GATEWAY PACIFIC TERMINAL
WHATCOM COUNTY, WASHINGTON

SEDIMENT INVESTIGATION WORK PLAN

Submitted to:
Pacific International Terminals,
Seattle, Washington

Submitted by:
AMEC Geomatrix, Inc.
Lynnwood, Washington

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ABBREVIATIONS AND ACRONYMS

AMEC	**AMEC Geomatrix, Inc.**
ARI	Analytical Resources, Inc.
cm	centimeter
CSL	Cleanup Screening Level
DGPS	Differential Global Positioning System
DQI	data-quality indicator
DQO	data-quality objectives
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
EIM	Environmental Information Management
EPA	U.S. Environmental Protection Agency
GPT	Gateway Pacific Terminal
GFAA/CVAA	graphite furnace atomic absorption/cold vapor atomic adsorption
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
ICP	inductively coupled plasma
LCS	laboratory control sample
LPAH	low-molecular-weight polycyclic aromatic hydrocarbon
m	meter
m^2	square meter
mL	milliliters
MLLW	mean lower low water
PAH	polycyclic aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, comparability, and completeness
PCB	polychlorinated biphenyl
PIT	Pacific International Terminals
ppt	parts per thousand
PSEP	Puget Sound Estuary Program

ABBREVIATIONS AND ACRONYMS - Continued

QA	**quality assurance**
QC	quality control
RRM	regional reference material
SA	Settlement Agreement
SAPA	Sediment Sampling and Analysis Plan Appendix
SMS	Sediment Management Standards
SOP	standard operating procedure
SQS	Sediment Quality Standards
TOC	total organic carbon
WDNR	Washington Department of Natural Resources
µm	micrometer
UV	ultraviolet
WAC	Washington Administrative Code

SEDIMENT INVESTIGATION WORK PLAN
Gateway Pacific Terminal
Whatcom County, Washington

1.0 INTRODUCTION

This Work Plan describes sediment investigations to be conducted the location of the proposed Gateway Pacific Terminal in the Strait of Georgia, Washington within the Washington Department of Natural Resources (WDNR) Lease Application No. 20-013265.

This Work Plan has been prepared by AMEC Geomatrix, Inc. (AMEC), on behalf of Pacific International Terminals (PIT). This Work Plan conforms to the substantive requirements of the Washington State Department of Ecology (Ecology) *Sediment Sampling and Analysis Plan Appendix* (SAPA; Ecology, 2008), the *Puget Sound Estuary Program 1996 Protocols* and the *Settlement Agreement Pacific International Terminals, Shoreline Substantial Permit SHS 92-0020 and SHB Appeals Numbers 97-22 and 97-23* filed with the Shoreline Hearings Board on August 31,1999.

1.1 SITE DESCRIPTION AND BACKGROUND

This section presents a brief description of the study location, project background, and the historical and current use of the site.

1.1.1 Location

Pacific International Terminals proposes to construct the Gateway Pacific Terminal (GPT) project, a bulk commodities terminal and storage facility in Whatcom County, Washington (Figure 1). The facility would be located on heavy-impact industrial zoned land located between BP's Cherry Point pier and refinery to the north and the ALCOA – Intalco Works pier and aluminum smelter to the south.

The sediment investigation within the proposed WDNR Lease Area covers a 46.77-acre area extending from the ordinary high water mark to a maximum depth of approximately -125 feet mean lower low water (MLLW). Approximately 5.3 acres of the WDNR lease area occurs in waters less than -12 feet MLLW (Figure 2).

1.1.2 Background

PIT is proposing to develop GPT, a deep-sea cargo shipping facility. Gateway Pacific Terminal will service transoceanic ships entering the Strait of Georgia through the Strait of Juan de Fuca. The upland portion of the terminal will include material storage facilities, conveyors to

move materials to and from ships, and railroad track to provide inland rail access. The marine development will include a three-berth deep-water wharf and a trestle accessing from the shore.

The vicinity has been identified by Whatcom County and the State of Washington for marine-dependent industry because of its proximity to shipping lanes; the bathymetry of nearshore waters that would accommodate cargo vessels; and close proximity to existing railways and Interstate 5 for inland transportation to this location.

Pacific International Terminals' proposal to construct GPT was evaluated in a final Environmental Impact Statement (Whatcom County, 1996). The County subsequently issued a Shoreline Substantial Development Permit (SHS92-0020) and a Major Development Permit (MDP92-0020) for the project in 1997. The Washington Environmental Council, Washington Department of Fish and Wildlife, and Ecology along with 5 other appellants appealed the permit. In 1999, PIT and the appellants entered into a Settlement Agreement on issues which were raised during the permit appeal (SHB Appeals Numbers 97-22 and 97-23) that incorporates a number of conditions which Whatcom County and PIT must meet prior, during, and after construction of the facility.

Section 2.5 of the Settlement Agreement calls for "…*annual sampling of sediments, marine water, and shellfish and/or other identified indicator species in the vicinity of the project site in accordance with the State Sediment Management Standards/Sediment Sampling and Analysis Plan Appendix and the Puget Sound Estuary Program 1996 Protocols*."

Section 2.5 of the Settlement Agreement further states that the requirements for sediment sampling are:

- "…*provide a scientifically sound basis for establishing existing pollutant levels* [i.e., baseline conditions] *and related biological conditions in the proposed Department of Natural Resources lease area…*", and
- conduct annual sampling of sediments and compare the results to baseline conditions in order to detect changes or trends in sediment quality.

This Work Plan addresses the Settlement Agreement requirement to evaluate sediment quality following the guidelines for recommended sampling presented by Ecology's *Sediment Sampling and Analysis Plan Appendix* (SAPA; Ecology, 2008), the *Puget Sound Estuary Program 1996 Protocols* and the *Settlement Agreement Pacific International Terminals, Shoreline Substantial Permit SHS 92-0020 and SHB Appeals Numbers 97-22 and 97-23* filed with the Shoreline Hearings Board on August 31,1999. As well, this Work Plan addresses the

objectives of standard sediment investigations conducted under the Sediment Source Control Program as established by Washington Administrative Code (WAC) 173-204-100.

1.1.3 Historical and Current Use

Drainage from the upland currently flows mainly through roadside ditches and empties to the Strait of Georgia via an unnamed stream adjacent to the sediment study area. There are no engineered stormwater discharges on the site and no known history of wastewater or stormwater discharge to the sediment in the study area.

2.0 OBJECTIVE AND DESIGN OF INVESTIGATION

The objective of this investigation is two fold. This investigation will fulfill PIT's obligations provided in the *Settlement Agreement, Pacific International Terminals; Shoreline Substantial Permit SHS 92-0020 and SHB Appeals Numbers 97-22 and 97-23.* Specifically, the objective is to comply with Section 2.5 of the Settlement Agreement providing for annual sampling of sediments, marine water and shellfish and/or other identified indicator species in the vicinity of GPT. As stated earlier, Section 2.5 requires the monitoring program to be developed in accordance with Ecology's *Sediment Sampling and Analysis Plan Appendix* (SAPA; Ecology, 2008) and the *Puget Sound Estuary Program 1996 Protocols.*

The second objective of this investigation is to provide an analysis of baseline conditions in the potential WDNR lease area prior to entering into a lease agreement with WDNR. In addition, this Work Plan addresses the objectives of sediment investigations conducted under the Sediment Source Control Program as established by WAC 173-204-100.

The objectives of this investigation are to:

- Conduct a baseline characterization of the concentration of metals and organic chemicals in sediment within the WDNR lease No. 20-013265 area;
- determine if sediments within the WDNR lease area meet the Washington Marine Sediment Quality Standards (SQS) chemical criteria (WAC 173-204-320);
- conduct sediment bioassays to assess toxicity for locations where the SQS chemical criteria are exceeded; and
- use the chemical data collected to determine the statistical variance of SQS chemicals within the lease area.

This information will be used to develop a robust statistical design for the annual monitoring program to detect future changes from baseline conditions. The annual monitoring program

will be developed based on specific areas where chemicals may be detected during baseline monitoring.

The data gathered during this monitoring program will meet the objectives of the Settlement Agreement to develop a scientifically sound basis for establishing existing pollutant conditions and related biological conditions in the proposed WDNR lease area. The annual sampling design will provide a scientifically sound basis for comparison of the background data to the annual results in order to detect changes or trends in samples over the long-term.

2.1 SAMPLING DESIGN

This project will use a tiered testing approach. For the Tier I analysis, surficial sediment samples (upper 10 centimeter [cm]) will be collected and split into two samples. One sample will be analyzed for the metals and organic chemicals that have Washington Marine SQS. The second sample will be archived for potential Tier II analysis.

Sediment concentrations measured at each sampling location will be compared to the SQS. If any of the SQS are exceeded, a Tier II analysis will be conducted on the archived sample to evaluate compliance with the Washington sediment management standards for Biological Effects Criteria [WAC 173-204-320 (3)].

The Biological Effects Criteria include testing sediment for two of the acute and one of the chronic tests listed in the sediment management standards (SMS; WAC 173-204-315). Sediment samples that pass all of the biological tests are designated as passing the applicable SQS of WAC 173-204-320 through 173-204-340. Any sample which fails any one of the biological tests is interpreted as not complying with the SQS. The sediment bioassays proposed for the two acute tests are the 10-day amphipod bioassay using *Rhepoxynius abronius*, and the sediment larval bioassay using a mollusk or an echinoderm species. The chronic test will be run using the cultured marine bacteria *Vibrio fisheri*.

The sediment investigation design considers the shallow (sampling locations in water depths less than -12 MLLW) and deeper areas of the lease area as two separate areas of investigation because benthic-dwelling organisms exposed to polycyclic aromatic hydrocarbons (PAHs) in waters less than -12 feet MLLW may experience increased toxicity due to the photoactivation of selected PAHs from ultraviolet (UV) radiation (Ecology, 2008). If Tier II analysis is required for sediments collected in the shallow area, bioassays will be performed in the presence of full spectrum laboratory lighting that includes ultraviolet wavelengths of sufficient intensity to mimic the site conditions.

2.2 STATISTICAL DESIGN

The program, *Visual Sample Plan, Version 5.0,* was used to develop the sampling design included in this Work Plan. This program was specifically created to develop sampling designs based on specified statistical objectives. Current sponsors of the model include the U.S. Environmental Protection Agency (EPA), U.S. Department of Energy, U.S. Department of Defense, U.S. Department of Homeland Security, U.S. Centers for Disease Control, and the United Kingdom Atomic Weapons Establishment.

The statistical objectives specified for the sampling design are:

- systematic triangular grid pattern within the proposed WDNR lease area; and
- 95 percent probability of detecting a circular hot spot with a diameter of 155.3 feet (an area of 75,744 square feet).

The sampling design specifies the collection of 26 samples as shown on Figure 2. Twenty-four of the sampling locations are in water depths greater than -12 feet MLLW; two locations are in waters shallower than -12 feet MLLW.

If Tier II testing is required at either of the locations in waters shallower than -12 feet MLLW, the bioassays will be performed in the presence of full spectrum laboratory lighting that includes ultraviolet wavelengths of sufficient intensity to mimic the conditions at the site (Ecology, 2008).

2.3 ANALYSIS SCHEDULE

The initial round of analysis (Tier I; Table 1) is chemical testing of the sediments collected within the lease area (Figure 2). Tier II biological effects testing will be conducted on sediment samples that fail to meet the SQS chemical criteria.

3.0 FIELD SAMPLING METHODS

3.1 STATION POSITIONING

The planned sampling locations are shown on Figure 2 and given in Table 2. In the field, sample stations will be located with a Differential Global Positioning System (DGPS). Samples will be collected within 3 meters (m) of the proposed sampling locations. If samples cannot be collected after two attempts, the AMEC Project Manager (refer to Section 11) will be notified and an alternative location may be selected. The actual sample locations will be recorded and logged.

3.2 SEDIMENT SAMPLES

A hand-core sediment sampler (20 cm diameter x 10 cm deep) will be used to collect the sediment samples at the shallowest water depth (Station GP-1). Sediments at all other sampling location will be collected using a 0.1 m² stainless-steel Van Veen sediment grab sampler deployed from a sampling vessel. Prior to sampling, the surface of the sediment will be photographed, visually inspected, and logged.

3.3 DECONTAMINATION PROCEDURES

Sample containers, instruments, working surfaces, technician protective gear, and other items that may come into contact with sediment sample material will meet high standards of cleanliness. All sediment-handling equipment will be cleaned and decontaminated prior to arrival at the site. The hand-core samplers will be precleaned prior to arrival at the site. The hand-core samplers will be rinsed clean of any visible sediment and decontaminated between uses. All equipment and instruments used to remove sediment from the sampler or to homogenize samples will be stainless steel and will be decontaminated before and in between each use.

The AMEC standard decontamination procedure for the hand-core samplers, Van Veen grab, and other sample handling equipment is modeled after Puget Sound Estuary Program (PSEP) protocols (PSEP, 1997); however, the decontamination procedure will not use any acid or solvent rinses (the final rinse will use distilled water).

3.4 SAMPLE COMPOSITING

During the initial round of sampling, surface sediment (top 10 cm) from a minimum of two hand cores at Station GP-1, and a single Van Veen grab at other sample locations will be collected. Sediments for pore water extraction for the Microtox® bioassay will be placed directly from the sampler into the 16-oz glass jar to minimize disturbance and possible volatilization of potential contaminants. The remaining sediments will be homogenized and bottled. A portion of the

bottled sediment will be tested during the initial round of chemical testing. The remaining sediment will be archived for possible biological effects testing.

3.5 WASTE SEDIMENT

All solid waste derived during this investigation will be placed in proper containers, labeled, characterized, and disposed of by AMEC in accordance with appropriate regulations.

4.0 SAMPLE HANDLING PROCEDURES

This section outlines the protocol for field and laboratory handling and storage of samples.

4.1 SAMPLE CONTAINERS

Sample containers will be provided by Analytical Resources, Inc. (ARI), and will be precleaned, certified, and individually labeled with a lot number traceable to a Certificate of Analysis.

4.2 SAMPLE STORAGE

Samples scheduled for the initial round of chemical analysis will be refrigerated until delivered to the laboratory. Samples scheduled for potential Tier II analysis will be archived and stored at the analytical laboratory in a secure area. Storage requirements for the bioassay sediments will include storage in the dark at 4°C. No headspace will be left in the bioassay jars after filling to minimize aerobic activity.

4.3 CHAIN OF CUSTODY

Sediment samples will be kept in sight of the sampling crew or in a secure, locked vehicle at all times. Samples will be placed in coolers with commercial frozen chill packs ("blue ice") or frozen until transferred to the testing laboratories. Transfer of samples from AMEC custody to the laboratory will be documented using chain-of-custody procedures.

If someone other than the sample collector transports samples to the laboratory, the collector will sign and date the chain-of-custody form and insert the name of the person or firm transporting the samples under "transported by" before sealing the container with a custody seal.

5.0 LABORATORY ANALYTICAL METHODS

5.1 BIOLOGICAL ANALYSES

The sediment bioassay testing conducted will include the 10-day amphipod bioassay using *Rhepoxynius abronius* and the sediment larval bioassay using a molluscan species (e.g., *Crassostrea gigas*) or an echinoderm species (e.g., *Dendraster excentricus*). The Microtox® test will be run using the cultured marine bacteria *Vibrio fisheri*. Bioassay procedures will follow PSEP (1995) protocols, with any applicable revisions identified in the Ecology (2008) or modifications recommended during the annual Sediment Management Annual Review Meetings.

The following general requirements apply to sediment bioassays.

- Reference test sediments are analyzed for grain size, total volatile solids, bulk ammonia, and total organic carbon (TOC).
- Blind testing is done by randomized test sequence and code numbers.
- Water quality is controlled throughout the entire bioassay, and the following water quality variables are measured daily: salinity, dissolved oxygen, pH, and temperature. Ammonia and sulfides are measured at the beginning and end of each test.
- Seawater for conducting these tests is obtained from Port Gamble, Washington. Seawater is filtered to 0.45 micrometer (µm).
- All tests are aerated during the exposure period.
- Standard laboratory procedures are followed in all testing, including proper documentation, proper cleaning, avoidance of contamination, and maintenance of appropriate test conditions.
- Bioassay-specific controls and use of reference sediments are observed or sediments may need to be retested.
- All unusual observations or deviations from established procedures are recorded and reported.

Final selection of the test organisms will be made in consultation with the testing laboratory and the Ecology Project Manager. Bioassay testing requires that test sediments be matched and run with appropriate reference sediments to factor out sediment grain-size effects on bioassay organisms. The approach for selecting reference sediment samples is as follows.

The analytical laboratory will conduct grain-size analyses first. The grain-size data will allow selection of appropriate reference sediment(s). After the analytical laboratory has completed

the grain-size analyses, selection of appropriate reference sediment(s) will be made in consultation with the Ecology Project Manager.

5.1.1 Amphipod Sediment Bioassay

The amphipod sediment bioassay is a 10-day acute-lethal test used to determine the influence of experimental sediments on amphipod survival. The amphipod test will be conducted using *Rhepoxynius abronius* as recommended in PSEP (1995). The selection of amphipod species is based on sediment interstitial salinity and grain size. *Rhepoxynius abronius was selected because* the sediments within the project area are expected to consist of less than 60 percent fine- grained particles and have interstitial salinities greater than or equal to 25 parts per thousand (ppt). *Rhepoxynius abronius* used in the tests will be purchased from a commercial supplier.

Upon arrival in the laboratory, amphipods will be acclimated to the testing temperature in sediments provided by the supplier and then introduced to the sediment-loaded test vessels and aerated during the test. Seawater used in acclimation and each bioassay test vessel will be filtered to 0.45 µm. Each test will be run with the appropriate negative (native sediment supplied by the vendor) and positive (cadmium chloride) controls.

Individual test vessels will be inspected daily for the emergence of individual amphipods from sediments to determine the number of organisms that refuse to rebury. Positive controls will also be inspected daily and are terminated after 4 days, at which time survivorship at each concentration will be determined. After 10 days, control, reference, and experimental sediments are sieved, and surviving individuals are recovered and counted. Statistical comparisons of amphipod survivorship will be made between test vessels from the reference and experimental sediments. All information concerning testing conditions and environments, positive controls, negative controls, and experimental sediments will be included in the final report.

5.1.2 Microtox® (Marine Pore Water) Toxicity Assessment

The Microtox® sediment pore water toxicity assessment is a rapid bioassay procedure that uses differences in bioluminescence between test, reference, and control samples as an indication of relative toxicity. The test will be conducted using the marine bacteria *Vibrio fisheri* as recommended in Ecology (2008).

Tests will be run using pore water extracted from both test and reference sediments. Pore water extraction involves centrifugation of 500 milliliters (mL) of sediment at approximately 4,500 G for 30 minutes. A pore water volume of 25 mL will be needed. Salinity and pH will be

adjusted as needed and the samples aerated to achieve dissolved oxygen saturation between 50 to 100 percent.

Freeze-dried bacterial suspensions will be reconstituted and allowed to equilibrate before being adding to the test, reference, and laboratory control samples. After an initial 5-minute incubation period, the sample's bioluminescence will be determined (reading I_0). The samples are measured again after an additional 5 minutes (I_5) and a final reading is taken at 15 minutes (I_{15}).

Statistical comparisons will be made between the reference and test sediment bioluminescence data. Information concerning testing conditions, positive and negative controls, and experimental sediments will be evaluated in the final report.

5.1.3 Sediment Larval Bioassay

The larval sediment bioassay will consist of a 48- to 96-hour mortality and abnormal development test used to determine the influence of experimental sediments on larval development. Depending on the time of year, one of several species of echinoderm or mollusk will be used for this test. The primary factor affecting the selection of an appropriate species for the larval test is the time of year. It is desirable to select a species that is naturally spawning at the time of year the biological test will be conducted. The natural spawning seasons for the test species in the Puget Sound area are listed below (Ecology, 2008):

- *Crassostrea gigas (Pacific oyster) – summer*
- *Mytilus galloprovincialis* (Blue mussel) – late spring through early summer
- *Strongylocentrotus purpuratus* (Purple sea urchin) - December through April
- *Dendraster excentricus* (Sand dollar) – April through October

Final selection of the test organism will be made in consultation with the testing laboratory and the Ecology Project Manager.

Adult mollusks or echinoderms will be induced to spawn using temperature stimuli. Eggs will be fertilized at the appropriate concentration, and the resultant embryos will be introduced into prepared testing vessels and aerated during the test. Seawater used in acclimation and each bioassay test vessel will be filtered to 0.45 µm. Each test will be run with the appropriate negative (seawater) and positive (cadmium chloride) controls. Replicate test vessels will be monitored daily for water quality.

The test will be terminated after 48 hours, by which time the organisms will have developed to the appropriate larval stage in the seawater control and any unaffected test vessels. The test will be terminated by the addition of 5 percent buffered formalin to well-mixed aliquots from each test vessel.

Determination of development stage is made by microscope. Statistical comparisons of embryo development will be made between test vessels from the reference and experimental sediments. Information concerning testing conditions and environments (e.g., stocking density and aliquot size), positive controls, negative controls, experimental sediments, initial counts for the seawater control, and the number of normal and abnormal embryos in each container at the end of the test will be included in the final report.

5.1.4 Photoactivation of PAHs

The photoactivation of polycyclic aromatic hydrocarbons (PAH) exposed to ultraviolet (UV) radiation can result in increased toxicity for exposed organisms. Ultraviolet exposure is a potential problem in intertidal and shallow subtidal communities. Approximately 5.3 acres of the lease area occurs in shallow areas with elevations less than -12 feet MLLW. If sediment bioassays conducted under the Tier II testing are performed at the two sampling locations in this area, they will be conducted using full-spectrum laboratory lighting to include UV light intensities similar to the site conditions and will follow the recommendations presented in *Appendix D of the report, Recommendations for Conducting Bioassays on Sediment Containing Polycyclic Aromatic Hydrocarbons Exposed to Ultra-Violet (UV) Radiation* (Ecology, 2008).

5.2 CHEMICAL ANALYSIS AND TARGET DETECTION LIMITS

All analytical methods will follow rigorous standard testing protocols. The specific analyses chosen for the samples must be capable of returning accurate results at the data-quality objective (DQO) concentrations listed in Table 3. Test methods selected to achieve these results are presented in Table 4 along with the reporting limits for each analytical method provided by ARI. If the reporting limits for an analyte are above the DQO, then the sample may be reanalyzed using a different method to obtain a satisfactory reporting limit.

As described in the SMS, total polychlorinated biphenyl (PCB) concentrations will be calculated by summing the detected concentrations for seven Aroclors (i.e., Aroclor 1016, 1221, 1232, 1242, 1248, 1254, and 1260). If all seven Aroclors are reported as undetected, then the value reported as the total PCB value will be the highest reporting limit among the individual Aroclors.

Total low-molecular-weight polycyclic aromatic hydrocarbons (LPAH) will be calculated by summing the detected concentrations for naphthalene, acenaphthylene, acenaphthene, phenanthrene, anthracene, and fluorene. If the entire spectrum of specific LPAH are reported as undetected, then the value reported as the total LPAH value will be the LPAH compound with the highest reporting limit.

Total high-molecular-weight polycyclic aromatic hydrocarbons (HPAHs) will be calculated by summing the detected concentrations of fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. If the entire spectrum of specific HPAH's are reported as undetected, then the value reported as the total HPAH value will be the HPAH compound with the highest reporting limit.

Analytical laboratory quality control (QC) checks include the use of standard U.S. EPA analytical methodologies (including analysis of method blanks, spikes, and surrogates), laboratory QC samples, and suitable regional reference materials (RRM). These QC checks are detailed in Tables 5 through 9. Additionally, the analyses will be carried out under the laboratory's standard operating procedures (SOP).

6.0 QUALITY OBJECTIVES AND CRITERIA

This section outlines the objectives of this Work Plan and summarizes relevant quality assurance (QA) criteria.

6.1 QUALITY OBJECTIVES AND CRITERIA FOR BIOLOGICAL DATA

The quality assurance/quality control procedures for the amphipod 10-day acute/lethal bioassay, Microtox® saline pore water bioassay, and sediment larval abnormality bioassay are described in the applicable protocols and provided in Table 10. The QA/QC requirements include control limits for water quality parameters (e.g., temperature, salinity dissolved oxygen, pH). Monitoring of sulfides and ammonia is also required during the sediment bioassays. Protocols also specify acceptable performance limits for negative controls, positive controls, and reference sediments. The percentage of fines in reference sediments should be within 20 percent of the percentage of fines in the test sediment.

6.2 QUALITY OBJECTIVES AND CRITERIA FOR ANALYTICAL DATA

The goals for the analytical data are to produce data of sufficient quality to meet the project DQO. The primary DQO for this project is that the sediment concentrations must be sufficiently accurate to compare to the SQS for marine sediments (Table 3). Because the SQS for many organic compounds is based on carbon-normalized concentrations, the samples must also be analyzed for TOC. Comparison of carbon-normalized values against the SQS listed in Table 3 may be inappropriate if TOC values are below 0.5 percent. The upper limit of TOC where carbon normalization is inappropriate is a site-specific value based on background levels. The range of TOC values where it is appropriate to carbon-normalize the PAH and PCB data have not been determined for the site; therefore, the carbon-normalization range will be determined in consultation with the Ecology Project Manager once the analytical data has been obtained. The project DQOs for PAH and PCB data must be accurate at the dry-weight-based standards specified in Table 3. The practical quantitation limits for the analytes in this study must be at least as low as the concentrations presented in Table 3.

To meet the goal of returning data accurate to within the SQS, data-quality indicators (DQIs) also need to be established. Data quality indicators are specific measured parameters, including the familiar parameters: precision, accuracy, representativeness, comparability, and completeness (PARCC), as well as sensitivity.

The basis for assessing each of these elements of data quality is discussed in the following sections. Precision and accuracy QC limits for analytical methods are identified in Tables 5 through 8.

6.2.1 Precision

Precision measures the reproducibility of measurements. Precision is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Analytical precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. If the recoveries of analytes in the laboratory control sample (LCS) are within established control limits, then precision is within limits. Total precision is the measurement of the variability associated with the entire sampling and analysis process. Total precision measures variability introduced by both the laboratory and field operations and is determined by analysis of duplicate or replicate field samples. Field-duplicate samples (5 percent frequency) and matrix-duplicate spiked samples (one per analytical batch) shall be analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference between the duplicate sample results. For replicate analyses, the relative standard deviation is determined.

6.2.2 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS to a control limit. For compounds, such as PCBs, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. The formula for calculation of accuracy returns a percent recovery from pure and sample matrices. Limits of accuracy for Method 8082 (PCBs), Method 6010 (inductively coupled plasma [ICP] metals), Method 7000 series (graphite furnace atomic absorption/cold vapor atomic absorption [GFAA/CVAA] metals), Method 8270D (semivolatile organic compounds [SVOCs], and the standard methods for conventionals analysis are contained in Tables 5 through 8, respectively.

6.2.3 Representativeness

Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Representativeness will be achieved through use of standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper sample

locations, sampling procedures, and sample intervals. Decisions regarding the number and locations of samples to be collected are documented in Section 3.0.

6.2.4 Comparability

Comparability is the confidence with which one data set can be compared to another data set. An objective for this QA/QC program is to produce data comparable to previously collected data. The range of field conditions encountered is considered in determining comparability. Comparability will be achieved by using standard methods for sampling and analysis, reporting data in standard units, using RRM, and using standard reporting formats. Field documentation using standardized data collection forms shall support the assessment of comparability.

6.2.5 Completeness

Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of intended individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an "R" flag (see Table 11 for an explanation of flagging criteria). The requirement for completeness is 90 percent for the sediment samples scheduled for the initial round of analyses.

6.3 FIELD QUALITY ASSURANCE

Field QC will include the collection and chemical analysis of field-duplicate samples to meet a field-duplicate frequency of approximately 10 percent. Decontamination blanks will be collected from the hand cores and sediment compositing equipment.

6.4 DOCUMENTATION AND RECORDS

6.4.1 Field

Data and log forms produced in the field will be reviewed daily by the person recording the data, so that any errors or omissions can be corrected. All completed data sheets will be removed daily from the field clipboard and photocopied; the original data sheets are filed in a fireproof file cabinet and the photocopies stored in the project file. All data transcribed from field forms into electronic forms and tables will be 100 percent verified for accuracy and freedom from transcription errors.

6.4.2 Bioassay Laboratory

The bioassay laboratory will prepare written reports for each test system (i.e., organism) documenting all sample analyses and associated activities, including the following:

- Chain-of-custody procedures and discussion of any deviations from the procedures;

- Summary of protocols implemented during analyses and discussion of any deviations from the protocols;
- Tabulated bioassay and QC results;
- Discussion of laboratory documentation, laboratory notebooks, and chain-of-custody forms and their use to record data and storage location;
- All data qualifications and explanations for all departures from the protocols;
- Results of water quality monitoring; and
- Results for all the QA/QC checks initiated by the laboratory.

6.4.2.1 Amphipod Mortality Test

Laboratories performing this bioassay test shall be required to report the following data:

- Daily water quality measurements during testing (dissolved oxygen, temperature, salinity, pH, and ammonia + sulfides at start and end of test);
- Daily emergence for each beaker and the 10-day mean and standard deviation for each treatment;
- 10-day survival in each beaker and the mean and standard deviation for each treatment;
- Interstitial salinity values of test sediments;
- 96-hour LC50 values with reference toxicants; and
- Any problems that may have influenced data quality.

6.4.2.2 Microtox® (Saline Pore Water) Toxicity Assessment

Laboratories performing this bioassay test shall be required to report the following data:

- Initial and adjusted pore water salinities and pH of test and reference samples;
- Initial light readings (I_0) and final light readings (I_5 or I_{15}) for each replicate and the mean and standard deviation for each treatment;
- Final control and reference mean light output; and
- Any problems that may have influenced data quality.

6.4.2.3 Echinoderm or Bivalve Sediment Larval Test

Laboratories performing this bioassay test shall be required to report the following data:

- Daily water quality measurements (dissolved oxygen, temperature, salinity, pH, and ammonia plus sulfides at start and end of test);
- Individual replicate and mean and standard deviation data for larval survival at test termination;
- Individual replicate and mean and standard deviation data for larval abnormalities at test termination;
- 48-hour LC_{50} and EC_{50} values with reference toxicants; and
- Any problems that may have influenced data quality.

Project documentation records related to sediments testing will be kept on file at the AMEC office in Lynnwood, Washington.

6.4.3 Analytical Laboratory

Analytical laboratory documentation will consist of a case narrative, providing descriptions of any problems and corrective actions, copies of the chain-of-custody forms, tabulated analytical results, data qualifiers, and blank and matrix spike results with calculated percent recoveries and differences. A detailed documentation package (raw data, analyst's reports, extraction logs, chromatograms, etc.) will be provided by the laboratory in case the basic data review discussed in Section 7.1 encounters deficiencies requiring more thorough laboratory documentation.

6.5 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, MAINTENANCE, AND CALIBRATION

6.5.1 Field Equipment

Prior to each daily sampling event, the DGPS will be tested for accuracy. A checkpoint accessible to the field crew will be occupied. At the DGPS checkpoint, the DGPS unit will be stationed and a position reading will be taken. The DGPS position will be compared to the known checkpoint coordinates. The DGPS position readings should agree to within 1 to 2 m of the known checkpoint coordinates. If the position readings do not agree within 1 to 2 m, the DGPS unit will be carefully checked and electronics reset. After checking and resetting the DGPS the positions still do not agree, other actions may be taken including replacing the unit.

6.5.2 Analytical Laboratory

Analytical instruments shall be calibrated in accordance with the analytical methods specified in the laboratory SOPs. All analytes reported shall be included in the initial and continuing calibrations, and these calibrations shall meet the acceptance criteria specified in Tables 5 through 9. Records of standard preparation and instrument calibration shall be maintained, and calibration standards shall be traceable to RRMs.

Instrument calibration shall be checked at the frequency specified by the relevant analytical method, using materials prepared independently of the RRM. Multipoint calibrations will contain the minimum number of calibration points specified by the applicable analytical method, with all points used for the calibration being contiguous. If more than the minimum number of standards is analyzed for the initial calibration, all of the standards analyzed will be included in the initial calibration. The continuing calibration verification will not be used as the LCS.

6.6 DATA MANAGEMENT

The analytical and field data will be compiled into an Environmental Information Management (EIM) System and MyEIM Portal v1.0 electronic data deliverable for possible submission to Ecology. The analytical data will also be maintained in ARI's electronic Laboratory Information Management System or archival system. Hard copies of the analytical laboratory data reports will be retained at the AMEC office.

6.7 ASSESSMENT AND RESPONSE ACTIONS

This section describes laboratory oversight, procedures for corrective actions, and reporting responsibilities.

6.7.1 Field

The Field Manager will be responsible for correcting equipment malfunctions during the field sampling. In addition to equipment failures, conditions that require a modification of the intent of the sampling program will be coordinated with the Ecology Project Manager by the Field Manager or the Consultant Team Project Manager. All response actions will be documented in a field logbook.

6.7.2 Biological Laboratory

Biological laboratories selected for toxicity testing will be participants in Ecology's Environmental Laboratory Accreditation Program. Corrective actions will be taken whenever the QC limits are exceeded for any protocol specified in PSEP (1995) or in Ecology (2008), and any relevant annual updates to the protocols and procedures. Details of the corrective actions to be taken are contained in the bioassay laboratory SOPs for each method and conform to the corrective actions outlined in Ecology (2008).

Whenever a corrective action does occur, the Laboratory Manager will be notified. If the corrective action is judged to be routine, such as a slight exceedance of a water quality parameter, the corrective action will be implemented without notifying the Consultant Project Manager. If the corrective action requires rerunning of a bioassay, the Consultant Project Manager and Laboratory Coordinator will be notified.

The standard holding time for bioassay sediment is 56 days from data of collection. The biological laboratory should be able to conduct any required bioassay testing within the 56-day holding time. However, if bioassay testing or retesting is needed and the standard holding time will be exceeded, then the Ecology Project Manager will be notified prior to running the test.

6.7.3 Analytical Laboratory

Corrective actions will occur whenever the QC limits are exceeded for any method specified in Tables 5 through 9. Details of the corrective actions to be taken are contained in the laboratory SOP for each analytical method and conform to the corrective actions outlined in Ecology (2008).

Whenever a corrective action occurs, the Laboratory Manager will be notified. If the corrective action is judged to be routine, such as a slight exceedance of a percent recovery limit, the corrective action will be implemented without notifying the Consultant Team Project Manager. If the corrective action requires reanalysis or re-extraction, the Consultant Team Project Manager and Laboratory Coordinator will be notified.

Following removal of material for the initial analyses the samples will be frozen, which allows for a 6-month hold time. Therefore, the laboratory will likely be able to reanalyze/re-extract samples within the holding time, should reanalysis be necessary.

7.0 DATA VALIDITY AND USABILITY

This section describes procedures for data validation, verification, and usability.

7.1 DATA REVIEW, VERIFICATION, AND VALIDATION

One hundred percent of the data received from the laboratory will be validated at a Level 1 (basic) review.

Level 1 review will include the following steps:

- Verify that the laboratory utilized the specified extract, analysis, and cleanup methods.
- Review sample holding time.
- Verify that sample numbers and analyses match those requested on the chain-of-custody form.
- Verify that the required reporting limits have been achieved.
- Verify that field duplicates, matrix spikes, and laboratory control samples were run at the proper frequency and have met QC criteria.
- Verify that the surrogate compound analyses have been performed and have met QC criteria.
- Verify that initial and continuing calibrations were run at the proper frequency and have met acceptance criteria.
- Verify that the lab blanks are free of contaminants.

7.2 VERIFICATION AND VALIDATION METHODS

Data that appear to have significant deficiencies will be validated using the more comprehensive Level 2 verification and review in accordance with the EPA's functional guidelines for data validation (EPA, 1999 and 2004). Following this review, data qualifiers assigned by the laboratory may be amended.

7.3 RECONCILIATION WITH USER REQUIREMENTS

Following receipt of all of the analytical data reports, the Consultant Team Project Manager will review the sample results to determine if they fall within the acceptance limits and goals set forth in this Work Plan. If the DQIs do not meet the project requirements, the data may be discarded and reanalysis performed. The decision to discard or reanalyze will be made jointly between the Consultant Project Manager and PIT. If the failure is traced to the analytical

laboratory (e.g., sample handling, extraction, or instrument calibration and maintenance), techniques will be reassessed prior to reanalysis.

8.0 DATA ANALYSIS AND REPORTING REQUIREMENTS

This section describes procedures for data analysis, interpretation, and reporting.

8.1 ANALYSIS OF BIOLOGICAL DATA

The bioassay data will be compared to the SMS biological effects criteria (Table 10).

8.2 ANALYSIS OF SEDIMENT CHEMICAL DATA

Sediment chemistry data will be compared against the SQS and cleanup screening level (CSL) numerical criteria. The SMS SQS for many organic compounds is based on carbon-normalized concentrations. If TOC values are below 0.5 percent, chemical concentrations will be compared to the dry-weight-based standards specified in Table 3.

8.3 REPORTS TO MANAGEMENT

A data report summarizing the results of the characterization will be prepared by AMEC and PIT for submittal to Ecology.

The data report will include:

- a narrative of field activities,
- chain-of-custody records,
- Level 1 data review,
- data tables and maps for sample locations,
- data tables and maps summarizing the results of the analytical analyses, and
- electronic data tables including an EIM-compatible data deliverable.

9.0 HEALTH AND SAFETY

Work will be conducted in accordance with the AMEC's GPT Health and Safety Plan for Sediment sampling and analysis.

10.0 SCHEDULE

The sediment sampling schedule will be developed following approval of this Work Plan. Sample collection is expected to take up to 1 week. Bioassay tests are expected to take up to 5 weeks, and subsequent chemical analyses will take an additional 12 weeks. It is anticipated that a data report summarizing the results of this investigation will be submitted 8 weeks after the data-quality assurance review is completed. Annual monitoring will not begin until the GPT is constructed.

11.0 PROJECT MANAGEMENT

This section provides an overview of the project organization, as well as a summary of the nature of the project and QA objectives.

11.1 PRIME CONSULTANT

AMEC is the prime consultant working under contract to PIT.

11.2 CONSULTANT TEAM PROJECT MANAGER

AMEC's Senior Project Manager for the GPT project is Dr. Kristie Dunkin. The Project Manager for the sediment investigation is Dr. Steven Ellis. Dr. Ellis will be responsible for the overall conduct of the work described in this Work Plan.

11.3 QUALITY ASSURANCE MANAGER

Mr. Rob Gilmour of AMEC will be the QA Manager for the work conducted under this Work Plan. He will be responsible for performing field and quality reviews and ensuring that the sampling and analysis are conducted as per the requirements specified in this Work Plan.

11.4 FIELD MANAGER

Mr. Gary Maxwell of AMEC will be the Field Manager for the work conducted under this Work Plan. He will be responsible for:

- ensuring that all samples are collected in accordance with this Work Plan;
- obtaining authorization to work and anchor at the site;
- establishing and following chain-of-custody procedures;
- overseeing compliance with AMEC's Corporate Health and Safety Plan; and
- ensuring that all sediment sampling and analysis equipment is available and in working order.

11.5 ANALYTICAL LABORATORY COORDINATOR

Ms. Melinda Gray, M.S. will be the Laboratory Coordinator for the work conducted under this Work Plan. She will be responsible for:

- communicating with and overseeing the analytical laboratory, to ensure that project goals are met; and
- coordinating sample analysis with the analytical laboratory.

11.6 BIOLOGICAL LABORATORY COORDINATOR

Mr. Rob Gilmour of AMEC will be the Biological Laboratory Coordinator for the work conducted under this Work Plan. He will:

- communicate with and oversee the bioassay laboratory, to ensure that project goals are met; and
- coordinate sample testing with the bioassay laboratory.

11.7 DATA MANAGEMENT

Ms. Melinda Gray, M.S. will be responsible for the analytical data management for the work conducted under this Work Plan. She will:

- import the electronic data deliverable (EDD) provided by the analytical laboratory into a data management system;
- produce analytical data tables for the Data Report that will be provided as part of this work (see Section 8.3); and
- produce the EIM-compatible EDD described in Section 8.3.

11.8 DATA VALIDATION

Dr. Steve Ellis will perform the validation of all analytical data, as described in Section 7.0 of this Work Plan.

11.9 ANALYTICAL LABORATORY PROJECT MANAGER

Analytical testing will be conducted by ARI, Tukwila, Washington. Analytical Resources, Inc is a Washington accredited, full-service chemical analytical laboratory. Mr. Mark Harris will be the ARI project manager.

11.10 BIOASSAY LABORATORY PROJECT MANAGER

Bioassay testing will be conducted by NewFields Northwest, LLC, Port Gamble, Washington. NewFields Northwest is an accredited bioassay laboratory. Mr. Brian Hester will be the NewFields Northwest Project Manager.

12.0 REFERENCES

Ecology (Washington Department of Ecology), February 2008. Sediment Sampling and Analysis Plan Appendix: Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (Chapter 173-204 WAC). Publication Number 03-09-043. Ecology, Olympia, Washington.

EPA (U.S. Environmental Protection Agency), 1999. Contract Laboratory Program National Functional Guidelines for Organic Data Review. EPA, OSWER, EPA 540/R 99-008, Washington, D.C.

EPA, 2004. Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. EPA, OSWER, EPA 540/R 04-004, Washington, D.C.

PSEP (Puget Sound Estuary Program), 1995. Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments, Interim Final Report. PSEP, U.S. EPA Region 10, Seattle, Washington.

PSEP, 1997. Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound. Prepared for the U.S. Environmental Protection Agency and Puget Sound Water Quality Action Team, Seattle, Washington.

Whatcom County, 1996. Gateway Pacific Terminal Draft Environmental Impact Statement. Whatcom County Planning and Development Services, Bellingham, Washington.

TABLES

TABLE 1

TIERED ANALYSIS SCHEDULE

Gateway Pacific Terminal
Whatcom County, Washington

Stations Tested	Parameters	Methods	Criteria	
Tier I—Chemical Analysis			SMS	
All samples collected within the Lease Area (Figure 2)	SMS Metals	EPA 6010/ EPA 7471A	SQS	CSL
	SMS aromatic hydrocarbons	EPA 8270D	SQS	CSL
	SMS chlorinated benzenes	EPA 8270D	SQS	CSL
	SMS phthalate esters	EPA 8270D	SQS	CSL
	SMS miscellaneous	EPA 8270D	SQS	CSL
	PCB Aroclors	EPA 8082	SQS	CSL
	SMS ionizable organic compounds	EPA 8270D	SQS	CSL
Tier II—Biological Testing				
All locations where SMS criteria are exceeded	Amphipod	PSEP	SQS	CSL
	Sediment larval	PSEP	SQS	CSL
	Microtox® saline pore water	Appendix B (Ecology, 2008)	SQS	NA

Abbreviations

CSL: Cleanup Screening Level
EPA: U.S. Environmental Protection Agency
PCB: polychlorinated biphenyls
PSEP: Puget Sound Estuary Program
SMS: Sediment Management Standards
SQS: Sediment Quality Standards

TABLE 2

PROPOSED SAMPLE LOCATIONS

Gateway Pacific Terminal
Whatcom County, Washington

Station Name	Water Depth	Proposed Sample Location (SPCS WA N [4601] NAD83 Survey Feet)	
		Easting	Northing
GP-1	0 to -12 ft MLLW	1181660.71	683504.67
GP-2 [1]	0 to -12 ft MLLW	1181510.71	683244.87
GP-3	-15 to -40 ft MLLW	1181660.71	682985.06
GP-4	-15 to -40 ft MLLW	1181360.71	682985.06
GP-5	-40 to -60 ft MLLW	1179560.71	683504.67
GP-6	-40 to -60 ft MLLW	1180010.71	683244.87
GP-7	-40 to -60 ft MLLW	1180760.71	682985.06
GP-8	-40 to -60 ft MLLW	1181210.71	682725.25
GP-9	-40 to -60 ft MLLW	1181510.71	682725.25
GP-10	-40 to -60 ft MLLW	1181960.71	682465.44
GP-11	-40 to -60 ft MLLW	1182260.71	682465.44
GP-12	-40 to -60 ft MLLW	1182410.71	682205.64
GP-13	-60 to -80 ft MLLW	1179710.71	683244.87
GP-14	-60 to -80 ft MLLW	1180460.71	682985.06
GP-15	-60 to -80 ft MLLW	1180910.71	682725.25
GP-16	-60 to -80 ft MLLW	1181360.71	682465.44
GP-17	-60 to -80 ft MLLW	1181660.71	682465.44
GP-18	-60 to -80 ft MLLW	1181810.71	682205.64
GP-19	-60 to -80 ft MLLW	1182110.71	682205.64
GP-20	-80 to -100 ft MLLW	1180160.71	682985.06
GP-21	-80 to -100 ft MLLW	1180610.71	682725.25
GP-22	-80 to -100 ft MLLW	1181060.71	682465.44
GP-23	-100 to -120 ft MLLW	1179410.71	683244.87
GP-24	-80 to -100 ft MLLW	1179860.71	682985.06
GP-25	-80 to -100 ft MLLW	1180310.71	682725.25
GP-26	-100 to -125 ft MLLW	1179560.71	682985.06

Notes
1 A duplicate sample for chemistry will be collected at this location

Abbreviations
NAD83: North American Datum of 1983
SPCS WA: State Plane Coordinate System of Washington, Zone 4601

Continued

TABLE 3

DATA QUALITY OBJECTIVES FOR THE CONSTITUENTS OF CONCERN
PRACTICAL QUANTITATION REQUIREMENTS
Gateway Pacific Terminal
Whatcom County, Washington

	Sediment Management Standards		
	SQS [1]	**CSL [2]**	**LAET [3]**
Metals	**mg/kg dry wt**	**mg/kg dry wt**	**mg/kg dry wt**
Arsenic	57	93	57
Cadmium	5.1	6.7	5.1
Chromium	260	270	260
Copper	390	390	390
Lead	450	530	450
Mercury	0.41	0.59	0.41
Silver	6.1	6.1	6.1
Zinc	410	960	410
Nonionizable Organic Compounds			
Aromatic Hydrocarbons	**mg/kg carbon**	**mg/kg carbon**	**µg/kg dry wt**
Total LPAH	370	780	5,200
Naphthalene	99	170	2,100
Acenaphthylene	66	66	1,300
Acenaphthene	16	57	500
Fluorene	23	79	540
Phenanthrene	100	480	1,500
Anthracene	220	1,200	960
2-Methylnaphthalene	38	780	670
Total HPAH	960	5,300	12,000
Fluoranthene	160	1,200	1,700
Pyrene	1,000	1,400	2,600
Benz[a]anthracene	110	270	1,300
Chrysene	110	460	1,400
Total benzofluoranthenes	230	450	3,200
Benzo[a]pyrene	99	210	1,600
Indeno[1,2,3-c,d]pyrene	34	88	600
Dibenzo[a,h]anthracene	12	33	230
Benzo[g,h,i]perylene	31	78	670
Chlorinated Benzenes			
1,2-Dichlorobenzene	2.3	2.3	35
1,4-Dichlorobenzene	3.1	9	110
1,2,4-Trichlorobenzene	0.81	1.8	31
Hexachlorobenzene	0.38	2.3	22
Phthalate Esters			
Dimethyl phthalate	53	53	71
Diethyl phthalate	61	110	200

Continued

TABLE 3

DATA QUALITY OBJECTIVES FOR THE CONSTITUENTS OF CONCERN
PRACTICAL QUANTITATION REQUIREMENTS
Gateway Pacific Terminal
Whatcom County, Washington

	Sediment Management Standards		
	SQS [1]	**CSL [2]**	**LAET [3]**
Phthalate Esters			
Di-n-butyl phthalate	220	1,700	1,400
Butyl benzyl phthalate	4.9	64	63
Bis[2-ethylhexyl] phthalate	47	78	1,300
Di-n-octyl phthalate	58	4,500	6,200
Miscellaneous			
Dibenzofuran	15	58	540
Hexachlorobutadiene	3.9	6.2	11
N-nitrosodiphenylamine	11	11	28
PCBs			
Total PCBs	12	65	130
Ionizable Organic Compounds	**µg/kg dry wt**	**µg/kg dry wt**	**µg/kg dry wt**
Phenol	420	1,200	420
2-Methylphenol	63	63	63
4-Methylphenol	670	670	670
2,4-Dimethylphenol	29	29	29
Pentachlorophenol	360	690	360
Benzyl alcohol	57	73	57
Benzoic acid	650	650	650

Notes
1 Sediment Management Standards Sediment Quality Standards (WAC 173-204-320)
2 Sediment Management Standards Cleanup Screening Levels (WAC 173-204-520)
3 LAET: Lowest Apparent Effects Threshold

Abbreviations
LPAH: low-molecular-weight polycyclic aromatic hydrocarbons
HPAH: high-molecular-weight polycyclic aromatic hydrocarbons
mg/kg: milligrams per kilogram
PCBs: polychlorinated biphenyls

Continued

TABLE 4

ANALYTICAL METHODOLOGIES AND REPORTING LIMITS

Gateway Pacific Terminal

Whatcom County, Washington

Parameter	Sample Prep/Extraction Method	Analytical Method	Reporting [1] Limit
Conventionals			
Total Organic Carbon		ARI SOP 602S	200 ppm
Total Volatile Solids		ASTM D2974	0.1%
Total Solids		ARI SOP 639S	0.01%
Pore Water Ammonia		EPA 350.1	0.10 mg-N/L
Pore Water Sulfide		SM 4500-S2	0.50 mg/L
Metals			
Arsenic	ARI 515S	EPA 6010	5 ppm dry wt
Cadmium	ARI 515S	EPA 6010	0.2 ppm dry wt
Chromium	ARI 515S	EPA 6010	0.5 ppm dry wt
Copper	ARI 515S	EPA 6010	0.2 ppm dry wt
Lead	ARI 515S	EPA 6010	2 ppm dry wt
Mercury	ARI 515S	EPA 7471A	0.05 ppm dry wt
Silver	ARI 515S	EPA 6010	0.3 ppm dry wt
Zinc	ARI 515S	EPA 6010	0.6 ppm dry wt
Nonionizable Organic Compounds			
Aromatic Hydrocarbons			
Total LPAH			
Naphthalene	Sonication	EPA 8270D	20 ppb dry wt
Acenaphthylene	Sonication	EPA 8270D	20 ppb dry wt
Acenaphthene	Sonication	EPA 8270D	20 ppb dry wt
Fluorene	Sonication	EPA 8270D	20 ppb dry wt
Phenanthrene	Sonication	EPA 8270D	20 ppb dry wt
Anthracene	Sonication	EPA 8270D	20 ppb dry wt
2-Methylnaphthalene	Sonication	EPA 8270D	20 ppb dry wt
Total HPAH			
Fluoranthene	Sonication	EPA 8270D	20 ppb dry wt
Pyrene	Sonication	EPA 8270D	20 ppb dry wt
Benz[a]anthracene	Sonication	EPA 8270D	20 ppb dry wt
Chrysene	Sonication	EPA 8270D	20 ppb dry wt
Total Benzofluoranthenes			
Benzo(b)fluoranthene	Sonication	EPA 8270D	20 ppb dry wt
Benzo(k)fluoranthene	Sonication	EPA 8270D	20 ppb dry wt
Benzo[a]pyrene	Sonication	EPA 8270D	20 ppb dry wt
Indeno[1,2,3-c,d]pyrene	Sonication	EPA 8270D	20 ppb dry wt
Dibenzo[a,h]anthracene	Sonication	EPA 8270D	20 ppb dry wt
Benzo[g,h,i]perylene	Sonication	EPA 8270D	20 ppb dry wt

Continued

TABLE 4

ANALYTICAL METHODOLOGIES AND REPORTING LIMITS

Gateway Pacific Terminal

Whatcom County, Washington

Parameter	Sample Prep/Extraction Method	Analytical Method	Reporting [1] Limit
Chlorinated Benzenes			
1,2-Dichlorobenzene	Sonication	EPA 8270D	20 ppb dry wt
1,4-Dichlorobenzene	Sonication	EPA 8270D	20 ppb dry wt
1,2,4-Trichlorobenzene	Sonication	EPA 8270D	20 ppb dry wt
Hexachlorobenzene	Sonication	EPA 8270D	20 ppb dry wt
Phthalate Esters			
Dimethyl phthalate	Sonication	EPA 8270D	20 ppb dry wt
Diethyl phthalate	Sonication	EPA 8270D	20 ppb dry wt
Di-n-butyl phthalate	Sonication	EPA 8270D	20 ppb dry wt
Butyl benzyl phthalate	Sonication	EPA 8270D	20 ppb dry wt
Bis[2-ethylhexyl] phthalate	Sonication	EPA 8270D	20 ppb dry wt
Di-n-octyl phthalate	Sonication	EPA 8270D	20 ppb dry wt
Miscellaneous			
Dibenzofuran	Sonication	EPA 8270D	20 ppb dry wt
Hexachlorobutadiene	Sonication	EPA 8270D	20 ppb dry wt
N-nitrosodiphenylamine	Sonication	EPA 8270D	20 ppb dry wt
PCBs			
Total PCBs	Sonication	EPA Method 8082	20 ppb dry wt per Aroclor
Ionizable Organic Compounds			
Phenol	Sonication	EPA 8270D	20 ppb dry wt
2-Methylphenol	Sonication	EPA 8270D	20 ppb dry wt
4-Methylphenol	Sonication	EPA 8270D	20 ppb dry wt
2,4-Dimethylphenol	Sonication	EPA 8270D	20 ppb dry wt
Pentachlorophenol	Sonication	EPA 8270D	100 ppb dry wt
Benzyl alcohol	Sonication	EPA 8270D	100 ppb dry wt
Benzoic acid	Sonication	EPA 8270D	200 ppb dry wt

Notes

1 Reporting limits obtained from Analytical Resources, Inc

Abbreviations

ARI: Analytical Resources, Inc.
ASTM: ASTM International
EPA: U.S. Environmental Protection Agency
LPAH: low-molecular-weight polycyclic aromatic hydrocarbons
HPAH: high-molecular-weight polycyclic aromatic hydrocarbons
mg/L: milligrams per liter
PCBs: polychlorinated biphenyls
ppb: parts per billion
ppm: parts per million
PSEP: Puget Sound Estuary Program
SOP: Standard Operating Procedure
SM: Standard Method for the Analysis of Water and Wastewater

TABLE 5

SUMMARY OF METHOD QUALITY OBJECTIVES FOR METHOD 8082—PCBs

Gateway Pacific Terminal
Whatcom County, Washington

Quality Control Element	Frequency of Implementation	Acceptance Criteria
Initial Calibration	After CCVs fail	RSD ≤ 20% or r ≥ 0.995
Continuing Calibration Verification (CCV)	At the beginning and end of analytical sequence, and every 10 samples	% Recovery = 75% to 125%
Method Blank (MB)	1 per extraction batch of <20 samples	Analytes < RL
Laboratory Control Sample (LCS)	1 per extraction batch of <20 samples	Solids: % Recovery = 50% to 130%
Matrix Spike (MS)	1 per 20 samples	% Recovery = 40% to 140%
Matrix Duplicate (MD) or Matrix-Spike Duplicate (MSD)	1 per 20 samples	RPD ≤ 50%
Regional Reference Material (RRM)	1 per 60 samples	Advisory Limits: Average +/- 2 SD % Recovery 19% to 112%
Surrogates	Every sample as specified	% Recovery = 30% to 150%
Target Analyte Confirmation		RPD ≤ 40%

Abbreviations
RL: reporting limit
RPD: relative percent difference
RSD: relative standard deviation
PCBs: polychlorinated biphenyls
SD: standard deviation

TABLE 6

SUMMARY OF METHOD QUALITY OBJECTIVES FOR METHOD 6010—ICP METALS

Gateway Pacific Terminal
Whatcom County, Washington

Quality Control Element	Description of Element	Frequency of Implementation	Acceptance Criteria
Initial Calibration	Option 1: 1 standard and blank, and a low-level-check standard at two times the RL	Daily	Option 1: Low-level-check standard ± 1 RL
	Option 2: 3 standards and blank		Option 2: $r \geq 0.995$
Instrumental Precision	% RSD 3 integrations (exposures)	Each calibration and calibration verification standards (ICV/CCV)	% RSD <5%
Initial Calibration Verification (ICV)	Midlevel (2nd source) verification	After initial calibration	% Recovery 90% to 110%
Initial Calibration Blank (ICB)	Interference-free matrix to assess analysis contamination	After initial calibration	Analytes <RL
Continuing Calibration Verification (CCV)	Midlevel verification	Every 10 samples and at end of analytical sequence	% Recovery 90% to 110%
Continuing Calibration Blank (CCB)	Interference-free matrix to assess analysis contamination	Every 10 samples and at end of analytical sequence	Analytes <RL
Method Blank (MB)	Interference-free matrix to assess overall method contamination	1 per extraction batch of ≤20 samples	Analytes <RL or <1/10th lowest sample instrument concentration.
Laboratory Control Sample (LCS)	Interference-free matrix containing all target analytes	1 per extraction batch of ≤20 samples	% Recovery = 80% to 120% Sporadic Marginal Failures[1]; % Recovery = 80% to 140%
Matrix Spike (MS)	Sample matrix spiked with all or a subset of target analytes prior to digestion	1 per 20 samples	% Recovery = 75% to 125%
Matrix Duplicate (MD) or Matrix-Spike Duplicate (MSD)	Refer to text for MD or MS	1 per 20 samples	RPD ≤ 20%

Notes

1 The number of sporadic marginal failure (SMF) allowances depend on the number of target analytes reported from the analysis. In the instance of only seven metals, one SMF is allowed.

Abbreviations

ICP: inductivity coupled plasma

RL: reporting limit

RPD: relative percent difference

RSD: relative standard deviation

TABLE 7

SUMMARY OF METHOD QUALITY OBJECTIVES FOR METHOD 7000 SERIES—METALS VIA GFAA/CVAA

Gateway Pacific Terminal
Whatcom County, Washington

Quality Control Element	Description of Element	Frequency of Implementation	Acceptance Criteria
Initial Calibration	3 stds and blank	Daily	r > 0.995
Instrumental Precision	RPD of 2 injections	All standards, and ICV/CCV	RPD ≤ 10%
Initial Calibration Verification (ICV)	Midlevel (2nd source) verification	After initial calibration	% Recovery = 90% to 110%
Initial Calibration Blank (ICB)	Interference-free matrix to assess analysis contamination	After initial calibration	Analytes < RL
Continuing Calibration Blank (CCB)	Interference-free matrix to assess analysis contamination	Every 10 samples and at end of analytical sequence	Analytes < RL
Continuing Calibration Verification (CCV)	Midlevel verification	Every 10 samples and at end of analytical sequence	% Recovery = 80% to 120%
Method Blank (MB)	Interference-free matrix to assess overall method contamination	1 per preparation batch of ≤20 samples	Analytes < RL
Laboratory Control Sample (LCS)	Interference-free matrix containing target analytes	1 per preparation batch of ≤20 samples	% Recovery = 80% to 120%
Matrix Spike (MS)	Sample matrix spiked with target analytes prior to digestion	1 per 20 samples	% Recovery = 75% to 125%
Matrix Duplicate (MD) or Matrix-Spike Duplicate (MSD)	Refer to text for MD or MS	1 per 20 samples	RPD <20%
Post-Digestion Spike (PDS)	Sample digestate spiked with target analytes	As needed to confirm matrix effects	% Recovery = 85% to 115%

Abbreviations
GFAA/CVAA: graphite furnace atomic absorption/cold vapor atomic absorption
RL: reporting limit
RPD: relative percent difference

TABLE 8

SUMMARY OF METHOD QUALITY OBJECTIVES FOR METHOD 8270D—SVOCs

Gateway Pacific Terminal
Whatcom County, Washington

Quality Control Element	Frequency of Implementation	Acceptance Criteria
Initial Calibration	After CCV fails	r ≥ 0.995 or RSD ≤ 15%, RRF > 0.050 for SPCC and >0.010 for other compounds
Continuing Calibration Verification (CCV)	At the beginning of each 12 hour shift	%D < 20% for CCC and < 40% for other compounds, RRF > 0.050 for SPCC and > 0.010 for other compounds
Method Blank (MB)	1 per extraction batch of ≤ 20 samples	Analytes < RL
Laboratory Control Sample (LCS)	1 per extraction batch of ≤ 20 samples	Solids: % Recovery = 50% to 130% B/N compounds % Recovery = 40% to 140% A compounds
Matrix Spike (MS)	1 per 20 samples	Solids: % Recovery = 40% to 140% B/N compounds % Recovery = 30% to 150% A compounds
Matrix Duplicate (MD) or Matrix-Spike Duplicate (MSD)	1 per 20 samples	RPD ≤ 60%
Surrogates: Interference-Free Matrix Project Sample Matrix	Every sample as specified	Interference-Free Matrix Solids: % Recovery = 50% to 130% B/N compounds % Recovery = 40% to 140% A compounds Project Sample Matrix Solids: % Recovery = 40% to 140% B/N compounds % Recovery = 30% to 150% A compounds

Abbreviations

A: acid
B/N: base/neutral
CCC: calibration check compounds
CCV: continuing calibration verification
MDL: method detection limit
%D: percent difference
RL: reporting limit
RPD: relative percent difference
RRF: relative response factor
RSD: relative standard deviation
SPCC: system performance check compounds

TABLE 9

SUMMARY OF METHOD QUALITY OBJECTIVES FOR SEDIMENT CONVENTIONALS

Gateway Pacific Terminal
Whatcom County, Washington

Quality Control Element	Suggested Control Limit					
	Total Organic Carbon	**Ammonia**	**Sulfide**	**Total Volatile Solids**	**Grain Size**	**Total Solids**
Initial Calibration	r > 0.995	r > 0.995	r > 0.990	NA	NA	NA
Continuing Calibrations	% recovery + 10%	% recovery + 10%	% recovery + 15%	NA	NA	NA
Calibration Blank	Analytes <RL	Analytes <RL	Analytes <RL	NA	NA	NA
Laboratory Control Sample (LCS)	% recovery + 20%	% recovery + 20%	% recovery + 35%	NA	NA	NA
Matrix Spike (MS)	% recovery + 25%	% recovery + 25%	% recovery + 35%	NA	NA	NA
Laboratory Triplicates	RSD <20%	RSD <20%	RSD <20%	RSD <20%	RSD <20%	RSD <20%
Method Blank	Analytes <RL	Analytes <RL	Analytes <RL	Analytes <RL	NA	Analytes <RL

Abbreviations

NA:	not applicable
RL:	reporting limit
RSD:	relative standard deviation
r:	correlation coefficient

TABLE 10

SEDIMENT MANAGEMENT STANDARDS BIOLOGICAL TESTING CONTROL LIMITS, PERFORMANCE STANDARDS, AND EFFECTS CRITERIA

GATEWAY PACIFIC TERMINAL
WHATCOM COUNTY, WASHINGTON

BIOASSAY	CONTROL LIMITS	PERFORMANCE STANDARDS		SEDIMENT QUALITY STANDARDS INTERPRETATION ENDPOINTS	MINIMUM CLEANUP LEVEL ENDPOINTS
		NEGATIVE CONTROL	REFERENCE SEDIMENT		
AMPHIPOD (M EXPRESSED AS %)	TEMP 15±1°C (*AMPELISCA* 20±1°C) SAL 28±1PPT AERATED	M_C <10%	M_R <25%	THE TEST SEDIMENT HAS A SIGNIFICANTLY HIGHER (T-TEST, P≤0.05) MEAN MORTALITY THAN THE REFERENCE SEDIMENT, AND THE TEST SEDIMENT MEAN MORTALITY IS MORE THAN 25 PERCENT GREATER, ON AN ABSOLUTE BASIS, THAN THE REFERENCE SEDIMENT MEAN MORTALITY.	THE TEST SEDIMENT HAS A SIGNIFICANTLY HIGHER (T-TEST, P≤0.05) MEAN MORTALITY THAN THE REFERENCE SEDIMENT, AND THE TEST SEDIMENT MEAN MORTALITY IS MORE THAN 30 PERCENT GREATER, ON AN ABSOLUTE BASIS, THAN THE REFERENCE SEDIMENT MEAN MORTALITY.
SEDIMENT LARVAL (N EXPRESSED AS ACTUAL COUNTS)	TEMP 20±1°C (*CRASSOSTREA*) 15±1°C (ECHINODERM) SAL 28±1 PPT DO>60% SATURATION	$N_C \div I \geq 0.70$	$N_R \div N_C \geq 0.65$ (PER QA/QC GUIDANCE)	THE TEST SEDIMENT HAS A MEAN SURVIVORSHIP OF NORMAL LARVAE THAT IS SIGNIFICANTLY LESS (T-TEST, P≤0.1) THAN THE MEAN NORMAL SURVIVORSHIP IN THE REFERENCE SEDIMENT, AND THE MEAN NORMAL SURVIVORSHIP IN THE TEST SEDIMENT IS LESS THAN 85 PERCENT OF THE MEAN NORMAL SURVIVORSHIP IN THE REFERENCE SEDIMENT.	THE TEST SEDIMENT HAS A MEAN SURVIVORSHIP OF NORMAL LARVAE THAT IS SIGNIFICANTLY LESS (T-TEST, P≤0.1) THAN THE MEAN NORMAL SURVIVORSHIP IN THE REFERENCE SEDIMENT, AND THE MEAN NORMAL SURVIVORSHIP IN THE TEST SEDIMENT IS LESS THAN 70 PERCENT OF THE MEAN NORMAL SURVIVORSHIP IN THE REFERENCE SEDIMENT.

-Continued-

TABLE 10

SEDIMENT MANAGEMENT STANDARDS BIOLOGICAL TESTING CONTROL LIMITS, PERFORMANCE STANDARDS, AND EFFECTS CRITERIA

GATEWAY PACIFIC TERMINAL
WHATCOM COUNTY, WASHINGTON

BIOASSAY	CONTROL LIMITS	PERFORMANCE STANDARDS		SEDIMENT QUALITY STANDARDS INTERPRETATION ENDPOINTS	MINIMUM CLEANUP LEVEL ENDPOINTS
		NEGATIVE CONTROL	REFERENCE SEDIMENT		
MICROTOX®	TEMP 15°C 7.9 ≤ PH ≤ 8.2 SAL 20±2 PPT DO 50-100% SATURATION	$F_{C(MEAN)} \div I_{C(MEAN)} \geq 0.$	$F_{R(MEAN)} \div F_{C(MEAN)} \geq 0.80$ AND $I_{R(MEAN)} \div I_{C(MEAN)} \geq 0.80$	THE MEAN LIGHT OUTPUT OF THE HIGHEST CONCENTRATION OF THE TEST SEDIMENT IS LESS THAN 80% OF THE REFERENCE SEDIMENT, AND THE TWO MEANS ARE STATISTICALLY DIFFERENT (T-TEST, P≤0.05).	

Abbreviations
DO: dissolved oxygen
F: final
I: initial
M: mortality
N: normals
ppt: parts per thousand
Sal: salinity

Subscripts
C: negative control
R: reference sediment

TABLE 11

DATA QUALIFIERS

Gateway Pacific Terminal
Whatcom County, Washington

Qualifier	Description
J	The analyte was positively identified; the quantitation is an estimation.
U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the reporting limit.
R	The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

FIGURES

		CLIENT: PACIFIC INTERNATIONAL TERMINALS	DWN BY: CF	PROJECT: Gateway Pacific Terminal	DATE: November 11, 2008	
			CHK'D BY: MG		PROJECT NO.: 891515338B	
			DATUM:	TITLE: PROJECT VICINITY MAP	REV. NO.:	
		AMEC Earth & Environmental 11810 North Creek Parkway North Bothell, Washington 98011	PROJECTION:		FIGURE NO.: FIGURE 1	
			SCALE: 1 inch equals 2,640 feet			

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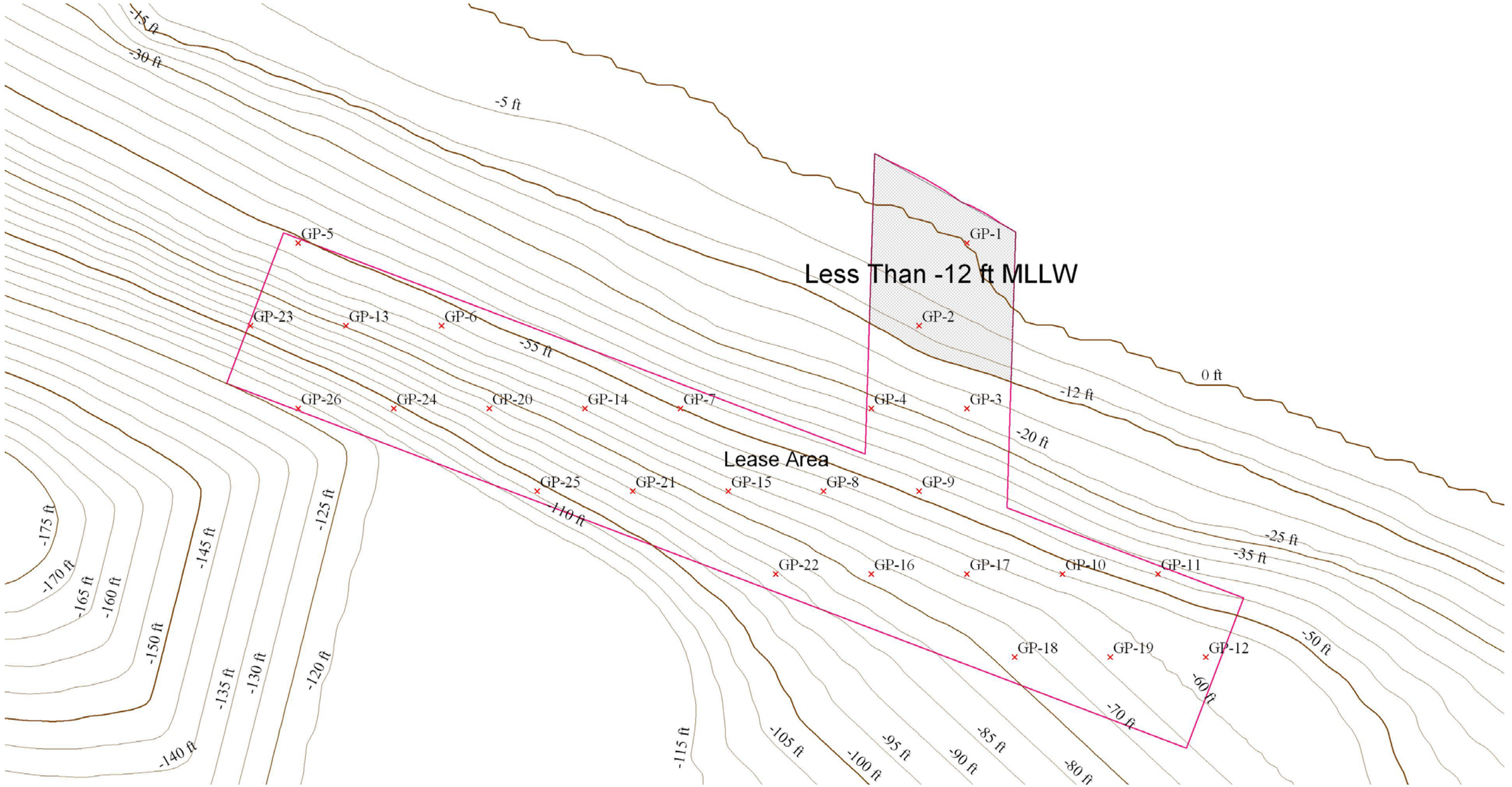
i:\project\pacific international terminals\a00014-00 gpt\3000 reports\figure 2.doc



SEDIMENT SAMPLING DESIGN
Gateway Pacific Terminal
Whatcom County, Washington

By: sge	Date: 11/11/08	Project No. 891515338B
AMEC Geomatrix	Figure	2