Remedial Investigation Report
Sediments Operable Unit
Cascade Pole Site
Olympia, Washington

Volume II of III

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APPENDIX A

Field Methodologies

APPENDIX A
FIELD STUDIES

PHASE I

This Section describes the procedures followed for collection of sediment samples during Phase I of the Sediments RI. The procedures described in the following sections were devised to meet the objectives of the Phase I Sampling and Analysis Plan (SAP) (Landau Associates 1990).

Phase I Sample Collection

Prior to Phase I sample collection, temporary buoys were placed near all of the proposed sediment sample locations using a rangefinder. The buoy locations were adjusted during actual sample collection in order to place the buoy anchor as close as possible to the actual sample location for subsequent sampling location surveying.

Surveys of the Phase I sample locations were performed periodically during the sediment sampling event. The Port provided a surveyor with a theodolite who shot the sampling locations via a stadia rod tied to the davit of a boat. The boat was positioned by the buoys where samples had been collected, and the boat was maneuvered until the buoy anchor was located directly below the stadia. If the tide was too low to use the boat, a person walked to the buoy anchor carrying the stadia.

Phase I sediment samples were collected as close as possible to the original buoy locations by using one of the following methods: from a boat using a piston core sampler or on foot by pushing a core tube by hand into the sediment. Only a few of the 10-cm sediment cores were collected on foot; most 10-cm cores and all 100-cm cores were collected from the boat.

The boat employed was a 22-ft boat owned and operated by Ardea Enterprises. The davit, shallow draft, and low gunwales of this boat were well suited for the type of sampling performed. Anchors resting on the sediment bottom were used to securely hold the boat on station with the least amount of sediment disturbance.

The piston-tube core sampler was designed and constructed by Landau Associates specifically for this project. The piston-tube core sampler consisted of three parts: the core tube, the piston assembly, and the hammer assembly; its operation is shown on Figure A-1.

To obtain enough sediment for chemical and physical testing, a thin-walled stainless-steel Shelby tube (3-inch diameter) was used. The piston assembly lowered the core tube to the

sediment surface and held it vertically while a 10-lb hammer with a 2.5-ft stroke drove the core tube into the sediment. After full penetration was achieved, the core tube was pulled out of the sediment using a cable and winch. The bottom end of the core tube was capped prior to lifting the core tube above the water.

Phase I Sample Handling

Following sample collection, each sample was processed in general accordance with Puget Sound Estuary Program (PSEP) protocols for sampling, describing, and decontamination (PSEP 1986a). Upon collection of sediment sample cores, each steel tube was marked to denote the following: station identification, depth interval, bottom and top, and time sampled. Each sample core was then placed vertically (top up) into a sample core holding box and transported to an onshore work station.

At the onshore work station, sample cores were stored vertically (top up), in a sample core holding box. The cores generally were processed in the same order in which they were obtained, to reduce holding times. Care was taken to reduce disturbance to the sediment when handling and storing the tubes.

Prior to extrusion of each sample core, the station identification, depth interval, date, and time recorded on each core tube was also recorded on a corresponding core log. The top cap of the core was removed, and any water resting on the surface of the sample was removed.

The length of the recovered sample was measured and recorded. Partial recovery of a sample was most often due to loss of sediment during sample collection, or an inability to penetrate the sediments the full length of the sampler. As a result, loss of sample was assumed to be from the bottom of the core unless otherwise noted by the sample collector.

A piston was used to manually extrude each surface core sample. The extruded sample was collected on a precleaned, plastic-lined PVC core tray. A skill saw was used to remove deep core samples from their aluminum core tube. The core tube was cut lengthwise then rotated 180 degrees and cut lengthwise again. The sample remained in the subsequent core tube half until compositing for collection of subsamples. All samples were split lengthwise down the middle by using precleaned, stainless-steel knives (a separate knife was generally used for each sample interval). Immediately following the splitting of each sample, a photoionization detector (PID) was used for field detection of volatile organic compounds that may be associated with the sample. PID readings in parts per million were taken for each sample and recorded on the corresponding core log.

Each sample was inspected visually under natural light and ultraviolet light for evidence of free creosote or other oil. The vertical distribution of visible contamination was recorded to the nearest centimeter, and a qualitative description of the contamination was included. The lithology of each sample core was described in general accordance with PSEP protocols (PSEP 1986a) and each description recorded.

The sediment samples were collected from the inner portion of the core; the outermost 0.5 cm was discarded. Nonrepresentative material (e.g., large wood fragments, large shells, human artifacts, etc.) and particles greater than 0.25 inches in diameter were removed from the sample (as specified in the Quality Assurance Project Plan (QAPP) (ESE 1990) using a stainless-steel spoon. The particle(s) were weighed and the weight and description reported. Each sample interval was homogenized by mixing to visible uniformity in a stainless-steel bowl.

Sample intervals generally followed the scheme described in the SAP (Landau Associates 1990) where a = 0-10 cm, b = 10-55 cm, c = 55-100 cm, etc. However, on occasion the intervals were altered to coincide with stratigraphic horizons or sections of no sample recovery. Each sample interval was recorded on the corresponding core log (Appendix B).

Once the sample interval was homogenized, subsamples were collected for individual analyses, in I-Chem certified clean jars [as specified in the QAPP (ESE 1990)]. Each sample jar was labeled and recorded on a chain-of-custody form.

Jars that contained samples with visual evidence of contamination were placed in individual plastic zip-lock bags to prevent cross contamination. The sample jars were placed in thermally insulated coolers on double-bagged ice. At the end of the day, samples were inventoried and the coolers were sealed with fiber tape and a custody seal, and labeled for transport. Samples were locked in a secure area overnight and shipped to the laboratory the next day.

All appropriate site and sampling information was documented in the field on sediment sampling worksheets and/or in a field logbook at the time of sampling.

PHASE II

This section describes the procedures followed for collection of sediment, water and tissue samples during Phase II of the Sediments RI. The procedures described in the sections below were designed to meet the objectives of the Phase II Work Plan (Landau Associates 1991).

Phase II Sediment Sample Collection

As in the Phase I investigation, temporary buoys were placed prior to sample collection near each of the proposed sediment sample locations. The Phase II buoys were placed by surveying the proposed sample location using a transit and stadia rod rather than with a rangefinder, due to experience during Phase I of poor accuracy using the rangefinder. Surveys of Phase II sediment sample locations were performed during the sampling event using a transit and stadia rod. All surveying was performed by a Port surveyor. Sample locations collected offshore were surveyed from shore immediately following sample collection and prior to relocating to a new sample location. Onshore sample locations were staked, labeled, and later surveyed.

Phase II sediment samples were collected by using one of the following methods:

- From a barge positioned offshore using a 4-¼ inch inside diameter (ID) hollow-stem auger (bolt connector) advanced with a truck-mounted drill rig
- From a boat using a piston core sampler or a van Veen grab sampler
- Onshore using 4-¼ inch ID hollow-stem auger (bolt connector) advanced with a portable skid-mounted drill rig
- On foot by pushing a core tube into the sediment by hand.

The truck-mounted drill rig positioned atop a barge was employed for offshore drilling of 4-m and deeper cores. The barge employed was capable of accessing the required sampling locations and maneuvered to each sampling location at high tide by a tug boat. The barge and tug was successful at accessing all planned sampling locations except H7. Anchors resting on the sediment bottom and onshore, and ropes tied to existing pilings (and breakwater, when applicable) were used to hold the barge on station. The truck-mounted drill rig was owned and operated by Holt Testing, Inc.

To obtain enough sediment for chemical and physical testing, a GUS sampler with thin-walled stainless-steel Shelby tubes (3-inch diameter, 2-½ ft long) was pushed hydraulically below the auger. Sediment samples were collected continuously from the sediment surface to the designated bottom depth of each boring. Upon completion of each borehole, the borehole was abandoned and immediately backfilled with bentonite.

The three borings that were planned as deep borings, and thereby were designed to proceed through the aquitard into the Lower Aquifer, represented potential cross-contamination from the upper sediments to the Lower Aquifer. To minimize this potential, it was planned that

any deep boring that encountered significant volumes of NAPL (such as the DNAPL onshore at EW3) would not proceed through the aquitard, and that all borings would be backfilled with grout as soon as possible upon reaching the Lower Aquifer. None of the three deep borings encountered what was judged to be a significant source of NAPL. However, at C1, oil was visible on the outside of the sampler in the upper few feet of sediments. The evidence of oil on the sampler diminished as the boring proceeded, and the boring was continued to the Lower Aquifer, at which point the hole was plugged with bentonite grout. Evidence from the grouting and sample logging indicates that the aquitard materials were soft and closed in on the borehole naturally as the augers were withdrawn. This suggests that the borehole also sealed around the outside of augers during drilling. Evidence from sample logging indicates that some carrydown of oil did occur but that it ended approximately halfway through the aquitard.

A portable skid-mounted drill rig owned and operated by Boretec, Inc. was employed for onshore drilling during low tide at the 4-m sampling locations that were not accessible by barge. Repositioning of the drill rig between boreholes was done manually. Wooden planks were placed atop the sediment to reduce disturbance of the sediments and to make the transport of the drill rig easier. To obtain enough sediment for chemical and physical testing, the GUS sampler, as previously described, was pushed hydraulically below a 4-¼ inch hollow-stem auger. Upon completion of each borehole, the borehole was abandoned and immediately backfilled with bentonite chips. A stake, labeled with the borehole location, was then placed at the center of each borehole for future surveying purposes.

One-meter sediment cores and 10-cm sediment samples were obtained from a 22-ft boat owned and operated by Ardea Enterprises. To obtain enough sediment for chemical and physical testing at the 1-m core locations, a thin-walled stainless-steel Shelby tube (3-inch diameter), was used with the piston-tube core sampler constructed and used in the Phase I sampling program (Figure A-1). During Phase II, a diver assisted with the operation of the piston corer to verify vertical coring. The 10-cm samples for bioassay and the sediment samples for benthic abundance/diversity were collected using a van Veen grab sampler deployed from the boat using the davit.

Some surface sediment samples were collected onshore by foot during low tide using a 1-ft long section of a 3-inch diameter, thin-walled, stainless-steel Shelby tube.

Phase II Sediment Sample Handling

Following sample collection, each Phase II sample was processed following PSEP protocols for sampling, describing, and decontamination (PSEP 1986a). Phase II sample handling was similar to that employed during Phase I, with the following exceptions:

- A hydraulic piston was used to extrude each sample core.
- An electric mixer was used to homogenize most samples.

Phase II sample intervals generally followed the scheme described in the June 14, 1991, SAP (Landau Associates 1990) where a = 0-10 cm, b = 10-55 cm, c = 55-100 cm, etc. However, on occasion the intervals were altered to coincide with stratigraphic horizons or sections of no sample recovery. Each sample interval was recorded on the corresponding core log (see Appendix B). When it was necessary to subdivide a sample interval , the sample interval letter designation was doubled (CC) or tripled (CCC) to allow subsequent intervals to retain the planned designation.

Phase II Water Sample Collection and Handling

Surface water samples collected in the water column were sampled between the high and low stages of an ebb tide. This reduced potential contributions from other sources in East Bay. The station in the surface drainage channel offshore of the site and the stations in ponded water on the surface of the sediment were sampled at low tide.

Collection of the samples from the water column was accomplished with an electronically operated peristaltic pump, and weighted PTFE (Teflon) tubing. At all stations (at the site and background) the weighted Teflon tubing was lowered to a depth just above the sediment surface and then raised during pumping of the water sample to achieve a sample integrated over the water column. The volume of water collected in each case varied from the total volume required for analyses. A representative sample from the total volume collected from the water column was transferred to precleaned glass containers designated for the individual analyses.

Ponded water samples were collected directly from water discharging through a natural channel, or from natural or artificially created depressions. All of these samples were collected using a peristaltic pump and Teflon tubing.

Prior to collection of each water sample, the pump was run for a sufficient time to purge several times the sampling system volume. All water samples were processed and shipped according to sample handling and custody procedures described in the QAPP (ESE 1990). The water samples were not filtered prior to chemical analysis.

Phase II Tissue Sample Collection and Handling

Clams collected for analysis were removed from the sediment with a shovel. Only undamaged clams were retained for analyses. Clams retained for analyses were of the same species (bentnose) and similar in size to reduce potential species- and age-related variability in bioaccumulation among stations. A sufficient number of clams (approximately 10-30, depending on their size) were collected from each location to provide a shucked weight of the composite sample of 200 g. The number of clams represented in the composited tissue sample were recorded and reported with the chemical results.

So that only chemicals in tissue were analyzed, it was important that the clams be cleaned of adhering sediment before chemical analyses were conducted. Accordingly, the shells of the clams were rinsed with seawater and scrubbed with a brush, if necessary, to remove any sediment adhering to the exterior of the shells. In order to provide a conservative estimate of the concentrations of chemical contaminants potentially ingested by humans, the clams were not depurated.

The clams were wrapped in solvent-rinsed (methanol) foil, placed in plastic bags, and frozen prior to transport to the laboratory. Tissue samples were prepared following the recommendations of the PSEP protocols (PSEP 1989a,b). When a tissue sample was thawed, the associated liquid was maintained as a part of the sample. This liquid contained lipid material. To avoid loss of moisture from the sample, partially thawed samples were homogenized. Each composite sample was placed in a glass jar with teflon-lined lids and refrigerated or frozen depending on the expected time of analysis.

The benthic macroinvertebrate diversity evaluation followed PSEP protocols (PSEP 1986b). Five replicate samples were collected from each station using a modified 0.1-m^2 van Veen bottom grab sampler deployed from a 22-ft boat owned and operated by Ardea Enterprises. Sample collection protocol and sample acceptability criteria are outlined in the PSEP protocols (PSEP 1986b). Once the sample acceptability criteria was satisfied, each sample was characterized by location (station ID/replicate letter), depth, surface sediment description, vertical profile, and maximum penetration depth. These data were recorded in a field log

during sampling. Following characterization, the grab sampler was opened and its contents gently washed with filtered seawater and directed into a 1.0-mm mesh sieve. Biological material was identified as representative of one of the following phyla or categories and, if possible, identified to genus or species level: annelid, arthropod, mollusc, echinoderm, and miscellaneous. Sample composition (percent in each category) was estimated and recorded in the field log before samples were transferred from the sieve to sample containers. The sample containers were labeled (station ID/replicate letter) inside and outside and filled with 15 percent formaldehyde solution, buffered to pH 8.5 (plus or minus 0.3) with sodium borate ($Na_2B_4O_7$). The sediment samples were processed and shipped according to sample handling and custody procedures described in the QAPP (ESE 1990).

DECONTAMINATION AND DISPOSAL

Decontamination

All sampling equipment was decontaminated prior to initiation of sampling and between sampling locations. Decontamination methods described in the Phase I SAP and the Phase II Work Plan (Landau Associates 1990 and 1991) were used. All sampling equipment used in collecting samples in this investigation was washed and scrubbed with Alconox detergent, rinsed with tap water, rinsed once with methanol, and once with hexane, and then rinsed with distilled water. Any sediment adhering to the piston coring assembly or the van Veen grab that was not in direct contact with samples was washed off with seawater prior to deployment at a new location. Oil adhering to the auger was steam cleaned and collected in labeled 55-gal drums.

Handling and Disposal of Investigation-Derived Wastes

Filled drums containing sediment residuals collected either on board the sampling vessel or in the processing area were appropriately sealed and labeled to include the sampling station(s), sample number(s), and date sealed. Filled drums containing other wastes (e.g., contaminated protective clothing, trash, and decontamination solutions) generated in this investigation were appropriately sealed and labeled. The sealed and labeled drums with investigation-derived wastes were stored onsite pending determination of the ultimate disposal method(s) based on analytical results.

REFERENCES

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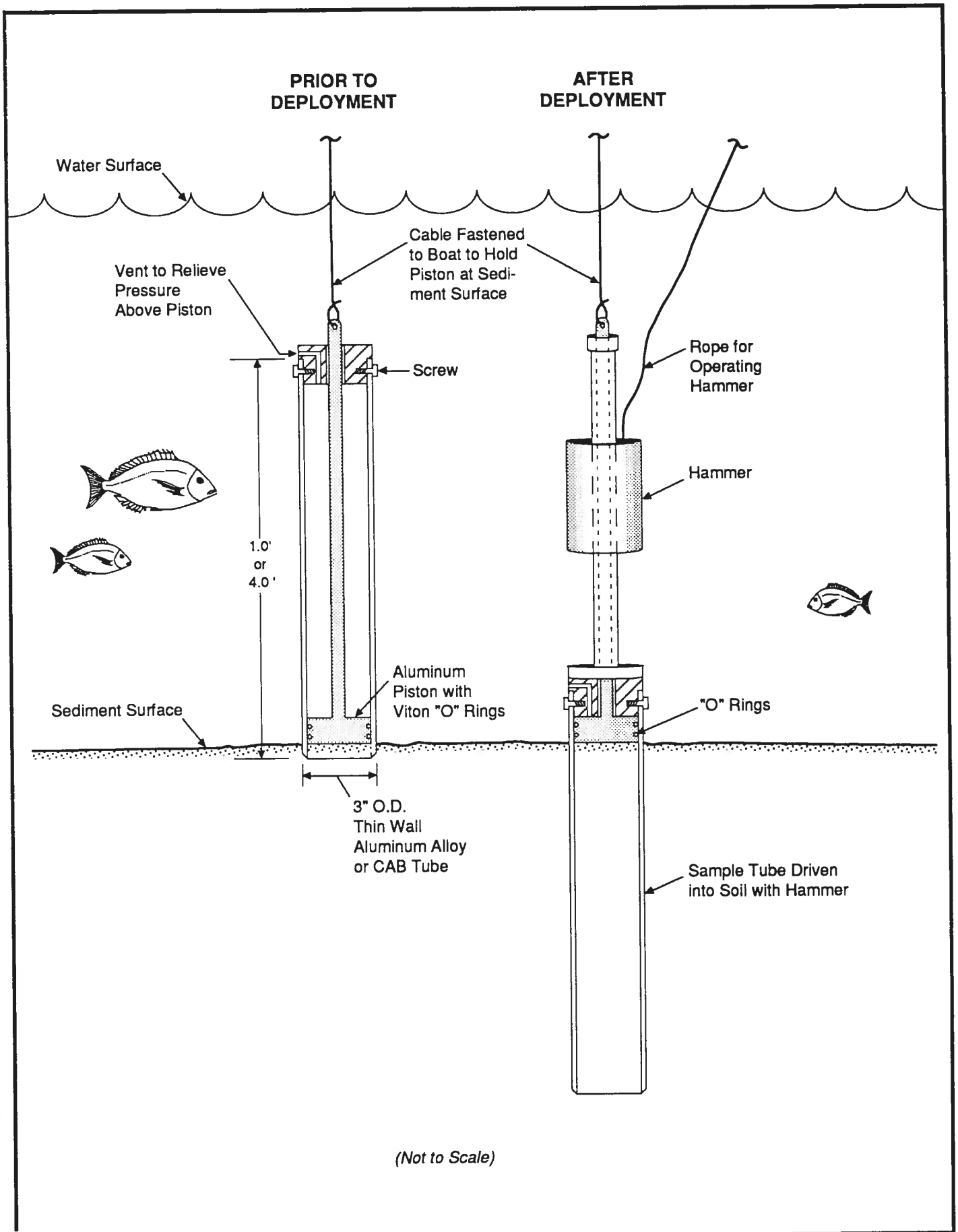

(Not to Scale)

Operation of Piston Tube Core Sampler

Figure A-1

APPENDIX B

Sediment Core Logs

TABLE B-1

SUMMARY OF CORE LOGS
SEDIMENTS OPERABLE UNIT
CASCADE POLE SITE
OLYMPIA, WASHINGTON

Core	Phase	Core Log		Type of Core			
		Table No.	Figure No.	10-cm Core	1-m Core	4-m Core	> 4-m Core
A1	I	B-2		✓			
A2	I	B-2		✓			
	II		B-17			✓	
A3	I	B-2		✓			
A4	I	B-2		✓			
B1	I	B-2	B-2		✓		
B2	I	B-2	B-3		✓		
B3	I	B-2	B-4		✓		
B4	I	B-2		✓			
B14[a]	I	B-2		✓			
B5	I	B-2	B-5		✓		
B6	II		B-18		✓		
B7	II		B-19		✓		
C1	I	B-2	B-6		✓		
	II		B-20				✓
C2	I	B-2	B-7		✓		
	II		B-21			✓	
C12[b]	I	B-2	B-8		✓		
C3	I	B-2	B-9		✓		
C4	I	B-2	B-10		✓		
C5	I	B-2		✓			
C6	II		B-22		✓		
D1	I	B-2	B-11		✓		
D11[c]	I	B-2		✓			
D2	I	B-2	B-12		✓		
D3	I	B-2	B-13		✓		
	II		B-23			✓	
D3[d]	I,II	B-2	B-24			✓	
D4	I	B-2		✓			
	II		B-25			✓	
D5	I	B-2		✓			
E1	I	B-2		✓			
	II		B-26				✓
E2	I	B-2	B-14		✓		
E3	I	B-2		✓			

TABLE B-1

SUMMARY OF CORE LOGS
SEDIMENTS OPERABLE UNIT
CASCADE POLE SITE
OLYMPIA, WASHINGTON

Core	Phase	Core Log		Type of Core			
		Table No.	Figure No.	10-cm Core	1-m Core	4-m Core	> 4-m Core
E4	I	B-2		✓			
	II		B-27			✓	
E5	I	B-2		✓			
E6	II		B-28		✓		
F1	I	B-2		✓			
	II		B-29				✓
F2	I		B-15		✓		
F3	I	B-2		✓			
F4	I	B-2		✓			
F5	I	B-2		✓			
G1	I	B-2		✓			
G2	I	B-2		✓			
G3	I	B-2	B-16		✓		
	II		B-30			✓	
G4	I	B-2		✓			
G14[e]	I	B-2		✓			
G5	I	B-2		✓			
G6	I	B-2		✓			
G7	I	B-2		✓			
H1	II		B-31			✓	
H2	II		B-32				✓
H3	II		B-33				✓
H4	II		B-34		✓		
H5	II		B-35			✓	
H6	II		B-36			✓	
H7	II		B-37		✓		
H8	II		B-38			✓	
H9	II		B-39				✓
H10	II		B-40		✓		
H11	II		B-41			✓	

(a) Replicate core of Core B4.
(b) Replicate core of Phase I Core C2.
(c) Replicate core of Core D1.
(d) Replicate core of Phase II Core D3.
(e) Replicate core of Core G4.

Phase I Core Logs

TABLE B-2
FIELD DESCRIPTIONS OF NEARSURFACE (0-10 CM) PHASE I SEDIMENT SAMPLES

Location	Replicate No.	Description	Visible Sheen and/or Odor	U.V. Light Response
CP1-M-A1a				
	1.	Black SILT with some shell fragments from 9.7 cm - 11 cm.	None	None
	2.	Black SILT with some shell fragments.	None	None
CP1-M-A2a				
	1.	Very dark gray SILT with trace shell fragments.	None	None
	2.	Black SILT with some shell fragments.	None	None
CP1-M-A3a				
	1	Black SILT with some shell fragments.	None	None
	2.	Black SILT with some shell fragments.	None	None
CP1-M-A4a				
	1	Black SILT with some shell fragments and trace of wood debris.	None	None
	2	Dark gray SILT with some shell fragments.	None	None
CP1-M-B1a				
	1.	Dark olive gray SILT with layer of shell fragments from 4 cm - 6 cm.	Spotty sheen on outer surface of core. Layer of oily sheen at 16 cm - 18 cm. No odor.	Spotted milky white and band of creamy yellow discoloration from 16 cm - 18 cm.
	2.	Dark olive gray fine sandy SILT grading into SILT at 6 cm. Some shell fragments.	None	None
	3.	Very dark gray fine sandy SILT with some small shell fragments grading into SILT at 11 cm.	None	None
CP1-M-B2a				
	1.	Very dark gray SILT with trace of fine sand and shell. Some wood debris at 14 cm.	None	None
	2.	Very dark gray SILT with trace of worms from 0 cm - 10 cm; trace of shell fragments from 10 cm - 23.5 cm; and a large piece of wood debris at 21 cm.	Visible oily specks on surface at 9 cm. No odor.	Spotted milky white color at 3 cm, 5 cm and 9 cm.
CP1-M-B3a				
	1.	Very dark gray SILT with some shell fragments from 16 cm - 22 cm.	Visible oily specks at 16 cm - 28 cm. No odor.	None
	2.	Very dark gray SILT with trace of shell fragments.	None	None
CP1-M-B4a				
	1.	Very dark gray SILT with trace of shell fragments.	None	None
	2.	Dark gray SILT with some shell fragments.	None	None
CP1-M-B14a				
	1.	Dark gray SILT with trace of small shell fragments.	None	None
	2.	Dark gray SILT.	None	None

TABLE B-2
FIELD DESCRIPTIONS OF NEARSURFACE (0-10 CM) PHASE I SEDIMENT SAMPLES

Location	Replicate No.	Description	Visible Sheen and/or Odor	U.V. Light Response
CP1-M-B5a				
	1.	Very dark olive gray SILT with trace of wood debris.	None	None
	2.	Very dark gray SILT.	None	None
CP1-M-C1a				
	1.	Very black SILT with some wood debris.	Visible oily product from 0 cm - 15 cm, and strong oily odor.	Thick milky white blotches.
	2.	Black SILT with some wood debris. Some shell fragments from 9 cm - 12 cm.	Visible oily sheen from 0 cm - 16 cm. Visible oily product from 9 cm - 12 cm. Strong oily odor.	Thick milky white blotches.
	3.	Black SILT with trace of wood chips. Some shell fragments from 8 cm - 15 cm.	Visible oily sheen and strong oily odor.	Thick milky white blotches.
CP1-M-C2a				
	1.	Very dark olive gray SILT with trace of small wood debris.	None	None
	2.	Very dark olive gray SILT with 20-30% wood debris from 0 cm - 10 cm and some shell fragments from 22 cm - 24 cm.	Visibile oily sheen and slightly oily odor.	None
	3.	Very dark olive gray SILT with trace of wood debris.	None	None
CP1-M-C12a				
	1.	Very dark gray SILT with some wood debris from 0 - 18 cm.	Very visible oily sheen from 0 cm - 18 cm. Slightly visible sheen from 18 cm - 23 cm. Strong oily odor.	
	2.	Very dark olive gray SILT with large wood debris at 10 cm. (SOFT)	Slightly visible oily sheen on outer surface at 21 cm and slight oily odor.	Milky white discoloration at 21 cm.
	3.	Very dark olive gray SILT with trace of wood debris at 21 cm.	Slightly visible oily sheen on outer surface at 21 cm and slight oily odor.	Milky white specks at 21 cm.
CP1-M-C3a				
	1.	Very dark gray fine sandy SILT with trace of shell fragments.	None	None
	2.	Very dark gray fine sandy SILT with some shell fragments.	None	None
	3.	Very dark gray fine sandy SILT with some shell fragments.	None	None
	4.	Very dark gray fine sandy SILT with trace of shell fragments.	None	None
	5	Very dark gray fine sandy SILT with some shell fragments.	None	None
CP1-M-C4a				
	1.	Very dark gray SILT with trace of small shell fragments.	None	None
	2.	Very dark gray SILT with trace of shell fragments.	None	None
CP1-M-C5a			None	None
	1.	Dark gray SILT with trace of small shell fragments and some wood debris.		
	2.	Dark gray SILT with trace of small shell fragments and some wood debris.	None	None

TABLE B-2
FIELD DESCRIPTIONS OF NEARSURFACE (0-10 CM) PHASE I SEDIMENT SAMPLES

Location	Replicate No.	Description	Visible Sheen and/or Odor	U.V. Light Response
CP1-M-D1a				
	1.	0 cm - 5 cm: Black fine to medium SAND with some gravel and shell fragments. 5 cm - 14 cm: Dark olive gray silty fine SAND with some shell fragments.	No vislible sheen and slight oily odor.	None
	2.	Dark olive gray fine SAND with trace of shell fragments and some wood debris from 0 cm - 2 cm.	None	None
	3.	0 cm - 4 cm: Very black fine SAND with some gravel and shell fragments. 5 cm - 14 cm: Dark olive gray silty fine SAND with trace of shell fragments.	No visible sheen and slight oily odor.	None
CP1-M-D11a				
	1.	0 cm - 3 cm: Very dark olive gray silty fine SAND with trace of shell and gravel. 3 cm - 15 cm: Dark gray medium SAND with some shell fragments from 13 cm - 15 cm.	No visible sheen and slight oily odor.	None
	2.	0 cm - 4 cm: Very black fine to medium SAND with some gravel and shell fragments. 4 cm - 12 cm: Very dark olive gray silty fine SAND. 12 cm - 15 cm. Dark gray medium SAND with some shell fragments.	No visible sheen and slight oily odor.	None
CP1-M-D2a				
	1.	Very dark gray fine to medium SAND with some shell fragments.	None	None
	2.	Very dark gray fine to medium SAND with some shell fragments.	None	None
CP1-M-D3a				
	1.	Very dark gray SILT with trace of shell fragments.	None	None
	2.	Very dark gray SILT with trace of worms at 10 cm.	None	None
CP1-M-D4a				
	1.	Dark gray SILT with trace of wood debris and small shell fragments and some organic material.	None	None
	2.	Dark gray SILT with trace of wood debris and organic material.	None	None
CP1-M-D5a				
	1.	Very dark gray SILT with trace of wood debris and some shell fragments from 7.6 cm - 10.6 cm.	None	None
	2.	Very dark gray SILT with trace of small shell fragments.	None	None
CP1-M-E1a				
	1.	Dark olive gray silty fine SAND with some small shell tragments.	None	None
	2.	Very dark olive gray SILT with lenses of fine sand and some organic material from 0 cm - 3 cm.	None	None

TABLE B-2
FIELD DESCRIPTIONS OF NEARSURFACE (0-10 CM) PHASE I SEDIMENT SAMPLES

Location	Replicate No.	Description	Visible Sheen and/or Odor	U.V. Light Response
CP1-M-E2a				
	1.	Very dark gray SILT with some wood debris and worms and shell fragments from 8 cm - 14 cm.	None	None
	2.	Very dark gray silty fine to medium SAND with some wood debris and shell fragments.	None	None
CP1-M-E3a				
	1.	Very dark olive gray SILT with some small shell fragments and wood debris.	No visible sheen and slight oily odor.	None
	2.	Very dark olive gray SILT with some large pieces of wood debris and trace of shell fragments.	No visible sheen and slight oily odor.	None
CP1-M-E4a				
	1	Very dark gray SILT with some lenses of fine sand and trace of small shell fragments, wood debris, and organic material.	None	None
	2.	Very dark gray SILT with trace of organic material and some shell fragments from 15 cm - 18 cm.	None	None
CP1-M-E5a				
	1.	Very dark gray SILT with trace of small shell fragments.	None	None
	2.	Very dark gray SILT with trace of small shell fragments.	None	None
CP1-M-F1a				
	1.	0 cm - 13.5 cm: Very dark gray silty fine to medium SAND with some large wood chips from 4 cm - 13.5 cm. 13.5 cm - 19.5 cm: Dark gray medium SAND with some shell fragments from 13.5 cm - 17 cm.	None	None
	2.	0 cm - 13.5 cm: Very dark gray to black silty fine SAND with large pieces of wood debris from 7 cm - 13 cm. 13 cm - 15.5 cm: Dark gray fine to medium SAND with some shell fragments.	None	None
CP1-M-F2a				
	1.	0 cm - 6.5 cm: Dark gray silty fine SAND with some shell fragments and wood debris. 6.5 cm - 11 cm: Dark gray fine to medium SAND with some shell fragments. 11 cm - 18 cm: Dark gray fine sandy SILT with large pieces of wood debris from 12 cm - 14 cm.	None	None
	2.	0 cm - 3.5 cm: Dark gray fine sandy SILT. 3.5 cm - 13 cm: Dark gray fine to medium SAND with some wood debris from 9 cm - 10 cm. 13 cm - 25 cm: Dark gray SILT with trace of shell and wood debris at 25 cm.	None	None

TABLE B-2
FIELD DESCRIPTIONS OF NEARSURFACE (0-10 CM) PHASE I SEDIMENT SAMPLES

Location	Replicate No.	Description	Visible Sheen and/or Odor	U.V. Light Response
CP1-M-F3a				
	1.	0 cm - 2cm: Olive black SILT. 2 cm - 10 cm: Black SILT with some organic material and wood chips, and trace of shells. 10 cm - 19 cm: Black SILT with some shell fragments, wood debris and organic material.	None	None
	2.	Black SILT with some organic material, wood debris and trace shell fragments.	None	None
CP1-M-F4a				
	1.	Dark gray fine to medium SAND with some small shell fragments and trace of wood debris and worms. Some large pieces of wood debris at 17 cm.	None	None
	2.	Dark gray fine to medium SAND with some shell fragments and wood debris.	None	None
CP1-M-F5a				
	1.	Very dark gray SILT with some shell fragments from 11 cm - 14 cm.	None	None
	2.	Very dark gray SILT with some shell fragments and some wood and some organic material.	None	None
CP1-M-G1a				
	1.	Very dark gray SILT.	None	None
	2.	Very dark gray SILT.	None	None
CP1-M-G2a				
	1.	Olive black SILT with trace of shell fragments.	None	None
	2.	0 cm - 10 cm: Black SILT 10 cm - 15 cm: Black silty GRAVEL with some shell fragments.	None	None
CP1-M-G3a				
	1.	0 cm - 10 cm: Very dark gray SILT with some organic material and trace of wood debris and shell fragments. 10 cm - 18 cm: Very dark gray fine sandy SILT with some wood debris and organic material.	Slightly visibile oily sheen at 10 cm and slight oily odor. Very visible oily sheen (strongest from 11 cm - 15 cm) and strong oily odor.	Spotted milky white discoloration.
	2.	0 cm - 10 cm: Very dark gray SILT with trace of shell fragments, wood debris and organic material. 10 cm - 15 cm: Very dark gray SILT with some wood debris and trace of organic material and shell fragments.	Slightly visible oily sheen at 10 cm and slight oily odor. Visible oily sheen and oily odor.	Spotted milky white discoloration. Spotted milky white discoloration.
CP1-M-G4a				
	1.	Dark olive gray SILT with trace of shell fragments.	None	None
	2.	Dark gray SILT with small wood debris at surface and some large shell fragments at 8 cm.	None	None

TABLE B-2
FIELD DESCRIPTIONS OF NEARSURFACE (0-10 CM) PHASE I SEDIMENT SAMPLES

Location	Replicate No.	Description	Visible Sheen and/or Odor	U.V. Light Response
CP1-M-G14a				
	1.	Very dark gray SILT with trace of shell fragments at 21 cm.	None	None
	2.	Very dark gray SILT with some wood debris and shell fragments from 17 cm - 20 cm.	None	None
CP1-M-G5a				
	1.	0 cm - 5 cm: Very dark olive gray fine to medium SAND with trace of shell fragments and some wood debris. 5 cm - 20 cm: Very dark olive gray SILT with trace of shell fragments and some wood debris.	None	None
	2.	Very dark gray fine sandy SILT with trace of small shell fragments grading into very dark gray SILT with some wood debris.	None	None
CP1-M-G6a				
	1.	Dark gray silty fine SAND with some large pieces of wood debris and trace of gravel and some large shell fragments from 8 cm - 11 cm.	No	None
	2.	Dark gray silty fine SAND with some wood debris and trace of shell fragments.	No	None
CP1-M-G7a				
	1.	0 cm - 1 cm: Olive gray silty fine SAND. 1 cm - 9 cm: Very dark gray to black fine sandy SILT with some wood debris. 9 cm - 13 cm: Black SILT with charcoal-like sediments. 13 cm - 21 cm: Dark gray fine to medium SAND with some wood debris and trace of shell fragments.	No	None
	2.	0 cm - 1 cm: Olive gray silty fine SAND. 1 cm - 19.5 cm: Black silty fine SAND with some wood debris.	No	None

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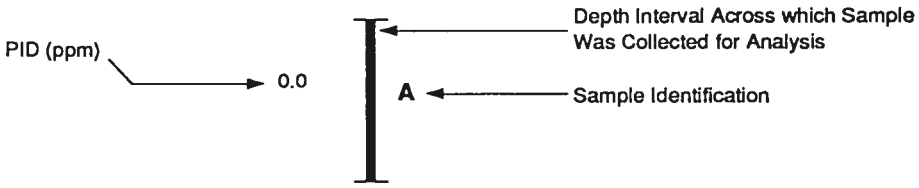
KEY



Note: Depths on the core logs are recorded in the metric system (units of centimeters).
The following formula converts depth in centimeters to depth in feet: 1 foot = 30.5 cm.

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL[1]	TYPICAL DESCRIPTIONS[2][3]
COARSE-GRAINED SOIL (More than 50% of material is larger than No.200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No.4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/silt mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No.4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No.200 sieve size)	SILT AND CLAY (Liquid Limit less than 50)			ML	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid Limit greater than 50)			MH	Inorganic silt; micaceous or diatomaceous fine sand or silty soil
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
HIGHLY ORGANIC SOIL				PT	Peat; humus; swamp soil with high organic content

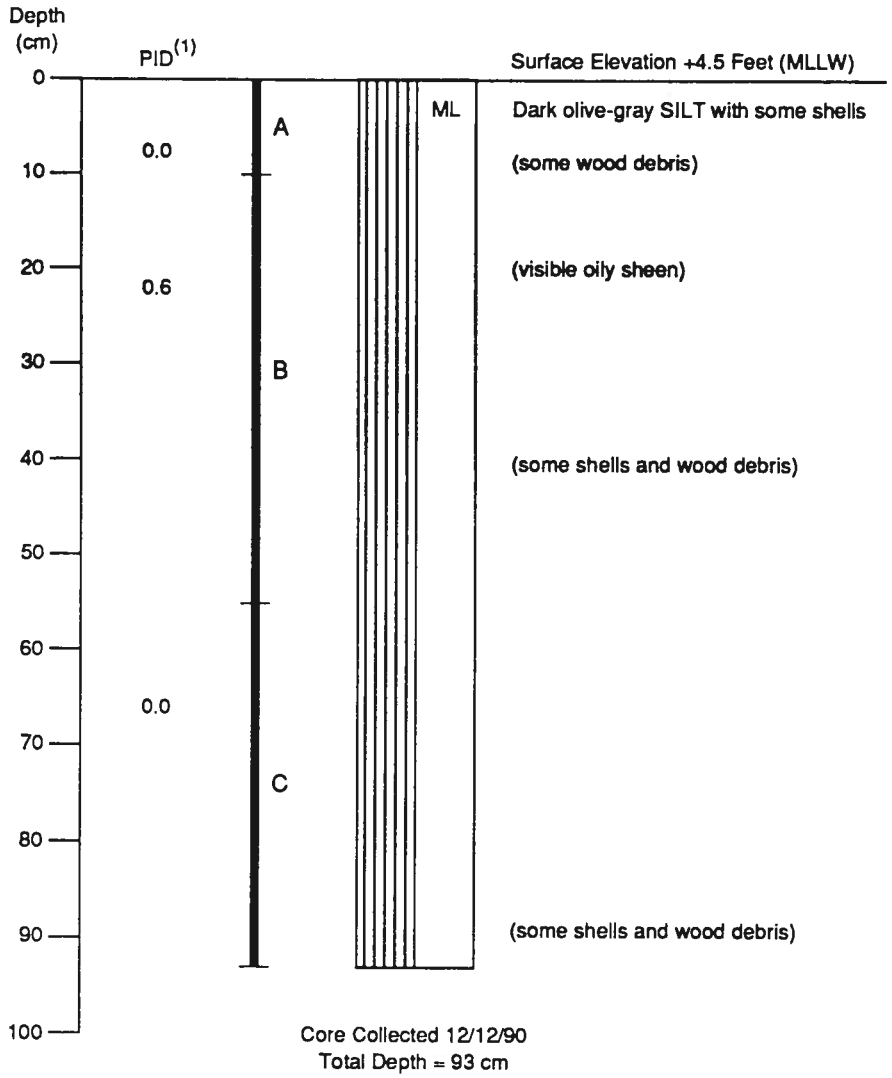
Notes: 1. USCS letter symbols correspond to the Unified Soil Classification System. Dual letter symbols (e.g., SM-SP) for a sand or gravel indicate a soil with an estimated 5-15% fines. Multiple letter symbols (e.g., ML/CL) indicate borderline or multiple soil classifications. Only the first letter symbol's respective pattern is shown on logs.

2. Soil descriptions shown on logs are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, as outlined in ASTM D 2488.

3. Soil description terminology (which is based on visual estimates of the percentages of each soil type) is as follows:
   Primary Soil Type(s) - e.g., "GRAVEL," "SAND," "SILT," "CLAY," etc.
   Secondary Soil Type(s) (>15%) - e.g., "gravelly," "sandy," "clayey," etc.
   Modifier(s) (>5% and ≤15%) - e.g., "with gravel," "with sand," "with clay," etc.
   Minor Component(s) (≤5%) - e.g., either "trace gravel," "trace sand," "trace clay," etc., or no mention of minor soil type

Key and Soil Classification System for Phase I and Phase II Sediment Core Logs | Figure B-1

Core B1

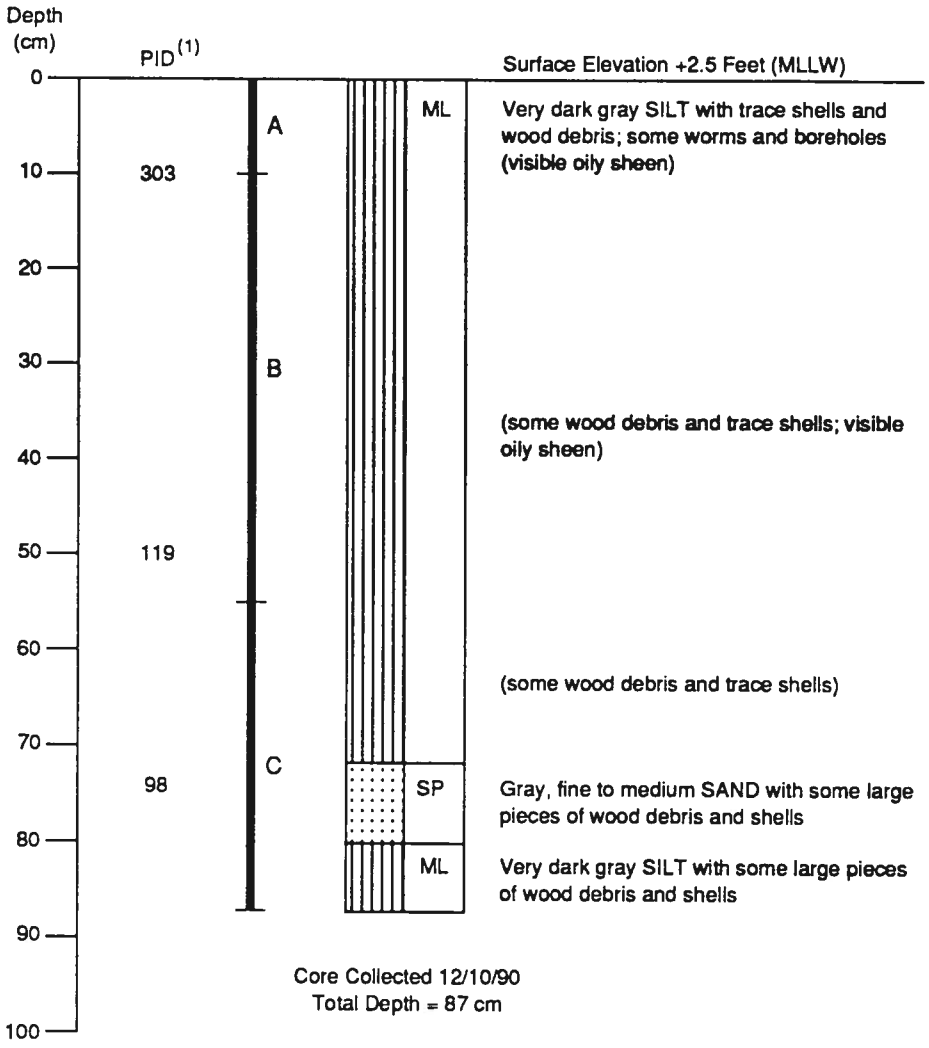


Core Collected 12/12/90
Total Depth = 93 cm

Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Visible oily sheen at 21 cm and 28 cm.
3. Yellow discoloration at 21 cm and 28 cm under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Sediment Core B1 | Figure B-2

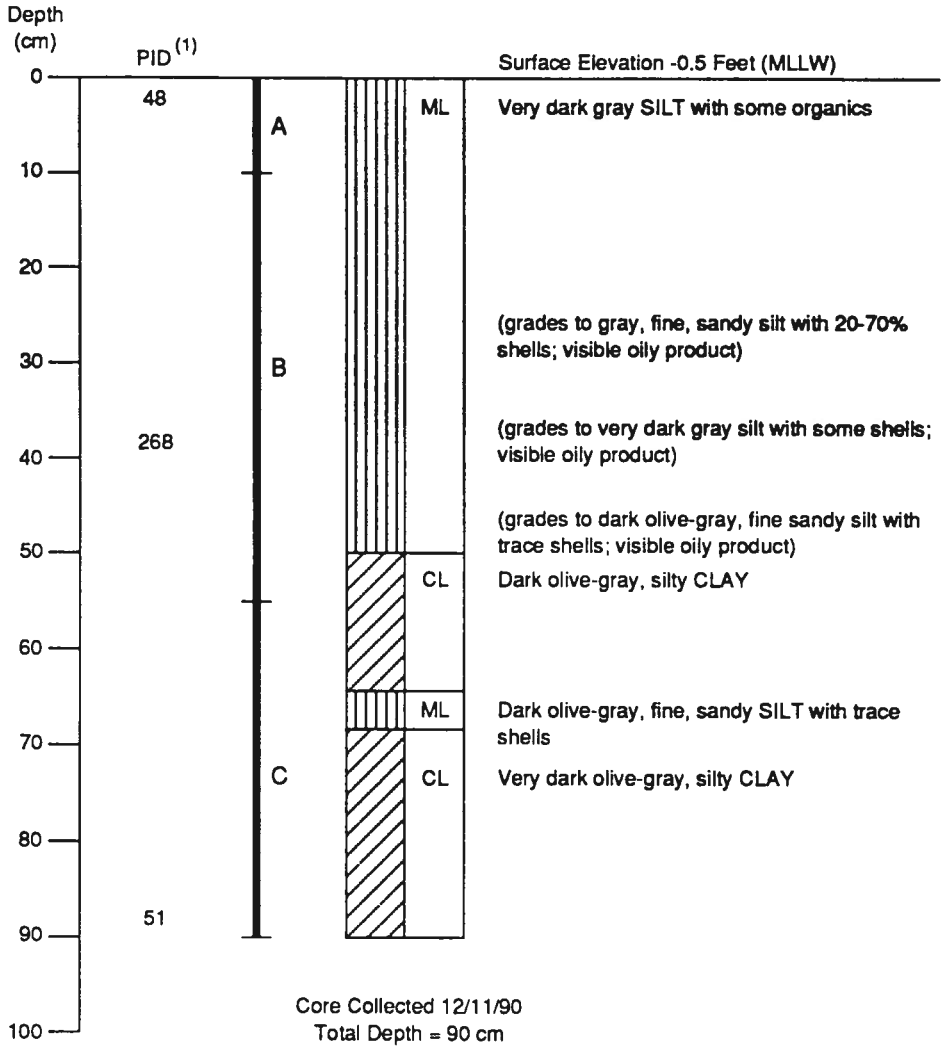
Core B2



Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Visible oily sheen from 0 cm to 35 cm.
3. Oily sheen appears creamy yellow color under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Sediment Core B2 | Figure B-3

Core B3

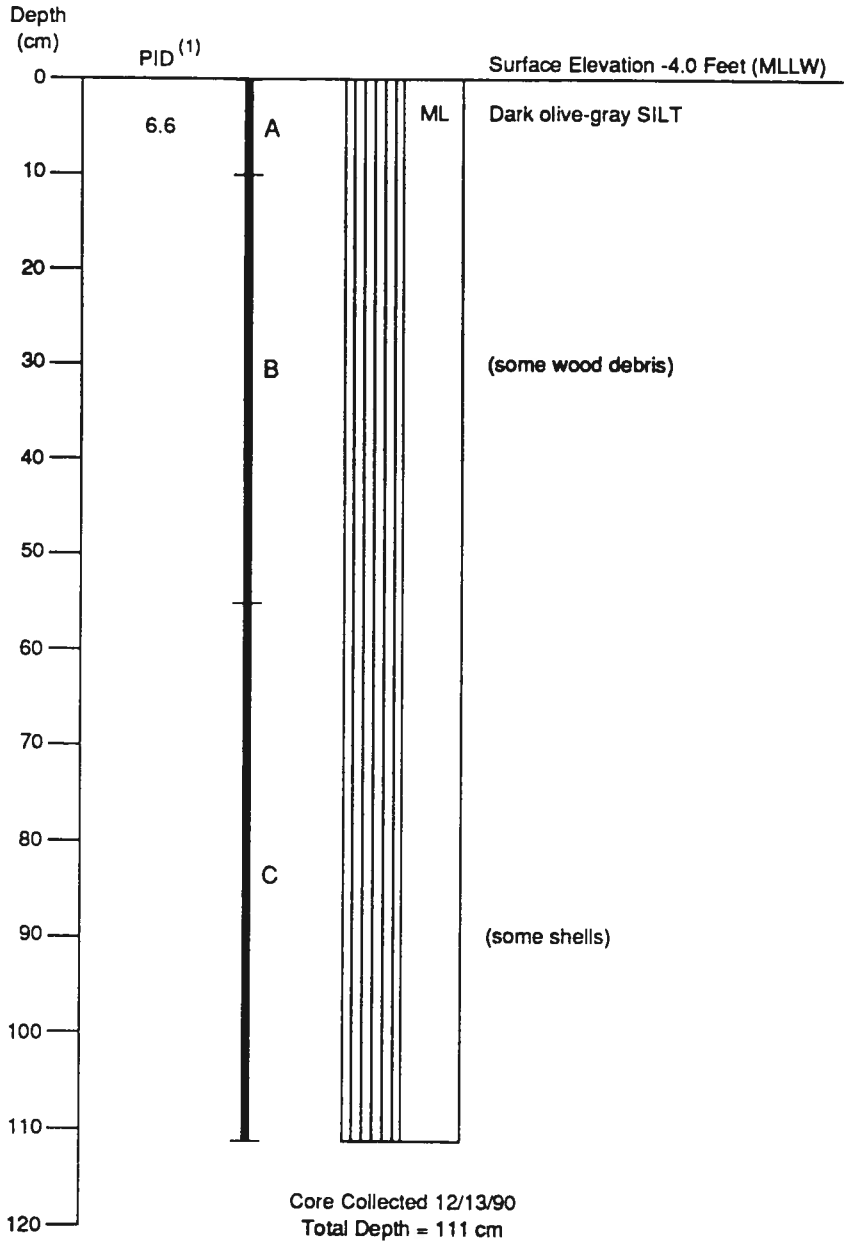


Core Collected 12/11/90
Total Depth = 90 cm

Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Visible product from 24 cm to 51 cm.
3. No ultraviolet light test done.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Sediment Core B3 | Figure B-4

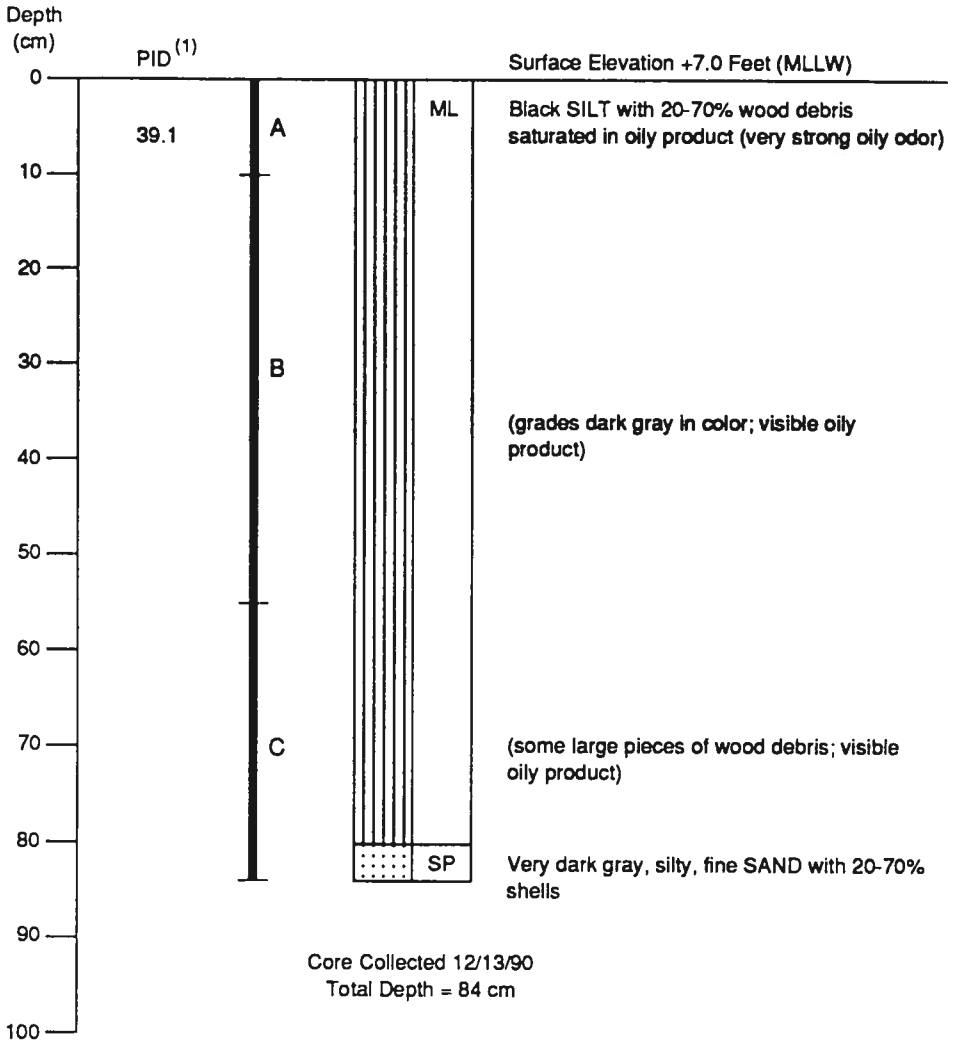
Core B5



Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. No visible sheen; no odor.
3. No response under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Sediment Core B5 | Figure B-5

Core C1



Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Visible product from 0 cm to 82 cm.
3. No ultraviolet light test done.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

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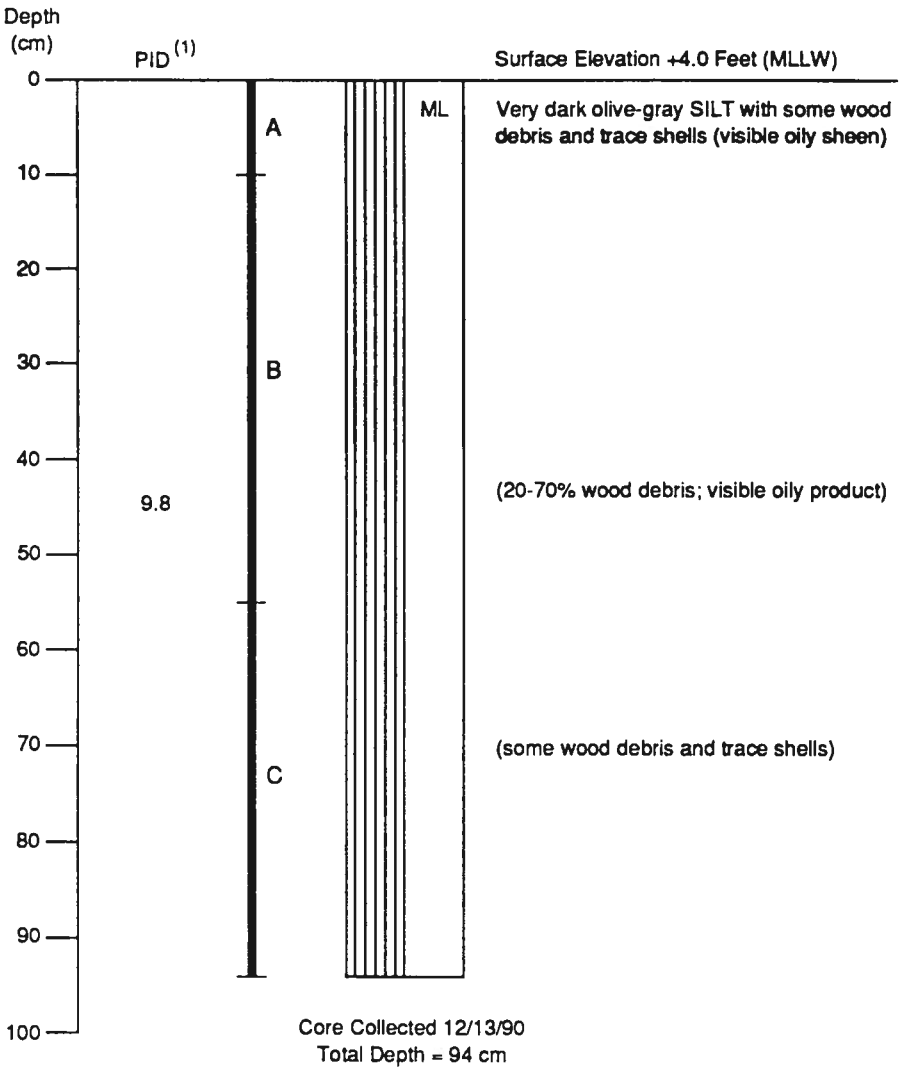
Log of Sediment Core C1 | Figure B-6

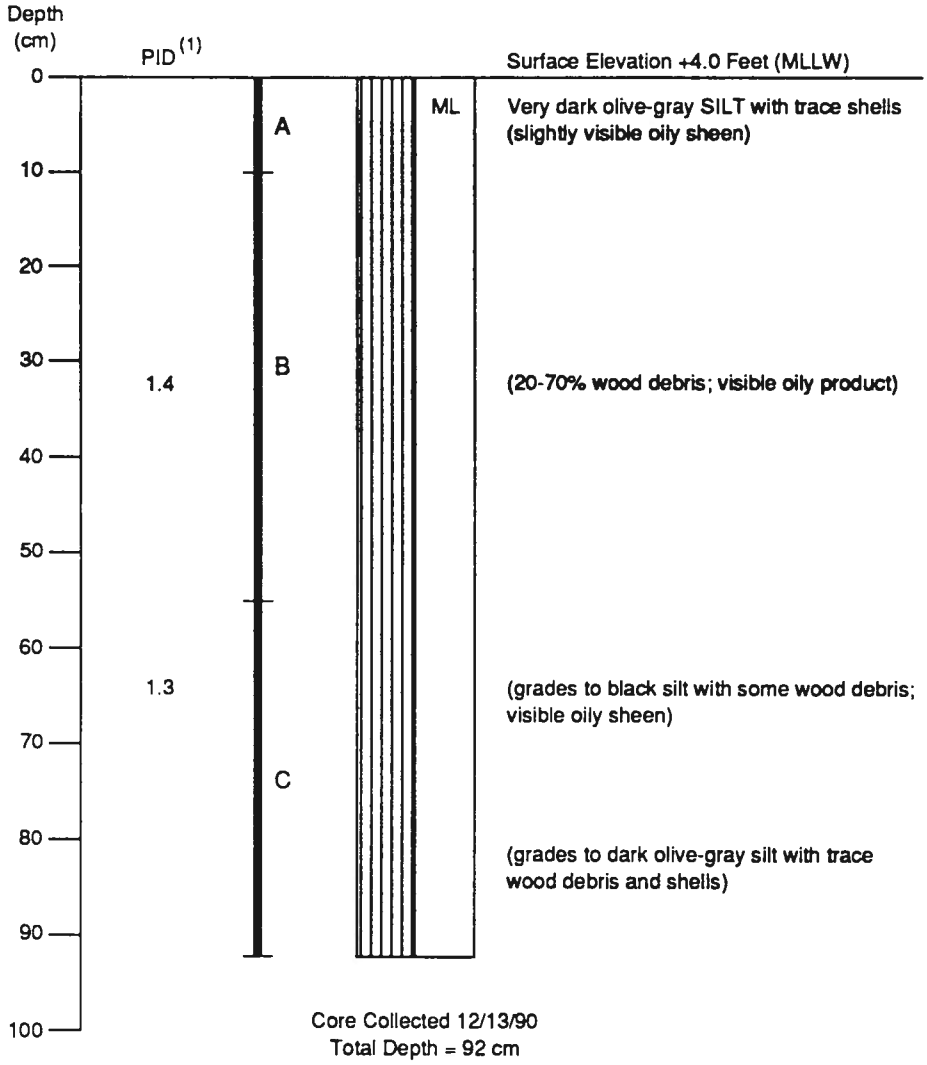
Core C2



Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Visible sheen from 0 cm to 40 cm; visible oily product from 40 cm to 50 cm.
3. Some milky white discoloration from 21 cm to 32 cm and 40 cm to 50 cm under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Sediment Core C2 | Figure B-7

Core C12



Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Visible oily sheen from 13 cm to 21 cm and 60 cm to 68 cm; visible oily product from 21 cm to 60 cm.
3. Bands of creamy yellow discoloration from 21 cm to 60 cm under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

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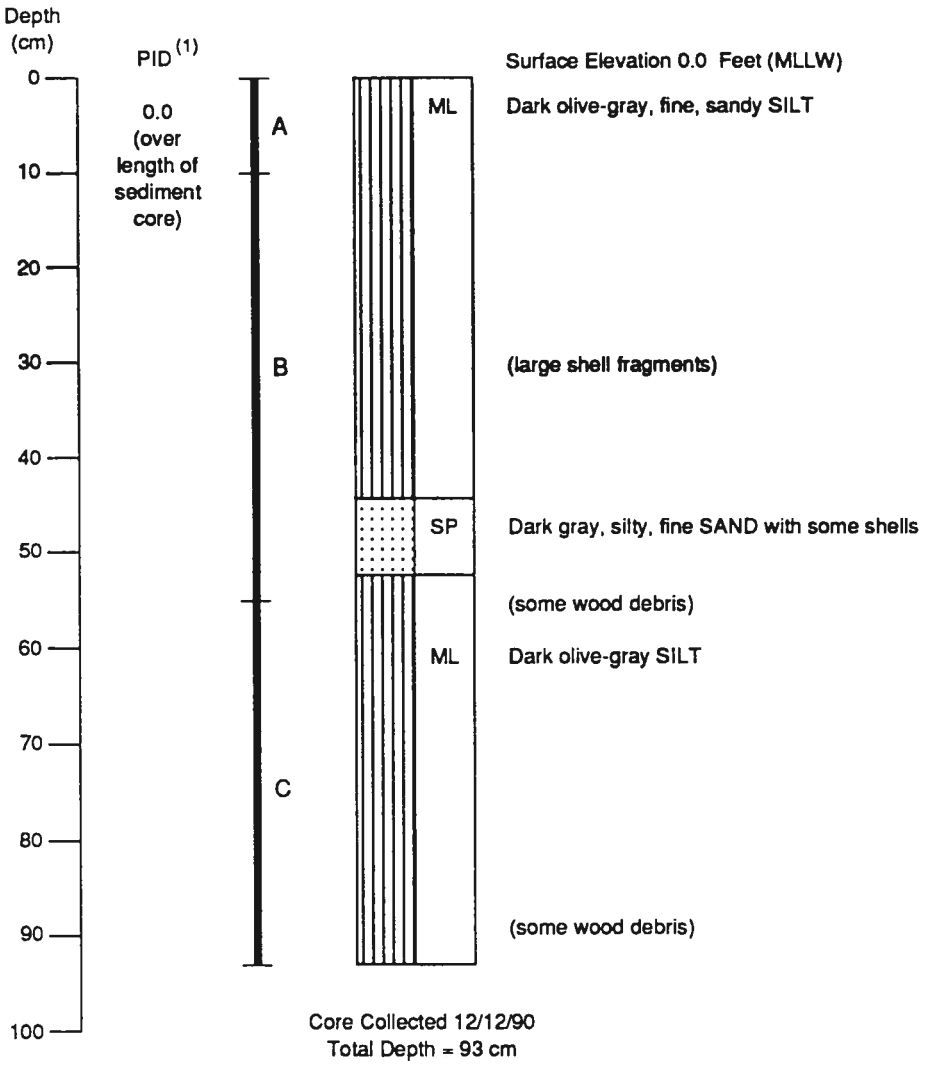
Log of Sediment Core C12 | Figure B-8

Core C3



Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. No visible sheen; no odor.
3. No response under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

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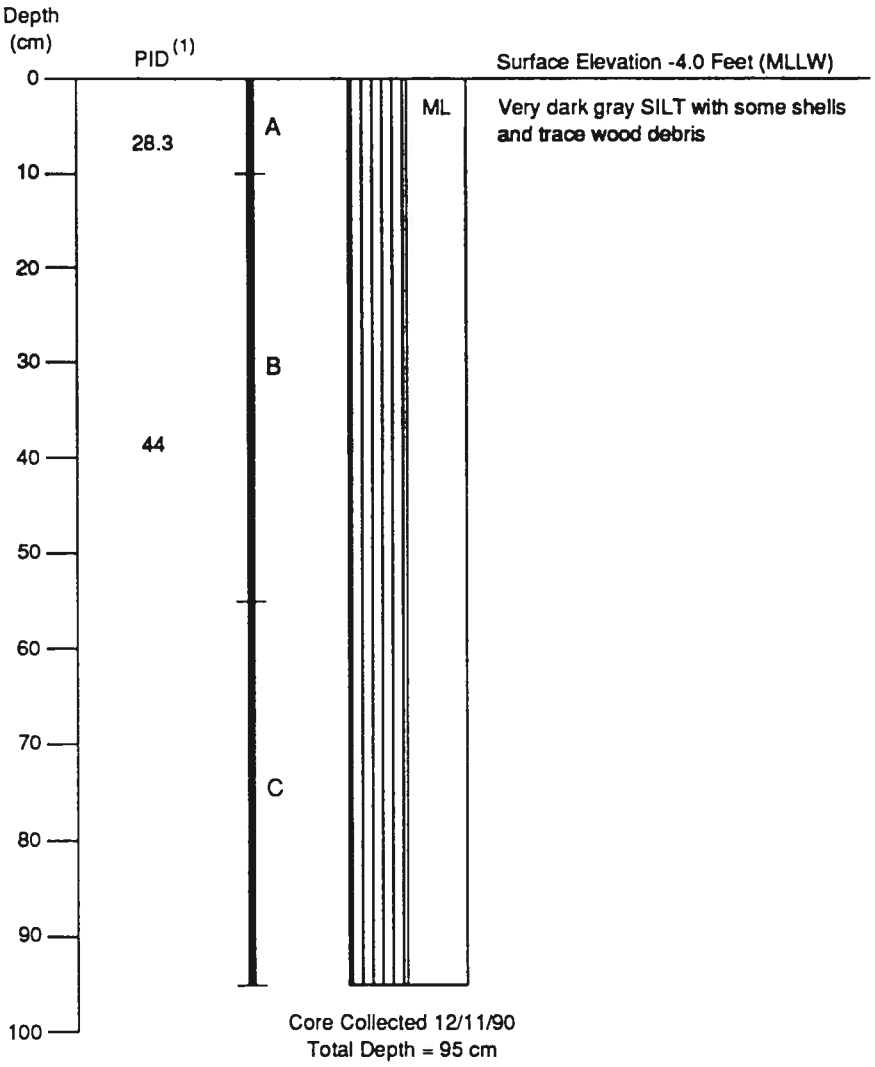
Log of Sediment Core C3 | Figure B-9

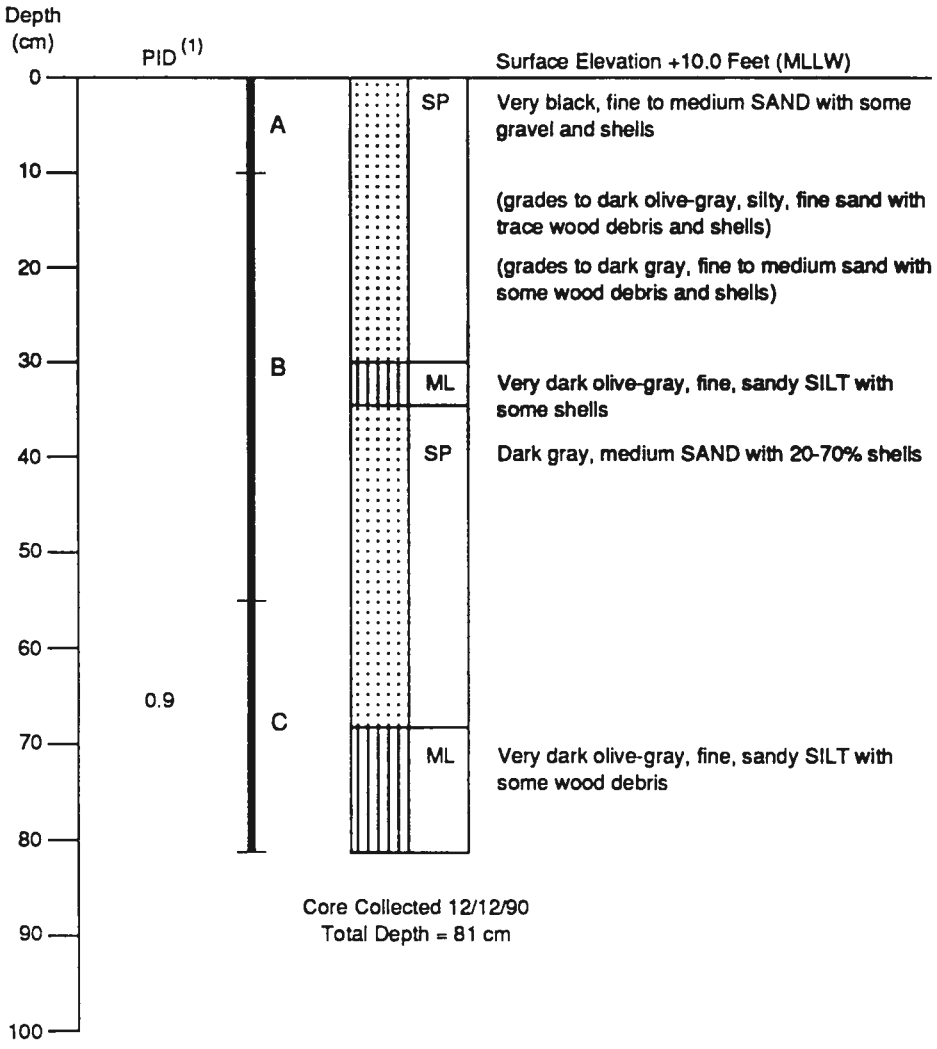
Core C4



Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. No visible sheen; no odor.
3. No response under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Sediment Core C4 | Figure B-10

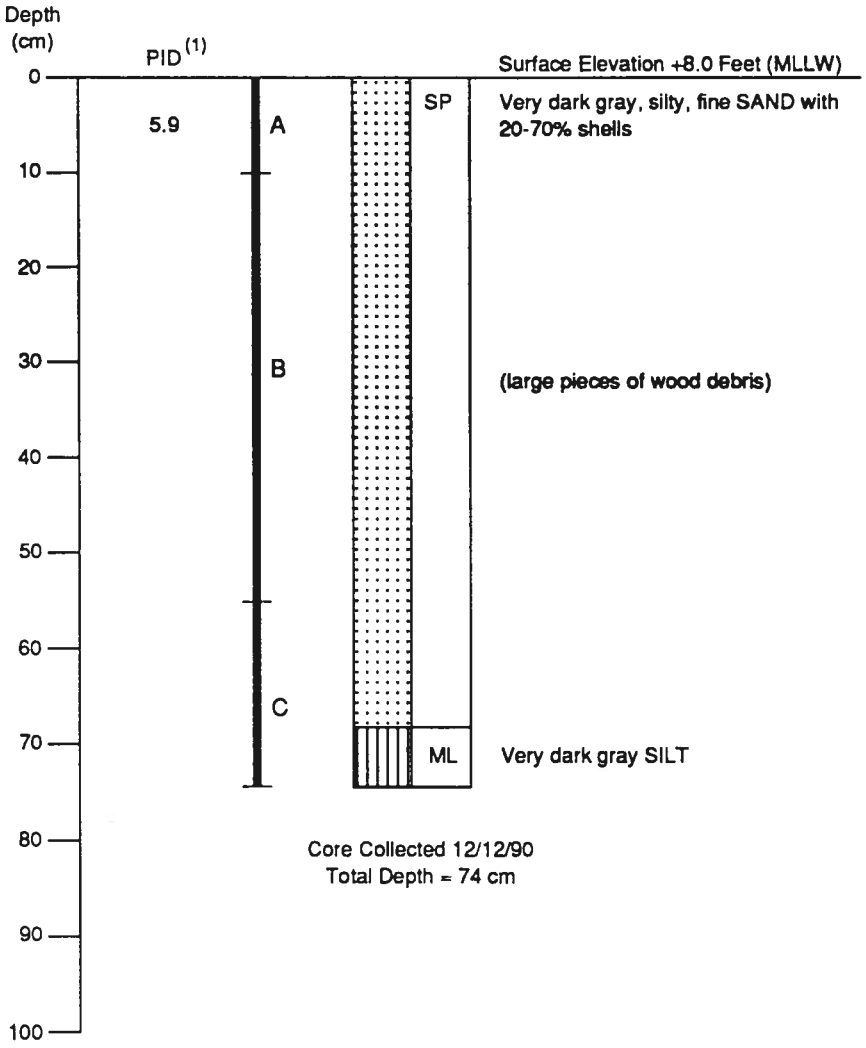
Core D1



Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. No visible sheen; slight oily odor.
3. No response under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Sediment Core D1 | Figure B-11

Core D2

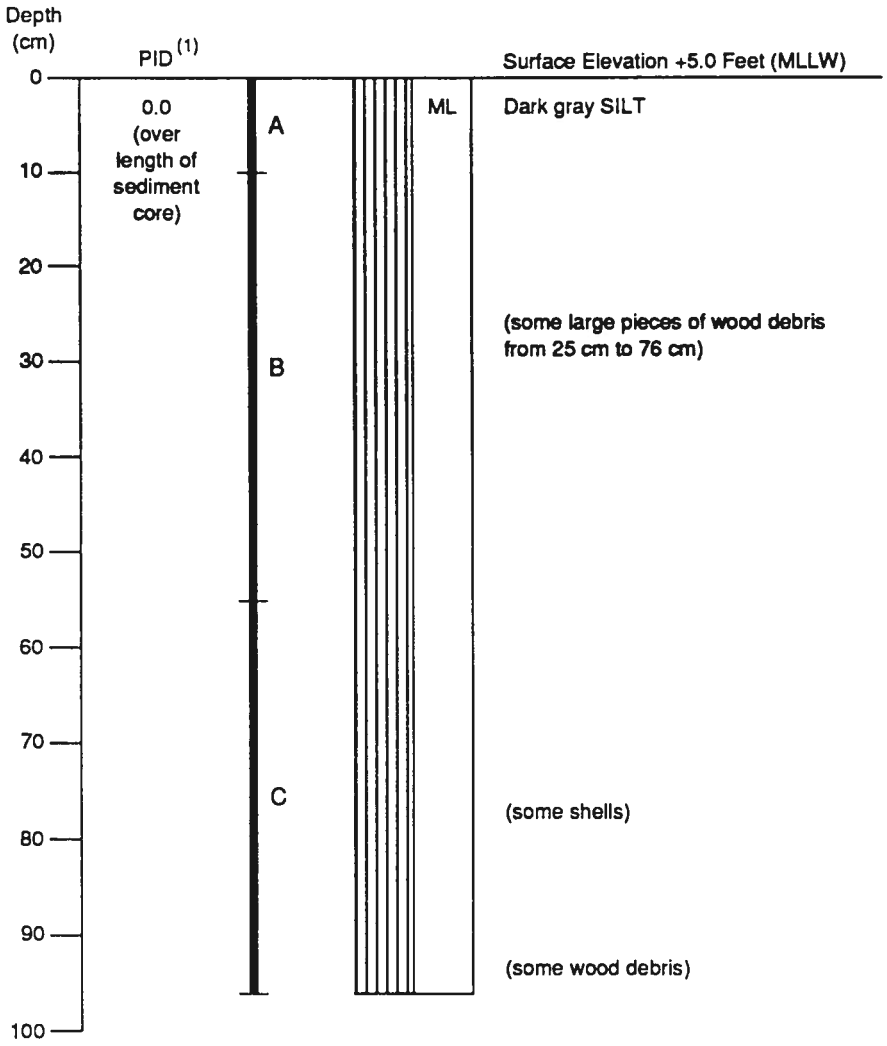


Core Collected 12/12/90
Total Depth = 74 cm

Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. No visible sheen; no odor.
3. No response under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Sediment Core D2 | Figure B-12

Core D3



Core Collected 12/11/90
Total Depth = 96 cm

Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. No visible sheen; no odor.
3. No response under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

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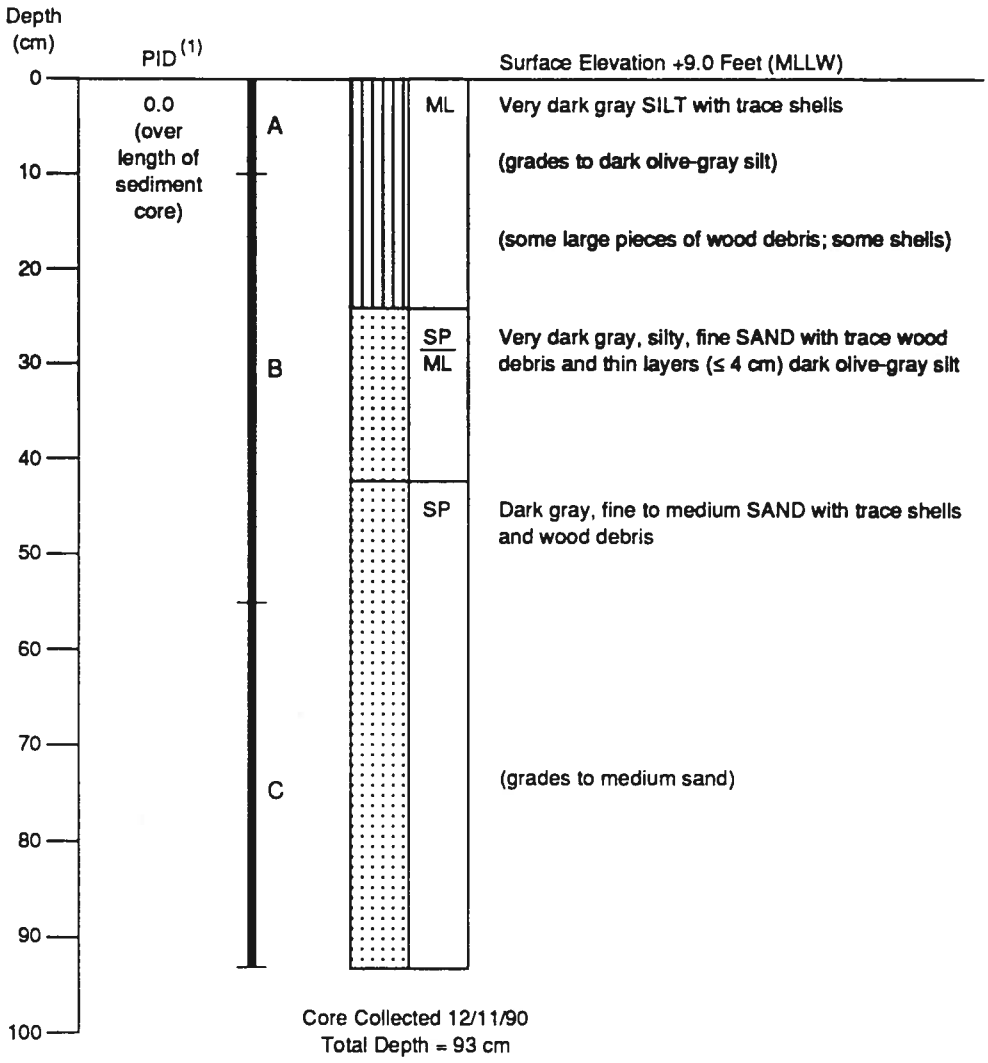
Log of Sediment Core D3 | Figure B-13

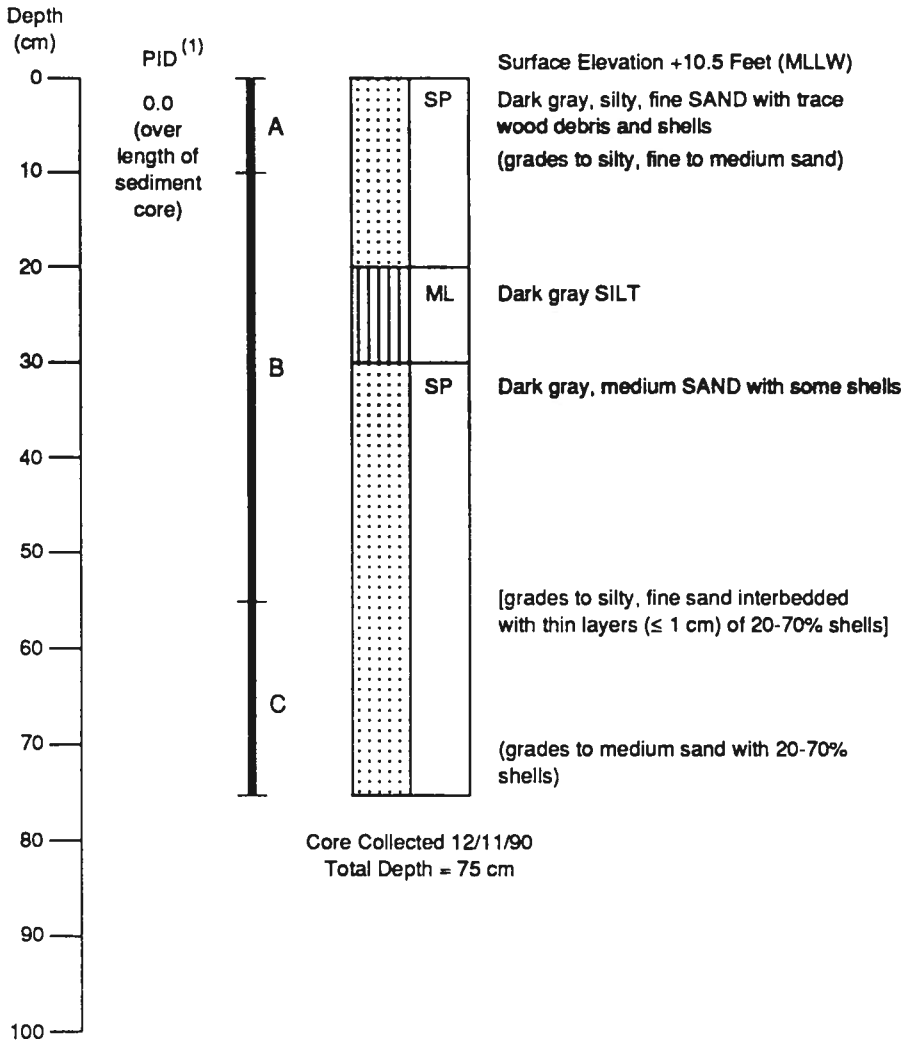
Core E2



Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. No visible sheen; no odor.
3. No response under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

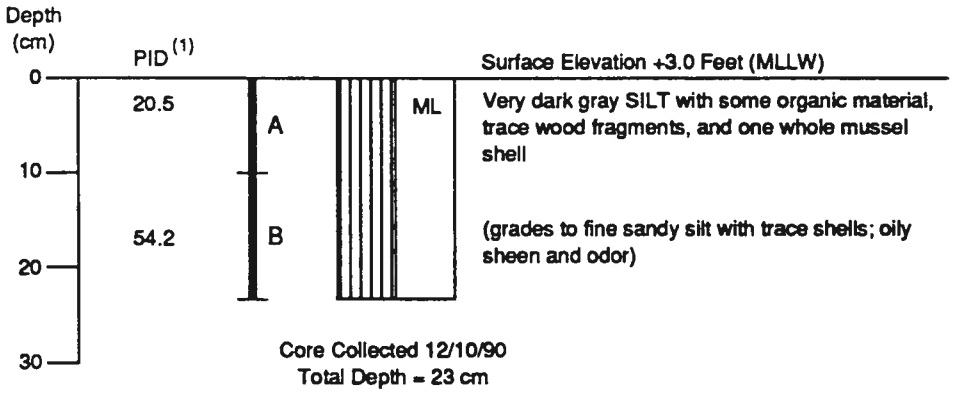
Log of Sediment Core E2 | Figure B-14

Core F2



Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. No visible sheen; no odor.
3. No response under ultraviolet light.
4. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Core G3

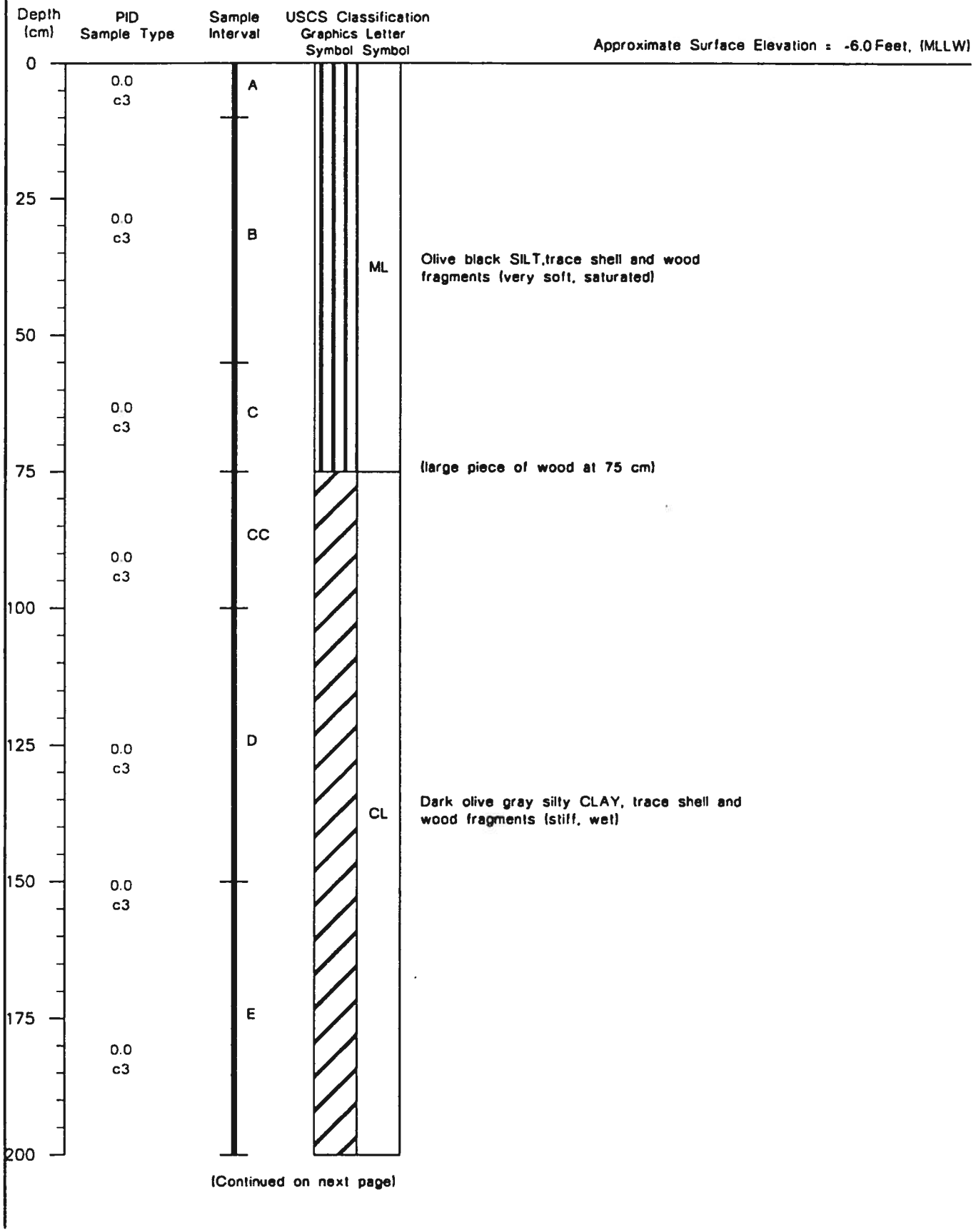


Notes:
1. PID = Maximum photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Visible oily sheen and strong odor from 10 cm to 21 cm.
3. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Sediment Core G3 | Figure B-16

Phase II Core Logs

Core A2



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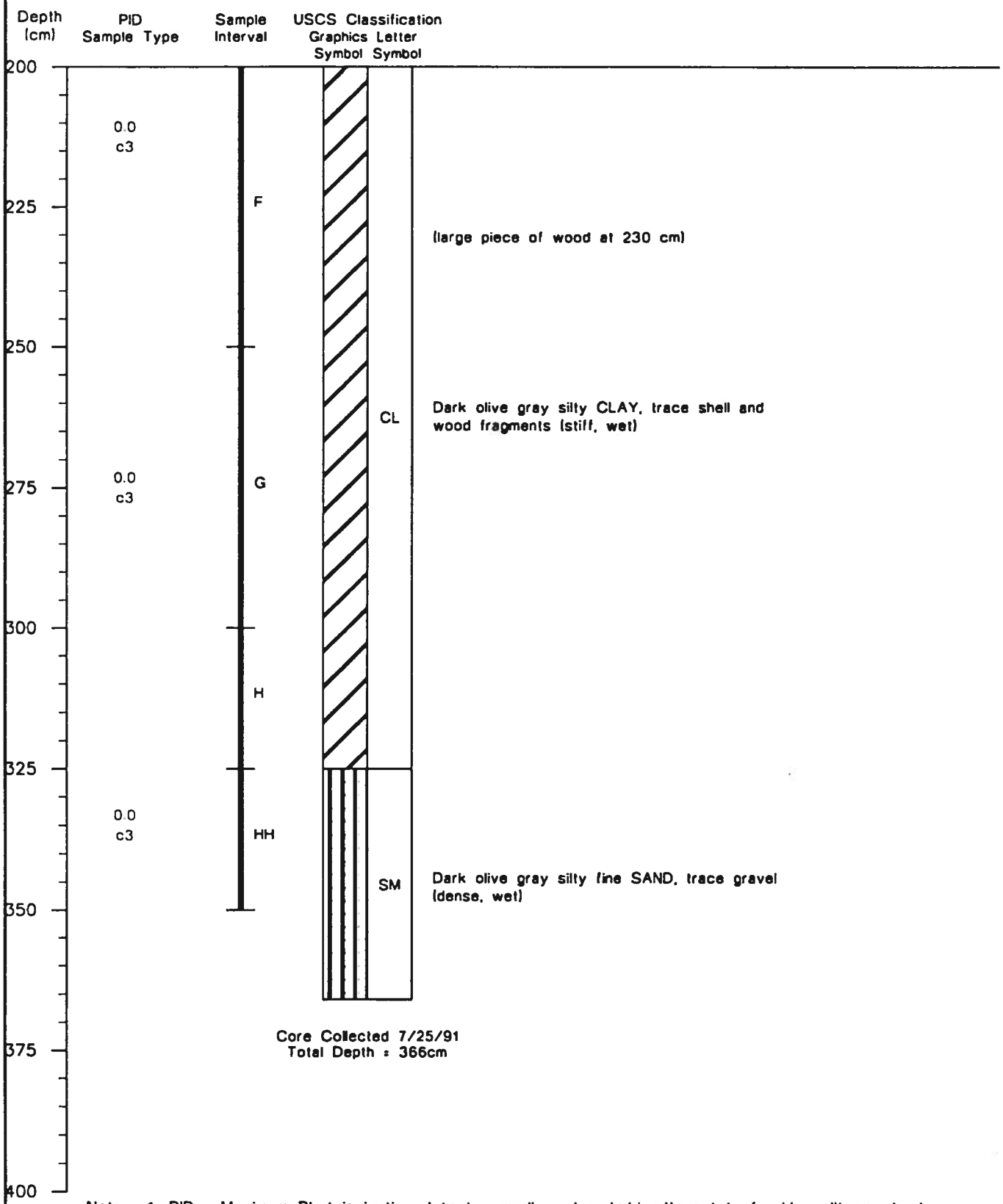
Log of Sediment Core A2

Figure B-17
(1 of 2)

Core A2
(continued)



Notes: 1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor from 0-120cm; no visible sheen.
4. No response under Ultraviolet light.

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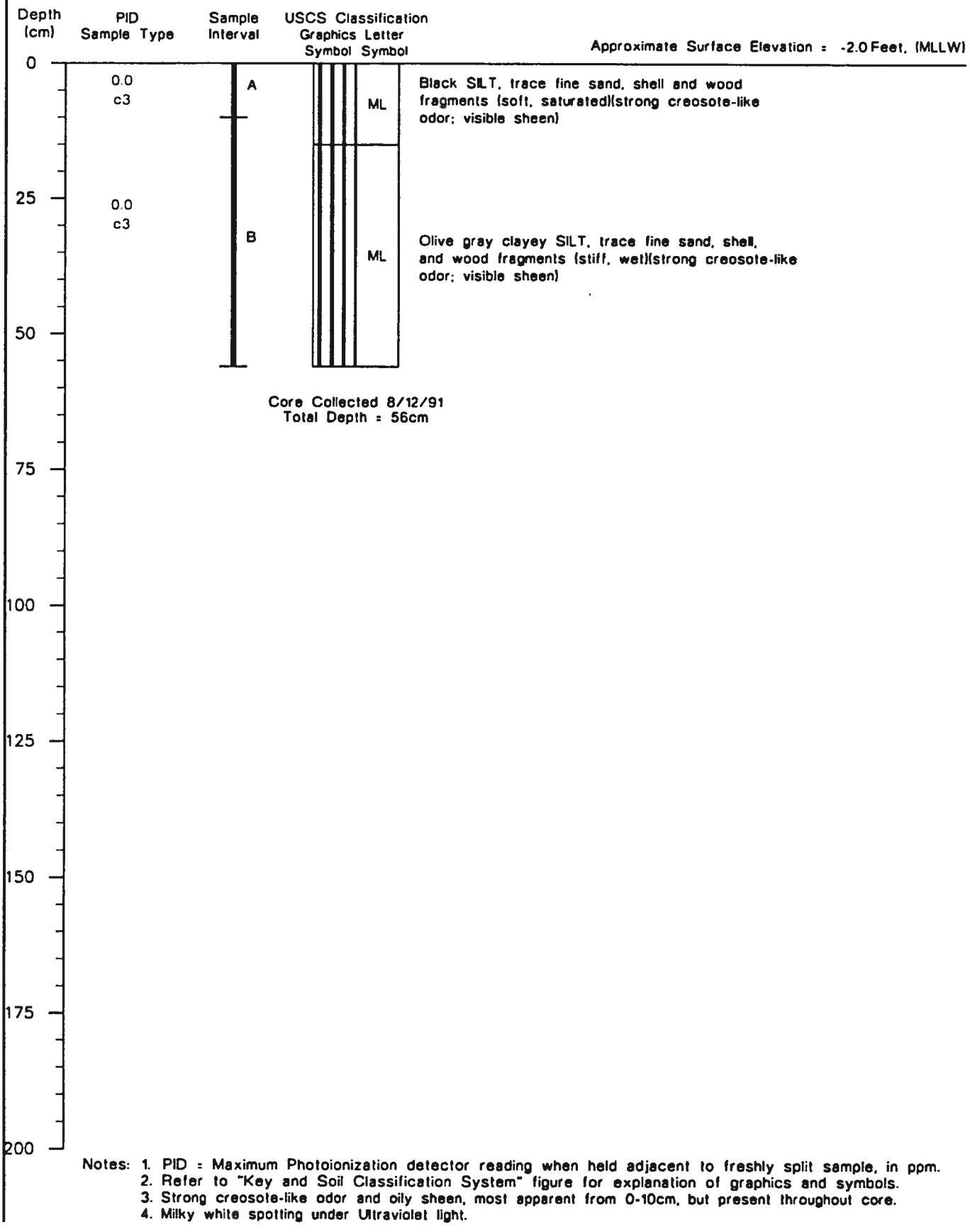
Log of Sediment Core A2

Figure B-17
(2 of 2)

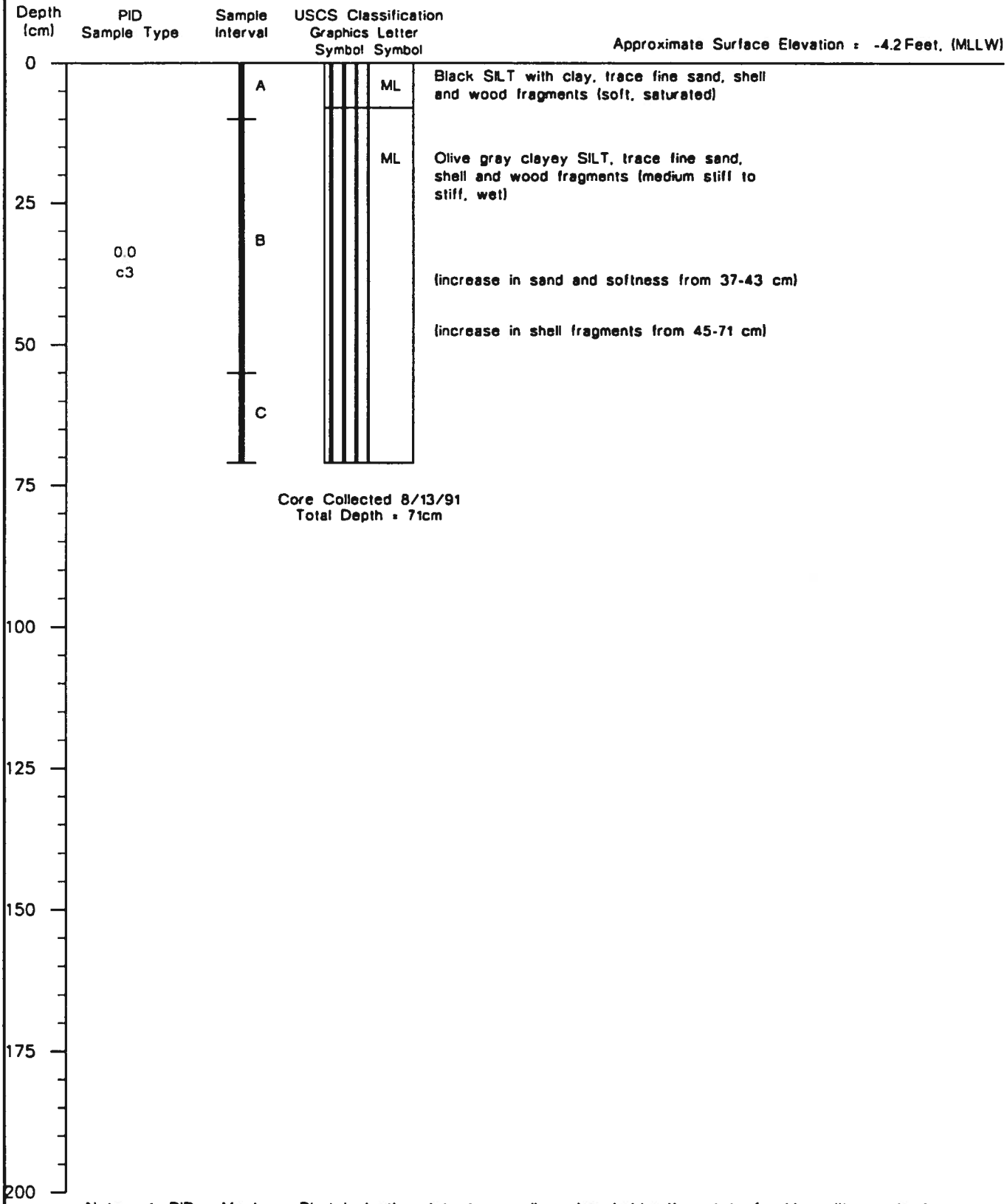
Core B6



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Strong creosote-like odor and oily sheen, most apparent from 0-10cm, but present throughout core.
4. Milky white spotting under Ultraviolet light.

	Log of Sediment Core B6	Figure B-18

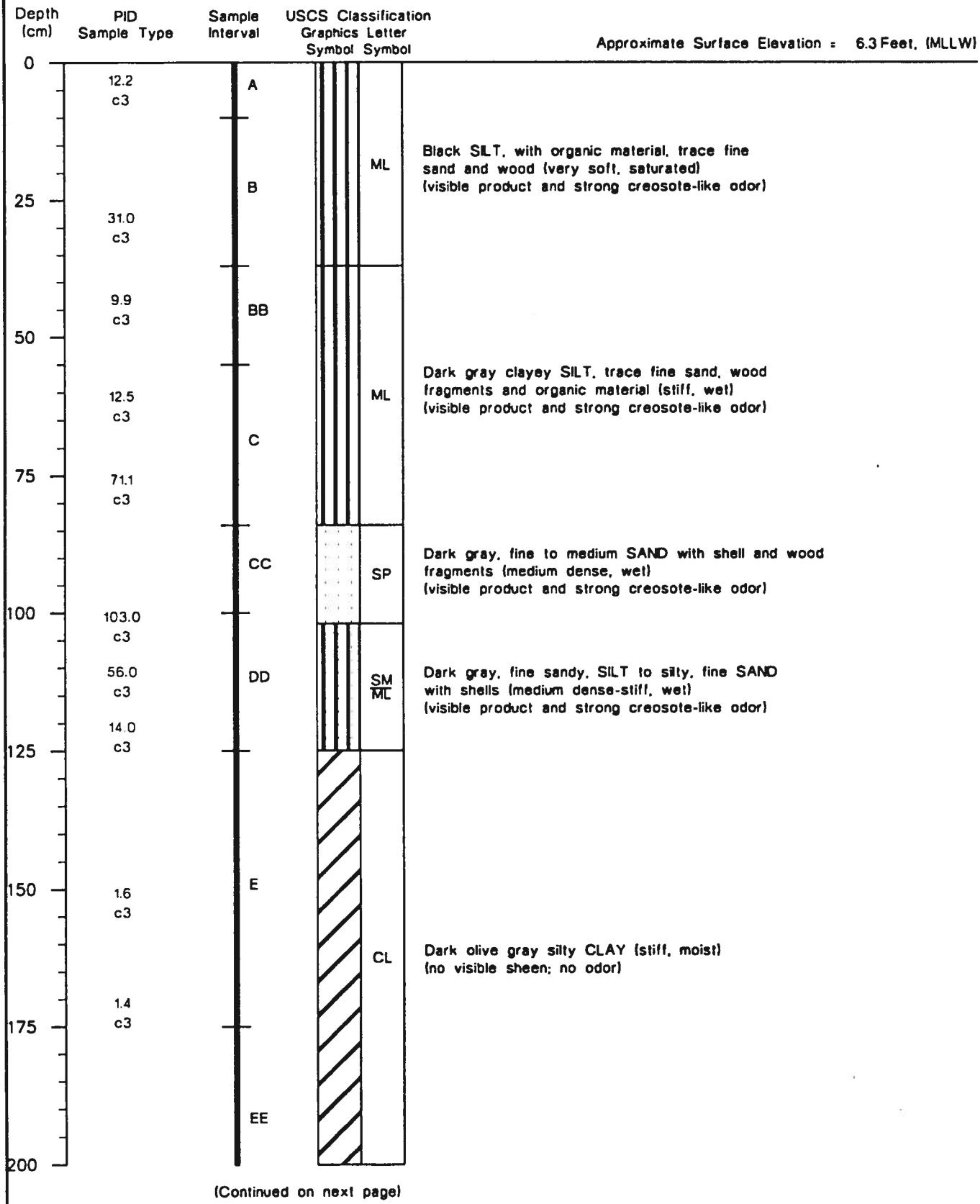
Core B7



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; no visible sheen.
4. No response under Ultraviolet light.

Log of Sediment Core B7 | Figure B-19

Core C1



(Continued on next page)

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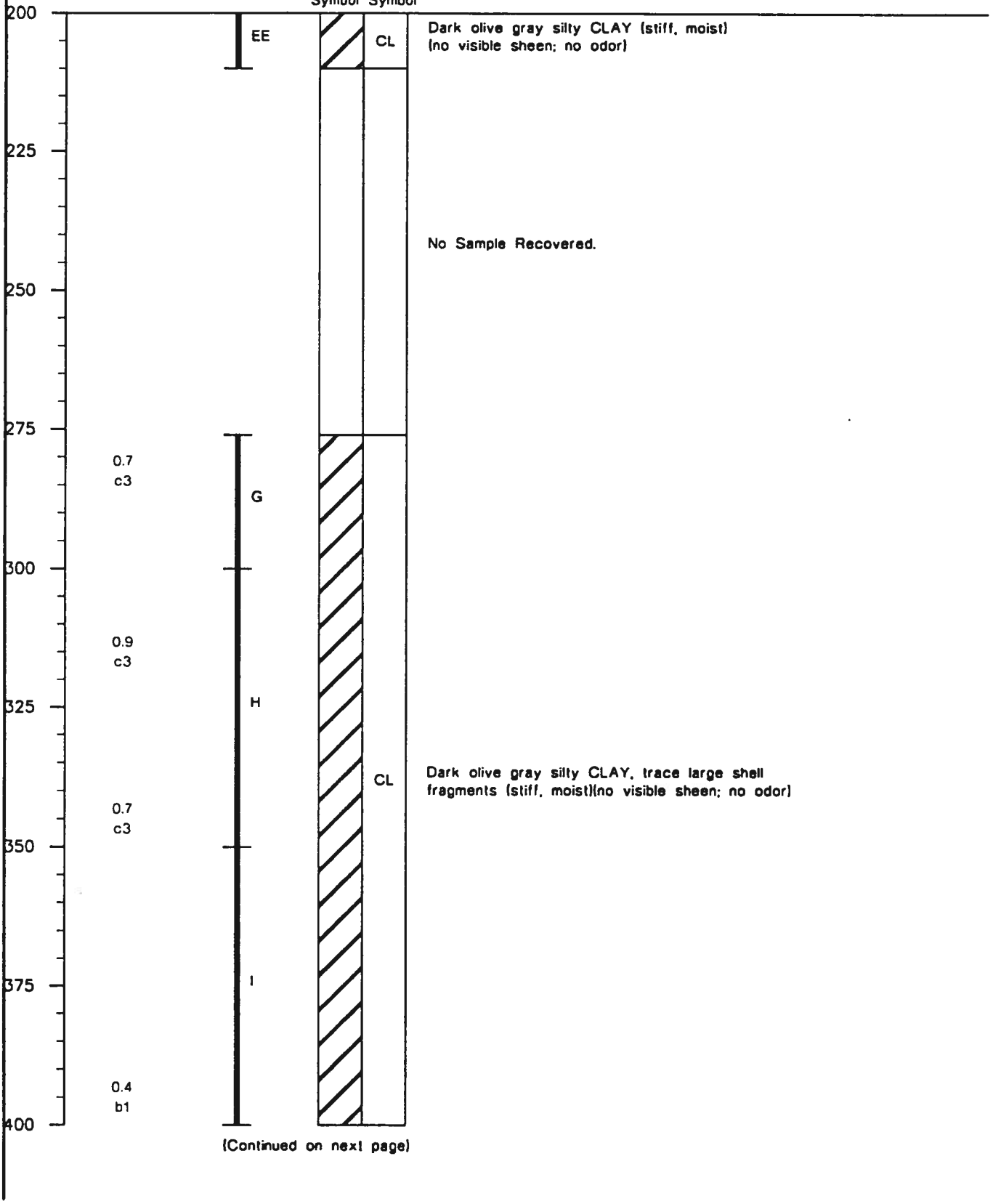
Log of Sediment Core C1

Figure B-20 (1 of 5)

Core C1
(continued)



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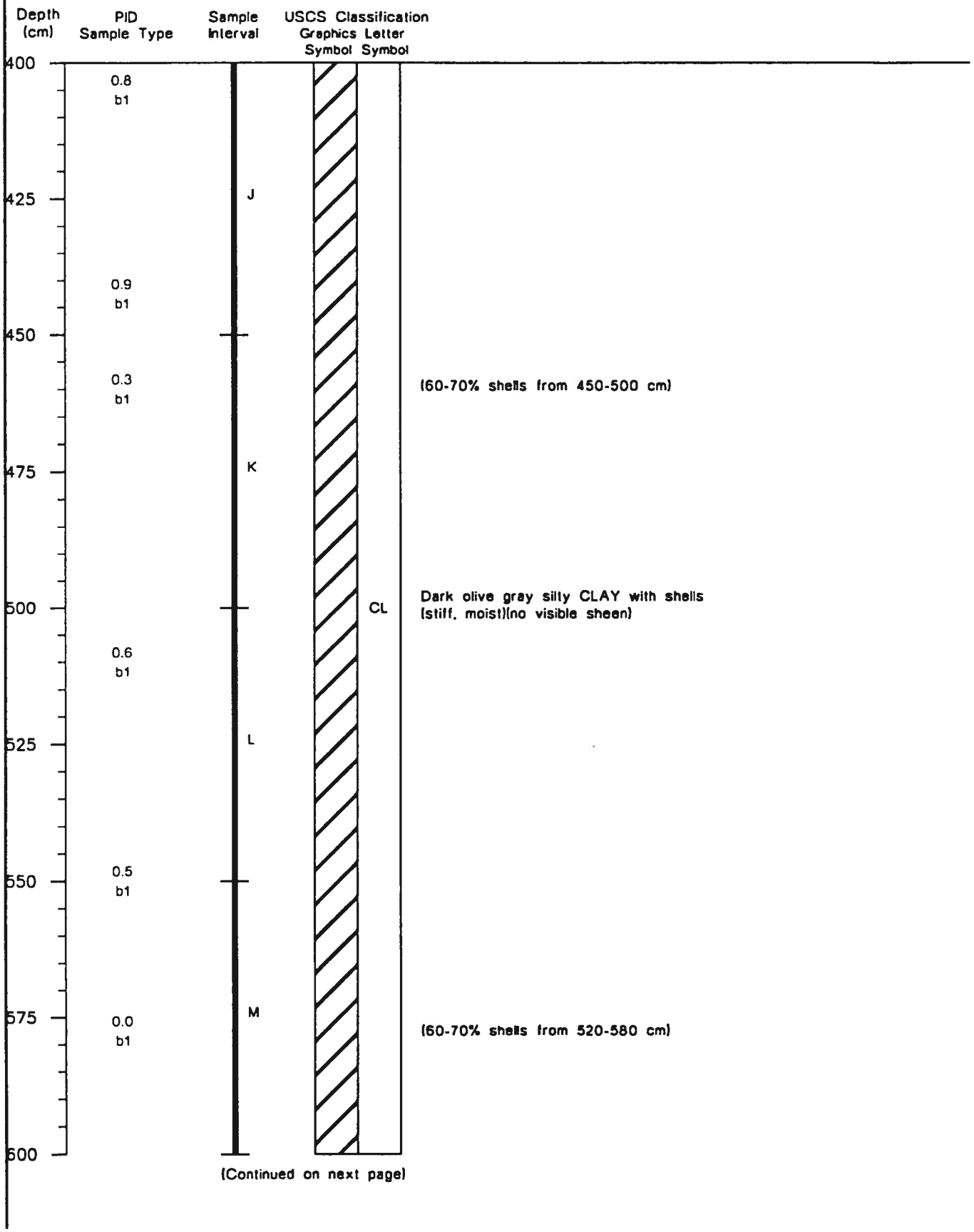
Log of Sediment Core C1

Figure B-20
(2 of 5)

Core C1
(continued)



Log of Sediment Core C1

Figure B-20
(3 of 5)

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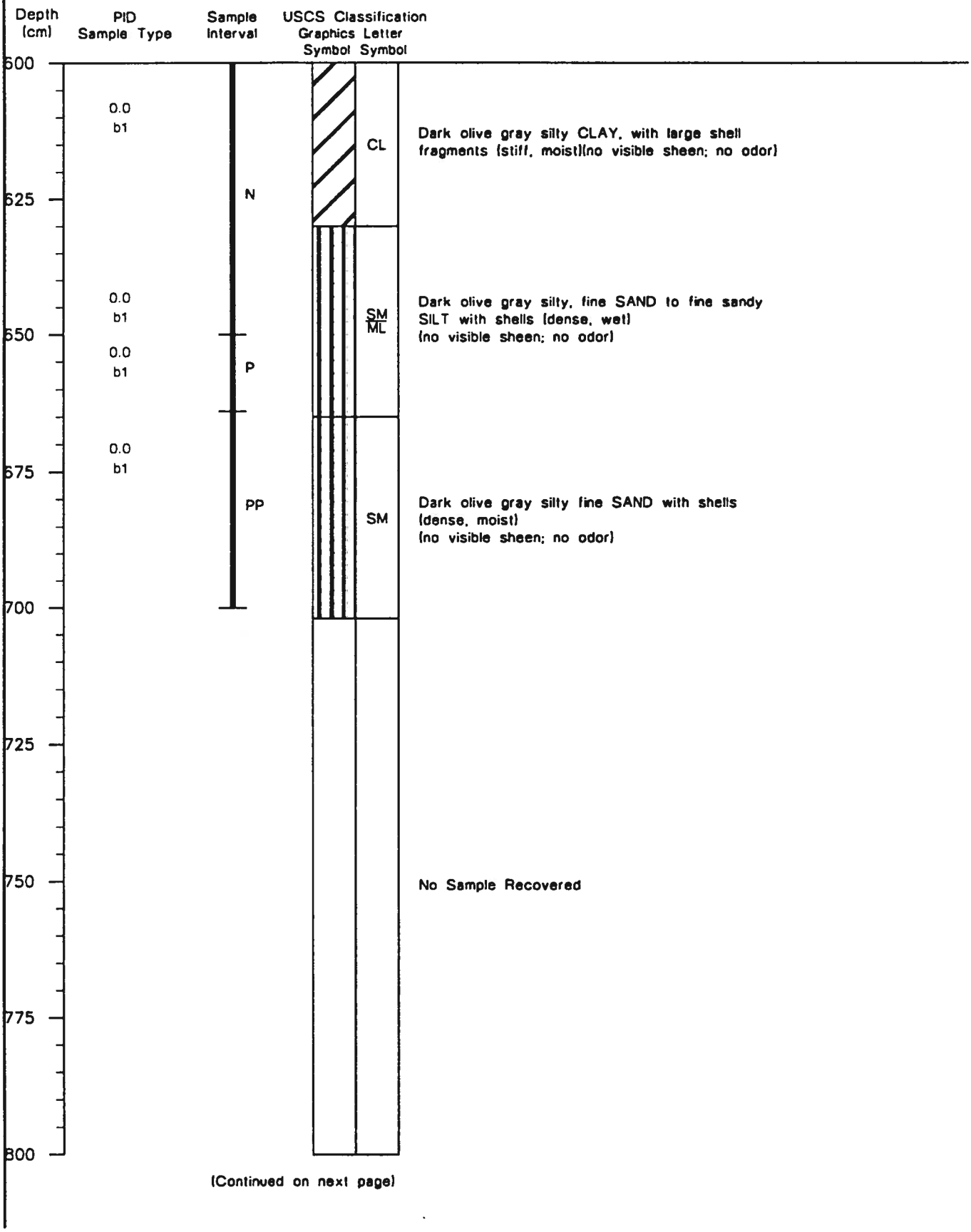
Core C1
(continued)



(Continued on next page)

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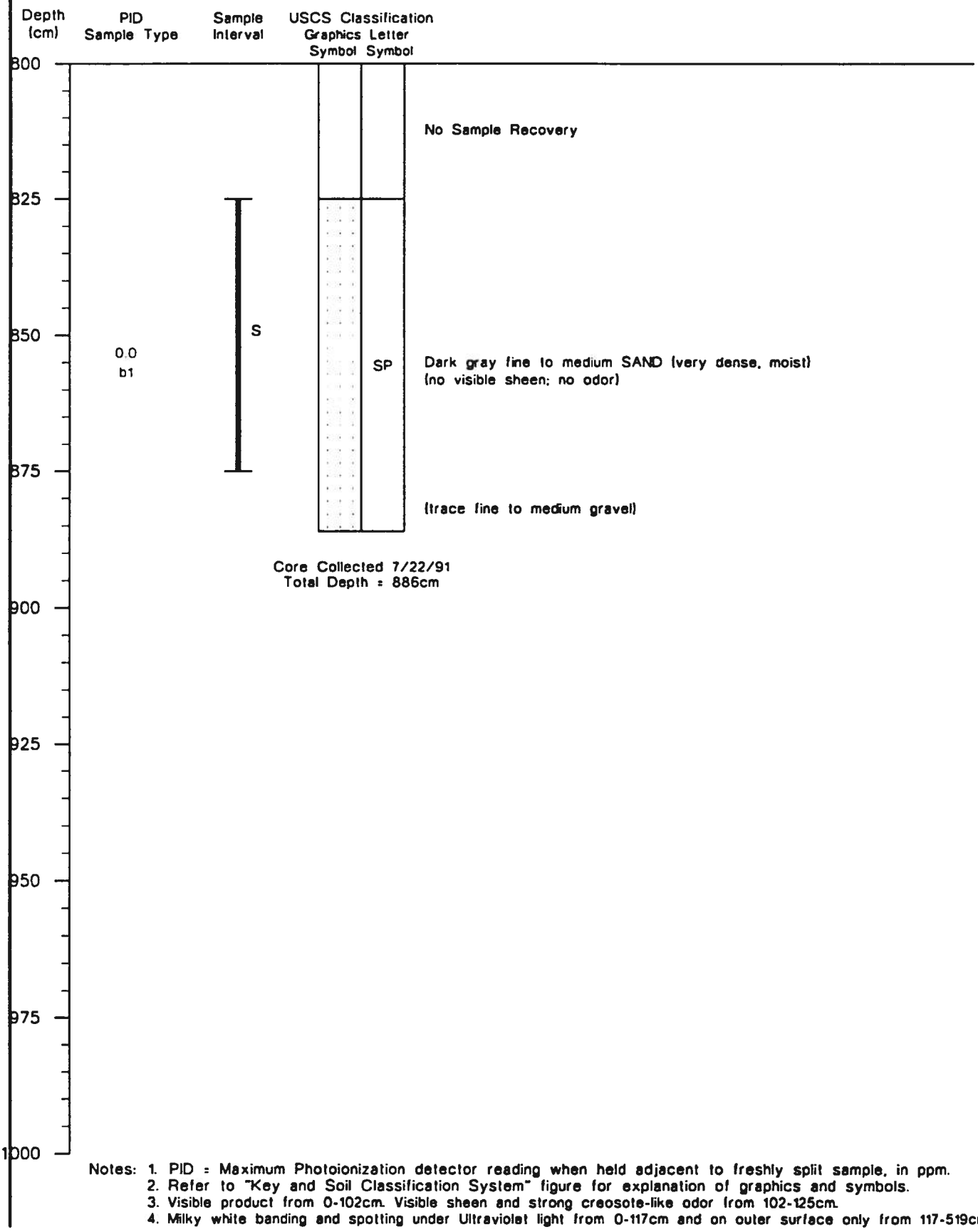
Log of Sediment Core C1

Figure B-20
(4 of 5)

Core C1
(continued)



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Visible product from 0-102cm. Visible sheen and strong creosote-like odor from 102-125cm.
4. Milky white banding and spotting under Ultraviolet light from 0-117cm and on outer surface only from 117-519cm.

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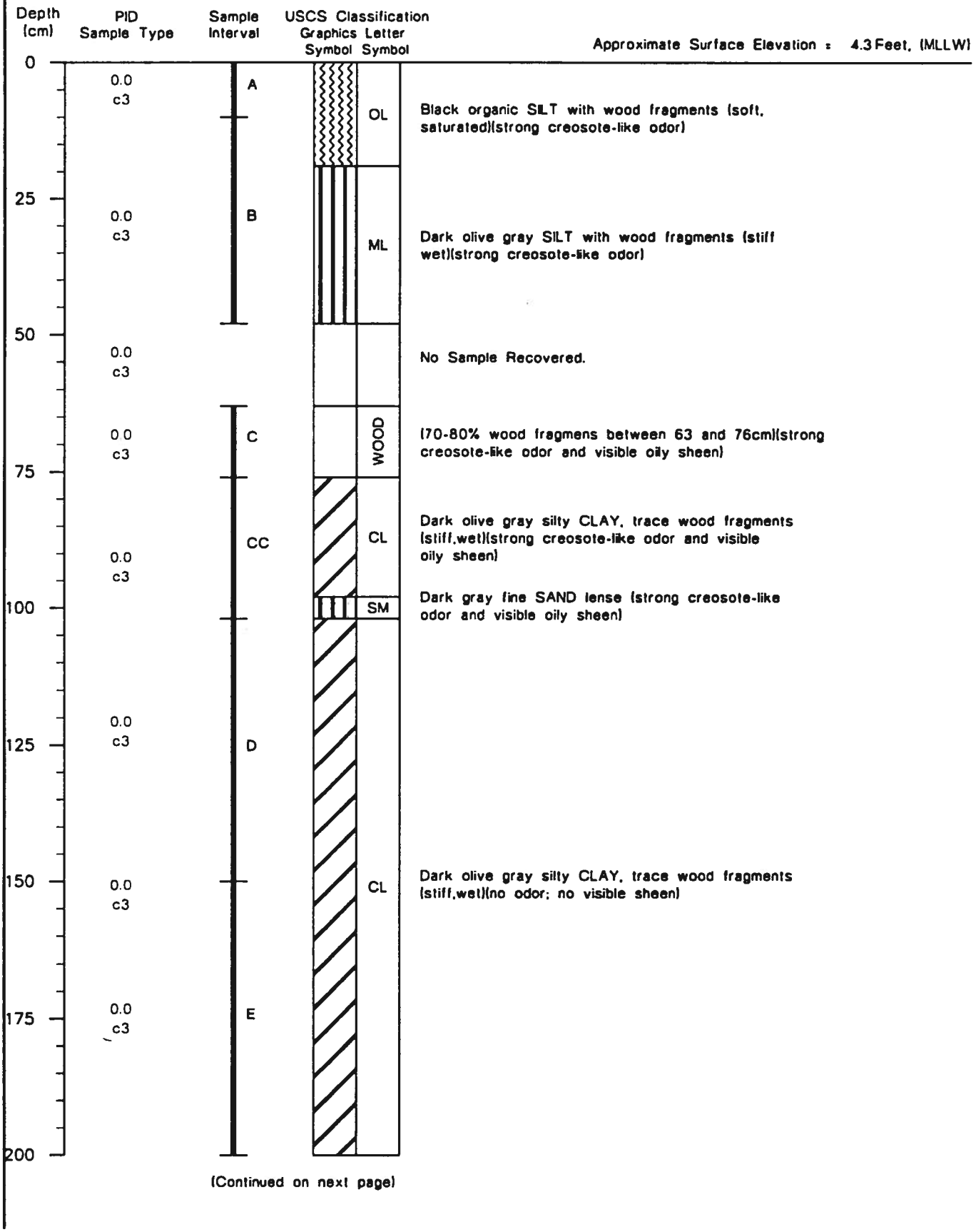
Log of Sediment Core C1

Figure B-20
(5 of 5)

Core C2



(Continued on next page)

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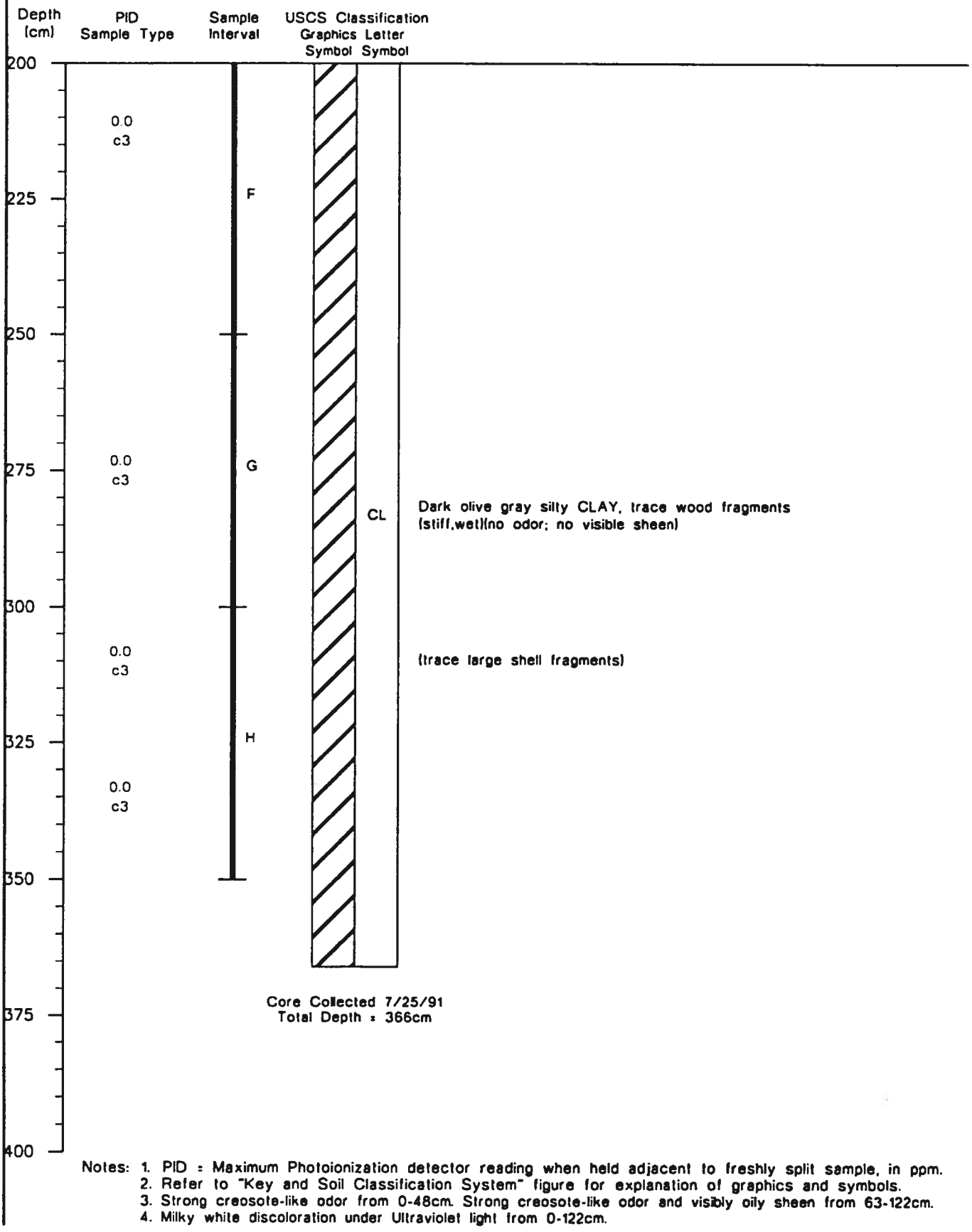
Log of Sediment Core C2

Figure B-21
(1 of 2)

Core C2
(continued)



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Strong creosote-like odor from 0-48cm. Strong creosote-like odor and visibly oily sheen from 63-122cm.
4. Milky white discoloration under Ultraviolet light from 0-122cm.

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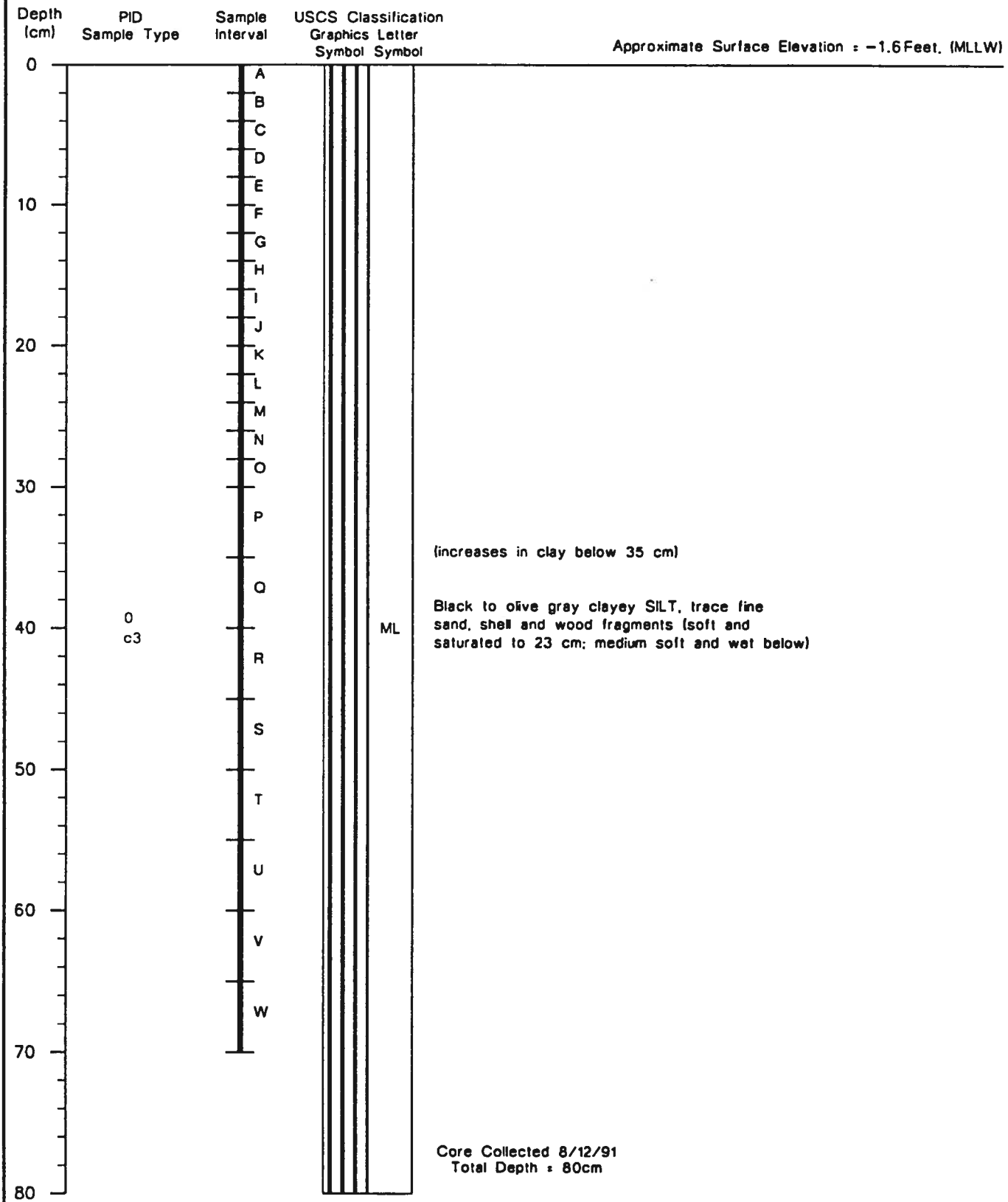
Log of Sediment Core C2

Figure B-21
(2 of 2)

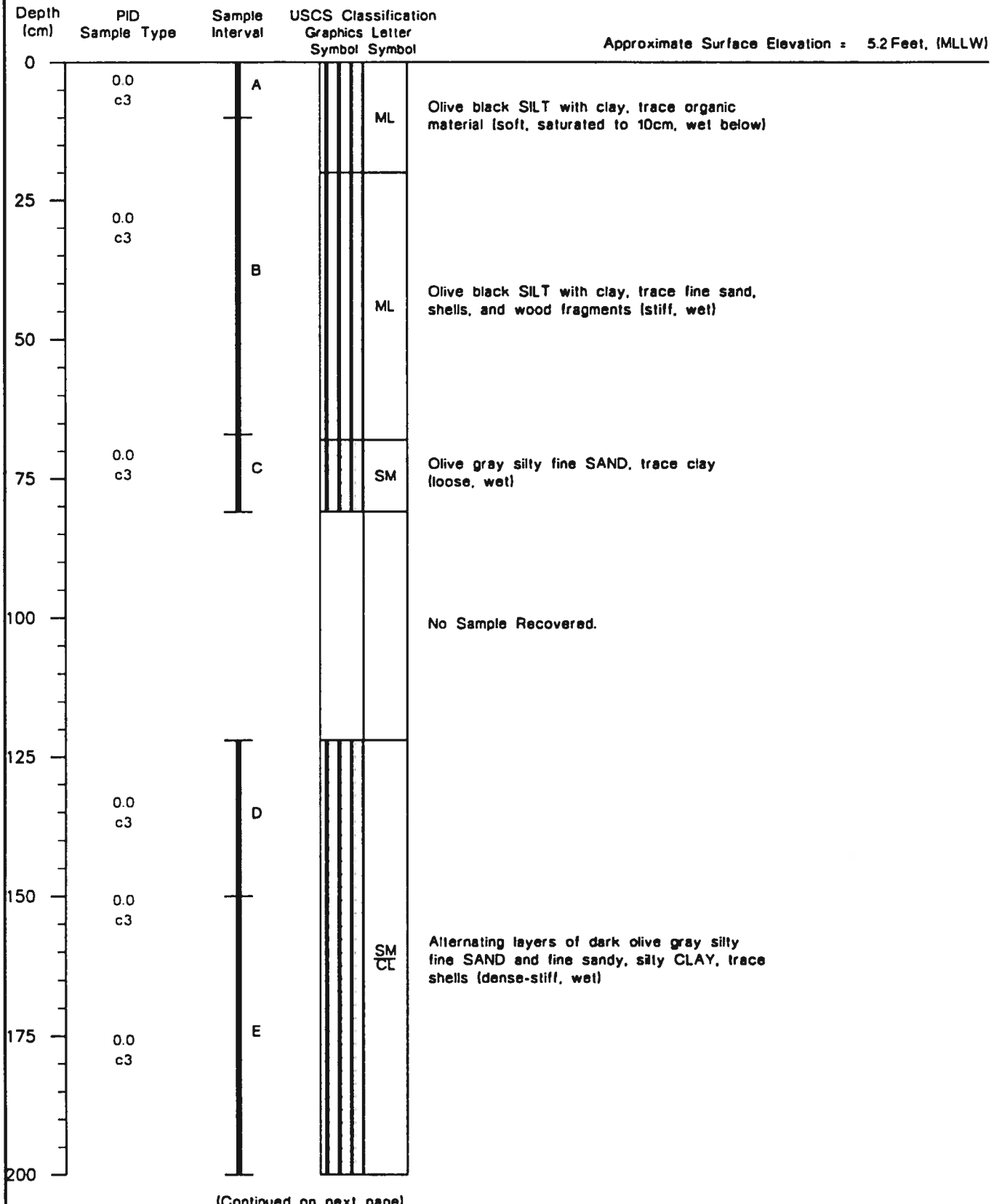
CORE C6



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; no visible sheen.
4. No response under Ultraviolet light.

Log of Sediment Core C6 | Figure B-22

Core D3



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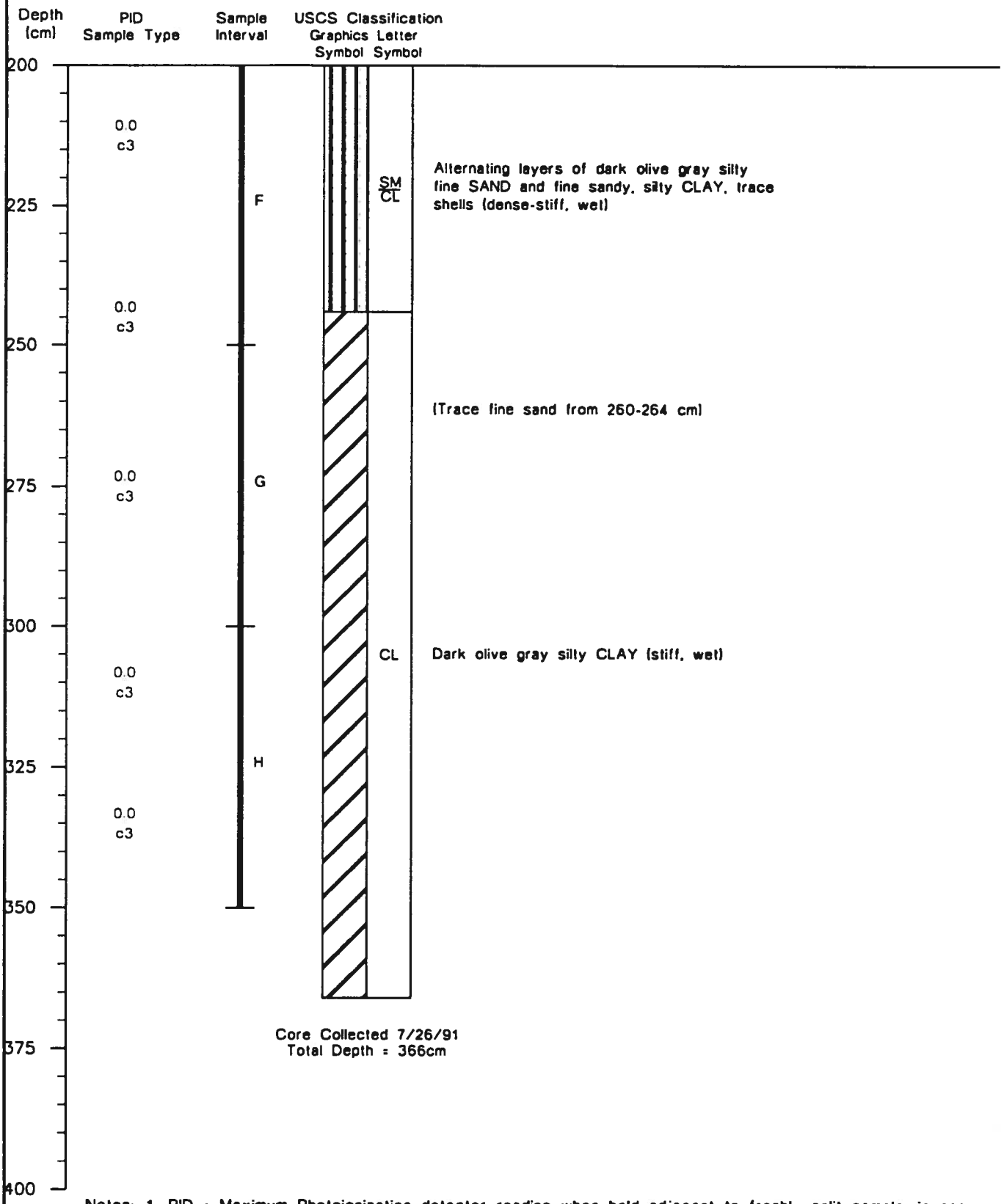
Log of Sediment Core D3

Figure B-23 (1 of 2)

Core D3
(continued)



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; no visible sheen.
4. No response under Ultraviolet light.

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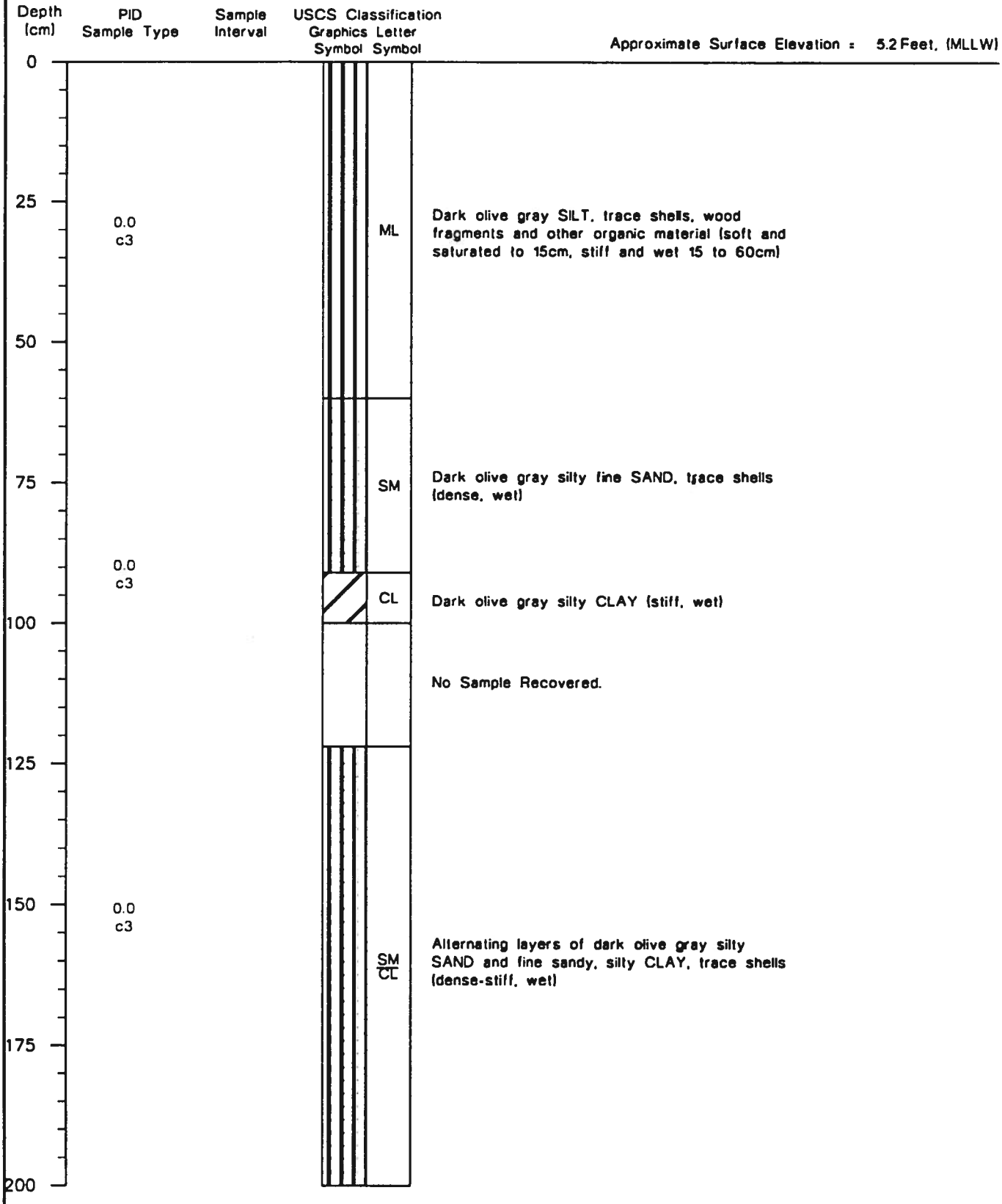
Log of Sediment Core D3

Figure B-23
(2 of 2)

Core D3 (replicate)



(Continued on next page)

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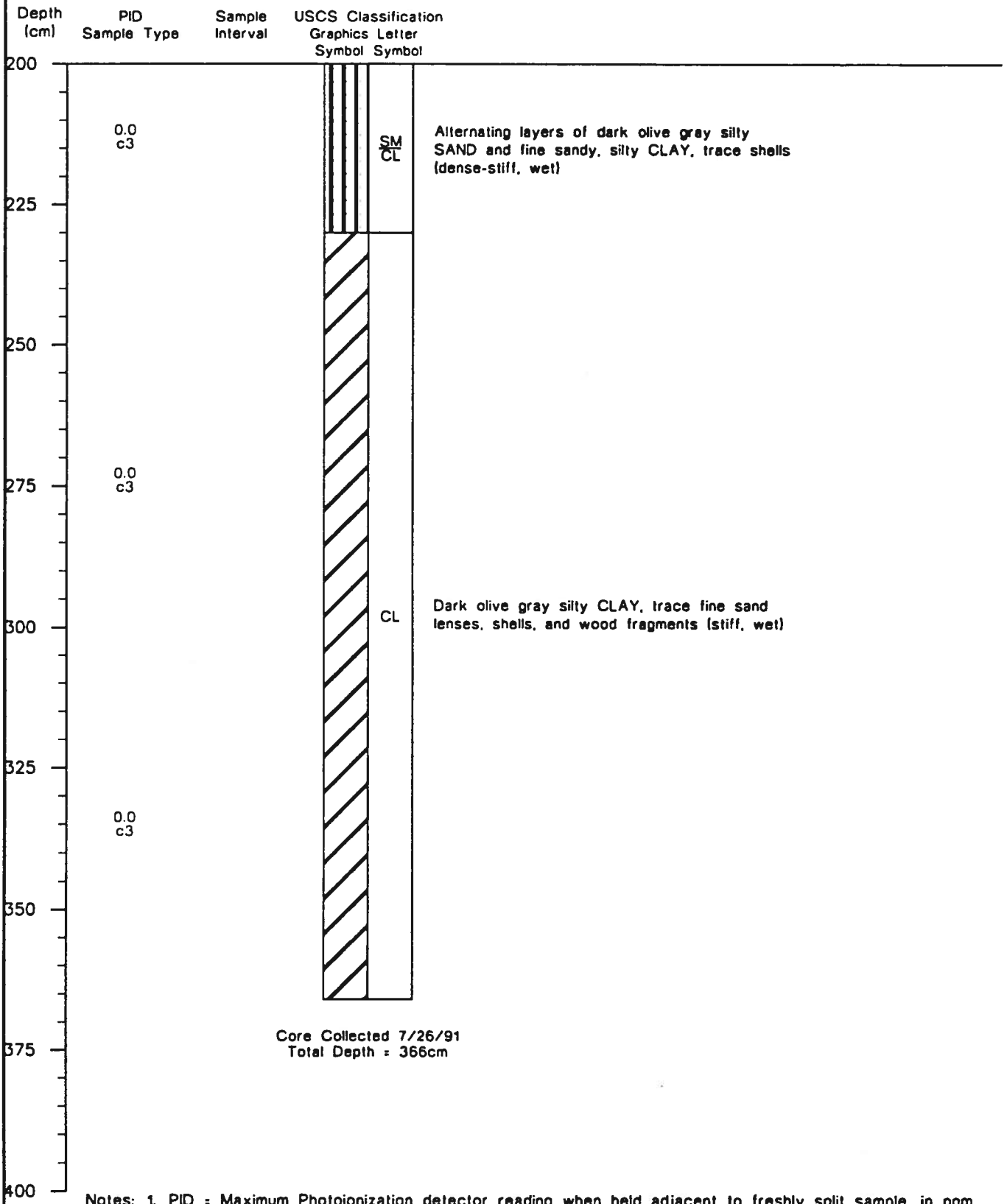
	Log of Sediment Core D3 (replicate)	Figure B-24 (1 of 2)

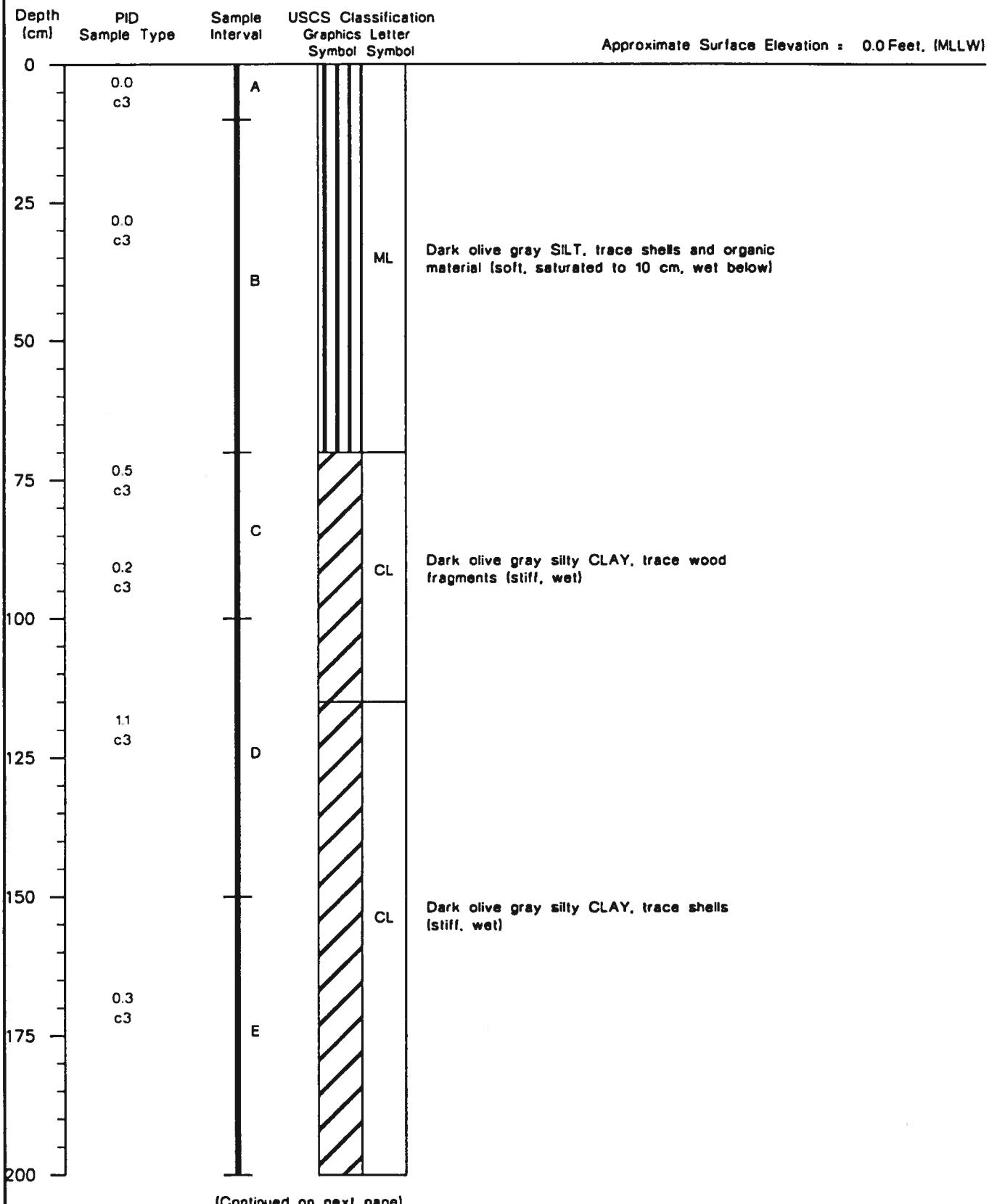
Core D3 (replicate)
(continued)



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; no visible sheen.
4. No response under Ultraviolet light.
5. Replicate core of D3; no samples collected.

	Log of Sediment Core D3 (replicate)	Figure B-24 (2 of 2)

Core D4



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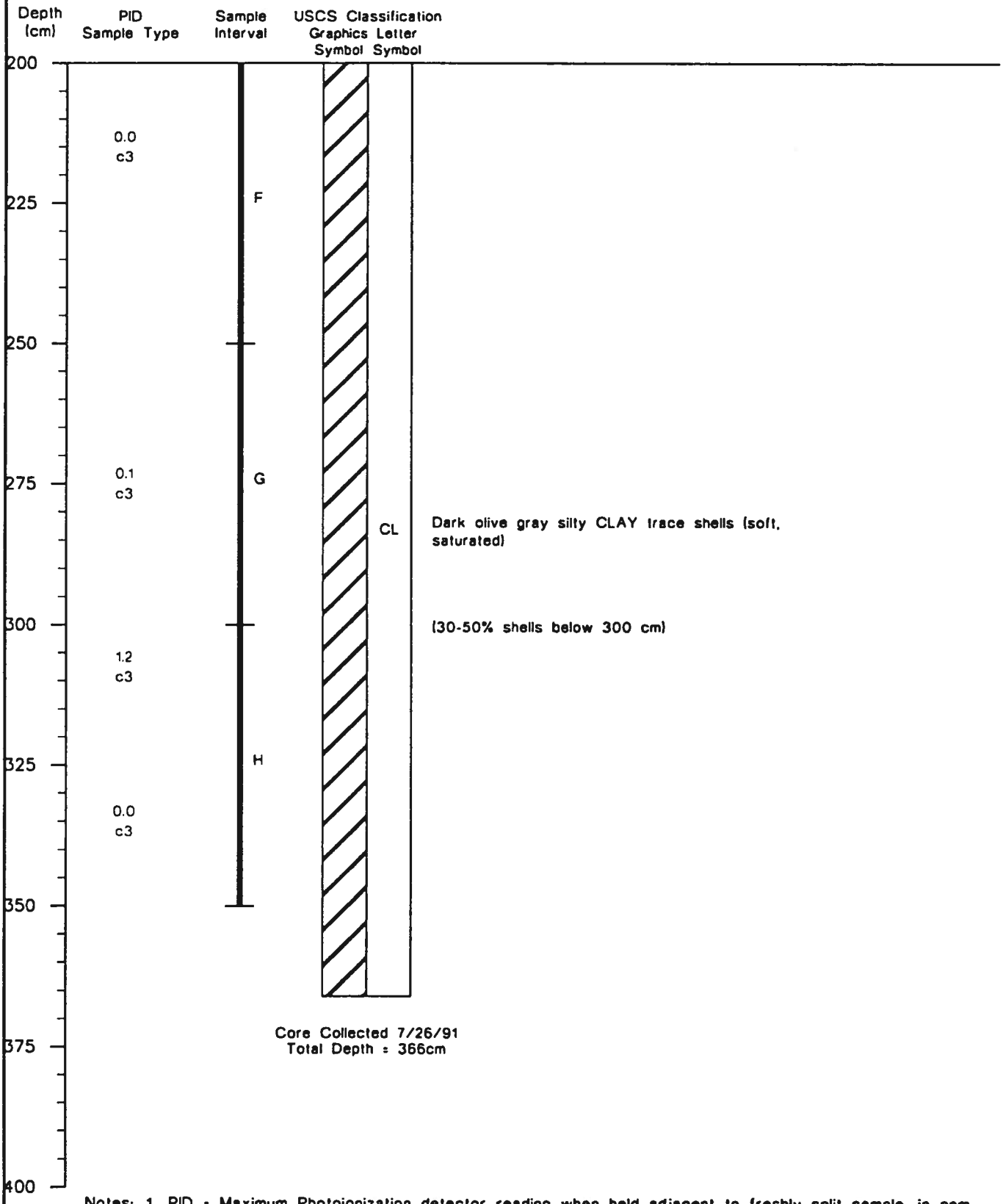
Log of Sediment Core D4

Figure B-25
(1 of 2)

Core D4
(continued)



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor from 0-183cm; no visible sheen.
4. No response under Ultraviolet light.

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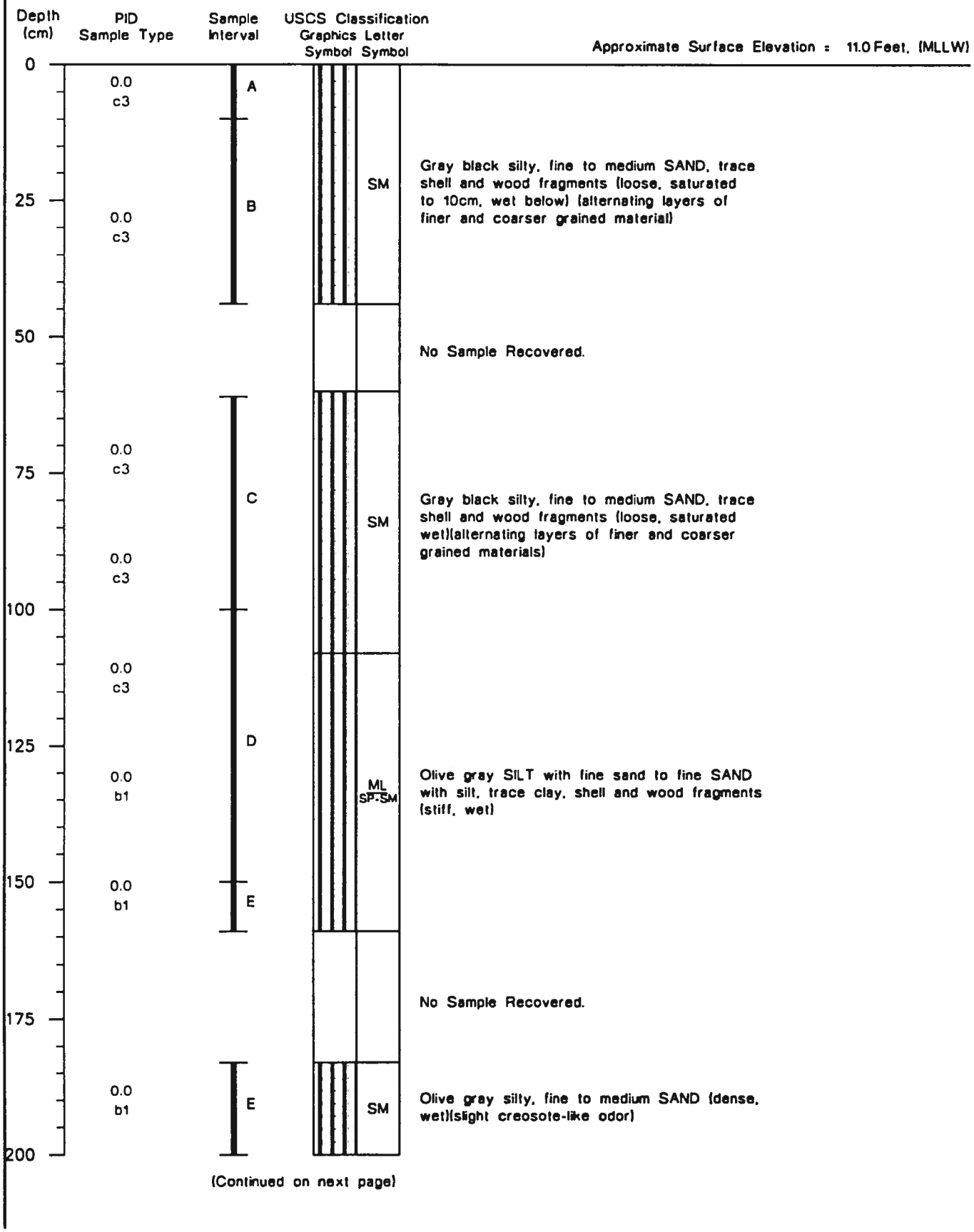
Log of Sediment Core D4

Figure B-25
(2 of 2)

Core E1



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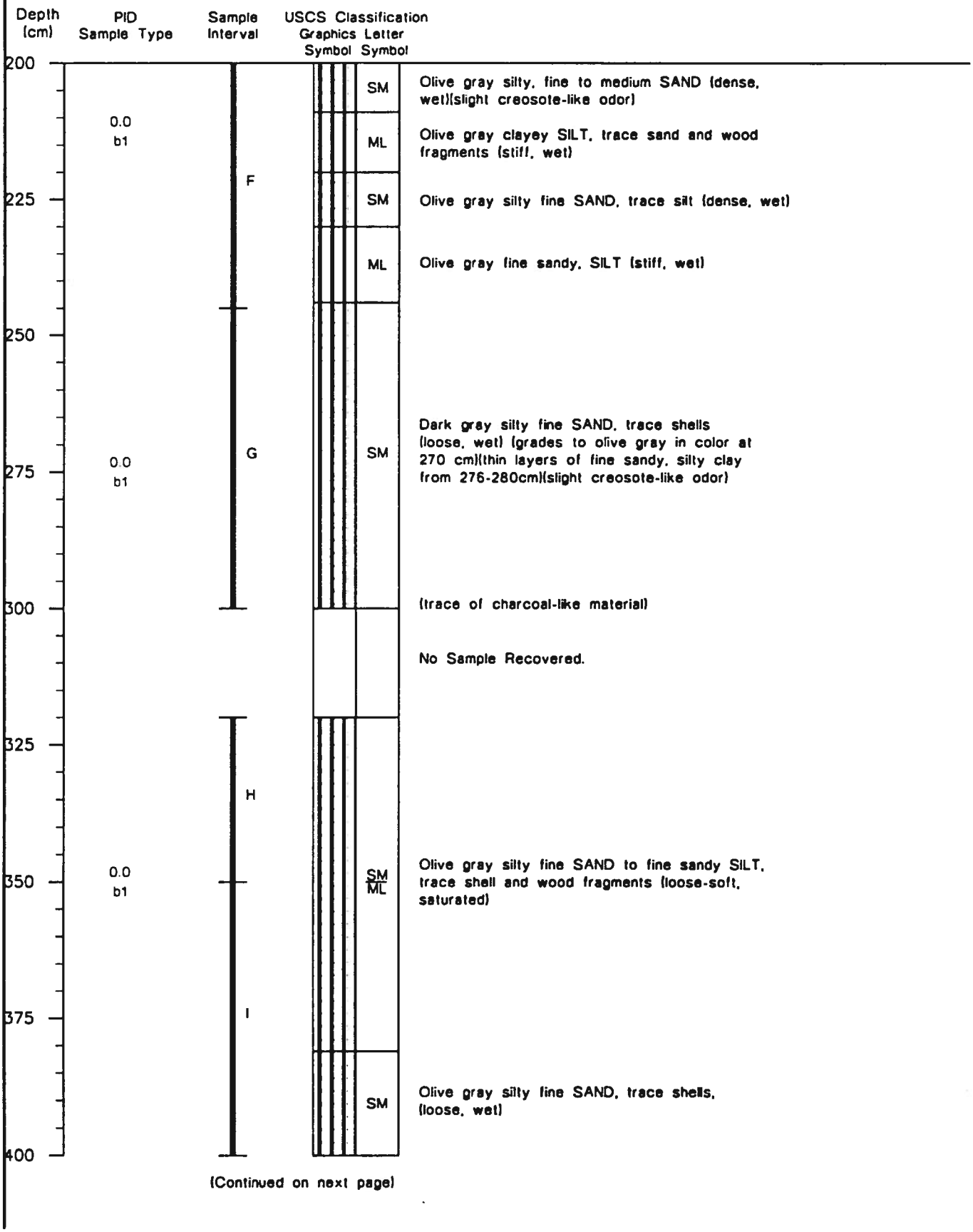
Log of Sediment Core E1

Figure B-26 (1 of 3)

Core E1
(continued)



(Continued on next page)

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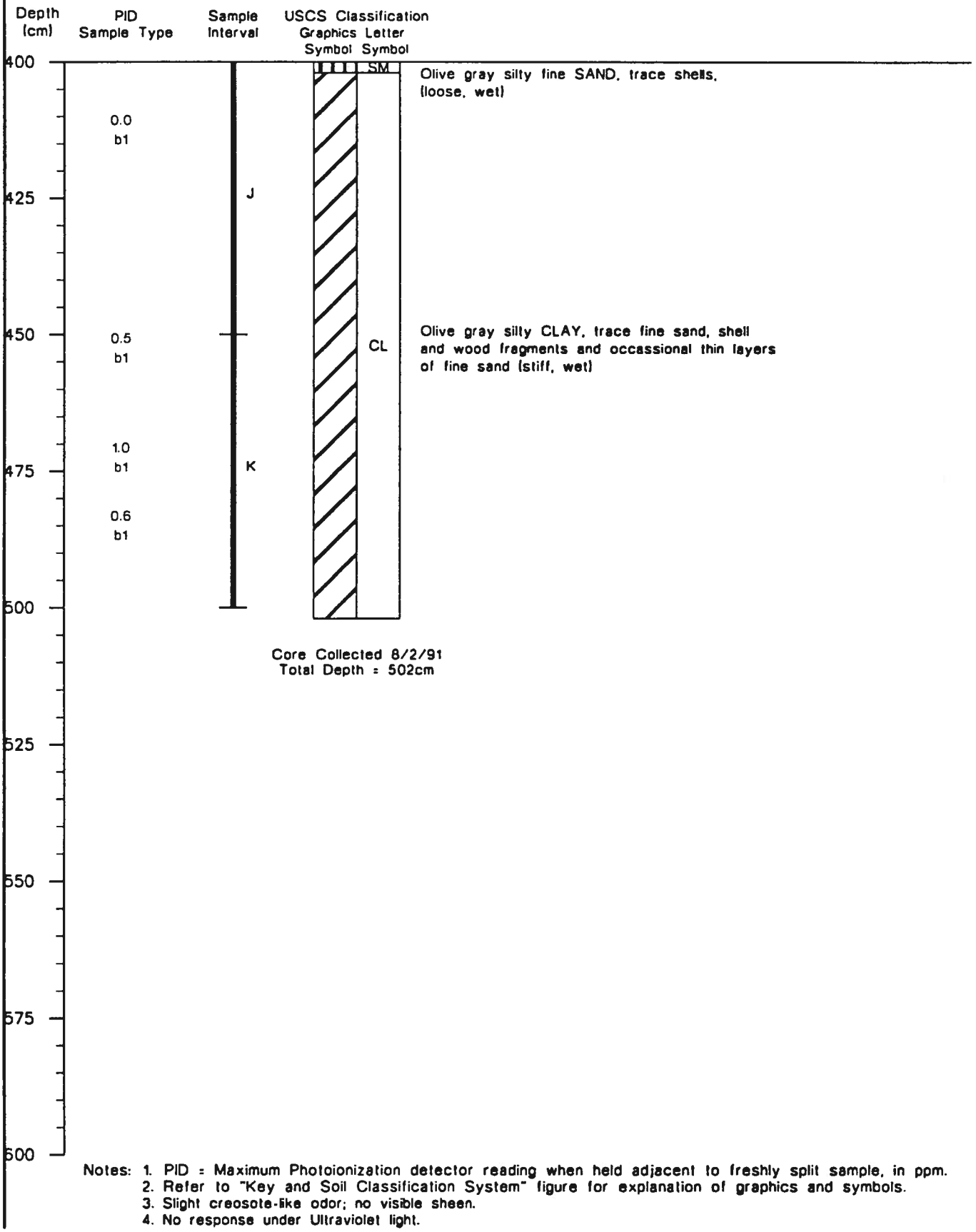
Log of Sediment Core E1

Figure B-26
(2 of 3)

Core E1
(continued)

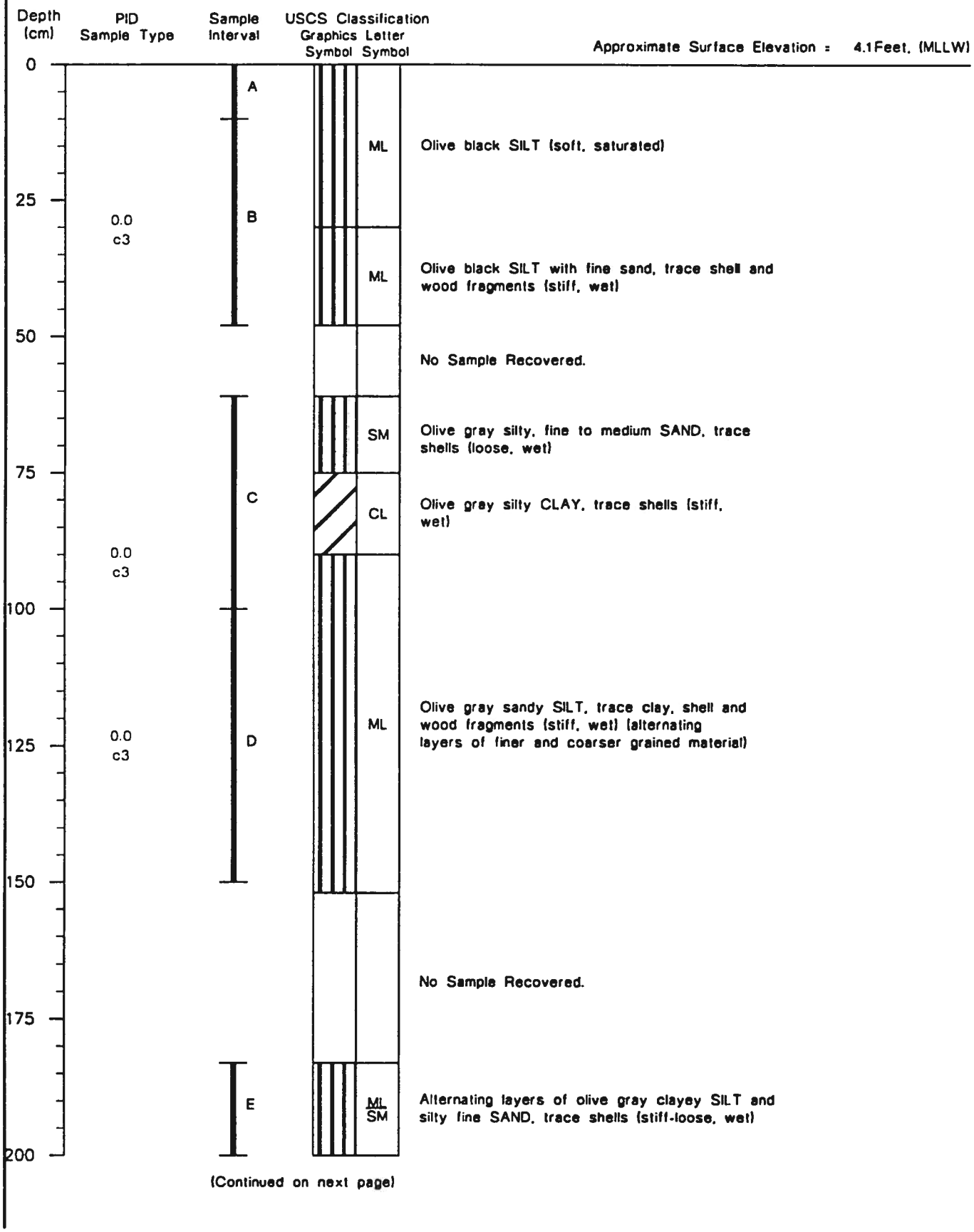


Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight creosote-like odor; no visible sheen.
4. No response under Ultraviolet light.

Log of Sediment Core E1

Figure B-26
(3 of 3)

Core E4



(Continued on next page)

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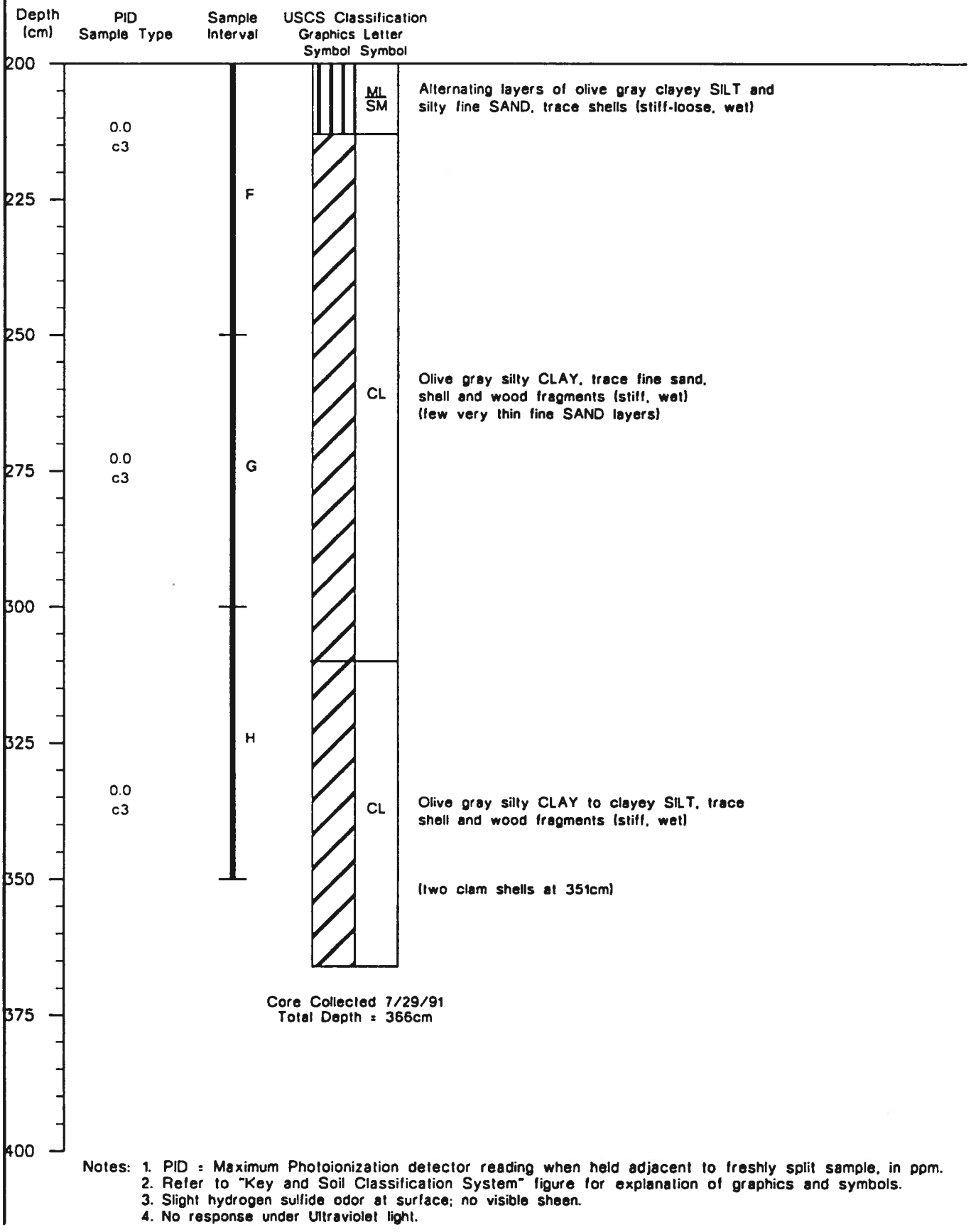
Log of Sediment Core E4

Figure B-27
(1 of 2)

Core E4
(continued)



Core Collected 7/29/91
Total Depth = 366cm

Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; no visible sheen.
4. No response under Ultraviolet light.

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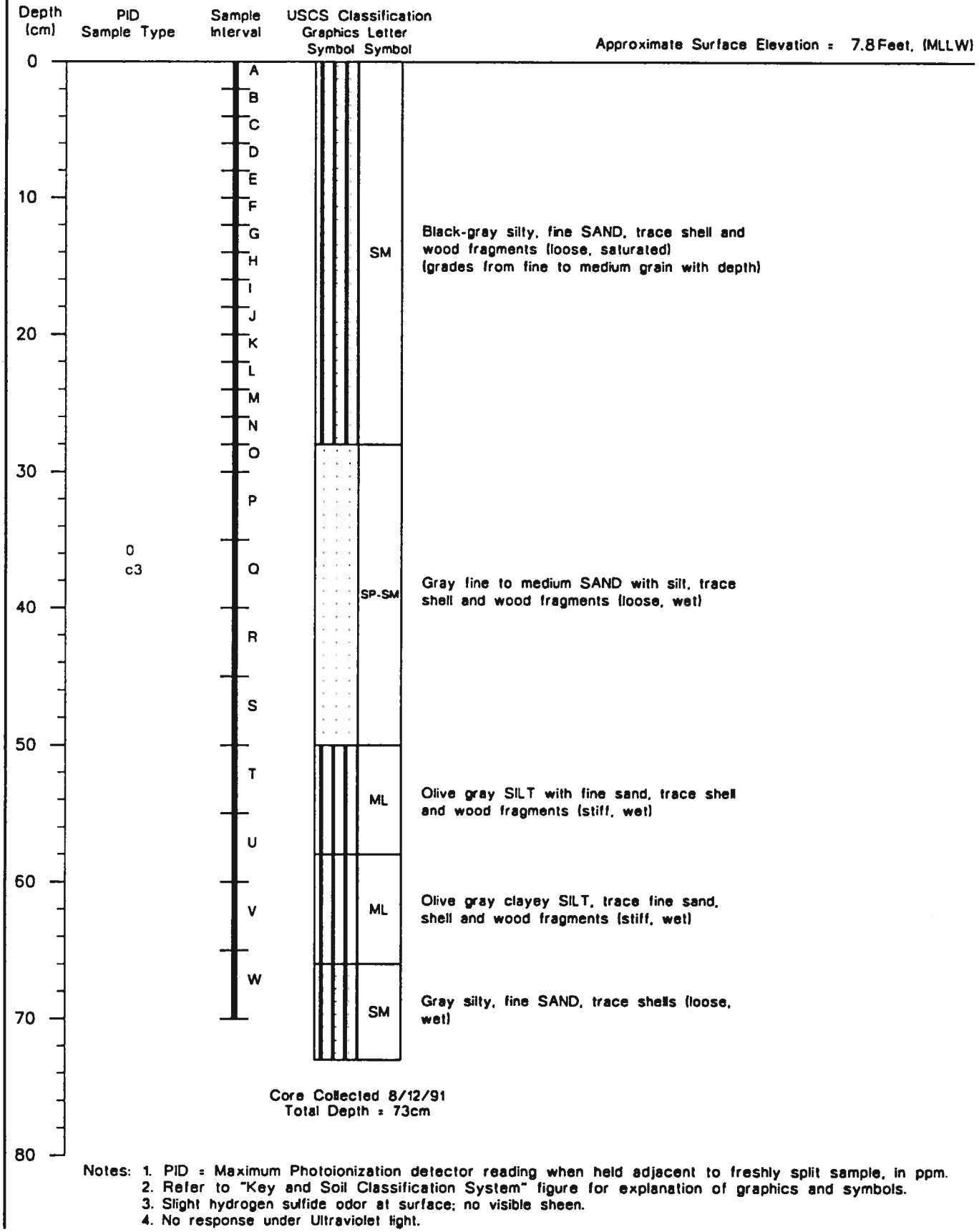
Log of Sediment Core E4

Figure B-27
(2 of 2)

Core E6



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; no visible sheen.
4. No response under Ultraviolet light.

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Log of Sediment Core E6 | Figure B-28

Core F1

Approximate Surface Elevation = 11.9 Feet, (MLLW)

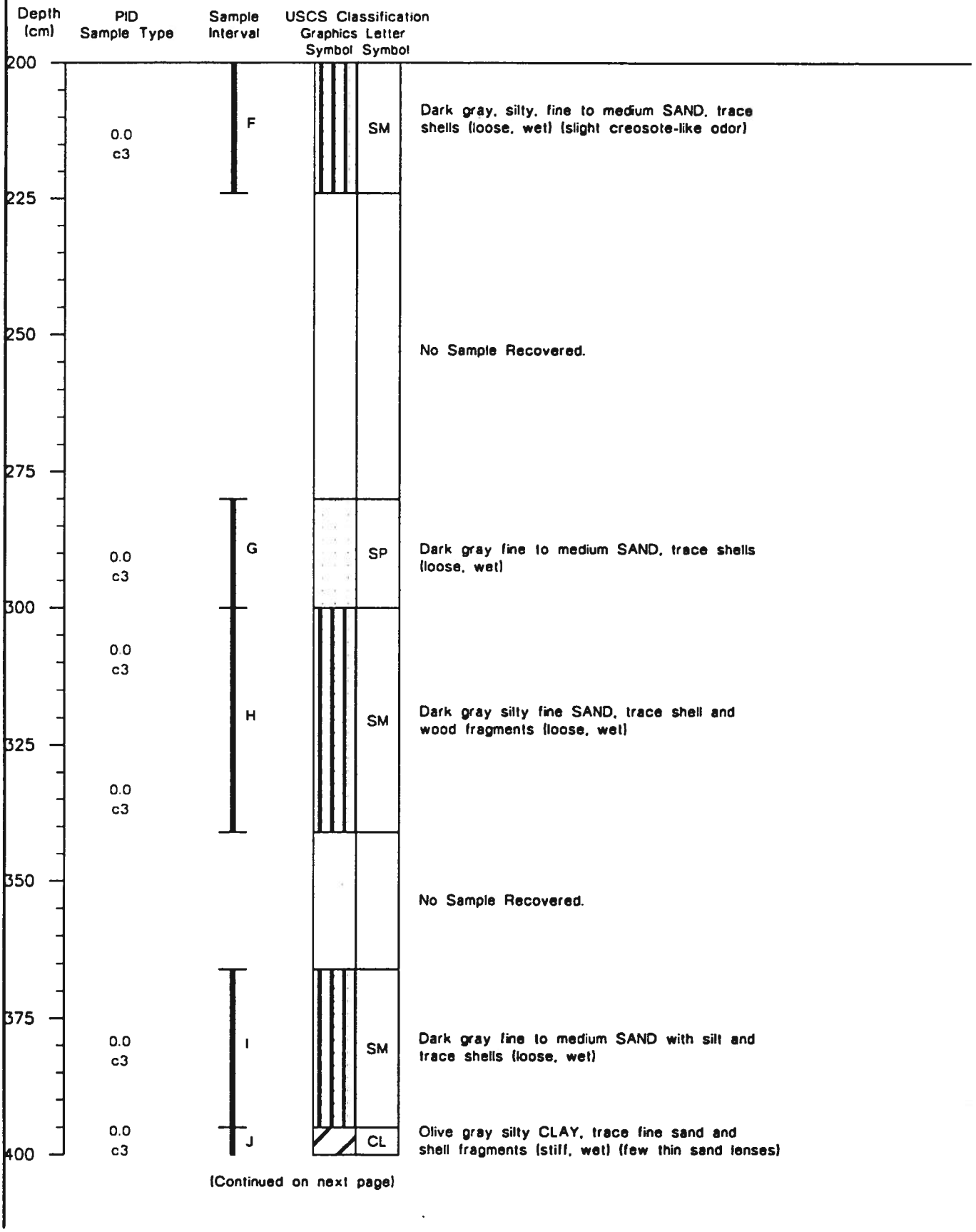
Depth (cm)	PID Sample Type	Sample Interval	USCS Graphics Symbol	USCS Letter Symbol	
0	0.0 c3+b1	A		SM	Black silty fine SAND, trace shell and wood fragments (loose, wet)
25	0.0 c3+b1	B		SP	Dark gray fine to medium SAND, trace silt and shells (loose, wet)
50				SM	Black silty fine SAND (loose, wet)
					No Sample Recovered.
75	0.0 c3	C		SP	Dark gray fine to medium SAND, trace shell and wood fragments from 61-65cm (loose, wet)(slight creosote-like odor)
	0.0 c3				
100					No Sample Recovered.
125	0.0 c3	D		SP	Dark gray fine to medium SAND, trace shell and wood fragments (loose, wet)(no odor)
150	0.0 c3	E			
175					No Sample Recovered.
200	0.0 c3	E		SM	Dark gray, silty, fine to medium SAND, trace shells (loose, wet)(slight creosote-like odor)

(Continued on next page)

Log of Sediment Core F1

Figure B-29 (1 of 3)

Core F1
(continued)



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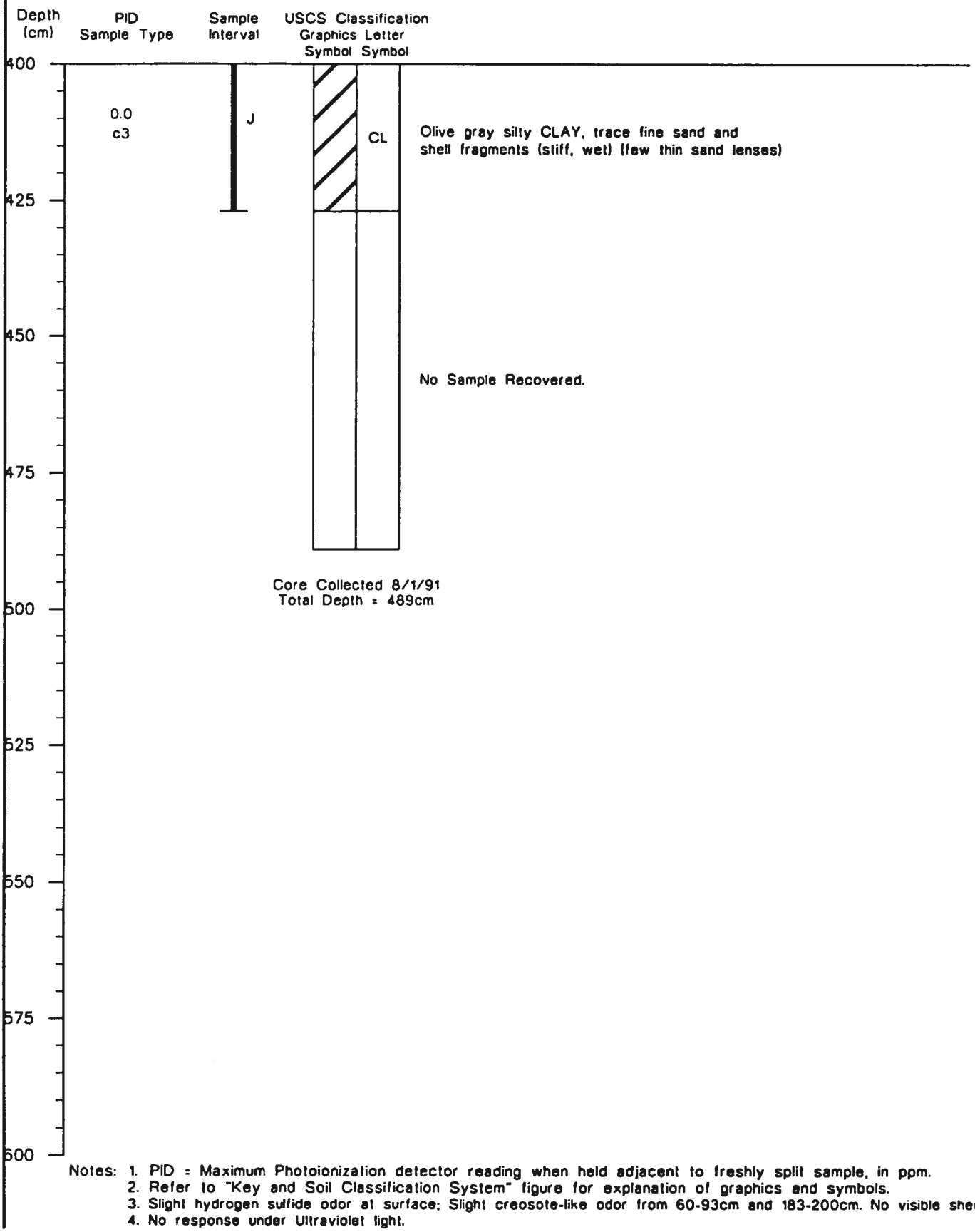
Log of Sediment Core F1

Figure B-29
(2 of 3)

Core F1
(continued)

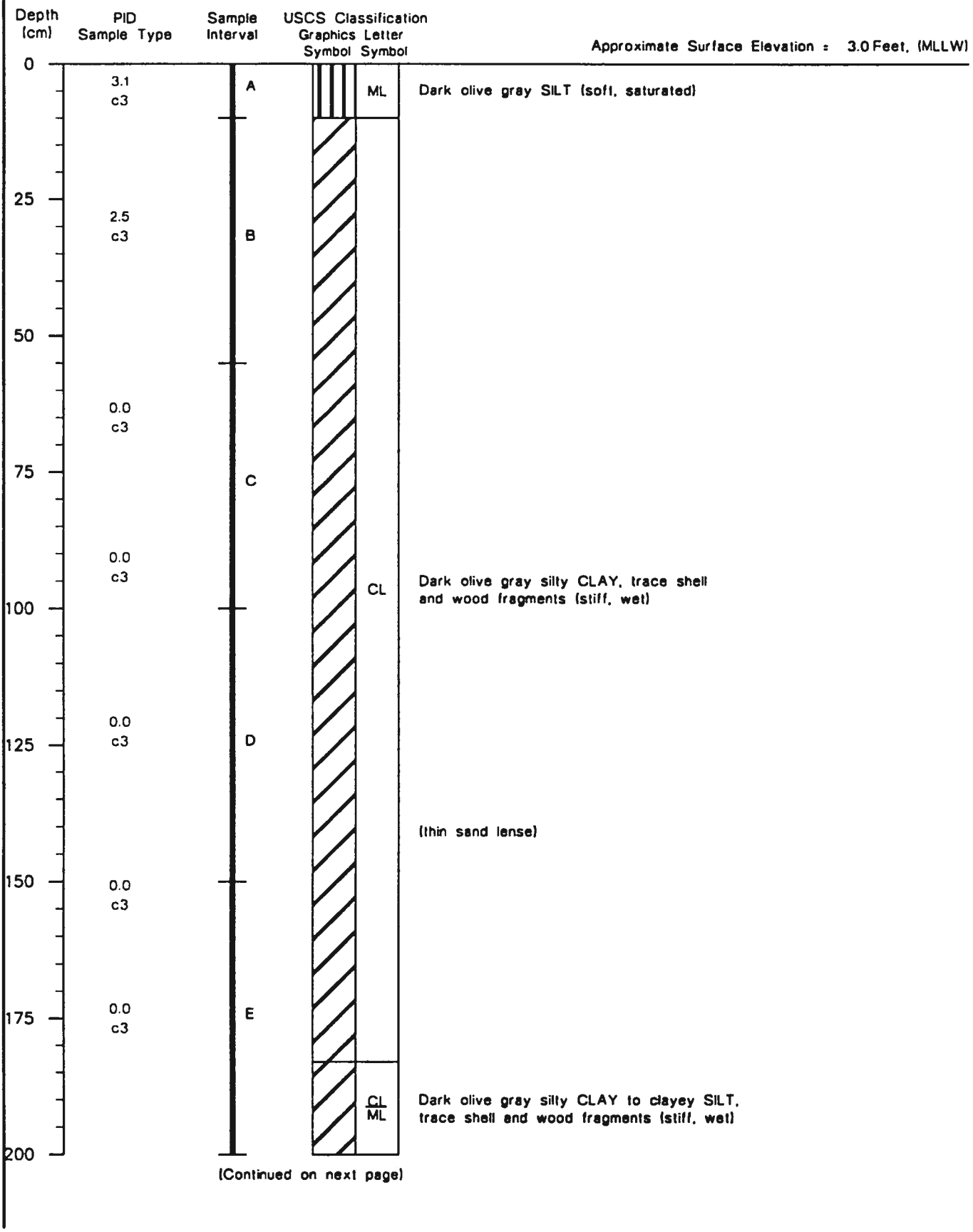


Notes: 1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; Slight creosote-like odor from 60-93cm and 183-200cm. No visible sheen.
4. No response under Ultraviolet light.

Log of Sediment Core F1

Figure B-29
(3 of 3)

Core G3



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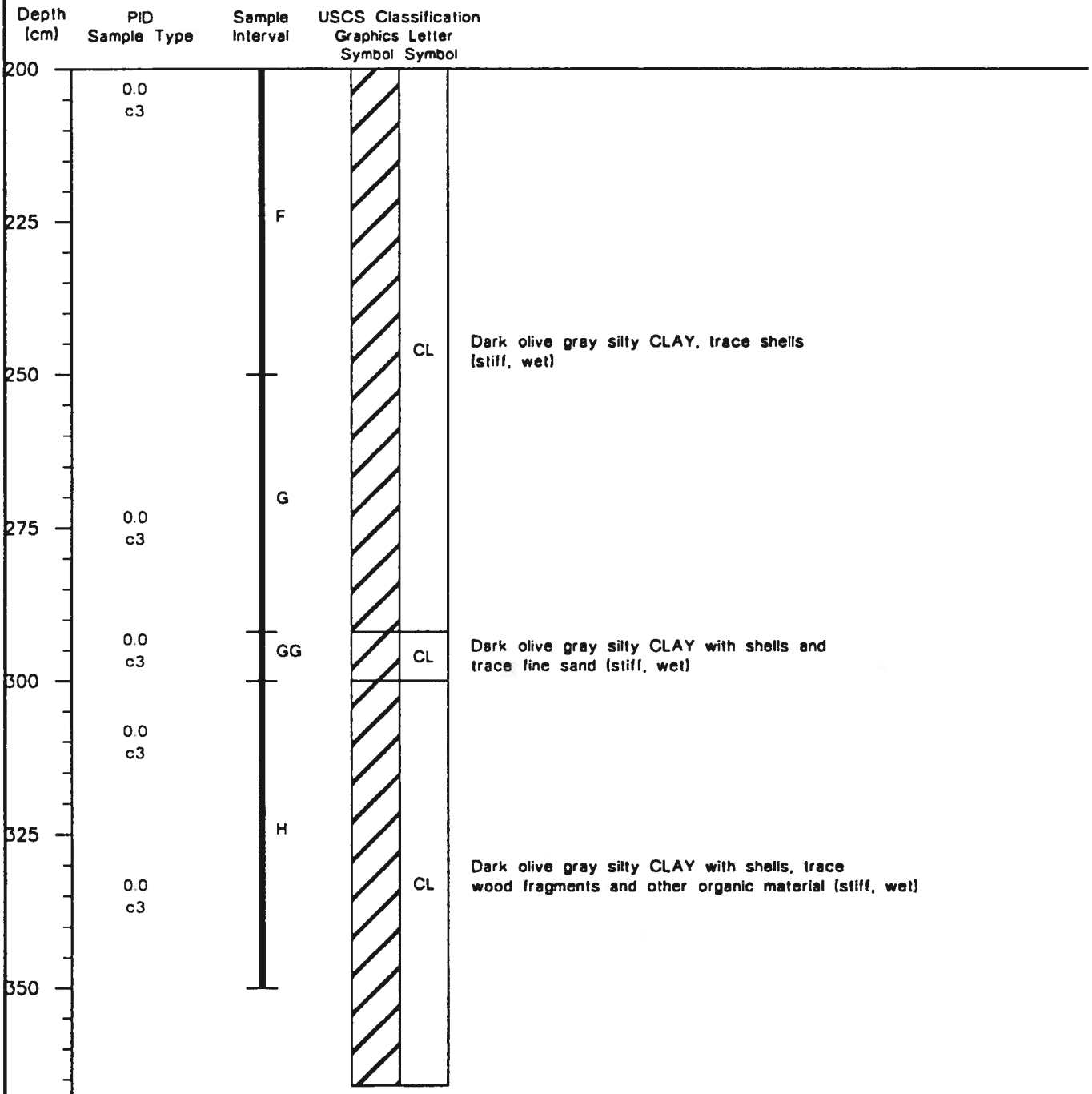
Log of Sediment Core G3

Figure B-30
(1 of 2)

Core G3
(continued)



Core Collected 7/25/91
Total Depth = 366cm

Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. No odor; no visible sheen.
4. No response under Ultraviolet light.

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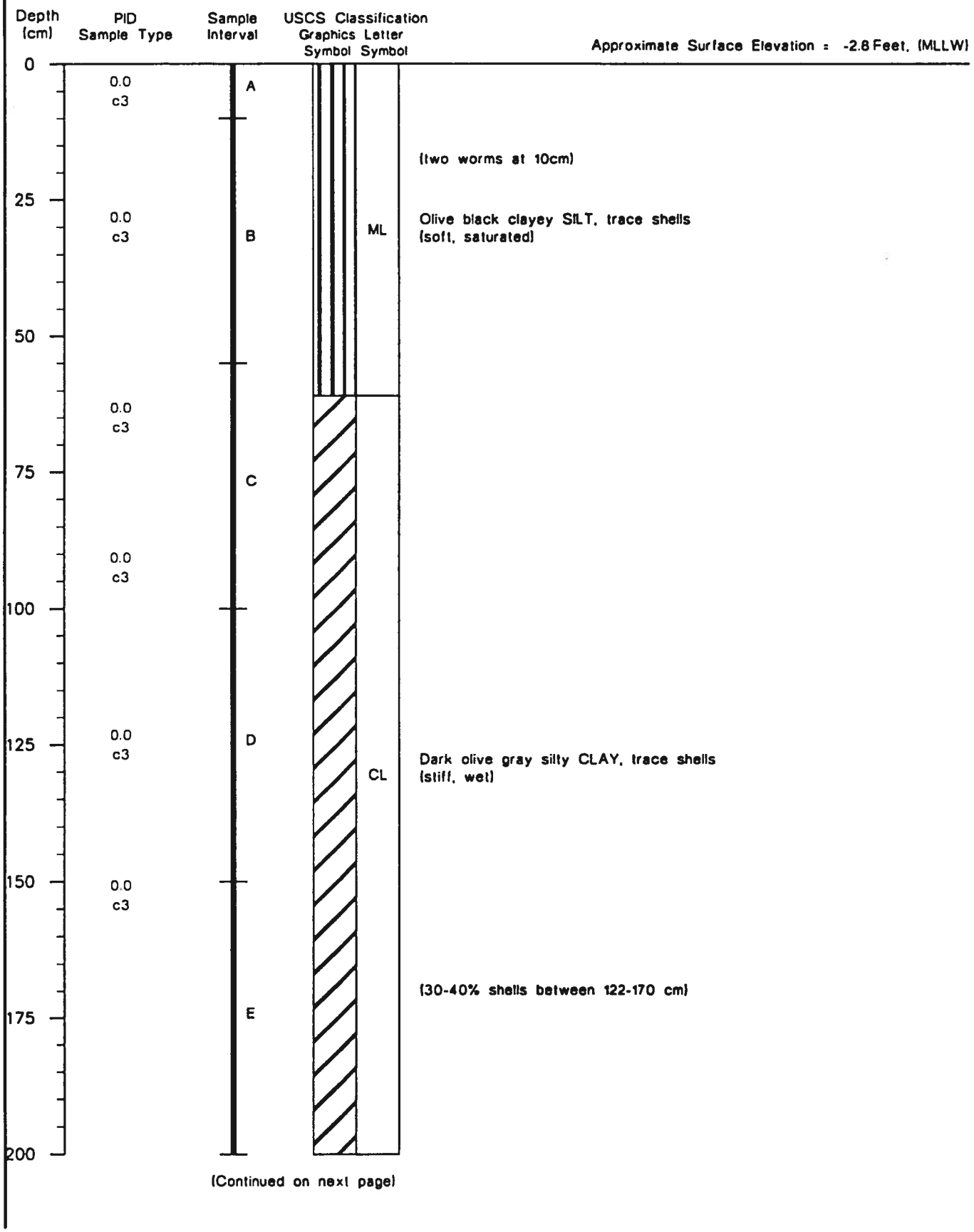
Log of Sediment Core G3

Figure B-30
(2 of 2)

Core H1



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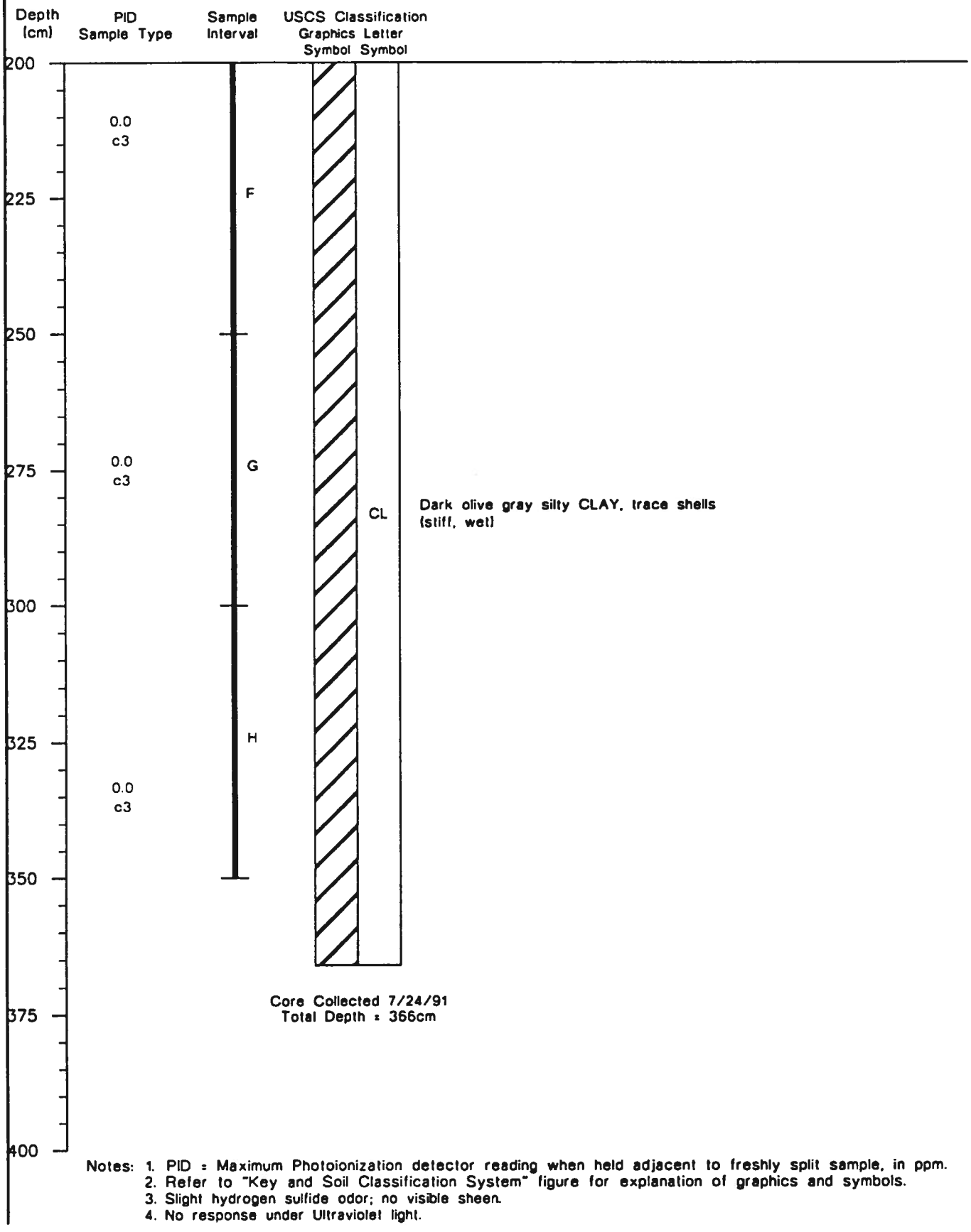
Log of Sediment Core H1

Figure B-31
(1 of 2)

Core H1
(continued)



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor; no visible sheen.
4. No response under Ultraviolet light.

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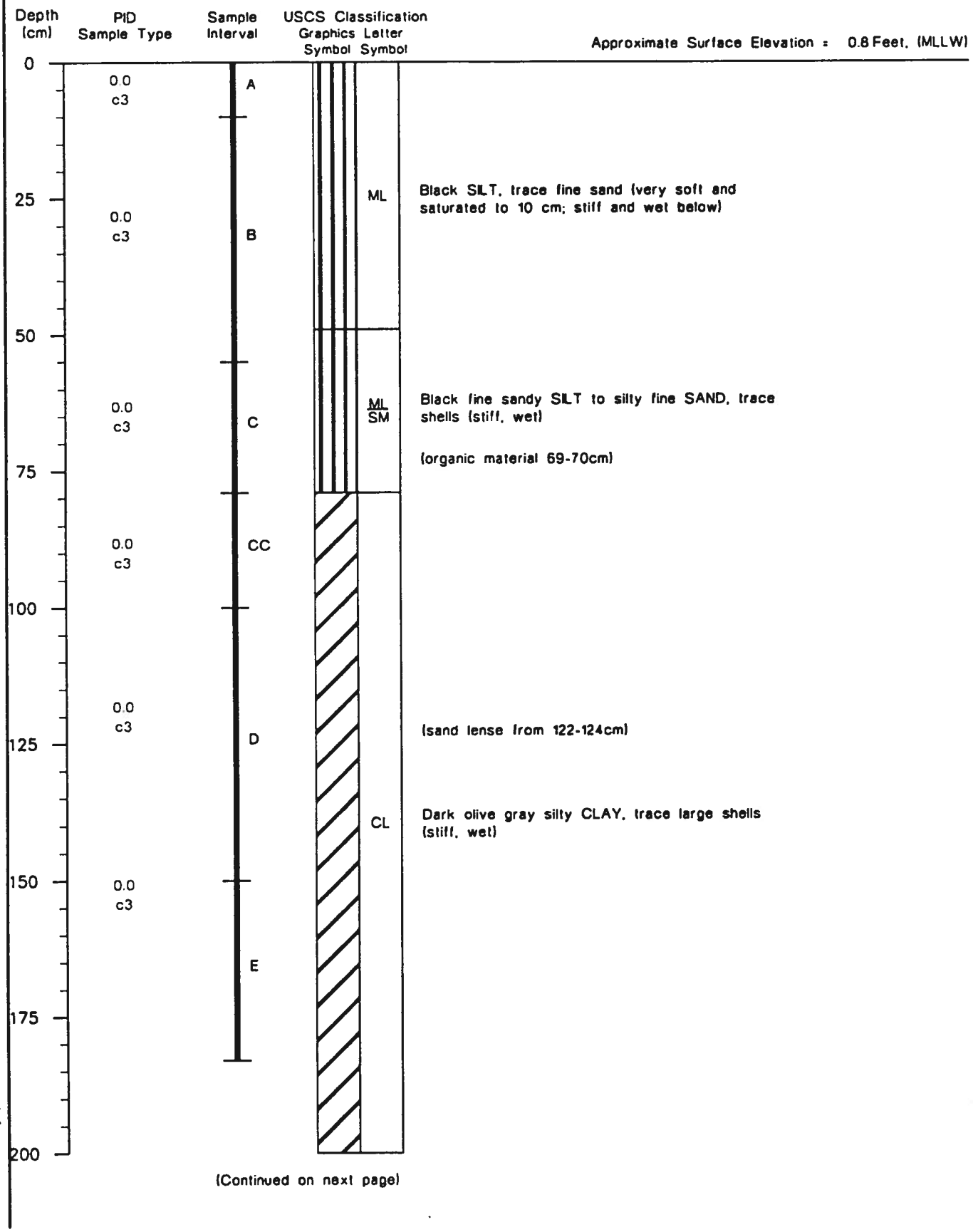
Log of Sediment Core H1

Figure B-31
(2 of 2)

Core H2



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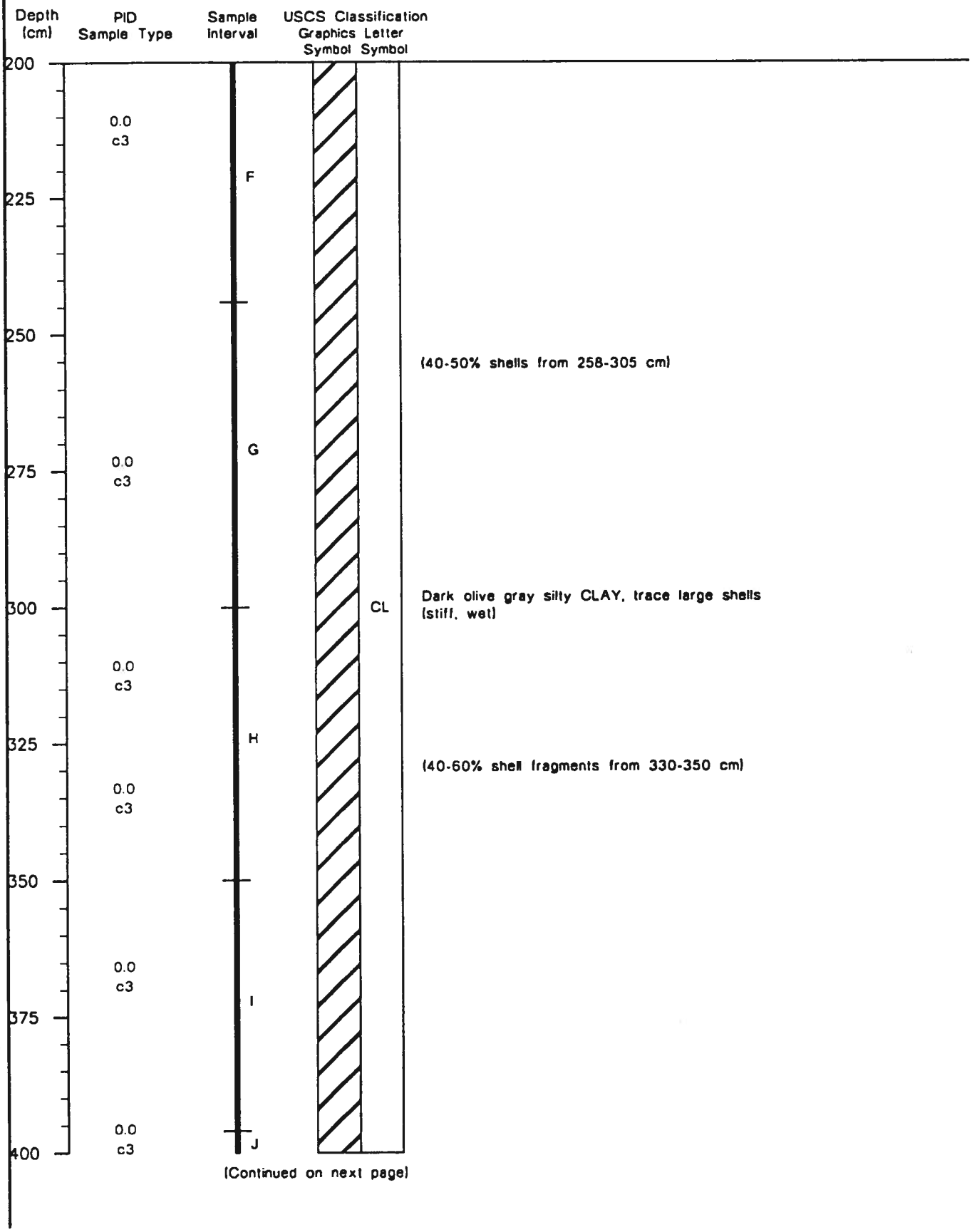
Log of Sediment Core H2

Figure B-32 (1 of 4)

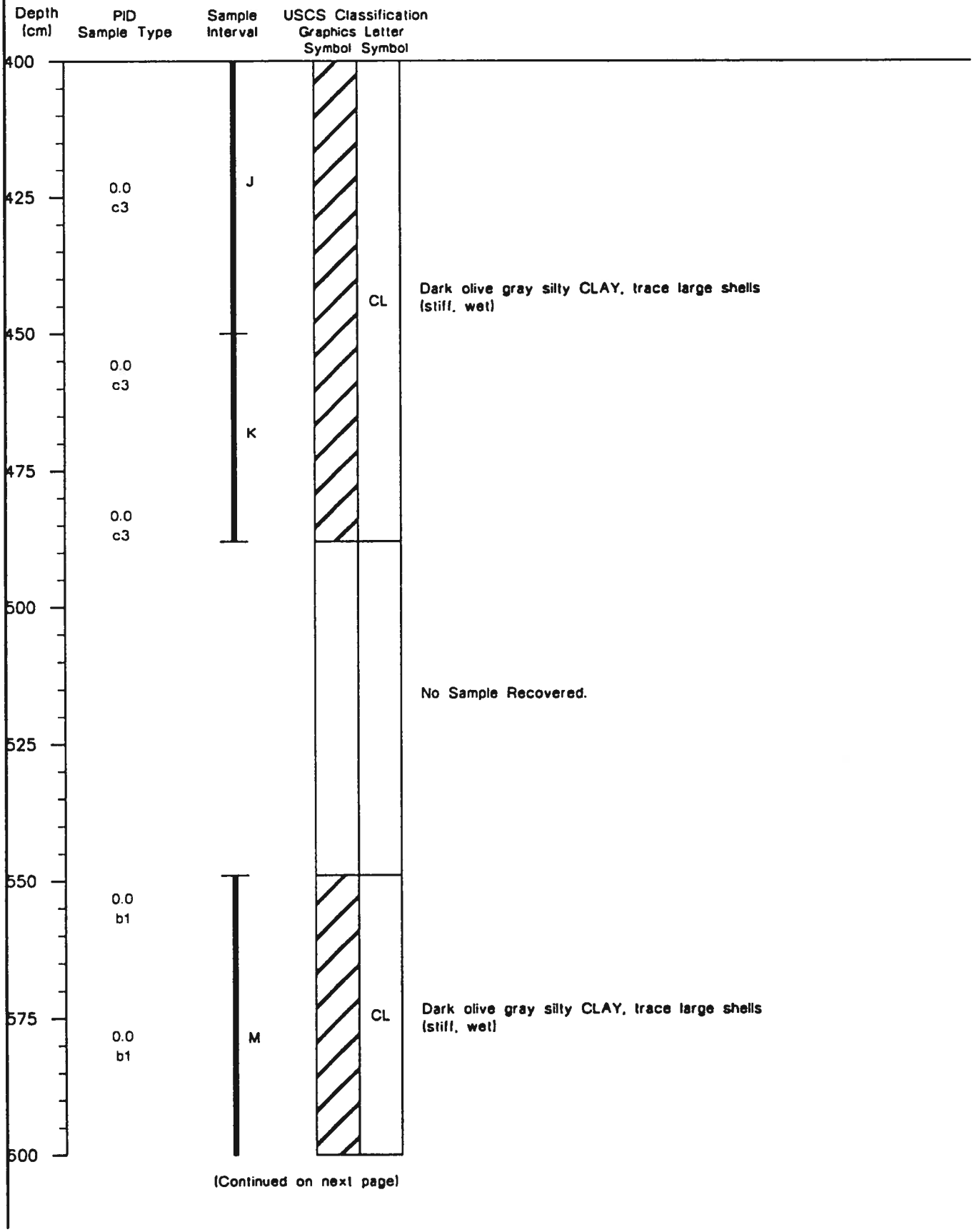
Core H2
(continued)



Log of Sediment Core H2

Figure B-32
(2 of 4)

Core H2
(continued)



(Continued on next page)

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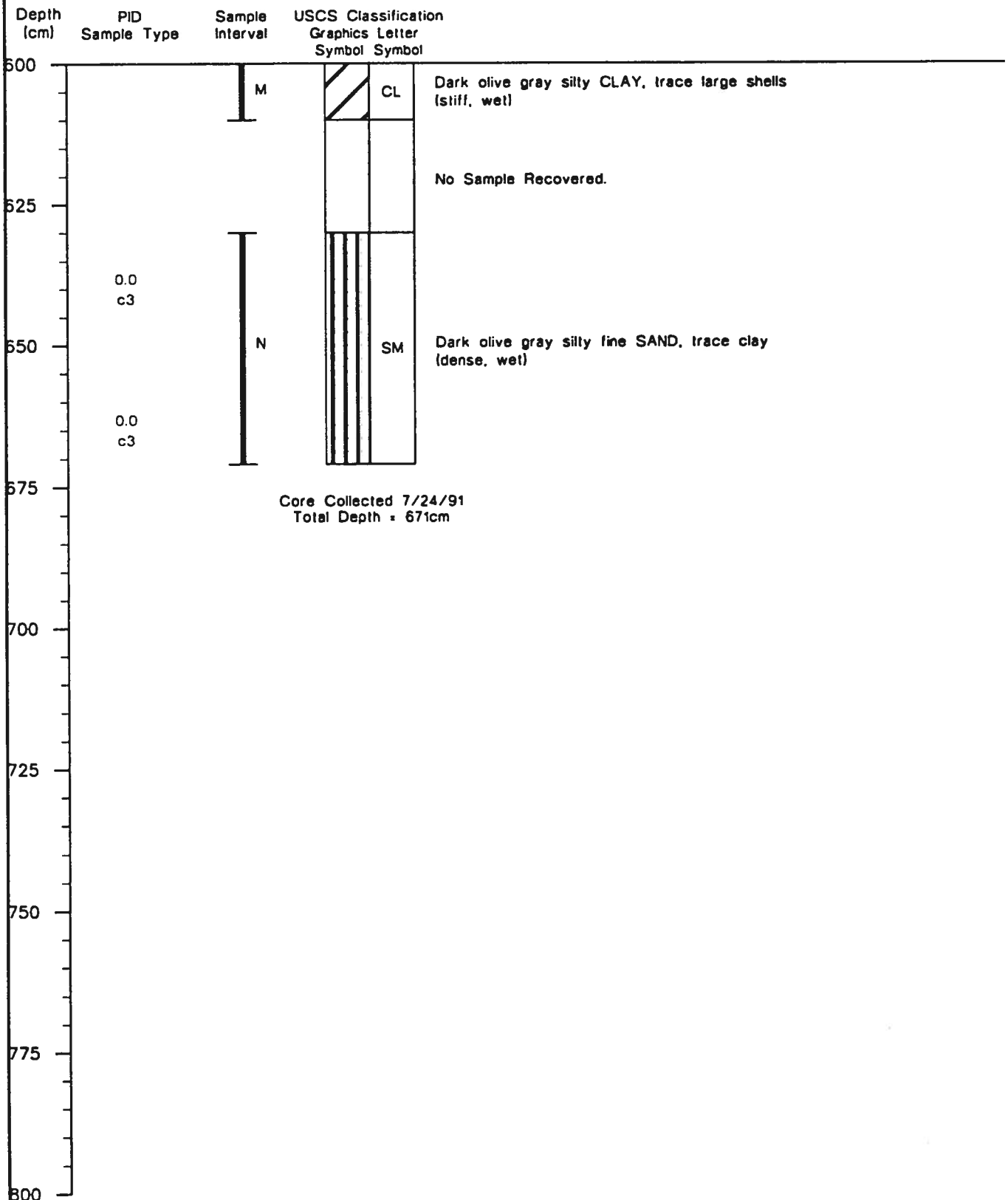
Log of Sediment Core H2

Figure B-32
(3 of 4)

Core H2
(continued)

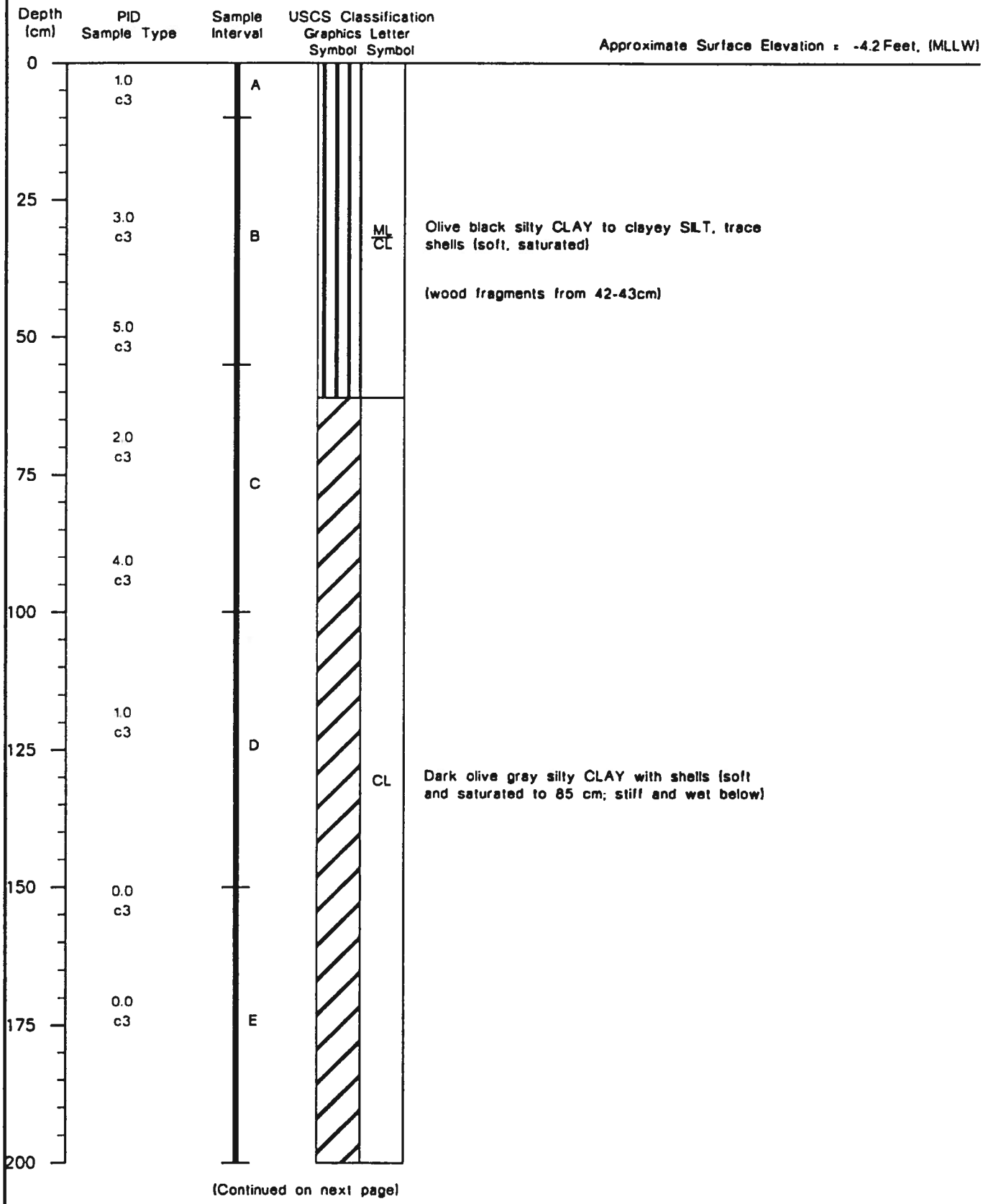


Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. No odor; no visible sheen.
4. Very slight white discoloration on outer surface of core from 13-19cm and 427-488cm.

Log of Sediment Core H2

Figure B-32
(4 of 4)

Core H3



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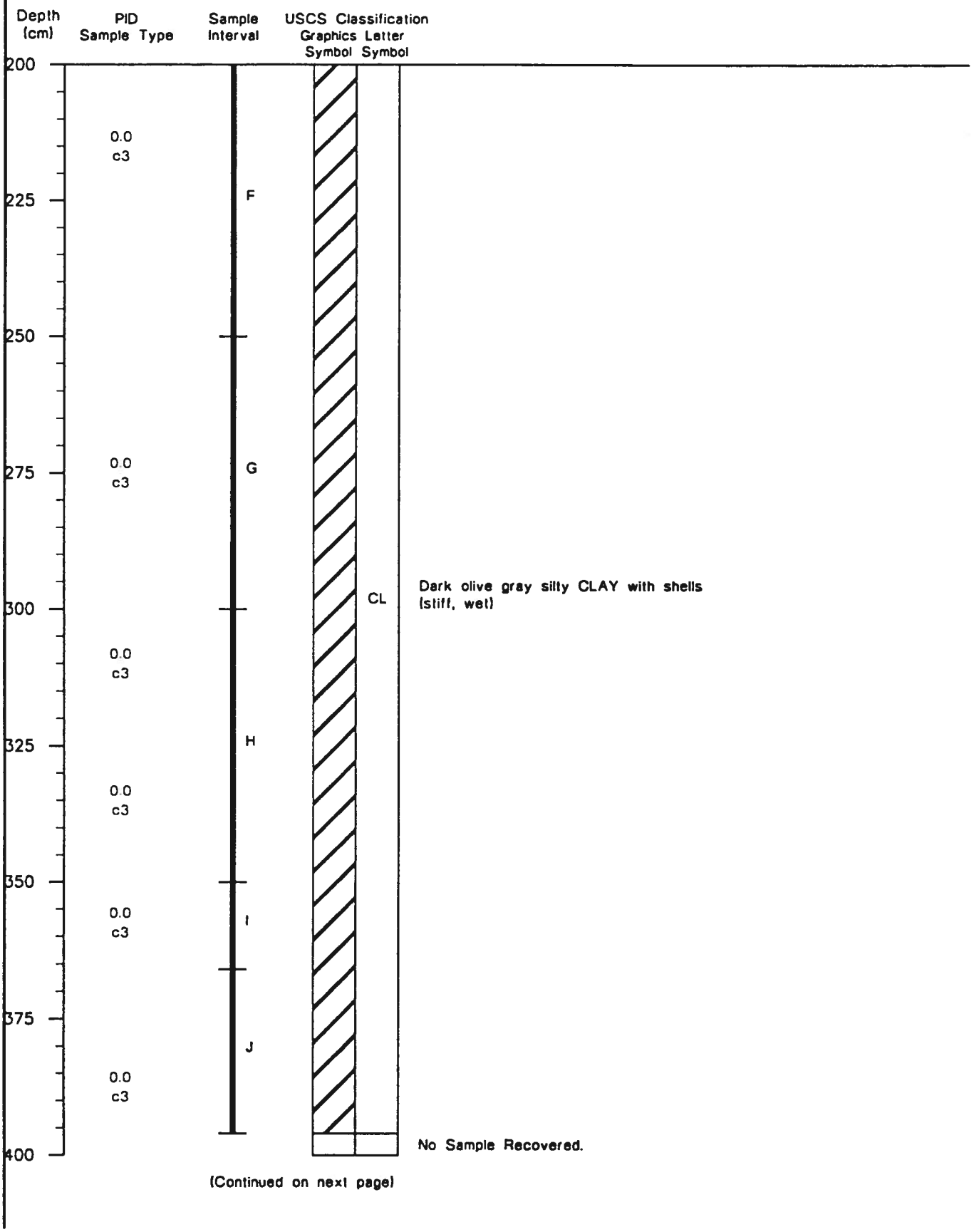
Log of Sediment Core H3

Figure B-33
(1 of 4)

Core H3
(continued)



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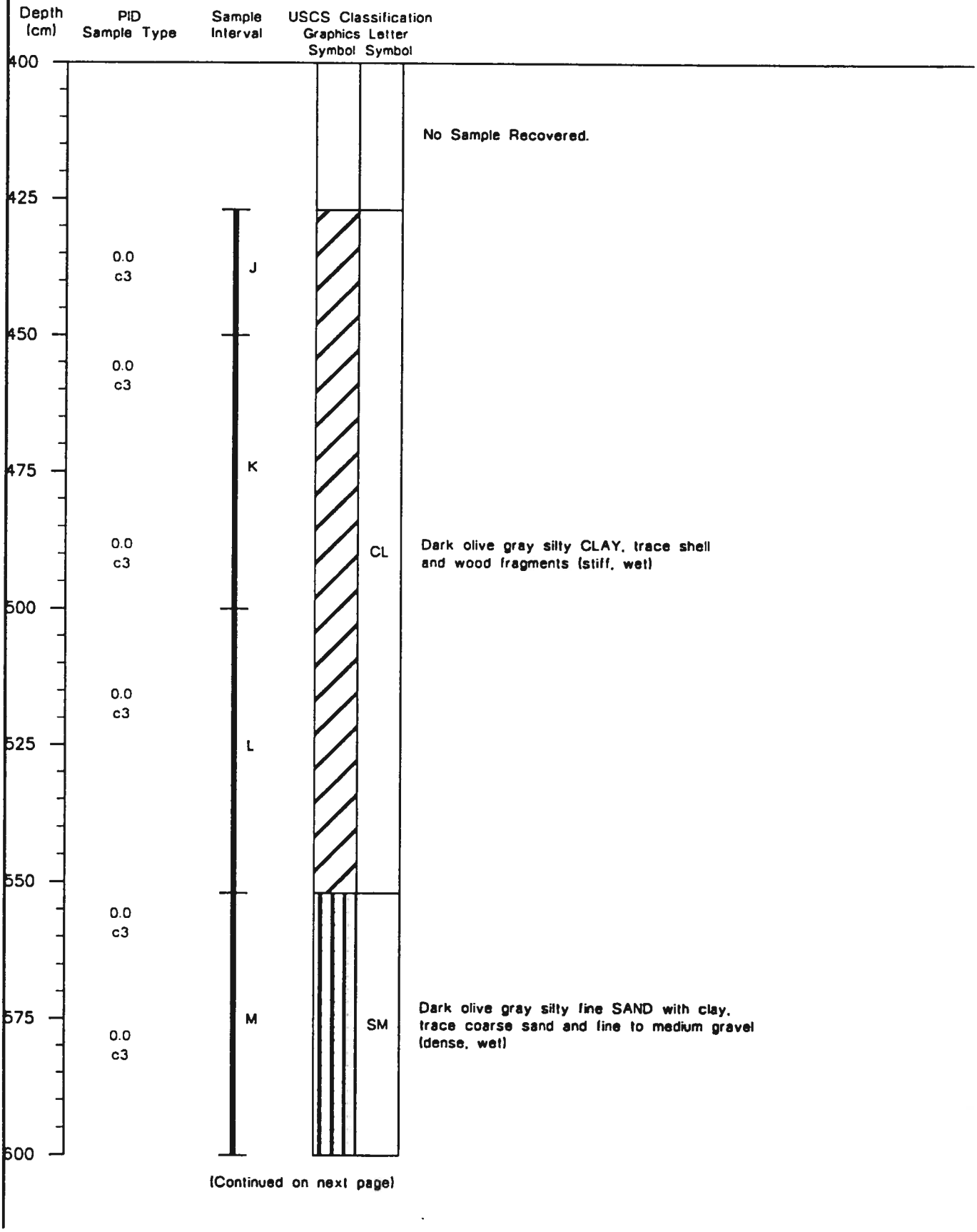
Log of Sediment Core H3

Figure B-33
(2 of 4)

Core H3
(continued)



(Continued on next page)

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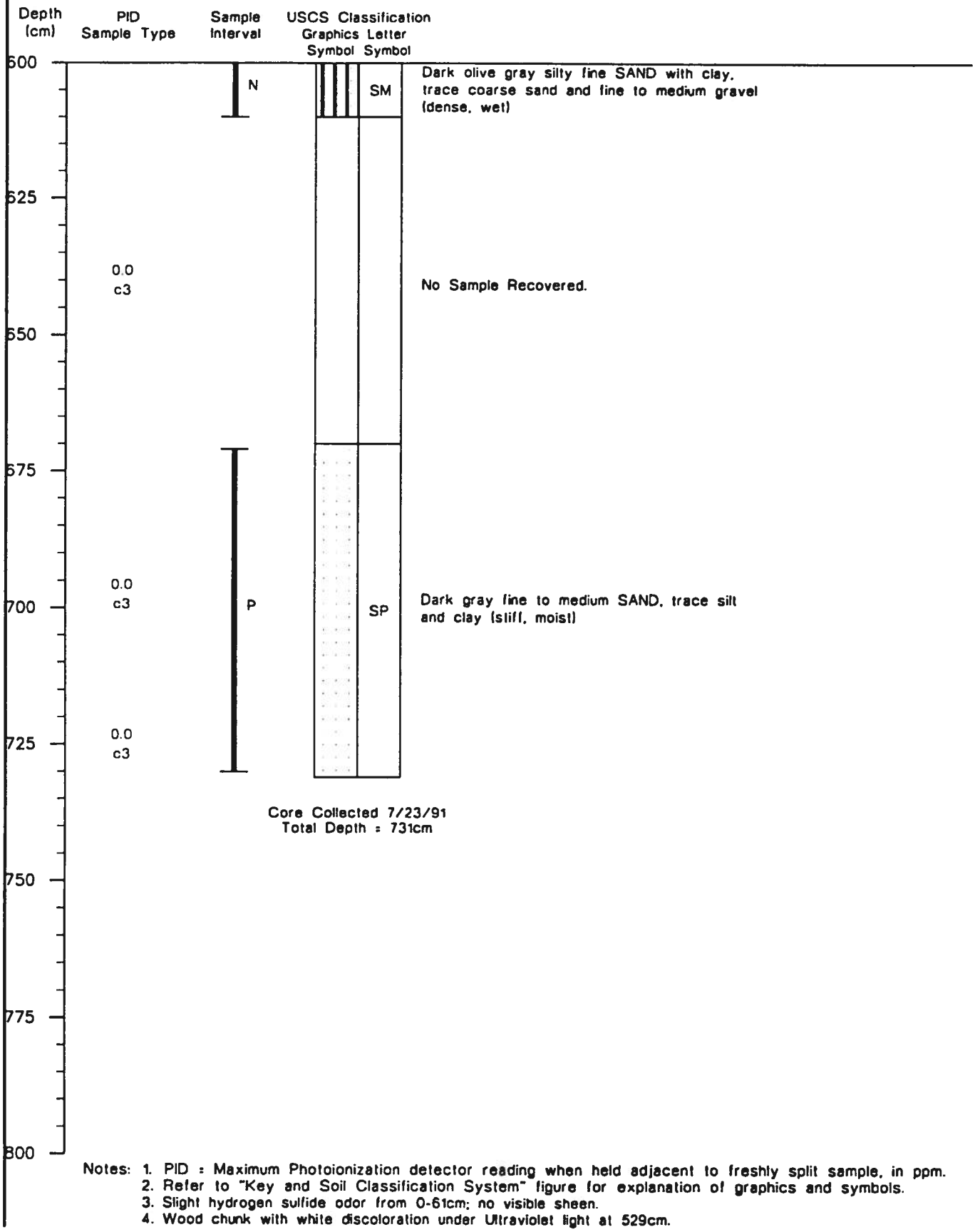
Log of Sediment Core H3

Figure B-33
(3 of 4)

Core H3
(continued)



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor from 0-61cm; no visible sheen.
4. Wood chunk with white discoloration under Ultraviolet light at 529cm.

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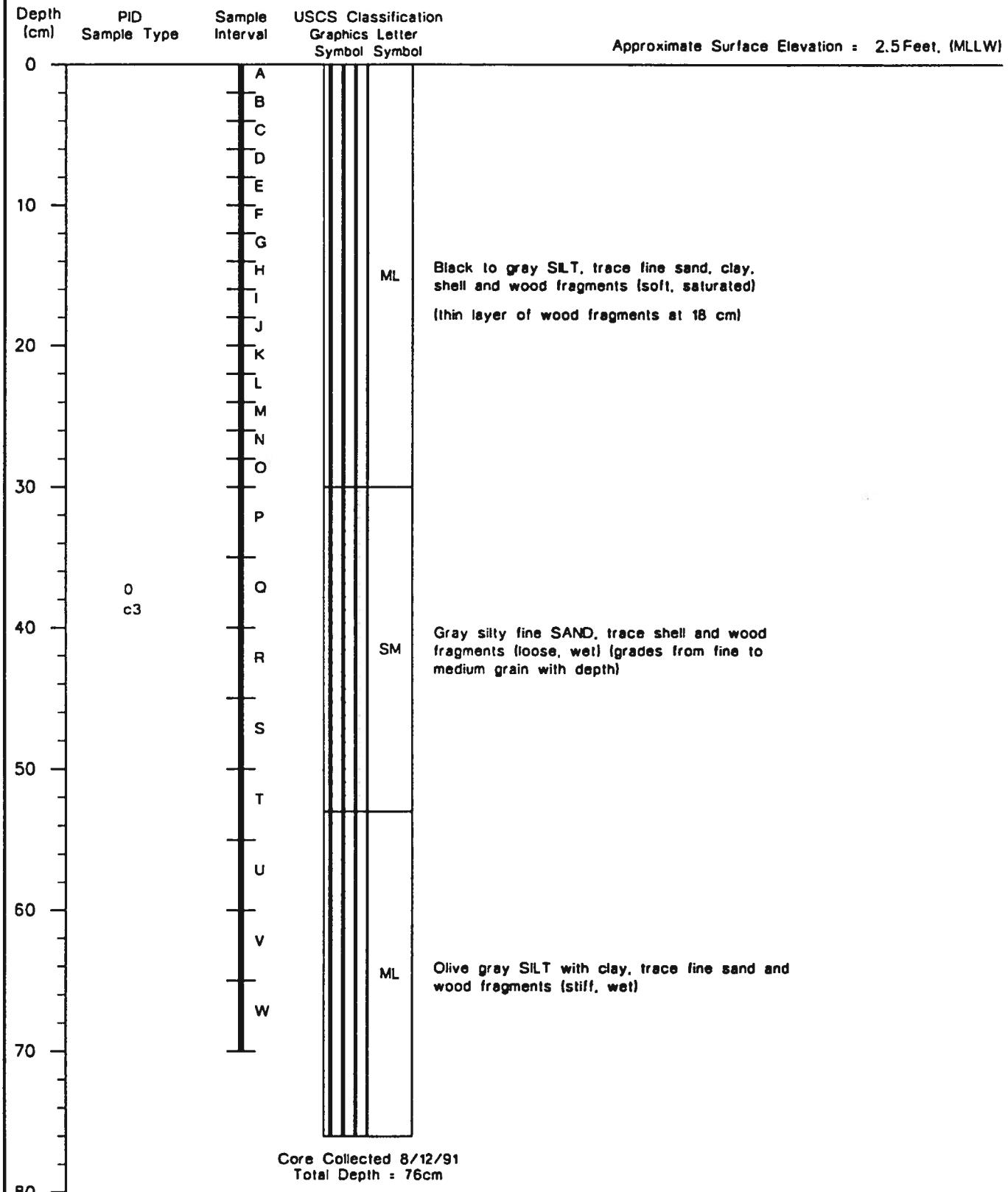
Log of Sediment Core H3

Figure B-33
(4 of 4)

Core H4



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; no visible sheen.
4. No response under Ultraviolet light.

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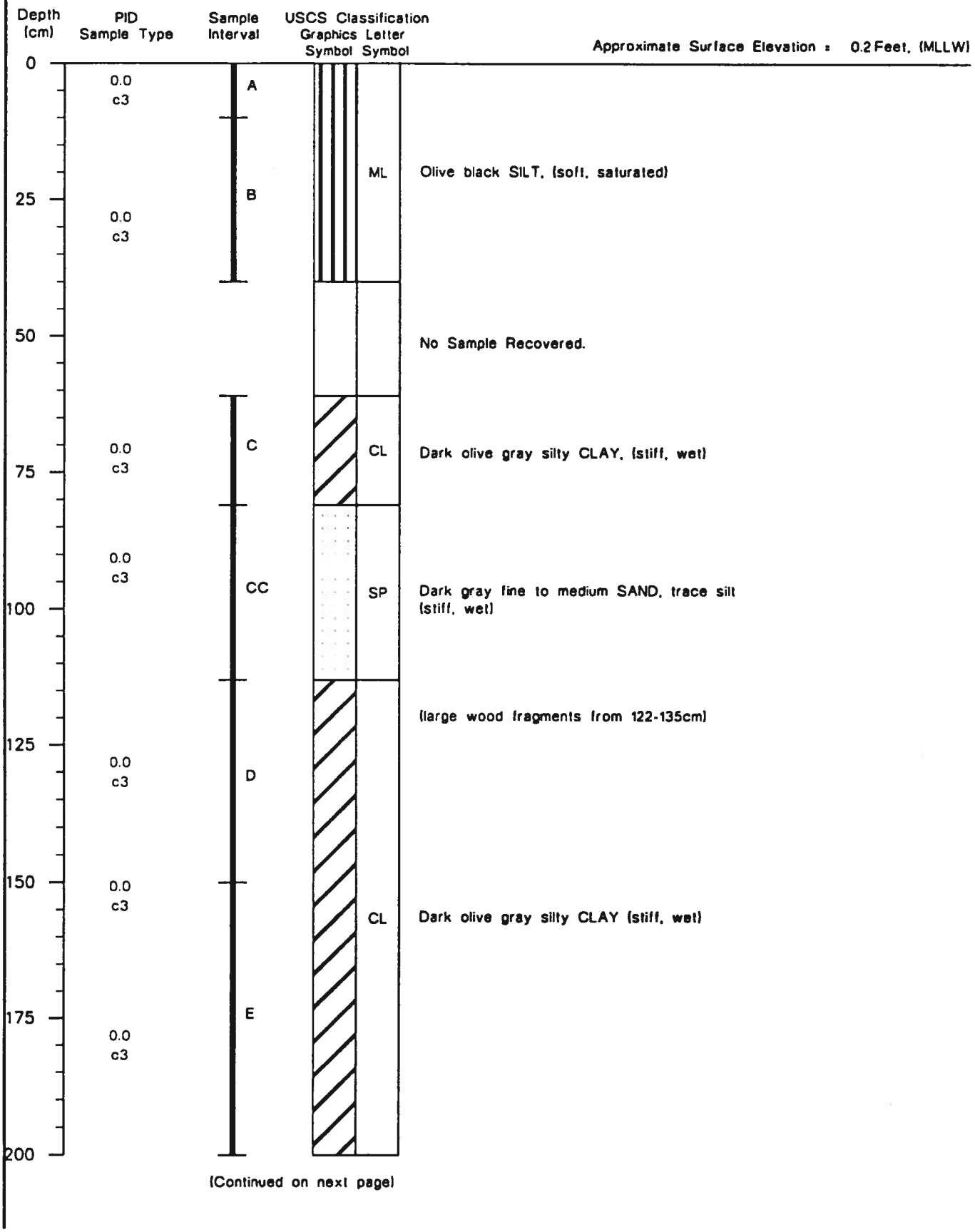
Log of Sediment Core H4	Figure B-34

Core H5



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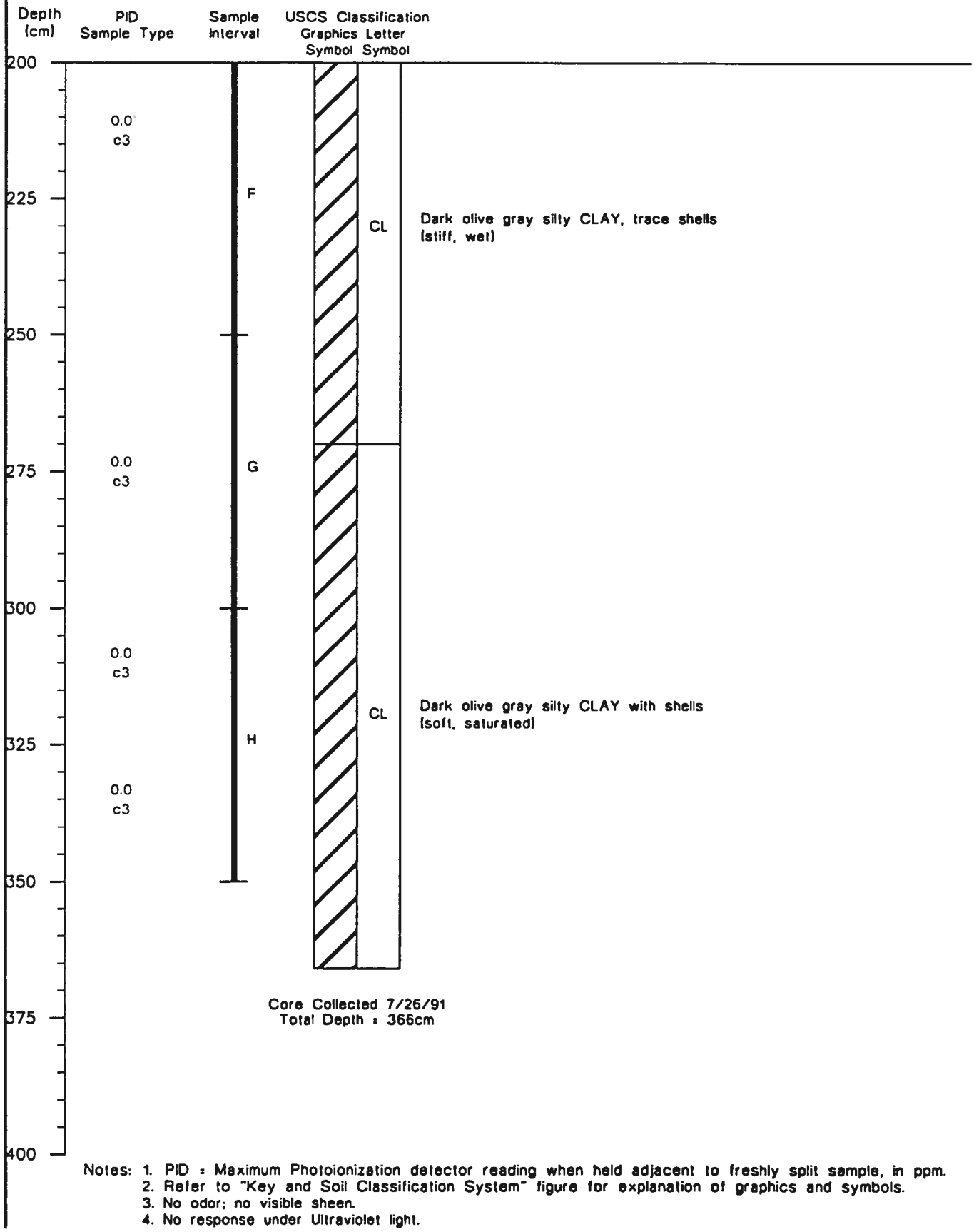
	Log of Sediment Core H5	Figure B-35 (1 of 2)

Core H5
(continued)



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. No odor; no visible sheen.
4. No response under Ultraviolet light.

Log of Sediment Core H5

Figure B-35
(2 of 2)

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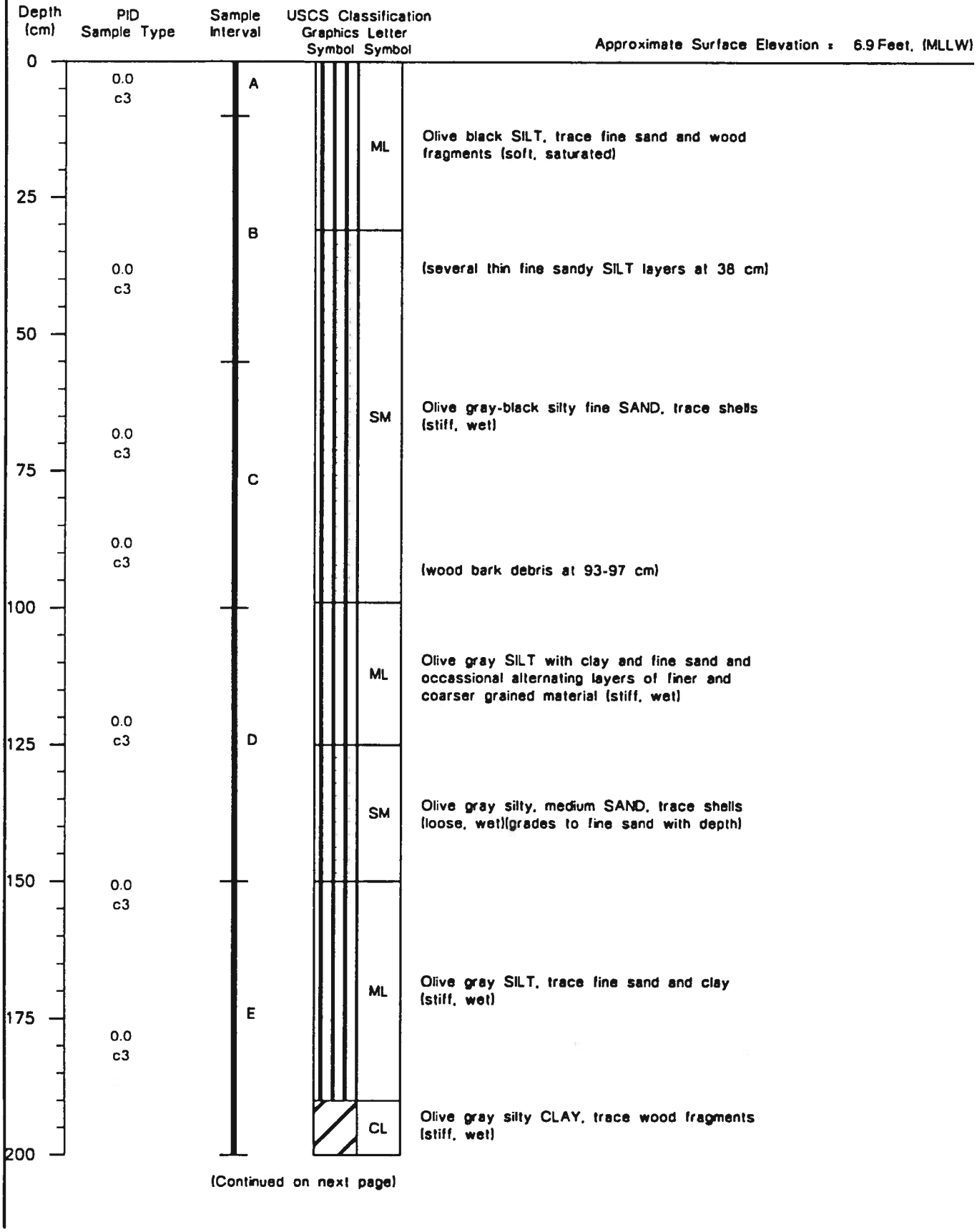
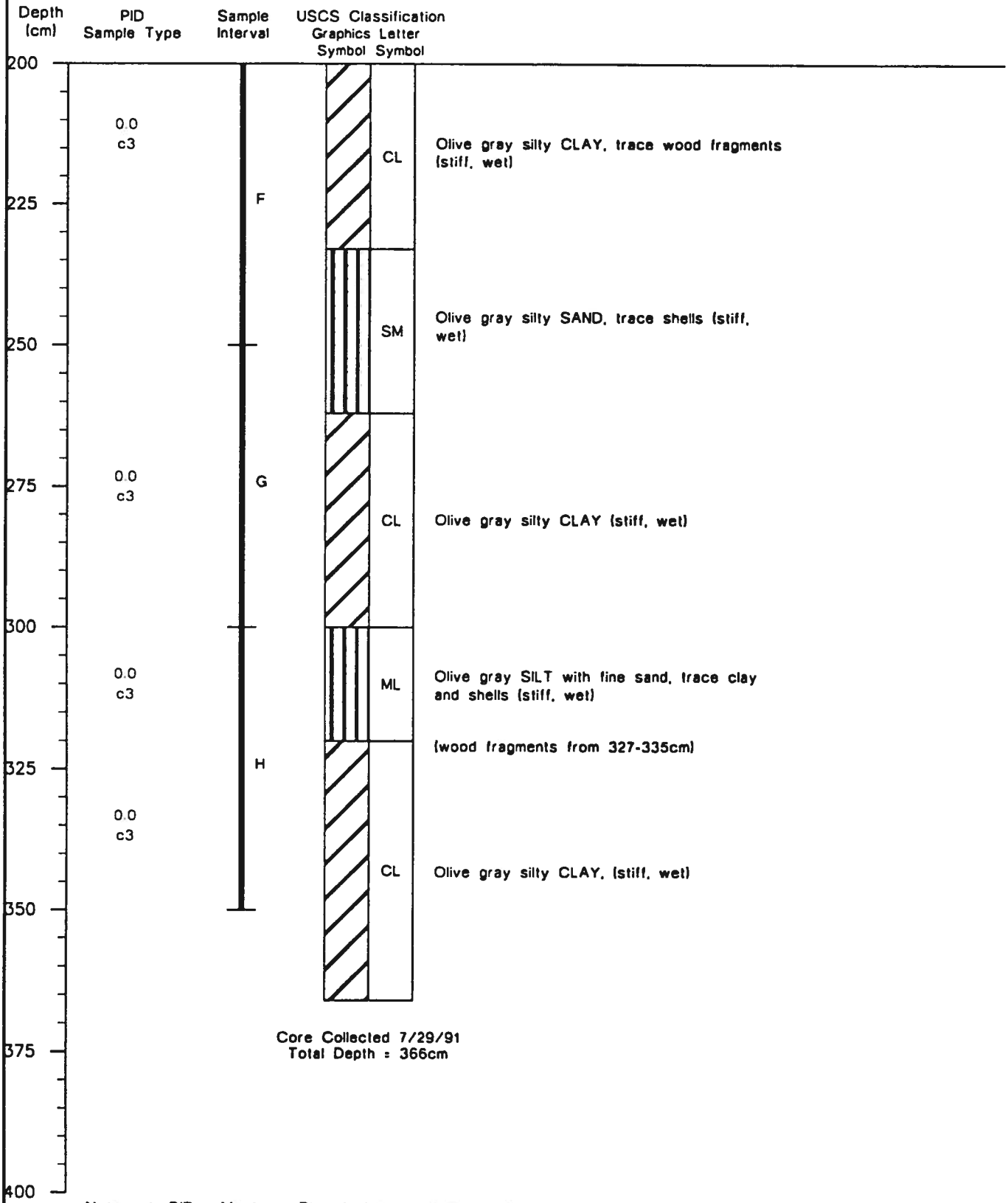
Core H6



Log of Sediment Core H6

Figure B-36
(1 of 2)

Core H6
(continued)



Core Collected 7/29/91
Total Depth = 366cm

Notes: 1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; no visible sheen.
4. No response under Ultraviolet light.

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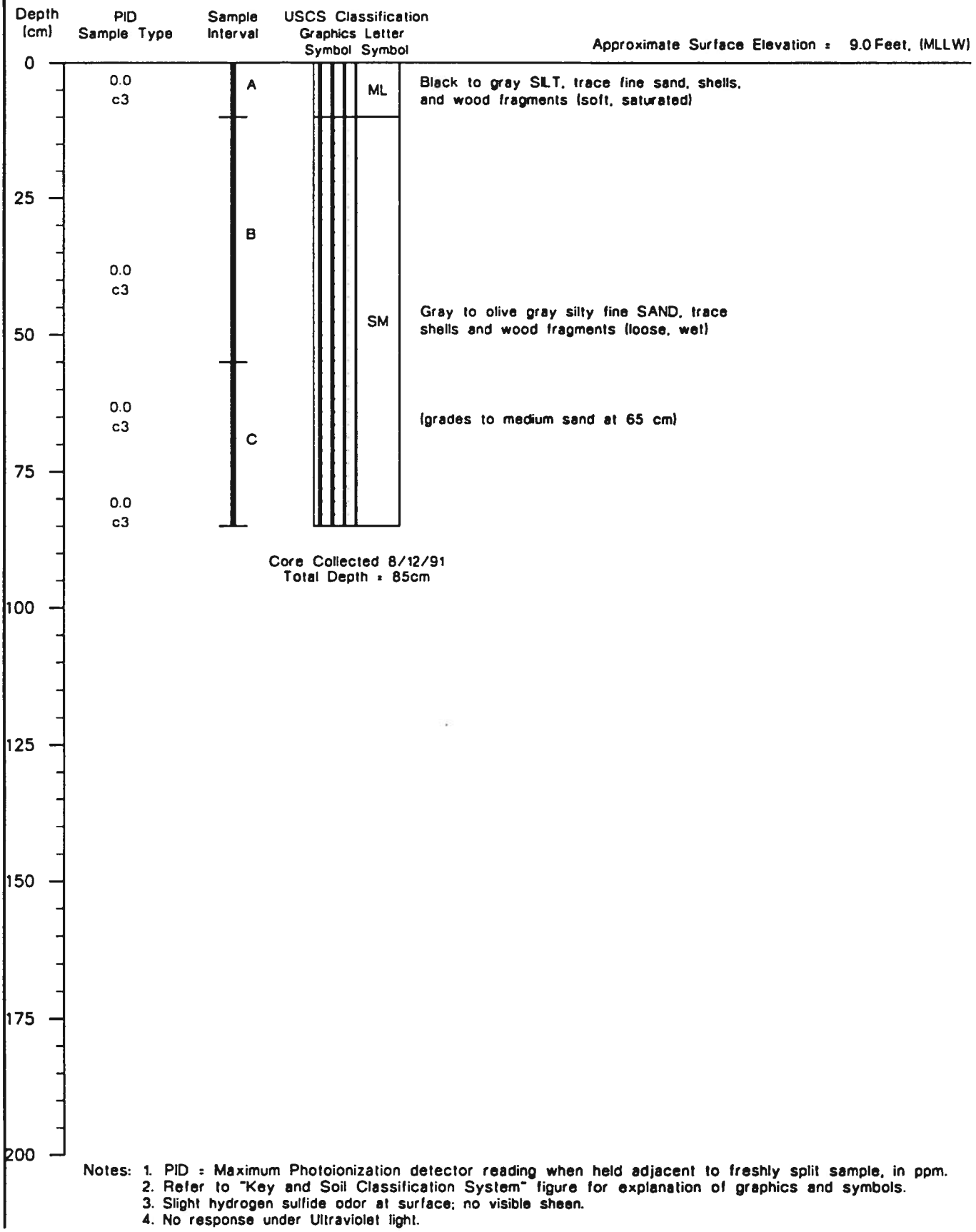
Log of Sediment Core H6

Figure B-36
(2 of 2)

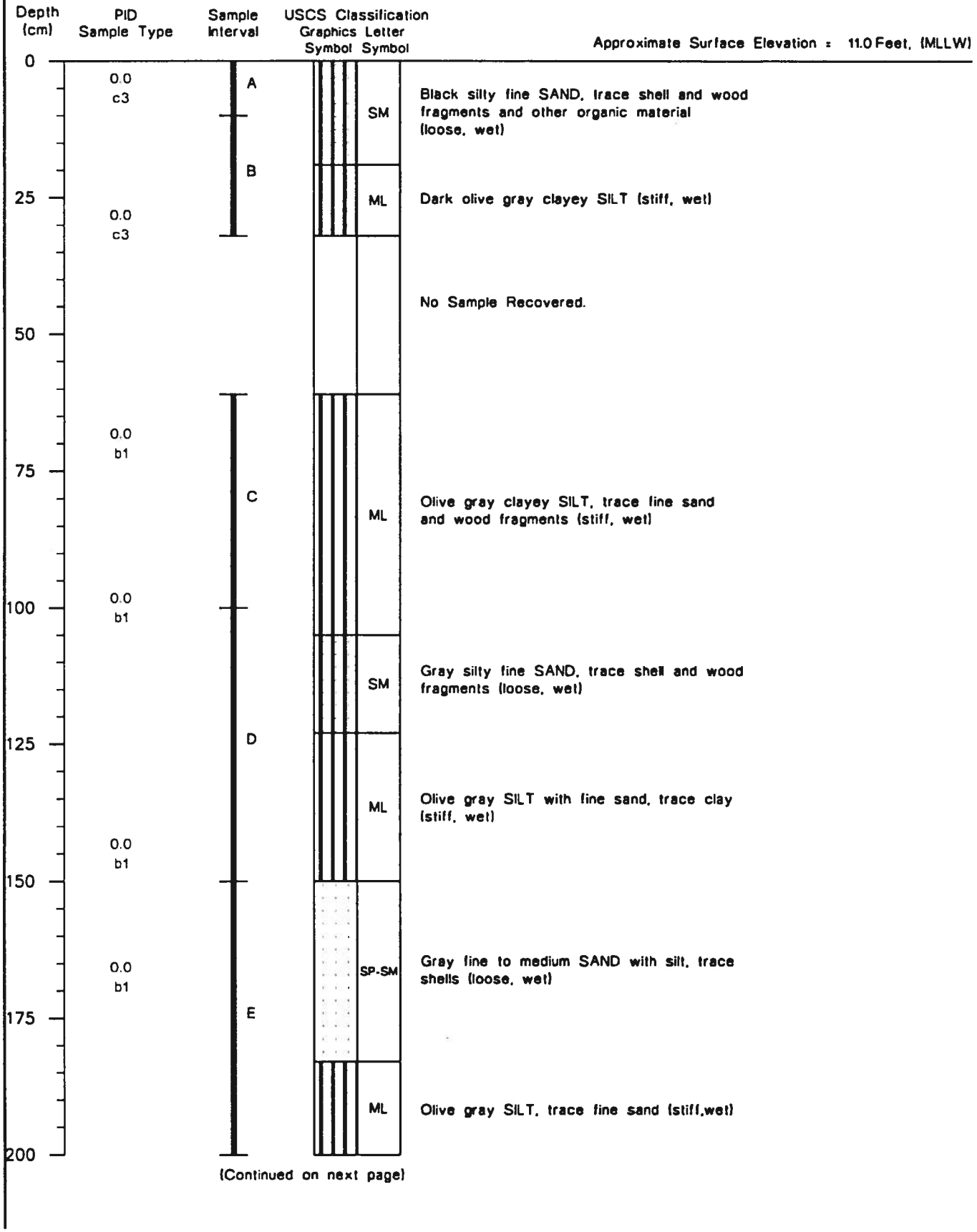
Core H7



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; no visible sheen.
4. No response under Ultraviolet light.

Log of Sediment Core H7 | Figure B-37

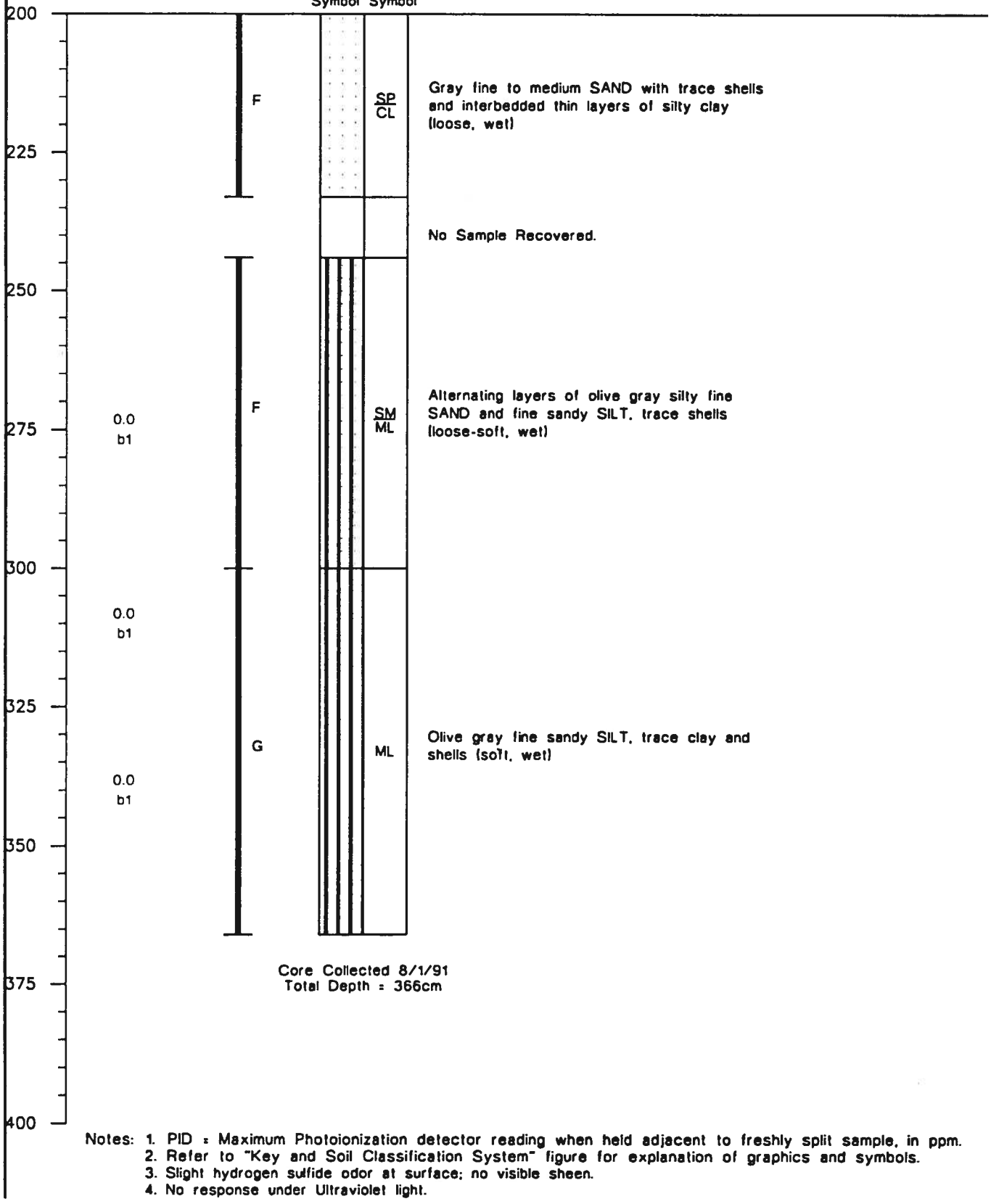
Core H8



Log of Sediment Core H8

Figure B-38
(1 of 2)

Core H8
(continued)



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; no visible sheen.
4. No response under Ultraviolet light.

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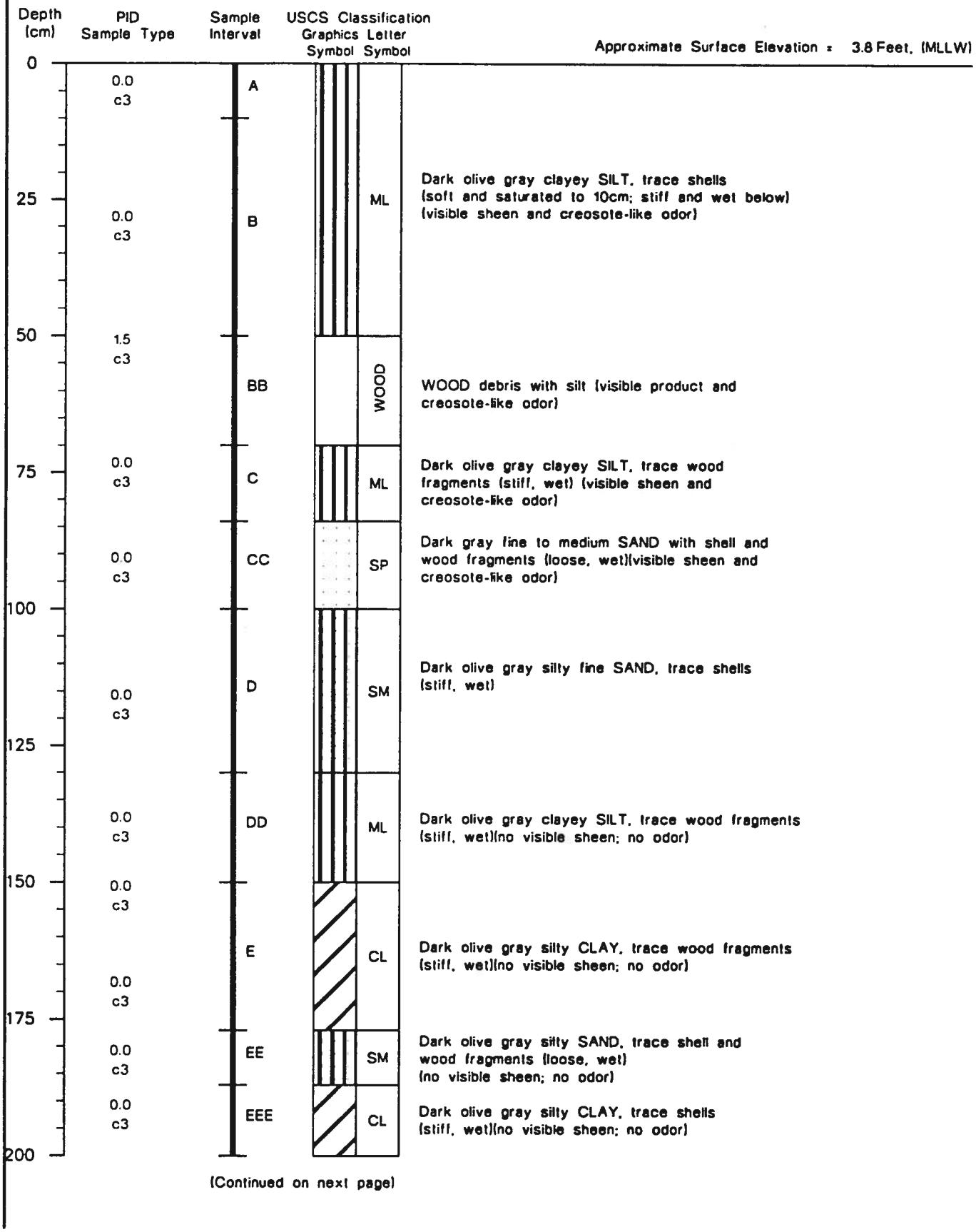
Log of Sediment Core H8

Figure B-38
(2 of 2)

Core H9



(Continued on next page)

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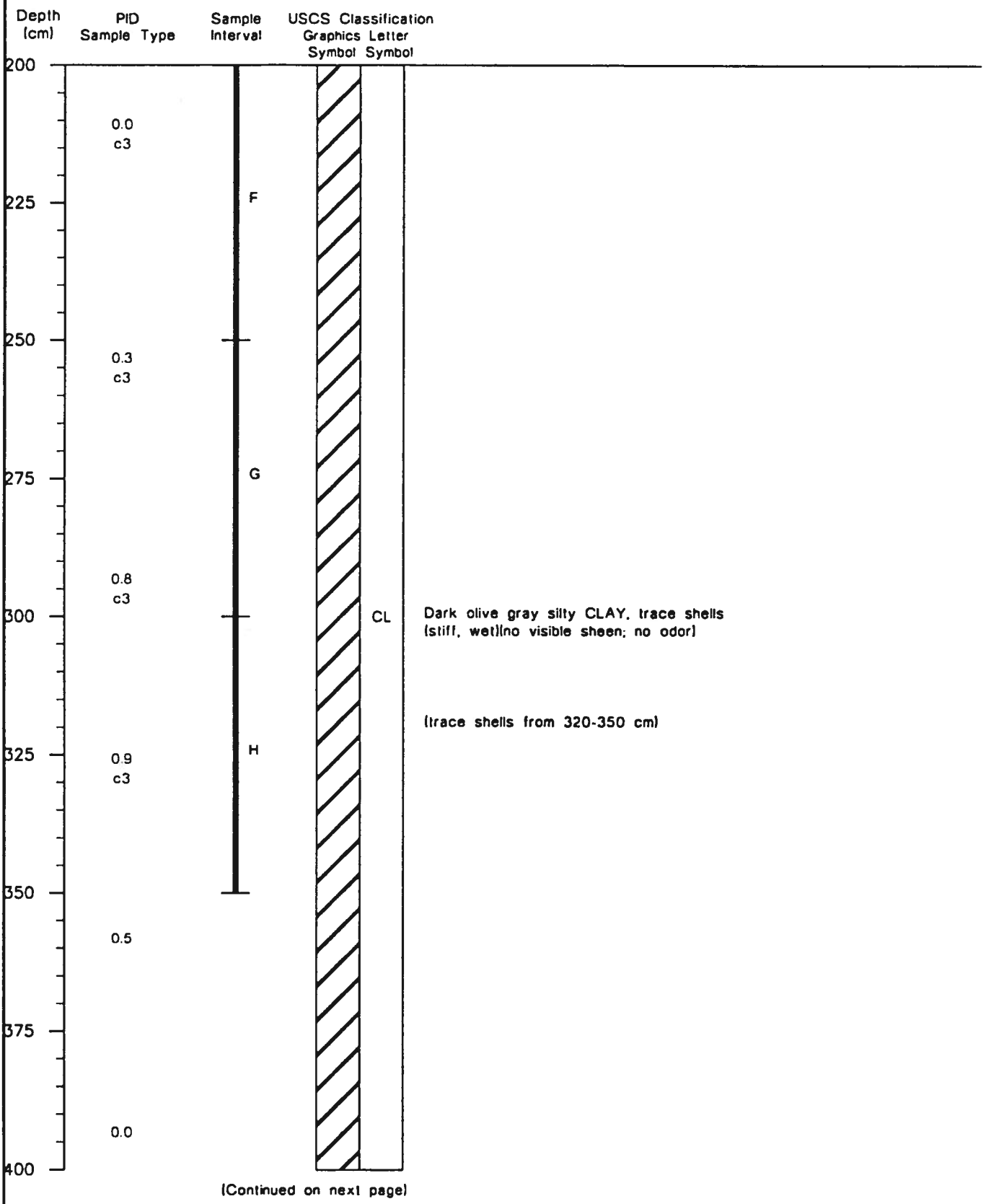
Log of Sediment Core H9

Figure B-39 (1 of 3)

Core H9
(continued)



(Continued on next page)

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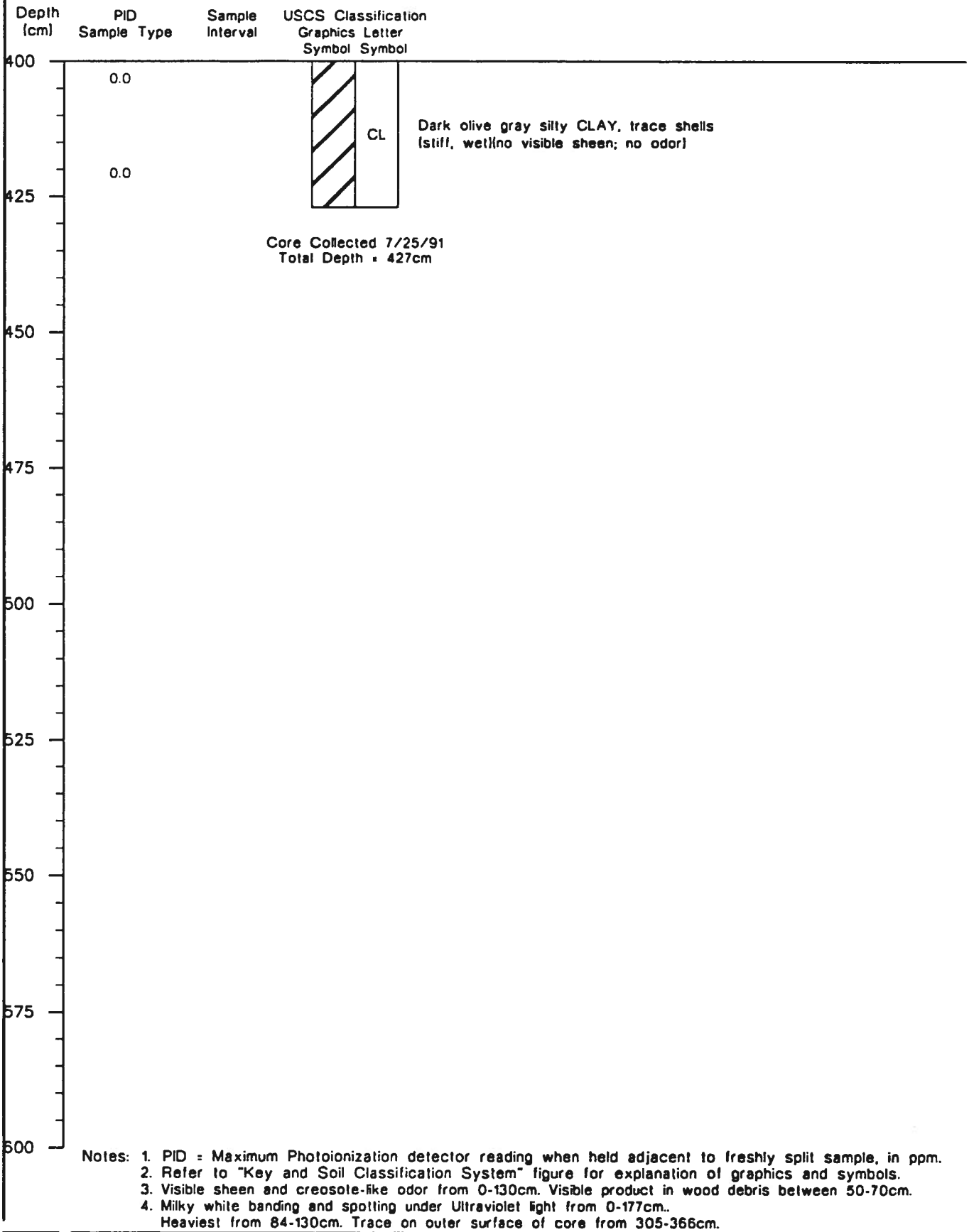
Log of Sediment Core H9

Figure B-39
(2 of 3)

Core H9
(continued)

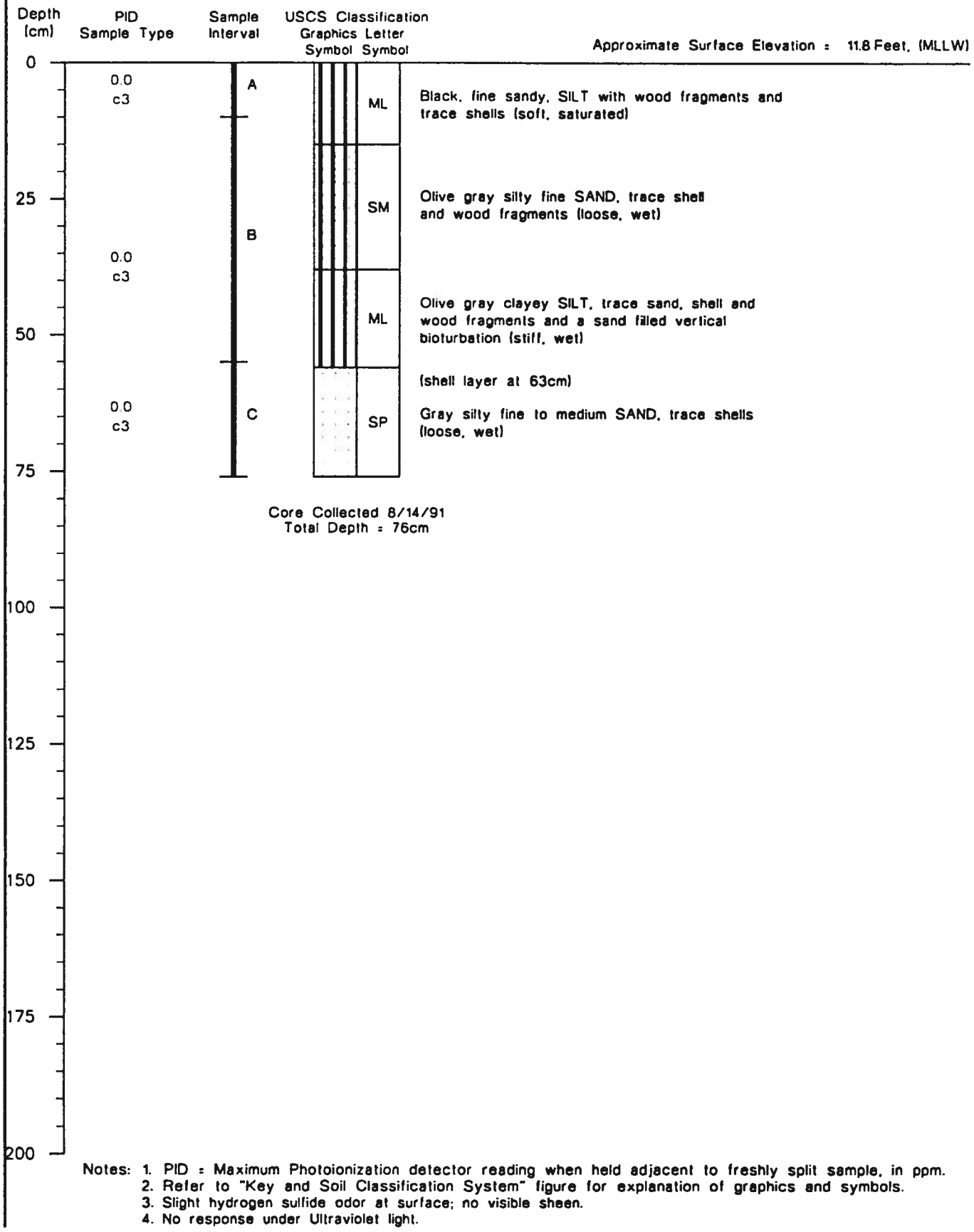


Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Visible sheen and creosote-like odor from 0-130cm. Visible product in wood debris between 50-70cm.
4. Milky white banding and spotting under Ultraviolet light from 0-177cm.. Heaviest from 84-130cm. Trace on outer surface of core from 305-366cm.

Log of Sediment Core H9

Figure B-39 (3 of 3)

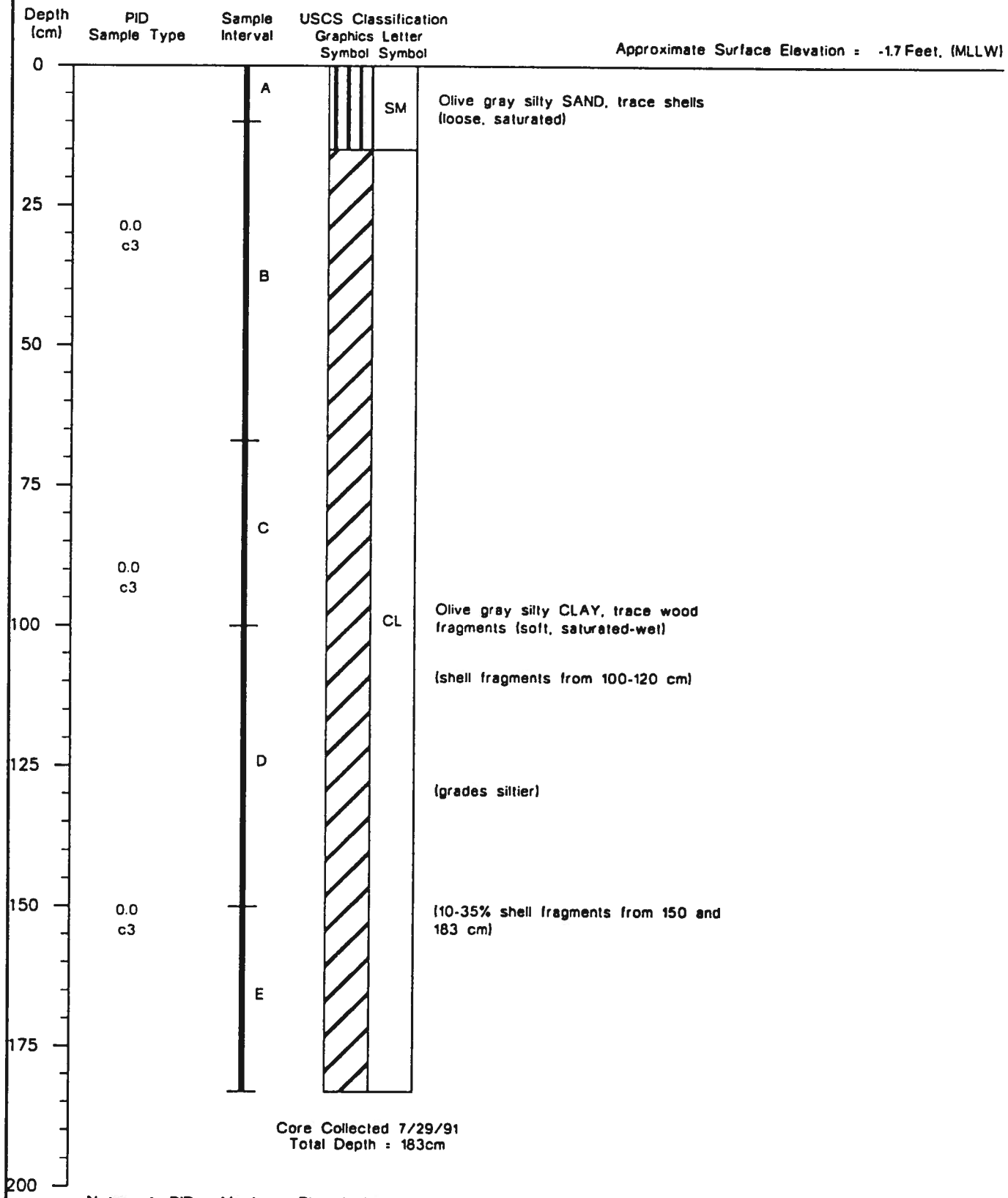
Core H10



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor at surface; no visible sheen.
4. No response under Ultraviolet light.

Log of Sediment Core H10 | Figure B-40

Core H11



Notes:
1. PID = Maximum Photoionization detector reading when held adjacent to freshly split sample, in ppm.
2. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.
3. Slight hydrogen sulfide odor; slight oily sheen associated with wood fragments between 0-60cm.
4. No response under Ultraviolet light.

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Log of Sediment Core H11 | Figure B-41

APPENDIX C

Chemistry Data Tables

- Table C-1 Guide to Sample Numbering System and Data Qualifiers
- Table C-2 Remedial Investigation Sediment Chemistry
- Table C-3 Remedial Investigation Sediment Chemistry (Recalculated to Reflect TOC and TEF)
- Table C-4 Remedial Investigation Phase II Water Chemistry
- Table C-5 Remedial Investigation Phase II Tissue Chemistry

TABLE C-1

GUIDE TO SAMPLE NUMBERING SYSTEM AND DATA QUALIFIERS

SAMPLE NUMBERING SYSTEM

CP# - media code - location name - depth interval code

Where:

CP =	Cascade Pole Site
# =	Sampling Phase
Media Code =	M for marine sediment; W for background water samples; WC for Site surface water column samples; WP for Site ponded surface water samples; C for clam tissue; B for bioassay or benthic diversity samples.
Location Name =	Sample Station Identifier.
Depth Code =	

a = 0-10 cm	k = 450-500 cm
b = 10-55 cm	l = 500-550 cm
c = 55-100 cm	m = 550-600 cm
d = 100-150 cm	n = 600-650 cm
e = 150-200 cm	o = 650-700 cm
f = 200-250 cm	p = 700-750 cm
g = 250-300 cm	q = 750-800 cm
h = 300-350 cm	s = 800-850 cm
i = 350-400 cm	t = 850-900 cm
j = 400-450 cm	r = rinsate blank

Note that for sample intervals that were subsectioned on the basis of lithologic changes, a double letter was used (e.g., CC) to identify the subsection.

When duplicates were taken, the location names changed from a single 0-9 location to a corresponding 11-19 location (e.g., the duplicate sample from C2A was identified as C12A). The only exceptions to this are the water samples taken at Stations H12, H13, and H14.

DATA QUALIFIERS

B =	Analyte was also detected in the associated method blank.
J =	Analyte was positively identified, but the associated numerical value is estimated.
JB =	Analyte was positively identified, but the associated numerical value is estimated, and the reported sample concentration is within 5 times or 10 times the blank concentration.
EMPC =	Reported value is an estimated maximum possible concentration.
S =	Response of a specific PCDD/PCDF isomer exceeded the normal range of the mass spectrometer detection system. The corresponding signal was saturated and the reported analyte concentration is a "minimum estimate" regardless of whether or not the ion-abundance ratio or the retention time criteria were met. When the S qualifier is associated with the reporting of "totals", its use is to warn the data user of the existence of one (not necessarily from a specific isomer) or more saturated signals for a given class of compounds.
PR =	Presence of "poorly resolved" GC peaks. This is normally used for specific analytes only.
Q =	Warns data user of the existence of a "quantitative interference." The reported concentrations and percent recoveries may be questionable.
R =	Analyte quantification was rejected during a data quality review.
U =	Analyte was not detected; value presented is the sample detection limit
UJ =	Analyte was analyzed for, but not detected at a sample quantitation limit that is an estimated quantity.
* =	Not confirmed with second column.
D =	Reported value is based on a diluted sample aliquot.

After each sample result, there are at times multiple data qualifiers separated by commas. Any qualifier(s) before the first comma represents the data qualifier(s) assigned by the analytical laboratory. Qualifiers after the first comma represent the data qualifiers assigned following a data quality review per the QAPP.

TABLE C-1 (continued)

GUIDE TO SAMPLE NUMBERING SYSTEM AND DATA QUALIFIERS

Sediment Quality Standards and Cleanup Screening Level values were taken from Ecology's Sediment Management Standards (WAC 173-204).

The sums of individual compounds may differ slightly from reported totals (e.g., LPAH, HPAH, TPAH) due to rounding. Rounding may also affect the reported values less than 0.5 mg/kg organic carbon.

DATA SUMMATIONS, TRANSFORMATIONS, AND REPORTING

A blank in the table signifies that the sample was not analyzed for that analyte.

Note that where chemical concentrations in this table represent the sum of individual compounds or isomers and a chemical analysis identifies an undetected value for one or more individual compounds or isomers, the nondetected chemical was included in the sum of the respective compounds or isomers at a concentration equal to the detection limit.

On Table C-3, PAH and dibenzofuran concentrations are "normalized," or expressed, on a total organic carbon basis, as "mg/kg organic carbon." To normalize to total organic carbon, the dry weight concentration for each parameter was divided by the decimal fraction representing the percent total organic carbon content (dry weight) of the sediment sample. For example:

Sample CP1-M-A1A:
Acenaphthene concentration equals 250 µg/kg dry weight
TOC equals 2.08 percent
250 µg/kg x (1 mg/1,000 µg) x (1/0.0208) = 12 mg/kg organic carbon

To be consistent with the Sediment Management Standards, the LPAH sums do not include 2-methylnaphthalene.

Also in Table C-3, dioxin and furan data for individual isomers are expressed as equivalents of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), also referred to as Toxicity Equivalents (TEQs). This is a procedure that provides a method for consistently interpreting the significance of the concentrations of the various dioxin and furan isomers in the environment. It is accomplished by multiplying the reported concentrations for specified isomers by Toxicity Equivalency Factors (TEF) published by EPA (EPA 1989). The isomers that are included in the TEQ calculation, and each associated TEF are as shown in the following table:

Compound	Toxicity Equivalency Factors
Mono-, Di-, and TriCDDs	0
2,3,7,8-TCDD	1
Other TCDDs	0
2,3,7,8-PeCDD	0.5
Other PeCDDs	0
2,3,7,8-HxCDDs	0.1
Other HxCDDs	0
2,3,7,8-HpCDD	0.01
Other HpCDDs	0
OCDD	0.001
Mono-, Di-, and TriCDFs	0
2,3,7,8-TCDF	0.1
Other TCDFs	0
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
Other PeCDFs	0
2,3,7,8-HxCDFs	0.1
Other HxCDFs	0
2,3,7,8-HpCDFs	0.01
Other HpCDFs	0
OCDF	0.001

Reference: Adapted from NATO/CCMS, 1988a in EPA 1989.

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-A1A 12/06/90 surface to 10cm	CP1-M-A2A 12/06/90 surface to 10cm	CP2-M-A2A 07/25/1991 surface to 10 cm	CP2-M-A2B 07/25/1991 10 to 55 cm	CP2-M-A2C 07/25/1991 55 to 75 cm
PAH (ug/kg DB)					
Acenaphthene	250	75		55 U	220
Acenaphthylene	59 U	57 U		55 U	46 U
Anthracene	340	140		190	450
Fluorene	200	48 J		55 U,	200
Naphthalene	1200	460		590	1100
Phenanthrene	430	170		320	440
2-Methylnaphthalene	100	57 U		55 U	91
Total LPAH	2600	1000		1300	2500
Benzo(a)anthracene	280	150		230	760
Benzo(a)pyrene	290	220		210	770
Benzo(b)fluoranthene	550	370		230	970
Benzo(g,h,i)perylene	57 J	57 U		55 U,	200
Benzo(k)fluoranthene	170	130		350	550
Chrysene	710	300		510	1800
Dibenz(a,h)anthracene	59 U	57 U		55 U,	82
Fluoranthene	1600	330		570	550
Indeno(1,2,3-cd)pyrene	59 U	57 U		55 U,	210
Pyrene	2000	1300		1400	3000
Total HPAH	5800	3000		3700	8900
Total Carcinogenic PAH	2100	1300		1600	5100
Total PAH	8400	4000		5000	11000
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	2400 U,UJ	2400 U,UJ		R	R
2,4-Dichlorophenol	630 J	48 U,UJ		47 U	330 ,J
2,4,5-Trichlorophenol	12 U	12 U		12 U	9.6 U
2,4,6-Trichlorophenol	12 U	12 U		12 U	9.6 U
Tetrachlorophenol	12 U	12 U		12 U	9.6 U
Pentachlorophenol	17 B	11 B		19 *,J	9.2 *,J
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin			0.003	0.005	
2,3,7,8-tetra-CD-Dioxin			0.002 EM,J	0.002 EM,J	
Total penta-CD-Dioxin			0.04 Q,J	0.02 Q,J	
1,2,3,7,8-penta-CD-Dioxin			0.009	0.01	
Total hexa-CD-Dioxin			1.1	1.1	
1,2,3,4,7,8-hexa-CD-Dioxin			0.02	0.03 EM,J	
1,2,3,6,7,8-hexa-CD-Dioxin			0.11	0.13	
1,2,3,7,8,9-hexa-CD-Dioxin			0.1	0.07	
Total hepta-CD-Dioxin			11.8	13.7	
1,2,3,4,6,7,8-hepta-CD-Dioxin			4.8	5.3	
Octachlorodibenzo-Dioxin			38.3 B,	43.3 B,	
Total Dioxin			51.2	58.1	
FURANS (ug/kg DB)					
Dibenzofuran	190	50 J		55 U	180
Total tetra-CD-Furan			0.02	0.02	
2,3,7,8-tetra-CD-Furan			0.006	0.006	
Total penta-CD-Furan			0.02	0.02	
1,2,3,7,8-penta-CD-Furan			0.009	0.01	
2,3,4,7,8-penta-CD-Furan			0.01	0.009	
Total hexa-CD-Furan			1.8	10.4	
1,2,3,6,7,8-hexa-CD-Furan			0.01	0.1 U,	
1,2,3,4,7,8-hexa-CD-Furan			0.1	0.31	
1,2,3,7,8,9-hexa-CD-Furan			0.02 U,	0.46	
2,3,4,6,7,8-hexa-CD-Furan			0.13 PR,	0.2 U,	
Total hepta-CD-Furan			2.8	7.2	
1,2,3,4,6,7,8-hepta-CD-Furan			0.43	0.41	
1,2,3,4,7,8,9-hepta-CD-Furan			0.05	0.14	
Octadichlorodibenzo-Furan			1.1 B,	1.3 B,	
Total Furan			5.74	18.9	
METALS (mg/kg DB)					
Antimony	0.5 U,UJ	0.5 U,UJ			
Arsenic	3.5 ,J	6.6 ,J			
Cadmium	1.9	1.9			
Chromium	32	35			
Copper	55	55			
Lead	22	18			
Mercury	0.08	0.08			
Nickel	27	30			
Silver	1 U	1 U			
Zinc	100	88			
CONVENTIONALS (%)					
Total Solids	41.2	41.5		43	52
Total Organic Carbon	2.08	1.19		6.494	3.4969

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-A2D 07/25/1991 100 to 150 cm	CP1-M-A3A 12/06/90 surface to 10cm	CP1-M-A4A 12/06/90 surface to 10cm	CP1-M-B1A 12/12/90 surface to 10cm	CP1-M-B1B 12/12/90 10 to 55 cm
PAH (ug/kg DB)					
Acenaphthene	5400	140	65	680	1800
Acenaphthylene	140	53 U	57 U	58	77
Anthracene	1800	140	92	350	540
Fluorene	2400	82	56 J	330	350
Naphthalene	3700	700	560	1200	1100
Phenanthrene	4000	290	180	830	1100
2-Methylnaphthalene	400	72	57 U	210	230
Total LPAH	18000	1500	1100	3700	5200
Benzo(a)anthracene	3200	180	170	470	890
Benzo(a)pyrene	1700	190	180	260	310
Benzo(b)fluoranthene	2400	310	290	450	540
Benzo(g,h,i)perylene	410	53 U	61	99	100
Benzo(k)fluoranthene	1000	110	90	190	160
Chrysene	3400	240	180 J	660	860
Dibenz(a,h)anthracene	41 U,	53 U	57 U	44 U	46 U
Fluoranthene	7100	350	520	1800	4500
Indeno(1,2,3-cd)pyrene	430	53 U	89	94	97
Pyrene	10000	910	820 J	1700	3200
Total HPAH	30000	2400	2500	5800	11000
Total Carcinogenic PAH	12000	1100	1100	2200	2900
Total PAH	48000	3900	3500	9400	16000
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	R		2400 U,UJ	1800 U,UJ	1900 U,UJ
2,4-Dichlorophenol	34 U		48 U,UJ	37 U,UJ	38 U,UJ
2,4,5-Trichlorophenol	8.6 U	11 U	12 U	9.2 U	9.6 U
2,4,6-Trichlorophenol	8.6 U	11 U	12 U	9.2 U	9.6 U
Tetrachlorophenol	8.6 U	11 U	12 U	9.2 U	9.6 U
Pentachlorophenol	13 *,J	5.6 B,UJ	3.6 B,UJ	4.7	1.9
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin				0.03	
2,3,7,8-tetra-CD-Dioxin				0.003 U	
Total penta-CD-Dioxin				0.01 Q,J	
1,2,3,7,8-penta-CD-Dioxin				0.001 U	
Total hexa-CD-Dioxin				0.27	
1,2,3,4,7,8-hexa-CD-Dioxin				0.003	
1,2,3,6,7,8-hexa-CD-Dioxin				0.03	
1,2,3,7,8,9-hexa-CD-Dioxin				0.01	
Total hepta-CD-Dioxin				3.5	
1,2,3,4,6,7,8-hepta-CD-Dioxin				1.4	
Octachlorodibenzo-Dioxin				10.2	
Total Dioxin				14.0	
FURANS (ug/kg DB)					
Dibenzofuran	1500	84	73	320	46 U
Total tetra-CD-Furan				0.008	
2,3,7,8-tetra-CD-Furan				0.002	
Total penta-CD-Furan				0.03	
1,2,3,7,8-penta-CD-Furan				0.002 EM,J	
2,3,4,7,8-penta-CD-Furan				0.003 EM,J	
Total hexa-CD-Furan				0.13	
1,2,3,6,7,8-hexa-CD-Furan				0.009 EM,J	
1,2,3,4,7,8-hexa-CD-Furan				0.003	
1,2,3,7,8,9-hexa-CD-Furan				0.003 U	
2,3,4,6,7,8-hexa-CD-Furan				0.005	
Total hepta-CD-Furan				0.35	
1,2,3,4,6,7,8-hepta-CD-Furan				0.08	
1,2,3,4,7,8,9-hepta-CD-Furan				0.006	
Octadichlorodibenzo-Furan				0.41	
Total Furan				0.928	
METALS (mg/kg DB)					
Antimony		0.5 U,UJ		0.5 U,UJ	0.5 U,UJ
Arsenic		6.5 J		6.1 J	6.9 J
Cadmium		2.3		1.2	1.4
Chromium		35		26	33
Copper		65		42	53
Lead		18		7.5 J	7.8 J
Mercury		0.12		0.05	0.05
Nickel		28		23	29
Silver		1 U		1 U	1 U
Zinc		96		43	54
CONVENTIONALS (%)					
Total Solids	58	44.8	41.8	53.6	51.7
Total Organic Carbon	3.2002	2.56	2.65	2.32	4.58

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-B1C 12/12/90 55 to 100 cm	CP1-M-B2A 12/10/90 surface to 10cm	CP1-M-B2B 12/10/90 10 to 55 cm	CP1-M-B2C 12/10/90 55 to 100 cm	CP1-M-B3A 12/11/90 surface to 10cm
PAH (ug/kg DB)					
Acenaphthene	99	410	44000	14000	230
Acenaphthylene	32 J	150	1300	430	86
Anthracene	120	1200	26000	11000	1200
Fluorene	78	370	30000	10000	240
Naphthalene	490 B,UJ	970	4500	10000	1000
Phenanthrene	360	2400	50000	25000	660
2-Methylnaphthalene	39 J	150	560	2200	110
Total LPAH	1200	5700	160000	73000	3500
Benzo(a)anthracene	110	1900	18000	8500	340
Benzo(a)pyrene	72	890	7500	5800	320
Benzo(b)fluoranthene	100	1400	11000	8900	1600 J
Benzo(g,h,i)perylene	47 U	260	2400	2000	230
Benzo(k)fluoranthene	40 J	1900 J	4200	3100	730 J
Chrysene	120	2700	16000	8100	610
Dibenz(a,h)anthracene	47 U	77	140 J	150 J	56
Fluoranthene	430	6600	53000	33000	870
Indeno(1,2,3-cd)pyrene	47 U	280	2200	2000	240
Pyrene	310	5100	36000	180 U	1000
Total HPAH	1300	21000	150000	72000	6000
Total Carcinogenic PAH	540	9100	59000	37000	3900
Total PAH	2500	27000	310000	140000	9500
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	2000 U,UJ	2000 U,UJ	2000 U,UJ	1900 U,UJ	1900 U,UJ
2,4-Dichlorophenol	39 U,UJ	52 J	39 U,UJ	37 U,UJ	38 U,UJ
2,4,5-Trichlorophenol	9.8 U	10 U	9.8 U	9.3 U	9.6 U
2,4,6-Trichlorophenol	9.8 U	10 U	9.8 U	9.3 U	9.6 U
Tetrachlorophenol	9.8 U	10	50 U	23	18
Pentachlorophenol	2 U	15 B	14 JB	15 B	87
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin					
2,3,7,8-tetra-CD-Dioxin					
Total penta-CD-Dioxin					
1,2,3,7,8-penta-CD-Dioxin					
Total hexa-CD-Dioxin					
1,2,3,4,7,8-hexa-CD-Dioxin					
1,2,3,6,7,8-hexa-CD-Dioxin					
1,2,3,7,8,9-hexa-CD-Dioxin					
Total hepta-CD-Dioxin					
1,2,3,4,6,7,8-hepta-CD-Dioxin					
Octachlorodibenzo-Dioxin					
Total Dioxin					
FURANS (ug/kg DB)					
Dibenzofuran	56	220	16000	6600	190
Total tetra-CD-Furan					
2,3,7,8-tetra-CD-Furan					
Total penta-CD-Furan					
1,2,3,7,8-penta-CD-Furan					
2,3,4,7,8-penta-CD-Furan					
Total hexa-CD-Furan					
1,2,3,6,7,8-hexa-CD-Furan					
1,2,3,4,7,8-hexa-CD-Furan					
1,2,3,7,8,9-hexa-CD-Furan					
2,3,4,6,7,8-hexa-CD-Furan					
Total hepta-CD-Furan					
1,2,3,4,6,7,8-hepta-CD-Furan					
1,2,3,4,7,8,9-hepta-CD-Furan					
Octadichlorodibenzo-Furan					
Total Furan					
METALS (mg/kg DB)					
Antimony	0.5 U,UJ				
Arsenic	7.1 J				
Cadmium	1.6				
Chromium	30				
Copper	56				
Lead	7.3 J				
Mercury	0.06				
Nickel	27				
Silver	1 U				
Zinc	53				
CONVENTIONALS (%)					
Total Solids	50.9	50.4	50.9	53.5	52
Total Organic Carbon	2.9	2.69	9.27	3.49	3.68

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-B3B 12/11/90 10 to 55 cm	CP1-M-B3C 12/11/90 55 to 100 cm	CP1-M-B4A 12/06/90 surface to 10cm	CP1-M-B14A 12/07/90 Duplicate	CP1-M-B5A 12/13/90 surface to 10cm
PAH (ug/kg DB)					
Acenaphthene	100000	3300	210	240	240
Acenaphthylene	14000	180	210	120	31 J
Anthracene	240000	360	540	250	140
Fluorene	120000	2100	360	180	110
Naphthalene	180000	8200	1100	1000	630
Phenanthrene	230000	3600	1600	480	270
2-Methylnaphthalene	85000	2300	140	120	92
Total LPAH	970000	20000	4200	2400	1500
Benzo(a)anthracene	110000	150	420	130	140 J
Benzo(a)pyrene	36000	79	950	210	180
Benzo(b)fluoranthene	54000	260 J	1300	420	290
Benzo(g,h,i)perylene	13000	40 J	460	120	70 J
Benzo(k)fluoranthene	14000	100 J	200	180	110 J
Chrysene	77000	130	650 J	220	210 J
Dibenz(a,h)anthracene	990	47 U	140	59 U	52 U,UJ
Fluoranthene	350000	1100	2000	580	240
Indeno(1,2,3-cd)pyrene	13000	47 U	550	120	71 J
Pyrene	140000	560	1800 J	1500	560 J
Total HPAH	810000	2500	8500	3500	1900
Total Carcinogenic PAH	300000	810	4200	1300	1100
Total PAH	1800000	23000	13000	5900	3400
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	2300 J	2000 U,UJ	2100 U,UJ	2400 U,UJ	2200 U,UJ
2,4-Dichlorophenol	30 U,UJ	39 U,UJ	42 U,UJ	48 U,UJ	43 U,UJ
2,4,5-Trichlorophenol	7.5 U	9.8 U	11 U	12 U	11 U
2,4,6-Trichlorophenol	7.5 U	9.8 U	11 U	12 U	11 U
Tetrachlorophenol	7.5	9.8 U	11 U	12 U	11 U
Pentachlorophenol	7.5 U	2 U	6 B,UJ	14 B	8.4
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin					
2,3,7,8-tetra-CD-Dioxin					
Total penta-CD-Dioxin					
1,2,3,7,8-penta-CD-Dioxin					
Total hexa-CD-Dioxin					
1,2,3,4,7,8-hexa-CD-Dioxin					
1,2,3,6,7,8-hexa-CD-Dioxin					
1,2,3,7,8,9-hexa-CD-Dioxin					
Total hepta-CD-Dioxin					
1,2,3,4,6,7,8-hepta-CD-Dioxin					
Octachlorodibenzo-Dioxin					
Total Dioxin					
FURANS (ug/kg DB)					
Dibenzofuran	100000	2100	140	160	120
Total tetra-CD-Furan					
2,3,7,8-tetra-CD-Furan					
Total penta-CD-Furan					
1,2,3,7,8-penta-CD-Furan					
2,3,4,7,8-penta-CD-Furan					
Total hexa-CD-Furan					
1,2,3,6,7,8-hexa-CD-Furan					
1,2,3,4,7,8-hexa-CD-Furan					
1,2,3,7,8,9-hexa-CD-Furan					
2,3,4,6,7,8-hexa-CD-Furan					
Total hepta-CD-Furan					
1,2,3,4,6,7,8-hepta-CD-Furan					
1,2,3,4,7,8,9-hepta-CD-Furan					
Octadichlorodibenzo-Furan					
Total Furan					
METALS (mg/kg DB)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Silver					
Zinc					
CONVENTIONALS (%)					
Total Solids	67	51	46.6	41.4	46.4
Total Organic Carbon	4.67	4.19	2.99	3.51	3.47

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-B5B 12/13/90 10 to 55 cm	CP1-M-B5C 12/13/90 55-100 cm	CP2-M-BI1 08/13/1991 Background surface to 10 cm	CP2-M-BI11 08/13/1991 Background Duplicate	CP2-M-BI2 08/13/1991 Background surface to 10 cm
PAH (ug/kg DB)					
Acenaphthene	120	47 U	53 U	54 U	65 U
Acenaphthylene	30 J	47 U	53 U	54 U	65 U
Anthracene	180	31 J	110	110	94
Fluorene	77	47 U	64	79	65 U
Naphthalene	720	47 U	380	320	180
Phenanthrene	250	30 J	320	340	170
2-Methylnaphthalene	100	47 U	60	61	65 U
Total LPAH	1500	300	1000	1000	700
Benzo(a)anthracene	440 ,J	47 U	82	160	140
Benzo(a)pyrene	300	65	53 U,	150	150
Benzo(b)fluoranthene	350	47 U	230	210	260
Benzo(g,h,i)perylene	97 ,J	47 U	53	54 U,	68
Benzo(k)fluoranthene	230 ,J	47 U	150	180	160
Chrysene	670 ,J	47 U	160	190	320
Dibenz(a,h)anthracene	52 U,UJ	47 U	53 U,	54 U,	65 U,
Fluoranthene	270	25 J	610	620	340
Indeno(1,2,3-cd)pyrene	96 ,J	47 U	53 U,	54 U,	65 U,
Pyrene	590 ,J	47 U	540	520	330
Total HPAH	3100	470	2000	2200	1900
Total Carcinogenic PAH	2100	350	780	1000	1200
Total PAH	4600	760	3000	3200	2600
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	2200 U,UJ	2000 U,UJ	R	R	R
2,4-Dichlorophenol	43 U,UJ	39 U,UJ	44 U	45 U	54 U
2,4,5-Trichlorophenol	11 U	9.8 U	11 U	11 U	14 U
2,4,6-Trichlorophenol	11 U	9.8 U	11 U	11 U	14 U
Tetrachlorophenol	11 U	9.8 U	11 U	11 U	14 U
Pentachlorophenol	3.5	2 U	3 *,J	5.2 *,J	6.1 *,J
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin			0.0502 Q,J	0.0414	0.0328
2,3,7,8-tetra-CD-Dioxin			0.0018	0.0016	0.0012
Total penta-CD-Dioxin			0.256 Q,J	0.176 Q,J	0.0493 Q,J
1,2,3,7,8-penta-CD-Dioxin			0.0065	0.0067 EM,J	0.0031 EM,J
Total hexa-CD-Dioxin			0.947 Q,J	2.04 Q,J	0.292 Q,J
1,2,3,4,7,8-hexa-CD-Dioxin			0.0191	0.0795	0.012
1,2,3,6,7,8-hexa-CD-Dioxin			0.0597 ,U	0.0539 ,U	0.0254
1,2,3,7,8,9-hexa-CD-Dioxin			0.0607 PR,	0.151 PR,	0.0176 PR,
Total hepta-CD-Dioxin			2.84 Q,J	2.85 Q,J	0.912 Q,J
1,2,3,4,6,7,8-hepta-CD-Dioxin			1.37	1.3	0.432
Octachlorodibenzo-Dioxin			8.88 B,	8.97 B,	2.65 B,
Total Dioxin			13.0	14.1	3.94
FURANS (ug/kg DB)					
Dibenzofuran	75	47 U	59	61	65
Total tetra-CD-Furan			0.0895 Q,J	0.0217	0.0399
2,3,7,8-tetra-CD-Furan			0.0079 B,	0.0073 B,	0.0086 B,
Total penta-CD-Furan			0.0467 Q,J	0.0354	0.0193 Q,J
1,2,3,7,8-penta-CD-Furan			0.0055 ,	0.0072 ,U	0.0029 EM,J
2,3,4,7,8-penta-CD-Furan			0.0074	0.0074	0.0033
Total hexa-CD-Furan			0.265 Q,J	0.317 Q,J	0.174 Q,J
1,2,3,6,7,8-hexa-CD-Furan			0.011	0.0107	0.0049
1,2,3,4,7,8-hexa-CD-Furan			0.0333	0.0351	0.0143
1,2,3,7,8,9-hexa-CD-Furan			0.00096 EM,J	0.0061	0.00089
2,3,4,6,7,8-hexa-CD-Furan			0.0034	0.0247 PR,	0.0065 EM,J
Total hepta-CD-Furan			0.611 Q,J	0.662 Q,J	0.438 Q,J
1,2,3,4,6,7,8-hepta-CD-Furan			0.191	0.195	0.127
1,2,3,4,7,8,9-hepta-CD-Furan			0.015	0.0155	0.0091
Octadichlorodibenzo-Furan			0.336	0.358	0.176
Total Furan			1.35	1.39	0.847
METALS (mg/kg DB)					
Antimony			0.11 U,J	0.11 U,J	0.13 U,J
Arsenic			8.5	8.5	8.5
Cadmium			1.9	1.8	2
Chromium			28	28	24
Copper			43	44	49
Lead			42	40	17
Mercury			0.12	0.11	0.1
Nickel			23	22	20
Silver			0.7	0.71	0.37
Zinc			79	79	70
CONVENTIONALS (%)					
Total Solids	46.5	51.1	50 ,	50 ,	43 ,
Total Organic Carbon	3.94	2.3	2.4887 ,	2.6036 ,	4.3027 ,

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-BI3 08/13/1991 Background surface to 10 cm		CP1-M-C1A 12/13/90 surface to 10cm		CP1-M-C1B 12/13/90 10 to 55 cm		CP1-M-C1C 12/13/90 55 to 100 cm		CP2-M-C1E 07/22/1991 125 to 175 cm	
PAH (ug/kg DB)										
Acenaphthene	58	U	13000	J	150000	J	110000	J	40	U
Acenaphthylene	86		570	J	4100	J	2500	J	40	U
Anthracene	84		8900	J	60000	J	45000	J	42	
Fluorene	58	U,	11000	J	100000	J	67000	J	40	U,
Naphthalene	490		12000	J	190000	J	190000	J	410	
Phenanthrene	260		35000	J	230000	J	150000	J	230	
2-Methylnaphthalene	58	U	6700	J	150000	J	97000	J	40	U
Total LPAH	1100		87000		880000		660000		840	
Benzo(a)anthracene	58	U,	7000	J	34000	J	24000	J	40	U
Benzo(a)pyrene	58	U,	2300	J	13000	J	9500	J	570	
Benzo(b)fluoranthene	130		3400	J	23000	J	15000	J	40	U,
Benzo(g,h,i)perylene	58	U,	880	J	3700	J	3100	J	40	U,
Benzo(k)fluoranthene	74		1400	J	7300	J	6600	J	40	U,
Chrysene	58	U,	4700	J	24000	J	20000	J	40	U,
Dibenz(a,h)anthracene	58	U,	210	J	970	J	890	J	40	U,
Fluoranthene	390		24000	J	150000	J	120000	J	100	
Indeno(1,2,3-cd)pyrene	58	U,	890	J	3900	J	3100	J	40	U
Pyrene	420		16000	J	93000	J	77000	J	100	
Total HPAH	1400		61000		350000		280000		1100	
Total Carcinogenic PAH	490		20000		110000		79000		810	
Total PAH	2500		150000		1200000		940000		1900	
CHLORINATED PHENOLS (ug/kg DB)										
2-Chlorophenol	R		2400	UJ	21000	UJ	2100	UJ	1700	U
2,4-Dichlorophenol	49	U	48	UJ	420	UJ	42	UJ	34	U
2,4,5-Trichlorophenol	12	U	12	UJ	110	UJ	10	UJ	8.5	U
2,4,6-Trichlorophenol	12	U	12	UJ	110	UJ	10	UJ	8.5	U
Tetrachlorophenol	12	U	12	UJ	110	UJ	10	UJ	8.5	U
Pentachlorophenol	5.8	*,J	43	J	100	J	140	J	1.7	U
DIOXINS (ug/kg DB)										
Total tetra-CD-Dioxin	0.0277		0.003	U	0.07	Q,J	0.06	Q,J	0.003	U,
2,3,7,8-tetra-CD-Dioxin	0.0013		0.003	U	0.007		0.003	U	0.003	U,
Total penta-CD-Dioxin	0.0676	Q,J	0.05	Q,J	0.16		0.11	Q,J	0.003	U,
1,2,3,7,8-penta-CD-Dioxin	0.0053		0.008	EM,J	0.03		0.01		0.003	U,
Total hexa-CD-Dioxin	0.353	Q,J	2.2	Q,J	9.9	Q,J	6.9	Q,J	0.003	U,
1,2,3,4,7,8-hexa-CD-Dioxin	0.0104		0.03		0.1		0.06		0.005	U,
1,2,3,6,7,8-hexa-CD-Dioxin	0.0323	,U	0.25		1.3		0.54		0.003	U,
1,2,3,7,8,9-hexa-CD-Dioxin	0.012	PR,	0.13	PR,Q,J	0.32	Q,J	0.08		0.005	U,
Total hepta-CD-Dioxin	1.75	Q,J	31.4		161		86.7	S,J	0.03	EM,J
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.824		12.2	B	64.3	B	37.4	B	0.01	EM,J
Octachlorodibenzo-Dioxin	5.06	B,	90.3	B	241	S,B,J	170	S,B,J	0.1	B,
Total Dioxin	7.26		124		412		264		0.139	
FURANS (ug/kg DB)										
Dibenzofuran	58		6800		83000		50000		40	U
Total tetra-CD-Furan	0.0376		0.02		0.12	Q,J	0.1	Q,J	0.003	U,
2,3,7,8-tetra-CD-Furan	0.0064	B,	0.006		0.03		0.01		0.003	U,
Total penta-CD-Furan	0.0276		0.1	Q,J	0.59		0.17	Q,J	0.003	U,
1,2,3,7,8-penta-CD-Furan	0.0042		0.02		0.11		0.02		0.003	U,
2,3,4,7,8-penta-CD-Furan	0.0053		0.02		0.13		0.03		0.003	U,
Total hexa-CD-Furan	0.24	Q,J	1.2		7.6		2.5	Q,J	0.003	U,
1,2,3,6,7,8-hexa-CD-Furan	0.0066		0.02		0.13		0.03		0.003	U,
1,2,3,4,7,8-hexa-CD-Furan	0.0243		0.07		0.52		0.11		0.003	U,
1,2,3,7,8,9-hexa-CD-Furan	0.00074	EM,J	0.01	U	0.03	EM,J	0.004		0.003	U,
2,3,4,6,7,8-hexa-CD-Furan	0.0112		0.02		0.14		0.03		0.003	U,
Total hepta-CD-Furan	0.496	Q,J	3.2		17.6		11.8		0.004	EM,J
1,2,3,4,6,7,8-hepta-CD-Furan	0.143		0.64	PR	3.5		2.3		0.003	U,
1,2,3,4,7,8,9-hepta-CD-Furan	0.0099		0.05		0.28		0.13		0.003	U,
Octadichlorodibenzo-Furan	0.252		3.8		14	Q,J	15.2		0.005	U,
Total Furan	1.05		8.32		39.9		29.8		0.018	
METALS (mg/kg DB)										
Antimony	0.12	U,J	0.5	UJ	0.5	UJ	0.5	UJ	0.1	U,J
Arsenic	8.1		5.9	J	7.4	J	13	J	6.5	J
Cadmium	2.2		1.5		1.8		2		1	
Chromium	26		32		31		31		19	
Copper	43		67		77		100		24	J
Lead	18		19		34		24		3	
Mercury	0.11		0.16		0.17		0.37		0.04	**
Nickel	20		24		26		31		28	
Silver	0.48		1	U	1	J	1	U	1	U
Zinc	70		87		98		92		34	
CONVENTIONALS (%)										
Total Solids	43	,	42.1		47		48.4		59	
Total Organic Carbon	2.5271	,	4.19		6.25		6.82		2.3576	

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-C1PP 07/22/1991 664 to 700 cm		CP1-M-C2A 12/13/90 surface to 10cm		CP1-M-C12A 12/13/90 Duplicate		CP1-M-C2B 12/13/90 10 to 55 cm		CP1-M-C12B 12/13/90 Duplicate	
PAH (ug/kg DB)										
Acenaphthene	24	U	860	J	2100	J	37000	J	17000	J
Acenaphthylene	24	U	80	J	83	J	1200	J	590	J
Anthracene	24	U	1300	J	1500	J	27000	J	11000	J
Fluorene	24	U	630	J	1600	J	18000	J	9500	J
Naphthalene	24	U	1700	J	1900	J	13000	J	8100	J
Phenanthrene	24	U	1900	J	5700	J	14000	J	18000	J
2-Methylnaphthalene	24	U	310	J	450	J	2200	J	2200	J
Total LPAH	170		6800		13000		110000		66000	
Benzo(a)anthracene	24	U	1700	J	1500	J	18000	J	11000	J
Benzo(a)pyrene	74		920	J	740	J	6400	J	4700	J
Benzo(b)fluoranthene	24	U	1700	J	1400	J	11000	J	7000	J
Benzo(g,h,i)perylene	24	U	420	J	300	J	2900	J	1900	J
Benzo(k)fluoranthene	24	U	420	J	470	J	5700	J	2100	J
Chrysene	24	U	1600	J	1400	J	14000	J	5900	J
Dibenz(a,h)anthracene	24	U	120	J	97	J	150	J	110	J
Fluoranthene	24	U	6200	J	6200	J	56000	J	29000	J
Indeno(1,2,3-cd)pyrene	24	U	420	J	290	J	2700	J	1800	J
Pyrene	24	U	4900	J	5100	J	40000	J	22000	J
Total HPAH	290		18000		17000		160000		86000	
Total Carcinogenic PAH	220		6900		5900		58000		33000	
Total PAH	460		25000		31000		270000		150000	
CHLORINATED PHENOLS (ug/kg DB)										
2-Chlorophenol	R		2200	U,UJ	2200	U,UJ	2200	U,UJ	2200	U,UJ
2,4-Dichlorophenol	20	U	340	J	310	J	44	U,UJ	44	U,UJ
2,4,5-Trichlorophenol	5	U	11	U,UJ	11	U,UJ	11	U,UJ	12	J
2,4,6-Trichlorophenol	5	U	11	U,UJ	11	U,UJ	11	U,UJ	11	U,UJ
Tetrachlorophenol	5	U	20	J	11	U,UJ	150	J,J	65	J
Pentachlorophenol	1	U	18	J	12	J	220	J	80	J,J
DIOXINS (ug/kg DB)										
Total tetra-CD-Dioxin			0.02		0.02		0.04	Q,J		
2,3,7,8-tetra-CD-Dioxin			0.001	U	0.001	U	0.007			
Total penta-CD-Dioxin			0.03	Q,J	0.04	Q,J	0.15	Q,J		
1,2,3,7,8-penta-CD-Dioxin			0.005		0.008		0.02			
Total hexa-CD-Dioxin			0.94	Q,J	1.4		9	Q,J		
1,2,3,4,7,8-hexa-CD-Dioxin			0.02		0.02		0.08			
1,2,3,6,7,8-hexa-CD-Dioxin			0.13		0.18		1			
1,2,3,7,8,9-hexa-CD-Dioxin			0.05	Q,J	0.09	PR	0.22	Q,J		
Total hepta-CD-Dioxin			13.2		17.9		91.3	S,J		
1,2,3,4,6,7,8-hepta-CD-Dioxin			5.4	B	7.3	B	43.4	S,B,J		
Octachlorodibenzo-Dioxin			31.2	S,B,J	50.7	B	116	S,B,J		
Total Dioxin			45.4		70.1		216			
FURANS (ug/kg DB)										
Dibenzofuran	24	U	450		1000		5900		5000	
Total tetra-CD-Furan			0.02		0.04		0.16	Q,J		
2,3,7,8-tetra-CD-Furan			0.004		0.005		0.02			
Total penta-CD-Furan			0.07	Q,J	0.08		0.27	Q,J		
1,2,3,7,8-penta-CD-Furan			0.008		0.01		0.04			
2,3,4,7,8-penta-CD-Furan			0.01		0.01		0.05	Q,J		
Total hexa-CD-Furan			0.68	Q,J	0.92		5.4			
1,2,3,6,7,8-hexa-CD-Furan			0.01		0.02		0.06			
1,2,3,4,7,8-hexa-CD-Furan			0.04		0.05		0.23			
1,2,3,7,8,9-hexa-CD-Furan			0.002	Q,J	0.005	U	0.008			
2,3,4,6,7,8-hexa-CD-Furan			0.01		0.02	EM,PR,J	0.06			
Total hepta-CD-Furan			1.4		1.7		23.5			
1,2,3,4,6,7,8-hepta-CD-Furan			0.31		0.41		4.1			
1,2,3,4,7,8,9-hepta-CD-Furan			0.02		0.03	EM,J	0.27			
Octadichlorodibenzo-Furan			1.4		1.9		27.3	Q,J		
Total Furan			3.57		4.64		56.6			
METALS (mg/kg DB)										
Antimony			0.5	U,UJ			0.5	U,UJ	0.5	U,UJ
Arsenic			6.6	J			8.3	J	9.7	J
Cadmium			2.1				2.1		2.1	
Chromium			33				34		32	
Copper			69				84		89	
Lead			20				25		28	
Mercury			0.18				0.33		0.43	
Nickel			29				30		27	
Silver			1	U			1	U	1.1	J
Zinc			94				90		110	
CONVENTIONALS (%)										
Total Solids	79		45.5		45.8		45		45.4	
Total Organic Carbon	0.6324		3.27		3.42		8.39		7.89	

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-C2C 12/13/90 55 to 100 cm		CP1-M-C12C 12/13/90 Duplicate		CP2-M-C2E 07/25/1991 150 to 200 cm		CP1-M-C3A 12/12/90 surface to 10cm		CP1-M-C13A 12/12/90 Duplicate	
PAH (ug/kg DB)										
Acenaphthene	5200	J	18000	J	55		360		300	J
Acenaphthylene	150	J	500	J	46	U	54		26	J,J
Anthracene	4600	J	17000	J	56		340		270	J
Fluorene	4900	J	18000	J	46	U	210		150	J
Naphthalene	13000	J	35000	J	150		1300	B,UJ	920	J
Phenanthrene	15000	J	61000	J	100		530		450	J
2-Methylnaphthalene	4000	J	4100	J	46	U	180		160	J
Total LPAH	47000		150000		500		3000		2300	
Benzo(a)anthracene	4600	J	9700	J	46	U	250		240	J
Benzo(a)pyrene	1500	J	4900	J	240		230		220	J
Benzo(b)fluoranthene	2300	J	7000	J	46	U	390		430	J
Benzo(g,h,i)perylene	700	J	2000	J	46	U	95		96	J
Benzo(k)fluoranthene	780	J	2000	J	46	U	140		130	J
Chrysene	3100	J	8100	J	46	U	390		270	J
Dibenz(a,h)anthracene	160	J	660	J	46	U	41	U	29	J,J
Fluoranthene	12000	J	41000	J	420		860		680	J
Indeno(1,2,3-cd)pyrene	610	J	1800	J	46	U	95		95	J
Pyrene	8500	J	24000	J	360		1100		840	J
Total HPAH	34000		100000		1300		3600		3000	
Total Carcinogenic PAH	13000		34000		520		1500		1400	
Total PAH	81000		250000		1800		6600		5300	
CHLORINATED PHENOLS (ug/kg DB)										
2-Chlorophenol	1700	U,UJ	16000	U,UJ	R		1700	U,UJ	1600	U,UJ
2,4-Dichlorophenol	33	U,UJ	320	U,UJ	38	U	34	U,UJ	140	J
2,4,5-Trichlorophenol	8.3	U,UJ	79	U,UJ	9.6	U	8.5	U	7.9	U,UJ
2,4,6-Trichlorophenol	8.3	U,UJ	79	U,UJ	9.6	U	8.5	U	7.9	U,UJ
Tetrachlorophenol	8.3	U,UJ	79	U,UJ	9.6	U	8.5	U	13	J
Pentachlorophenol	1.7	U,UJ	16	U,UJ	1.9	U	4.6		10	J
DIOXINS (ug/kg DB)										
Total tetra-CD-Dioxin	0.03						0.05			
2,3,7,8-tetra-CD-Dioxin	0.001	U					0.001	U		
Total penta-CD-Dioxin	0.04	Q,J					0.03	Q,J		
1,2,3,7,8-penta-CD-Dioxin	0.005	U					0.003			
Total hexa-CD-Dioxin	0.1						0.43			
1,2,3,4,7,8-hexa-CD-Dioxin	0.008	U					0.008			
1,2,3,6,7,8-hexa-CD-Dioxin	0.006	EM,J					0.06			
1,2,3,7,8,9-hexa-CD-Dioxin	0.01	U					0.02	EM,J		
Total hepta-CD-Dioxin	0.29						5.8			
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.13	B					2.3			
Octachlorodibenzo-Dioxin	0.62	B					16.5	B		
Total Dioxin	1.08						22.8			
FURANS (ug/kg DB)										
Dibenzofuran	3200		11000		46	U	180		150	
Total tetra-CD-Furan	0.08						0.02			
2,3,7,8-tetra-CD-Furan	0.005						0.003			
Total penta-CD-Furan	0.03						0.03			
1,2,3,7,8-penta-CD-Furan	0.005						0.005			
2,3,4,7,8-penta-CD-Furan	0.004						0.005	EM,J		
Total hexa-CD-Furan	0.14						0.28			
1,2,3,6,7,8-hexa-CD-Furan	0.003						0.02			
1,2,3,4,7,8-hexa-CD-Furan	0.004						0.006			
1,2,3,7,8,9-hexa-CD-Furan	0.008	U					0.003	U		
2,3,4,6,7,8-hexa-CD-Furan	0.007						0.008			
Total hepta-CD-Furan	0.68						0.59			
1,2,3,4,6,7,8-hepta-CD-Furan	0.35						0.15			
1,2,3,4,7,8,9-hepta-CD-Furan	0.01	U					0.009	EM,J		
Octadichlorodibenzo-Furan	0.27						0.57			
Total Furan	1.20						1.49			
METALS (mg/kg DB)										
Antimony	0.5	U,UJ					0.5	U,UJ	0.5	U,UJ
Arsenic	6.2	J					4.9	J	4.9	J
Cadmium	1.4						1		0.9	
Chromium	31						23		21	
Copper	240						28		27	
Lead	9.2	J					8.7	J	8.1	J
Mercury	0.08						0.09		0.08	
Nickel	26						20		18	
Silver	1	U					1	U	1	U
Zinc	60						53		50	
CONVENTIONALS (%)										
Total Solids	59.8		63.3		52		58.8		62.8	
Total Organic Carbon	3.81		2.44		2.0616		2.09		2.67	

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-C3B 12/12/90 10 to 55 cm	CP1-M-C3C 12/12/90 55 to 100 cm	CP1-M-C4A 12/11/90 surface to 10cm	CP1-M-C4B 12/11/90 10 to 55 cm	CP1-M-C4C 12/11/90 55 to 100 cm
PAH (ug/kg DB)					
Acenaphthene	410	48 U	160	52 U	50 U
Acenaphthylene	80	35 J	91	52 U	50 U
Anthracene	330	72	200	52 U	50 U
Fluorene	240	48 U	120	52 U	50 U
Naphthalene	1500 J,UJ	380 B,UJ	1100	210	50 U
Phenanthrene	650	73	310	67	50 U
2-Methylnaphthalene	220	48 U	100	52 U	50 U
Total LPAH	3400	700	2100	540	350
Benzo(a)anthracene	340	48 U	120	52 U	50 U
Benzo(a)pyrene	270	220	210	110	66
Benzo(b)fluoranthene	530	48 U	340	52 U	50 U
Benzo(g,h,i)perylene	140	48 U	100	52 U	50 U
Benzo(k)fluoranthene	210	48 U	86 J	63 J	50 U
Chrysene	570	48 U	180	52 U	50 U
Dibenz(a,h)anthracene	38 J	48 U	52 U	52 U	50 U
Fluoranthene	1400	68	420	87	50 U
Indeno(1,2,3-cd)pyrene	130	48 U	100	52 U	50 U
Pyrene	1500	69	670	88	50 U
Total HPAH	5100	690	2300	660	520
Total Carcinogenic PAH	2100	510	1100	430	370
Total PAH	8600	1400	4400	1200	870
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	1500 U,UJ	2000 U,UJ	2200 U,UJ	2200 U,UJ	2100 U,UJ
2,4-Dichlorophenol	31 U,UJ	40 U,UJ	43 U,UJ	43 U,UJ	42 U,UJ
2,4,5-Trichlorophenol	7.7 U	10 U	11 U	11 U	10 U
2,4,6-Trichlorophenol	7.7 U	10 U	11 U	11 U	10 U
Tetrachlorophenol	7.7 U	10 U	11 U	11 U	10 U
Pentachlorophenol	4	2 U	9.3	2.2 U	2.1 U
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin	0.003	0.001 U			
2,3,7,8-tetra-CD-Dioxin	0.003 U	0.001 U			
Total penta-CD-Dioxin	0.009 Q,J	0.003 U			
1,2,3,7,8-penta-CD-Dioxin	0.002	0.003 U			
Total hexa-CD-Dioxin	0.16	0.003 U			
1,2,3,4,7,8-hexa-CD-Dioxin	0.004 EM,J	0.003 U			
1,2,3,6,7,8-hexa-CD-Dioxin	0.02	0.003 U			
1,2,3,7,8,9-hexa-CD-Dioxin	0.01	0.003 U			
Total hepta-CD-Dioxin	1.9	0.005 U			
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.8	0.005 U			
Octachlorodibenzo-Dioxin	5.5 B	0.02 B			
Total Dioxin	7.57	0.032			
FURANS (ug/kg DB)					
Dibenzofuran	200	48 U	110	52 U	50 U
Total tetra-CD-Furan	0.007	0.001 U			
2,3,7,8-tetra-CD-Furan	0.002	0.001 U			
Total penta-CD-Furan	0.02	0.001 U			
1,2,3,7,8-penta-CD-Furan	0.002	0.001 U			
2,3,4,7,8-penta-CD-Furan	0.002	0.001 U			
Total hexa-CD-Furan	0.11	0.001 EM,J			
1,2,3,6,7,8-hexa-CD-Furan	0.002 EM,J	0.003 U			
1,2,3,4,7,8-hexa-CD-Furan	0.007 EM,J	0.001 U			
1,2,3,7,8,9-hexa-CD-Furan	0.003 U	0.003 U			
2,3,4,6,7,8-hexa-CD-Furan	0.004	0.002 EM,J			
Total hepta-CD-Furan	0.004	0.003 U			
1,2,3,4,6,7,8-hepta-CD-Furan	0.06 EM,J	0.003 U			
1,2,3,4,7,8,9-hepta-CD-Furan	0.005	0.003 U			
Octadichlorodibenzo-Furan	0.2	0.005 U			
Total Furan	0.341	0.011			
METALS (mg/kg DB)					
Antimony	0.5 U,UJ	0.5 U,UJ			
Arsenic	4.8 J	7 J			
Cadmium	0.74	1.4			
Chromium	23	32			
Copper	21	40			
Lead	4.9 J	7 J			
Mercury	0.04	0.04			
Nickel	20	30			
Silver	1 U	1 U			
Zinc	43	56			
CONVENTIONALS (%)					
Total Solids	65.2	50.1	46	46	48
Total Organic Carbon	1.67	3.93	3.55	2.28	2.33

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-C5A 12/07/90 surface to 10cm		CP1-M-D1A 12/12/90 surface to 10cm		CP1-M-D11A 12/12/90 Duplicate		CP1-M-D1B 12/12/90 10 to 55 cm		CP1-M-D1C 12/12/90 55 to 100 cm	
PAH (ug/kg DB)										
Acenaphthene	60		270		260	J	1200		670	
Acenaphthylene	73		49		39	U,J	42		35	U
Anthracene	91		210		95	J	2200		32	J
Fluorene	48	J	130		94	J	620		260	
Naphthalene	640		1300	B,J	1200	J	2700	B	2300	B,J
Phenanthrene	210		260		250	J	920		250	
2-Methylnaphthalene	45	J	210		79	J	290		81	
Total LPAH	1200		2400		2000		8000		3600	
Benzo(a)anthracene	83		260		71	J	630		35	U
Benzo(a)pyrene	110		150		53	J	250		37	
Benzo(b)fluoranthene	110		290		110	J	460		35	U
Benzo(g,h,i)perylene	56	U	83		38	J,J	97		35	U
Benzo(k)fluoranthene	33	J	140		39	U,J	180		35	U
Chrysene	210		320		56	J	760		35	U
Dibenz(a,h)anthracene	56	U	23	J	39	U,J	33		35	U
Fluoranthene	260		1100		380	J	3100		39	
Indeno(1,2,3-cd)pyrene	56	U	81		30	J,J	100		35	U
Pyrene	430		770		300	J	1800		23	J
Total HPAH	1400		3200		1100		7400		340	
Total Carcinogenic PAH	660		1300		400		2400		250	
Total PAH	2600		5600		3100		15000		4000	
CHLORINATED PHENOLS (ug/kg DB)										
2-Chlorophenol	2300	U,J	1400	U,J	1600	U,J	1000	U,J	1500	U,J
2,4-Dichlorophenol	46	U,J	28	U,J	33	U,J	20	U,J	29	U,J
2,4,5-Trichlorophenol	12	U	7.1	U	8.2	U,J	5	U	7.4	U
2,4,6-Trichlorophenol	12	U	7.1	U	8.2	U,J	5	U	7.4	U
Tetrachlorophenol	12	U	11		8.2	U,J	5	U	7.4	U
Pentachlorophenol	9	B	24		6.2	J	1.3		1.5	U
DIOXINS (ug/kg DB)										
Total tetra-CD-Dioxin			0.01							
2,3,7,8-tetra-CD-Dioxin			0.002							
Total penta-CD-Dioxin			0.04	Q,J						
1,2,3,7,8-penta-CD-Dioxin			0.005							
Total hexa-CD-Dioxin			0.69							
1,2,3,4,7,8-hexa-CD-Dioxin			0.02							
1,2,3,6,7,8-hexa-CD-Dioxin			0.15							
1,2,3,7,8,9-hexa-CD-Dioxin			0.06							
Total hepta-CD-Dioxin			7.6							
1,2,3,4,6,7,8-hepta-CD-Dioxin			3.9							
Octachlorodibenzo-Dioxin			31.8	B						
Total Dioxin			40.1							
FURANS (ug/kg DB)										
Dibenzofuran	44	J	72		71		630		350	
Total tetra-CD-Furan			0.01							
2,3,7,8-tetra-CD-Furan			0.002							
Total penta-CD-Furan			0.07							
1,2,3,7,8-penta-CD-Furan			0.006							
2,3,4,7,8-penta-CD-Furan			0.004							
Total hexa-CD-Furan			0.53							
1,2,3,6,7,8-hexa-CD-Furan			0.009							
1,2,3,4,7,8-hexa-CD-Furan			0.02							
1,2,3,7,8,9-hexa-CD-Furan			0.002							
2,3,4,6,7,8-hexa-CD-Furan			0.01							
Total hepta-CD-Furan			0.77							
1,2,3,4,6,7,8-hepta-CD-Furan			0.18							
1,2,3,4,7,8,9-hepta-CD-Furan			0.02							
Octadichlorodibenzo-Furan			0.78							
Total Furan			2.16							
METALS (mg/kg DB)										
Antimony			0.5	U,J			0.5	U,J	0.5	U,J
Arsenic			6.4	J			3	J	3.7	J
Cadmium			0.44				0.5	U	0.5	U
Chromium			23				10		18	
Copper			38				79		8.8	
Lead			5.2	J			4.1	J	2.2	J
Mercury			0.02				0.02	U	0.02	U
Nickel			20				14		17	
Silver			1	U			1	U	1	U
Zinc			44				21		25	
CONVENTIONALS (%)										
Total Solids	42.6		70.5		61.1		83.4		67.9	
Total Organic Carbon	6.76		1.67		2.83		0.89		0.74	

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-D2A 12/12/90 surface to 10cm	CP1-M-D2B 12/12/90 10 to 55 cm	CP1-M-D2C 12/12/90 55 to 100 cm	CP1-M-D3A 12/11/90 surface to 10cm	CP1-M-D3B 12/11/90 10 to 55 cm
PAH (ug/kg DB)					
Acenaphthene	270	260	36 U	750	2600
Acenaphthylene	29	87	36 U	550	300
Anthracene	200	1400	36 U	460	3000
Fluorene	120	200	36 U	1200	2100
Naphthalene	1100 B,UJ	1100 B,UJ	290 B,UJ	3100	4700
Phenanthrene	310	620	61	7200	6200
2-Methylnaphthalene	150	120	36 U	1500	880
Total LPAH	2200	3800	530	15000	20000
Benzo(a)anthracene	100	1200	36 U	400	1800
Benzo(a)pyrene	81	650	77	250	1600
Benzo(b)fluoranthene	180	1500	21 J	770	2500
Benzo(g,h,i)perylene	46	24 U	36 U	170	690
Benzo(k)fluoranthene	39 J	160 J	26 J,J	340	1100
Chrysene	89	1000	36 U	1200	2400
Dibenz(a,h)anthracene	14 J	24 U	36 U	54	170
Fluoranthene	510	2900	56	4100	9600
Indeno(1,2,3-cd)pyrene	40	260	36 U	200	740
Pyrene	460	3600	49	3000	6500
Total HPAH	1600	11000	410	10000	27000
Total Carcinogenic PAH	540	4800	270	3200	10000
Total PAH	3700	15000	940	25000	47000
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	1000 U,UJ	1000 U,UJ	1500 U,UJ	2000 U,UJ	2000 U,UJ
2,4-Dichlorophenol	20 U,UJ	20 U,UJ	30 U,UJ	39 U,UJ	39 U,UJ
2,4,5-Trichlorophenol	5 U	5 U	7.5 U	9.8 U	12
2,4,6-Trichlorophenol	5 U	5 U	7.5 U	9.8 U	9.8 U
Tetrachlorophenol	5 U	5 U	7.5 U	9.8 U	22
Pentachlorophenol	6.3	1.2	1.5 U	14	14
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin					
2,3,7,8-tetra-CD-Dioxin					
Total penta-CD-Dioxin					
1,2,3,7,8-penta-CD-Dioxin					
Total hexa-CD-Dioxin					
1,2,3,4,7,8-hexa-CD-Dioxin					
1,2,3,6,7,8-hexa-CD-Dioxin					
1,2,3,7,8,9-hexa-CD-Dioxin					
Total hepta-CD-Dioxin					
1,2,3,4,6,7,8-hepta-CD-Dioxin					
Octachlorodibenzo-Dioxin					
Total Dioxin					
FURANS (ug/kg DB)					
Dibenzofuran	91	210	36 U	1700	1200
Total tetra-CD-Furan					
2,3,7,8-tetra-CD-Furan					
Total penta-CD-Furan					
1,2,3,7,8-penta-CD-Furan					
2,3,4,7,8-penta-CD-Furan					
Total hexa-CD-Furan					
1,2,3,6,7,8-hexa-CD-Furan					
1,2,3,4,7,8-hexa-CD-Furan					
1,2,3,7,8,9-hexa-CD-Furan					
2,3,4,6,7,8-hexa-CD-Furan					
Total hepta-CD-Furan					
1,2,3,4,6,7,8-hepta-CD-Furan					
1,2,3,4,7,8,9-hepta-CD-Furan					
Octadichlorodibenzo-Furan					
Total Furan					
METALS (mg/kg DB)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Silver					
Zinc					
CONVENTIONALS (%)					
Total Solids	72.6	74.4	67.2	51	51
Total Organic Carbon	2.44	5.63	2.01	1.97	8.2

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-D3C 12/11/90 55 to 100 cm	CP2-M-D3E 07/26/1991 150 to 200 cm	CP2-M-D13E 07/26/1991 Duplicate	CP1-M-D4A 12/07/90 surface to 10cm	CP2-M-D4B 07/26/1991 10 to 70 cm
PAH (ug/kg DB)					
Acenaphthene	2000	42	36 U	190	470
Acenaphthylene	150	42	36 U	34 J	79 U
Anthracene	1900	42	36 U	200	320
Fluorene	1700	42	36 U	140	350
Naphthalene	3600	42	36 U	1200	2300
Phenanthrene	4800	60	75	330	640
2-Methylnaphthalene	430	42	36 U	150	350
Total LPAH	15000	310	290	2200	4500
Benzo(a)anthracene	2400	42	36 U	130	240
Benzo(a)pyrene	1100	42	36 U	120	210
Benzo(b)fluoranthene	2000	42	36 U	210	330
Benzo(g,h,i)perylene	460	42	36 U	54	79 U
Benzo(k)fluoranthene	770	42	36 U	180 J	240
Chrysene	2600	42	36 U	340	360
Dibenz(a,h)anthracene	110	42	36 U	46 U	79 U
Fluoranthene	7600	87	85	690	890
Indeno(1,2,3-cd)pyrene	490	42	36 U	51	79 U
Pyrene	4800	98	110	790	1400
Total HPAH	22000	520	480	2600	3900
Total Carcinogenic PAH	9500	290	250	1100	1500
Total PAH	37000	830	770	4900	8400
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	1500 U,UJ	1800	R		R
2,4-Dichlorophenol	29 U,UJ	35	30 U		300
2,4,5-Trichlorophenol	7.4 U	8.8	7.6 U	11 J	17
2,4,6-Trichlorophenol	7.4 U	8.8	7.6 U	9.6 U	11
Tetrachlorophenol	7.4 U	8.8	7.6 U	9.6 U	16
Pentachlorophenol	1.5 U	1.8	2 *,J	14 JB	12 J
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin					
2,3,7,8-tetra-CD-Dioxin					
Total penta-CD-Dioxin					
1,2,3,7,8-penta-CD-Dioxin					
Total hexa-CD-Dioxin					
1,2,3,4,7,8-hexa-CD-Dioxin					
1,2,3,6,7,8-hexa-CD-Dioxin					
1,2,3,7,8,9-hexa-CD-Dioxin					
Total hepta-CD-Dioxin					
1,2,3,4,6,7,8-hepta-CD-Dioxin					
Octachlorodibenzo-Dioxin					
Total Dioxin					
FURANS (ug/kg DB)					
Dibenzofuran	1100	42	36 U	120	270
Total tetra-CD-Furan					
2,3,7,8-tetra-CD-Furan					
Total penta-CD-Furan					
1,2,3,7,8-penta-CD-Furan					
2,3,4,7,8-penta-CD-Furan					
Total hexa-CD-Furan					
1,2,3,6,7,8-hexa-CD-Furan					
1,2,3,4,7,8-hexa-CD-Furan					
1,2,3,7,8,9-hexa-CD-Furan					
2,3,4,6,7,8-hexa-CD-Furan					
Total hepta-CD-Furan					
1,2,3,4,6,7,8-hepta-CD-Furan					
1,2,3,4,7,8,9-hepta-CD-Furan					
Octadichlorodibenzo-Furan					
Total Furan					
METALS (mg/kg DB)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Silver					
Zinc					
CONVENTIONALS (%)					
Total Solids	68	57	66	52.1	60
Total Organic Carbon	1.65	2.131	1.3573	2.64	2.6795

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-D4D 07/26/1991 100 to 150 cm	CP1-M-D5A 12/07/90 surface to 10cm	CP1-M-E1A 12/13/90 surface to 10cm	CP2-M-E1B 07/31/1991 10 to 44 cm	CP2-M-E1C 07/31/1991 61 to 100 cm
PAH (ug/kg DB)					
Acenaphthene	46	39 J	56	95	49
Acenaphthylene	46	24 J	20 J	24 U	24 U
Anthracene	46	56	81	130	44
Fluorene	46	33 J	47	67	24 U
Naphthalene	100	390	110	240	560
Phenanthrene	94	130	190	190	32
2-Methylnaphthalene	46	24 J	38 U	50	24 U
Total LPAH	420	700	540	800	760
Benzo(a)anthracene	46	44 U	46	68	24 U
Benzo(a)pyrene	410	44 U	36 J	99	24 U
Benzo(b)fluoranthene	46	64	63	110	24 U
Benzo(g,h,i)perylene	46	44 U	26 J	24 U	24 U
Benzo(k)fluoranthene	46	48 J	29 J,J	66	24 U
Chrysene	46	44 U	44	140	24 U
Dibenz(a,h)anthracene	46	44 U	38 U	24 U	24 U
Fluoranthene	180	180	210	260	70
Indeno(1,2,3-cd)pyrene	46	44 U	19 J	24 U	24 U
Pyrene	260	260	180	460	99
Total HPAH	1200	820	690	1300	360
Total Carcinogenic PAH	690	330	280	530	170
Total PAH	1600	1500	1200	2100	1100
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	1900	1800 U,UJ	1600 U,UJ	R	R
2,4-Dichlorophenol	38	37 U,UJ	31 U,UJ	20 U	20 U
2,4,5-Trichlorophenol	9.6	9.2 U	7.8 U	5 U	5 U
2,4,6-Trichlorophenol	9.6	9.2 U	7.8 U	5 U	5 U
Tetrachlorophenol	9.6	9.2 U	7.8 U	5 U	5 U
Pentachlorophenol	4.2	3.7 B,UJ	11	8.8 J	4.5
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin					
2,3,7,8-tetra-CD-Dioxin					
Total penta-CD-Dioxin					
1,2,3,7,8-penta-CD-Dioxin					
Total hexa-CD-Dioxin					
1,2,3,4,7,8-hexa-CD-Dioxin					
1,2,3,6,7,8-hexa-CD-Dioxin					
1,2,3,7,8,9-hexa-CD-Dioxin					
Total hepta-CD-Dioxin					
1,2,3,4,6,7,8-hepta-CD-Dioxin					
Octachlorodibenzo-Dioxin					
Total Dioxin					
FURANS (ug/kg DB)					
Dibenzofuran	46	32 J	32 J	40	24 U
Total tetra-CD-Furan					
2,3,7,8-tetra-CD-Furan					
Total penta-CD-Furan					
1,2,3,7,8-penta-CD-Furan					
2,3,4,7,8-penta-CD-Furan					
Total hexa-CD-Furan					
1,2,3,6,7,8-hexa-CD-Furan					
1,2,3,4,7,8-hexa-CD-Furan					
1,2,3,7,8,9-hexa-CD-Furan					
2,3,4,6,7,8-hexa-CD-Furan					
Total hepta-CD-Furan					
1,2,3,4,6,7,8-hepta-CD-Furan					
1,2,3,4,7,8,9-hepta-CD-Furan					
Octadichlorodibenzo-Furan					
Total Furan					
METALS (mg/kg DB)					
Antimony			0.5 U,UJ		
Arsenic			5.6 J,J		
Cadmium			0.84 J		
Chromium			26 J		
Copper			30 J		
Lead			7 J,J		
Mercury			0.04 J		
Nickel			24 J		
Silver			1 J		
Zinc			40 J		
CONVENTIONALS (%)					
Total Solids	52	53.8	64.5	73	76
Total Organic Carbon	2.7129	1.96	1.26	1.134	0.2751

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-E1F 07/31/1991 200 to 244 cm	CP1-M-E2A 12/11/90 surface to 10cm	CP1-M-E2B 12/11/90 10 to 55 cm	CP1-M-E2C 12/11/90 55 to 100 cm	CP1-M-E3A 12/13/90 surface to 10cm
PAH (ug/kg DB)					
Acenaphthene	71	310	500	140	160
Acenaphthylene	36	78	120	24 U	35 J
Anthracene	39	1700	740	28	220
Fluorene	24	390	490	24 U	130
Naphthalene	560	2200	2800	230	710
Phenanthrene	74	860	1100	29	310
2-Methylnaphthalene	24 U	160	340	26	82
Total LPAH	830	5700	6100	500	1600
Benzo(a)anthracene	24 U	220	460	24 U	200
Benzo(a)pyrene	42	210	310	24 U	120
Benzo(b)fluoranthene	24 U	470	630	24 U	270
Benzo(g,h,i)perylene	24 U	130	210	24 U	71
Benzo(k)fluoranthene	24 U	130	190	24 U	110
Chrysene	24 U	350	780	24 U	310
Dibenz(a,h)anthracene	24 U	43 U	35 U	24 U	21 J
Fluoranthene	83	1000	2100	32	800
Indeno(1,2,3-cd)pyrene	24 U	140	150	24 U	65
Pyrene	97	1000	1400	26	590
Total HPAH	390	3700	6300	250	2600
Total Carcinogenic PAH	190	1600	2600	170	1100
Total PAH	1200	9400	12000	750	4200
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	R	1800 U,UJ	1400 U,UJ	1000 U,UJ	1800 U,UJ
2,4-Dichlorophenol	20 U	36 U,UJ	29 U,UJ	20 U,UJ	35 U,UJ
2,4,5-Trichlorophenol	5 U	8.9 U	7.2 U	5 U	8.8 U
2,4,6-Trichlorophenol	5 U	8.9 U	7.2 U	5 U	8.8 U
Tetrachlorophenol	5 U	8.9 U	7.2 U	5 U	8.8 U
Pentachlorophenol	3.5 UJ	37	2.6	1 U	9.7
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin					
2,3,7,8-tetra-CD-Dioxin					
Total penta-CD-Dioxin					
1,2,3,7,8-penta-CD-Dioxin					
Total hexa-CD-Dioxin					
1,2,3,4,7,8-hexa-CD-Dioxin					
1,2,3,6,7,8-hexa-CD-Dioxin					
1,2,3,7,8,9-hexa-CD-Dioxin					
Total hepta-CD-Dioxin					
1,2,3,4,6,7,8-hepta-CD-Dioxin					
Octachlorodibenzo-Dioxin					
Total Dioxin					
FURANS (ug/kg DB)					
Dibenzofuran	24 U	290	280	24 U	110
Total tetra-CD-Furan					
2,3,7,8-tetra-CD-Furan					
Total penta-CD-Furan					
1,2,3,7,8-penta-CD-Furan					
2,3,4,7,8-penta-CD-Furan					
Total hexa-CD-Furan					
1,2,3,6,7,8-hexa-CD-Furan					
1,2,3,4,7,8-hexa-CD-Furan					
1,2,3,7,8,9-hexa-CD-Furan					
2,3,4,6,7,8-hexa-CD-Furan					
Total hepta-CD-Furan					
1,2,3,4,6,7,8-hepta-CD-Furan					
1,2,3,4,7,8,9-hepta-CD-Furan					
Octadichlorodibenzo-Furan					
Total Furan					
METALS (mg/kg DB)					
Antimony		0.5 U,UJ			0.5 U,UJ
Arsenic		7.5 J			4.1 J
Cadmium		0.86			1.3
Chromium		19			25
Copper		51			42
Lead		18			13 J
Mercury		0.07			0.15
Nickel		21			21
Silver		1 U			1 U
Zinc		78			50
CONVENTIONALS (%)					
Total Solids	77	56	69	78	57.2
Total Organic Carbon	0.7183	2.02	0.91	3.41	2.85

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-E4A 12/10/90 surface to 10cm	CP2-M-E4B 07/29/1991 10 to 48 cm	CP2-M-E4C 07/29/1991 61 to 100 cm	CP2-M-E4E 07/29/1991 183 to 200 cm	CP1-M-E5A 12/07/90 surface to 10cm
PAH (ug/kg DB)					
Acenaphthene	99	200	24 U	24 U	75
Acenaphthylene	24 J	37 U	24 U	24 U	45 U
Anthracene	140	160	57	24 U	69
Fluorene	82	110	24 U	24 U	53
Naphthalene	530	920	190	24 U	490
Phenanthrene	190	210	96	24 U	140
2-Methylnaphthalene	52	89	24 U	24 U	41 J
Total LPAH	1100	1700	440	170	910
Benzo(a)anthracene	92	130	86	24 U	45 U
Benzo(a)pyrene	93	110	60	110	43 J
Benzo(b)fluoranthene	200	210	73	24 U	84
Benzo(g,h,i)perylene	48	37 U	24 U	24 U	45 U
Benzo(k)fluoranthene	170 J	77	74	24 U	72 J
Chrysene	150	190	92	24 U	45 U
Dibenz(a,h)anthracene	44 U	37 U	24 U	24 U	45 U
Fluoranthene	370	340	270	24 U	200
Indeno(1,2,3-cd)pyrene	43 J	37 U	24 U	24 U	45 U
Pyrene	500	730	240	24 U	270
Total HPAH	1700	1900	1000	330	890
Total Carcinogenic PAH	790	790	430	250	380
Total PAH	2800	3600	1400	490	1800
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	1800 U,UJ	R	R	R	1900 U,UJ
2,4-Dichlorophenol	36 U,UJ	31 U	20 U	20 U	580 J
2,4,5-Trichlorophenol	9.1 U	7.8 U	5 U	5 U	9.3 U
2,4,6-Trichlorophenol	9.1 U	7.8 U	5 U	5 U	9.3 U
Tetrachlorophenol	11	7.8 U	5 U	5 U	11
Pentachlorophenol	10 B	5.6 J	1 U	1 U	39 B,J
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin					
2,3,7,8-tetra-CD-Dioxin					
Total penta-CD-Dioxin					
1,2,3,7,8-penta-CD-Dioxin					
Total hexa-CD-Dioxin					
1,2,3,4,7,8-hexa-CD-Dioxin					
1,2,3,6,7,8-hexa-CD-Dioxin					
1,2,3,7,8,9-hexa-CD-Dioxin					
Total hepta-CD-Dioxin					
1,2,3,4,6,7,8-hepta-CD-Dioxin					
Octachlorodibenzo-Dioxin					
Total Dioxin					
FURANS (ug/kg DB)					
Dibenzofuran	69	71	24 U	24 U	43 J
Total tetra-CD-Furan					
2,3,7,8-tetra-CD-Furan					
Total penta-CD-Furan					
1,2,3,7,8-penta-CD-Furan					
2,3,4,7,8-penta-CD-Furan					
Total hexa-CD-Furan					
1,2,3,6,7,8-hexa-CD-Furan					
1,2,3,4,7,8-hexa-CD-Furan					
1,2,3,7,8,9-hexa-CD-Furan					
2,3,4,6,7,8-hexa-CD-Furan					
Total hepta-CD-Furan					
1,2,3,4,6,7,8-hepta-CD-Furan					
1,2,3,4,7,8,9-hepta-CD-Furan					
Octadichlorodibenzo-Furan					
Total Furan					
METALS (mg/kg DB)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Silver					
Zinc					
CONVENTIONALS (%)					
Total Solids	55	64	71	71	53.4
Total Organic Carbon	3.21	1.8695	1.3898	0.5952	2.58

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-EI1 08/15/1991 surface to 10 cm	CP1-M-F1A 12/11/90 surface to 10cm	CP2-M-F1A 08/01/1991 surface to 10 cm	CP2-M-F1B 08/01/1991 10 to 51 cm	CP2-M-F11B 08/01/1991 Duplicate
PAH (ug/kg DB)					
Acenaphthene		260	300	760	620
Acenaphthylene		110	250	37	27
Anthracene		660	1300	240	140
Fluorene		240	540	460	320
Naphthalene		850	940	2300	1900
Phenanthrene		700	2300	600	470
2-Methylnaphthalene		120	230	86	66
Total LPAH		2900	5900	4500	3500
Benzo(a)anthracene		330	1200	230	160
Benzo(a)pyrene		440	1300	87	67
Benzo(b)fluoranthene		2400 ,J	2800	250	190
Benzo(g,h,i)perylene		290	590	24 U	24 U
Benzo(k)fluoranthene		770 ,J	2900	260	200
Chrysene		570	1400	260	180
Dibenz(a,h)anthracene		70	270	24 U	24 U
Fluoranthene		990	2300	1400	920
Indeno(1,2,3-cd)pyrene		310	580	24 U	24 U
Pyrene		1200	3200	830	540
Total HPAH		7400	17000	3400	2300
Total Carcinogenic PAH		4900	10000	1100	850
Total PAH		10000	22000	7900	5900
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol		1700 U,UJ	R	R	R
2,4-Dichlorophenol		33 U,UJ	32 U	20 U	20 U
2,4,5-Trichlorophenol		8.3 U	7.9 U	5 U	5 U
2,4,6-Trichlorophenol		8.3 U	7.9 U	5 U	5 U
Tetrachlorophenol		31	7.9 U	5 U	5 U
Pentachlorophenol		160	120 D	2.6 ,J	1 U
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin			0.004	0.02 EM,J	0.01
2,3,7,8-tetra-CD-Dioxin			0.005 U,	0.001 EM,J	0.003 U,
Total penta-CD-Dioxin			0.21 Q,J	0.007 Q,J	0.009
1,2,3,7,8-penta-CD-Dioxin			0.04 EM,J	0.003 U,	0.005 U,
Total hexa-CD-Dioxin			2.9	0.03	0.03
1,2,3,4,7,8-hexa-CD-Dioxin			0.08	0.003 U,	0.005 U,
1,2,3,6,7,8-hexa-CD-Dioxin			0.36	0.002 EM,J	0.003 U,
1,2,3,7,8,9-hexa-CD-Dioxin			0.29	0.003	0.005 U,
Total hepta-CD-Dioxin			25.7	0.06	0.07
1,2,3,4,6,7,8-hepta-CD-Dioxin			11.2	0.03	0.04
Octachlorodibenzo-Dioxin			94.8 B,	0.11 B,	0.14 B,
Total Dioxin			124	0.227	0.259
FURANS (ug/kg DB)					
Dibenzofuran		190	230	370	300
Total tetra-CD-Furan			0.07	0.02 Q,J	0.02
2,3,7,8-tetra-CD-Furan			0.009	0.003	0.002
Total penta-CD-Furan			0.55 Q,J	0.01 Q,J	0.007
1,2,3,7,8-penta-CD-Furan			0.04 EM,J	0.003 U,	0.003 U,
2,3,4,7,8-penta-CD-Furan			0.06	0.003	0.003 U,
Total hexa-CD-Furan			2.4	0.01	0.03
1,2,3,6,7,8-hexa-CD-Furan			0.04 EM,J	0.001	0.003 U,
1,2,3,4,7,8-hexa-CD-Furan			0.19	0.002	0.004
1,2,3,7,8,9-hexa-CD-Furan			0.05 Q,J	0.003 U,	0.003 U,
2,3,4,6,7,8-hexa-CD-Furan			0.08	0.003 EM,J	0.005 EM,J
Total hepta-CD-Furan			3.1	0.04	0.03
1,2,3,4,6,7,8-hepta-CD-Furan			0.87	0.02	0.02
1,2,3,4,7,8,9-hepta-CD-Furan			0.06	0.003 U,	0.005 U,
Octadichlorodibenzo-Furan			1.1	0.01	0.008 U,
Total Furan			7.22	0.090	0.095
METALS (mg/kg DB)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Silver					
Zinc					
CONVENTIONALS (%)					
Total Solids		60	63	76	74
Total Organic Carbon	1.094 J	9.49	3.033	0.3325	4.139

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-F1C 08/01/1991 55 to 100 cm		CP1-M-F2A 12/11/90 surface to 10cm		CP1-M-F2B 12/11/90 10 to 55 cm		CP1-M-F2C 12/11/90 55 to 100 cm		CP1-M-F3A 12/11/90 surface to 10cm	
PAH (ug/kg DB)										
Acenaphthene	800		160		34	U	24	U	360	
Acenaphthylene	46		34	J	34	U	24	U	52	U
Anthracene	310		170		34	J	24	U	280	
Fluorene	720		120		34	U	24	U	250	
Naphthalene	920		610		57		24	U	1100	
Phenanthrene	1500		300		35		24	U	570	
2-Methylnaphthalene	150		85		34	U	24	U	150	
Total LPAH	4400		1500		260		170		2800	
Benzo(a)anthracene	170		76		34	U	24	U	170	
Benzo(a)pyrene	130		72		34	U	24	U	120	
Benzo(b)fluoranthene	460		300	J	35	J	24	U,UJ	460	
Benzo(g,h,i)perylene	24	U	52		34	U	24	U	63	
Benzo(k)fluoranthene	470		150	J	34	U,UJ	24	U,UJ	280	J
Chrysene	190		130		34	U	24	U	300	
Dibenz(a,h)anthracene	24	U	38	U	34	U	24	U	52	U
Fluoranthene	780		520		53		24	U	900	
Indeno(1,2,3-cd)pyrene	55		44		34	U	24	U	60	
Pyrene	900		430		41		24	U	550	
Total HPAH	3200		1800		370		240		3000	
Total Carcinogenic PAH	1500		810		240		170		1400	
Total PAH	7600		3300		630		410		5700	
CHLORINATED PHENOLS (ug/kg DB)										
2-Chlorophenol	R		1600	U,UJ	1400	U,UJ	1000	U,UJ	2200	U,UJ
2,4-Dichlorophenol	20	U	31	U,UJ	28	U,UJ	20	U,UJ	43	U,UJ
2,4,5-Trichlorophenol	5	U	7.8	U	7.1	U	5	U	11	U
2,4,6-Trichlorophenol	5	U	7.8	U	7.1	U	5	U	11	U
Tetrachlorophenol	5	U	7.8	U	7.1	U	5	U	11	U
Pentachlorophenol	21		8.1		1.4	U	1	U	12	
DIOXINS (ug/kg DB)										
Total tetra-CD-Dioxin	0.02									
2,3,7,8-tetra-CD-Dioxin	0.001	EM,J								
Total penta-CD-Dioxin	0.01									
1,2,3,7,8-penta-CD-Dioxin	0.004	EM,J								
Total hexa-CD-Dioxin	0.35									
1,2,3,4,7,8-hexa-CD-Dioxin	0.01									
1,2,3,6,7,8-hexa-CD-Dioxin	0.05									
1,2,3,7,8,9-hexa-CD-Dioxin	0.03									
Total hepta-CD-Dioxin	3.4									
1,2,3,4,6,7,8-hepta-CD-Dioxin	1.5									
Octachlorodibenzo-Dioxin	12.5	B,								
Total Dioxin	16.3									
FURANS (ug/kg DB)										
Dibenzofuran	630		95		34	U	24	U	190	
Total tetra-CD-Furan	0.006									
2,3,7,8-tetra-CD-Furan	0.003	U,								
Total penta-CD-Furan	0.05									
1,2,3,7,8-penta-CD-Furan	0.005									
2,3,4,7,8-penta-CD-Furan	0.007									
Total hexa-CD-Furan	0.35									
1,2,3,6,7,8-hexa-CD-Furan	0.008	EM,J								
1,2,3,4,7,8-hexa-CD-Furan	0.03									
1,2,3,7,8,9-hexa-CD-Furan	0.001	U,								
2,3,4,6,7,8-hexa-CD-Furan	0.01	EM,J								
Total hepta-CD-Furan	0.25									
1,2,3,4,6,7,8-hepta-CD-Furan	0.11	EM,J								
1,2,3,4,7,8,9-hepta-CD-Furan	0.008									
Octadichlorodibenzo-Furan	0.21									
Total Furan	0.866									
METALS (mg/kg DB)										
Antimony										
Arsenic										
Cadmium										
Chromium										
Copper										
Lead										
Mercury										
Nickel										
Silver										
Zinc										
CONVENTIONALS (%)										
Total Solids	71		64		70		78		46	
Total Organic Carbon	0.8341		1.55		2.49		2.15		3.94	

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-F4A 12/10/90 surface to 10cm	CP1-M-F5A 12/07/90 surface to 10cm	CP1-M-G1A 12/13/90 surface to 10cm	CP1-M-G2A 12/12/90 surface to 10cm	CP1-M-G3A 12/10/90 surface to 10cm
PAH (ug/kg DB)					
Acenaphthene	25	39 J	58 J	71 U,UJ	5500
Acenaphthylene	24 U	23 J	71 U	71 U,UJ	190
Anthracene	41	57	110	71 U,UJ	2200
Fluorene	21 J	34 J	38 J	71 U,UJ	870
Naphthalene	120	380	130	10 U,UJ	1100
Phenanthrene	61	110	150	71 U,UJ	2300
2-Methylnaphthalene	24 U	37 J	71 U	71 U,UJ	200
Total LPAH	320	680	630	440	12000
Benzo(a)anthracene	24 U	39 U	150	71 U,UJ	3300
Benzo(a)pyrene	45	31 J	100	71 U,UJ	1300
Benzo(b)fluoranthene	44	75	200	350 J	2200
Benzo(g,h,i)perylene	24 U	39 U	45 J	71 U,UJ	470
Benzo(k)fluoranthene	17 J,J	290 J	55 J,J	59 J,J	610 J
Chrysene	24 U	46	140	71 U,UJ	4100
Dibenz(a,h)anthracene	24 U	39 U	71 U	71 U,UJ	35 J
Fluoranthene	110	150	570	330 J	13000
Indeno(1,2,3-cd)pyrene	22 J	39 U	39 J	71 U,UJ	520
Pyrene	120	190	460	600 J	9000
Total HPAH	450	940	1800	1800	35000
Total Carcinogenic PAH	200	560	760	760	12000
Total PAH	770	1600	2500	2200	47000
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	1000 U,UJ	1600 U,UJ	2900 U,UJ	2900 U,UJ	2300 U,UJ
2,4-Dichlorophenol	20 U,UJ	33 U,UJ	59 U,UJ	59 U,UJ	46 U,UJ
2,4,5-Trichlorophenol	5 U	8.2 U	15 U	15 U,UJ	12 U
2,4,6-Trichlorophenol	5 U	8.2 U	15 U	16 J	12 U
Tetrachlorophenol	5 U	27	15 U	15 U,UJ	37
Pentachlorophenol	3.6 B	9.1 JB	5.4	7.5 J	89 B
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin					
2,3,7,8-tetra-CD-Dioxin					
Total penta-CD-Dioxin					
1,2,3,7,8-penta-CD-Dioxin					
Total hexa-CD-Dioxin					
1,2,3,4,7,8-hexa-CD-Dioxin					
1,2,3,6,7,8-hexa-CD-Dioxin					
1,2,3,7,8,9-hexa-CD-Dioxin					
Total hepta-CD-Dioxin					
1,2,3,4,6,7,8-hepta-CD-Dioxin					
Octachlorodibenzo-Dioxin					
Total Dioxin					
FURANS (ug/kg DB)					
Dibenzofuran	14 J	31 J	41 J	71 U	900
Total tetra-CD-Furan					
2,3,7,8-tetra-CD-Furan					
Total penta-CD-Furan					
1,2,3,7,8-penta-CD-Furan					
2,3,4,7,8-penta-CD-Furan					
Total hexa-CD-Furan					
1,2,3,6,7,8-hexa-CD-Furan					
1,2,3,4,7,8-hexa-CD-Furan					
1,2,3,7,8,9-hexa-CD-Furan					
2,3,4,6,7,8-hexa-CD-Furan					
Total hepta-CD-Furan					
1,2,3,4,6,7,8-hepta-CD-Furan					
1,2,3,4,7,8,9-hepta-CD-Furan					
Octadichlorodibenzo-Furan					
Total Furan					
METALS (mg/kg DB)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Silver					
Zinc					
CONVENTIONALS (%)					
Total Solids	74.5	60.9	33.7	34.4	43
Total Organic Carbon	1.65	2.15	3.53	3.81	3.82

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-G3B 12/10/90 10 to 55 cm	CP2-M-G3B 07/25/1991 10 to 55 cm	CP2-M-G3C 07/25/1991 55 to 100 cm	CP2-M-G3E 07/25/1991 150 to 200 cm	CP1-M-G4A 12/13/90 surface to 10cm
PAH (ug/kg DB)					
Acenaphthene	14000	8900	1700	1800	470
Acenaphthylene	360	210	110	54	110
Anthracene	7200	3900	500	270	890
Fluorene	8500	4000	750	1200	300
Naphthalene	3800	3500	3200	2400	1200
Phenanthrene	19000	4500	1200	2000	740
2-Methylnaphthalene	680	760	400	520	260
Total LPAH	54000	26000	7900	8200	4000
Benzo(a)anthracene	6000	8700	810	110	1000
Benzo(a)pyrene	2600	3400	330	260	710
Benzo(b)fluoranthene	3500	4400	460	59	1300
Benzo(g,h,i)perylene	830	1000	130	40 U	380
Benzo(k)fluoranthene	1900	3300	920	40 U	310
Chrysene	6100	8600	840	120	1400
Dibenz(a,h)anthracene	58 J	660	40 U	40 U	95
Fluoranthene	21000	28000 D,U	3800	790	4400
Indeno(1,2,3-cd)pyrene	760	1200	120	40 U	380
Pyrene	92 U	26000 D,U	2800	800	3100
Total HPAH	43000	85000	10000	2300	13000
Total Carcinogenic PAH	21000	30000	3500	670	5200
Total PAH	96000	110000	18000	11000	17000
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	1900 U,UJ	R	R	R	2200 U,UJ
2,4-Dichlorophenol	38 U,UJ	43 U	33 U	34 U	43 U,UJ
2,4,5-Trichlorophenol	9.6 U	19	8.3 U	8.5 U	11 U
2,4,6-Trichlorophenol	9.6 U	11 U	8.3 U	8.5 U	11 U
Tetrachlorophenol	9.6 U	30 UJ	8.3 U	8.5 U	11 U
Pentachlorophenol	14 B	51 D	4.8	1.7 U	14
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin					
2,3,7,8-tetra-CD-Dioxin					
Total penta-CD-Dioxin					
1,2,3,7,8-penta-CD-Dioxin					
Total hexa-CD-Dioxin					
1,2,3,4,7,8-hexa-CD-Dioxin					
1,2,3,6,7,8-hexa-CD-Dioxin					
1,2,3,7,8,9-hexa-CD-Dioxin					
Total hepta-CD-Dioxin					
1,2,3,4,6,7,8-hepta-CD-Dioxin					
Octachlorodibenzo-Dioxin					
Total Dioxin					
FURANS (ug/kg DB)					
Dibenzofuran	4600	2500	490	710	280
Total tetra-CD-Furan					
2,3,7,8-tetra-CD-Furan					
Total penta-CD-Furan					
1,2,3,7,8-penta-CD-Furan					
2,3,4,7,8-penta-CD-Furan					
Total hexa-CD-Furan					
1,2,3,6,7,8-hexa-CD-Furan					
1,2,3,4,7,8-hexa-CD-Furan					
1,2,3,7,8,9-hexa-CD-Furan					
2,3,4,6,7,8-hexa-CD-Furan					
Total hepta-CD-Furan					
1,2,3,4,6,7,8-hepta-CD-Furan					
1,2,3,4,7,8,9-hepta-CD-Furan					
Octadichlorodibenzo-Furan					
Total Furan					
METALS (mg/kg DB)					
Antimony		0.1 UJ	0.1 UJ	0.1 UJ	
Arsenic		7.6 J	3.8 J	3.7 J	
Cadmium		1.6	1	2	
Chromium		31	30	31	
Copper		100 J	194 J	66 J	
Lead		22	11	9	
Mercury		0.21 **	0.03 **	0.04	
Nickel		29	30	29	
Silver		0.06 U	1 U	1 U	
Zinc		79	55	53	
CONVENTIONALS (%)					
Total Solids	52	47	60	59	45.8
Total Organic Carbon	2.85	5.982	2.6088	2.6768	3.25

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP1-M-G14A 12/13/90 Duplicate	CP1-M-G5A 12/13/90 surface to 10cm	CP1-M-G6A 12/13/90 surface to 10cm	CP1-M-G7A 12/11/90 surface to 10cm	CP2-M-H1A 07/24/1991 surface to 10 cm
PAH (ug/kg DB)					
Acenaphthene	290	460	410	350	380
Acenaphthylene	71	64	74	100	52 U
Anthracene	570	480	360	710	440
Fluorene	170	240	200	280	260
Naphthalene	640	1200	1500	1000	1700
Phenanthrene	380	700	540	640	650
2-Methylnaphthalene	130	240	430	140	240
Total LPAH	2300	3400	3500	3200	3700
Benzo(a)anthracene	1100	510	130	1200	410
Benzo(a)pyrene	470	300	120	930	440
Benzo(b)fluoranthene	950	690	280	3400	450
Benzo(g,h,i)perylene	170	140	88	350	180
Benzo(k)fluoranthene	270 J	250	71 J	1400	670
Chrysene	880	800	130	1500	1000
Dibenz(a,h)anthracene	51 U	40 J	38 U	39 U	100
Fluoranthene	4600	1700	740	1900	770
Indeno(1,2,3-cd)pyrene	170	140	68	350	170
Pyrene	3200	1700	740	2400	2000
Total HPAH	12000	6300	2400	13000	6200
Total Carcinogenic PAH	3900	2700	840	8800	3200
Total PAH	14000	9700	5900	17000	9900
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	2100 U,UJ	1800 U,UJ	1600 U,UJ	1600 U,UJ	R
2,4-Dichlorophenol	410 J	37 U,UJ	32 U,UJ	32 U,UJ	43 U
2,4,5-Trichlorophenol	11 U	9.2 U	7.9 U	8.1 U	11 U
2,4,6-Trichlorophenol	11 U	9.2 U	7.9 U	8.1 U	11 U
Tetrachlorophenol	11 U	13	11	8.1 U	11 U
Pentachlorophenol	22	34	16	12	240 D
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin					0.02
2,3,7,8-tetra-CD-Dioxin					0.001 U,
Total penta-CD-Dioxin					0.03 Q,J
1,2,3,7,8-penta-CD-Dioxin					0.004
Total hexa-CD-Dioxin					1.1
1,2,3,4,7,8-hexa-CD-Dioxin					0.02
1,2,3,6,7,8-hexa-CD-Dioxin					0.11
1,2,3,7,8,9-hexa-CD-Dioxin					0.07
Total hepta-CD-Dioxin					12.7
1,2,3,4,6,7,8-hepta-CD-Dioxin					5.1
Octachlorodibenzo-Dioxin					44.3 B,
Total Dioxin					58.2
FURANS (ug/kg DB)					
Dibenzofuran	200	44 U	150	250	52 U
Total tetra-CD-Furan					0.02
2,3,7,8-tetra-CD-Furan					0.006
Total penta-CD-Furan					0.05
1,2,3,7,8-penta-CD-Furan					0.01
2,3,4,7,8-penta-CD-Furan					0.01
Total hexa-CD-Furan					0.87
1,2,3,6,7,8-hexa-CD-Furan					0.003 U,
1,2,3,4,7,8-hexa-CD-Furan					0.09 EM,PR,J
1,2,3,7,8,9-hexa-CD-Furan					0.005 U,
2,3,4,6,7,8-hexa-CD-Furan					0.04 EM,PR,J
Total hepta-CD-Furan					2
1,2,3,4,6,7,8-hepta-CD-Furan					0.35
1,2,3,4,7,8,9-hepta-CD-Furan					0.03
Octadichlorodibenzo-Furan					1.2 B,
Total Furan					4.14
METALS (mg/kg DB)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Silver					
Zinc					
CONVENTIONALS (%)					
Total Solids	47.4	53.5	63.4	62	46
Total Organic Carbon	3.88	2.88	2.46	1.45	3.873

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-H1B 07/24/1991 10 to 55 cm	CP2-M-H1C 07/24/1991 55 to 100 cm	CP2-M-H1E 07/24/1991 150 to 200 cm	CP2-M-H2A 07/23/1991 surface to 10 cm	CP2-M-H2B 07/23/1991 10 to 55 cm
PAH (ug/kg DB)					
Acenaphthene	270	48 U	37 U	1200	1100
Acenaphthylene	49 U	48 U	37 U	44 U	37 U
Anthracene	250	48 U	37 U	1200	890
Fluorene	49 U	48 U	37 U	800	620
Naphthalene	1200	48 U	37 U	3600	2800
Phenanthrene	430	48 U	37 U	1900	1400
2-Methylnaphthalene	49 U	48 U	37 U	600	530
Total LPAH	2300	340	260	9300	7400
Benzo(a)anthracene	200	48 U	37 U	1000	570
Benzo(a)pyrene	310	130	130	900	780
Benzo(b)fluoranthene	280	48 U	37 U	1100	800
Benzo(g,h,i)perylene	110	48 U	37 U	390	300
Benzo(k)fluoranthene	480	48 U	37 U	930	1000
Chrysene	310	48 U	37 U	1900	880
Dibenz(a,h)anthracene	49 U	48 U	37 U	200	140
Fluoranthene	440	120		2900	1800
Indeno(1,2,3-cd)pyrene	120	48 U	37 U	440	330
Pyrene	1700	110		4500	4900
Total HPAH	4000	700	390	14000	12000
Total Carcinogenic PAH	1700	420	350	6500	4500
Total PAH	6300	1000	650	24000	19000
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	R	R	R	R	R
2,4-Dichlorophenol	42 U	41 U	31 U	37 U	31 U
2,4,5-Trichlorophenol	10 U	10 U	7.8 U	12	7.8 U
2,4,6-Trichlorophenol	10 U	10 U	7.8 U	9.3 U	7.8 U
Tetrachlorophenol	10 U	10 U	7.8 U	9.3 U	14 J
Pentachlorophenol	8.4 *,J	2 U	1.6 U	47 D	54 D
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin	0.001				
2,3,7,8-tetra-CD-Dioxin	0.001 U,				
Total penta-CD-Dioxin	0.005				
1,2,3,7,8-penta-CD-Dioxin	0.003 U,				
Total hexa-CD-Dioxin	0.45				
1,2,3,4,7,8-hexa-CD-Dioxin	0.006 EM,J				
1,2,3,6,7,8-hexa-CD-Dioxin	0.05				
1,2,3,7,8,9-hexa-CD-Dioxin	0.03				
Total hepta-CD-Dioxin	6.2				
1,2,3,4,6,7,8-hepta-CD-Dioxin	2.5				
Octachlorodibenzo-Dioxin	21.6 B,				
Total Dioxin	28.3				
FURANS (ug/kg DB)					
Dibenzofuran	49 U	48 U	37 U	44 U	37 U
Total tetra-CD-Furan	0.005				
2,3,7,8-tetra-CD-Furan	0.002				
Total penta-CD-Furan	0.009				
1,2,3,7,8-penta-CD-Furan	0.004 EM,J				
2,3,4,7,8-penta-CD-Furan	0.007				
Total hexa-CD-Furan	4.7				
1,2,3,6,7,8-hexa-CD-Furan	0.05 U,				
1,2,3,4,7,8-hexa-CD-Furan	0.15 EM,PR,J				
1,2,3,7,8,9-hexa-CD-Furan	0.07 U,				
2,3,4,6,7,8-hexa-CD-Furan	0.49 PR,				
Total hepta-CD-Furan	3.2				
1,2,3,4,6,7,8-hepta-CD-Furan	0.16 EM,J				
1,2,3,4,7,8,9-hepta-CD-Furan	0.06 EM,J				
Octadichlorodibenzo-Furan	0.63 B,				
Total Furan	8.54				
METALS (mg/kg DB)					
Antimony				0.1 U,J	0.1 U,J
Arsenic				4.7 J	4.4 J
Cadmium				1.1	0.97
Chromium				24	20
Copper				40 J	37 J
Lead				12	8.8
Mercury				0.13 **	0.09 **
Nickel				19	18
Silver				0.06 U	0.05 U
Zinc				62	48
CONVENTIONALS (%)					
Total Solids	48	49	64	54	64
Total Organic Carbon	4.3197	4.2141	1.6417	3.3622	3.0356

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-H12B 07/23/1991 Duplicate	CP2-M-H2C 07/23/1991 55 to 79 cm	CP2-M-H2D 07/23/1991 100 to 150 cm	CP2-M-H2M 07/23/1991 560 to 610 cm	CP2-M-H3A 07/23/1991 surface to 10 cm
PAH (ug/kg DB)					
Acenaphthene	1100	24 U	45 U	38 U	47 U
Acenaphthylene	38 U	24 U	45 U	38 U	47 U
Anthracene	1000	24 U	45 U	38 U	260
Fluorene	690	24 U	45 U	38 U	47 U
Naphthalene	2900	290	45 U	38 U	1000
Phenanthrene	1500	170	45 U	38 U	390
2-Methylnaphthalene	530	24 U	45 U	38 U	47 U
Total LPAH	7800	580	320	270	1800
Benzo(a)anthracene	740	24 U	45 U	38 U	350
Benzo(a)pyrene	950	150	500	200	340
Benzo(b)fluoranthene	1600	30	45 U	38 U	260
Benzo(g,h,i)perylene	370	24 U	45 U	38 U	130
Benzo(k)fluoranthene	38 U	58	45 U	38 U	480
Chrysene	1200	24 U	45 U	38 U	590
Dibenz(a,h)anthracene	190	24 U	45 U	38 U	47 U
Fluoranthene	1800	180	45 U	38 U	410
Indeno(1,2,3-cd)pyrene	410	24 U	45 U	38 U	140
Pyrene	5300	300	220	38 U	900
Total HPAH	13000	840	1100	540	3600
Total Carcinogenic PAH	5100	330	770	430	2200
Total PAH	20000	1400	1400	810	5500
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	R	R	R	R	R
2,4-Dichlorophenol	32 U	20 U	38 U	32 U	40 U
2,4,5-Trichlorophenol	8.1 U	5 U	9.4 U	7.9 U	10 U
2,4,6-Trichlorophenol	8.1 U	5 U	9.4 U	7.9 U	10 U
Tetrachlorophenol	8.1 U	5 U	9.4 U	7.9 U	10 U
Pentachlorophenol	110 D	1 U	1.9 U	1.6 U	8.7
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin			0.003 U,		
2,3,7,8-tetra-CD-Dioxin			0.003 U,		
Total penta-CD-Dioxin			0.003 U,		
1,2,3,7,8-penta-CD-Dioxin			0.003 U,		
Total hexa-CD-Dioxin			0.01 EM,J		
1,2,3,4,7,8-hexa-CD-Dioxin			0.003 U,		
1,2,3,6,7,8-hexa-CD-Dioxin			0.003 U,		
1,2,3,7,8,9-hexa-CD-Dioxin			0.003 U,		
Total hepta-CD-Dioxin			0.07 U,		
1,2,3,4,6,7,8-hepta-CD-Dioxin			0.06 EM,J		
Octachlorodibenzo-Dioxin			0.53 B,U		
Total Dioxin			0.616		
FURANS (ug/kg DB)					
Dibenzofuran	38 U	24 U	45 U	38 U	47 U
Total tetra-CD-Furan			0.001 U,		
2,3,7,8-tetra-CD-Furan			0.001 U,		
Total penta-CD-Furan			0.003 U,		
1,2,3,7,8-penta-CD-Furan			0.003 U,		
2,3,4,7,8-penta-CD-Furan			0.003 U,		
Total hexa-CD-Furan			0.09		
1,2,3,6,7,8-hexa-CD-Furan			0.02 U,		
1,2,3,4,7,8-hexa-CD-Furan			0.02 U,		
1,2,3,7,8,9-hexa-CD-Furan			0.02 U,		
2,3,4,6,7,8-hexa-CD-Furan			0.02 U,		
Total hepta-CD-Furan			0.04		
1,2,3,4,6,7,8-hepta-CD-Furan			0.04		
1,2,3,4,7,8,9-hepta-CD-Furan			0.008 U,		
Octadichlorodibenzo-Furan			R		
Total Furan			0.164		
METALS (mg/kg DB)					
Antimony	0.1 U,J	0.1 U,J	0.1 U,J		
Arsenic	4.9 ,J	2.7 ,J	6.6 ,J		
Cadmium	0.72	4	12		
Chromium	17	150	350		
Copper	31 ,J	230 ,J	410 ,J		
Lead	7.9	26	67		
Mercury	0.13 **	0.03 **	0.06 **		
Nickel	19	18	33		
Silver	0.05 U	0.2 U	1 U		
Zinc	41	270	580		
CONVENTIONALS (%)					
Total Solids	62	74	53	63	50
Total Organic Carbon	2.4812	0.8231	2.4713	1.6059	3.9431

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-H3B 07/23/1991 10 to 55 cm	CP2-M-H3C 07/23/1991 55 to 100 cm	CP2-M-H3E 07/23/1991 150 to 200 cm	CP2-M-H3L 07/23/1991 500 to 552 cm	CP2-M-H5A 07/26/1991 surface to 10 cm
PAH (ug/kg DB)					
Acenaphthene	46 U	47 U	43 U	43 U	200
Acenaphthylene	46 U	47 U	43 U	43 U	40 U
Anthracene	190	47 U	43 U	43 U	140
Fluorene	46 U	47 U	43 U	43 U	140
Naphthalene	920	47 U	43 U	43 U	1100
Phenanthrene	400	47 U	43 U	43 U	300
2-Methylnaphthalene	46 U	47 U	43 U	43 U	120
Total LPAH	1700	330	300	300	2000
Benzo(a)anthracene	46 U	47 U	43 U	43 U	180
Benzo(a)pyrene	230	47 U	43 U	43 U	120
Benzo(b)fluoranthene	210	47 U	43 U	43 U	210
Benzo(g,h,i)perylene	110	47 U	43 U	43 U	40 U
Benzo(k)fluoranthene	280	47 U	43 U	43 U	79
Chrysene	46 U	47 U	43 U	43 U	210
Dibenz(a,h)anthracene	46 U	47 U	43 U	43 U	40 U
Fluoranthene	440	47 U	43 U	43 U	330
Indeno(1,2,3-cd)pyrene	110	47 U	43 U	43 U	40 U
Pyrene	850	47 U	43 U	43 U	840
Total HPAH	2400	470	430	430	2100
Total Carcinogenic PAH	1000	330	300	300	880
Total PAH	4100	800	730	730	4100
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	R	R	R	R	R
2,4-Dichlorophenol	38 U	39 U	36 U	32 U	33 U
2,4,5-Trichlorophenol	9.6 U	9.8 U	9.1 U	7.9 U	16
2,4,6-Trichlorophenol	9.6 U	9.8 U	9.1 U	7.9 U	8.3 U
Tetrachlorophenol	9.6 U	9.8 U	9.1 U	7.9 U	8.3 U
Pentachlorophenol	5.9 *,J	2 U	1.8 U	1.6 U	7.2 *,J
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin					0.03
2,3,7,8-tetra-CD-Dioxin					0.002 EM,J
Total penta-CD-Dioxin					0.04 Q,J
1,2,3,7,8-penta-CD-Dioxin					0.003
Total hexa-CD-Dioxin					0.58 Q,J
1,2,3,4,7,8-hexa-CD-Dioxin					0.02 Q,J
1,2,3,6,7,8-hexa-CD-Dioxin					0.04
1,2,3,7,8,9-hexa-CD-Dioxin					0.04 Q,J
Total hepta-CD-Dioxin					2.9
1,2,3,4,6,7,8-hepta-CD-Dioxin					1.2
Octachlorodibenzo-Dioxin					9.5 B,
Total Dioxin					13.1
FURANS (ug/kg DB)					
Dibenzofuran	46 U	47 U	43 U	43 U	120
Total tetra-CD-Furan					0.02
2,3,7,8-tetra-CD-Furan					0.005
Total penta-CD-Furan					0.02 Q,J
1,2,3,7,8-penta-CD-Furan					0.007 EM,J
2,3,4,7,8-penta-CD-Furan					0.006 EM,J
Total hexa-CD-Furan					0.2
1,2,3,6,7,8-hexa-CD-Furan					0.005
1,2,3,4,7,8-hexa-CD-Furan					0.02
1,2,3,7,8,9-hexa-CD-Furan					0.003 U,
2,3,4,6,7,8-hexa-CD-Furan					0.01 PR, B
Total hepta-CD-Furan					0.39
1,2,3,4,6,7,8-hepta-CD-Furan					0.12
1,2,3,4,7,8,9-hepta-CD-Furan					0.006
Octadichlorodibenzo-Furan					0.31
Total Furan					0.940
METALS (mg/kg DB)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Silver					
Zinc					
CONVENTIONALS (%)					
Total Solids	52	51	55	63	60
Total Organic Carbon	4.555	3.1924	1.3174	1.2325	2.4024

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-H5B 07/26/1991 10 to 40 cm	CP2-M-H5CC 07/26/1991 81 to 113 cm	CP2-M-H5E 07/26/1991 150 to 200 cm	CP2-M-H6A 07/29/1991 surface to 10 cm	CP2-M-H6B 07/29/1991 10 to 55 cm
PAH (ug/kg DB)					
Acenaphthene	260	24 U	47 U	560	610
Acenaphthylene	46	24 U	47 U	38 U	61
Anthracene	220	24 U	47 U	500	410
Fluorene	190	24 U	47 U	390	380
Naphthalene	1300	24 U	47 U	2100	2700
Phenanthrene	440	24 U	47 U	840	780
2-Methylnaphthalene	150	24 U	47 U	380	430
Total LPAH	2600	170	330	4800	5400
Benzo(a)anthracene	170	24 U	47 U	290	210
Benzo(a)pyrene	150	24 U	47 U	210	180
Benzo(b)fluoranthene	310	24 U	47 U	390	240
Benzo(g,h,i)perylene	38 U	24 U	47 U	38 U	35 U
Benzo(k)fluoranthene	100	24 U	47 U	260	270
Chrysene	280	24 U	47 U	380	300
Dibenz(a,h)anthracene	38 U	24 U	47 U	38 U	35 U
Fluoranthene	570	24 U	47 U	1500	1200
Indeno(1,2,3-cd)pyrene	38 U	24 U	47 U	99	73
Pyrene	1300	24 U	47 U	1500	1500
Total HPAH	3000	240	470	4700	4000
Total Carcinogenic PAH	1100	170	330	1700	1300
Total PAH	5600	410	800	9500	9400
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	R	R	R	R	R
2,4-Dichlorophenol	32 U	20 U	39 U	32 U	30 U
2,4,5-Trichlorophenol	7.9 U	7.1	9.8 U	8.7	7.5 U
2,4,6-Trichlorophenol	7.9 U	5 U	9.8 U	8.1 U	7.5 U
Tetrachlorophenol	7.9 U	5 U	9.8 U	8.1 U	7.5 U
Pentachlorophenol	14 *,J	1.3	4.1 *,J	27 D,J	14 ,J
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin	0.01			0.02	0.02
2,3,7,8-tetra-CD-Dioxin	0.003 U,			0.002 B,U	0.003 U,
Total penta-CD-Dioxin	0.02 Q,J			0.05	0.08 Q,J
1,2,3,7,8-penta-CD-Dioxin	0.005 U,			0.008	0.005
Total hexa-CD-Dioxin	0.26			0.78	0.5
1,2,3,4,7,8-hexa-CD-Dioxin	0.008 EM,J			0.02	0.01
1,2,3,6,7,8-hexa-CD-Dioxin	0.03			0.09	0.04
1,2,3,7,8,9-hexa-CD-Dioxin	0.02			0.06	0.06 PR,
Total hepta-CD-Dioxin	2.2			6.6	4.5
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.91			2.8	1.8 Q,J
Octachlorodibenzo-Dioxin	6.3 B,			22.3 B,	14.7 B,
Total Dioxin	8.79			29.8	19.8
FURANS (ug/kg DB)					
Dibenzofuran	150	24 U	47 U	250	200
Total tetra-CD-Furan	0.03			0.02	0.04
2,3,7,8-tetra-CD-Furan	0.003			0.006 B,	0.005
Total penta-CD-Furan	0.03 Q,J			0.07	0.03 Q,J
1,2,3,7,8-penta-CD-Furan	0.003 U,			0.01 EM,J	0.005 EM,J
2,3,4,7,8-penta-CD-Furan	0.003 EM,J			0.01	0.006 EM,J
Total hexa-CD-Furan	0.15			0.45	0.24
1,2,3,6,7,8-hexa-CD-Furan	0.003			0.01	0.006
1,2,3,4,7,8-hexa-CD-Furan	0.01			0.04	0.02 PR,
1,2,3,7,8,9-hexa-CD-Furan	0.003 U,			0.002	0.005 U,
2,3,4,6,7,8-hexa-CD-Furan	0.008 EM,B,U,J			0.02 B,	0.02 PR,
Total hepta-CD-Furan	0.1			0.85	0.61
1,2,3,4,6,7,8-hepta-CD-Furan	0.08			0.21 B,	0.19
1,2,3,4,7,8,9-hepta-CD-Furan	0.003			0.02	0.01
Octadichlorodibenzo-Furan	0.27			0.67 B,	0.58
Total Furan	0.580			2.06	1.50
METALS (mg/kg DB)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Silver					
Zinc					
CONVENTIONALS (%)					
Total Solids	63	80	51	62	67
Total Organic Carbon	2.1789	0.4205	2.6609	1.6238	1.5134

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-H6C 07/29/1991 55 to 100 cm	CP2-M-H6E 07/29/1991 150 to 200 cm	CP2-M-H7A 08/12/1991 surface to 10 cm	CP2-M-H7B 08/12/1991 10 to 55 cm	CP2-M-H7C 08/12/1991 55 to 85 cm
PAH (ug/kg DB)					
Acenaphthene	24 U	35 U	1200	41	24 U
Acenaphthylene	24 U	35 U	96	24 U	32
Anthracene	24 U	35 U	940	54	32
Fluorene	24 U	35 U	1000	48	24 U
Naphthalene	86	35 U	4000	320	220
Phenanthrene	24 U	35 U	1800	130	140
2-Methylnaphthalene	24 U	35 U	550	44	24 U
Total LPAH	230	250	9600	660	500
Benzo(a)anthracene	24 U	35 U	520	56	44
Benzo(a)pyrene	63	110	350	42	46
Benzo(b)fluoranthene	24 U	35 U	470	60	70
Benzo(g,h,i)perylene	24 U	35 U	160	24 U	24 U
Benzo(k)fluoranthene	24 U	35 U	340	49	24 U
Chrysene	24 U	35 U	920	79	50
Dibenz(a,h)anthracene	24 U	35 U	79	24 U	24 U
Fluoranthene	24 U	35 U	2400	280	210
Indeno(1,2,3-cd)pyrene	24 U	35 U	150	24 U	24 U
Pyrene	69	35 U	1800	190	200
Total HPAH	320	430	7200	830	720
Total Carcinogenic PAH	210	320	2800	330	280
Total PAH	550	670	17000	1500	1200
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	R	R	R	R	R
2,4-Dichlorophenol	20 U	29 U	36 U	20 U	20 U
2,4,5-Trichlorophenol	5 U	7.4 U	11	5 U	5 U
2,4,6-Trichlorophenol	5 U	7.4 U	8.9 U	5 U	5 U
Tetrachlorophenol	5 U	7.4 U	8.9 U	5 U	5 U
Pentachlorophenol	5.4 ,J	1.5 U	17 *,J	1.2 *,J	1 U
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin			0.0738	0.0231	
2,3,7,8-tetra-CD-Dioxin			0.0022	0.00067 EM,J	
Total penta-CD-Dioxin			0.128	0.023 Q,J	
1,2,3,7,8-penta-CD-Dioxin			0.0157	0.0015 EM,J	
Total hexa-CD-Dioxin			1.2 Q,J	0.0685 Q,J	
1,2,3,4,7,8-hexa-CD-Dioxin			0.0397	0.0028	
1,2,3,6,7,8-hexa-CD-Dioxin			0.144 B,	0.0057 B,	
1,2,3,7,8,9-hexa-CD-Dioxin			0.0589 PR,	0.0055 PR,	
Total hepta-CD-Dioxin			6.85 Q,S,J	0.289 Q,J	
1,2,3,4,6,7,8-hepta-CD-Dioxin			3.33 B,S,J	0.123 B,	
Octachlorodibenzo-Dioxin			9.77 B,S,J	0.857 B,	
Total Dioxin			18.0	1.26	
FURANS (ug/kg DB)					
Dibenzofuran	24 U	35 U	770	32	24
Total tetra-CD-Furan			0.0656	0.0208	
2,3,7,8-tetra-CD-Furan			0.008 B,	0.0021 B,	
Total penta-CD-Furan			0.0728	0.0133	
1,2,3,7,8-penta-CD-Furan			0.0124	0.0024	
2,3,4,7,8-penta-CD-Furan			0.0141	0.0023 EM,J	
Total hexa-CD-Furan			0.675 Q,J	0.0694 Q,J	
1,2,3,6,7,8-hexa-CD-Furan			0.015	0.0019	
1,2,3,4,7,8-hexa-CD-Furan			0.0521	0.0049	
1,2,3,7,8,9-hexa-CD-Furan			0.0026	0.00028	
2,3,4,6,7,8-hexa-CD-Furan			0.029 B,	0.0045 B,PR,U	
Total hepta-CD-Furan			1.18 Q,J	0.156 Q,J	
1,2,3,4,6,7,8-hepta-CD-Furan			0.347 B,	0.0775 B,	
1,2,3,4,7,8,9-hepta-CD-Furan			0.021	0.001	
Octadichlorodibenzo-Furan			0.968 B,	0.0626 B,	
Total Furan			2.96	0.322	
METALS (mg/kg DB)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Silver					
Zinc					
CONVENTIONALS (%)					
Total Solids	75	68	56	72	77
Total Organic Carbon	0.4893	0.9091	3.9069	1.2321	1.6323

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-H8A 08/01/1991 surface to 10 cm	CP2-M-H8B 08/01/1991 10 to 32 cm	CP2-M-H8C 08/01/1991 61 to 100 cm	CP2-M-H8E 08/01/1991 150 to 200 cm	CP2-M-H9CC 07/25/1991 84 to 100 cm
PAH (ug/kg DB)					
Acenaphthene	89	40 U	40 U	24 U	90000 D
Acenaphthylene	77	40 U	40 U	24 U	700
Anthracene	240	40 U	40 U	24 U	18000
Fluorene	120	40 U	40 U	24 U	85000 D
Naphthalene	300	160	150	62	140000 D
Phenanthrene	400	75	77	24	150000 D
2-Methylnaphthalene	64	54	40 U	24 U	33000
Total LPAH	1300	450	430	210	520000
Benzo(a)anthracene	270	40 U	40 U	24 U	23000
Benzo(a)pyrene	170	64	71	24 U	9400
Benzo(b)fluoranthene	310	66	44	24 U	14000
Benzo(g,h,i)perylene	79	40 U	40 U	24 U	2400
Benzo(k)fluoranthene	570	67	45	24 U	6200
Chrysene	560	40 U	40 U	24 U	18000
Dibenz(a,h)anthracene	35 U	40 U	40 U	24 U	950
Fluoranthene	940	120	92	55	100000 D
Indeno(1,2,3-cd)pyrene	35 U	40 U	40 U	24 U	2600
Pyrene	1000	150	120	68	66000 D
Total HPAH	4000	670	570	320	240000
Total Carcinogenic PAH	2000	360	320	170	74000
Total PAH	5300	1100	1000	520	760000
CHLORINATED PHENOLS (ug/kg DB)					
2-Chlorophenol	R	R	R	R	R
2,4-Dichlorophenol	29 U	33 U	34 U	20 U	20 U
2,4,5-Trichlorophenol	7.4 U	8.3 U	8.5 U	5 U	5 U
2,4,6-Trichlorophenol	7.4 U	8.3 U	8.5 U	5 U	5 U
Tetrachlorophenol	7.4 U	8.3 U	8.5 U	5 U	5 U
Pentachlorophenol	11 ,J	1.7 U	1.7 U	1 U	1 U
DIOXINS (ug/kg DB)					
Total tetra-CD-Dioxin	0.01	0.006			
2,3,7,8-tetra-CD-Dioxin	0.001 U,	0.001 U,			
Total penta-CD-Dioxin	0.06	0.009 Q,J			
1,2,3,7,8-penta-CD-Dioxin	0.007	0.003 EM,J			
Total hexa-CD-Dioxin	0.57	0.1			
1,2,3,4,7,8-hexa-CD-Dioxin	0.02	0.003			
1,2,3,6,7,8-hexa-CD-Dioxin	0.05	0.008			
1,2,3,7,8,9-hexa-CD-Dioxin	0.04	0.006			
Total hepta-CD-Dioxin	3.8	0.54			
1,2,3,4,6,7,8-hepta-CD-Dioxin	1.5	0.21			
Octachlorodibenzo-Dioxin	11.5 B,	1.6 B,			
Total Dioxin	15.9	2.26			
FURANS (ug/kg DB)					
Dibenzofuran	70	40 U	40	24	62000 D,U
Total tetra-CD-Furan	0.02	0.01			
2,3,7,8-tetra-CD-Furan	0.004	0.002			
Total penta-CD-Furan	0.03	0.005 Q,J			
1,2,3,7,8-penta-CD-Furan	0.006 EM,J	0.001 U,			
2,3,4,7,8-penta-CD-Furan	0.006	0.002			
Total hexa-CD-Furan	0.27	0.05			
1,2,3,6,7,8-hexa-CD-Furan	0.007 EM,J	0.002 EM,J			
1,2,3,4,7,8-hexa-CD-Furan	0.03	0.004 EM,J			
1,2,3,7,8,9-hexa-CD-Furan	0.006	0.003 U,			
2,3,4,6,7,8-hexa-CD-Furan	0.02	0.005			
Total hepta-CD-Furan	0.18	0.18			
1,2,3,4,6,7,8-hepta-CD-Furan	0.14	0.09			
1,2,3,4,7,8,9-hepta-CD-Furan	0.01	0.003 U,			
Octadichlorodibenzo-Furan	0.29	0.07			
Total Furan	0.790	0.315			
METALS (mg/kg DB)					
Antimony					
Arsenic					
Cadmium					
Chromium					
Copper					
Lead					
Mercury					
Nickel					
Silver					
Zinc					
CONVENTIONALS (%)					
Total Solids	68	60	59	76	76
Total Organic Carbon	2.4545	1.4263	1.8952	0.6881	1.2086

TABLE C-2
Remedial Investigation Sediment Chemistry
Port of Olympia
Cascade Pole Site

	CP2-M-H9F 07/25/1991 200 to 250 cm		CP2-M-H10A 08/14/1991 surface to 10 cm	
PAH (ug/kg DB)				
Acenaphthene	670		130	
Acenaphthylene	45	U	53	
Anthracene	130		410	
Fluorene	520		160	
Naphthalene	1600		460	
Phenanthrene	1300		430	
2-Methylnaphthalene	200		120	
Total LPAH	4500		1800	
Benzo(a)anthracene	110		340	
Benzo(a)pyrene	300		240	
Benzo(b)fluoranthene	45	U	430	
Benzo(g,h,i)perylene	45	U	110	
Benzo(k)fluoranthene	45	U	400	
Chrysene	100		460	
Dibenz(a,h)anthracene	45	U	43	U
Fluoranthene	630		980	
Indeno(1,2,3-cd)pyrene	45	U	120	
Pyrene	590		1300	
Total HPAH	2000		4400	
Total Carcinogenic PAH	690		2000	
Total PAH	6400		6200	
CHLORINATED PHENOLS (ug/kg DB)				
2-Chlorophenol	R		R	
2,4-Dichlorophenol	350	J	36	U
2,4,5-Trichlorophenol	9.4	U	8.9	U
2,4,6-Trichlorophenol	9.4	U	8.9	U
Tetrachlorophenol	9.4	U	8.9	U
Pentachlorophenol	1.9	U	28	J
DIOXINS (ug/kg DB)				
Total tetra-CD-Dioxin				
2,3,7,8-tetra-CD-Dioxin				
Total penta-CD-Dioxin				
1,2,3,7,8-penta-CD-Dioxin				
Total hexa-CD-Dioxin				
1,2,3,4,7,8-hexa-CD-Dioxin				
1,2,3,6,7,8-hexa-CD-Dioxin				
1,2,3,7,8,9-hexa-CD-Dioxin				
Total hepta-CD-Dioxin				
1,2,3,4,6,7,8-hepta-CD-Dioxin				
Octachlorodibenzo-Dioxin				
Total Dioxin				
FURANS (ug/kg DB)				
Dibenzofuran	290		130	
Total tetra-CD-Furan				
2,3,7,8-tetra-CD-Furan				
Total penta-CD-Furan				
1,2,3,7,8-penta-CD-Furan				
2,3,4,7,8-penta-CD-Furan				
Total hexa-CD-Furan				
1,2,3,6,7,8-hexa-CD-Furan				
1,2,3,4,7,8-hexa-CD-Furan				
1,2,3,7,8,9-hexa-CD-Furan				
2,3,4,6,7,8-hexa-CD-Furan				
Total hepta-CD-Furan				
1,2,3,4,6,7,8-hepta-CD-Furan				
1,2,3,4,7,8,9-hepta-CD-Furan				
Octadichlorodibenzo-Furan				
Total Furan				
METALS (mg/kg DB)				
Antimony				
Arsenic				
Cadmium				
Chromium				
Copper				
Lead				
Mercury				
Nickel				
Silver				
Zinc				
CONVENTIONALS (%)				
Total Solids	53		56	
Total Organic Carbon	2.5692		3.9286	

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-A1A 12/06/90 surface to 10cm	CP1-M-A2A 12/06/90 surface to 10cm	CP2-M-A2A 07/25/1991 surface to 10 cm	CP2-M-A2B 07/25/1991 10 to 55 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	12	6.3		0.85 U	16	57
Acenaphthylene	2.8 U	4.8 U		0.85 U	66	66
Anthracene	16	12		2.9	220	1200
Fluorene	10	4.0 J		0.85 U,	23	79
Naphthalene	58	39		9.1	99	170
Phenanthrene	21	14		4.9	100	480
2-Methylnaphthalene	4.8	4.8 U		0.85 U	38	64
Total LPAH	120	80		19	370	780
Benzo(a)anthracene	13	13		3.5	110	270
Benzo(a)pyrene	14	18		3.2	99	210
Benzo(b)fluoranthene	26	31		3.5		
Benzo(k)fluoranthene	8.2	11		5.4		
Total Benzofluoranthene	35	42		8.9	230	450
Benzo(g,h,i)perylene	2.7 J	4.8 U		0.85 U,	31	78
Chrysene	34	25		7.9	110	460
Dibenz(a,h)anthracene	2.8 U	4.8 U		0.85 U,	12	33
Fluoranthene	77	28		8.8	160	1200
Indeno(1,2,3-cd)pyrene	2.8 U	4.8 U		0.85 U,	34	88
Pyrene	96	110		22	1000	1400
Total HPAH	280	250		56	960	5300
Total Carcinogenic PAH	100	110		25		
Total PAH	400	330		75		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	2400 U,UJ	2400 U,UJ		R		
2,4-Dichlorophenol	630 J	48 U,UJ		47 U		
2,4,5-Trichlorophenol	12 U	12 U		12 U		
2,4,6-Trichlorophenol	12 U	12 U		12 U		
Tetrachlorophenol	12 U	12 U		12 U		
Pentachlorophenol	17 B	11 B		19 *,J	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin			0.002 EM,J	0.002 EM,J		
1,2,3,7,8-penta-CD-Dioxin			0.005	0.005		
1,2,3,4,7,8-hexa-CD-Dioxin			0.002	0.003 EM,J		
1,2,3,6,7,8-hexa-CD-Dioxin			0.011	0.013		
1,2,3,7,8,9-hexa-CD-Dioxin			0.010	0.007		
1,2,3,4,6,7,8-hepta-CD-Dioxin			0.048	0.053		
Octachlorodibenzo-Dioxin			0.038 B,	0.043 B,		
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	9.1	4.2 J		0.85 U	15	58
2,3,7,8-tetra-CD-Furan			0.001	0.001		
1,2,3,7,8-penta-CD-Furan			0.000	0.001		
2,3,4,7,8-penta-CD-Furan			0.005	0.005		
1,2,3,6,7,8-hexa-CD-Furan			0.001	0.010 U,		
1,2,3,4,7,8-hexa-CD-Furan			0.010	0.031		
1,2,3,7,8,9-hexa-CD-Furan			0.002 U,	0.046		
2,3,4,6,7,8-hexa-CD-Furan			0.013 PR,	0.020 U,		
1,2,3,4,6,7,8-hepta-CD-Furan			0.004	0.004		
1,2,3,4,7,8,9-hepta-CD-Furan			0.001	0.001		
Octadichlorodibenzo-Furan			0.001 B,	0.001 B,		
Total Dioxins/Furans			0.154	0.246		
METALS (mg/kg DB)						
Antimony	0.5 U	0.5 U,UJ				
Arsenic	3.5 J	6.6 J			57	93
Cadmium	1.9	1.9			5.1	6.7
Chromium	32	35			260	270
Copper	55	55			390	390
Lead	22	18			450	530
Mercury	0.08	0.08			0.41	0.59
Nickel	27	30				
Silver	1 U	1 U			6.1	6.1
Zinc	100	88			410	960
CONVENTIONALS (%)						
Total Solids	41.2	41.5		43		
Total Organic Carbon	2.08	1.19		6.494		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-A2C 07/25/1991 55 to 75 cm	CP2-M-A2D 07/25/1991 100 to 150 cm	CP1-M-A3A 12/06/90 surface to 10cm	CP1-M-A4A 12/06/90 surface to 10cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	6.3	170	5.5	2.5	16	57
Acenaphthylene	1.3 U	4.4	2.1 U	2.2 U	66	66
Anthracene	13	56	5.5	3.5	220	1200
Fluorene	5.7	75	3.2	2.1 J	23	79
Naphthalene	31	120	27	21	99	170
Phenanthrene	13	120	11	6.8	100	480
2-Methylnaphthalene	2.6	12	2.8	2.2 U	38	64
Total LPAH	70	550	55	38	370	780
Benzo(a)anthracene	22	100	7.0	6.4	110	270
Benzo(a)pyrene	22	53	7.4	6.8	99	210
Benzo(b)fluoranthene	28	75	12	11		
Benzo(k)fluoranthene	16	31	4.3	3.4		
Total Benzofluoranthene	43	110	16	14	230	450
Benzo(g,h,i)perylene	5.7	13	2.1 U	2.3	31	78
Chrysene	51	110	9.4	6.8 J	110	460
Dibenz(a,h)anthracene	2.3	1.3 U,	2.1 U	2.2 U	12	33
Fluoranthene	16	220	14	20	160	1200
Indeno(1,2,3-cd)pyrene	6.0	13	2.1 U	3.4	34	88
Pyrene	86	310	36	31 J	1000	1400
Total HPAH	250	930	96	93	960	5300
Total Carcinogenic PAH	150	380	44	40		
Total PAH	320	1500	150	130		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R		2400 U,UJ		
2,4-Dichlorophenol	330 J	34 U		48 U,UJ		
2,4,5-Trichlorophenol	9.6 U	8.6 U	11 U	12 U		
2,4,6-Trichlorophenol	9.6 U	8.6 U	11 U	12 U		
Tetrachlorophenol	9.6 U	8.6 U	11 U	12 U		
Pentachlorophenol	9.2 *,J	13 *,J	5.6 B,UJ	3.6 B,UJ	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	5.1	47	84	2.8	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony			0.5 U,UJ			
Arsenic			6.5 J		57	93
Cadmium			2.3		5.1	6.7
Chromium			35		260	270
Copper			65		390	390
Lead			18		450	530
Mercury			0.12		0.41	0.59
Nickel			28			
Silver			1 U		6.1	6.1
Zinc			96		410	960
CONVENTIONALS (%)						
Total Solids	52	58	44.8	41.8		
Total Organic Carbon	3.4969	3.2002	2.56	2.65		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-B1A 12/12/90 surface to 10cm	CP1-M-B1B 12/12/90 10 to 55 cm	CP1-M-B1C 12/12/90 55 to 100 cm	CP1-M-B2A 12/10/90 surface to 10cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	29	39	3.4	15	16	57
Acenaphthylene	2.5	1.7	1.1 J	5.6	66	66
Anthracene	15	12	4.1	45	220	1200
Fluorene	14	7.6	2.7	14	23	79
Naphthalene	52	24	17 B,UJ	36	99	170
Phenanthrene	36	24	12	89	100	480
2-Methylnaphthalene	9.1	5.0	1.3 J	5.6	38	64
Total LPAH	150	110	41	200	370	780
Benzo(a)anthracene	20	19	3.8	71	110	270
Benzo(a)pyrene	11	6.8	2.5	33	99	210
Benzo(b)fluoranthene	19	12	3.4	52		
Benzo(k)fluoranthene	8.2	3.5	1.4 J	71 J		
Total Benzofluoranthene	28	15	4.8	120	230	450
Benzo(g,h,i)perylene	4.3	2.2	1.6 U	10	31	78
Chrysene	28	19	4.1	100	110	460
Dibenz(a,h)anthracene	1.9 U	1.0 U	1.6 U	2.9	12	33
Fluoranthene	78	98	15	250	160	1200
Indeno(1,2,3-cd)pyrene	4.1	2.1	1.6 U	10	34	88
Pyrene	73	70	11	190	1000	1400
Total HPAH	250	230	46	790	960	5300
Total Carcinogenic PAH	93	63	18	340		
Total PAH	400	340	87	990		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	1800 U,UJ	1900 U,UJ	2000 U,UJ	2000 U,UJ		
2,4-Dichlorophenol	37 U,UJ	38 U,UJ	39 U,UJ	52 J		
2,4,5-Trichlorophenol	9.2 U	9.6 U	9.8 U	10 U		
2,4,6-Trichlorophenol	9.2 U	9.6 U	9.8 U	10 U		
Tetrachlorophenol	9.2 U	9.6 U	9.8 U	10		
Pentachlorophenol	4.7	1.9	2 U	15 B	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin	0.003 U					
1,2,3,7,8-penta-CD-Dioxin	0.001 U					
1,2,3,4,7,8-hexa-CD-Dioxin	0.000					
1,2,3,6,7,8-hexa-CD-Dioxin	0.003					
1,2,3,7,8,9-hexa-CD-Dioxin	0.001					
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.014					
Octachlorodibenzo-Dioxin	0.010 B					
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	14	1.0 U	1.9	8.2	15	58
2,3,7,8-tetra-CD-Furan	0.000					
1,2,3,7,8-penta-CD-Furan	0.000 EM,J					
2,3,4,7,8-penta-CD-Furan	0.002 EM,J					
1,2,3,6,7,8-hexa-CD-Furan	0.001 EM,J					
1,2,3,4,7,8-hexa-CD-Furan	0.000					
1,2,3,7,8,9-hexa-CD-Furan	0.000 U					
2,3,4,6,7,8-hexa-CD-Furan	0.001					
1,2,3,4,6,7,8-hepta-CD-Furan	0.001					
1,2,3,4,7,8,9-hepta-CD-Furan	0.000					
Octadichlorodibenzo-Furan	0.000					
Total Dioxins/Furans	0.037					
METALS (mg/kg DB)						
Antimony	0.5 U,UJ	0.5 U,UJ	0.5 U,UJ			
Arsenic	6.1 J	6.9 J	7.1 J		57	93
Cadmium	1.2	1.4	1.6		5.1	6.7
Chromium	26	33	30		260	270
Copper	42	53	56		390	390
Lead	7.5 J	7.8 J	7.3 J		450	530
Mercury	0.05	0.05	0.06		0.41	0.59
Nickel	23	29	27			
Silver	1 U	1 U	1 U		6.1	6.1
Zinc	43	54	53		410	960
CONVENTIONALS (%)						
Total Solids	53.6	51.7	50.9	50.4		
Total Organic Carbon	2.32	4.58	2.90	2.69		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-B2B 12/10/90 10 to 55 cm	CP1-M-B2C 12/10/90 55 to 100 cm	CP1-M-B3A 12/11/90 surface to 10cm	CP1-M-B3B 12/11/90 10 to 55 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	470	400	6.3	2100	16	57
Acenaphthylene	14	12	2.3	300	66	66
Anthracene	280	320	33	5100	220	1200
Fluorene	320	290	6.5	2600	23	79
Naphthalene	49	290	27	3900	99	170
Phenanthrene	540	720	18	4900	100	480
2-Methylnaphthalene	6.0	63	3.0	1800	38	64
Total LPAH	1700	2000	93	19000	370	780
Benzo(a)anthracene	190	240	9.2	2400	110	270
Benzo(a)pyrene	81	170	8.7	770	99	210
Benzo(b)fluoranthene	120	260	43 J	1200		
Benzo(k)fluoranthene	45	89	20 J	300		
Total Benzofluoranthene	160	340	63	1500	230	450
Benzo(g,h,i)perylene	26	57	6.3	280	31	78
Chrysene	170	230	17	1600	110	460
Dibenz(a,h)anthracene	1.5 J	4 J	1.5	21	12	33
Fluoranthene	570	950	24	7500	160	1200
Indeno(1,2,3-cd)pyrene	24	57	6.5	280	34	88
Pyrene	390	5 U	27.2	3000	1000	1400
Total HPAH	1600	2100	160	17000	960	5300
Total Carcinogenic PAH	640	1000	110	6500		
Total PAH	3300	4100	250	36000		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	2000 U,UJ	1900 U,UJ	1900 U,UJ	2300 J		
2,4-Dichlorophenol	39 U,UJ	37 U,UJ	38 U,UJ	30 U,UJ		
2,4,5-Trichlorophenol	9.8 U	9.3 U	9.6 U	7.5 U		
2,4,6-Trichlorophenol	9.8 U	9.3 U	9.6 U	7.5 U		
Tetrachlorophenol	50 U	23	18	7.5		
Pentachlorophenol	14 JB	15 B	87	7.5 U	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	170	190	5.2	2100	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony						
Arsenic					57	93
Cadmium					5.1	6.7
Chromium					260	270
Copper					390	390
Lead					450	530
Mercury					0.41	0.59
Nickel						
Silver					6.1	6.1
Zinc					410	960
CONVENTIONALS (%)						
Total Solids	50.9	53.5	52	67		
Total Organic Carbon	9.27	3.49	3.68	4.67		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-B3C 12/11/90 55 to 100 cm	CP1-M-B4A 12/06/90 surface to 10cm	CP1-M-B14A 12/07/90 Duplicate	CP1-M-B5A 12/13/90 surface to 10cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	79	7.0	6.8	6.9	16	57
Acenaphthylene	4.3	7.0	3.4	0.9 J	66	66
Anthracene	8.6	18	7.1	4.0	220	1200
Fluorene	50	12	5.1	3.2	23	79
Naphthalene	200	37	28	18	99	170
Phenanthrene	86	54	14	7.8	100	480
2-Methylnaphthalene	55	4.7	3.4	2.7	38	64
Total LPAH	430	130	65	41	370	780
Benzo(a)anthracene	3.6	14	3.7	4.0 J	110	270
Benzo(a)pyrene	1.9	32	6.0	5.2	99	210
Benzo(b)fluoranthene	6.2 J	43	12	8.4		
Benzo(k)fluoranthene	2.4 J	6.7	5.1	3.2 J		
Total Benzofluoranthene	8.6	50	17	12	230	450
Benzo(g,h,i)perylene	1.0 J	15	3.4	2.0 J	31	78
Chrysene	3.1	22 J	6.3	6.1 J	110	460
Dibenz(a,h)anthracene	1.1 U	4.7	1.7 U	1.5 U,UJ	12	33
Fluoranthene	26	67	17	6.9	160	1200
Indeno(1,2,3-cd)pyrene	1.1 U	18	3.4	2.0 J	34	88
Pyrene	13	60 J	43	16 J	1000	1400
Total HPAH	60	280	100	55	960	5300
Total Carcinogenic PAH	19	140	38	30		
Total PAH	490	410	170	100		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	2000 U,UJ	2100 U,UJ	2400 U,UJ	2200 U,UJ		
2,4-Dichlorophenol	39 U,UJ	42 U	48 U,UJ	43 U,UJ		
2,4,5-Trichlorophenol	9.8 U	11 U	12 U	11 U		
2,4,6-Trichlorophenol	9.8 U	11 U	12 U	11 U		
Tetrachlorophenol	9.8 U	11 U	12 U	11 U		
Pentachlorophenol	2.0 U	6.0 B,UJ	14 B	8.4	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	50	4.7	4.6	3.5	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony						
Arsenic					57	93
Cadmium					5.1	6.7
Chromium					260	270
Copper					390	390
Lead					450	530
Mercury					0.41	0.59
Nickel						
Silver					6.1	6.1
Zinc					410	960
CONVENTIONALS (%)						
Total Solids	51	46.6	41.4	46.4		
Total Organic Carbon	4.19	2.99	3.51	3.47		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-B5B 12/13/90 10 to 55 cm	CP1-M-B5C 12/13/90 55 to 100 cm	CP2-M-BI1 08/13/1991 Background surface to 10 cm	CP2-M-BI11 08/13/1991 Background Duplicate	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	3.0	2.0 U	2.1 U	2.1 U	16	57
Acenaphthylene	0.8 J	2.0 U	2.1 U	2.1 U	66	66
Anthracene	4.6	1.3 J	4.4	4.2	220	1200
Fluorene	2.0	2.0 U	2.6	3.0	23	79
Naphthalene	18	2.0 U	15	12	99	170
Phenanthrene	6.3	1.3 J	13	13	100	480
2-Methylnaphthalene	2.5	2.0 U	2.4	2.3	38	64
Total LPAH	34	11	39	37	370	780
Benzo(a)anthracene	11 J	2.0 U	3.3	6.1	110	270
Benzo(a)pyrene	7.6	2.8	2.1 U,	5.8	99	210
Benzo(b)fluoranthene	8.9	2.0 U	9.2	8.1		
Benzo(k)fluoranthene	5.8 J	2.0 U	6.0	6.9		
Total Benzofluoranthene	15	4.1	15	15	230	450
Benzo(g,h,i)perylene	2.5 J	2.0 U	2.1	2.1 U,	31	78
Chrysene	17 J	2.0 U	6.4	7.3	110	460
Dibenz(a,h)anthracene	1.3 UJ,UJ	2.0 U	2.1 U,	2.1 U,	12	33
Fluoranthene	6.9	1.1 J	25	24	160	1200
Indeno(1,2,3-cd)pyrene	2.4 J	2.0 U	2.1 U,	2.1 U,	34	88
Pyrene	15 J	2.0 U	22	20	1000	1400
Total HPAH	79	20	80	84	960	5300
Total Carcinogenic PAH	54	15	31	38		
Total PAH	110	31	120	120		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	2200 UJ,UJ	2000 UJ,UJ	R	R		
2,4-Dichlorophenol	43 UJ,UJ	39 UJ,UJ	44 U	45 U		
2,4,5-Trichlorophenol	11 U	9.8 U	11 U	11 U		
2,4,6-Trichlorophenol	11 U	9.8 U	11 U	11 U		
Tetrachlorophenol	11 U	9.8 U	11 U	11 U		
Pentachlorophenol	3.5	2.0 U	3.0 *,J	5.2 *,J	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin			0.0018	0.0016		
1,2,3,7,8-penta-CD-Dioxin			0.0033	0.0034 EM,J		
1,2,3,4,7,8-hexa-CD-Dioxin			0.0019	0.0080		
1,2,3,6,7,8-hexa-CD-Dioxin			0.0060 ,U	0.0054 ,U		
1,2,3,7,8,9-hexa-CD-Dioxin			0.0061 PR,	0.0151 PR,		
1,2,3,4,6,7,8-hepta-CD-Dioxin			0.0137	0.0130		
Octachlorodibenzo-Dioxin			0.0089 B,	0.0090 B,		
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	1.9	2.0 U	0.24	2.3	15	58
2,3,7,8-tetra-CD-Furan			0.0008 B,	0.0007 B,		
1,2,3,7,8-penta-CD-Furan			0.0003 ,	0.0004 ,U		
2,3,4,7,8-penta-CD-Furan			0.0037	0.0037		
1,2,3,6,7,8-hexa-CD-Furan			0.0011	0.0011		
1,2,3,4,7,8-hexa-CD-Furan			0.0033	0.0035		
1,2,3,7,8,9-hexa-CD-Furan			0.0001 EM,J	0.0006		
2,3,4,6,7,8-hexa-CD-Furan			0.0003	0.0025 PR,		
1,2,3,4,6,7,8-hepta-CD-Furan			0.0019	0.0020		
1,2,3,4,7,8,9-hepta-CD-Furan			0.0002	0.0002		
Octadichlorodibenzo-Furan			0.0003	0.0004		
Total Dioxins/Furans			0.0536	0.0703		
METALS (mg/kg DB)						
Antimony			0.11 UJ	0.11 UJ		
Arsenic			8.5	8.5	57	93
Cadmium			1.9	1.8	5.1	6.7
Chromium			28	28	260	270
Copper			43	44	390	390
Lead			42	40	450	530
Mercury			0.12	0.11	0.41	0.59
Nickel			23	22		
Silver			0.7	0.71	6.1	6.1
Zinc			79	79	410	960
CONVENTIONALS (%)						
Total Solids	46.5	51.1	50	50		
Total Organic Carbon	3.94	2.30	2.4887	2.6036		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-BI2 08/13/1991 Background surface to 10 cm		CP2-M-BI3 08/13/1991 Background surface to 10 cm		CP1-M-C1A 12/13/90 surface to 10cm		CP1-M-C1B 12/13/90 10 to 55 cm		Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)										
Acenaphthene	1.5	U	2.3	U	310	J	2400	J	16	57
Acenaphthylene	1.5	U	3.4		14	J	66	J	66	66
Anthracene	2.2		3.3		210	J	960	J	220	1200
Fluorene	1.5	U	2.3	U,	260	J	1600	J	23	79
Naphthalene	4.2		19		290	J	3000	J	99	170
Phenanthrene	4.0		10		840	J	3700	J	100	480
2-Methylnaphthalene	1.5	U	2.3	U	160	J	2400	J	38	64
Total LPAH	15		41		1900		12000		370	780
Benzo(a)anthracene	3.3		2.3	U,	170	J	540	J	110	270
Benzo(a)pyrene	3.5		2.3	U,	55	J	210	J	99	210
Benzo(b)fluoranthene	6.0		5.1		81	J	370	J		
Benzo(k)fluoranthene	3.7		2.9		33	J	120	J		
Total Benzofluoranthene	9.8		8.1		110		480		230	450
Benzo(g,h,i)perylene	1.6		2.3	U,	21	J	59	J	31	78
Chrysene	7.4		2.3	U,	110	J	380	J	110	460
Dibenz(a,h)anthracene	1.5	U,	2.3	U,	5	J	16	J	12	33
Fluoranthene	7.9		15		570	J	2400	J	160	1200
Indeno(1,2,3-cd)pyrene	1.5	U,	2.3	U,	21	J	62	J	34	88
Pyrene	7.7		17		380	J	1500	J	1000	1400
Total HPAH	44		54		1400		5600		960	5300
Total Carcinogenic PAH	27		20		470		1700			
Total PAH	59		95		3300		18000			
CHLORINATED PHENOLS (ug/kg DB)										
2-Chlorophenol	R		R		2400	UJ	21000	UJ		
2,4-Dichlorophenol	54	U	49	U	48	UJ	420	UJ		
2,4,5-Trichlorophenol	14	U	12	U	12	UJ	110	UJ		
2,4,6-Trichlorophenol	14	U	12	U	12	UJ	110	UJ		
Tetrachlorophenol	14	U	12	U	12	UJ	110	UJ		
Pentachlorophenol	6.1	*J	5.8	*J	43	J	100	J	360	690
DIOXINS (ug/kg TEQ DB)										
2,3,7,8-tetra-CD-Dioxin	0.0012		0.0013		0.003	U	0.007			
1,2,3,7,8-penta-CD-Dioxin	0.0016	EM,J	0.0027		0.004	EM,J	0.015			
1,2,3,4,7,8-hexa-CD-Dioxin	0.0012		0.0010		0.003		0.010			
1,2,3,6,7,8-hexa-CD-Dioxin	0.0025		0.0032	,U	0.025		0.130			
1,2,3,7,8,9-hexa-CD-Dioxin	0.0018	PR,	0.0012	PR,	0.013	PR,Q,J	0.032	Q,J		
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.0043		0.0082		0.122	B	0.643	B		
Octachlorodibenzo-Dioxin	0.0027	B,	0.0051	B,	0.090	B	0.241	S,B,J		
FURANS (ug/kg TEQ DB)										
Dibenzofuran (mg/kg organic carbon DB)	1.5		2.3		160		1300		15	58
2,3,7,8-tetra-CD-Furan	0.0009	B,	0.0006	B,	0.001		0.003			
1,2,3,7,8-penta-CD-Furan	0.0001	EM,J	0.0002		0.001		0.006			
2,3,4,7,8-penta-CD-Furan	0.0017		0.0027		0.010		0.065			
1,2,3,6,7,8-hexa-CD-Furan	0.0005		0.0007		0.002		0.013			
1,2,3,4,7,8-hexa-CD-Furan	0.0014		0.0024		0.007		0.052			
1,2,3,7,8,9-hexa-CD-Furan	0.0001		0.0001	EM,J	0.001	U	0.003	EM,J		
2,3,4,6,7,8-hexa-CD-Furan	0.0007	EM,J	0.0011		0.002		0.014			
1,2,3,4,6,7,8-hepta-CD-Furan	0.0013		0.0014		0.006	PR	0.035			
1,2,3,4,7,8,9-hepta-CD-Furan	0.0001		0.0001		0.001		0.003			
Octadichlorodibenzo-Furan	0.0002		0.0003		0.004		0.014	Q,J		
Total Dioxins/Furans	0.0221		0.0323		0.295		1.29			
METALS (mg/kg DB)										
Antimony	0.13	U,J	0.12	U,J	0.5	UJ	0.5	UJ		
Arsenic	8.5		8.1		5.9	J	7.4	J	57	93
Cadmium	2		2.2		1.5		1.8		5.1	6.7
Chromium	24		26		32		31		260	270
Copper	49		43		67		77		390	390
Lead	17		18		19		34		450	530
Mercury	0.1		0.11		0.16		0.17		0.41	0.59
Nickel	20		20		24		26			
Silver	0.37		0.48		1	U	1	J	6.1	6.1
Zinc	70		70		87		98		410	960
CONVENTIONALS (%)										
Total Solids	43		43		42.1		47.0			
Total Organic Carbon	4.3027		2.5271		4.19		6.25			

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-C1C 12/13/90 55 to 100 cm	CP2-M-C1E 07/22/1991 125 to 175 cm	CP2-M-C1PP 07/22/1991 664 to 700 cm	CP1-M-C2A 12/13/90 surface to 10cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	1600 J	1.7 U	3.8 U	26 J	16	57
Acenaphthylene	37 J	1.7 U	3.8 U	2.4 J	66	66
Anthracene	660 J	1.8	3.8 U	40 J	220	1200
Fluorene	980 J	1.7 U,	3.8 U,	19 J	23	79
Naphthalene	2800 J	17	3.8 U	52 J	99	170
Phenanthrene	2200 J	9.8	3.8 U	58 J	100	480
2-Methylnaphthalene	1400 J	1.7 U	3.8 U	9.5 J	38	64
Total LPAH	8300	34	23	200	370	780
Benzo(a)anthracene	350 J	1.7 U	3.8 U	52 J	110	270
Benzo(a)pyrene	140 J	24	12	28 J	99	210
Benzo(b)fluoranthene	220 J	1.7 U,	3.8 U	52 J		
Benzo(k)fluoranthene	97 J	1.7 U,	3.8 U	13 J		
Total Benzofluoranthene	320	3.4	7.6	65	230	450
Benzo(g,h,i)perylene	45 J	1.7 U,	3.8 U	13 J	31	78
Chrysene	290 J	1.7 U,	3.8 U	49 J	110	460
Dibenz(a,h)anthracene	13 J	1.7 U,	3.8 U	3.7 J	12	33
Fluoranthene	1800 J	4.2	3.8 U	190 J	160	1200
Indeno(1,2,3-cd)pyrene	45 J	1.7 U	3.8 U	13 J	34	88
Pyrene	1100 J	4.2	3.8 U	150 J	1000	1400
Total HPAH	4100	45	46	560	960	5300
Total Carcinogenic PAH	1200	34	34	210		
Total PAH	12000	79	69	760		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	2100 U,UJ	1700 U	R	2200 U,UJ		
2,4-Dichlorophenol	42 U,UJ	34 U	20 U	340 J		
2,4,5-Trichlorophenol	10 U,UJ	8.5 U	5.0 U	11 U,UJ		
2,4,6-Trichlorophenol	10 U,UJ	8.5 U	5.0 U	11 U,UJ		
Tetrachlorophenol	10 U,UJ	8.5 U	5.0 U	20 J		
Pentachlorophenol	140 J	1.7 U	1.0 U	18 J	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin	0.003 U	0.003 U,		0.001 U		
1,2,3,7,8-penta-CD-Dioxin	0.005	0.002 U,		0.003		
1,2,3,4,7,8-hexa-CD-Dioxin	0.006	0.001 U,		0.002		
1,2,3,6,7,8-hexa-CD-Dioxin	0.054	0.000 U,		0.013		
1,2,3,7,8,9-hexa-CD-Dioxin	0.008	0.001 U,		0.005 Q,J		
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.374 B	0.000 EM,J		0.054 B		
Octachlorodibenzo-Dioxin	0.170 S,B,J	0.000 B,		0.031 S,B,J		
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	730	1.7 U	3.8 U	14	15	58
2,3,7,8-tetra-CD-Furan	0.001	0.000 U,		0.000		
1,2,3,7,8-penta-CD-Furan	0.001	0.000 U,		0.000		
2,3,4,7,8-penta-CD-Furan	0.015	0.002 U,		0.005		
1,2,3,6,7,8-hexa-CD-Furan	0.003 Q,J	0.000 U,		0.001		
1,2,3,4,7,8-hexa-CD-Furan	0.011	0.000 U,		0.004		
1,2,3,7,8,9-hexa-CD-Furan	0.000	0.000 U,		0.000 Q,J		
2,3,4,6,7,8-hexa-CD-Furan	0.003	0.000 U,		0.001		
1,2,3,4,6,7,8-hepta-CD-Furan	0.023	0.000 U,		0.003		
1,2,3,4,7,8,9-hepta-CD-Furan	0.001	0.000 U,		0.000		
Octadichlorodibenzo-Furan	0.015	0.000 U,		0.001		
Total Dioxins/Furans	0.694	0.009		0.125		
METALS (mg/kg DB)						
Antimony	0.5 U,UJ	0.1 U,J		0.5 U,UJ		
Arsenic	13 J	6.5 J		6.6 J	57	93
Cadmium	2	1		2.1	5.1	6.7
Chromium	31	19		33	260	270
Copper	100	24 J		69	390	390
Lead	24	3		20	450	530
Mercury	0.37	0.04 **		0.18	0.41	0.59
Nickel	31	28		29		
Silver	1 U	1 U		1 U	6.1	6.1
Zinc	92	34		94	410	960
CONVENTIONALS (%)						
Total Solids	48.4	59	79	45.5		
Total Organic Carbon	6.82	2.3576	0.6324	3.27		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-C12A 12/13/90 Duplicate		CP1-M-C2B 12/13/90 10 to 55 cm		CP1-M-C12B 12/13/90 Duplicate		CP1-M-C2C 12/13/90 55 to 100 cm		Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)										
Acenaphthene	61	J	440	J	220	J	140	J	16	57
Acenaphthylene	2.4	J	14	J	7	J	4	J	66	66
Anthracene	44	J	320	J	140	J	120	J	220	1200
Fluorene	47	J	210	J	120	J	130	J	23	79
Naphthalene	56	J	150	J	100	J	340	J	99	170
Phenanthrene	170	J	170	J	230	J	390	J	100	480
2-Methylnaphthalene	13	J	26	J	28	J	100	J	38	64
Total LPAH	380		1300		810		1100		370	780
Benzo(a)anthracene	44	J	210	J	140	J	120	J	110	270
Benzo(a)pyrene	22	J	76	J	60	J	39	J	99	210
Benzo(b)fluoranthene	41	J	130	J	89	J	60	J		
Benzo(k)fluoranthene	14	J	68	J	27	J	20	J		
Total Benzofluoranthene	55		200		110		81		230	450
Benzo(g,h,i)perylene	8.8	J	35	J	24	J	18	J	31	78
Chrysene	41	J	170	J	75	J	81	J	110	460
Dibenz(a,h)anthracene	2.8	J	2.0	J	1.4	J	4.2	J	12	33
Fluoranthene	180	J	670	J	370	J	310	J	160	1200
Indeno(1,2,3-cd)pyrene	8.5	J	32	J	23	J	16	J	34	88
Pyrene	150	J	480	J	280	J	220	J	1000	1400
Total HPAH	510		1900		1100		900		960	5300
Total Carcinogenic PAH	170		690		410		340			
Total PAH	890		3200		1900		2000			
CHLORINATED PHENOLS (ug/kg DB)										
2-Chlorophenol	2200	U,UJ	2200	U,UJ	2200	U,UJ	1700	U,UJ		
2,4-Dichlorophenol	310	J	44	U,UJ	44	U,UJ	33	U,UJ		
2,4,5-Trichlorophenol	11	U,UJ	11	U,UJ	12	J	8	U,UJ		
2,4,6-Trichlorophenol	11	U,UJ	11	U,UJ	11	U,UJ	8	U,UJ		
Tetrachlorophenol	11	U,UJ	150	J,J	65	J	8	U,UJ		
Pentachlorophenol	12	J	220	J	80	J,J	1.7	U,UJ	360	690
DIOXINS (ug/kg TEQ DB)										
2,3,7,8-tetra-CD-Dioxin	0.001	U	0.007				0.001	U		
1,2,3,7,8-penta-CD-Dioxin	0.004		0.010				0.003	U		
1,2,3,4,7,8-hexa-CD-Dioxin	0.002		0.008				0.001	U		
1,2,3,6,7,8-hexa-CD-Dioxin	0.018		0.100				0.001	EM,J		
1,2,3,7,8,9-hexa-CD-Dioxin	0.009	PR	0.022	Q,J			0.001	U		
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.073	B	0.434	S,B,J			0.001	B		
Octachlorodibenzo-Dioxin	0.051	B	0.116	S,B,J			0.001	B		
FURANS (ug/kg TEQ DB)										
Dibenzofuran (mg/kg organic carbon DB)	29		70		63		84		15	58
2,3,7,8-tetra-CD-Furan	0.001		0.002				0.001			
1,2,3,7,8-penta-CD-Furan	0.001		0.002				0.000			
2,3,4,7,8-penta-CD-Furan	0.005		0.025	Q,J			0.002			
1,2,3,6,7,8-hexa-CD-Furan	0.002		0.006				0.000			
1,2,3,4,7,8-hexa-CD-Furan	0.005		0.023				0.000			
1,2,3,7,8,9-hexa-CD-Furan	0.001	U	0.001				0.001	U		
2,3,4,6,7,8-hexa-CD-Furan	0.002	EM,PR,J	0.006				0.001			
1,2,3,4,6,7,8-hepta-CD-Furan	0.004		0.041				0.004			
1,2,3,4,7,8,9-hepta-CD-Furan	0.000	EM,J	0.003				0.000	U		
Octadichlorodibenzo-Furan	0.002		0.027	Q,J			0.000			
Total Dioxins/Furans	0.180		0.833				0.017			
METALS (mg/kg DB)										
Antimony			0.5	U,UJ	0.5	U,UJ	0.5	U,UJ		
Arsenic			8.3	J	9.7	J	6.2	J	57	93
Cadmium			2.1		2.1		1.4		5.1	6.7
Chromium			34		32		31		260	270
Copper			84		89		240		390	390
Lead			25		28		9.2	J	450	530
Mercury			0.33		0.43		0.08		0.41	0.59
Nickel			30		27		26			
Silver			1	U	1.1	J	1	U	6.1	6.1
Zinc			90		110		60		410	960
CONVENTIONALS (%)										
Total Solids	45.8		45.0		45.4		59.8			
Total Organic Carbon	3.42		8.39		7.89		3.81			

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-C12C 12/13/90 Duplicate		CP2-M-C2E 07/25/1991 150 to 200 cm		CP1-M-C3A 12/12/90 surface to 10cm		CP1-M-C13A 12/12/90 Duplicate		Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)										
Acenaphthene	740	J	2.7		17		11	J	16	57
Acenaphthylene	20	J	2.2	U	2.6		1.0	J,J	66	66
Anthracene	700	J	2.7		16		10	J	220	1200
Fluorene	740	J	2.2	U	10		6.0	J	23	79
Naphthalene	1400	J	7.3		62	B,UJ	34	J	99	170
Phenanthrene	2500	J	4.9		25		17	J	100	480
2-Methylnaphthalene	170	J	2.2	U	8.6		6.0	J	38	64
Total LPAH	6100		22		130		79		370	780
Benzo(a)anthracene	400	J	2.2	U	12		9.0	J	110	270
Benzo(a)pyrene	200	J	12		11		8.0	J	99	210
Benzo(b)fluoranthene	290	J	2.2	U	19		16	J		
Benzo(k)fluoranthene	82	J	2.2	U	6.7		5.0	J		
Total Benzofluoranthene	370		4.5		25		21		230	450
Benzo(g,h,i)perylene	82	J	2.2	U	4.5		4.0	J	31	78
Chrysene	330	J	2.2	U	19		10	J	110	460
Dibenz(a,h)anthracene	27	J	2.2	U	2.0	U	1.0	J,J	12	33
Fluoranthene	1700	J	20		41		25	J	160	1200
Indeno(1,2,3-cd)pyrene	74	J	2.2	U	4.5		4.0	J	34	88
Pyrene	980	J	17		53		31	J	1000	1400
Total HPAH	4200		65		170		110		960	5300
Total Carcinogenic PAH	1400		25		73		53			
Total PAH	10000		87		300		190			
CHLORINATED PHENOLS (ug/kg DB)										
2-Chlorophenol	16000	U,UJ	R		1700	U,UJ	1600	,UJ		
2,4-Dichlorophenol	320	U,UJ	38	U	34	U,UJ	140	J		
2,4,5-Trichlorophenol	79	U,UJ	9.6	U	8.5	U	8	U,UJ		
2,4,6-Trichlorophenol	79	U,UJ	9.6	U	8.5	U	8	U,UJ		
Tetrachlorophenol	79	U,UJ	9.6	U	8.5	U	13	J		
Pentachlorophenol	16	U,UJ	1.9	U	4.6		10	J	360	690
DIOXINS (ug/kg TEQ DB)										
2,3,7,8-tetra-CD-Dioxin					0.001	U				
1,2,3,7,8-penta-CD-Dioxin					0.002					
1,2,3,4,7,8-hexa-CD-Dioxin					0.001					
1,2,3,6,7,8-hexa-CD-Dioxin					0.006					
1,2,3,7,8,9-hexa-CD-Dioxin					0.002	EM,J				
1,2,3,4,6,7,8-hepta-CD-Dioxin					0.023					
Octachlorodibenzo-Dioxin					0.017	B				
FURANS (ug/kg TEQ DB)										
Dibenzofuran (mg/kg organic carbon DB)	450		2.2	U	8.6		5.6		15	58
2,3,7,8-tetra-CD-Furan					0.000					
1,2,3,7,8-penta-CD-Furan					0.000					
2,3,4,7,8-penta-CD-Furan					0.003	EM,J				
1,2,3,6,7,8-hexa-CD-Furan					0.002					
1,2,3,4,7,8-hexa-CD-Furan					0.001					
1,2,3,7,8,9-hexa-CD-Furan					0.000	U				
2,3,4,6,7,8-hexa-CD-Furan					0.001					
1,2,3,4,6,7,8-hepta-CD-Furan					0.002					
1,2,3,4,7,8,9-hepta-CD-Furan					0.000	EM,J				
Octadichlorodibenzo-Furan					0.001					
Total Dioxins/Furans					0.060					
METALS (mg/kg DB)										
Antimony					0.5	U,UJ	0.5	U,UJ		
Arsenic					4.9	J	4.9	J	57	93
Cadmium					1		0.9		5.1	6.7
Chromium					23		21		260	270
Copper					28		27		390	390
Lead					8.7	J	8.1	J	450	530
Mercury					0.09		0.08		0.41	0.59
Nickel					20		18			
Silver					1	U	1	U	6.1	6.1
Zinc					53		50		410	960
CONVENTIONALS (%)										
Total Solids	63.3		52		58.8					
Total Organic Carbon	2.44		2.0616		2.09					

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-C3B 12/12/90 10 to 55 cm		CP1-M-C3C 12/12/90 55 to 100 cm		CP1-M-C4A 12/11/90 surface to 10cm		CP1-M-C4B 12/11/90 10 to 55 cm		Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)										
Acenaphthene	25		1.2	U	4.5		2.3	U	16	57
Acenaphthylene	4.8		0.9	J	2.6		2.3	U	66	66
Anthracene	20		1.8		5.6		2.3	U	220	1200
Fluorene	14		1.2	U	3.4		2.3	U	23	79
Naphthalene	90	J,W	10	B,W	31		9.2		99	170
Phenanthrene	39		1.9		8.7		2.9		100	480
2-Methylnaphthalene	13		1.2	U	2.8		2.3	U	38	64
Total LPAH	190		17		56		22		370	780
Benzo(a)anthracene	20		1.2	U	3.4		2.3	U	110	270
Benzo(a)pyrene	16		5.6		5.9		4.8		99	210
Benzo(b)fluoranthene	32		1.2	U	10		2.3	U		
Benzo(k)fluoranthene	13		1.2	U	2.4	J	2.8	J		
Total Benzofluoranthene	44		2.4		12		5.0		230	450
Benzo(g,h,i)perylene	8.4		1.2	U	2.8		2.3	U	31	78
Chrysene	34		1.2	U	5.1		2.3	U	110	460
Dibenz(a,h)anthracene	2.3	J	1.2	U	1.5	U	2.3	U	12	33
Fluoranthene	84		1.7		12		3.8		160	1200
Indeno(1,2,3-cd)pyrene	7.8		1.2	U	2.8		2.3	U	34	88
Pyrene	90		1.8		19		3.9		1000	1400
Total HPAH	310		18		64		29		960	5300
Total Carcinogenic PAH	130		13		31		19			
Total PAH	500		35		120		51			
CHLORINATED PHENOLS (ug/kg DB)										
2-Chlorophenol	1500	U,W	2000	U,W	2200	U,W	2200	U,W		
2,4-Dichlorophenol	31	U,W	40	U,W	43	U,W	43	U,W		
2,4,5-Trichlorophenol	7.7	U	10	U	11	U	11	U		
2,4,6-Trichlorophenol	7.7	U	10	U	11	U	11	U		
Tetrachlorophenol	7.7	U	10	U	11	U	11	U		
Pentachlorophenol	4.0		2.0	U	9.3		2.2	U	360	690
DIOXINS (ug/kg TEQ DB)										
2,3,7,8-tetra-CD-Dioxin	0.003	U	0.001	U						
1,2,3,7,8-penta-CD-Dioxin	0.001		0.002	U						
1,2,3,4,7,8-hexa-CD-Dioxin	0.000	EM,J	0.000	U						
1,2,3,6,7,8-hexa-CD-Dioxin	0.002		0.000	U						
1,2,3,7,8,9-hexa-CD-Dioxin	0.001		0.000	U						
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.008		0.000	U						
Octachlorodibenzo-Dioxin	0.006	B	0.000	B						
FURANS (ug/kg TEQ DB)										
Dibenzofuran (mg/kg organic carbon DB)	12		1.2		3.1		2.3	U	15	58
2,3,7,8-tetra-CD-Furan	0.000		0.000	U						
1,2,3,7,8-penta-CD-Furan	0.000		0.000	U						
2,3,4,7,8-penta-CD-Furan	0.001		0.001	U						
1,2,3,6,7,8-hexa-CD-Furan	0.000	EM,J	0.000	U						
1,2,3,4,7,8-hexa-CD-Furan	0.001	EM,J	0.000	U						
1,2,3,7,8,9-hexa-CD-Furan	0.000	U	0.000	U						
2,3,4,6,7,8-hexa-CD-Furan	0.000		0.000	EM,J						
1,2,3,4,6,7,8-hepta-CD-Furan	0.001	EM,J	0.000	U						
1,2,3,4,7,8,9-hepta-CD-Furan	0.000		0.000	U						
Octadichlorodibenzo-Furan	0.000		0.000	U						
Total Dioxins/Furans	0.025		0.005							
METALS (mg/kg DB)										
Antimony	0.5	U,W	0.5	U,W						
Arsenic	4.8	J	7	J					57	93
Cadmium	0.74		1.4						5.1	6.7
Chromium	23		32						260	270
Copper	21		40						390	390
Lead	4.9	J	7	J					450	530
Mercury	0.04		0.04						0.41	0.59
Nickel	20		30							
Silver	1	U	1	U					6.1	6.1
Zinc	43		56						410	960
CONVENTIONALS (%)										
Total Solids	65.2		50.1		46.0		46.0			
Total Organic Carbon	1.67		3.93		3.55		2.28			

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-C4C 12/11/90 55 to 100 cm	CP1-M-C5A 12/07/90 surface to 10cm	CP1-M-D1A 12/12/90 surface to 10cm	CP1-M-D11A 12/12/90 Duplicate	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	2.1 U	0.9	16	9.2 J	16	57
Acenaphthylene	2.1 U	1.1	2.9	1.4 U,UJ	66	66
Anthracene	2.1 U	1.3	13	3.4 J	220	1200
Fluorene	2.1 U	0.7 J	7.8	3.3 J	23	79
Naphthalene	2.1 U	9.5	78 B,UJ	42 J	99	170
Phenanthrene	2.1 U	3.1	16	8.8 J	100	480
2-Methylnaphthalene	2.1 U	0.7 J	13	2.8 J	38	64
Total LPAH	13	16	130	68	370	780
Benzo(a)anthracene	2.1 U	1.2	16	2.5 J	110	270
Benzo(a)pyrene	2.8	1.6	9.0	1.9 J	99	210
Benzo(b)fluoranthene	2.1 U	1.6	17	3.9 J		
Benzo(k)fluoranthene	2.1 U	0.5 J	8.4	1.4 U,UJ		
Total Benzofluoranthene	4.3	2.1	26	5.3	230	450
Benzo(g,h,i)perylene	2.1 U	0.8 U	5.0	1.3 J,J	31	78
Chrysene	2.1 U	3.1	19	2.0 J	110	460
Dibenz(a,h)anthracene	2.1 U	0.8 U	1.4 J	1.4 U,UJ	12	33
Fluoranthene	2.1 U	3.8	66	13 J	160	1200
Indeno(1,2,3-cd)pyrene	2.1 U	0.8 U	4.9	1.1 J,J	34	88
Pyrene	2.1 U	6.4	46	11 J	1000	1400
Total HPAH	22	21	190	39	960	5300
Total Carcinogenic PAH	16	10	76	14		
Total PAH	35	37	320	110		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	2100 U,UJ	2300 U,UJ	1400 U,UJ	1600 U,UJ		
2,4-Dichlorophenol	42 U,UJ	46 U,UJ	28 U,UJ	33 U,UJ		
2,4,5-Trichlorophenol	10 U	12 U	7.1 U	8.2 U,UJ		
2,4,6-Trichlorophenol	10 U	12 U	7.1 U	8.2 U,UJ		
Tetrachlorophenol	10 U	12 U	11	8.2 U,UJ		
Pentachlorophenol	2.1 U	9.0 B	24.0	6.2 J	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin			0.002			
1,2,3,7,8-penta-CD-Dioxin			0.003			
1,2,3,4,7,8-hexa-CD-Dioxin			0.002			
1,2,3,6,7,8-hexa-CD-Dioxin			0.015			
1,2,3,7,8,9-hexa-CD-Dioxin			0.006			
1,2,3,4,6,7,8-hepta-CD-Dioxin			0.039			
Octachlorodibenzo-Dioxin			0.032 B			
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	2.1 U	0.65 J	4.3	2.5	15	58
2,3,7,8-tetra-CD-Furan			0.000			
1,2,3,7,8-penta-CD-Furan			0.000			
2,3,4,7,8-penta-CD-Furan			0.002			
1,2,3,6,7,8-hexa-CD-Furan			0.001			
1,2,3,4,7,8-hexa-CD-Furan			0.002			
1,2,3,7,8,9-hexa-CD-Furan			0.000			
2,3,4,6,7,8-hexa-CD-Furan			0.001			
1,2,3,4,6,7,8-hepta-CD-Furan			0.002			
1,2,3,4,7,8,9-hepta-CD-Furan			0.000			
Octadichlorodibenzo-Furan			0.001			
Total Dioxins/Furans			0.108			
METALS (mg/kg DB)						
Antimony			0.5 U,UJ			
Arsenic			6.4 J		57	93
Cadmium			0.44		5.1	6.7
Chromium			23		260	270
Copper			38		390	390
Lead			5.2 J		450	530
Mercury			0.02		0.41	0.59
Nickel			20			
Silver			1 U		6.1	6.1
Zinc			44		410	960
CONVENTIONALS (%)						
Total Solids	48.0	42.6	70.5	61.1		
Total Organic Carbon	2.33	6.76	1.67	2.83		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-D1B 12/12/90 10 to 55 cm		CP1-M-D1C 12/12/90 55 to 100 cm		CP1-M-D2A 12/12/90 surface to 10cm		CP1-M-D2B 12/12/90 10 to 55 cm		Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)										
Acenaphthene	130		91		11		4.6		16	57
Acenaphthylene	4.7		4.7	U	1.2		1.5		66	66
Anthracene	250		4.3	J	8.2		25		220	1200
Fluorene	70		35		4.9		3.6		23	79
Naphthalene	300	B	310	B,UJ	45	B,UJ	20	B,UJ	99	170
Phenanthrene	100		34		13		11		100	480
2-Methylnaphthalene	33		11		6.1		2.1		38	64
Total LPAH	850		480		83		65		370	780
Benzo(a)anthracene	71		4.7	U	4.1		21		110	270
Benzo(a)pyrene	28		5.0		3.3		12		99	210
Benzo(b)fluoranthene	52		4.7	U	7.4		27			
Benzo(k)fluoranthene	20		4.7	U	1.6	J	2.8	J		
Total Benzofluoranthene	72		9.5		9.0		29		230	450
Benzo(g,h,i)perylene	11		4.7	U	1.9		0.43	U	31	78
Chrysene	85		4.7	U	3.6		18		110	460
Dibenz(a,h)anthracene	3.7		4.7	U	0.6	J	0.43	U	12	33
Fluoranthene	350		5.3		21		52		160	1200
Indeno(1,2,3-cd)pyrene	11		4.7	U	1.6		4.6		34	88
Pyrene	200		3.1	J	19		64		1000	1400
Total HPAH	830		46		64		200		960	5300
Total Carcinogenic PAH	270		33		22		85			
Total PAH	1700		530		150		270			
CHLORINATED PHENOLS (ug/kg DB)										
2-Chlorophenol	1000	U,UJ	1500	U,UJ	1000	U,UJ	1000	U,UJ		
2,4-Dichlorophenol	20	U,UJ	29	U,UJ	20	U,UJ	20	U,UJ		
2,4,5-Trichlorophenol	5.0	U	7.4	U	5.0	U	5.0	U		
2,4,6-Trichlorophenol	5.0	U	7.4	U	5.0	U	5.0	U		
Tetrachlorophenol	5.0	U	7.4	U	5.0	U	5.0	U		
Pentachlorophenol	1.3		1.5	U	6.3		1.2		360	690
DIOXINS (ug/kg TEQ DB)										
2,3,7,8-tetra-CD-Dioxin										
1,2,3,7,8-penta-CD-Dioxin										
1,2,3,4,7,8-hexa-CD-Dioxin										
1,2,3,6,7,8-hexa-CD-Dioxin										
1,2,3,7,8,9-hexa-CD-Dioxin										
1,2,3,4,6,7,8-hepta-CD-Dioxin										
Octachlorodibenzo-Dioxin										
FURANS (ug/kg TEQ DB)										
Dibenzofuran (mg/kg organic carbon DB)	71		47		3.7		3.7		15	58
2,3,7,8-tetra-CD-Furan										
1,2,3,7,8-penta-CD-Furan										
2,3,4,7,8-penta-CD-Furan										
1,2,3,6,7,8-hexa-CD-Furan										
1,2,3,4,7,8-hexa-CD-Furan										
1,2,3,7,8,9-hexa-CD-Furan										
2,3,4,6,7,8-hexa-CD-Furan										
1,2,3,4,6,7,8-hepta-CD-Furan										
1,2,3,4,7,8,9-hepta-CD-Furan										
Octadichlorodibenzo-Furan										
Total Dioxins/Furans										
METALS (mg/kg DB)										
Antimony	0.5	U,UJ	0.5	U,UJ						
Arsenic	3	J	3.7	J					57	93
Cadmium	0.5	U	0.5	U					5.1	6.7
Chromium	10		18						260	270
Copper	79		8.8						390	390
Lead	4.1	J	2.2	J					450	530
Mercury	0.02	U	0.02	U					0.41	0.59
Nickel	14		17							
Silver	1	U	1	U					6.1	6.1
Zinc	21		25						410	960
CONVENTIONALS (%)										
Total Solids	83.4		67.9		72.6		74.4			
Total Organic Carbon	0.89		0.74		2.44		5.63			

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-D2C 12/12/90 55 to 100 cm	CP1-M-D3A 12/11/90 surface to 10cm	CP1-M-D3B 12/11/90 10 to 55 cm	CP1-M-D3C 12/11/90 55 to 100 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	1.8 U	38	32	120	16	57
Acenaphthylene	1.8 U	28	3.7	9.1	66	66
Anthracene	1.8 U	23	37	110	220	1200
Fluorene	1.8 U	61	26	100	23	79
Naphthalene	14 B,UJ	160	57	220	99	170
Phenanthrene	3.0	360	76	290	100	480
2-Methylnaphthalene	1.8 U	76	11	26	38	64
Total LPAH	24	670	230	850	370	780
Benzo(a)anthracene	1.8 U	20	22	140	110	270
Benzo(a)pyrene	3.8	13	20	67	99	210
Benzo(b)fluoranthene	1.0 J	39	30	120		
Benzo(k)fluoranthene	1.3 J,J	17	13	47		
Total Benzofluoranthene	2.3	56	44	170	230	450
Benzo(g,h,i)perylene	1.8 U	8.6	8.4	28	31	78
Chrysene	1.8 U	61	29	160	110	460
Dibenz(a,h)anthracene	1.8 U	2.7	2.1	6.7	12	33
Fluoranthene	2.8	210	120	460	160	1200
Indeno(1,2,3-cd)pyrene	1.8 U	10	9.0	30	34	88
Pyrene	2.4	150	79	290	1000	1400
Total HPAH	20	530	330	1400	960	5300
Total Carcinogenic PAH	13	160	130	570		
Total PAH	44	1200	560	2300		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	1500 U,UJ	2000 U,UJ	2000 U,UJ	1500		
2,4-Dichlorophenol	30 U,UJ	39 U,UJ	39 U,UJ	29		
2,4,5-Trichlorophenol	7.5 U	9.8 U	12	7.4		
2,4,6-Trichlorophenol	7.5 U	9.8 U	9.8 U	7.4		
Tetrachlorophenol	7.5 U	9.8 U	22	7.4		
Pentachlorophenol	1.5 U	14	14	1.5	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	1.8 U	86	15	67	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony						
Arsenic					57	93
Cadmium					5.1	6.7
Chromium					260	270
Copper					390	390
Lead					450	530
Mercury					0.41	0.59
Nickel						
Silver					6.1	6.1
Zinc					410	960
CONVENTIONALS (%)						
Total Solids	67.2	51.0	51.0	68.0		
Total Organic Carbon	2.01	1.97	8.20	1.65		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-D3E 07/26/1991 150 to 200 cm	CP2-M-D13E 07/26/1991 Duplicate	CP1-M-D4A 12/07/90 surface to 10cm	CP2-M-D4B 07/26/1991 10 to 70 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	2.0 U	2.7 U	7.2	18	16	57
Acenaphthylene	2.0 U	2.7 U	1.3 J	2.9 U	66	66
Anthracene	2.0 U	2.7 U	7.6	12	220	1200
Fluorene	2.0 U	2.7 U	5.3	13	23	79
Naphthalene	2.0 U	2.7 U	45	86	99	170
Phenanthrene	2.8	5.5	13	24	100	480
2-Methylnaphthalene	2.0 U	2.7 U	5.7	13	38	64
Total LPAH	13	19	79	160	370	780
Benzo(a)anthracene	2.0 U	2.7 U	4.9	9.0	110	270
Benzo(a)pyrene	2.0 U	2.7 U	4.5	7.8	99	210
Benzo(b)fluoranthene	2.0 U	2.7 U	8.0	12		
Benzo(k)fluoranthene	2.0 U	2.7 U	6.8 J	9.0		
Total Benzofluoranthene	3.9	5.3	15	21	230	450
Benzo(g,h,i)perylene	2.0 U	2.7 U	2.0	2.9 U	31	78
Chrysene	2.0 U	2.7 U	13	13	110	460
Dibenz(a,h)anthracene	2.0 U	2.7 U	1.7 U	2.9 U	12	33
Fluoranthene	4.1	6.3	26	33	160	1200
Indeno(1,2,3-cd)pyrene	2.0 U	2.7 U	1.9	2.9 U	34	88
Pyrene	4.6	8.1	30	52	1000	1400
Total HPAH	24	36	100	150	960	5300
Total Carcinogenic PAH	14	19	41	57		
Total PAH	37	55	180	310		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R		R		
2,4-Dichlorophenol	35 U	30 U		300		
2,4,5-Trichlorophenol	8.8 U	7.6 U	11 J	17		
2,4,6-Trichlorophenol	8.8 U	7.6 U	9.6 U	11		
Tetrachlorophenol	8.8 U	7.6 U	9.6 U	16		
Pentachlorophenol	1.8 U	2.0 *,J	14 JB	12 J	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	2.0 U	2.7 U	4.5	10	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony						
Arsenic					57	93
Cadmium					5.1	6.7
Chromium					260	270
Copper					390	390
Lead					450	530
Mercury					0.41	0.59
Nickel						
Silver					6.1	6.1
Zinc					410	960
CONVENTIONALS (%)						
Total Solids	57	66	52.1	60		
Total Organic Carbon	2.131	1.3573	2.64	2.6795		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-D4D 07/26/1991 100 to 150 cm	CP1-M-D5A 12/07/90 surface to 10cm	CP1-M-E1A 12/13/90 surface to 10cm	CP2-M-E1B 07/31/1991 10 to 44 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	1.7 U	2.0 J	4.4	8.4	16	57
Acenaphthylene	1.7 U	1.2 J	1.6 J	2.1 U	66	66
Anthracene	1.7 U	2.9	6.4	11	220	1200
Fluorene	1.7 U	1.7 J	3.7	5.9	23	79
Naphthalene	3.7	20	8.7	21	99	170
Phenanthrene	3.5	6.6	15	17	100	480
2-Methylnaphthalene	1.7 U	1.2 J	3.0 U	4.4	38	64
Total LPAH	14	34	40	66	370	780
Benzo(a)anthracene	1.7 U	2.2 U	3.7	6.0	110	270
Benzo(a)pyrene	15	2.2 U	2.9 J	8.7	99	210
Benzo(b)fluoranthene	1.7 U	3.3	5.0	9.7		
Benzo(k)fluoranthene	1.7 U	2.4 J	2.3 J,J	5.8		
Total Benzofluoranthene	3.4	5.7	7.3	16	230	450
Benzo(g,h,i)perylene	1.7 U	2.2 U	2.1 J	2.1 U	31	78
Chrysene	1.7 U	2.2 U	3.5	12	110	460
Dibenz(a,h)anthracene	1.7 U	2.2 U	3.0 U	2.1 U	12	33
Fluoranthene	6.6	9.2	17	23	160	1200
Indeno(1,2,3-cd)pyrene	1.7 U	2.2 U	1.5 J	2.1 U	34	88
Pyrene	9.6	13	14	40.6	1000	1400
Total HPAH	43	42	55	110	960	5300
Total Carcinogenic PAH	25	17	22	47		
Total PAH	57	77	95	180		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	1800 U,UJ	1600 U,UJ	R		
2,4-Dichlorophenol	38 U	37 U,UJ	31 U,UJ	20 U		
2,4,5-Trichlorophenol	9.6 U	9.2 U	7.8 U	5.0 U		
2,4,6-Trichlorophenol	9.6 U	9.2 U	7.8 U	5.0 U		
Tetrachlorophenol	9.6 U	9.2 U	7.8 U	5.0 U		
Pentachlorophenol	4.2 *,J	3.7 B,UJ	11	8.8 J	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	1.7 U	1.6 J	2.5 J	3.5	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony			0.5 U,UJ			
Arsenic			5.6 J,J		57	93
Cadmium			0.84 J		5.1	6.7
Chromium			26 J		260	270
Copper			30 J		390	390
Lead			7 J,J		450	530
Mercury			0.04 J		0.41	0.59
Nickel			24 J			
Silver			1 U		6.1	6.1
Zinc			40		410	960
CONVENTIONALS (%)						
Total Solids	52	53.8	64.5	73		
Total Organic Carbon	2.7129	1.96	1.26	1.134		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-E1C 07/31/1991 61 to 100 cm	CP2-M-E1F 07/31/1991 200 to 244 cm	CP1-M-E2A 12/11/90 surface to 10cm	CP1-M-E2B 12/11/90 10 to 55 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	18	9.9	15	55	16	57
Acenaphthylene	8.7 U	5.0	3.9	13	66	66
Anthracene	16	5.4	84	81	220	1200
Fluorene	8.7 U	3.3	19	54	23	79
Naphthalene	200	78	110	310	99	170
Phenanthrene	12	10	43	120	100	480
2-Methylnaphthalene	8.7 U	3.3 U	7.9	37	38	64
Total LPAH	260	110	280	630	370	780
Benzo(a)anthracene	8.7 U	3.3 U	11	51	110	270
Benzo(a)pyrene	8.7 U	5.8	10	34	99	210
Benzo(b)fluoranthene	8.7 U	3.3 U	23	69		
Benzo(k)fluoranthene	8.7 U	3.3 U	6.4	21		
Total Benzofluoranthene	17	6.7	30	90	230	450
Benzo(g,h,i)perylene	8.7 U	3.3 U	6.4	23	31	78
Chrysene	8.7 U	3.3 U	17	86	110	460
Dibenz(a,h)anthracene	8.7 U	3.3 U	2.1 U	3.8 U	12	33
Fluoranthene	25	12	50	230	160	1200
Indeno(1,2,3-cd)pyrene	8.7 U	3.3 U	6.9	16	34	88
Pyrene	36	14	50	150	1000	1400
Total HPAH	130	54	180	680	960	5300
Total Carcinogenic PAH	61	26	77	280		
Total PAH	390	160	460	1300		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R	1800 U,UJ	1400 U,UJ		
2,4-Dichlorophenol	20 U	20 U	36 U,UJ	29 U,UJ		
2,4,5-Trichlorophenol	5.0 U	5.0 U	8.9 U	7.2 U		
2,4,6-Trichlorophenol	5.0 U	5.0 U	8.9 U	7.2 U		
Tetrachlorophenol	5.0 U	5.0 U	8.9 U	7.2 U		
Pentachlorophenol	4.5	3.5 J	37	2.6	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	8.7 U	3.3 U	14	31	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony			0.5 U,UJ			
Arsenic			7.5 J		57	93
Cadmium			0.86		5.1	6.7
Chromium			19		260	270
Copper			51		390	390
Lead			18		450	530
Mercury			0.07		0.41	0.59
Nickel			21			
Silver			1 U		6.1	6.1
Zinc			78		410	960
CONVENTIONALS (%)						
Total Solids	76	77	56.0	69.0		
Total Organic Carbon	0.2751	0.7183	2.02	0.91		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-E2C 12/11/90 55 to 100 cm	CP1-M-E3A 12/13/90 surface to 10cm	CP1-M-E4A 12/10/90 surface to 10cm	CP2-M-E4B 07/29/1991 10 to 48 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	4.1	5.6	3.1	11	16	57
Acenaphthylene	0.7 U	1.2 J	0.7 J	2.0 U	66	66
Anthracene	0.8	7.7	4.4	8.6	220	1200
Fluorene	0.7 U	4.6	2.6	5.9	23	79
Naphthalene	6.7	25	17	49	99	170
Phenanthrene	0.9	11	5.9	11	100	480
2-Methylnaphthalene	0.8	2.9	1.6	4.8	38	64
Total LPAH	14	55	33	88	370	780
Benzo(a)anthracene	0.7 U	7.0	2.9	7.0	110	270
Benzo(a)pyrene	0.7 U	4.2	2.9	5.9	99	210
Benzo(b)fluoranthene	0.7 U	9.5	6.2	11		
Benzo(k)fluoranthene	0.7 U	3.9	5.3 J	4.1		
Total Benzofluoranthene	1.4	13	12	15	230	450
Benzo(g,h,i)perylene	0.7 U	2.5	1.5	2.0 U	31	78
Chrysene	0.7 U	11	4.7	10	110	460
Dibenz(a,h)anthracene	0.7 U	0.7 J	1.4 U	2.0 U	12	33
Fluoranthene	0.9	28	12	18	160	1200
Indeno(1,2,3-cd)pyrene	0.7 U	2.3	1.3 J	2.0 U	34	88
Pyrene	0.8	21	16	39	1000	1400
Total HPAH	7.0	90	53	100	960	5300
Total Carcinogenic PAH	5.0	38	25	42		
Total PAH	21	150	86	190		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	1000 U,UJ	1800 U,UJ	1800 U,UJ	R		
2,4-Dichlorophenol	20 U,UJ	35 U,UJ	36 U,UJ	31 U		
2,4,5-Trichlorophenol	5.0 U	8.8 U	9.1 U	7.8 U		
2,4,6-Trichlorophenol	5.0 U	8.8 U	9.1 U	7.8 U		
Tetrachlorophenol	5.0 U	8.8 U	11	7.8 U		
Pentachlorophenol	1.0 U	9.7	10 B	5.6 J	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	0.70 U	3.9	2.1	3.8	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony		0.5 U,UJ				
Arsenic		4.1 J			57	93
Cadmium		1.3			5.1	6.7
Chromium		25			260	270
Copper		42			390	390
Lead		13 J			450	530
Mercury		0.15			0.41	0.59
Nickel		21				
Silver		1 U,U			6.1	6.1
Zinc		50			410	960
CONVENTIONALS (%)						
Total Solids	78.0	57.2	55.0	64		
Total Organic Carbon	3.41	2.85	3.21	1.8695		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-E4C 07/29/1991 61 to 100 cm	CP2-M-E4E 07/29/1991 183 to 200 cm	CP1-M-E5A 12/07/90 surface to 10cm	CP2-M-El1 08/15/1991 surface to 10 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	1.7 U	4.0 U	2.9		16	57
Acenaphthylene	1.7 U	4.0 U	1.7 U		66	66
Anthracene	4.1	4.0 U	2.7		220	1200
Fluorene	2 U	4.0 U	2.1		23	79
Naphthalene	14	4.0 U	19		99	170
Phenanthrene	6.9	4.0 U	5.4		100	480
2-Methylnaphthalene	1.7 U	4.0 U	1.6 J		38	64
Total LPAH	30	24	34		370	780
Benzo(a)anthracene	6.2	4.0 U	1.7 U		110	270
Benzo(a)pyrene	4.3	18	1.7 J		99	210
Benzo(b)fluoranthene	5.3	4.0 U	3.3			
Benzo(k)fluoranthene	5.3	4.0 U	2.8 J			
Total Benzofluoranthene	11	8.1	6.0		230	450
Benzo(g,h,i)perylene	1.7 U	4.0 U	1.7 U		31	78
Chrysene	6.6	4.0 U	1.7 U		110	460
Dibenz(a,h)anthracene	1.7 U	4.0 U	1.7 U		12	33
Fluoranthene	19	4.0 U	7.8		160	1200
Indeno(1,2,3-cd)pyrene	1.7 U	4.0 U	1.7 U		34	88
Pyrene	17	4.0 U	10		1000	1400
Total HPAH	70	55	35		960	5300
Total Carcinogenic PAH	31	43	15			
Total PAH	100	79	69			
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R	1900 U,UJ			
2,4-Dichlorophenol	20 U	20 U	580 UJ			
2,4,5-Trichlorophenol	5.0 U	5.0 U	9.3 U			
2,4,6-Trichlorophenol	5.0 U	5.0 U	9.3 U			
Tetrachlorophenol	5.0 U	5.0 U	11			
Pentachlorophenol	1.0 U	1.0 U	39 B,UJ		360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	1.7 U	4.0 U	1.7 J		15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony						
Arsenic					57	93
Cadmium					5.1	6.7
Chromium					260	270
Copper					390	390
Lead					450	530
Mercury					0.41	0.59
Nickel						
Silver					6.1	6.1
Zinc					410	960
CONVENTIONALS (%)						
Total Solids	71	71	53.4			
Total Organic Carbon	1.3898	0.5952	2.58	1.094 J		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-F1A 12/11/90 surface to 10cm	CP2-M-F1A 08/01/1991 surface to 10 cm	CP2-M-F1B 08/01/1991 10 to 51 cm	CP2-M-F11B 08/01/1991 Duplicate	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	2.7	9.9	230	15	16	57
Acenaphthylene	1.2	8.2	11	0.65	66	66
Anthracene	7.0	43	72	3.4	220	1200
Fluorene	2.5	18	140	7.7	23	79
Naphthalene	9.0	31	690	46	99	170
Phenanthrene	7.4	76	180	11	100	480
2-Methylnaphthalene	1.3	7.6	26	1.6	38	64
Total LPAH	30	190	1300	84	370	780
Benzo(a)anthracene	3.5	40	69	3.9	110	270
Benzo(a)pyrene	4.6	43	26	1.6	99	210
Benzo(b)fluoranthene	25 J	92	75	4.6		
Benzo(k)fluoranthene	8.1 J	96	78	4.8		
Total Benzofluoranthene	33	190	150	9.4	230	450
Benzo(g,h,i)perylene	3.1	19	7.2 U	0.58 U	31	78
Chrysene	6.0	46	78	4.3	110	460
Dibenz(a,h)anthracene	0.7	8.9	7.2 U	0.58 U	12	33
Fluoranthene	10	76	420	22	160	1200
Indeno(1,2,3-cd)pyrene	3.3	19	7.2 U	0.58 U	34	88
Pyrene	13	110	250	13	1000	1400
Total HPAH	78	550	1000	56	960	5300
Total Carcinogenic PAH	52	340	340	20		
Total PAH	110	740	2300	140		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	1700 U,UJ	R	R	R		
2,4-Dichlorophenol	33 U,UJ	32 U	20 U	20 U		
2,4,5-Trichlorophenol	8.3 U	7.9 U	5.0 U	5.0 U		
2,4,6-Trichlorophenol	8.3 U	7.9 U	5.0 U	5.0 U		
Tetrachlorophenol	31	7.9 U	5.0 U	5.0 U		
Pentachlorophenol	160	120 D	2.6 J	1.0 U	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin		0.005 U,	0.001 EM,J	0.003 U,		
1,2,3,7,8-penta-CD-Dioxin		0.020 EM,J	0.002 U,	0.003 U,		
1,2,3,4,7,8-hexa-CD-Dioxin		0.008	0.000 U,	0.001 U,		
1,2,3,6,7,8-hexa-CD-Dioxin		0.036	0.000 EM,J	0.000 U,		
1,2,3,7,8,9-hexa-CD-Dioxin		0.029	0.000	0.001 U,		
1,2,3,4,6,7,8-hepta-CD-Dioxin		0.112	0.000	0.000		
Octachlorodibenzo-Dioxin		0.095 B,	0.000 B,	0.000 B,		
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	2.0	7.6	110	7.2	15	58
2,3,7,8-tetra-CD-Furan		0.001	0.000	0.000		
1,2,3,7,8-penta-CD-Furan		0.002 EM,J	0.000 U,	0.000 U,		
2,3,4,7,8-penta-CD-Furan		0.030	0.002	0.002 U,		
1,2,3,6,7,8-hexa-CD-Furan		0.004 EM,J	0.000	0.000 U,		
1,2,3,4,7,8-hexa-CD-Furan		0.019	0.000	0.000		
1,2,3,7,8,9-hexa-CD-Furan		0.005 Q,J	0.000 U,	0.000 U,		
2,3,4,6,7,8-hexa-CD-Furan		0.008	0.000 EM,J	0.001 EM,J		
1,2,3,4,6,7,8-hepta-CD-Furan		0.009	0.000	0.000		
1,2,3,4,7,8,9-hepta-CD-Furan		0.001	0.000 U,	0.000 U,		
Octadichlorodibenzo-Furan		0.001	0.000	0.000 U,		
Total Dioxins/Furans		0.384	0.007	0.011		
METALS (mg/kg DB)						
Antimony					57	93
Arsenic					5.1	6.7
Cadmium					260	270
Chromium					390	390
Copper					450	530
Lead					0.41	0.59
Mercury						
Nickel					6.1	6.1
Silver					410	960
Zinc						
CONVENTIONALS (%)						
Total Solids	60.0	63	76	74		
Total Organic Carbon	9.49	3.033	0.3325	4.139		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-F1C 08/01/1991 55 to 100 cm	CP1-M-F2A 12/11/90 surface to 10cm	CP1-M-F2B 12/11/90 10 to 55 cm	CP1-M-F2C 12/11/90 55 to 100 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	96	10	1.4 U	1.1 U	16	57
Acenaphthylene	5.5	2.2 J	1.4 U	1.1 U	66	66
Anthracene	37	11	1.4 J	1.1 U	220	1200
Fluorene	86	7.7	1.4 U	1.1 U	23	79
Naphthalene	110	39	2.3	1.1 U	99	170
Phenanthrene	180	19	1.4	1.1 U	100	480
2-Methylnaphthalene	18	5.5	1.4 U	1.1 U	38	64
Total LPAH	510	90	9.2	6.7	370	780
Benzo(a)anthracene	20	4.9	1.4 U	1.1 U	110	270
Benzo(a)pyrene	16	4.6	1.4 U	1.1 U	99	210
Benzo(b)fluoranthene	55	19 J	1.4 J	1.1 U,UJ		
Benzo(k)fluoranthene	56	10 J	1.4 U,UJ	1.1 U,UJ		
Total Benzofluoranthene	110	29	2.8	2.2	230	450
Benzo(g,h,i)perylene	2.9 U	3.4	1.4 U	1.1 U	31	78
Chrysene	23	8.4	1.4 U	1.1 U	110	460
Dibenz(a,h)anthracene	2.9 U	2.5 U	1.4 U	1.1 U	12	33
Fluoranthene	94	34	2.1	1.1 U	160	1200
Indeno(1,2,3-cd)pyrene	6.6	2.8	1.4 U	1.1 U	34	88
Pyrene	110	28	1.6	1.1 U	1000	1400
Total HPAH	380	120	15	11	960	5300
Total Carcinogenic PAH	180	52	10	8.0		
Total PAH	890	210	25	18		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	1600 U,UJ	1400 U,UJ	1000 U,UJ		
2,4-Dichlorophenol	20 U	31 U,UJ	28 U,UJ	20 U,UJ		
2,4,5-Trichlorophenol	5.0 U	7.8 U	7.1 U	5.0 U		
2,4,6-Trichlorophenol	5.0 U	7.8 U	7.1 U	5.0 U		
Tetrachlorophenol	5.0 U	7.8 U	7.1 U	5.0 U		
Pentachlorophenol	21	8.1	1.4 U	1.0 U	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin	0.001 EM,J					
1,2,3,7,8-penta-CD-Dioxin	0.002 EM,J					
1,2,3,4,7,8-hexa-CD-Dioxin	0.001					
1,2,3,6,7,8-hexa-CD-Dioxin	0.005					
1,2,3,7,8,9-hexa-CD-Dioxin	0.003					
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.015					
Octachlorodibenzo-Dioxin	0.013 B,					
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	76	6.1	1.4 U	1.1 U	15	58
2,3,7,8-tetra-CD-Furan	0.000 U,					
1,2,3,7,8-penta-CD-Furan	0.000					
2,3,4,7,8-penta-CD-Furan	0.004					
1,2,3,6,7,8-hexa-CD-Furan	0.001 EM,J					
1,2,3,4,7,8-hexa-CD-Furan	0.003					
1,2,3,7,8,9-hexa-CD-Furan	0.000 U,					
2,3,4,6,7,8-hexa-CD-Furan	0.001 EM,J					
1,2,3,4,6,7,8-hepta-CD-Furan	0.001 EM,J					
1,2,3,4,7,8,9-hepta-CD-Furan	0.000					
Octadichlorodibenzo-Furan	0.000					
Total Dioxins/Furans	0.050					
METALS (mg/kg DB)						
Antimony						
Arsenic					57	93
Cadmium					5.1	6.7
Chromium					260	270
Copper					390	390
Lead					450	530
Mercury					0.41	0.59
Nickel						
Silver					6.1	6.1
Zinc					410	960
CONVENTIONALS (%)						
Total Solids	71	64.0	70.0	78.0		
Total Organic Carbon	0.8341	1.55	2.49	2.15		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-F3A 12/11/90 surface to 10cm	CP1-M-F4A 12/10/90 surface to 10cm	CP1-M-F5A 12/07/90 surface to 10cm	CP1-M-G1A 12/13/90 surface to 10cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	9.1	1.5	1.8 J	1.6 J	16	57
Acenaphthylene	1.3 U	1.5 U	1.1 J	2.0 U	66	66
Anthracene	7.1	2.5	2.7	3.1	220	1200
Fluorene	6.3	1.3 J	1.6 J	1.1 J	23	79
Naphthalene	28	7.3	18	3.7	99	170
Phenanthrene	14	3.7	5.1	4.2	100	480
2-Methylnaphthalene	3.8	1.5 U	1.7 J	2.0 U	38	64
Total LPAH	66	18	30	16	370	780
Benzo(a)anthracene	4	1 U	2 U	4	110	270
Benzo(a)pyrene	3	3	1 J	3	99	210
Benzo(b)fluoranthene	12	3	3	6		
Benzo(k)fluoranthene	7 J	1 J,J	13 J	2 J,J		
Total Benzofluoranthene	19	4	17	7	230	450
Benzo(g,h,i)perylene	2	1 U	2 U	1 J	31	78
Chrysene	8	1 U	2	4	110	460
Dibenz(a,h)anthracene	1 U	1 U	2 U	2 U	12	33
Fluoranthene	23	7	7	16	160	1200
Indeno(1,2,3-cd)pyrene	2	1 J	2 U	1 J	34	88
Pyrene	14	7	9	13	1000	1400
Total HPAH	75	28	44	52	960	5300
Total Carcinogenic PAH	37	12	26	21		
Total PAH	140	46	74	68		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	2200 U,UJ	1000 U,UJ	1600 U,UJ	2900 U,UJ		
2,4-Dichlorophenol	43 U,UJ	20 U,UJ	33 U,UJ	59 U,UJ		
2,4,5-Trichlorophenol	11 U	5.0 U	8.2 U	15 U		
2,4,6-Trichlorophenol	11 U	5.0 U	8.2 U	15 U		
Tetrachlorophenol	11 U	5.0 U	27	15 U		
Pentachlorophenol	12	3.6 B	9.1 JB	5.4	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	4.8	0.85 J	1.4 J	1.2 J	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony						
Arsenic					57	93
Cadmium					5.1	6.7
Chromium					260	270
Copper					390	390
Lead					450	530
Mercury					0.41	0.59
Nickel						
Silver					6.1	6.1
Zinc					410	960
CONVENTIONALS (%)						
Total Solids	46.0	74.5	60.9	33.7		
Total Organic Carbon	3.94	1.65	2.15	3.53		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-G2A 12/12/90 surface to 10cm	CP1-M-G3A 12/10/90 surface to 10cm	CP1-M-G3B 12/10/90 10 to 55 cm	CP2-M-G3B 07/25/1991 10 to 55 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	1.9 U,UJ	144	490	150	16	57
Acenaphthylene	1.9 U,UJ	5	13	3.5	66	66
Anthracene	1.9 U,UJ	58	250	65	220	1200
Fluorene	1.9 U,UJ	23	300	67	23	79
Naphthalene	0.26 U,UJ	29	130	59	99	170
Phenanthrene	1.9 U,UJ	60	670	75	100	480
2-Methylnaphthalene	1.9 U,UJ	5	24	13	38	64
Total LPAH	10	320	1900	420	370	780
Benzo(a)anthracene	1.9 U,UJ	86	210	140	110	270
Benzo(a)pyrene	1.9 U,UJ	34	91	57	99	210
Benzo(b)fluoranthene	9.2 J	58	120	74		
Benzo(k)fluoranthene	1.5 J,J	16 J	67	55		
Total Benzofluoranthene	11	74	190	130	230	450
Benzo(g,h,i)perylene	1.9 U,UJ	12	29	17	31	78
Chrysene	1.9 U,UJ	110	210	150	110	460
Dibenz(a,h)anthracene	1.9 U,UJ	0.9 J	2 J	11	12	33
Fluoranthene	8.7 J	340	740	470 D,U	160	1200
Indeno(1,2,3-cd)pyrene	1.9 U,UJ	14	27	20	34	88
Pyrene	16 J	240	3 U	430 D,U	1000	1400
Total HPAH	46	910	1500	1400	960	5300
Total Carcinogenic PAH	20	320	730	510		
Total PAH	56	1200	3400	1800		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	2900 U,UJ	2300 U,UJ	1900 U,UJ	R		
2,4-Dichlorophenol	59 U,UJ	46 U,UJ	38 U,UJ	43 U		
2,4,5-Trichlorophenol	15 U,UJ	12 U	9.6 U	19		
2,4,6-Trichlorophenol	16 J	12 U	9.6 U	11 U		
Tetrachlorophenol	15 U,UJ	37	9.6 U	30 J		
Pentachlorophenol	7.5 J	89 B	14 B	51 D	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	1.9 U	24	160	42	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony				0.1 U,J		
Arsenic				7.6 J	57	93
Cadmium				1.6	5.1	6.7
Chromium				31	260	270
Copper				100 J	390	390
Lead				22	450	530
Mercury				0.21 **	0.41	0.59
Nickel				29		
Silver				0.06 U	6.1	6.1
Zinc				79	410	960
CONVENTIONALS (%)						
Total Solids	34.4	43.0	52.0	47		
Total Organic Carbon	3.81	3.82	2.85	5.982		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-G3C 07/25/1991 55 to 100 cm	CP2-M-G3E 07/25/1991 150 to 200 cm	CP1-M-G4A 12/13/90 surface to 10cm	CP1-M-G14A 12/13/90 Duplicate	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	65	67	14	7.5	16	57
Acenaphthylene	4.2	2.0	3.4	1.8	66	66
Anthracene	19	10	27	15	220	1200
Fluorene	29	45	9.2	4.4	23	79
Naphthalene	120	90	37	16	99	170
Phenanthrene	46	75	23	10	100	480
2-Methylnaphthalene	15	19	8.0	3.4	38	64
Total LPAH	280	290	110	55	370	780
Benzo(a)anthracene	31	4.1	31	28	110	270
Benzo(a)pyrene	13	9.7	22	12	99	210
Benzo(b)fluoranthene	18	2.2	40	24		
Benzo(k)fluoranthene	35	1.5 U	10	7.0 J		
Total Benzofluoranthene	53	3.7	50	31	230	450
Benzo(g,h,i)perylene	5.0	1.5 U	12	4.4	31	78
Chrysene	32	4.5	43	23	110	460
Dibenz(a,h)anthracene	1.5 U	1.5 U	2.9	1.3 U	12	33
Fluoranthene	150	30	140	119	160	1200
Indeno(1,2,3-cd)pyrene	4.6	1.5 U	12	4.4	34	88
Pyrene	110	30	95	82	1000	1400
Total HPAH	400	86	400	310	960	5300
Total Carcinogenic PAH	130	25	160	100		
Total PAH	680	380	510	370		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R	2200 U,UJ	2100 U,UJ		
2,4-Dichlorophenol	33 U	34 U	43 U,UJ	410 J		
2,4,5-Trichlorophenol	8.3 U	8.5 U	11 U	11 U		
2,4,6-Trichlorophenol	8.3 U	8.5 U	11 U	11 U		
Tetrachlorophenol	8.3 U	8.5 U	11 U	11 U		
Pentachlorophenol	4.8	1.7 U	14	22	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	19	27	8.6	5.2	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony	0.1 U,J	0.1 U,J				
Arsenic	3.8 J	3.7 J			57	93
Cadmium	1	2			5.1	6.7
Chromium	30	31			260	270
Copper	194 J	66 J			390	390
Lead	11	9			450	530
Mercury	0.03 **	0.04			0.41	0.59
Nickel	30	29				
Silver	1 U	1 U			6.1	6.1
Zinc	55	53			410	960
CONVENTIONALS (%)						
Total Solids	60	59	45.8	47.4		
Total Organic Carbon	2.6088	2.6768	3.25	3.88		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP1-M-G5A 12/13/90 surface to 10cm	CP1-M-G6A 12/13/90 surface to 10cm	CP1-M-G7A 12/11/90 surface to 10cm	CP2-M-H1A 07/24/1991 surface to 10 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	16	17	24	9.8	16	57
Acenaphthylene	2.2	3.0	6.9	1.3 U	66	66
Anthracene	17	15	49	11	220	1200
Fluorene	8.3	8.1	19	6.7	23	79
Naphthalene	42	61	69	44	99	170
Phenanthrene	24	22	44	17	100	480
2-Methylnaphthalene	8.3	17	10	6.2	38	64
Total LPAH	110	130	210	90	370	780
Benzo(a)anthracene	18	5.3	83	11	110	270
Benzo(a)pyrene	10	4.9	64	11	99	210
Benzo(b)fluoranthene	24	11	230	12		
Benzo(k)fluoranthene	8.7	2.9 J	97	17		
Total Benzofluoranthene	33	14	330	29	230	450
Benzo(g,h,i)perylene	4.9	3.6	24	4.6	31	78
Chrysene	28	5.3	100	26	110	460
Dibenz(a,h)anthracene	1.4 J	1.5 U	2.7 U	2.6	12	33
Fluoranthene	59	30	130	20	160	1200
Indeno(1,2,3-cd)pyrene	4.9	2.8	24	4.4	34	88
Pyrene	59	30	170	52	1000	1400
Total HPAH	220	100	930	160	960	5300
Total Carcinogenic PAH	95	34	610	84		
Total PAH	330	230	1100	250		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	1800 UJ	1600 UJ	1600 UJ	R		
2,4-Dichlorophenol	37 UJ	32 UJ	32 UJ	43 U		
2,4,5-Trichlorophenol	9.2 U	7.9 U	8.1 U	11 U		
2,4,6-Trichlorophenol	9.2 U	7.9 U	8.1 U	11 U		
Tetrachlorophenol	13	11	8.1 U	11 U		
Pentachlorophenol	34	16	12	240 D	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin				0.001 U,		
1,2,3,7,8-penta-CD-Dioxin				0.002		
1,2,3,4,7,8-hexa-CD-Dioxin				0.002		
1,2,3,6,7,8-hexa-CD-Dioxin				0.011		
1,2,3,7,8,9-hexa-CD-Dioxin				0.007		
1,2,3,4,6,7,8-hepta-CD-Dioxin				0.051		
Octachlorodibenzo-Dioxin				0.044 B,		
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	1.5 U	6.1	17	1.3 U	15	58
2,3,7,8-tetra-CD-Furan				0.001		
1,2,3,7,8-penta-CD-Furan				0.001		
2,3,4,7,8-penta-CD-Furan				0.005		
1,2,3,6,7,8-hexa-CD-Furan				0.000 U,		
1,2,3,4,7,8-hexa-CD-Furan				0.009 EM,PR,J		
1,2,3,7,8,9-hexa-CD-Furan				0.001 U,		
2,3,4,6,7,8-hexa-CD-Furan				0.004 EM,PR,J		
1,2,3,4,6,7,8-hepta-CD-Furan				0.004		
1,2,3,4,7,8,9-hepta-CD-Furan				0.000		
Octadichlorodibenzo-Furan				0.001 B,		
Total Dioxins/Furans				0.143		
METALS (mg/kg DB)						
Antimony					57	93
Arsenic					5.1	6.7
Cadmium					260	270
Chromium					390	390
Copper					450	530
Lead					0.41	0.59
Mercury						
Nickel					6.1	6.1
Silver					410	960
Zinc						
CONVENTIONALS (%)						
Total Solids	53.5	63.4	62.0	46		
Total Organic Carbon	2.88	2.46	1.45	3.873		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-H1B 07/24/1991 10 to 55 cm		CP2-M-H1C 07/24/1991 55 to 100 cm		CP2-M-H1E 07/24/1991 150 to 200 cm		CP2-M-H2A 07/23/1991 surface to 10 cm		Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)										
Acenaphthene	6.3		1.1	U	2.3	U	36		16	57
Acenaphthylene	1.1	U	1.1	U	2.3	U	1.3	U	66	66
Anthracene	5.8		1.1	U	2.3	U	36		220	1200
Fluorene	1.1	U	1.1	U	2.3	U	24		23	79
Naphthalene	28		1.1	U	2.3	U	110		99	170
Phenanthrene	10.0		1.1	U	2.3	U	57		100	480
2-Methylnaphthalene	1.1	U	1.1	U	2.3	U	18		38	64
Total LPAH	52		7.0		14		260		370	780
Benzo(a)anthracene	4.6		1.1	U	2.3	U	30		110	270
Benzo(a)pyrene	7.2		3.1		7.9		27		99	210
Benzo(b)fluoranthene	6.5		1.1	U	2.3	U	33			
Benzo(k)fluoranthene	11		1.1	U	2.3	U	28			
Total Benzofluoranthene	18		2.3		4.5		60		230	450
Benzo(g,h,i)perylene	2.5		1.1	U	2.3	U	12		31	78
Chrysene	7.2		1.1	U	2.3	U	57		110	460
Dibenz(a,h)anthracene	1.1	U	1.1	U	2.3	U	5.9		12	33
Fluoranthene	10		2.8				86		160	1200
Indeno(1,2,3-cd)pyrene	2.8		1.1	U	2.3	U	13		34	88
Pyrene	39		2.6				130		1000	1400
Total HPAH	93		17		24		420		960	5300
Total Carcinogenic PAH	40		10		21		190			
Total PAH	150		24		38		680			
CHLORINATED PHENOLS (ug/kg DB)										
2-Chlorophenol	R		R		R		R			
2,4-Dichlorophenol	42	U	41	U	31	U	37	U		
2,4,5-Trichlorophenol	10	U	10	U	7.8	U	12			
2,4,6-Trichlorophenol	10	U	10	U	7.8	U	9.3	U		
Tetrachlorophenol	10	U	10	U	7.8	U	9.3	U		
Pentachlorophenol	8.4	*,J	2.0	U	1.6	U	47	D	360	690
DIOXINS (ug/kg TEQ DB)										
2,3,7,8-tetra-CD-Dioxin	0.001	U,								
1,2,3,7,8-penta-CD-Dioxin	0.002	U,								
1,2,3,4,7,8-hexa-CD-Dioxin	0.001	EM,J								
1,2,3,6,7,8-hexa-CD-Dioxin	0.005									
1,2,3,7,8,9-hexa-CD-Dioxin	0.003									
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.025									
Octachlorodibenzo-Dioxin	0.022	B,								
FURANS (ug/kg TEQ DB)										
Dibenzofuran (mg/kg organic carbon DB)	1.1	U	1.1	U	2.3	U	1.3	U	15	58
2,3,7,8-tetra-CD-Furan	0.000									
1,2,3,7,8-penta-CD-Furan	0.000	EM,J								
2,3,4,7,8-penta-CD-Furan	0.004									
1,2,3,6,7,8-hexa-CD-Furan	0.005	U,								
1,2,3,4,7,8-hexa-CD-Furan	0.015	EM,PR,J								
1,2,3,7,8,9-hexa-CD-Furan	0.007	U,								
2,3,4,6,7,8-hexa-CD-Furan	0.049	PR,								
1,2,3,4,6,7,8-hepta-CD-Furan	0.002	EM,J								
1,2,3,4,7,8,9-hepta-CD-Furan	0.001	EM,J								
Octadichlorodibenzo-Furan	0.001	B,								
Total Dioxins/Furans	0.140									
METALS (mg/kg DB)										
Antimony							0.1	U,J		
Arsenic							4.7	,J	57	93
Cadmium							1.1		5.1	6.7
Chromium							24		260	270
Copper							40	,J	390	390
Lead							12		450	530
Mercury							0.13	**	0.41	0.59
Nickel							19			
Silver							0.06	U	6.1	6.1
Zinc							62		410	960
CONVENTIONALS (%)										
Total Solids	48		49		64		54			
Total Organic Carbon	4.3197		4.2141		1.6417		3.3622			

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-H2B 07/23/1991 10 to 55 cm	CP2-M-H12B 07/23/1991 Duplicate	CP2-M-H2C 07/23/1991 55 to 79 cm	CP2-M-H2D 07/23/1991 100 to 150 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	36	44	2.9 U	1.8 U	16	57
Acenaphthylene	1.2 U	1.5 U	2.9 U	1.8 U	66	66
Anthracene	29	40	2.9 U	1.8 U	220	1200
Fluorene	20	28	2.9 U	1.8 U	23	79
Naphthalene	92	120	35	1.8 U	99	170
Phenanthrene	46	60	21	1.8 U	100	480
2-Methylnaphthalene	17	21	2.9 U	1.8 U	38	64
Total LPAH	230	290	68	11	370	780
Benzo(a)anthracene	19	30	2.9 U	1.8 U	110	270
Benzo(a)pyrene	26	38	18	20	99	210
Benzo(b)fluoranthene	26	64	3.6	1.8 U		
Benzo(k)fluoranthene	33	1.5 U	7.0	1.8 U		
Total Benzofluoranthene	59	66	11	3.6	230	450
Benzo(g,h,i)perylene	9.9	15	2.9 U	1.8 U	31	78
Chrysene	29	48	2.9 U	1.8 U	110	460
Dibenz(a,h)anthracene	4.6	7.7	2.9 U	1.8 U	12	33
Fluoranthene	59	73	22	1.8 U	160	1200
Indeno(1,2,3-cd)pyrene	11	17	2.9 U	1.8 U	34	88
Pyrene	160	210	36	8.9	1000	1400
Total HPAH	380	500	100	44	960	5300
Total Carcinogenic PAH	150	210	41	31		
Total PAH	610	790	170	55		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R	R	R		
2,4-Dichlorophenol	31 U	32 U	20 U	38 U		
2,4,5-Trichlorophenol	7.8 U	8.1 U	5.0 U	9.4 U		
2,4,6-Trichlorophenol	7.8 U	8.1 U	5.0 U	9.4 U		
Tetrachlorophenol	14 J	8.1 U	5.0 U	9.4 U		
Pentachlorophenol	54 D	110 D	1.0 U	1.9 U	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin				0.003 U,		
1,2,3,7,8-penta-CD-Dioxin				0.002 U,		
1,2,3,4,7,8-hexa-CD-Dioxin				0.000 U,		
1,2,3,6,7,8-hexa-CD-Dioxin				0.000 U,		
1,2,3,7,8,9-hexa-CD-Dioxin				0.000 U,		
1,2,3,4,6,7,8-hepta-CD-Dioxin				0.001 EM,J		
Octachlorodibenzo-Dioxin				0.001 B,U		
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	1.2 U	1.5 U	2.9 U	1.8 U	15	58
2,3,7,8-tetra-CD-Furan				0.000 U,		
1,2,3,7,8-penta-CD-Furan				0.000 U,		
2,3,4,7,8-penta-CD-Furan				0.002 U,		
1,2,3,6,7,8-hexa-CD-Furan				0.002 U,		
1,2,3,4,7,8-hexa-CD-Furan				0.002 U,		
1,2,3,7,8,9-hexa-CD-Furan				0.002 U,		
2,3,4,6,7,8-hexa-CD-Furan				0.002 U,		
1,2,3,4,6,7,8-hepta-CD-Furan				0.000		
1,2,3,4,7,8,9-hepta-CD-Furan				0.000 U,		
Octadichlorodibenzo-Furan				0.000 EM,R,U,J		
Total Dioxins/Furans				0.017		
METALS (mg/kg DB)						
Antimony	0.1 U,J	0.1 U,J	0.1 U,J	0.1 U,J		
Arsenic	4.4 J	4.9 J	2.7 J	6.6 J	57	93
Cadmium	0.97	0.72	4	12	5.1	6.7
Chromium	20	17	150	350	260	270
Copper	37 J	31 J	230 J	410 J	390	390
Lead	8.8	7.9	26	67	450	530
Mercury	0.09 **	0.13 **	0.03 **	0.06 **	0.41	0.59
Nickel	18	19	18	33		
Silver	0.05 U	0.05 U	0.2 U	1 U	6.1	6.1
Zinc	48	41	270	580	410	960
CONVENTIONALS (%)						
Total Solids	64	62	74	53		
Total Organic Carbon	3.0356	2.4812	0.8231	2.4713		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-H2M 07/23/1991 560 to 610 cm	CP2-M-H3A 07/23/1991 surface to 10 cm	CP2-M-H3B 07/23/1991 10 to 55 cm	CP2-M-H3C 07/23/1991 55 to 100 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	2.4 U	1.2 U	1.0 U	1.5 U	16	57
Acenaphthylene	2.4 U	1.2 U	1.0 U	1.5 U	66	66
Anthracene	2.4 U	6.6	4.2	1.5 U	220	1200
Fluorene	2.4 U	1.2 U	1.0 U	1.5 U	23	79
Naphthalene	2.4 U	25	20	1.5 U	99	170
Phenanthrene	2.4 U	9.9	8.8	1.5 U	100	480
2-Methylnaphthalene	2.4 U	1.2 U	1.0 U	1.5 U	38	64
Total LPAH	14	45	36	8.8	370	780
Benzo(a)anthracene	2.4 U	8.9	1.0 U	1.5 U	110	270
Benzo(a)pyrene	12	8.6	5.0	1.5 U	99	210
Benzo(b)fluoranthene	2.4 U	6.6	4.6	1.5 U		
Benzo(k)fluoranthene	2.4 U	12	6.1	1.5 U		
Total Benzofluoranthene	4.7	19	11	2.9	230	450
Benzo(g,h,i)perylene	2.4 U	3.3	2.4	1.5 U	31	78
Chrysene	2.4 U	15	1.0 U	1.5 U	110	460
Dibenz(a,h)anthracene	2.4 U	1.2 U	1.0 U	1.5 U	12	33
Fluoranthene	2.4 U	10	9.7	1.5 U	160	1200
Indeno(1,2,3-cd)pyrene	2.4 U	3.6	2.4	1.5 U	34	88
Pyrene	2.4 U	23	19	1.5 U	1000	1400
Total HPAH	34	92	52	15	960	5300
Total Carcinogenic PAH	27	56	21	10		
Total PAH	48	140	88	24		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R	R	R		
2,4-Dichlorophenol	32 U	40 U	38 U	39 U		
2,4,5-Trichlorophenol	7.9 U	10 U	9.6 U	9.8 U		
2,4,6-Trichlorophenol	7.9 U	10 U	9.6 U	9.8 U		
Tetrachlorophenol	7.9 U	10 U	9.6 U	9.8 U		
Pentachlorophenol	1.6 U	8.7	5.9 *,J	2.0 U	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	2.4 U	1.2 U	1.0 U	1.5 U	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony						
Arsenic					57	93
Cadmium					5.1	6.7
Chromium					260	270
Copper					390	390
Lead					450	530
Mercury					0.41	0.59
Nickel						
Silver					6.1	6.1
Zinc					410	960
CONVENTIONALS (%)						
Total Solids	63	50	52	51		
Total Organic Carbon	1.6059	3.9431	4.555	3.1924		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-H3E 07/23/1991 150 to 200 cm	CP2-M-H3L 07/23/1991 500 to 552 cm	CP2-M-H5A 07/26/1991 surface to 10 cm	CP2-M-H5B 07/26/1991 10 to 40 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	3.3 U	3.5 U	8.3	12	16	57
Acenaphthylene	3.3 U	3.5 U	1.7 U	2.1	66	66
Anthracene	3.3 U	3.5 U	5.8	10	220	1200
Fluorene	3.3 U	3.5 U	5.8	8.7	23	79
Naphthalene	3.3 U	3.5 U	46	60	99	170
Phenanthrene	3.3 U	3.5 U	12	20	100	480
2-Methylnaphthalene	3.3 U	3.5 U	5.0	6.9	38	64
Total LPAH	20	21	80	110	370	780
Benzo(a)anthracene	3.3 U	3.5 U	7.5	7.8	110	270
Benzo(a)pyrene	3.3 U	3.5 U	5.0	6.9	99	210
Benzo(b)fluoranthene	3.3 U	3.5 U	8.7	14		
Benzo(k)fluoranthene	3.3 U	3.5 U	3.3	4.6		
Total Benzofluoranthene	6.5	7.0	12	19	230	450
Benzo(g,h,i)perylene	3.3 U	3.5 U	1.7 U	1.7 U	31	78
Chrysene	3.3 U	3.5 U	8.7	13	110	460
Dibenz(a,h)anthracene	3.3 U	3.5 U	1.7 U	1.7 U	12	33
Fluoranthene	3.3 U	3.5 U	14	26	160	1200
Indeno(1,2,3-cd)pyrene	3.3 U	3.5 U	1.7 U	1.7 U	34	88
Pyrene	3.3 U	3.5 U	35	60	1000	1400
Total HPAH	33	35	87	140	960	5300
Total Carcinogenic PAH	23	24	37	50		
Total PAH	53	56	170	250		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R	R	R		
2,4-Dichlorophenol	36 U	32 U	33 U	32 U		
2,4,5-Trichlorophenol	9.1 U	7.9 U	16	7.9 U		
2,4,6-Trichlorophenol	9.1 U	7.9 U	8.3 U	7.9 U		
Tetrachlorophenol	9.1 U	7.9 U	8.3 U	7.9 U		
Pentachlorophenol	1.8 U	1.6 U	7.2 *,J	14 *,J	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin			0.002 EM,J	0.003 U,		
1,2,3,7,8-penta-CD-Dioxin			0.002	0.003 U,		
1,2,3,4,7,8-hexa-CD-Dioxin			0.002 Q,J	0.001 EM,J		
1,2,3,6,7,8-hexa-CD-Dioxin			0.004	0.003		
1,2,3,7,8,9-hexa-CD-Dioxin			0.004 Q,J	0.002		
1,2,3,4,6,7,8-hepta-CD-Dioxin			0.012	0.009		
Octachlorodibenzo-Dioxin			0.010 B,	0.006 B,		
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	3.3 U	3.5 U	5.0	6.9	15	58
2,3,7,8-tetra-CD-Furan			0.001	0.000		
1,2,3,7,8-penta-CD-Furan			0.000 EM,J	0.000 U,		
2,3,4,7,8-penta-CD-Furan			0.003 EM,J	0.002 EM,J		
1,2,3,6,7,8-hexa-CD-Furan			0.001	0.000		
1,2,3,4,7,8-hexa-CD-Furan			0.002	0.001		
1,2,3,7,8,9-hexa-CD-Furan			0.000 U,	0.000 U,		
2,3,4,6,7,8-hexa-CD-Furan			0.001 PR, B	0.001 EM,B,U,J		
1,2,3,4,6,7,8-hepta-CD-Furan			0.001	0.001		
1,2,3,4,7,8,9-hepta-CD-Furan			0.000	0.000		
Octadichlorodibenzo-Furan			0.000	0.000		
Total Dioxins/Furans			0.044	0.032		
METALS (mg/kg DB)						
Antimony					57	93
Arsenic					5.1	6.7
Cadmium					260	270
Chromium					390	390
Copper					450	530
Lead					0.41	0.59
Mercury						
Nickel					6.1	6.1
Silver					410	960
Zinc						
CONVENTIONALS (%)						
Total Solids	55	63	60	63		
Total Organic Carbon	1.3174	1.2325	2.4024	2.1789		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-H5CC 07/26/1991 81 to 113 cm	CP2-M-H5E 07/26/1991 150 to 200 cm	CP2-M-H6A 07/29/1991 surface to 10 cm	CP2-M-H6B 07/29/1991 10 to 55 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	5.7 U	1.8 U	34	40	16	57
Acenaphthylene	5.7 U	1.8 U	2.3 U	4.0	66	66
Anthracene	5.7 U	1.8 U	31	27	220	1200
Fluorene	5.7 U	1.8 U	24	25	23	79
Naphthalene	5.7 U	1.8 U	130	180	99	170
Phenanthrene	5.7 U	1.8 U	52	52	100	480
2-Methylnaphthalene	5.7 U	1.8 U	23	28	38	64
Total LPAH	34	11	270	330	370	780
Benzo(a)anthracene	5.7 U	1.8 U	18	14	110	270
Benzo(a)pyrene	5.7 U	1.8 U	13	12	99	210
Benzo(b)fluoranthene	5.7 U	1.8 U	24	16		
Benzo(k)fluoranthene	5.7 U	1.8 U	16	18		
Total Benzofluoranthene	11	3.5	40	34	230	450
Benzo(g,h,i)perylene	5.7 U	1.8 U	2.3 U	2.3 U	31	78
Chrysene	5.7 U	1.8 U	23	20	110	460
Dibenz(a,h)anthracene	5.7 U	1.8 U	2.3 U	2.3 U	12	33
Fluoranthene	5.7 U	1.8 U	92	79	160	1200
Indeno(1,2,3-cd)pyrene	5.7 U	1.8 U	6.1	4.8	34	88
Pyrene	5.7 U	1.8 U	92	99	1000	1400
Total HPAH	57	18	290	270	960	5300
Total Carcinogenic PAH	40	12	100	86		
Total PAH	91	29	560	600		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R	R	R		
2,4-Dichlorophenol	20 U	39 U	32 U	30 U		
2,4,5-Trichlorophenol	7.1	9.8 U	8.7	7.5 U		
2,4,6-Trichlorophenol	5.0 U	9.8 U	8.1 U	7.5 U		
Tetrachlorophenol	5.0 U	9.8 U	8.1 U	7.5 U		
Pentachlorophenol	1.3	4.1 *,J	27 D,J	14 ,J	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin			0.002 B,U	0.003 U,		
1,2,3,7,8-penta-CD-Dioxin			0.004	0.003		
1,2,3,4,7,8-hexa-CD-Dioxin			0.002	0.001		
1,2,3,6,7,8-hexa-CD-Dioxin			0.009	0.004		
1,2,3,7,8,9-hexa-CD-Dioxin			0.006	0.006 PR,		
1,2,3,4,6,7,8-hepta-CD-Dioxin			0.028	0.018 Q,J		
Octachlorodibenzo-Dioxin			0.022 B,	0.015 B,		
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	5.7 U	1.8 U	15	13	15	58
2,3,7,8-tetra-CD-Furan			0.001 B,	0.001		
1,2,3,7,8-penta-CD-Furan			0.001 EM,J	0.000 EM,J		
2,3,4,7,8-penta-CD-Furan			0.005	0.003 EM,J		
1,2,3,6,7,8-hexa-CD-Furan			0.001	0.001		
1,2,3,4,7,8-hexa-CD-Furan			0.004	0.002 PR,		
1,2,3,7,8,9-hexa-CD-Furan			0.000	0.001 U,		
2,3,4,6,7,8-hexa-CD-Furan			0.002 B,	0.002 PR,		
1,2,3,4,6,7,8-hepta-CD-Furan			0.002 B,	0.002		
1,2,3,4,7,8,9-hepta-CD-Furan			0.000	0.000		
Octadichlorodibenzo-Furan			0.001 B,	0.001		
Total Dioxins/Furans			0.090	0.061		
METALS (mg/kg DB)						
Antimony						
Arsenic					57	93
Cadmium					5.1	6.7
Chromium					260	270
Copper					390	390
Lead					450	530
Mercury					0.41	0.59
Nickel						
Silver					6.1	6.1
Zinc					410	960
CONVENTIONALS (%)						
Total Solids	80	51	62	67		
Total Organic Carbon	0.4205	2.6609	1.6238	1.5134		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-H6C 07/29/1991 55 to 100 cm	CP2-M-H6E 07/29/1991 150 to 200 cm	CP2-M-H7A 08/12/1991 surface to 10 cm	CP2-M-H7B 08/12/1991 10 to 55 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	4.9 U	3.8 U	31	3.3	16	57
Acenaphthylene	4.9 U	3.8 U	2.5	1.9 U	66	66
Anthracene	4.9 U	3.8 U	24	4.4	220	1200
Fluorene	4.9 U	3.8 U	26	3.9	23	79
Naphthalene	18	3.8 U	100	26	99	170
Phenanthrene	4.9 U	3.8 U	46	11	100	480
2-Methylnaphthalene	4.9 U	3.8 U	14	3.6	38	64
Total LPAH	42	23	230	50	370	780
Benzo(a)anthracene	4.9 U	3.8 U	13	4.5	110	270
Benzo(a)pyrene	13	12	9.0	3.4	99	210
Benzo(b)fluoranthene	4.9 U	3.8 U	12	4.9		
Benzo(k)fluoranthene	4.9 U	3.8 U	8.7	4.0		
Total Benzofluoranthene	9.8	7.7	21	8.8	230	450
Benzo(g,h,i)perylene	4.9 U	3.8 U	4.1	1.9 U	31	78
Chrysene	4.9 U	3.8 U	24	6.4	110	460
Dibenz(a,h)anthracene	4.9 U	3.8 U	2.0	1.9 U	12	33
Fluoranthene	4.9 U	3.8 U	61	23	160	1200
Indeno(1,2,3-cd)pyrene	4.9 U	3.8 U	3.8	1.9 U	34	88
Pyrene	14	3.8 U	46	15	1000	1400
Total HPAH	66	47	180	67	960	5300
Total Carcinogenic PAH	42	35	72	27		
Total PAH	110	70	410	120		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R	R	R		
2,4-Dichlorophenol	20 U	29 U	36 U	20 U		
2,4,5-Trichlorophenol	5.0 U	7.4 U	11	5.0 U		
2,4,6-Trichlorophenol	5.0 U	7.4 U	8.9 U	5.0 U		
Tetrachlorophenol	5.0 U	7.4 U	8.9 U	5.0 U		
Pentachlorophenol	5.4 ,J	1.5 U	17 *,J	1.2 *,J	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin			0.0022	0.00067 EM,J		
1,2,3,7,8-penta-CD-Dioxin			0.0079	0.00075 EM,J		
1,2,3,4,7,8-hexa-CD-Dioxin			0.0040	0.00028		
1,2,3,6,7,8-hexa-CD-Dioxin			0.0144 B,	0.00057 B,		
1,2,3,7,8,9-hexa-CD-Dioxin			0.0059 PR,	0.00055 PR,		
1,2,3,4,6,7,8-hepta-CD-Dioxin			0.0333 B,S,J	0.00123 B,		
Octachlorodibenzo-Dioxin			0.0098 B,S,J	0.00086 B,		
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	4.9 U	3.8 U	20	2.6	15	58
2,3,7,8-tetra-CD-Furan			0.0008 B,	0.00021 B,		
1,2,3,7,8-penta-CD-Furan			0.0006	0.00012		
2,3,4,7,8-penta-CD-Furan			0.0071	0.00115 EM,J		
1,2,3,6,7,8-hexa-CD-Furan			0.0015	0.00019		
1,2,3,4,7,8-hexa-CD-Furan			0.0052	0.00049		
1,2,3,7,8,9-hexa-CD-Furan			0.0003	0.00003		
2,3,4,6,7,8-hexa-CD-Furan			0.0029 B,	0.00045 B,PR,U		
1,2,3,4,6,7,8-hepta-CD-Furan			0.0035 B,	0.00078 B,		
1,2,3,4,7,8,9-hepta-CD-Furan			0.0002	0.00001		
Octadichlorodibenzo-Furan			0.0010 B,	0.00006 B,		
Total Dioxins/Furans			0.1004	0.00839		
METALS (mg/kg DB)						
Antimony					57	93
Arsenic					5.1	6.7
Cadmium					260	270
Chromium					390	390
Copper					450	530
Lead					0.41	0.59
Mercury						
Nickel					6.1	6.1
Silver					410	960
Zinc						
CONVENTIONALS (%)						
Total Solids	75	68	56	72		
Total Organic Carbon	0.4893	0.9091	3.9069	1.2321		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-H7C 08/12/1991 55 to 85 cm	CP2-M-H8A 08/01/1991 surface to 10 cm	CP2-M-H8B 08/01/1991 10 to 32 cm	CP2-M-H8C 08/01/1991 61 to 100 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	1.5 U	3.6	2.8 U	2.1 U	16	57
Acenaphthylene	2.0	3.1	2.8 U	2.1 U	66	66
Anthracene	2.0	9.8	2.8 U	2.1 U	220	1200
Fluorene	1.5 U	4.9	2.8 U	2.1 U	23	79
Naphthalene	13	12	11	7.9	99	170
Phenanthrene	8.6	16	5.3	4.1	100	480
2-Methylnaphthalene	1.5 U	2.6	3.8	2.1 U	38	64
Total LPAH	29	50	28	20	370	780
Benzo(a)anthracene	2.7	11	2.8 U	2.1 U	110	270
Benzo(a)pyrene	2.8	6.9	4.5	3.7	99	210
Benzo(b)fluoranthene	4.3	13	4.6	2.3		
Benzo(k)fluoranthene	1.5 U	23	4.7	2.4		
Total Benzofluoranthene	5.8	36	9.3	4.7	230	450
Benzo(g,h,i)perylene	1.5 U	3.2	2.8 U	2.1 U	31	78
Chrysene	3.1	23	2.8 U	2.1 U	110	460
Dibenz(a,h)anthracene	1.5 U	1.4 U	2.8 U	2.1 U	12	33
Fluoranthene	13	38	8.4	4.9	160	1200
Indeno(1,2,3-cd)pyrene	1.5 U	1.4 U	2.8 U	2.1 U	34	88
Pyrene	12	41	11	6.3	1000	1400
Total HPAH	44	160	47	30	960	5300
Total Carcinogenic PAH	17	79	25	17		
Total PAH	73	210	75	50		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R	R	R		
2,4-Dichlorophenol	20 U	29 U	33 U	34 U		
2,4,5-Trichlorophenol	5.0 U	7.4 U	8.3 U	8.5 U		
2,4,6-Trichlorophenol	5.0 U	7.4 U	8.3 U	8.5 U		
Tetrachlorophenol	5.0 U	7.4 U	8.3 U	8.5 U		
Pentachlorophenol	1.0 U	11 J	1.7 U	1.7 U	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin		0.001 U,	0.001 U,			
1,2,3,7,8-penta-CD-Dioxin		0.004	0.002 EM,J			
1,2,3,4,7,8-hexa-CD-Dioxin		0.002	0.000			
1,2,3,6,7,8-hexa-CD-Dioxin		0.005	0.001			
1,2,3,7,8,9-hexa-CD-Dioxin		0.004	0.001			
1,2,3,4,6,7,8-hepta-CD-Dioxin		0.015	0.002			
Octachlorodibenzo-Dioxin		0.012 B,	0.002 B,			
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	1.5	2.9	2.8 U	2.1	15	58
2,3,7,8-tetra-CD-Furan		0.000	0.000			
1,2,3,7,8-penta-CD-Furan		0.000 EM,J	0.000 U,			
2,3,4,7,8-penta-CD-Furan		0.003	0.001			
1,2,3,6,7,8-hexa-CD-Furan		0.001 EM,J	0.000 EM,J			
1,2,3,4,7,8-hexa-CD-Furan		0.003	0.000 EM,J			
1,2,3,7,8,9-hexa-CD-Furan		0.001	0.000 U,			
2,3,4,6,7,8-hexa-CD-Furan		0.002	0.001			
1,2,3,4,6,7,8-hepta-CD-Furan		0.001	0.001			
1,2,3,4,7,8,9-hepta-CD-Furan		0.000	0.000 U,			
Octadichlorodibenzo-Furan		0.000	0.000			
Total Dioxins/Furans		0.054	0.012			
METALS (mg/kg DB)						
Antimony					57	93
Arsenic					5.1	6.7
Cadmium					260	270
Chromium					390	390
Copper					450	530
Lead					0.41	0.59
Mercury						
Nickel					6.1	6.1
Silver					410	960
Zinc						
CONVENTIONALS (%)						
Total Solids	77	68	60	59		
Total Organic Carbon	1.6323	2.4545	1.4263	1.8952		

TABLE C-3
Remedial Investigation Sediment Chemistry
(Recalculated to Reflect TOC and TEF)
Port of Olympia
Cascade Pole Site

	CP2-M-H8E 08/01/1991 150 to 200 cm	CP2-M-H9CC 07/25/1991 84 to 100 cm	CP2-M-H9F 07/25/1991 200 to 250 cm	CP2-M-H10A 08/14/1991 surface to 10 cm	Sediment Quality Standards	Cleanup Screening Level
PAH (mg/kg organic carbon DB)						
Acenaphthene	3.5 U	7400 D	26	3.3	16	57
Acenaphthylene	3.5 U	58	1.8	1.3	66	66
Anthracene	3.5 U	1500	5.1	10	220	1200
Fluorene	3.5 U	7000 D	20	4.1	23	79
Naphthalene	9.0	12000 D	62	12	99	170
Phenanthrene	3.5	12000 D	51	11	100	480
2-Methylnaphthalene	3.5 U	2700	7.8	3.1	38	64
Total LPAH	26	40000	170	42	370	780
Benzo(a)anthracene	3.5 U	1900	4.3	8.7	110	270
Benzo(a)pyrene	3.5 U	780	12	6.1	99	210
Benzo(b)fluoranthene	3.5 U	1200	1.8	11		
Benzo(k)fluoranthene	3.5 U	510	1.8	10		
Total Benzofluoranthene	7.0	1700	3.5	21	230	450
Benzo(g,h,i)perylene	3.5 U	200	1.8	2.8	31	78
Chrysene	3.5 U	1500	3.9	12	110	460
Dibenz(a,h)anthracene	3.5 U	79	1.8	1.1 U	12	33
Fluoranthene	8.0	8300 D	25	25	160	1200
Indeno(1,2,3-cd)pyrene	3.5 U	220	1.8	3.1	34	88
Pyrene	9.9	5500 D	23	33	1000	1400
Total HPAH	46	20000	76	110	960	5300
Total Carcinogenic PAH	24	6100	27	52		
Total PAH	72	60000	250	150		
CHLORINATED PHENOLS (ug/kg DB)						
2-Chlorophenol	R	R	1900	R		
2,4-Dichlorophenol	20 U	20 U	350	36 U		
2,4,5-Trichlorophenol	5.0 U	5.0 U	9.4	8.9 U		
2,4,6-Trichlorophenol	5.0 U	5.0 U	9.4	8.9 U		
Tetrachlorophenol	5.0 U	5.0 U	9.4	8.9 U		
Pentachlorophenol	1.0 U	1.0 U	1.9	28 *,J	360	690
DIOXINS (ug/kg TEQ DB)						
2,3,7,8-tetra-CD-Dioxin						
1,2,3,7,8-penta-CD-Dioxin						
1,2,3,4,7,8-hexa-CD-Dioxin						
1,2,3,6,7,8-hexa-CD-Dioxin						
1,2,3,7,8,9-hexa-CD-Dioxin						
1,2,3,4,6,7,8-hepta-CD-Dioxin						
Octachlorodibenzo-Dioxin						
FURANS (ug/kg TEQ DB)						
Dibenzofuran (mg/kg organic carbon DB)	3.5	5100 D,U	11	3.3	15	58
2,3,7,8-tetra-CD-Furan						
1,2,3,7,8-penta-CD-Furan						
2,3,4,7,8-penta-CD-Furan						
1,2,3,6,7,8-hexa-CD-Furan						
1,2,3,4,7,8-hexa-CD-Furan						
1,2,3,7,8,9-hexa-CD-Furan						
2,3,4,6,7,8-hexa-CD-Furan						
1,2,3,4,6,7,8-hepta-CD-Furan						
1,2,3,4,7,8,9-hepta-CD-Furan						
Octadichlorodibenzo-Furan						
Total Dioxins/Furans						
METALS (mg/kg DB)						
Antimony						
Arsenic					57	93
Cadmium					5.1	6.7
Chromium					260	270
Copper					390	390
Lead					450	530
Mercury					0.41	0.59
Nickel						
Silver					6.1	6.1
Zinc					410	960
CONVENTIONALS (%)						
Total Solids	76	76	53	56		
Total Organic Carbon	0.6881	1.2086	2.5692	3.9286		

TABLE C-4
Remedial Investigation Water Chemistry
Port of Olympia
Cascade Pole Site

	CP2-WC-B3 08/14/91 Water Column		CP2-WC-C2 08/14/91 Water Column		CP2-WC-G3 08/14/91 Water Column		CP2-WP-C2 08/14/91 Ponded Water	
PAH (ug/L)								
Acenaphthene	0.05	U	0.05	U	0.05	U	0.05	U
Acenaphthylene	0.2	U	0.2	U	0.2	U	0.2	U
Anthracene	0.01	U	0.063	B,U	0.063	B,U	0.053	B,U
Fluorene	0.02	U	0.02	U	0.02	U	R	
Naphthalene	0.05	U	0.05	U	0.05	U	0.05	U
Phenanthrene	0.01	U	0.01	U	0.01	U	0.19	
2-Methylnaphthalene								
Total LPAH	0.34		0.393		0.393		0.543	
Benzo(a)anthracene	0.01	U	0.01	U	0.01	U	0.01	U
Benzo(a)pyrene	0.01	U	0.01	U	0.01	U	0.01	U
Benzo(b)fluoranthene	0.01	U	0.01	U	0.01	U	0.01	U
Benzo(k)fluoranthene	0.01	U	0.01	U	0.01	U	R	
Benzo(b)+Benzo(k)fluoranthene								
Benzo(g,h,i)perylene	0.02	U	0.02	U	0.02	U	0.02	U
Chrysene	0.01	U	0.01	U	0.01	U	0.01	U
Dibenz(a,h)anthracene	0.01	U	0.01	U	0.01	U	0.01	U
Fluoranthene	0.01	U	0.01	U	0.01	U	0.51	
Indeno(1,2,3-cd)pyrene	0.02	U	0.02	U	0.02	U	0.02	U
Pyrene	0.01	U	0.01	U	0.01	U	0.28	
Total HPAH	0.08		0.12		0.12		0.88	
Total Carcinogenic PAH	0.08		0.08		0.08		0.07	
Total PAH	0.42		0.513		0.513		1.423	
CHLORINATED PHENOLS (ug/L)								
2-Chlorophenol	50	U	50	U	50	U	78	U
2,4-Dichlorophenol	1	U	1	U	1	U	1.6	U
2,4,5-Trichlorophenol	0.4	U	0.4	U	0.4	U	0.63	U
2,4,6-Trichlorophenol	0.2	U	0.2	U	0.2	U	0.31	U
Tetrachlorophenol	0.2	U	0.2	U	0.2	U	0.31	U
Pentachlorophenol	0.05	U	0.05	U	0.05	U	0.078	U
DIOXINS (ug/L TEQ)								
2,3,7,8-tetra-CD-Dioxin	0.0000050	U,	0.00001	U,	0.000003	U,	0.000003	U,
1,2,3,7,8-penta-CD-Dioxin	0.0000050	U,	0.000015	U,	0.000005	U,	0.0000015	U,
1,2,3,4,7,8-hexa-CD-Dioxin	0.0000010	U,	0.000003	U,	0.000001	U,	0.000001	
1,2,3,6,7,8-hexa-CD-Dioxin	0.0000010		0.000002	U,	0.0000008	U,	0.000004	
1,2,3,7,8,9-hexa-CD-Dioxin	0.0000020	PR,	0.000003	U,	0.000001	U,	0.000004	PR,
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.0000018		0.0000006		0.0000002	EM,J	0.000016	
Octachlorodibenzo-Dioxin	0.00000048	B,U	0.00000045	EM,B,U	0.00000016	B,U	0.000013	B,U
Total Dioxins	0.00001628		0.00003405		0.00001116		0.0000425	
FURANS (ug/L TEQ)								
Dibenzofuran (ug/L)								
2,3,7,8-tetra-CD-Furan	0.0000003	U,	0.000001	U,	0.0000004	B,U	0.0000008	U,
1,2,3,7,8-penta-CD-Furan	0.00000025	U,	0.000001	U,	0.00000025	U,	0.00000015	EM,J
2,3,4,7,8-penta-CD-Furan	0.000005	EM,J	0.00001	U,	0.0000025	U,	0.0000015	EM,J
1,2,3,6,7,8-hexa-CD-Furan	0.0000009		0.000002	U,	0.0000008	U,	0.0000005	
1,2,3,4,7,8-hexa-CD-Furan	0.000003		0.000002	U,	0.0000008	U,	0.000002	
1,2,3,7,8,9-hexa-CD-Furan	0.0000008	U,	0.000003	U,	0.000001	U,	0.0000003	U,
2,3,4,6,7,8-hexa-CD-Furan	0.000003		0.000002	U,	0.0000008	U,	0.000001	EM,J
1,2,3,4,6,7,8-hepta-CD-Furan	0.0000005	B,U	0.0000002	U,	0.00000008	U,	0.0000013	B,U
1,2,3,4,7,8,9-hepta-CD-Furan	0.0000002		0.0000003	U,	0.0000001	U,	0.0000001	
Octadichlorodibenzo-Furan	0.00000011	B,U	0.00000007	U,	0.00000002	U,	0.00000046	B,U
Total Furans	0.00001406		0.00002157		0.00000675		0.00000811	
CONVENTIONALS								
Total Suspended Solids (mg/L)	33		50		49		35	
Salinity (g/L)	27.84		24.56		28.71		23.34	

TABLE C-4
Remedial Investigation Water Chemistry
Port of Olympia
Cascade Pole Site

	CP2-WP-H12 08/14/91 Ponded Water	CP2-WP-H13 08/14/91 Ponded Water	CP2-WP-H14 08/14/91 Ponded Water	CP2-W-BI1 08/13/91 Background
PAH (ug/L)				
Acenaphthene	6.3	0.05 U	0.05 U	0.05 U
Acenaphthylene	1 U	0.2 U	0.2 U	0.2 U
Anthracene	0.96 B	0.056 B,U	0.06 B,U	0.01 U
Fluorene	3.8	0.02 U	0.02 U	0.02 U
Naphthalene	0.73	0.05 U	0.05 U	0.05 U
Phenanthrene	7.9	0.01 U	0.01 U	0.01 U
2-Methylnaphthalene				
Total LPAH	20.69	0.386	0.39	0.34
Benzo(a)anthracene	0.89	0.01 U	0.01 U	0.01 U
Benzo(a)pyrene	0.42	0.01 U	0.01 U	0.01 U
Benzo(b)fluoranthene	0.49	0.01 U	0.01 U	0.01 U
Benzo(k)fluoranthene	0.31	0.01 U	0.01 U	0.01 U
Benzo(b)+Benzo(k)fluoranthene				
Benzo(g,h,i)perylene	0.28	0.02 U	0.02 U	0.02 U
Chrysene	0.96	0.01 U	0.01 U	0.01 U
Dibenz(a,h)anthracene	0.2 U	0.01 U	0.01 U	0.01 U
Fluoranthene	8.3	0.01 U	0.01 U	0.01 U
Indeno(1,2,3-cd)pyrene	0.21	0.02 U	0.02 U	0.02 U
Pyrene	6.3	0.01 U	0.01 U	0.01 U
Total HPAH	18.36	0.12	0.12	0.08
Total Carcinogenic PAH	3.48	0.08	0.08	0.08
Total PAH	39.05	0.506	0.510	0.42
CHLORINATED PHENOLS (ug/L)				
2-Chlorophenol	50 U	51 U	55 U	50 U
2,4-Dichlorophenol	1 U	1 U	1.1 U	1 U
2,4,5-Trichlorophenol	0.4 U	0.41 U	0.44 U	0.4 U
2,4,6-Trichlorophenol	0.2 U	0.2 U	0.22 U	0.2 U
Tetrachlorophenol	0.2 U	0.2 U	0.22 U	0.2 U
Pentachlorophenol	0.05 U	0.051 U	0.055 U	0.05 U
DIOXINS (ug/L TEQ)				
2,3,7,8-tetra-CD-Dioxin	0.00001 U,	0.000005 U,	0.000003 U,	0.000003 U,
1,2,3,7,8-penta-CD-Dioxin	0.000005	0.000005 U,	0.000004 U,	0.0000025 U,
1,2,3,4,7,8-hexa-CD-Dioxin	0.000005	0.000001 U,	0.000001 U,	0.0000008 U,
1,2,3,6,7,8-hexa-CD-Dioxin	0.000022	0.0000008 U,	0.0000007	0.0000005 U,
1,2,3,7,8,9-hexa-CD-Dioxin	0.000012 PR,	0.000001 U,	0.0000008 U,	0.0000008 U,
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.000097	0.0000016	0.0000017	0.0000003 B,U
Octachlorodibenzo-Dioxin	0.0000757 B	0.0000011 B,	0.0000013 B,	0.00000028 B,U
Total Dioxins	0.0002267	0.0000155	0.0000125	0.00000818
FURANS (ug/L TEQ)				
Dibenzofuran (ug/L)				
2,3,7,8-tetra-CD-Furan	0.000001	0.0000003	0.0000004	0.0000003 U,
1,2,3,7,8-penta-CD-Furan	0.000001	0.00000025 U,	0.00000015 U,	0.00000015 EM,B,J,U
2,3,4,7,8-penta-CD-Furan	0.00001 EM,J	0.0000025 U,	0.0000015 U,	0.0000015 U,
1,2,3,6,7,8-hexa-CD-Furan	0.000002	0.0000005 U,	0.0000005 U,	0.0000003 U,
1,2,3,4,7,8-hexa-CD-Furan	0.000008 EM,J	0.0000008 U,	0.0000005 U,	0.0000005 U,
1,2,3,7,8,9-hexa-CD-Furan	0.0000005 U,	0.000001 U,	0.0000005 U,	0.0000005 U,
2,3,4,6,7,8-hexa-CD-Furan	0.000003 EM,J	0.0000008 U,	0.0000005 U,	0.0000005 EM,B,J,U
1,2,3,4,6,7,8-hepta-CD-Furan	0.0000062 B,	0.0000002 EM,B,J	0.0000002 B,U	0.00000005 U,
1,2,3,4,7,8,9-hepta-CD-Furan	0.0000004	0.0000001 U,	0.00000008 U,	0.00000008 U,
Octadichlorodibenzo-Furan	0.0000027 B,U	0.00000007 B,U	0.00000008 B,U	0.00000002 B,U
Total Furans	0.0000348	0.00000652	0.00000441	0.0000039
CONVENTIONALS				
Total Suspended Solids (mg/L)	39	30	30	34
Salinity (g/L)	27.65	24.23	25.15	24

TABLE C-4
Remedial Investigation Water Chemistry
Port of Olympia
Cascade Pole Site

	CP2-W-BI11 08/13/91 Duplicate of BI1		CP2-W-BI2 08/13/91 Background		CP2-W-BI3 08/13/91 Background	
PAH (ug/L)						
Acenaphthene	0.05	U	0.05	U	0.05	U
Acenaphthylene	0.2	U	0.2	U	0.2	U
Anthracene	0.061	B,U	0.067	B,U	0.01	U
Fluorene	0.02	U	0.02	U	0.02	U
Naphthalene	0.05	U	0.05	U	0.05	U
Phenanthrene	0.01	U	0.01	U	0.01	U
2-Methylnaphthalene						
Total LPAH	0.391		0.397		0.34	
Benzo(a)anthracene	0.01	U	0.01	U	0.01	U
Benzo(a)pyrene	0.01	U	0.01	U	0.01	U
Benzo(b)fluoranthene	0.01	U	0.01	U	0.01	U
Benzo(k)fluoranthene	0.01	U	0.01	U	0.01	U
Benzo(b)+Benzo(k)fluoranthene						
Benzo(g,h,i)perylene	0.02	U	0.02	U	0.02	U
Chrysene	0.01	U	0.01	U	0.01	U
Dibenz(a,h)anthracene	0.01	U	0.01	U	0.01	U
Fluoranthene	0.01	U	0.01	U	0.01	U
Indeno(1,2,3-cd)pyrene	0.02	U	0.02	U	0.02	U
Pyrene	0.01	U	0.01	U	0.01	U
Total HPAH	0.08		0.08		0.12	
Total Carcinogenic PAH	0.08		0.08		0.08	
Total PAH	0.471		0.477		0.46	
CHLORINATED PHENOLS (ug/L)						
2-Chlorophenol	50	U	50	U	50	U
2,4-Dichlorophenol	1	U	1	U	1	U
2,4,5-Trichlorophenol	0.4	U	0.4	U	0.4	U
2,4,6-Trichlorophenol	0.2	U	0.2	U	0.2	U
Tetrachlorophenol	0.2	U	0.2	U	0.2	U
Pentachlorophenol	0.05	U	0.05	U	0.05	U
DIOXINS (ug/L TEQ)						
2,3,7,8-tetra-CD-Dioxin	0.000003	U,	0.000001	U,	0.000003	U,
1,2,3,7,8-penta-CD-Dioxin	0.0000015	U,B	0.0000015	U,	0.0000025	U,
1,2,3,4,7,8-hexa-CD-Dioxin	0.0000003	U,	0.0000003	U,	0.0000008	U,
1,2,3,6,7,8-hexa-CD-Dioxin	0.0000002	EM,J	0.0000003	U,	0.0000005	U,
1,2,3,7,8,9-hexa-CD-Dioxin	0.0000003	U,	0.0000003	U,	0.0000008	U,
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.0000003	B,U	0.0000002	B,U	0.0000004	B,EM,J,U
Octachlorodibenzo-Dioxin	0.00000035	B,U	0.00000034	B,U	0.00000042	B,U
Total Dioxins	0.00000595		0.00000394		0.00000842	
FURANS (ug/L TEQ)						
Dibenzofuran (ug/L)						
2,3,7,8-tetra-CD-Furan	0.0000003	U,B,U	0.0000002	EM,B,J,U	0.0000001	U,
1,2,3,7,8-penta-CD-Furan	0.0000001	B,U	0.0000001	EM,B,J,U	0.00000015	U,
2,3,4,7,8-penta-CD-Furan	0.0000015	U,	0.0000005	U,	0.0000015	U,
1,2,3,6,7,8-hexa-CD-Furan	0.0000003	U,	0.0000001	U,	0.0000003	U,
1,2,3,4,7,8-hexa-CD-Furan	0.0000003	U,	0.0000003	U,	0.0000005	U,
1,2,3,7,8,9-hexa-CD-Furan	0.0000003	U,	0.0000003	U,	0.0000005	U,
2,3,4,6,7,8-hexa-CD-Furan	0.0000003	EM,B,J,U	0.0000003	B,U	0.0000005	U,
1,2,3,4,6,7,8-hepta-CD-Furan	0.00000004		0.00000004		0.00000005	U,
1,2,3,4,7,8,9-hepta-CD-Furan	0.00000003	U,	0.00000003	U,	0.00000008	U,
Octadichlorodibenzo-Furan	0.00000003	B,U	0.00000005	B,U	0.00000006	B,U
Total Furans	0.0000032		0.00000192		0.00000374	
CONVENTIONALS						
Total Suspended Solids (mg/L)	72		51		36	
Salinity (g/L)	27		1	U,	22	

TABLE C-5
Remedial Investigation Phase II Tissue Chemistry
Port of Olympia
Cascade Pole Site

	CP2-C-EI 08/08/91 Reference		CP2-C-F5 08/07/91		CP2-C-H2 08/07/91	
PAH (ug/kg)						
Acenaphthene	24	U,	96	U,	96	U,
Acenaphthylene	24	U,	96	U,	96	U,
Anthracene	24	U,	96	U,	160	,
Fluorene	24	U,	96	U,	96	U,
Naphthalene	24	U,	96	U,	96	U,
Phenanthrene	24	U,	96	U,	330	,
2-Methylnaphthalene	24	U,	96	U,	96	U,
Total LPAH	170		670		970	
Benzo(a)anthracene	24	U,	96	U,	220	,
Benzo(a)pyrene	24	U,	96	U,	190	,
Benzo(b)fluoranthene	24	U,	96	U,	400	,
Benzo(k)fluoranthene	24	U,	96	U,	96	U,
Benzo(b)+Benzo(k)fluoranthene						
Benzo(g,h,i)perylene	24	U,	96	U,	96	U,
Chrysene	24	U,	96	U,	400	,
Dibenz(a,h)anthracene	24	U,	96	U,	96	U,
Fluoranthene	24	U,	96	U,	740	,
Indeno(1,2,3-cd)pyrene	24	U,	96	U,	96	U,
Pyrene	24	U,	96	U,	1600	,
Total HPAH	240		960		3900	
Total Carcinogenic PAH	170		670		1500	
Total PAH	400		1600		4900	
CHLORINATED PHENOLS (ug/kg)						
2-Chlorophenol	1000	U,R	1000	U,R	1000	U,R
2,4-Dichlorophenol	20	U,	20	U,	20	U,
2,4,5-Trichlorophenol	5	U,	5	U,	5	U,
2,4,6-Trichlorophenol	5	U,	5	U,	5	U,
Tetrachlorophenol	5	U,	5	U,	5	U,
Pentachlorophenol	1	U,	1	U,	1.5	,
DIOXINS (TEQ) (ug/kg)						
2,3,7,8-tetra-CD-Dioxin	0.0002	U,	0.0004	U,	0.00027	EM,J
1,2,3,7,8-penta-CD-Dioxin	0.00015	U,	0.00045	U,	0.00055	
1,2,3,4,7,8-hexa-CD-Dioxin	0.00002	U,	0.00009	U,	0.00025	
1,2,3,6,7,8-hexa-CD-Dioxin	0.000025		0.00022		0.00114	
1,2,3,7,8,9-hexa-CD-Dioxin	0.00002	U,	0.000097	PR,	0.00038	PR,
1,2,3,4,6,7,8-hepta-CD-Dioxin	0.000024		0.000473		0.00245	
Octachlorodibenzo-Dioxin	0.0000209	B,	0.000272	B,	0.00162	B,
FURANS (TEQ) (ug/kg)						
2,3,7,8-tetra-CD-Furan	0.00002	U,	0.000048		0.00009	
1,2,3,7,8-penta-CD-Furan	0.00001	U,	0.000025	U,	0.00008	
2,3,4,7,8-penta-CD-Furan	0.0001	U,	0.0002	U,	0.00065	
1,2,3,6,7,8-hexa-CD-Furan	0.00002	U,	0.00004	U,	0.000082	
1,2,3,4,7,8-hexa-CD-Furan	0.00002	U,	0.000085		0.00035	
1,2,3,7,8,9-hexa-CD-Furan	0.00003	U,	0.00005	U,	0.00003	U,
2,3,4,6,7,8-hexa-CD-Furan	0.000037	B,Q,J	0.000069	B,U	0.00021	B,PR
1,2,3,4,6,7,8-hepta-CD-Furan	0.0000062	EM,J	0.000079		0.000174	
1,2,3,4,7,8,9-hepta-CD-Furan	0.000003	U,	0.000007	U,	0.0000086	EM,J
Octadichlorodibenzo-Furan	0.0000036		0.0000141		0.0000622	
Total Dioxins and Furans (TEQ)	7.1E-04		2.6E-03		8.4E-03	
Dibenzofuran (ug/kg)	24	U,	96	U,	96	U,

TABLE C-5
Remedial Investigation Phase II Tissue Chemistry
Port of Olympia
Cascade Pole Site

	CP2-C-E1 08/08/91 Reference	CP2-C-F5 08/07/91	CP2-C-H2 08/07/91
METALS (mg/kg)			
Antimony	0.2 U,	0.2 U,	0.2 U
Arsenic	1.8	2.4	2.2
Cadmium	0.06	0.09	0.06
Chromium	1.2	1.5	0.8
Copper	2	9.6	5.5
Lead	0.2	1.1	0.97
Mercury	0.01	0.06	0.01 U,
Nickel	1.1	1.3	0.8
Silver	0.02 U,	0.59	0.36
Zinc	13	15	12
CONVENTIONALS			
Lipids (%), Method 1 (a)	0.2	0.2	0.3
Lipids (%), Method 2 (b)	0.25	0.85	0.48

(a) An aliquot of tissue sample was taken, extracted in ethyl ether, and analyzed for lipids by ATI. Subsampling may not have yielded a representative sample for analysis. This may contribute to the difference in results reported by the two methods.
(b) The entire tissue sample was extracted in methylene chloride. A fraction of the extract was analyzed for lipids by Triangle Labs and another fraction for dioxins and furans. The extraction efficiency of methylene chloride for lipids may yield considerably different results.

APPENDIX D

Data Validation Reports

- Sediments RI Phase I
  Cascade Pole Site
- Cascade Pole Site Phase II
  Sediment, Tissue, and Water

DATA VALIDATION REPORT

FOR

SEDIMENTS RI PHASE I

CASCADE POLE SITE

PORT OF OLYMPIA, WASHINGTON

Prepared for:

Landau Associates, Inc.
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Prepared by:

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911 Western Avenue
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Seattle, WA 98104

March 27, 1991

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INTRODUCTION

The submitted data packages have been reviewed by EcoChem, Inc. The contract laboratories and analyses performed are summarized in Table 1. Data validation packets for the chlorinated phenol and polycyclic aromatic hydrocarbons (PAH) organic analyses, dioxin organic analyses, total metals, and conventional analyses which detail items reviewed, are on file at EcoChem, Inc. The quality assurance evaluations performed and recommended data qualifications from the review are summarized under each section. Samples may be qualified for several reasons, but these reasons are discussed separately and the samples may be listed in more than one qualification table within a section. Tables 2 and 3 summarize the sample results to be qualified.

Recommended data qualifiers are based on the EPA Contract Laboratory Program (CLP) data validation functional guidelines (U.S. EPA, 1988a, 1988b) for the organic and total metals analyses. The data quality review of the conventional analyses is based on the Data Validation Guidance Manual for Selected Sediment Variables (PTI, 1989). These guidelines require that the data reviewer use professional judgement as to necessary data qualifications. The data qualifiers assigned after the data validation review provide additional information, but do not replace, those assigned by the laboratory. Data may be qualified even though the laboratory fulfilled all the requirements stated in the EPA SOWs (U.S. EPA, 1987b, 1988c) or the QAPP (Landau, 1990). The guidelines for reviewing data are more strict and take into account all variables of data quality (accuracy, precision, etc.). Unless specifically stated in the text, data qualifications are not due to laboratory error or deviations from the analysis protocols defined in the EPA SOWs or the Puget Sound Estuary Program (Tetra Tech, 1986), but are based on the data validation guidelines specified in the EPA functional guidelines for inorganic and organic analyses. For analyses performed by non-CLP methods, the data validation guidelines established under the EPA CLP program are used where applicable. The EPA CLP functional guidelines have established procedures to follow for qualifying data (blank contamination, surrogate recoveries, etc.) that can be applied to non-CLP methods. EcoChem, Inc.'s goal in assigning data validation qualifiers is to assist in proper data interpretation. If values are assigned a "J" or "UJ", data can be used for site evaluation 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 all data quality goals as outlined in the EPA CLP functional guidelines (U.S. EPA, 1988a, 1988b).

The data results were reviewed 100 percent following level III data validation guidelines (U.S. EPA, 1987a). Theses guidelines require surrogate recoveries, matrix spikes, duplicates, and method blank results be reported by the laboratory, but no raw data or instrument calibration information is required. In addition, 10 percent of the samples were reviewed following level IV data validation guidelines. Level IV data validation requires the raw data and instrument calibration be evaluated along with the parameters reviewed under level III. Because the samples chosen for level IV data validation were contained in all the organic analytical batches, the calibrations were evaluated 100 percent. For the trace metals analyses, the samples chosen for the level IV data validation were contained in two out of six analytical batches for all metals, except arsenic and antimony. All the samples were analyzed for arsenic and antimony in one analytical run, therefore, the instrument calibration and raw data results were evaluated 100 percent. For the remaining metals, the samples not reviewed for level IV data validation were A1A, A2A, A3A, E2A, RB1, and RB2. A level III data validation was performed on the conventional analyses. A level IV data validation was not performed because of the nature of the analytical methods employed. No instrument calibration is required for the total solids analysis. The Total Organic Carbon (TOC) analysis is performed on an instrument with preset calibration parameters. A known standard is analyzed to monitor the internal calibration and these results were reported by the laboratory. The grain size calculations are performed with a specially designed proprietary software, and calculation checks cannot be performed on the information that is provided by the laboratory.

DATA QUALITY SUMMARY

All deliverables required by the Landau Cascade Pole Site QAPP (Landau, 1990) of the laboratory were included in the data package, except the raw data for the conventional analyses. The raw data for the conventionals were not included because no calibration checks are required for the total solids and TOC analyses, and the information provided for review of the grain size analyses are insufficient without the computer software designed by the laboratory, and not available to the public. The acceptability of the conventionals data is not affected by the lack of raw data.

The laboratory name and analyses performed are presented in Table 3. All references to the data in the text are based on the sample numbers assigned by Landau. The initial part of the sample identification, CP1-M, has been left off, in many instances, to simplify the text.

Overall data quality and adherence to protocols by the laboratory were good. Problems with specific sample analyses are discussed below. The data packages submitted met the Cascade Pole Site Quality Assurance Project Plan (QAPP) objective of 90% valid data. All required field quality control samples (blanks, field duplicates) were submitted and analyzed. Analytical results were reported and associated quality control analyses (blanks, duplicates, spikes) were performed for all samples except as noted. Based on this review zero (0) results were rejected out of over 2300 data points reported. Therefore, overall completeness for the data set was 100%.

Chlorinated Phenols Organic Analyses

Overall data quality was acceptable. Surrogate(s) need to be added to samples in appropriate quantities for electron capture detection in future work.

Polycyclic Aromatic Hydrocarbons (PAH) Organic Analyses

Data quality was acceptable except for continuing calibration standards that were outside of acceptable ranges, causing qualifiers to be applied to the data.

Dioxin Organic Analyses

Data quality was acceptable and well documented. Methodologies adhered to Triangle Protocols.

Total Metals Analyses

Overall data quality was acceptable. Two main areas of concern were: 1) The analysis of lead and silver by Flame Atomic Absorption (FAA); and 2) No adequate Standard Reference Material (SRM) was analyzed to determine the digestion efficiency.

Conventional Analyses

The overall data quality was good. No raw data were submitted so calculation checks, and protocol review were not possible. However, the data reported by the laboratory indicated that PSEP analysis protocols were followed. The data acceptability was not affected.

TABLE 1. CONTRACT LABORATORIES

Analytical Technologies
560 Naches Avenue SW
Suite 101
Renton, WA 98055

Analyses Performed: Chlorinated phenols organic analyses, PAH semi-volatile organic analyses, total metals.

Soil Technologies, Inc.
7865 Northeast Day Road West
Bainbridge Island, WA 98110

Analyses Performed: Grain Size. Subcontracted through Analytical Technologies.

Pacific Testing
3220 17th Avenue West
Seattle, WA 98119

Analyses Performed: Total Organic Carbon (TOC). Subcontracted through Analytical Technologies.

Triangle Laboratories
801-10 Capitola Drive
Research Triangle Park, NC 27713

Analyses Performed: Polychlorinated Dibenzo-p-dioxins and dibenzofurans.

Table 2. Summary of Data Qualifications for Organic Analyses

Compound	Qualifier	Sample Number	Reason
All PAH and Chlorinated phenols	J(+) UJ(-)	C2A, C2B, C2C, C12A, C12B, C12C, C1A, C1B, C1C, D11A, C13A, G2A	Samples extracted 7-8 days outside recommended holding time.
All PAH and Chlorinated phenols	J(+) UJ(-)	C2C	Some extract lost during sample concentration.

Compounds	Qualifier	Sample Number	Reason
Pyrene, Chrysene	J(+) UJ(-)	A4A, B4A, C2A, C2B, C2C, C12A, C12B, C12C, C1A, C1B, B5A, B5B	Continuing Calibration Compounds greater than 25% D from Initial Calibration
Benzo (k) Fluoranthene	J(+) UJ(-)	D4A, D5A, E5A, F5A, B2A, E4A, F4A, G3A, C4A, C4B, C1C, D2A, D2B, D2C, D11A, C13A, G2A, Sequim Bay, G14A, E1A, G6A, G1A, F2A, F2B, F2C, B3A, B3C, F1A, C2A, C2B, C2C, C12A, C12B, C12C, C1A, C1B, B5A, B5B	Continuing Calibration Compounds greater than 25% D from Initial Calibration
Benzo (b) Fluoranthene	J(+) UJ(-)	Sequim Bay, F2A, F2B, F2C, B3A, B3C, F1A	Continuing Calibration Compounds greater than 25% D from Initial Calibration
Benzo (a) Anthracene, Indeno (1,2,3,c,d) Pyrene, Dibenz (a,h) anthracene, Benzo (g,h,i) perylene	J(+) UJ(-)	C2A, C2B, C2C, C12A, C12B, C12C, C1A, C1B, B5A, B5B	Continuing Calibration Compounds greater than 25% D from Initial Calibration

Compound	Qualifier	Sample Number	Reason
Naphthalene	UJ	B1C, C3A, C3B, C3C, D1A, D1C, D2A, D2B, D2C	Sample concentration less than 5 times blank contamination
Pentachlorophenol	UJ	A3A, A4A, B4A, D5A	Sample concentration less than 5 times blank contamination
Pentachlorophenol	J	E5A	Sample dilution possibly contaminated sample extract

Compound	Qualifier	Sample Number	Reason
2,4 - Dichlorophenol	J(+) UJ(-)	All	Inconsistent and poor MS/MSD recoveries
2 - Chlorophenol	J(+) UJ(-)	All	No MS/MSD values, derivitization problems

Compound	Qualifier	Sample Number	Reason
All EMPC Data	J	All	EMPC data are estimates
All "Q" Data	J(+) UJ(-)	All	Quantitative interferences may cause data inaccuracy
OCDD	J	C1B, C1C, C2A, C2B	Saturation of GC/MS Signal, results estimated
1,2,3,4,6,7,8 - HpCDD	J	C2B	Saturation of GC/MS Signal, results estimated
Total HpCDD	J	C1C, C2B	Saturation of GC/MS Signal, results estimated

Table 3. Summary of Data Qualifications for Inorganic Analyses

ANALYTE	QUALIFIER	SAMPLE NUMBER	REASON
Antimony	J	C3A, C3B, C3C, D1A, D1B	CCV outside the control limits.
Lead	J	B1A, B1B, B1C, C3A, C3B, C3C, D1A, D1B, D1C, C13A, C2C, E1A, E3A	Sample absorbance below 0.010 absorbance units.
Silver	J	C12B, C1B	Sample absorbance below 0.010 absorbance units.

ANALYTE	QUALIFIER	SAMPLE NUMBER	REASON
Antimony	J	All	No MS Recovery due to dilution prior to analysis.
Arsenic	J	All	No MS results available.

ANALYTE	QUALIFIER	SAMPLE NUMBER	REASON
Arsenic	J	A1A, A2A, A3A, B1B, C3B, C13A, C1C, C12B, D1A, E3A.	Post spike recoveries outside the control limits.

CHLORINATED PHENOLS AND PAH ORGANIC ANALYSES
DATA VALIDATION REPORT

I. Sample Holding Times: ACCEPTABLE/With the following exceptions.

Qualified Data: MARINE SEDIMENTS

Compound	Qualifier	Sample Number	Reason
All PAH and Chlorinated phenols	J(+) UJ(-)	C2A, C2B, C2C, C12A, C12B, C12C, C1A, C1B, C1C, D11A, C13A, G2A	Samples extracted 7-8 days outside recommended holding time
All PAH and Chlorinated phenols	J(+) UJ(-)	C2C	Some extract lost during sample concentration

Discussion

The chain of custody sheets were reviewed and the holding times evaluated. The recommended holding time specified in the laboratory contract was 14 days for extraction and 40 days for analysis. Because of a laboratory error, the samples were extracted from 7 - 8 days outside the recommended holding time. Under CLP protocols, it is recommended that all results for these samples be considered approximate and assigned a J or UJ qualifier.

II. GC/MS System Performance Checks: ACCEPTABLE/All criteria were met.

Qualified Data: NONE

III. GC/ECD Instrument Performance Checks: ACCEPTABLE/With the following exceptions.

Qualified Data: NONE

Discussion

No instrument performance protocols are specified for this method. The retention times of the compounds of interest were compared between the external standards and the samples and were found acceptable. The order of sample analysis was also reviewed

because chlorinated phenolic compounds are easily carried over in the column after a highly contaminated sample is analyzed. The laboratory re-analyzed any samples that followed a highly contaminated sample, and verified the column was clean with blank analyses.

IV. **Calibration:** ACCEPTABLE/with the following exceptions.

Qualified Data: MARINE SEDIMENTS

Compounds	Qualifier	Sample Number	Reason
Pyrene, Chrysene	J(+) UJ(-)	A4A, B4A, C2A, C2B, C2C, C12A, C12B, C12C, C1A, C1B, B5A, B5B	Continuing Calibration Compounds greater than 25% D from Initial Calibration
Benzo (k) Fluoranthene	J(+) UJ(-)	D4A, D5A, E5A, F5A, B2A, E4A, F4A, G3A, C4A, C4B, C1C, D2A, D2B, D2C, D11A, C13A, G2A, Sequim Bay, G14A, E1A, G6A, G1A, F2A, F2B, F2C, B3A, B3C, F1A, C2A, C2B, C2C, C12A, C12B, C12C, C1A, C1B, B5A, B5B	Continuing Calibration Compounds greater than 25% D from Initial Calibration
Benzo (b) Fluoranthene	J(+) UJ(-)	Sequim Bay, F2A, F2B, F2C, B3A, B3C, F1A	Continuing Calibration Compounds greater than 25% D from Initial Calibration
Benzo (a) Anthracene, Indeno (1,2,3,c,d) Pyrene, Dibenz (a,h) anthracene, Benzo (g,h,i) perylene	J(+) UJ(-)	C2A, C2B, C2C, C12A, C12B, C12C, C1A, C1B, B5A, B5B	Continuing Calibration Compounds greater than 25% D from Initial Calibration

Discussion

The laboratory has modified the EPA CLP Semivolatile (GC/MS) Form VII (Continuing Calibration) to read 80% as the maximum percent difference for continuing calibration compounds (CCC). The required value is 25% difference. The laboratory should correct this value so subsequent reviewers of the data are not mislead.

GC/MS calibrations data was reviewed for linearity and reproducibility. Data were generally of acceptable quality with the above listed exceptions being outside of the 25% difference criteria between initial and continuing calibration standards defined by the Functional Guidelines for Evaluating Organic Analyses. (US EPA, 1988). Variability of greater than 25% can affect accurate quantitation and possibly detection limits. It is recommended that all positive results for these compounds be considered approximate and assigned a J qualifier and all non-detected results assigned a UJ qualifier.

V. Surrogate Spike Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

Laboratory performance on individual samples is established by means of spiking activities. All samples are spiked with surrogate compounds prior to sample preparation. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific samples results is frequently subjective and demands analytical experience and professional judgement. Data qualifications are generally based on the surrogate instrument calibration, reagent blanks, surrogate spikes, and sample surrogate spikes data.

No surrogate results were available for the chlorinated phenols analyses. 2,4,6 - Tribromophenol was added to all samples before extraction and was going to be used as a surrogate for the chlorinated phenols fraction. The amount of tribromophenol added to the samples was at appropriate GC/MS levels, but the high levels saturated the electron capture detector used to quantify the chlorinated phenols, rendering any tribromophenol surrogate data useless. No data qualifiers are recommended for the chlorinated phenols analysis. EPA Method 8040 specifies the addition of two surrogates (2-fluorophenol and 2,4,6 - tribromophenol) to each sample before extraction. EPA Method 8270 (GC/MS) employs the use of three surrogates (d5-nitrobenzene, 2-fluorobiphenyl and d-14 terphenyl). The laboratory only reported one of the surrogates, d-14 terphenyl, stating the others were lost in the silica gel cleanup that was employed to remove interference in some of the GC/MS samples. Every effort should be made by the laboratory to report all the surrogate compound recoveries as they help better define the data.

VI. **Laboratory Blank Analysis:** ACCEPTABLE/With the following exceptions.

Qualified Data: MARINE SEDIMENTS

Compound	Qualifier	Sample Number	Reason
Naphthalene	UJ	B1C, C3A, C3B, C3C, D1A, D1C, D2A, D2B, D2C	Sample concentration less than 5 times blank contamination
Pentachlorophenol	UJ	A3A, A4A, B4A, D5A	Sample concentration less than 5 times blank contamination
Pentachlorophenol	J	E5A	Sample dilution possibly contaminated sample extract

Discussion

The laboratory method blanks were reviewed for both the chlorinated phenols and the PAH organic analyses. Under CLP protocols, an action level of five times the blank concentration is determined and samples with concentrations less than the action level are evaluated. If the sample result is undetected or greater than the action level, no data qualifiers are required. If the sample result is less than the action level, there are two steps in the qualifying process. Samples with reported concentrations less than the Contract Required Quantitation Limit (CRQL) but greater than the Instrument Detection Limit (IDL) are reported as undetected at the CRQL and assigned a UJ data validation qualifier. The sample result is changed because, under CLP protocols, sample concentrations cannot be reported as undetected at concentrations less than the CRQL. Samples with concentrations greater than the CRQL but less than the action level, are considered undetected at the reported concentration and assigned a UJ data validation qualifier.

No contaminants were found in the laboratory method blanks, except pentachlorophenol in two method blank for the chlorinated phenols and naphthalene in one laboratory method blank for the PAH analyses. The sample concentrations were evaluated based on the action level, and samples to be qualified are listed in the above table.

Sample E5A was diluted ten fold before analysis with 39 ppb pentachlorophenol reported in the diluted sample. Since no dilution blanks were reported and the source of the pentachlorophenol method blank contamination was not determined by the laboratory, it is not certain that the dilution procedure did not contaminate sample E5A. Because the diluted sample amount is close to the method blank amount when the 10 fold dilution factor is taken in account, the pentachlorophenol result for E5A should be estimated (J).

VII. Field Blank Analysis: ACCEPTABLE/ALL criteria were met.

Qualified Data: NONE

Discussion

Four water field rinsate blanks were submitted to the laboratory for analysis. No chlorinated phenol or PAH compounds were found in the field rinsate blanks.

VIII. Matrix Spike/Matrix Spike Duplicate Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data: MARINE SEDIMENTS

Compound	Qualifier	Sample Number	Reason
2,4 - Dichlorophenol	J(+) UJ(-)	All	Inconsistent and poor MS/MSD recoveries
2 - Chlorophenol	J(+) UJ(-)	All	No MS/MSD values, derivitization problems

Discussion

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed on both the marine sediment samples and laboratory sand blank samples. No data qualifiers were recommended based on sand blanks results or anomalous recovery problems. If the MS/MSD recoveries or the Relative Percent Difference (RPD) for marine sediment samples were outside the control limits, the data were reviewed and data qualification was determined. Samples to be qualified are listed in the above table.

For the chlorinated phenols analyses, the laboratory reported no spike recovery for 2-chlorophenol. The laboratory spiked the samples at a concentration less than the detection limit. The estimated level for the spike was based on a theoretical instrument sensitivity that was not achieved. It is recommended that the laboratory spike future samples at a higher concentration and demonstrate that level is achievable before analyzing the next set of samples. The poor response can also indicate incomplete derivitization of the compound. It is recommended that the laboratory employ a longer derivitization time with the diazomethane, or use an alternative derivitization approach. Since there are no measures of 2 - chlorophenol recovery through matrix spikes and since there is an apparent derivitization problem with the compound, all detected 2 - chlorophenol values should be assigned a J qualifier and all non-detected assigned a UJ qualifier. The MS and/or MSD

recoveries, were regularly outside the control limits for 2,4-dichlorophenol. Because 2,4-dichlorophenol shows a systemic variability, it is recommended that the sample results be considered approximate, and all positive sample results be assigned a J qualifier and all undetected sample results be assigned a UJ qualifier. Since other spiked compounds showed acceptable accuracy and precision, only 2,4-dichlorophenol should be qualified. 2,4,6-Trichlorophenol had MS/MSD recoveries outside the control limits for the laboratory sand blanks. MS/MSD recoveries were within the control limits for the marine sediment spikes, therefore, no data qualifiers are recommended.

For the PAH analyses, all MS/MSD recoveries were within the control limits, except sample CP1-M-D1C for both acenaphthene and pyrene. No data qualifiers are recommended based on the MS/MSD recoveries outside the control limits for one sample.

IX. Laboratory Duplicate Analysis: Acceptable/ with the following exceptions.

Qualified Data: None

Discussion

Of the four laboratory duplicates analyzed, one sample, CP1-M-B4A, showed poor reproducibility for PAHs. As shown in Table I, over half of the RPDs for the laboratory duplicate are over 100%. Although no data qualifiers are recommended based solely on the results of one laboratory duplicate, it should be noted that the precision of the PAH analysis is highly variable and should be considered when applying these data to the interpretation of the site.

X. Field Quality Control Sample Analysis: No acceptance criteria.

Qualified Data: NONE

Discussion

Chlorinated phenol results showed generally less than 50% difference between positive results except for samples requiring dilutions (CP1-M-C2B/C12B, CP1-M-D1A/D11A and CP1-M-C3A/C13A) which detected pentachlorophenol and tetrachlorophenol at close to detection limit levels. 2,4-Dichlorophenol was reported as non-detected on sample CP1-M-C3A and was detected in the field duplicate CP1-M-C13A at roughly four times the detection limit. Substantial variation in 2,4-Dichlorophenol recoveries was also observed in the laboratory matrix spike samples. Based on field and laboratory quality assurance samples, it appears that the laboratory analytical procedures for chlorophenols have unacceptable variation for 2,4-Dichlorophenol, making recoveries for this analyte of questionable accuracy and precision.

More variation is expected between results that are close to the detection limit. The variability between samples requiring dilution could be a function of the dilution process or variability in the marine sediment matrix.

Polycyclic aromatic hydrocarbon (PAH) analysis for field duplicates showed no readily distinguishable pattern or trend as some compounds had good agreement in one field duplicate set and poor agreement in others.

XI. **Standard Reference Material Analysis:** ACCEPTABLE/With the following exceptions.

Qualified Data: NONE

Discussion

The laboratory analyzed the Sequim Bay spiked sediment sample. The true values reported for the Sequim Bay sediment sample are based on an average and are reported as a known average concentration. The population of sample results used to determine the known average concentration range from 15 to 33 points. All the PAH compounds reported for the submitted sediment samples were present in the Sequim Bay sediment sample, except three. Pentachlorophenol was the only chlorinated phenol compound with a known average concentration. The percent recoveries for all PAH compounds with available known average concentrations were acceptable. The percent recoveries of the pentachlorophenol were 23.7% and 19.8%. The standard deviation for the pentachlorophenol average known concentration was very high (average value = 463, standard deviation = 425.6, N=33), indicating the extreme variability of the results. The laboratory results were within plus or minus one standard deviation of the known average concentration reported, but might indicate low biased pentachlorophenol results. However, data qualifications are not made based on the SRM results alone.

XII. **Compound Identification:** ACCEPTABLE/All criteria were met.

Qualified Data: NONE

XIII. **Compound Quantitation and Reported Detection Limits:** ACCEPTABLE/with the following exceptions.

Qualified Data: NONE

The following samples were reviewed for calibration, compound identification and quantification and reporting accuracy.

Chlorinated Phenols/PAH

CP1-M-A4A
CP1-M-B1A
CP1-M-B5C
CP1-M-C2B
CP1-M-C2C
CP1-M-D2B
CP1-M-E5A
CP1-M-F3A

Data were accurately calculated and correctly reported for all samples except the multiplication factor used for the quantitation of chlorinated phenols was incorrectly reported and used as 3.93. When calculated from the sample weight, % total solids and final extract volume, the actual value should be 3.75% No qualifiers are recommended as the only detected result (pentachlorophenol) did not change with the corrected multiplication factor. In general, detection limit goals were met except for 2,4-dichlorophenol and 2-chlorophenol.

XIV. Data Quality Summary:

Data quality was generally acceptable for PAH and chlorinated phenol analyses in Marine Sediment, with the previously discussed exceptions. Precision was acceptable for the PAH analyses based on matrix spike data, however, precision was low for one of the three laboratory duplicates. Precision was acceptable for the chlorinated phenols in most cases. 2,4-Dichlorphenol showed poor reproducibiity in the MS/MSD data and in some of the laboratory duplicates and has been qualified as estimated. There is no measure of precision for 2-chlorophenol. The addition of an appropriate concentration surrogate to the chlorinated phenol samples would strengthen the quality of forthcoming laboratory data. In the future, additional surrogates should be added to both PAH and chlorophenol samples to comply with the QAPP. The laboratory should be requested to more closely monitor the GC/MS continuing calibrations precision to reduce qualified data in the future.

Part of the sample extract for CP1-M-C2C was lost during sample concentration. Because the total sample extract wasn't captured, the concentrations found should be considered minimum values and all values estimated for both PAH and chlorinated phenols samples, as both extracts are splits from the same sample extraction.

Accuracy was generally acceptable based on results from laboratory matrix spikes.

These data can be accepted into a permanent data base after applying the above mentioned qualifiers which are summarized in the Organic Data Qualifier Table (Table 2).

PCDD/PCDF ORGANIC ANALYSES

DATA VALIDATION REPORT

I. **Sample Holding Times:** Acceptable/All criteria met.

Qualified Data: None

II. **GC/MS System Performance Checks:** Acceptable/All qualitative and quantitative criteria met.

Qualified Data: None

III. **Calibration:** Acceptable/All criteria were met.

Qualified Data: None

IV. **Surrogate Spike Analysis:** Acceptable/With the following exceptions.

Qualified Data: None

Discussion: Review of the HR/GC/MS lock mass indicates that quantitative interferences exist for the 2 recovery standards (13C12-1234-TCDD and 13C12-HxCDD 789) in some samples. Data from these samples has been qualified by the laboratory with a "Q". As these unknown sample-related interferences probably affect compound quantitation, all positive "Q" data are recommended to be qualified with a J and non-detected "Q" data qualified as UJ.

Compound values that have the Estimated Maximum Possible Concentrations (EMPC) indicate that some compounds are present that don't meet all of the qualitative identification criteria but have acceptable signal to noise ratios. As they are estimates, all EMPC data should be qualified with a J.

Triangle Laboratories flagged certain compounds or compound classes that responded outside of the normal dynamic working range as "S" for saturated. Results so qualified should be estimated (J) as the true value is unknown and the results should be considered biased low and are listed on the Table below.

Analyte	Qualifier	Sample Number	Reason
All EMPC Data	J	All	EMPC data are estimates

All "Q" Data	J(+) UJ(-)	All	Quantitative interferences may cause data inaccuracy
OCDD	J	C1B, C1C, C2A, C2B	Saturation of GC/MS Signal, results estimated
1,2,3,4,6,7,8 - HpCDD	J	C2B	Saturation of GC/MS Signal, results estimated
Total HpCDD	J	C1C, C2B	Saturation of GC/MS Signal, results estimated

V. **Laboratory Blank Analyses:** Acceptable/With the following exceptions:

Qualified Data: Marine Sediments

Sample	Analyte	Reported Value	Qualifier
CP1-M-C3C	OCDD	0.02	UJ

Discussion: OCDD was detected in low concentrations in both method blanks that were concurrently extracted and analyzed with the Marine Sediment samples. None of the sample results are within five times the concentration of the blank concentration except for CP1-M-C3C which had 0.02 PPB OCDD. Because detection limit cannot be positively determined in the sample for OCDD, the result should be estimated. Low level 1,2,3,7,8,9 - HpCDD was detected in one of the method blanks but since associated sample values were substantially higher, no data qualifiers are recommended.

VI. **Field Blank Analysis:** None submitted or identified

VII. **Matrix Spike/Matrix Spike Duplicate Analysis:** None submitted or required by EPA method 8290 as it is an isotope dilution technique.

VIII. **Field Quality Control Sample Analysis**/No acceptance criteria

Qualified Data: None

Discussion: Samples CP1-M-C12A and CP1-M-C2A were submitted to the laboratory to evaluate field sample replication. Agreement was generally good with most positive results have a relative percent difference (RPD) of less than 50%. This indicates good field and laboratory performance.

IX. Standard Reference Material: None Analyzed

X. Compound Identification: Acceptable/All criteria met.

Qualified Data: None

XI. Compound Quantitation and Reported Detection Limits: Acceptable/ All criteria met.

Qualified Data: None

Discussion: Samples CP1-M-B1A and CP1-M-C2B were fully evaluated using backup data provided by Triangle Laboratories, Inc. and found to be accurate and consistent with the report sheets.

XII. Data Quality Summary:

Data for this set was found to be accurate and should be accepted with the exceptions previously noted.

TOTAL METALS ANALYSES
DATA VALIDATION REPORT

I. Sample Holding Times: ACCEPTABLE/With the following exceptions.

Qualified Data: NONE

Discussion

All holding times were met for the sediment and water rinsate blank samples, except mercury for 13 sediment samples and one rinsate blank. Under CLP, the contractual holding time for mercury is 30 days and 28 days for PSEP. The technical requirements for sample holding times have only been established for water matrices and no statistical determination of holding times for sediments is available. Based on the data validation guidelines provided in the functional guidelines (U.S. EPA, 1988a), the nature of the analyte, matrix, degree of violation, and the concentration of the analyte are to be taken into consideration. Because analysis of the 13 sediment samples and one rinsate blank sample for mercury exceeded the holding time by only 1 - 4 days, no data qualifiers are recommended because sample integrity was not significantly affected.

II. Instrument Calibration: ACCEPTABLE/With the following exceptions.

Qualified Data: MARINE SEDIMENTS

ANALYTE	QUALIFIER	SAMPLE NUMBER	REASON
Antimony	J	C3A, C3B, C3C, D1A, D1B.	CCV outside the control limits.
Lead	J	B1A, B1B, B1C, C3A, C3B, C3C, D1A, D1B, D1C, C13A, C2C, E1A, E3A	Sample absorbance below 0.010 absorbance units.
Silver	J	C12B, C1B.	Sample absorbance below 0.010 absorbance units.

Discussion

Evaluation of instrument calibration is done under a level IV data validation. Because a level IV data validation was performed on only 10 percent of the samples, six samples (A1A, A2A, A3A, E2A, RB1, and RB2) were not evaluated because they were analyzed in separate instrument analysis runs for FAA than the samples specified for the 10 percent level IV data validation.

All Initial and Continuing Calibration Verification (ICV and CCV) standards were within the control limits for all sediment and water samples reviewed, except one CCV for antimony. Because all the samples were analyzed in one analytical batch for both antimony and arsenic, the calibration results were verified 100 percent. Five samples were analyzed associated with the CCV outside the control limits. It is recommended these samples be considered an estimate and assigned a J qualifier. The samples to be qualified are listed in the above table. No evaluation of the ICV and CCV samples was possible for the six samples not included in the 10 percent level IV data validation for the metals analyzed by FAA.

The samples were analyzed by flame atomic absorption (FAA) for all metals, except antimony, arsenic, and mercury. The detection limits described in the QAPP, in most cases, could be adequately met using FAA. However, in several cases, the absorbance of the CRDL check standard was less than 0.010 absorbance units. Under PSEP guidelines (PTI, 1989), samples with absorbances less than 0.010 should be analyzed by graphite furnace atomic absorption (GFAA) because of the loss of instrument sensitivity due to noise. The laboratory did analyzed four check samples, at or near the IDL, to measure the noise of the instrument. Even though the absorbance was below 0.010 for the CRDL standard, most samples had analytes with detected concentrations considerably higher than the CRDL, except silver and lead. Because of the variability of results due to instrument noise at low absorbances, all samples with detected sample results for silver and lead results with absorbances less than 0.010, should be considered an estimate and assigned a J qualifier. The samples to be qualified are listed in the above table. The sample results for the six samples not included in the level IV data validation were reviewed for lead and silver. The lead and silver results were compared to those reported in the instrument analysis runs reviewed. None of the six samples were qualified for lead and silver based upon this comparison.

III. Preparation Blank Analysis: ACCEPTABLE/All criteria were met.

Qualified Data: NONE

IV. Field Rinsate Blanks: ACCEPTABLE/All criteria were met.

Qualified Data: NONE

V. Standard Reference Material Analysis: UNACCEPTABLE

Qualified Data: NONE

Discussion

Standard Reference Material Samples (SRM) were not analyzed for the total metals. Alternately, the laboratory analyzed spiked sand samples. For mercury the laboratory analyzed a certified standard (Buffalo River Sediment) instead of spiked sand samples. Under PSEP protocols, the SRM (or LCS) sample is to be a sample of similar matrix as the samples submitted for analysis. The purpose of the SRM is to measure the digestion efficiency of the procedure employed, especially important when analyzing marine sediments. The laboratory was to analyze the samples according to PSEP protocols, and the strong acid digestion was to be employed if acceptable analyte recovery could be obtained. Without digesting an SRM of similar matrix, analyte recovery cannot be measured. However, the laboratory achieved good analyte recovery (86% - 112%) for the spiked sand samples. Therefore, no data qualifications are recommended. It is recommended the laboratory obtain and analyze a SRM of similar (or as close as possible) matrix with any future analyses.

VI. Duplicate Sample Analysis: ACCEPTABLE/All criteria were met.

Qualified Data: NONE

VII. Spiked Sample Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data: MARINE SEDIMENTS

ANALYTE	QUALIFIER	SAMPLE NUMBER	REASON
Antimony	J	All	No MS Recovery due to dilution prior to analysis.
Arsenic	J	All	No MS results available.

Discussion:

All Matrix Spike (MS) percent recoveries were within the control limits, except antimony, arsenic, mercury, and zinc. The large sample size digested required dilution of the samples prior to analysis for antimony. Therefore, no MS recovery was possible. For arsenic, the sample concentrations were over four times the spike concentration. Normally, no action is required, but because no other measure of accuracy is available (i.e., suitable SRM analysis), the sample results should be considered approximate and assigned a J qualifier for antimony and arsenic. For mercury, the water MS and one of two sediment MSs were outside the control limits. For the water sample, the MS percent recovery only exceeded the control limit by 2 percent. For the sediment samples, one MS was within the control limits and the SRM recoveries were good, therefore, no data qualifiers are recommended for mercury. For zinc, one MS percent recovery could not be determined because the sample concentration was greater than four times the spike concentration. All other MS percent recoveries were within the control limits.

VIII. GFAA Quality Control Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data: MARINE SEDIMENTS

ANALYTE	QUALIFIER	SAMPLE NUMBER	REASON
Arsenic	J	A1A, A2A, A3A, B1B, C3B, C13A, C1C, C12B, D1A, E3A	Post spike recoveries outside the control limits.

Discussion

Antimony and arsenic were the only metals analyzed by GFAA. Post digestion spikes are not required for FAA. The post spike percent recoveries were outside the control limits for the antimony and arsenic analyses. Because all the samples were analyzed in one batch for the instrument analysis, the data were verified 100 percent. The data evaluations and qualifications are based on the guidelines provided in the functional guidelines (U.S. EPA, 1988a) and the guidance manual for PSEP data (PTI, 1989). If the sample result is less than 50% of the post spike concentration and the percent recovery greater than 40%, no further action is required by the laboratory, but the laboratory must flag the data with a W. The antimony sample results had post spike recoveries between 40 and 79 percent and the sample results were less than 50 % of the post spike concentration. The sample results should have been assigned a W qualifier by the laboratory under CLP protocols. If the post spike recoveries are outside the control limits and the sample absorbance is greater than 50% of the post spike concentration, the laboratory is required to analyze the samples by Methods of Standard Additions (MSA). The laboratory did not analyzed the arsenic

samples outside the control limits by MSA. It is recommended that samples with post spike recoveries outside the control limits be considered an estimate and assigned a J qualifier for arsenic.

IX. Sample Result Verification: ACCEPTABLE/All criteria were met.

Qualified Data: NONE

Discussion

The sample calculations were spot checked at a frequency of 10 percent, and 100 percent for the two samples requested under the contract. No data errors were found. The detection limits were checked and were less than the CRDLs specified in the laboratory contract.

X. Field Quality Control Sample Analysis: ACCEPTABLE/All criteria were met.

Qualified Data: NONE

Discussion

The RPDs between field duplicate samples were calculated and found to be less than 30 percent. The field duplicate results are summarized in Appendix A.

XI. Quarterly Submissions: ACCEPTABLE/All criteria met.

CONVENTIONAL ANALYSES
DATA VALIDATION REPORT

I. Sample Holding Times: ACCEPTABLE/All criteria were met.

Qualified Data: NONE

II. Instrument Calibration: ACCEPTABLE/With the following exceptions.

Qualified Data: NONE

Discussion

No daily instrument calibration is required for the Total Solids (TS) or Grain Size Distribution. The laboratory did not submit raw data sheets for the TOC analyses. However, TOC analyzers have preset internal calibrations and a Laboratory Control Sample (LCS) is analyzed to measure the accuracy of the internal calibration. The laboratory did analyze a LCS with each batch, and the calibration was acceptable.

III. Preparation Blank Analysis: ACCEPTABLE/All criteria were met.

Qualified Data: NONE

IV. Field Rinsate Blanks: NOT APPLICABLE

V. Laboratory Control Sample: ACCEPTABLE/All criteria were met.

Qualified Data: NONE

VI. Duplicate/Triplicate Sample Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data: NONE

Discussion

Under PSEP protocols, all conventional analyses are to have triplicate analyses performed on one sample out of 20. However, the laboratory only analyzed duplicates for TOC and TS, but at a frequency greater than one sample out of 20. Two triplicate and one duplicate analyses were performed for grain size distribution analyses. The Relative Percent Difference (RPD) between duplicates was within the control limits for the TS and TOC, except 2 of the 5 TOC analyses. Because most of the duplicate samples RPDs were within the control limits, no data qualifiers are recommended for the TOC analyses. The RPD, or coefficient of variance (CV), was calculated for each sieve fraction of the grain size distribution analyses. The RPD, or CV, was less than 30 percent for all fractions, except two for the 0.9 - 0.4 micron fraction. No data qualifiers are recommended because the duplicate/triplicate samples indicated good laboratory precision for grain size distribution.

VII. Spiked Sample Analysis: ACCEPTABLE/All criteria were met.

Qualified Data: NONE

VIII. Sample Result Verification: NOT EVALUATED

Qualified Data: NONE

Discussion

Because no raw data were submitted by the laboratory, sample result verification was not possible. Calculation checks were performed on the matrix spike recoveries, LCS recoveries, and the RPDs between laboratory duplicates.

IX. Field Quality Control Sample Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data: NONE

Discussion

Field duplicate analyses were performed on seven samples. The RPD between field duplicates was less than 30% for all samples and analyses, except two samples for TOC and one grain size sample for 8 seive sizes, and five grain size samples for one seive size. No data qualifications are made based on the field duplicate results. The field duplicate results are summarized in Appendix A.

X. Quarterly Submissions: NOT EVALUATED

Qualified Data: NONE

Discussion

Quarterly submissions are not required for the conventional analyses.

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A P P E N D I X A

TABLE A.

Analytical Technologies, Inc.
CHLORINATED PHENOLS ANALYSIS
Sediment Field Duplicate Samples

COMPOUND	CP1-M-B4A	CP1-M-B14A	RPD %	CV %
Pentachlorophenol	6.0B	14B	80	
Tetrachlorophenol	<11	<12		
2,4,5-Trichlorophenol	<11	<12		
2,4,6-Trichlorophenol	<11	<12		
2,4-Dichlorophenol	<42	<48		
2-Chlorophenol	<2100	<2400		

TABLE B.

Analytical Technologies, Inc.
CHLORINATED PHENOLS ANALYSIS
Sediment Field Duplicate Samples

COMPOUND	CP1-M-C2A	CP1-M-C12A	CP1-M-C2A DUP	RPD %	CV %
Pentachlorophenol	18	12		40	
Tetrachlorophenol	20	<11		NC	
2,4,5-Trichlorophenol	<11	<11			
2,4,6-Trichlorophenol	<11	<11			
2,4-Dichlorophenol	340	310		9.2	
2-Chlorophenol	<2200	<2200			

NC = Not Calculated

TABLE C.

Analytical Technologies, Inc.
CHLORINATED PHENOLS ANALYSIS
Sediment Field Duplicate Samples

COMPOUND	CP1-M-C2B	CP1-M-C12B	CP1-M-C2B DUP	RPD %	CV %
Pentachlorophenol	220	80		93.3	
Tetrachlorophenol	150	65		79.1	
2,4,5-Trichlorophenol	<11	12		NC	
2,4,6-Trichlorophenol	<11	<11			
2,4-Dichlorophenol	<44	<44			
2-Chlorophenol	<2200	<2200			

NC = Not Calculated

TABLE D.

Analytical Technologies, Inc.
CHLORINATED PHENOLS ANALYSIS
Sediment Field Duplicate Samples

COMPOUND	CP1-M-G4A	CP1-M-G14A	CP1-M-G4A DUP	RPD %	CV %
Pentachlorophenol	14	22		44.4	
Tetrachlorophenol	<11	<11		NC	
2,4,5-Trichlorophenol	<11	<11		NC	
2,4,6-Trichlorophenol	<11	<11		NC	
2,4-Dichlorophenol	<43	410		NC	
2-Chlorophenol	<2200	<2100		NC	

NC = Not Calculated

TABLE E.

Analytical Technologies, Inc.
CHLORINATED PHENOLS ANALYSIS
Sediment Field Duplicate Samples

COMPOUND	CP1-M-D1A	CP1-M-D11A	CP1-M-D1A DUP	RPD %	CV %
Pentachlorophenol	24	6.2		117.9	
Tetrachlorophenol	11	<8.2		NC	
2,4,5-Trichlorophenol	<7.1	<8.2			
2,4,6-Trichlorophenol	<7.1	<8.2			
2,4-Dichlorophenol	<28	<33			
2-Chlorophenol	<1400	<1600			

NA = Not Calculated

TABLE F.

Analytical Technologies, Inc.
CHLORINATED PHENOLS ANALYSIS
Sediment Field Duplicate Samples

COMPOUND	CP1-M-C3A	CP1-M-C13A	CP1-M-C3A DUP	RPD %	CV %
Pentachlorophenol	4.6	10		73.9	
Tetrachlorophenol	<8.5	13		NC	
2,4,5-Trichlorophenol	<8.5	<7.9			
2,4,6-Trichlorophenol	<8.5	<7.9			
2,4-Dichlorophenol	<34	140		NC	
2-Chlorophenol	<1700	<1600			

NA = Not Calculated

TABLE G.

Triangle Laboratories, Inc.
PCDD/PCDF ANALYSIS
Sediment Field Duplicate Samples

Compounds	CP1-M-C2A	CP1-M-C12A	RPD (%)
2378-TCDD	ND	ND	--
12378-PeCDD	0.005	0.008	46.2
123478-HxCDD	0.02	0.02	0.00
123678-HxCDD	0.13	0.18	32.3
123789-HxCDD	0.05	0.09	57.1
1234678-HpCDD OCDD	5.4	7.3	29.9
OCDD	31.2	50.7	47.6
2378-TCDF	0.007	0.01	35.3
12378-PeCDF	0.008	0.01	22.2
23478-PeCDF	0.01	0.01	0.00
123478-HxCDF	0.04	0.05	22.2
123678-HxCDF	0.01	0.02	66.67
234678-HxCDF	0.01	EMPC	--
123789-HxCDF	0.02	ND	--
1234678-HpCDF	0.31	0.41	27.8
1234789-HpCDF	0.02	EMPC	--
OCDF	1.4	1.9	30.3
Total TCDD	0.01	0.02	66.7
Total PeCDD	0.03	0.04	28.6
Total HxCDD	0.94	1.4	39.3
Total HpCDD	13.2	17.9	30.2
Total TCDF	0.04	0.04	0.00
Total PeCDF	0.07	0.08	13.3
Total HxCDF	0.68	0.92	30
Total HpCDF	1.4	1.7	19.4

EMPC = Estimated Maximum Possible Concentration

TABLE H.

SEQUIM BAY REFERENCE MATERIAL RESULTS

COMPOUND	AVERAGE	S.D	SAMPLE 1 %R	SAMPLE 2 %R
Naphthalene	79	24.78	84.8	86.1
2-Methylnaphthalene	91	36.57	82.4	93.4
Acenaphthylene	69	22.28	46.3	47.8
Acenaphthene	97	23.34	85.6	94.8
Fluorene	105	24.38	79.0	79.0
Phenanthrene	157	50.59	86.0	82.8
Anthracene	121	35.00	70.2	76.9
Dibenzofuran	NA	--	NA	NA
Fluoranthene	126	37.16	95.2	79.3
Pyrene	126	44.97	59.5	59.5
Benzo(a)anthracene	115	35.38	62.6	62.6
Chrysene	117	30.41	62.4	66.7
Benzo(b)fluoranthene	113	38.35	75.2	70.8
Benzo(k)fluoranthene	NA	--	NA	NA
Benzo(a)pyrene	121	46.87	61.9	63.6
Indeno(1,2,3-cd)pyrene	47	32.84	NC	NC
Dibenz(a,h)anthracene	102	35.14	51.9	60.8
Benzo(g,h,i)perylene	103	37.67	53.4	66.0
Pentachlorophenol	463	425.6	23.7	19.8

NC = Not Calculated
NA = Not Applicable

TABLE I.

Analytical Technologies, Inc.
SEMI-VOLATILE ORGANICS ANALYSIS
Sediment Field Duplicate Samples

Compound	CP1-M-B4A	CP1-M-B14A	CP1-M-B4A DUP	RPD% (Field Dups)	CV (Field Dups)	RPD % (Lab Dups)
Naphthalene	1100	1000	980	9.5	6.3	11.5
2-Methylnaphthalene	140	120	100	15.4	16.7	33.3
Acenaphthylene	210	120	44J	54.5	66.7	130.7
Acenaphthene	210	240	97	13.3	41.4	73.6
Fluorene	360	180	84	40.0	67.3	124.3
Phenanthrene	1600	480	240	107.6	94.9	147.8
Anthracene	540	250	81	73.4	80	147.8
Dibenzofuran	140	160	82	13.3	31.8	52.3
Fluoranthene	2000	580	240	110.1	99.3	157.1
Pyrene	1800	1500	310	18.2	65.5	141.2
Benzo(a)anthracene	420	130	280	105.5	53.4	40.0
Chrysene	650	220	300	98.9	58.6	73.7
Benzo(b)fluoranthene	1300	420	340	102.3	77.5	117.1
Benzo(k)fluoranthene	200	180	<51	10.5	10.5	N/C
Benzo(a)pyrene	950	210	170	128	99.1	139.3
Indeno (1,2,3 - cd) Pyrene	550	120	80	128	104	149.2
Dibenz (a,h) anthracene	140	<59	<51	N/C	--	N/C
Benzo(g,h,i)perylene	460	120	62	117	100.5	152.5

NC = Not Calculated
J = Estimate

TABLE J.

Analytical Technologies, Inc.
SEMI-VOLATILE ORGANICS ANALYSIS
Sediment Field Duplicate Samples

COMPOUND	CP1-M-C2B	CP1-M-C12B	RPD(%)
Naphthalene	13000D	8100	46.4
2-Methylnaphthalene	2200	2200	0
Acenaphthylene	1200	590	68.2
Acenaphthene	37000D	17000D	74.1
Fluorene	18000D	9500	61.8
Phenanthrene	14000D	18000D	25.0
Anthracene	27000D	11000	84.2
Dibenzofuran	5900	5000	16.5
Fluoranthene	56000D	29000D	63.5
Pyrene	40000D	22000D	58.1
Benzo(a)anthracene	18000D	11000D	61.1
Chrysene	14000D	5900	81.4
Benzo(b)fluoranthene	11000D	7000	44.4
Benzo(k)fluoranthene	5700	2100	92.3
Benzo(a)pyrene	6400D	4700	30.6
Indeno(1,2,3-cd)pyrene	2700D	1800	40.0
Dibenz(a,h)anthracene	150	110	30.8
Benzo(g,h,i)perylene	2900	1900	41.7

D = Dilution factor = 4.

TABLE K.

Analytical Technologies, Inc.
SEMI-VOLATILE ORGANICS ANALYSIS
Sediment Field Duplicate Samples

COMPOUND	CP1-M-C2A	CP1-M-C12A	RPD(%)
Naphthalene	1700	1900	11.1
2-Methylnaphthalene	310	450	36.8
Acenaphthylene	80	83	3.7
Acenaphthene	860	2100	83.8
Fluorene	630	1600	87.0
Phenanthrene	1900	5700	100
Anthracene	1300	1500	14.3
Dibenzofuran	450	1000	81.5
Fluoranthene	6200	6200	0
Pyrene	4900	5100	4.0
Benzo(a)anthracene	1700	1500	12.5
Chrysene	1600	1400	13.3
Benzo(b)fluoranthene	1700	1400	19.4
Benzo(k)fluoranthene	420	470	11.2
Benzo(a)pyrene	920	740	21.7
Indeno(1,2,3-cd)pyrene	420	290	32.1
Dibenz(a,h)anthracene	120	97	21.2
Benzo(g,h,i)perylene	420	300	33.3

TABLE L.

Analytical Technologies, Inc.
SEMI-VOLATILE ORGANICS ANALYSIS
Sediment Field Duplicate Samples

COMPOUND	CP1-M-G4A	CP1-M-G14A	RPD(%)
Naphthalene	1200	640	60.9
2-Methylnaphthalene	260	130	66.7
Acenaphthylene	110	71	43.1
Acenaphthene	470	290	47.4
Fluorene	300	170	55.3
Phenanthrene	740	380	64.3
Anthracene	890	570	43.8
Dibenzofuran	280	200	33.3
Fluoranthene	4400	4600	4.4
Pyrene	3100	3200	3.2
Benzo(a)anthracene	1000	1100	9.5
Chrysene	1400	880	45.6
Benzo(b)fluoranthene	1300	950	31.1
Benzo(k)fluoranthene	310	270	13.8
Benzo(a)pyrene	710	470	40.7
Indeno(1,2,3-cd)pyrene	380	170	76.4
Dibenz(a,h)anthracene	95	<51	NC
Benzo(g,h,i)perylene	380	170	76.4

NC = Not Calculated

TABLE M.

Analytical Technologies, Inc.
SEMI-VOLATILE ORGANICS ANALYSIS
Sediment Field Duplicate Samples

COMPOUND	CP1-M-C3A	CP1-M-C13A	RPD(%)
Naphthalene	1300B	920	34.2
2-Methylnaphthalene	180	160	11.8
Acenaphthylene	54	26J	70
Acenaphthene	360	300	18.2
Fluorene	210	150	33.3
Phenanthrene	530	450	16.3
Anthracene	340	270	22.9
Dibenzofuran	180	150	18.2
Fluoranthene	860	680	23.4
Pyrene	1100	840	26.8
Benzo(a)anthracene	250	240	4.1
Chrysene	390	270	36.4
Benzo(b)fluoranthene	390	430	9.8
Benzo(k)fluoranthene	140	130	7.4
Benzo(a)pyrene	230	220	4.4
Indeno(1,2,3-cd)pyrene	95	95	0
Dibenz(a,h)anthracene	<41	29J	NC
Benzo(g,h,i)perylene	95	96	1.0

NC = Not Calculated
B = Also found in Blank

TABLE N.

Analytical Technologies, Inc.
SEMI-VOLATILE ORGANICS ANALYSIS
Sediment Field Duplicate Samples

COMPOUND	CP1-M-D1A	CP1-M-D11A	RPD(%)
Naphthalene	1300B	1200	8.0
2-Methylnaphthalene	210	79	90.7
Acenaphthylene	49	<39	NC
Acenaphthene	270	260	3.8
Fluorene	130	94	32.1
Phenanthrene	260	250	3.9
Anthracene	210	95	75.4
Dibenzofuran	72	71	1.4
Fluoranthene	1100	380	97.3
Pyrene	770	300	87.9
Benzo(a)anthracene	260	71	114
Chrysene	320	56	140
Benzo(b)fluoranthene	290	110	140
Benzo(k)fluoranthene	140	<39	NC
Benzo(a)pyrene	150	53	95.6
Indeno(1,2,3-cd)pyrene	81	30J	91.9
Dibenz(a,h)anthracene	23J	<39	NC
Benzo(g,h,i)perylene	83	38J	81.2

NC = Not Calculated
B = Also found in Blank
J = Estimate

Table O. Summary of Field Duplicate Sample Results
for Total Metals and Conventional Analyses

Parameter	-Duplicate- C2B	C12B	RPD (%)	-Duplicate- C3A	C13A	RPD (%)
Total Solids(%)	45.0	45.4	0.9	58.8	62.8	6.6
TOC(%)	8.39	7.89	6.1	2.09	2.67	24.4
Antimony (mg/Kg)	ND	ND	NC	ND	ND	NC[1]
Arsenic (mg/Kg)	8.3	9.7	15.6	4.9	4.9	4.9[1]
Cadmium (mg/Kg)	2.1	2.1	0.0	1.0	0.90	5.3[1]
Chromium (mg/Kg)	34	32	6.1	23	21	5.8[1]
Copper (mg/Kg)	84	89	5.8	28	27	1.7[1]
Lead (mg/Kg)	25	28	11.3	8.7	8.1	3.0[1]
Mercury (mg/Kg)	0.33	0.43	26.3	0.09	0.08	10.2[1]
Nickel (mg/Kg)	30	27	10.5	20	18	5.1[1]
Silver (mg/Kg)	ND	1.1	NC	ND	ND	NC[1]
Zinc (mg/Kg)	90	110	20.0	43	50	7.9[1]
-Grain Size Distribution (percent passing)-						
>4750 microns	99	99	0.0	100	100	0.0
4750-2000 microns	96	96	0.0	100	100	0.0
2000-850 microns	94	94	0.0	99	99	0.0
850-425 microns	93	92	1.1	98	98	0.0
425-250 microns	91	91	0.0	89	89	0.0
250-106 microns	87	85	2.2	65	65	0.0
106-75 microns	85	83	2.4	55	55	0.0
75-62.5 microns	83	81	2.4	49	49	0.0
62.5-31.2 microns	77	72	6.7	31	26	17.5
31.2-15.6 microns	53	56	5.5	18	16	11.8
15.6-7.8 microns	42	45	6.9	13	11	16.7
7.8-3.9 microns	32	34	6.1	11	8	31.6
3.9-1.9 microns	24	26	8.0	9 7	25.0	
1.9-0.9 microns	17	19	11.1	8 6	28.6	
0.9-0.4 microns	1	1	0.0	3 0	NC	

ND = Sample result reported as not detected.
NC = RPD not calculated due to undetected sample results.
[1] The coefficient of variance was calculated because sample C13A was analyzed as a laboratory duplicate.

Table P. Summary of Field Duplicate Sample Results
for Total Metals and Conventional Analyses

Parameter	-Duplicate- C2C	C12C	RPD (%)	-Duplicate- D1A	D11A	RPD (%)
Total Solids(%)	59.8	63.3	5.7	70.5	61.1	14.3
TOC(%)	3.81	2.44	43.8	1.67	2.83	51.6
	-Grain Size Distribution (percent passing)-					
>4750 microns	100	100	0.0	89	89	0.0
4750-2000 microns	100	100	0.0	85	87	2.3
2000-850 microns	99	99	0.0	81	86	6.0
850-425 microns	99	99	0.0	78	84	7.4
425-250 microns	98	98	0.0	74	82	10.3
250-106 microns	93	91	2.2	42	58	32.0
106-75 microns	87	83	4.7	29	45	43.2
75-62.5 microns	82	77	6.2	22	38	53.3
62.5-31.2 microns	63	55	13.6	12	23	62.9
31.2-15.6 microns	45	37	19.5	7 18	88.0	
15.6-7.8 microns	34	28	19.4	5 16	104	
7.8-3.9 microns	25	21	17.4	4 14	111	
3.9-1.9 microns	19	16	17.1	3	12	120
1.9-0.9 microns	14	13	7.4	0	11	NC
0.9-0.4 microns	1	2	66.7	0 8	NC	

NC = RPD not calculated due to undetected sample results.

Table Q. Summary of Field Duplicate Sample Results
for Total Metals and Conventional Analyses

Parameter	-Duplicate- B4A	B14A	RPD (%)	-Duplicate- C2A	C12A	RPD (%)
Total Solids(%)	46.6	41.4	11.8	45.5	45.8	0.7
TOC(%)	2.99	3.51	16.0	3.27	3.42	4.54
	-Grain Size Distribution (percent passing)-					
>4750 microns	97	100	3.0	100	100	0.0
4750-2000 microns	95	100	5.1	100	100	0.0
2000-850 microns	93	99	6.3	99	99	0.0
850-425 microns	92	97	5.2	99	99	0.0
425-250 microns	90	95	5.4	98	98	0.0
250-106 microns	80	88	9.5	96	95	1.0
106-75 microns	73	81	10.4	93	91	2.2
75-62.5 microns	69	77	10.9	89	88	1.1
62.5-31.2 microns	57	64	11.5	67	66	1.5
31.2-15.6 microns	45	50	10.5	46	45	2.2
15.6-7.8 microns	34	38	11.1	32	32	0.0
7.8-3.9 microns	25	29	14.8	23	24	4.3
3.9-1.9 microns	18	21	15.3	20	19	5.1
1.9-0.9 microns	12	15	22.2	13	14	7.4
0.9-0.4 microns	0	1	NC	1 4	120	

NC = RPD not calculated due to undetected sample results.

Table R. Summary of Field Duplicate Sample Results
for Total Metals and Conventional Analyses

Parameter	-Duplicate- G4A	G14A	RPD (%)
Total Solids(%)	45.8	47.4	3.4
TOC(%)	3.25	3.88	17.7
	-Grain Size Distribution (percent passing)-		
>4750 microns	100	100	0.0
4750-2000 microns	100	100	0.0
2000-850 microns	100	100	0.0
850-425 microns	99	99	0.0
425-250 microns	99	99	0.0
250-106 microns	96	97	1.0
106-75 microns	93	94	1.1
75-62.5 microns	90	91	1.1
62.5-31.2 microns	76	71	6.8
31.2-15.6 microns	53	51	3.8
15.6-7.8 microns	38	36	5.4
7.8-3.9 microns	28	26	7.4
3.9-1.9 microns	22	20	9.5
1.9-0.9 microns	16	14	13.3
0.9-0.4 microns	2	1	66.7

DATA VALIDATION REPORT

FOR

CASCADE POLE SITE PHASE II
SEDIMENT, TISSUE, AND WATER

PORT OF OLYMPIA, WASHINGTON

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REPORT OUTLINE

INTRODUCTION

I. Data Quality Summary

II. Section I - Sediment Analysis

II. Section II - Tissue Analysis

IV. Section III - Marine Water Analysis

V. Appendix A - Field Duplicate Analysis

VI. Appendix B - Sequim Bay Reference Material Results

INTRODUCTION

The submitted data packages for sediment, tissue, and water analyses have been reviewed by EcoChem, Inc. The contract laboratories and analyses performed are summarized in Table 1. The data results were reviewed 100 percent following level III data validation guidelines (U.S. EPA, 1987a). Guidelines require surrogate recoveries, matrix spikes, duplicates, and method blank results be reported by the laboratory, but no raw data or instrument calibration information is required. Data validation packets for the chlorinated phenol and polycyclic aromatic hydrocarbons (PAH) organic analyses, dioxin organic analyses, total metals, and conventional analyses which detail items reviewed, are on file at EcoChem, Inc. The quality assurance evaluations performed and recommended data qualifications from the review are summarized under three sections: 1) Sediment, 2) Tissue, and 3) Water. Samples may be qualified for several reasons, but these reasons are discussed separately and the samples may be listed in more than one qualification table within a section. Tables 2, 3, and 4 summarize the sample results to be qualified.

Recommended data qualifiers are based on the EPA Contract Laboratory Program (CLP) data validation functional guidelines (U.S. EPA, 1988a, 1988b) for the organic and total metals analyses. To be consistent with Phase I data validation, CLP data validation qualifiers are used rather than the Puget Sound Estuarine Protocol (PSEP) qualifiers. The data quality review of the conventional analyses is based on the Data Validation Guidance Manual for Selected Sediment Variables (PTI, 1989). These guidelines require that the data reviewer use professional judgement as to necessary data qualifications. The data qualifiers assigned after the data validation review provide additional information, but do not replace, those assigned by the laboratory. Data may be qualified even though the laboratory fulfilled all the requirements stated in the EPA SOWs (U.S. EPA, 1987b, 1988c) or the QAPP (Landau, 1991). The guidelines for reviewing data are more strict and take into account all variables of data quality (accuracy, precision, etc.). Unless specifically stated in the text, data qualifications are not due to laboratory error or deviations from the analysis protocols defined in the EPA SOWs or the Puget Sound Estuary Program (Tetra Tech, 1986), but are based on the data validation guidelines specified in the EPA functional guidelines for inorganic and organic analyses. For analyses performed by non-CLP methods, the data validation guidelines established under the EPA CLP program are used where applicable. The EPA CLP functional guidelines have established procedures to follow for qualifying data (blank contamination, surrogate recoveries, etc.) that can be applied to non-CLP methods.

EcoChem, Inc.'s goal in assigning data validation qualifiers is to assist in proper data interpretation. If values are assigned a "J" or "UJ", data can be used for site evaluation 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 all data quality goals as outlined in the EPA CLP functional guidelines (U.S. EPA, 1988a, 1988b).

DATA QUALITY SUMMARY

All deliverables required by the Landau Cascade Pole Site QAPP (Landau, 1991) were included in the data package from the laboratories. Overall data quality and adherence to protocols by the laboratories were good. Problems with specific sample analyses are discussed below. The data packages submitted met the Cascade Pole Site Quality Assurance Project Plan (QAPP) objective of 90% valid data. All required field quality control samples (blanks, field duplicates) were submitted and analyzed. Analytical results were reported and associated quality control analyses (blanks, duplicates, spikes) were performed for all samples except as noted. Based on this review 64 results were rejected out of over 3223 data points reported. Therefore, overall completeness for the data set was 98%.

Overall data quality and adherence to protocols by the laboratory were generally good. Problems with specific sample analyses are discussed below:

Chlorinated Phenols Organic Analyses

Marine sediment and tissue analyses showed poor or no recovery of 2-chlorophenol requiring rejection of some samples. Pentachlorophenol was not confirmed with a confirmation column for some samples which resulted in data qualification. Other chlorinated phenols were qualified in some sample because of poor matrix spike recoveries. Some water extraction holding times were exceeded because of laboratory error.

Polycyclic Aromatic Hydrocarbons (PAH) Organic Analyses

Sediment and tissue analyses were acceptable. Some water samples were qualified because of anthracene contamination detected in a method blank and positive hits not being confirmed on a confirmation detector.

PCDD/PCDF Organic Analyses

Data quality were generally acceptable for the dioxin and furan analyses except for some low level blank contamination requiring qualification of some sediment, tissue and water samples.

Total Metals Analysis

Poor antimony matrix spike recovery required the estimation ("J") of some sediment samples for antimony. An incorrect reference material was used for evaluation of laboratory performance of arsenic and copper. Since the matrix analyzed was greatly different than the sediments, estimation of arsenic and copper results are recommended. Tissue analysis was acceptable.

Conventional Analyses

All conventional analyses were acceptable. TOC results should be adjusted to two significant figures.

Table 1. Contract Laboratories

Matrix	**Analytical Technologies, Inc.** **560 Naches Ave. S.W. Suite 101** **Renton, WA 98055**	**Soil Technologies, Inc.** **7865 N. E. Day Road West** **Bainbridge Is., WA 98110**	**Analytical Resources, Inc.** **333 9th Avenue North** **Seattle, WA 98109**	**Triangle Laboratories** **801-10 Capitola Drive** **Reseach Triangle Park, NC** **27713**	**Analytical** **Technologies, Inc.** **11 East Olive Road** **Pensecola, FL 32514**
Sediments	Chlorinated Phenols Organic Analysis PAH Semivolatile Organic Analysis by Method 8270 PAH by Method 8310 Total Metals Total Solids	Grain Size	Total Organic Carbon subcontracted through Analytical Technologies	Polychlorinated dibenzo - p - dioxins and dibenzofurans	N/A
Marine Water	Chlorinated Phenols Organic Analysis PAH Semivolatile Organic Analysis by Method 8270 PAH by Method 8310 Total Suspended Solids	N/A	N/A	Polychlorinated dibenzo - p - dioxins and dibenzofurans	Salinity
Clam Tissue	Chlorinated Phenols Organic Analysis PAH Semivolatile Organic Analysis by Method 8270 Total Metals and Lipids	N/A	N/A	Polychlorinated dibenzo - p - dioxins and dibenzofurans	N/A

Table 2. Sediment Data Qualifier Summary Tables

Compound	Qualifier	Sample Number	Reason
2-Chlorophenol	R	CP2-M-E4B, CP2-M-E4C, CP2-M-E4E, CP2-M-H6B, CP2-M-H6A, CP2-M-H6C, CP2-M-H6E, CP2-M-H7C, CP2-M-H7B, CP2-M-H7A, CP2-M-H10A, CP2-M-F11B, CP2-M-H8A, CP2-M-F1A, CP2-M-F1C, CP2-M-F1B, CP2-M-H8B, CP2-M-H8C, CP2-M-H8E, CP2-M-BI1, CP2-M-BI11 CP2-M-BI2, CP2-M-BI3, CP2-M-E1B, CP2-M-E1C, CP2-M-E1F, CP2-M-C1PP, CP2-M-H2A, CP2-M-H2B, CP2-M-H12B, CP2-M-D3E, CP2-M-D13E, CP2-M-H2C, CP2-M-H2D, CP2-M-H2M, CP2-M-H3A, CP2-M-H3B, CP2-M-H3C, CP2-M-H3E, CP2-M-H3L, CP2-M-H1A, CP2-M-H1B, CP2-M-H1C, CP2-M-H1E, CP2-M-A2B, CP2-M-A2C, CP2-M-A2D, CP2-M-G3B, CP2-M-G3C, CP2-M-G3E, CP2-M-H9CC, CP2-M-H9F, CP2-M-D4B, CP2-M-D4D, CP2-M-H5A, CP2-M-H5B, CP2-M-H5CC, CP2-M-H5E, CP2-M-C2E	No MS/MSD recovery.
2,4-Dichlorophenol	J	CP2-M-A2C, CP2-M-H9F	High MS/MSD recovery.
Tetrachlorophenol	J	CP2-M-H2B, CP2-M-G3B	Low MS/MSD recovery.

Table 2. Sediment Data Qualifier Summary Tables Continued

Compound	Qualifier	Sample Number	Reason
Pentachlorophenol	J	CP2-M-E4B, CP2-M-H6B, CP2-M-H6A, CP2-M-H6C, CP2-M-E1B, CP2-M-E1B(DUP), CP2-M-E1F, CP2-M-A2B, CP2-M-A2C, CP2-M-A2D, CP2-M-D4B, CP2-M-D4D, CP2-M-H5A, CP2-M-H5B, CP2-M-H5E, CP2-M-D13E, CP2-M-H7B, CP2-M-H7A, CP2-M-H10A, CP2-M-BI1, CP2-M-BI11, CP2-M-BI2, CP2-M-BI3, CP2-M-H8A, CP2-M-F1B, CP2-M-H3B, CP2-M-H1B	Pentachlorophenol not confirmed.

Compound	Qualifier	Sample Number	Reason
OCDD	U at Reported Value	CP2-M-H2D	Sample concentration less than 5 times blank concentration but greater than CRQL.
2378-TCDD	U at CRQL	CP2-M-H6A	Sample concentration less than 5 times blank concentration and less than CRQL.
234678-HxCDF	U at Reported Value	CP2-M-H7B CP2-M-H5B	Sample concentration less than 5 times blank concentration but greater than CRQL.
OCDF	U at Reported Value	CP2-M-H2D	Sample concentration less than 5 times blank concentration but greater than CRQL.

Compound	Qualifier	Sample Number	Reason
All "Q" Data	J	All	Quantitative interferences may cause data inaccuracy.
All EMPC Data	J	All	EMPC data are estimates.
All "S" Data	J	All	Saturation of QC/MS signal, results estimated.

Table 2. Sediment Data Qualifier Summary Tables Continued

Analyte	Qualifier	Sample Number	Reason
Antimony	J	CP2-M-H12C CP2-M-H2D CP2-M-H2A CP2-M-H2B CP2-M-H12B CP2-M-BI1 CP2-M-BI11 CP2-M-BI2 CP2-M-BI3 CP2-M-CIE CP2-M-G3C CP2-M-G3E CP2-M-G3B	Matrix spike recovery poor. Results may be biased low.
Arsenic Copper	J	CP2-M-H12C CP2-M-H2D CP2-M-H2A CP2-M-H2B CP2-M-H12B CP2-M-CIE CP2-M-G3C CP2-M-G3E CP2-M-G3B	No matrix spike results available.

Table 3. Tissue Data Qualifier Summary Tables

Compound	Qualifier	Sample Number	Reason
2-Chlorophenol	R	CP2-C-H2 CP-C-F5 CP2-C-EI	No MS/MSD recovery

Analyte	Qualifier	Sample Number	Reason
234678-HxCDF	U at Reported Value	CP2-C-F5, CP2-C-EI	Concentration less than 5 times blank contamination.

Analyte	Qualifier	Sample Number	Reason
All "EMPC" Data	J	All	EMPC data are estimates.
All "Q" Data	J(+) UJ(-)	All	Quantitative interferences may cause data inaccuracy.

Table 4. Marine Water Data Qualifier Summary Tables

Compound	Qualifier	Sample Number	Reason
All chlorinated phenols	J(+) UJ(-)	CP2-WC-G3-RE, CP2-WC-C2-RE, CP2-WC-B3-RE, CP2-WP-H13-RE, CP2-WP-H12-RE, CP2-WP-C2-RE, CP2-WP-H14-RE, CP2-W-BI1-RE, CP2-W-BI11-RE, CP2-W-BI2-RE, CP2-W-BI3-RE	Exceeded extraction holding time.

Compound	Qualifier	Sample Number	Reason
Anthracene	U at reported value	CP2-W-BI11 CP2-W-BI2 CP2-WC-G3 CP2-WC-C2 CP2-WP-H13 CP2-WP-C2 CP2-WP-H14	Sample within 5 times blank concentration.

Compound	Qualifier	Sample Number	Reason
Fluorene Benzo(k)fluoranthene	R	CP2-WP-C2	Not confirmed on UV detector.

Analyte	Qualifier	Sample Number	Reason
1234678-HpCDD	U at Reported Value	CP2-W-BI1, CP2-W-BI11, CP2-W-BI2, CP2-W-BI3, CP2-W-~~C1R~~ RB1 lcm	Sample concentration less than 5 times blank contamination.
OCDD	U at Reported Value	CP2-M-RB2, CP2-W-BI1, CP2-W-BI11, CP2-W-BI2, CP2-W-BI3, CP2-M-RB1, CP2-WC-G3, CP2-WC-B3, CP2-WC-C2	Sample concentration less than 5 times blank contamination.
2378-TCDF	U at CRQL	CP2-W-BI11, CP2-W-BI2	Sample concentration less than 5 times blank contamination and less than CRQL.
2378-TCDF	U at Reported Value	CP2-WC-G3	Sample concentration less than 5 times blank contamination.
12378-PeCDF	U at CRQL	CP2-W-BI11, CP2-W-BI2	Sample concentration less than 5 times blank contamination and less than CRQL.

12378-PeCDF	U at Reported Value	CP2-W-BI1	Sample concentration less than 5 times blank contamination.
234678-HxCDF	U at Reported Value	CP2-W-BI1, CP2-W-BI11, CP2-W-BI2	Sample concentration less than 5 times blank contamination.
123678-HpCDF	U at Reported Value	CP2-WC-B3, CP2-WP-C2, CP2-WP-H13, CP2-WP-H14	Sample concentration less than 5 times blank contamination.
OCDF	U at Reported Value	CP2-W-BI1, CP2-W-BI11, CP2-W-BI2, CP2-W-BI3, CP2-M-RB1, CP2-WC-B3, CP2-WC-C2, CP2-WP-H12, CP2-WP-H13, CP2-WP-H14	Sample concentration less than 5 times blank contamination.

Analyte	Qualifier	Sample Number	Reason
All "EMPC" Data	J	All	EMPC data are estimates.
All "Q" Data	J(+) UJ(-)	All	Quantitative interferences may cause data inaccuracy.

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SECTION I

SEDIMENT

DATA VALIDATION REPORT
CHLORINATED PHENOLS SEDIMENT ANALYSES

I. **Sample Holding Times:** ACCEPTABLE/All criteria met.

II. **Blank Analyses:** ACCEPTABLE/All criteria met.

III. **Surrogate Recovery:** ACCEPTABLE/All criteria met.

Qualified Data: None

Discussion

EPA Method 8040 specifies the addition of two surrogates (2-fluorophenol and 2,4,6-tribromophenol) to each sample before extraction. For this analysis, only 2,4,6-tribromophenol was added by the laboratory. EPA Method 8270 (GC/MS) employs the use of three surrogates (d5-nitrobenzene, 2-fluorobiphenyl and d14-terphenyl). For most samples, the laboratory only reported one of the surrogates (d14-terphenyl), stating that the others were not added before extraction or were lost in the silica gel cleanup that was employed to remove interferences in some of the GC/MS samples. It is recommended that, in the future, the laboratory spike all samples with appropriate concentrations of the specified surrogate compounds and report results of all surrogate recoveries. The resulting information will result in much greater confidence in the accuracy of the data.

Since no acceptance or rejection criteria for tribromophenol were specified by the QAPP or have been developed by the laboratory, surrogate recovery limits were calculated three standard deviations from the mean of all sediment surrogate recovery values. The calculated range is 11%-178%. All surrogate values were within these limits and are acceptable.

IV. **Matrix Spike/Matrix Spike Duplicate Sample Analyses:** ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
2-Chlorophenol	R	CP2-M-E4B, CP2-M-E4C, CP2-M-E4E, CP2-M-H6B, CP2-M-H6A, CP2-M-H6C, CP2-M-H6E, CP2-M-H7C, CP2-M-H7B, CP2-M-H7A, CP2-M-H10A, CP2-M-F11B, CP2-M-H8A, CP2-M-F1A, CP2-M-F1C, CP2-M-F1B, CP2-M-H8B, CP2-M-H8C, CP2-M-H8E, CP2-M-BI1, CP2-M-BI11 CP2-M-BI2, CP2-M-BI3, CP2-M-E1B, CP2-M-E1C, CP2-M-E1F, CP2-M-C1PP, CP2-M-H2A, CP2-M-H2B, CP2-M-H12B, CP2-M-D3E, CP2-M-D13E, CP2-M-H2C, CP2-M-H2D, CP2-M-H2M, CP2-M-H3A, CP2-M-H3B, CP2-M-H3C, CP2-M-H3E, CP2-M-H3L, CP2-M-H1A, CP2-M-H1B, CP2-M-H1C, CP2-M-H1E, CP2-M-A2B, CP2-M-A2C, CP2-M-A2D, CP2-M-G3B, CP2-M-G3C, CP2-M-G3E, CP2-M-H9CC, CP2-M-H9F, CP2-M-D4B, CP2-M-D4D, CP2-M-H5A, CP2-M-H5B, CP2-M-H5CC, CP2-M-H5E, CP2-M-C2E	No MS/MSD recovery.
2,4-Dichlorophenol	J	CP2-M-A2C, CP2-M-H9F	High MS/MSD recovery.
Tetrachlorophenol	J	CP2-M-H2B, CP2-M-G3B	Low MS/MSD recovery.

Discussion

The laboratory labelled only high matrix spike results that were greater than 120% recovery as outside control limits, because the control limits that the QAPP specified were calculated from a limited statistical base. For this data review, qualifiers were assigned only if the 120% control limit was exceeded.

All matrix spike/matrix spike duplicates and blank spike results were 0% recovery for 2-chlorophenol. All 2-chlorophenol results should be qualified rejected (R) for all marine sediment samples. Two samples contained 2,4-dichlorophenol and are qualified as estimated

(J) for positive results due to high 2,4-dichlorophenol recovery in matrix spikes. Two samples contained tetrachlorophenol and are qualified (J) for positive results due to low MS/MSD recovery. However, because the tetrachlorophenol matrix spike recoveries were only slightly low (48%-74%) and the surrogate recoveries were acceptable, no data qualifiers are recommended for the non-detect tetrachlorophenol results.

2,4,5-Trichlorophenol spikes were above the QAPP control limits on all but one sample. However, of these spikes, only one recovery was reported by the laboratory as being high (132%) because the value is above the 120% limit. No data qualifiers are recommended based on this one high recovery for 2,4,5-trichlorophenol.

V. **Field Duplicates:** ACCEPTABLE/All criteria met. Duplicate results are summarized in Appendix A.

VI. **Compound Identification:** ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
Pentachlorophenol	J	CP2-M-E4B, CP2-M-H6B, CP2-M-H6A, CP2-M-H6C, CP2-M-E1B, CP2-M-E1B(DUP), CP2-M-E1F, CP2-M-A2B, CP2-M-A2C, CP2-M-A2D, CP2-M-D4B, CP2-M-D4D, CP2-M-H5A, CP2-M-H5B, CP2-M-H5E, CP2-M-D13E, CP2-M-H7B, CP2-M-H7A, CP2-M-H10A, CP2-M-BI1, CP2-M-BI11, CP2-M-BI2, CP2-M-BI3, CP2-M-H8A, CP2-M-F1B, CP2-M-H3B, CP2-M-H1B	Pentachlorophenol not confirmed.

Discussion

Of the 34 samples that had pentachlorophenol detected, 27 samples did not have pentachlorophenol confirmed due to an interfering peak on the confirmation column chromatogram and are to be qualified "J" estimated for pentachlorophenol as positive confirmation cannot be assured. The laboratory should use a confirmation column that allows adequate separation between analytes to enable positive confirmation.

VII. Compound Quantitation and Reported Contract Required Quantitation Detection Limits (CRQLs): ACCEPTABLE/All criteria met.

VIII. Standard Reference Material:

Reference material values were generally acceptable except for low recoveries for pentachlorophenol in the reference material indicating a low bias. However, since the reported average values were calculated with laboratory data from a variety of methodologies including GC/MS and GC/ECD procedures, the allowable standard deviation is very wide. Since matrix spikes, blank spikes and other quality control data was acceptable, no data qualifiers are recommended.

Appendix B summarizes and compares the EPA statistically derived results with ATI results.

IX. Overall Assessment of the Data

Overall quality of the data is generally acceptable except for pentachlorophenol and 2-chlorophenol results. All 2-chlorophenol results were rejected due to poor MS/MSD recoveries. Pentachlorophenol results were qualified because the laboratory did not confirm positive hits. Two samples were qualified due to high 2,4-chlorophenol matrix spike recoveries. Two other samples were also qualified for low tetrachlorophenol recovery.

DATA VALIDATION REPORT
POLYCYCLIC AROMATIC HYDROCARBONS (PAH)
SEDIMENT ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
All semivolatile compounds	**J(+) UJ(-)**	**CP2-M-H1ARE**	**Reextract outside required extraction time.**

Discussion

Sample CP2-M-H1ARE was reextracted outside the required extraction time and is to be qualified "J" for positive results and "UJ" for nondetects.

II. Blank Analyses: ACCEPTABLE/All criteria met.

III. Surrogate Recovery: ACCEPTABLE/All criteria met.

IV. Matrix Spike/Matrix Spike Duplicate Sample Analyses: ACCEPTABLE/All criteria met.

V. Field Duplicates: ACCEPTABLE/All criteria met.

VI. Compound Identification: ACCEPTABLE/All criteria met.

VII. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQLs): ACCEPTABLE/All criteria met.

VIII. Standard Reference Material: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Laboratory generated reference material values were generally acceptable except for low recoveries for the 2-3 ring PNAs which include naphthalene, 2-methylnaphthalene, acenaphthylene and acenaphthene which might indicate a low bias. However, since matrix spikes and blank spike recoveries were acceptable, no data qualifiers are recommended. All other PAH compounds showed acceptable recoveries.

Appendix B summarizes and compares the EPA statistically derived results with ATI results.

IX. Overall Assessment of the Data

Overall quality of the data was acceptable. No major problems were encountered in this data set.

DATA VALIDATION REPORT
PCDD/PCDF SEDIMENT ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. Surrogate Spike Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

Quantitative interferences exist for several recovery standards/surrogates in many of the water samples. Data from these samples have been qualified by the laboratory with a "Q." As these unknown samples-related interferences probably affect compound quantitation, all positive "Q" data are recommended to be qualified with a "J."

All data qualifications are summarized in Section VII.

III. Laboratory Blank Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
OCDD	U at Reported Value	CP2-M-H2D	Sample concentration less than 5 times blank concentration but greater than CRQL.
2378-TCDD	U at CRQL	CP2-M-H6A	Sample concentration less than 5 times blank concentration and less than CRQL.
234678-HxCDF	U at Reported Value	CP2-M-H7B CP2-M-H5B	Sample concentration less than 5 times blank concentration but greater than CRQL.
OCDF	U at Reported Value	CP2-M-H2D	Sample concentration less than 5 times blank concentration but greater than CRQL.

Discussion

Several compounds were detected in low concentrations in the method blanks that were concurrently extracted and analyzed with the water samples. Those contaminants

found in samples at concentrations greater than five times the corresponding blank concentrations are not qualified since the contribution to the final result from the contamination is negligible. The contaminants found in samples at concentrations less than five times the corresponding blank concentrations should be qualified as not-detected. Qualifications are summarized above.

IV. Field Blank Analyses: None submitted or identified.

V. Matrix Spike/Matrix Spike Duplicate Sample Analyses: None submitted or required.

VI. Field Quality Control Sample Analysis: ACCEPTABLE/All criteria met.

Qualified Data: None

Discussion

The field duplicate samples demonstrated very good field and laboratory precision. Considering the extremely low levels observed, the higher %RPD values achieved (151.6%, 122.5% and 100.0%) are not unreasonable for sediment samples and no data qualifications are recommended based on field duplicate analysis.

VII. Compound Quantitation and Reported Detection Limits: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
All "Q" Data	J	All	Quantitative interferences may cause data inaccuracy.
All EMPC Data	J	All	EMPC data are estimates.
All "S" Data	J	All	Saturation of QC/MS signal, results estimated.

Discussion

Quantitation interferences exist for several recovery standards and surrogates in most samples. Data from these samples have been qualified by the laboratory with a "Q." As these unknown sample-related interferences probably affect compound quantitation, positive

"Q" data are recommended to be qualified with a "J" and non-detected "Q" data qualified as "UJ."

Compound values that have estimated Maximum Possible Concentrations (EMPC) indicate that some compounds are present that do not meet all of the qualitative identification criteria but have acceptable signal-to-noise ratios. As they are estimates, all EMPC data should be qualified with a "J."

TLI flagged certain compounds or compound classes that responded outside of the normal dynamic working range as "J" for saturated. Results so qualified should be estimated (J) as the true value is unknown.

All data qualifications are summarized in the above table.

VIII. Overall Assessment of Data:

Data for this set was found to be accurate and should be accepted with the exceptions previously noted.

DATA VALIDATION REPORT
TOTAL METAL SEDIMENT ANALYSES

I. Sample Holding Times: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

Holding times were met for all sediment samples and rinsate blanks, except mercury for 9 sediment samples and one rinsate blank. Under CLP, the contractual holding time for mercury is 30 days and under PSEP 28 days. The technical requirements for sample holding times have only been established for water matrices and no statistical determination of holding times for sediments is available. Based on the data validation guidelines provided in the functional guidelines (U.S. EPA, 1988a), the nature of the analyte, matrix, degree of violation, and the concentration of the analyte are to be taken into consideration. Because analysis of the 9 sediment samples and one rinsate blank for mercury exceeded the holding time by only 4 to 8 days, no data qualifiers are recommended because sample integrity was not significantly affected.

II. Preparation Blank Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

Copper and zinc were detected in all method blanks. Nickel was detected in one blank. Because all associated sample concentrations for copper, zinc and nickel were greater than five times the blank concentration, no data qualifiers are required.

III. Field Rinsate Blanks: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

Two field rinsate blanks were analyzed. Copper and zinc were detected in one field blank and only zinc in the other blank. Concentrations were less than 1 mg/L for the elements detected indicating cross-contamination between samples during sampling was minimal and not significant. No data qualifiers are recommended.

IV. Standard Reference Material (SRM): UNACCEPTABLE

Qualified Data: None

Discussion

Standard Reference Material (SRM) was not analyzed for total metals. Alternately, the laboratory analyzed spiked sand samples. For arsenic the laboratory reported results for a certified tissue standard (NBS1566A) instead of spiked sand samples. Under PSEP protocols, the SRM or laboratory control sample (LCS) is to be a sample of similar matrix as the samples submitted for analysis. The purpose of the SRM is to measure the digestion efficiency of the procedure employed which is especially important when analyzing marine sediments. The laboratory was to analyze the samples according to PSEP protocols, and the strong acid digestion was to be employed if acceptable analyte recovery could be obtained. Without digesting an SRM of similar matrix, analyte recovery cannot be measured. However, the laboratory achieved good analyte recovery (86% - 112%) for spiked sand samples. Therefore, no data qualifications are recommended. It is recommended the laboratory obtain and analyze a SRM of similar (or as close as possible) matrix with any future analyses.

V. Duplicate Sample Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

All relative percent differences (RPDs) between duplicates were within control limits except for one mercury duplicate (40%). No qualifiers are recommended based on this exceedance as sample results were less than the detection limit.

VI. **Spiked Sample Analysis:** ACCEPTABLE/With the following exceptions.

Qualified Data:

Analyte	Qualifier	Sample Number	Reason
Antimony	J	CP2-M-H2C CP2-M-H2D CP2-M-H2A CP2-M-H2B CP2-M-H12B CP2-M-BI1 CP2-M-BI11 CP2-M-BI2 CP2-M-BI3 CP2-M-CIE CP2-M-G3C CP2-M-G3E CP2-M-G3B	Matrix spike recovery poor. Results may be biased low.
Arsenic Copper	J	CP2-M-H2C CP2-M-H2D CP2-M-H2A CP2-M-H2B CP2-M-H12B CP2-M-CIE CP2-M-G3C CP2-M-G3E CP2-M-G3B	No matrix spike results available.

Discussion

All matrix spike (MS) percent recoveries were within the control limits, except antimony and mercury. No MS recovery was reported for arsenic and copper for one of the two MSs reported. The laboratory stated this was because of required sample dilution. A National Bureau of Standards reference material (oyster tissue) was analyzed for arsenic and a blank spike for copper. Results found for these analyses were within acceptable limits. However, these matrices are significantly different than sediment. Therefore, associated arsenic and copper results are recommended to be qualified as estimated (J). A matrix spike for mercury was low (40%), but no data qualifiers are recommended as sample results were less than the detection limit and the detection limit was judged not be affected. For antimony, the MS percent recovery was found to be 18% and 25% in the two MSs analyzed. Although a blank spike was analyzed and found to be within limits, because the actual MS showed such low recovery, all antimony data are recommended to be estimated (J).

VII. Sample Result Verification: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

The laboratory did not state on the data summary sheets if results were reported on a wet or dry weight basis. The laboratory was contacted and it was verified that the sediment results for metals are reported on a dry weight basis.

Because no raw data were submitted by the laboratory, complete sample result verification was not possible. Calculation checks were performed on the matrix spike recoveries and the RPDs between laboratory duplicates. No errors were noted.

VIII. Field Quality Control Sample Analysis: ACCEPTABLE/All criteria met.

Qualified Data: None

Discussion

The relative percent difference (RPD) between field duplicate sample results was calculated and found to be less than 10 percent. The results are summarized in Appendix A.

DATA VALIDATION REPORT
CONVENTIONAL SEDIMENT ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. Preparation Blank Analysis: ACCEPTABLE/All criteria met.

III. Duplicate/Triplicate Sample Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

Under PSEP protocols, all conventional analyses are to have triplicate analyses performed on one sample out of 20. Triplicates were performed at the proper frequency for grain size and total organic carbon (TOC) analyses. Duplicates were performed for total solids. The coefficient of variation among triplicates and the relative percent difference (RPDs) between duplicates were less than 30 percent. Therefore, no qualifiers are recommended.

IV. Spiked Sample Analysis: ACCEPTABLE/All criteria met.

V. Sample Result Verification: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

Because no raw data were submitted by the laboratory, complete sample result verification was not possible. Calculation checks were performed on the matrix spike recoveries and the RPDs between laboratory duplicates. No errors were noted.

TOC results were reported using four to five significant figures. The results should be rounded to three significant figures.

VI. Field Quality Control Sample Analysis: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

Field duplicate analyses were performed on three samples for grain size and total solids and two samples for TOC. The RPD between field duplicates was less than 30% for all samples and analyses, except for one TOC duplicate and one grain size duplicate for one sieve size. No data qualifications are made based on the field duplicate results. The field duplicate results are summarized in Appendix A.

SECTION II

TISSUE

DATA VALIDATION REPORT
CHLORINATED PHENOLS ORGANICS
TISSUE ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. Blank Analyses: ACCEPTABLE/All criteria met.

III. Surrogate Recovery: ACCEPTABLE/All criteria met.

IV. Matrix Spike/Matrix Spike Duplicate Sample Analyses: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
2-Chlorophenol	R	CP2-C-H2 CP-C-F5 CP2-C-EI	No MS/MSD recovery

Discussion

The matrix spike and matrix spike duplicate for sample CP2-C-H2 had no recovery for 2-chlorophenol and high recovery for 2,4-dichlorophenol (236%).

2-Chlorophenol should be qualified "R" reject for all sample results. 2,4-Dichlorophenol does not require qualification because 2,4-dichlorophenol was not detected in any of the samples. The high MS/MSD recovery does not affect the detection limit for 2,4-dichlorophenol.

V. Field Duplicates: None submitted.

VI. Compound Identification: ACCEPTABLE/All criteria met.

VII. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQLs): ACCEPTABLE/All criteria met.

VIII. Overall Assessment of the Data

Overall quality of the data is generally acceptable except that 2-chlorophenol results were rejected due to systematically poor MS/MSD recovery. No other major problems were encountered.

DATA VALIDATION REPORT
POLYCYCLIC AROMATIC HYDROCARBON (PAH)
TISSUE ANALYSES

I. **Sample Holding Times:** ACCEPTABLE/All criteria met.

II. **Blank Analyses:** ACCEPTABLE/All criteria met.

III. **Surrogate Recovery:** ACCEPTABLE/All criteria met.

IV. **Matrix Spike/Matrix Spike Duplicate Sample Analyses:** ACCEPTABLE/All criteria met.

V. **Field Duplicates:** None submitted.

VI. **Compound Identification:** ACCEPTABLE/All criteria met.

VII. **Compound Quantitation and Reported Contract Required Quantitation Limits (CRQLs):** ACCEPTABLE/All criteria met.

VIII. **Overall Assessment of the Data**

Overall quality of the data was acceptable. No major problems were encountered in this set.

DATA VALIDATION REPORT
PCDD/PCDF TISSUE ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. Surrogate Spike Analysis: ACCEPTABLE/With the following exceptions:

Qualified Data: None

Discussion

Quantitative interferences exist for five recovery standards/surrogates in both samples in this set. Data from these samples have been qualified by the laboratory with a "Q." As these unknown sample-related interferences probably affect compound quantitation, all positive "Q" data are recommended to be qualified with a "J."

Data qualifications are summarized in Section VII.

III. Laboratory Blank Analysis: ACCEPTABLE/With the following exceptions:

Qualified Data:

Analyte	Qualifier	Sample Number	Reason
234678-HxCDF	U at Reported Value	CP2-C-F5, CP2-C-EI	Concentration less than 5 times blank contamination.

Discussion

ODCC and 234678-HxCDF were detected in concentrations in the method blank that was concurrently extracted and analyzed with the tissue samples.

OCDD was detected in all samples at concentration above five times the blank concentration. Since contribution to OCDD results in the samples from contamination was negligible, no data qualifiers are recommended.

234578-HxCDF was detected in sample CP2-C-H2 above five times the blank concentration. Since contribution to 234578-HxCDF results in the sample from contamination was negligible, no data qualification is recommended.

Samples CP2-C-F5 and CP2-C-EI contained 234678-HxCDF at less than five times the blank contamination. The results have been qualified as not-detected as shown in the table above.

IV. Matrix Spike/Matrix Spike Duplicate Analysis: None submitted or required.

V. Field Quality Control Sample Analysis: None submitted or required.

Qualified Data: None

VI. Compound Quantitation and Reported Detection Limits:

Qualified Data:

Analyte	Qualifier	Sample Number	Reason
All "EMPC" Data	J	All	EMPC data are estimates.
All "Q" Data	J(+) UJ(-)	All	Quantitative interferences may cause data inaccuracy.

Discussion

Quantitative interferences exist for several recovery standards and surrogates in all samples. Data from these samples have been qualified by the laboratory with a "Q." As these unknown sample-related interferences probably affect compound quantitation, positive "Q" data are recommended to be qualified with a "J" and non-detected "Q" data qualified as "UJ."

Compound values that have the Estimated Maximum Possible Concentration (EMPC) indicate that some compounds are present that do not meet all of the qualitative identification criteria but have acceptable signal-to-noise ratios. As they are estimates, all EMPC data should be qualified with a "J."

Data qualifications are summarized above.

VII. Data Quality Summary:

Data for this set were found to be accurate and should be accepted with the exceptions previously noted.

DATA VALIDATION REPORT
TOTAL METAL TISSUE ANALYSES

I. **Sample Holding Times:** ACCEPTABLE/All criteria met.

II. **Blank Analyses:** ACCEPTABLE/All criteria met.

III. **Standard Reference Material (SRM):** ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

The SRM analyzed with the tissue samples was NBS 1566A (Oyster Tissue). High recovery was obtained for arsenic (128%) and lead (162%), and low recovery for chromium (66%), mercury (62%), and nickel (62%). For these analytes the spiked sample recovery was within control limits. Therefore, no data qualifiers are recommended based solely on SRM results.

IV. **Duplicate Sample Analysis:** ACCEPTABLE/All criteria met.

V. **Spiked Sample Analysis:** ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

All reported spiked sample results were within criteria except antimony (68%). As antimony was not detected in the tissue samples no data qualifiers are recommended. It cannot be determined from a Level III data review if the detection limit would have been affected.

VI. **Sample Result Verification:** ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

The laboratory did not state on the data summary sheets if results were reported on a wet or dry weight basis. The laboratory was contacted and it was verified that the tissue results for metals are reported on a wet weight basis.

Because no raw data were submitted by the laboratory, complete sample result verification was not possible. Calculation checks were performed on the matrix spike recoveries and the RPDs

between laboratory duplicates. No errors were noted.

SECTION III

MARINE WATER

DATA VALIDATION REPORT
CHLORINATED PHENOLS
MARINE WATER ANALYSES

I. Sample Holding Times: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
All chlorinated phenols	J(+) UJ(-)	CP2-WC-G3-RE, CP2-WC-C2-RE, CP2-WC-B3-RE, CP2-WP-H13-RE, CP2-WP-H12-RE, CP2-WP-C2-RE, CP2-WP-H14-RE, CP2-W-BI1-RE, CP2-W-BI11-RE, CP2-W-BI2-RE, CP2-W-BI3-RE	**Exceeded extraction holding time by 17 days.**

Discussion

According to the narrative, all marine water samples were re-extracted due to a contaminated derivatizing agent. The blank and all spikes in the original extraction were affected. The re-extraction of the water samples was performed 17 days after the required extraction holding time and all data should be qualified "J" for positive results and "UJ" for non-detects.

II. Laboratory Blank Analyses: ACCEPTABLE/All criteria met.

III. Surrogate Recovery: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

Since no acceptance or rejection criteria for tribromophenol were specified by the QAPP or have been developed by the laboratory, recovery limits were calculated statistically from the reported surrogate values of the marine water samples. Three standard deviations from the mean surrogate value yielded the acceptable limits as 26-159% recovery for tribromophenol.

Sample CP2-M-RB1 had a low recovery of tribromophenol (4%). Because the sample is a blank sample and it appears that this low recovery is an isolated incident, no data qualifiers are recommended.

IV. Matrix Spike/Matrix Spike Duplicate Sample Analyses: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

The matrix spike recovery for 2-chlorophenol was acceptable, but had a slightly high relative percent difference (RPD) (21%). 2,4-Dichlorophenol matrix spike recovery was very high 231% and 247% Since none of these compounds were detected in any of the samples and all other MS/MSD and QA/QC criteria were generally acceptable, no data qualifiers are recommended.

V. Field Duplicates: ACCEPTABLE/All criteria met.

VI. Compound Identification: ACCEPTABLE/All criteria met.

VII. Compound Quantitation and Reported Contract Required Quantitation Detection Limits (CRQLs): ACCEPTABLE/All criteria met.

VIII. Overall Assessment of the Data

Overall quality of the data is acceptable except that 11 samples were qualified due to exceeded extraction holding times. Sample CP2-M-C1PP should have the sampling date 7/23/91 on the laboratory report according to the chain-of-custody rather than 7/24/91. No other major problems were encountered with this set.

DATA VALIDATION REPORT
POLYCYCLIC AROMATIC HYDROCARBONS (PAH)
MARINE WATER ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. Blank Analyses: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
Anthracene	U at reported value	CP2-W-BI11 CP2-W-BI2 CP2-WC-G3 CP2-WC-C2 CP2-WP-H13 CP2-WP-C2 CP2-WP-H14	Sample within 5 times blank concentration.

Discussion

Anthracene was detected in a method blank. Associated samples are qualified "U" at the reported value, as summarized above.

III. Surrogate Recovery: ACCEPTABLE/All criteria met.

IV. Matrix Spike/Matrix Spike Duplicate Sample Analyses: ACCEPTABLE/With the following exceptions.

Qualified Data: None

Discussion

The MS/MSD relative percent difference (RPD) was slightly high (22%) for acenaphthylene, however, no data qualifiers are required based strictly on MS/MSD data.

V. Field Duplicates: ACCEPTABLE/All criteria met.

VI. Compound Identification: ACCEPTABLE/With the following exceptions.

Qualified Data:

Compound	Qualifier	Sample Number	Reason
Fluorene Benzo(k)fluoranthene	**R**	**CP2-WP-C2**	**Not confirmed on UV detector.**

Discussion

Sample CP2-WP-C2 did not have fluorene and benzo(k)fluoranthene confirmed on the UV detector and reported values should be rejected (R).

VII. Compound Quantitation and Reported Contract Required Quantitation Limits (CRQLs): ACCEPTABLE/All criteria met.

VIII. Overall Assessment of the Data

Overall quality of the data was acceptable. No major problems were encountered with this data set.

DATA VALIDATION REPORT
PCDD/PCDF MARINE WATER ANALYSES

I. Sample Holding Times: ACCEPTABLE/All criteria met.

II. Surrogate Spike Analysis: ACCEPTABLE/With the following exceptions:

Qualified Data: None

Discussion

Quantitative interferences exist for several recovery standards/surrogates in many of the water samples. Data from these samples have been qualified by the laboratory with a "Q." As these unknown sample related interferences probably affect compound quantitation, all positive "Q" data are recommended to be qualified with a "J."

Data qualifications are summarized in Section VII.

III. Laboratory Blank Analysis: ACCEPTABLE/With the following exceptions:

Qualified Data: Water

Analyte	Qualifier	Sample Number	Reason
1234678-HpCDD	U at Reported Value	CP2-W-BI1, CP2-W-BI11, CP2-W-BI2, CP2-W-BI3, CP2-W-C1R	Sample concentration less than 5 times blank contamination.
OCDD	U at Reported Value	CP2-M-RB2, CP2-W-BI1, CP2-W-B11, CP2-W-BI2, CP2-W-BI3, CP2-M-RB1, CP2-WC-G3, CP2-WC-B3, CP2-WC-C2	Sample concentration less than 5 times blank contamination.
2378-TCDF	U at CRQL	CP2-W-BI11, CP2-W-BI2	Sample concentration less than 5 times blank contamination and less than CRQL.
2378-TCDF	U at Reported Value	CP2-WC-G3	Sample concentration less than 5 times blank contamination.
12378-PeCDF	U at CRQL	CP2-W-BI11, CP2-W-BI2	Sample concentration less than 5 times blank contamination and less than CRQL.

12378-PeCDF	U at Reported Value	CP2-W-BI1	Sample concentration less than 5 times blank contamination.
234678-HxCDF	U at Reported Value	CP2-W-BI1, CP2-W-BI11, CP2-W-BI2	Sample concentration less than 5 times blank contamination.
123678-HpCDF	U at Reported Value	CP2-WC-B3, CP2-WP-C2, CP2-WP-H13, CP2-WP-H14	Sample concentration less than 5 times blank contamination.
OCDF	U at Reported Value	CP2-W-BI1, CP2-W-BI11, CP2-W-BI2, CP2-W-BI3, CP2-M-RB1, CP2-WC-B3, CP2-WC-C2, CP2-WP-H12, CP2-WP-H13, CP2-WP-H14	Sample concentration less than 5 times blank contamination.

Discussion

Several compounds were detected in low concentrations in the method blanks that were concurrently extracted and analyzed with the water samples. Those contaminants found in samples at concentrations greater than five times the corresponding blank concentrations are not qualified since the contribution to the final result from the contaminant is negligible. The contaminants found in samples at concentrations less than five times the corresponding blank concentrations should be qualified as not-detected at the CRQL. Qualifications are summarized above.

IV. Field Blank Analyses: None submitted or identified.

V. Matrix Spike/Matrix Spike Duplicate Analysis: None submitted or required.

VI. Field Quality Control Sample Analysis: ACCEPTABLE/All criteria met.

Qualified Data: None

Discussion

The field duplicate samples demonstrated very good field and laboratory precision. Considering the extremely low levels observed, the highest %RPD value achieved (80.0%) is not unreasonable and no data qualifications are recommended based on field duplicate analysis.

VII. Compound Quantitation and Reported Detection Limits:

Qualified Data: Water

Analyte	Qualifier	Sample Number	Reason
All "EMPC" Data	J	All	EMPC data are estimates.
All "Q" Data	J(+) UJ(-)	All	Quantitative interferences may cause data inaccuracy.

Discussion

Quantitative interferences exist for several recovery standards and surrogates in all samples. Data from these samples have been qualified by the laboratory with a "Q." As these unknown sample-related interferences probably affect compound quantitation, positive "Q" data are recommended to be qualified with a "J" and non-detected "Q" data qualified as "UJ."

Compound values that have the Estimated Maximum Possible Concentration (EMPC) indicate that some compounds are present that do not meet all of the qualitative identification criteria but have acceptable signal-to-noise ratios. As they are estimates, all EMPC data should be qualified with a "J."

All data qualifications are summarized above.

VIII. Data Quality Summary:

Data for this set were found to be accurate and should be accepted with the exceptions previously noted.

DATA VALIDATION REPORT
CONVENTIONAL MARINE WATER ANALYSES

Conventionals: ACCEPTABLE/With the following exceptions.

Qualified Data: None

The water samples were analyzed for total suspended solids (TSS) and salinity. One laboratory duplicate was analyzed for each parameter. RPDs were less than 10 percent. A spike analysis was performed for salinity. Recovery was slightly low (68%). Data qualifiers are not recommended based on one low spike result.

A field duplicate was submitted for these analyses and results are summarized in Appendix A. RPD between TSS results was high (72%). Because the RPD between laboratory duplicates was so low, no data qualifiers are recommended based solely on field duplicates.

A P P E N D I X A

Analytical Technologies, Inc.
POLYCYCLIC AROMATIC HYDROCARBONS
Water Field Duplicate Data Summary

COMPOUND	CP2-W-BI1	CP2-W-BI11	RPD(%)
Naphthalene	<0.05	<0.05	NC
Acenaphthylene	<0.20	<0.20	NC
Acenaphthene	<0.50	<0.50	NC
Fluorene	<0.20	<0.20	NC
Phenanthrene	<0.10	<0.10	NC
Anthracene	<0.10	.061	NC
Fluoranthene	<0.10	<0.10	NC
Pyrene	<0.10	<0.10	NC
Benzo(a)anthracene	<0.10	<0.10	NC
Chrysene	<0.10	<0.10	NC
Benzo(b)fluoranthene	<0.10	<0.10	NC
Benzo(k)fluoranthene	<0.10	<0.10	NC
Benzo(a)pyrene	<0.10	<0.10	NC
Indeno(1,2,3)pyrene	<0.20	<0.20	NC
Dibenz(a,h)anthracene	<0.10	<0.10	NC
Benzo(g,h,i)perylene	<0.20	<0.20	NC

NC = Not calculated
RPD = Relative Percent Difference

Analytical Technologies, Inc.
POLYCYCLIC AROMATIC HYDROCARBON ANALYSES
Sediment Field Duplicate Samples

COMPOUND	CP2-M-H2B	CP2-M-H12B	RPD(%)
Naphthalene	2,800	3,300	11.1
2-Methylnaphthalene	530	590	36.8
Acenaphthylene	ND	ND	NC
Acenaphthene	1,100	1,000	83.8
Fluorene	620	680	87.0
Phenanthrene	1400	1800	100
Anthracene	890	930	14.3
Dibenzofuran	ND	ND	NC
Fluoranthene	1,800	1,800	0
Pyrene	4,900	4,000	4.0
Benzo(a)anthracene	570	550	12.5
Chrysene	880	980	13.3
Benzo(b)fluoranthene	800	980	13.3
Benzo(k)fluoranthene	1,000	870	11.2
Benzo(a)pyrene	780	670	21.7
Indeno(1,2,3-cd)pyrene	330	260	32.1
Dibenz(a,h)anthracene	140	140	21.2
Benzo(g,h,i)perylene	300	260	33.3

NC = Not Calculated
ND = Not Detected
RPD = Relative Percent Difference

Analytical Technologies, Inc.
POLCYCLIC AROMATIC IIYDROCARBON ANALYSES
Sediment Field Duplicate Samples

COMPOUND	CP2-M-BI1	CP2-M-BI11	RPD(%)
Naphthalene	380	320	17.1
2-Methylnaphthalene	60	61	1.6
Acenaphthylene	<53	<54	NC
Acenaphthene	<53	<54	NC
Fluorene	64	79	21.0
Phenanthrene	320	340	6.1
Anthracene	110	110	0
Dibenzofuran	59	61	3.3
Fluoranthene	610	620	1.6
Pyrene	540	520	3.8
Benzo(a)anthracene	82	160	64.5
Chrysene	160	190	17.1
Benzo(b)fluoranthene	230	210	9.1
Benzo(k)fluoranthene	150	180	18.2
Benzo(a)pyrene	ND	150	NC
Indeno(1,2,3-cd)-pyrene	<53	<54	NC
Dibenz(a,h)-anthracene	<53	<54	NC
Benzo(g,h,i)-perylene	<53	<54	NC

Analytical Technologies, Inc.
POLYCYCLIC AROMATIC HYDROCARBON ANALYSES
Sediment Field Duplicate Samples

COMPOUND	CP2-M-D3E	CP2-M-D13E	RPD(%)
Naphthalene	<42	<36	NC
2-Methylnaphthalene	<42	<36	NC
Acenaphthylene	<42	<36	NC
Acenaphthene	<42	<36	NC
Fluorene	<42	<36	NC
Phenanthrene	60	75	22.2
Anthracene	<42	<36	NC
Dibenzofuran	<42	<36	NC
Fluoranthene	87	85	2.3
Pyrene	98	110	11.5
Benzo(a)anthracene	<42	<36	NC
Chrysene	<42	<36	NC
Benzo(b)fluoranthene	<42	<36	NC
Benzo(k)fluoranthene	<42	<36	NC
Benzo(a)pyrene	<42	<36	NC
Indeno(1,2,3-cd)-pyrene	<42	<36	NC
Dibenz(a,h)-anthracene	<42	<36	NC
Benzo(g,h,i)-perylene	<42	<36	NC

NC = Not Calculated
RPD = Relative Percent Difference

Analytical Technologies, Inc.
POLYCYCLIC AROMATIC IIYDROCARBON ANALYSES
Sediment Field Duplicate Samples

COMPOUND	CP2-M-F11B	CP2-M-F1B	RPD(%)
Naphthalene	2300	1900	19.0
2-Methylnaphthalene	86	66	26.3
Acenaphthylene	37	27	31.2
Acenaphthene	760	620	20.3
Fluorene	460	320	35.9
Phenanthrene	600	470	24.3
Anthracene	240	140	52.6
Dibenzofuran	370	300	20.9
Fluoranthene	1400	920	41.4
Pyrene	830	540	42.3
Benzo(a)anthracene	230	160	35.9
Chrysene	260	180	36.3
Benzo(b)fluoranthene	250	190	27.3
Benzo(k)fluoranthene	260	200	26.1
Benzo(a)pyrene	87	67	26.0
Indeno(1,2,3-cd)pyrene	<24	<24	NC
Dibenz(a,h)anthracene	<24	<24	NC
Benzo(g,h,i)perylene	<24	<24	NC

NC = Not Calculated
RPD = Relative Percent Difference

Analytical Technologies, Inc.
CONVENTIONALS ANALYSES
Water Field Duplicate Samples

Parameter	Duplicate		RPD(%)
	W-BI1	W-BI11	
Total Suspended Solids (mg/L)	34	72	72
Salinity (parts per thousand)	24	27	12

Triangle Laboratories, Inc.
PCDD/PCDF ANALYSIS
Sediment Field Duplicate Samples

Compounds	CP2-M-BI1	CP2-M-BI11	RPD (%)
2378-TCDD	1.8	1.6	11.8
12378-PeCDD	6.5	EMPC	NC
123478-HxCDD	19.1	79.5	122.5
123678-HxCDD	59.7	53.9	10.2
123789-HxCDD	60.7	151	85.3
1234678-HpCDD	1370	1300	5.2
OCDD	8880	8970	1.0
2378-TCDF	13.9	12.6	9.8
12378-PeCDF	5.5	7.2	26.8
23478-PeCDF	7.4	7.4	0.0
123478-HxCDF	33.3	35.1	5.3
123678-HxCDF	11.0	10.7	2.8
234678-HxCDF	3.4	24.7	151.6
123789-HxCDF	EMPC	6.1	NC
1234678-HpCDF	191	195	2.1
1234789-HpCDF	15.0	15.5	3.3
OCDF	336	358	6.3
Total TCDD	50.2	41.4	19.2
Total PeCDD	256	176	39.4
Total HxCDD	947	2040	73.2
Total HpCDD	2840	2850	0.4
Total TCDF	74.8	62.3	18.2
Total PeCDF	46.7	35.4	27.5
Total HxCDF	265	317	17.9
Total HpCDF	611	662	8.0

EMPC = Estimated Maximum Possible Concentration
NC = Not Calculated
RPD = Relative Percent Difference

Triangle Laboratories, Inc.
PCDD/PCDF ANALYSIS
Sediment Field Duplicate Samples

Compounds	CP2-M-F1B	CP2-M-F11B	RPD (%)
2378-TCDD	EMPC	ND	NC
12378-PeCDD	ND	ND	NC
123478-HxCDD	ND	ND	NC
123678-HxCDD	EMPC	ND	NC
123789-HxCDD	0.003	ND	NC
1234678-HpCDD OCDD	0.03	0.04	20.0
OCDD	0.11	0.14	24.0
2378-TCDF	0.006	0.006	0
12378-PeCDF	ND	ND	NC
23478-PeCDF	0.003	ND	NC
123478-HxCDF	0.002	0.004	66.7
123678-HxCDF	0.001	ND	NC
234678-HxCDF	EMPC	EMPC	NC
123789-HxCDF	ND	ND	NC
1234678-HpCDF	0.02	0.02	NC
1234789-HpCDF	ND	ND	NC
OCDF	0.01	ND	NC
Total TCDD	EMPC	0.01	NC
Total PeCDD	0.007	0.009	25.0
Total HxCDD	0.03	0.03	0
Total HpCDD	0.06	0.07	15.4
Total TCDF	0.02	0.02	0
Total PeCDF	0.01	0.007	35.3
Total HxCDF	0.01	0.03	100.0
Total HpCDF	0.04	0.03	28.6

EMPC = Estimated Maximum Possible Concentration
NC = Not Calculated
ND = Not Detected
RPD = Relative Percent Difference

Triangle Laboratories, Inc.
PCDD/PCDF ANALYSIS
Water Field Duplicate Samples

Compounds	CP2-M-BI1	CP2-M-BI11	RPD (%)
2378-TCDD	ND	ND	NC
12378-PeCDD	ND	ND	NC
123478-HxCDD	ND	ND	NC
123678-HxCDD	ND	EMPC	NC
123789-HxCDD	ND	ND	NC
1234678-HpCDD	0.03	0.03	NC
OCDD	0.28	0.35	22.2
2378-TCDF	ND	0.002	NC
12378-PeCDF	EMPC	0.002	NC
23478-PeCDF	ND	ND	NC
123478-HxCDF	ND	ND	NC
123678-HxCDF	ND	ND	NC
234678-HxCDF	EMPC	EMPC	NC
123789-HxCDF	ND	ND	0
1234678-HpCDF	ND	0.004	NC
1234789-HpCDF	ND	ND	NC
OCDF	0.02	0.03	40.0
Total TCDD	ND	ND	NC
Total PeCDD	EMPC	EMPC	NC
Total HxCDD	ND	0...006	NC
Total HpCDD	0.03	0.07	80.0
Total TCDF	ND	0.002	NC
Total PeCDF	EMPC	0.002	NC
Total HxCDF	EMPC	0.002	NC
Total HpCDF	ND	0.02	NC

EMPC = Estimated Maximum Possible Concentration
ND = Not Detected
RPD = Relative Percent Difference

Analytical Technoldogies, Inc.
Total Metals and Conventionals
Sediment Field Duplicate Samples

Parameter	Duplicate BI1	BI11	RPD (%)	Duplicate D3E	D13E	RPD (%)	Duplicate F1B	F11B	RPD (%)
Total Solids (%)	45	44	2.2	67	71	5.8	76	74	2.7
TOC (%)	NA	NA	NA	2.13	1.36	44	0.33	0.41	22
Antimony (mg/Kg)	ND	ND	NC	NA	NA	NA	NA	NA	NA
Arsenic (mg/Kg)	8.5	8.5	0	NA	NA	NA	NA	NA	NA
Cadmium (mg/Kg)	1.9	1.8	5.4	NA	NA	NA	NA	NA	NA
Chromium (mg/Kg)	28	28	0	NA	NA	NA	NA	NA	NA
Copper (mg/Kg)	43	44	2.3	NA	NA	NA	NA	NA	NA
Lead (mg/Kg)	42	40	4.9	NA	NA	NA	NA	NA	NA
Mercury (mg/Kg)	0.12	0.11	8.7	NA	NA	NA	NA	NA	NA
Nickel (mg/Kg)	23	22	4.4	NA	NA	NA	NA	NA	NA
Silver (mg/Kg)	0.70	0.71	1.4	NA	NA	NA	NA	NA	NA
Zinc (mg/Kg)	79	79	0	NA	NA	NA	NA	NA	NA

NA = Not Analyzed
ND = Sample result reported as not detected
NC = RPD not calculated due to undetected sample results
RPD = Relative Percent Difference

Soil Technologies, Inc.
Grain Size Distribution (% passing)
Sediment Field Duplicate Samples

Parameter	Duplicate BI1	BI11	RPD (%)	Duplicate F1B	F11B	RPD (%)	Duplicate E1F	E11F	RPD (%)
>4750 microns	100	100	0.0	100	99	1.0	100	100	0.0
4750-2000 microns	100	100	0.0	96	96	0.0	96	96	0.0
2000-850 microns	100	100	0.0	93	92	1.1	95	94	1.1
850-425 microns	99	99	0.0	79	78	1.3	88	85	3.4
425-250 microns	99	99	0.0	54	51	5.7	74	69	7.0
250-106 microns	96	96	0.0	24	21	13.3	40	36	10.5
106-75 microns	93	94	1.1	18	17	5.7	30	26	14.3
75-62.5 microns	91	91	0.0	15	13	14.3	25	21	17.4
62.5-31.2 microns	72	73	1.4	9	8	11.8	15	12	22.2
31.2-15.6 microns	48	49	2.1	6	6	0.0	11	9	20.0
15.6-7.8 microns	33	32	3.1	5	5	0.0	9	7	25.0
7.8-3.9 microns	22	21	4.6	4	4	0.0	6	5	18.1
3.9-1.9 microns	15	15	0.0	3	2	40.0	5	4	22.2
1.9-0.9 microns	11	11	0.0	2	2	0.0	4	3	28.6
0.9-0.4 microns	1	1	0.0	0	0	0.0	1	1	0.0

Analytical Technologies, Inc.
Chlorinated Phenols Analysis
Water Field Duplicate Samples

Compound	CP2-W-BI1	CP2-W-BI11	RPD%
Pentachlorophenol	<0.50	<0.50	NC
Tetrachlorophenol	<0.20	<0.20	NC
2,4,5-Trichlorophenol	<0.40	<0.40	NC
2,4,6-Trichlorophenol	<0.20	<0.20	NC
2,4-Dichlorophenol	<1.0	<1.0	NC
2-Chlorophenol	<50	<50	NC

NC = Not Calculated
RPD = Relative Percent Difference

Analytical Technologies, Inc.
Chlorinated Phenols Analysis
Sediment Field Duplicate Samples

Compound	CP2-W-BI1	CP2-W-BI11	RPD%
Pentachlorophenol	3.0	5.2	53%
Tetrachlorophenol	<11	<11	NC
2,4,5-Trichlorophenol	<11	<11	NC
2,4,6-Trichlorophenol	<11	<11	NC
2,4-Dichlorophenol	<44	<45	NC
2-Chlorophenol	<2200	<2300	NC

NC = Not Calculated
RPD = Relative Percent Difference

Analytical Technologies, Inc.
Chlorinated Phenols Analysis
Water Field Duplicate Samples

Compound	CP2-W-EIB	CP2-W-EIB (Dup)	RPD%
Pentachlorophenol	8.8	11.0	22%
Tetrachlorophenol	<5.0	<5.0	NC
2,4,5-Trichlorophenol	<5.0	6.1	NC
2,4,6-Trichlorophenol	<11	<12	NC
2,4-Dichlorophenol	<20	<20	NC
2-Chlorophenol	<1000	<1000	NC

NC = Not Calculated
RPD = Relative Percent Difference

A P P E N D I X B

Appendix B
Sequim Bay Reference Sample Summary

Compound	Reported Average Value	Calculated Standard Deviation	1st Analysis ATI	2nd Analysis ATI	3rd Analysis ATI
Naphthalene	73	28.62	<24	<24	<24
2-Methynaphthalene	93	41.03	47	31	<24
Acenaphthylene	89	20.05	<24	<24	<24
Acenaphthene	94	24.19	57	35	<24
Fluorene	105	28.66	85	65	<24
Phenanthrene	166	57.25	95	81	150
Anthracene	124	39.29	90	83	98
Fluoranthene	120	37.23	120	130	140
Pyrene	133	61.04	110	110	120
Benzo(a)anthracene	120	38.28	110	100	110
Chrysene	117	28.24	99	96	110
Benzo(b)fluoranthene	109	37.09	120	120	93
Benzo(a)pyrene	124	47.85	120	110	110
Indeno(1,2,3-cd)pyrene	58	39.51	<24	<24	<24
Dibenzo(a,b)anthracene	113	31.87	80	80	87
Benzo(g,h,i)perylene	111	39.32	84	<24	98
Pentachlorophenol	552	501.34	170	-	-

APPENDIX E

Biological Laboratory Reports

- Invert-Aid

OCT 2 5 1991
LANDAU ASSOCIATES,INC.

INVERT•AID
Diane E. Robbins
BIOLOGICAL CONSULTANT

8414 - 280TH STREET EAST
GRAHAM, WA 98338
(206) 846-2774

To: Ms. Leslie Matthews
Landau Associates
P.O. Box 1029
Edmonds. WA. 98020-9129

Regarding: Bioassays for Cascade Pole. Port of Olympia.

INVERT*AID has completed sediment bioassays as part of consulting services to Landau Associates for the Port of Olympia, Cascade Pole Site project. Bioassays conducted on sediments provided by Landau Associates included the Amphipod bioassay using *Rhepoxynius abronius*. the Echinoderm larval bioassay using *Dendraster excentricus*, and the Microtox saline extract bioassay. Results of these three tests are appended to this report.

Procedures for the bioassays followed standard procedures described in *Recommended Protocols for Conducting Laboratory Bioassays on Puget Sound Sediments* (PSEP 1986). Reference sediments were obtained by Landau Associates from Eld Inlet. These sediments were tested for sulfide content prior to test initiation. Sample El-1. with an interstitial sulfide concentration of .3 ppm, was chosen as the reference sample for this suite of tests. Control sediments were obtained from West Beach. Whidbey Island.

Amphipod bioassay. The data sheet for the amphipod test is appended. Amphipods were obtained from West Beach, Whidby Island, and held for 5 days prior to test initiation. Five replicates of each test were run along with five replicates of a negative control. A 96 hour LC_{50} (Cadmium chloride) value for this test was 1.327 mg Cd/L.

Results - Performance Standards		
Control Mean = 100% absolute	:	acceptable
Reference mean = 95% control	:	acceptable
Results - Regulatory		
C-3 mean survival = 20 =	:	non-hit
D-3 mean survival = 17.6 =	:	non-hit

Echinoderm larval bioassay. Results and data sheets for the larval bioassay are appended. Sand dollars were obtained from the Kopachuck State Park area, and were spawned immediately upon arrival at the laboratory. Fertilization was approximately 95% and $T_{initial}$ was 206.7 live larvae/10 ml. The test was run at 14°C, and generally followed the protocols of Dinnel and Stober, 1985: and the PSEP Draft Report, *Recommended Protocols for Conducting Laboratory Bioassay on Puget Sound Sediments*, April, 1990. The five replicates of each sample were gently aerated during the 55 hour test period. The Cadmium chloride EC_{50} for this test was 4.059 mg/L.

Normal larvae in Sample C-3 were equal to 63.7% of Control and normal larvae in sample D-3 were equal to 88.4% of Control.

Microtox: saline extraction . Samples were analyzed by Laucks Testing Laboratories, results are appended. No decrease in luminescence was detectable in Samples C-3, D-3, or E1-1.

Thank you for the opportunity to conduct these tests, if you have any questions please call.

Diane E. Robbins

Diane E. Robbins

October 23, 1991

CASCADE POLE- PORT OF OLYMPIA
ECHINODERM LARVAL BIOASSAY
AUGUST 26 TO AUGUST 29. 1991. 55 HOURS
Dendraster excentricus
RESULTS: PERFORMANCE STANDARDS
FERTILIZATION = 95% : $T_{initial}$ = 206.7 larvae/ml
Number of normal larvae/ml
CONTROL mean = 174.4 = 84.37% $T_{initial}$
REFERENCE MEAN = 198.4 = 95.98% $T_{initial}$
RESULTS REGULATORY
C-3 mean = 111 = 63.7% CONTROL
D-3 MEAN = 154.2 = 88.4% CONTROL

SAMPLE	NORMAL	ABNORMAL	MEAN NORMAL	MEAN ABNORMAL
Control			174.4 ± 27.1	9.6 ± 2.70
A	153	8		
B	221	10		
C	157	7		
D	171	9		
E	170	14		
REFERENCE (E1 1)			198.4 ± 10.6	4.2 ± 3.96
A	201	11		
B	195	4		
C	210	2		
D	204	3		
E	182	1		
C3			111 ± 7.78	2.8 ± 2.77
A	116	3		
B	102	5		
C	117	6		
D	117	0		
E	103	0		
D3			154 ± 27.43	3.2 ± 1.64
A	192	5		
B	175	2		
C	135	4		
D	136	4		
E	133	1		

Echinoderm Larval Bioassay 8-26-91 to 8-29-91

Cascade Pole. P. by Olympia Dendraster excentricus

Control					Ref (Eh I)					C-3					D-3				
A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
20-2	16	17	16-2	16	21-1	20-1	20	23	16	12-1	10-1	11	12	9	20-1	20	10	12	13
19-1	16-3	17	16	16-2	20-2	20-1	18	22	16	12-1	19-2	6-1	13	9	19-1	18	12	12	13
18-1	16-2	18-2	16	20-1	20-2	19-0	18	24	14	9	11	15	13	8	23-2	16-1	13	12	15
18	17-1	12-1	18-2	20-2	21-1	18	18-1	18-1	23-1	12	10	10	12	8	18-1	16-1	15-2	13-1	15
18	18-1	20-2	18-1	18-1	25-2	18	20	18-1	20	10	10	16-2	10	12	20	18	15-1	15	13
17	18	20	17-1	18-1	15-	18	22	20	20	13-1	9-1	9-1	10	13	18	18	15-1	15	13
17	20	18-1	17-1	18-3	20-2	20	23	20-1	19	13	9	9-1	9	13	18	16	13	15-3	13
18-1	21-3	18	17	17-2	19	20-2	20-1	21	19	12	11-1	15	9	15	19	17	15	12	12-1
20-2	21	17-1	18-1	15	20	21	16	22	18	11	12	15	10	06	17	17	15	15	12-
16-1	16	18	18-1	12-2	20	21	15	16	17	12	11	11-1	9	10	20	19	12	15	12
(153 + 221 + 157 + 171 + 170)					(201 + 195 + 210 + 204 + 182)					(116 + 102 + 117 + 117 + 103)					(192 + 175 + 135 + 136 + 133				
174.4 ± 27.2					198.4 ± 10.6					111 ± 7.78 (2.8 ab)					154.2 ± 27.45				
abnormal 9.6					abnormal 4.2					63.7% Control					(3.2 abnormal)				
84.4 Finitial										55.9% Ref									

Finitial = 20,670/L

Finitial Counts

Temperature −14°C

		Air
Day 1	↘	235
	↘	212
2	↘	220
	↘	189
3	↘	197
	↘	205
4	DR	209
	DR	222
		192
		186
		206.7

Sulfide 0

Nitrogen < .1

Mendocino Mariculture LARVAL TEST

Water Quality Data

SAMPLE		DAY 1	2	3	4
Control	pH	7.6	7.8	7.8	7.8
	O_2	7	7.1	7.2	7
	S	28	28	28	28
	T	14	14	14	14
	SO	4.1			4.1
	NH_3	4.1			4.1
Ref E1-1	pH	7.8	7.7	7.8	7.7
	O_2	7	7	6.8	7
	S	28	28	28	28
	T	14	14	14	14
	SO	.3 in sediment 4.1			4.1
	NH_3	4.1 in sediment 4.1			4.1
C-3	pH	7.8	7.8	7.7	7.8
	O_2	6.9	7	7	7.2
	S	28	28.5	28.5	28
	T	14	14	14	14
	SO	4.1			4.1
	NH_3	4.1			4.1
D-3	pH	7.8	7.8	7.8	7.8
	O_2	7.4	7.2	7	6.8
	S	28	28	28	28
	T	14	14	14	14
	SO	4.1			4.1
	NH_3	4.1			4.1
	pH				
	O_2				
	S				
	T				
	SO				
	NH_3				

Client: Landeau Assoc - Cascade Pole

Test begun 8-26-91 Test terminated 8-29-91

Samples aerated 53 hrs

EPA PROBIT ANALYSIS PROGRAM
USED FOR CALCULATING EC VALUES
Version 1.4

PORT OF OLYMPIA CASCADE POLE
FOO Echinoderm

Conc.	Number Exposed	Number Resp.	Observed Proportion Responding	Adjusted Proportion Responding	Predicted Proportion Responding
1.9600	207	30	0.1449	0.1449	0.0791
3.9400	207	75	0.3623	0.3623	0.4769
5.9000	207	142	0.6860	0.6860	0.7657
7.8700	207	201	0.9710	0.9710	0.9003
11.8000	207	207	1.0000	1.0000	0.9807

Chi - Square Heterogeneity = 46.158

****
* WARNING *
*
* Significant heterogeneity exists. The results reported *
* for this data set may not be valid. The results should *
* be interpreted with appropriate caution. *
****

Mu = 0.608478
Sigma = 0.224066

Parameter	Estimate	Std. Err.	95% Confidence Limits
Intercept	2.284382	0.655755	(0.197769, 4.370996)
Slope	4.462967	0.921388	(1.531111, 7.394823)

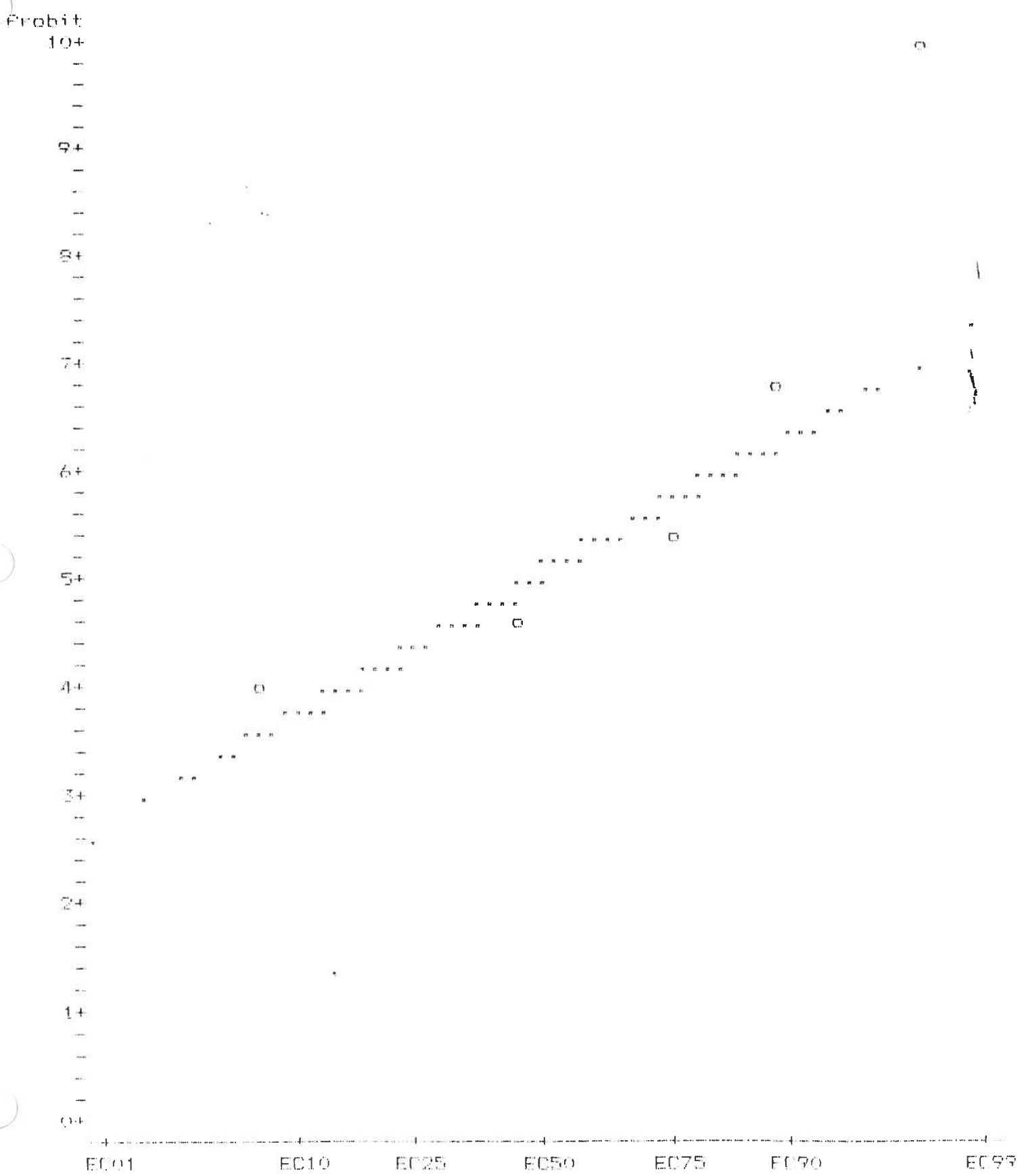
Theoretical Spontaneous Response Rate = 0.0000

Estimated EC Values and Confidence Limits

Point	Conc.	Lower 95% Confidence Limits	Upper 95% Confidence Limits
EC 1.00	1.2225	0.0850	2.2218
EC 5.00	1.7374	0.2324	2.7992
EC10.00	2.0956	0.3950	3.1849
EC15.00	2.3782	0.5628	3.4891
EC50.00	4.0596	2.2483	5.7311
EC85.00	6.9295	5.0078	16.8845
EC90.00	7.8640	5.5985	23.5704
EC95.00	9.4852	6.4823	39.3654
EC99.00	13.4810	8.2927	106.0067

8-26-91 ; 8-29-91
POU Echinoderm

PLOT OF ADJUSTED PROBITS AND PREDICTED REGRESSION LINE



Amphipod BIOASS

SAMPLE C-3 IS = _____ | SAMPLE D-3 IS = _____ | SAMPLE EL-1 IS = _____ | SAMPLE Control IS = 29.5 | SAMPLE _____ IS = _____

Day 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10

pH
O
S
T
SO
NH_3

A	7.3 7.3 7.3 7.4 7.4 7.4 7.4 7.4 7.6 7.6 / 8 8 8 8 8 8 8 8 8 8 / 28 28 28 28 28 28 28 28 28 28 / 15 → 15 / 0.1 0.1	7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 7.7 / 8 8 8 8 8 8 8 8 8 8 / 28 28 28 28 28 28 28 28 28 28 / 15 → 15 / 0.1 0.1	7.8 7.8 7.8 7.8 7.8 7.8 7.8 7.8 7.8 7.8 / 8 8 8 8 8 8 8 8 8 8 / 28 28 28 28 28 28 28 28 28 28 / 15 → 15 / 0.3 0.1	7.9 7.9 7.9 7.9 7.9 7.9 8 8 8 8 / 8 8 8 8 8 8 8 8 8 8 / 28 28 28 28 28 28 28 28 28 28 / 15 → 15 / 0.1 0.1
A	0 0 0 0 0 0 0 0 0 0	2 2 1 1 2 2 2 3 2 2	0 0 0 0 1 0 1 0 1 1	0 0 0 0 0 0 0 0 0 0
B	0 0 0 0 0 0 0 0 0 1	1 1 1 1 1 1 0 1 1 1	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0
C	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0
D	0 0 0 0 0 0 0 0 0 0	2 3 2 2 2 0 3 3 0 4	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0
E	0 0 0 0 0 0 0 0 0 0	3 3 3 2 2 2 2 2 2 3	1 0 1 1 1 0 0 0 1 1	0 0 0 0 0 0 0 0 0 0

e

SURVIVAL	20-20-20-20-20	16-18-19-16-19	18-19-19-20-19	20-20-20-20-20
MEAN SURV. ±SD	20	17.6 ± 1.51	19 ± .70	20
MEAN e ± SD	0	1.52 ± 1.07	.2 ± .40	0

EL-8

SAMPLE _____ IS = _____ | SAMPLE _____ IS = _____ | SAMPLE _____ IS = _____ | SAMPLE _____ IS = _____ | SAMPLE _____ IS = _____

Day 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10 | 1 2 3 4 5 6 7 8 9 10

pH
O
S
T
SO
NH_3

A				
A				
B				
C				
D				
E				

e

SURVIVAL				
MEAN SURV. ±SD				
MEAN e ± SD				

CLIENT Landau Assoc PERMIT # Port of Olympia LOCATION Cascade Pole

DATE BEGUN 8-26-91 DATE TERMINATED 9-5-91

O (Dissolved O_2 ppm)
S (salinity, ppt)
SO (sulfide, ppm)
T (Temperature, °C)
NH_3 (ammonia, ppm)
e (# amphipods emerged from sediment)
IS (Interstitial salinity)

INVERT * AID

EPA PROBIT ANALYSIS PROGRAM
USED FOR CALCULATING EC VALUES
Version 1.4

PORT OF OLYMPIA, CASCADE POLE

POO amphipod

Conc.	Number Exposed	Number Resp.	Observed Proportion Responding	Adjusted Proportion Responding	Predicted Proportion Responding
0.2400	30	2	0.0667	0.0667	0.0430
0.4800	30	5	0.1667	0.1667	0.1536
0.9600	30	9	0.3000	0.3000	0.3725
1.4400	30	12	0.4000	0.4000	0.5326
1.9200	30	24	0.8000	0.8000	0.6445

Chi - Square Heterogeneity = 6.406

Mu = 0.122989
Sigma = 0.432629

Parameter	Estimate	Std. Err.	95% Confidence Limits	
Intercept	4.715716	0.115758	(4.488830,	4.942603)
Slope	2.311450	0.422765	(1.482832,	3.140069)

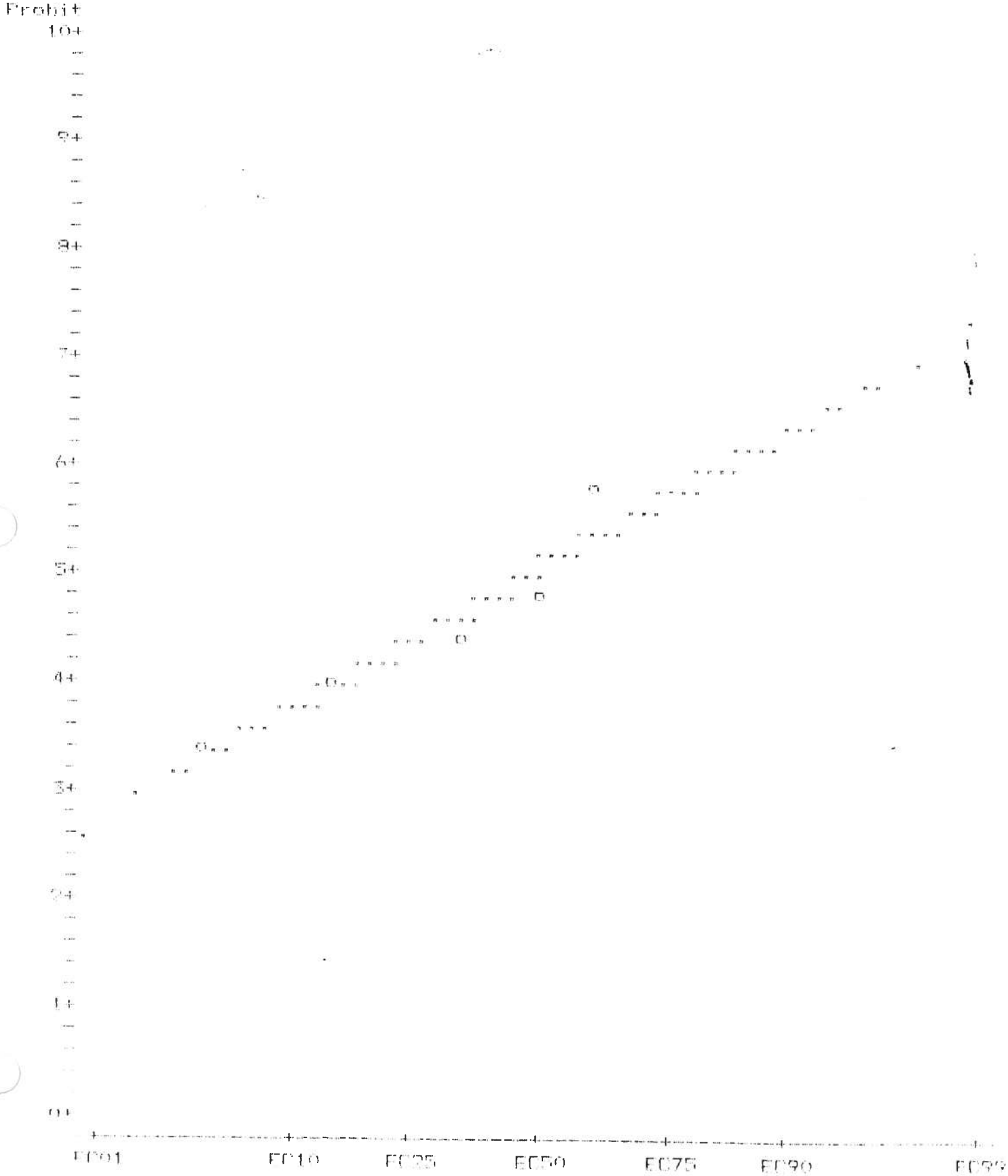
Theoretical Spontaneous Response Rate = 0.0000

Estimated EC Values and Confidence Limits

Point	Conc.	Lower 95% Confidence Limits	Upper 95% Confidence Limits
EC 1.00	0.1308	0.0406	0.2314
EC 5.00	0.2578	0.1151	0.3876
EC10.00	0.3703	0.1991	0.5141
EC15.00	0.4727	0.2863	0.6262
EC50.00	1.3274	1.0578	1.8117
EC85.00	3.7271	2.5001	8.1946
EC90.00	4.7582	3.0151	11.9021
EC95.00	6.8331	3.9667	20.7586
EC99.00	13.4714	6.5981	59.2572

PUU Amphipod

PLOT OF ADJUSTED PROBITS AND PREDICTED REGRESSION LINE



Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

CLIENT: Invert-Aid
8414 280th St. E
Graham, WA 98338
ATTN: Diane Robbins

LABORATORY NO. 9108B09

DATE: August 28, 1991

REPORT ON: SEDIMENT

SAMPLE IDENTIFICATION: Submitted 08/22/91 and identified as shown:

1) EI-2 08/15/91
2) EI-1 08/13/91
3) C3 08/13/91
4) D3 08/13/91

Sample #1 was on hold without analysis

TESTS PERFORMED AND RESULTS:

Samples were analyzed in accordance with Recommended Protocols for Conducting Laboratory Bioassays on Puget Sound Sediments, (Tetra Tech, 1986), employing the saline extraction, with results attached.

Respectfully submitted,

Laucks Testing Laboratories, Inc.

Mark Babich

MB:emt

This report is submitted for the exclusive use of the person, partnership, or corporation to whom it is addressed. Subsequent use of the name of this company or any member of its staff in connection with the advertising or sale of any product or process will be granted only on contract. This company accepts no responsibility except for the due performance of inspection and/or analysis in good faith and according to the rules of the trade and of science.

Laucks 83 years
Testing Laboratories, Inc.
940 South Harney St., Seattle, WA 98108 (206) 767-5060 FAX 767-5063
Chemistry, Microbiology, and Technical Services

APPENDIX

Microtox Analysis Report

This report is submitted for the exclusive use of the person, partnership, or corporation to whom it is addressed. Subsequent use of the name of this company or any member of its staff in connection with the advertising or sale of any product or process will be granted only on contract. This company accepts no responsibility except for the due performance of inspection and/or analysis in good faith and according to the rules of the trade and of science.

Microtox Analysis Report
Saline Extraction

Sample: PHENOL 162ppm
Analysis Date: 8/28/91

	Rep. 1	Rep. 2	Mean	RPD
15 Minute EC50:	13.283	14.315	13.799	1.9%
95% CI:				
Upper Limit	15.057	16.921		
Lower Limit	11.718	12.110		

Percent Decrease in Luminescence

Concentration	Rep. 1	Rep. 2
10.1250	43.8%	41.0%
20.2500	59.1%	59.0%
40.5000	74.0%	73.4%
81.0000	83.2%	83.1%

Significant Dose Response Relationship

Rep. 1	Rep. 2
0.9993	0.9986

Legend:

*NT = Not Toxic
**NLD = No Luminescence Decrease
N/C = Not able to calculate

Microtox Analysis Report
Saline Extraction

Sample: 9108B09-2
Analysis Date: 8/28/91

	Rep. 1	Rep. 2	Mean	RPD
15 Minute EC50:	NT*	NT*	N/C	N/C
95% CI:				
Upper Limit	N/C	N/C		
Lower Limit	N/C	N/C		

Percent Decrease in Luminescence

Concentration	Rep. 1	Rep. 2
6.2500	NLD**	NLD**
12.5000	NLD**	NLD**
25.0000	NLD**	NLD**
50.0000	NLD**	NLD**

Significant Dose Response Relationship

Rep. 1	Rep. 2
N/C	N/C

Legend:

*NT = Not Toxic
**NLD = No Luminescence Decrease
N/C = Not able to calculate

Microtox Analysis Report
Saline Extraction

Sample: 9108B09-3
Analysis Date: 8/28/91

	Rep. 1	Rep. 2	Mean	RPD
15 Minute EC50:	NT*	NT*	N/C	N/C
95% CI:				
Upper Limit	N/C	N/C		
Lower Limit	N/C	N/C		

Percent Decrease in Luminescence

Concentration	Rep. 1	Rep. 2
6.2500	NLD**	NLD**
12.5000	NLD**	NLD**
25.0000	NLD**	NLD**
50.0000	NLD**	NLD**

Significant Dose Response Relationship

Rep. 1	Rep. 2
N/C	N/C

Legend:

*NT = Not Toxic
**NLD = No Luminescence Decrease
N/C = Not able to calculate

Microtox Analysis Report
Saline Extraction

Sample: 9108B09-4
Analysis Date: 8/28/91

	Rep. 1	Rep. 2	Mean	RPD
15 Minute EC50:	NT*	NT*	N/C	N/C
95% CI:				
Upper Limit	N/C	N/C		
Lower Limit	N/C	N/C		

Percent Decrease in Luminescence

Concentration	Rep. 1	Rep. 2
6.2500	NLD**	NLD**
12.5000	NLD**	NLD**
25.0000	NLD**	NLD**
50.0000	NLD**	NLD**

Significant Dose Response Relationship

Rep. 1	Rep. 2
N/C	N/C

Legend:

*NT = Not Toxic
**NLD = No Luminescence Decrease
N/C = Not able to calculate

INVERT•AID

Diane E. Robbins

BIOLOGICAL CONSULTANT

8414 - 280TH STREET EAST
GRAHAM, WA 98338
(206) 846-2774

PORT OF OLYMPIA - CASCADE POLE

BENTHIC INFAUNA DIVERSITY

MATERIALS, METHODS

In general all procedures used in this project were according to accepted PSEP Protocols of 1986. Logs were kept of all activities. Reference specimens are kept at the INVERT*AID Laboratories.

Washed sediment samples were received by INVERT*AID laboratories on August 19, 1991. They were rescreened on September 3-4, 1991 using a .5 mm mesh sieve, and transferred to 70% ethanol solution according to PSEP Protocols. Samples were sorted and 20 % of each sample resorted as described in PSEP protocols. Due to the amount of detritus included in the .5 mm samples, and the time involved in the sorting procedure, only one-half of six replicates (two at each station) were completed. This was done after discussion with, and with the approval of, Landau Associates.

Organisms were identified to the lowest possible taxon. Molluscs were identified by Ms Julia Schroeder, Crustaceans by Mr Kevin Li, and Polychaetes by Ms Diane Robbins. Polychaete identifications were checked against the EPA Polychaete Voucher collection held at the Department of Ecology Sediment Monitoring Unit Laboratories in Tumwater.

RESULTS

Results are appended.

Diane E. Robbins
December 10, 1991

BENTHIC INFAUNA DIVERSITY : PORT OF OLYMPIA (CASCADE POLE)

			CRUSTACEA		POLYCHAETA		MOLLUSCA	
STATION	REP	% SORT	# TAXA	NUMBER	# TAXA	NUMBER	# TAXA	NUMBER
CP2-M-E4	1	100	8	50	6	46	4	179
	2	50	6	33	6	40	3	117
	3	50	5	26	5	19	4	121
	4	100	6	26	6	27	3	16
	5	100	4	25	8	51	4	19
	TOTAL		10	160(219)	12	183(242)	5	452(690)
CP2-M-E11	1	50	6	220	4	14	5	44
	2	100	5	161	2	4	1	4
	3	100	4	137	3	4	2	3
	4	50	5	143	6	13	2	18
	5	100	5	26	3	7	4	67
	TOTAL		9	687(1050)	12	42(69)	7	136(198)
CP2-M-C2	1	100	2	2	4	52	2	4
	2	100			4	79		
	3	50	3	4	4	16	1	4
	4	50			6	104		
	5	100			5	31	1	12
	TOTAL		5	6(8)	7	282(402)	2	20(24)

Totals are expressed in actual numbers with numbers to be expected with 100% sort in parentheses

Inert-Aid Labs

PORT OF OLYMPIA - SORTING

		COLL.	SORT.
1-QUART ¼ full	CP2-M-E4 GRAB #4	8-14-91 1-200 ML JAR	9-9-91 3 hrs
1-QUART 1/8 full	CP2-M-E11 GRAB #3	1-200 ML JAR 8-15-91	2 hrs 9-9-91
1-QUART full	CP2-M-C2 GRAB #5	1-200 ML JAR 8-14-91	3 hrs 9-10-91
1-QUART ⅓ full	CP2-M-E4 GRAB # 1	1-200 ML JAR 8-14-91	4 hrs 9-10,11-91
1-QUART ½ full	CP2-M-E11 GRABS # 5	2-200 ML JARS 8-15-91	2 hrs 9-11-91
1-QUART full	CP2-M-C2 GRAB # 2	1-200 ML JAR 8-14-91	2½ hrs 9-11-91
1-QUART ⅔ full	CP2-M-C2 GRAB # 1	1 200 ML JAR 8-14-91	2½ hrs 9-11-91
1-QUART 1/8 full	CP2-M-E11 GRAB # 2	1-200ML JAR 8-15-91	1½ hrs 9-16-91
1-QUART ⅓ full	CP2-M-E4 GRAB #5	2-200 ML JARS 8-14-91	4 hrs 9-16-91
* 1-QUART full	CP2-M-C2 GRAB #3	1-200ML JAR SORTED HALF 8-14-91	2 hrs 9-17-91
* 1-QUART 3/4 full	CP2-M-C2 GRAB # 4	1-200 ML JAR SORTED HALF	2 hrs 9-17-91

PORT OF OLYMPIA – SORTING

		COLL	SORT
1-QUART ½ full	CP2-M-EI1 GRAB # 4	SORTED HALF 8-15-91 2-200H JARS	9-19-91 2 hrs
1-QUART 3/4 full	CP2-M-EI1 GRAB # 1	8-15-91 1-200ML JAR SORTED HALF	2 hrs 9-19-91
1-QUART ⅓ full	CP2-M-E4 GRAB # 3	8-14-91 1-200ML JAR SORTED HALF	2½ hrs 9-23-91
1-QUART ½ full	CP2-M-E4 GRAB # 2	8-14-91 1-200ML JAR SORTED HALF	2½ hrs 9-23-91

Inert-Acid Labs.
8414 280th E.
98338
846-2774

Machine Sorted 6

LANDAU ASSOCIATES, INC.
Edmonds, WA (206) 778-0907
FAX (206)778-6409

Chain-of-Custody Record

1170

Date 8/19/91
Page 1 of 1

Project Cascade Pole Sed RI Job No. 21-5.52
Client Port of Olympia
Project Location Olympia, WA
Sampler's Name MJH

Testing Parameters / Observations/Comments: Following Phase II Sediments Work Plan

Sample No.	Date	Time 1820	Matrix ~~Location~~	No. of Containers	Amphipod Bioassay	Echinoderm Larval	Microtox		Benthic Infauna Overall						Observations/Comments
CP2-m-C3	8/13/91	~~1715~~	Sediment	5	X	X	X								
CP2-m-D3	8/13/91	1920		5	X	X	X								
CP2-m-EI1	8/15/91	1200		6	X	X	X								* Only one reference sample
CP2-m-EI2	8/15/91	1220		6	X	X	X								should be run for bioassays
															depending on concentrations
CP2-m-E4	8/14/91	0850	Grab #1	1					X						of sulfide and ammonium.
CP2-m-E4		0900	Grab #2	1					X						Screen sediments first
CP2-m-E4		0915	Grab #3	1					X						call Leslie Mathews with
CP2-m-E4		0920	Grab #4	1					X						results and we will pick
CP2-m-E4		0930	Grab #5	1					X						the reference sample for
CP2-m-C2		1105	Grab #1	1					X						bioassays.
CP2-m-C2		1115	Grab #2	1					X						
CP2-m-C2		1130	Grab #3	1					X						
CP2-m-C2		1145	Grab #4	1					X						
CP2-m-C2		1200	Grab #5	1					X						

Special Shipment/Handling or Storage Requirements

Method of Shipment Hand Delivery

Relinquished by	Received by	Relinquished by	Received by
Signature: Mark J. Herrenkohl	Signature: Greg Landau	Signature: Greg Landau	Signature: Debbie J. Conley
Printed Name: MARK J. Herrenkohl	Printed Name: Greg Landau	Printed Name: Greg Landau	Printed Name: DEBBIE CONLEY
Company: Landau, Assoc	Company: Landau Assoc	Company: Landau Assoc	Company: INVERT BIO LAB
Date 8/19/91 Time 1015	Date 8/19/91 Time 10:45	Date 8/19/91 Time 12:45	Date 8/19/91 Time 12:45

3/90

WHITE COPY - Project File YELLOW COPY - Laboratory PINK COPY - Client Representative

LANDAU ASSOCIATES, INC.
Edmonds, WA (206) 778-0907
FAX (206)778-6409

Chain-of-Custody Record

1175

Date 2/

Page 1 of 2

Project [illegible] Job No. [illegible]

Client [illegible]

Project Location [illegible]

Sampler's Name [illegible]

Testing Parameters

Benthic Organisms & Tetramin

Further the Phase II Sediments Work Plan

Sample No.	Date	Time	Matrix Location	No. of Containers		Observations/Comments
[illegible]	8/15/91	1030	Comp #1 Sediment	1	X	
[illegible]	"	1050	Comp # 2 "	1	X	
[illegible]	"	1150	Comp # 3 "	1	X	
[illegible]	"	1130	Comp # 4 "	1	X	
[illegible]	↓	1200	Comp #5 ↓	1	X	

Special Shipment/Handling or Storage Requirements

Method of Shipment Hand Deliver

Relinquished by	Received by	Relinquished by	Received by
Signature [illegible]	Signature [illegible]	Signature [illegible]	Signature [illegible]
Printed Name Mark J. Heinzkill	Printed Name [illegible]	Printed Name [illegible]	Printed Name [illegible]
Company Landau Assoc.	Company [illegible]	Company [illegible]	Company [illegible]
Date 8/15/91 Time 1645	Date 8/16/91 Time 1045	Date 8/16/91 Time 1345	Date 8/16/91 Time 1345

E-22

3/90

WHITE COPY - Project File YELLOW COPY - Laboratory PINK COPY - Client Representative

Amphipod BIOASSAY

	SAMPLE	IS =
1	C-3	29
2	D-3	29
3	EL-1	28.5
4	Cont	29.5
5		

Day 1 2 3 4 5 6 7 8 9 10

pH
O
S
T
SO
NH_3
e
e
e
e
e

	1	2	3	4
SURVIVAL	20-20-20-20-20	16-18-19-16-19	18-19-19-20-19	20-20-20-20-20
MEAN SURV. ±SD	20	17.6 ± 1.51	19 ± .70	20
MEAN e ± SD	0	1.52 ± 1.07	.2 ± .40	0

	SAMPLE	IS =
1		
2		
3		
4		
5		

Day 1 2 3 4 5 6 7 8 9 10

pH
O
S
T
SO
NH_3
e
e
e
e
e

	1	2	3	4
SURVIVAL				
MEAN SURV. ±SD				
MEAN e ± SD				

CLIENT Landau Assoc PERMIT # Port of Olympia LOCATION Cascade Pole

DATE BEGUN 8-26-91 DATE TERMINATED 9-5-91

O (Dissolved O_2 ppm)
S (salinity, ppt)
SO (sulfide, ppm)
T (Temperature, °C)
NH_3 (ammonia, ppm)
e (# amphipods emerged from sediment)
IS (Interstitial salinity)

INVERT * AID

TAXONOMIST COUNT SHEETS

PROJECT NAME Cascade Pole PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE 10-30-91 PAGE 1 OF 2

STATION # CP2-M-EI1 REPLICATE 5 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
Scleroplax granulata	2		
Pinnotheridae	3		
Leucon subnasica	11		
Corophium salmonis	8		
Crangonidae	3		

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE 10-30-91 PAGE _____ OF _____

STATION # CP2-M-EI1 REPLICATE 4 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
Crangon nigricauda	1		
Crangonidae	4		
Leucon subnasica	17		
Pinnotheridae	11		
Corophium salmonis	110		

PROJECT NAME ~~The Grays Control Project~~ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE 10-30-91 PAGE 1 OF 1

STATION # CP2-M-EI1 REPLICATE 3 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
Hemigrapsus oregonensis	2		
Pinnotheridae	15		
Corophium salmonis	119		
Leucon subnasica	1		

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE 10-28-91 PAGE 2 OF 2

STATION # CP2-M-EI1 REPLICATE 2 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
Leucon subnasica	5		
Corophium salmonis	95		
Pinnotheridae	60		
Upogebia pugettensis	1		

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE 11-1-91 PAGE ____ OF ____

STATION # CP2-M-EI1 REPLICATE 1 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
Pinnixa sp.	9		
Scleroplax granulata	7		
Pinnotheridae	4		
Leucon subnasica	3		
Corophium salmonis	198		
Balanus sp.	2		

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE 11-1-91 PAGE ____ OF ____

STATION # CPZ-M-E4 REPLICATE 3 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
PINNIXA SP.	7		
LEUCON SUBNASICA	15		
CRANGONIDAE	1		
CAROPHIUM SALMONI	1		
PINNOTHERIDAE	2		

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE 11-1-91 PAGE ____ OF ____

STATION # CPZ-M-E4 REPLICATE 2 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
LEUCON SUBNASICA	9		
PINNIXA SP.	11		
Scleroplax granulata	1		
PINNOTHERIDAE	6		
CRANGONIDAE	1		
Foecitas lovialcida	5		

TAXONOMIST COUNT SHEETS

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE 11-1-91 PAGE ____ OF ____

STATION # CPZ-M-E4 REPLICATE 1 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
Upogebia pugettensis	1		
Scleroplax granulata	7		
PINNIXA SP.	9		
CRANGON FRANCISCORUM	1		FRANCISCORUM
CRANGONIDAE	5		
LEUCON SUBNASICA	12		
Grandidierella japonica	1		
PINNOTHERIDAE	14		

TAXONOMIST COUNT SHEETS

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE 11-1-91 PAGE ____ OF ____

STATION # CP2-M-E'1 REPLICATE 5 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
PINNIXA sp.	6		
Cryptoniidae	3		
Brachyura	1		megalops
Leucon subnasica	16		

TAXONOMIST COUNT SHEETS

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE 11-1-91 PAGE ____ OF ____

STATION # CP2-M-E'1 REPLICATE 4 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
PINNIXA sp.	8		
Scleroplax granulata	1		
Leucon subnasica	11		
Eorophium salmonis	3		
Crangon franciscorum	1		-franciscorum
Crangonidae	2		

PROJECT NAME [illegible] PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE 11-1-91 PAGE 1 OF 1

STATION # CP2-M-C2 REPLICATE 3 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
Leucon subnasica	2		
Cranyonidae	1		
Grandidierella japonica	1		

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Kevin Li DATE _____ PAGE _____ OF _____

STATION # CP2-M-C2 REPLICATE 1 DEPTH _____

MAJOR TAXON Arthropoda

	COUNT	TO REF. COLLECTION	COMMENTS
Corophium brevis	1		
Pinnixa sp.	1		

Taxon Identification Sheet

PROJECT NAME CASCADE POLE PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Robbins DATE _____ PAGE 1 OF 1

STATION CP2-M-EI1

MAJOR TAXON POLYCHAETA

	TO REF.	TAXON	COMMENTS	NODC CODE	Count
GRAB 5		Glycinde picta			3
		Glycera americana			1
		Capitella capitata			3
GRAB 4		Glycinde picta			5
		Glycera americana			1
		Goniada brevipalpa			3
		Cheilonereis cyclurus			1
		Spiophanes berkeleyorum			2
		Polydora sp.			1
GRAB 3		Glycinde armigera			2
		Capitella capitata			1
		Sigambra tentaculata			1
GRAB 2		Glycinde armigera			3
		Capitella capitata			1
GRAB 1		Glycinde armigera			8
		Scoloplos armiger			2
		Harpinia mutilis			3
		Microprotopus dubius			1

Taxon Identification Sheet

PROJECT NAME Corrode Pole PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Robbins DATE 12-01-91 PAGE 1 OF 1

STATION CP2-M-C2

MAJOR TAXON Polychaeta

	TO REF.	TAXON	COMMENTS	NODC CODE	Count
Grab 5		Neanthes brandti			1
		Capitella capitata			3
		Platynereis bicanaliculata			5
		Eypatis brevipalpa			1
		Polydora ligni			21
Gr 4		Platynereis bicanaliculata			7
		Capitella capitata			30
		Eypatis brevipalpa			2
		Polydora ligni			60
		~~Prionо~~ Prinospio steenstrupi			4
		Polydora sp.			1
GRAB 3	1	Platynereis bicanaliculata			4
		Sigambra bassi			2
		Prinospio steenstrupi			2
		Polydora sp			8
GRAB 2		Platynereis bicaneculata			4
		Capitella capitata			41
		Prionospio steenstrupi			2
		Polydora ligni			32
GRAB 1		Platynereis bicanaliculata			7
		Capitella capitata			15
	1	Polydora ligni			28
		Prionospio steenstrupi			2

Taxon Identification Sheet

PROJECT NAME Cascade Pole PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST Robbins DATE 12-01-91 PAGE 1 OF 1

STATION CP2-M-E4

MAJOR TAXON Polychaeta

	TO REF.	TAXON	COMMENTS	NODC CODE	Count
GRAB 5		Glycinde picta			11
		Glycera americana			2
		Goniada brevipalpa			3
		Spiophanes berkeleyorum			29
		Polydora sp			1
		Sigambra bassi			7
		Capitella capitata			4
		Nephtys caeca			1
GRAB 4		Glycinde picta			4
		Glycinde armigera			4
		Glycera americana			2
		Goniada brevipalpa			1
		Spiophanes berkeleyorum			15
		Sigambra bassi			1
GRAB 3	1	glycinde picta			6
		Sigambra bassi			1
		Goniada brevipalpa			4
	1	Spiophanes berkeleyorum			7
	1	glycera americana			1
GRAB 2		Spiophanes berkeleyorum			12
	1	Prionospio cirrifera			7
		Polydora sp			2
		Glycinde picta			16
	1	Leitoscoloplos pugettensis			1
		Goniada brevipalpa			2
GRAB 1		Spiophanes berkeleyorum			26
		Goniada brevipalpa			3
		Glycinde picta			11
		Polydora sp			2
		Glycinde americana			3
		Leitoscoloplos pugettensis			1

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-C2 ~~REPLICATE~~ GRAB 1

MAJOR TAXON MOLLUSCA

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Mya arenaria			2
	Macoma nasuta			2

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-C2 ~~REPLICATE~~ GRAB 3

MAJOR TAXON MOLLUSCA

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Mya arenaria			4

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHRIEVER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-C2 ~~GRAB~~ REPLICATE 5

MAJOR TAXON MOLLUSCA

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Mya arenaria			12

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-E4 GRAB ~~REPLICATE~~ 1

MAJOR TAXON MOLLUSCA

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Macoma nasuta			168
	Macoma balthica			3
	Mya arenaria			2
	Diaphana sp.			2

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-E2 GRAB REPLICATE 2

MAJOR TAXON MOLLUSCA

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Macoma nasuta			11
	Mya arenaria			4
	Diaphana sp.			2

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-B4 REPLICATE GRAB 3

MAJOR TAXON MOLLUSCA

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Macoma nasuta			115
	Mysella tumida			2
	Mya arenaria			1
	Diaphana sp.			2

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-E4 GRAB REPLICATE 4

MAJOR TAXON _____

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Macoma nasuta			12
	Mya arenaria			2
	Diaphana sp.			2

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-E4 GRAB ~~REPLICATE~~ 5

MAJOR TAXON MOLLUSCA

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Macoma nasuta			8 + 4
	Mya arenaria			1 + 3
	Mysella tumida			2
	Diaphana sp.			1
				JAR 1 JAR 2

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-24-91 PAGE 1 OF 1

STATION CP2-M-BI GRAB ~~REPLICATE~~ 1

MAJOR TAXON MOLLUSCA

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Macoma nasuta			26
	Mysella tumida			14
	Mya arenaria			2
	Macoma sp.			1
	Melanochlamys sp.			1

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-EI1 ~~REPLICATE~~ GRAB 2

MAJOR TAXON MOLLUSCA

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Mya arenaria			4

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-BH ~~REPLICATE~~ GRAB 3

MAJOR TAXON MOLLUSCA

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Mya arenaria			2
	Mytilus edulis			1

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-EH ~~REPLICATE~~ GRAB 4

MAJOR TAXON MOLLUSCA

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Macoma nasuta			57+2
	Prototnaca staminea			1 JAR 1 JAR 2

Taxon Identification Sheet

PROJECT NAME _____ PROJECT NUMBER _____ SAMPLING DATE _____

TAXONOMIST J. SCHROEDER DATE 10-28-91 PAGE 1 OF 1

STATION CP2-M-EI1 ~~GRAB~~ REPLICATE 5

MAJOR TAXON Mollusca

TO REF.	TAXON	COMMENTS	NODC CODE	Count
	Macoma nasuta			8+46
	Mya arenaria			1+3
	Mysella tumida			1
	Diaphana sp.			8
				STAR 1 STAR 2

APPENDIX F

Resuspension Analysis

- Hartman Associates

CASCADE POLE SEDIMENT RESUSPENSION ANALYSIS

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SUMMARY

This report is provided for the information of Landau Associates, Inc.

In the course of this study, it was determined that contaminated sediments at the Cascade Pole Superfund Site were vulnerable to resuspension and transport out of the identified area of contamination. It was determined that this transport would occur due to two mechanisms, both of them related to wind waves.

The predominant transport mechanism will be longshore drift to the east caused by small waves generated by north and northwest winds. This transport to the east will move contaminated sediments toward the East Bay Marina basin, where the sediments will settle out in deeper water.

The second mechanism will be the action of infrequent large storm waves. These waves will move contaminated sediments offshore into deep water. It was calculated that sediments moved into water deeper than -17 MLLW would be deposited and would be beyond the reach of further resuspension by waves.

A recommendation was made to consider capping as a measure of preventing the transport of the contaminated sediments in the nearshore region.

STUDY OBJECTIVE

The objective of this study was to describe the natural environmental processes of shoreline sediment transport occurring at the Cascade Pole Superfund Treatment Site and to quantify sediment transport from the site. This was accomplished utilizing existing data to describe the wave climate, the local nearshore current and the shoreline sediment characteristics. The data was applied and longshore transport calculated, by standard coastal-engineering analysis methodology.

SITE DESCRIPTION

The study site is on the north-eastern tip of the isthmus which divides Budd Inlet into East and West Bays. This site is the former location of a creosote treatment plant for Cascade Pole. Contaminated sediments have been identified over an approximate 4 acre nearshore region, between -3 and +12 feet MLLW elevation (Landau, 1991). See Figure 1 for approximate location of contaminated sediments in the nearshore zone. The exact extent and severity of contamination is being defined by others.

The nearshore region of concern is characterized by tidal mud-flats whose surface layer is a loose saturated silt. The western part of the study site has a silty sand surface sediment in the inshore and foreshore zones. In the vicinity of the radio station on the west border of the study site, there is a shingled beach composed of small stone and sand sediments.

The East Bay Marina's revetment borders the study site on the east and the northern tip of the isthmus borders the study site on the west. There is a large scalloped upland area in the shoreline between the shingled beach and the revetment to the east. The material here is predominantly a soft marine silt, and this shoreline has experienced historical bank line erosion. The foreshore region of the site (See figures 1 and 3) has been lined with rip rap composed of concrete and asphalt pavement slabs in an effort to limit or prevent bank erosion.

SEDIMENT RESUSPENSION

The objective of this study is to determine the probability of contaminant migration due to movement of sediments.

Figure 2 shows a typical beach cross-section with various nearshore regions labeled. The sediments of concern for this project presently lie in the inshore and foreshore regions. As the diagram shows, these regions are also located within the nearshore, where waves will break because of shallowing water depth (the breaker region).

Sediment resuspension and transport in the intertidal zone occurs when waves break in shallow water, thereby creating turbulence and the longshore current. The impact of the breaking waves and subsequent turbulence near the bed in the water column resuspend the bed sediment. As the tide moves the water's edge across the sloping intertidal area of contamination, it also moves the zone of breaking waves across this area.

After being resuspended the fine grain sediments are then transported with the alongshore current and the energy vector of the wave until the sediment resettles to the bed. Resuspended sand sediments (>0.1 mm) will return to the bed sooner and will generally not be transported as far as the fine grained sediment.

In general, any point in the contaminated area as identified in figure 1 is in the breaker region--given the correct combination of tide level and wave energy. Over the long term, it is assured that a breaking wave condition and resulting sediment transport will occur in the area of contaminated sediments.

SHORELINE TRANSPORT

Sediment transport along the Puget Sound shoreline is typically a function of energy transmitted along the shoreline by wave action or tidal current conditions. This is the condition existing at the study site.

Tidal Currents

Actual measurements of tidal current conditions existing across the study site are not available. The presence of fine grain silt and sand on the nearshore bed suggests that typical tidal currents are significantly less than 1 foot per second. Median grain sizes within the contaminated area identify a silt to sandy silt sediment, and range from 0.06 to 0.25 mm. A range of critical velocity at 3 feet above the bed for incipient motion of these sediments is 1.2 to 1.4 feet per second (Sternberg, 1972). Tidal current charts developed by the National Oceanic & Atmospheric Administration (NOAA, 1991) show that currents in the Budd Inlet are weak and variable, with speeds ranging from 0.2 to 0.5 knots (0.3 to 0.8 feet per second).

Longshore currents are also created by waves along the shore. This wave induced water motion is parallel to the shoreline and restricted mainly between the zone of breaking waves and the shoreline. Longshore currents typically have mean values of one foot per second or less (U.S. Army Corps of Engineers {USACE}, 1984).

Wind Waves

Waves arriving at the shore are the primary cause of sediment transport in the nearshore. Waves in large, open bodies of water such as the Puget Sound are naturally created by surface winds. The greater the wind speed, the longer the duration of the wind and the longer the wind fetch across an open body of water, the greater the wave. The orientation of a shoreline to the seasonal distribution of winds and to storm tracks is a major factor in determining the wave energy available for alongshore transport.

Alongshore transport of sediment takes place when waves approach the beach at an angle. See figure 3. A wave crest moving towards shore has energy which must be dissipated at the shore. If the wave crest is parallel to the shore, the energy is dissipated by wave runup and turbulence. If the wave approaches at a skew angle (alpha) as in figure 3, then the wave energy has a component directly onshore, which is dissipated as described above, and a component alongshore which results in alongshore drift. This is also known as littoral transport.

The study site, on the northeastern side of the isthmus, is protected from the prevailing winds, which are from the south or southwest. The fetch in West Bay for these winds is sufficiently small so that only smaller amplitude waves would be generated. It is possible for small waves generated in West Bay to refract around the peninsula and add energy for sediment transport at the study site in the easterly direction. Investigation however revealed that the energy contributed from West Bay would be insignificant.

The largest waves to reach the study site come from infrequent storms which generate winds from the north. The fetch from the north is approximately 3.6 miles. Using winds of record curves, compiled by the U.S. Army Corps of Engineers for this site, a wave height of 2.0 feet can be predicted (USACE, 1976).

The winds of record curve for this site was generated prior to December, 1990 and therefore does not include a recent storm event of record. Information obtained from the Washington State Ferry System for the December, 1990 storm indicates that in Central Puget Sound off Vashon Island, North winds gusting to 50 mph continued for a duration exceeding six hours. This wind condition would equate to an approximate average sustained wind of 30 mph for that duration. Using a wind value of 30 mph for six hours at the Cascade Pole site, the predicted wave height is 2.9 feet with a period of 3.3 seconds.

Large Storm Waves vs. Wave Climate

Powerful storms can generate large waves which can move significant volumes of shoreline sediment while the waves persist. However, these storms are infrequent and commonly the lesser winds which occur more frequently control the net movement at the Cascade Pole site. The storm of record was on the order of a 50 to 100 year storm and thus while it moved sediment (on the order of 290 cubic yards), the fact that it will happen only once every 50 to 100 years means that its average annual contribution to alongshore drift is small.

The maximum storm does control the maximum depth of resuspension. Suspended sediment moves into deep water, beyond the reach of waves. As waves approach the shore, they generate velocities throughout the water column, but these velocities decrease with depth in the water column. Below a certain depth the velocities are so small that they can no longer resuspend the sediment resting on the bottom. Linear wave theory was applied to determine the depths wherein sediments that settle out will not be resuspended again.

Historical wind data was used to generate waves and compile a significant wave climate for the site. Reference Table 1. There are four waves from two directions which contribute wave energy to this site, two from the northwest and two from the north. Table 1 lists the percent frequency of occurrence, the deep water wave height, the deep water wavelength and the wave period as well as the quantity of longshore transport each wave contributes per year.

TABLE 1 - WAVE CLIMATE AT CASCADE POLE SITE

Wave Number	Percent Frequency Of Occurrence	H_o Wave Amplitude (ft)	T Wave Period (sec)	L_o Wave Length (ft)	Longshore Transport Rate CY/Year	Longshore Transport Rate CY/Storm
NW1	0.3%	0.37	1.4	10.3	6	
NW2	0.1%	0.75	1.8	15.7	16	
N1	2.2%	0.67	2.0	20.5	947	
N2	0.3%	1.2	2.5	32.0	525	
			Total Annual Transport		1493 CY	
Storm of Record		2.9	3.3	55.8		285 CY

Ship and Boat Wakes

There are two navigation channels in the project vicinity. One is the deep-draft shipping channel to the Port of Olympia docks in West Bay; and the other is the small boat channel to the East Bay Marina. Traffic in either of these two channels creates vessel wake conditions, or vessel waves, which could impact the contaminated sediments at the site.

The amount of energy and the direction of transport caused by the West Bay shipping channel was estimated based on number of ship passages per year and average vessel size. Wake dimensions are derived from vessel wake data developed under previous studies (Sorensen, 1973) (Hochstein & Adams, 1989). The amount of sediment transport contributed by ship wakes was determined to be an insignificant amount (0.3 cubic yards per year) when compared to the contribution of wind waves.

Small recreational craft in the East Bay channel leaving the East Bay Marina will provide some wake energy that could result in transport in the opposite or westerly direction. However if one assumes that the same number of craft return through the channel as leave, there will be an equal and approximately opposite amount of energy moving in the eastward and westward

directions. These would tend to cancel each other out. The small vessel transport is not expected to be significant when compared to the natural waves at the site.

CONCLUSIONS

The predicted storm waves created by major winter storm conditions will move contaminated sediments offshore into deeper water. Some of the sediment will return to the nearshore at a future time, due to the action of milder storm conditions and smaller waves. Sediment moved during major storms such as that experienced during December 1990 will be deposited permanently offshore in waters 13 feet deeper than the tide at the time of the storm, or deeper than -17 feet MLLW if the storm occurs when the tide is at -4 MLLW. The wave conditions identified for the nine year period of record would tend to move sediment offshore to depths of -12 feet MLLW (Again assuming the event occurred when the tide was at -4 MLLW). These depths are based on the median grain size, current velocity required for sediment erosion and horizontal velocities of the wind wave at depth determined by linear wave theory (Sternberg, 1972) (USACE, 1984).

In addition to the offshore movement and capture of contaminated sediments, there will be some eastward transport. A variety of energy sources prompt eastward transport.

The following energy sources were investigated to determine their contribution to alongshore transport of sediment in the eastward direction.

- Storm waves due to northerly winds refract as they move south in Budd Inlet and approach the study site. Their resultant angle of attack at the site in question is skewed towards the east because of the shoreline bathymetry. This results in sediment movement east along the shore and to the offshore.

- Ship Wakes from the West Bay channel also have a skew towards the east as they reach the shoreline, resulting in an easterly transport of any sediments they resuspend. The area of concern is immediately east of the Port of Olympia deep draft terminal. Reference figure 1. Due to the slow speeds of the vessels when approaching the

terminal dock, this contribution was determined to be insignificant, relative to natural wave conditions, because of smaller waves and short duration of the wave train.

- Prop-wash from departing vessels and maneuvering tugs may have an impact on the site. This would occur after vessel loading, as the departing vessels make the turn into the outer channel. The effect of this prop wash can not be determined without additional field measurements and was not included in the comparison. Discussion with the Port Engineer suggests that the localized turbulence of the prop wash during turning is not significant because of the distance from the shoreline and the limited duration of the activity. An estimated velocity at the site, caused by prop wash, is on the order of 0.5 feet per second.

- Wind waves from West Bay that refract around the point will have an easterly skew. The short fetch available to the generation of these winds combined with other factors make this contribution insignificant.

- Due to canceling effects of opposing traffic, the net transport of sediment from small boat traffic is not considered to be significant when compared to the natural wave climate at the site.

An estimate of longshore transport of sediment was derived using empirical curves and methodology developed by others (USACE, 1984). Results of the calculations for each wave source are provided in Table 1.

Summary of Transport

- Storm waves due to northerly winds..... 1470 cubic yards per year
- Storm waves due to northwesterly winds.... 20 cubic yards per year
- Deep draft vessel wakes..... Less than 1 cubic yard per year

Based on these calculations, and a typical median grain size from 0.06 mm to .25 mm, the

annual rate of sediment transport from the contaminated nearshore site is estimated to be less than or equal to 1490 cubic yards per year in the easterly direction.

These sediments are being moved eastward and into deeper water in the East Bay Marina. The fine grained sediments may remain in suspension long enough to be distributed throughout the basin. This is borne out by observers at the Port of Olympia, who have reported that waves from the north tend to increase turbidity throughout the basin. Historical aerial photos also show evidence of suspended sediments throughout the basin.

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FIGURE 1 **SITE MAP**

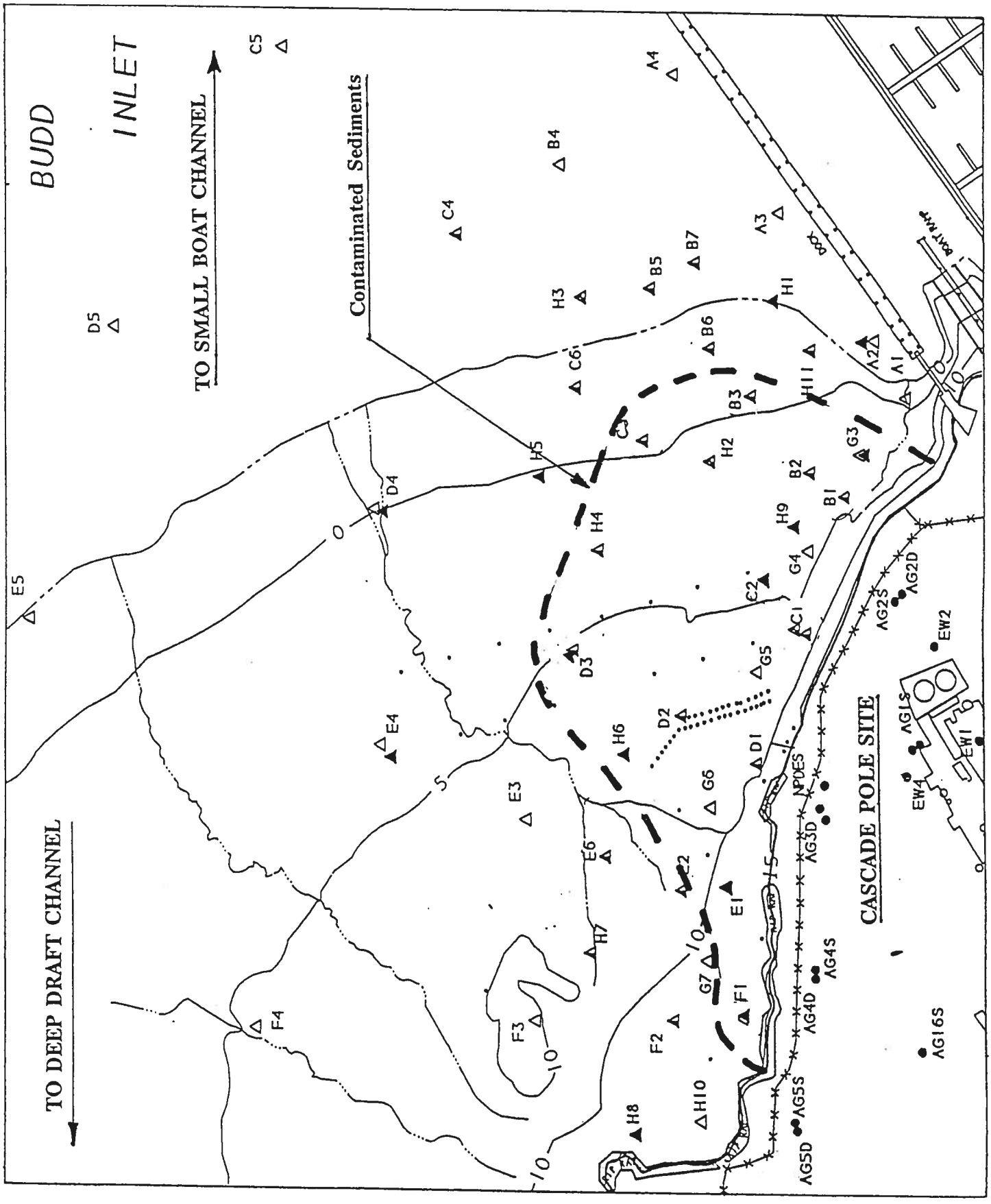


FIGURE 2 REGION OF SHORELINE EXPOSURE TO WAVE ATTACK

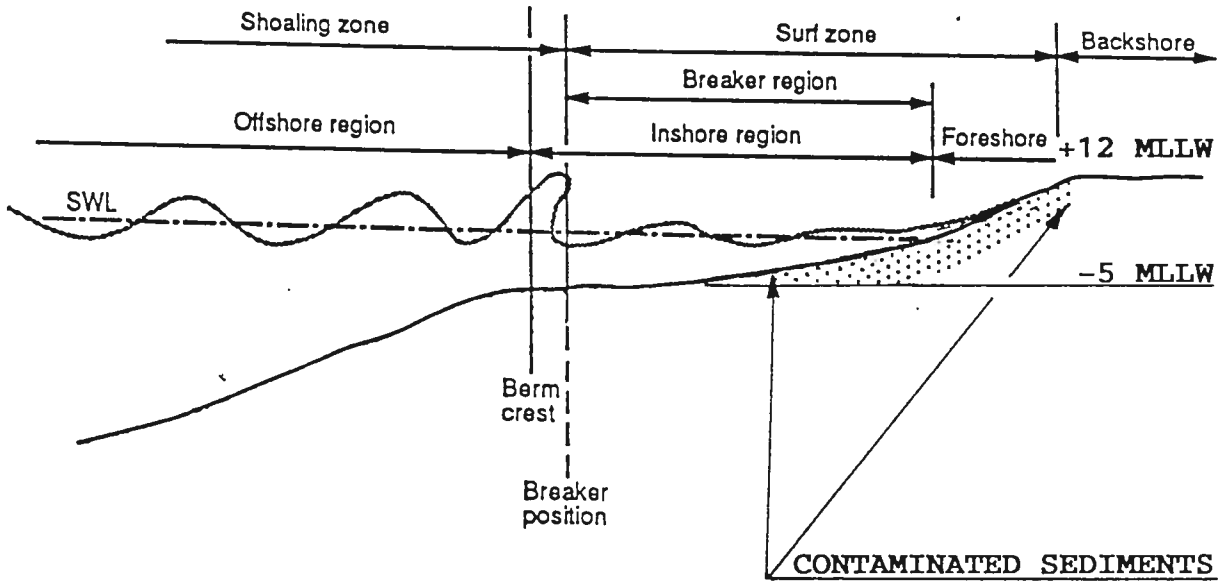
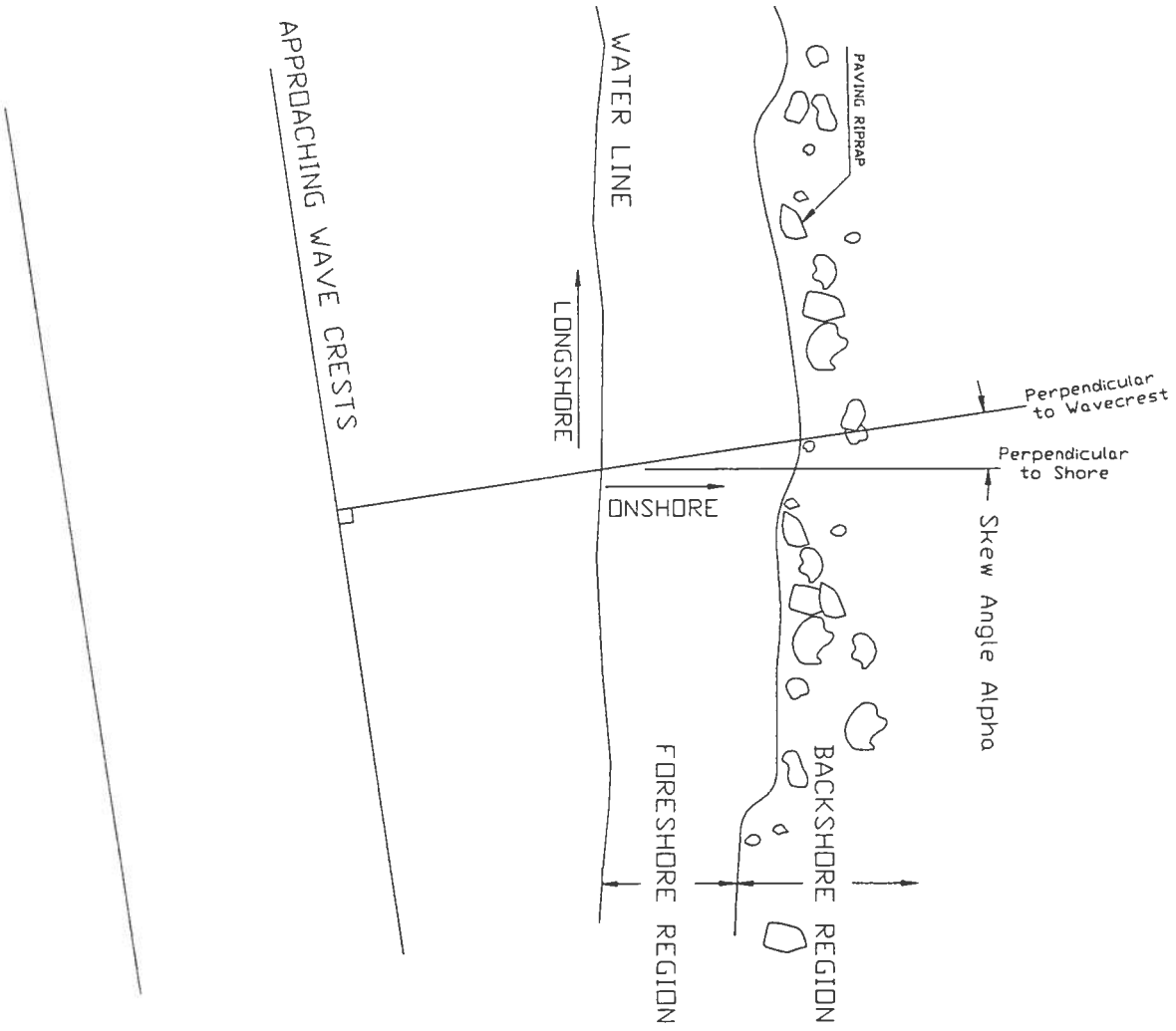


FIGURE 3 **LONGSHORE TRANSPORT DIAGRAM**



APPENDIX G

Biological Evaluation

- Pentec

Review and Evaluation of Biological and Related Chemical Sampling Data Remedial Investigation Port of Olympia

Project Number 84-002
Final Report

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INTRODUCTION

Pentec Environmental, Inc., was contracted by Landau Associates, Inc., to review and evaluate biological and related chemical sampling data from the Phase II field sampling that is part of the Remedial Investigation for the Cascade Pole Company (CPC) site at the Port of Olympia. The CPC facility historically treated wood with creosote and pentachlorophenol (PCP), and residuals of these chemicals have been found in adjacent intertidal sediments.

Limited biological sampling was conducted in late summer 1991 to supplement extensive chemical monitoring and delineation at the site. Biological sampling comprised:

- Sediment collections for bioassays from two on-site stations (C3 and D3); amphipod, echinoderm larvae, and Microtox tests were run.

- Replicate grab sampling for infaunal analysis at two stations in the intertidal zone at the site (C2 and E4) as well as at an Eld Inlet control site.

- Collections of bivalves for analysis of tissue chemical contamination; sampling occurred at two stations in the intertidal zone at the site (H2 and F5) as well as at an Eld Inlet control site.

Pentec's objectives were to:

- Review available and relevant data related to the biological sampling and associated chemical and physical testing of sediments; describe data limitations and define their significance.

- Assess the data quality of the bioassay and benthic invertebrate sampling data.

- Evaluate the sample results with respect to:

  - Established standards.

  - Similar sites in Puget Sound.

  - Nonurban sites in Puget Sound.

- Extrapolate likely impacts of the CPC site on the infaunal community at the site and discuss other factors that may influence these communities.

RESULTS AND DISCUSSION

MATERIALS REVIEWED

The following materials provided by Landau Associates were reviewed:

- Final Phase II Work Plan, Sediments Operable Unit, Cascade Pole Site Olympia Washington, Landau Associates, Inc. June 14, 1991.
- Appendix C—Chemistry Tables (partial; includes data in Phase II Work Plan).
- Field Notes from biological field sampling activities.
- Sediment Grain Size Distribution, data from Soil Technology. August 29, 1991.
- Data Validation Report for Cascade Pole Site Phase II Sediment, Tissue, and Water. Report to Landau Associates, Inc. by EcoChem, Inc. November 4, 1991.
- Port of Olympia—Cascade Pole Benthic Infauna Diversity; letter report and laboratory data sheets from Invert-Aid. December 10, 1991.
- Bioassays for Cascade Pole, Port of Olympia; letter report, laboratory data sheets, and reference toxicant printouts from Invert-Aid. October 23, 1991.
- Consent Decree between the State of Washington Department of Ecology and Cascade Pole Company/Port of Olympia, dated May 29, 1990 includes Remedial Action Plan).

DATA QUALITY

Observations on the quality of biological data reviewed are provided in the Appendix to this report.

DISCUSSION OF RESULTS

Comparison with Standards

In addition to several chemical exceedances of Sediment Quality Standards of WAC 173-204-320, sediments at stations C2 and C3 violated standards for benthic organism abundance and invertebrate larval bioassays, respectively.

Total organism density and density of crustaceans and bivalves at Station C2 were much less than 50 percent of those at station E4 and EI1. Density of polychaetes was 50 percent greater at C2 than at the other stations. At station E4, crustaceans were about 20 percent as abundant as at the reference station (EI1); density of molluscs was about 3.5 times as great.

The survival of normal echinoderm larvae from station C3 (63.7% of controls; 56% of Eld Inlet reference) violates the 85 percent criterion of WAC 173-204-320. The survival of normal larvae from station D3 (88.4% of controls; 77.8% of Eld Inlet reference) violates the 85 percent criterion of WAC 173-204-320 in comparison with the reference sediment only. Only station C3 would violate the Puget Sound Dredged Disposal Analysis (PSDDA) criterion of a single bioassay test response greater than 30 percent over controls.

General Biological Conditions

Because these intertidal samples were taken with gear normally employed for subtidal sampling (a 0.1-m^2 van Veen grab), no fully comparable data sets from polluted or unpolluted intertidal areas elsewhere in Puget Sound were found. Numbers of taxa were surprisingly low at all three stations, especially at the unpolluted Eld Inlet reference station. The nature of the benthic community differed greatly among the three stations sampled as indicated by the August 1991 data.

The +4-ft (MLLW) Eld Inlet reference station, EI1, had a relatively diverse and rich community strongly dominated by crustaceans, particularly the tube-building amphipod *Corophium salmonis*. The small, usually commensal crabs Pinnotheridae were also abundant, followed by the cumacean *Leucon subnasica*. Molluscs were well represented and were strongly dominated by the bent-nose clam *Macoma nasuta*, a species tolerant of fine-grained, sulfide-rich sediments. The softshelled clam *Mya arenaria* was also common, and the hardshelled clam *Protothaca staminea* was present in one sample. This latter species is typically found in areas with

substantially coarser material. Species composition (lack of dominance by a few pollution-tolerant species) and presence of sensitive species (crustaceans) suggests that this site meets the criteria set forth for a reference site in WAC-173-204-315.

The only data from unimpacted mudflats in central or southern Puget Sound are from a transect sampled in the eastern side of the Nisqually Delta by Wisseman et al. (1977). The +3-ft elevation sampled there is suitable for direct comparison with the Eld Inlet site, although the Nisqually site has a much higher exposure to fresh water and sampling was accomplished during low tide. The total benthic density at Eld Inlet was only slightly less (2,630 organisms/m^2) than at the Nisqually station (about 2,800/m^2 in April 1977). The total number of taxa at the Eld site (28) was also similar to that at the Nisqually site (25). The most abundant taxon at the Nisqually site was identified as *Corophium brevis*, followed by *Macoma balthica; M. nasuta* was also common. Polychaetes were more abundant at the Nisqually site than at the Eld Inlet with several taxa (Capitellidae, Spionidae, *Eteone longa, Eulalia quadrioculata*) present at more than 100/m^2.

Total organism density at Eld Inlet (EI1) was somewhat lower than that at the Carr Inlet subtidal control site sampled in the Commencement Bay Remedial Investigation (Tetra Tech 1985). Mean density of crustaceans was lower at the Carr Inlet subtidal site than at the Eld Inlet intertidal site, but densities of polychaetes and molluscs were far greater in the Carr Inlet samples, as was mean number of taxa per grab in all three groups. This difference may reflect the more marine condition in Carr Inlet in addition to the typically richer subtidal infauna. The total benthic density at the Eld Inlet intertidal site was greater than at shallow (-2.5 m MLLW) stations sampled by the Corps of Engineers in the West Bay of Inner Budd Inlet (Pentec 1991).

The benthic assemblage at station E4 on the northern portion of the CPC site at about +4 ft MLLW was noticeably different from that at the Eld Inlet reference site, although some similarities were also seen. Total organism density was similar (2,302/m^2) to that at Eld Inlet, but organisms were more evenly distributed among the three major taxa reported: crustaceans were much less abundant at E4 while polychaetes and bivalves were much more abundant than at EI1. Reduced numbers of crustaceans were not unexpected because this group is highly sensitive to a variety of organic pollutants. Polychaetes, and to a lesser extent, bivalves, are somewhat more tolerant of these pollutants.

Apart from the very high abundance at EI1 of *Corophium salmonis* (a taxon not common at E4), however, the composition and abundances of crustaceans did not differ much between EI1 and E4. Dominants at E4 were pinnotherids (several taxa) and the cumacean *L. subnasica*.

Dominant polychaetes at E4 were the spionid *Spiophanes berkeleyorum* (also a dominant in the shallow subtidal stations in the Corps West Bay sampling; Pentec 1991) and the goniadid *Glycinde picta*. The extremely high density (838/m^2) of the bent-nose clam *M. nasuta* at station E4 was not seen in any other Puget Sound database examined. The high degree of variability in this species in the five replicates (three grabs averaged 132 per grab while the other two had 12 each) suggests a patchy settlement of young clams in an area of moderate overall abundance of larger animals. *Mya arenaria* and the very small *Mysella tumida* were also common bivalves at station E4.

In contrast to the relatively consistent total density and relative evenness of taxonomic distribution of benthic invertebrates at stations EI1 and E4, station C2 displayed several characteristics of a highly stressed community. Mean numbers of taxa in all three groups reported were markedly lower at C2. Numbers of crustacean, polychaete, and molluscan taxa were 5, 7, and 2, respectively, compared to 10, 12, and 5 at station E4. Density of organisms within individual taxa was even more obviously affected. Total density of crustaceans was only 20/m^2 at C2 compared with 438/m^2 at E4 and 2,100/m^2 at the reference site (EI1). Molluscs were also poorly represented at C2 (48/m^2) relative to E4 (1,380/m^2) and EI1 (396/m^2). *M. arenaria* was the dominant. In contrast, polychaete numbers were greater at C2 (804/m^2) than at other sites and were strongly dominated by a few taxa known to be pollution tolerant: the family Spionidae, especially *Polydora ligni* and *Capitella capitata*. These two species were present in low numbers at the unpolluted intertidal site on the Nisqually Delta (Wisseman et al. 1977).

A potential data set for comparison of intertidal infauna from sites with varied degrees of contamination would be that reported by Blaylock and Houghton (1981) for several areas in Commencement Bay. Those samples (0.003-m^2 cores) were taken during periods of low tide, however, and were sieved using a 0.5-mm screen. There, the dominant groups at the most heavily polluted middle intertidal stations (e.g., Hylebos and Middle Waterways) in April were oligochaetes and nematodes (not reported in this data set) followed by harpacticoid copepods (more likely to be collected in the smaller mesh size used). In November, the amphipod *Corophium* sp. was second only to the oligochaetes. Polychaetes were also important and included *C. capitata* and several spionids.

A more intensive survey of infaunal assemblages in the lower intertidal zone of three Port of Tacoma waterways was conducted in 1991 as part of the Superfund damage assessment. Results will be available in early February 1992.

Bioaccumulation

Data on accumulation of certain organic contaminants in the soft tissues of the bent-nose clam *Macoma nasuta* show a strong relationship with the trend in sediment contamination, i.e., increasing from stations EI1 (Eld Inlet reference) to F5 (northern portion site intertidal) to H3 (near field station). No similar trend was evident for metals in tissue, and metals are not considered a problem on the site. The genus *Macoma* has long been recognized as an excellent bioindicator group because its members are deposit feeders that sweep the sediment surface, ingesting fine materials that are often sites of binding for pollutants. Lack of depuration in these tests leaves open the possibility that measured contamination in the organisms reflects gut contents, not actual bioaccumulation in tissues.

What appear to be significant increases (no statistical testing is possible with the data set available) occurred across this series of stations in LPAH, HPAH, and TPAH and in total dioxins and furans. Several of those compounds that were elevated in tissue samples from H3 were also elevated in sediment chemical analyses from that site. TPAH and total dioxins and furans were 1 and 2 orders of magnitude, respectively, greater in tissues from H2 than in those from EI1. It was interesting that station F5, which showed relatively little sediment contamination, had moderately elevated levels of many of the same chemicals that were strongly elevated at station H2. In particular, total dioxins and furans were an order of magnitude higher at F5 than at EI1.

Impact of the Cascade Pole Site on Benthos

The sampling conducted under the Phase II Work Plan provides a clear indication of the nature of the influence of contamination at the CPC site on benthic assemblages. Physical and chemical data are sufficient to identify chemical contamination as the probable cause of differences between station C2 and E4. These two stations are at a similar elevation and differ only slightly in exposure. The finer grain size and higher content of wood debris at C2 likely influenced the greater importance of polychaetes at C2 (cf. E4), but the low numbers of molluscs and crustaceans are almost certainly the result of chemical contamination.

Grain size and chemical data are lacking from station EI1, but differences between C2 and EI1 are probably also primarily related to chemistry. Lower total organic carbon at EI1 is a probable contributing factor to the differences between this site and E4, especially the lower polychaete importance at EI1.

Because of the limited number of sites sampled, the geographic extent of the area of significant impact cannot be delineated. Certainly, it can be assumed to extend throughout the area with similar or greater levels of contamination. Based on LPAH and HPAH contours in surface sediments and the bioassay results, it can be assumed that the benthic community is affected by site contaminant levels to at least the vicinity of stations C3 and D3 but grades quickly to improved community characteristics by station E4. Additional infaunal data would be required along a depth contour from transect A to E or F to confirm this.

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DATA QUALITY APPENDIX

Benthic Assemblage

Sampling of benthic assemblages appears to have been conducted in general concordance with methods specified in the Puget Sound Estuary Program protocols (PSEP 1986) and the Standard Operating Procedures (SOPs) of the Phase II Work Plan. The following list of potential discrepancies from those protocols is based only on materials received from Landau Associates; additional documentation may be available to demonstrate that these deficiencies did not occur:

Field

- Other than penetration depth, sediment characteristics of individual grab samples were not provided. In particular, no mention was made of biological structures observed at the surface of any grabs nor of field estimations of percent composition by phylum.

- Sample CP2-M-EI2, grab 2, did not meet the minimum criterion for sample penetration (14 to 15 cm). The depth achieved (13 cm) would provide about 93 percent of the minimum sample volume.

- Field notes provided were not signed and contained areas where original entries were written over rather than lined through.

Laboratory

- Time limits from field preservation to laboratory rescreening of samples (14 days) were exceeded by approximately 1 week. This deviation is not expected to seriously impact data quality if properly buffered formalin was used in field preservation.

- One laboratory taxon identification sheet (J. Schroeder, CP2-M-E2 grab 2) was apparently mislabeled and should have been "CP2-M-E4."

- An error in calculation appears on the data summary sheet; for sample CP2-M-C2, under Crustacea, the total number of crustaceans corrected for a 100 percent sorting should be 10(2 + (2 x 4))not 8. Other numbers were not 100 percent verified.

- No data were provided on taxa other than the groups Mollusca, Polychaeta, and Crustacea. Were no other taxa encountered?

Data Presentation

- Benthic assemblage data presentations were minimal and poorly explained. Calculations of mean densities by taxonomic group and of total density and diversity were lacking.

- No statistical testing was performed.

- No results of QA/QC checks on laboratory procedures were described.

Assuming that PSEP protocols were in fact followed in other areas of data collection and sample processing and given the large apparent differences between stations, the above-cited discrepancies should not affect overall quality of the data for the purposes intended.

Bioassays

- Sample collection and handling appears satisfactory except that the samples were not delivered "blind" to the laboratory.

- Laboratory data presentations for the echinoderm and amphipod tests were of poor quality, unsigned, and lacking explanations. For example, the computer printouts were not identified as relating to the reference toxicant tests; the mean survival of 20 for station C3 is not related to anything in the text; a user not familiar with the protocol must seek interpretation from the laboratory data sheet.

Amphipod

- Criteria for survival of organisms in reference and control sediments (WAC 173-204-315) were met.

- Mean number of emergent animals in sample C3 was not calculated; it should be 0.02. Standard deviation cannot be calculated.

- Data presented were not statistically tested but do not constitute a "hit" under the 25 percent criterion of WAC 173-204-320.

Echinoderm Larvae

- Criteria for survival of organisms in reference and control sediments (WAC 173-204-315) were met.

- Data presented were not statistically tested.

Microtox

- This test appears to have been adequately conducted and reported. No decrease in luminescence was reported.

Bioaccumulation

- The species sampled, *Macoma nasuta*, is an appropriate species for evaluating sediment contaminants.

APPENDIX H

Environmental Fate of the Chemicals of Concern

APPENDIX H
ENVIRONMENTAL FATE OF THE CHEMICALS OF CONCERN

CREOSOTE

Creosote is a complex mixture of many chemicals. Coal tar creosote, made from the high-temperature treatment of coal, is the most widely used wood preservative in the United States. About 300 chemicals have been identified in coal tar creosote, and there may be 10,000 other chemicals present, but not yet identified, in the mixture. The major chemicals in coal tar creosote that can cause harmful health effects are polycyclic aromatic hydrocarbons (PAH), phenol, and cresols (ATSDR 1989). Creosote is heavier than water and has a continuous boiling range beginning at about 200°C.

Creosote typically contains 85 percent PAH and 10 percent phenolic compounds (Mueller et al. 1989) although the composition of the mixture may vary across manufacturing lots and manufacturers. The major PAH components of creosote are shown in Table H-1. Other constituents include coal tar acids such as phenols, cresols, and cresylic acids; and coal tar bases such as pyridines, quinolines, and acridines.

The major source of creosote released to the environment is the release of creosote and creosote-containing wastewater effluents from wood-treatment facilities. Some creosote components may also be released to the atmosphere by fugitive emissions from these facilities; however, atmospheric releases are considered to be relatively minimal (ATSDR 1989). Creosote components also may be slowly released from the surface of treated wood products by oil exudation, leaching by rainwater, or volatilization. Losses of creosote from impregnated wood are dependent on the kind of coal used to produce the coal tar, the kind of coke oven used to make the coal tar, and the conditions under which the wood is used (Leach and Weinert 1976).

Environmental Fate in Air

Atmospheric releases of creosote from wood-preserving plants are not well documented. Creosote constituents such as naphthalene, acenaphthylene, acenaphthene, phenanthrene, and fluorene have been detected in emissions at a pressure treatment facility that treated logs for use as utility poles and marine pilings (AGI 1986). Lower molecular weight PAH such as acenaphthene and naphthalene may volatilize directly from the surface of treated wood. Other potential sources of atmospheric releases include incineration of scrap wood-treated with the mixture, and reentrainment of contaminated dust and soils.

Environmental Fate in Water, Soil, and Sediment

Creosote may be released to soil at wood-treatment facilities as a result of drippage of the product from treated timber in the stockyard and storage areas, and through spillage and/or direct disposal of the wood-treatment product and residuals. Rain water may also wash the soluble components directly from the surface of treated timber into the soil.

Creosote constituents released to surface waters will differentially partition between water and soil or sediments depending on their water solubility and sorptive properties. For example, PAH, the major constituents of creosote, generally tend to sorb to soil and sediment particulates and have low aqueous solubilities and mobilities (Hickock et al. 1982). Nitrogenous bases present in creosote wastewater (e.g., aniline, toluidines, and xylidines) are relatively soluble, mobile, and persistent in groundwater (Pereira et al. 1983). However, behavior at a given site is also dependent on site-specific characteristics. For example, PAH, phenol, and heterocyclic components of creosote wood-treatment process wastes were found to migrate en masse in groundwater through a contaminated sand and gravel aquifer in Pensacola, Florida. Sorption of these different classes of organic constituents in the low organic carbon (<0.1 percent) aquifer materials was not important (Pereira and Rostad 1986).

In an investigation of the release of creosote from treated wood into freshwater and seawater, naphthalene, phenanthrene, acenaphthene, dibenzofuran, fluorene, and 2-methyl-naphthalene were the major components that migrated into water (Ingram et al. 1982).

PAH

PAH is a group of chemicals formed during the incomplete combustion of petroleum, coal, garbage, or other organic substances. PAH can be naturally occurring or anthropogenic, and are major constituents of creosote. They are found throughout the environment in the air, water, and, especially, soil. Although there are many PAH, only the 16 priority pollutant PAH, shown in Table H-2, are considered in this review.

As pure chemicals, PAH generally exist as colorless, white, or pale yellow-green solids. Most PAH do not occur alone in the environment, but are found as mixtures of two or more PAH.

Environmental Fate in Air

Most of the PAH present in the atmosphere are sorbed to particulates, although a portion may also occur in the gaseous phase from volatilization. Atmospheric residence time

and transport distance depend on the size of the particulates to which PAH are sorbed. Larger particles emitted from urban sources tend to settle onto streets and become part of urban runoff. PAH associated with submicron soot particles may be subject to long-range transport. PAH are removed from the atmosphere by both wet and dry deposition.

PAH can undergo photo-oxidation and can react in the atmosphere with pollutants such as ozone, nitrogen oxides, sulfur dioxide, and peroxyacetylnitrate (NRC 1983). Reaction products include nitrated PAH, quinones, phenols, and dihydrodiols (Kamens et al. 1986; Holloway et al. 1987) and singlet oxygen (Eisenberg and Cunningham 1985).

Environmental Fate in Soils and Sediments

In soils and sediments, PAH occur mainly sorbed to surfaces. If separate phases of organic liquids are present (NAPL), the PAH may preferentially accumulate in these.

The degree of sorption varies with the individual PAH. The organic carbon partition coefficient, Koc, indicates the potential of a chemical to bind to organic carbon in soil and sediment. The low molecular weight PAH have Koc values in the range of 10^3 to 10^4, which indicates a moderate potential to be adsorbed to organic carbon in the soils and sediments. The medium molecular weight compounds have Koc values around 10^4. High molecular weight PAH have Koc values in the range of 10^5 to 10^6, which indicates stronger tendencies to adsorb to organic carbon.

Sorption of PAH to soil and sediment increases with increasing organic carbon content, and is also directly dependent on particle size. Karickhoff et al. (1979) reported partition coefficients (Kp) for sorption of pyrene to sediments as follows: sand 9.4 to 68; silt 1,500 to 3,600; and clay 1,400 to 3,800. Gardner et al. (1979) found that three to four times more anthracene and about twice as much fluoranthene, benzo(a)anthracene, and benzo(a)pyrene were retained by marsh sediment than by sand. PAH may also volatilize from soil. Volatilization of acenaphthene, anthracene, fluorene, and phenanthrene (low molecular weight PAH) from soil may be substantial (Coover and Sims 1987). Lower molecular weight compounds may also volatilize from sediments, whereas this process is not significant for the higher molecular weight compounds (Southworth 1979).

Microbial metabolism is the major process for degradation of PAH in soil environments. Photolysis, hydrolysis, and oxidation are not considered important processes for the degradation of PAH in soils. Environmental factors that may influence the rate of PAH degradation in soil include temperature, pH, oxygen concentration, PAH concentrations; and contamination history

of the soil, soil type, moisture, nutrients, and other substances that may act as substrate co-metabolites (Sims and Overcash 1983).

Metabolism of PAH by bacteria includes the formation of cis-dihydrodiols through dioxetane intermediates, whereas in fungi (and mammalian systems) trans-dihydrodiols are produced through arene oxide intermediates (Sims and Overcash 1983). This is significant because arene oxides have been linked to the carcinogenicity of PAH. The initial reaction products of PAH microbial degradation are further degraded to catechol, protocatechuic acid, and gentisic acid. These compounds are then degraded to acetic, fumaric, pyruvic, and succinic acid, and acetaldehyde.

Environmental Fate in Water

Because of their low solubilities, PAH in aquatic systems are primarily found sorbed to particles that either have settled to the bottom or are suspended in the water column. Deposition is probably the major removal mechanism from water. Volatilization and microbial degradation may also be important removal mechanisms. Readman et al. (1982) found that in an estuary, volatilization and adsorption to suspended sediments with subsequent deposition are the primary removal processes for medium and high molecular weight PAH, whereas volatilization and microbial degradation are the major removal processes for low molecular weight compounds.

Volatilization rates from water are described by Henry's law constants. The low molecular weight PAH have Henry's law constants in the range of 10^{-3} to 10^{-5} atm-m^3/mol; medium molecular weight PAH have constants in the 10^{-6} range; and high molecular weight PAH have values in the range of 10^{-5} to 10^{-8} (as shown in Table H -3). Compounds with values ranging from 10^{-3} to 10^{-5} are associated with significant volatilization, while compounds with values less than 10^{-5} volatilize from water only to a limited extent (Lyman et al. 1982).

The most important processes contributing to the degradation of PAH in water are photo-oxidation, chemical oxidation, and biodegradation by aquatic microorganisms (Neff 1979). Hydrolysis is not considered to be an important degradation process for PAH (Radding et al. 1976). In natural aquatic systems, photo-oxidation and biodegradation can significantly contribute to the degradation of PAH, depending on environmental conditions.

In general, PAH can be significantly metabolized by microbes under oxygenated conditions. However, under anoxic conditions, degradation will be extremely slow (Neff 1979).

PCP

PCP was at one time one of the most widely used biocides in the United States. Before restrictions were placed on its use, PCP was widely used as a wood preservative for poles used for power lines, cross arms, and fence posts, with small use in cooling towers, and pulp and paper mills. PCP was registered for use by the EPA as an insecticide, fungicide, herbicide, molluscicide, algicide, disinfectant, and as an ingredient in antifouling paint. It is now a restricted-use pesticide. The wide spectrum of uses can be partially attributed to the solubility of the nonpolar form (PCP) in organic solvents and the sodium salt (pentachlorophenate) in water.

Pure PCP exists as colorless crystals and has a very sharp, characteristic smell when hot, but very little odor at room temperature (Merck 1989). Technical-grade PCP is dark gray to brown dust, beads, or flakes. Technical-grade PCP also contains impurities, including chlorodiphenylethers, dioxins, furans, and hydroxychloro-diphenylethers. Commercial PCP contains significant quantities of tetrachlorophenols; the ratio of PCP to tetrachlorophenol in Dowicide G-ST, a commercial PCP formulation, was 2.5$\pm$0.1, or 29 percent (Verschueren 1983). Properties relevant to environmental behavior are shown in Table H-3. Unlike strictly nonpolar organics, PCP changes its properties with pH. Under acid conditions, PCP is nonpolar; it is soluble in organics and has very low solubility in water. Sorption and consequent retardation can be estimated by partitioning into the organic carbon fraction (Kow). Under neutral to alkaline conditions, PCP is transformed into the anionic form, pentachlorophenate. As an anion, it has a lower solubility in organics, a higher water solubility, less sorption, and higher mobility in aqueous environments.

Environmental Fate in Air

PCP can be volatilized directly into air from treated wood products. It can also enter the air through volatilization or aerosols from impoundments and other liquid pools. Once in the air phase, PCP is susceptible to photolysis. It may also leave the air through wet deposition into water or soil phases.

Environmental Fate in Soil and Sediment

PCP releases to soil and sediment occur through direct discharge and direct entry from numerous nonpoint and point sources, including the leaching of treated wood, seepage from impoundments, and spillage from transfer operations. Arsenault (1976) reported that PCP

migrated from the surface of utility poles to the adjacent soil, which had an average PCP concentration of 654 mg/kg; however, the mobility away from the pole was limited.

Once in soil, PCP is susceptible to microbial biodegradation, sorption, and transport in aqueous and NAPL phases. Photo-oxidation may occur in the surface layer. Hydrolysis, oxidation, and volatilization are probably not important pathways in soil.

Biodegradation is considered to be the major transformation mechanism for PCP in soil. PCP is metabolized rapidly by many acclimated microorganisms. Chu and Kirsch (1972) found that native organisms from a wood-treating facility were able to metabolize PCP as a sole source of organic carbon. Edgehill and Finn (1983) inoculated soils with a PCP-acclimated *arthrobacter* bacteria and increased the degradation by 12-14 times in laboratory tests and doubled the degradation in outdoor tests. Watanabe (1973) isolated a *pseudomonas* species from soil, which was able to release all five chlorine atoms from PCP. The rate of biodegradation in soil has been observed to increase in soil with high organic content, in higher moisture content, and at optimum temperatures for microbial growth. Reducing conditions appeared in several experiments to increase the rate of biodegradation (Ide et al. 1972, and Kuwatsuka and Igarashi 1975), although it has been observed to occur under both aerobic and anaerobic conditions.

Major reaction products of biodegradation are pentachloroanisole, 2,3,4,5-; 2,3,4,6-; and 2,3,5,6-tetrachlorophenol; 2,3,4-; 2,3,5-; and 2,3,6-trichlorophenol.

Sorption reactions of PCP in soil are pH dependent. Under acid conditions in which organic matter is present, sorption can be described by Koc, as with other nonpolar organic compounds. Mobility is retarded relative to aqueous flow. An average Koc value of 32,900 was measured by Schellenberg et al. (1984) for lake sediment, river sediment, and aquifer materials. Under neutral to alkaline conditions, PCP transforms to pentachlorophenate, an anion, and mobility is greatly increased. Choi and Aomine (1974) observed maximum sorption at pH of 4.6-5.1 with no sorption observed above pH 6.8.

Environmental Fate in Water

Photolysis and biodegradation are believed to be the dominant transformation processes for PCP in aquatic systems. Hydrolysis and oxidation are not important mechanisms for the removal of the compounds from surface waters.

Photolysis has been observed to be rapid in surface waters, but greatly attenuated with increasing depth of the water column. Pignatello et al. (1983) reported a half life of 0.7 hours at 0.5-cm depth in outdoor tests. This rate decreased to 228 hours at 30-cm depth.

Biodegradation has been observed to be a major pathway for PCP in water as well as in soil. Researchers have observed faster degradation under aerobic than anaerobic conditions (Liu et al. 1981 and Pignatello et al. 1985). Boyle et al. (1980) found that PCP degradation increased with the amount of light, the presence of sediments, the pH being greater than the pKa, and with the presence of oxygen.

METALS

This section discusses the environmental behavior of the metals observed in the Sediments Operable Unit above background: cadmium, chromium, copper, lead, and zinc.

Cadmium

In natural waters and sediments, cadmium occurs in the +2 state. It may occur in the uncomplexed Cd^{2+}, as a soluble complex with inorganic or organic ligands, adsorbed onto particulate surfaces, or precipitated into mineral structures. It is relatively more mobile in the environment than other divalent heavy metals.

The pH of sediments or waters is perhaps the single most important variable controlling the speciation and mobility of cadmium. Cadmium tends to adsorb less to surfaces and occur as an uncomplexed ion under acidic conditions. The most important complexing ligand is often humic materials or natural organic matter, if present. In systems with relatively little organic matter, the exchange of cadmium for calcium in carbonate minerals is a controlling process. The affinity of cadmium for complexing ligands has been observed to be humic acids > CO_3^{2-} > OH^- $\geq$ Cl^- $\geq$ SO_4^{2-} (EPA 1979).

Redox potential has relatively little effect on the speciation of cadmium, except that the presence of sulfides may cause precipitation as cadmium sulfide. In sediments, if reducing conditions are present, the solubility of cadmium may be controlled by formation of CdS.

Cadmium is strongly accumulated by many organisms. Cadmium has been shown to accumulate in aquatic organisms at levels thousands of times greater than ambient water concentrations.

Volatilization and biotransformation of cadmium are not important to cadmium behavior in natural systems.

Chromium

Chromium exists in two oxidation states in natural systems: Cr(III) and Cr(VI). The hexavalent form is quite soluble, existing in solution as a complex anion, and is not sorbed to any significant degree by clays or hydrous metal oxides. However, the trivalent form, which occurs as a cation, may be strongly sorbed to particulate surfaces, may be precipitated as the insoluble chromium hydroxide $Cr(OH)_3$, or may be complexed with a variety of organic materials.

Hexavalent chromium, Cr(VI), is a strong oxidizing agent and is always found in aqueous solution as a component of a complex anion. The anionic form varies with pH and may be chromate (CrO_4^{2-}), hydrochromate ($HCrO_4^-$), or dichromate ($Cr_2O_7^{2-}$). Dichromate concentration is not significant unless pH values are well below those observed in most natural waters. Thus, hexavalent chromium present in most natural water (pH>6.5) will be in the form of the chromate ion, CrO_4^{2-}. All of the anionic forms are quite soluble and are quite mobile in the aquatic environment.

Trivalent chromium is the most stable form under redox conditions normally found in natural waters and sediments, and when in solution at pH greater than 5, quickly precipitates due to formation of the insoluble hydroxide or oxide.

The two oxidation states of chromium are readily interconvertible under natural conditions. A study by Schroeder and Lee (1975) indicated that Cr(VI) can be reduced by Fe(II), dissolved sulfides, and certain organic compounds with sulfhydryl groups, while Cr(III) can be oxidized by a large excess of MnO_2 and at a slower rate by O_2 under natural water conditions. Moreover, if aquatic conditions favor Cr(VI), then chromium will accumulate as soluble forms in waters; if, however, Cr(III) is favored, then the accumulation will occur in the sediments.

Copper

Copper occurs in natural environments predominantly in the +2 oxidation state, although it may be occur in the +1 state under certain reducing conditions. Environmental behavior of copper is highly dependent on such variables as pH , redox, concentrations of organic material and mineral adsorbents, biological activity, and competition with other heavy metals.

Copper has a pronounced affinity for organic materials. Several studies have reported that the majority of copper in river waters studied was associated with organic matter either as suspended particulates or as dissolved organic complexes (Stiff 1971 and Ramamoorthy and

Kushner 1975). The adsorption or complexation of copper with organic matter may result in increased mobility of copper if the products formed are soluble.

The most important inorganic ligands for copper complexation are HCO_3^-, $CO_3^{2-}$and OH^-, although SO_4^{2-} and Cl^- are also important. Adsorption or coprecipitation of copper with iron oxides may be an important factor in limiting copper mobility; however, the effects are often secondary if organic matter is present.

Lead

Although lead may exist in the 0, +2, or +4 oxidation states, throughout most natural systems Pb^{2+} is the stable ionic species. If the sulfur activity is very low, metallic lead can be a stable phase in alkaline or neutral reducing conditions. Sorption processes appear to exert a dominant effect on the distribution of lead in the environment. Under most natural conditions, adsorption to clay and other mineral surfaces, coprecipitation/sorption by hydrous iron oxides, and incorporation into cationic lattice sites in crystalline sediments are the important sorption processes. The sorption of lead, like that of most metals, is highly pH dependent, with increased sorption with increased pH. While lead may also form complexes with organic matter, it appears that these organo-lead complexes are also sorbed to the extent that the addition of organic complexing agents have been found to increase overall sorption (Huang et al. 1977).

There is also evidence that lead in sediments may be biotransformed under anaerobic conditions into a methylated form that is volatile (Wong et al. 1975). The importance of volatilization of methylated forms of lead is uncertain.

Zinc

Zinc occurs in natural systems with an oxidation state of +2. The main factor controlling zinc solubility in sediments and waters is adsorption and complexation. Precipitation, mainly with sulfides, is more important under very reducing conditions.

Adsorption of zinc onto clay minerals, hydrous metal oxides, and organic materials is probably the dominant fate of zinc in the aquatic environment. Concentrations of zinc in suspended and bed sediments are usually observed to exceed concentrations in ambient waters (EPA 1979). Furthermore, the smaller the sediment grain size, the higher the relative zinc concentration, an observation consistent with the importance of adsorption. The degree of adsorption is dependent on environmental conditions, the most important of which is pH.

Adsorption of zinc increases with increases in pH. Other factors include the presence of complexing ligands, especially Cl^-, OH^-, and SO_4^{2-}, and salinity, in that zinc has been observed to desorb from sediments as salinity increases (Helz et al. 1975).

Organic matter may also complex or adsorb zinc although the affinity of zinc for organic matter is not as strong as it is with other metals.

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TABLE H-1

MAJOR COMPONENTS OF CREOSOTE
REPORTED IN SEVERAL SOURCES

Component	Approximate Percentage of Whole Creosote (a)	(a)	(b)	(c)	(d)	(e)	(f)	(g)	Boiling Point (h)
Acenaphthene	9.0	14.7	7.8	4.1	3.1	9.0	5.5	3.4	279
Acenaphthylene	-	-	0.5	-	-	-	-	-	265-275 (l)
Anthracene	2.0	17.4 (j)	2.5	-	1.5	7.0	-	11.1	340
Biphenyl	0.8	1.6	1.9	-	-	1.0	-	6.8	255.9
Benzofluorenes	2.0	1.0	-	4.6	-	-	-	0.85	413
Carbazole	2.0	1.2	5.1	-	2.4	-	1.2	-	355
Chrysene	3.0	2.6	4.2 (k)	2.8	-	-	-	1.7	448
Dibenzofuran	5.0	7.5	5.2	9.6	1.1	4.0	6.4	-	287
Dimethylnaphthalenes	2.0	2.3	-	3.2	-	-	-	6.8	268
Fluoranthene	10.0	7.6	11.8	6.8	3.4	3.0	10.4	3.4	382
Fluorene	10.0	7.3	6.0	9.6	3.1	9.0	8.3	6.8	293-295
Methylfluorenes	3.0	2.3	-	-	-	-	-	-	318
Methylanthracenes	4.0	3.9 (l)	-	-	-	-	-	0.85	360
2-Methylnaphthalene	1.2	2.8	6.5	2.1 (m)	3.9	12.0 (m)	7.3 (m)	11.1	214.05
1-Methylnaphthalene	0.9	1.7	3.5	2.1 (m)	3.0	12.0 (m)	7.3 (m)	6.8	244.64
Methylphenanthrenes	3.0	3.9 (l)	-	5.4	-	-	-	-	-
Naphthalene	3.0	1.3	17.0	7.3	15.8	18.0	8.5	11.1	218
Phenanthrene	21.0	17.4 (j)	19.4	12.6	10.7	16.0	19.6	11.1	340
Pyrene	8.5	7.0	8.4	5.0	2.2	1.0	8.5	1.7	393
9,10-Dihydroanthracene	-	-	-	-	0.2	-	-	-	313 (l)
Percent of Creosote	90.4	82.2	99.8	73.1	50.4	80.0	75.7	83.5	

Footnotes:

(a) Lorenz, L.F. and Gjovik, L.R. 1972. Analyzing creosote by gas chromatography: relationship to creosote specifications. Proc. Am. Wood-Pres. Assoc.
(b) USDA Biological and economic assessment of pentachlorophenol, inorganic arsenicals, and creosote, U.S. Department of Agriculture Tech. Bulletin #1658-1, Nov. 1980.
(c) Becker, G. 1977. Experience and experiments with Creosote for Crossties. Proc. Am. Wood-Pres. Assoc. 73:16-25.
(d) Stasse, H.L. 1954. Fractional distillation of creosote and composition of preservatives used in the cooperative creosote program. Proc. Am. Wood-Pres. Assoc. 50:13-40.
(e) Andersson et al. 1983. Sampling and analysis of particulate and gaseous polycyclic aromatic hydrocarbons from coal tar sources in the working environment. Chemosphere 12:197-207.
(f) _____, and Becker, G. Chemical compostion of creosote in beech and pine sleepers after various service times. Material prufung 6(12):461-470.
(g) Mueller, James G. et al. Creosote contaminated sites- Their potential for bioremediation.
(h) Handbook of Chemistry and Physics, 1971-1972, 52nd ed., Chemical Rubber Company, Cleveland, Ohio.
(i) Handbook of Chemistry and Physics, 1968-1969, 49th ed., Chemical Rubber Company, Cleveland, Ohio.
(j) Value is sum of anthracene and phenanthrene.
(k) Value is sum of chrysene and 1,2-benzanthracene.
(l) Value is sum of methylanthracenes and methylphenanthrenes.
(m) Value is sum of methylnaphthalenes.

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TABLE H-2

16 PRIORITY POLLUTANT PAH

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Chrysene
Dibenz(a,h)anthracene
Fluoranthene
Fluorene
Indeno(1,2,3-cd)pyrene
Naphthalene
Phenanthrene
Pyrene

TABLE H-3

PHYSICAL-CHEMICAL PARAMETERS FOR PAH, PENTACHLOROPHENOL, DIOXINS, AND DIBENZOFURAN

Compound	Melting Point (°C)	Mole Weight (g/mole)	Water Solubility (mg/L)	Vapor Pressure (mm Hg)	Henry's Law Constant (atm-m^3/mol)	Log K_{ow}
LPAH						
Naphthalene	80(M)	128(M)	3.1E+01(M)	2.34E-01(E)	4.82E-04(E)	3.1/3.3(E)
Acenaphthylene	92(M)	152(M)	3.93E+00(M)	2.90E-02(M)	1.48E-03(E)	3.70(E)
Acenaphthene	96(M)	154(M)	2.42E+00(M)	1.55E-03(M)	9.20E-05(E)	4.00(E)
Fluorene	116(M)	166(M)	1.69E+00(M)	7.10E-04(E)	6.42E-05(E)	4.20(E)
Phenanthrene	101(M)	178(M)	1.00E+00(M)	6.80E-04(M)	1.59E-04(E)	4.46(M)
Anthracene	218(E)	178(M)	4.50E-02(M)	1.95E-04(M)	1.02E-03(E)	4.45(M)
HPAH						
Fluoranthene	111(M)	202(M)	2.06E-01(M)	5.00E-06(M)	6.46E-06(E)	4.90(E)
Pyrene	156(M)	202(M)	1.32E-01(M)	2.50E-06(M)	5.04E-06(E)	4.88(M)
Benzo(a)anthracene	162(M)	228(M)	5.70E-03(M)	2.20E-08(M)	1.16E-06(E)	5.61(M)
Chrysene	254(E)	228(M)	1.80E-3(M)	6.30E-09(M)	1.05E-06(E)	5.61(M)
Benzo(b)fluoranthene	168(M)	252(M)	1.40E-02(M)	5.00E-07(M)	1.2E-05(M)	6.06(E)
Benzo(k)fluoranthene	217(M)	252(M)	4.30E-03(E)	5.10E-07(E)	3.94E-05(E)	6.06(E)
Benzo(a)pyrene	179(M)	252(M)	1.20E-03(M)	5.60E-09(M)	1.55E-06(E)	6.06(E)
Dibenz(a,h)anthracene	270(M)	278(M)	5.00E-04(M)	1.00E-10(M)	7.33E-09(M)	6.80(E)
Benzo(g,h,i)perylene	277(M)	276(M)	7.00E-04(E)	1.03E-10(E)	5.34E-08(E)	6.51(E)
Indeno(1,2,3-c,d)pyrene	163(M)	276(M)	5.30E-04(E)	1.00E-10(M)	6.86E-08(E)	6.50(E)
OTHERS						
Pentachlorophenol	191(M)	266(M)	1.4E+01(M)	1.1E-4(M)	3.4E-06(M)	5.24(E)
Dioxin (2,3,7,8-TCDD)	295/305(M)	322(M)	2.0E-04/ 1.93E-05(M)	6.4E-10(M)	5.4E-23(M)	6.20(M)
Dibenzofuran	86/87(M)	168(M)	1.0E+01(M)	--	--	4.17/4.12/ 4.31(M)

Sources: (M) = Montgomery & Welkom 1990; (E) = EPA 1986c.

APPENDIX J

Sediment Grain Size Data

RECEIVED JAN 7 1991

SOIL TECHNOLOGY
SPECIALIZING IN PHYSICAL SOIL TESTING
7865 N.E. Day Road West
Bainbridge Island, WA 98110
(206) 842-8977 Fax 842-9014

LETTER OF TRANSMITTAL

TO: Analytical Technologies, Inc.
560 Naches Avenue SW, Suite 101
Renton, WA 98055

DATE: January 2, 1991

JOB NO: J-123

ATTN: Karen Mixon

RE: Port of Olympia
Sediment Grain Size Distribution

We are sending the following items:

DATE	COPIES	DESCRIPTION
12/27	2	Sediment Grain Size Distribution Tables 9012-080-1 through 6, 9012-097-1 through 7, and 9012-074-1 through 5.

These are transmitted for your use.

REMARKS: Data submitted in Letter of Transmittal dated 12/27/90 had errors in reporting of finer than Phi size 10. Attached are corrected copies. Please call if you have any questions.

COPIES TO: FILE

Best regards,
SOIL TECHNOLOGY, INC.

Richard G. Sheets,
President

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-074

CPI-M-A1A
Sample ID: 9012-074-1 — 47 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	82	74	69	67	66	63	60	48	35	26	19	14	10	1

CPI-M-A2A
Sample ID: 9012-074-2 — 41 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	100	99	96	94	91	86	83	81	68	52	38	26	18	13	0

CPI-M-A3A
Sample ID: 9012-074-3 — 47 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	100	97	95	93	91	83	78	75	64	50	37	28	21	15	1

CPI-M-A4A
Sample ID: 9012-074-4 — 43 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	100	100	99	98	96	89	84	81	67	55	42	30	23	16	1

CPI-M-B4A
Sample ID: 9012-074-5 — 48 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	97	95	93	92	90	80	73	69	57	45	34	25	18	12	0

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-080

CP1-M-B1YA

Sample ID: 9012080-1 — 44 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	97	95	88	81	77	64	50	38	29	21	15	1

CP1-M-C5A

Sample ID: 9012080-2 — 42 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	99	98	97	96	94	90	86	84	75	62	46	35	27	20	2

CP1-M-D4A

Sample ID: 9012080-3 — 53 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	98	97	95	81	70	61	40	23	17	14	12	9	3

CP1-M-D5A

Sample ID: 9012080-4 — 60 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	99	95	79	50	44	41	35	25	20	15	12	10	2

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-080

CP1-M-ESA

Sample ID: 90[illegible]0-5 — 56 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	100	98	94	75	63	56	35	25	19	15	12	10	3

CP1-M-FSA

Sample ID: 90[illegible]0-6 — 66 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	99	98	96	95	90	56	40	32	19	13	10	9	7	5	2

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-097

CP1-M-B2A

Sample ID: 9012097-1 51 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	99	98	93	87	83	64	44	32	25	20	15	4

CP1-M-B2B

Sample ID: 9012097-2 49 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	98	97	97	96	95	90	85	82	63	47	33	26	20	14	0

CP1-M-B2C

Sample ID: 9012097-3 54 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	98	96	93	86	81	77	61	45	35	26	21	15	2

CP1-M-E4A

Sample ID: 9012097-4 60 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	100	98	95	84	76	69	43	26	19	14	12	9	1

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-097

CP1-M-F4A

Sample ID: 9012097-5 — 78 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	91	64	29	19	15	8	6	5	3	3	2	0

CP1-M-G3A

Sample ID: 9012097-6 — 43 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	100	99	98	96	93	91	80	62	47	35	28	19	1

CP1-M-G3B

Sample ID: 9012097-7 — 54 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	99	97	94	86	80	75	59	44	33	25	20	21	2

SOIL TECHNOLOGY
SPECIALIZING IN PHYSICAL SOIL TESTING
7865 N.E. Day Road West
Bainbridge Island, WA 98110
(206) 842-8977 Fax 842-9014

RECEIVED JAN 7 1991

LETTER OF TRANSMITTAL

TO: Analytical Technologies, Inc. DATE: January 3, 1990
560 Naches Avenue SW, Suite 101
Renton, WA 98055 JOB NO: J-123

ATTN: Karen Mixon

RE: Port of Olympia
Sediment Grain Size Distribution

We are sending the following items:

DATE	COPIES	DESCRIPTION
01/03	2	Sediment Grain Size Distribution Tables Samples 9012-108-1 through 9012-108-15 and 9012-108-17 through 9012-108-19.

These are transmitted for your use.

REMARKS: Samples were tested in general accordance with Puget Sound Estuary Protocol (Conventional Sediment Variables Particle Size March 1986). Values reported are "apparent" particle size as organic material is included in the analysis.

COPIES TO: FILE

Best regards,
SOIL TECHNOLOGY, INC.

Richard G. Sheets,
President

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-108

CP1-M-C4A

Sample ID: 9012-108-1 46 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	97	96	95	88	81	76	61	47	35	27	21	14	0

CP1-M-C4A

Sample ID: 9012-108-1 Replicate 46 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	98	96	89	82	77	59	47	36	27	22	15	1

J-8

CP1-M-C4B

Sample ID: 9012-108-2 46 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	98	97	96	91	86	83	74	60	45	34	26	18	0

CP1-M-C4C

Sample ID: 9012-108-3 49 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	99	98	90	83	79	68	54	40	31	24	19	3

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-108

CP1-M-D3A

Sample ID: 9012-108-4 — 54 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	100	99	99	96	91	85	58	36	27	21	17	14	6

CP1-M-D3B

Sample ID: 9012-108-5 — 49 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	98	97	96	95	90	86	82	68	51	40	31	24	19	3

CP1-M-D3C

Sample ID: 9012-108-6 — 70 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	99	96	74	61	53	31	20	15	12	10	8	3

CP1-M-E2A

Sample ID: 9012-108-7 — 61 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	94	87	82	76	65	50	44	40	31	24	19	15	13	10	6

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-108

CP1-M-E2B

Sample ID: 9012108-8 — 70 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	100	99	99	97	81	40	32	28	20	15	12	9	7	6	3

CP1-M-E2C

Sample ID: 9012108-9 — 77 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	100	100	99	95	71	31	22	17	7	5	3	2	2	1	0

J-10

CP1-M-F2A

Sample ID: 9012108-10 — 67 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	100	99	97	91	71	38	29	24	15	10	8	5	3	2	0

CP1-M-F2B

Sample ID: 9012108-11 — 74 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	100	99	96	89	68	36	29	26	17	12	9	7	5	3	1

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-108

CP1-M-F2C

Sample ID: 9012~~08~~-12 — 79 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	92	83	77	64	39	9	5	4	2	1	1	0	0	0	0

CP1-M-B3A

Sample ID: 9012~~08~~-13 — 54 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	98	94	82	75	70	50	32	22	16	12	9	1

CP1-M-B3B

Sample ID: 9012~~08~~-14 — 68 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	99	96	94	89	72	46	41	39	30	24	17	13	11	9	1

CP1-M-B3C

Sample ID: 9012~~08~~-15 — 51 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	100	99	99	95	91	88	79	64	48	35	27	20	1

J-11

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-108

CP1-M-F1A

Sample ID: 9012~~08~~-17 60 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	97	95	90	77	42	31	25	16	11	9	6	5	3	0

CP1-M-F3A

Sample ID: 9012~~08~~-18 45 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	96	91	85	81	77	63	52	46	32	22	17	13	11	8	2

CP1-M-G7A

Sample ID: 9012~~08~~-19 64 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	98	96	94	90	57	41	33	20	16	12	10	9	7	3

SOIL TECHNOLOGY
SPECIALIZING IN PHYSICAL SOIL TESTING
7865 N.E. Day Road West
Bainbridge Island, WA 98110
(206) 842-8977 Fax 842-9014

RECEIVED JAN 10 1991

LETTER OF TRANSMITTAL

TO: Analytical Technologies, Inc. DATE: January 8, 1990
560 Naches Avenue SW, Suite 101
Renton, WA 98055 JOB NO: J-123

ATTN: Karen Mixon

RE: Port of Olympia
Sediment Grain Size Distribution

We are sending the following items:

DATE	COPIES	DESCRIPTION
01/03	2	Sediment Grain Size Distribution Tables Samples 9012-121-2 through 9012-121-16 with triplicate on 9012-121-7.

These are transmitted for your use.

REMARKS: Samples were tested in general accordance with Puget Sound Estuary Protocol (Conventional Sediment Variables Particle Size March 1986). Values reported are "apparent" particle size as organic material is included in the analysis.

COPIES TO: FILE

Best regards,
SOIL TECHNOLOGY, INC.

Richard G. Sheets,
President

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-121

CP1-M-B1A

Sample ID: 9012121-2 — 57 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	97	96	93	81	72	67	49	37	28	20	16	13	2

CP1-M-B1B

Sample ID: 9012121-3 — 52 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	100	99	98	94	90	88	76	61	47	34	27	22	2

J-14

CP1-M-B1C

Sample ID: 9012121-4 — 52 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	99	98	94	89	86	73	55	40	30	23	18	1

CP1-M-C3A

Sample ID: 9012121-5 — 62 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	98	89	65	55	49	31	18	13	11	9	8	3

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-121

CP1-M-C3B

Sample ID: 9012121-6 70 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	100	99	98	94	81	55	46	41	27	18	13	10	8	7	2

CP1-M-C3C

Sample ID: 9012121-7 53 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	100	100	100	99	99	98	97	95	84	63	50	36	28	22	3

J-15

CP1-M-C3C

Sample ID: 9012121-7 Replicate1 53 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	100	100	100	99	99	99	97	95	82	64	49	34	26	20	1

CP1-M-C3C

Sample ID: 9012121-7 Replicate2 53 % SOLIDS

Sieve Size --> / Finer than Phi Size --> / Grain Size -->	No. 4: > 4750 microns	No. 10: 4750-2000 microns	No. 20: 2000-850 microns	No. 40: 850-425 microns	No. 60: 425-250 microns	No. 140: 250-106 microns	No. 200: 106-75 microns	No. 230: 75-62.5 microns	4 62.5-31.2 microns	5 31.2-15.6 microns	6 15.6-7.8 microns	7 7.8-3.9 microns	8 3.9-1.9 microns	9 1.9-0.9 microns	10 0.9-0.4 microns
Percent Passing (%) -->	100	100	100	100	99	99	97	95	84	65	50	36	28	21	3

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-121

CP1-M-D1A

Sample ID: 9012-121-8 — 77 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	89	85	81	78	74	42	29	22	12	7	5	4	3	0	0

CP1-M-D1B

Sample ID: 9012-121-9 — 82 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	99	90	79	57	31	13	10	9	7	6	5	3	2	2	1

J-16

CP1-M-D1C

Sample ID: 9012-121-10 — 81 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	99	96	89	78	68	38	26	19	7	5	4	4	3	3	2

CP1-M-D2A

Sample ID: 9012-121-11 — 77 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	90	61	20	15	12	8	6	5	4	3	2	0

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-121

CP1-D2B

Sample ID: 9012-12 — 77 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	98	91	68	28	21	18	11	8	6	4	3	2	0

CP1-M-D2C

Sample ID: 9012-13 — 71 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	97	96	94	80	38	30	27	20	14	12	9	7	6	2

J-17

CP1-M-D11A

Sample ID: 9012-14 — 80 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	89	87	86	84	82	58	45	38	23	18	16	14	12	11	8

CP1-M-C13A

Sample ID: 9012-15 — 61 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	98	89	65	55	49	26	16	11	8	7	6	0

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-121

Sample ID: 9012-121-16 (Col-M-G2A)

38 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	98	98	97	96	93	92	91	80	65	47	31	21	13	0

SOIL TECHNOLOGY
SPECIALIZING IN PHYSICAL SOIL TESTING
7865 N.E. Day Road West
Bainbridge Island, WA 98110
(206) 842-8977 Fax 842-9014

RECEIVED JAN 17 1991

LETTER OF TRANSMITTAL

TO: Analytical Technologies
560 Naches Ave. SW., Suite 101
Renton, WA 98055

DATE: January 14, 1991

JOB NO: J-123

ATTN: Karen Mixon

RE: Port of Olympia
Sediment Grain Size Distribution

We are sending the following items:

DATE	COPIES	DESCRIPTION
01/14	2	Sediment Grain Size Distribution Tables Samples 9012-133-1 through 9012-133-19 with triplicate on 9012-133-11.

These are transmitted for your use.

REMARKS: Samples were tested in general accordance with Puget Sound Estuary Protocol (Conventional Sediment Variables Particle Size March 1986). Values reported are "apparent" particle size as organic material is included in the analysis.

COPIES TO: FILE

Best regards,
SOIL TECHNOLOGY, INC.

Richard G. Sheets,
President

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-133

CP1-M-C2A

Sample ID: 9012133-1 — 49 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	99	98	96	93	89	67	46	32	23	20	13	1

CP1-M-C2B

Sample ID: 9012133-2 — 44 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	99	96	94	93	91	87	85	83	77	53	42	32	24	17	1

J-20

CP1-M-C2C

Sample ID: 9012133-3 — 58 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	99	98	93	87	82	63	45	34	25	19	14	1

CP1-M-C2A

Sample ID: 9012133-4 — 47 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	99	98	95	91	88	66	45	32	24	19	14	4

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-133

CP1-M-C12B

Sample ID: 9012133-5 42 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	99	96	94	92	91	85	83	81	72	56	45	34	26	19	1

CP1-M-C12C

Sample ID: 9012133-6 61 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	99	98	91	83	77	55	37	28	21	16	13	2

J-21

CP1-M-C1A

Sample ID: 9012133-7 47 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	99	96	94	92	91	82	76	71	52	35	26	19	14	10	0

CP1-M-C1B

Sample ID: 9012133-8 48 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	98	93	89	87	85	79	75	72	62	48	37	29	23	18	4

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-133

CP1-M-C1C

Sample ID: 9012[illegible]-9 — 47 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	97	95	92	90	86	80	77	76	67	52	39	29	22	16	0

CP1-M-G4A

Sample ID: 9012[illegible]-10 — 49 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	100	99	99	96	93	90	76	53	38	28	22	16	2

J-22

CP1-M-G5A

Sample ID: 9012[illegible]-11 — 61 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	98	96	91	77	69	64	41	28	20	16	13	10	3

CP1-M-G5A

Sample ID: 9012[illegible]-11 — 61 % SOLIDS

Replicate 1

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	98	96	90	76	69	64	43	31	24	20	16	13	7

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO. 9012-133

CP1-M-65A

Sample ID: 9012133-11 61 % SOLIDS
Replicate 2

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	99	99	98	96	90	77	69	64	43	31	25	20	17	14	

CP1-M-85A

Sample ID: 9012133-12 49 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	99	99	98	93	86	81	62	43	31	22	17	11	0

CP1-M-85B

Sample ID: 9012133-13 48 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	99	99	97	96	95	89	84	80	68	53	39	28	22	13	0

CP1-M-85C

Sample ID: 9012133-14 51 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	99	98	97	89	82	78	65	48	33	23	17	9	0

SEDIMENT GRAIN SIZE DISTRIBUTION
ATI PROJECT NO.9012-133

CP1-M-E3A

Sample ID: 9012133-15 — 56 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	98	96	94	93	91	78	66	58	34	22	16	12	9	6	0

CP1-M-G14A

Sample ID: 9012133-16 — 49 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	100	99	99	97	94	91	71	51	36	26	20	14	1

CP1-M-E1A

Sample ID: 9012133-17 — 64 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	99	96	90	73	63	57	40	27	20	15	12	9	0

CP1-M-G6A

Sample ID: 9012133-18 — 69 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	99	99	97	88	48	35	28	18	13	11	9	8	6	2

CP1-M-G1A

Sample ID: 9012133-19 — 38 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:							
Finer than Phi Size -->									4	5	6	7	8	9	10
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	0.9-0.4 microns
Percent Passing (%) -->	100	100	100	98	94	85	82	80	76	61	46	32	22	14	3

SOIL TECHNOLOGY
SPECIALIZING IN PHYSICAL SOIL TESTING
7865 N.E. Day Road West
Bainbridge Island, WA 98110
(206) 842-8977 Fax 842-9014

LETTER OF TRANSMITTAL

TO: Landau Associates, Inc.
P.O. Box 694
Edmonds, WA 98020-9129

DATE: August 29, 1991

JOB NO: J-162

ATTENTION: Leslee Matthews

SUBJECT: Sediment Grain Size Distribution
Cascade Pole
Port of Olympia

We are sending the following items:

DATE	COPIES	DESCRIPTION
8/29/91	2	Sediment Grain Size Distribution Tables for Cascade Pole CP-M series samples.

These are transmitted for your use.

REMARKS: Samples were tested in general accordance with Puget Sound Estuary Protocol (Conventional Sediment Variables Particle Size March 1986). Values reported are "apparent" particle size as organic material is included in the analysis. Per PSEP Protocol dispersant corrections are made, however per EPA, US Army Corps, "Dredged Material Testing Manual, February 1991" any methods proposed for the determination of parameters in sediment and water from estuarine or marine environments have to explicitly address steps taken to control salt interference.

The floppy disk will follow.

Best regards,
SOIL TECHNOLOGY, INC.

Richard G. Sheets,
Vice President

CASCADE POLE
PORT OF OLYMPIA
SEDIMENT GRAIN SIZE DISTRIBUTION

Sample ID: CP2-M-A2B — 43 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	99	98	96	94	92	82	62	45	33	25	19	1	
Fractional Percent % -->	0	0	0	1	1	2	2	2	10	20	17	12	8	6	18	1

Sample ID: CP2-M-A2C — 52 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	93	86	80	76	70	67	65	56	45	34	26	19	14	1	
Fractional Percent % -->	0	7	7	6	4	6	3	2	9	11	11	8	7	5	13	1

Sample ID: CP2-M-A2D — 58 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	95	90	84	80	77	71	67	65	55	44	33	23	19	15	0	
Fractional Percent % -->	5	5	6	4	3	6	4	2	10	11	11	10	4	4	15	0

Sample ID: CP2-M-C1E — 52 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size - >	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	100	99	98	96	95	89	75	58	41	30	23	0	
Fractional Percent % -->	0	0	0	0	1	1	2	1	6	14	17	17	11	7	23	0

CASCADE POLE
PORT OF OLYMPIA
SEDIMENT GRAIN SIZE DISTRIBUTION

Sample ID: CP2-M-C1PP — 81 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	87	82	74	56	34	26	21	20	17	13	10	7	6	5	1	
Fractional Percent % -->	13	5	8	18	22	8	5	1	3	4	3	3	1	1	4	1

Sample ID: CP2-M-C2E — 54 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	100	99	97	93	89	72	56	43	31	24	18	1	
Fractional Percent % -->	0	0	0	0	1	2	4	4	17	16	13	12	7	6	17	1

Sample ID: CP2-M-D3E — 65 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	99	96	69	58	53	40	29	23	17	14	11	3	
Fractional Percent % -->	0	0	1	0	3	27	11	5	13	11	6	6	3	3	8	3

Sample ID: CP2-M-D4B — 62 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	98	96	89	67	58	52	36	24	18	15	12	10	2	
Fractional Percent % -->	0	1	1	2	7	22	9	6	16	12	6	3	3	2	8	2

CASCADE POLE
PORT OF OLYMPIA
SEDIMENT GRAIN SIZE DISTRIBUTION

Sample ID: CP2-M-D4D									52 % SOLIDS							
Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	100	100	98	95	93	82	68	53	38	29	22	1	
Fractional Percent % -->	0	0	0	0	0	2	3	2	11	14	15	15	9	7	21	1

Sample ID: CP2-M-E1B									77 % SOLIDS							
Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	97	95	90	79	39	26	23	13	10	9	7	6	5	3	
Fractional Percent % -->	0	3	2	5	11	40	13	3	10	3	1	2	1	1	2	3

Sample ID: CP2-M-E1C									77 % SOLIDS							
Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	99	97	90	40	26	19	8	5	5	4	3	2	1	
Fractional Percent % -->	0	1	0	2	7	50	14	7	11	3	0	1	1	1	1	1

Sample ID: CP2-M-E11F									78 % SOLIDS							
Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	98	94	85	69	36	26	21	12	9	7	5	4	3	1	
Fractional Percent % -->	0	2	4	9	16	33	10	5	9	3	2	2	1	1	2	1

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SEDIMENT GRAIN SIZE DISTRIBUTION

Sample ID: CP2-M-F1B — 79 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	96	93	79	54	24	18	15	9	6	5	4	3	2	0	
Fractional Percent % -->	0	4	3	14	25	30	6	3	6	3	1	1	1	1	2	0

Sample ID: CP2-M-F11B — 78 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	99	96	92	78	51	21	17	13	8	6	5	4	2	2	0	
Fractional Percent % -->	1	3	4	14	27	30	4	4	5	2	1	1	2	0	2	0

Sample ID: CP2-M-G3B — 46 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	99	99	97	94	92	79	64	48	33	28	21	1	
Fractional Percent % -->	0	0	0	1	0	2	3	2	13	15	16	15	5	7	20	1

Sample ID: CP2-M-G3C — 60 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	98	97	95	88	80	74	56	40	30	22	17	13	0	
Fractional Percent % -->	0	1	1	1	2	7	8	6	18	16	10	8	5	4	13	0

CASCADE POLE
PORT OF OLYMPIA
SEDIMENT GRAIN SIZE DISTRIBUTION

Sample ID: CP2-M-G3E — 59 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	99	99	94	86	80	62	49	37	28	22	18	4	
Fractional Percent % -->	0	0	1	0	0	5	8	6	18	13	12	9	6	4	14	4

Sample ID: CP2-M-H1A — 47 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	98	97	89	82	77	61	45	33	25	20	15	1	
Fractional Percent % -->	0	0	1	1	1	8	7	5	16	16	12	8	5	5	14	1

Sample ID: CP2-M-H1B — 50 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	98	97	95	89	84	81	70	54	41	31	24	18	1	
Fractional Percent % -->	0	1	1	1	2	6	5	3	11	16	13	10	7	6	17	1

Sample ID: CP2-M-H1C — 48 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	98	98	92	86	83	73	57	43	32	24	18	0	
Fractional Percent % -->	0	0	1	1	0	6	6	3	10	16	14	11	8	6	18	0

CASCADE POLE
PORT OF OLYMPIA
SEDIMENT GRAIN SIZE DISTRIBUTION

Sample ID: CP2-M-H1E — 66 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	88	76	61	55	51	48	46	45	42	36	30	22	17	13	2	
Fractional Percent % -->	12	12	15	6	4	3	2	1	3	6	6	8	5	4	11	2

Sample ID: CP2-M-H2A — 58 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	98	95	85	78	72	47	28	20	15	12	10	2	
Fractional Percent % -->	0	0	1	1	3	10	7	6	25	19	8	5	3	2	8	2

Sample ID: CP2-M-H2B — 62 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	98	96	90	68	60	55	39	25	19	14	11	9	0	
Fractional Percent % -->	0	1	1	2	6	22	8	5	16	14	6	5	3	2	9	0

Sample ID: CP2-M-H2C — 74 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	99	97	87	45	34	28	19	14	10	8	7	5	1	
Fractional Percent % -->	0	1	0	2	10	42	11	6	9	5	4	2	1	2	4	1

CASCADE POLE
PORT OF OLYMPIA
SEDIMENT GRAIN SIZE DISTRIBUTION

Sample ID: CP2-M-H2D	52 % SOLIDS															
Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	100	99	95	93	91	81	67	48	34	26	20	0	
Fractional Percent % -->	0	0	0	0	1	4	2	2	10	14	19	14	8	6	20	0

Sample ID: CP2-M-H2M	63 % SOLIDS															
Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	90	79	75	72	68	65	62	52	40	30	23	18	14	2	
Fractional Percent % -->	0	10	11	4	3	4	3	3	10	12	10	7	5	4	12	2

Sample ID: CP2-M-H3A	50 % SOLIDS															
Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	99	98	92	85	80	60	42	31	23	18	13	0	
Fractional Percent % -->	0	0	0	1	1	6	7	5	20	18	11	8	5	5	13	0

Sample ID: CP2-M-H3B	51 % SOLIDS															
Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	97	96	94	86	79	74	59	45	34	26	21	16	2	
Fractional Percent % -->	0	1	2	1	2	8	7	5	15	14	11	8	5	5	14	2

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Sample ID: CP2-M-H3C Replicate 1 50 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	99	98	97	88	82	78	69	54	40	31	24	16	1	
Fractional Percent % -->	0	1	0	1	1	9	6	4	9	15	14	9	7	6	17	1

Sample ID: CP2-M-H3C Replicate 2 50 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	99	98	89	82	79	66	52	38	29	22	17	0	
Fractional Percent % -->	0	0	1	0	1	9	7	3	13	14	14	9	7	5	17	0

Sample ID: CP2-M-H3C Replicate 3 50 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	99	98	97	88	82	78	68	54	40	30	23	17	1	
Fractional Percent % -->	0	1	0	1	1	9	6	4	10	14	14	10	7	6	16	1

Sample ID: CP2-M-H3E 59 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	95	78	65	60	58	56	54	53	49	44	34	24	20	15	1	
Fractional Percent % -->	5	17	13	5	2	2	2	1	4	5	10	10	4	5	14	1

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Sample ID: CP2-M-H3L 64 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	99	96	91	85	83	81	60	41	27	20	17	14	1	
Fractional Percent % -->	0	1	0	3	5	6	2	2	21	19	14	7	3	3	13	1

Sample ID: CP2-M-H5A 62 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	99	98	96	80	69	61	36	22	16	13	11	10	3	
Fractional Percent % -->	0	1	0	1	2	16	11	8	25	14	6	3	2	1	7	3

Sample ID: CP2-M-H5B 62 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	98	97	94	79	70	64	43	30	23	19	15	12	3	
Fractional Percent % -->	0	1	1	1	3	15	9	6	21	13	7	4	4	3	9	3

Sample ID: CP2-M-H5CC 79 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	98	87	52	15	10	8	5	4	3	2	2	2	1	
Fractional Percent % -->	0	1	1	11	35	37	5	2	3	1	1	1	0	0	1	1

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Sample ID: CP2-M-H5E 51 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	99	99	90	84	80	67	53	39	30	23	17	2	
Fractional Percent % -->	0	0	1	0	0	9	6	4	13	14	14	9	7	6	15	2

Sample ID: CP2-M-H6A 67 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	99	97	89	60	40	27	19	15	12	10	8	2	
Fractional Percent % -->	0	0	0	1	2	8	29	20	13	8	4	3	2	2	6	2

Sample ID: CP2-M-H6B 71 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	97	93	85	70	41	32	27	17	13	10	8	6	5	1	
Fractional Percent % -->	0	3	4	8	15	29	9	5	10	4	3	2	2	1	4	1

Sample ID: CP2-M-H6C 77 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	97	88	61	55	41	22	15	12	11	9	8	5	
Fractional Percent % -->	0	0	1	2	9	27	6	14	19	7	3	1	2	1	3	5

Sample ID: CP2-M-H6E 68 % SOLIDS

Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	99	99	79	64	56	36	26	20	16	13	11	4	
Fractional Percent % -->	0	0	0	1	0	20	15	8	20	10	6	4	3	2	7	4

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Sample ID: CP2-M-H8A 65 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	98	95	87	53	39	32	19	13	10	8	6	4	0	
Fractional Percent % -->	0	1	1	3	8	34	14	7	13	6	3	2	2	2	4	0

Sample ID: CP2-M-H8B Replicate 1 60 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	99	98	95	85	78	73	52	35	26	20	15	11	0	
Fractional Percent % -->	0	1	0	1	3	10	7	5	21	17	9	6	5	4	11	0

Sample ID: CP2-M-H8B Replicate 2 60 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	98	96	86	79	74	52	36	26	20	15	12	0	
Fractional Percent % -->	0	0	1	1	2	10	7	5	22	16	10	6	5	3	12	0

Sample ID: CP2-M-H8B Replicate 3 60 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	98	96	86	79	74	53	34	28	19	14	11	0	
Fractional Percent % -->	0	0	1	1	2	10	7	5	21	19	6	9	5	3	11	0

Sample ID: CP2-M-H12B 64 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	99	97	91	69	61	56	40	27	20	15	12	10	2	
Fractional Percent % -->	0	1	0	2	6	22	8	5	16	13	7	5	3	2	8	2

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Sample ID: CP2-M-C3	57 % SOLIDS															
Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	98	93	74	65	58	35	20	15	11	9	6	1	
Fractional Percent % -->	0	0	0	2	5	19	9	7	23	15	5	4	2	3	5	1
Sample ID: CP2-M-D3	56 % SOLIDS															
Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	.100	100	99	96	89	81	50	30	22	16	12	9	1	
Fractional Percent % -->	0	0	0	0	1	3	7	8	31	20	8	6	4	3	8	1
Sample ID: CP2-M-E11	65 % SOLIDS															
Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	95	86	61	53	48	28	18	12	9	8	5	1	
Fractional Percent % -->	0	0	1	4	9	25	8	5	20	10	6	3	1	3	4	1
Sample ID: CP2-M-E12	61 % SOLIDS															
Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	97	92	80	71	64	39	23	16	13	10	8	4	
Fractional Percent % -->	0	0	1	2	5	12	9	7	25	16	7	3	3	2	4	4

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SEDIMENT GRAIN SIZE DISTRIBUTION

Sample ID: CP2-M-E4B 63 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	99	96	86	66	58	54	40	29	21	16	13	10	1	
Fractional Percent % -->	0	1	0	3	10	20	8	4	14	11	8	5	3	3	9	1

Sample ID: CP2-M-E4C 70 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	97	92	75	48	44	42	36	28	21	16	12	10	1	
Fractional Percent % -->	0	1	2	5	17	27	4	2	6	8	7	5	4	2	9	1

Sample ID: CP2-M-E1F 77 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	98	95	88	74	40	30	25	15	11	9	6	5	4	1	
Fractional Percent % -->	0	2	3	7	14	34	10	5	10	4	2	3	1	1	3	1

Sample ID: CP2-M-E4E 73 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	99	97	92	70	57	48	25	16	13	10	8	7	3	
Fractional Percent % -->	0	1	0	2	5	22	13	9	23	9	3	3	2	1	4	3

CASCADE POLE
PORT OF OLYMPIA
SEDIMENT GRAIN SIZE DISTRIBUTION

Sample ID: CP2-M-BI11 48 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	99	99	96	94	91	73	49	32	21	15	11	1	
Fractional Percent % -->	0	0	0	1	0	3	2	3	18	24	17	11	6	4	10	1

Sample ID: CP2-M-BI1 Replicate 1 48 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	99	99	96	93	91	72	48	33	22	15	11	1	
Fractional Percent % -->	0	0	0	1	0	3	3	2	19	24	15	11	7	4	10	1

Sample ID: CP2-M-BI1 Replicate 2 48 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	99	98	98	98	98	95	92	90	72	48	31	23	16	12	2	
Fractional Percent % -->	1	1	0	0	0	3	3	2	18	24	17	8	7	4	10	2

Sample ID: CP2-M-BI1 Replicate 3 48 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	99	99	99	96	93	90	71	47	31	21	15	10	0	
Fractional Percent % -->	0	0	1	0	0	3	3	3	19	24	16	10	6	5	10	0

CASCADE POLE
PORT OF OLYMPIA
SEDIMENT GRAIN SIZE DISTRIBUTION

Sample ID: CP2-M-Bl2			40 % SOLIDS													
Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	98	95	88	75	71	68	58	44	34	24	17	12	0	
Fractional Percent % -->	0	1	1	3	7	13	4	3	10	14	10	10	7	5	12	0

Sample ID: CP2-M-Bl3			42 % SOLIDS													
Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	100	100	99	98	94	89	85	68	48	34	24	13	12	0	
Fractional Percent % -->	0	0	0	1	1	4	5	4	17	20	14	10	11	1	12	0

Sample ID: CP2-M-F1A			66 % SOLIDS													
Sieve Size -->	No. 4:	No. 10:	No. 20:	No. 40:	No. 60:	No. 140:	No. 200:	No. 230:								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	98	95	92	84	70	36	25	21	12	9	7	5	3	2	0	
Fractional Percent % -->	2	3	3	8	14	34	11	4	9	3	2	2	2	1	2	0

CASCADE POLE
PORT OF OLYMPIA
SEDIMENT GRAIN SIZE DISTRIBUTION

Sample ID: CP2-M-H7A — 55 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	95	92	89	87	82	62	50	44	28	20	15	12	9	6	0	
Fractional Percent % -->	5	3	3	2	5	20	12	6	16	8	5	3	3	3	6	0

Sample ID: CP2-M-H7C — 74 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	99	96	92	83	66	34	26	23	13	12	10	7	5	4	0	
Fractional Percent % -->	1	3	4	9	17	32	8	3	10	1	2	3	2	1	4	0

Sample ID: CP2-M-H7B — 72 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	100	99	99	96	87	55	44	38	26	18	14	10	8	6	1	
Fractional Percent % -->	0	1	0	3	9	32	11	6	12	8	4	4	2	2	5	1

Sample ID: CP2-M-H10A — 57 % SOLIDS

Sieve Size -->	No. 4	No. 10	No. 20	No. 40	No. 60	No. 140	No. 200	No. 230								
Finer than Phi Size -->									4	5	6	7	8	9	10	Balance
Grain Size -->	> 4750 microns	4750-2000 microns	2000-850 microns	850-425 microns	425-250 microns	250-106 microns	106-75 microns	75-62.5 microns	62.5-31.2 microns	31.2-15.6 microns	15.6-7.8 microns	7.8-3.9 microns	3.9-1.9 microns	1.9-0.9 microns	<0.9 microns	
Percent Passing (%) -->	93	91	88	83	70	44	38	35	29	22	17	13	9	7	2	
Fractional Percent % -->	7	2	3	5	13	26	6	3	6	7	5	4	4	2	5	2

APPENDIX K

Response to Ecology Comments

APPENDIX K
RESPONSE TO ECOLOGY COMMENTS
ON THE DRAFT *REMEDIAL INVESTIGATION REPORT*
SEDIMENTS OPERABLE UNIT
CASCADE POLE SITE
OLYMPIA, WASHINGTON

Draft Report dated February 28, 1992
Ecology Comments dated October 15, 1992

Please note that the page numbers referenced in Ecology comments refer to pages in the draft RI Report, not this final report.

General Comments

1. It would be helpful if the report clearly identified and summarized areas that may require additional evaluation prior to the implementation of remedial action at the site. Many of the concerns raised in this letter are focused on verifying the completeness of the investigation in defining the limits of contamination that require cleanup. This includes identifying areas around the perimeter of the area sampled that may require further chemical analysis, and the need for an expanded biological sampling and assay effort.

   New Section 6.2 addresses this comment.

2. There are several occasions in the report where significant information that was presented in the appendices was not well incorporated or summarized in the text.

   Where Ecology has identified examples of this problem in the Specific Comments, the text has been revised accordingly.

3. The Executive Summary does not provide a very clear picture of the amount and degree of contamination (particularly biological contamination) in the intertidal sediments. In other words, the lay reader currently has no way of judging the scale or severity of the contaminant impacts on the offshore environment as defined by this investigation. Considering the high level of community concern for this site, the Executive Summary should be clarified wherever possible in lay persons language.

   The Executive Summary has been revised to address this comment.

4. Whenever chemical concentrations are reported in text, figures, or tables, information regarding dry or wet weight analysis, and TOC normalization (if applicable), should be given. There are a number of cases, particularly in the text, where this has not been made clear for the reader.

The appropriate changes have been made to address Ecology's concern.

5. All references or comparisons to the Sediment Management Standards should include the identification of the specific criteria being referred to (i.e., Sediment Quality Standards or Cleanup Screening Levels).

The requested change has been made to the text.

6. The terms "background" and "reference" should be clearly defined for the reader wherever used, in order to avoid confusion. Standardize these terms and explain their meaning in context with the Eld Inlet sample stations, stations at the perimeter of the site, the stations elsewhere in Budd Inlet, and data bases from Puget Sound reference stations.

This change has been made to Section 4.1 of the document.

Specific Comments

7. On p. iv, please list out the metals that exceed the Sediment Management Standards. It should also be noted in the Executive Summary that there is no standard for dioxin in sediments, but dioxin has been demonstrated to be elevated above background in the Sediments Operable Unit.

The text has been revised to address this comment.

8. On p. iv, the Executive Summary notes that bioassays from two locations exceeded State criteria. A better description of the location of these two stations should be included in order to clarify the areal extent of biological impact for the reader.

The requested change has been made to the text.

9. On p. v, the clams collected from the H2 sample station are not in the area of highest sediment contamination, as indicated by the text.

The text has been revised to address this comment.

10. On p. v, please describe for the reader the significance of the Eld Inlet data in the context of the site (i.e., thought to be representative of pristine conditions?).

The requested change has been made to the text.

11. On p. v, the paragraph describing the results of the benthic abundance and diversity studies is poorly written. Considering the level of concern regarding this issue in the community, this section should be revised in clear, lay persons language. Provide the reader with a more straightforward understanding of the health of the biological community in the intertidal zone adjacent to the site and the scale or severity of the impacts from site contaminants. The references to "an urban embayment and a less developed area" add to this confusion. Biological data results from the site should be described in the context of the site chemistry and to the reference station at Eld Inlet, not to undefined assumptions regarding urban embayment conditions.

The summary of the benthic abundance and diversity studies has been revised.

12. On p. 3, the resident population at the East Bay Marina should be mentioned in this section. Are there estimates of how many people live on boats in the marina? There should also be some mention of shellfish harvesting and the current restrictions/warnings placed on that activity along the site shoreline. Some description should be provided regarding the usage of the public boat ramp adjacent to the site, including estimates of the annual number of people using this facility. Do people swim, jet ski, or board sail from this ramp?

The text has been revised to address this comment. Usage of the marina by swimmers, jet skiers, and board sailors is reported to be minimal.

13. On p. 3, the report should provide a description of the public dock/breakwater immediately adjacent to the site. How is this dock constructed? Is it possible that this dock can influence contaminant transport or distribution in any way?

A description of the breakwater and its possible influence on sediment transport has been incorporated into Section 3.4.1.

14. On p. 3, the report should identify property ownership of the intertidal and subtidal area. Where does state-owned property begin offshore? A map should be provided that shows the relationship of any navigation channels (and general offshore bathymetry beyond the -2.8ft MLLW line) to the sediments unit.

A figure (new Figure 2) that addresses Ecology's property boundary and navigation channel questions has been added to the document.

15. On p. 3, very little discussion is presented regarding the overall benthic infauna present in the intertidal area, beyond the data specific to one or two locations found later in the report. Was the depth of the biologically active zone defined at the site? Biological information should be shown on the core logs and cross sections in the report if possible, as was done for the Phase I report. This information could be critical for remedial purposes, but is never discussed in the RI report. Are the depths used for the bioassay samples (10 cm) appropriate considering the depths established for the surface-mixed layer (25 cm), and the biologically active zone (30 cm??)?

A statement regarding benthic fauna observed at the Site has been included in the text. Biological information recorded at the time of sampling has been noted on the core logs.

In a sedimentary environment dominated by biological mixing, the depth of the surface mixed layer can provide an estimate of the depth of the predominant biologically active zone and can be estimated by identifying the interval of sediment with uniform excess Pb-210 activity. However, Pb-210 distributions do not always provide unequivocal evidence of the depth of the mixed layer due to patchy mixing, the existence of nonsteady state profiles, or uneven flux of Pb-210 to the seabed. Pb-210 data obtained from the Site during the RI was found to be influenced by these variables to such an extent that precise definition of the mixed layer from the data is not possible. In general, benthic activity in coastal marine sedimentary environments is highest in the upper few centimeters of the sediment column although burrowing organisms can go as deep as 1 meter. Typically, the very deep burrowers are rarer, and given the types of fauna observed at the Site, the majority of biological activity is estimated to be within the upper 0-25 cm interval of the Site sediment. This estimate is not contradicted by the rough estimate of 25 cm for the mixing zone that has been postulated from the data from Station H4 (the station with Pb-210 data least subject to interferences) and also is consistent with direct (albeit limited) observations at the Site.

PSEP guidelines recommend using a composite of the 0-2 cm interval of sediment for bioassays (most benthic activity, including feeding, is at the sediment water interface). The greater interval used for the RI bioassays (10-cm) was chosen because this was the interval over which the sediment chemistry was defined, allowing comparisons between biological and chemical data. The RI sediment bioassay samples actually exceeded the depth interval required under the PSEP guidelines. Given the fact that at this site, most of the highest concentrations of contaminants were found below 10 cm, it may be that lower concentrations of contaminants at the Site occur in the upper 0-2 cm of the sediment, and that the bioassays, which were conducted with the 0-10 cm interval of sediment, overestimate biological effects.

16. On p. 4, the references for the evaluation of species status (i.e., endangered, etc.) are from 1990. Have they been reconfirmed recently?

Letters have been sent to the Washington State Department of Wildlife, the Washington State Department of Fisheries, and the U.S. Fish and Wildlife Service requesting confirmation of the results of the Inventory of Potentially Protected Resources (Landau Associates 1990b). A response was received from Washington State Department of Wildlife, and the information in the response has been incorporated into the text.

17. On p. 4, the report states that the occurrence of marine mammals in Olympia Harbor is judged to be unlikely. Is this statement based on a formal reference or study, or is this simply an opinion? Is this true for harbor seals?

A citation was provided for the statement regarding marine mammal occurrence and observance of harbor seals. The primary source for the information is not known.

18. On p. 5, is the absence of vegetation in the Sediments Operable Unit normal for this type environment? Could this be the result of contaminant impacts?

The text has been revised to address this comment.

Inspection of aerial photographs of the intertidal region at the terminus of the Port peninsula indicates the presence of patchy vegetation on the western portion of the intertidal region. Vegetation is not common on the eastern side of the intertidal region. The lack of vegetation to the east may be more related to the lack of coarse substrate than to contamination. In general, muddy intertidal sediments of Budd Inlet are sparsely vegetated.

19. On p. 5, when was the dredging for the dock/breakwater that is noted on the base map conducted? This information could be important since it is clear that there are still elevated concentrations of contaminants at the edge of the drop off in sediment surface topography and beyond (A2). Could contaminated sediments have been removed and transported from this area during this activity? If this is true, where would that material have been redeposited?

The dredging was conducted in the early 1980s. It is not known whether contaminated sediments were excavated during the dredging. The excavated material was part of the fill that now constitutes the East Bay Marina section of the Port peninsula.

20. On p. 6, it should be noted in the text that neither the original RI or FS were considered adequate investigations by Ecology.

Ecology's position regarding the noted efforts is documented in the Consent Decree, but is not believed to be appropriate for this document. Therefore, the requested revision has not been made.

21. On p. 6, as the project progresses, it may be wise to make sure descriptions of the "treatment facility" are not confused with references to the ground water "treatment plant," or the LOTT wastewater treatment plant.

The requested clarification has been made throughout the text.

22. On p. 7, why have BTEX and copper been left out of the list of chemicals of concern for the Sediments Operable Unit? These contaminants were found at elevated concentrations on the uplands.

The text has been revised to address this comment.

23. On p. 9, where is the line delineating the subtidal area from the intertidal area? How does this compare to the -2.8 ft MLLW line on the base maps?

The distinction between the subtidal and intertidal sediments can be expressed on the basis of the average low tide, the average of the lower low tides, or on the basis of the maximum low tide. For lower Budd Inlet, the average low tide is 3.06 ft MLLW, the average of the lower lot tide is 0 ft MLLW and the lowest tide on record with NOAA is -4.5 ft MLLW (NOAA 1990b). Based upon the slope of the sediment surface at the Site, the -4.5 ft MLLW elevation is expected to lie slightly over half again the distance outward from the -2.8 ft elevation as the -2.8 ft elevation is from the 0 ft elevation.

24. On p. 10, the level of duplication (5%) seems low for the amount of samples analyzed. Typically QA duplication is conducted on 10% of a sample set. Does this in any way influence the data usefulness? How does a 5% level of duplication compare to the Puget Sound Estuary Program protocols?

PSEP guidelines recommend a minimum of 5 percent replication overall. The Quality Assurance Plan for the Remedial Investigation, which was accepted by Ecology, clearly identified 5 percent as the replication goal. With the level of duplication conducted during the RI, the data collected are considered acceptable and useful for the purposes intended, subject only to the data qualifiers identified during the data validation.

25. On p. 12, the TSS results for the water samples (30-72 mg/L, Appendix C) appear to be elevated above what would be expected for sea water. This may indicate that bottom material was disturbed when the water sampling was conducted.

The TSS values reported (33-72 mg TSS/L) are certainly high for open sea water, but in a dynamic, estuarine environment with a muddy bottom these values are not unreasonable. Field notes taken during the water sampling indicate that no major disturbance of the bottom material was noted during sampling; however, the presence of sediment in the sample from Station H12 was recorded in the field notes. If, in fact, bottom disturbance did occur, the data from the samples with the higher TSS values may represent worst-case water quality, rather than average.

26. On p. 12, a discussion should be provided in the text regarding the timing of the water sampling events vs. tidal stage, weather conditions, and wave action. Did any of these factors influence the data results? For example, were samples of water in surface channels collected shortly after the tide had receded, or after some time had passed? Is the timing of the sampling event believed to bias the representativeness of the results in any way (e.g., is it possible there is a "peak" in concentration immediately after the tide recedes, tailing off through the remainder of the cycle?)? Would different results be expected during or shortly following a storm event?

Appendix A provides information regarding the tidal stages at the time of the water sampling events. The samples were collected in August, and no major storms directly preceded the sampling. Naturally, water quality would be expected to vary over time due to many variables, of which the occurrence of storms is only one.

27. On p. 12, a floating oil phase (LNAPL) has regularly been observed on the water surface in the intertidal area immediately adjacent to the site shoreline, indicating that high levels of organics are concentrating in the upper several centimeters(?) of the water column. Over what depths were the water column samples collected for this investigation? Doesn't the sampling approach used fail to adequately distinguish this vertical "stratification" of contaminants in the water column? This could be significant when considering the importance of the upper layers of the water column to biological processes or human exposure. What significance does the concentration of a floating oil phase on the water surface have for transport of contaminants away from the site?

As stated in Appendix A, the water column samples were collected, as planned, from the entire depth of the water that existed at the sampling location at the time of sampling. The sampling, as conducted, certainly would not (nor was it intended to) identify vertical stratification of contamination if it exists.

It should be noted that Ecology and the Parties discussed the pros and cons of evaluating the surface microlayer of the water in the planning stages of the RI, and Ecology accepted the Work Plan for Phase II without such a study. The Parties contend that a study that would be comprehensive enough to cover all variables and complexities so as to provide meaningful data regarding the surface microlayer is unjustified. A remedy that addresses offsite migration of free phase

contamination and those sediments with concentrations above human health and environmentally based cleanup standards will concurrently improve the surface microlayer (insofar as it is affected by this Site).

28. On p. 13, information should be provided in the text regarding the depth of collection for the bentnose clam samples, and the depth intervals for the sediment grab samples that were used for benthic abundance/diversity evaluation.

The requested information is provided in the text.

29. On p. 13, more explanation should be provided for the reader regarding the logic for locating the biological samples. For instance, why were no bentnose clam samples collected along the shoreline where the sediment PAH concentrations are significantly elevated, and recreational shellfish harvesters are more likely to visit (e.g., the sediment concentrations noted for the A horizon at station H2 are significantly lower than those reported at C1, and H2 is over 200 feet out from the shoreline)? Why were only two clam samples collected for this investigation? Comparing the sediment concentrations at the biological sampling stations to the range and median of concentrations encountered in sediments throughout the operable unit could assist the reader in understanding the representativeness of the clam sampling effort (preferably through the use of a graphic).

The number of clam samples and the locations from which they were collected during the RI were in accordance with the Phase II Work Plan reviewed and approved by Ecology. A comparison of sediment chemistry at clam sampling location H2 to other sediment concentrations is as follows:

	TPAH (µg/kg)	PCP (µg/kg)
Mean	57483±228788	18.5±39
Median	4855	5.9 J
H2A	23604	47
H2B	18877	54

From these data, it is clear that Station H2 represents a location with sediment concentrations well above the median sediment concentrations for two primary constituents of concern (sediment dioxin/furan data are not available for Station H2). Station H2 is not, however, a station exhibiting the highest concentrations detected at the Site (which, it should be noted, was not an objective of the sampling program).

30. On p. 13, why were bentnose clams chosen for sampling, rather than littleneck, manila, or softshell clams?

Bentnose clams were chosen for sampling because that was the species that was found consistently and in sufficient abundance at all the locations sampled. It would have been ineffective to collect different species at different locations and then attempt to compare the resulting analytical data.

31. On p. 14, a very complete review of the chemical data is conducted in Appendix D. However, nowhere in the report is the overall precision or variability of the data clearly stated or summarized. This would include variability introduced from sample collection and processing, and laboratory analysis. Field and laboratory duplicates would be a measure of this precision, but are not discussed in the report. A summary discussion of the QA/QC results and conclusions should be presented in the text of the report.

A summary discussion of the QA/QC results is now included in the report. Field and laboratory protocols were designed and effected to minimize variations that would affect comparability of the data. Variations inevitably occurred, but the effects of these are considered minor unless specifically noted at the appropriate place within the RI Report. The field duplicates submitted during the RI provide a measurement of many field sample handling variables along with laboratory variability.

32. On p. 15, the document references three erosional channels originating from the area near the log pond and NPDES outfall, but notes these features have not been placed on the base map for the figures. Considering the coincidence of these channels with the most highly contaminated areas of the Sediments Operable Unit, it is essential to plot the position of these channels. Offshore transport of contaminants sorbed to sediments (or free phase contamination) is a concern, and these channels are more likely than any to facilitate that process. The base maps should be modified to show these features. Has the sediment and water sampling that was conducted for this investigation adequately characterized the downgradient areas of these channels? Does the data exist to confirm if offshore transport of contaminants via these channels has impacted sediments adversely further out into the bay? It is unlikely a one time sampling event of the water flowing in a channel can provide enough information to answer this concern.

The approximate locations of the three channels not originally plotted on the base map have been added to Figures 7, 9, and 12. Sediment Stations C1, C2, and H2 correspond to the nearshore portion of the channel that originates at the historical log pond. Stations H3 and B5 are subtidal sampling stations that would be expected to be influenced by particle transport within two of the primary drainage channels of concern (one originates near the outlet of the NPDES discharge pipe and the other originates near the historical log pond). Stations B4, C4, C5, and D5 represent locations farther outward in the subtidal zone, and therefore provide information to assess whether significant deposition is occurring subtidally on a broad scale due to drainage channel particle transport. And finally, Stations A2,

A3, and A4 provide information regarding channelized flow that may direct particles to the marina area. Based upon the chemistry for the upper 10 cm at these locations, a concern that a significant area of contaminated sediment has been overlooked is not supported.

33. On p. 15, are the positions of the channels that were identified during the RI fixed, or have they been observed to move over time?

Recent high resolution aerial photos from the site indicate that, except for a few meanders that have migrated, the primary drainage channels did not change their locations between July 1989 and July 1990. Land-based observations in spring of 1992 generally confirm this observation. Pre-1989 historical aerial photos, which are at a lower resolution than those available since 1989, support the observation that the general locations of the drainage channels through the intertidal area have not changed significantly since at least August 1985. However, it would seem likely that the channels would meander over time, and significant changes to drainage patterns east of the former wood treatment plant likely occurred concurrently with the placement of fill along the east side of the treatment plant in the early 1980s.

34. On p. 15, the report should provide some information on the Port's breakwater that lies to the southeast of the site. What is this breakwater composed of? Can it influence, redirect, or contain contaminant transport in any way?

See response to Specific Comment 13.

35. On p. 16, sediment grain size results are discussed in a number of instances throughout the report, but they are not reported. A grain size map and/or data table should be included in the report. Perhaps percent fines in the A layer throughout the site could be plotted, and provided immediately after the TOC% map.

The grain size data are reported in Appendix J.

36. On p. 17, the cross-sections presented in the report are based solely on lithology. Can hydrogeologic interpretations identifying preferred pathways for ground water and contaminant transport also be identified (e.g., laterally continuous sand layers vs. silty lenses)? Can biological information be included? Is it possible to mark the 1979 sediment surface more accurately on the large scale cross sections?

To the extent that laterally continuous strata can be inferred from the data obtained during the RI, the interconnections are shown on the cross sections. Biological information was not included on the cross sections, due to the fact that it is qualitative only. The 1979 sediment surface has not been transferred to the large-scale cross sections.

37. On p. 18, piezometric data showing downward gradients in a known ground water discharge area (i.e., a seepage face) seems suspect. Further explanation should be provided for this observation.

The piezometric data cited were reported in ESE 1992a.

38. On p. 18, circulation and flushing for Budd Inlet (2.8 tidal cycles) is stated as being relatively fast compared to other bays in the vicinity. Values reported for Eld and Totten Inlets in the literature are 2.7 and 2.4 tidal cycles, respectively (URS, 1986).

The text has been changed slightly to reflect the small differences in flushing between Budd, Totten, and Eld Inlets according to the URS and Evans Hamilton (1986) data.

39. On p. 19, the report states that current data are not available for the site. Several investigations (URS, 1986; Cox et al., 1984; and the LOTT outfall improvement studies conducted by Parametrix) report data for the vicinity. These data should be examined for applicability.

There seems to be confusion regarding the current information stated in the report. The report states that "tidal current data are not available for the *Site*." Tidal current measurements developed by NOAA for the vicinity are reported and discussed later in the same paragraph.

40. On p. 19, the report estimates the current velocity that would be necessary 3 feet above the sediment surface to induce suspension of surface sediments. Specifically what grain size and density was this calculated for? It is known that the organic contaminants found at the site tend to sorb to the finer grained particles such as silts, clays, and fine, low density organic material. Would the velocity necessary to resuspend the grain sizes normally associated with sorbed contaminants be a lower value than given in the text?

The discussion in Section 3.4.1. has been expanded to address these issues.

41. On p. 20, how does the fact that the sediment surface was reestablished by dredge and fill activities in the early 1980's influence the validity of the Pb-210 analysis? How does this relate to a SML of 25 cm? Can sedimentation rates calculated for the C6 station provide representative data for the area of highest contaminant concentration closer to shore?

Superposition of the 1979 sediment elevation isopleth map (Figure 13) onto the present bathymetry map of the Sediments Operable Unit shows that the elevations at the locations of the core samples for Pb-210 analysis (C6, E6, and H4) have not changed significantly since before the filling activities. Therefore, the estimation of 25 cm for the mixed layer at Station H4 is considered valid.

Sedimentation rates calculated for Station C6 apply to that location only.

42. On p. 20, how was the depth of the SML identified? Where did the 25 cm value come from? More discussion should be presented somewhere in the report regarding the depth of bioturbation or biological activity that was observed in the borings. What are the ramifications of this information for the natural recovery potential?

See the response to Specific Comment 15 for an explanation for the identification of the SML at the Site. A statement regarding observations of biological activity during the RI has been added to the text. The potential for natural recovery of the sediment at the Site is addressed in the Sediment Feasibility Study. Uncertainty regarding the depth of the mixing zone is incorporated into the natural recovery evaluation.

43. On p. 20, it is unclear why an attempt was not made to directly calculate sedimentation rates from the core data. The procedure used incorrectly uses total Pb-210 activity vs depth (cm). The standard procedure is to plot excess (unsupported) Pb-210 activity (dpm) vs accumulation rate (g/cm^2), and then run a linear regression. See the methods used by Carpenter, et al., 1985, Figures 3 and 4. There seems to be some indication that the upper portion of the core was lost. One method of checking this may be to compare the surface concentrations of Pb-210 at the site to surface concentrations from other Puget Sound investigations.

No attempt was made to directly calculate sediment accumulation rates from the core data in the draft RI because the Pb-210 profiles are very likely disturbed by mixing. No clear surface mixed zone and underlying decay zone existed in the cores examined. The method that seems most appropriate for estimating the accumulation rate in this case involves a comparison of Pb-210 fluxes. This technique was outlined in the draft RI Report and now appears in expanded form in the revised document.

The procedures used in the draft and revised RI to estimate the accumulation rates correctly use excess Pb-210 activity. Figure 23 has been changed to show the profile of excess Pb-210.

The Pb-210 inventory estimates are not unreasonable in comparison to other shallow bays of Puget Sound, and therefore do not support the suggestion by Ecology of an indication that part of the upper portion of the cores was lost.

44. On p. 22, the section describing the factors influencing sediment resuspension and transport should also include some discussion regarding the role of erosional channels crossing the intertidal area, particularly to the east of the uplands.

The requested change has been made to the text.

45. On p. 22, Appendix F mentions that the predominant transport mechanism for transport of sediments from the site to areas further offshore is the action of longshore drift to the east caused by small waves. This is not clearly summarized in the text of the report, which tends to emphasize the effects of storm action. Can maps be provided in the report that roughly predict the areas sediments would be transported to, such as the East Bay Marina basin (see Appendix F)? Have these areas been adequately sampled during this study to determine if sediment concentrations are above levels of concern? Considering the calculated potential for over 1400 yd^3 of sediment to be resuspended on an annual basis, isn't this a significant consideration?

The RI Report correctly summarizes the information in Appendix F. Maps showing areas of sediment redeposition have not been developed. As noted in the text, the estimate of up to 1,470 yd^3 of resuspended material from the 25-acre Sediments Operable Unit does not represent a net loss from the Site. Some of the resuspended material would be expected to resettle within the Sediments Operable Unit.

46. On p. 23, easterly transport of material from the intertidal area would be into East Bay. This area is relatively shallow and needs to be periodically dredged. It is unclear why the -17 MLLW elevation was calculated as the elevation beyond which material is no longer available for resuspension.

The -17 MLLW elevation is based on the depth of influence from a maximum storm wave from the north, that occurs at the maximum low tide of approximately -4 ft MLLW. For other storms at other tidal stages, the depth below which no resuspension would be expected to occur would be different.

47. On p. 23, how was the conclusion regarding the +5 ft MLLW elevation range made? No such conclusion is mentioned in the report in Appendix F.

The statement in the text regarding the +5 ft MLLW elevation was based upon a telephone conversation with Hartman Associates in which the Appendix F report was discussed. The citation for the statement has been corrected.

48. On p. 24, although the report initially acknowledges that the data that was collected from various "background" stations within Budd Inlet are for descriptive purposes only, the information is used as a statistically valid data set for comparison to site data throughout the remainder of the report. This is not a valid application of this information, and should be modified within the RI. Not only is the data set a limited one [WAC 173-340-708 (11) requires a data set of at least 10 sampling points from areas that are not impacted by releases from local human activities to establish background], but the report fails to acknowledge that the stations are biased towards impacted areas within Budd Inlet. Further, non-standard statistical techniques for determining "background" chemical concentrations are used (e.g., doubling the average of three stations), although the reasons for doing so are not well supported. A more appropriate background data set for reference comparison would be, as one example, Puget Sound values presented in the Pollutants of Concern in Puget Sound matrix (PTI, 1991a). Examination of the Pollutants of Concern matrix indicates that the "background" values used in the RI are, in many cases, quite high. The use of the stations within Budd Inlet for comparison to site data should be modified, and language added to the report making the limitations of any comparison clearer for the reader. The report should also clearly identify for the reader the factors that may influence the data results reported for the three Budd Inlet samples (e.g., storm drains, adjacent industries, etc.).

Whenever comparisons are made in the RI Report to the Budd Inlet background sample data that was generated during the RI, clarification has been provided regarding the limitations of the data set. In many cases, the discussions regarding background concentrations have been revised to incorporate the data noted by Ecology.

From as early as the RI planning stages, the Parties have made it clear to Ecology that the purpose of the offsite RI sampling of Budd Inlet was to provide information that would allow a comparison of Site concentrations with respect to an urban embayment. The sampling was never meant to provide data representing a nonanthropogenically affected area, nor was there ever an assertion that the resulting data was intended to, or in fact did, constitute a database sufficient to meet the requirements of WAC 173-340-708(11). The data do, however, provide perspective in evaluating Site data.

As a point of clarification, Ecology's reference to a MTCA requirement of at least 10 sampling points to establish natural background per WAC 173-340-708(11) is for soil only and refers to a "background" that has not been influenced by localized human activity. Sediment falls into the category of other media, for which the minimum requirement is to be set on a case-by-case basis. Furthermore, data from lower Budd Inlet would typify "area background" rather than "natural background" as

these terms are defined in MTCA. The Parties agree that three sampling locations do not constitute a statistically valid database for rigorous evaluations; however, the minimum number of sampling stations for establishing background in Budd Inlet with respect to the Site has not been established.

The Ecology contention that the Budd Inlet stations sampled during the RI are biased toward impacted areas is misleading to the public. All of lower Budd Inlet is impacted by a number of anthropogenic sources, and as stated previously to Ecology, the stations do, and were always intended to, represent lower Budd Inlet. In this way, data would be available to provide perspective for the public in assessing the magnitude of the contamination at the Site in relation to other areas in urbanized Budd Inlet. Furthermore, in developing the specific locations for the lower Budd Inlet sampling stations, locations of known point sources were mapped so as to prevent the RI stations from being located directly in front of known point discharges and, at the time of sampling, additional attention was paid to the shoreline to prevent sampling at unmapped but obvious discharges.

Ecology's statement regarding the comparison of the RI Budd Inlet data with data in the cited Pollutants of Concern report is also misleading. Certainly, as would be expected for an urbanized area, the Budd Inlet data are "in many cases, quite high" compared to pristine reference areas. Ecology failed to note that the Budd Inlet data are well below the concentrations documented in the Pollutants of Concern report as representative of heavily industrialized areas. The Budd Inlet concentrations are judged to be reasonable for a lightly industrialized embayment.

49. On p. 24, how do the authors know if the contaminants present at some or all of the Budd Inlet stations are not actually from the site?

It is not known, unequivocally, that the chemicals measured in sediment samples from the Budd Inlet locations are not due, at least in part, to the Site. However, as Ecology states at the end of Comment 48, there are a number of potential sources in lower Budd Inlet that may influence the chemistry of the background sediment samples. Therefore, in no case would the chemistry of a background station be due only to the Site.

50. On p. 24, the descriptions of the extent and nature of contamination below 100 cm in the sediments should be more detailed, particularly since there are no maps presented for depth intervals below 100 cm. Sample stations that were determined to have contaminant concentrations above the Sediment Management Standards at intervals below 100 cm (Figure 46) should be emphasized, as well as any station that exhibited a pattern of increasing concentration with depth (e.g., 2-chlorophenol @150-200 cm @D3).

New figures have been added to the document to show concentrations of most of the contaminants of concern (and TOC) in sediment below 100 cm. Text has been added to Section 4.1 to clarify the distribution and any exceedances of the Sediment Management Standards. However, emphasizing samples from below 100 cm that exceed the Sediment Management Standards is not appropriate. The Sediment

Management Standards apply to surface sediments, which are defined as those sediments within the predominant biologically active zone (which is estimated to be between 0-25 cm at the Site), and those sediments exposed to the water column. Therefore, comparisons of sediment quality to the Sediment Management Standards for those samples obtained below 25 cm are provided primarily to allow evaluations of the status of sediment should dredging or other remedial action expose the deeper sediments permanently, such that they then constitute surface sediments. There is a discussion of cores with concentrations that are decreasing with depth; however, the example stated by Ecology (2-chlorophenol in the 150-200 cm sample from Station D3) was not discussed because it was not clearly increasing with depth. Samples from all depth intervals but one at Station D3 were reported as undetected; the only detection was close to the detection limit.

51. On p. 25, while the substitution of the detection limit for non-detects in summing compound totals may overestimate concentrations, it should be added that tentatively identified compounds (TICs) are not included, and therefore, overall contaminant concentrations may possibly be underestimated. The report should discuss TICs and how they were handled.

The text has been revised to address this comment.

52. On p. 25, it may be helpful for the reader to clarify that the various contour maps use data that has not been normalized to organic carbon (the maps should clearly indicate that data are reported as µg/kg dry weight). Do maps using normalized data indicate anything significantly different about the distribution of contaminants? What affect do high TOC values (8-9%) have on the plots?

The figure legends have been amended. In general, normalizing the data does not significantly alter the interpreted pattern of contaminant distribution as represented by the nonnormalized figures. Exceptions to this have been noted in the text.

53. On p. 26, is the H1 station associated with a drainage channel? It seems interesting that the PAH and PCP values at this station are higher in the 0-10 cm interval than other stations closer to source areas. The same question can be posed for the B4 location, why do the concentrations begin to rise again as you move further offshore? Could this be related to the DNAPL continuum discussed later in this letter?

Station H1 does not appear to be associated with a drainage channel. The PCP and PAH concentrations are only slightly higher in the A zone at H1 than at stations closer to the source area. These slightly higher concentrations may be attributed to a number of different factors, including an artifact of field variability, soil heterogeneities, erosion of the surface sediment layer, or transport from an area of more contaminated sediments via dissolved phase transport or resuspension of sediments. Occurrence of slightly higher PAH concentrations in the A Zone at Station B4 may also be attributed to one or more of these same factors. A duplicate sample of B4A (B14A) had significantly lower PAH concentrations than B4A (5,929 vs. 12,630 µg/kg total PAH), illustrating the effect of field variability.

54. On p. 28, metals concentrations from deep cores in Puget Sound are available from a number of references in the literature, in order to assess background (historical) conditions.

The discussion of metals concentrations in the text has been revised.

55. On p. 29, again, on what basis is twice the average "background" concentration of three samples chosen as a valid statistical comparison?

See response to Specific Comment 48.

56. On p. 29, it should be noted for the reader that copper and chromium, contaminants found at elevated concentrations in the sediments, are common components of certain wood preserving processes.

The suggested text has been added.

57. On p. 29, the report states that "only a few samples had concentrations that were clearly elevated." However this statement is based on a comparison of the values in the sediments operable unit to values collected at the Budd Inlet "background" stations. Would this statement still be true if the site data was compared to a more valid data set representing Puget Sound background? Is there any inorganics data from the Eld Inlet station that can be used for comparison?

The data have been re-interpreted using the 90th Percentile values for Reference Areas as reported in PTI (1991a). The Eld Inlet samples were not analyzed for chemical parameters.

58. On p. 29, the report should discuss the implications of applying the TEF/TEQ method of normalizing dioxins and furans to sediments. Are there any problems or limitations that may result in using such data?

The discussion of the normalization procedure has been expanded. Because the composition of dioxin/furan congeners is fairly uniform in Site samples, TEQ is a good measure of both toxicity and total dioxin/furan distribution.

59. On p. 30, one of the highest surface sediment dioxin hits (TEQ) is found at the A2 location, the station closest to the East Bay marina, at the lateral limits of sampling. This suggests additional sampling may be necessary beyond this area.

New Section 6.2 addresses this comment.

60. On p. 30, how do the TOC values reported for the site compare to the Eld Inlet reference sample? Can a median value for TOC be estimated for the various depth intervals? Do the presence of high concentrations of organic contaminants in any way influence the reported TOC value (TOC values of 8% and 9% are very high)? How do the site values compare to the values reported in other baseline Puget Sound studies? It should also be noted for the reader that the TOC normalization method required by the Sediment Management Standards may artificially depress the reported chemical concentration below the regulatory criteria for stations with abnormally high TOC concentrations. This may be one of a number of explanations for the failure of the chemical criteria to provide similar results to bioassays.

No TOC analyses were conducted on the Eld Inlet samples. Variability of TOC between depth intervals did not appear to be greater than that within each depth interval, so medians for each interval were not calculated. Some TOC values reported for Site samples exceeded those reported in other Puget Sound studies. This alone is not considered unusual for sediment offshore from an historical wood treating site, where bark and wood chips are common. The reported concentrations of organic chemicals do not significantly contribute to the TOC content. It is recognized that a significant portion of creosote is not accounted for in the PAH analyses; whether the unaccounted portion contributes significantly to the TOC is unknown.

The TOC values reported for samples C3A and D3A were both approximately 2 percent, which are not "abnormally high," and therefore would not be expected to skew the interpretation as suggested by Ecology.

61. On p. 31, the calculations that were run for estimating the presence or absence of NAPL are based on the idea that the porewater concentration can be predicted using the sediment concentration and theoretical partitioning coefficients. Earlier comments from Ecology have noted a number of reasons why this approach may underestimate true porewater values in the field. The limitations of this technique should be more clearly identified for the reader.

The text has been revised to address this comment.

62. On p. 32, the justification for rejecting the use of the effective solubility when calculating pore water NAPL is not supported. This does not appear to be an appropriate use of this evaluation technique.

Additional justification for not using effective solubility has been provided.

63. On p. 32, it is noted that there are several samples that were collected in the field that had visible evidence of NAPL, but were not predicted to have NAPL using the theoretical calculations. One suggestion given for this is the limited amount of NAPL in a given sample interval. However, the report should note that an equally valid reason would be the inaccuracy of the predictive technique.

The text has been revised to include further discussion regarding the limitations of the NAPL evaluation.

64. On p. 33, an additional source of data for chemical concentrations in Budd Inlet is the Puget Sound Ambient Monitoring Program (Tetra Tech, 1989, and PTI, 1991b). See stations 48 and 49, which are in Budd Inlet.

The noted data have been incorporated into the document.

65. On p. 34, the conclusions reached regarding the level of PCP concentrations relative to other areas of Budd Inlet may need to be modified when comparing site data to reference areas (Pollutant of Concern Matrix), the Puget Sound Ambient Monitoring Program data, or criteria outlined in the Reference Area Performance Standards for Puget Sound (PTI 1991c).

The data referenced by Ecology have been incorporated into the PCP discussion in Section 4.1.2. Other references (PTI 1991a; TetraTech 1989) were searched to find a background value representative of Budd Inlet, without success. PCP was reported as detected in one reference area sample at 0.1 µg/kg DB (PTI 1991a); however, the 90th percentile value for nonreference areas and urban bays increased to 380 µg/kg DB. Budd Inlet, with its partial industrialization, would presumably be somewhere between these extremes.

66. On p. 34, it should be clearly noted in the report that metals data from One Tree Island Marina may be a very poor indicator of background conditions if the sampling conducted there was collected where boats are maintained or worked on.

The text has been revised to note the historical activities that may have affected the referenced sample. However, the data again place the quality of the Site sediments in context for the public, in that lower Budd Inlet is not a pristine water body.

67. On p. 35, it should be stated if any samples were above the SQS for PCP.

The requested text has been added (no samples were above the SQS for PCP).

68. On p. 35, the selection of a site near the mouth of Indian/Moxlie Creek basin, which is a major input source to Budd Inlet, does not seem appropriate for "background" comparison. Moxlie/Indian Creek has a flow of up to 350 cfs during storm events and drains a largely developed area (Indian Moxlie Comprehensive Drainage Basin Plan 1989-1992). The report should, at a minimum, acknowledge the urban influences on this and the other samples used for comparison from Budd Inlet and clarify the limitations of using these stations for "background" purposes. Again, it is probably more appropriate to compare the data from the site to established reference data bases, including the Reference Area Performance Standards for Puget Sound.

An expanded discussion of background samples is now included in Section 4.1.

69. On p. 36, the highest PAH concentrations in water samples were found in a drainage channel leading away from the log pond area. Can any conclusions be drawn regarding the long term significance of contaminant transport via this mechanism from more highly contaminated areas to areas further offshore that are less contaminated? Was velocity data collected for the channel flow at station H12? Can contaminant flux be estimated? Was sampling conducted in the channel downstream of the H12 location to characterize redeposited contaminants?

If the onshore source of PAH is cut off as a result of remediation, increases of PAH concentrations in sediments farther offshore would not be expected to occur in the long term. Velocity data were not collected at Station H12, therefore contaminant flux to offshore sediments can not be estimated. Sediment sampling directly downstream of the H12 location in the channel was not conducted.

70. On p. 36, LNAPL is frequently observable on the water surface along the northeastern shoreline of the site. It is clear that contaminants are concentrating in the uppermost centimeters of the water column when an LNAPL is present. Yet the samples collected during the RI are composites of a substantial section of the water column. How and where would a NAPL floating on the water surface be distributed away from the site into Budd Inlet? Would this enhance the distribution of contaminants?

The text of Section 5.3 has been revised to address this comment. See also the response to Specific Comment 27.

71. On. p. 37, it is stated that TEQ concentrations were "low" for all site water column samples. Yet the value reported for the H12 station was more than three orders of magnitude greater than the average reported for the stations in Budd Inlet. How do the site values compare to values reported from other baseline Puget Sound studies?

The text has been changed to clarify that Site ponded water samples had higher TEQ values than did Site water column or Budd Inlet background water column samples. Very little data exists for TEQ at other locations within Puget Sound. One nonreference area sample is reported in PTI 1991a, as undetected at a detection limit of 0.01 µg/L for the 2,3,7,8-TCDD isomer. This detection limit is well above any value detected in Site samples.

72. On p. 37, how many clams were collected at each of the stations sampled?

The text has been revised to address this comment.

73. On p. 37, no data for the chemical or physical parameters for the Eld Inlet reference sample is presented in the report. This information should be included. How did the data reported for the reference sample compare to the criteria outlined in Reference Area Performance Standards for Puget Sound? Why are two reference sample locations shown on Figure 10?

The reference sample utilized for the bioassays (Station EI1) is reported by the laboratory to have had a sulfide content of 0.3 ppm and an ammonia content of less than 0.1 ppm. No other chemical data are available for the reference samples. Grain size data for the reference samples are presented in Appendix K.

The *Reference Area Performance Standards for Puget Sound* (PTI 1991) identify quantitative standards for several chemicals (including sulfides), and for amphipod mortality; all other standards are qualitative. Because the standards are for subtidal sediment rather than intertidal sediment, deviations from the standards for the RI reference sample would not necessarily indicate a problem with the RI reference sample.

Data relative to the RI reference sample are available for four of the quantitative standards specified in PTI 1991: 1) sulfides, 2) amphipod mortality, 3) the echinoderm abnormality end point, and 4) the echinoderm combined abnormality and mortality end point. For these parameters, the RI reference sample is within the standards established for subtidal reference areas:

- **The reference sample was reported to contain 0.3 ppm sulfides with 65 percent solids compared with an interim standard of 85 ppm dry weight for sulfides.**
- **The reference sample was reported to exhibit a 5 percent mean amphipod mortality; the proposed standard is 30 percent mean amphipod mortality.**
- **The reference sample was reported to exhibit a 2 percent echinoderm abnormality end point; the proposed standard is 7.2 percent echinoderm abnormality end point.**
- **The reference sample was reported to exhibit a 4 percent echinoderm combined end point; the proposed standard is 16 percent echinoderm combined end point.**

Please note that the lack of chemical data for the reference area sample is not considered a deficiency for the RI because the Work Plan for the RI bioassays was finalized prior to the 1991 publication of the PSEP guidance specifically addressing reference area performance standards. The Work Plan requires that the bioassays be conducted in accordance with the 1986 PSEP bioassay guidance, which did not

contain the detailed reference area performance standards that the 1991 revision contains.

To avoid confusion, Figure 10 has been revised to delete the reference station that was sampled but not used.

74. On p. 37, are tissue samples reported in µg/kg wet weight? Is the detection limit of PCP 1 µg/kg wet weight?

The tissue sample data are reported as wet weight, and the detection limit for pentachlorophenol was 1 µg/kg on an as-received basis, which in this case was met.

75. On p. 38, can the metals values reported in the clam samples be put in context for the reader? How do these values compare to available health standards for human consumption of clams, or to baseline Puget Sound studies?

The Risk Assessment Report for the Sediments Operable Unit addresses this issue.

76. On p. 38, it should be noted for the reader in the text that a brief explanation is provided in Table 9b regarding the Sediment Management Standards biological criteria for SQS and CSL concentrations.

The text has been revised to address this comment.

77. On p. 38, endpoints in the Microtox® test are not survival, they are expressed as a reduction in light output. The bioassay section needs to be expanded to discuss the specific results of the tests. In addition, the Sediment Management Standards require a t-test to be performed at the 0.05 significance level. The results of this test should be noted in the report.

The text has been revised to clarify the Microtox test end point, and to clarify the results of the statistical tests.

78. On p. 38, the replacement table for "NEW LCM" should be incorporated into the final draft of the RI.

This change has been made to the document.

79. On p. 38, clarify the language summarizing the conclusions about the differences in the bioassay results versus the chemical data. As written the statement is confusing for the reader. Does this mean that in some cases it can be demonstrated that the chemical criteria set forward in the Sediment Management Standards are apparently not protective of biota at the site? Guidance from Ecology's Sediment Management program indicates that biological results will always be used as the defining criteria in such cases where conflicting answers are derived. Given that the table value chemical criteria may not be protective for biota for this site, and the limited character of the sampling effort, the need for expanded biological testing is clearly necessary. Considering the significance of the bioassay results to future remedial decisions, a thorough discussion should be presented in the report regarding the possible reasons why the test results are in conflict.

Ecology's Sediment Management Standards state that a sediment sample that fails any one of the biological tests shall be designated as failing the applicable Sediment Management Standards notwithstanding the sediment's designation on the basis of sediment chemistry. Given this, the apparent contradictions observed in the comparison of chemical concentration or bioassay-based passes or failures of SQS and CSL for Stations C3 and D3 may indicate the need for reconfirmation of the results during remedial design sampling. However, a possible explanation for the discrepancy between the results of the limited bioassay survey and the chemical criteria based survey is that the sediment used in the bioassays was collected separately (approximately 8 months later) from the sampling for the chemical survey. The difficulty in resampling the same station and the heterogeneity both vertically and laterally in the intertidal sediments at the Site may have contributed to the discrepancy in the results. Another potential reason includes noncontaminant related sensitivities of the bioassays.

80. On p. 39, clarify what is meant by the statement "(t)he small, usually commercial crabs, pimotheridae..."

The text has been revised to address this comment.

81. On p. 40, means are mentioned in the discussion regarding benthic abundance, but none of these values are presented in the report. The report also refers to "significant" differences. Please provide more information regarding the statistical methods and significance levels that were used to determine this.

The reference to mean taxa was incorrect; the text has been revised to reference total number of taxa, which are enumerated in the sentence immediately succeeding the statement. The report refers to "suggested significant differences," not absolute significant differences. No formal statistical methods were applied to these data.

82. On p. 40, in trying to establish the potential effects of historic activities at the site to the sediments environment, the differences noted at station E4 should be discussed within the context of the site data, and not simply explained away as "...consistent with expected occurrences in an urban embayment."

The text has been modified to address this comment.

83. On p. 40, in the last paragraph of this page, the reference to Station "E2" should be changed to "E4."

The reference has been revised.

84. On p. 41, again, the comments regarding the limitations of earlier comparisons to "background" conditions in Budd Inlet should be addressed in the opening statements of this section.

The text has been revised to address this comment.

85. On p. 41, the report describes a "fingerprinting" method used to assist in identifying potential sources of contamination. This term tends to imply a method that is certain and unequivocal. There are many factors that act to make source identifications of complex PAH mixtures tentative at best. A term such as "chemical profiling" or "comparison of relative abundance" would give the reader a better understanding that this is an inexact process.

The term fingerprinting has been changed to "chemical profiling" in response to Ecology's concern, and the text has been revised to clarify the limitations of the profiling.

86. On p. 41, the report uses a method to sort PAH concentration ratios into three types. However, it is not clear what criteria were used to sort the PAH into these three categories. As presented, the logic for selection becomes circular: sites are selected because they fit a given profile, a given profile is defined by the results from the sites. The report should provide a better explanation of how the three types of contours were selected and what criteria were used.

The text has been revised to address this comment. Sorting was accomplished by the following steps:

1) HPAH ratios that had a pyrene ratio less than 1, and chrysene and benzo(b and k)fluoranthene ratios less than the benzo(a)anthracene ratio were designated Type 1. These HPAH ratios match the ratios for Site creosote and NAPL.

2) **A significant percentage of HPAH ratios for sediment samples also exhibited a pattern similar to Type 1, but with chrysene and benzo(b and k)fluoranthene ratios that were slightly higher than the benzo(a)anthracene ratio. These samples were designated Type 2.**

3) **The remainder of the samples exhibited a pyrene ratio greater than 1 and, frequently, a benzo(b and k)fluoranthene ratio greater than 1. These samples were designated Type 3.**

The logic of this approach is not circular. The objective of this chemical profiling technique was to gain information regarding the nature of the chemical distribution in the sediments. Other studies have used this method with success to distinguish sediment contaminated with creosote, based on the very distinctive HPAH ratio pattern exhibited by creosote. As mentioned in the report, all Site samples were unambiguously classifiable into one of the three types, with virtually no outliers. This grouping is judged to be a reasonable approach in evaluating potential sources of HPAH in sediments.

87. On p. 41, the profiling method that is used in the report is based on the concept of normalizing concentrations to fluoranthene=1. The problem with this method is that if fluoranthene is deficient in a sample, all other compounds will have a proportionally higher index. This method can be too sensitive to the amount of fluoranthene. Figure 52 shows the three categories of ratios. Types 2 and 3 are quite similar in their relative abundance of all HPAH except fluoranthene. Instead of the fluoranthene index, perhaps the percentage of HPAH by chemical should be evaluated.

The chemical HPAH profiling method used in the Sediments RI Report has been previously used in other studies (Cubbage 1989 and Ecology 1988) to identify HPAH contamination in sediment that is derived from creosote, with success. These studies determined that sediments affected by creosote exhibit a characteristic pattern. Creosote is enriched in fluoranthene relative to other HPAH, so this method works well for sediments affected by creosote contamination. If a sample was deficient in fluoranthene, then its chemical profile would be different from creosote. This may suggest another PAH source, but it also may represent a weathered creosote.

88. On p. 44, is it possible that the Type 3 chemical profile represents advanced weathering of HPAH?

The Type 3 profile may reflect a combination of HPAH inputs, advanced weathering of creosote HPAH, or both. The latter would result from a relatively higher loss of fluoranthene.

89. On p. 44, does this information support the suggestion that the log pond area on shore is an ongoing source area for PAH contamination in the sediments?

HPAH chemical profiling results suggest that the sediments directly offshore from the former wood treatment plant are affected by creosote, probably from the treatment plant area, which includes the log pond area.

90. On p. 44, the report characterizes those sediments that show a Type 2 chemical profile as weathered Type 1. Stations BI1 and BI2 and their duplicates have been characterized as Type 2 sediments. Strictly interpreted, this seems to imply that the sediments at the southern end of East Bay show characteristics of weathered NAPL from the site. Does this say something about contaminant transport away from the site, or is it indicative of the reliability of the profiling technique to clearly distinguish source areas? What does this say about the reliability of using these stations for "background" comparison.

Background station sample BI1 most closely resembles the Type 2 chemical HPAH profile but Sample BI2 is between a Type 2 and Type 3 profile. Based on this, Sample BI1 appears to be influenced by creosote, but Sample BI2 is less conclusive. Whether or not the creosote influence at Station BI1 is related to the CPC Site is unknown.

91. On p. 45, how is the fact that creosote as NAPL may act as a wetting agent in sediments significant to the transport and mobility of NAPL? Is there any evidence regarding the wetting characteristics of the NAPL at the CPC site?

According to Mercer and Cohen (1990) a NAPL that acts as a wetting fluid may exhibit a greater residual saturation, would preferentially occupy the smaller pore spaces, would require a lower displacement entry pressure, and would exhibit a continuous phase at residual saturation. Migration of creosote would most likely be enhanced if it were a wetting fluid.

There are no specific data concerning the wettability of the Site LNAPL or DNAPL. In a modelling study of creosote migration near the Bow River in Calgary, Alberta, creosote was determined to be a nonwetting fluid.

92. On p. 45, the report should clarify that while PAH compounds are known to have a tendency to adsorb onto organic carbon in sediments and soils, there are a number of factors that can hinder or prevent this sorption from occurring, particularly in the presence of an oily phase. It should also be clarified for the reader that PAH compounds, in concentrating in a NAPL (such as a floating oil layer on the water column surface, or a mobile DNAPL), can be transported significant distances not otherwise predicted by sorption-based transport models. Given the apparent affinity of PAH for sediment particles, how have NAPL level concentrations reached as far as three and four hundred feet offshore? Would this accumulation have been predicted or probable via aqueous phase transport alone?

Section 5.2.2 of the report has been revised to address this comment. An aqueous phase transport model would not predict "NAPL level concentrations" of PAH accumulation; therefore, NAPL level concentrations 300 or 400 ft offshore are judged to be due to migration or placement of NAPL or NAPL-laden sediments.

93. On p. 47, how does the pH data for the sediments and water column at the site compare to the information presented for the sorption potential for PCP?

There are no sediment pH data for the Site. The pH of sea water is approximately 8. At this pH, it is expected that PCP would be predominantly in the anionic state and would be more soluble than in the neutral form, and therefore would have a lower potential to sorb to sediment.

94. On p. 48, Section 5.3 provides generic information on the potential transport mechanisms that emplaced the contaminants in the sediments offshore of the site. However, there should be more information provided regarding the potential mechanisms and rates of transport from the near shore environment to areas further out into Budd Inlet. In addition to resuspension, this includes the potential for free phase DNAPL already in the sediments to migrate, the potential for LNAPL (from a separate source area or as a result of fractionation from the DNAPL) to migrate on the water surface, and the potential for ongoing dissolution of contaminants in NAPL to seawater.

A potential exists for bulk flow of DNAPL from the near shore sediment to areas further offshore, if a continuous phase of DNAPL exists. DNAPL could potentially migrate downdip through a more permeable sand or shell lens, if a sufficient head of DNAPL or hydraulic pressure gradient exists. Both the head of DNAPL and hydraulic pressure gradient decrease with distance from the shoreline, therefore, bulk DNAPL flow would be less likely to occur offshore. A potential also exists for DNAPL to migrate downward into fractures, worm holes, or other more permeable zones in the aquitard. If the source of DNAPL is remediated onshore, the main driving forces for bulk DNAPL migration would be eliminated.

If DNAPL exists in a residual saturation state, migration of residual DNAPL only would be expected to occur if one of the forces controlling DNAPL migration changed.

95. On p. 49, it should be clarified for the reader that ground water seepage from the shallow aquifer could discharge throughout the interface between the onshore aquifer and Budd Inlet. Discrete seep discharge points exposed during low tide represent only a portion of the total volume of ground water that can migrate off-site. Ground water discharge from the shallow aquifer can occur throughout the intertidal and subtidal area found between the site shoreline and the "daylight" line of the top of the aquitard. Was such a daylight line ever identified? Where is it predicted to lie?

The text has been revised to clarify that groundwater seepage could occur throughout the stated interface. "Fresh" groundwater would probably not discharge as far out as the aquitard daylight line, due to saltwater intrusion into the sediments and base of the aquifer. An aquitard "daylight" line was not identified during the Sediments RI. The aquitard/recent sediment contact may be exposed in places where dredging has occurred. At other locations offshore of the Site, the aquitard is probably covered with at least a thin veneer of recent sediments.

96. On p. 49, Yim and Mohsen (1992), while reporting that exit concentration levels of contaminant plumes are expected to be significantly diluted by adjacent tidal fluctuations, also noted the overall rate of contaminant flux is significantly increased. This may mean that while the measurable contaminant concentrations in seep discharges at any single point in time may be very low in comparison to on-site ground water results, the actual mass loading of contaminants (and possibly a resultant increase in sediment concentrations) can be significantly higher than non-tidally influenced seepage over time. This should be noted in the report.

The text has been revised to reflect the findings of Yim and Mohsen (1992), which state that "tidal fluctuation hastens the rate of plume migration near the bank of the estuary because of the relatively high advective and dispersive fluxes induced by tides."

97. On p. 49, information should be provided for the reader regarding the potential for the NAPL in the sediments to act as a wetting agent. How would this characteristic influence the processes described in the text for NAPL migration?

See response to Specific Comment 91. Some additional text has been provided concerning NAPL transport processes of a wetting fluid, however, based on available information, creosote is not known to be a wetting fluid at this Site.

98. On p. 50, the conceptual contaminant transport model presented in Section 5.4 should be specifically related to the data that was derived during the RI. As currently written, the text presents the conceptual model in terms that are too generic, failing to adequately describe for the reader how well the specific observations made in the field are accounted for by the model. There are a number of results reported for the RI that seem to fit poorly with or contradict the model, and remain to be explained. Several of these cases are noted below. Establishing how well the data fits the conceptual model developed can help to either confirm if the sampling effort that has been conducted to date is adequate, or signal the need for additional sampling.

Rarely do all data fit completely into any conceptual model. There exist many plausible explanations for why the data from any one sampling station does not fit the Site model. Some of the examples cited in Ecology's comment may be important, while others appear academic. In general, where Sediment Management Standards are exceeded at locations at the vertical or horizontal terminus of the extent of sampling, further sampling may be warranted. If the same situation occurs where low concentrations (well below the Sediment Management Standards or other concentrations of concern) are encountered, then the need for further sampling may be unjustified. The need for additional sampling is addressed in new Section 6.2.

99. On p. 50, can any explanation be given for the fact that the second highest LPAH value encountered at 0-10 cm was the D3 station? This station is approximately 300 feet from the site shoreline, side gradient to the C1 area, and not apparently associated with a drainage channel of any sort.

Station D3 exhibits anomalously high LPAH and HPAH concentrations for all depth intervals between 0 and 100 cm. This may be the result of a number of possible influences, potentially including an historical drainage channel, an offshore spill, the nearby presence of creosote-treated pilings, or from dredge spoils. Large pieces of wood debris were encountered from 25 to 76 cm in the D3 core. A comparison of PAH concentrations as reported by the laboratory and those normalized to TOC indicate that the elevated TOC at Station D3 may contribute to the elevated organic chemical concentrations.

100. On p. 50, no discussion has been provided to explain the presence of elevated contaminant levels in samples collected from within the aquitard clays (i.e.: A2; G3; H9). The aquitard has always been represented (and depended upon) as a barrier to the vertical migration of contaminants, making the observations at stations A2 and G3 particularly significant. How were contaminants emplaced to depths well below the aquitard surface at these stations? In fact, the data shows that concentrations continue to increase with depth at the A2 station, and the G3 location exhibits elevated PAH levels nearly 2 meters into the aquitard clays. Has the vertical extent of contamination been adequately characterized in the vicinity of these stations? Considering the lack of data to the southeast of the A2 station, it seems apparent that additional sampling is justified in the area south and east of the breakwater.

There exists some uncertainty with respect to the elevation of the top of the aquitard at Stations G3 and A2. Station G3 is in an area that experienced disturbance during the East Bay fill in the early 1980s, and Station A2 is in an area dredged at that time for marina construction. Therefore, although the possibility exists that contamination has been detected in the aquitard at these locations, there is also the possibility that the top of the aquitard lies below these samples.

Less uncertainty is attributed to the interpreted top of the aquitard at Station H9. However, the HPAH concentrations in Sample H9F are not elevated with respect to Puget Sound "nonreference areas" and do not exceed Sediment Management criteria. Given this, the data for Sample H9F does not represent significant concern regarding the extent of the RI sampling program. Questions that remain in the vicinity of Station A2 are addressed in new Section 6.2.

101. On p. 50, why are HPAH elevated in the F1/G7 area? Unlike the C1/log pond area, these stations are not in close proximity to the old facility operations and have no immediately apparent source area (offshore spills in this area are clearly unlikely considering the bathymetry in this area). This seems to suggest the off-site migration/seepage of contaminants is the most likely explanation for contamination in this area, a point that has been suggested by Ecology in the past. In fact, an active discharge of oily sheen (interpreted as LNAPL discharging from the onshore aquifer by Ecology) has been observed in this area in the recent past. This should be discussed at some point in the report.

Contamination in the F1/G7 area may be the result of groundwater seepage and/or surface water runoff from the adjacent former treated wood storage area onshore.

102. On p. 50, the highest HPAH concentrations found in the B interval were found nearly 400 ft from the site shoreline. Why is this? How is this fact reconciled with the conceptual model developed in the report? Again, has the sampling downgradient of this station been adequate?

Sample B3B, which is the sample referenced by Ecology, was collected from directly above the clay interpreted to be the aquitard and contained NAPL. Higher HPAH concentrations in sample B3B may be explained by an interval of preferential NAPL accumulation resulting in a higher proportion of NAPL in the sampled interval. The need for further sampling downgradient of Station B3 is addressed in Section 6.2.

103. On p. 50, it is still not clear from the report why there is such a significant difference in the areal distribution pattern of contaminants between the A and B horizons. Does this imply different mechanisms of placement? It has also not been made clear in the report why the authors believe the contamination is vertically distributed or stratified in the way it is. Specifically, why do concentrations increase so dramatically below 10 cm? Does this pattern suggest the possibility that emplacement of contaminants was via lateral flow of DNAPL versus chronic seepage of dissolved phase contaminants? Examine this possibility, particularly in light of the continuum of DNAPL that has been encountered along the C1-H9-B3-B6 line. What does this mean for the adequacy of the sampling effort?

The primary interpretations for why contaminants in the Sediment Operable Unit are generally found to be higher in the B interval rather than the A interval are 1) the A interval is subject to more weathering than the B interval, and 2) offshore transport and deposition of contaminants were probably greater prior to 1980 and sedimentation since that time may have buried somewhat the most affected sediments. With creation of more land east of the former treatment plant during the East Bay Marina project in 1980, an additional impedance to NAPL transport from the former wood treatment plant directly to the Sediments Operable Unit was created.

The described vertical distribution does not necessarily suggest separate phase DNAPL migration along the aquitard or within a more permeable sand lens. Separate phase DNAPL migration may be occurring in some places, however the widespread distribution of NAPL in fine-grained sediments suggests that the formerly discussed mechanisms are more likely. The need for additional sampling is addressed in Section 6.2.

Ecology has apparently interpreted the discrete observances of NAPL at several sampling locations to be a "continuum" of DNAPL. This interpretation exceeds the limitations of the data available regarding NAPL at the site. Variations in the extent of NAPL observed at these locations, in the soil type associated with the NAPL, and the fact that the RI observations do not quantitatively distinguish between residual and saturated NAPL make such an interpretation tenuous, and potentially misleading.

104. On p. 50, elevated concentrations of dichlorophenol were detected at stations E5A and D4B. These stations are a long way from the apparent source areas on shore; how did the contamination arrive at these points? Again, is there a possibility that the contamination was carried offshore by drainage channels crossing the intertidal zone? Has the downgradient sampling been adequate in these areas?

Station D4 appears to be on a drainage channel, however Station E5 does not. Dichlorophenol is a breakdown product of PCP and is more soluble, less sorptive, and has a higher dissociation constant than PCP. All of these properties make dichlorophenol more prone to aqueous phase transport than PCP, suggesting that migration of dichlorophenol to the noted sediment locations may be occurring by aqueous phase transport. The dichlorophenol concentrations at these locations do not suggest the need for further sampling.

105. On p. 50, why the lack of PCP and other chlorophenols at depth? What does this tell us about emplacement mechanisms, weathering, and timing? The most highly contaminated intervals, B and C, barely show phenols. Why? The one area of the site that does show elevated PCP concentrations at depth is adjacent to the log pond. Does this suggest this area is a more active or recent source area? Why is the highest PCP value reported during the investigation located nearly 250 feet offshore?

Because of the increased solubility (and mobility) of PCP in the higher pH environment of sea water, PCP that enters the intertidal marine environment would be much more rapidly dispersed into the ambient waters. The presence of dioxins (which are associated with the PCP) in intertidal sediments at significantly greater levels than would be predicted by the PCP concentration found in the sediments, indicate that contaminants associated with PCP did migrate or were emplaced in the intertidal sediments. The subsequent mobilization of the PCP from the sediment due to the chemical effects discussed above would have left behind a residue of the less mobile dioxins.

106. On p. 50, why does station H2 show elevated metals concentrations? This station is well out from the shoreline, and the contaminated intervals are fairly deep. No explanation is provided for the reader for the presence or distribution of any of the inorganic contaminants in the sediments. It would be helpful to have data maps of inorganics distribution to determine if any recognizable patterns exist that may explain emplacement (at least for copper and chromium, the two metals found in excess of the Sediment Management Standards). Copper has been found to be elevated in soil and ground water on shore, yet the report never evaluates the possible mechanisms for emplacement.

It is not known why Station H2 exhibits elevated metals concentrations. No clear trend emerged for metals occurrences, and therefore maps to supplement the text were not included in the document.

107. On p. 50, again, there is a lack of information regarding the fate or transport of contaminants once they have reached the intertidal area, the report primarily discusses emplacement from the uplands.

The text has been revised to address this comment.

108. On p. 50, while ground water flow is not normally thought to influence DNAPL flow, do tidal fluctuations show any influence? Have DNAPL levels in near-shore wells like EW-3 shown any tidally influenced changes?

Tidal fluctuations probably do affect transport of DNAPL near the shoreline, as discussed in our response to Specific Comment 115. To our knowledge, data sufficient to evaluate tidal influences on DNAPL in Well EW3 have not been collected.

109. On p. 50, is the viscosity of the DNAPL found at the site low enough to be influenced by flow of ground water, as reported by Parker (1989)? At what viscosities was Parker reporting this phenomenon?

The case reported by Parker (1989) was of a DNAPL with a oil-water viscosity ratio of 0.5.

110. On p. 50, again, there is no mention of the movement of NAPL as a floating phase in open water.

See response to Specific Comment 70.

111. On p. 50, does the contaminant distribution offshore support the idea that the old NPDES outfall was a significant source of contaminants?

The data suggest that the NPDES outfall contributed to the contamination in the sediments.

112. On p. 51, the report notes that NAPL has been shown to be present along an alignment that "follows" the current sediment surface and the pre-East Bay fill sediment surface. Please clarify what this statement means. The report also states that NAPL has been observed at depths that correspond to the old sediment surface and downward from that point to the clay aquitard. However, there do appear to be a number of samples collected from above that surface that exhibit NAPL. It is not clear what is being implied about emplacement or transport of NAPL in this section.

The text has been revised to address this comment.

To clarify NAPL transport and emplacement mechanisms: DNAPL could possibly migrate laterally (or downdip) in a sand or shell lens. It is not probable that lateral

migration of DNAPL would occur through a fine grained silt or clay unit. NAPL that was observed in silt and clay samples may have been emplaced by: vertical flow through fractures, root or burrow holes, or concurrent deposition with sediments, or could be associated with thin coarse lenses within the predominantly fine-grained sediment.

113. On p. 51, it should be clarified for the reader that the NAPL that has been encountered in the sediments is found in a relatively narrow channel or continuum in the intertidal sediments, roughly defined by the C1-H9-B3-B6 stations. The alignment of this section is coincident with the alignment of the log pond on site (directly in line with well EW-3). The alignment of this DNAPL channel is coincident with the dip of both the aquitard upper surface, and the current sediment surface. These facts should be noted for the reader.

The occurrence of NAPL in sediments is more broadly distributed than the narrow channel described by Ecology, especially near the shoreline (see Figure 41). Therefore, no change has been made to the text.

114. On p. 51, it would be more appropriate to state that the primary historical transport process for NAPL and dissolved phase contamination is seepage, not seeps. The term seep implies an individual or discrete discharge point, whereas the term seepage better reflects what is probably taking place at the site, a discharge of contaminants and NAPL throughout an interface.

The text has been revised to address this comment.

115. On p. 51, the statement is made that NAPL in soil would have been subject to migration to the sediments "through daily seepage at low tide." This implies that the migration of NAPL, including DNAPL, is in some way tidally influenced, and that this cannot occur during periods of high tide. Why would this be true? Again, it should be noted that once LNAPL has seeped to the adjacent water, as a floating phase it may be free to migrate well away from shore before dissipating, degrading, or binding with resettling sediments. This may result in a wider distribution of contaminants than may be predicted. Considering what is know about current direction and speed, tidal cycles, wind speed, etc., what is the likely distribution of a floating phase into East Bay? Would the East Bay Marina dock influence this distribution pattern in any way?

NAPL migration from onshore to the Sediments Operable Unit would be expected to be affected by tidal fluctuations in the groundwater by the following mechanisms. During low tide a steep seepage face exists on the water table. A portion of the saturated zone, between the high and low tide water tables, is desaturated during the low tide. This phenomena would accelerate NAPL migration in this zone by 1) removing the buoyant forces, which otherwise tend to retard vertical DNAPL migration and prevent vertical LNAPL migration, and 2) creating a steeper slope on the water table, thereby increasing the gradient and velocity for NAPL flow in the unsaturated zone. Migration of DNAPL in the saturated zone

may also be accelerated by tidal changes, by temporarily decreasing the hydraulic pressure during low tides, as observed by Reitman et al. (1992).

See the response to Specific Comments 13 and 70 regarding the influence of the breakwater and the distribution of a floating phase.

116. On. p. 51, it should be noted for the reader that the aquitard rise the report refers to is not a laterally continuous feature, as evidenced by Figure 21 of the report. Due to that fact, in addition to other considerations, it is Ecology's opinion that this feature is not an effective permanent barrier to DNAPL flow off site.

The text has been revised to refer the reader to Figure 22, which shows that the interpreted extent of the rise is not laterally continuous.

117. On p. 52, clarify what evidence exists to support the theory that the rise in the aquitard surface in the C1 area is the result of filling activities.

According to East Bay Marina project construction notes, gravel was end dumped from a truck onto the sediment surface, creating a dike to retain the hydraulic fill. Photographs and field notes document the formation of a mud wave in this area, due to the gravel displacing the sediments. Figure 3-7 in the SSI Report illustrates a vertical cross-section, roughly along the dike's alignment. The aquitard is depressed along this alignment, likely indicating that the gravel displaced the aquitard sediments. These sediments were most likely displaced upward from the dike, creating the rise in the aquitard surface observed at station C1.

118. On p. 52, the report states that "physical limitations" to DNAPL flow in the sediments is likely to limit bulk DNAPL transport, yet no evidence or data is presented to support this contention. What limitations are being referred to? What characteristics of the sediments would inhibit or prevent the flow of DNAPL currently present in the sediments to areas further out into Budd Inlet? Is there evidence to prove that DNAPL present offshore will not continue to move? The statement presented in this section appears to be contradicted by the evidence of a continuum of DNAPL reaching as far out as the B6 location, 400 feet from the shoreline.

Physical limitations of bulk DNAPL flow in the sediments include the following: small pore size of the silt and clay sediments, insufficient head of DNAPL to act as a driving force and probable small DNAPL lens size. There is no empirical evidence to prove that DNAPL present off shore will not continue to move. Calculations that show the orders of magnitude of the forces needed to move DNAPL vertically into fine-grained material and laterally are presented in the text. There is no contradiction between the text and the RI data.

Again, we caution Ecology regarding an interpretation and potential misrepresentation of the continuity of DNAPL along a "continuum" (see response to Specific Comment 103).

119. On p. 52, the report should also note some of the factors that suggest continued DNAPL flow within the sediments remains a possibility (e.g.: the DNAPL encountered offshore is resting on a low permeability stratigraphic unit that continues to slope away from the site - providing a gradient for flow, i.e., there is no evidence the DNAPL has reached a resting point on the aquitard surface; the viscosity of the material is not significantly higher than ground water; the saturation or near saturation of the sediments by NAPL increases the effective permeability for that fluid phase and eliminates the resistant capillary pressure initially presented by pore water; creosote may be a wetting fluid in a sea water system; preferential pathways for DNAPL flow such as coarser grained interbeds or channel features may exist within the sediment stratigraphy).

The text of Sections 5.3 and 5.4 has been revised to address this comment.

120. On p. 52, has the offshore limit of the DNAPL channel or continuum seen from C1-H9-B3-B6 been adequately defined? The H1 station is the only sample point down slope of the B3/B6 area that reaches the aquitard. Where is the "daylight" line for the aquitard predicted to be, and what does that mean for the distribution of DNAPL beyond the B3/B6 area? Is additional sampling justified in this area? Could the increasing concentration of PAH at the B4 location be related to this continuum in any way?

The offshore limit of the sediment NAPL area has not been fully defined. Additional sampling is expected to be conducted during the predesign stage of remediation. As noted in the response to Specific Comment 95, an aquitard "daylight" line was not identified, but the aquitard/recent sediment contact may be exposed along the sides of dredged areas (e.g., the breakwater dock area). The increase in PAH concentration at station B4A may be the result of dissolved phase transport or resuspension of sediments from the NAPL area.

Again, we caution Ecology regarding an interpretation and potential misrepresentation of the continuity of DNAPL along a "continuum" (see response to Specific Comment 103).

121. On p. 52, what is the significance of the information regarding the PCP concentrations in the sediments versus EW-3? Why is this significant to understanding the past or ongoing potential for DNAPL transport in the sediments?

See response to Specific Comment 105.

122. On p. 52, it is not clear from the text why the PCP concentrations are elevated in the sediments north of the site in comparison to the area to the east of the log pond. Is there the possibility that the elevation of the PCP levels in the sediments along the northern shoreline of the site reflects a more recent or ongoing source of contaminants (LNAPL?) being transported offshore, whereas the areas to the east have experienced more weathering? In fact, oily discharges (interpreted as LNAPL discharges by Ecology) have been observed recently along the northern shoreline.

PCP in sediments north of the Site may be attributed to dissolved phase transport from the former treated log storage area, or possibly LNAPL/dissolved phase PCP seepage associated with groundwater discharge in this area. The pattern in this area suggests surficial input, not input from depth.

123. On p. 52, it is noted that contaminant transport is limited vertically by the clay strata of the aquitard. What about beyond the area where the aquitard daylights? How are the high concentrations of contaminants in the aquitard clays for the A2 and G3 stations explained?

See responses to Specific Comments 95 and 100.

124. On p. 53, the findings for several of the chapters of the report are not summarized in Section 6.0 (e.g., there are no summary conclusions regarding the potential for resuspension or burial by current sedimentation rates, or conclusions regarding the source identification effort, etc.).

The text has been revised to address this comment.

125. On Figure 21, the contour lines on this figure are incorrectly identified as "Aquitard Iso-Concentration" lines.

The figure has been revised to address this comment, as well as revised to reflect
1) new data available from borings completed onshore during 1992, and
2) reinterpretation of the aquitard surface based on hydrologic as well as geologic considerations.

126. On Figure 22, graphs of Pb-210 profiles should plot excess Pb-210 activity vs accumulation rate in g/cm^2.

The graphs on old Figure 22 (now Figure 23) have been revised to address this comment.

127. On Figures 23-28, the text of the report should very clearly note for the reader that the contour maps presented in these figures for HPAH and LPAH distribution are very approximate interpretations. In many cases, the contouring decisions selected are questionable, and could lead to an incorrect understanding or degree of confidence in the contaminant distribution. Considering the estimates of total data variability, is it really appropriate to plot values on these maps with up to six significant figures? Figures 43, 44, and 45 provide much more useful information about the site at this time.

The referenced figures themselves contain notes that clearly identify the approximate nature of the contours; therefore, no revision to the text has been made. The figures have been revised to reflect the appropriate number of significant figures for summed concentrations such as LPAH and HPAH.

128. On Figures 23-28, it would also be interesting to see contour plots of contaminant concentrations that are based on stratigraphic position, rather than sample depth interval. Since the distance between the sediment surface and the aquitard surface varies, the current maps may be comparing samples that represent different units in the stratigraphy. As presented, the current maps strictly represent contamination vs. depth, rather than relating contamination to the geologic matrix.

The figures have not been revised; however, the samples that are interpreted to be from below the top of the aquitard are as follows:

B Zone = G3*
C Zone = G3*, B3*
D, E, and F Zones = A2 *, C1, C2, D4, G3*, H1, H2, H3, H5, H9

The asterisks denote increased uncertainty in the interpretation of the top of the aquitard.

129. On Figure 48, this figure should include a typical profile for creosote.

Figure 48 presented HPAH chemical profiles of refined petroleum products. Creosote is not a refined petroleum product. Figure 55 presents HPAH ratios of CPC NAPL samples, and has been revised to include a creosote sample obtained from the Site.

130. On Table 4, the footnote (d) for the table indicates reference station TEQ concentrations are presented in mg/kg units. Should this be µg/kg? Again, units need to be clearly identified.

Table 4 has been revised with the correct units.

131. On Table 4, see previous comments regarding the methods used to calculate background.

Table 4 has been revised to address this comment.

132. On Table 7, it would be helpful to include Puget Sound Ambient Monitoring data (see reference list) in this comparison. In addition, it should be noted whether concentrations are reported on a dry or wet weight basis. Is there any data from the Eld Inlet reference station that can be added to this table?

PSAMP data have been added to Table 7. There are no chemistry data from the Eld Inlet samples.

133. On Table 9, the fish consumption criteria for phenanthrene, as well as for the other HPAH listed, is 0.0311 µg/L.

The table has been revised to reflect the correct criteria for HPAH. Please note that the referenced criteria for phenanthrene was a proposed criteria, which was deleted from the final rule that will become effective on February 5, 1993 (57 FR 60848).

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134. On p. A-4, it would be helpful to have a table which links individual stations with the method used to collect samples, along with any pertinent descriptive information.

Table B-1, which identifies the type of core obtained at each sampling station, together with the text of Appendix A, which identifies the collection method for each type of core, provides the requested information.

135. On p. A-5, What was the sequence of sample collection? Were any samples collected prior to skidding the drill rig through the area?

The barge-mounted rig was mobilized first, followed by the skid-mounted rig and then the boat. Samples collected on foot were collected last.

136. On p. A-6, different methods of homogenizing samples were utilized in Phase I and II. Depending on the degree of agitation, this could make it difficult to compare concentrations for certain parameters between Phase I and II. It should be specified as to what types of field blanks were prepared, especially for water samples.

Field blanks for all sample matrices were equipment rinsate blanks.

137. On p. B-1, the second page of Table B-1 was not provided in the draft.

The omission has been corrected.

138. On p. B-1 through B76, the depth scale for cores and borings should also include units in feet, allowing comparison to the cross sections. The log for boring E-5 was not provided in the draft.

The core logs have not been reproduced with an additional scale; however, Figure B-9 has been revised to provide the reader with the conversion between units of feet and centimeters. The "log" for the 0-10 cm core obtained at Station E5 was provided in Table B-2.

139. On Table C-2 and C-3, grain size information should be presented in this table.

Grain size data has been provided in Appendix J.

140. On Tables C-2 and C-3, discussion should be added to these tables summarizing the data variability evaluation, and the significant figures reported for the various contaminants. The sums reported for LPAH and HPAH suggest a level of precision not really known. Clarify this for the reader.

The reference to a "data variability" evaluation is assumed to mean the data validation conducted during the RI. Data validation qualifiers exist on all tables presented in Appendix C. The tables in Appendix C, as well as in the text, have been revised to correctly reflect the level of precision known for the summed chemical parameters such as LPAH and HPAH or calculated values such as PAH normalized to TOC.

141. On Tables C-2, and C-3, is there a salinity value for CP2-W-B12?

A salinity value was reported for sample CP2-W-BI2 in Table C-4. Sample CP2-W-B12 does not exist.

142. On Table C5, it should be shown whether concentrations in tissue are reported on a dry or wet weight basis. Were percent solids determined on the samples?

Tissue sample data were reported on a wet weight basis. Percent solids were not determined for tissue samples.

143. Appendix D, see previous comments on data variability.

See response to Specific Comment 31.

144. Appendix F, the conclusion to recommend sediment capping is well beyond the scope of the analysis presented in this document. It is unclear from this report if sediment transported to East Bay would be unavailable for resuspension given the water depths in the area. Alternate sources of tidal current data should be considered for this analysis.

The text of Appendix F only recommends that sediment capping *be considered* to address potential resuspension of contaminated material. Whether or not sediment is available for resuspension depends upon the energy of the waves and the tidal level at which the waves occurred. It is unclear why alternate sources of tidal data are requested; no change has been made to the document.

145. Appendix G, again, the statistical methods and significance levels used to determine "significant" differences should be presented, or the wording revised.

See response to Specific Comment 77.

APPENDIX L

Chemistry Laboratory Reports

- Analytical Technologies, Inc.
- Triangle Laboratories
- Soil Technology, Inc.
- Battelle Northwest

APPENDIX L

CHEMISTRY LABORATORY REPORTS

This appendix submitted under separate cover as Volume III of this report.