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Quality Assurance Project Plan

Monitoring Seep Water from the Port Angeles Landfill to an Intertidal Area

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Quality Assurance Project Plan

Monitoring Seep Water from the Port Angeles Landfill to an Intertidal Area

September 2009

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SWRO – Southwest Regional Office
TSU – Toxics Studies Unit
EAP - Environmental Assessment Program
WOS – Western Operations Section
EIM - Environmental Information Management system

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Abstract

This Quality Assurance (QA) Project Plan is provided for monitoring seep water discharging to the intertidal area below the City of Port Angeles landfill adjacent to Dry Creek. The landfill began as a dump in the early 1950s.

The purpose of this study is to evaluate whether the seep water contains high concentrations of metals being discharged to the beach from the landfill. The project was prompted by a citizen who reported water seeping from the ground in front of the landfill during a negative tide and collected a sample in June 2008. A total metals analysis showed a high level of lead and copper and an elevated zinc concentration.

The site had been an unconfined disposal site until closed by the City of Port Angeles. The site was capped in 1990, and a retaining wall was completed in 2007. The portion of the landfill adjacent to the beach is unlined.

Monitoring will take place in 2009 during a negative tidal elevation. Intertidal seep water will be sampled for total recoverable and dissolved priority pollutant metals. Seep water samples will also be analyzed for hardness, total suspended solids, and conductivity.

Each study conducted by the Washington State Department of Ecology must have an approved QA Project Plan. The plan describes the objectives of the study and the procedures to be followed to achieve those objectives. After completion of the study, a final report describing the study results will be posted to the Internet.

Background

The Port Angeles landfill is located in an area west of the city and adjacent to and east of the mouth of Dry Creek (Figure 1).

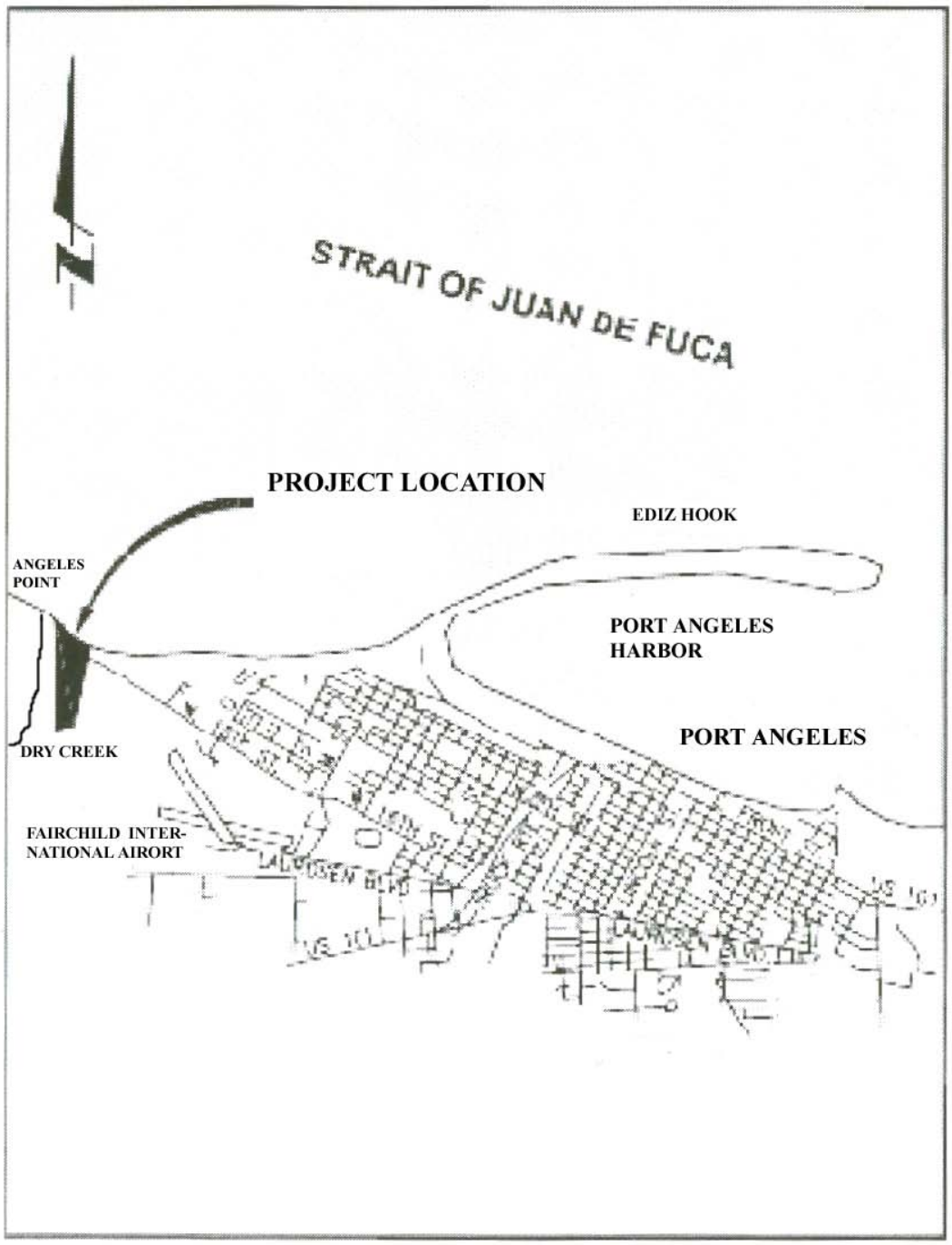

Figure 1. Study Site.

Figure from Aspect Engineering memorandum to City of Port Angeles Public Works and Utilities Department, 2009. The map is modified to show Dry Creek.

The Port Angeles landfill is located on a bluff above a beach. A gravel pit there began to be used as a dump in the early 1950s. The pre-disposal conditions included ravines which were subsequently filled with solid waste. Wave action from the Strait of Juan de Fuca eroded the bank of the landfill so that debris, some of it as large as auto engines and transmissions, was deposited on the beach (Figure 2).

Figure 2. Bluff Erosion, approximately 200 feet East of Dry Creek Mouth, Prior to Construction of Seawall.

Photograph by Dry Creek Coalition.

The City of Port Angeles took ownership of the landfill in 1979. Two to four inches of soil was placed on the landfill near the beach in 1983. An impermeable cap was placed on the landfill in 1990. Newer portions of the landfill are lined, but the portion of the landfill near the beach (the original dump site) is not. The landfill closed in 1990 (Neal, 2009).

A 454-foot-long seawall was constructed and completed in October 2007 to stabilize the slope above the beach. The seawall extends downward a minimum of 10 feet below mean high-high water (MHHW) (Neal, 2009). A perforated drain along the back side of the seawall collects liquids which are treated at the City of Port Angeles wastewater treatment plant. Three monitoring wells have been placed at the toe of the slope behind the seawall as part of the slope stabilization project. One older monitoring well is installed in the beach at the toe of the natural bluff east of the seawall.

A photograph of the wall appears as Figure 3.

Figure 3. Stabilized Slope and Seawall at Base of the Closed Landfill, March 2008.

Photograph by Dry Creek Coalition.

Jim Jewell, a member of the community group, the Dry Creek Coalition, sampled a seep on the beach in front of the seawall on June 3, 2008 at a negative tide. He stated that sediment particles may have entered the sample bottle since the seep was shallow and difficult to sample (Jewell, 2009).

Figure 4 is a profile design drawing of the slope and seawall. As shown in Figure 4, MHHW intersects the lowest point of the wall.

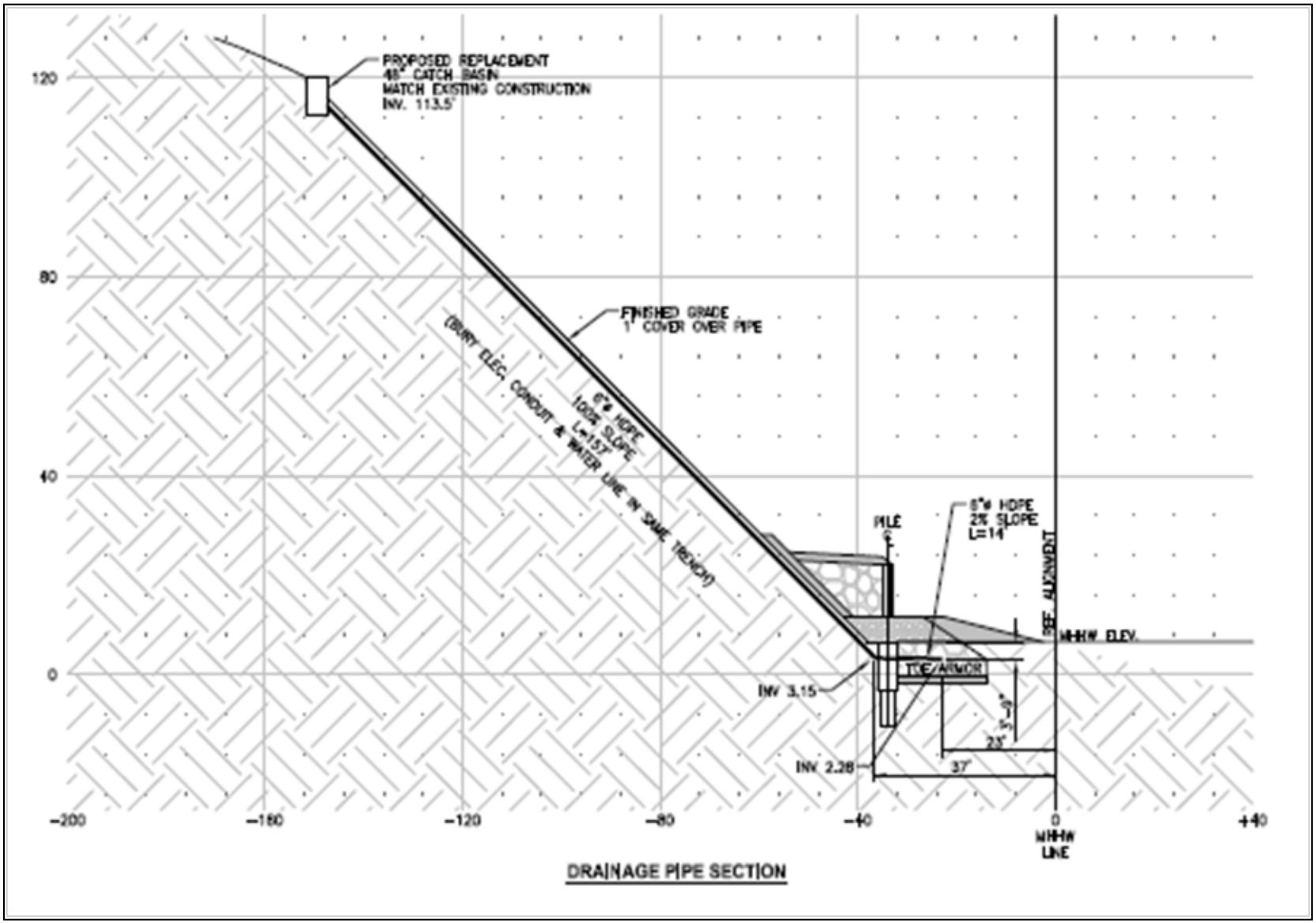

Figure 4. Design Drawing of Slope Stabilization and Seawall.

MHHW elevation is at the foot of the wall.

Table 1 shows the results of sampling by the Dry Creek Coalition in 2008. Because the sample was analyzed for total recoverable methods rather than dissolved metals, the results could not be compared directly with Washington State water quality standards. No measurements such as conductivity were made to indicate the portion of seep water resulting from tidal water mixing. The Coalition sample provides the only known monitoring data on the seaward side of the wall.

Table 1. Total Metals Concentrations in the Dry Creek Coalition Sample, June 3, 2008.

Metals (Total)	Concentration (µg/L)
Arsenic	3.68 U
Silver	0.45 U
Antimony	60.4
Beryllium	0.3 U
Cadmium	2.54
Chromium	33.7
Copper	750
Mercury	1
Lead	1170
Nickel	35.7
Selenium	4.5 U
Thallium	15 U
Zinc	260

U – The analyte was not detected at or above the reported result.

Aspect Consulting monitored fluid from the drain along the back side of the seawall for the City of Port Angeles on December 18, 2007 and July 31, 2008. High concentrations of copper, lead, and zinc were found from the July sampling, and relatively low concentrations were found in December (Table 2).

Table 2. Total Metals Concentrations in the Seawall Fluid, December 18, 2007 and July 31, 2008.

Metals (Total)	December 18, 2007 (µg/L)	July 31, 2008 (µg/L)
Arsenic	2	50 U
Silver	8	4
Antimony	100 U	50U
Beryllium	2U	2
Cadmium	4 U	5
Chromium	10 U	199
Copper	9	554
Mercury	0.10 U	0.70
Lead	5 U	350
Nickel	7	220
Selenium	3	50 U
Thallium	100 U	50 U
Zinc	20	1230

U – The analyte was not detected at or above the reported result.

Project Description

The purpose of this study is to evaluate whether elevated concentrations of metals are being discharged to the beach in front of the Port Angeles landfill seawall. Other than the total metals sampled by the Dry Creek Coalition in June 2008, there has been no monitoring in the intertidal area in front of the seawall. Analyzing the seepage may provide an indication of contaminant migration. Both total recoverable methods and dissolved priority pollutant metals will be analyzed. Total suspended solids, hardness, sodium, chloride, magnesium, and conductivity will also be monitored.

This project will address concerns about leaching from the decommissioned landfill to the beach and the Strait of Juan de Fuca given the history of large masses of landfill material deposited on the beach. Other reasons for concern are that the seawall was constructed at the edge of the landfill on the upslope end with a minimum depth at MHHW and the portion of the landfill above the beach remains unlined.

Water Quality Criteria

Metals concentrations will be compared to Washington State marine water quality criteria shown in Table 3. Marine standards will be applied because the seep discharges to a marine intertidal area. The water quality standards for priority pollutant metals other than mercury require analysis of the dissolved form of the metal, the portion that is most available for biological uptake.

The state of Washington, under the federal Clean Water Act, formulated standards to evaluate dissolved metals toxicity (WAC 173-201A, 2006). Acute criteria are based on a one-hour average concentration, not to be exceeded more than once every three years on the average. Chronic criteria are based on the four-day average concentration, not to be exceeded more than once every three years on the average (Chapter 173-201A, WAC).

Table 3. Marine Water Criteria for Priority Pollutant Metals Based on Dissolved Metals Concentrations.

Substance	Acute (µg/L)	Chronic (µg/L)	Human Health (µg/L)
Arsenic Dissolved	69	36	
Arsenic Inorganic			0.14
Antimony Inorganic	--	--	4300
Beryllium	--	--	--
Cadmium	42.0	9.3	--
Chromium (Hex)	1100	50	--
Copper	4.80	3.10	--
Mercury*	2.10	0.012	0.15
Lead	210.0	8.10	--
Nickel	74.0	8.20	4600
Selenium	290	71	4200
Silver	1.90	--	--
Thallium	--	--	6.30
Zinc	90.0	81.0	--

*Total recoverable.

Organization and Schedule

The following people are involved in this project (Table 4). All are employees of the Washington State Department of Ecology. Proposed project scheduling is shown in Table 5.

Table 4. Organization of Project Staff and Responsibilities.

Staff (all are EAP except client)	Title	Responsibilities
William Harris Waste 2 Resources Program/SWRO Phone: (360) 407-6253	EAP Client	Clarifies scopes of the project. Provides internal review of the QAPP and approves the final QAPP.
Steven Golding Toxic Studies Unit Statewide Coordination Section Phone: (360) 407-6701	Project Manager/ Principal Investigator	Writes the QAPP. Conducts field sampling. Conducts QA review of data, analyzes and interprets data, and enters data into EIM. Writes the draft report and final report.
Dale Norton Toxic Studies Unit Statewide Coordination Section Phone: (360) 407-6765	Unit Supervisor for the Project Manager	Provides internal review of the QAPP, approves the budget, and approves the final QAPP.
Will Kendra Statewide Coordination Section Phone: (360) 407-6698	Section Manager for the Project Manager	Reviews the project scope and budget, tracks progress, reviews the draft QAPP, and approves the final QAPP.
Brandee Era-Miller Toxics Studies Unit Statewide Coordination Section Phone (360) 407-6771	EIM Data Entry Engineer	Formats/enters data into EIM.
Robert F. Cusimano Western Operations Section Phone: (360) 407-6596	Section Manager for the Study Area	Reviews the project scope and budget, tracks progress, reviews the draft QAPP, and approves the final QAPP.
Stuart Magoon Manchester Environmental Laboratory Phone: (360) 871-8801	Director	Approves the final QAPP.
William R. Kammin Phone: (360) 407-6964	Ecology Quality Assurance Officer	Reviews the draft QAPP and approves the final QAPP.

EAP – Environmental Assessment Program.
SWRO – Southwest Regional Office.
EIM – Environmental Information Management system.
QAPP – Quality Assurance Project Plan.

Table 5. Proposed Schedule for Completing Field and Laboratory Work, Data Entry into EIM, and Reports.

Field and laboratory work	Due date	Lead staff
Field work completed	August 2009	Steven Golding
Laboratory analyses completed	October 2009	
Environmental Information System (EIM) database		
EIM user study ID	ID number SGOL010	
Product	Due date	Lead staff
EIM data loaded	February 2010	Brandee Era-Miller
EIM QA	March 2010	Callie Meredith
EIM complete	April 2010	Brandee Era-Miller
Final report		
Author lead	Steven Golding	
Schedule		
Draft due to supervisor	December 2009	
Draft due to client/peer reviewer	January 2010	
Draft due to external reviewer(s)	January 2010	
Final (all reviews done) due to publications coordinator	March 2010	
Final report due on web	April 2010	

Quality Objectives

Manchester Environmental Laboratory (MEL) is expected to meet quality control (QC) requirements of methods selected for the project. QC procedures used during field sampling and laboratory analysis will provide estimates for determining accuracy of the monitoring data. Table 6 shows the measurement quality objectives (MQOs) for the analytical methods selected.

Table 6. Measurement Quality Objectives for Analysis of Water Samples.

Analysis	Check Standards/LCS (recovery)	Duplicates (RPD)	Matrix Spikes (recovery)	Matrix Spikes Duplicates (RPD)
PP metals	85-115%	25%	75-125%	20%
TSS	80-120%	25%	NA	NA
Conductivity	NA	25%	NA	NA

Reporting limits (Table 7) are expected to be low enough to meet the marine water criteria shown in Table 3 with the exceptions of (1) mercury with a reporting limit of 0.05 µg/L and a marine chronic water quality criterion of 0.012 µg/L, and (2) arsenic with a reporting limit of 0.1 µg/L and a human health criterion of 0.14 (Ecology, 2002). The reporting limit for mercury of 0.05 applies for collection into HDPE bottles (Momohara, 2009). The higher reporting limits for mercury and arsenic are considered acceptable since the primary purpose of the study is contaminant level assessment.

Table 7. Method Reporting Limits, µg/L.

Parameter	Reporting Limit (TR and diss)*
Arsenic	0.1
Silver	0.1
Antimony	0.2
Beryllium	0.1
Cadmium	0.1
Chromium	0.5
Copper	0.1
Mercury	0.05
Lead	0.1
Nickel	0.1
Selenium	0.5
Thallium	0.1
Zinc	5
TSS	1 mg/l
Hardness	1 mg/L
Conductivity	0.1 µmhos/cm

*Metals units are µg/L; TR – total recoverable metals; Diss – dissolved metals.

Bias and Precision

MQOs may be difficult to achieve for concentrations near the limits of detection. Relative accuracy will decrease when concentrations are near reporting limits.

Bias can be defined as systematic error due to contamination, sample preparation, calibration, or the analytical process. Most sources of bias can be minimized by adherence to established protocols for collection, preservation, transportation, storage, and analysis of study samples.

Precision is a measure of the ability to consistently reproduce results. Precision will be evaluated by analysis of check standards, duplicates/replicates, spikes, and blanks. Results of multiple analyses will be used as a means to estimate precision. Field replicates will be analyzed to estimate *overall precision* of the entire sampling and analysis process. Analysis of laboratory duplicates, which consist of aliquots from one sample container, will estimate *laboratory precision*. The difference between the precision estimate of the laboratory duplicates and the precision estimate of field replicates is an estimate of *field precision.*

Sampling Process Design (Experimental Design)

Sampling of two seeps in the intertidal zone in front of the seawall will take place August 18, 2009, a day with a low tide of -1.7 feet at approximately 7:30 AM. The period of negative tides for that day is from 7:30 AM to about 10:30 AM. The week of August 17 is the only period of sufficiently low tides during daylight hours (less than -1.0 feet) until April and May 2010.

Location of Sampling Sites

During a visit to the beach in front of the landfill seawall on July 24, 2009 at a low tide of -1.4 feet, a seep was observed at the water's edge at a -1.0 feet tide. Jim Jewell, the citizen who sampled a seep in June 2009 was present and identified it as the seep he had sampled. The seep forms a small stream approximately three inches deep and four inches wide as it passes between narrow spaces between the debris. A second seep was found approximately 50 feet to the west of the first. Its flow was somewhat less. The seeps are in an area of beach with sufficient slope that the flow appears to be well defined, not mixing with other surface water for about ten feet. No other seeps or outflows from the landfill were observed.

The first seep is at mid-span of the seawall and can be visually located as directly opposite a monitoring well with an orange cap. It is in the middle of three monitoring wells sampled by the City of Port Angeles. The wells are located behind the seawall where the slope flattens. The seep flows past readily identifiable debris.

On July 24, the seeps were above water level and able to be sampled from the low tide of -1.4 feet at 11:00 AM until 12:30 PM (approximately -1.0 feet) before being inundated by seawater. It is anticipated that on the August sampling date with a -1.7 low tide, the seeps can be sampled from approximately 7:30 AM until 9:00 AM or later.

Sampling Methods

Sampling will be for low-level priority pollutant metals analysis. Low-level sampling is indicated due to the uncertainty of metals concentrations in the seeps and given the results of seawall drain water sampling which included nondetect values as low as 2 µg/ (Aspect Engineering, 2009). Low-level metals filters will be used for dissolved metals samples and Teflon vials of HNO_3 (nitric acid) for preservative.

Low-level sampling procedures will be modified by the use of HDPE collection bottles rather than Teflon. This is because HDPE bottles provide similar reporting limits for total recoverable metals and only slightly higher reporting limits for dissolved metals limits, typically of 0.1 µg/L instead of 0.02 µg/L and 0.05 µg/L instead of 0.002 µg/L for total mercury (Momohara, 2009). Because this study is to determine if high concentrations of metals are present in seep water, these reporting limits are considered acceptable.

Two samples from each of the two seeps will be collected. The first samples will be collected at low tide. Timing of the second samples will be based on field conductivity measurements. The seep flow with the greatest portion of freshwater is considered to correspond to the measurement of lowest conductivity. Conductivity will be measured when the seep is exposed. After conductivity drops or low tide is reached, whichever occurs first, the second samples will be collected for each seep. Extra containers will allow for samples above lowest conductivity to be discarded if necessary.

Table 8 summarizes the number of samples for laboratory analyses. Magnesium will be added to the priority pollutant sample analyses. Although marine water quality standards are to be applied, hardness will be analyzed to provide the possibility of comparisons with freshwater quality standards.

Table 8. Sampling Summary for Laboratory Analysis.

Parameters	Samples	Total Number of samples		
		Replicates	Blank	Samples to Lab
Total priority pollutant metals (water)	4	1		5
Dissolved metals (water)	4	1	1	6
TSS	4			4
Hardness	4			4
Sodium	4			4
Chloride	4			4
Magnesium*	8			8
Sulfate	4			4

* Magnesium: 4 total and 4 dissolved.

Sampling Procedures

Standard field sampling and measurement protocols will be followed (Ecology, 1993). Water samples will be collected with a peristaltic pump with Teflon intake tubing. The pump will be used to sample the shallow seep flow while not disturbing underlying sediment. The opening of the intake tubing will be held just below the water. The pump outlet line will discharge into each sample bottle. Water will be pumped for one minute before each sample is collected.

Procedures for collecting metal samples will follow guidance in EPA Method 1669 *Sampling Ambient Water for Trace Metals at EPA Water Quality Levels* (EPA, 1995) and Ecology Standard Operating Procedures (SOPs). Samples for dissolved metals will be filtered in the field through pre-cleaned 0.45 µm Nalgene filter units (#450-00045, type S). Sampling personnel will wear powder-free nitrile gloves. Because there will be only one person sampling, clean hands/dirty hands will be achieved by wearing double gloves and removing the first pair when performing clean-hands sample handling.

Before the sampling date, new silastic tubing will be installed in the pump. The pump/tubing assembly will be pre-cleaned by pumping a solution of Liquinox® detergent, followed by deionized water, 10% nitric acid rinse (laboratory grade), and deionized water.

To help minimize field variability from sample collection, staff will be familiar with and follow methods described in EPA Method 1669 and two Ecology SOPs:

- *Manually Obtaining Surface Water Samples* (Joy, 2006).
- *Collection and Field Processing of Metals Samp*les (Ward, 2007).

The samples will be given unique field identification. Following collection and filtration, composite samples will be placed in polyethylene bags in the field and placed in ice chests at 4ºC. After returning from the field, sample ice chests will be put in a secure walk-in cooler at the Ecology EAP Operations Center. Samples will be delivered to the laboratory within the one-week holding time for TSS analysis. Staff will follow chain-of-custody procedures throughout the sampling process (MEL, 2006).

Field personnel will record weather conditions, degree of wind speed, and degree of choppy water as they relate to wave height because this may influence the time of seep inundation. Field measurements for conductivity will be recorded.

Table 9 shows the summary of parameters, collection containers, preservation, and holding times.

Table 9. Sample Size, Container, Preservation, and Holding Time by Parameter.

Parameter	Sample Size	Container	Preservation	Holding Time
Priority pollutant metals (TR and diss)*	500 mL	1 L HDPE bottle	(field filtered dissolved) HNO_3 to pH < 2 Cool to 4ºC	6 months
TSS	1000 mL	1000 mL w/m poly	Cool to 4ºC	7 days
Hardness	100 mL	100 mL	H_2SO_4 to pH<2	6 months
Sodium chloride sulfate	500 mL	500 mL w/m poly	Cool to 4ºC	28 days

*Mercury in total recoverable form only. TR = total recoverable. Diss = dissolved.

Sample sites will be located by a handheld global positioning system (GPS) and recorded in field books. Ecology's Environmental Assessment Program SOPs for *Determining Global Positioning System Coordinates* (Janisch, 2006) will be followed. The location of significant identifying structures and debris relative to the sample site including location relative to the seawall, will be photographed and recorded in a field book.

Measurement Procedures

All project samples will be analyzed at MEL. Table 10 shows the expected range of results, sample preparation, and the analytical methods for the project. Metals samples, with the exception of mercury, will be analyzed by ICP/MS (Inductively Coupled Plasma Mass Spectrometer) using EPA Method 200.8. Mercury will be analyzed by cold vapor atomic absorbance using Methods 245.1 and 245.5. The laboratory may use other appropriate methods following consultation with the project lead.

Table 10. Analytical Methods.

Analyte (no. samples)	Sample Type	Analysis	Expected Range of Results	Sample Preparation Method	Analytical Method
Lead	whole water	total recoverable	0.05 – 2000 ug/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	0.05 – 100 ug/L	HNO3/HCl digest field filtered and preserved	EPA 200.8
Arsenic	whole water inorganic	total recoverable	1 – 100 ug/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	1 – 100 ug/L	HNO3/HCl digest field filtered and preserved	EPA 200.8
Antimony inorganic	whole water	total recoverable	5– 100 ug/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	5 – 100 ug/L	HNO3/HCl digest field filtered and preserved	EPA 200.8
Beryllium	whole water	total recoverable	1 – 10 ug/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	1 – 10 ug/L	HNO3/HCl digest field filtered and preserved	EPA 200.8
Cadmium	whole water	total recoverable	1 – 10 ug/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	1 – 10 ug/L	HNO3/HCl digest field filtered and preserved	EPA 200.8
Chromium	whole water	total recoverable	10 – 400 ug/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	10 – 400 ug/L	HNO3/HCl digest field filtered and preserved	EPA 200.8
Copper	whole water	total recoverable	1 – 100 µg/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	1 – 100 µg/L	HNO3/HCl digest field filtered and preserved	EPA 200.8

Analyte (no. samples)	Sample Type	Analysis	Expected Range of Results	Sample Preparation Method	Analytical Method
Mercury	whole water	total recoverable	0.02 -2 µg/L	HNO3/HCl digest	Cold Vapor Atomic Absorbance Methods 245.1 and 245.5
Selenium	whole water	total recoverable	1 – 100 µg/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	1 – 100 µg/L	HNO3/HCl digest field filtered and preserved	EPA 200.8
Silver	whole water	total recoverable	1 – 100 µg/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	1 – 100 µg/L	HNO3/HCl digest field filtered and preserved	EPA 200.8
Nickel	whole water	total recoverable	2 - 400 µg/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	2 - 400 µg/L	HNO3/HCl digest field filtered and preserved	EPA 200.8
Thallium	whole water	total recoverable	1-10 µg/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	1-10 µg/L	HNO3/HCl digest field filtered and preserved	EPA 200.8
Zinc	whole water	total recoverable	5 – 1500 µg/L	HNO3/HCl digest	EPA 200.8
	filtered water	dissolved	5 – 1500 µg/L	HNO3/HCl digest field filtered and preserved	EPA 200.8
TSS	whole water	total	1 – 50 mg/L	NA	SM 2540D
Conductivity	whole water	total	500 – 20 umhos	NA	SM 2510B

NA = not applicable.
HNO3 = nitric acid.
HCl = hydrochloric acid.
EPA = U.S. Environmental Protection Agency.

Quality Control Procedures

Quality objectives for this project are to obtain high quality data so that uncertainties are minimized and results are comparable to other studies using these methods. These objectives will be achieved through careful attention to the sampling, measurement, and quality control (QC) procedures described in this plan.

Field

Table 11 shows a list of field quality assurance (QA) samples to be analyzed for the project. The intent of QA samples is to provide an estimate of the total variability of each analysis, field plus laboratory.

Field QA will consist of collection and analysis of replicate samples and filter blanks. One replicate sample for total recoverable and dissolved metals will be collected for the project. A filter blank will consist of reagent-grade deionized water prepared by MEL. This water will be taken to the field during the sampling event, filtered with other samples, transferred to an unused collection bottle, acidified, and returned to MEL along with the study samples.

Table 11. Field Quality Assurance Samples.

Analysis	QA Samples
Replicates	
Total recoverable priority pollutant metals	1
Dissolved priority pollutant metals	1
Filter Blanks	
Dissolved priority pollutant metals	1

Laboratory

MEL will follow SOPs as described in the *Manchester Environmental Laboratory Quality Assurance Manual* (MEL, 2006). Laboratory QC samples will include laboratory control samples, methods blanks, analytical duplicates, and matrix spikes and matrix spike duplicates. Types and frequencies of laboratory QC samples to be analyzed for the project are presented in Table 12.

Table 12. Laboratory Quality Control Samples.

Analysis	Laboratory Control Sample	Standard Reference Material	Method Blank	Analytical Duplicate	Matrix Spikes and Spike Duplicates
Total recoverable and dissolved priority pollutant metals	1/batch	1/batch	1/batch	1/batch	1/batch

Total variation (field plus lab) will be assessed by collecting replicate samples for total and dissolved priority pollutant metals. The difference between field and laboratory variability is a measure of the sample field variability. These will be used to determine whether the data quality objectives for precision were met. If the objectives were not met, the data will be qualified. MEL routinely analyzes duplicate sample analyses in the laboratory for QC purposes.

MEL will not be able to directly assess bias from field procedures. However, bias will be minimized by strictly following standard protocols.

Study Budget

A summary of the sample numbers and laboratory costs are presented below in Table 13. The total laboratory cost for the project is estimated at $3,300.

All analyses will be conducted by MEL. The cost estimates reflect a 50% discount for analyses conducted by MEL.

Table 13. Summary of Laboratory Costs.

Analysis	Number of Samples	Cost
Water, priority pollutant metals – total and dissolved *	8 + 2 rep + 1 filter blank	$2,310
Low level filters	6	$162
Teflon vials preservative	6	$54
Hardness	4	$88
Total suspended solids	4	$44
Magnesium* (add to metals costs)	8	$480
Sodium	4	$54
Chloride	4	$54
Sulfate	4	$54
Total Project Lab Cost:		$3,300

*4 total and 4 dissolved priority pollutant samples.

Data Verification and Review

MEL will prepare case narratives for each data set. The data package from MEL will include a case narrative discussing any problems with the analyses, corrective actions taken, changes to the referenced method, and an explanation of data qualifiers. The data package will also include all associated QC results. This information is needed to evaluate the accuracy of the data and to determine whether the MQOs have been met. This will include results for all laboratory control samples, method blanks, standards and labeled compounds, and laboratory duplicates included in the sample batch.

MEL will conduct a QA review of all laboratory data and case narratives. This will include a verification that (1) methods and protocols specified in this QA Project Plan were followed, (2) all calibrations, checks on QC, and intermediate calculations were performed for all samples, and (3) the data are consistent, correct, and complete, with no errors or omissions. Evaluation criteria will include the acceptability of holding times, instrument calibration, procedural blanks, spike sample analyses, precision data, laboratory control sample analyses, and appropriateness of data qualifiers assigned.

MEL will review these data by using SOPs for data qualification.

To determine if MQOs have been met, the project lead will review results for initial precision and recovery, continuing calibration, laboratory control samples, duplicate samples, and labeled compound recovery. The field and method blank results will be examined to verify there was no significant contamination of the samples. To evaluate whether the targets for reporting limits have been met, the results will be examined for *non-detects* to determine if any values exceed the lowest concentration of interest.

The project lead will review the laboratory data packages, verify the report, and assess the usability of the data. Based on these assessments, the data will be either accepted, accepted with appropriate qualifications, or rejected and re-analysis considered.

Data Quality (Usability) Assessment

After the data have been verified, the project lead will determine if the data can be used to make the calculations, determinations, and decisions for which the project was conducted. If the results are satisfactory, data analysis will proceed.

Data Management Procedures

All project data will be entered into Excel spreadsheets. All entries will be independently verified for accuracy by Ecology's Environmental Assessment Program.

All project data will be entered into Ecology's Environmental Information Management system (EIM). Data entered into EIM follow a formal Data Verification Review Procedure where data are reviewed by the project manager of the study, the person entering the data, and an independent reviewer from Ecology's Environmental Assessment Program.

Audits and Reports

MEL participates in performance and system audits of their routine procedures. Results of these audits are available on request.

The following reports will be prepared for this project:

- The data will be provided to the project lead in printed and electronic formats.
- A draft technical report will be prepared by Ecology's Environmental Assessment Program staff on or before December 2009.
- A final technical report will be complete in April 2010.

The project data will be entered into Ecology's EIM on or before March 2010.

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Appendix. Glossary, Acronyms, and Abbreviations

Clean Water Act: A federal act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the Clean Water Act establishes the TMDL program.

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Dissolved metals: Metals entrained in water, defined as passing through a 0.45 µm filter.

Priority pollutant metals: A standards suite of 13 metals: arsenic, aluminum, antimony, beryllium, cadmium, chromium, copper, mercury, lead, nickel, selenium, thallium, and zinc**.**

Seep: A place where small flows of water exit the ground or other solid surface.

Total recoverable metals: Total metals analyzed following an acid extraction process.

Total suspended solids: Portion of solids retained by a filter.

Turbidity: A measure of water clarity. High levels of turbidity can have a negative impact on aquatic life.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Acronyms and Abbreviations

Following are acronyms and abbreviations used frequently in this report.

Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
HDPE	High Density Polyethylene
MHHW	Mean high-high water
MEL	Manchester Environmental Laboratory
MQO	Measurement quality objective
QA	Quality assurance
QC	Quality Control
SOP	Standard operating procedures
TSS	Total suspended solids
WAC	Washington Administrative Code

Units of Measurement

°C	degrees centigrade
g	gram, a unit of mass
mg/L	milligrams per liter (parts per million)
mL	milliliters
µg/L	micrograms per liter (parts per billion)
umhos/cm	micromhos per centimeter