG
SW846 8082	CO02A	Tetrachloro-m-xylene	39	45 - 155	JG, JTG, or UJG
SW846 8082	CO02A	Decachlorobiphenyl	42	50 – 150	JG, JTG, or UJG
SW846 8082	EC03A	Decachlorobiphenyl	44	50 - 150	JG, JTG, or UJG
SW846 8082	ED01A	Tetrachloro-m-xylene	36	45 - 155	JG, JTG, or UJG
SW846 8082	ED01A	Decachlorobiphenyl	37	50 – 150	JG, JTG, or UJG
SW846 8082	ED01B	Decachlorobiphenyl	49	50 - 150	JG, JTG, or UJG
SW846 8082	ED02A	Tetrachloro-m-xylene	39	45 - 155	JG, JTG, or UJG
SW846 8082	ED02A	Decachlorobiphenyl	34	50 – 150	JG, JTG, or UJG
SW846 8082	ED03A	Tetrachloro-m-xylene	38	45 - 155	JG, JTG, or UJG
SW846 8082	ED03A	Decachlorobiphenyl	37	50 - 150	JG, JTG, or UJG
SW846 8082	ED05A	Decachlorobiphenyl	40	50 – 150	JG, JTG, or UJG
SW846 8082	IE12B	Tetrachloro-m-xylene	36	45 - 155	JG, JTG, or UJG
SW846 8082	IE12B	Decachlorobiphenyl	41	50 – 150	JG, JTG, or UJG
SW846 8082	IE14B	Tetrachloro-m-xylene	42	45 - 155	JG, JTG, or UJG
SW846 8082	IE14B	Decachlorobiphenyl	33	50 – 150	JG, JTG, or UJG
SW846 8082	KP07B	Tetrachloro-m-xylene	30	45 - 155	JG, JTG, or UJG
SW846 8082	KP07B	Decachlorobiphenyl	26	50 – 150	JG, JTG, or UJG
SW846 8082	KP08A	Decachlorobiphenyl	44	50 - 150	JG, JTG, or UJG
SW846 8082	MD01A	Decachlorobiphenyl	43	50 – 150	JG, JTG, or UJG
SW846 8082	MD02A	Tetrachloro-m-xylene	44	45 - 155	JG, JTG, or UJG
SW846 8082	MD02A	Decachlorobiphenyl	41	50 – 150	JG, JTG, or UJG
SW846 8082	MD03A	Tetrachloro-m-xylene	37	45 - 155	JG, JTG, or UJG
SW846 8082	MD03A	Decachlorobiphenyl	29	50 – 150	JG, JTG, or UJG

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8082	MD04A	Tetrachloro-m-xylene	43	45 - 155	JG, JTG, or UJG
SW846 8082	MD04A	Decachlorobiphenyl	38	50 – 150	JG, JTG, or UJG
SW846 8082	MD04B	Tetrachloro-m-xylene	35	45 - 155	JG, JTG, or UJG
SW846 8082	MD04B	Decachlorobiphenyl	32	50 – 150	JG, JTG, or UJG
SW846 8082	OH01A-R	Decachlorobiphenyl	35	50 – 150	JG, JTG, or UJG

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8081	EI01A MS	Beta-BHC	123	48 - 121	None
SW846 8081	EI01A MS	4,4'-DDE	146	47 – 140	None
SW846 8081	EI01A MS	Endosulfan I	124	52 - 122	None
SW846 8081	EI01A MSD	4,4'-DDE	154	47 – 140	None
SW846 8081	EI01A MSD	Endosulfan I	129	52 - 122	None
SW846 8081	EI01A MSD	gamma-Chlordane	124	49 - 122	None
SW846 8081	FT02A MS	Beta-BHC	145	48 - 121	JK
SW846 8081	FT02A MS	4,4'-DDE	220	47 – 140	JTK
SW846 8081	FT02A MS	Dieldrin	219	53 - 134	None
SW846 8081	FT02A MS	Endosulfan I	161	52 - 122	None
SW846 8081	FT02A MS	Heptachlor epoxide	155	49 - 123	None
SW846 8081	FT02A MS	alpha-Chlordane	470	46 - 118	None
SW846 8081	FT02A MS	gamma-Chlordane	173	49 - 122	JTK
SW846 8081	FT02A MSD	Beta-BHC	134	48 - 121	JK
SW846 8081	FT02A MSD	4,4'-DDE	237	47 – 140	JTK
SW846 8081	FT02A MSD	Dieldrin	238	53 - 134	None
SW846 8081	FT02A MSD	Endosulfan I	161	52 - 122	None
SW846 8081	FT02A MSD	Heptachlor epoxide	159	49 - 123	None
SW846 8081	FT02A MSD	alpha-Chlordane	516	46 - 118	None
SW846 8081	FT02A MSD	gamma-Chlordane	256	49 - 122	JTK
SW846 8081	EC03A MS	Endosulfan sulfate	141	42 - 128	JL
SW846 8081	EC03A MS	Endrin ketone	248	45 - 127	None
SW846 8081	EC03A MSD	4,4'-DDD	rpd = 46	30	JK
SW846 8081	EC03A MSD	4,4'-DDT	rpd = 70	30	JK
SW846 8081	EC03A MSD	Endosulfan sulfate	rpd = 70	30	JK
SW846 8081	EC03A MSD	Endrin aldehyde	rpd = 70	30	None
SW846 8082	FT02A MSD	PCB-1016	rpd = 42	20	UJK
SW846 8082	EC03A MS	PCB-1016	53	57 - 128	UJG
SW846 8082	EC03A MS	PCB-1060	64	65 -132	JG
NWTPH	WW01A MS	#2 Diesel	130	70 – 125	JTG
NWTPH	WW01A MSD	#2 Diesel	141	70 – 125	JTG
NWTPH	WW01A MSD	Motor Oil	136	64 – 127	JTG

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
NWTPH	EC03A MSD	#2 Diesel	rpd = 32	16	JK
NWTPH	EC03A MSD	Motor Oil	rpd = 21	17	JK

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.

NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: November 11, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10425-2	Solid	BL01A	580-10425-1	6/19/2008	MS/MSD	None
580-10425-2	Solid	BL03A	580-10425-2	6/13/2008	MS/MSD	None
580-10425-2	Solid	BL06A	580-10425-3	6/11/2008		None
580-10425-2	Solid	FT05A	580-10425-47	6/12/2008		None
580-10425-2	Solid	FT06A	580-10425-48	6/12/2008		None
580-10425-2	Solid	FT11A	580-10425-49	6/12/2008		None
580-10425-2	Solid	IE07A	580-10425-54	6/16/2008	MS/MSD	None
580-10425-2	Solid	IE09A	580-10425-56	6/16/2008		None
580-10425-2	Solid	IH01A	580-10425-63	6/16/2008		None
580-10425-2	Solid	IH02A	580-10425-64	6/16/2008		None
580-10425-2	Solid	IH03A	580-10425-66	6/16/2008		None
580-10425-2	Solid	IH05A	580-10425-67	6/16/2008		None
580-10425-2	Solid	IH06A	580-10425-68	6/16/2008		None
580-10425-2	Solid	KP01A	580-10425-69	6/17/2008		None
580-10425-2	Solid	KP02A	580-10425-70	6/17/2008		None
580-10425-2	Solid	KP05A	580-10425-73	6/12/2008		None
580-10425-2	Solid	KP08A	580-10425-77	6/12/2008		None
580-10425-2	Solid	MA01A	580-10425-82	6/17/2008		None
580-10425-2	Solid	MA02A	580-10425-83	6/13/2008		None
580-10425-2	Solid	MA03A	580-10425-84	6/13/2008		None
580-10425-2	Solid	MA04A	580-10425-85	6/12/2008		None
580-10425-2	Solid	MA05A	580-10425-86	6/13/2008		None
580-10425-2	Solid	RL01A	580-10425-98	6/18/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10746-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	16	Sediment
580-10746-1	Solid	SW846 8081	Chlorinated Pesticides by Gas Chromatography	8	Sediment
580-10746-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	21	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form? Where samples archived (frozen) properly?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Chlorinated Pesticides and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes.
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes.
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	No, refer to Table 3. Samples results were qualified as estimated biased low (UJG) based on surrogate outliers.
MS/MSD percent recovery values within laboratory QC criteria?	No, refer to Table 4. Samples results were qualified as estimated biased low (UJG) based on MS/MSD outliers.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes.
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	No. No action was taken, since the recovery values were high with no positive values in the associated samples.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes

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Date Completed: November 11, 2008	Completed by: David Ikeda

Chlorinated Pesticides and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Yes

Metals by ICP	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	No, refer to Table 4. Samples results were qualified as estimated biased low (UJG) based on MS/MSD outliers.
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes.
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes.
Spot check ICS recoveries 80-120%.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	All are acceptable.
Spot check CCV 90-110%.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results that had surrogate outliers were qualified as estimated bias low (UJG). Sample results that had MS/MSD outliers were qualified as estimated bias low (UJG or JG).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 8081	MB 580-37035	MBLK	Endosulfan II	0.43	J	mg/Kg	0.26	2.0
SW846 8081	MB 580-37047	MBLK	Endosulfan II	0.45	J	mg/Kg	0.26	2.0
SW846 6020	MB 580-37079	MBLK	Barium	0.0069	J	mg/Kg	0.00065	0.20

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 6020	MB 580-37079	MBLK	Cadmium	0.00055	J	mg/Kg	0.00051	0.20
SW846 6020	MB 580-37079	MBLK	Copper	0.021	J	mg/Kg	0.0011	0.20
SW846 6020	MB 580-37079	MBLK	Lead	0.0060	J	mg/Kg	0.0012	0.20
SW846 6020	MB 580-37079	MBLK	Silver	0.0026	J	mg/Kg	0.00050	0.20
SW846 6020	MB 580-37079	MBLK	Zinc	0.38	J	mg/Kg	0.0091	0.70
SW846 6020	MB 580-37539	MBLK	Zinc	0.14	J	mg/Kg	0.0091	0.70
SW846 6020	MB 580-37614	MBLK	Lead	0.00015	J	mg/Kg	0.0012	0.20
SW846 6020	MB 580-37614	MBLK	Silver	0.000057	J	mg/Kg	0.00050	0.20
SW846 6020	MB 580-37614	MBLK	Zinc	0.020	J	mg/Kg	0.0091	0.70

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
SW846 8081	FT05A	Endosulfan II	3.5	U
SW846 8081	FT11A	Endosulfan II	3.1	U
SW846 8081	KP01A	Endosulfan II	4.0	U
SW846 8081	KP02A	Endosulfan II	4.2	U
SW846 8081	KP05A	Endosulfan II	4.0	U
SW846 8081	RL01A	Endosulfan II	2.5	U

Table 3 - List of Samples with Surrogates outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8081	BL01A	Tetrachloro-m-xylene	20	49 – 123	UJG
SW846 8081	BL01A	Decachlorobiphenyl	31	40 - 158	UJG
SW846 8081	FT05A	Tetrachloro-m-xylene	36	49 – 123	UJG
SW846 8081	FT05A	Decachlorobiphenyl	36	40 - 158	UJG
SW846 8081	FT06A	Tetrachloro-m-xylene	27	49 – 123	UJG
SW846 8081	FT06A	Decachlorobiphenyl	27	40 - 158	UJG
SW846 8081	FT11A	Decachlorobiphenyl	37	40 - 158	UJG
SW846 8081	KP01A	Tetrachloro-m-xylene	21	49 – 123	UJG
SW846 8081	KP01A	Decachlorobiphenyl	25	40 - 158	UJG
SW846 8081	KP02A	Tetrachloro-m-xylene	20	49 – 123	UJG
SW846 8081	KP02A	Decachlorobiphenyl	26	40 - 158	UJG
SW846 8081	KP05A	Tetrachloro-m-xylene	32	49 – 123	UJG
SW846 8081	KP05A	Decachlorobiphenyl	25	40 - 158	UJG
SW846 8082	BL01A	Tetrachloro-m-xylene	42	45 - 155	UJG
SW846 8082	BL01A	Decachlorobiphenyl	36	60 - 125	UJG
SW846 8082	BL06A	Tetrachloro-m-xylene	26	45 - 155	UJG
SW846 8082	BL06A	Decachlorobiphenyl	24	60 - 125	UJG
SW846 8082	FT06A	Decachlorobiphenyl	54	60 - 125	UJG
SW846 8082	FT11A	Tetrachloro-m-xylene	26	45 - 155	UJG
SW846 8082	FT11A	Decachlorobiphenyl	21	60 - 125	UJG
SW846 8082	IE07A	Tetrachloro-m-xylene	22	45 - 155	UJG

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8082	IE07A	Decachlorobiphenyl	22	60 - 125	UJG
SW846 8082	IE09A	Tetrachloro-m-xylene	31	45 - 155	UJG
SW846 8082	IE09A	Decachlorobiphenyl	35	60 - 125	UJG
SW846 8082	IH01A	Tetrachloro-m-xylene	33	45 - 155	UJG
SW846 8082	IH01A	Decachlorobiphenyl	43	60 - 125	UJG
SW846 8082	IH02A	Tetrachloro-m-xylene	42	45 - 155	UJG
SW846 8082	IH02A	Decachlorobiphenyl	44	60 - 125	UJG
SW846 8082	IH03A	Tetrachloro-m-xylene	30	45 - 155	UJG
SW846 8082	IH03A	Decachlorobiphenyl	36	60 - 125	UJG
SW846 8082	IH05A	Tetrachloro-m-xylene	28	45 - 155	UJG
SW846 8082	IH05A	Decachlorobiphenyl	33	60 - 125	UJG
SW846 8082	IH06A	Decachlorobiphenyl	46	60 - 125	UJG
SW846 8082	KP01A	Tetrachloro-m-xylene	44	45 - 155	UJG
SW846 8082	KP01A	Decachlorobiphenyl	53	60 - 125	UJG
SW846 8082	KP02A	Tetrachloro-m-xylene	40	45 - 155	UJG
SW846 8082	KP02A	Decachlorobiphenyl	29	60 - 125	UJG
SW846 8082	KP05A	Tetrachloro-m-xylene	22	45 - 155	UJG
SW846 8082	KP05A	Decachlorobiphenyl	23	60 - 125	UJG
SW846 8082	MA01A	Decachlorobiphenyl	48	60 - 125	UJG
SW846 8082	MA03A	Decachlorobiphenyl	51	60 - 125	UJG
SW846 8082	MA04A	Decachlorobiphenyl	55	60 - 125	UJG

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8082	IE07A MS	PCB 1260	58	60 – 130	UJG
SW846 8082	IE07A MSD	PCB 1260	50	60 – 130	UJG
SW846 6020	BL02A MS	Chromium	68	75 – 125	JG (for associated samples).

Table 5 - List LCS Percent Recovery Values outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8081	LCS 580-37547	4,4'-DDT	142	44 – 144	None
SW846 8081	LCS 580-37547	Heptachlor	141	50 - 130	None
SW846 8081	LCS 580-37547	Endrin Ketone	130	45 – 127	None

Table 6 –Samples that were Reanalyzed
None

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.

EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 12, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10430-1	Tissue	EI08TM	580-10524-2	6/14/2008		EI08TH
580-10430-1	Tissue	IE21TM	580-10524-6	6/14/2008		IE21TL
580-10430-1	Tissue	IE22TM	580-10524-3	6/14/2008		IE22TL
580-10430-1	Tissue	IE23TM	580-10524-5	6/14/2008		IE23TL
580-10430-1	Tissue	IE24TM	580-10524-4	6/14/2008		IE24TL
580-10430-1	Tissue	IE26TM	580-10524-1	6/14/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10524-1	Tissue	Bligh-Dyer	Percent Lipids	1	Tissue
580-10524-1	Tissue	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	6	Tissue
580-10524-1	Tissue	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	6	Tissue
580-10524-1	Tissue	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	1	Tissue

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	No, samples were wrong electronic files were corrected.
Did coolers arrive at lab less than 0^oC and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)

- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	No, tetrachloro-m-xylene was outside QC limits.
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	No, No sample results were qualified.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Several compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes

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Date Completed: September 12, 2008	Completed by: David Ikeda

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Were elements recovered <u><</u>30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Anal Type	Units	MDL	PQL
SW846 8081	MB 580-33810	MBLK	delta-BHC	0.34	J	A	µg/Kg	0.12	1.0
SW846 8081	MB 580-33810	MBLK	Heptachlor	0.16	J	A	µg/Kg	0.14	1.0
SW846 8081	MB 580-33810	MBLK	Methoxychlor	2.9	J	A	µg/Kg	1.3	10
SW846 6020	MB 580-33888	MBLK	Barium	0.0093	J	A	mg/Kg	0.00032	0.10
SW846 6020	MB 580-33888	MBLK	Cadmium	0.0016	J	A	mg/Kg	0.00026	0.10
SW846 6020	MB 580-33888	MBLK	Copper	0.0017	J	A	mg/Kg	0.00055	0.10
SW846 6020	MB 580-33888	MBLK	Lead	0.11		A	mg/Kg	0.00060	0.10
SW846 6020	MB 580-33888	MBLK	Silver	0.0032	J	A	mg/Kg	0.00025	0.10
SW846 6020	MB 580-33888	MBLK	Zinc	0.0073	J	A	mg/Kg	0.0046	0.25

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual

Method	Sample ID	Analyte	Result	Qual
SW846 6020	EI08TM	Lead	0.12	U
SW846 6020	IE21TL	Barium	0.081	U
SW846 6020	IE21TL	Cadmium	0.081	U
SW846 6020	IE21TL	Silver	0.081	U
SW846 6020	IE21TL	Lead	0.081	U
SW846 6020	IE22TL	Barium	0.093	U
SW846 6020	IE22TL	Cadmium	0.093	U
SW846 6020	IE22TL	Silver	0.093	U
SW846 6020	IE22TL	Lead	0.093	U
SW846 6020	IE23TL	Barium	0.093	U
SW846 6020	IE23TL	Cadmium	0.093	U
SW846 6020	IE23TL	Silver	0.093	U
SW846 6020	IE23TL	Lead	0.093	U
SW846 6020	IE24TL	Lead	0.12	U
SW846 6020	IE24TL	Barium	0.083	U
SW846 6020	IE24TL	Cadmium	0.083	U
SW846 6020	IE24TL	Silver	0.083	U
SW846 6020	IE26TM	Lead	0.45	U
SW846 6020	IE26TM	Silver	0.09	U

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits

Method	Sample ID	Analyte	LCS Recovery	QC Limit	Sample Qualification
SW846 8081	LCS 580-33096	Beta-BHC	122	48 - 121	None
SW846 8081	LCSD 580-33096	Beta-BHC	127	48 – 121	None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 11, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10524-1	Tissue	EC06TH	580-10524-1	6/22/2008		None
580-10524-1	Tissue	IE18TH	580-10524-2	6/21/2008		None
580-10524-1	Tissue	IE20TH	580-10524-3	6/21/2008		None
580-10524-1	Tissue	IE25TH	580-10524-4	6/21/2008		IE25TM
580-10524-1	Tissue	MD06TH	580-10524-5	6/22/2008		None
580-10524-1	Tissue	MD07TH	580-10524-6	6/22/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10524-1	Tissue	Bligh-Dyer	Percent Lipids	1	Tissue
580-10524-1	Tissue	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	6	Tissue
580-10524-1	Tissue	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	6	Tissue
580-10524-1	Tissue	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	1	Tissue

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab less than 0°C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)

- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	No, tetrachloro-m-xylene was outside QC limits.
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	No, Sample results were qualified as estimated biased low (JTL) based on pesticide LCS outliers.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Several compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Were elements recovered <30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated biased low (JTL) based on pesticide LCS outliers. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK). Due to method blank contamination, samples results below the PQL are reported at the PQL and flagged U or sample results greater than PQL are not changed and flagged U.

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Anal Type	Units	MDL	PQL
SW846 8081	MB 580-33810	MBLK	delta-BHC	0.34	J	A	µg/Kg	0.12	1.0
SW846 8081	MB 580-33810	MBLK	Heptachlor	0.16	J	A	µg/Kg	0.14	1.0
SW846 8081	MB 580-33810	MBLK	Methoxychlor	2.9	J	A	µg/Kg	1.3	10
SW846 6020	MB 580-33888	MBLK	Barium	0.0093	J	A	mg/Kg	0.00032	0.10
SW846 6020	MB 580-33888	MBLK	Cadmium	0.0016	J	A	mg/Kg	0.00026	0.10
SW846 6020	MB 580-33888	MBLK	Copper	0.0017	J	A	mg/Kg	0.00055	0.10
SW846 6020	MB 580-33888	MBLK	Lead	0.11		A	mg/Kg	0.00060	0.10
SW846 6020	MB 580-33888	MBLK	Silver	0.0032	J	A	mg/Kg	0.00025	0.10
SW846 6020	MB 580-33888	MBLK	Zinc	0.0073	J	A	mg/Kg	0.0046	0.25

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
SW846 8081	EC06TH	Heptachlor	0.93	U
SW846 6020	IE18TH	Lead	0.52	U
SW846 6020	IE20TH	Lead	0.37	U
SW846 6020	IE25TH	Lead	0.091	U
SW846 6020	MD07TH	Lead	0.32	U

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits

Method	Sample ID	Analyte	LCS Recovery	QC Limit	Sample Qualification
SW846 8081	LCS 580-33096	Beta-BHC	122	48 - 121	JTL
SW846 8081	LCSD 580-33096	Beta-BHC	127	48 – 121	JTL

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.

JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10671-1	Solid	CO05B	580-10671-01	7/15/2008		None
580-10671-1	Solid	EC03B	580-10671-02	7/16/2008		None
580-10671-1	Solid	EC03C	580-10671-03	7/16/2008		None
580-10671-1	Solid	EC04B	580-10671-04	7/16/2008		None
580-10671-1	Solid	EC05B	580-10671-05	7/16/2008		None
580-10671-1	Solid	EE01B	580-10671-06	7/16/2008		None
580-10671-1	Solid	EE03B	580-10671-07	7/16/2008		None
580-10671-1	Solid	EE03C	580-10671-08	7/16/2008	MS/MSD	None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10671-1	Solid	EPA 160.3	160.3 Modified	8	Sediment
580-10671-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	8	Sediment
580-10671-1	Solid	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	8	Sediment
580-10671-1	Solid	NWTPH-Dx	Semi-Volatile Petroleum Products by NWTPH-Dx	8	Sediment
580-10671-1	Solid	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	8	Sediment
580-10671-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	8	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	**Completed by: David Ikeda**

General Sample Information	
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes.
MS/MSD percent recovery values within laboratory QC criteria?	Not applicable.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Several compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Any compounds present in method blank?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
	not changed and flagged U.
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%?	Yes.
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110%.	Yes

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns

Sample results were qualified as estimated biased low (JG, JTG, or UJG) based on pesticide surrogate outliers. Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 8081	MB 580-34409	MBLK	beta-BHC	0.54	J	µg/Kg	0.13	1.0
SW846 6020	MB 580-33412	MBLK	Cadmium	0.0015	J	mg/Kg	0.00051	0.20
SW846 6020	MB 580-33412	MBLK	Copper	0.0060	J	mg/Kg	0.00011	0.20
SW846 6020	MB 580-33412	MBLK	Lead	0.010	J	mg/Kg	0.0012	0.20
SW846 6020	MB 580-33412	MBLK	Silver	0.0025	J	mg/Kg	0.00050	0.20
SW846 6020	MB 580-33412	MBLK	Zinc	0.014	J	mg/Kg	0.0091	0.50

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
SW846 8081	CO05B	beta-BHC	1.7	U
SW846 8081	EC03B	beta-BHC	2	U
SW846 8081	ED05B	beta-BHC	1.5	U
SW846 8081	EE01B	beta-BHC	1	U
SW846 8081	EE03B	beta-BHC	1.1	U
SW846 8081	EE03C	beta-BHC	1.1	U

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code **Description**

B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10694-1	Solid	CO02B	580-10694-01	7/17/2008	MS/MSD	None
580-10694-1	Solid	EE04B	580-10694-02	7/17/2008		None
580-10694-1	Solid	EE04C	580-10694-03	7/17/2008		None
580-10694-1	Solid	MD01B	580-10694-04	7/17/2008		None
580-10694-1	Solid	MD01C	580-10694-05	7/17/2008		None
580-10694-1	Solid	MD02B	580-10694-06	7/17/2008		None
580-10694-1	Solid	MD02C	580-10694-07	7/17/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10694-1	Solid	EPA 160.3	160.3 Modified	7	Sediment
580-10694-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	5	Sediment
580-10694-1	Solid	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	5	Sediment
580-10694-1	Solid	NWTPH-Dx	Semi-Volatile Petroleum Products by NWTPH-Dx	7	Sediment
580-10694-1	Solid	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	3	Sediment
580-10694-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	7	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and

General Sample Information	
	analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	No, refer to Table 3.
MS/MSD percent recovery values within laboratory QC criteria?	Not applicable.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Several compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Any compounds present in method blank?	No.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	Completed by: David Ikeda

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%?	Yes.
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110%.	Yes

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns

Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 8081	MB 580-34426	MBLK	beta-BHC	0.88	J	µg/Kg	0.13	1.0
SW846 8081	MB 580-34426	MBLK	Heptachlor epoxide	0.42	J	µg/Kg	0.13	1.0
SW846 8081	MB 580-34426	MBLK	gamma-Chlordane	0.17	J	µg/Kg	0.12	1.0
SW846 6020	MB 580-33412	MBLK	Cadmium	0.0015	J	mg/Kg	0.00051	0.20
SW846 6020	MB 580-33412	MBLK	Copper	0.0060	J	mg/Kg	0.00011	0.20
SW846 6020	MB 580-33412	MBLK	Lead	0.010	J	mg/Kg	0.0012	0.20
SW846 6020	MB 580-33412	MBLK	Silver	0.0025	J	mg/Kg	0.00050	0.20
SW846 6020	MB 580-33412	MBLK	Zinc	0.014	J	mg/Kg	0.0091	0.50

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
SW846 8081	CO02B	beta-BHC	2.3	U
SW846 8081	EE04B	beta-BHC	2.5	U
SW846 8081	EE04B	Heptachlor Epoxide	1.1	U
SW846 8081	EE04C	beta-BHC	2	U
SW846 8081	EE04C	Heptachlor Epoxide	1.2	U

Table 3 - List of Samples with Surrogates outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8082	MD02B	Tetrachloro-m-xylene	43	45 - 155	JG, JTG, or UJG
SW846 8082	MD02B	Decachlorobiphenyl	37	50 – 150	JG, JTG, or UJG

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10697-1	Solid	CO03B	580-10697-01	7/20/2008		None
580-10697-1	Solid	CO04B	580-10697-02	7/18/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10697-1	Solid	EPA 160.3	160.3 Modified	2	Sediment
580-10697-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	2	Sediment
580-10697-1	Solid	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	2	Sediment
580-10697-1	Solid	NWTPH-Dx	Semi-Volatile Petroleum Products by NWTPH-Dx	2	Sediment
580-10697-1	Solid	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	2	Sediment
580-10697-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	2	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)

- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes.
MS/MSD percent recovery values within laboratory QC criteria?	Not applicable.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Several compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Any compounds present in method blank?	No.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
MS/MSD percent recovery values within QC criteria of 75-125%?	Yes.
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110%.	Yes

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 8081	MB 580-34426	MBLK	beta-BHC	0.88	J	µg/Kg	0.13	1.0

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 8081	MB 580-34426	MBLK	Heptachlor epoxide	0.42	J	µg/Kg	0.13	1.0
SW846 8081	MB 580-34426	MBLK	gamma-Chlordane	0.17	J	µg/Kg	0.12	1.0
SW846 6020	MB 580-33412	MBLK	Cadmium	0.0015	J	mg/Kg	0.00051	0.20
SW846 6020	MB 580-33412	MBLK	Copper	0.0060	J	mg/Kg	0.00011	0.20
SW846 6020	MB 580-33412	MBLK	Lead	0.010	J	mg/Kg	0.0012	0.20
SW846 6020	MB 580-33412	MBLK	Silver	0.0025	J	mg/Kg	0.00050	0.20
SW846 6020	MB 580-33412	MBLK	Zinc	0.014	J	mg/Kg	0.0091	0.50

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
SW846 8081	CO03B	beta-BHC	1.3	U
SW846 8081	CO04B	beta-BHC	1.8	U
SW846 8081	CO04B	Heptachlor Epoxide	1.8	U

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.

J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10698-1	Solid	EI02B	580-10698-01	7/18/2008	MS/MSD	None
580-10698-1	Solid	FT12B	580-10698-02	7/18/2008		None
580-10698-1	Solid	FT12C	580-10698-03	7/18/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10698-1	Solid	EPA 160.3	160.3 Modified	3	Sediment
580-10698-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	3	Sediment
580-10698-1	Solid	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	3	Sediment
580-10698-1	Solid	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	3	Sediment
580-10698-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	1	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)

- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	No, refer to Table 3.
MS/MSD percent recovery values within laboratory QC criteria?	No, the sample was not qualified. The spike percent recovery value was high; and the associated sample results were qualified non-detect.
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Several compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated biased low (JG, JTG, or UJG) based on pesticide surrogate outliers. Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 8081	MB 580-34426	MBLK	beta-BHC	0.88	J	µg/Kg	0.13	1.0
SW846 8081	MB 580-34426	MBLK	Heptachlor epoxide	0.42	J	µg/Kg	0.13	1.0
SW846 8081	MB 580-34426	MBLK	gamma-Chlordane	0.17	J	µg/Kg	0.12	1.0
SW846 6020	MB 580-33412	MBLK	Cadmium	0.0015	J	mg/Kg	0.00051	0.20
SW846 6020	MB 580-33412	MBLK	Copper	0.0060	J	mg/Kg	0.00011	0.20
SW846 6020	MB 580-33412	MBLK	Lead	0.010	J	mg/Kg	0.0012	0.20
SW846 6020	MB 580-33412	MBLK	Silver	0.0025	J	mg/Kg	0.00050	0.20
SW846 6020	MB 580-33412	MBLK	Zinc	0.014	J	mg/Kg	0.0091	0.50

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
SW846 8081	EI02B	beta-BHC	1.8	U
SW846 8081	EI02B	Heptachlor epoxide	1.2	U
SW846 8081	EI02B	gamma-Chlordane	1.2	U
SW846 8081	FT12B	beta-BHC	2	U
SW846 8081	FT12B	Heptachlor epoxide	1.3	U
SW846 8081	FT12B	gamma-Chlordane	1.3	U
SW846 8081	FT12C	beta-BHC	1.3	U

Method	Sample ID	Analyte	Result	Qual
SW846 8081	FT12C	Heptachlor epoxide	1.3	U

Table 3 - List of Samples with Surrogates outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8082	EI02B	Decachlorobiphenyl	41	50 - 150	JG, JTG, or UJG

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8081	EI02B MSD	beta-BHC	128	48 – 121	None
SW846 8081	EI02B MSD	Endrosulfan I	124	52 – 122	None
SW846 8081	EI02B MSD	alpha-Chlordane	119	46 – 118	None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.

JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate .
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10745-1	Solid	LA01A	580-10745-01	7/23/2008		None
580-10745-1	Solid	LA02A	580-10745-02	7/23/2008		None
580-10745-1	Solid	LA02B	580-10745-03	7/23/2008		None
580-10745-1	Solid	LA02C	580-10745-04	7/23/2008	MS/MSD	None
580-10745-1	Solid	LA03A	580-10745-05	7/23/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10745-1	Solid	EPA 160.3	160.3 Modified	5	Sediment
580-10745-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	3	Sediment
580-10745-1	Solid	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	5	Sediment
580-10745-1	Solid	NWTPH-Dx	Semi-Volatile Petroleum Products by NWTPH-Dx	5	Sediment
580-10745-1	Solid	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	3	Sediment
580-10745-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	3	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	No, refer to Table 3.
MS/MSD percent recovery values within laboratory QC criteria?	Yes>
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Several compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Any compounds present in method blank?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%?	Yes.
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110%.	Yes

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
Sample results were qualified as estimated biased low (JG, JTG, or UJG) based on pesticide surrogate outliers. Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 8081	MB 580-34519	MBLK	beta-BHC	0.44	J	µg/Kg	0.13	1.0
SW846 8081	MB 580-34519	MBLK	Endosulfan I	0.42	J	µg/Kg	0.12	1.0
SW846 6020	MB 580-34543	MBLK	Barium	0.0031	J	mg/Kg	0.00065	0.20
SW846 6020	MB 580-34543	MBLK	Copper	0.0053	J	mg/Kg	0.00011	0.20
SW846 6020	MB 580-34543	MBLK	Lead	0.0021	J	mg/Kg	0.0012	0.20
SW846 6020	MB 580-34543	MBLK	Silver	0.0027	J	mg/Kg	0.00050	0.20

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
SW846 8081	LA01A	beta-BHC	4.7	U
SW846 8081	LA02B	beta-BHC	1.5	U
SW846 8081	LA02C	beta-BHC	1.6	U

Table 3 - List of Samples with Surrogates outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8082	LA01A	Decachlorobiphenyl	33	50 - 150	JG, JTG, or UJG

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits

Method	Sample ID	Analyte	Recovery	QC Limit	Sample Qualification
SW846 8081	EI02B MSD	beta-BHC	128	48 – 121	None
SW846 8081	EI02B MSD	Endosulfan I	124	52 – 122	None
SW846 8081	EI02B MSD	alpha-Chlordane	119	46 – 118	None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
- A = Analyte
- NC = Not Calculated
- ND = Not Detected
- PQL = Practical Quantitation Limit
- RPD = Relative Percent Difference
- T = Tentatively Identified Compound

Data Validation Qualifiers:

Code **Description**

B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10746-1	Solid	DO04B	580-10746-01	7/22/2008	MS/MSD	None
580-10746-1	Solid	DO04C	580-10746-02	7/22/2008		None
580-10746-1	Solid	DO04D	580-10746-03	7/22/2008		None
580-10746-1	Solid	DO05B	580-10746-04	7/22/2008		None
580-10746-1	Solid	DO05C	580-10746-05	7/22/2008		None
580-10746-1	Solid	EE02B	580-10746-04	7/21/2008		None
580-10746-1	Solid	EE02C	580-10746-05	7/21/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10746-1	Solid	EPA 160.3	160.3 Modified	7	Sediment
580-10746-1	Solid	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	7	Sediment
580-10746-1	Solid	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	7	Sediment
580-10746-1	Solid	NWTPH-Dx	Semi-Volatile Petroleum Products by NWTPH-Dx	2	Sediment
580-10746-1	Solid	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	2	Sediment
580-10746-1	Solid	SW846 8082	Polychlorinated Biphenyls (PCBs) by Gas Chromatography	2	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and

	analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes.
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Several compounds were quantitatively confirmed on the confirmation sample. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Any compounds present in method blank?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then “U” flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	Completed by: David Ikeda

NWTPH-Dx by GC/FID	
Description	**Notes and Qualifiers**
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria of 75-125%?	Yes.
LCS percent recovery values within QC criteria of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%.	Yes
Spot check CCV 90-110%.	Yes

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent difference values within laboratory QC criteria?	Yes
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns

Samples results below the PQL are reported at the PQL and flagged not detected (U) due to method blank contamination. Sample results that exceeded a relative percent difference of 40% were qualified as estimated bias unknown (JK or JTK).

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Units	MDL	PQL
SW846 8081	MB 580-34519	MBLK	beta-BHC	0.44	J	µg/Kg	0.13	1.0
SW846 8081	MB 580-34519	MBLK	Endrosulfan I	0.42	J	µg/Kg	0.12	1.0
SW846 6020	MB 580-34543	MBLK	Barium	0.0031	J	mg/Kg	0.00065	0.20
SW846 6020	MB 580-34543	MBLK	Copper	0.0053	J	mg/Kg	0.00011	0.20
SW846 6020	MB 580-34543	MBLK	Lead	0.0021	J	mg/Kg	0.0012	0.20
SW846 6020	MB 580-34543	MBLK	Silver	0.0027	J	mg/Kg	0.00050	0.20

Table 2A - List of Samples Qualified for Method Blank Contamination

Method	Sample ID	Analyte	Result	Qual
SW846 8081	EE02C	beta-BHC	1.2	U

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.

G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10751-1	Solid	RL03-012	580-10746-01	7/25/2008		None
580-10751-1	Solid	RL03-022	580-10746-02	7/25/2008		None
580-10751-1	Solid	RL03-032	580-10746-03	7/25/2008		None
580-10751-1	Solid	RL03-042	580-10746-04	7/25/2008		None
580-10751-1	Solid	RL03-052	580-10746-05	7/25/2008		None
580-10751-1	Solid	MA06-002	580-10746-01	7/25/2008	DUP	None
580-10751-1	Solid	MA06-012	580-10746-01	7/25/2008	DUP	None
580-10751-1	Solid	MA06-022	580-10746-02	7/25/2008		None
580-10751-1	Solid	MA06-032	580-10746-03	7/25/2008		None
580-10751-1	Solid	MA06-042	580-10746-04	7/25/2008		None
580-10751-1	Solid	MA06-052	580-10746-05	7/25/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10751-1	Solid	EPA 901	Gamma Spectroscopy for Cesium-137	3	Sediment
580-10751-1	Solid	EPA 901	Gamma Spectrometry for Lead-210	10	Sediment

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab between 2 and 6°C and in good condition as indicated on COC and Cooler Receipt Form?	Not required by method.
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)

- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Gamma Spectroscopy for Cesium and Lead	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	No.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	NA
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	NA
MS/MSD percent recovery values within laboratory QC criteria?	NA
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	NA
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
None.

Table 2 - List of Positive Results for Blank Samples
None

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
Not Applicable

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
Not Applicable

Table 5 - List LCS Percent Recovery Values outside Control Limits
None

Table 6 –Samples that were Reanalyzed
None

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10808-1	Tissue	MD08TG	580-10808-1	7/12/2008	MS/MSD	None
580-10808-1	Tissue	MD08TH	580-10808-2	7/12/2008		None
580-10808-1	Tissue	MD09TH	580-10808-3	7/12/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10808-1	Tissue	Bligh-Dyer	Percent Lipids	3	Tissue
580-10808-1	Tissue	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	3	Tissue
580-10808-1	Tissue	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	3	Tissue
580-10808-1	Tissue	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	3	Tissue

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab less than 0^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
- Surrogates Outside Limits (Table 3)
- MS/MSD Outside Limits (Table 4)
- LCS Outside Limits (Table 5)
- Re-analysis Results (Table 6)

Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, refer to Table 2.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
Surrogate recovery values for method blanks and LCS/LCSD samples within laboratory QC limits?	Yes.
Surrogate recovery values for samples and MS/MSD within laboratory QC limits?	Yes
MS/MSD percent recovery values within laboratory QC criteria?	Yes
MS/MSD relative percent difference values within QC criteria (see Table 4) of <35%?	Yes
LCS percent recovery values within laboratory QC criteria (see Table 5)? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes.
Is initial calibration for target compounds <20 % RSD or curve fit?	Yes
Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Yes.

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
Laboratory QC frequency of one blank and LCS with each batch and one set of MS/MSD per 20 samples?	Yes
MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Were elements recovered ≤30%? If so, “REJ” flag associated NDs on Form 1’s.	No
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent	Yes

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 15, 2008	Completed by: David Ikeda

Metals by ICP and Mercury by CVAA	
Description	**Notes and Qualifiers**
difference values within laboratory QC criteria?	
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
Spot check Correlation Coefficient > 0.995.	All are acceptable.
Spot check ICV 90-110%. Contact lab.	All are acceptable.
Spot check CCV 90-110% or 80-120% for Hg. Contact lab.	All are acceptable.
Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
None
Minor Concerns
None.

Table 2 - List of Positive Results for Blank Samples

Method	Sample ID	Samp Type	Analyte	Result	Qual	Anal Type	Units	MDL	PQL
SW846 8081	MB 580-34938	MBLK	Methoxychlor	6.1	J	A	µg/Kg	1.3	10
SW846 6020	MB 580-35119	MBLK	Barium	0.0010	J	A	mg/Kg	0.00032	0.10
SW846 6020	MB 580-35119	MBLK	Copper	0.0060	J	A	mg/Kg	0.00055	0.10
SW846 6020	MB 580-35119	MBLK	Zinc	0.030	J	A	mg/Kg	0.0046	0.25

Table 2A - List of Samples Qualified for Method Blank Contamination
None

Table 3 - List of Samples with Surrogates outside Control Limits
None

Table 4 - List MS/MSD Percent Recovery Values and RPDs outside Control Limits
None

Table 5 - List LCS Percent Recovery Values outside Control Limits

Table 6 –Samples that were Reanalyzed
None

Key:
A = Analyte
NC = Not Calculated
ND = Not Detected
PQL = Practical Quantitation Limit
RPD = Relative Percent Difference
T = Tentatively Identified Compound

Data Validation Qualifiers:

Code	Description
B	Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
B1	Analyte detected in sample and method blank. Reported result is blank-corrected.
C	See Result Comment for qualifying statement.
E	Reported result is an estimate because it exceeds calibration range.
EST	Reported result is an estimate.
G	Value is likely greater than the reported result. Reported result may be biased low.
J	Analyte was positively identified. The reported result is an estimate.
JG	Analyte was positively identified. Value may be greater than the reported estimate.
JK	Analyte was positively identified. Reported result is an estimate with unknown bias.
JL	Analyte was positively identified. Value may be less than the reported estimate.
JT	Analyte was positively identified. Reported result is an estimate below the associated quantitation limit but above the MDL.
JTG	Analyte was positively identified. Value may be greater than the reported result, which is an estimate below the associated quantitation limit but above the MDL.
JTK	Analyte was positively identified. Reported result is an estimate with unknown bias, below the associated quantitation limit but above the MDL.
JTL	Analyte was positively identified. Value may be less than the reported result which is an estimate below associated quantitation limit but above MDL.
K	Reported result with unknown bias.
L	Value is likely less than the reported result. Reported result may be biased high.
N	There is evidence the analyte is present in the sample. Tentatively identified analyte.
NJ	There is evidence that the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate.
NJT	There is evidence the analyte is present in the sample. Reported result for the tentatively identified analyte is an estimate below the associated quantitation limit but above the MDL.
NU	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported result.
NUJ	There is evidence the analyte is present in the sample. Tentatively identified analyte was not detected at or above the reported estimate.
NAF	Not analyzed for.
NC	Not calculated.
QNS	Quantity not sufficient for analysis.
REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
T	Reported result below associated quantitation limit but above MDL
U	Analyte was not detected at or above the reported result.
UJ	Analyte was not detected at or above the reported estimate
UJG	Analyte was not detected at or above the reported estimate with likely low bias.
UJK	Analyte was not detected at or above the reported estimate with unknown bias.
UJL	Analyte was not detected at or above the reported estimate with likely high bias.

Quality Assurance Review Level 1 Report	Project: Ecology – Port Angeles
Date Completed: September 11, 2008	Completed by: David Ikeda

The analytical data provided by the laboratory were reviewed for precision, accuracy, and completeness per Washington Department of Ecology (Ecology) Quality Assurance Review Guidance for the quality assurance review level 1 review (QA1) of sediments (PTI, 1989). Specific criteria for QC limits were obtained from the project QAPP and Ecology Sediment Sampling and Analysis Plan Appendix. Compliance with the project QA program is indicated on the in the checklist and tables. Any major or minor concern affecting data usability is summarized below. The checklist and tables also indicate whether data qualification is required and/or the type of qualifier assigned.

Reference:

Table 1 Sample Summary Tables from Electronic Data Deliverable

Work Order	Matrix	Sample ID	Lab ID	Sample Date	Lab QC	ID Corrections
580-10809-1	Tissue	RF04TH	580-10809-1	7/12/2008		None
580-10809-1	Tissue	RF05TH	580-10809-2	7/12/2008		None
580-10809-1	Tissue	RF06TH	580-10809-3	7/12/2008		None

Work Orders, Tests and Number of Samples included in this DUSR

Work Orders	Matrix	Test Method	Method Name	Number of Samples	Sample Type
580-10809-1	Tissue	Bligh-Dyer	Percent Lipids	3	Tissue
580-10809-1	Tissue	SW846 6020	Inductively Coupled Plasma - Mass Spectrometry	3	Tissue
580-10809-1	Tissue	SW846 7471A	Mercury in Solid or Semisolid Waste (Manual Cold Vapor)	3	Tissue
580-10809-1	Tissue	SW846 8081A	Organochlorine Pesticides by Gas Chromatography	3	Tissue

General Sample Information	
Do Samples and Analyses on COC check against Lab Sample Tracking Form?	Yes
Did coolers arrive at lab less than 0^{o}C and in good condition as indicated on COC and Cooler Receipt Form?	Yes
Frequency of Field QC Samples Correct? Field Duplicate – Not required. Equipment Blank – Not required. MS/MSD samples – 1/20 samples, if requested.	Yes
Case narrative present and complete?	Yes
Any holding time violations?	No - All samples were prepared and analyzed within holding times.

The following tables are presented at the end of this QA1 Review Memorandum and provided summaries of results outside QC criteria.

- Method Blanks Results (Table 2)
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Pesticide and PCBs by GC/ECD	
Description	**Notes and Qualifiers**
Any compounds present in method and field blanks?	Yes, refer to Table 2.
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Is continuing calibration for target compounds < 20%?	Yes
Were any samples re-analyzed or diluted (see Table 6)? For any sample re-analysis and dilutions is only one reportable result by flagged?	No
Spot check retention time windows and second column confirmations as complete.	Yes.

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Description	**Notes and Qualifiers**
Any compounds present in method and field blanks as noted on Table 2?	Yes – Several analytes were detected in the Method Blank.
For samples, if results are <5 times the blank then "U" flag data.	Samples results below the PQL are reported at the PQL and flagged U. Sample results greater than PQL are not changed and flagged U.
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MS/MSD percent recovery values within QC criteria (see Table 4) of 75-125%? QC limits are not applicable to sample results greater than 4 times spike amount.	Yes
Were elements recovered <u><</u>30%? If so, "REJ" flag associated NDs on Form 1's.	No
Sample and duplicate relative percent difference values within QC criteria (see Table 4) of <20%? Apply criteria only when both results are >PQL.	Yes
LCS percent recovery values within QC criteria (see Table 5) of 80-120%? If the value is high with no positive values in the associated data; then no data qualification is required.	Yes
Is there one serial dilution per 20 samples? Are percent	Yes

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Description	**Notes and Qualifiers**
difference values within laboratory QC criteria?	
Spot check ICS recoveries 80-120%. Contact lab.	All are acceptable.
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Do field duplicate results show good precision for all compounds (see Table 7)?	Yes

Summary of Potential Impacts on Data Usability
Major Concerns
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Minor Concerns
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Table 2 - List of Positive Results for Blank Samples

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REJ	Data are unusable for all purposes. Sample results rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
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EcoChem, INC.
Environmental Data Quality

DATA VALIDATION REPORT

Port Angeles Harbor Sediment Characterization Study
Harbor Wide Areas of Concern (WD20)

Prepared for:

Ecology and Environment, Inc.
720 Third Avenue, Suite 1700
Seattle, Washington 98104

Prepared by:

EcoChem, Inc.
710 Second Avenue, Suite 660
Seattle, Washington 98104

EcoChem Project: C1103-1

April 15, 2009

Approved by:

Melissa Swanson
Project Manager
EcoChem, Inc.

PROJECT NARRATIVE

Basis for Data Validation

This report summarizes the results of QA-2 data review (full validation) performed on sediment and tissue sample data and the associated laboratory quality control data collected in support of the Port Angeles Sediment Characterization Study, Harbor-Wide Area WD-20. Refer to the **Sample Index** for a complete list of samples for which data were reviewed.

Dioxin/furan samples were analyzed by AXYS Analytical Services, Sidney, British Colombia and polynuclear aromatic hydrocarbon samples were analyzed by Analytical Resources, Inc. (ARI), Tukwila, Washington. The analytical methods and EcoChem project chemists are listed in the table below.

Test	Method	Primary Chemist	Secondary Chemist
Polynuclear Aromatic Hydrocarbons	EPA 8270D	Jennifer Newkirk	Eric Strout
		Lucy Panteleeff	
Dioxin/Furan Compounds	EPA 1613B	Melissa Swanson	

The data were reviewed using guidance and quality control criteria documented in the analytical methods; *Port Angeles Harbor Sediment Characterization Study Sampling and Analysis Plan* (E&E 2008); *Data Validation Guidance Manual for Selected Sediment Variables* (PTI 1989); *Puget Sound Dredged Disposal Analysis Guidance Manual: Data Quality Evaluation for Proposed Dredged Material Disposal Projects* (PTI 1989); and *National Functional Guidelines for Organic and/or Inorganic Data Review* (USEPA 1994, 1999 & 2002). The dioxin/furan data were also evaluated using *USEPA Region 10 SOP for Validation of Dioxins & Furans* (Region 10 1996) and *USEPA National Function Guidelines for Chlorinated Dibenzo-p Dioxins (CDD) and Chlorinated Dibenzofurans (CDF) Data Review* (USEPA 2005).

EcoChem's goal in assigning data assessment qualifiers is to assist in proper data interpretation. If values are estimated (J or UJ), data may be used for site evaluation and risk assessment purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet the data quality objectives as stated in the documents and methods referenced above.

Data qualifier definitions, reason codes, and validation criteria are included as **Appendix A. Appendix B** contains the Qualified Data Summary Table. Data Validation Worksheets will be kept on file at EcoChem, Inc. A qualified laboratory electronic data deliverable (EDD) is also submitted with this report.

SAMPLE INDEX

Harbor-Wide Area WD20

Shading indicates that the analysis was not requested for the sample.

1 PAH analysis was requested on the COC but results were not reported.

Field ID	Matrix	DIOXIN	Axys ID	Axys SDG	PAH	ARI ID	ARI SDG
BL01A	Sediment	X	L11352-1	20081010B	X	NW05B	NW05
BL02A	Sediment	X	L11304-1	20080618A	X	NC54B	NC54
BL02B	Sediment	X	L11304-2	20080618A	X	NB71A	NB71
BL02C	Sediment	X	L11304-3	20080618A	X	NB71B	NB71
BL03A	Sediment	X	L11303-1	20081010A	X	NV14S	NV14
BL04A	Sediment	X	L11303-2	20081010A	X	NV14T	NV14
BL06A	Sediment	X	L11303-4	20081010A	X	NV13N	NV13
BL08A	Sediment	X	L11303-6	20081010A	X	NV13H	NV13
BL08B	Sediment	X	L11304-4	20080618A	X	NB97B	NB97
BL08C	Sediment	X	L11304-5	20080618A	X	NB97C	NB97
EI01A	Sediment				X	NC41H	NC41
EI02A	Sediment	X	L11346-14	20080626A	X	NC41I	NC41
EI02B	Sediment				X	NG55A	NG55
EI03A	Sediment				X	NC41J	NC41
EI04A	Sediment	X	L11334-19	20080624B	X	NC41K	NC41
EI06A	Sediment				X	NC41L	NC41
EI07A	Sediment	X	L11334-20	20080624B	X	NC41M	NC41
EI08TH	Tissue	X	L11299-1	20080617A	X	ND44F	ND44
FT01A	Sediment	X	L11346-28	20080626B	X	NC41N	NC41
FT02A	Sediment				X	NC41O	NC41
FT04A	Sediment	X	L11346-27	20080626B	X	NC41P	NC41
FT05A	Sediment				X	NV13O	NV13
FT06A	Sediment	X	L11303-10	20081010A	X	NV13P	NV13
FT06B	Sediment				X	NB71F	NB71
FT06C	Sediment				X	NB71G	NB71
FT10A	Sediment	X	L11303-11	20081010A	X	NV13R	NV13
FT11A	Sediment				X	NV13S	NV13
FT12A	Sediment	X	L11304-20	20080618B			
FT12B	Sediment				X	NG55B	NG55
FT12C	Sediment				X	NG55C	NG55
FT13A	Sediment	X	L11304-6	20080618A	X	NC14M	NC14
IE01B	Sediment	X	L11334-21	20080624B	X	NC39B	NC39
IE01C	Sediment				X	NC39C	NC39
IE03A	Sediment	X	L11303-12	20081010A	X	NV13B	NV13
IE04A	Sediment	X	L11303-13	20081010A	X	NV13C	NV13
IE05A	Sediment	X	L11303-14	20081010A	X	NV13D	NV13
IE05B	Sediment	X	L11304-7	20080618A	X	NC39D	NC39
IE05C	Sediment				X	NC39E	NC39
IE06A	Sediment	X	L11303-16	20081010A	X	NV13E	NV13
IE07A	Sediment	X	L11352-3	20081010B	X	NV14A	NV14
IE09A	Sediment	X	L11352-4	20081010B	X	NV14C	NV14
IE09B	Sediment	X	L11304-8	20080618A	X	NC39I	NC39

SAMPLE INDEX

Harbor-Wide Area WD20

Shading indicates that the analysis was not requested for the sample.

1 PAH analysis was requested on the COC but results were not reported.

Field ID	Matrix	DIOXIN	Axys ID	Axys SDG	PAH	ARI ID	ARI SDG
IE12A	Sediment	X	L11303-20	20081010A			
IE12B	Sediment	X	L11346-15	20080626B	X	NC39L	NC39
IE12C	Sediment				X	NC39M	NC39
IE13A	Sediment				X	NV13J	NV13
IE14A	Sediment	X	L11303-22	20081010A	X	NV13G	NV13
IE14B	Sediment	X	L11346-16	20080626B	X	NC39O	NC39
IE14C	Sediment				X	NC39P	NC39
IE15A	Sediment	X	L11303-23	20081010A	X	NV13K	NV13
IE16A	Sediment				X	NV13L	NV13
IE16B	Sediment	X	L11304-9	20080618A	X	NC14N	NC14
IE16C	Sediment				X	NC14O	NC14
IE18TH	Tissue	X	L11299-6	20080624C	X	NE18B	NE18
IE20TH	Tissue	X	L11299-2	20080624C	X	NE18C	NE18
IE21TL	Tissue	X	L11297-2	20080617A	X	ND44B	ND44
IE22TL	Tissue	X	L11297-3	20080617A	X	ND44C	ND44
IE23TL	Tissue	X	L11297-4	20080617A	X	ND44D	ND44
IE24TL	Tissue	X	L11297-1	20080617A	X	ND44A	ND44
IE25TM	Tissue	X	L11298-2	20080624C	X	NE18D	NE18
IE26TM	Tissue	X	L11298-1	20080617A	X	ND44E	ND44
IH01A	Sediment	X	L11352-5	20081010B	X	NV14F	NV14
IH02A	Sediment	X	L11352-6	20081010B	X	NV14G	NV14
IH02B	Sediment	X	L11304-10	20080618A	X	NC14P	NC14
IH02C	Sediment	X	L11304-11	20080618A	X	NC14Q	NC14
IH03A	Sediment	X	L11352-7	20081010B	X	NV14H	NV14
IH04A	Sediment	X	L11352-8	20081010B	X	NV14I	NV14
IH05A	Sediment	X	L11303-26	20081010A	X	NV14J	NV14
IH06A	Sediment	X	L11303-27	20081010A	X	NV14K	NV14
IH06B	Sediment	X	L11304-12	20080618A	X	NB71M	NB71
IH06C	Sediment	X	L11304-13	20080618B	X	NB97G	NB97
KP01A	Sediment	X	L11334-22	20080624B	X	NV14L	NV14
KP02A	Sediment	X	L11352-9	20081010B	X	NV14M	NV14
KP02B	Sediment	X	L11304-14	20080618B	X	NB97H	NB97
KP02C	Sediment				X	NB71N	NB71
KP03A	Sediment	X	L11334-23	20080624B	X	NC48J	NC48
KP03B	Sediment	X	L11304-15	20080618B	X	NB97J	NB97
KP03C	Sediment				X	NB97K	NB97
KP04A	Sediment	X	L11334-24	20080624B	X	NC48K	NC48
KP05A	Sediment	X	L11303-30	20081010A	X	NV13T	NV13
KP07A	Sediment	X	L11304-16	20080618B	X	NC14V	NC14
KP07B	Sediment	X	L11334-25	20080624B	X	NC50A	NC50
KP07C	Sediment				X	NC50B	NC50
KP08A	Sediment				X	NV13U	NV13

SAMPLE INDEX
Harbor-Wide Area WD20

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Field ID	Matrix	DIOXIN	Axys ID	Axys SDG	PAH	ARI ID	ARI SDG
KP08B	Sediment	X	L11304-17	20080618B	1		
LA01A	Sediment	X	L11487-6	20080725A	X	NH43A	NH43
LA02A	Sediment	X	L11488-1	20081010B	X	NH42B	NH42
LA02B	Sediment	X	L11487-7	20080725A	X	NH43B	NH43
LA02C	Sediment	X	L11487-8	20080725A	X	NH43C	NH43
LA03A	Sediment	X	L11488-2	20081010B	X	NH43D	NH43
MA01A	Sediment	X	L11349-2	20081010B	X	NV14O	NV14
MA02A	Sediment	X	L11303-34	20081010B	X	NV14P	NV14
MA02B	Sediment	X	L11304-18	20080618B	X	NC14Y	NC14
MA02C	Sediment	X	L11304-19	20080618B	X	NB97O	NB97
MA03A	Sediment	X	L11303-35	20081010B	X	NV14Q	NV14
MA04A	Sediment	X	L11303-36	20081010B	X	NV13V	NV13
MA05A	Sediment	X	L11303-37	20081010B	X	NV14R	NV14
OH01A-R	Sediment	X	L11334-31	20080624B	X	NC44D	NC44
OH02A	Sediment	X	L11304-21	20080618B	X	NB97Q	NB97
OH03A	Sediment	X	L11304-22	20080618B	X	NB97R	NB97
RF01A	Sediment	X	L11304-23	20080618B	X	NB97S	NB97
RF02A	Sediment	X	L11304-24	20080618B	X	NB71P	NB71
RF03A	Sediment	X	L11304-25	20080618B	X	NB71Q	NB71
RF04TH	Tissue	X	L11432-1	20080716A	X	NI28D	NI28
RF05TH	Tissue	X	L11432-2	20080716A	X	NI28E	NI28
RF06TG	Tissue	X	L11432-3	20080716A	X	NI28F	NI28
RL01A	Sediment	X	L11349-5	20081010B	X	NV14E	NV14
WW01A	Sediment	X	L11334-32	20080624B			

DATA VALIDATION REPORT
Harbor-Wide Investigation Area WD-20
Polynuclear Aromatic Hydrocarbons by Method SW8270D
Matrix: Sediment

This report documents the review of analytical data from the analysis of sediment samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc. (ARI), Tukwila, Washington. Refer to the **Sample Index** for a list of samples reviewed.

SDG	Number of Samples	Validation Level
NA16	4	Full
NB71	8	Full
NB97	10	Full
NC14	7	Full
NC39	9	Full
NC41	9	Full
NC44	1	Full
NC48	2	Full
NC50	2	Full
NC54	1	Full
NG55	3	Full
NH42	1	Full
NH43	4	Full
NV13	17	Full
NV14	17	Full
NW05	1	Full

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

No PAH data were reported for Sample KP08B. No action was taken other than to note this discrepancy.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1	Holding Times and Sample Preservation		Laboratory Control Samples (LCS)
	GC/MS Tuning		Field Duplicates
	Initial Calibration (ICAL)	2	Internal Standards
	Continuing Calibration (CCAL)	1	Compound Identification and Reported Results
	Laboratory Blanks		Reference Material
	Field Blanks		Reporting Limits
1	Surrogate Compounds	1	Calculation Verification (full validation only)
2	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)		

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received many of the sample coolers with temperatures outside the advisory control limits. These temperature outliers did not impact data quality and no qualifiers were required.

SDG NG55: The laboratory incorrectly labeled Sample EI02B as E102B in the LIMS system, substituting a "1" for the "I". The EDD was corrected to reflect the correct sample name. No further action was taken.

SDG NH43C: The laboratory incorrectly labeled Sample LA02C as LA02X in the LIMS system. The EDD was corrected to reflect the correct sample name.

Surrogate Compounds

SDG NB71: The percent recovery (%R) value for the surrogate d14-p-terphenyl was greater than the upper control limit in Sample IH06B. No qualifiers were required because at least two other base-neutral surrogate %R values were within control limits.

SDG NC14: The %R value for surrogate d14-p-terphenyl was greater than the upper control limit in Sample IH02B. No qualifiers were required because at least two other base-neutral surrogate %R values were within control limits.

SDG NC39: All surrogates were not recovered in the 100x dilution of Sample IE09B. No compounds were reported from this analysis, no qualification was necessary.

SDG NV14: The %R value for surrogate d14-p-terphenyl was less than the lower control limit in Sample MA02A. No qualifiers were required because at least two other base-neutral surrogate %R values were within control limits.

Matrix Spike/Matrix Spike Duplicate

SDG NA16: Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed using Sample KP08C. The MS %R values for all compounds were less than the lower control limit. No action was required as the MSD %R values were acceptable. The relative percent difference (RPD) values for all compounds exceeded the control limit. There were no positive results in the parent sample; no action was taken.

SDG NB97: MS/MSD analyses were performed using Sample KP03C. MSD %R values for eight compounds were greater than the upper control limit. No action was required as the MS %R value was within the control limits. The RPD values for nine compounds exceeded the control limit. These analytes were estimated (J-9) in the parent sample.

SDG NC39: MS/MSD analyses were performed using Sample IE12C. The MS/MSD %R values for indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene were less than the lower control limits. These analytes were estimated (UJ-8) in the parent sample.

SDGs NC50 & NC54: MS/MSD analyses were performed using a Batch QC sample. The MS/MSD %R values for benzo(g,h,i)perylene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were less than the lower control limit. No qualification is necessary on Batch QC.

SDG MW05: MS/MSD analyses were not performed. Accuracy was assessed using the surrogate and laboratory control sample (LCS) recovery values. Precision could not be assessed.

Internal Standards

SDG NB71: The area for internal standard chrysene-d12 was greater than the 200% upper control limit in Sample BL02B. Positive results associated with the internal standard outlier were qualified as estimated (J-19).

SDG NC14: The area for internal standard chrysene-d12 was greater than the 200% upper control limit in Sample MA02B. Positive results associated with the internal standard outlier were qualified as estimated (J-19). The areas for internal standards perylene-d12 and di-n-octylphthalate-d4 were less than the 50% lower control limit in Sample IH02B. Results associated with the internal standard outliers were estimated (J/UJ-19).

SDG NC39: The area for internal standards perylene-d12 and di-n-octylphthalate were less than the 50% lower control limit in Sample IE09B. Results associated with the internal standard outliers were estimated (J/UJ-19).

SDG NV14: The area for internal standard chrysene-d12 was greater than the 200% upper control limit in Sample IH03A. Positive results associated with the internal standard outlier were qualified as estimated (J-19).

Compound Identification and Reported Results

SDG NB71: The laboratory flagged benzo(a)anthracene and chrysene results with an "M" in Sample IH06B indicating a poor spectral ion match. The identification was reviewed and is acceptable. No qualification was necessary.

SDG NC39: The laboratory flagged anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, and benzo(k)fluoranthene results with an "M" in Sample IE09B, indicating a poor spectral ion match. The identification was reviewed and is acceptable. No qualification was necessary.

Calculation Verification

Several results were verified by recalculation from the raw data. No calculation or transcription errors were found.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, LCS, and MS/MSD %R values, with the exceptions noted above. Precision was also acceptable as demonstrated by the RPD values for the MS/MSD analyses, with the exceptions noted above.

Data were estimated based on MS/MSD accuracy and precision outliers, and internal standard area outliers.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Harbor-Wide Investigation Area WD-20
Polynuclear Aromatic Hydrocarbons by Method 8270D
Matrix: Tissue

This report documents the review of analytical data from the analysis of tissue samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc. (ARI), Tukwila, Washington. Refer to the **Sample Index** for a list of samples.

SDG	Number of Samples	Validation Level
ND44	6	Full
NE18	3	Full
NI28	3	Full

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1	Holding Times and Sample Preservation	1	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
	GC/MS Tuning		Laboratory Control Samples (LCS)
	Initial Calibration (ICAL)		Field Duplicates
2	Continuing Calibration (CCAL)		Internal Standards
	Laboratory Blanks		Compound Identification and Reported Results
	Field Blanks	1	Reporting Limits
	Surrogate Compounds	1	Calculation Verification (full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received many of the sample coolers with temperatures outside the advisory control limits. These temperature outliers did not impact data quality and no qualifiers were required.

SDG ND44: The laboratory received an inter-laboratory chain of custody form (samples transferred from Axys Analytical Services to ARI) rather than a field chain of custody form. The inter-laboratory chain of custody only listed the Axys laboratory ID. When assigning the field ID to the samples, ARI made several transposition errors (for example, IE24TL became EI24TL). All errors were corrected by the validator in the validation worksheets and in the electronic data deliverable. No further action was taken.

Continuing Calibration

All values for the relative response factor (RRF) were greater than the 0.05 minimum control limit. The values for percent difference (%D) were within the ±25% control limits, with the exceptions noted below. Results and reporting limits from samples associated with outliers indicative of a low bias were estimated (J/UJ-5B) and positive results in samples associated with outliers indicative of a high bias were estimated (J-5B).

SDG NE18 and ND44:

CCAL Date	Instrument ID	Analyte	Bias
8/9/08	NT4	Indeno(1,2,3-cd)pyrene	Low

Matrix Spike/Matrix Spike Duplicate

SDG ND44: Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed using a Batch QC sample. Several MS/MSD percent recovery (%R) values and relative percent difference (RPD) values were outside control limits. No qualification is necessary on Batch QC.

Reporting Limits

All reporting limits were significantly greater than the 20 µg/kg target reporting limit specified in the sampling and analysis plan. The reporting limits ranged from 460 µg/kg to 2000 µg/kg. The elevated reporting limits were due to the need to extract a small sample size and analyze at a dilution to lower matrix interference from the lipid content. No action was taken.

Calculation Verification

Several results were verified by recalculation from the raw data. No calculation or transcription errors were found.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, laboratory control sample, and MS/MSD %R values, with the exceptions noted above. Precision was also acceptable as demonstrated by the RPD values for the MS/MSD analyses, with the exceptions noted above.

Data were estimated due to CCAL %D outliers.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Harbor-Wide Investigation Area WD-20
Dioxin/Furan Compounds by Axys Method MLA-017
Matrix: Sediment

This report documents the review of analytical data from the analyses of sediment samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Axys Analytical Services Ltd., Sidney, British Columbia, Canada. See the **Sample Index** for a complete list of samples for which data were reviewed.

SDG	Number of Samples	Validation Level
20080618A	12	Full
20080618B	13	Full
20080624B	9	Full
20080626A	1	Full
20080626B	4	Full
20080725A	3	Full
20081010A	16	Full
20081010B	16	Full

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are summarized in the following table:

1	Holding Times and Sample Receipt	1	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
	Initial Calibration (ICAL)	2	Ongoing Precision and Recovery (OPR)
	Continuing Calibration (CCAL)	2	Laboratory Duplicates
2	Laboratory Blanks	2	Compound Identification
	Field Blanks		Reporting Limits
	Labeled Compounds	1	Calculation Verification (full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received some sample coolers with temperatures less than the lower control limit. These temperature outliers did not impact data quality and no qualifiers were required.

SDG 20080618A: One cooler was received at 8°C and two coolers at 7°C. Dioxin congeners are persistent compounds, this temperature variation had no impact on data quality; no qualifiers were applied.

SDG 20080618B: One cooler was received at 7°C. Dioxin congeners are persistent compounds, this temperature variation had no impact on data quality; no qualifiers were applied.

The chain of custody listed Sample OH02A with the laboratory ID of L11304-20 handwritten alongside. In the solids preparation record, this sample ID was changed to FT12A with the note "as per AW instructions". Results for laboratory ID L11304-20 were presented with the Sample ID FT12A.

SDG 20080725A: The laboratory incorrectly labeled Sample LA02C as LA02X in the LIMS system. The EDD was corrected to reflect the correct sample name.

SDG 20081010B: One cooler was received at 8°C and two coolers at 7°C. Dioxin congeners are persistent compounds, this temperature variation had no impact on data quality; no qualifiers were applied.

Laboratory Blank

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times the concentration detected in the blank. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U-7). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Laboratory (method) blanks were analyzed at the appropriate frequency. Various target analytes were detected in the method blanks. A summary of contaminant levels, associated samples, and action levels is provided in the data validation worksheets. Results less than the action levels were qualified as not detected (U-7) in the associated samples. Only the following were qualified:

SDG 20080618B: OCDF (2 results), 1,2,3,4,6,7,8-HpCDF (2 results)

SDG 20080624B: 1,2,3,4,7,8-HxCDF (1 result)

Matrix Spike/Matrix Spike Duplicate

No matrix spike/matrix spike duplicate (MS/MSD) analyses were performed. Accuracy and precision were assessed using labeled compound recoveries, ongoing precision and recovery (OPR) samples, and laboratory duplicate samples.

Ongoing Precision and Recovery Sample

SDG 20080618A: The percent recovery (%R) value for 1,2,3,4,7,8,9,-HpCDF was greater than the upper control limits in the OPR sample for Batch WG25979-102. The result for this congener was estimated (J-10) in Sample IE16B.

Laboratory Duplicates

Duplicate sample pairs are listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL.

SDG 20080626A, 20081010B: No laboratory duplicate analyses were submitted with these packages. There was no measure of precision with these packages.

SDG 20081010A: Duplicate analyses were performed on Sample IH05A. The RPD value for 2,3,4,7,8-PeCDF exceeded the acceptance criteria. The result for this analyte was estimated (J-9) in the parent sample.

Compound Identification

All results for 2,3,7,8-TCDF were confirmed on a DB-225 column as required by the method. The results from both columns were reported in the raw data and in the EDD. The 2,3,7,8-TCDF results on the DB-5 column were qualified as do-not-report (DNR-11). The results from the DB-225 column should be used.

For several samples, the laboratory reported EMPC or "estimated maximum possible concentrations" values for one or more of the target analytes. As required by the method, an EMPC value is reported when a peak was detected but did not meet quantitation criteria, therefore the result cannot be considered as positive identification for the analyte. To indicate that the reported result is essentially an elevated detection limit, the EMPC values were qualified as not detected (U-22) at the reported values.

The following were flagged as EMPC values by the laboratory and qualified U-22:

SDG 20080618A: 11 results

SDG 20080618B: 7 results

SDG 20080624B: 6 results

SDG 20080626A: 5 results

SDG 20080626B: 1 result

SDG 20080725A: 3 results

SDG 20081010A: 1 result

SDG 20081010B: 11 results

Calculation Verification

Calculation verifications were performed on all SDG. No calculation errors were found.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the labeled compound, and OPR %R values. Precision was acceptable as demonstrated by the RPD values for the laboratory duplicate, with the above exceptions.

Data were qualified as not detected to indicate that EMPC values represent elevated detection limits. Data were also qualified as not detected because of method blank contamination. Data were estimated because of laboratory duplicate precision outliers.

Data were labeled DNR in order to indicate the most appropriate value when multiple values are reported. Data that have been labeled DNR should not be used for any purpose. Since a usable result remains for all compounds in each sample, completeness is not affected.

All other data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Harbor-Wide Investigation Area WD-20
Dioxin/Furan Compounds by Axys Method MLA-017
Matrix: Tissue

This report documents the review of analytical data from the analyses of tissue samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Axys Analytical Services Ltd., Sidney, British Columbia, Canada. See the **Sample Index** for a complete list of samples for which data were reviewed.

SDG	Number of Samples	Validation Level
20080617A	6	Full
20080624C	3	Full
20080716A	3	Full

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are summarized in the following table:

1	Holding Times and Sample Receipt	1	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
	Initial Calibration (ICAL)		Ongoing Precision and Recovery (OPR)
	Continuing Calibration (CCAL)	1	Laboratory Duplicates
2	Laboratory Blanks	2	Compound Identification
	Field Blanks		Reporting Limits
	Labeled Compounds	1	Calculation Verification (full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received some sample coolers with temperatures less than the lower control limit. These temperature outliers did not impact data quality and no qualifiers were required.

SDG 20080716A: No client chain-of-custody arrived with these samples. The laboratory contacted the client who then emailed an unsigned electronic copy. No further action was taken.

Laboratory Blank

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times the concentration detected in the blank. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U-7). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Laboratory (method) blanks were analyzed at the appropriate frequency. Various target analytes were detected in the method blanks. A summary of contaminant levels, associated samples, and action levels is provided in the data validation worksheets. Results less than the action levels were qualified as not detected (U-7) in the associated samples. Only the following were qualified:

SDG 20080617A: OCDD (3 results), 1,2,3,4,6,7,8-HpCDD (2 results)

SDG 20080716A: OCDD (3 results), OCDF (3 results)

Matrix Spike/Matrix Spike Duplicate

No matrix spike/matrix spike duplicate (MS/MSD) analyses were performed. Accuracy and precision were assessed using labeled compound recoveries, ongoing precision and recovery (OPR) samples, and laboratory duplicate samples.

Laboratory Duplicates

Duplicate sample pairs are listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL.

SDG 20080624C: No laboratory duplicate analyses were submitted with this package. There was no measure of precision with this package.

Compound Identification

All results for 2,3,7,8-TCDF were confirmed on a DB-225 column as required by the method. The results from both columns were reported in the raw data and in the EDD. The 2,3,7,8-TCDF results on the DB-5 column were qualified as do-not-report (DNR-11). The results from the DB-225 column should be used.

For several samples, the laboratory reported EMPC or "estimated maximum possible concentrations" values for one or more of the target analytes. As required by the method, an EMPC value is reported when a peak was detected but did not meet quantitation criteria, therefore the result cannot be considered as positive identification for the analyte. To indicate that the reported result is essentially an elevated detection limit, the EMPC values were qualified as not detected (U-22) at the reported values.

The following were flagged as EMPC values by the laboratory and qualified U-22:

SDG 20080617A: 14 results

SDG 20080624C: 4 results

SDG 20080716A: 6 results

Calculation Verification

Calculation verifications were performed on all SDG. No calculation errors were found.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the labeled compound, and OPR %R values. Precision was acceptable as demonstrated by the RPD values for the laboratory duplicate, with the above exceptions.

Data were qualified as not detected to indicate that EMPC values represent elevated detection limits. Data were also qualified as not detected because of method blank contamination.

Data were labeled DNR in order to indicate the most appropriate value when multiple values are reported. Data that have been labeled DNR should not be used for any purpose. Since a usable result remains for all compounds in each sample, completeness is not affected.

All other data, as qualified, are acceptable for use.

EcoChem, INC.
Environmental Data Quality

APPENDIX A

DATA QUALIFIER DEFINITIONS
REASON CODES
AND CRITERIA TABLES

DATA VALIDATION QUALIFIER CODES
National Functional Guidelines

The following definitions provide brief explanations of the qualifiers assigned to results in the data review process.

U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents the approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

The following is an EcoChem qualifier that may also be assigned during the data review process:

DNR	Do not report; a more appropriate result is reported from another analysis or dilution.

DATA QUALIFIER REASON CODES

1	Holding Time/Sample Preservation
2	Chromatographic pattern in sample does not match pattern of calibration standard.
3	Compound Confirmation
4	Tentatively Identified Compound (TIC) (associated with NJ only)
5A	Calibration (initial)
5B	Calibration (continuing)
6	Field Blank Contamination
7	Lab Blank Contamination (e.g., method blank, instrument, etc.)
8	Matrix Spike(MS & MSD) Recoveries
9	Precision (all replicates)
10	Laboratory Control Sample Recoveries
11	A more appropriate result is reported (associated with "R" and "DNR" only)
12	Reference Material
13	Surrogate Spike Recoveries (a.k.a., labeled compounds & recovery standards)
14	Other (define in validation report)
15	GFAA Post Digestion Spike Recoveries
16	ICP Serial Dilution % Difference
17	ICP Interference Check Standard Recovery
18	Trip Blank Contamination
19	Internal Standard Performance (e.g., area, retention time, recovery)
20	Linear Range Exceeded
21	Potential False Positives
22	Elevated Detection Limit Due to Interference (i.e., laboratory, chemical and/or matrix)

EcoChem Validation Guidelines for Semivolatile Analysis by GC/MS
(Based on Organic NFG 1999)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Cooler Temperature	4°C ±2°	J(+)/UJ(-) if greater than 6 deg. C (EcoChem PJ)	1
Holding Time	Water: 7 days from collection Soil: 14 days from collection Analysis: 40 days from extraction	Water: J(+)/UJ(-) if ext. > 7 and < 21 days J(+)/R(-) if ext > 21 days (EcoChem PJ) Solids/Wastes: J(+)/UJ(-) if ext. > 14 and < 42 days J(+)/R(-) if ext. > 42 days (EcoChem PJ) J(+)/UJ(-) if analysis >40 days	1
Tuning	DFTPP Beginning of each 12 hour period Method acceptance criteria	R(+/-) all analytes in all samples associated with the tune	5A
Initial Calibration (Minimum 5 stds.)	RRF > 0.05	(EcoChem PJ, see TM-06) If MDL= reporting limit: J(+)/R(-) if RRF < 0.05 If reporting limit > MDL: note in worksheet if RRF <0.05	5A
	%RSD < 30%	(EcoChem PJ, see TM-06) J(+) if %RSD > 30%	5A
Continuing Calibration (Prior to each 12 hr. shift)	RRF > 0.05	(EcoChem PJ, see TM-06) If MDL= reporting limit: J(+)/R(-) if RRF < 0.05 If reporting limit > MDL: note in worksheet if RRF <0.05	5B
	%D <25%	(EcoChem PJ, see TM-06) If > +/-90%: J+/R- If -90% to -26%: J+ (high bias) If 26% to 90%: J+/UJ- (low bias)	5B
Method Blank	One per matrix per batch No results > CRQL	U(+) if sample (+) result is less than CRQL and less than appropriate 5X or 10X rule (raise sample value to CRQL)	7
		U(+) if sample (+) result is greater than or equal to CRQL and less than appropriate 5X and 10X rule (at reported sample value)	7
	No TICs present	R(+) TICs using 10X rule	7
Field Blanks (Not Required)	No results > CRQL	Apply 5X/10X rule; U(+) < action level	6

EcoChem Validation Guidelines for Semivolatile Analysis by GC/MS (Based on Organic NFG 1999)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
MS/MSD (recovery)	One per matrix per batch Use method acceptance criteria	Qualify parent only unless other QC indicates systematic problems: J(+) if both %R > UCL J(+)/UJ(-) if both %R < LCL J(+)/R(-) if both %R < 10% PJ if only one %R outlier	8
MS/MSD (RPD)	One per matrix per batch Use method acceptance criteria	J(+) in parent sample if RPD > CL	9
LCS low conc. H2O SVOA	One per lab batch Within method control limits	J(+) assoc. cmpd if > UCL J(+)/R(-) assoc. cmpd if < LCL J(+)/R(-) all cmpds if half are < LCL	10
LCS regular SVOA (H2O & solid)	One per lab batch Lab or method control limits	J(+) if %R > UCL J(+)/UJ(-) if %R <LCL J(+)/R(-) if %R < 10% (EcoChem PJ)	10
LCS/LCSD *(if required)*	One set per matrix and batch of 20 samples RPD < 35%	J(+)/UJ(-) assoc. cmpd. in all samples	9
Surrogates	Minimum of 3 acid and 3 base/neutral compounds Use method acceptance criteria	Do not qualify if only 1 acid and/or 1 B/N surrogate is out unless <10% J(+) if %R > UCL J(+)/UJ(-) if %R < LCL J(+)/R(-) if %R < 10%	13
Internal Standards	Added to all samples Acceptable Range: IS area 50% to 200% of CCAL area RT within 30 seconds of CC RT	J(+) if > 200% J(+)/UJ(-) if < 50% J(+)/R(-) if < 25% RT>30 seconds, narrate and Notify PM	19
Field Duplicates	Use QAPP limits. If no QAPP: Solids: RPD <50% OR absolute diff. < 2X RL (for results < 5X RL) Aqueous: RPD <35% OR absolute diff. < 1X RL (for results < 5X RL)	Narrate and qualify if required by project (EcoChem PJ)	9
TICs	Major ions (>10%) in reference must be present in sample; intensities agree within 20%; check identification	NJ the TIC unless: R(+) common laboratory contaminants See Technical Director for ID issues	4
Quantitation/ Identification	RRT within 0.06 of standard RRT Ion relative intensity within 20% of standard All ions in std. at > 10% intensity must be present in sample	See Technical Director if outliers	14 21 (false +)

EcoChem Validation Guidelines for Dioxin/Furan Analysis by HRMS
(Based on EPA Reg. 10 SOP, Rev. 2, 1996 & EPA SW-846, Methods 1613b and 8290)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Cooler/Storage Temperature	Waters/Solids < 4°C Tissues <-10°C	EcoChem PJ, see TM-05	1
Holding Time	Extraction - Water: 30 days from collection *Note:* Under CWA, SDWA, and RCRA the HT for H2O is 7 days* Extraction - Soil: 30 days from collection Analysis: 40 days from extraction	J(+)/UJ(-) if ext > 30 days J(+)/UJ(-) if analysis > 40 Days EcoChem PJ, see TM-05	1
Mass Resolution	>=10,000 resolving power at m/z 304.9824 Exact mass of m/z 380.9760 w/in 5 ppm of theoretical value (380.97410 to 380.97790) . Analyzed prior to ICAL and at the start and end of each 12 hr. shift	R(+/-) if not met	14
Window Defining Mix and Column Performance Mix	Window defining mixture/Isomer specificity std run before ICAL and CCAL Valley < 25% (valley = (x/y)*100%) x = ht. of TCDD y = baseline to bottom of valley For all isomers eluting near 2378-TCDD/TCDF isomers (TCDD only for 8290)	J(+) if valley > 25%	5A (ICAL) 5B (CCAL
Initial Calibration	Minimum of five standards %RSD < 20% for native compounds %RSD <30% for labeled compounds (%RSD <35% for labeled compounds under 1613b)	J(+) natives if %RSD > 20%	5A
	Abs. RT of $^{13}C_{12}$-1234-TCDD >25 min on DB5 >15 min on DB-225	EcoChem PJ, see TM-05	
	Ion Abundance ratios within QC limits (Table 8 of method 8290) (Table 9 of method 1613B)	EcoChem PJ, see TM-05	
	S/N ratio > 10 for all native and labeled compounds in CS1 std.	If <10, elevate Det. Limit or R(-)	

EcoChem Validation Guidelines for Dioxin/Furan Analysis by HRMS
(Based on EPA Reg. 10 SOP, Rev. 2, 1996 & EPA SW-846, Methods 1613b and 8290)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Continuing Calibration	Analyzed at the start and end of each 12 hour shift. %D+/-20% for native compounds %D +/-30% for labeled compounds (Must meet limits in Table 6, Method 1613B) (If %Ds in the closing CCAL are w/in 25%/35% the avg RF from the two CCAL may be used to calculate samples per Method 8290, Section 8.3.2.4)	Do not qualify labeled compounds. Narrate in report for labeled compound %D outliers. For native compound %D outliers: 8290: J(+)/UJ(-) if %D = 20% - 75% J(+)/R(-) if %D > 75% 1613: J(+)/UJ(-) if %D is outside Table 6 limits J(+)/R(-) if %D is +/- 75% of Table 6 limit	5B
	Abs. RT of $^{13}C_{12}$-1234-TCDD and ^{13}C12-123789-HxCDD +/- 15 sec of ICAL.	EcoChem PJ, see ICAL section of TM-05	
	RRT of all other compounds must meet Table 2 of 1613B.	EcoChem PJ, see TM-05	
	Ion Abundance ratios within QC limits (Table 8 of method 8290) (Table 9 of method 1613B)	EcoChem PJ, see TM-05	
	S/N ratio > 10	If <10, elevate Det. Limit or R(-)	
Method Blank	One per matrix per batch No positive results	If sample result <5X action level, qualify U at reported value.	7
Field Blanks (Not Required)	No positive results	If sample result <5X action level, qualify U at reported value.	6
LCS / OPR	Concentrations must meet limits in Table 6, Method 1613B or lab limits.	J(+) if %R > UCL J(+)/UJ(-) if %R < LCL J(+)/R(-) using PJ if %R <<LCL (< 10%)	10
MS/MSD (recovery)	May not analyze MS/MSD %R should meet lab limits.	Qualify parent only unless other QC indicates systematic problems: J(+) if both %R > UCL J(+)/UJ(-) if both %R < LCL J(+)/R(-) if both %R < 10% PJ if only one %R outlier	8
MS/MSD (RPD)	May not analyze MS/MSD RPD < 20%	J(+) in parent sample if RPD > CL	9

EcoChem Validation Guidelines for Dioxin/Furan Analysis by HRMS
(Based on EPA Reg. 10 SOP, Rev. 2, 1996 & EPA SW-846, Methods 1613b and 8290)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Lab Duplicate	RPD <25% if present.	J(+)/UJ(-) if outside limts	9
Labeled Compounds / Internal Standards	*Method 8290:* %R = 40% - 135% in all samples ------------------------------ *Method 1613B:* %R must meet limits specified in Table 7, Method 1613	J(+)/UJ(-) if %R = 10% to LCL J(+) if %R > UCL J(+)/R(-) if %R < 10%	13
Quantitation/ Identification	Ions for analyte, IS, and rec. std. must max w/in 2 sec. S/N >2.5 IA ratios meet limits in Table 9 of 1613B or Table 8 of 8290 RRTs w/in limits in Table 2 of 1613B	If RT criteria not met, use PJ (see TM-05) If S/N criteria not met, J(+). if unlabelled ion abundance not met, change to EMPC If labelled ion abundance not met, J(+).	21
EMPC (estimated maximum possible concentration)	If quantitation idenfication criteria are not met, laboratory should report an EMPC value.	If laboratory correctly reported an EMPC value, qualify with U to indicate that the value is a detection limit.	14
Interferences	PCDF interferences from PCDPE	If both detected, change PCDF result to EMPC	14
Second Column Confirmation	All 2378-TCDF hits must be confirmed on a DB-225 (or equiv) column. All QC specs in this table must be met for the confirmation analysis.	Report lower of the two values. If not performed use PJ (see TM-05).	3
Field Duplicates	Use QAPP limits. If no QAPP: Solids: RPD <50% OR absolute diff. < 2X RL (for results < 5X RL) Aqueous: RPD <35% OR absolute diff. < 1X RL (for results < 5X RL)	Narrate and qualify if required by project (EcoChem PJ)	9
Two analyses for one sample	Report only one result per analyte	"DNR" results that should not be used	11

EcoChem, INC.
Environmental Data Quality

APPENDIX B
QUALIFIED DATA SUMMARY TABLE

QUALIFIED DATA SUMMARY TABLE
Rayonier Area WD20

Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifiers	DV Reason Codes
BL01A	Sediment	20081010B	L11352-1	1,2,3,7,8,9-HXCDF	U	22
BL01A	Sediment	20081010B	L11352-1	2,3,7,8-TCDF	DNR	11
BL02A	Sediment	20080618A	L11304-1	2,3,7,8-TCDF	DNR	11
BL02B	Sediment	20080618A	L11304-2	1,2,3,4,7,8,9-HPCDF	U	22
BL02B	Sediment	20080618A	L11304-2	2,3,7,8-TCDF	DNR	11
BL02B	Sediment	NB71	NB71A	Benzo(a)anthracene	J	19
BL02B	Sediment	NB71	NB71A	Chrysene	J	19
BL02B	Sediment	NB71	NB71A	Pyrene	J	19
BL02C	Sediment	20080618A	L11304-3	2,3,7,8-TCDD	U	22
BL02C	Sediment	20080618A	L11304-3	2,3,7,8-TCDF	DNR	11
BL03A	Sediment	20081010A	L11303-1	2,3,7,8-TCDF	DNR	11
BL04A	Sediment	20081010A	L11303-2	2,3,7,8-TCDF	DNR	11
BL06A	Sediment	20081010A	L11303-4	2,3,7,8-TCDF	DNR	11
BL08A	Sediment	20081010A	L11303-6	2,3,7,8-TCDF	DNR	11
BL08B	Sediment	20080618A	L11304-4	2,3,7,8-TCDF	DNR	11
BL08C	Sediment	20080618A	L11304-5	1,2,3,4,7,8-HXCDF	U	22
BL08C	Sediment	20080618A	L11304-5	1,2,3,7,8-PECDD	U	22
BL08C	Sediment	20080618A	L11304-5	2,3,4,7,8-PECDF	U	22
BL08C	Sediment	20080618A	L11304-5	2,3,7,8-TCDD	U	22
BL08C	Sediment	20080618A	L11304-5	2,3,7,8-TCDF	DNR	11
EI02A	Sediment	20080626A	L11346-14	1,2,3,4,7,8,9-HPCDF	U	22
EI02A	Sediment	20080626A	L11346-14	1,2,3,6,7,8-HXCDF	U	22
EI02A	Sediment	20080626A	L11346-14	1,2,3,7,8-PECDF	U	22
EI02A	Sediment	20080626A	L11346-14	2,3,4,7,8-PECDF	U	22
EI02A	Sediment	20080626A	L11346-14	2,3,7,8-TCDD	U	22
EI02A	Sediment	20080626A	L11346-14	2,3,7,8-TCDF	DNR	11
EI04A	Sediment	20080624B	L11334-19	1,2,3,4,7,8,9-HPCDF	U	22
EI04A	Sediment	20080624B	L11334-19	1,2,3,4,7,8-HXCDF	U	7
EI04A	Sediment	20080624B	L11334-19	1,2,3,7,8-PECDD	U	22
EI04A	Sediment	20080624B	L11334-19	2,3,7,8-TCDD	U	22
EI04A	Sediment	20080624B	L11334-19	2,3,7,8-TCDF	DNR	11
EI07A	Sediment	20080624B	L11334-20	1,2,3,4,7,8-HXCDF	U	22
EI07A	Sediment	20080624B	L11334-20	2,3,7,8-TCDD	U	22
EI07A	Sediment	20080624B	L11334-20	2,3,7,8-TCDF	DNR	11
EI08TH	Tissue	20080617A	L11299-1	1,2,3,4,6,7,8-HPCDF	U	22
EI08TH	Tissue	20080617A	L11299-1	2,3,7,8-TCDF	DNR	11
EI08TH	Tissue	ND44	ND44F	Indeno(1,2,3-cd)pyrene	UJ	5B
FT01A	Sediment	20080626B	L11346-28	2,3,7,8-TCDF	DNR	11
FT04A	Sediment	20080626B	L11346-27	1,2,3,7,8,9-HXCDF	U	22
FT04A	Sediment	20080626B	L11346-27	2,3,7,8-TCDF	DNR	11
FT06A	Sediment	20081010A	L11303-10	2,3,7,8-TCDF	DNR	11
FT10A	Sediment	20081010A	L11303-11	2,3,7,8-TCDF	DNR	11
FT12A	Sediment	20080618B	L11304-20	2,3,7,8-TCDF	DNR	11

QUALIFIED DATA SUMMARY TABLE
Rayonier Area WD20

Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifiers	DV Reason Codes
FT13A	Sediment	20080618A	L11304-6	2,3,7,8-TCDF	DNR	11
IE01B	Sediment	20080624B	L11334-21	2,3,7,8-TCDF	DNR	11
IE03A	Sediment	20081010A	L11303-12	1,2,3,7,8,9-HXCDF	U	22
IE03A	Sediment	20081010A	L11303-12	2,3,7,8-TCDF	DNR	11
IE04A	Sediment	20081010A	L11303-13	2,3,7,8-TCDF	DNR	11
IE05A	Sediment	20081010A	L11303-14	2,3,7,8-TCDF	DNR	11
IE05B	Sediment	20080618A	L11304-7	2,3,7,8-TCDF	DNR	11
IE06A	Sediment	20081010A	L11303-16	2,3,7,8-TCDF	DNR	11
IE07A	Sediment	20081010B	L11352-3	2,3,7,8-TCDF	DNR	11
IE09A	Sediment	20081010B	L11352-4	1,2,3,7,8,9-HXCDF	U	22
IE09A	Sediment	20081010B	L11352-4	2,3,7,8-TCDF	DNR	11
IE09B	Sediment	20080618A	L11304-8	2,3,7,8-TCDD	U	22
IE09B	Sediment	20080618A	L11304-8	2,3,7,8-TCDF	DNR	11
IE09B	Sediment	NC39	NC39I	Benzo(a)pyrene	J	19
IE09B	Sediment	NC39	NC39I	Benzo(b)fluoranthene	J	19
IE09B	Sediment	NC39	NC39I	Benzo(g,h,i)perylene	UJ	19
IE09B	Sediment	NC39	NC39I	Benzo(k)fluoranthene	J	19
IE09B	Sediment	NC39	NC39I	bis(2-Ethylhexyl)phthalate	UJ	19
IE09B	Sediment	NC39	NC39I	Dibenz(a,h)anthracene	UJ	19
IE09B	Sediment	NC39	NC39I	Di-n-Octyl phthalate	UJ	19
IE09B	Sediment	NC39	NC39I	Indeno(1,2,3-cd)pyrene	UJ	19
IE12A	Sediment	20081010A	L11303-20	2,3,7,8-TCDF	DNR	11
IE12B	Sediment	20080626B	L11346-15	2,3,7,8-TCDF	DNR	11
IE12C	Sediment	NC39	NC39M	Benzo(g,h,i)perylene	UJ	8
IE12C	Sediment	NC39	NC39M	Dibenz(a,h)anthracene	UJ	8
IE12C	Sediment	NC39	NC39M	Indeno(1,2,3-cd)pyrene	UJ	8
IE14A	Sediment	20081010A	L11303-22	2,3,7,8-TCDF	DNR	11
IE14B	Sediment	20080626B	L11346-16	2,3,7,8-TCDF	DNR	11
IE15A	Sediment	20081010A	L11303-23	2,3,7,8-TCDF	DNR	11
IE16B	Sediment	20080618A	L11304-9	1,2,3,4,7,8,9-HPCDF	J	10
IE16B	Sediment	20080618A	L11304-9	1,2,3,4,7,8-HXCDD	U	22
IE16B	Sediment	20080618A	L11304-9	2,3,4,7,8-PECDF	U	22
IE16B	Sediment	20080618A	L11304-9	2,3,7,8-TCDD	U	22
IE16B	Sediment	20080618A	L11304-9	2,3,7,8-TCDF	DNR	11
IE18TH	Tissue	20080624C	L11299-6	1,2,3,4,6,7,8-HPCDF	U	22
IE18TH	Tissue	20080624C	L11299-6	2,3,4,7,8-PECDF	U	22
IE18TH	Tissue	20080624C	L11299-6	2,3,7,8-TCDF	DNR	11
IE18TH	Tissue	NE18	NE18B	Indeno(1,2,3-cd)pyrene	UJ	5B
IE20TH	Tissue	20080624C	L11299-2	2,3,7,8-TCDF	DNR	11
IE20TH	Tissue	NE18	NE18C	Indeno(1,2,3-cd)pyrene	UJ	5B
IE21TL	Tissue	20080617A	L11297-2	1,2,3,4,6,7,8-HPCDD	U	22
IE21TL	Tissue	20080617A	L11297-2	2,3,7,8-TCDD	U	22
IE21TL	Tissue	20080617A	L11297-2	2,3,7,8-TCDF	DNR	11
IE21TL	Tissue	ND44	ND44B	Indeno(1,2,3-cd)pyrene	UJ	5B

QUALIFIED DATA SUMMARY TABLE
Rayonier Area WD20

Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifiers	DV Reason Codes
IE21TL	Tissue	20080617A	L11297-2	OCDD	U	22
IE22TL	Tissue	20080617A	L11297-3	1,2,3,4,6,7,8-HPCDD	U	22
IE22TL	Tissue	20080617A	L11297-3	2,3,7,8-TCDF	U	22
IE22TL	Tissue	20080617A	L11297-3	2,3,7,8-TCDF	DNR	11
IE22TL	Tissue	ND44	ND44C	Indeno(1,2,3-cd)pyrene	UJ	5B
IE22TL	Tissue	20080617A	L11297-3	OCDD	U	7
IE23TL	Tissue	20080617A	L11297-4	1,2,3,4,6,7,8-HPCDD	U	7
IE23TL	Tissue	20080617A	L11297-4	1,2,3,6,7,8-HXCDD	U	22
IE23TL	Tissue	20080617A	L11297-4	2,3,7,8-TCDF	U	22
IE23TL	Tissue	20080617A	L11297-4	2,3,7,8-TCDF	DNR	11
IE23TL	Tissue	ND44	ND44D	Indeno(1,2,3-cd)pyrene	UJ	5B
IE23TL	Tissue	20080617A	L11297-4	OCDD	U	7
IE23TL	Tissue	20080617A	L11297-4	OCDF	U	22
IE24TL	Tissue	20080617A	L11297-1	1,2,3,4,6,7,8-HPCDD	U	7
IE24TL	Tissue	20080617A	L11297-1	1,2,3,7,8-PECDF	U	22
IE24TL	Tissue	20080617A	L11297-1	2,3,7,8-TCDD	U	22
IE24TL	Tissue	20080617A	L11297-1	2,3,7,8-TCDF	U	22
IE24TL	Tissue	20080617A	L11297-1	2,3,7,8-TCDF	DNR	11
IE24TL	Tissue	ND44	ND44A	Indeno(1,2,3-cd)pyrene	UJ	5B
IE24TL	Tissue	20080617A	L11297-1	OCDD	U	7
IE24TL	Tissue	20080617A	L11297-1	OCDF	U	22
IE25TM	Tissue	20080624C	L11298-2	1,2,3,4,6,7,8-HPCDD	U	22
IE25TM	Tissue	20080624C	L11298-2	1,2,3,4,6,7,8-HPCDF	U	22
IE25TM	Tissue	NE18	NE18D	Indeno(1,2,3-cd)pyrene	UJ	5B
IE26TM	Tissue	20080617A	L11298-1	2,3,7,8-TCDD	U	22
IE26TM	Tissue	ND44	ND44E	Indeno(1,2,3-cd)pyrene	UJ	5B
IH01A	Sediment	20081010B	L11352-5	1,2,3,4,7,8-HXCDD	U	22
IH01A	Sediment	20081010B	L11352-5	2,3,7,8-TCDF	DNR	11
IH02A	Sediment	20081010B	L11352-6	2,3,7,8-TCDF	DNR	11
IH02B	Sediment	NC14	NC14P	1-Methylnaphthalene	J	19
IH02B	Sediment	20080618A	L11304-10	2,3,7,8-TCDF	DNR	11
IH02B	Sediment	NC14	NC14P	Benzo(a)pyrene	J	19
IH02B	Sediment	NC14	NC14P	Benzo(b)fluoranthene	J	19
IH02B	Sediment	NC14	NC14P	Benzo(g,h,i)perylene	J	19
IH02B	Sediment	NC14	NC14P	Benzo(k)fluoranthene	J	19
IH02B	Sediment	NC14	NC14P	Dibenz(a,h)anthracene	UJ	19
IH02B	Sediment	NC14	NC14P	Indeno(1,2,3-cd)pyrene	J	19
IH02C	Sediment	20080618A	L11304-11	1,2,3,4,7,8-HXCDD	U	22
IH02C	Sediment	20080618A	L11304-11	2,3,7,8-TCDF	DNR	11
IH03A	Sediment	20081010B	L11352-7	1,2,3,7,8,9-HXCDF	U	22
IH03A	Sediment	20081010B	L11352-7	2,3,7,8-TCDF	DNR	11
IH03A	Sediment	NV14	NV14H	Benzo(a)anthracene	J	19
IH03A	Sediment	NV14	NV14H	Chrysene	J	19
IH03A	Sediment	NV14	NV14H	Pyrene	J	19

QUALIFIED DATA SUMMARY TABLE
Rayonier Area WD20

Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifiers	DV Reason Codes
IH04A	Sediment	20081010B	L11352-8	2,3,7,8-TCDF	DNR	11
IH05A	Sediment	20081010A	L11303-26	2,3,4,7,8-PECDF	J	9
IH05A	Sediment	20081010A	L11303-26	2,3,7,8-TCDF	DNR	11
IH06A	Sediment	20081010A	L11303-27	2,3,7,8-TCDF	DNR	11
IH06B	Sediment	20080618A	L11304-12	2,3,7,8-TCDF	DNR	11
IH06C	Sediment	20080618B	L11304-13	2,3,7,8-TCDF	DNR	11
KP01A	Sediment	20080624B	L11334-22	2,3,7,8-TCDF	DNR	11
KP02A	Sediment	20081010B	L11352-9	1,2,3,7,8,9-HXCDF	U	22
KP02A	Sediment	20081010B	L11352-9	2,3,7,8-TCDF	DNR	11
KP02B	Sediment	20080618B	L11304-14	2,3,7,8-TCDF	DNR	11
KP03A	Sediment	20080624B	L11334-23	2,3,7,8-TCDF	DNR	11
KP03B	Sediment	20080618B	L11304-15	2,3,7,8-TCDF	DNR	11
KP03C	Sediment	NB97	NB97K	Anthracene	J	9
KP03C	Sediment	NB97	NB97K	Benzo(a)anthracene	J	9
KP03C	Sediment	NB97	NB97K	Benzo(a)pyrene	J	9
KP03C	Sediment	NB97	NB97K	Benzo(b)fluoranthene	J	9
KP03C	Sediment	NB97	NB97K	Benzo(k)fluoranthene	J	9
KP03C	Sediment	NB97	NB97K	Chrysene	J	9
KP03C	Sediment	NB97	NB97K	Fluoranthene	J	9
KP03C	Sediment	NB97	NB97K	Indeno(1,2,3-cd)pyrene	J	9
KP03C	Sediment	NB97	NB97K	Pyrene	J	9
KP04A	Sediment	20080624B	L11334-24	2,3,7,8-TCDF	DNR	11
KP05A	Sediment	20081010A	L11303-30	2,3,7,8-TCDF	DNR	11
KP07A	Sediment	20080618B	L11304-16	2,3,7,8-TCDF	DNR	11
KP07B	Sediment	20080624B	L11334-25	2,3,7,8-TCDF	DNR	11
KP08B	Sediment	20080618B	L11304-17	2,3,7,8-TCDF	DNR	11
LA01A	Sediment	20080725A	L11487-6	2,3,7,8-TCDF	DNR	11
LA02A	Sediment	20081010B	L11488-1	1,2,3,7,8,9-HXCDF	U	22
LA02A	Sediment	20081010B	L11488-1	2,3,7,8-TCDF	DNR	11
LA02B	Sediment	20080725A	L11487-7	1,2,3,7,8,9-HXCDF	U	22
LA02B	Sediment	20080725A	L11487-7	2,3,7,8-TCDF	DNR	11
LA02C	Sediment	20080725A	L11487-8	1,2,3,6,7,8-HXCDF	U	22
LA02C	Sediment	20080725A	L11487-8	1,2,3,7,8,9-HXCDD	U	22
LA02C	Sediment	20080725A	L11487-8	2,3,7,8-TCDF	DNR	11
LA03A	Sediment	20081010B	L11488-2	2,3,7,8-TCDF	DNR	11
MA01A	Sediment	20081010B	L11349-2	2,3,7,8-TCDF	DNR	11
MA02A	Sediment	20081010B	L11303-34	1,2,3,7,8,9-HXCDF	U	22
MA02A	Sediment	20081010B	L11303-34	2,3,7,8-TCDF	DNR	11
MA02B	Sediment	20080618B	L11304-18	2,3,7,8-TCDF	DNR	11
MA02B	Sediment	NC14	NC14Y	Benzo(a)anthracene	J	19
MA02B	Sediment	NC14	NC14Y	Chrysene	J	19
MA02B	Sediment	NC14	NC14Y	Pyrene	J	19
MA02C	Sediment	20080618B	L11304-19	2,3,7,8-TCDF	DNR	11
MA03A	Sediment	20081010B	L11303-35	2,3,7,8-TCDF	DNR	11

QUALIFIED DATA SUMMARY TABLE
Rayonier Area WD20

Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifiers	DV Reason Codes
MA04A	Sediment	20081010B	L11303-36	1,2,3,7,8,9-HXCDF	U	22
MA04A	Sediment	20081010B	L11303-36	2,3,7,8-TCDF	DNR	11
MA05A	Sediment	20081010B	L11303-37	2,3,7,8-TCDF	DNR	11
OH01A-R	Sediment	20080624B	L11334-31	1,2,3,7,8,9-HXCDF	U	22
OH01A-R	Sediment	20080624B	L11334-31	2,3,7,8-TCDF	DNR	11
OH02A	Sediment	20080618B	L11304-21	2,3,7,8-TCDF	DNR	11
OH03A	Sediment	20080618B	L11304-22	2,3,7,8-TCDF	U	22
OH03A	Sediment	20080618B	L11304-22	2,3,7,8-TCDF	DNR	11
RF01A	Sediment	20080618B	L11304-23	1,2,3,4,6,7,8-HPCDF	U	7
RF01A	Sediment	20080618B	L11304-23	1,2,3,4,7,8-HXCDF	U	22
RF01A	Sediment	20080618B	L11304-23	1,2,3,6,7,8-HXCDD	U	22
RF01A	Sediment	20080618B	L11304-23	1,2,3,6,7,8-HXCDF	U	22
RF01A	Sediment	20080618B	L11304-23	2,3,7,8-TCDF	DNR	11
RF01A	Sediment	20080618B	L11304-23	OCDF	U	7
RF02A	Sediment	20080618B	L11304-24	1,2,3,4,6,7,8-HPCDF	U	7
RF02A	Sediment	20080618B	L11304-24	1,2,3,4,7,8-HXCDF	U	22
RF02A	Sediment	20080618B	L11304-24	2,3,7,8-TCDF	U	22
RF02A	Sediment	20080618B	L11304-24	2,3,7,8-TCDF	DNR	11
RF02A	Sediment	20080618B	L11304-24	OCDF	U	7
RF03A	Sediment	20080618B	L11304-25	2,3,4,6,7,8-HXCDF	U	22
RF03A	Sediment	20080618B	L11304-25	2,3,7,8-TCDF	DNR	11
RF04TH	Tissue	20080716A	L11432-1	2,3,7,8-TCDF	DNR	11
RF04TH	Tissue	20080716A	L11432-1	OCDD	U	7
RF04TH	Tissue	20080716A	L11432-1	OCDF	U	7
RF05TH	Tissue	20080716A	L11432-2	1,2,3,4,6,7,8-HPCDF	U	22
RF05TH	Tissue	20080716A	L11432-2	1,2,3,4,7,8,9-HPCDF	U	22
RF05TH	Tissue	20080716A	L11432-2	1,2,3,7,8,9-HXCDD	U	22
RF05TH	Tissue	20080716A	L11432-2	OCDD	U	7
RF05TH	Tissue	20080716A	L11432-2	OCDF	U	7
RF06TG	Tissue	20080716A	L11432-3	1,2,3,4,6,7,8-HPCDD	U	22
RF06TG	Tissue	20080716A	L11432-3	1,2,3,6,7,8-HXCDD	U	22
RF06TG	Tissue	20080716A	L11432-3	2,3,7,8-TCDF	U	22
RF06TG	Tissue	20080716A	L11432-3	2,3,7,8-TCDF	DNR	11
RF06TG	Tissue	20080716A	L11432-3	OCDD	U	7
RF06TG	Tissue	20080716A	L11432-3	OCDF	U	7
RL01A	Sediment	20081010B	L11349-5	1,2,3,7,8,9-HXCDF	U	22
RL01A	Sediment	20081010B	L11349-5	1,2,3,7,8-PECDD	U	22
RL01A	Sediment	20081010B	L11349-5	2,3,7,8-TCDD	U	22
RL01A	Sediment	20081010B	L11349-5	2,3,7,8-TCDF	DNR	11
WW01A	Sediment	20080624B	L11334-32	2,3,7,8-TCDF	DNR	11

DATA VALIDATION REPORT

Port Angeles Harbor Sediment Characterization Study
Rayonier Investigation Area of Concern - WD25

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April 15, 2009

Approved by:

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PROJECT NARRATIVE

Basis for Data Validation

This report summarizes the results of QA-2 data review (full validation) performed on sediment and tissue sample data and the associated laboratory quality control data collected in support of the Port Angeles Sediment Characterization Study, Rayonier Investigation Area WD-25. Refer to the **Sample Index** for a complete list of samples for which data were reviewed.

Dioxin/furan samples were analyzed by AXYS Analytical Services, Sidney, British Colombia and polynuclear aromatic hydrocarbon samples were analyzed by Analytical Resources, Inc. (ARI), Tukwila, Washington. The analytical methods and EcoChem project chemists are listed in the table below.

Analysis	Method	Primary Review	Secondary Review
Polynuclear Aromatic Hydrocarbons	EPA 8270D	Jennifer Newkirk	Eric Strout
		Lucy Panteleeff	
Dioxin/Furan Compounds	EPA 1613B	Melissa Swanson	

The data were reviewed using guidance and quality control criteria documented in the analytical methods; *Port Angeles Harbor Sediment Characterization Study Sampling and Analysis Plan* (E&E 2008); *Data Validation Guidance Manual for Selected Sediment Variables* (PTI 1989); *Puget Sound Dredged Disposal Analysis Guidance Manual: Data Quality Evaluation for Proposed Dredged Material Disposal Projects* (PTI 1989); and *National Functional Guidelines for Organic and/or Inorganic Data Review* (USEPA 1994, 1999 & 2002). The dioxin/furan data were also evaluated using *USEPA Region 10 SOP for Validation of Dioxins & Furans* (Region 10 1996) and *USEPA National Function Guidelines for Chlorinated Dibenzo-p Dioxins (CDD) and Chlorinated Dibenzofurans (CDF) Data Review* (USEPA 2005).

EcoChem's goal in assigning data assessment qualifiers is to assist in proper data interpretation. If values are estimated (J or UJ), data may be used for site evaluation and risk assessment purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet the data quality objectives as stated in the documents and methods referenced above.

Data qualifier definitions, reason codes, and validation criteria are included as **Appendix A. Appendix B** contains the Qualified Data Summary Table. Data Validation Worksheets will be kept on file at EcoChem, Inc. A qualified laboratory electronic data deliverable (EDD) is also submitted with this report.

SAMPLE INDEX
Rayonier Investigation Area WD25

Shading indicates that the analysis was not requested for the sample.

1 PAH analysis was requested on the COC but results were not reported.

Field ID	Matrix	DIOXIN	Axys ID	Axys SDG	PAH	ARI ID	ARI SDG
CO01A	Sediment	X	L11346-1	20080626A	X	NC49A	NC49
CO02A	Sediment	X	L11346-2	20080626A	X	NC49B	NC49
CO02B	Sediment	X	L11458-10	20080722A	X	NG45A	NG45
CO03A	Sediment	X	L11346-3	20080626A	X	NC49C	NC49
CO03B	Sediment	X	L11458-11	20080722A	X	NG54A	NG54
CO04A	Sediment	X	L11334-1	20080624A	X	NC49D	NC49
CO04B	Sediment	X	L11458-12	20080722A	X	NG54B	NG54
CO05A	Sediment	X	L11346-26	20080626B	X	NC49E	NC49
CO05B	Sediment	X	L11458-1	20080722A	X	NG11A	NG11
DO01A	Sediment	X	L11334-2	20080624A	X	NC49F	NC49
DO02A	Sediment	X	L11334-3	20080624A	X	NC49G	NC49
DO03A	Sediment	X	L11334-4	20080624A	X	NC49H	NC49
DO04A	Sediment	X	L11334-5	20080624A	X	NC49I	NC49
DO04B	Sediment	X	L11487-1	20080725A	X	NH40A	NH40
DO04C	Sediment	X	L11487-2	20080725A	X	NH40B	NH40
DO04D	Sediment	X	L11487-3	20080725A	X	NH40C	NH40
DO05A	Sediment	X	L11334-6	20080624A	X	NC49J	NC49
DO05B	Sediment	X	L11487-4	20080725A	X	NH41A	NH41
DO05C	Sediment	X	L11487-5	20080725A	X	NH41B	NH41
EC01A	Sediment	X	L11346-4	20080626A	X	NC49K	NC49
EC02A	Sediment	X	L11346-5	20080626A	X	NC45A	NC45
EC03A	Sediment	X	L11334-7	20080624A	X	NC45B	NC45
EC03B	Sediment	X	L11458-2	20080722A	X	NG11B	NG11
EC03C	Sediment	X	L11458-13	20080722A	X	NG11C	NG11
EC04A	Sediment	X	L11346-6	20080626A	X	NC45C	NC45
EC04B	Sediment	X	L11458-14	20080722A	X	NG11D	NG11
EC05A	Sediment	X	L11346-7	20080626A	X	NC45D	NC45
EC05B	Sediment	1			X	NG11E	NG11
EC06TH	Tissue	X	L11299-5	20080624C	X	NE18A	NE18
ED01A	Sediment	X	L11346-8	20080626A	X	NC45E	NC45
ED01B	Sediment	X	L11334-8	20080624A	X	NC45F	NC45
ED01C	Sediment	X	L11334-9	20080624A	X	NC45G	NC45
ED02A	Sediment	X	L11346-9	20080626A	X	NC45H	NC45
ED02B	Sediment	X	L11346-10	20080626A	X	NC45I	NC45
ED02C	Sediment	X	L11334-10	20080624A	X	NC45J	NC45
ED03A	Sediment	X	L11334-11	20080624A	X	NC45K	NC45
ED03B	Sediment	X	L11346-11	20080626A	X	NC45L	NC45
ED03C	Sediment	X	L11346-12	20080626A	X	NC45M	NC45
ED04A	Sediment	X	L11334-12	20080624A	X	NC45N	NC45
ED04B	Sediment	X	L11346-13	20080626A	X	OI79A	OI79
ED05A	Sediment	X	L11334-13	20080624A	X	NC41B	NC41

SAMPLE INDEX
Rayonier Investigation Area WD25

Shading indicates that the analysis was not requested for the sample.

1 PAH analysis was requested on the COC but results were not reported.

Field ID	Matrix	DIOXIN	Axys ID	Axys SDG	PAH	ARI ID	ARI SDG
ED05B	Sediment	X	L11458-3	20080722A			
EE01A	Sediment	X	L11334-14	20080624A	X	NC41C	NC41
EE01B	Sediment	X	L11458-4	20080722A	X	NG11F	NG11
EE02A	Sediment	X	L11334-15	20080624A	X	NC41D	NC41
EE02B	Sediment	X	L11458-15	20080722A	X	NH40D	NH40
EE02C	Sediment	X	L11458-16	20080722A	X	NH40E	NH40
EE03A	Sediment	X	L11334-16	20080624A	X	NC41E	NC41
EE03B	Sediment	X	L11458-5	20080722A	X	NG11G	NG11
EE03C	Sediment	X	L11458-6	20080722A	X	NG11H	NG11
EE04A	Sediment	X	L11334-17	20080624B	X	NC41F	NC41
EE04B	Sediment	X	L11458-7	20080722A	X	NG45B	NG45
EE04C	Sediment	X	L11458-9	20080722A	X	NG45C	NG45
EE05A	Sediment	X	L11334-18	20080624B	X	NC41G	NC41
LP01A	Sediment	X	L11346-17	20080626B	X	NC50C	NC50
LP03A	Sediment	X	L11346-18	20080626B	X	NC50D	NC50
LP04A	Sediment	X	L11346-19	20080626B	X	NC50E	NC50
LP05A	Sediment	X	L11346-20	20080626B	X	NC50F	NC50
LP05B	Sediment				X	NG54C	NG54
MD01A	Sediment	X	L11346-21	20080626B	X	NC50K	NC50
MD01B	Sediment	X	L11458-17	20080722A	X	NG45D	NG45
MD01C	Sediment	X	L11458-8	20080722A	X	NG45F	NG45
MD02A	Sediment	X	L11346-22	20080626B	X	NC50L	NC50
MD02B	Sediment	X	L11458-18	20080722A	X	NG45E	NG45
MD02C	Sediment	X	L11458-19	20080722A	X	NG45G	NG45
MD03A	Sediment	X	L11346-23	20080626B	X	NC50M	NC50
MD03B	Sediment	X	L11334-26	20080624B	X	NC50N	NC50
MD03C	Sediment	X	L11334-27	20080624B	X	NC50O	NC50
MD04A	Sediment	X	L11346-24	20080626B	X	NC50P	NC50
MD04B	Sediment	X	L11334-28	20080624B	X	NC50Q	NC50
MD05A	Sediment	X	L11346-25	20080626B	X	NC44A	NC44
MD05B	Sediment	X	L11334-29	20080624B	X	NC44B	NC44
MD05C	Sediment	X	L11334-30	20080624B	X	NC44C	NC44
MD06TH	Tissue	X	L11299-3	20080624C	X	NE18E	NE18
MD07TH	Tissue	X	L11299-4	20080624C	X	NE18F	NE18
MD08TG	Tissue	X	L11431-1	20080716A	X	NI28A	NI28
MD08TH	Tissue	X	L11431-2	20080716A	X	NI28B	NI28
MD09TH	Tissue	X	L11431-3	20080716A	X	NI28C	NI28

DATA VALIDATION REPORT
Rayonier Investigation Area WD-25
Polynuclear Aromatic Hydrocarbons by Method SW8270D
Matrix: Sediment

This report documents the review of analytical data from the analysis of sediment samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc. (ARI), Tukwila, Washington. Refer to the **Sample Index** for a list of samples.

SDG	Number of Samples	Validation Level
NC41	6	Full
NC44	3	Full
NC45	14	Full
NC49	11	Full
NC50	11	Full
NG11	8	Full
NG45	7	Full
NG54	3	Full
NH40	5	Full
NH41	2	Full
OI97A	1	Full

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1	Holding Times and Sample Preservation	1	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
	GC/MS Tuning		Laboratory Control Samples (LCS)
	Initial Calibration (ICAL)		Field Duplicates
	Continuing Calibration (CCAL)	2	Internal Standards
	Laboratory Blanks	1	Compound Identification and Reported Results
	Field Blanks		Reporting Limits
2	Surrogate Compounds	1	Calculation Verification (full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received many of the sample coolers with temperatures outside the advisory control limits. These temperature outliers did not impact data quality and no qualifiers were required.

SDG NC45: Sample ED04B was missed by the lab and not analyzed with this SDG. The sample was analyzed at a later date and reported as SDG OI79.

Surrogate Compounds

SDG NC45: The percent recovery (%R) value for surrogate 2,4,6-tribromophenol was greater than the upper control limit in Sample ED04A. No qualifiers were required because at least two other acid surrogate %R values were within control limits. The sample was reanalyzed with all surrogate recovery values not recovered due to a 30x dilution. All PAH results were reported from the original analysis; no action was necessary.

SDG NC49: The %R value for d4-1,2-dichlorobenzene was less than the lower control limits in Sample DO03A. No qualifiers were required because at least two other base-neutral surrogate %R values were within control limits.

The %R values for d4-1,2-dichlorobenzene and 2,4,6-tribromophenol were less than 10% in Sample DO04A. In addition, the %R value for 2-fluorobiphenyl was less than the lower control limit. The sample was re-extracted and re-analyzed with acceptable surrogate recovery values. Values were reported from the re-extraction and all results from the original analysis were labeled do-not-report (DNR-11). The %R values for all surrogates were less than 10% in Sample EC01A. The sample was re-extracted and re-analyzed with acceptable surrogate recovery values. Values were reported from the re-extraction and all results from the original analysis were labeled do-not-report (DNR-11).

SDG NG45: No surrogates were recovered in the dilution analysis of Sample MD02B due to a 50x dilution factor. No action was taken.

SDG NG54: No surrogates were recovered in the dilution analysis of Sample LP05B due to a 100x dilution factor. No action was taken.

Matrix Spike/Matrix Spike Duplicate

SDG NC45: Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed using Sample ED01C. The MS %R values for benzo(g,h,i)perylene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were less than the lower control limit. No action was required, as the MSD %R values for these analytes were within the control limits.

SDG NC50: MS/MSD analyses were performed using a Batch QC sample. The MS/MSD %R values for benzo(g,h,i)perylene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were less than the lower control limit. No qualification is necessary on Batch QC.

SDG OI79: MS/MSD analyses were not performed. Accuracy and precision were evaluated using the laboratory control sample/laboratory control sample duplicate (LCS/LCSD) analyses.

Internal Standards

SDG NC45: The area for the internal standard chrysene-d12 was greater than the 200% upper control limit in Samples ED03A, ED03B, and ED04A. In addition, the area for the internal standard di-n-octylphthalate-d4 was greater than the 200% upper control limit in Sample ED04A. Positive results associated with the internal standard outliers were estimated (J-19).

SDG NC39: The area for internal standards perylene-d12 and di-n-octylphthalate-d4 were less than the 50% lower control limit in Sample IE09B. Results associated with the internal standard outliers were estimated (J/UJ-19).

Calculation Verification

Several results were verified by recalculation from the raw data. No calculation or transcription errors were found.

IV. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, LCS/LCSD, and MS/MSD %R values, with the exceptions noted above. Precision was also acceptable as demonstrated by the relative percent difference values for the MS/MSD and LCS/LCSD analyses, with the exceptions noted above.

Data were estimated due to internal standard area outliers.

Data were labeled DNR in order to indicate the most appropriate value when multiple values were reported. Data that have been labeled DNR should not be used for any purpose. Since a usable result remains for all compounds in each sample, completeness is not affected.

All other data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Rayonier Investigation Area WD-25
Polynuclear Aromatic Hydrocarbons by Method 8270D
Matrix: Tissue

This report documents the review of analytical data from the analysis of tissue samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc. (ARI), Tukwila, Washington. Refer to the Sample Index for a list of samples reviewed.

SDG	Number of Samples	Validation Level
NE18	3	Full
NI28	3	Full

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1	Holding Times and Sample Preservation		Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
	GC/MS Tuning		Laboratory Control Samples (LCS)
	Initial Calibration (ICAL)		Field Duplicates
2	Continuing Calibration (CCAL)		Internal Standards
	Laboratory Blanks		Compound Identification and Reported Results
	Field Blanks	1	Reporting Limits
	Surrogate Compounds	1	Calculation Verification (full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received many of the sample coolers with temperatures outside the advisory control limits. These temperature outliers did not impact data quality and no qualifiers were required.

Continuing Calibration

All values for the relative response factor (RRF) were greater than the 0.05 minimum control limit. The values for percent difference (%D) were within the ±25% control limits, with the exceptions noted below. Results and reporting limits from samples associated with outliers indicative of a low bias were estimated (J/UJ-5B) and positive results in samples associated with outliers indicative of a high bias were estimated (J-5B).

SDG NE18:

CCAL Date	Instrument ID	Analyte	Bias
8/9/08	NT4	Indeno(1,2,3-cd)pyrene	Low

Reporting Limits

All reporting limits were significantly greater than the 20 µg/kg target reporting limit specified in the sampling and analysis plan. The reporting limits ranged from 460 µg/kg to 2000 µg/kg. The elevated reporting limits were due to the need to extract a small sample size and analyze at a dilution to lower matrix interference from the lipid content. No action was taken.

Calculation Verification

Several results were verified by recalculation from the raw data. No calculation or transcription errors were found.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, laboratory control sample, and matrix spike/matrix spike duplicate (MS/MSD) percent recovery values, with the exceptions noted above. Precision was also acceptable as demonstrated by the relative percent difference values for the MS/MSD analyses, with the exceptions noted above.

Data were estimated due to CCAL %D outliers.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Rayonier Investigation Area WD-25
Dioxin/Furan Compounds by Axys Method MLA-017
Matrix: Sediment

This report documents the review of analytical data from the analyses of sediment samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Axys Analytical Services Ltd., Sidney, British Columbia, Canada. See the **Sample Index** for a complete list of samples for which data were reviewed.

SDG	Number of Samples	Validation Level
20080624A	16	Full
20080624B	7	Full
20080626A	13	Full
20080626B	10	Full
20080722A	19	Full
20080725A	5	Full

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

No dioxin/furan data were reported for Sample EC05B. No action was taken other than to note this discrepancy.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are summarized in the following table:

1	Holding Times and Sample Receipt	1	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
	Initial Calibration (ICAL)		Ongoing Precision and Recovery (OPR)
	Continuing Calibration (CCAL)	2	Laboratory Duplicates
2	Laboratory Blanks	2	Compound Identification
	Field Blanks		Reporting Limits
	Labeled Compounds	1	Calculation Verification (full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received some sample coolers with temperatures less than the lower control limit. These temperature outliers did not impact data quality and no qualifiers were required.

Laboratory Blank

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times the concentration detected in the blank. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U-7). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Laboratory (method) blanks were analyzed at the appropriate frequency. Various target analytes were detected in the method blanks. A summary of contaminant levels, associated samples, and action levels is provided in the data validation worksheets. Results less than the action levels were qualified as not detected (U-7) in the associated samples. Only the following were qualified:

SDG 20080624A: 1,2,3,4,6,7,8-HpCDF (1 result), 1,2,3,4,7,8-HxCDF (3 results)

SDG 20080624B: 1,2,3,4,7,8-HxCDF (1 result), 1,2,3,4,6,7,8-HpCDF (1 result)

SDG 20080626A: OCDF (2 results)

SDG 20080722A: 1,2,3,4,6,7,8-HpCDF (7 results), 1,2,3,4,7,8,9-HpCDF (8 results), 1,2,3,4,7,8-HxCDF (6 results), 1,2,3,6,7,8-HxCDF (4 results), 2,3,4,6,7,8-HxCDF (2 results), 1,2,3,7,8-PeCDF (2 results), 2,3,4,7,8-PeCDF (5 results), OCDF (6 results)

Matrix Spike/Matrix Spike Duplicate

No matrix spike/matrix spike duplicate (MS/MSD) analyses were performed. Accuracy and precision were assessed using labeled compound recoveries, ongoing precision and recovery (OPR) samples, and laboratory duplicate samples.

Laboratory Duplicates

Duplicate sample pairs are listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL.

SDG 20080624A, 20080626A: No laboratory duplicate analyses were submitted with these packages. There was no measure of precision with these packages.

SDG 20080626B: Duplicate analyses were performed on Sample LP03A. The RPD value for 1,2,3,4,6,7,8-HpCDD exceeded the acceptance criteria. The result for this analyte was estimated (J-9) in the parent sample.

SDG 20080722A: Duplicate analyses were performed on Sample EE03B. The RPD values for 1,2,3,4,7,8,9-HpCDF and OCDF exceeded the acceptance criteria. The result for these analytes were estimated (J-9) in the parent sample.

Compound Identification

All results for 2,3,7,8-TCDF were confirmed on a DB-225 column as required by the method. The results from both columns were reported in the raw data and in the EDD. The 2,3,7,8-TCDF results on the DB-5 column were qualified as do-not-report (DNR-11). The results from the DB-225 column should be used.

For several samples, the laboratory reported EMPC or "estimated maximum possible concentrations" values for one or more of the target analytes. As required by the method, an EMPC value is reported when a peak was detected but did not meet quantitation criteria, therefore the result cannot be considered as positive identification for the analyte. To indicate that the reported result is essentially an elevated detection limit, the EMPC values were qualified as not detected (U-22) at the reported values.

The following were flagged as EMPC values by the laboratory and qualified U-22:

SDG 20080624A: 23 results

SDG 20080624B: 8 results

SDG 20080626A: 3 results

SDG 20080626B: 2 results

SDG 20080722A: 38 results

SDG 20080725A: 10 results

Calculation Verification

Calculation verifications were performed on all SDG. No calculation errors were found.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the labeled compound, and OPR %R values. Precision was acceptable as demonstrated by the RPD values for the laboratory duplicate, with the above exceptions.

Data were qualified as not detected to indicate that EMPC values represent elevated detection limits or because of method blank contamination. Data were also estimated because of laboratory duplicate precision outliers.

Data were labeled DNR in order to indicate the most appropriate value when multiple values are reported. Data that have been labeled DNR should not be used for any purpose. Since a usable result remains for all compounds in each sample, completeness is not affected.

All other data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Rayonier Investigation Area WD-25
Dioxin/Furan Compounds by Axys Method MLA-017
Matrix: Tissue

This report documents the review of analytical data from the analyses of tissue samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Axys Analytical Services Ltd., Sidney, British Columbia, Canada. See the **Sample Index** for a complete list of samples for which data were reviewed.

SDG	Number of Samples	Validation Level
20080624C	3	Full
20080716A	3	Full

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are summarized in the following table:

1	Holding Times and Sample Receipt	1	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
	Initial Calibration (ICAL)		Ongoing Precision and Recovery (OPR)
	Continuing Calibration (CCAL)	1	Laboratory Duplicates
2	Laboratory Blanks	2	Compound Identification
	Field Blanks		Reporting Limits
	Labeled Compounds	1	Calculation Verification (full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received some sample coolers with temperatures less than the lower control limit. These temperature outliers did not impact data quality and no qualifiers were required.

SDG 20080716A: No client chain-of-custody arrived with these samples. The laboratory contacted the client who then emailed an unsigned electronic copy. No further action was taken.

Laboratory Blank

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times the concentration detected in the blank. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U-7). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Laboratory (method) blanks were analyzed at the appropriate frequency. Various target analytes were detected in the method blanks. A summary of contaminant levels, associated samples, and action levels is provided in the data validation worksheets. Results less than the action levels were qualified as not detected (U-7) in the associated samples. Only the following were qualified:

SDG 20080716A: 1,2,3,4,6,7,8-HpCDF (2 results), OCDF (2 results)

Matrix Spike/Matrix Spike Duplicate

No matrix spike/matrix spike duplicate (MS/MSD) analyses were performed. Accuracy and precision were assessed using labeled compound recoveries, ongoing precision and recovery (OPR) samples, and laboratory duplicate samples.

Laboratory Duplicates

Duplicate sample pairs are listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL.

SDG 20080624C: No laboratory duplicate analyses were submitted with this package. There was no measure of precision with this package.

Compound Identification

All results for 2,3,7,8-TCDF were confirmed on a DB-225 column as required by the method. The results from both columns were reported in the raw data and in the EDD. The 2,3,7,8-TCDF results on the DB-5 column were qualified as do-not-report (DNR-11). The results from the DB-225 column should be used.

For several samples, the laboratory reported EMPC or "estimated maximum possible concentrations" values for one or more of the target analytes. As required by the method, an EMPC value is reported when a peak was detected but did not meet quantitation criteria, therefore the result cannot be considered as positive identification for the analyte. To indicate that the reported result is essentially an elevated detection limit, the EMPC values were qualified as not detected (U-22) at the reported values.

The following were flagged as EMPC values by the laboratory and qualified U-22:

SDG 20080624C: 12 results

SDG 20080716A: 9 results

Calculation Verification

Calculation verifications were performed on all SDG. No calculation errors were found.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the labeled compound, and OPR %R values. Precision was acceptable as demonstrated by the RPD values for the laboratory duplicate, with the above exceptions.

Data were qualified as not detected to indicate that EMPC values represent elevated detection limits. Data were also qualified as not detected because of method blank contamination.

Data were labeled DNR in order to indicate the most appropriate value when multiple values are reported. Data that have been labeled DNR should not be used for any purpose. Since a usable result remains for all compounds in each sample, completeness is not affected.

All other data, as qualified, are acceptable for use.

EcoChem, INC.
Environmental Data Quality

APPENDIX A

DATA QUALIFIER DEFINITIONS
REASON CODES
AND CRITERIA TABLES

DATA VALIDATION QUALIFIER CODES
National Functional Guidelines

The following definitions provide brief explanations of the qualifiers assigned to results in the data review process.

U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents the approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

The following is an EcoChem qualifier that may also be assigned during the data review process:

DNR	Do not report; a more appropriate result is reported from another analysis or dilution.

DATA QUALIFIER REASON CODES

1	Holding Time/Sample Preservation
2	Chromatographic pattern in sample does not match pattern of calibration standard.
3	Compound Confirmation
4	Tentatively Identified Compound (TIC) (associated with NJ only)
5A	Calibration (initial)
5B	Calibration (continuing)
6	Field Blank Contamination
7	Lab Blank Contamination (e.g., method blank, instrument, etc.)
8	Matrix Spike(MS & MSD) Recoveries
9	Precision (all replicates)
10	Laboratory Control Sample Recoveries
11	A more appropriate result is reported (associated with "R" and "DNR" only)
12	Reference Material
13	Surrogate Spike Recoveries (a.k.a., labeled compounds & recovery standards)
14	Other (define in validation report)
15	GFAA Post Digestion Spike Recoveries
16	ICP Serial Dilution % Difference
17	ICP Interference Check Standard Recovery
18	Trip Blank Contamination
19	Internal Standard Performance (e.g., area, retention time, recovery)
20	Linear Range Exceeded
21	Potential False Positives
22	Elevated Detection Limit Due to Interference (i.e., laboratory, chemical and/or matrix)

EcoChem Validation Guidelines for Semivolatile Analysis by GC/MS
(Based on Organic NFG 1999)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Cooler Temperature	4°C ±2°	J(+)/UJ(-) if greater than 6 deg. C (EcoChem PJ)	1
Holding Time	Water: 7 days from collection Soil: 14 days from collection Analysis: 40 days from extraction	Water: J(+)/UJ(-) if ext. > 7 and < 21 days J(+)/R(-) if ext > 21 days (EcoChem PJ) Solids/Wastes: J(+)/UJ(-) if ext. > 14 and < 42 days J(+)/R(-) if ext. > 42 days (EcoChem PJ) J(+)/UJ(-) if analysis >40 days	1
Tuning	DFTPP Beginning of each 12 hour period Method acceptance criteria	R(+/-) all analytes in all samples associated with the tune	5A
Initial Calibration (Minimum 5 stds.)	RRF > 0.05	(EcoChem PJ, see TM-06) If MDL= reporting limit: J(+)/R(-) if RRF < 0.05 If reporting limit > MDL: note in worksheet if RRF <0.05	5A
	%RSD < 30%	(EcoChem PJ, see TM-06) J(+) if %RSD > 30%	5A
Continuing Calibration (Prior to each 12 hr. shift)	RRF > 0.05	(EcoChem PJ, see TM-06) If MDL= reporting limit: J(+)/R(-) if RRF < 0.05 If reporting limit > MDL: note in worksheet if RRF <0.05	5B
	%D <25%	(EcoChem PJ, see TM-06) If > +/-90%: J+/R- If -90% to -26%: J+ (high bias) If 26% to 90%: J+/UJ- (low bias)	5B
Method Blank	One per matrix per batch No results > CRQL	U(+) if sample (+) result is less than CRQL and less than appropriate 5X or 10X rule (raise sample value to CRQL)	7
		U(+) if sample (+) result is greater than or equal to CRQL and less than appropriate 5X and 10X rule (at reported sample value)	7
	No TICs present	R(+) TICs using 10X rule	7
Field Blanks (Not Required)	No results > CRQL	Apply 5X/10X rule; U(+) < action level	6

EcoChem Validation Guidelines for Semivolatile Analysis by GC/MS
(Based on Organic NFG 1999)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
MS/MSD (recovery)	One per matrix per batch Use method acceptance criteria	Qualify parent only unless other QC indicates systematic problems: J(+) if both %R > UCL J(+)/UJ(-) if both %R < LCL J(+)/R(-) if both %R < 10% PJ if only one %R outlier	8
MS/MSD (RPD)	One per matrix per batch Use method acceptance criteria	J(+) in parent sample if RPD > CL	9
LCS low conc. H2O SVOA	One per lab batch Within method control limits	J(+) assoc. cmpd if > UCL J(+)/R(-) assoc. cmpd if < LCL J(+)/R(-) all cmpds if half are < LCL	10
LCS regular SVOA (H2O & solid)	One per lab batch Lab or method control limits	J(+) if %R > UCL J(+)/UJ(-) if %R <LCL J(+)/R(-) if %R < 10% (EcoChem PJ)	10
LCS/LCSD *(if required)*	One set per matrix and batch of 20 samples RPD < 35%	J(+)/UJ(-) assoc. cmpd. in all samples	9
Surrogates	Minimum of 3 acid and 3 base/neutral compounds Use method acceptance criteria	Do not qualify if only 1 acid and/or 1 B/N surrogate is out unless <10% J(+) if %R > UCL J(+)/UJ(-) if %R < LCL J(+)/R(-) if %R < 10%	13
Internal Standards	Added to all samples Acceptable Range: IS area 50% to 200% of CCAL area RT within 30 seconds of CC RT	J(+) if > 200% J(+)/UJ(-) if < 50% J(+)/R(-) if < 25% RT>30 seconds, narrate and Notify PM	19
Field Duplicates	Use QAPP limits. If no QAPP: Solids: RPD <50% OR absolute diff. < 2X RL (for results < 5X RL) Aqueous: RPD <35% OR absolute diff. < 1X RL (for results < 5X RL)	Narrate and qualify if required by project (EcoChem PJ)	9
TICs	Major ions (>10%) in reference must be present in sample; intensities agree within 20%; check identification	NJ the TIC unless: R(+) common laboratory contaminants See Technical Director for ID issues	4
Quantitation/ Identification	RRT within 0.06 of standard RRT Ion relative intensity within 20% of standard All ions in std. at > 10% intensity must be present in sample	See Technical Director if outliers	14 21 (false +)

EcoChem Validation Guidelines for Dioxin/Furan Analysis by HRMS
(Based on EPA Reg. 10 SOP, Rev. 2, 1996 & EPA SW-846, Methods 1613b and 8290)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Cooler/Storage Temperature	Waters/Solids < 4°C Tissues <-10°C	EcoChem PJ, see TM-05	1
Holding Time	Extraction - Water: 30 days from collection *Note:* Under CWA, SDWA, and RCRA the HT for H2O is 7 days* Extraction - Soil: 30 days from collection Analysis: 40 days from extraction	J(+)/UJ(-) if ext > 30 days J(+)/UJ(-) if analysis > 40 Days EcoChem PJ, see TM-05	1
Mass Resolution	>=10,000 resolving power at m/z 304.9824 Exact mass of m/z 380.9760 w/in 5 ppm of theoretical value (380.97410 to 380.97790) . Analyzed prior to ICAL and at the start and end of each 12 hr. shift	R(+/-) if not met	14
Window Defining Mix and Column Performance Mix	Window defining mixture/Isomer specificity std run before ICAL and CCAL Valley < 25% (valley = (x/y)*100%) x = ht. of TCDD y = baseline to bottom of valley For all isomers eluting near 2378-TCDD/TCDF isomers (TCDD only for 8290)	J(+) if valley > 25%	5A (ICAL) 5B (CCAL
Initial Calibration	Minimum of five standards %RSD < 20% for native compounds %RSD <30% for labeled compounds (%RSD <35% for labeled compounds under 1613b)	J(+) natives if %RSD > 20%	5A
	Abs. RT of $^{13}C_{12}$-1234-TCDD >25 min on DB5 >15 min on DB-225	EcoChem PJ, see TM-05	
	Ion Abundance ratios within QC limits (Table 8 of method 8290) (Table 9 of method 1613B)	EcoChem PJ, see TM-05	
	S/N ratio > 10 for all native and labeled compounds in CS1 std.	If <10, elevate Det. Limit or R(-)	

EcoChem Validation Guidelines for Dioxin/Furan Analysis by HRMS
(Based on EPA Reg. 10 SOP, Rev. 2, 1996 & EPA SW-846, Methods 1613b and 8290)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Continuing Calibration	Analyzed at the start and end of each 12 hour shift. %D+/-20% for native compounds %D +/-30% for labeled compounds (Must meet limits in Table 6, Method 1613B) (If %Ds in the closing CCAL are w/in 25%/35% the avg RF from the two CCAL may be used to calculate samples per Method 8290, Section 8.3.2.4)	Do not qualify labeled compounds. Narrate in report for labeled compound %D outliers. For native compound %D outliers: 8290: J(+)/UJ(-) if %D = 20% - 75% J(+)/R(-) if %D > 75% 1613: J(+)/UJ(-) if %D is outside Table 6 limits J(+)/R(-) if %D is +/- 75% of Table 6 limit	5B
	Abs. RT of $^{13}C_{12}$-1234-TCDD and ^{13}C12-123789-HxCDD +/- 15 sec of ICAL.	EcoChem PJ, see ICAL section of TM-05	
	RRT of all other compounds must meet Table 2 of 1613B.	EcoChem PJ, see TM-05	
	Ion Abundance ratios within QC limits (Table 8 of method 8290) (Table 9 of method 1613B)	EcoChem PJ, see TM-05	
	S/N ratio > 10	If <10, elevate Det. Limit or R(-)	
Method Blank	One per matrix per batch No positive results	If sample result <5X action level, qualify U at reported value.	7
Field Blanks (Not Required)	No positive results	If sample result <5X action level, qualify U at reported value.	6
LCS / OPR	Concentrations must meet limits in Table 6, Method 1613B or lab limits.	J(+) if %R > UCL J(+)/UJ(-) if %R < LCL J(+)/R(-) using PJ if %R <<LCL (< 10%)	10
MS/MSD (recovery)	May not analyze MS/MSD %R should meet lab limits.	Qualify parent only unless other QC indicates systematic problems: J(+) if both %R > UCL J(+)/UJ(-) if both %R < LCL J(+)/R(-) if both %R < 10% PJ if only one %R outlier	8
MS/MSD (RPD)	May not analyze MS/MSD RPD < 20%	J(+) in parent sample if RPD > CL	9

EcoChem Validation Guidelines for Dioxin/Furan Analysis by HRMS
(Based on EPA Reg. 10 SOP, Rev. 2, 1996 & EPA SW-846, Methods 1613b and 8290)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Lab Duplicate	RPD <25% if present.	J(+)/UJ(-) if outside limts	9
Labeled Compounds / Internal Standards	*Method 8290:* %R = 40% - 135% in all samples ------------------------------ *Method 1613B:* %R must meet limits specified in Table 7, Method 1613	J(+)/UJ(-) if %R = 10% to LCL J(+) if %R > UCL J(+)/R(-) if %R < 10%	13
Quantitation/ Identification	Ions for analyte, IS, and rec. std. must max w/in 2 sec. S/N >2.5 IA ratios meet limits in Table 9 of 1613B or Table 8 of 8290 RRTs w/in limits in Table 2 of 1613B	If RT criteria not met, use PJ (see TM-05) If S/N criteria not met, J(+). if unlabelled ion abundance not met, change to EMPC If labelled ion abundance not met, J(+).	21
EMPC (estimated maximum possible concentration)	If quantitation idenfication criteria are not met, laboratory should report an EMPC value.	If laboratory correctly reported an EMPC value, qualify with U to indicate that the value is a detection limit.	14
Interferences	PCDF interferences from PCDPE	If both detected, change PCDF result to EMPC	14
Second Column Confirmation	All 2378-TCDF hits must be confirmed on a DB-225 (or equiv) column. All QC specs in this table must be met for the confirmation analysis.	Report lower of the two values. If not performed use PJ (see TM-05).	3
Field Duplicates	Use QAPP limits. If no QAPP: Solids: RPD <50% OR absolute diff. < 2X RL (for results < 5X RL) Aqueous: RPD <35% OR absolute diff. < 1X RL (for results < 5X RL)	Narrate and qualify if required by project (EcoChem PJ)	9
Two analyses for one sample	Report only one result per analyte	"DNR" results that should not be used	11

EcoChem, INC.
Environmental Data Quality

APPENDIX B
QUALIFIED DATA SUMMARY TABLE

QUALIFIED DATA SUMMARY TABLE
Rayonier Area WD25

Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifier	DV Reason Code
CO01A	Sediment	20080626A	L11346-1	2,3,7,8-TCDF	DNR	11
CO02A	Sediment	20080626A	L11346-2	2,3,7,8-TCDF	DNR	11
CO02B	Sediment	20080722A	L11458-10	1,2,3,4,7,8,9-HPCDF	U	7
CO02B	Sediment	20080722A	L11458-10	2,3,7,8-TCDF	DNR	11
CO03A	Sediment	20080626A	L11346-3	2,3,7,8-TCDF	DNR	11
CO03B	Sediment	20080722A	L11458-11	1,2,3,7,8,9-HXCDF	U	22
CO03B	Sediment	20080722A	L11458-11	2,3,7,8-TCDF	DNR	11
CO04A	Sediment	20080624A	L11334-1	1,2,3,4,7,8-HXCDD	U	22
CO04A	Sediment	20080624A	L11334-1	1,2,3,4,7,8-HXCDF	U	7
CO04A	Sediment	20080624A	L11334-1	1,2,3,7,8-PECDD	U	22
CO04A	Sediment	20080624A	L11334-1	1,2,3,7,8-PECDF	U	22
CO04A	Sediment	20080624A	L11334-1	2,3,7,8-TCDD	U	22
CO04A	Sediment	20080624A	L11334-1	2,3,7,8-TCDF	DNR	11
CO04B	Sediment	20080722A	L11458-12	1,2,3,4,6,7,8-HPCDF	U	7
CO04B	Sediment	20080722A	L11458-12	1,2,3,4,7,8,9-HPCDF	U	7
CO04B	Sediment	20080722A	L11458-12	1,2,3,4,7,8-HXCDD	U	22
CO04B	Sediment	20080722A	L11458-12	1,2,3,4,7,8-HXCDF	U	22
CO04B	Sediment	20080722A	L11458-12	1,2,3,6,7,8-HXCDF	U	7
CO04B	Sediment	20080722A	L11458-12	1,2,3,7,8-PECDD	U	22
CO04B	Sediment	20080722A	L11458-12	1,2,3,7,8-PECDF	U	22
CO04B	Sediment	20080722A	L11458-12	2,3,4,6,7,8-HXCDF	U	7
CO04B	Sediment	20080722A	L11458-12	2,3,4,7,8-PECDF	U	7
CO04B	Sediment	20080722A	L11458-12	2,3,7,8-TCDF	DNR	11
CO04B	Sediment	20080722A	L11458-12	OCDF	U	7
CO05A	Sediment	20080626B	L11346-26	1,2,3,7,8,9-HXCDF	U	22
CO05A	Sediment	20080626B	L11346-26	2,3,7,8-TCDF	DNR	11
CO05B	Sediment	20080722A	L11458-1	2,3,7,8-TCDF	DNR	11
DO01A	Sediment	20080624A	L11334-2	2,3,7,8-TCDF	DNR	11
DO02A	Sediment	20080624A	L11334-3	1,2,3,7,8,9-HXCDF	U	22
DO02A	Sediment	20080624A	L11334-3	2,3,7,8-TCDF	DNR	11
DO03A	Sediment	20080624A	L11334-4	1,2,3,6,7,8-HXCDF	U	22
DO03A	Sediment	20080624A	L11334-4	2,3,7,8-TCDF	DNR	11
DO04A	Sediment	NC49	NC49I	1-Methylnaphthalene	DNR	11
DO04A	Sediment	20080624A	L11334-5	2,3,7,8-TCDF	DNR	11
DO04A	Sediment	NC49	NC49I	2-Methylnaphthalene	DNR	11
DO04A	Sediment	NC49	NC49I	Acenaphthene	DNR	11
DO04A	Sediment	NC49	NC49I	Acenaphthylene	DNR	11
DO04A	Sediment	NC49	NC49I	Anthracene	DNR	11
DO04A	Sediment	NC49	NC49I	Benzo(a)anthracene	DNR	11
DO04A	Sediment	NC49	NC49I	Benzo(a)pyrene	DNR	11
DO04A	Sediment	NC49	NC49I	Benzo(b)fluoranthene	DNR	11
DO04A	Sediment	NC49	NC49I	Benzo(g,h,i)perylene	DNR	11
DO04A	Sediment	NC49	NC49I	Benzo(k)fluoranthene	DNR	11
DO04A	Sediment	NC49	NC49I	Chrysene	DNR	11
DO04A	Sediment	NC49	NC49I	Dibenz(a,h)anthracene	DNR	11

QUALIFIED DATA SUMMARY TABLE
Rayonier Area WD25

Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifier	DV Reason Code
DO04A	Sediment	NC49	NC49I	Fluoranthene	DNR	11
DO04A	Sediment	NC49	NC49I	Fluorene	DNR	11
DO04A	Sediment	NC49	NC49I	Indeno(1,2,3-cd)pyrene	DNR	11
DO04A	Sediment	NC49	NC49I	Naphthalene	DNR	11
DO04A	Sediment	NC49	NC49I	Phenanthrene	DNR	11
DO04A	Sediment	NC49	NC49I	Pyrene	DNR	11
DO04B	Sediment	20080725A	L11487-1	2,3,7,8-TCDF	DNR	11
DO04C	Sediment	20080725A	L11487-2	1,2,3,7,8-PECDF	U	22
DO04C	Sediment	20080725A	L11487-2	2,3,4,6,7,8-HXCDF	U	22
DO04C	Sediment	20080725A	L11487-2	2,3,7,8-TCDD	U	22
DO04C	Sediment	20080725A	L11487-2	2,3,7,8-TCDF	U	22
DO04C	Sediment	20080725A	L11487-2	2,3,7,8-TCDF	DNR	11
DO04D	Sediment	20080725A	L11487-3	1,2,3,4,7,8-HXCDD	U	22
DO04D	Sediment	20080725A	L11487-3	1,2,3,4,7,8-HXCDF	U	22
DO04D	Sediment	20080725A	L11487-3	1,2,3,6,7,8-HXCDD	U	22
DO04D	Sediment	20080725A	L11487-3	1,2,3,7,8-PECDD	U	22
DO04D	Sediment	20080725A	L11487-3	2,3,7,8-TCDF	DNR	11
DO05A	Sediment	20080624A	L11334-6	2,3,7,8-TCDF	DNR	11
DO05B	Sediment	20080725A	L11487-4	1,2,3,4,7,8-HXCDF	U	22
DO05B	Sediment	20080725A	L11487-4	2,3,7,8-TCDF	DNR	11
DO05C	Sediment	20080725A	L11487-5	2,3,7,8-TCDD	U	22
DO05C	Sediment	20080725A	L11487-5	2,3,7,8-TCDF	DNR	11
EC01A	Sediment	20080626A	L11346-4	2,3,7,8-TCDF	DNR	11
EC01A	Sediment	20080626A	L11346-4	OCDF	U	7
EC02A	Sediment	20080626A	L11346-5	2,3,7,8-TCDD	U	22
EC02A	Sediment	20080626A	L11346-5	2,3,7,8-TCDF	DNR	11
EC03A	Sediment	20080624A	L11334-7	2,3,7,8-TCDF	DNR	11
EC03B	Sediment	20080722A	L11458-2	2,3,7,8-TCDF	DNR	11
EC03C	Sediment	20080722A	L11458-13	2,3,7,8-TCDF	DNR	11
EC04A	Sediment	20080626A	L11346-6	2,3,7,8-TCDF	DNR	11
EC04B	Sediment	20080722A	L11458-14	2,3,7,8-TCDF	DNR	11
EC05A	Sediment	20080626A	L11346-7	1,2,3,4,7,8-HXCDD	U	22
EC05A	Sediment	20080626A	L11346-7	2,3,7,8-TCDD	U	22
EC05A	Sediment	20080626A	L11346-7	2,3,7,8-TCDF	DNR	11
EC05A	Sediment	20080626A	L11346-7	OCDF	U	7
EC06TH	Tissue	20080624C	L11299-5	1,2,3,4,6,7,8-HPCDF	U	22
EC06TH	Tissue	20080624C	L11299-5	1,2,3,4,7,8-HXCDF	U	22
EC06TH	Tissue	20080624C	L11299-5	1,2,3,7,8,9-HXCDD	U	22
EC06TH	Tissue	20080624C	L11299-5	2,3,4,7,8-PECDF	U	22
EC06TH	Tissue	20080624C	L11299-5	2,3,7,8-TCDD	U	22
EC06TH	Tissue	20080624C	L11299-5	2,3,7,8-TCDF	DNR	11
EC06TH	Tissue	NE18	NE18A	Indeno(1,2,3-cd)pyrene	UJ	5B
EC06TH	Tissue	20080624C	L11299-5	OCDF	U	22
ED01A	Sediment	20080626A	L11346-8	2,3,7,8-TCDF	DNR	11
ED01B	Sediment	20080624A	L11334-8	2,3,7,8-TCDF	DNR	11

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Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifier	DV Reason Code
ED01C	Sediment	20080624A	L11334-9	1,2,3,4,7,8,9-HPCDF	U	22
ED01C	Sediment	20080624A	L11334-9	1,2,3,4,7,8-HXCDF	U	22
ED01C	Sediment	20080624A	L11334-9	1,2,3,6,7,8-HXCDF	U	22
ED01C	Sediment	20080624A	L11334-9	1,2,3,7,8-PECDF	U	22
ED01C	Sediment	20080624A	L11334-9	2,3,4,6,7,8-HXCDF	U	22
ED01C	Sediment	20080624A	L11334-9	2,3,4,7,8-PECDF	U	22
ED01C	Sediment	20080624A	L11334-9	2,3,7,8-TCDD	U	22
ED01C	Sediment	20080624A	L11334-9	2,3,7,8-TCDF	DNR	11
ED02A	Sediment	20080626A	L11346-9	2,3,7,8-TCDF	DNR	11
ED02B	Sediment	20080626A	L11346-10	2,3,7,8-TCDF	DNR	11
ED02C	Sediment	20080624A	L11334-10	2,3,7,8-TCDF	DNR	11
ED03A	Sediment	20080624A	L11334-11	2,3,7,8-TCDF	DNR	11
ED03A	Sediment	NC45	NC45K	Benzo(a)anthracene	J	19
ED03A	Sediment	NC45	NC45K	Chrysene	J	19
ED03A	Sediment	NC45	NC45K	Pyrene	J	19
ED03B	Sediment	20080626A	L11346-11	2,3,7,8-TCDF	DNR	11
ED03B	Sediment	NC45	NC45L	Benzo(a)anthracene	J	19
ED03B	Sediment	NC45	NC45L	Chrysene	J	19
ED03B	Sediment	NC45	NC45L	Pyrene	J	19
ED03C	Sediment	20080626A	L11346-12	2,3,7,8-TCDF	DNR	11
ED04A	Sediment	20080624A	L11334-12	2,3,7,8-TCDF	DNR	11
ED04A	Sediment	NC45	NC45N	Benzo(a)anthracene	J	19
ED04A	Sediment	NC45	NC45N	Chrysene	J	19
ED04A	Sediment	NC45	NC45N	Pyrene	J	19
ED04B	Sediment	20080626A	L11346-13	2,3,7,8-TCDF	DNR	11
ED05A	Sediment	20080624A	L11334-13	2,3,7,8-TCDF	DNR	11
ED05B	Sediment	20080722A	L11458-3	2,3,7,8-TCDF	DNR	11
EE01A	Sediment	20080624A	L11334-14	1,2,3,4,6,7,8-HPCDF	U	7
EE01A	Sediment	20080624A	L11334-14	1,2,3,4,7,8,9-HPCDF	U	22
EE01A	Sediment	20080624A	L11334-14	1,2,3,4,7,8-HXCDF	U	22
EE01A	Sediment	20080624A	L11334-14	1,2,3,6,7,8-HXCDF	U	22
EE01A	Sediment	20080624A	L11334-14	2,3,4,7,8-PECDF	U	22
EE01A	Sediment	20080624A	L11334-14	2,3,7,8-TCDD	U	22
EE01A	Sediment	20080624A	L11334-14	2,3,7,8-TCDF	DNR	11
EE01B	Sediment	20080722A	L11458-4	1,2,3,4,6,7,8-HPCDF	U	7
EE01B	Sediment	20080722A	L11458-4	1,2,3,4,7,8,9-HPCDF	U	22
EE01B	Sediment	20080722A	L11458-4	1,2,3,4,7,8-HXCDD	U	22
EE01B	Sediment	20080722A	L11458-4	1,2,3,4,7,8-HXCDF	U	7
EE01B	Sediment	20080722A	L11458-4	1,2,3,6,7,8-HXCDD	U	22
EE01B	Sediment	20080722A	L11458-4	1,2,3,6,7,8-HXCDF	U	22
EE01B	Sediment	20080722A	L11458-4	1,2,3,7,8,9-HXCDD	U	22
EE01B	Sediment	20080722A	L11458-4	2,3,4,7,8-PECDF	U	22
EE01B	Sediment	20080722A	L11458-4	2,3,7,8-TCDD	U	22
EE01B	Sediment	20080722A	L11458-4	2,3,7,8-TCDF	DNR	11
EE01B	Sediment	20080722A	L11458-4	OCDF	U	7

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Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifier	DV Reason Code
EE02A	Sediment	20080624A	L11334-15	1,2,3,4,7,8-HXCDF	U	7
EE02A	Sediment	20080624A	L11334-15	2,3,7,8-TCDF	U	22
EE02A	Sediment	20080624A	L11334-15	2,3,7,8-TCDF	DNR	11
EE02B	Sediment	20080722A	L11334-15	1,2,3,4,7,8,9-HPCDF	U	7
EE02B	Sediment	20080722A	L11334-15	1,2,3,7,8,9-HXCDF	U	22
EE02B	Sediment	20080722A	L11334-15	2,3,7,8-TCDD	U	22
EE02B	Sediment	20080722A	L11334-15	2,3,7,8-TCDF	DNR	11
EE02C	Sediment	20080722A	L11458-16	1,2,3,4,6,7,8-HPCDF	U	7
EE02C	Sediment	20080722A	L11458-16	1,2,3,4,7,8,9-HPCDF	U	22
EE02C	Sediment	20080722A	L11458-16	1,2,3,4,7,8-HXCDD	U	22
EE02C	Sediment	20080722A	L11458-16	1,2,3,4,7,8-HXCDF	U	7
EE02C	Sediment	20080722A	L11458-16	1,2,3,6,7,8-HXCDD	U	22
EE02C	Sediment	20080722A	L11458-16	1,2,3,6,7,8-HXCDF	U	22
EE02C	Sediment	20080722A	L11458-16	1,2,3,7,8-PECDF	U	22
EE02C	Sediment	20080722A	L11458-16	2,3,4,6,7,8-HXCDF	U	22
EE02C	Sediment	20080722A	L11458-16	2,3,4,7,8-PECDF	U	7
EE02C	Sediment	20080722A	L11458-16	2,3,7,8-TCDF	U	22
EE02C	Sediment	20080722A	L11458-16	2,3,7,8-TCDF	DNR	11
EE02C	Sediment	20080722A	L11458-16	OCDF	U	7
EE03A	Sediment	20080624A	L11334-16	1,2,3,4,7,8-HXCDF	U	7
EE03A	Sediment	20080624A	L11334-16	1,2,3,6,7,8-HXCDF	U	22
EE03A	Sediment	20080624A	L11334-16	1,2,3,7,8-PECDF	U	22
EE03A	Sediment	20080624A	L11334-16	2,3,4,6,7,8-HXCDF	U	22
EE03A	Sediment	20080624A	L11334-16	2,3,7,8-TCDD	U	22
EE03A	Sediment	20080624A	L11334-16	2,3,7,8-TCDF	DNR	11
EE03B	Sediment	20080722A	L11458-5	1,2,3,4,7,8,9-HPCDF	J	9
EE03B	Sediment	20080722A	L11458-5	1,2,3,6,7,8-HXCDF	U	7
EE03B	Sediment	20080722A	L11458-5	2,3,7,8-TCDF	DNR	11
EE03B	Sediment	20080722A	L11458-5	OCDF	J	9
EE03C	Sediment	20080722A	L11458-6	1,2,3,4,7,8,9-HPCDF	U	7
EE03C	Sediment	20080722A	L11458-6	1,2,3,4,7,8-HXCDF	U	7
EE03C	Sediment	20080722A	L11458-6	1,2,3,7,8-PECDD	U	22
EE03C	Sediment	20080722A	L11458-6	2,3,7,8-TCDD	U	22
EE03C	Sediment	20080722A	L11458-6	2,3,7,8-TCDF	DNR	11
EE04A	Sediment	20080624B	L11334-17	1,2,3,4,7,8-HXCDF	U	7
EE04A	Sediment	20080624B	L11334-17	1,2,3,7,8,9-HXCDD	U	22
EE04A	Sediment	20080624B	L11334-17	2,3,7,8-TCDD	U	22
EE04A	Sediment	20080624B	L11334-17	2,3,7,8-TCDF	DNR	11
EE04B	Sediment	20080722A	L11458-7	1,2,3,4,6,7,8-HPCDF	U	7
EE04B	Sediment	20080722A	L11458-7	1,2,3,4,7,8,9-HPCDF	U	7
EE04B	Sediment	20080722A	L11458-7	1,2,3,4,7,8-HXCDF	U	7
EE04B	Sediment	20080722A	L11458-7	1,2,3,6,7,8-HXCDF	U	7
EE04B	Sediment	20080722A	L11458-7	1,2,3,7,8-PECDF	U	7
EE04B	Sediment	20080722A	L11458-7	2,3,4,6,7,8-HXCDF	U	7
EE04B	Sediment	20080722A	L11458-7	2,3,4,7,8-PECDF	U	7

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Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifier	DV Reason Code
EE04B	Sediment	20080722A	L11458-7	2,3,7,8-TCDD	U	22
EE04B	Sediment	20080722A	L11458-7	2,3,7,8-TCDF	DNR	11
EE04C	Sediment	20080722A	L11458-9	1,2,3,4,6,7,8-HPCDF	U	7
EE04C	Sediment	20080722A	L11458-9	1,2,3,4,7,8,9-HPCDF	U	7
EE04C	Sediment	20080722A	L11458-9	1,2,3,4,7,8-HXCDF	U	7
EE04C	Sediment	20080722A	L11458-9	1,2,3,6,7,8-HXCDD	U	22
EE04C	Sediment	20080722A	L11458-9	1,2,3,6,7,8-HXCDF	U	22
EE04C	Sediment	20080722A	L11458-9	1,2,3,7,8,9-HXCDD	U	22
EE04C	Sediment	20080722A	L11458-9	1,2,3,7,8-PECDD	U	22
EE04C	Sediment	20080722A	L11458-9	1,2,3,7,8-PECDF	U	22
EE04C	Sediment	20080722A	L11458-9	2,3,4,7,8-PECDF	U	7
EE04C	Sediment	20080722A	L11458-9	2,3,7,8-TCDD	U	22
EE04C	Sediment	20080722A	L11458-9	2,3,7,8-TCDF	DNR	11
EE04C	Sediment	20080722A	L11458-9	OCDF	U	7
EE05A	Sediment	20080624B	L11334-18	1,2,3,4,6,7,8-HPCDF	U	7
EE05A	Sediment	20080624B	L11334-18	1,2,3,4,7,8-HXCDF	U	22
EE05A	Sediment	20080624B	L11334-18	1,2,3,7,8-PECDD	U	22
EE05A	Sediment	20080624B	L11334-18	2,3,7,8-TCDD	U	22
EE05A	Sediment	20080624B	L11334-18	2,3,7,8-TCDF	DNR	11
LP01A	Sediment	20080626B	L11346-17	2,3,7,8-TCDF	DNR	11
LP03A	Sediment	20080626B	L11346-18	1,2,3,4,6,7,8-HPCDD	J	9
LP03A	Sediment	20080626B	L11346-18	2,3,7,8-TCDD	U	22
LP03A	Sediment	20080626B	L11346-18	2,3,7,8-TCDF	DNR	11
LP04A	Sediment	20080626B	L11346-19	2,3,7,8-TCDF	DNR	11
LP05A	Sediment	20080626B	L11346-20	2,3,7,8-TCDF	DNR	11
MD01A	Sediment	20080626B	L11346-21	2,3,7,8-TCDF	DNR	11
MD01B	Sediment	20080722A	L11458-17	1,2,3,7,8,9-HXCDF	U	22
MD01B	Sediment	20080722A	L11458-17	2,3,7,8-TCDF	DNR	11
MD01C	Sediment	20080722A	L11458-8	1,2,3,4,6,7,8-HPCDF	U	7
MD01C	Sediment	20080722A	L11458-8	1,2,3,4,7,8,9-HPCDF	U	7
MD01C	Sediment	20080722A	L11458-8	1,2,3,4,7,8-HXCDD	U	22
MD01C	Sediment	20080722A	L11458-8	1,2,3,4,7,8-HXCDF	U	22
MD01C	Sediment	20080722A	L11458-8	1,2,3,6,7,8-HXCDD	U	22
MD01C	Sediment	20080722A	L11458-8	1,2,3,6,7,8-HXCDF	U	7
MD01C	Sediment	20080722A	L11458-8	1,2,3,7,8-PECDF	U	7
MD01C	Sediment	20080722A	L11458-8	2,3,4,6,7,8-HXCDF	U	22
MD01C	Sediment	20080722A	L11458-8	2,3,4,7,8-PECDF	U	7
MD01C	Sediment	20080722A	L11458-8	2,3,7,8-TCDD	U	22
MD01C	Sediment	20080722A	L11458-8	2,3,7,8-TCDF	DNR	11
MD01C	Sediment	20080722A	L11458-8	OCDF	U	7
MD02A	Sediment	20080626B	L11346-22	2,3,7,8-TCDF	DNR	11
MD02B	Sediment	20080722A	L11458-18	2,3,7,8-TCDF	DNR	11
MD02C	Sediment	20080722A	L11458-19	1,2,3,4,6,7,8-HPCDF	U	7
MD02C	Sediment	20080722A	L11458-19	1,2,3,4,7,8,9-HPCDF	U	7
MD02C	Sediment	20080722A	L11458-19	1,2,3,4,7,8-HXCDF	U	7

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Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifier	DV Reason Code
MD02C	Sediment	20080722A	L11458-19	2,3,4,6,7,8-HXCDF	U	22
MD02C	Sediment	20080722A	L11458-19	2,3,7,8-TCDD	U	22
MD02C	Sediment	20080722A	L11458-19	2,3,7,8-TCDF	DNR	11
MD02C	Sediment	20080722A	L11458-19	OCDF	U	7
MD03A	Sediment	20080626B	L11346-23	2,3,7,8-TCDF	DNR	11
MD03B	Sediment	20080624B	L11334-26	2,3,7,8-TCDF	DNR	11
MD03C	Sediment	20080624B	L11334-27	2,3,7,8-TCDF	DNR	11
MD04A	Sediment	20080626B	L11346-24	2,3,7,8-TCDF	DNR	11
MD04B	Sediment	20080624B	L11334-28	2,3,7,8-TCDF	DNR	11
MD05A	Sediment	20080626B	L11346-25	2,3,7,8-TCDF	DNR	11
MD05B	Sediment	20080624B	L11334-29	2,3,7,8-TCDF	U	22
MD05B	Sediment	20080624B	L11334-29	2,3,7,8-TCDF	DNR	11
MD05C	Sediment	20080624B	L11334-30	1,2,3,4,7,8-HXCDF	U	22
MD05C	Sediment	20080624B	L11334-30	2,3,7,8-TCDD	U	22
MD05C	Sediment	20080624B	L11334-30	2,3,7,8-TCDF	DNR	11
MD06TH	Tissue	20080624C	L11299-3	2,3,7,8-TCDD	U	22
MD06TH	Tissue	20080624C	L11299-3	2,3,7,8-TCDF	DNR	11
MD06TH	Tissue	NE18	NE18E	Indeno(1,2,3-cd)pyrene	UJ	5B
MD07TH	Tissue	20080624C	L11299-4	1,2,3,4,7,8-HXCDF	U	22
MD07TH	Tissue	20080624C	L11299-4	1,2,3,7,8,9-HXCDD	U	22
MD07TH	Tissue	20080624C	L11299-4	1,2,3,7,8-PECDD	U	22
MD07TH	Tissue	20080624C	L11299-4	2,3,4,7,8-PECDF	U	22
MD07TH	Tissue	20080624C	L11299-4	2,3,7,8-TCDD	U	22
MD07TH	Tissue	20080624C	L11299-4	2,3,7,8-TCDF	DNR	11
MD07TH	Tissue	NE18	NE18F	Indeno(1,2,3-cd)pyrene	UJ	5B
MD08TG	Tissue	20080716A	L11431-1	1,2,3,4,6,7,8-HPCDF	U	22
MD08TG	Tissue	20080716A	L11431-1	1,2,3,6,7,8-HXCDD	U	22
MD08TG	Tissue	20080716A	L11431-1	1,2,3,7,8,9-HXCDD	U	22
MD08TG	Tissue	20080716A	L11431-1	1,2,3,7,8-PECDD	U	22
MD08TG	Tissue	20080716A	L11431-1	2,3,4,7,8-PECDF	U	22
MD08TG	Tissue	20080716A	L11431-1	2,3,7,8-TCDF	U	22
MD08TG	Tissue	20080716A	L11431-1	2,3,7,8-TCDF	DNR	11
MD08TG	Tissue	20080716A	L11431-1	OCDF	U	22
MD08TH	Tissue	20080716A	L11431-2	1,2,3,4,6,7,8-HPCDF	U	7
MD08TH	Tissue	20080716A	L11431-2	1,2,3,6,7,8-HXCDD	U	22
MD08TH	Tissue	20080716A	L11431-2	2,3,7,8-TCDF	DNR	11
MD08TH	Tissue	20080716A	L11431-2	OCDF	U	7
MD09TH	Tissue	20080716A	L11431-3	1,2,3,4,6,7,8-HPCDF	U	7
MD09TH	Tissue	20080716A	L11431-3	2,3,7,8-TCDF	U	22
MD09TH	Tissue	20080716A	L11431-3	2,3,7,8-TCDF	DNR	11
MD09TH	Tissue	20080716A	L11431-3	OCDF	U	7

THIRD-PARTY DATA VALIDATION MEMORANDA

EcoChem, INC.
Environmental Data Quality

DATA VALIDATION REPORT

Port Angeles Harbor Sediment Characterization Study
Harbor Wide Areas of Concern (WD20)

Prepared for:

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January 12, 2010

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PROJECT NARRATIVE

Basis for Data Validation

This report summarizes the results of QA-2 data review (full validation) performed on tissue sample data and the associated laboratory quality control data collected in support of the Port Angeles Sediment Characterization Study, Harbor-Wide Area WD-20. Refer to the **Sample Index** for a complete list of samples for which data were reviewed.

Polycyclic aromatic hydrocarbon (PAH) analyses were performed by AXYS Analytical Services, Sidney, British Colombia and polychlorinated biphenyl (PCB) Aroclor analyses were performed by TestAmerica Laboratories, Inc. (TA), Tacoma, Washington. The analytical methods and EcoChem project chemists are listed in the table below.

Test	Method	Primary Chemist	Secondary Chemist
Polycyclic Aromatic Hydrocarbons (PAH)	Axys MLA-21	Melissa Swanson	Eric Strout
PCB Aroclors	SW8082	Lucy Panteleeff	

The data were reviewed using guidance and quality control criteria documented in the analytical methods and as appropriate, the *Port Angeles Harbor Sediment Characterization Study Sampling and Analysis Plan* (E&E 2008); *Data Validation Guidance Manual for Selected Sediment Variables* (PTI 1989); *Puget Sound Dredged Disposal Analysis Guidance Manual: Data Quality Evaluation for Proposed Dredged Material Disposal Projects* (PTI 1989); and *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (USEPA 2008).

EcoChem's goal in assigning data assessment qualifiers is to assist in proper data interpretation. If values are estimated (J or UJ), data may be used for site evaluation and risk assessment purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet the data quality objectives as stated in the documents and methods referenced above.

Data qualifier definitions, reason codes, and validation criteria are included as **Appendix A. Appendix B** contains the Qualified Data Summary Table. Data Validation Worksheets will be kept on file at EcoChem, Inc. A qualified laboratory electronic data deliverable (EDD) is also submitted with this report.

SAMPLE INDEX
Harbor-Wide Area WD20

Shading indicates that the analysis was not requested for the sample.

Field ID	Matrix	PAH	Axys ID	Axys SDG	PCB	TA ID	TA SDG
EI08TH	Tissue	X	L11299-1	20080617A			
IE20TH	Tissue	X	L11299-2	20080624C			
IE21TL	Tissue	X	L11297-2	20080617A	X	580-14339-2	14339
IE22TL	Tissue	X	L11297-3	20080617A	X	580-14339-3	14339
IE23TL	Tissue	X	L11297-4	20080617A	X	580-14339-4	14339
IE24TL	Tissue	X	L11297-1	20080617A	X	580-14339-1	14339
IE25TM	Tissue	X	L11298-2	20080624C	X	580-14339-6	14339
IE26TM	Tissue	X	L11298-1	20080617A	X	580-14339-5	14339
RF04TH	Tissue	X	L11432-1	20080716A			
RF05TH	Tissue	X	L11432-2	20080716A			
RF06TG	Tissue	X	L11432-3	20080716A			
MD06TH	Tissue	X	L11299-3	20080624C			
MD07TH	Tissue	X	L11299-4	20080624C			
MD08TG	Tissue	X	L11431-1	20080716A			
MD08TH	Tissue	X	L11431-2	20080716A			
MD09TH	Tissue	X	L11431-3	20080716A			
EC06TH	Tissue	X	L11299-5	20080624C			
IE18TH	Tissue	X	L11299-6	20080624C			

DATA VALIDATION REPORT
Harbor-Wide Investigation Area WD-20
Polycyclic Aromatic Hydrocarbons by Axys Method MLA-021
Matrix: Tissue

This report documents the review of analytical data from the analyses of tissue samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Axys Analytical Services Ltd., Sidney, British Columbia, Canada. See the **Sample Index** for a complete list of samples for which data were reviewed.

SDG	Number of Samples	Validation Level
20080617A	6	Full
20080624C	6	Full
20080716A	6	Full

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are summarized in the following table:

1	Holding Times and Sample Receipt	1	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
	Instrument Resolution Checks		Ongoing Precision and Recovery (OPR)
	Initial Calibration (ICAL)	1	Laboratory Duplicates
	Continuing Calibration (CCAL)	2	Compound Identification
2	Laboratory Blanks	1	Reporting Limits
1	Field Blanks	1	Calculation Verification (full validation only)
2	Labeled Compounds		EDD to Hardcopy Verification

[1] *Quality control results are discussed below, but no data were qualified.*
[2] *Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.*

Holding Times and Sample Receipt

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received some sample coolers with temperatures less than the lower control limit. These temperature outliers did not impact data quality and no qualifiers were required.

These samples were extracted at 335, 356, or 363 days after collection. Since the samples were stored under archive conditions (-20°C) until immediately prior to extraction and analysis, the extended holding times should not have any impact on the reported results. No qualifiers were applied.

Laboratory Blank

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times the concentration detected in the blank. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U-7). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Laboratory (method) blanks were analyzed at the appropriate frequency. Various target analytes were detected in the method blanks. A summary of contaminant levels, associated samples, and action levels is provided in the data validation worksheets. Results less than the action levels were qualified as not detected (U-7) in the associated samples. Only the following were qualified:

2-methylnaphthalene (15 results), fluoranthene (1 result), phenanthrene (6 results), pyrene (6 results)

Field Blanks

No samples identified as field blanks were submitted.

Labeled Compounds

The percent recovery (%R) value for $^{13}C_{12}$-benzo(g,h,i)perylene was less than the lower control limit in Sample EI08TH. Benzo(g,h,i)perylene was estimated (J-13) in this sample.

Matrix Spike/Matrix Spike Duplicate

No matrix spike/matrix spike duplicate (MS/MSD) analyses were performed. Accuracy and precision were assessed using labeled compound recoveries, ongoing precision and recovery (OPR) samples, and laboratory duplicate samples.

Laboratory Duplicates

Sample IE22TL was analyzed in duplicate. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 35% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than the RL. Precision was acceptable.

Compound Identification

For all samples, the laboratory reported EMPC or "estimated maximum possible concentrations" values for one or more of the target analytes. As required by the method, an EMPC value is reported when a peak was detected but did not meet quantitation criteria, therefore the result cannot be considered as positive identification for the analyte. To indicate that the reported result is essentially an elevated detection limit, the EMPC values were qualified as not detected (U-22) at the reported values. A total of 140 values were flagged as EMPC values by the laboratory and qualified U-22.

Reporting Limits

Several analytes in Sample MD07TH exceeded the linear calibration range. The sample was re-analyzed at dilution (8x), and all results were within the linear range. The laboratory reported single result for each analyte. No action was necessary.

Calculation Verification

Calculation verifications were performed. No calculation errors were found.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the labeled compound, and OPR %R values, with the above exceptions. Precision was acceptable as demonstrated by the RPD values for the laboratory duplicate.

Data were qualified as not detected to indicate that EMPC values represent elevated detection limits. Data were also qualified as not detected because of method blank contamination. Data were estimated based on labeled compound recovery outliers.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Harbor-Wide Investigation Area WD-20
Polychlorinated Biphenyls (PCB Aroclors) by Method SW8082
Matrix: Tissue

This report documents the review of analytical data from the analyses of tissue samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by TestAmerica Laboratories, Inc., Tacoma, WA. See the **Sample Index** for a complete list of samples for which data were reviewed.

SDG	Number of Samples	Validation Level
J14339	6 Tissue	Full

1.0 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

2.0 TECHNICAL DATA VALIDATION

The quality control (QC) requirements that were reviewed are listed in the following table:

1	Holding Times and Sample Receipt		Matrix Spike / Matrix Spike Duplicate (MS/MSD)
	Initial Calibration (ICAL)	1	Field Duplicates
	Continuing Calibration (CCAL)		Target Analyte List
	Laboratory Blanks		Reporting Limits
1	Field Blanks	1	Compound Identification
	Surrogate Compounds	1	Calculation Verification (Full validation only)
	Laboratory Control Samples (LCS/LCSD)	1	EDD to Hardcopy Verification

[1] *Quality control results are discussed below, but no data were qualified.*
[2] *Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.*

Holding Times and Sample Receipt

The analytes of concern are persistent compounds which have been found to remain stable in tissue after several years of storage; therefore, no maximum holding time criterion has been established. The samples were maintained at the required temperature of $-20^{\circ}C \pm 2^{\circ}$ prior to analysis.

Field Blanks

No samples identified as field blanks were submitted.

Field Duplicates

No samples identified as field duplicates were submitted.

Compound identification

The reported compound identifications were verified by using the quantitation reports (comparing the reported concentrations for each congener used for Aroclor identification), and also by comparing the patterns in the sample chromatogram to the patterns in the standard chromatogram. All compound identifications were acceptable.

Calculation Verification

Calculation verifications were performed. No calculation errors were found.

EDD to Hardcopy Verification

Two samples (IE25TM and IE26TM) were incorrectly logged in at the laboratory as IE25TL and IE26TL. The correct sample identifications were verified from the chain-of-custody form, and the sample identifications were corrected in the electronic data deliverable. No addition action was necessary.

3.0 OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, matrix spike/matrix spike duplicate, and the laboratory control sample %R values. Precision was also acceptable as demonstrated by the MS/MSD RPD values.

No data were qualified for any reason.

All data, as reported, are acceptable for use.

EcoChem, INC.
Environmental Data Quality

APPENDIX A
DATA QUALIFIER DEFINITIONS
REASON CODES
AND CRITERIA TABLES

DATA VALIDATION QUALIFIER CODES
National Functional Guidelines

The following definitions provide brief explanations of the qualifiers assigned to results in the data review process.

U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification".
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents the approximate concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

The following is an EcoChem qualifier that may also be assigned during the data review process:

DNR	Do not report; a more appropriate result is reported from another analysis or dilution.

DATA QUALIFIER REASON CODES

1	Holding Time/Sample Preservation
2	Chromatographic pattern in sample does not match pattern of calibration standard.
3	Compound Confirmation
4	Tentatively Identified Compound (TIC) (associated with NJ only)
5A	Calibration (initial)
5B	Calibration (continuing)
6	Field Blank Contamination
7	Lab Blank Contamination (e.g., method blank, instrument, etc.)
8	Matrix Spike(MS & MSD) Recoveries
9	Precision (all replicates)
10	Laboratory Control Sample Recoveries
11	A more appropriate result is reported (associated with "R" and "DNR" only)
12	Reference Material
13	Surrogate Spike Recoveries (a.k.a., labeled compounds & recovery standards)
14	Other (define in validation report)
15	GFAA Post Digestion Spike Recoveries
16	ICP Serial Dilution % Difference
17	ICP Interference Check Standard Recovery
18	Trip Blank Contamination
19	Internal Standard Performance (e.g., area, retention time, recovery)
20	Linear Range Exceeded
21	Potential False Positives
22	Elevated Detection Limit Due to Interference (i.e., laboratory, chemical and/or matrix)

EcoChem Validation Guidelines for Compounds Analyzed By HRMS (Methods 1613B or SW846 - 8290) Polycyclic Aromatic Hydrocarbons (PAH), PCB Congeners and Dioxins/Furans

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Cooler/Storage Temperature	Aqueous/Soil/Sediment <4°C Tissues <-10°C	EcoChem PJ, see TM-05	1
Holding Time	*Water*: 30 days from collection *Soil*: 30 days from collection (1 year if frozen) *Rinsate Blank*: 1 year from collection *Analysis*: 40 days from extraction Note: Under CWA, SDWA, and RCRA the HT for water is 7 days	J(+)/UJ(-) if extraction > holding time J(+)/UJ(-) if analysis > 40 Days EcoChem PJ, see TM-05	1
Mass Resolution	>=10,000 resolving power at m/z 304.9824 Exact mass of m/z 380.9760 w/in 5 ppm of theoretical value (380.97410 to 380.97790) . Analyzed prior to ICAL & at the start & end of each 12 hr. shift	R(+/-) if not met	14
Window Defining Mix and Column Performance Mix	Window defining mixture/Isomer specificity std run before ICAL and CCAL Valley < 25% (valley = (x/y)*100%) x = ht. of TCDD y = baseline to bottom of valley For all isomers eluting near 2378-TCDD/TCDF isomers (TCDD only for 8290)	J(+) if valley > 25%	5A (ICAL) 5B (CCAL
Initial Calibration	ICAL: Minimum of five standards %RSD < 20% for native compounds %RSD <30% for labeled compounds (%RSD <35% for labeled compounds under 1613b)	J(+) natives if %RSD > 20%	5A
	Abs. RT of $^{13}C_{12}$-1234-TCDD >25 min on DB5 >15 min on DB-225	EcoChem PJ, see TM-05	
	Ion Abundance ratios within QC limits (Table 8 of method 8290) (Table 9 of method 1613B)	EcoChem PJ, see TM-05	
	S/N ratio > 10 for all native and labeled compounds in CS1 std.	If <10, elevate Det. Limit or R(-)	

EcoChem Validation Guidelines for Compounds Analyzed By HRMS (Methods 1613B or SW846 - 8290) Polycyclic Aromatic Hydrocarbons (PAH), PCB Congeners and Dioxins/Furans

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Continuing Calibration	Analyzed at the start and end of each 12 hour shift. %D+/-20% for native compounds %D +/-30% for labeled compounds (Must meet limits in Table 6 for 1613B) (If %D in the closing CCAL are w/in 25%/35%, the avg RF from the 2 CCAL may be used to calculate samples per Section 8.3.2.4 of 8290)	**Do not qualify labeled compounds.** Narrate in report for labeled compound %D outliers. **For native compound %D outliers:** *Method 8290:* J(+)/UJ(-) if %D = 20% - 75% J(+)/R(-) if %D > 75% *Method 1613:* J(+)/UJ(-) if %D is outside Table 6 limits J(+)/R(-) if %D is +/- 75% of Table 6 limit	5B
	Abs. RT of $^{13}C_{12}$-1234-TCDD and ^{13}C12-123789-HxCDD +/- 15 sec of ICAL.	EcoChem PJ, see ICAL section of TM-05	
	RRT of all other compounds must meet table 2 of 1613B.	EcoChem PJ, see TM-05	
	Ion Abundance ratios within QC limits (Table 8 of method 8290) (Table 9 of method 1613B)	EcoChem PJ, see TM-05	
	S/N ratio > 10	If <10, elevate Det. Limit or R(-)	
Method Blank	One per matrix per batch No positive results	If sample result <5X action level, qualify U at reported value. (<10X for phthalates)	7
Field Blanks	No results > QL	Apply 5X rule; U(+) < action level	6
LCS / OPR	Concentrations must meet limits in Table 6 of method 1613B or lab limits.	J(+) if %R > UCL J(+)/UJ(-) if %R < LCL J(+)/R(-) using PJ if %R <<LCL (< 10%)	10
MS/MSD (recovery)	May not analyze MS/MSD %R should meet lab limits.	Qualify parent only unless other QC indicates systematic problems: J(+) if both %R > UCL J(+)/UJ(-) if both %R < LCL J(+)/R(-) if both %R < 10% PJ if only one %R outlier	8

EcoChem Validation Guidelines for Compounds Analyzed By HRMS (Methods 1613B or SW846 - 8290) Polycyclic Aromatic Hydrocarbons (PAH), PCB Congeners and Dioxins/Furans

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
MS/MSD (RPD)	May not analyze MS/MSD RPD <520%	J(+) if RPD > CL	9
Lab Duplicate	RPD <50% if present.	J(+) if outside limts	9
Labeled Compounds Internal Standards	*Method 8290:* %R = 40% - 135% in all samples *Method 1668*: %R = 25% - 150% in all samples *Method 1613B:* %R must meet limits specified inTable 7	J(+)/UJ(-) if %R = 10% to LCL J(+) if %R > UCL J(+)/R(-) if %R < 10%	13
Quantitation/ Identification	Ions for analyte, IS, and rec. std. must max w/in 2 sec. S/N >2.5 IA ratios meet limits in Table 9 of 1613B or Table 8 of 8290 RRTs w/in limits in table 2 of 1613B	If RT criteria not met, use PJ (**see TM-05**) If S/N criteria not met, J(+). if unlabelled ion abundance not met, change to EMPC If labelled ion abundance not met, J(+).	21
EMPC (est. max. possible concentration)	If quantitation identification criteria are not met, laboratory should report an EMPC value.	If laboratory correctly reported an EMPC value, qualify with U to indicate that the value is a detection limit.	14
Interferences	PCDF interferences from PCDPE	If both detected, change PCDF result to EMPC	14
Second Column Confirmation	All 2,3,7,8-TCDF hits must be confirmed on a DB-225 column (or equiv). All QC specs in this table must be met for the confirmation analysis.	Report lower of the two values. If not performed use PJ (**see TM-05**).	3
Field Duplicates	QAPP specified RPD < 50% (all matrices)	Narrate; do not qualify	na
Two analyses for one sample	Report only one result per analyte	"DNR" results that should not be used	11

EcoChem Validation Guidelines for Pesticides, PCBs, Herbicides, and Phenol by GC/ECD (Based on Organic NFG 1999/2008 & EPA SW-846 Methods 8081/8082/8041/8151)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
Cooler Temperature	4°C ±2°	J(+)/UJ(-) if greater than 6 deg. C (EcoChem PJ)	1
Holding Time	Water: 7 days from collection Soil: 14 days from collection Analysis: 40 days from extraction	J(+)/UJ(-) if ext/analyzed > HT J(+)/R(-) if ext/analyzed > 3X HT (EcoChem PJ)	1
Resolution Check	Beginning of ICAL Sequence Within RTW Resolution >90%	Narrate (Use Professional Judgement to qualify)	14
Instrument Performance (Breakdown)	DDT Breakdown: < 20% Endrin Breakdown: <20% Combined Breakdown: <30% Compounds within RTW	J(+) DDT NJ(+) DDD and/or DDE R(-) DDT - If (+) for either DDE or DDD J(+) Endrin NJ(+) EK and/or EA R(-) Endrin - If (+) for either EK or EA	5A
Retention Times	Surrogates: TCX (+/- 0.05); DCB (+/- 0.10) Target compounds: elute before heptachlor epoxide (+/- 0.05) elute after heptachlor epoxide (+/- 0.07)	NJ(+)/R(-) results for analytes with RT shifts For full DV, use PJ based on examination of raw data	5B
Initial Calibration	Pesticides: Low=CRQL, Mid=4X, High=16X Multiresponse - one point Calibration %RSD<20% %RSD<30% for surr; two comp. may exceed if <30% Resolution in Mix A and Mix B >90%	J(+)/UJ(-)	5A
Continuing Calibration	Alternating PEM standard and INDA/INDB standards every 12 hours (each preceeded by an inst. Blank) %D < 25% Resolution >90% in IND mixes; 100% for PEM	J(+)/UJ(-) J(+)R(-) if %D > 90% PJ for resolution	5B
Method Blank	One per matrix per batch No results > CRQL	U(+) if sample result is < CRQL and < 5X rule (raise sample value to CRQL) U(+) if sample result is > or equal to CRQL and < 5X rule (at reported sample value)	7
Instrument Blanks	Analyzed at the beginning of every 12 hour sequence No analyte > 1/2 CRQL	Same as Method Blank	7
Field Blanks	Not addressed by NFG No results > CRQL	Apply 5X rule; U(+) < action level	6

EcoChem Validation Guidelines for Pesticides, PCBs, Herbicides, and Phenol by GC/ECD (Based on Organic NFG 1999/2008 & EPA SW-846 Methods 8081/8082/8041/8151)

VALIDATION QC ELEMENT	ACCEPTANCE CRITERIA	ACTION	REASON CODE
MS/MSD (recovery)	One set per matrix per batch Method Acceptance Criteria	Qualify parent only unless other QC indicates systematic problems: J(+) if both %R > UCL J(+)/UJ(-) if both %R < LCL J(+)/R(-) if both %R < 10% **PJ if only one %R outlier**	8
MS/MSD (RPD)	One set per matrix per batch Method Acceptance Criteria	J(+) in parent sample if RPD > CL	9
LCS	One per SDG Method Acceptance Criteria	J(+) if %R > UCL J(+)/UJ(-) if %R < LCL J(+)/R(-) using PJ if %R <<LCL (< 10%)	10
LCS/LCSD *(if required)*	One set per matrix and batch of 20 samples RPD < 35%	J(+)/UJ(-) assoc. cmpd. in all samples	9
Surrogates	TCX and DCB added to every sample %R = 30-150%	J(+)/UJ(-) if both %R = 10 - 60% J(+) if both >150% J(+)/R(-) if any %R <10%	13
Quantitation/ Identification	Quantitated using ICAL calibration factor (CF) RPD between columns <40%	J(+) if RPD = 40 - 60% NJ(+) if RPD >60% **EcoChem PJ - See TM-08**	3
Two analyses for one sample	Report only one result per analyte	"DNR" results that should not be used to avoid reporting two results for one sample	11
Sample Clean-up	GPC required for soil samples Florisil required for all samples Sulfur is optional Clean-up standard check %R within CLP limits	J(+)/UJ(-) if %R < LCL J(+) if %R > UCL	14
Field Duplicates	**Use QAPP limits. If no QAPP:** Solids: RPD <50% OR absolute diff. < 2X RL (for results < 5X RL) Aqueous: RPD <35% OR absolute diff. < 1X RL (for results < 5X RL)	Narrate **(Qualifiy if required by project QAPP)**	9

EcoChem, INC.
Environmental Data Quality

APPENDIX B
QUALIFIED DATA SUMMARY TABLE

QUALIFIED DATA SUMMARY TABLE
Rayonier Area WD20

Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifiers	DV Reason Codes
IE24TL	TISSUE	20080617A	L11297-1	Benzo[ghi]perylene	U	22
IE24TL	TISSUE	20080617A	L11297-1	Pyrene	U	22
IE24TL	TISSUE	20080617A	L11297-1	Acenaphthylene	U	22
IE24TL	TISSUE	20080617A	L11297-1	Fluorene	U	22
IE24TL	TISSUE	20080617A	L11297-1	Dibenzothiophene	U	22
IE24TL	TISSUE	20080617A	L11297-1	Benzo[e]pyrene	U	22
IE24TL	TISSUE	20080617A	L11297-1	Benzo[a]pyrene	U	22
IE24TL	TISSUE	20080617A	L11297-1	Benzo[j,k]fluoranthenes	U	22
IE24TL	TISSUE	20080617A	L11297-1	Benzo[b]fluoranthene	U	22
IE24TL	TISSUE	20080617A	L11297-1	Phenanthrene	U	7
IE24TL	TISSUE	20080617A	L11297-1	2-Methylnaphthalene	U	7
IE21TL	TISSUE	20080617A	L11297-2	Anthracene	U	22
IE21TL	TISSUE	20080617A	L11297-2	Acenaphthylene	U	22
IE21TL	TISSUE	20080617A	L11297-2	2,3,5-Trimethylnaphthalene	U	22
IE21TL	TISSUE	20080617A	L11297-2	Fluorene	U	22
IE21TL	TISSUE	20080617A	L11297-2	Benzo[ghi]perylene	U	22
IE21TL	TISSUE	20080617A	L11297-2	Indeno[1,2,3-cd]pyrene	U	22
IE21TL	TISSUE	20080617A	L11297-2	Benzo[a]pyrene	U	22
IE21TL	TISSUE	20080617A	L11297-2	Benzo[e]pyrene	U	22
IE21TL	TISSUE	20080617A	L11297-2	Dibenzothiophene	U	22
IE21TL	TISSUE	20080617A	L11297-2	Chrysene	U	22
IE21TL	TISSUE	20080617A	L11297-2	Benzo[j,k]fluoranthenes	U	22
IE21TL	TISSUE	20080617A	L11297-2	Benz[a]anthracene	U	22
IE21TL	TISSUE	20080617A	L11297-2	Pyrene	U	7
IE21TL	TISSUE	20080617A	L11297-2	Phenanthrene	U	7
IE21TL	TISSUE	20080617A	L11297-2	Fluoranthene	U	7
IE21TL	TISSUE	20080617A	L11297-2	2-Methylnaphthalene	U	7
IE22TL	TISSUE	20080617A	L11297-3 (A)	2-Methylnaphthalene	U	7
IE22TL	TISSUE	20080617A	L11297-3 (A)	Anthracene	U	22
IE22TL	TISSUE	20080617A	L11297-3 (A)	Dibenzothiophene	U	22
IE22TL	TISSUE	20080617A	L11297-3 (A)	Fluoranthene	U	22
IE22TL	TISSUE	20080617A	L11297-3 (A)	Phenanthrene	U	7
IE22TL	TISSUE	20080617A	L11297-3 (A)	Pyrene	U	7
IE23TL	TISSUE	20080617A	L11297-4	Anthracene	U	22
IE23TL	TISSUE	20080617A	L11297-4	Acenaphthylene	U	22
IE23TL	TISSUE	20080617A	L11297-4	Dibenzothiophene	U	22
IE23TL	TISSUE	20080617A	L11297-4	Benz[a]anthracene	U	22
IE23TL	TISSUE	20080617A	L11297-4	Chrysene	U	22
IE23TL	TISSUE	20080617A	L11297-4	Pyrene	U	7
IE23TL	TISSUE	20080617A	L11297-4	Phenanthrene	U	7
IE23TL	TISSUE	20080617A	L11297-4	2-Methylnaphthalene	U	7
IE26TM	TISSUE	20080617A	L11298-1	1-Methylphenanthrene	U	22
IE26TM	TISSUE	20080617A	L11298-1	Benzo[ghi]perylene	U	22
IE26TM	TISSUE	20080617A	L11298-1	Anthracene	U	22
IE26TM	TISSUE	20080617A	L11298-1	Acenaphthylene	U	22
IE26TM	TISSUE	20080617A	L11298-1	Dibenzothiophene	U	22
IE26TM	TISSUE	20080617A	L11298-1	2-Methylnaphthalene	U	7
IE25TM	TISSUE	20080624C	L11298-2	Anthracene	U	22
IE25TM	TISSUE	20080624C	L11298-2	Benzo[e]pyrene	U	22
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QUALIFIED DATA SUMMARY TABLE
Rayonier Area WD20

Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifiers	DV Reason Codes
IE25TM	TISSUE	20080624C	L11298-2	Acenaphthylene	U	22
IE25TM	TISSUE	20080624C	L11298-2	2-Methylnaphthalene	U	7
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EI08TH	TISSUE	20080617A	L11299-1	Benz[a]anthracene	U	22
EI08TH	TISSUE	20080617A	L11299-1	Benzo[e]pyrene	U	22
EI08TH	TISSUE	20080617A	L11299-1	Benzo[ghi]perylene	UJ	13,22
EI08TH	TISSUE	20080617A	L11299-1	Dibenzothiophene	U	22
EI08TH	TISSUE	20080617A	L11299-1	Indeno[1,2,3-cd]pyrene	U	22
EI08TH	TISSUE	20080617A	L11299-1	Perylene	U	22
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IE20TH	TISSUE	20080624C	L11299-2	Fluorene	U	22
IE20TH	TISSUE	20080624C	L11299-2	Anthracene	U	22
IE20TH	TISSUE	20080624C	L11299-2	2,3,5-Trimethylnaphthalene	U	22
IE20TH	TISSUE	20080624C	L11299-2	Benz[a]anthracene	U	22
IE20TH	TISSUE	20080624C	L11299-2	Benzo[e]pyrene	U	22
IE20TH	TISSUE	20080624C	L11299-2	Perylene	U	22
IE20TH	TISSUE	20080624C	L11299-2	Benzo[ghi]perylene	U	22
IE20TH	TISSUE	20080624C	L11299-2	Acenaphthylene	U	22
IE20TH	TISSUE	20080624C	L11299-2	Indeno[1,2,3-cd]pyrene	U	22
IE20TH	TISSUE	20080624C	L11299-2	Dibenzothiophene	U	22
MD06TH	TISSUE	20080624C	L11299-3	Benzo[ghi]perylene	U	22
MD06TH	TISSUE	20080624C	L11299-3	Dibenzothiophene	U	22
MD06TH	TISSUE	20080624C	L11299-3	2,3,5-Trimethylnaphthalene	U	22
MD06TH	TISSUE	20080624C	L11299-3	1-Methylphenanthrene	U	22
MD06TH	TISSUE	20080624C	L11299-3	Dibenz[a,h]anthracene	U	22
MD07TH	TISSUE	20080624C	L11299-4	Benzo[e]pyrene	U	22
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EC06TH	TISSUE	20080624C	L11299-5	2,3,5-Trimethylnaphthalene	U	22
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EC06TH	TISSUE	20080624C	L11299-5	Dibenzothiophene	U	22
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IE18TH	TISSUE	20080624C	L11299-6	Benzo[ghi]perylene	U	22
IE18TH	TISSUE	20080624C	L11299-6	Benzo[a]pyrene	U	22
IE18TH	TISSUE	20080624C	L11299-6	Indeno[1,2,3-cd]pyrene	U	22
IE18TH	TISSUE	20080624C	L11299-6	2,3,5-Trimethylnaphthalene	U	22
IE18TH	TISSUE	20080624C	L11299-6	Acenaphthylene	U	22
IE18TH	TISSUE	20080624C	L11299-6	Dibenzothiophene	U	22
IE18TH	TISSUE	20080624C	L11299-6	Dibenz[a,h]anthracene	U	22
IE18TH	TISSUE	20080624C	L11299-6	2-Methylnaphthalene	U	7
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MD08TG	TISSUE	20080716A	L11431-1	Benzo[ghi]perylene	U	22
MD08TG	TISSUE	20080716A	L11431-1	2,6-Dimethylnaphthalene	U	22
MD08TG	TISSUE	20080716A	L11431-1	Indeno[1,2,3-cd]pyrene	U	22
MD08TG	TISSUE	20080716A	L11431-1	Acenaphthylene	U	22
MD08TG	TISSUE	20080716A	L11431-1	Dibenzothiophene	U	22
MD08TG	TISSUE	20080716A	L11431-1	Dibenz[a,h]anthracene	U	22
MD08TG	TISSUE	20080716A	L11431-1	2-Methylnaphthalene	U	7

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Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifiers	DV Reason Codes
MD08TH	TISSUE	20080716A	L11431-2	Benz[a]anthracene	U	22
MD08TH	TISSUE	20080716A	L11431-2	Benzo[e]pyrene	U	22
MD08TH	TISSUE	20080716A	L11431-2	Benzo[ghi]perylene	U	22
MD08TH	TISSUE	20080716A	L11431-2	Indeno[1,2,3-cd]pyrene	U	22
MD08TH	TISSUE	20080716A	L11431-2	2,3,5-Trimethylnaphthalene	U	22
MD08TH	TISSUE	20080716A	L11431-2	Acenaphthylene	U	22
MD08TH	TISSUE	20080716A	L11431-2	1-Methylphenanthrene	U	22
MD08TH	TISSUE	20080716A	L11431-2	Dibenzothiophene	U	22
MD08TH	TISSUE	20080716A	L11431-2	Dibenz[a,h]anthracene	U	22
MD08TH	TISSUE	20080716A	L11431-2	2-Methylnaphthalene	U	7
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MD09TH	TISSUE	20080716A	L11431-3	Benzo[e]pyrene	U	22
MD09TH	TISSUE	20080716A	L11431-3	Benzo[ghi]perylene	U	22
MD09TH	TISSUE	20080716A	L11431-3	Acenaphthylene	U	22
MD09TH	TISSUE	20080716A	L11431-3	2,3,5-Trimethylnaphthalene	U	22
MD09TH	TISSUE	20080716A	L11431-3	Dibenzothiophene	U	22
MD09TH	TISSUE	20080716A	L11431-3	Dibenz[a,h]anthracene	U	22
MD09TH	TISSUE	20080716A	L11431-3	2-Methylnaphthalene	U	7
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RF04TH	TISSUE	20080716A	L11432-1	Anthracene	U	22
RF04TH	TISSUE	20080716A	L11432-1	Acenaphthene	U	22
RF04TH	TISSUE	20080716A	L11432-1	Benzo[ghi]perylene	U	22
RF04TH	TISSUE	20080716A	L11432-1	Benzo[e]pyrene	U	22
RF04TH	TISSUE	20080716A	L11432-1	Benz[a]anthracene	U	22
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RF04TH	TISSUE	20080716A	L11432-1	Acenaphthylene	U	22
RF04TH	TISSUE	20080716A	L11432-1	Pyrene	U	7
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RF05TH	TISSUE	20080716A	L11432-2	2,6-Dimethylnaphthalene	U	22
RF05TH	TISSUE	20080716A	L11432-2	Fluorene	U	22
RF05TH	TISSUE	20080716A	L11432-2	2,3,5-Trimethylnaphthalene	U	22
RF05TH	TISSUE	20080716A	L11432-2	Benzo[ghi]perylene	U	22
RF05TH	TISSUE	20080716A	L11432-2	Anthracene	U	22
RF05TH	TISSUE	20080716A	L11432-2	Benzo[e]pyrene	U	22
RF05TH	TISSUE	20080716A	L11432-2	1-Methylphenanthrene	U	22
RF05TH	TISSUE	20080716A	L11432-2	Acenaphthene	U	22
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RF05TH	TISSUE	20080716A	L11432-2	Pyrene	U	7
RF05TH	TISSUE	20080716A	L11432-2	2-Methylnaphthalene	U	7
RF06TG	TISSUE	20080716A	L11432-3	Benzo[e]pyrene	U	22
RF06TG	TISSUE	20080716A	L11432-3	Anthracene	U	22
RF06TG	TISSUE	20080716A	L11432-3	2,3,5-Trimethylnaphthalene	U	22
RF06TG	TISSUE	20080716A	L11432-3	Benzo[ghi]perylene	U	22
RF06TG	TISSUE	20080716A	L11432-3	Benzo[j,k]fluoranthenes	U	22
RF06TG	TISSUE	20080716A	L11432-3	Indeno[1,2,3-cd]pyrene	U	22
RF06TG	TISSUE	20080716A	L11432-3	Acenaphthylene	U	22
RF06TG	TISSUE	20080716A	L11432-3	Benz[a]anthracene	U	22
RF06TG	TISSUE	20080716A	L11432-3	Acenaphthene	U	22

QUALIFIED DATA SUMMARY TABLE
Rayonier Area WD20

Client ID	Matrix	SDG	Lab ID	Analyte	DV Qualifiers	DV Reason Codes
RF06TG	TISSUE	20080716A	L11432-3	Phenanthrene	U	7
RF06TG	TISSUE	20080716A	L11432-3	2-Methylnaphthalene	U	7
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	2,6-Dimethylnaphthalene	U	22
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	2-Methylnaphthalene	U	7
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	Anthracene	U	22
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	Benzo[a]pyrene	U	22
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	Benzo[e]pyrene	U	22
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	Benzo[ghi]perylene	U	22
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	Benzo[j,k]fluoranthenes	U	22
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	Chrysene	U	22
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	Fluoranthene	U	22
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	Indeno[1,2,3-cd]pyrene	U	22
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	Perylene	U	22
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	Phenanthrene	U	7
IE22TL	TISSUE	20080617A	)062-104 (DUP L11	Pyrene	U	7

Appendix I
Geomorphic Report

GEOMORPHIC REPORT

Port Angeles Harbor

Prepared for

Ecology & Environment, Inc.

February 23, 2011

GEOMORPHIC REPORT

Port Angeles Harbor

Prepared for

Ecology & Environment, Inc.
368 Pleasant View Drive
Lancaster, New York 14086

Prepared by

Herrera Environmental Consultants
2200 Sixth Avenue, Suite 1100
Seattle, Washington 98121

February 23, 2011

Contents

Tables

Figures

Executive Summary

This report describes the physical environment (currents, waves, sediment transport) within Port Angeles Harbor, defined by the marine waters and seabed between the mouth of Morse Creek and the tip of Ediz Hook. Port Angeles Harbor, like any deep marine basin, is filling with sediment (broadly defined as any solid material denser than water, including woody debris) from sources on land. A process-based approach was adopted to describe sediment transport throughout Port Angeles Harbor. Three primary physical processes are responsible for sediment transport and are treated in order from source to sink:

- Sediment input
- Nearshore sediment transport (transport from waves)
- Sediment transport by tides and currents

Sediment input to the harbor has changed dramatically since European settlement. The dominant historical source of sediment to the south shore of the harbor has been eliminated by the disconnection of the adjacent bluffs from intertidal areas. Sediment is also currently prevented from entering the confines of the harbor from the seaward side of Ediz Hook by fill associated with Ediz Hook Road. Thus, small creeks are the only major source of sediment to the harbor. The elimination of other historical sources of sediment to the harbor places relatively tight constraints on the volume of sediments entering the harbor, which was found in this study to be between 1.35 and 5.69 kilograms per second.

Once sediment enters the confines of the harbor it can be transported by two primary mechanisms: waves and tidal currents. Wave-induced transport dominates in nearshore areas and is dominated by longshore, or littoral, transport. The direction of longshore transport in the nearshore is clockwise overall throughout Port Angeles Harbor. For areas east of Lees Creek, transport is eastward. Eastward transport terminates on Ediz Hook abruptly once swell is encountered at the south end of the spit.

The relatively modest wave energy in the harbor means that sediment in deeper portions is transported by currents, which are dominated by tidal motions. Tides in the area are mixed semi-diurnal (i.e., tides occur every six hours with low tides of different magnitudes), with a mean tide range of 4.6 feet. Due to strong and persistent wind stress from the west and an intense eastward boundary current along the southern shoreline of the Strait of Juan de Fuca, surface currents are strongly eastward east of Lees Creek. However, strong tidal eddies are common in areas protected by Ediz Hook. These motions are not coherent across the harbor in the form of a single eddy, contrary to assumptions made in earlier work, including several dye studies performed at the University of Washington and by Battelle. Rather, they appear to be small, localized events of short duration. It appears that strong eastward surface currents within the harbor caused by west winds are balanced by westward counterflows near the bed (as is typical in an estuary). Localized sediment gravity flows were observed in the innermost harbor with transport of suspended sediment northeast (downslope).

These physical processes result in sediment that enters the harbor west of Lees Creek remaining in the harbor and migrating westward towards the point of connection between Ediz Hook and the mainland (i.e., the neck of Ediz Hook). A sediment budget based on existing sediment accumulation data and new radioisotopic measurements confirms that most, if not all, of the sediment discharged to the harbor remains within the harbor. Most of this sediment ends up near the neck of Ediz Hook. This hypothesis is also supported by observation of sediment gravity flows in this area, including direct observations of suspended fine-grained sediments made during the instrument deployment and accounts of local divers who have observed large accumulations near the neck of Ediz Hook.

1.0 Introduction

This report describes the physical environment of Port Angeles Harbor, particularly with respect to bottom currents and sediment transport. The study area is defined as the shoreline between the mouth of Morse Creek and the tip of Ediz Hook on the Strait of Juan de Fuca (Figure 1). This includes all of Port Angeles Harbor as well as a short distance of shoreline on the Strait of Juan de Fuca east of the harbor. The goals of the study were to characterize general circulation patterns in the harbor, both in the water column and near the bed; identify the role of waves to mobilize bed materials; determine the character and temporal change in extreme events associated with sediment transport; and characterize the nature and quantity of sediments being delivered to the harbor; as well as to link these elements to arrive at a broad picture of sediment transport throughout the harbor.

Port Angeles Harbor, like any deep marine basin, is filling with sediment (broadly defined as any solid material denser than water, including woody debris which is assumed to behave similarly to mineral sediment for the purposes of this report) from sources on land. Sediment transport is a complicated physical process that cannot be easily measured directly, so several different techniques and analyses are used to build a coherent, qualitative picture of transport and fate mechanisms. Understanding of each analysis and the assumptions made is essential to develop a complete picture of sediment transport across the harbor. Despite the qualitative nature of the final model, quantitative measurements form the backbone of a sediment budget that defines the dominant sediment sources and sinks and confirms the direction of sediment transport identified by direct observations (e.g., bottom currents) and other analyses (e.g., sediment trends analyses).

A process-based approach was adopted to describe sediment transport throughout Port Angeles Harbor. Three primary physical processes are responsible for sediment transport and are treated in order from source to sink:

- Sediment input
- Nearshore sediment transport (transport from waves)
- Sediment transport by tides and currents

This report provides a summary of the methodology used to estimate sediment input and transport in Port Angeles Harbor (Section 2); an overview of the study area background and characteristics (Section 3); results of the geomorphic evaluations (Section 4); and a summary and conclusions (Section 5). A glossary of terms used and references are provided at the end of this report.

The work was performed by Herrera Environmental Consultants, Inc., (Herrera) with support from GeoSea Consulting (GeoSea), which conducted the sediment trends analysis (STA), and Evans & Hamilton, Inc., which made the hydrographic observations (i.e., currents, waves, and turbidity).

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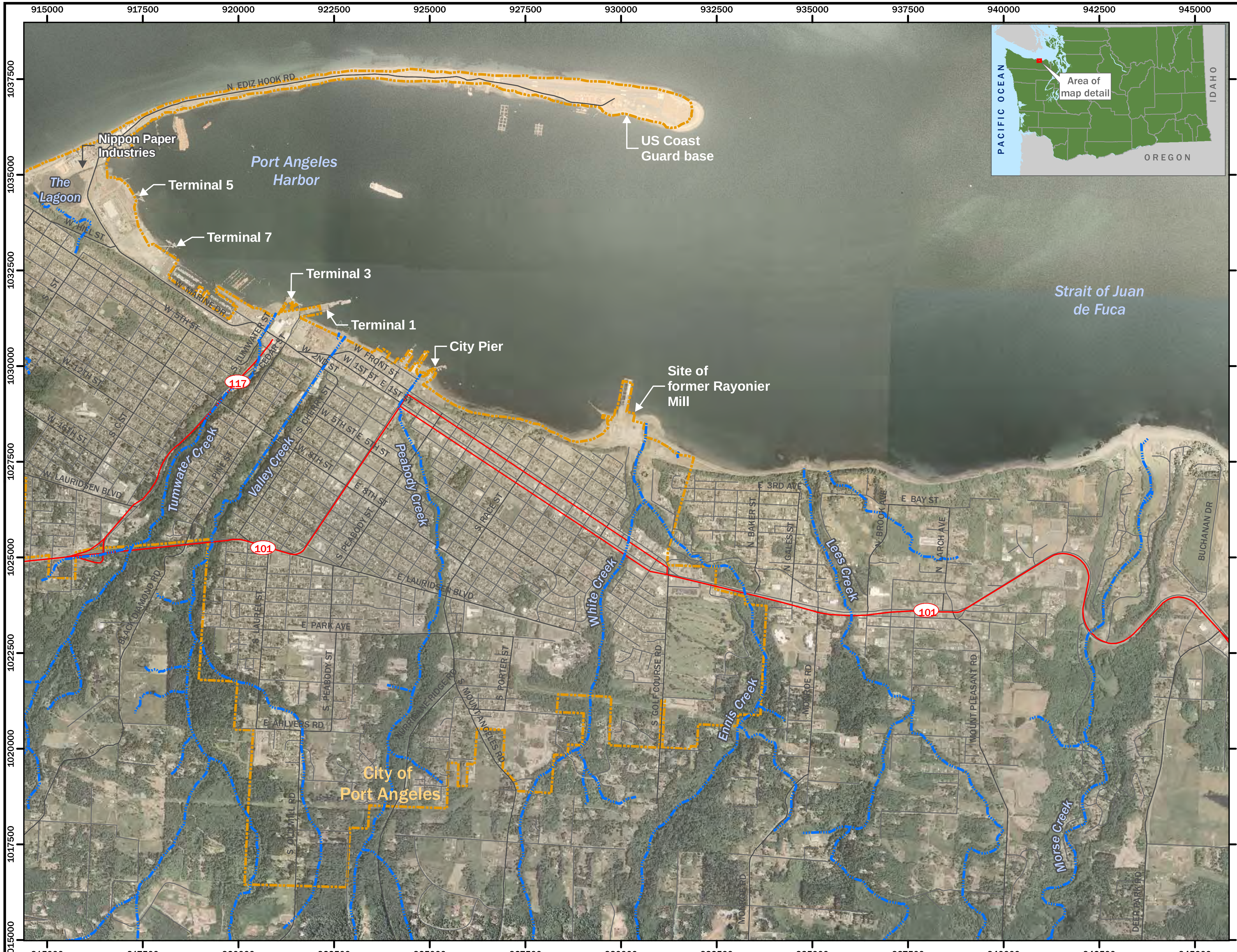
Figure 1.
Port Angeles Harbor and vicinity.



Legend

- River
- Highway
- Arterial or Collector Road
- Road
- City Limits

ecology and environment, inc.
International Specialists in the Environment

HERRERA ENVIRONMENTAL CONSULTANTS

0 1,250 2,500 5,000 feet

Coordinates: Washington State Plane South
NAD 83 (feet)
Aerial: USDA, 2006

N

Produced By: GIS (RDR)
Project:
K:/Projects/06-03386-005/Projects/pa_site_and_vicinity.mxd

2.0 Methodology

Due to development along the Port Angeles Harbor shoreline, sediment input to the harbor has been limited to small creek sources. These creeks, which are quite similar in size, each have deltas that can be assessed to estimate sediment input to the harbor. Where the deltas are sufficiently protected from wave action, they serve as accurate recorders of bedload sediment input.

Earlier work on transport within Port Angeles Harbor focused on the ability of surface currents to transport buoyant discharges from the former Rayonier facility on the east end of Port Angeles (Ebbesmeyer et al. 1979, Battelle 2004, Yang et al. 2004). While there has been some work on net longshore drift (Bubnick 1986; Ecology 2008), it was found upon the first site visit that these studies possessed errors. These errors include, but are not limited to, alongshore drift observed in areas where previous work suggested no such drift existed; and on the west side of the Ennis Creek delta, previous work identified drift from west to east but the present study observed drift in the opposite direction. Therefore, a new analysis of nearshore sediment transport was performed. Previous work has shown that nearshore sediment transport in Puget Sound and the Strait of Juan de Fuca is dominated by large wind storms (Finlayson 2006). To address this, an analysis of these events was also performed.

The hydrography (currents) described by previous studies using surface tracers, numerical modeling, physical modeling, and drogues provided limited information about the mobility of bed sediments and bottom currents. To better estimate hydrographic conditions, continuous measurements of near-bed currents and turbidity were collected over one month (approximately two spring-neap cycles) with modern hydrographic equipment (Evans-Hamilton 2008).

In addition to the hydrographic observations, an estimate of the net direction of sediment transport was determined from the STA (McLaren et al. 2007). STA relates trends in sediment grain size as a proxy for transport assuming that the direction of transport is described by grain-size gradients (i.e., transport is directed toward areas of sediment that is finer and better sorted). Areas of erosion are indicated by regions where the skewness of the grain-size distribution is negative (McLaren et al. 2007). Further details about the STA method can be found in McLaren (2009). Radioisotopic analysis of cores was used to verify sediment accumulation rates in select portions of the harbor. These accumulation rates serve as an estimate of sink in the sediment budget.

The methodologies used to evaluate sediment input, nearshore sediment transport, and sediment transport by tides and currents are presented in the following sections.

2.1 Sediment Input

Sediment input to Port Angeles Harbor was estimated by measuring sediment that has accumulated at the mouth of a representative creek and extrapolating the results across the rest of the harbor by using an analytical model developed for basins without stream gages (Syvitski et al. 2003). Because of land reclamation activities (fill) on the waterfront of Port Angeles, most of the creeks (Tumwater, Valley, Peabody, and Ennis) discharge to the harbor anywhere from 500 to 1,000 feet north (seaward) of their pre-development position. Each of the creek mouths became drainage ditches that route flow from the pre-development creek mouth to the new shoreline.

Historically, as the shoreline was moved far into the harbor, the creek mouths were also moved into deep water and did not possess deltas. Today the deltas are large and well-developed, indicating that considerable amounts of sediment have been deposited within the last 100 years. However, only the Tumwater Creek delta has been sufficiently sheltered from wave energy to provide an accurate record of recent sediment input (i.e., the other deltas show significant evidence of alongshore transport away from the delta or signs of significant human alteration). Because the Tumwater Creek delta, like all deltas, is created from bedload transport only (consisting of sand and gravel), total sediment loading that includes suspended load (consisting of fine sand, silt, and clay) was estimated using a range of empirical ratios recommended by the scientific literature (Pratt-Sitaula et al. 2007; Syvitski et al. 2005). Given the extreme similarity in geology and basin size of the streams that feed Port Angeles Harbor, the model, referenced to the measured Tumwater Creek delta volume, provides a reasonable estimate of the sediment flux from all of the contributing streams.

2.1.1 Extreme Precipitation Events

The primary driver for sediment input are floods associated with extreme precipitation events. As such, a trend analysis of past extreme precipitation events, a reasonable proxy for sediment input, was performed. Precipitation data recorded at Port Angeles Harbor gauge ID #456624 from August 1933 through the present (daily) and from July 1948 through present (hourly) were evaluated (Table 1; Western Regional Climate Center 2008a). Both the hourly and daily data are reported to the hundredths of an inch (Table 1).

Table 1. Available precipitation and streamflow data used to identify extreme nearshore sediment input events, Port Angeles Harbor

Measurement	Gauge ID	Timestep	Beginning of Record	End of Record	Length of Record
Precipitation	456624	Daily	8/1/1933	Present	75 years
Precipitation	456624	Hourly	7/1/1948	Present	60 years

Since the primary objective of this study was to evaluate long-term changes in sediment input over time, the longer daily precipitation record was selected for analysis. The available data were filtered and ranked to provide a single maximum annual daily precipitation value per calendar year. These data were then plotted with a trend line to quantitatively identify potential trends.

2.2 Nearshore Sediment Transport

A process-based approach was used to understand and quantify the direction and magnitude of sediment transport into and around Port Angeles Harbor. Understanding historical changes is crucial to determining the physical processes controlling sediment transport in a particular locale. Quantification of transport only comes from rigorous analyses of the underlying physical processes known to occur and measurements of relevant variables used to drive these analyses.

Historical information compiled for the Port Angeles Harbor Sediment Study (E&E 2008) was used as the basis for historical changes in the area, particularly since 1914. Additional information sources included:

- Geologic maps associated with the greater Port Angeles area (Schasse 2003) and the 7.5-minute Port Angeles Quadrangle (Schasse et al. 2004)
- A PhD thesis on the geomorphology of western Washington beaches (Finlayson 2006)
- T-sheets of the area, hand-drawn maps illustrating the study area prior to most commercial development (U.S. Coast and Geodetic Survey 1892a; U.S. Coast and Geodetic Survey 1892b; U.S. Coast and Geodetic Survey 1907)
- An article describing the coastal geomorphology of Ediz Hook and the beach nourishment activities (Galster 1989)
- Historical nautical charts (U.S. Coast and Geodetic Survey 1898; U.S. Coast and Geodetic Survey 1931; U.S. Coast Survey Office 1853) and recent nautical charts made in 1948, 1969, 1972, 1976, 1984, 1990, and 1996 (NOAA 2008a)
- Historical documents and photographs of the Port Angeles regrade 1914 (University of Washington 2008b)
- Washington Coastal Atlas oblique aerial photographs taken in 1977, 1994, 2002, and 2006 (Ecology 2008)
- A drift cell analysis of Clallam County, including the study area (Bubnick 1986)
- Water Resource Inventory Area (WRIA) documents relating to water resources within the project area and their implications to resident salmonids (Entrix 2004; Haring 1999)
- A recent summary of the physical consequences of shoreline protection and their implications to local aquatic species (Herrera 2008b)

- A recent summary of indigenous settlement, activity, and artifacts in the vicinity of Port Angeles (LAAS 2006)

Government Land Office (GLO) maps of the area were obtained, but they were made at approximately the same time as the T-sheets and therefore did not provide additional information about the characteristics of the shoreline. Historical aerial photographs from 1942, 1972, 1982, 1988, and 2006 were used to determine the timing of different shoreline modifications.

Two site visits were made to verify geomorphic conditions described in earlier studies and to determine the nature and quantity of sediment inputs to the harbor. On May 8, 2008, the following locations were examined:

- The southern edge of Ediz Hook including the tip
- The lagoon on the Nippon Paper Industries property
- Easily accessible points along the shoreline in Port Angeles, including the mouths of Tumwater, Valley, Peabody and Ennis creeks
- The shoreline between the mouths of Ennis Creek and Morse Creek

Spring tides occurred that day with a low tide of -3.76 feet mean lower low water (MLLW). Maximum tidal flow velocities occurred approximately 3 hours before and after the low tide (NOAA 2008c). Where possible, these currents were estimated through observation and professional judgment and noted. Flow rates exiting each of the small creeks were also estimated. Measurements were taken that enabled a volume estimate of Tumwater Creek delta, along with photographs of all relevant geomorphic features.

On May 22, 2008, the second site visit was timed to coordinate with STA sampling. Nearshore site reconnaissance was limited to the reach of shoreline between Ennis Creek and Morse Creek, including the mouth of Lees Creek, and the lagoon on the Nippon Paper Industries property during low tide (-1.60 feet MLLW;(NOAA 2008c).

Sediment transport direction was determined from the combined analysis of historical modifications and an assessment of substrate conditions on the two site visits, based on:

- Identification of newly deposited sediment (i.e., sediment devoid of barnacles and other marine-derived organic matter)
- Lateral coarsening and fining trends alongshore
- Truncation of deltas in areas of wave erosion
- Changes in topography/bathymetry seen between older aerial photographs and the conditions on the site visit

- Professional experience of shoreforms in similar environments in western Washington.

2.2.1 Extreme Wave Events

Preliminary STA results indicated that extreme events delivered sediment to parts of Port Angeles Harbor that were degradational under normal conditions. An analysis was performed to identify the type and frequency of extreme events most likely to transport sediment across the study area. Available wind data sources are summarized in Table 2.

Table 2. Available wind data used to identify extreme nearshore sediment transport events, Port Angeles Harbor

Gauge ID	Timestep	Beginning of Record	End of Record	Length of Record
KCLM	Hourly	7/1/1996	Present	12 years
24228	Hourly	1/1/1973	7/30/1990	17 years (intermittent)

Most of the waves inside Port Angeles Harbor are produced by local winds. The dominant direction of the wind during all times of the year is from the west (Western Regional Climate Center 2008b). Hourly wind data recorded at the William R. Fairchild International Airport in Port Angeles were reviewed (University of Washington 2008a). Data from the National Climatic Data Center and records associated with various air quality studies conducted in the greater Port Angeles area generally lacked the consistency or duration for the type of analysis required and were not used.

2.3 Sediment Transport by Tides and Currents

In portions of the harbor that are deeper than the influence of waves (i.e., approximately 55 feet, see Section 4.2.1)), oceanographic currents dominate sediment transport. Several studies have described current motions in the harbor, but none were targeted specifically toward identifying near-bed currents and sediment transport. As such, new hydrographic observations were made using a variety of instruments affixed to bottom-mounted tripods. To further constrain sediment transport processes on longer time-scales, two complementary analyses of near-surface sedimentation patterns were performed (STA and radioisotopic core analysis).

2.3.1 Previous Studies Review

The analysis of currents and their potential influence on sediment transport within the harbor consisted of a review of existing work on the hydrography of Port Angeles. A series of studies was performed in the 1970s by Rayonier and Crown Zellerbach and their consultants in association with regulatory actions taken by Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA). When placed in context with recent modeling advances, these earlier studies provide the basis for understanding the likelihood of motion of bed sediments in the harbor. In addition, the following studies were reviewed:

- A surface tracer study performed for the Department of Justice (Ebbesmeyer et al. 1979)
- A summary of current and dye studies and sediment sampling performed in Port Angeles Harbor in the 1970s (Shea et al. 1981)
- Two related studies of currents and sediment transport potential in Port Angeles Harbor performed for Rayonier (Battelle 2004, Yang et al. 2004)
- A summary of previous current studies in the Strait of Juan de Fuca and the identification of the Olympic Countercurrent, and a new analysis of long-term current moorings (Thomson et al. 2007)
- Recent review articles on sediment gravity flows (Parsons et al. 2007; Wright and Friedrichs 2006)

2.3.2 Tripod Observations

Three bottom-mounted tripods with monitoring equipment were deployed in March and April 2008 (Evans-Hamilton 2008). The equipment allowed simultaneous measurements of tidal height, wave conditions (period and height), currents both near the bed and throughout the water column, and turbidity. Together, these parameters indicate periods when sediment is in transport and the physical circumstances under which that transport occurs. The positions of the tripods were chosen to determine the spatial and temporal structure of tidal motions across the harbor (Figure 2). The deployment also sought to identify the types and frequencies of physical processes responsible for resuspension of sediment.

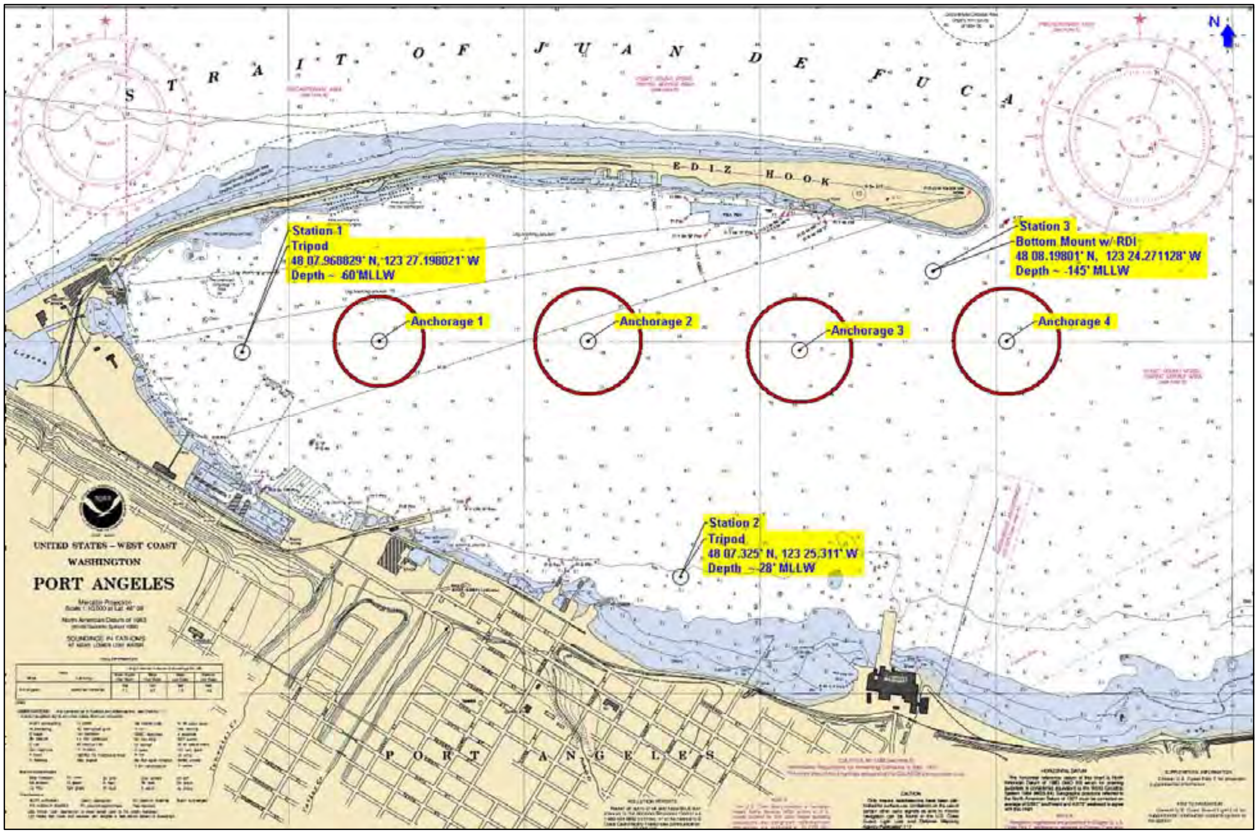


Figure 2. Location of the three bottom-mounted tripods deployed between March 26 and April 25, 2008, Port Angeles Harbor

2.3.3 Near-Surface Sedimentation Analysis

The surface of the seabed reflects the history of transport and deposition in the harbor. Two methods were employed to exploit the information available in the sediment record from deeper portions of the harbor:

- An STA of 765 grab samples, which were also used to map the extent of wood waste and sediment textural variability in the harbor
- Two cores sampled for their radioisotopic characteristics, one collected in the mouth of the harbor between the former Rayonier mill site and the tip of Ediz Hook and the other collected from the inner harbor near the Nippon Paper Industries site; the cores were selectively tested for lead-210 (^{210}Pb) and cesium-137 (^{137}Cs). Results were used to indicate average rates of sedimentation at these core locations.

Sediment Trends Analysis

Inferring sediment transport direction through spatial changes in grain size of surficial sediments is well established in the sedimentology literature (McLaren et al. 2007). The STA method uses the first- (mean), second- (standard deviation), and third-order (skewness) moments of the grain-size distribution to determine transport directions. STA is based on only the finer portion of the

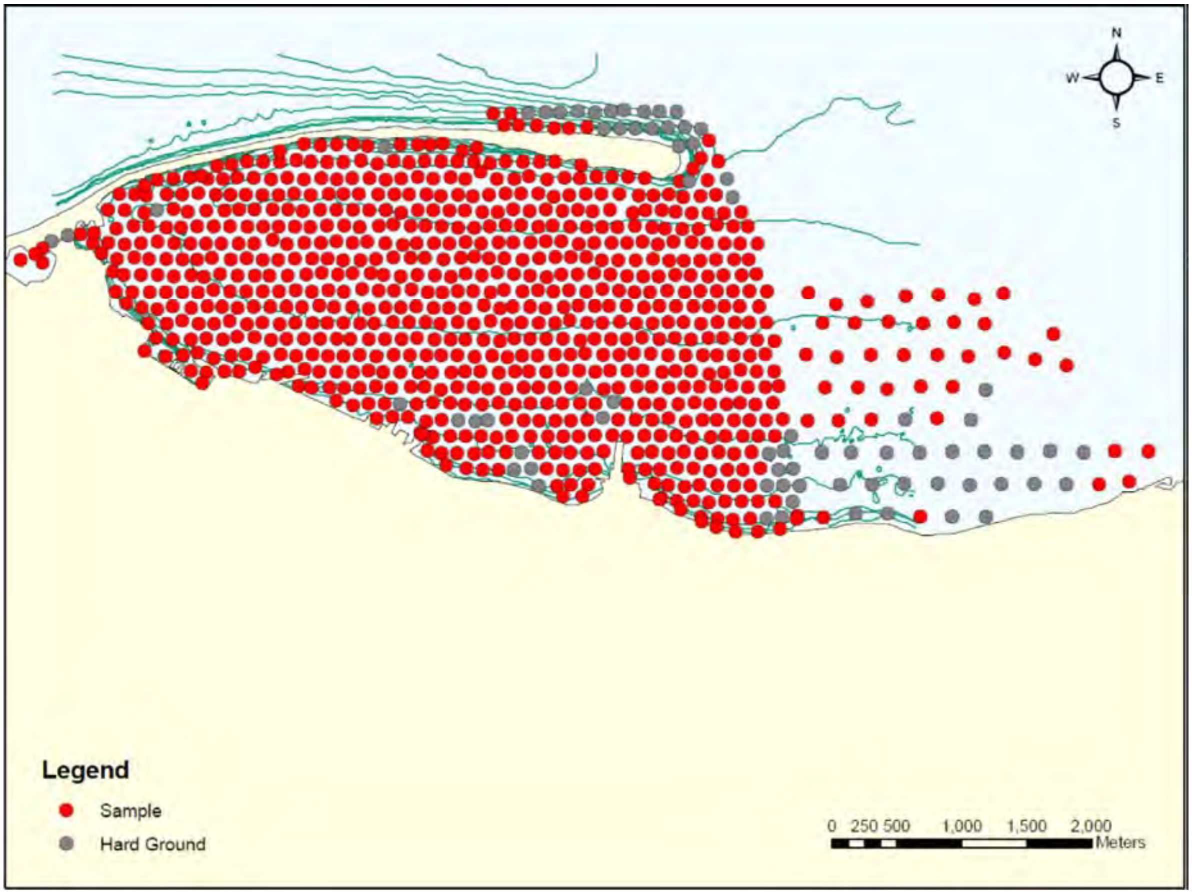


Figure 3. STA sample locations, Port Angeles Harbor

grain-size distribution (<4 millimeters in diameter). A full description of the theory behind STA is provided in Section 2 of McLaren (2009).

In this investigation, grab samples were attempted from 837 locations throughout Port Angeles Harbor (Figure 3). Grab samples were made with a van Veen-type sampler capable of collecting the top 4 to 6 inches of the bed surface. If the seabed was composed of bedrock or coarse cobble (sediment particles greater than a few inches in diameter) or was highly compacted, the sampler did not return a sample. This occurred in 72 instances, primarily at the eastern end of the study area (Figure 3).

Sediment grain size distributions were determined using a Malvern MasterSizer 2000 laser particle sizer. Contribution to the grain size distribution from sediment particles with diameters between 1.0 millimeters and 4.0 millimeters was determined by sieving. In addition to grain size, the presence of wood, shells, and other distinguishing characteristics found in each sample were recorded and mapped.

Radioisotopic Analysis

Two cores (MA06 and RL03/) were sampled for presence and concentration of ^{137}Cs and ^{210}Pb (Figure 4). Radioisotopic analyses were performed on 2-centimeter core sections at 10-centimeter intervals throughout both cores (MA06 total sampled depth = 42 centimeters, RL03 total depth = 52 centimeters).

^{210}Pb is one of the last daughter product isotopes created by the radioactive decay of the isotope uranium-238 (^{238}U). ^{210}Pb forms naturally in the sediments and rocks that contain ^{238}U. ^{210}Pb also forms in the atmosphere as a daughter product of radon gas decay. Within 10 days of its formation from decay of radon, ^{210}Pb falls out of the atmosphere and accumulates on the surface of the earth in soils and in lake and ocean sediments, as well as in glacial ice. ^{210}Pb eventually decays into a non-radioactive form of lead. ^{210}Pb has a half-life of 22.3 years; that is, after this time elapses, half of the original amount of remains. It takes about seven half-lives, or 150 years, for ^{210}Pb in a sample to reach near-zero radioactivity. If the sediment layers are undisturbed, then as the sediment ages, it slowly loses ^{210}Pb radioactivity. The age of a sediment layer can thus be estimated by its ^{210}Pb content. In addition, net accumulation rates can be estimated by evaluating the ^{210}Pb age and depth relationship of samples.

^{137}Cs is a radioactive form of cesium with a half-life of 30.3 years. It is a thermonuclear byproduct whose presence in the environment is a result of atmospheric testing of nuclear devices primarily during the latter half of the 1950s and early 1960s. Because it was not present in the atmosphere or on the Earth's surface prior to 1945 (63 years prior to core sampling), it provides an independent check on the results of ^{210}Pb analysis. ^{137}Cs analysis is generally a presence-absence test, typically performed following review of ^{210}Pb results focusing on portions of the core estimated to be 50 to 60 years old. In this study, ^{210}Pb and ^{137}Cs analysis were performed simultaneously, due to schedule constraints.

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N
W E
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Feet

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Figure 4. Map of core locations in Port Angeles Harbor.

source: ecology & environment, inc., 8/6/2008 ...\port_angeles_sta\actual core sample locs.mxd

3.0 Study Area Background

Port Angeles Harbor, formerly called False Dungeness Harbor (U.S. Coast Survey Office 1853), is on the southern shoreline of the Strait of Juan de Fuca. It is protected from significant exposure to open-ocean waves by Ediz Hook, a 3-mile-long spit; however, significant swell is present on the seaward (north) side of Ediz Hook and points west of the Morse Creek delta. The bathymetry of the harbor is asymmetric, with the deepest portion in the north adjacent to Ediz Hook approximately 150 to 200 feet deep. The southern end of the harbor has a subtidal bench 20 to 50 feet deep that widens to the east. Winds are dominantly from the west, driving a surface current eastward (Ebbesmeyer et al. 1979). Easterly and northeasterly winds are unusual, but can occur when high pressure persists over mainland British Columbia (Finlayson 2006).

Like most of the rest of western Washington, the landscape of Port Angeles was set by the most recent continental-scale glaciation. Beginning about 20,000 years ago, ice flowed into the Strait of Juan de Fuca and into the study area from the north, driven by increased snow accumulation in British Columbia associated with warming at the end of the last ice age (Schasse et al. 2004). In front of this glacier, a layer of sediment called outwash was laid down, while tills (comprised of well consolidated but poorly sorted mixes of silt, sand, gravel, and cobble) were laid down underneath the glacier.

By about 17,000 years ago, the ice sheet began to collapse. This, in conjunction with global sea-level rise, caused the landscape to be inundated by marine water up to 130 feet above modern sea level over the following 4,000 years (Dethier et al. 1995). This inundation left a thin layer of glaciomarine drift (marine sediments often derived from melting glacial ice) on the landscape up to this altitude. However, with the rapid loss of the weight of the ice, the land surface rebounded dramatically over the next 2,300 years, resulting in a lowering of relative (local) sea level by as much as 2 inches per year (Schasse et al. 2004). This rapid drop in relative sea level caused the small creeks draining to the Strait to incise deeply into the freshly deposited glaciomarine drift. Because the base level drop was so quick, the valleys of the creeks that drain into the harbor are remarkably straight and perpendicular to the shoreline. Following this dramatic drop in relative sea level to 200 feet below modern sea level (Mosher and Hewitt 2004), the global sea level rose slowly again. This caused a backfilling of the new creek valleys cut during the preceding relative sea level drop.

By 6,000 years ago, most of the global sea level rise to current levels had already occurred (Schasse et al. 2004), although slow sea level rise persists today at approximately 0.06 inches per year (NOAA 2008b). As sea level rose, upland areas became susceptible to erosion, and bluffs along the modern-day shoreline of the harbor began to form. The record of this shoreline recession is confirmed by the hard bottom (wave cut) bench described on the earliest nautical chart of the area (U.S. Coast Survey Office 1853). At the same time, Ediz Hook migrated eastward from the mouth of the Elwha River to enclose the modern harbor (Galster 1989). A balance was struck over time between recession of the shoreline and the associated shortening of the river valleys (Schasse et al. 2004). This made for efficient delivery of sediments from eroding uplands to fill the harbor, which is not yet complete; that is, the depth of the harbor is much greater than the volume of sediments released since the onset of modern conditions within the last few thousand years. This has created a repository of sediment below the closure depth of the harbor (at depths below the effect of waves), which has numerous implications for the present study, such as the ability of the harbor to serve as a permanent sink of sediment.

3,1 Pre-European Settlement Geomorphic Conditions

Prior to European settlement, most of the bluffs along the south shore of Port Angeles Harbor actively supplied sediment to the nearshore across the study area, with the exception of the area in the vicinity of the lagoon and neck of Ediz Hook. The shoreline along the modern-day town of Port Angeles was much more complex (U.S. Coast Survey Office 1853), with a series of bars and spits associated with both bluff landslides and sediment from the small creeks entering the harbor (Figures 5 through 7). Figure 5, covering the east end of the study area, identifies two landslides between the mouth of Ennis Creek and Morse Creek, corroborating the hypothesis that the bluffs have supplied significant sediment to nearshore areas. Transport of this material was dominantly westward west of Lees Creek and eastward east of the creek as indicated by the shape of the deltas at each of the creek mouths. As was found in the aerial photographic analysis of the modern Morse Creek delta, historical spits formed with a southeast to northwest orientation, with necks connected to the primary shoreline east of the creek mouth and tips on the west of the mouth, causing the main channel to make a left turn before entering the harbor. Near the lagoon, the picture was somewhat more complicated. The lagoon has historically been isolated from the harbor by a small beach berm arising from sediment supplied from the shore bluffs and small creeks in the area that is now downtown Port Angeles. The beach ridge was in one location at the north end of the lagoon, near the limit of sedimentation from the shore bluffs. The connection of the lagoon to the harbor was likely maintained by a combination of freshwater input from the adjacent bluffs and the slight reduction in transport capacity (from waves, due to increased protection from Ediz Hook) at this location.

The dynamics of Ediz Hook prior to European settlement was likely very similar to other spits in the Pacific Northwest (e.g., Dungeness Spit, Ala Spit) (Herrera 2008a). Ediz Hook was maintained by overwash splays of sand and gravel during large storms. With time, these splays have occasionally vegetated with dunegrass and other salt-tolerant grasses. The process of overwash deposition and salt-tolerant vegetation growth continued along the length of the spit with its tip prograding (advancing eastward) with time. The overwash splays resulted in a relatively wide spit in pre-development times as seen in comparison between historical photographs and modern conditions (University of Washington 2008). Most of the material that built the spit was derived from the Elwha River and eroding bluffs to the west of Port Angeles (Galster 1989). Damming the Elwha River in 1913 (Elwha Dam) has caused erosion of the spit, initiating a large-scale beach nourishment program sponsored by the U.S. Army Corps of Engineers.

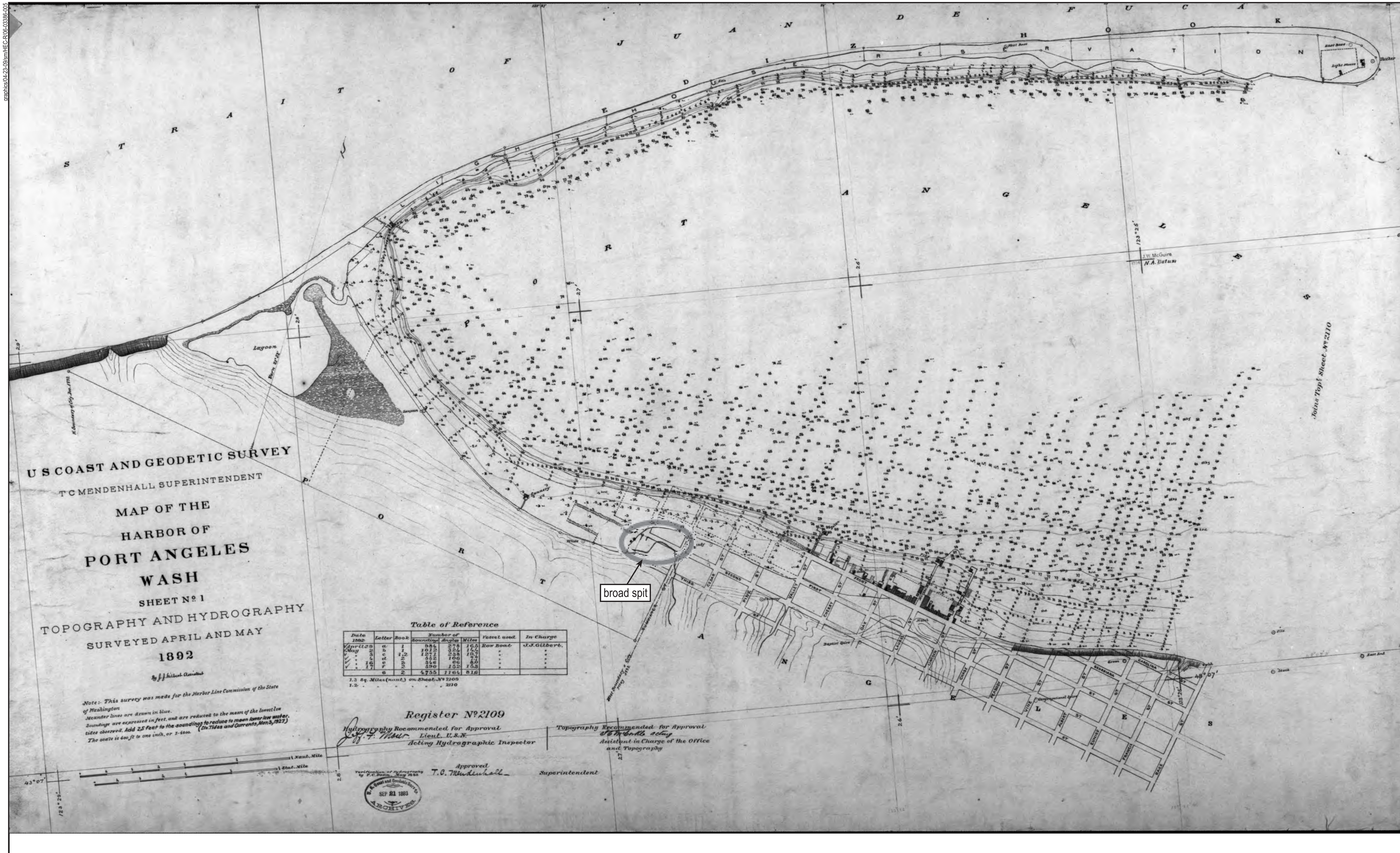


Figure 5. T-sheet of inner Port Angeles Harbor (USCGS 1892).

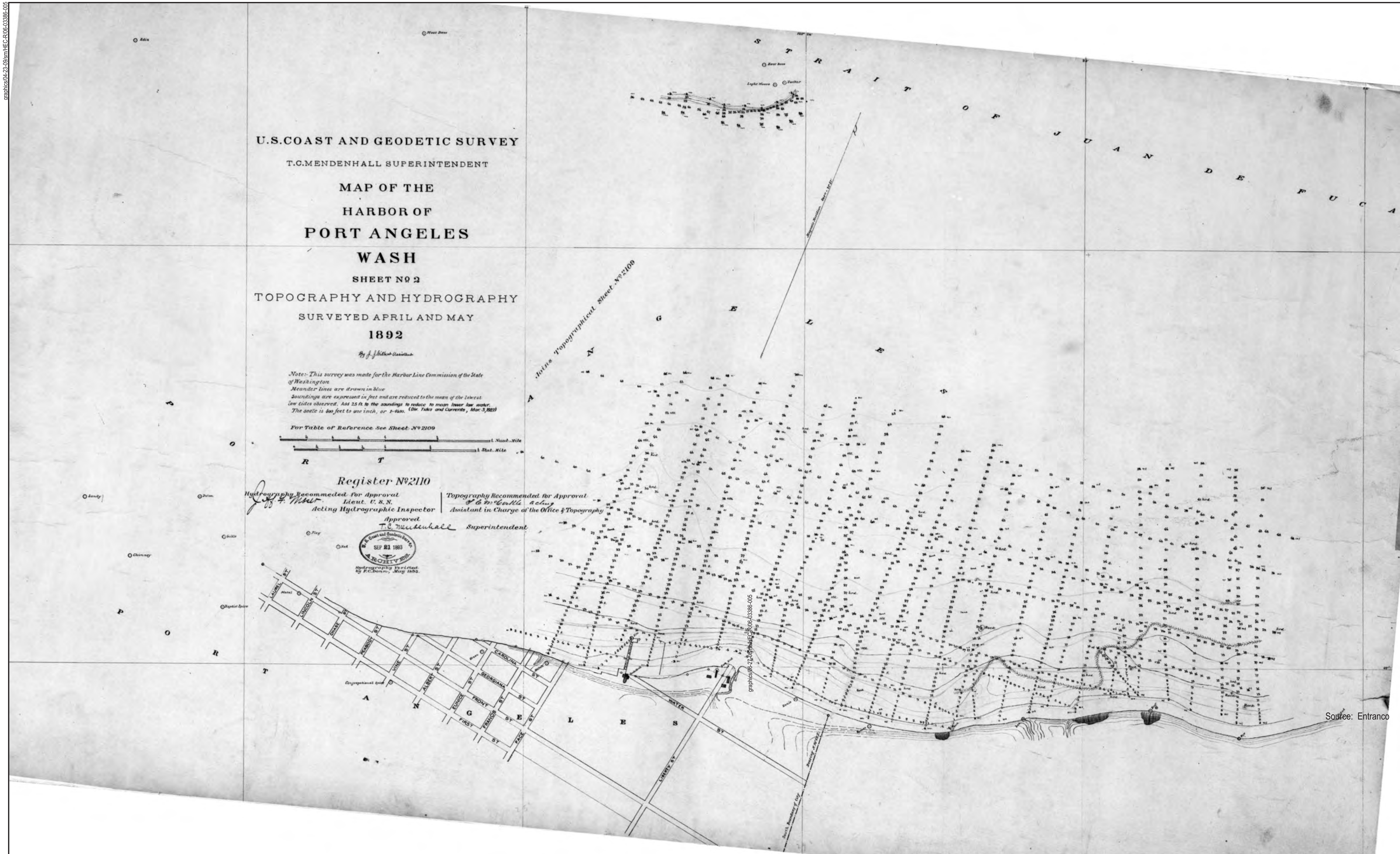
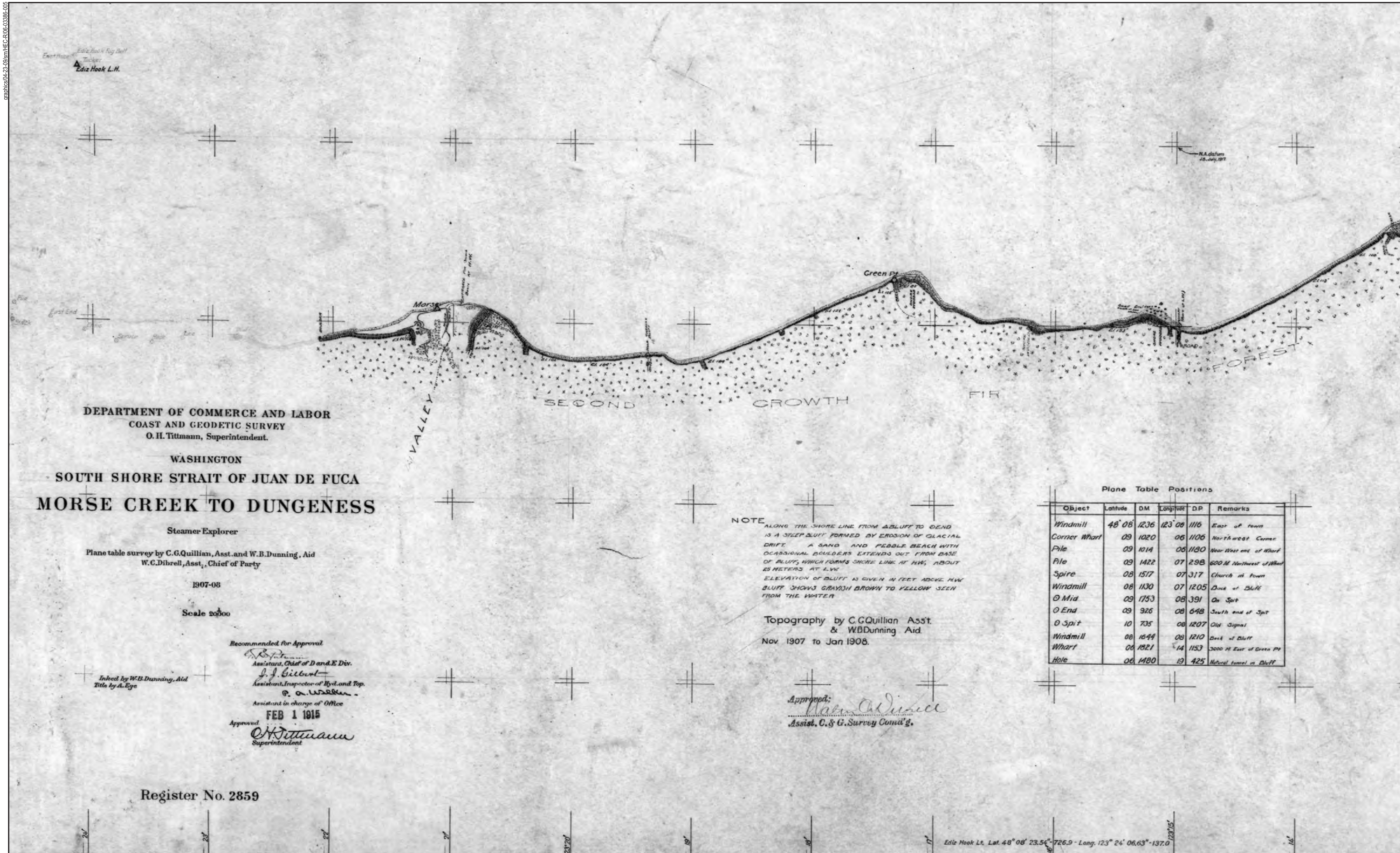


Figure 6. T-sheet of east Port Angeles Harbor (USCGS 1892).



Object	Latitude	D.M.	Longitude	D.P.	Remarks
Windmill	48° 08'	1236	123° 06'	1116	East of town
Corner Wharf	09	1020	06	1106	Northwest Corner
Pile	09	1014	06	1180	Near West end of Wharf
Pile	09	1422	07	298	600 M Northwest of Wharf
Spire	08	1517	07	317	Church in town
Windmill	08	1130	07	1205	Back of Bluff
⊙ Mid	09	1753	08	391	On Spit
⊙ End	09	926	08	648	South end of Spit
⊙ Spit	10	735	08	1207	Old Signal
Windmill	08	1644	08	1210	Back of Bluff
Wharf	06	1821	14	1153	3000 M East of Green Pt
Hole	06	1480	19	425	Natural tunnel in Bluff

Figure 7. T-sheet of Morse Creek and points east (USCGS 1907).

4.0 Results

4.1 Sediment Input

Determining sediment inputs is the first step in explaining the origin, transport, and fate of sediments in an enclosed system. In the case of Port Angeles Harbor, sediment inputs are somewhat limited due to the significant impact of human activities and development. Shoreline modifications (mostly fill) have completely disconnected the bluffs from the nearshore. Prior to European settlement, bluff erosion was the dominant source of coarse sediment to the nearshore on the southern portion of the harbor.

Since the elimination of bluff material as a source, sediment entering the study area has come primarily from two sources of direct input; human activities and from the creeks that drain to the harbor. In Port Angeles Harbor, it is likely that human activities have been responsible primarily for input of organic sediments, including, but not limited to, deliberate and inadvertent disposal of wood waste, fine woody debris and other waste products (e.g., sewage and bilge water from marine vessels), suspended sediments delivered to the harbor from land reclamation activities alongshore, and application of materials associated with aquaculture operations (fish food and waste). The straight, incised nature of the small creeks draining to Port Angeles Harbor provides for especially efficient delivery of sediments from steep mountain slopes to the south shore of Port Angeles Harbor. Since land reclamation activities have ceased, most recent input of inorganic sediment has been from the creeks.

The large supply of sediment from some of the streams has resulted in significant progradation of their deltas, including growth that has occurred subsequent to shoreline land reclamation activities. If the post-reclamation deltas are large enough and have been protected from erosion since they began forming, their volumes can be estimated by determining the difference between modern configuration of the shoreline and seabed and that documented in historical nautical charts. These resulting volume estimates can in turn be used to estimate the minimum volume of sediment input into the harbor from the associated creeks. The Tumwater Creek delta is sufficiently protected from wave action to be an accurate record of sediment discharged to the harbor. Using the Tumwater Creek delta as a reference, a standard sediment production model was used to estimate the sediment input from the other creeks discharging to the harbor (Syvitski et al. 2005; Syvitski et al. 2003). The analysis of the Tumwater Creek delta, as well as a discussion of the other creek deltas considered for this analysis, is provided below.

4.1.1 Morse Creek

The mouth of Morse Creek is a relatively unaltered marine delta. The creek channel is diked to within only a few hundred feet from its mouth. The flow is thus constrained for much of the upper (landward) portion of the delta. Nonetheless, the seawardmost portion is not constrained and reflects the interaction of natural depositional and erosional processes. The mouth of Morse

Creek has exhibited cyclical behavior since pre-development times. The cycle consists of spit development and direction of river flow to the east, followed by the river breaching the spit and flowing straight (north) into the Strait, as shown in historical photographs (Ecology 2008). This cycle is consistent with dominant alongshore transport to the east. Because much of the sediment input of Morse Creek is eroded from the mouth and transported alongshore by swell and other wind-generated waves from the Strait, it is not possible to use delta volume to estimate the flux of sediment to the nearshore. Furthermore, because most of Morse Creek sediment is removed from the Port Angeles Harbor area (i.e., transported further east), its sediment flux is not applicable to this investigation.

4.1.2 Lees Creek

A small asymmetric delta exists at the mouth of Lees Creek, with the creek flowing through the east side of the delta. The east side of the delta is dominated by cobble, while the west side has much finer-grained sediment. The west side also has accumulated sediment such that the seaward side of the Olympic Discovery Trail has been colonized by dune grass in front the revetment. This indicates intense westward transport of Lees Creek sediments. Because of the presence of a broad foreshore and low-tide terrace to the west, it is clear that much of the sand and gravel discharged by Lees Creek is transported away from the fan into the nearshore west of the fan. The delta is evident in the 1892 T-sheet (Figure 6) in the same location as the modern delta, indicating that it predates European settlement. Based on the evidence of strong westward transport of sediment at the creek mouth, the volume of sediment retained on the delta is likely only a small fraction of the total sediment discharged since European settlement. Therefore, the volume of the Lees Creek delta was not measured for sediment input analysis.

4.1.3 Ennis Creek

The mouth of Ennis Creek was substantially modified by Rayonier to construct its facility using fill placed before 1931 (U.S. Coast and Geodetic Survey 1931). Prior to development, transport was westward, as indicated by a small muted spit at the creek mouth in the 1892 T-sheet (Figure 6). The modifications allowed for accumulation of a new delta on the east side of the Rayonier property. The northern end of this delta has been eroded by wave action and transported to the west, but the southeast portion of the delta is symmetric and relatively fine-grained, even retaining sand in places. Historical aerial photography and nautical charts show limited delta growth since 1965, indicating that the delta may have reached equilibrium with the wave environment, with a loss of bedload sediment both alongshore and offshore. Based on this, the delta volume was not used to estimate sediment input.

4.1.4 Peabody Creek

The mouth of Peabody Creek was modified (culverted) before 1892. It is not clear what form the creek mouth had at the time of European settlement, since it was developed prior to the T-sheet (Figure 5). An earlier nautical chart shows only one creek outlet in Port Angeles east of Tumwater Creek (U.S. Coast Survey Office 1853). It was moved seaward late in the nineteenth century and moved an additional 400 feet sometime between 1944 and 1965 based on aerial photographic analysis and historical nautical charts. Currently the edge of the delta is truncated by erosion at the seaward limits of two artificial headlands associated with the City Pier. Sediment transport is dominantly westward, as indicated by the accumulation of creek-derived material in front of the riprap on the west promontory and the lack of such sediments to the east. This is despite the fact that beyond the eastern promontory, the waves reaching the delta must pass through pilings associated with the City Pier. The volume of the Peabody Creek delta was not measured, owing to significant erosion of the outermost portions of the delta.

4.1.5 Valley Creek

Valley Creek has the largest and most complex delta of the three creeks that discharge from Port Angeles proper (the others being Tumwater and Peabody creeks). The complexity is most likely due to an estuary restoration project removing some portion of previously placed material in the area. The mouth of Valley Creek, as with the other two creeks, has been moved seaward from its position prior to European settlement as a result of fill and development of the shoreline. This movement had already begun by 1892 (Figure 5). Large cobble and gravel bars more than 5 feet high are present on either side of the current channel. It is unclear whether these are natural features or constructed as a part of restoration work. Like Peabody Creek, the edge of the modern delta has been constrained by prior human activities. There is evidence of sediment accumulation in front of the riprap revetment on the west side of the delta. The east side of the delta is coarsened, indicating some degree of erosion. The volume of the modern Valley Creek delta was not measured because it was not possible to determine the portions attributable to fluvial processes versus imported fill.

4.1.6 Tumwater Creek

As with the other creeks draining to Port Angeles Harbor, the mouth of Tumwater Creek has also been moved seaward by land reclamation activities. In 1892, prior to most of the filling at the creek mouth, the creek channel was confined to the west by a broad spit next to the marine bluff (Figure 5), indicative of westward transport at the mouth. Its current position on the lee (west) side of Port of Port Angeles Terminal 1 has created an unusually calm creek mouth (Figure 8). This has caused rapid accumulation of sediment on the Tumwater Creek delta, likely since the creek was moved in the early twentieth century. This is consistent with the nearly symmetric shape of the delta and its development through time as seen in the historical aerial photographs and nautical charts (University of Washington 2008, NOAA 2008). This delta provides a convenient and reliable way to estimate historical (since development) sediment inputs to the harbor.

The delta volume was estimated by measuring the horizontal coordinates of the delta with a Global Positioning System (GPS) and surveying the vertical elevations relative to the known water level at the edge of the intertidal delta at an exceptionally low tide at the time of the first site visit, and comparing those coordinates and elevations to those documented in historical maps and charts.

Figure 8. Photographic panorama of the Tumwater Creek delta

To estimate the configuration of a delta based on the limited positional information gathered during the site visit as opposed to performing a detailed topographic and bathymetric survey of the delta, it is necessary to understand the typical morphology of a delta. Two primary elements define deltas: the topset and foreset (Figure 9). The topset of a delta is a gently sloped surface extending from the creek mouth to the foreset. The foreset is a relatively steep slope extending from the edge of the topset into the basin. The topset is influenced primarily by tides and wave energy, while the foreset is where deposition is focused. The topset and foreset meet at the roll-over point, which occurs in extremely quiescent environments near the lowest tide elevation. In the case of Tumwater Creek, the topset slope can be estimated by linearly interpolating between elevation measurements made at the low tide waterline and at the mouth of the creek (i.e., the head of the delta). The Tumwater Creek delta topset has a calculated slope of about 2 percent. The slope of the submerged foreset must be estimated because recent nautical charts lack the necessary spatial resolution for proper measurement. Studies that have highly resolved bathymetry of deltas in similar environments in the Pacific Northwest suggest that foreset slopes could reach as high as 10 percent (Mitchell 2005). Therefore, to provide a conservative (minimum) estimate of sediment retained, a 10 percent slope is used to describe the Tumwater Creek delta foreset slope.

The generated present surface was then compared to the seabed surface in the 1931 nautical chart. Areas nearest the present stream mouth were assumed to have an elevation equivalent to the elevation of the platform on adjacent shorelines in 1931. The difference in elevation of the present day surface and the 1931 surface results in a volume of 4.68 million cubic feet. This volume represents the total bedload accumulated between the present and sometime between 1892 and 1931 (i.e., 77 to 116 years ago), when the stream mouth was relocated. A range of starting times are cited because the 1931 bathymetry is not inclusive of the shoreline and most of the modifications were completed well before 1931, such that some limited delta may have existed in 1931.

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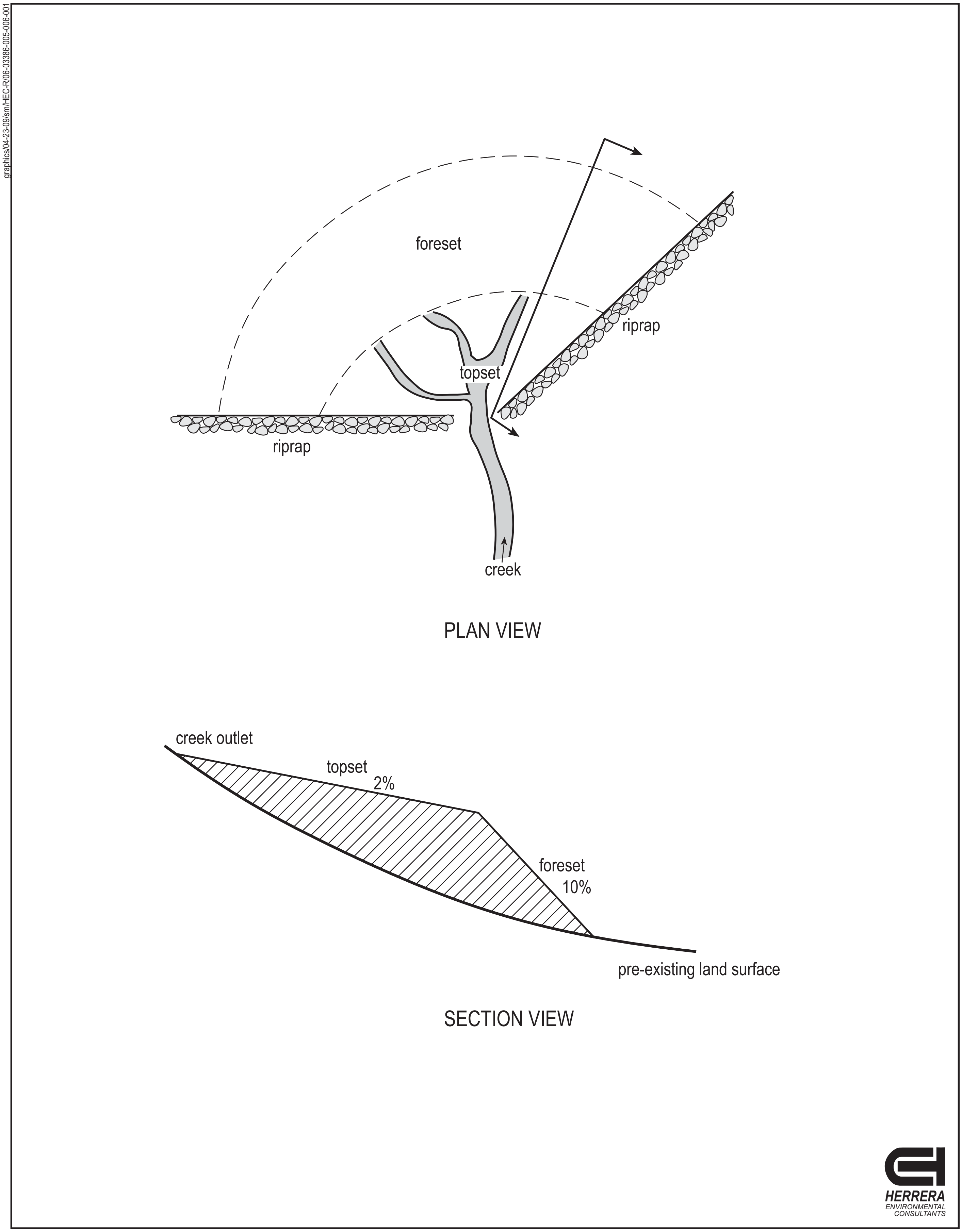

Figure 9. Schematic description of Tumwater delta.

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To estimate the total sediment loading to the harbor, the ratio of bedload to suspended load material deposited seaward of the delta must be estimated. While some recent work suggests that for steep watersheds, bedload can represent up to 33 percent of the total sediment load, non-Himalayan systems like those near Port Angeles Harbor have a smaller proportion of bedload, generally closer to 10 percent (Pratt-Sitaula et al. 2007). Assuming a solids bulk density (the weight of sediment solids per unit volume of seabed) of 1.55 metric tons per cubic meter for accumulating sediment, sediment fluxes ranging from 5,500 tons/year (0.18 kilograms per second) using a 33 percent bedload fraction and a delta age of 116 years, to 27,600 tons per year (0.87 kilograms per second), using a 10 percent bedload fraction and a delta age of 77 years, were calculated.

4.1.7 Total Input of Sediment to Port Angeles Harbor

Estimating sediment input to the sea has been the subject of numerous recent studies (Milliman and Syvitski 1992; Syvitski et al. 2005; Syvitski et al. 2003). From this work, a method to estimate sediment flux from unmonitored basins has emerged (Syvitski et al. 2005; Syvitski et al. 2003), hereafter referred to as the Syvitski model. The equation that has been shown most appropriate for northern hemisphere temperate basins, such as the creeks that drain to Port Angeles Harbor, is

$$Q_s = 6.15 \times 10^{-5} A^{0.55} R^{1.12} e^{0.07T} \qquad (1)$$

Where:

Q_s is the long-term average sediment flux (in kilograms per second),

A is the basin area (in square kilometers),

T is the average temperature throughout the basin (in degrees Celsius), and

R is maximum relief in the basin (in meters).

The average temperature T in the model is estimated from a single average temperature at the outlet of the basin T_0:

$$T = T_0 - LH \qquad (2)$$

Where:

T_0 is the average annual temperature in degrees Celsius at sea level at the basin outlet,

L is the lapse rate of the atmosphere (i.e., the decrease in temperature with height above sea level, equal to 7.43 degrees Celsius per kilometer for Port Angeles), and

H is the average elevation of the basin in meters determined using the U.S. Geological Survey (USGS) 10-meter digital elevation model (DEM).

For the purposes of this analysis, the average temperature measured at the William R. Fairchild International Airport in Port Angeles (49.4 degrees Fahrenheit or 9.67 degrees Celsius) was used to represent conditions at the outlet of each basin (Western Regional Climate Center 2008a). Applying these variables to each of the creeks, total sediment input to the harbor was modeled (Table 3).

Because the Syvitski model does not explicitly take into account lithology and other factors (e.g., degree of urban development, sediment diversion, storage), it is important to evaluate its applicability to the study area. Evaluation of the model was performed by comparing the predicted sediment input rates to the measured Tumwater Creek delta volume (between 0.18 and 0.87 kilograms per second) determined from volume calculations based on topographic measurements made on the first site visit. The Syvitski model prediction for Tumwater Creek (0.76 kilograms per second) is well constrained by the estimated limits of sediment input to the harbor from that measurement.

Table 3. Creek basin and delta characteristics and predicted sediment input, Port Angeles Harbor.

Creek	Maximum Elevation in Watershed (meters)	Age of Initiation of Current Delta (years)	Size of Drainage Basin (square kilometers)	Average Basin Temperature (°C)	Predicted Total Average Annual Sediment Input to the Harbor (kg/sec)
Tumwater	792	77–116	15.6	7.56	0.76
Valley	811	6–14	11.3	7.54	0.65
Peabody	866	43–60	9.6	8.04	0.67
Ennis	2,117	77–94	29.2	5.84	2.87
Lees	822	pre-settlement [b]	12.6	8.12	0.73
Morse [a]	2,222	pre-settlement [b]	152.3	2.73	6.05
Total					**5.69**

[a] Morse Creek is not included in the total sediment input because its sediment is transported out of and away from Port Angeles Harbor.
[b] Pre-settlement indicates that the delta has not been modified significantly since European settlement.
[c] Predictions were made using the Syvitski model; these inputs are an approximate upper bound of sediment input to Port Angeles Harbor.

A reasonable upper limit of total sediment input produced by all of the creeks was estimated with the Syvitski model to be 5.69 kilograms per second. An approximate lower bound was calculated by reducing the total modeled sediment input proportionate to the minimum sediment input rate on the Tumwater Creek delta (0.18 kilograms per second) compared with the assumed upper limit produced by the Syvitski model for that creek (i.e., 0.76 kilograms per second). That is, the minimum estimated sediment input is equal to $5.69 * 0.18/0.76 = 1.35$ kilograms per second.

Although the Syvitski model is non-linear (that is, reductions in sediment input associated with other processes not in the model may not be expressed exactly as a percentage), it serves well as a first-order approximation to the potential lower limit of sediment supply to the harbor given the inherent error (unquantifiable) in the measurements themselves. These estimates are used in the sediment budget (Section 4.3.4) to assess the efficiency of trapping sediment within the harbor.

4.1.8 Extreme Precipitation Events

To identify trends or potential changes in sediment supply in Port Angeles Harbor, an analysis of extreme events that could play a role in this process was performed. Extreme sediment discharge events from the creeks are caused by intense, short-period (e.g., hour-long) precipitation events. As a result, precipitation data were examined to determine the frequency, variability, and trends in the magnitude of discrete sediment input events.

Maximum annual daily precipitation values are shown in Figure 10 (the trendline from these data is equal to 0.0005X + 1.639). Although the trendline shows a slight increase in annual daily maximum precipitation (a 0.1-inch increase in precipitation over 200 years), this trendline appears to be dominated by the events ranging from 1.0 to 2.0 inches per day and is not applicable to possible trends for the higher magnitude events. This argument is supported by the fact that the four biggest precipitation events occurred prior to 1987, and that of the 10 biggest events, only 2 occurred within the last decade. The conclusion of this analysis is that there is no discernable trend in daily maximum precipitation values over the last 75 years.

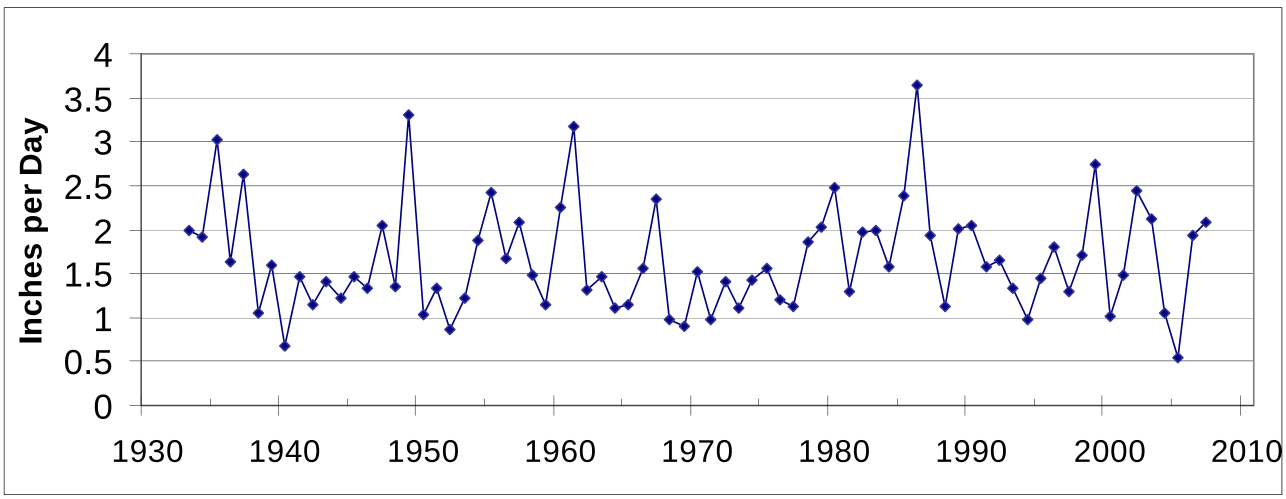

Figure 10. Maximum annual daily precipitation values for Port Angeles

The analysis and results above are applicable only to annual daily maximum precipitation values, which may or may not be the dominant parameter in the generation of peak discharge rates. Although peak discharge rates from larger watersheds like Ennis Creek (7,223 acres) are likely to be strongly correlated with daily or 24-hour precipitation volumes, the smaller watersheds that discharge into Port Angeles Harbor (i.e., Tumwater, Valley, Peabody, and Lees creeks) are likely to be similarly influenced by shorter duration and higher intensity events. Additionally, looking only at trends in precipitation does not account for the fact that land use has continued to change within the basin over the last century, and that the conversion from forested conditions to grass and impervious surface results in comparatively higher discharge rates. This shift in hydrologic conditions in the basin is expected to increase the total volume of sediment supplied to the harbor, as well as increasing its mean grain size.

4.2 Nearshore Sediment Transport

The primary purpose of the nearshore sediment transport analysis was to determine the dominant direction of sediment transport in the nearshore zone of the harbor, defined generally by those areas whose depths lie within the influence of wave action. Transport across this area is fundamentally different than in deeper portions of the harbor because it is driven almost exclusively by wave action. The Washington State Coastal Atlas provides estimates of drift direction (Ecology 2008). These estimates are based on analysis using geomorphic indicators to determine net drift (Bubnick 1986). Several discrepancies were found between conditions described by Bubnick including drift directions indicated on the Coastal Atlas, and geomorphic evidence found during the site visits. Directions of littoral (alongshore) transport described in the Washington Coastal Atlas, along with the directions of transport found during site visits, are given in Figure 11. In nearly all cases, differences arose from the bi-directional nature of transport along the nearshore. Bi-directional transport is common throughout Puget Sound and the Strait of Juan de Fuca, owing to wind direction variability, which can often reverse the direction of wave transport along shore (Finlayson 2006).

4.2.1 Nearshore Hydrographic Conditions

In general, water motion along the nearshore is dominated by waves. There is limited information on the Port Angeles Harbor wave field. Previous work has described large-scale currents but as these studies did not focus on the nearshore zone, they did not account for wave-induced transport, even though many of the early contaminant releases occurred along the nearshore (Malcolm-Pirnie 2005). Therefore, this previous work is of limited utility to the understanding of nearshore sediment transport in Port Angeles Harbor. The wave field is complex in Port Angeles Harbor, with swell (large waves originating from the open ocean) present in limited, but increasing, amounts as one moves east outside of the protection of Ediz Hook. An important physical process that occurs in Port Angeles Harbor is wave refraction. Refraction occurs as a result of the change in speeds of waves as they move across areas of changing water depths. As waves enter shallower water they move more slowly than they did in deeper water. Thus, when a wave is moving in a direction oblique to a uniformly sloping shoreline, the part of the wave in shallower water will move more slowly than the portion of the wave still in deep water, causing the wave to bend, or refract, with the crest tending to align parallel to the shoreline and the direction of wave motion tending to align perpendicular to the shoreline. In the case of Port Angeles Harbor, with the common wind-derived waves and swell originating from the west, the waves and swell in the Strait of Juan de Fuca that shoal in the vicinity of the tip of Ediz Hook refract around the tip of the hook. Thus, the angle of attack of the waves along the southern shoreline of the harbor west of Lees Creek has a westward component.

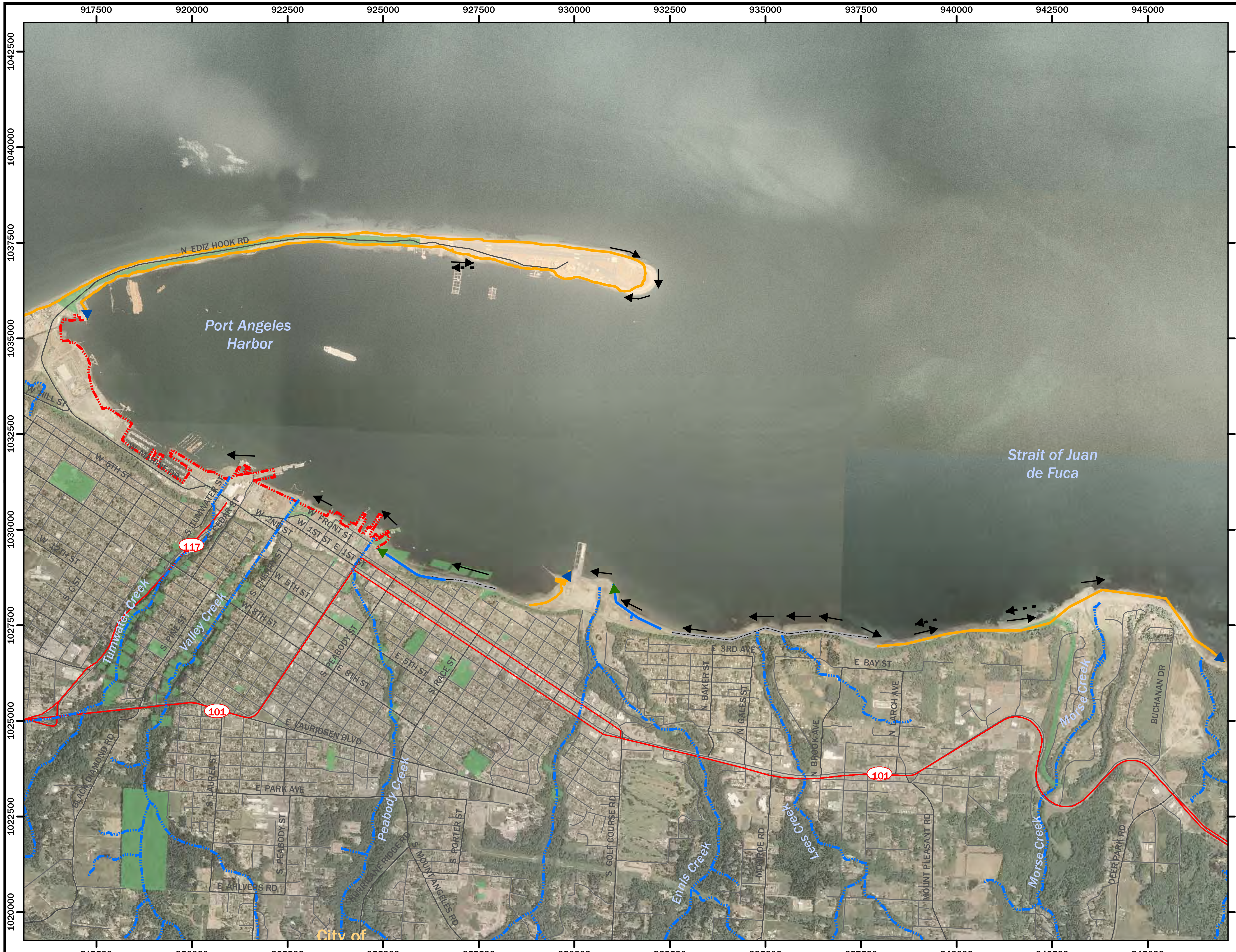

Figure 11.
Nearshore transport directions in the vicinity of Port Angeles Harbor.

Legend

Observed Geomorphic Indicators

- Dominant transport
- Secondary transport

Coastal Atlas Drift Cells

- Divergence Zone
- Left to right
- NAD (No Appreciable Drift)
- Right to left

- River
- Highway
- Arterial or Collector Road
- Road
- Park

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HERRERA ENVIRONMENTAL CONSULTANTS

0 1,250 2,500 5,000 feet

Coordinates: Washington State Plane South
NAD 83 (feet)
Aerial: USDA, 2006

N

Produced By: GIS (RDR)
Project:
K:/Projects/06-03386-005/Projects/Drift Cells.mxd (04-24-2009)

Although this refraction depletes the waves of much of their energy, there is nonetheless significant wave energy that drives nearshore sediment transport to the west into the harbor from a point between Morse Creek and Lees Creek. This westward transport can also be seen in the STA results for areas near the shoreline (McLaren 2009).

Throughout most of the rest of the harbor, particularly in western portions, waves are predominantly generated by local winds. The nature of locally generated waves is determined exclusively by wind speed and fetch. Fetch is the unobstructed distance over water that a given wind has blown. Winds originating from the west are predominant during all seasons (Western Regional Climate Center 2008b), but occasional atmospheric events can drive winds that originate in the east and northeast. These northeasterly winds are generally weaker than the strongest winds from the west, but the large fetch to the northeast of Port Angeles Harbor (in excess of 30 miles) means that the waves generated by these winds are larger than those generated by west winds.

A maximum deep-water wave height (H) of 3.4 feet with a period of 4.2 seconds was estimated based on a recorded sustained ENE wind of 18 knots on January 12, 2005, at the William R. Fairchild International Airport for areas in the harbor exposed to northeasterly winds from the Strait of Juan de Fuca, using the methods provided in the Shore Protection Manual (U.S. Army Corps of Engineers 1984). The 18 knot wind speed used in this analysis was the maximum wind speed recorded in that direction during the period of record between 1996 and 2008.

An estimate of maximum wave height provides constraints on the maximum depth of significant wave motion (closure depth, h_c), and thus the depth of wave-induced sediment transport. If we use a shallow-water approximation (in which the water depth is much less than the wavelength of the waves), h_c can be estimated by setting the wave orbital velocity equal to the maximum near-bed current (u_c) found by Evans-Hamilton (2008) in the following equation:

$$h_c = g\left(\frac{H}{2u_c}\right)^2 \qquad (3)$$

Where:

g is gravitational acceleration (32.2 feet per second squared), and

u_c equals 1.3 feet per second.

Substituting the known quantities in this equation yields a closure depth of 55 feet. While this estimate is made using both deep-water and shallow-water wave approximations, because the Shore Protection Manual equations assume a deep-water, wind-wave production while the wave orbital velocity estimation assumes shallow-water waves, the shoreline within Port Angeles Harbor is sufficiently steep that the transition from shallow-water to deep-water wave motion occurs within an extremely short distance near the estimated closure depth. The closure depth likely decreases in areas that are protected from northeasterly winds, such as the southern shore of Ediz Hook and the western extremes of the inner harbor. Considering the harbor has an average depth exceeding 50 feet, sediment transport throughout much of the harbor is not influenced by waves, even during the most extreme storms. For those areas within the closure depth, wave-induced sediment transport is important, as discussed further below.

4.2.2 Nearshore Geomorphic Conditions

The Port Angeles Harbor nearshore environment can be divided into six reaches, which are described below. Figure 11 provides an overview of nearshore sediment transport directions along the Port Angeles Harbor nearshore.

Morse Creek to Lees Creek

This reach exhibits a broad divergence of transport (Ecology 2008). At the east end near Morse Creek, alongshore transport is significant and eastward, while at Lees Creek near the west end of this reach, transport is clearly westward. The bluffs, which based on early maps of the area (U.S. Coast and Geodetic Survey 1892b) were active at the time of European settlement, have subsequently been separated from the nearshore by an abandoned railroad grade, now called the Olympic Discovery Trail. The railroad grade is composed of imported fill, confirmed by Schasse et al. (2004), indicating that the beach has been moved seaward since the time of European settlement. Due to the elimination of sediment supply, the shoreline is actively eroding, in some cases down to bedrock (Figure 12). A number of slides have occurred since transfer of the grade to a trail within the last 10 years, some of which have transported sediment across the fill prism and onto the beach. Along the portion of the shoreline that contained the slides, a foreshore reemerges. In areas on either side of this slide activity, the deflation of the beach surface is significant and the remaining coarse lag is easily distinguishable from newly delivered sediment. Because there are several culverts that currently transport sediment to the nearshore, observation of fresh material from these sources was used to precisely determine the direction of transport in these sediment-deprived areas. This area, approximately one mile east of Lees Creek, also corresponds with areas where a general lack of fine sediment was observed further offshore (McLaren 2008).

Figure 12. Bedrock exposed on the low-tide terrace of shoreline between the mouths of Lees Creek and Morse Creek, Port Angeles Harbor

On the first site visit, 6- to 12-inch swell was observed at the mouth of Morse Creek, with a median frequency of about 8 seconds. These wave crests broke in several feet of water. The orientation of the wave crests indicated transport of beach sediments in an eastward direction. Eastward transport is also consistent with several generations of spits observed at the mouth of Morse Creek.

Lees Creek to Ennis Creek

On the second visit, 3- to 6-inch swell was observed between Lees and Ennis creeks. Transport was clearly westward, consistent with the observed fining of sediment between the Lees Creek delta and the Rayonier site.

The mouth of Ennis Creek has been substantially altered during construction of the Rayonier facility, primarily through modification of the 41 acres of imported fill and a 5-acre over-water pier. Further modifications have included channelizing the creek outlet and directing the creek to the east side of the reclaimed land. The creek mouth has now built a sizeable delta on the east side of the artificial promontory (for details see section 4.3). An extremely muted swell (3- to 6-inch significant wave height) was observed on the north side of the delta during the site visit. The orientation of the swell resulted in transport of sediment to the west. This is consistent with the pre-European settlement conditions, images of which show a small spit oriented in this direction at the mouth of Ennis Creek, although this could also have been caused by large waves originating from the northeast.

Ennis Creek to Peabody Creek

This area has been modified since European settlement, but not as much as areas further west. Bubnick (1986) has this reach divided into differing drift cells suggesting eastward transport near the Rayonier property; however, on the site visit, there were no geomorphic indications of transport to the east. The mouth of Ennis Creek has been substantially modified by the placement of fill, which has led to a reduction in wave energy on its west side. There was no evidence for this having changed the direction from pre-European settlement, which was westward throughout this reach. Impounded sediment on the east side of an old raised outfall (indicative of westward transport) at Francis Street Park immediately west of the Rayonier property and near the edge of the eastward drift cell delineated by Bubnick (1986) supports this conclusion. The high-resolution 1964 aerial photograph obtained from the Washington Department of Natural Resources indicates that this accumulation of material on the east (updrift) side is a persistent feature.

The most significant fill in this reach has occurred immediately east of Peabody Creek. Here a promontory was filled, which now comprises the Port Angeles City Pier. A minor amount of sand fill has been placed more recently in front of the Red Lion Inn, most likely when that property was constructed in the 1960s. Because the fill material in front of the Red Lion Inn has remained in place (as seen in the Ecology oblique aerial photographs), and is fixed to the west by the City Pier, it suggests that transport is also generally westward at this location. The truncation of the Peabody Creek delta to the east (at the City Pier) and the narrow beach west of the delta indicates that transport is westward there as well.

Peabody Creek to Tumwater Creek

This reach has been the primary focus of development along Port Angeles Harbor shoreline, as it is immediately adjacent to the historical commercial core of the city. The shoreline had been modified by 1892 (Figure 5), with fill placed between Valley Street and Chase Street. Based on historical photographs, fill included construction debris and upland sediments. As a result, the small creeks were moved approximately 700 feet east (seaward) of their pre-European settlement locations. Despite the degree of alteration and the disconnection of the shoreline, geomorphic indicators at the mouths of Peabody, Valley, and Tumwater creeks indicate limited alongshore transport of coarse sediment (gravel), which is dominantly to the west throughout this reach. Terminals 1 and 2 (shown in Figure 1) intercept material from Peabody and Valley creeks, respectively, and likely direct any wave-driven transport offshore. Terminal 1 also protects the mouth of Tumwater Creek and ensures that most of the material discharged by this creek accumulates near the mouth.

Inner Harbor (Tumwater Creek to the Nippon Paper Industries Property)

As have areas further east, this reach has been heavily modified; the shoreline has been filled and reformed to accommodate the large Boat Haven Marina. Pre-European settlement conditions are barely distinguishable in the current landscape, and they must be interpreted from historical charts and surveys (U.S. Coast and Geodetic Survey 1892a; U.S. Coast Survey Office 1853). These information sources indicate that, prior to development, transport was dominantly from east to west based on the orientation of spits at the mouths of the creeks that discharge to Port Angeles Harbor.

A lagoon, which is a natural feature according to the surveys that predate most development (U.S. Coast and Geodetic Survey 1892a; U.S. Coast Survey Office 1853), is located on the southwest end of the Nippon Paper Industries property. The lagoon is almost completely evacuated during extremely low tides (observed during the site visit), but fills completely on high tide, indicating that it was most likely a low marsh prior to development. The existing connection of lagoon to the harbor is a narrow, straight, artificial channel. Much of the lagoon shoreline has been altered by the dumping of wood waste and other materials, including a constructed berm in the southwest corner that bisects the lagoon. A small stream also enters the south end of the lagoon. The 1965 aerial photograph does not show this feature; therefore, it is likely that this stream is a direct result of recent concentration of runoff from the contemporary stormwater infrastructure.

Ediz Hook

The inside (harbor/south side) of Ediz Hook has been elevated and armored with riprap to protect the roadway that connects the Coast Guard base to the mainland. This, in combination with removal of the sediment supply from storm overwash to the inside (south) of the spit, has caused the shoreline to erode. Although the southern shore of Ediz Hook is sheltered from both the largest locally generated waves and swell, erosion has persisted, particularly near the neck of the spit and the Nippon Paper Industries property. Erosion of the nearshore has created a coarsened, compact foreshore. Although there is evidence of transport in both directions along the inside of the spit, the dominant direction appears to be eastward. This is consistent with the STA results and from the supposition that the southern shore of the spit is protected from northeastern storms, but susceptible to smaller, more frequent westerly events. The presence of gullies along the eastern end of the spit indicates that offshore transport is also common (and possibly dominant), which is again consistent with STA. Gullies have been shown to be common in shallow marine environments on the U.S. west coast and often indicate offshore sediment transport, usually by sediment gravity flows (Field et al. 1999; Surpless et al. 2009).

A beach nourishment program begun in 1977 supplies sediment to the north side of the spit, restoring sediment supply to the tip of Ediz Hook (Galster 1989). As a result, the tip of the spit has prograded (lengthened) by about 50 to 75 feet since this time, or about 2 feet/year. This is somewhat greater than the growth seen during most of the middle of the 20th century, but not as much as pre-development growth, which averaged over 3 feet/year (Galster 1989).

4.2.3 Extreme Wave Events

Geomorphic work conducted across Puget Sound indicates that extreme events play an important role in nearshore sediment transport (Finlayson 2006). Because Port Angeles Harbor is generally sheltered from swell (westward of the Rayonier property and along most of the southern shore of Ediz Hook), waves are generated predominantly by wind. Similarly, extremes in currents are also influenced strongly by winds. Strong westerlies, in particular, amplify estuarine exchange in the harbor by intensifying eastward flow at the surface and westward flow at depth (Dunn 2008). Therefore, extremes associated with sediment transport, both wind-induced and current-induced, are expected from large wind storms (although no large wind events were linked to extreme wave, current, or sediment transport occurrences during the hydrographic instrument deployment due to the season of instrument deployment).

The Olympic Mountains and Vancouver Island ranges force winds in the Port Angeles area to be predominately out of the west and east (Finlayson 2006). The largest waves within the harbor are produced by rare wind storms that generate northeasterly winds and resultant waves that form across the long fetch of the eastern end of the Strait of Juan de Fuca. Westerly winds are stronger and, despite extremely short fetches in that direction, are likely important sources of eastward wave transport in areas sheltered from the northeast, such as the southern shore of Ediz Hook. Therefore, both of these types of these wind events were analyzed (Figure 13).

For this analysis, westerly winds were defined by all winds between WSW (240°) and WNW (300°); northeasterly were defined by all winds between NNE (30°) and E (90°). As can be seen in Figure 13, the trend is toward increasing annual maximum westerlies with time (0.68 knots per year with $r^2 = 0.35$), while the northeasterlies exhibit a much weaker trend, both statistically and in terms of rate of change (0.21 knots per year with $r^2 = 0.14$). While the records are extremely short and the r^2 values are small, they become significant when viewed in context with other recent studies.

These observations are consistent with results of recent work on the impacts of climate change on winds and waves in the Pacific Northwest. On the outer coast of Oregon and Washington the wave energy delivered to the coast from predominantly westerly winds has increased between 1976 and 2000 (Allan and Komar 2002, 2006). On the other hand, recent observations of wind and waves in Puget Sound have shown no statistically significant trend (Finlayson 2006). The reason for the difference in the two wind types (those generated at sea and those generated further inland) is that the physical processes for regulating the strength of each of the winds are distinctly different. Inland winds, such as those from the northeast in the study area, are “gap winds” driven by pressure gradients developed on either side of the Cascades (Overland and Walter 1981), similar to winds within the Puget Sound (Finlayson 2006). Westerly winds are driven by large cyclones moving west across the north Pacific. In the open North Pacific, winds and the waves they produce have been affected by the increased intensity of North Pacific cyclones, which has been associated with global warming (Allan and Komar 2002). However, the northeasterly winds are strongly influenced by topography and the pressure difference across mountain ranges (Finlayson 2006). In the case of northeasterly winds in Port Angeles, the pressure difference of importance is the one between the east and west sides of the Canadian

Cascades. A high pressure area east of the mountains forces air flow down the Fraser Valley (Overland and Walter 1981). Because this pressure difference is largely regulated by persistent large thermal gradients between the North American land mass and the north Pacific in the winter, it is less sensitive to basin-scale changes in oceanic temperatures associated with global climate change.

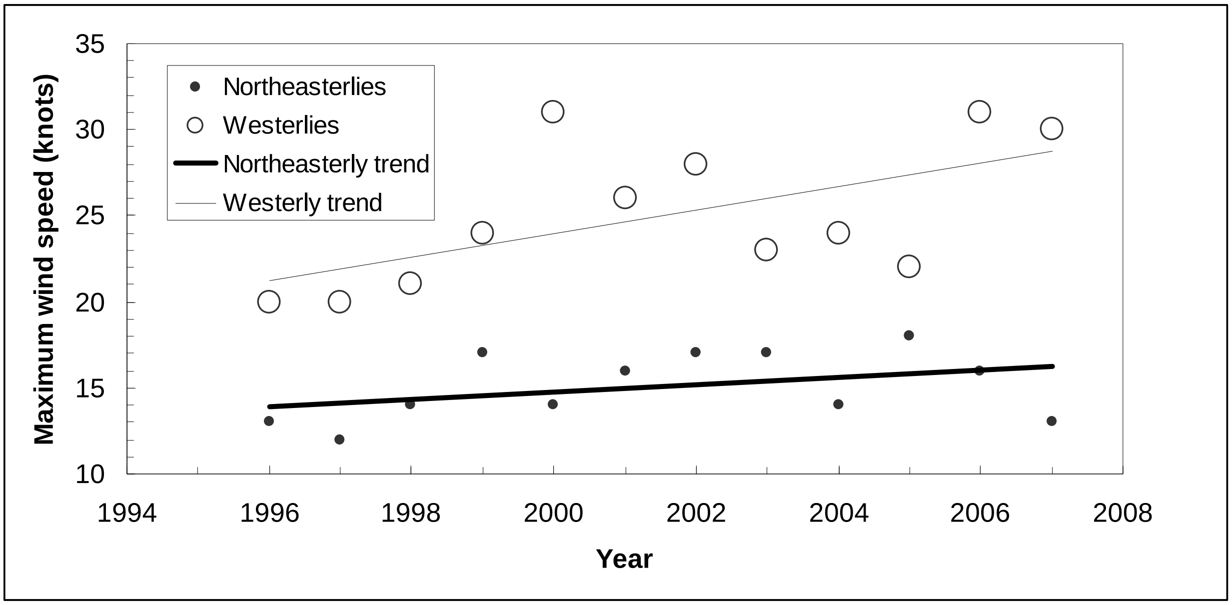

Figure 13. Maximum annual sustained wind speeds, Port Angeles

The only potential temporal trend in wave strength would be associated with the approximately 0.68 knots per year increase in westerly winds seen in Figure 13. As a result of this increase, there may be some slight increase in wave energy with time, but this effect will be small, and mostly limited to areas that are sheltered from northeasterly winds (i.e., the southern shore of Ediz Hook). The increasingly intense westerly winds would also likely play a role in enhancing estuarine exchange of freshwater to the east, and a more saline undercurrent at depth. Since the westerly winds enhance an existing pattern of transport, it is uncertain what, if any, effect the increase in intensity of winds would have on transport and burial of existing contaminants.

Although extreme westerly wind events have been shown to be stronger with time as a result of changes in the intensity of north Pacific cyclones, northeasterly winds do not show significant change with time. It is expected that increasingly intense westerly wind events will continue to erode and armor nearshore areas along the southern shore of Ediz Hook, so long as the revetment protecting infrastructure on the spit remains in place. Increasing intensity of extreme westerly winds also has the potential to heighten estuarine exchange (reinforcing existing transport patterns) in the harbor, but the probable net effect of these extreme events on erosion, transport, and deposition areas within the harbor is unknown.

4.2.4 Summary

Nearshore sediment transport, occurring in areas shallower than the closure depth of 55 feet, is predominantly clockwise within the harbor (Figure 11). East-to-west transport along the southern shore of the harbor begins approximately 1,500 feet east of the mouth of Lees Creek. Further east, transport is predominantly eastward. The intensity of transport in the nearshore diminishes as one moves west into the inner harbor along both Ediz Hook and the mainland. Near the neck of the spit (near the outlet of the lagoon) where the shoreline orientation changes dramatically and the dominant waves (generated by winds) change direction, there is a transport minimum (a point along the shoreline where there is a net accumulation of material). In this area the shoreline goes from being exposed to being sheltered from strong northeasterly wind storms. This area is protected from both westerly and northeasterly waves by Ediz Hook. The idea that a transport minimum occurs at the mouth of the lagoon is consistent with the observations of sulfur odor in sediments attributed to anoxic conditions (Figure AVI-14: McLaren 2009) and anecdotal accounts of sediment accumulation in the area (Dunn 2008). Anoxia in the surficial sediments is related to the sediment accumulation because this area has considerable inputs of fine-grained, organic rich sediments from resuspension further east, but a low degree of water column and near bed mixing due to its relative protection from waves and tidal currents. An increasing trend in intensity of wind and waves originating in the west has been observed since 1996; there may also be a slightly increasing trend for winds and waves coming from the east and northeast, the dominant source of nearshore wave energy in Port Angeles Harbor, although evidence of such a trend is unclear.

4.3 Sediment Transport by Tides and Currents

This section details the physical processes responsible for sediment transport in portions of the harbor deeper than the closure depth of 55 feet. Previous studies describing circulation in the harbor are reviewed, and a summary of measurements from instruments on bottom-mounted tripods related to sediment transport, waves, and currents is provided.

4.3.1 Previous Studies Review

There have been four major studies using four different methods to estimate currents in and around Port Angeles Harbor. Earlier informal studies conducted were either too short in duration or too limited in extent to support this investigation (Stein and Denison 1966; Tollefson et al. 1971; Washington State Pollution Control Commision 1967). The four major previous studies that provide useful insight into circulation and sediment transport are discussed below.

Surface tracers (Ebbesmeyer et al. 1979) – This investigation centered on the observation of several different types of items that drift on the water surface, including drift cards and sheets that were placed in and around the mouth of the harbor. Drift cards and sheets are similar, buoyant pieces of plastic labeled such that when discovered by beachcombers, they can be tracked and cataloged. The sheets and cards were deployed differently; drift sheets were released at different locations outside Ediz Hook and east of Morse Creek, while the cards were all released near the former Rayonier outfall at the mouth of the harbor.

Recovery of the sheets and cards suggested three general modes of surface transport:

- Eastward transport along the southern shore of the Strait of Juan de Fuca – Most of the sheets and cards released near the harbor mouth were found along the shoreline east of Green Point, including the west side Dungeness Spit. This is clearly the dominant mode of surface transport in the mouth of the harbor.

- Westward transport – Little evidence of transport to the west toward the inner harbor was observed. Transport into the inner harbor generally was noted when tracers were released from well within the protection of Ediz Hook in the center or western portion of the harbor. Transport out of the harbor to the west occurred for only a small number of cards.

- Transport eastward beyond Dungeness Spit – There was evidence of a small, but significant degree of transport beyond the Strait of Juan de Fuca shoreline. Cards were found as distant as Skagit Bay in Puget Sound and Birch Bay in the Strait of Georgia.

Numerical modeling (Battelle 2004; Yang et al. 2004) – This hydrodynamic analysis was conducted using the three-dimensional (3D) hydrodynamic and transport Environmental Fluid Dynamic Code (EFDC) model. The EFDC model simulates hydrodynamic and transport processes in rivers, reservoirs, lakes, estuaries, and coastal waters (Hamrick 1992). EFDC simultaneously solves the 3D equations of motion for velocities and the transport equations for temperature, salinity, effluent tracer, and suspended sediment concentrations in a finite difference framework. A second-moment turbulence closure model is solved to provide the vertical turbulent eddy viscosity (Mellor and Yamada 1982).

The model was used to provide information about deposition rates of sediment (inorganic earthen material) and particulate matter (organic debris and detritus) discharged from the Rayonier outfalls in Port Angeles Harbor, the Dungeness Spit region, and the Strait of Juan de Fuca. The model was calibrated against the surface tracer data generated by Ebbesmeyer et al. (1979). It was not calibrated to near-bed velocities or observed sediment concentrations during resuspension events. Prediction of the pattern of flow in the harbor due to tidal forcing is well described by the model, particularly for the buoyant (hot, fresh water) discharges. However, the model is not well suited to predicting sediment transport or near-bed flow. This is particularly true for the small intense tidal eddies that dominate at the mouth of the harbor (i.e., the area between the tip of the hook and the former Rayonier Mill site), which are related to small-scale turbulence.

Despite the limitations of the numerical model, it did predict that most of the sediment that made its way into the confines of the harbor was retained there. This is consistent with the STA results (McLaren 2009) and anecdotal accounts of typical transport patterns found by local divers, which have described a strong westward flow near the bed throughout the harbor (Dunn 2008). Of the near-bed water that escapes the harbor, the model predicts that most of it is swept east at great speed due to reconnection with the main tidal flow in the greater Strait of Juan de Fuca. Again, this is consistent with the STA results, the nearshore examination, and larger synoptic studies of the greater Strait of Juan de Fuca (Thomson et al. 2007).

Physical modeling (Ebbesmeyer et al. 1979) – Water movement was evaluated using a physical laboratory model of the Puget Sound located on the University of Washington campus in Seattle. The model was intended to simulate motions in Puget Sound and the Strait of Juan de Fuca due to tidal motions. Bronze dust and neutrally buoyant ink were used to track the surface velocity of fluid in the model, and streak photographs, which trace particle paths by exposing film over long periods of time, illustrated flow direction and were used to make a qualitative estimate of flow velocity.

The laboratory model has limited application to sediment transport in Port Angeles Harbor due to scale effects associated with the more subtle features of the harbor. More recent work has shown that scale effects are particularly pronounced in stratified shear flows, typically encountered in estuarine settings where mixing is intense (Parsons 1998). Furthermore, there are several physical processes not accounted for in the laboratory model, most notably wind. Both the surface stress and waves associated with wind-generated waves have a pronounced effect on currents in the harbor. Winds intensify transport near the surface and produce a counter-current at depth in confined areas such as Port Angeles Harbor. Specifically, in Port Angeles Harbor, westerly winds cause an eastward current at the surface and westward current at depth.

Recent long-term moored deployments (Holbrook et al. 1980; Thomson 1994; Thomson et al. 2007) – Deployments of moored monitoring equipment arrays in the Strait of Juan de Fuca have focused on tidal exchange and sub-tidal “residual” currents (flow associated with physical processes that have characteristic time scales greater than one day). These studies have all shown that intense eastward boundary currents (large-scale currents that consist of concentrated flow along a coast) run along the greater Washington shoreline (Thomson et al. 2007). They are generally strongest at the surface, but can, on occasion, penetrate the entire water column. Very little is mentioned in these studies about the interaction of currents with Ediz Hook in the vicinity of Port Angeles. Rather, they have focused primarily on exchange of water between the Strait of Juan de Fuca and the Strait of Georgia. The scale of these studies is significantly greater than Port Angeles Harbor and the study area.

None of these previous studies can accurately characterize water motions near the bed that initiate or maintain sediment transport within the harbor, particularly over periods of more than a few days. Even the targeted physical and numerical models possess inherent scale effects and can only reproduce general circulation patterns. They cannot reliably predict the small-scale, intense fluctuations in tidal flow that have been observed by many local residents (Dunn 2008). These models provide only a crude approximation of natural conditions, particularly in shallow areas near the bed and in places where turbulence is being produced. While surface tracers are capable of sampling these small fluctuations, they are generally more appropriate for describing transport of surface-trapped, buoyant (fresh, hot) discharges, as in the case of paper mill effluent (their design target). Surface tracers can also be subject to Stokes drift, which can overestimate water motion in the direction of propagation of surface waves (McDougall 1995).

4.3.2 Tripod Observations

A field investigation was performed to better identify the nature of sediment movement near the harbor bed. Three bottom-mounted tripods contained instruments that provided one month of current, wave, and suspended sediment measurements (Evans-Hamilton 2008). These tripods were placed near Nippon Paper Industries (Station #1: -60 feet MLLW), between the City Pier and the former Rayonier mill site (Station #2: -28 feet MLLW), and immediately south of the end of Ediz Hook (Station #3: -145 feet MLLW; Figure 2). Although the direct observations of sediment transport were limited to near the seafloor, the use of acoustic Doppler current profilers (ADCPs) provided information on currents throughout the water column, including near the water surface. These measurements serve to supplement earlier, less technologically sophisticated studies of Port Angeles Harbor surface currents. Data generated from the three tripod deployments indicated:

- *<u>No correlation was found between waves and suspended sediment</u>* – No large wind storms occurred during the study and wave heights did not exceed 2 feet. Wave energy was small to non-existent at all three tripods. Only Station #1 observed significant turbidity and it was not correlated to a particular wave event. The lack of correlation between waves and suspended sediment implies that wave energy does not penetrate deeper portions of the harbor. This is consistent with the estimate of closure depth of 55 feet.

- *<u>No strong simultaneous currents were observed at the tripods</u>* – Contrary to results of numerical and laboratory modeling, the strongest current events at the tripods did not occur simultaneously. The strongest currents observed at each tripod occurred at a different time, with no anomalous significant current being observed at the other tripods during each of these events. The large coherent tidal eddy seen in these models (Yang et al 2004; Battelle 2004) likely does not represent the most important type of event initiating or maintaining sediment transport. The most intense currents observed during the deployment (particularly at Station #2) were consistent with highly localized tidal eddies. This observation agrees with other anecdotal evidence from divers (Dunn 2008).

- *<u>The largest currents near the bed are dominantly westward in the outer harbor</u>* – Although there is substantial variability in flow velocity near the bed, the strongest currents at Stations #2 and #3 (in the outer harbor) are most commonly westward. The fact that sediment transport appears to occur only during the largest current events implies that transport at both of these stations is dominantly westward. This is broadly consistent with results of the STA.

- *<u>Sediment gravity flows occur in the inner harbor</u>* – Sediment gravity flows, sometimes called fluid muds or turbidity currents, drive flow downslope due to the added weight supplied to the water column from suspended sediment. They are common on steep seafloors where an excess of fresh sediment is available (Wright and Friedrichs 2006). Station #1 was the only tripod to report significant suspended sediment. The turbidity at this location was not associated with large currents or large wave events, but seems to be related to a persistent sub-tidal process. The current rose indicates highly coherent unidirectional flow in the direction of the local slope (Figure 14). Downslope flow in the extreme inner harbor is consistent with the STA, which indicates sediment transport directions consistently in the downslope direction. The mechanics of these flows in natural systems is poorly understood and is not included in existing numerical models of sediment transport.

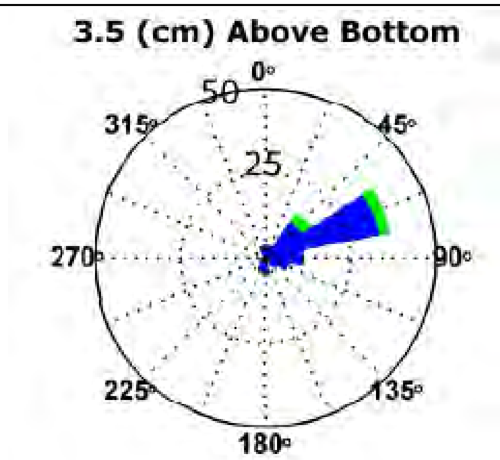

Figure 14. Station #1 rose diagram of current direction and magnitude (note: sediment bed slopes downward toward the northeast)

Summary of Tripod Observations and Previous Work

When combined with the previous work in the area, the tripod observations yield a clearer picture of Port Angeles Harbor hydrography. At the water surface in the outer harbor, tidal currents are energetic and driven strongly by tidal motions in the Strait of Juan de Fuca. These currents diminish in the inner harbor. While there may be some large coherent eddy associated with the tides, the strongest tidal currents are not coherent across the entire harbor. It is most likely these strong current events are typified by the highly localized event observed between March 30 and 31 at Station #2 (Evans-Hamilton 2008), which was probably associated with an intense tidal eddy much smaller than the harbor.

In the outer harbor, the strongest currents near the bed at both tripods (Stations #2 and #3) have a westward component. At Station #2, the near-bed currents are generally weak and most often directed toward the northwest. At Station #3, there are extremely strong currents to the west at just a few meters off the bed, but they do not persist near the bed (Figure 2). Currents appear most often toward the east; however, they are not as strong as those toward the west. Despite the lack of strong currents measured at the tripods, the currents observed are broadly consistent with the STA observations at the tripod deployment sites. It is important to mention that the lack of a definitive current direction correlated with observed sediment transport near the bed could be the result of the lack of strong west winds during the relatively short deployment. The westerly trend of near-bottom currents in the outer harbor is also consistent with anecdotal diver accounts (Dunn 2008) and with a simple mass balance associated with the better constrained eastern flow at the surface.

Evidence of sediment transport measured in the harbor also comes from the observation of a sediment gravity flow at Station #1. Sediment gravity flows require significant sediment supply (Wright and Friedrichs 2006); however, the historical supply to this area has been shut off (overwash from the west side of Ediz Hook cut off by the Ediz Hook Road prism and sediment from the bluffs along the southern shore of the harbor cut off by fill along the waterfront). The only source of sediment to this part of the harbor is from the creeks that feed the southern shoreline. Since all of the creek mouths are well east of Station #1, the freshly suspended sediment must be transported west from those creek mouths. Westward transport across the harbor is also broadly consistent with the STA results and anecdotal diver accounts (Dunn 2008). Once accumulated (but remaining in suspension) in this remarkably quiescent area, the suspended sediment responds to gravity and creeps downslope at approximately 10 centimeters per second. This would indicate the ultimate site of deposition is the deep hole at the northwest end of the harbor.

4.3.3 Near-Surface Sedimentation

Sediment Trends Analysis

The results of the STA are provided in McLaren (2009). Several of the conclusions are presented below:

- Textural analysis of the sediments revealed that sandy mud and muddy sand are the most common sediment types (76 percent); the former being confined to the western half of the harbor. Twelve percent of samples are principally sand, found in the more exposed eastern portion of the harbor. Hard ground dominated areas seaward of the spit in the Strait of Juan de Fuca and near the shoreline between the harbor entrance and Morse Creek.

- Sediment transport appears to be dominantly westward throughout much of the mouth of the harbor (Figure 15).

- Sediment transport at the northwestern end of the harbor is in the direction of the local bed slope (Figure 15); this conclusion is consistent with the tripod measurements indicating sediment gravity flows in this area.

- Most of the sediment delivered to the harbor by local streams west of Ennis Creek is transported to and permanently deposited in the inner harbor. Areas west of Ennis Creek are erosional, with the easternmost portions of the study area being dominated by eastward transport.

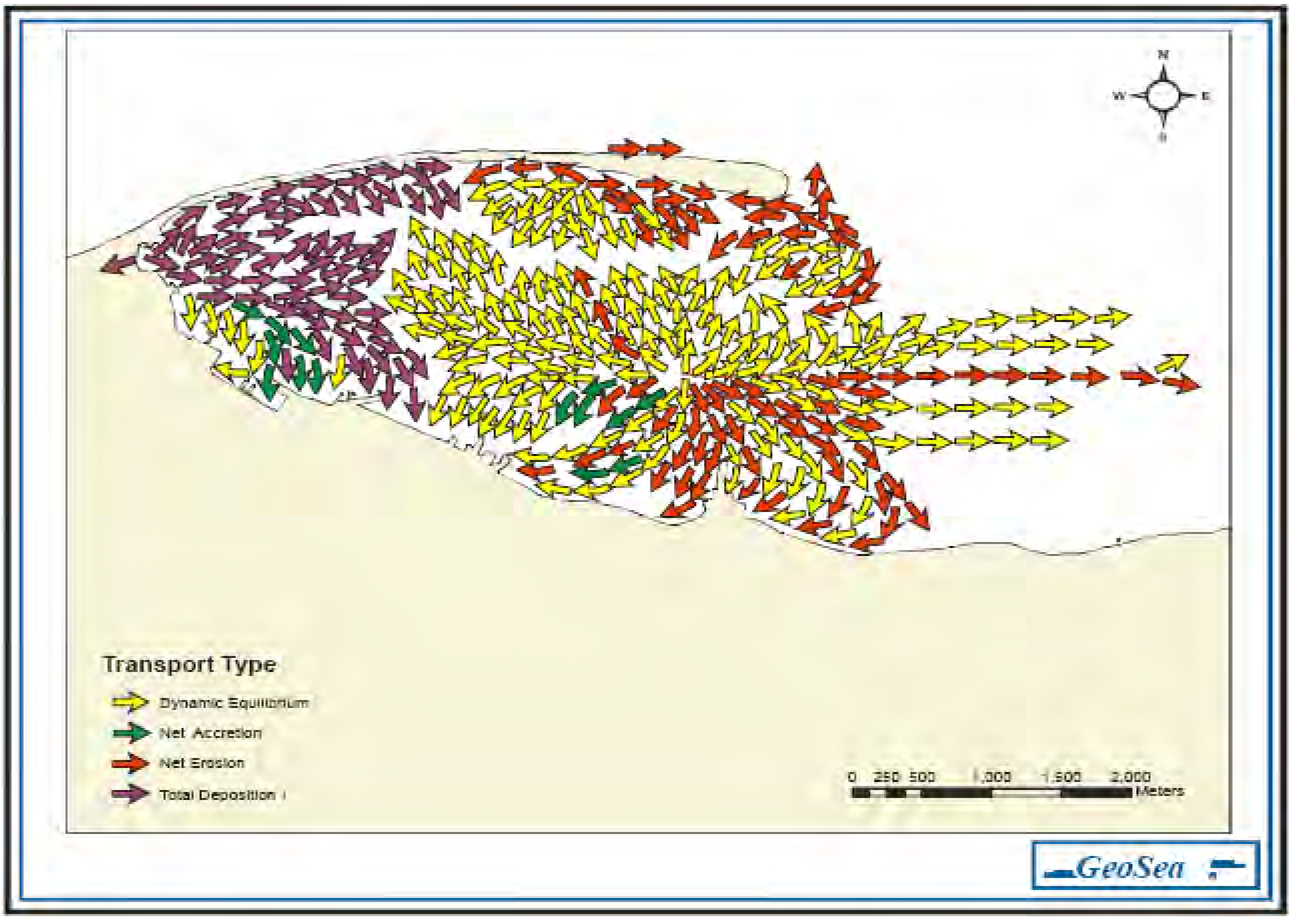

Figure 15. Sediment transport directions based on a sediment trends analysis (STA), Port Angeles Harbor

Radioisotopic Analysis

Results of radioisotopic measurements on the two sediment cores collected are summarized in Table 4. Because core depths were limited, there were not enough samples to fit a curve to the data to estimate accumulation rates, as is typically done (Appleby 2008). However, the data do provide a constraint on the net sediment accumulation rate in the harbor where sediment is not rapidly accumulating.

Table 4. Radioisotope measurement results, Port Angeles Harbor

Core ID	Average Core Section Depth (cm)	^{210}Pb Activity (pCi/g)	^{210}Pb Activity Uncertainty (pCi/g)	^{137}Cs presence [c]
MA06	1	3.96	0.57	Yes
MA06	11	1.64	0.33	-
MA06	21	0.97	0.27	No
MA06	31	0.561	0.23	-
MA06	41	0.767	0.25	-
RL03	11	2.47	0.39	-
RL03	21	1.28	0.29	No
RL03	31	0.555	0.21	-
RL03	41	0.405	0.19	-
RL03	51	0.529	0.33	-

[a] Core locations are shown in Figure 4.
[b] cm = centimeters, pCi = picocuries, g = gram.
[c] A dash indicates that the sample was not analyzed for ^{137}Cs.

In a ^{210}Pb sedimentation rate analysis, the first step is to determine the "supported" level of ^{210}Pb activity (Appleby 2008). This is the ^{210}Pb activity level in the sediment derived from sources not associated with atmospherically produced ^{210}Pb (derived from radon decay), and is dependent on factors such as sediment accumulation rate, grain-size distribution and other sediment mineralogical characteristics. Assuming that the rate of accumulation has not changed significantly over time, the deepest sample used to measure accumulation should not have any unsupported ^{210}Pb.

For core MA06, the ^{210}Pb activity of the deepest sample is similar to the activities of the two deepest samples from either core, suggesting that these activities (between approximately 0.4 and 0.8 picocuries per gram [pCi/g]) represent supported levels of ^{210}Pb in sediment within Port Angeles Harbor. Assuming that supported levels are attained in 150 years, the presence of unsupported ^{210}Pb at 21 centimeters and supported ^{210}Pb at 31 centimeters constrains accumulation rates of sediment at this core location between 0.14 and 0.21 centimeters per year. This interpretation is substantiated by absence of ^{137}Cs at 21 centimeters.

For core RL03, it is concluded that supported levels of ^{210}Pb are attained by 31 cm and unsupported ^{210}Pb activity is present at 21 centimeters. This conclusion is based on the ^{210}Pb activity profile in this core as well as on a comparison of ^{210}Pb levels in this core to supported levels encountered in the MA06 core. The lack of ^{137}Cs confirms that the accumulation rates are less than 0.33 centimeters per year. Depths of supported and unsupported ^{210}Pb in this core constrain a sediment accumulation rate range of 0.14 to 0.21 centimeters per year.

The results provided above are applicable only to areas around where each core was obtained. It should be noted that the selection of core sites was made prior to the STA and other analyses that identified areas where sediment may have preferentially accumulated, such as the inner harbor. Therefore, no cores were collected for radioisotopic dating from these possible preferential-accumulation areas to independently evaluate accumulation rates. It should also be noted that the two radioisotopic dating cores were collected from locations for which no high resolution bathymetric data are available. Therefore, it cannot be determined whether these cores were collected from areas of localized scour or deposition, which could bias the results toward lower or higher apparent accumulation rates, respectively. Nonetheless, the similarity of the ^{210}Pb profiles, in conjunction with other evidence presented in this report, suggests that accumulation rates at the two core locations are representative of those portions of the harbor.

Bioturbation can also significantly influence radioisotopic dating results due to mixing of unsupported ^{210}Pb to greater depths than would have occurred from deposition alone. The lack of ^{137}Cs at 21 centimeters in both cores indicates that bioturbation occurs shallower than 21 centimeters.

4.3.4 Sediment Budget

Despite the limited core data available, a sediment budget can be estimated if the two cores are assumed to be representative of conditions across most of the harbor. Total sediment input to the harbor calculated using the Syvitski model, referenced to the deposition observed at Tumwater Creek delta, ranges between 1.35 and 5.69 kilograms per second. To calculate the average accumulation rate that would be produced over 7.60 square kilometers of the harbor (roughly the area within the protection of Ediz Hook), a solids bulk density (the weight of solids per unit volume of seabed) of 1.7 metric tons per cubic meter is assumed for accumulating sediment (Peck et al. 1974). Making these calculations, it is found that the sediment input calculated in the Nearshore Sediment Input section could produce accumulation rates between 0.22 and 1.25 centimeters per year if the harbor acted as a no-loss repository for sediment. The accumulation rates are between 0.14 and 0.21 centimeters per year. The difference between these estimated rates and the calculated Harbor-wide average rates suggests that sediment accumulation within the Harbor does not occur uniformly throughout the Harbor.

The estimated range of sediment production (0.22 to 1.25 centimeters per year) assumes uniform accumulation throughout the harbor. However, the results of the STA and the physical transport processes observed during the hydrographic survey suggest that deeper portions of inner harbor likely exhibit much higher accumulation rates than the two core locations selected for radioisotopic analysis.

Previous radioisotopic analyses performed on cores from near the Nippon Paper Industries property suggest significantly greater accumulation rates (in excess of 2.5 centimeters per year in some cases (Exponent 2008). If these accumulation rates are typical of the inner harbor, the total accumulation of sediment in the harbor could account for all of the sediment discharged west of Lees Creek, even for the upper limit of estimated sediment input calculated above (i.e., 5.69 kilograms per second, with only 10 percent of the sediment load being bedload). Measurements conducted near the Nippon Paper Industries property may have been biased by human disturbance, such as dredging (Exponent 2008). It is also possible that the reported increase in ^{210}Pb activity with depth, the evidence cited for dredging, could be a result of large, natural, intermittent pulses of freshly delivered sediment to the area (Sommerfield and Nittrouer 1999). It is important to emphasize that even though Exponent found cores with high accumulation rates, other harbor areas with the greatest likely accumulation rates were not sampled in their study. These areas are prime targets for future radioisotopic analyses needed to refine the sediment budget.

The hypothesis of preferential accumulation of sediment in the inner harbor from sediment sources to the east is supported by the observation of sediment gravity flows. Recent work has shown that sediment gravity flows only occur when the water column experiences an excess of sediment supply (Parsons et al. 2007; Wright and Friedrichs 2006). There is no significant source of sediment to the inner harbor west of Tumwater Creek; therefore, the only way for sediment to build up in the inner harbor is for there to be significant westward transport of sediment from creeks discharging further east. Westward transport throughout the harbor from these creeks is also generally supported by the results of the STA (McLaren 2009) and anecdotal accounts of local divers (Dunn 2008). The minor deviations in westward transport in STA in the inner harbor likely represent a transition to gravity-driven transport to the northeast, the direction of the bed slope.

In summary, hydrographic observations, previous hydrographic studies in the harbor, radioisotopic measurements, nearshore geomorphic analysis, and the STA together support a model of sediment transport in the harbor and the physical processes that drive that transport (Figure 16). Sediment is delivered to the harbor almost exclusively by creeks. As is typical of small drainages on steep, wet coasts, this sediment is delivered intermittently, but efficiently, during flood events (Parsons et al. 2007; Wright and Friedrichs 2006). This sediment is then partially eroded and transported westward by energetic tidal flows (for depths below approximately 55 feet) and waves (for depths less than approximately 55 feet), where it accumulates in the inner harbor. Over time, this material slumps northeastward to settle in the deep portion of the northwest corner of Port Angeles Harbor. Because the estimated volume of material accumulated in the harbor is similar to the amount of sediment supplied, the budget indicates that sediment (including dense woody debris, adsorbed metals, and so forth) delivered to the harbor is trapped and retained within it. The area of sediment conservation includes most of the area associated with the broad sediment divergence zone (the “parting zone” in the STA) at the mouth of the harbor including the sediment discharged from Ennis Creek and material derived from the former Rayonier Mill.

Unfortunately, the most important physical processes responsible for transporting sediment in Port Angeles Harbor cannot be easily addressed with existing numerical models. The mechanics of sediment gravity flows, the dominant mode of sediment transport in the inner harbor, requires high resolution of bathymetry and accounting for sediment content in the estimation of fluid density (Yang et al. 2004). These parameters are not accounted for in most oceanographic models, and were not regarded in previous sediment transport modeling of the harbor (Yang et al. 2004). Even baseline suspended transport associated with tidal currents seems to be associated with small, localized, energetic tidal eddies, which are difficult to account for in existing models.

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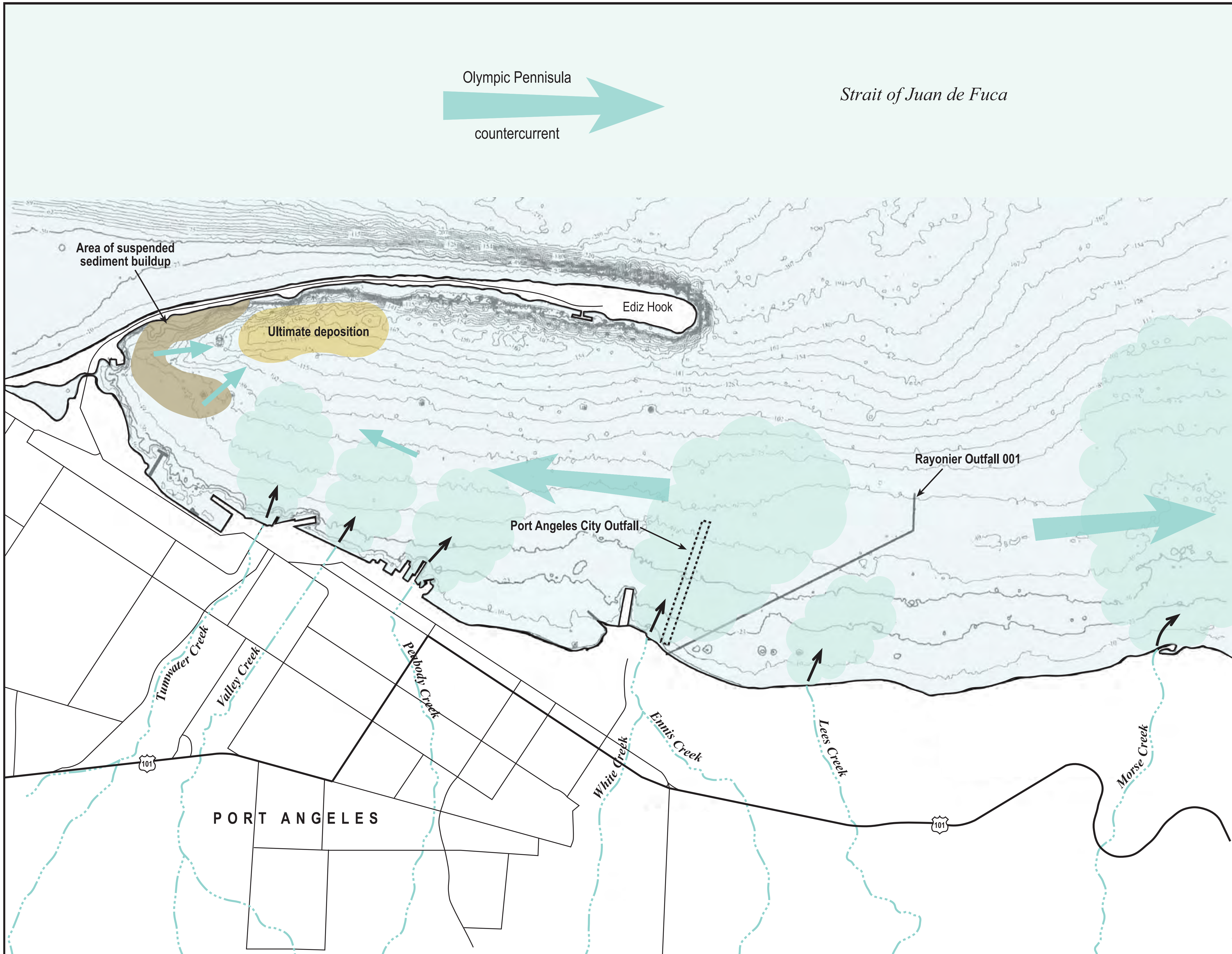

Figure 16.
Sediment budget and related sediment transport processess, Port Angeles Harbor.

Legend

Direction of sediment transport

Existing sediment imput

Note: Areas of build up and deposition are approximate.

N

0 1000 2000 4000

Approximate scale in feet

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graphics/04-23-09/sm/HEC-R/06-03386-005-006-001/PA Harbor

5.0 Summary and Conclusions

The dominant historical source of sediment to the south shore of the harbor has been eliminated by the disconnection of the adjacent bluffs. Sediment is also currently prevented from entering the confines of the harbor from the seaward side of Ediz Hook by fill associated with Ediz Hook Road. This has left small creeks as the only major source of sediment to the harbor. The elimination of other historical sources of sediment to the harbor places relatively tight constraints on the volume of sediments entering the harbor. Based on an estimate of the sediment yield from these creeks, between 1.35 and 5.69 kilograms per second of sediment is likely delivered to the harbor, averaged on an annual basis. If all of this sediment were retained within the harbor, it would result in sediment accumulation rates ranging from 0.22 to 1.25 centimeters per year (averaged over 7.60 square kilometers, the approximate area of the harbor roughly the area within the protection of Ediz Hook). Accumulation rates estimated from radioisotopic analysis of two cores from the main body of the harbor ranged from 0.14 to 0.21 centimeters per year, suggesting that the accumulation of the sediment does not occur uniformly throughout the Harbor.

Nearshore, wave-driven sediment transport is clockwise overall throughout Port Angeles Harbor. Eastward transport terminates abruptly once swell is encountered at the south end of the spit. The relatively modest wave energy in the harbor yields an approximate closure depth of only 55 feet. The innermost harbor and the south shore are likely even more protected than this, meaning the local closure depth is even shallower. A broad zone of sediment divergence along the shoreline west of the mouth of Lees Creek is deprived of loose sediment, evidenced by exposed bedrock in places. Shoreline areas well east of the mouth of Lees Creek are subject to strong eastward sediment transport. Currents in Port Angeles Harbor are closely linked to tidal motions in the Strait of Juan Fuca. Due to strong and persistent wind stress from the west and an intense eastward boundary current along the southern shoreline of the Strait, surface currents are strongly eastward and can penetrate the entire water column for areas well away from the protection of Ediz Hook. Strong tidal eddies are common in areas protected by Ediz Hook. These motions are not coherent across the harbor in the form of a single eddy, contrary to assumptions made in earlier work. Rather, they appear to be small, localized events of short duration. It appears that strong eastward surface currents within the harbor caused by west winds are balanced by westward counterflows near the bed (as is typical in an estuary). Localized sediment gravity flows were observed in the innermost harbor with transport of suspended sediment northeast (downslope).

The STA indicates a broad area of erosion across the mouth of the harbor from the tip of Ediz Hook southward across the harbor to east of the mouth of Lees Creek. The STA also indicated generally westward transport of sediments throughout most of the harbor. The eroded sediment from the mouth of the harbor and streams appears to collect and deposit in the innermost harbor near the Nippon Paper Industries property. Higher accumulation rates based on radioisotopic measurements conducted by others support this hypothesis. The hypothesis is also supported by the observed sediment gravity flows in the innermost harbor, from direct observations made during the instrument deployment, and from accounts made by local divers. The ramifications of this hypothesis are that sediment (broadly defined as any solid material denser than water, including woody debris and any adsorbed contaminants) that is released within the confines of the harbor tends to migrate westwards and be stored in the innermost harbor. Future work should focus on confirming the spatial variability in sediment accumulation in the northwest corner of the harbor in order to refine the sediment budget and verify the conceptual model of sediment transport presented in this report.

Glossary

Accumulation rate – The rate at which sediment accumulates in a particular location, usually expressed in terms of a length per unit time. Accumulation rate is not necessarily equivalent to the deposition rate because accumulation takes into account both erosion and deposition over time.

(Sediment) armor(ing) – The process by which fine-grained sediment is removed from the bed surface leaving behind only coarse, highly consolidated material.

Backshore – The area landward of the marine ordinary high water mark on a shoreline. Backshores are usually flat and possess dune grass communities adapted to inundation and disturbance.

Bedload – The fraction of sediment transport that occurs extremely close (within a few grain diameters) of the bed. Coarse sand, gravel, and cobbles are usually transported as bedload.

Clay – Electrostatically active, fine sediment. Generally sediment with a diameter less than 2 microns is considered clay.

Closure depth – The depth at which wave motions penetrate the water column. Deeper depths do not experience wave motions and therefore sediment can be moved by currents alone.

Cobbles – Sediment between 3.2 and 25.6 centimeters in diameter.

Delta – A delta is defined by the accumulation of sediment at the mouth of a stream or river.

(Sediment) divergence zone – An area of sediment erosion from which sediment is transported away. A sediment divergence zone is equivalent to the “parting zones” described by McLaren (2009).

Drogue – An instrument designed to float along a given density interface in order to measure currents at mid-depths in the ocean.

Fetch – The distance (length) over the water the wind blows to create waves.

Foreset – The front of a delta. The foreset is influenced by marine processes such as sediment gravity flows.

Glaciomarine drift – Generally fine-grained material, occasionally interspersed with gravel and cobbles, deposited in seawater near the edge of a glacier.

Gravel – Sediment between 2 and 32 millimeters in size.

Hydrographic – Relating to the motion of fluid in the marine environment.

Lapse rate – The rate of decrease of temperature with height above sea level. The lapse rate predicted for Port Angeles is 7.43 degrees Celsius per kilometer.

MLLW – Mean lower low water. The long-term average elevation of the lower of the two low tides that occur in a given day. MLLW is often used as a datum for measurements of depth.

Outwash – Sediment discharged in front of glacier. It is typically comprised of clean gravels and sands that are released in front of a glacier from erosion underneath the glacier.

Overwash – Inundation by waves and sediment into the backshore over a confining berm. The process that maintains beach spits.

(Wave) period – The average time between wave crests.

Radioisotope – An isotope of a chemical element that has an unstable nucleus and emits radiation during its decay to a stable form. Although atoms of a single element all have the same number of protons, they may have various numbers of neutrons (and thus different atomic mass), so various "versions," or isotopes, exist. The presence or absence of certain radioisotopes in sediment can indicate the time at which that sediment changed its physical environment (e.g., the time since that sediment went from being exposed to the atmosphere to being buried or submerged).

(Wave) refraction – The physical process by which wave crests tend to orient parallel to lines of constant water depth.

Roll-over point – The point at which the topset and foreset of a delta meet.

Sand – Sediment between 64 microns and 2 millimeters in size.

Sediment gravity flow – A flow near the seabed that is driven by density of the sediment in suspension. These flows occur when an excess of (fine) sediment causes the overall buoyancy of the water column to become denser than the fluid around it. Flow (and sediment transport) is directed downslope.

Silt – Sediment finer than 64 microns that is not influenced by electrostatic forces. Generally sediment finer than 2 microns is considered clay.

Skewness – A measure of the asymmetry of the probability distribution of a real-valued random variable, which refers to the third-order moment of a grain-size distribution.

Supported (levels of ^{210}Pb activity) – The activity (presence) of ^{210}Pb in sediment that remains after the sediment loses all of the ^{210}Pb generated from atmospherically induced radon decay. In a sediment core, once supported levels are reached, the sediment at that depth is assumed to be at least 150 years old.

Suspended load – The portion of sediment that is transported in the water column (at distances greater than a few grain diameters above the bed). Fine sand, silt, and clay are usually transported as suspended load.

Swell – Waves originating from the open ocean. Swell has a much longer period than locally generated wind waves.

Topset – The upper surface of a delta. The topset is most strongly influenced by waves and stream channel processes.

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Appendix J
Fingerprinting Technical Memorandum

(Included in its entirety on CD)

TECHNICAL MEMORANDUM

Port Angeles Harbor Sediment Characterization Study
Potential for Fingerprinting Analysis using Sediment Data

April 25, 2009
Updated March 17, 2010

Prepared for

DEPARTMENT OF
ECOLOGY
State of Washington

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Acronyms and Abbreviations

CDD	chlorinated dibenzo-p-dioxin compounds
CDF	chlorinated dibenzofuran compounds.
cm	centimeters
HpCDD	heptachlorodibenzo-p-dioxin
HpCDF	heptachlorodibenzofuran
HxCDD	hexachlorodibenzo-p-dioxin
HxCDF	hexachlorodibenzofuran
MDL	method detection limit
mg/kg	milligrams per kilogram
NWTPH-HCID	Northwest Total Petroleum Hydrocarbon (TPH) method for Hydrocarbon Identification
NWTPH-Dx	Northwest Semi-Volatile Petroleum Products Method for Soil and Water
OCDD	octachlorodibenzo-p-dioxin
OCDF	octachlorodibenzofuran
PAHs	polycyclic aromatic hydrocarbons
PCDD/PCDF	polychlorinated dibenzo-dioxin/polychlorinated dibenzo-furan (dioxin/furan)
PeCDD	pentachlorodibenzo-p-dioxin
PeCDF	pentachlorodibenzofuran
PQL	practical quantitation limit
RL	reporting limit
TCDD	tetrachlorodibenzo-p-dioxin
TCDF	tetrachlorodibenzofuran
TPH	total petroleum hydrocarbons
UCM	unresolved complex matrix

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1 Introduction

"Fingerprinting" is a technique used to link contaminants found in sediments to sources by comparing the sediment data with known source data.

This technical memorandum documents a screening-level evaluation that was done to determine whether fingerprinting of data collected during the Port Angeles Harbor Sediment Characterization Study would be warranted. For this initial evaluation, three lines of forensic evidence were investigated to indicate how well the data can support differentiation between sources of contaminants: total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), and dioxins/furans (PCDD/PCDF).

Results of the evaluation of the potential utility of fingerprinting studies for each contaminant type are discussed in the following sections.

2 Fingerprinting Usability

Generally accepted guidelines for reporting data recommend that concentrations between the method detection limit (MDL) and about three times the practical quantitation limit (PQL[1]) should be reported as detected but not quantified due to the potential for misuse of low-level data of relatively high quantitative uncertainty (Taylor 1987). For this investigation, concentrations of all analytes reported between the MDLs and PQLs have been annotated with a "J" qualifier (denoting "estimated concentration"). Statistical evaluations of data whose uncertainties are "high" can lead to erroneous conclusions, especially if the sample populations being compared are small or highly censored (having high percentages of non-detect data). In developing this preliminary indication of the usefulness of the analytical data to differentiate between sources of contaminants, only un-annotated data measured at concentrations three times or more above the PQL are used to estimate the viability of the data for further analysis.

3 Port Angeles Harbor Sampling

Sediment sample locations were identified in the Port Angeles Harbor Sediment Characterization Study Sampling and Analysis Plan (E & E 2008). Surface sediment samples were collected using grab samplers. Surface sediment samples were collected from the 0–10 centimeter (cm) interval. At one station the interval was 0–9 cm. Subsurface sediment samples were collected using a corer. Core samples were collected over multiple depth ranges (E & E 2008).

For this screening level evaluation, samples identified as the first subsurface depth interval analyzed below surface were combined and are referred to as "shallow" subsurface samples. The "shallow" sample intervals were generally 15–30 cm or 30–61

[1]Also sometimes known as reporting limit; this value may range from three to five times the MDL and indicates the point at which a laboratory can begin to quantify concentrations rather than merely showing a chemical exists in a concentration above background "noise."

cm, with some deeper intervals. Samples that came from the second or other subsurface horizons were combined and are referred to as "deeper" subsurface samples. "Deeper" samples were generally taken from greater than 90 cm in depth, although there were some shallower samples.

4 Analytes Considered for Fingerprinting

The following subsections discuss the fingerprinting potential of TPH, PAH, and dioxin/furan sediment data from the Port Angeles Harbor Sediment Characterization Study. Each analyte group is defined and the analytical protocols used are discussed. Data summaries are presented and the utility of the data for fingerprinting is discussed.

4.1 Total Petroleum Hydrocarbons

4.1.1 Nature of Petroleum Hydrocarbons

Petroleum products are often complex mixtures of hydrocarbons. Sources of petroleum products in the environment are numerous, and include diesel and motor oil from ships, motor vehicles, municipal/industrial outfalls, and runoff from combined sewer overflows and storm drains. The composition of crude oil is altered during refining, a process that may yield different petroleum products with distinct gas chromatographic patterns. These mixtures of petroleum hydrocarbons weather upon release into the environment. Weathering processes include evaporation, dissolution into water, sorption onto sediments, photo-oxidation, and biological degradation; all of these alter the fingerprint of the refined petroleum source material. A sample may contain mixtures of different petroleum products released into the environment at different times, together with naturally occurring hydrocarbons; this may confound identification of the type of petroleum in an environmental sample. Gas chromatogram patterns of peaks and their relative intensities may be evaluated to identify similarities and differences between environmental samples containing petroleum (Murphy and Morrison 2002).

4.1.2 Petroleum Hydrocarbon Analysis

Petroleum hydrocarbons were to be analyzed using the Northwest TPH Hydrocarbon Identification (NWTPH-HCID) method. NWTPH-HCID is a qualitative and semi-quantitative screening tool used to confirm the presence and type of petroleum product in a sediment sample. Results are reported qualitatively as gasoline, diesel, or heavy oil. The method is most useful when results indicate TPH concentrations are below regulatory limits, thus eliminating the need for more detailed petroleum analyses. The method's dry-weight reporting limits for sediment are 20 milligrams per kilogram (mg/kg) for gasoline, 50 mg/kg for #2 diesel, and 100 mg/kg for motor oil. Reporting limits are often elevated for sediment samples due to the water content (percent moisture) in the samples. Pattern matching with known reference product chromatograms is used to identify the type of hydrocarbon. Laboratory analysts categorize the TPH based on chromatogram identification.

The laboratory used for this study erred and entered the samples into the information management system for analysis using Ecology's qualitative and quantitative Semi-Volatile Petroleum Products Method for Soil and Water (NWTPH-Dx).

NWTPH-Dx provides qualitative identification of diesel and motor oil equal to that provided by NWTPH-HCID. In addition, NWTPH-Dx provides quantitative concentration data for diesel and motor oil, while the NWTPH-HCID method provides only semi-quantitative data. The NWTPH-Dx method also provides greater sensitivity and lower detection limits than the NWTPH-HCID method. Diesel reporting limits are approximately 25 mg/kg (dry weight). Motor oil reporting limits are approximately 50 mg/kg (dry weight).

The NWTPH-Dx method does not include the surrogates usually required for gasoline-range analyses, but its results have been used like NWTPH-HCID method results to estimate the concentration of gasoline in samples.

The laboratory provided the following information regarding its standard operating procedures for NWTPH-Dx and NWTPH-HCID.

NWTPH-Dx

<u>Extraction</u>
The laboratory extracts 10 grams of sample using 10 milliliters of methylene chloride. Extraction uses high pressure, heated sonication. An aliquot of the extract supernatant is centrifuged and transferred to a vial. There is no concentration step. The extraction used for NWTPH-Dx is the same extraction used for NWTPH-HCID (except the laboratory does not add the extra NWTPH-HCID [BFB] surrogate). The NWTPH-Dx surrogate is o-terphenyl.

<u>Analysis</u>
Quantitative analysis of diesel and motor oil is based on an initial calibration using known standards. Continuing calibration verification standards are analyzed to confirm control on each gas chromatograph instrument as required. Results are not estimates, unless detected between the MDL and reporting limit (RL), where the values are flagged with a "J" on the data report. A C8 and a C12 standard are run with this analysis.

Carbon ranges are as follows:
Diesel: C10–C24
Motor Oil: C24–C36

NWTPH-HCID

<u>Extraction</u>
The extraction is the same as for NWTPH-Dx noted above, except two surrogates are used, BFB and o-terphenyl.

Analysis
Results are reported as “present” or “non-detect” for gasoline, diesel, and motor oil. The reporting limit for gasoline is generally around 20 mg/kg.

Carbon ranges are as follows:
Gasoline: C7-C12
Diesel: C12-C24
Motor Oil: C24-C32

The laboratory used the following protocol for the calculation of gasoline range organics in the samples.

Qualitative Review of NWTPH-Dx Chromatograms and Data for Gasoline

Bench chemists evaluated the chromatograms of the samples with NWTPH-Dx detected above the RL. If there was anything detected between C8 and C12, the laboratory reported “present.” The laboratory’s organic supervisor evaluated the pattern and reported if it matched gasoline.

The laboratory provided its evaluation of the chromatograms and reported that no gasoline was detected above the detection limit (20 mg/kg).

In addition to the uncertainties associated with low level gasoline, diesel, and motor oil concentrations discussed in Section 2, TPH fingerprinting uncertainties are associated with an inherent limitation in the method: based on their operating parameters, different chromatographic instruments yield unequal spectra. Chromatograms from one gas chromatograph may not be directly comparable with spectra from other gas chromatographs or even the same instrument operating at different times. Significant effort would be required to convert spectral data using relative retention times and peak heights or areas normalized to known standards in order to accurately compare sample results.

4.1.3 Summary of Port Angeles Harbor Petroleum Hydrocarbon Analysis Results

Sediment sampling was described above. Figure 1 illustrates the locations of the samples analyzed for TPH.

As can be seen in Tables 1, 2, and 3, petroleum hydrocarbons were only sporadically detected, and when detected often had concentrations close to detection limits. These “low” concentrations are associated with high uncertainty in quantitative accuracy (Taylor 1987), as discussed in Section 2. Almost all of the annotated data were qualified because the concentrations measured were above the MDL but below the PQL.

Figure 2 presents several chromatograms associated with the range of samples from Port Angeles Harbor. These chromatograms illustrate the limited information available for fingerprinting.

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Figure 1

Port Angeles Harbor, Washington

Harbor-wide Surface Grab and Subsurface Core Stations with Total Petroleum Hydrocarbons (TPH) Data

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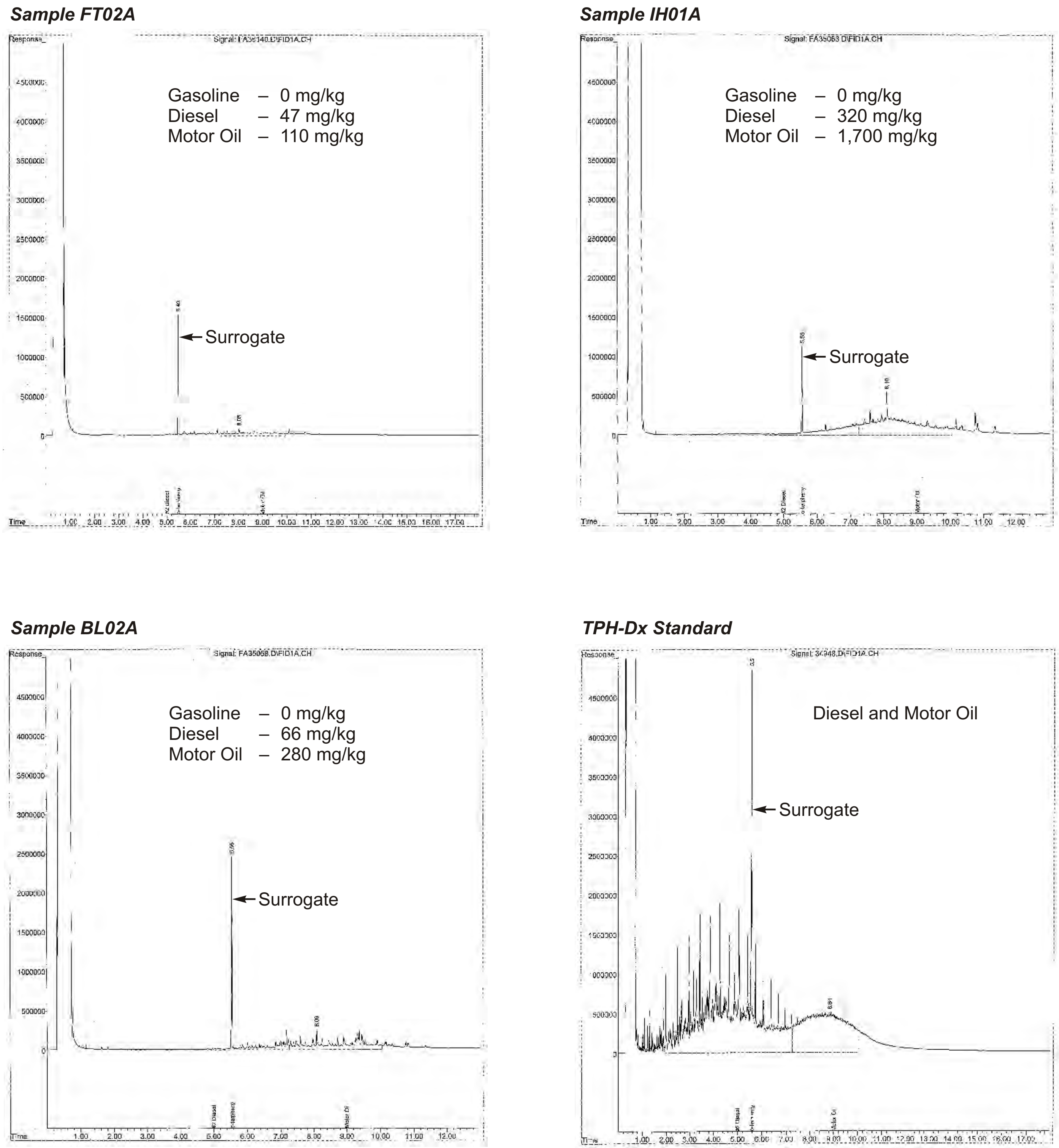

Figure 2

CHROMATOGRAMS SHOWING LABORATORY RESULTS
FOR TPH ANALYSIS OF SEDIMENTS FROM PORT ANGELES HARBOR

Table 1 Summary of Gasoline Data from Port Angeles Harbor Sediment Investigation

Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 x PQL	% of Un-Annotated Data > 3 x PQL
0–10 cm	70	0	0	70	0	0
Shallow subsurface	30	0	0	30	0	0
Deeper subsurface	20	0	0	20	0	0
All	120	0	0	120	0	0

Table 2 Summary of #2 Diesel Data from Port Angeles Harbor Sediment Investigation

Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
0–10 cm	70	18	26	26	1	1
Shallow subsurface	30	16	10	4	8	27
Deeper subsurface	20	5	7	8	2	10
All	120	39	43	38	11	9

Table 3 Summary of Motor Oil Data from Port Angeles Harbor Sediment Investigation

Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
0–10 cm	70	32	25	13	5	7
Shallow subsurface	30	19	9	2	11	37
Deeper subsurface	20	5	7	8	4	20
All	120	56	41	23	20	17

4.1.4 Utility of Petroleum Hydrocarbon Data for Fingerprinting

As shown in Tables 1, 2, and 3, the percentages of samples with petroleum concentrations above the range recommended for defining data as less certain (greater than 3 times the PQL) are low, with 0% of the gasoline, 9% of the #2 diesel, and 17% of the motor oil data meeting the minimum requirement for additional evaluation. In no single sample were all three components (gasoline, diesel, and motor oil) detected. Only 10 (8%) of the samples had both a diesel and a motor oil concentration above the level of uncertainty described above. These samples came from eight separate areas of concern within Port Angeles Harbor.

The Figure 2 chromatogram for sample IH01A illustrates the lack of information within chromatograms for fingerprinting. While the reported motor oil concentration is 1,700 mg/kg, the chromatogram shows that this is almost exclusively derived from the unresolved complex matrix (UCM) that appears as a "hump" in the chromatogram.

Based on the inherent limitations in TPH analyses and the highly censored nature of these data, the preliminary indication is that conducting a detailed fingerprinting analysis of the petroleum hydrocarbon data would not be practicable.

General statements regarding petroleum hydrocarbon presence and absence can be made based on the data gathered during these studies; however, the high degree of quantitative uncertainty associated with the analytical data allows for only rather broad interpretation of the results.

4.2 Polycyclic Aromatic Hydrocarbons

4.2.1 Nature of Polycyclic Aromatic Hydrocarbons

PAHs occur both naturally and from anthropogenic sources. PAHs are known to have characteristic distributions in different materials. For example, petroleum and wood combustion sources are known to have different PAH patterns, and creosote and coal tar creosote are often used as preservatives on piling for docks, dolphins, and piers; these complex mixtures degrade in the environment and release PAH compounds in characteristic patterns. As with TPHs, PAHs weather in the environment (Murphy and Morrison 2002).

4.2.2 Polycyclic Aromatic Hydrocarbons Analysis

Sediment samples were analyzed for 17 distinct PAHs using USEPA SW-846 method 8270 (EPA 1986). Analytes were naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, 2-methylnaphthalene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene (E & E 2008).

4.2.3 Summary of Port Angeles Harbor Polycyclic Aromatic Hydrocarbons Analysis Results

Sediment sampling was described above. Figure 3 illustrates the locations of the samples analyzed for PAHs.

As can be seen in Tables 4, 5, and 6, PAHs were only sporadically detected, and when detected often had concentrations close to detection limits. These “low” concentrations are associated with high uncertainty in quantitative accuracy (Taylor 1987), as discussed in Section 2. Almost all of the annotated data were flagged because the concentrations measured were above the MDL but below the PQL.

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N W E S

0 495 990 1,980 2,970 3,960 4,950 5,940

Feet

Scale 1:24,000

Figure 3

Port Angeles Harbor, Washington

Harbor-wide Surface Grab and Subsurface Core Stations with Polycyclic Aromatic Hydrocarbons (PAH) Data

source: ecology & environment, inc., 3/6/09 ...\port_angeles_sta\figure 3 grab_core pah.mxd

Table 4 Summary of Individual PAH Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
naphthalene	0–10 cm	92	26	12	54	3	3
	Shallow subsurface	43	20	1	21	6	14
	Deeper subsurface	32	6	1	25	2	6
	All	167	52	14	100	11	7
2-methyl naphthalene	0–10 cm	92	2	12	78	0	0
	Shallow subsurface	43	8	7	27	2	5
	Deeper subsurface	32	2	3	28	1	3
	All	167	12	22	132	3	2
acenaphthylene	0–10 cm	92	19	10	63	2	2
	Shallow subsurface	43	3	14	26	0	0
	Deeper subsurface	32	2	1	30	0	0
	All	167	24	25	119	2	1
acenaphthene	0–10 cm	92	10	11	71	0	0
	Shallow subsurface	43	9	5	28	4	10
	Deeper subsurface	32	9	1	29	1	3
	All	167	28	17	128	5	3

Table 4 Summary of Individual PAH Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
fluorene	0–10 cm	92	21	12	59	2	2
	Shallow subsurface	43	14	9	20	3	7
	Deeper subsurface	32	3	1	29	2	6
	All	167	38	21	107	7	4
phenanthrene	0–10 cm	92	57	8	27	39	42
	Shallow subsurface	43	26	5	12	19	45
	Deeper subsurface	32	8	3	21	3	9
	All	167	90	16	60	61	37
anthracene	0–10 cm	92	41	4	47	24	26
	Shallow subsurface	43	20	3	19	7	17
	Deeper subsurface	32	3	2	27	1	3
	All	167	64	9	93	32	19
fluoranthene	0–10 cm	92	66	4	22	52	57
	Shallow subsurface	43	27	7	8	23	55
	Deeper subsurface	32	9	3	20	3	9
	All	167	102	14	50	78	47

Table 4 Summary of Individual PAH Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
pyrene	0–10 cm	92	63	4	25	46	50
	Shallow subsurface	43	22	11	9	18	43
	Deeper subsurface	32	10	2	20	3	9
	All	167	95	17	54	67	40
benzo(a)anthracene	0–10 cm	92	50	10	32	33	36
	Shallow subsurface	43	19	6	18	11	26
	Deeper subsurface	32	4	3	25	3	9
	All	167	73	18	75	47	28
chrysene	0–10 cm	92	56	8	28	39	42
	Shallow subsurface	43	20	7	16	14	33
	Deeper subsurface	32	5	4	24	3	9
	All	167	81	19	68	56	34
benzo(b)fluoranthene	0–10 cm	92	54	5	33	38	41
	Shallow subsurface	43	22	4	17	15	36
	Deeper subsurface	32	4	3	25	3	9
	All	167	80	12	75	56	34

Table 4 Summary of Individual PAH Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
benzo(k)fluoranthene	0–10 cm	92	52	5	35	33	36
	Shallow subsurface	43	21	4	18	14	33
	Deeper subsurface	32	4	2	26	2	6
	All	167	77	11	79	49	30
benzo(a)pyrene	0–10 cm	92	51	5	36	32	35
	Shallow subsurface	43	21	4	18	12	29
	Deeper subsurface	32	3	5	24	2	6
	All	167	75	14	78	46	28
indeno(1,2,3-cd)pyrene	0–10 cm	92	27	11	54	8	9
	Shallow subsurface	43	9	11	23	1	2
	Deeper subsurface	32	1	2	29	0	0
	All	167	37	24	106	9	5
dibenzo(a,h)anthracene	0–10 cm	92	9	11	72	1	1
	Shallow subsurface	43	1	3	39	0	0
	Deeper subsurface	32	0	2	30	0	0
	All	167	10	16	141	1	1

Table 4 Summary of Individual PAH Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
benzo(g,h,i)perylene	0–10 cm	92	30	9	53	9	10
	Shallow subsurface	43	9	11	23	1	2
	Deeper subsurface	32	1	3	28	0	0
	All	167	40	23	104	10	6

Table 5 Summary of All PAH Analytes Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
All PAHs	0–10 cm	1,564	633	141	790	361	23
	Shallow subsurface	731	271	112	348	150	21
	Deeper subsurface	544	74	41	429	29	5
	All	2,839	978	294	1,567	540	19

Table 6 Summary of All PAH Data by Station from Port Angeles Harbor Sediment Investigation

# of Individual PAHs	# of Stations with Un-Annotated Positive Results > 3 X PQL	% of Stations with Un-Annotated Positive Results > 3 X PQL	Cumulative % of Stations with Un-Annotated Positive Results > 3 X PQL
0	86	51.8	51.8
1	4	2.4	54.2
2	7	4.2	58.4
3	6	3.6	62.0
4	8	4.8	66.9
5	3	1.8	68.7
6	8	4.8	73.5
7	3	1.8	75.3
8	11	6.6	81.9
9	14	8.4	90.4
10	4	2.4	92.8
11	7	4.2	97.0
12	2	1.2	98.2
13	3	1.8	100
14	0	0.0	100
15	0	0.0	100
16	0	0.0	100
17	0	0.0	100
total	166	100.0	100

4.2.4 Utility of Polycyclic Aromatic Hydrocarbons Data for Fingerprinting

Although PAH data are highly censored (large number of non-detect data) and a significant percentage of the un-annotated positive results are less than three times the PQL, the data presented in Tables 4, 5, and 6 indicate that fingerprinting may be appropriate for surface and shallow subsurface samples, for which 23% and 21%, respectively, of the un-annotated PAH data are greater than three times the PQL. Only 5% of the un-annotated deeper subsurface samples PAH data are greater than three times the PQL.

Assuming, for discussion purposes only, that a minimum of five individual PAHs must be present in a sample at concentrations above three times the PQL, approximately one-third of the stations would have sufficient data at one or more depth intervals to fingerprint the PAHs using relative ratios of the individual PAH concentration.

Any statistical tests conducted using either parametric techniques such as Analysis of Variance to compare populations or Pearson's correlation coefficient to evaluate relationships, or non-parametric tests (Wilcoxon's rank sum test or Spearman rank correlation coefficient) should acknowledge the inherent limitations in the data sets described above.

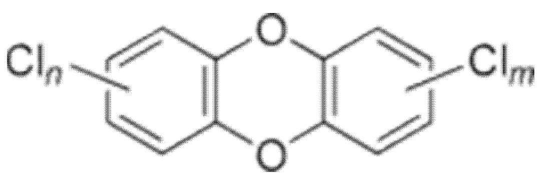
The use of more powerful chemometric tests (for example, principal component analysis) may help overcome some of the limitations in the data. However, these tests are not within the scope of this project.

Visual comparisons of ratios of the PAH analyte concentrations to published concentration ratios in materials such as creosote may provide some indication of the nature of potential source material.

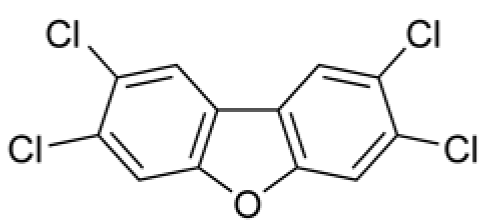
4.3 Dioxins/Furans

4.3.1 Nature of Dioxins/Furans

Briefly, dioxins and furans are families of related compounds with from 1 to 8 chlorine atoms located at various positions around the base carbon ring structure. Each unique compound is referred to as a congener. Congeners with the same number of chlorine atoms are referred to as homologues. There are 75 different dioxin congeners and 135 different furan congeners. Congeners vary significantly in their toxicity. The following figure illustrates the general structure of dioxin where *n* and *m* represent the number of chlorine atoms and may vary from 0 to 4.



The structure of the congener 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF) is illustrated below.



It is generally accepted that dioxins and furans do not occur naturally and are not deliberately manufactured. Small quantities of these compounds are inadvertent by-products resulting from a number of chemical processes. For example, pentachlorophenol used in wood preserving often contains dioxin/furan impurities. Chlorination of wastewater effluent from treatment plants may produce dioxins/furans.

Two important sources of dioxins/furans are waste incineration, especially when plastics are burned, and effluent from pulp and paper mills that use chlorine bleaching.

Different processes produce dioxins/furans in different congener ratios. These patterns may be used to indicate the type(s) of sources that may have generated the dioxins/furans. As with the TPH and PAH compounds noted above, dioxins/furans also “weather” in the environment. The use of homologue data for fingerprinting is limited since the concentration of each homologue is based on the sum of several congeners having the same number of chlorine atoms.

4.3.2 Dioxin/Furan Analysis

Sediment samples were analyzed for 17 dioxin/furan congeners and 8 dioxin/furan homologues using USEPA method 1613 (EPA 1994). Target analytes are listed below.

2,3,7,8-TCDD
Total TCDD
1,2,3,7,8-PeCDD
Total PeCDD
1,2,3,4,7,8-HxCDD
1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD
Total HxCDD
1,2,3,4,6,7,8-HpCDD
Total HpCDD
OCDD
2,3,7,8-TCDF
Total TCDF
1,2,3,7,8-PeCDF
2,3,4,7,8-PeCDF
Total PeCDF
1,2,3,4,7,8-HxCDF
1,2,3,6,7,8-HxCDF
1,2,3,7,8,9-HxCDF
2,3,4,6,7,8-HxCDF
Total HxCDF
1,2,3,4,6,7,8-HpCDF
1,2,3,4,7,8,9-HpCDF
Total HpCDF
OCDF

Key:

CDD	=	chlorinated dibenzo-p-dioxin compounds
CDF	=	chlorinated dibenzofuran compounds.
HxCDD	=	hexachlorodibenzo-p-dioxin
HxCDF	=	hexachlorodibenzofuran
HpCDD	=	heptachlorodibenzo-p-dioxin
HpCDF	=	heptachlorodibenzofuran
OCDD	=	octachlorodibenzo-p-dioxin
OCDF	=	octachlorodibenzofuran
PeCDD	=	pentachlorodibenzo-p-dioxin
PeCDF	=	pentachlorodibenzofuran
TCDD	=	tetrachlorodibenzo-p-dioxin
TCDF	=	tetrachlorodibenzofuran

4.3.3 Summary of Port Angeles Harbor Dioxin/Furan Analysis Results

Sediment sampling was described above. Figure 4 illustrates the locations of the samples analyzed for dioxins/furans.

As can be seen in Tables 7, 8, and 9, dioxin/furan congeners were detected in over 90% of all samples. Congener concentrations generally were close to detection limits. These “low” concentrations are associated with high uncertainty in quantitative accuracy (Taylor 1987), as discussed in Section 2. Most of the annotated data were flagged because the concentrations measured were above the MDL but below the PQL.

N W E S

0 500 1,000 2,000 3,000 4,000 5,000 6,000
Feet

Scale 1:24,000

Figure 4

Port Angeles Harbor, Washington

Harbor-wide Surface Grab and Subsurface Core Stations with Dioxin/Furan (PCDD/PCDF) Data

source: ecology & environment, inc., 3/6/09 ...\port_angeles_sta\figure 4 grab_core dx_fn.mxd

Table 7 Summary of Individual Dioxin/Furan Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
1,2,3,4,6,7,8-HpCDD	0–10 cm	86	64	22	0	60	70
	Shallow subsurface	38	27	10	1	27	71
	Deeper subsurface	19	14	5	0	11	58
	All	143	105	37	1	98	69
1,2,3,6,7,8-HxCDD	0–10 cm	86	54	32	0	41	48
	Shallow subsurface	38	22	16	0	17	45
	Deeper subsurface	19	7	12	0	4	21
	All	143	83	60	0	62	43
1,2,3,4,6,7,8-HpCDF	0–10 cm	86	57	25	4	54	63
	Shallow subsurface	38	25	10	3	21	55
	Deeper subsurface	19	9	4	6	5	26
	All	143	91	39	13	80	56
1,2,3,4,7,8,9-HpCDF	0–10 cm	86	32	45	9	16	19
	Shallow subsurface	38	13	19	6	6	16
	Deeper subsurface	19	3	9	7	2	11
	All	143	48	73	22	24	17

Table 7 Summary of Individual Dioxin/Furan Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
1,2,3,4,7,8-HxCDD	0–10 cm	86	33	49	4	21	24
	Shallow subsurface	38	16	22	0	11	29
	Deeper subsurface	19	4	15	0	3	16
	All	143	53	86	4	35	24
1,2,3,6,7,8-HxCDF	0–10 cm	86	32	50	4	15	17
	Shallow subsurface	38	16	18	4	10	26
	Deeper subsurface	19	3	12	4	3	16
	All	143	51	80	12	28	20
1,2,3,7,8,9-HxCDD	0–10 cm	86	54	32	0	31	36
	Shallow subsurface	38	22	16	0	16	42
	Deeper subsurface	19	5	14	0	4	21
	All	143	81	62	0	51	36
1,2,3,4,7,8-HxCDF	0–10 cm	86	35	40	11	24	28
	Shallow subsurface	38	16	17	5	2	5
	Deeper subsurface	19	3	10	6	0	0
	All	143	54	67	22	26	18

Table 7 Summary of Individual Dioxin/Furan Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
1,2,3,7,8,9-HxCDF	0–10 cm	86	2	57	27	0	0
	Shallow subsurface	38	0	26	12	0	0
	Deeper subsurface	19	0	5	14	0	0
	All	143	2	78	53	0	0
1,2,3,7,8-PeCDD	0–10 cm	86	34	50	2	20	23
	Shallow subsurface	38	16	22	0	10	26
	Deeper subsurface	19	4	15	0	3	16
	All	143	54	87	2	33	23
1,2,3,7,8-PeCDF	0–10 cm	86	33	47	6	13	15
	Shallow subsurface	38	16	18	4	8	21
	Deeper subsurface	19	3	11	5	2	11
	All	143	52	76	15	23	16
2,3,4,6,7,8-HxCDF	0–10 cm	86	31	47	8	14	16
	Shallow subsurface	38	15	20	3	10	26
	Deeper subsurface	19	3	11	5	3	16
	All	143	49	78	16	27	19

Table 7 Summary of Individual Dioxin/Furan Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
2,3,4,7,8-PeCDF	0–10 cm	86	35	51	0	22	26
	Shallow subsurface	38	18	18	2	14	37
	Deeper subsurface	19	5	11	3	2	11
	All	143	58	80	5	38	27
2,3,7,8-TCDD	0–10 cm	86	50	34	2	30	35
	Shallow subsurface	38	24	14	0	14	37
	Deeper subsurface	19	5	14	0	4	21
	All	143	79	62	2	48	34
2,3,7,8-TCDF	0–10 cm	86	55	28	3	54	63
	Shallow subsurface	38	28	18	1	6	16
	Deeper subsurface	19	9	8	2	2	11
	All	143	92	54	6	62	43
OCDD	0–10 cm	86	67	19	0	65	76
	Shallow subsurface	38	28	10	0	27	71
	Deeper subsurface	19	15	4	0	13	68
	All	143	110	33	0	105	73

Table 7 Summary of Individual Dioxin/Furan Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
OCDF	0–10 cm	86	56	24	6	52	60
	Shallow subsurface	38	26	10	2	22	58
	Deeper subsurface	19	7	6	6	6	32
	All	143	69	40	14	80	56
Total HpCDF	0–10 cm	86	81	3	2	80	93
	Shallow subsurface	38	27	10	1	27	71
	Deeper subsurface	19	12	4	4	12	63
	All	143	120	17	6	119	83
Total HxCDD	0–10 cm	86	83	3	0	83	97
	Shallow subsurface	38	28	10	0	28	74
	Deeper subsurface	19	15	4	0	15	79
	All	143	126	17	0	126	88
Total HxCDF	0–10 cm	86	81	3	2	80	93
	Shallow subsurface	38	25	10	3	25	66
	Deeper subsurface	19	12	4	3	12	63
	All	143	118	17	8	117	82

Table 7 Summary of Individual Dioxin/Furan Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
Total HpCDD	0–10 cm	86	83	3	0	83	97
	Shallow subsurface	38	28	10	0	28	74
	Deeper subsurface	19	15	4	0	15	79
	All	143	126	17	0	126	88
Total PeCDD	0–10 cm	86	82	3	1	81	94
	Shallow subsurface	38	28	10	0	28	74
	Deeper subsurface	19	15	4	0	15	79
	All	143	125	17	1	124	87
Total PeCDF	0–10 cm	86	82	4	0	82	95
	Shallow subsurface	38	26	10	2	26	68
	Deeper subsurface	19	12	4	3	12	63
	All	143	120	18	5	120	84
Total TCDD	0–10 cm	86	80	5	1	80	93
	Shallow subsurface	38	28	10	0	28	74
	Deeper subsurface	19	15	4	0	15	79
	All	143	123	19	1	123	86

Table 7 Summary of Individual Dioxin/Furan Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
Total TCDF	0–10 cm	86	83	3	0	83	97
	Shallow subsurface	38	27	10	1	27	71
	Deeper subsurface	19	13	4	2	13	68
	All	143	123	17	3	123	86

Table 8 Summary of All Dioxin/Furan Analytes Data from Port Angeles Harbor Sediment Investigation

Analyte	Depth Range	# of Samples	# of Un-Annotated Positive Results	# of Annotated Positive Results	# of Non-Detect Samples	# of Un-Annotated Positive Results > 3 X PQL	% of Un-Annotated Data > 3 X PQL
All dioxins/furans	0–10 cm	2,150	1,397	663	90	1,184	55
	Shallow subsurface	950	542	358	50	438	46
	Deeper subsurface	475	209	197	69	176	37
	All	3,575	2,148	1,218	209	1,798	50
Congeners only	0–10 cm	1,462	742	636	84	532	36
	Shallow subsurface	646	325	278	43	221	34
	Deeper subsurface	323	100	165	58	67	21
	All	2,431	1,167	1,079	185	820	34
Homologues only	0–10 cm	688	655	27	6	652	95
	Shallow subsurface	304	217	80	7	217	71
	Deeper subsurface	152	109	32	11	109	72
	All	1,144	981	139	24	978	85

Table 9 Summary of All Dioxin/Furan Data by Station from Port Angeles Harbor Sediment Investigation

# of Congeners	# of Stations with Un-Annotated Positive Results > 3 X PQL	% of Stations with Un-Annotated Positive Results > 3 X PQL	Cumulative % of Stations with Un-Annotated Positive Results > 3 X PQL
0	5	3.5	3.5
1	10	7.0	10.5
2	21	14.7	25.2
3	4	2.8	28.0
4	7	4.9	32.5
5	15	10.5	43.4
6	8	5.6	49.0
7	6	4.2	53.1
8	9	6.3	59.4
9	6	4.2	63.6
10	8	5.6	69.2
11	2	1.4	70.6
12	3	2.1	72.7
13	8	5.6	78.3
14	7	4.9	83.2
15	8	5.6	88.8
16	16	11.2	100
17	0	0.0	100
total	143	100.0	100

4.3.4 Utility of Dioxin/Furan Data for Fingerprinting

Tables 7, 8, and 9 show clearly that dioxin/furan data are not highly censored (less than 10% of the data were non-detect). However, a significant percentage of the un-annotated positive results are less than three times the PQL. Fingerprinting may be appropriate for surface and shallow subsurface samples, where 36% and 34%, respectively, of the un-annotated, congener only, dioxin/furan data are greater than three times the PQL. While only 21% of the un-annotated, congener only, deeper subsurface samples dioxin/furan data are greater than three times the PQL, it may be useful to fingerprint these data as well.

Assuming, for discussion purposes only, that a minimum of five congeners must be present in a sample at concentrations above three times the PQL, approximately two-thirds of the stations would have sufficient data at one or more depth intervals to fingerprint dioxin/furan congeners using relative ratios of the congener concentrations.

Any statistical tests conducted using either parametric techniques such as Analysis of Variance to compare populations or Pearson's correlation coefficient to evaluate relationships, or non-parametric tests (Wilcoxon's rank sum test or Spearman rank correlation coefficient) should acknowledge the inherent limitations in the data sets described above.

The use of more powerful chemometric tests (for example, principal component analysis) may help overcome some of the limitations in the data. However, these tests are not within the scope of this project.

5 Summary

Based on the available data, fingerprinting is not recommended for TPH in Port Angeles Harbor.

Both surface and shallow subsurface sediment PAH data appear amenable to fingerprinting. Deeper subsurface data can be evaluated but may not yield reasonable results due to the limited sample population. Surface, shallow subsurface, and deeper subsurface sediment dioxin/furan data appear amenable to fingerprinting.

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