QUALITY ASSURANCE PROJECT PLAN

Port of Seattle

BNSF ROW at Quendall Terminals

Renton, Washington

October 7, 2008

Prepared For

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1.0 TITLE AND APPROVAL PAGE

Quality Assurance Project Plan
Port of Seattle Rail Acquisition Study
BNSF ROW at Quendall Terminals

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Date

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Date

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Date

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Distribution List

This list identifies all individuals to receive a copy of the approved QA Project Plan either in hard copy or electronic format, as well as any subsequent revisions.

Project Manager: Roy Kuroiwa, Port of Seattle

Project Manager (Contractor): Steve Perrigo, Pinnacle GeoSciences

Laboratory Project Manager: Hillary Rittenberg, Port of Seattle

Field Coordinator: Norm Puri, Pinnacle GeoSciences

Data Quality Management: Linda Bohannon, EcoChem, Inc.

3.0 PROJECT DESCRIPTION

Port of Seattle (POS) is in the process of acquiring 39 miles of rail right of way (ROW) from BNSF. The intent of the overall Rail Acquisition Study is to define the nature and extent of contamination in soil, ground water and sediment within the ROW. A segment of the ROW is on the eastern edge of the former Quendall Terminals Site (Quendall) in Renton, Washington

The Quendall Terminals site is designated as a Federal Superfund site. It is presently under study with the oversight of the USEPA. Technical studies are being conducted at the former Quendall Terminals site by Anchor Engineering and Aspect Consulting. A RI/FS report prepared for the USEPA Region 10 by these consultants summarize remediation goals for the site. A copy of these Remediation Goals is provided in **Attachment 1.**

This Quality Assurance Project Plan (QAPP) addresses only the Quendall segment of the ROW. Exploration of the Quendall segment will be performed in two phases. Phase 1 will provide an initial survey of conditions on the Quendall segment as part of a broader survey of the entire ROW. The Phase 1 sampling has been completed. Phase 2 will provide a more detailed evaluation of the Quendall segment of the ROW.

The QAPP serves as the primary guide for the integration of quality assurance (QA) and quality control (QC) functions into project activities. The QAPP compiles the organization, objectives, and specific quality assurance and quality control activities required for project implementation and assessment This QAPP is based on guidance specified in Washington Administrative Code (WAC) 173, Chapter 173-340 and Washington Department of Ecology Guidance (February 2001) and EPA Guidance for Quality Assurance Project Plans (EPA-G5, December 2002).

The Port of Seattle's planned Phase 2 study of this part of the BNSF ROW will include up to 20 soil explorations with depths of up to 25 feet. A maximum of five of the soil explorations will be converted to ground water monitoring wells. Soil samples will be obtained from the upper five feet and the base of each exploration. Additional samples will be obtained for analysis based on field observations and screening results.

Exploration methods will include direct push soil sampling methodology using a truck-mounted rig such as a GeoProbe, and shallow soil sampling by hand auger or post-hole excavation. Details of sampling locations and likely well locations are shown in the *Work Plan, BNSF ROW at Quendall Terminals* (Pinnacle GeoSciences, October 7, 2008).

Throughout the project, environmental measurements will be conducted to produce data that are scientifically valid, of known and acceptable quality, and meet established objectives. QA/QC procedures will be implemented so that precision, accuracy, representativeness, completeness, and comparability (PARCC) of data generated meet the specified data quality objectives.

4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Descriptions of the lines of authority and communication for the key positions with responsibility for quality assurance and quality control are provided below. This organization facilitates the efficient production of project work, allows for an independent quality review, and permits resolution of any QA issues prior to final data submittal.

4.1 PROJECT LEADERSHIP AND MANAGEMENT

Within Pinnacle Geosciences there are two individuals with primary responsibility for technical quality, schedule, budget and staff resources, the Project Manager and the Field Manager. In addition, EcoChem, Inc. (Subcontractor) is responsible for quality assurance oversight for the data collection and analytical data quality evaluation and validation.

The Project Manager's duties consist of providing concise technical work statements for project tasks, selecting project team members, determining subcontractor participation, establishing budgets and schedules, adhering to budgets and schedules, providing technical oversight, and providing overall production and review of project deliverables. Stephen Perrigo is the Project Manager for this study.

4.1.1 Field Manager

The Field Manager is responsible for the daily management of activities in the field. Specific responsibilities include the following:

- Provides technical direction to the field staff.
- Develops schedules and allocates resources for field tasks.
- Coordinates data collection activities to be consistent with information requirements.
- Supervises the compilation of field data and laboratory analytical results.
- Assures that data are correctly and completely reported.
- Implements and oversees field sampling in accordance with project plans.
- Supervises field personnel.
- Coordinates work with on-site subcontractors.

- Schedules sample shipment with the analytical laboratory.
- Monitors that appropriate sampling, testing, and measurement procedures are followed.
- Coordinates the transfer of field data, sample tracking forms, and log books to the Project Manager for data reduction and validation.
- Participates in QA corrective actions as required.

The Field Manager for exploration activities at the Site is Norm Puri.

4.1.2 Data Quality Management

Project data quality management provides coordination of the QA/QC activities as they relate to the acquisition of field and analytical data. Specific responsibilities include the following:

- Serves as the official contact for laboratory data quality control (QC) concerns.
- Responds to laboratory data QC issues, resolves chemistry data quality issues, and answers requests for guidance and assistance.
- Prepares the QAPP and evaluates the adequacy of the data generated from a quality perspective.
- Implements corrective actions as necessary.
- Evaluates and validates the laboratory analytical data and applies qualifiers as necessary.
- Ensures that correct quality control checks for sampling, testing, and analysis procedures are implemented and documented.

The Project QA Oversight will be provided by EcoChem, Inc., under the direction of Linda Bohannon.

4.1.3 Laboratory Management

The subcontracted laboratory conducting sample analyses for this project is required to consult with the Data Quality Contractor, EcoChem, Inc., before the initiation of sample analysis to assure that the laboratory QA plan complies with the project QA objectives. The Laboratory Project Manager ensures that the Laboratory QA Plan is followed and is responsible for project quality control (QC). Specific responsibilities of this position include:

- Ensure implementation of the Laboratory QA Plan.
- Serve as the laboratory point of contact.
- Activate corrective action for out-of-control events.
- Issue the final laboratory data reports.

- Comply with the specifications established in the project plans as related to laboratory services.
- Participate in QA audits and compliance inspections (as applicable).

The analytical laboratory Project Manager is Hillary Rittenberg, Port of Seattle, at 206-728-3161.

5.0 DATA QUALITY OBJECTIVES

The quality assurance objective for technical data is to collect environmental monitoring data of known, acceptable, and documented quality. The QA goals established for the project are:

- Implement the procedures outlined in this QAPP for field sampling, sample custody, equipment operation and calibration, laboratory analysis, and data reporting so that consistency and thoroughness of data generation are facilitated.
- Achieve the acceptable level of quality required so that data generated are scientifically valid and of known and documented quality. This will be accomplished by establishing criteria for precision, accuracy, representativeness, completeness, and comparability, and by testing data against these criteria.

Specific data quality objectives (DQO) to evaluate data quality and usability are provided in the sections below.

5.1 ANALYTES AND MATRICES OF CONCERN

Soil, ground water and sediment samples were collected during the initial Phase 1 study. Soil and ground water samples will be collected during the Phase 2 study. **Table 1** summarizes the sample matrices and analyses to be performed during the Phase 1 and or Phase 2 parts of the study.

5.2 DETECTION LIMITS

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Although results reported near the MDL provide insight to site conditions, quality assurance requires that analytical methods achieve a consistently reliable level of quantitation known as the practical quantitation limit (MRL). The laboratory will provide numerical results for all analytes and report them as detected above the MRL or undetected at the MRL.

Analytical detection limits for the target analytes are helpful in providing statistically useful data. Intended data uses, such as comparison to regulatory criteria or risk assessment, usually dictate specific project detection levels necessary to fulfill stated objectives. **Table 2** provides a list of the Port of Seattle contract laboratory (ARI)

method detection limits (MDL) and method reporting limits (MRL) for each analyte. The analytical methods and processes selected should provide a MRL lower than the regulatory cleanup level under ideal conditions. The MDL and MRL presented in **Table 2** are considered targets because several factors may influence individual sample quantitation limits. First, physical conditions of soil (e.g., moisture, compaction, composition) affect detection limits. Second, analytical procedures may require sample dilutions and/or clean up and reanalysis to accurately quantify a particular analyte at concentrations above the range of the instrument. The effect is that other analytes may be reported as undetected at a MRL higher than a specified regulatory cleanup level. Data users must be aware that high non-detect values, although correctly reported, can bias statistical summaries and careful interpretation is required to correctly characterize site conditions. During data validation, evaluation will be made and the most appropriate result for each analyte will be reported.

5.3 PRECISION

Precision is the measure of mutual agreement among replicate or duplicate measurements of an analyte from the same sample and applies to field duplicate or split samples, replicate analyses, and duplicate spiked environmental samples (matrix spike duplicates). The closer the measured values are to each other, the more precise the measurement process. Precision error may affect data usefulness. Good precision is indicative of relative consistency and comparability between different samples. Precision will be expressed as the relative percent difference (RPD) for spike sample comparisons of various matrices and field duplicate comparisons for water samples. This value is calculated by:

$$RPD\,(\%) = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \; X\ 100,$$

Where

D_1 = Concentration of analyte in sample.
D_2 = Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked environmental samples (matrix spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Precision can also be expressed as the percent difference (%D) between replicate analyses. During data validation, EcoChem will evaluate all RPD values and take action as described in *National Functional Guidelines for Organic Data Review* (USEPA 1999) and *National Functional Guidelines Inorganic Data Review* (USEPA 2002). The project goal for the RPD value (in all types of sample replicates except field duplicates) is 20 percent in water and 35 percent in soil for all analyses.

5.4 ACCURACY

Accuracy is a measure of bias in the analytic process. The closer the measurement value is to the true value, the greater the accuracy. This measure is defined as the difference between the reported values versus the actual values, and is often measured with the addition of a known compound to a sample. The amount of known compound reported in the sample, or percent recovery, assists in determining the performance of the analytical system in correctly quantifying the compounds of interest. Since most environmental data collected represent one point spatially and temporally rather than an average of values, accuracy plays a greater role than precision in assessing the results. In general, if the percent recovery is low, non-detect results may indicate that compounds of interest are not present when in fact these compounds are present. Detected compounds may be biased low or reported at a value less than actual environmental conditions. The reverse is true when recoveries are high. Non-detect values are considered accurate while detected results may be higher than the true value.

Accuracy will be expressed as the percent recovery of a surrogate compound (also know as "system monitoring compound"), a matrix spike result, or from a standard reference material where:

$$Recovery\,(\%) = \frac{Sample\ Result}{Spike\ Amount}\ X\ 100$$

EcoChem will evaluate all %R values and take action as described in *National Functional Guidelines for Organic Data Review* (USEPA 1999) and *National Functional Guidelines Inorganic Data Review* (USEPA 2002). Current ARI control limits for surrogate spikes, matrix spikes, and laboratory control spikes are provided in **Attachment 2.**

5.5 REPRESENTATIVENESS, COMPLETENESS AND COMPARABILITY

To be considered representative, a data set should accurately and precisely represent the actual site conditions. The determination of the representativeness of the data will be performed by completing the following:

- Comparing actual sampling procedures to those prescribed within the Sampling and Analysis Plan and this QAPP.
- Comparing analytical results from field duplicates to determine variation in the analytical results.
- Invalidating non-representative data or identifying data that is questionable or qualitative. Only representative data will be used in subsequent data reduction, validation, and reporting activities.

Completeness establishes whether a sufficient amount of valid measurements were obtained to meet project goals. The number of samples and results expected establishes

the comparative basis for completeness. Completeness goals are 95 percent useable data for samples/analyses planned. If the completeness goal is not achieved an evaluation will be made to determine if the data are adequate to meet study objectives.

Comparability expresses the confidence with which one set of data can be compared to another. Since numeric goals do not exist for comparability, a statement of comparability will be prepared to determine overall usefulness of data sets, following the determination of both precision and accuracy. This statement will be included in Site final reports.

5.6 HOLDING TIMES

Holding times are defined as the time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. Some analytical methods specify a holding time for analysis only. If a sample exceeds a holding time, then the results may be biased low. During data validation, EcoChem will evaluate all holding time values and take action as described in *National Functional Guidelines for Organic Data Review* (USEPA 1999) and *National Functional Guidelines Inorganic Data Review* (USEPA 2002). Holding times are presented in **Table 3**.

5.7 BLANKS

According to the *National Functional Guidelines for Organic Data Review* (USEPA 1999) and *National Functional Guidelines Inorganic Data Review* (USEPA 2002):

> "The purpose of laboratory (or field) blank analyses is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks)".

Method blanks are created in the laboratory during sample preparation and follow samples throughout the analysis process. Frequency of method blanks will be one per 20 or fewer field samples per matrix.

Equipment blank samples will be collected at a frequency of one per 20 or fewer sampling equipment decontamination procedures. Equipment blank samples, collected by routing laboratory-provided de-ionized water (for inorganic analyses), or organic-free water (for organic analyses) through decontaminated sampling equipment, will be analyzed to check procedural contamination and/or ambient conditions and/or sample container contamination at Quendall Terminals site that may cause sample contamination. If sampling equipment is being decontaminated based on organic contamination, then organic free water will be used as the final rinse for purposes of collecting the blank sample. De-ionized water will be used if metals contamination is suspected.

During data validation, EcoChem will evaluate all blank sample results and take action as described in *National Functional Guidelines for Organic Data Review* (USEPA 1999)

and *National Functional Guidelines Inorganic Data Review* (USEPA 2002); professional judgment will be applied as necessary.

6.0 SAMPLE COLLECTION, HANDLING AND CUSTODY

6.1 SAMPLING EQUIPMENT AND DECONTAMINATION

The drilling equipment will be decontaminated before beginning each exploration using a hot-water pressure washer. Reusable sampling/monitoring equipment (trowels, split-spoons, hand augers, etc.) that comes in contact with soil or groundwater will be decontaminated before each use. Decontamination procedures for this equipment will consist of the following: (1) wash with non-phosphate detergent solution (Liqui-Nox and distilled water), (2) rinse with distilled water, and (3) place the decontaminated equipment on clean plastic sheeting or in a plastic bag. A sample of the final rinse water will be collected in sampling containers and submitted with the field samples collected with the decontaminated sampling equipment. Field personnel will limit cross-contamination by changing gloves between sampling locations. Wash water used to decontaminate the sampling equipment will be stored on-site in labeled 55-gallon drums for subsequent characterization and disposal.

In addition to the decontamination procedures described above, sampling equipment that has visible petroleum product staining will be decontaminated by steam cleaning and/or as follows:

- Wash with brush and Liqui-Nox soap.
- Rinse with potable water.
- Wash with ethyl-alcohol.
- Rinse with distilled water.

6.2 SAMPLE CONTAINERS AND LABELING

The Field Manager will establish field protocols to manage field sample collection, handling, and documentation. Soil samples obtained during this study will be placed in appropriate laboratory-prepared containers. Sample containers and preservatives are listed in **Table 3**.

Sample containers will be labeled with the following information at the time of collection: (1) project name and number, (2) sample name, which will include a reference to depth if appropriate, and (3) date and time of collection.

The sample collection activities will be noted in the field log books. The Field Manager will monitor consistency between the SAP, sample containers/labels, field logbooks, and the chain-of-custody.

6.3 SAMPLE STORAGE

Samples will be placed in a cooler with "blue ice" immediately after they are collected. The objective of the cold storage will be to attain a sample temperature of 0° - 6° Celsius. Holding times will be observed during sample storage. Holding times for the project analyses are summarized in **Table 3**.

6.4 SAMPLE SHIPMENT

Field personnel are responsible for the transportation and handling of the samples until received by the Port of Seattle contracted laboratory for analysis. If samples are submitted to a "local" laboratory for analysis, the field personnel will transport and hand-deliver samples to the laboratory. If samples are submitted to an out-of-town laboratory for analysis, they will be transported by a commercial express mailing service on an overnight basis. The Field Manager will ensure that all shipping containers (coolers) have been properly packed with cushioning materials and secured using clear plastic tape.

6.5 CHAIN OF CUSTODY RECORDS

Sampling personnel are responsible for the security of samples from the time the samples are taken until the samples have been received by the shipper or laboratory. A chain-of-custody (COC) form will be completed at the end of each field day for samples being shipped to the laboratory. Information to be included on the COC form includes:

- Project name and number.
- Sample identification number.
- Date and time of sampling.
- Sample matrix (soil, water, etc.) and number of containers from each sampling point, including preservatives used.
- Depth of subsurface soil sample.
- Analyses to be performed.
- Names of sampling personnel and transfer of custody acknowledgment spaces.
- Shipping information including shipping container number.

A member of the field team will sign the original COC record and retain one copy for field records. The original and remaining copies should be placed in a plastic bag, taped to the inside lid of the cooler before sealing the container for shipment. This record will accompany the samples during transit to the laboratory.

6.6 LABORATORY CUSTODY PROCEDURES

A designated sample custodian shall accept custody of the samples, record cooler temperature and verify all information on the COC prior to signing the COC. The samples will then be placed in appropriate storage refrigerators.

The laboratory will follow their standard operating procedures (SOPs) to document sample handling from time of receipt (sample log-in) to reporting. Documentation will include at a minimum, the analysts name or initial, time, and date.

6.7 FIELD DOCUMENTATION

Field documentation provides important information about potential problems or special circumstances surrounding sample collection. Field personnel will maintain daily field logs while on-site. The field logs will be prepared on field report forms or in a bound logbook. Entries in the field logs and associated sample documentation forms will be made in waterproof ink, and corrections will consist of line-out deletions that are initialed and dated. Individual logbooks will become part of the project files at the conclusion of this field exploration.

At a minimum, the following information will be recorded during the collection of each sample:

- Sample location and description
- Site or sampling area sketch showing sample location and measured distances
- Sampler's name(s)
- Date and time of sample collection
- Designation of sample as composite or discrete
- Type of sample (soil or water)
- Type of sampling equipment used
- Field instrument readings
- Field observations and details that are pertinent to the integrity/condition of the samples (e.g., weather conditions, performance of the sampling equipment, sample depth control, sample disturbance, etc.)
- Preliminary sample descriptions (e.g., lithologies, noticeable odors, colors, field screening results)
- Sample preservation
- Shipping arrangements (overnight air bill number)
- Name of recipient laboratory

In addition to the sampling information, the following specific information also will be recorded in the field log for each day of sampling:

- Team members and their responsibilities
- Time of arrival/entry on Site and time of Site departure
- Other personnel present at the Site
- Summary of pertinent meetings or discussions with regulatory agency or contractor personnel
- Deviations from sampling plans, Site safety plans, and QAPP procedures
- Changes in personnel and responsibilities with reasons for the changes
- Levels of safety protection
- Calibration readings for any equipment used and equipment model and serial number

The handling, use, and maintenance of field log books are the Field Manager's responsibilities.

7.0 ANALYTICAL PROCEDURES

The Port of Seattle contract laboratory will use the following analytical methods for all matrices. The laboratory shall document all modifications in approved standard operating procedures.

- Diesel-range organics by Washington State Department of Ecology Method NWTPH-Dx
- Gasoline-range organics by Washington State Department of Ecology Method NWTPH-G/BTEX
- Semivolatile organic compounds by EPA Method 8270C
- Polychlorinated biphenyls by EPA Method 8082
- Chlorinated herbicides by EPA Method 8151A
- Total metals silver, arsenic, cadmium, chromium, copper, lead, and zinc by EPA 6010B (ICP) or 6020 (ICPMS) and total mercury by EPA 7470A/7471A
- Turbidity in ground water by EPA Method 180.1

8.0 LABORATORY QUALITY CONTROL PROCEDURES

8.1 LABORATORY INSTRUMENT CALIBRATION

Several types of calibrations are used, depending on the method, to determine whether the linearity of the instrument is in control and to assure that the sample results reflect accurate and precise measurements.

The laboratory calibration procedures will be performed in accordance with the analytical methods cited and laboratory standard operating procedures. Calibration documentation will be retained at the laboratory and readily available for review. Preparing and analyzing calibration standards at appropriate levels for the analytes of interest monitor instrument calibration.

Calibration check standards are analyzed before and after each batch of samples. If recovery is not within acceptable method criteria, the standards and all samples will be reanalyzed.

8.2 LABORATORY METHOD BLANKS

Method blanks are laboratory quality control (QC) samples that consist of either a soil like material having undergone a contaminant destruction process or DI water. Method blanks will be extracted and analyzed at a minimum of 5% or with each batch of 20 samples or fewer for each matrix. If a substance is found in the method blank then one (or more) of the following occurred:

- Measurement apparatus or containers were not properly cleaned and contained contaminants.
- Reagents used in the process were contaminated with a substance(s) of interest.
- Contaminated analytical equipment was not properly cleaned.
- Volatile substances in the air contaminated the samples during preparation or analysis.

Given method blank results, validation guidelines aid in determining which substances in samples are considered “real,” and which ones are attributable to the analytical process.

8.3 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD)

Matrix spike/matrix spike duplicate sample analyses are used to determine accuracy and precision and to assess interferences caused by the physical or chemical properties of the sample itself. Matrix spike samples are prepared by spiking a known amount of one or more of the target analytes at a concentration of 5 to 10 times higher than the expected

sample result. Matrix spikes will be prepared and analyzed at a minimum of 5% or with each batch of 20 samples or fewer for each matrix.

MS/MSD data are reviewed in combination with other data quality indicators (e.g., LCS/LCSD) to determine matrix effects. In some cases, matrix affects cannot be determined due to dilution and/or high levels of related substances in the sample.

8.4 LABORATORY CONTROL SPIKS (LCS)

The purpose of the laboratory control spike samples (also known as blank spikes) is to aid in assessment of overall accuracy and precision of the entire analytical process e.g., sample preparation, instrument performance, and analyst performance. LCS will be prepared and analyzed at a minimum of 5% or with each batch of 20 samples or fewer for each matrix. LCS are similar to matrix spikes however, the LCS spike media is “clean” or contaminant free.

8.5 LABORATORY REPLICATES/DUPLICATES

Precision for inorganic analytes is monitored by analysis of sample replicates/duplicates. Laboratory duplicate sample analysis, for inorganic analytes, will be prepared and analyzed at a minimum of 5% or with each batch of 20 samples or fewer for each matrix.

8.6 SURROGATE SPIKE SAMPLES

Surrogate spike compounds are used during analysis for organic analytes in order to verify the accuracy of the instrument being used and assess extraction efficiency. Surrogates are substances similar to, but not one of, the target analytes. A known concentration of surrogate is added to the sample and passed through the instrument, recording the surrogate recovery. Each surrogate used has an acceptable range of percent recovery. If a surrogate recovery is low, sample results may be biased low and depending on the recovery value, a possibility of false negatives may exist. Conversely, when recoveries are above the specified range of acceptance a possibility of false positives exist, although non-detected results are considered accurate.

9.0 DATA REDUCTION, ASSESSMENT AND REPORTING

9.1 DATA REDUCTION

Data reduction involves the conversion or transcription of field and analytical data to a useable format. The laboratory personnel will reduce the analytical data for review by the laboratory Project Manager.

9.2 FIELD MEASUREMENT EVALUATION

Field data will be reviewed at the end of each day by following the quality control checks outlined below and procedures in the SAP. Field data documentation will be checked against the applicable criteria as follows:

- Sample collection information.
- Field instrumentation and calibration.
- Sample collection protocol.
- Sample containers, preservation and volume.
- Field QC samples collected at the frequency specified.
- Sample documentation and chain-of-custody (COC) protocols.
- Sample shipment.

Cooler receipt forms and sample condition forms provided by the laboratory will be reviewed for out-of-control incidents. The final report will contain what effects, if any, an incident has on data quality. Sample collection information will be reviewed for correctness before inclusion in a final report.

9.3 LABORATORY DATA QUALITY CONTROL EVALUATION

Data reduction and review at the laboratory will be carried out as described in the analytical methods and the laboratory Quality Assurance Plan. The laboratory will flag analytical results to identify quality concerns, and all flags will be defined and discussed the report narrative.

9.4 DATA VALIDATION

EcoChem, Inc. will conduct Full Data Validation (equivalent to EPA Level IV QA) on all analytical data packages. Data validation will be documented on worksheets and summarized in reports submitted to Pinnacle GeoSciences. The validation will include a formal review of the following data quality indicators, utilizing criteria identified in this QAPP:

- Holding times
- Instrument calibration
- Instrument performance
- Laboratory blanks (method and instrument)
- Detection limits (MRL)
- Matrix spike/spike duplicates
- Laboratory control spikes/spike duplicates

- Surrogate spikes
- Replicates (laboratory and field)

In addition to these data quality indicators, other documentation such as chain-of-custody forms and case narratives will be reviewed to verify sample numbers and analyses requested on the chain-of-custody and sample preservation.

Data validation qualifiers, validated concentrations and validation reason codes will be added to the verified laboratory EDD for direct upload to the Pinnacle database/spreadsheet.

9.5 DATA REPORTING

9.5.1 Laboratory Deliverables

The laboratory will report data in formatted hardcopy and digital form. In order to facilitate full data validation (equivalent to EPA Level IV), the final data package will include summarized results for all field samples and quality control samples, and all supporting raw data. Data packages will include the following (at a minimum):

- Project narrative, which includes analytical batch number(s), matrix, number of samples, analytical methods, and description of quality control issues and corrective actions taken.
- Copy of all chain-of-custody forms and laboratory sample receipt documentation.
- Tabulated sample results for all field and QC samples including: units, detection limits (PQL), laboratory flags, percent solids (if applicable), sample weight/volume, dilution factor (if applicable), laboratory batch number, laboratory sample ID, field/client sample ID, and dates sampled, received, extracted/prepared, and analyzed.
- Blank summary results indicating all samples associated with each blank.
- Matrix spike result summaries with calculated percent recovery (%R) and relative percent difference (RPD) values.
- Laboratory duplicate/replicate summaries with calculated RPD values.
- Laboratory control sample summaries (if applicable) with calculated %R and RPD values (as appropriate).
- Surrogate spike results with calculated %R values.
- Instrument performance summaries (tuning, initial calibration, continuing calibration & instrument blanks)
- Chromatograms for every sample analyzed for fuels (Ecology methods, NWTPH-Dx). The full height of all peaks should appear on the chromatograms and all chromatograms should use the same horizontal time scale for comparison to other chromatograms.

- All supporting raw data for all sample analyses and quality control results.

The laboratory will provide an electronic data deliverables (EDD) using the required Port of Seattle EDD format. During data validation, all hardcopy analytical summaries will be verified against the EDD summary tables.

Hardcopy data reports and EDD should be submitted to Pinnacle GeoSciences, with a copy to EcoChem for validation and verification.

10.0 CORRECTIVE ACTION

EcoChem will notify Pinnacle GeoSciences and Port of Seattle project managers immediately if the compliance screening identifies QA/QC parameters which are outside of control limits. The Pinnacle GeoSciences project manager shall communicate with the lab and instruct them to reanalyze the affected samples, within the unavoidable constraints of holding times. In the case where samples cannot be reanalyzed before the holding times have been exceeded, a qualitative decision will be made as to whether to reanalyze the samples.

Table 1
BNSF ROW at Quendall Terminals
Matrices and Analyses

Media / Analysis	Method(s)
Soil	
SVOCs	EPA 8270D
Diesel-range Organics	NWTPX-Dx
Gasoline-Range Organics	NWTPH-G/BTEX
Chlorinated Pesticides	EPA 8081
PCBs	EPA 8082
Metals Suite 1 - Pb & As	various
Metals Suite 2 - Pb, As, Cr, Cu, Ni & Zn	various

Sediment	
SVOCs	EPA 8270D
Diesel-range Organics	NWTPX-Dx
Chlorinated Herbicides	EPA 8151A
Metals Suite 3 - Ag,As,Cd,Cr,Cu,Hg,Pb & Zn	various

Ground Water	
SVOCs	EPA 8270D
Diesel-range Organics	NWTPX-Dx
Gasoline-Range Organics	NWTPH-G/BTEX
Metals Suite 1 - Pb & As	various
Turbidity	EPA 180.1

Table 2-a

BNSF ROW at Quendall Terminals
Method Detection Limits and Method Reporting Limits for Analytes in Soil

Analyte Group/Analyte	Analytical Resources Inc.	
	MDL	MRL
Herbicides	**mg/kg dw**	**mg/kg dw**
Dalapon	0.0227	0.033
Dicamba	0.00494	0.017
MCPA	3.533	8.3
Dichlorprop	0.00636	0.033
2,4-D	0.00782	0.033
MCPP	5.849	8.3
Silvex	0.00362	0.0083
2,4,5-T	0.00255	0.0083
2,4-DB	0.0893	0.17
Dinoseb	0.00903	0.017
Pesticides	**ug/kg dw**	**ug/kg dw**
Alpha-BHC	0.878	1.7
Beta-BHC	1.294	1.7
Gamma-BHC (Lindane)	0.581	1.7
Delta-BHC	0.826	1.7
Heptachlor	0.612	1.7
Aldrin	0.573	1.7
Heptachlor Epoxide	0.718	1.7
Gamma chlordane	0.504	1.7
Alpha chlordane	0.499	1.7
Endosulfan I	0.883	1.7
4,4'-DDE	1.074	3.3
Dieldrin	0.964	3.3
Endrin	1.043	3.3
Endosulfan II	1.014	3.3
4,4'-DDD	1.296	3.3
Endrin Aldehyde	2.36	3.3
4,4'-DDT	1.214	3.3
Endosulfan Sulfate	1.954	3.3
Endrin Ketone	1.976	3.3
Methoxychlor	6.489	17
Hexchlorobutadiene	1.128	1.7
Hexachlorobenzene	0.609	1.7
Tozaphene	--	170
Metals	**mg/kg dw**	**mg/kg dw**
Arsenic	0.52	5.0
Cadmium	0.02	0.2
Chromium	0.28	0.5
Copper	0.04	0.2
Lead	0.20	2.0
Mercury	0.005	0.05
Silver	0.11	0.3
Zinc	0.28	1.0
NWTPH-Dx	**mg/kg dw**	**mg/kg dw**
Diesel-range hydrocarbons	0.475	5.0
NWTPH-G/BTEX	**mg/kg dw**	**mg/kg dw**
Gasoline-range hydrocarbons	2.49	5.0
Benzene	0.0047	0.025
Toluene	0.00315	0.025
Ethylbenzene	0.00465	0.025
m/p-Xylene	0.00628	0.050
o-Xylene	0.00424	0.025
Meth tert-Butyl Ether (MTBE)	0.00728	0.050
PCB Aroclors	**µg/kg dw**	**µg/kg dw**
Aroclor 1016	6.6	20.0
Aroclor 1221	6.6	20.0
Aroclor 1232	6.6	20.0
Aroclor 1242	6.6	20.0
Aroclor 1248	6.6	20.0
Aroclor 1254	6.6	20.0
Aroclor 1260	6.6	20.0
Total PCB Aroclors	6.6	20.0

dw - dry weight
MDL - method detection limit
MRL - method reporting limit
PCB - polychlorinated biphenyl
SVOC - semivolatile organic compound

Analyte Group/Analyte	Analytical Resources Inc.	
	MDL	MRL
SVOCs	**µg/kg dw**	**µg/kg dw**
1,2,4-Trichlorobenzene	16.1	67
1,2-Dichlorobenzene	18.2	67
1,3-Dichlorobenzene	15.8	67
1,4-Dichlorobenzene	7.36	20
1-Methylnaphthalene	16.2	67
2,2'-oxybis(1-chloropropane)	14.6	67
2,4-Dinitrotoluene	102.3	330
2,6-Dinitrotoluene	114.9	330
2-Chloronaphthalene	14.1	67
2-Nitroaniline	80.0	330
3,3'-Dichlorobenzidine	213.2	330
3-Nitroaniline	143.9	330
4-Bromophenyl phenyl ether	16.8	67
4-Chloroaniline	202.5	67
4-Chlorophenyl phenyl ether	15.6	67
4-Nitroaniline	190	330
Aniline	0.0	67
Azobenzene	18.2	67
Benzidine	0.0	670
Benzoic acid	166.3	670
Benzyl alcohol	148.5	330
Bis(2-chloroethoxy) methane	15.9	67
Bis(2-chloroethyl) ether	15.4	67
Carbazole	7.7	67
Dibenzofuran	15.1	67
Hexachlorobenzene	14.7	67
Hexachlorobutadiene	14.5	67
Hexachlorocyclopentadiene	212.3	330
Hexachloroethane	15.8	67
Isophorone	17.8	67
Nitrobenzene	14.4	67
N-Nitrosodimethylamine	86.1	330
N-Nitroso-di-n-propylamine	67.2	330
N-Nitrosodiphenylamine	16.3	67
PAHs		
2-Methylnaphthalene	16.2	67
Acenaphthene	16.8	67
Acenaphthylene	14.5	67
Anthracene	14.2	67
Benz(a)anthracene	16.0	67
Benzo(a)pyrene	16.7	67
Benzo(b)fluoranthene	27.3	67
Benzo(g,h,i)perylene	9.9	67
Benzo(k)fluoranthene	14.5	67
Chrysene	14.7	67
Dibenz(a,h)anthracene	13.5	67
Fluoranthene	6.0	67
Fluorene	17.6	67
Indeno(1,2,3-cd)pyrene	12.0	67
Naphthalene	15.0	67
Phenanthrene	13.4	67
Pyrene	15.3	67
Phthalate esters		
Bis(2-ethylhexyl) phthalate	27.2	67
Butyl benzyl phthalate	7.7	67
Diethyl phthalate	16.4	20
Dimethyl phthalate	16.9	67
Di-n-butyl phthalate	7.1	67
Di-n-octyl phthalate	16.8	67
Phenols		
2,4,5-Trichlorophenol	64.7	330
2,4,6-Trichlorophenol	65.3	330
2,4-Dichlorophenol	117.5	330
2,4-Dimethylphenol	31.2	67
2,4-Dinitrophenol	105.5	670
2-Chlorophenol	12.1	67
2-Methylphenol	23.4	67
2-Nitrophenol	61.5	330
4,6-Dinitro-2-methylphenol	350.7	670
4-Chloro-3-methylphenol	61.8	330
4-Methylphenol	33.0	67
4-Nitrophenol	102.2	330
Pentachlorophenol	171.5	330
Phenol	33.5	67

Table 2-b

BNSF ROW at Quendall Terminals
Method Detection Limits and Method Reporting Limits for Analytes in Water

Analyte Group/Analyte	Analytical Resources Inc.	
	MDL	MRL
Herbicides	**ug/L**	**ug/L**
Dalapon	0.963	1.0
Dicamba	0.264	0.50
MCPA	116	250
Dichlorprop	0.741	1.0
2,4-D	0.292	1.0
MCPP	163	250
Silvex	0.194	0.25
2,4,5-T	0.11	0.25
2,4-DB	1.815	5.00
Dinoseb	0.497	0.50
Metals	**ug/L**	**ug/L**
Arsenic	0.039	0.20
Cadmium	0.011	0.20
Chromium	0.044	0.50
Copper	0.086	0.50
Lead	0.104	1.0
Mercury	0.015	0.10
Silver	0.01	0.20
Zinc	0.403	4.0
NWTPH-Dx	**mg/L**	**mg/L**
Diesel-range hydrocarbons	0.0123	0.25
NWTPH-G/BTEX	**ug/L**	**mg/L**
Gasoline-range hydrocarbons	15	30
Benzene	0.094	1.0
Toluene	0.057	1.0
Ethylbenzene	0.091	1.0
m/p-Xylene	0.122	1.0
o-Xylene	0.135	1.0
Meth tert-Butyl Ether (MTBE)	0.131	1.0
1,3,5-Trimethylbenzene	0.044	1.0
1,2,4-Trimethylbenzene	0.034	1.0
PCB Aroclors	**ug/L**	**ug/L**
Aroclor 1016	0.2	1.0
Aroclor 1221	0.2	1.0
Aroclor 1232	0.2	1.0
Aroclor 1242	0.2	1.0
Aroclor 1248	0.2	1.0
Aroclor 1254	0.2	1.0
Aroclor 1260	0.2	1.0
Total PCB Aroclors	0.2	1.0

Analyte Group/Analyte	Analytical Resources Inc.	
	MDL	MRL
SVOCs[1]	**ug/L**	**ug/L**
1,2,4-Trichlorobenzene	0.196	1.0
1,2-Dichlorobenzene	0.198	1.0
1,3-Dichlorobenzene	0.165	1.0
1,4-Dichlorobenzene	0.203	1.0
1-Methylnaphthalene	0.136	1.0
2,2'-oxybis(1-chloropropane)	0.159	1.0
2,4-Dinitrotoluene	0.861	5.0
2,6-Dinitrotoluene	1.049	5.0
2-Chloronaphthalene	0.167	1.0
2-Nitroaniline	0.670	5.0
3,3'-Dichlorobenzidine	1.114	5.0
3-Nitroaniline	0.754	5.0
4-Bromophenyl phenyl ether	0.227	1.0
4-Chloroaniline	0.893	5.0
4-Chlorophenyl phenyl ether	0.164	1.0
4-Nitroaniline	0.922	5.0
Aniline	0.115	1.0
Azobenzene	0.215	1.0
Benzidine	5.249	10.0
Benzoic acid	3.112	10.0
Benzyl alcohol	0.876	5.0
Bis(2-chloroethoxy) methane	0.188	1.0
Bis(2-chloroethyl) ether	0.165	1.0
Carbazole	0.237	1.0
Dibenzofuran	0.161	1.0
Hexachlorobenzene	0.208	1.0
Hexachlorobutadiene	0.236	1.0
Hexachlorocyclopentadiene	0.935	5.0
Hexachloroethane	0.267	1.0
Isophorone	0.196	1.0
Nitrobenzene	0.199	1.0
N-Nitrosodimethylamine	0.709	5.0
N-Nitroso-di-n-propylamine	0.751	5.0
N-Nitrosodiphenylamine	0.290	1.0
PAHs		
2-Methylnaphthalene	0.097	1.0
Acenaphthene	0.159	1.0
Acenaphthylene	0.187	1.0
Anthracene	0.187	1.0
Benz(a)anthracene	0.213	1.0
Benzo(a)pyrene	0.239	1.0
Benzo(b)fluoranthene	0.290	1.0
Benzo(g,h,i)perylene	0.241	1.0
Benzo(k)fluoranthene	0.298	1.0
Chrysene	0.205	1.0
Dibenz(a,h)anthracene	0.221	1.0
Fluoranthene	0.211	1.0
Fluorene	0.161	1.0
Indeno(1,2,3-cd)pyrene	0.215	1.0
Naphthalene	0.075	1.0
Phenanthrene	0.194	1.0
Pyrene	0.161	1.0
Phthalate esters		
Bis(2-ethylhexyl) phthalate	0.527	1.0
Butyl benzyl phthalate	0.235	1.0
Diethyl phthalate	0.101	1.0
Dimethyl phthalate	0.190	1.0
Di-n-butyl phthalate	0.212	1.0
Di-n-octyl phthalate	0.207	1.0
Phenols		
2,4,5-Trichlorophenol	0.800	5.0
2,4,6-Trichlorophenol	0.631	5.0
2,4-Dichlorophenol	0.664	5.0
2,4-Dimethylphenol	0.303	1.0
2,4-Dinitrophenol	1.795	10.0
2-Chlorophenol	0.189	1.0
2-Methylphenol	0.163	1.0
2-Nitrophenol	0.839	5.0
4,6-Dinitro-2-methylphenol	1.813	10.0
4-Chloro-3-methylphenol	0.717	5.0
4-Methylphenol	0.117	1.0
4-Nitrophenol	0.898	5.0
Pentachlorophenol	0.713	5.0
Phenol	0.137	1.0

1 - SVOC MDLs are for Liquid/Liquid extraction

MDL - method detection limit
MRL - method reporting limit
NA - Not applicable
PCB - polychlorinated biphenyl
SVOC - semivolatile organic compound

Table 3

BNSF ROW at Quendall Terminals

Sample Containers, Preservation and Holding Times

		Soil/Sediment				Ground Waters			
Analysis	**Method**	**Recommended Minimum Sample Size**	**Sample Containers**	**Sample Preservation**	**Holding Times (1)**	**Recommended Minimum Sample Size**	**Sample Containers**	**Sample Preservation**	**Holding Times (1)**
SVOC	SW-846 8270C	100 g	4 or 8 oz glass widemouth with Teflon-lined lid	Cool 4°C	14 days to extraction 40 days from extraction to analysis	2 x 1 L	1 liter amber glass with Teflon-lined lid	Cool 0° - 6°C	7 days to extraction 40 days from extraction to analysis
Herbicides	SW-846 8151	100 g	4 or 8 oz glass widemouth with Teflon-lined lid	Cool 4°C	14 days to extraction 40 days from extraction to analysis	2 x 1 L	1 liter amber glass with Teflon-lined lid	Cool 0° - 6°C	7 days to extraction 40 days from extraction to analysis
Pesticides	SW-846 8081	100 g	4 or 8 oz glass widemouth with Teflon-lined lid	Cool 4°C	14 days to extraction 40 days from extraction to analysis	2 x 1 L	1 liter amber glass with Teflon-lined lid	Cool 0° - 6°C	7 days to extraction 40 days from extraction to analysis
PCB	SW-846 8082	100 g	4 or 8 oz glass widemouth with Teflon-lined lid	Cool 4°C	14 days to extraction 40 days from extraction to analysis	2 x 1 L	1 liter amber glass with Teflon-lined lid	Cool 0° - 6°C	7 days to extraction 40 days from extraction to analysis
Diesel Range Hydrocarbons	NWTPH-Dx	100 g	8 or 16 oz amber glass wide-mouth with Teflon-lined lid	Cool 4°C	14 days to extraction 40 days from extraction to analysis	2 x 1 L	1 liter amber glass with Teflon-lined lid	Cool 4 C HCl to pH < 2	14 days to extraction 40 days from extraction to analysis
Gasoline-Range Hydrocarbons / BTEX	NWTPH-G/BTEX Method 5035	4 x 10g plus moisture content	4 x 40 mL vials	Cool 4°C	14 days preserved 2 days unpreserved	2 x 40 ml	40 ml voa vials	Cool 4 C HCl to pH < 2	14 days preserved 2 days unpreserved
Metals Mercury	SW-846 6010/6020 SW-846 7470/7471	100 g	4 or 8 oz glass widemouth with Teflon-lined lid	Cool 4°C	180 days (28 days for Hg)	500 mL	1 L poly bottle	Cool 0° - 6°C HNO_3 - pH<2 (Dissolved metals preserved after filtration)	180 days (28 days for Hg)
Moisture content		100g	4 or 8 oz glass widemouth with Teflon-lined lid	NA	NA	NA	NA	NA	NA
Turbidity	SW-846 180.1	NA	NA	NA	NA	500 ml	500 ml HDPE	Cool <=6°C	48 hours

Note: Holding Times are based on elapsed time from date of collection

SVOC = Semivolatile Organic Compound
PCB = Polychlorinated Biphenyls
HCl = Hydrochloric Acid
HNO_3 = Nitric Acid
oz = ounce
mL = milliliter
L = liter
g = gram

Attachment 1

Table 5-1
Summary of Preliminary Remediation Goals - Soil

Soil (mg/kg)	Most Conservative ARAR Screening Value	Preliminary Cleanup Screening Level	Federal Applicable Requirements			State Applicable Requirements					
			Region Six Residential Screening Level (4)		Region 6 Residential Screening Level (nc HQ = 0.1)	MTCA Method B Soil Unrestricted Criteria (1)		MTCA Protection of Groundwater	MTCA Simplified Terrestrial Ecological - Unrestricted Land Use	Puget Sound Regional Natural Background	Soil PQLs (by EPA Method)
Hexachlorobenzene	**0.3**		0.3	c	--	0.63	c	--	31	--	0.66 (8270)
Hexachlorobutadiene	**6.2**		6.2	c	--	13	c	--	--	--	0.66 (8270)
Hexachlorocyclohexane (BHC)	**0.32**		0.32	c	--	0.56	c	--	10	--	--
alpha-BHC	**0.09**		0.09	c	--	0.16	c	--	--	--	0.002 (8080)
beta-BHC	**0.32**		0.32	c	--	0.560	c	--	--	--	0.004 (8080)
gamma-BHC (Lindane)	**0.44**		0.44	c	--	0.770	c	--	--	--	0.003 (8080)
delta-BHC	**--**		--	--	--	--	--	--	--	--	0.006 (8080)
hexachlorocyclopentadiene	**37**		370	nc	37	480	nc	--	--	--	0.66 (8270)
Hexachloroethane	**35**		35	c	--	71	c	--	--	--	0.66 (8270)
Methoxychlor	**31**		310	nc	31	400	nc	--	--	--	0.12 (8080)
Mirex	**0.27**		0.27	c	--	0.56	c	--	--	--	--
Pentachlorobenzene	**4.9**		49	nc	4.9	64	nc	--	168	--	--
1,2,4,5-Tetrachlorobenzene	**1.8**		18	nc	1.8	24	nc	--	--	--	0.33 (8270)
Toxaphene	**0.44**		0.44	c	--	0.91	c	--	--	--	0.16 (8080)
Semivolatile, Organophosphate (mg/kg)											
Chlorpyrifos	**18**		180	nc	18	240	nc	--	--	--	--
Malathion	**120**		1,200	nc	120	1,600	nc	--	--	--	--
Parathion	**37**		370	nc	37	480	nc	--	--	--	0.06 (8141)
Semivolatile, Phenolic (mg/kg)											
2-Chlorophenol	**6.4**		64	nc	6.4	400	nc	--	--	--	0.66 (8270)
2,4-Dichlorophenol	**18**		180	nc	18	240	nc	--	--	--	0.66 (8270)
2,4-Dimethylphenol	**120**		1,200	nc	120	1,600	nc	470	--	--	0.66 (8270)
2-Methyl-4,6-Dinitrophenol	**--**		--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	**12**		120	nc	12	160	nc	--	--	--	3.3 (8270)
2-Methylphenol	**310**		3,100	nc	310	--	--	--	--	--	--
4-Methylphenol	**31**		310	nc	31	--	--	--	--	--	--
4-Nitrophenol	**49**		490	nc	49	--	--	--	--	--	3.3 (8270)
3-Methyl-4-Chlorophenol	**--**		--	--	--	--	--	--	--	--	--
Pentachlorophenol	**0.03**		3.0	c	--	8.3	c	0.03	11	--	3.3 (8270)
Phenol	**100**		18,000	nc	1,800	48,000	nc	100	--	--	0.66 (8270)
2,3,4,6-Tetrachlorophenol	**180**		1,800	nc	180	2,400	nc	--	--	--	--
2,4,5-Trichlorophenol	**610**		6,100	nc	610	8,000	nc	--	--	--	0.66 (8270)
2,4,6-Trichlorophenol	**4.4**		44	nc	4.4	91	c	--	--	--	0.66 (8270)
Semivolatile, Phthalate (mg/kg)											
Butyl Benzyl Phthalate	**240**		240	sat	--	16,000	nc	--	--	--	0.66 (8270)
Bis (2-Ethylhexyl) Phthalate	**35**		35	c	--	71	c	3,600	--	--	0.66 (8270)
Diethyl Phthalate	**4,900**		49,000	nc	4,900	64,000	nc	--	--	--	0.66 (8270)
Dimethyl Phthalate	**10,000**		100,000	max	10,000	80,000	nc	--	--	--	0.66 (8270)
Di-N-Octyl Phthalate	**1,600**		--	--	--	1,600	nc	--	--	--	0.66 (8270)
Di-N-Butyl Phthalate			--	--	--	--	--	--	200	--	0.66 (8270)
Semivolatile, Polycyclic Aromatic Hydrocarbons (mg/kg)											
Acenaphthene	**370**		3,700	nc	370	4,800	nc	570	--	--	0.66 (8270)
Acenaphthylene	**--**		--	--	--	--	--	--	--	--	0.66 (8270)
Anthracene	**2,200**		22,000	nc	2,200	24,000	nc	--	--	--	0.66 (8270)
Benzo(a)anthracene	**0.14**		0.15	c	--	0.14	c	2.0	--	--	0.66 (8270)

Table 5-1
Summary of Preliminary Remediation Goals - Soil

Soil (mg/kg)	Most Conservative ARAR Screening Value	Preliminary Cleanup Screening Level	Federal Applicable Requirements			State Applicable Requirements					
			Region Six Residential Screening Level (4)		Region 6 Residential Screening Level (nc HQ = 0.1)	MTCA Method B Soil Unrestricted Criteria (1)		MTCA Protection of Groundwater	MTCA Simplified Terrestrial Ecological - Unrestricted Land Use	Puget Sound Regional Natural Background	Soil PQLs (by EPA Method)
Benzo(a)pyrene	**0.015**		0.015	c	--	0.14	c	8.0	30	--	0.66 (8270)
Benzo(b)fluoranthene	**0.14**		0.15	c	--	0.14	c	5.0	--	--	0.66 (8270)
Benzo(k)fluoranthene	**0.14**		1.5	c	--	0.14	c	49	--	--	0.66 (8270)
Benzo(g,h,i)perylene	**--**		--	--	--	--	--	--	--	--	0.66 (8270)
Chrysene	**0.14**		15	c	--	0.14	c	160	--	--	0.66 (8270)
Dibenzo(a,h)anthracene	**0.015**		0.015	c	--	0.14	c	2.0	--	--	0.66 (8270)
Fluoranthene	**230**		2,300	nc	230	3,200	nc	4,300	--	--	0.66 (8270)
Fluorene	**260**		2,600	nc	260	3,200	nc	560	--	--	0.66 (8270)
Indeno(1,2,3-cd)pyrene	**0.14**		0.15	c	--	0.14	c	14	--	--	0.66 (8270)
2-Methylnaphthalene	**320**		--	--	--	320	nc	--	--	--	0.66 (8270)
Naphthalene	**12**		120	nc	12	1,600	nc	84	--	--	0.66 (8270)
Phenanthrene	**--**		--	--	--	--	--	--	--	--	0.66 (8270)
Pyrene	**230**		2,300	nc	230	2,400	nc	4,200	--	--	0.66 (8270)
HPAH	**--**		--	--	--	--	--	--	--	--	--
LPAH	**--**		--	--	--	--	--	--	--	--	--
Total cPAH	**(1)**		--	--	--	--	--	--	--	--	--
PCBs (mg/kg)											
Total PCBs	**0.22**		0.22	c	--	0.5	c	--	2	--	--
Dioxin (mg/kg)											
2,3,7,8-TCDD	**3.90E-06**		3.90E-06	c	--	6.70E-06	c	--	5.00E-06	--	0.000003 (8290)
Volatile, Aromatic and Halogenated (mg/kg)											
Benzene	**0.03**		0.66	c	--	18	c	0.03	--	--	0.005 (8240)
Bromoform	**62**		62	c	--	130	c	--	--	--	0.005 (8240)
Carbon Tetrachloride	**0.24**		0.24	c	--	7.7	c	--	--	--	0.005 (8240)
Chlorobenzene	**27**		270	nc	27	1,600	nc	--	--	--	0.005 (8240)
Chlorodibromomethane	**--**		--	--	--	--	--	--	--	--	0.002 (8010)
Chloroform	**0.25**		0.25	c	--	160	c	0.6	--	--	0.005 (8240)
Dibromomethane	**--**		--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	**28**		280	nc	28	7,200	nc	--	--	--	0.66 (8270)
1,4-Dichlorobenzene	**3.2**		3.2	c	--	42	c	--	--	--	0.66 (8270)
Dichlorobromomethane	**--**		--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane	**9.4**		94	nc	9.4	16,000	nc	--	--	--	0.005 (8240)
1,2-Dichloroethane	**0.35**		0.35	c	--	11	c	--	--	--	0.005 (8240)
1,1-Dichloroethylene	**1.7**		280	nc	28	1.7	c	--	--	--	0.005 (8240)
1,2-cis Dichloroethylene	**4.3**		43	nc	4.3	800	nc	--	--	--	0.005 (8240)
1,2-trans Dichloroethylene	**12**		120	nc	12	1,600	nc	--	--	--	0.005 (8240)
1,2-Dichloropropane	**0.35**		0.35	c	--	15	c	--	--	--	0.005 (8240)
1,3-Dichloropropene	**0.70**		0.70	c	--	5.6	c	--	--	--	0.005 (8240)
Ethylbenzene	**13**		230	sat	--	8,000	nc	13	--	--	0.005 (8240)
Ethylene Dichloride	**--**		--	--	--	--	--	--	--	--	--
Methyl Bromide	**--**		--	--	--	--	--	--	--	--	--
Methyl Chloride	**--**		--	--	--	--	--	--	--	--	--
Methylene Chloride	**0.02**		8.9	c	--	130	c	0.02	--	--	0.005 (8240)
Pentachloroethane	**--**		--	--	--	--	--	--	--	--	--
Propylene Dichloride	**--**		--	--	--	--	--	--	--	--	--

Table 5-1
Summary of Preliminary Remediation Goals - Soil

Soil (mg/kg)	Most Conservative ARAR Screening Value	Preliminary Cleanup Screening Level	Federal Applicable Requirements			State Applicable Requirements					
			Region Six Residential Screening Level (4)		Region 6 Residential Screening Level (nc HQ = 0.1)	MTCA Method B Soil Unrestricted Criteria (1)		MTCA Protection of Groundwater	MTCA Simplified Terrestrial Ecological - Unrestricted Land Use	Puget Sound Regional Natural Background	Soil PQLs (by EPA Method)
Styrene	**4.0**		1,700	sat	--	33	c	4.0	--	--	0.005 (8240)
1,1,2,2-Tetrachloroethane	**0.38**		0.38	c	--	5	c	--	--	--	0.005 (8240)
Tetrachloroethylene	**0.55**		0.55	c	--	1.9	c	--	--	--	0.0003 (8010)
Toluene	**12**		520	sat	--	6,400	nc	12	--	--	0.005 (8240)
1,2,4-Trichlorobenzene	**14**		140	nc	14	800	nc	--	--	--	0.66 (8270)
1,1,1-Trichloroethane	**1,400**		1,400	sat	--	72,000	nc	--	--	--	0.005 (8240)
1,1,2-Trichloroethane	**0.84**		0.84	c	--	18	c	--	--	--	0.005 (8240)
Trichlorethylene	**0.043**		0.043	c	--	2.5	c	--	--	--	0.001 (8010)
Trichlorofluoromethane	**39**		390	nc	39	24,000	nc	--	--	--	0.005 (8240)
Vinyl Chloride	**0.043**		0.043	c	--	0.67	c	--	--	--	0.02 (8240)
m,p-Xylene	**210**		210	sat	--	160,000	nc	--	--	--	0.005 (8240)
o-Xylene	**280**		280	sat	--	160,000	nc	--	--	--	0.005 (8240)
Total Xylene	**210**		210	sat	--	160,000	nc	--	--	--	0.005 (8240)
Volatile, Nitrile (mg/kg)											
Acrolein	**0.01**		0.1	nc	0.01	1,600	nc	--	--	--	0.007 (8030)
Acrylonitrile	**0.21**		0.21	c	--	2	c	--	--	--	0.005 (8030)

Notes:
Most Stringent Screening Level
c - Carcinogen
nc - Noncarcinogen
-- = Not Available
Soil PQLs presented above are soil PQLs listed by Washington Department of Ecology and applicable to accredited laboratories. Method detection limits and additional analytical methods may acquire values below reported PQLs.
(1) Total carcinogenic PAHs normalized to benzo(a)pyrene using TEFs from Collins et al. 1998

Table 5-2
Summary of Preliminary Remediation Goals - Groundwater

Groundwater (ug/L)	Most Conservative ARAR Screening Value	Preliminary Cleanup Screening Level	Federal Applicable Requirements					State Applicable Requirements				
			NPDWR MCL	NPDWR MCLG	Region 6 Tap Water Screening Level (7)		Region 6 Tap Water Screening Level (nc HQ = 0.1)	WAC 246-290-310 Water Quality MCL	MTCA Method B Groundwater Criteria		Most Restricive Surface Water Screening Criteria	PQLs (by EPA Method)
Metals (ug/L)												
Antimony	**1.5**		6.0	6.0	15	nc	1.5	6.0	6.4	nc	5.6	30 (7041)
Arsenic (inorganic)	**0.018**		10	0	0.045	c	--	0	0.058	c	0.018	20 (7061)
Barium (and compounds)	**730**		2,000	2,000	7,300	nc	730	2,000	3,200	nc	1,000	--
Beryllium	**4.0**		4.0	4.0	73	nc	7.3	4.0	32	nc	270	2 (7091)
Cadmium	**0.25**		5.0	5.0	18	nc	1.8	5.0	8.0	nc	0.25	1 (7131)
Chromium (Cr^{+6})	**10**		100	100	110	nc	11	100	48	nc	10 (Cr^{+6})	50 (7195)
Copper	**3.5**		1,300	1,300	1,400	nc	140	1,300	590	nc	3.5	10 (7211)
Lead	**0.54**		15	zero	15	nc	1.5	15	--	nc	0.54	10 (7421)
Mercury	**0.012**		2.0	2.0	11	nc	1.1	2.0	4.8	nc	0.012	2 (7470)
Nickel (soluble salts)	**49**		--	100	730	nc	73	100	320	nc	49	10 (249.2)
Selenium	**5.0**		50	50	180	nc	18	50	80	nc	5.0	20 (7740)
Silver	**18**		--	--	180	nc	18	--	80	nc	26,000	2 (7741)
Thallium	**0.24**		2.0	0.5	2.6	nc	0.26	2.0	1.1	nc	0.24	--
Tin	**2,200**		--	--	22,000	nc	2,200	--	9,600	nc	--	--
Zinc	**32**		--	--	11,000	nc	1,100	5,000	4,800	nc	32	0.5 (7951)
Cyanide	**5.2**		200	200	730	nc	73	200	320	nc	5.2	50 (9012)
Semivolatile (ug/L)												
Benzidine	**0.000086**		--	--	0.000094	c	--	--	0.00038	c	0.000086	0.8 (605)
Benzoic Acid	**15,000**		--	--	150,000	nc	15,000	--	64,000	nc	--	50 (8270)
Benzyl Alcohol	**1,100**		--	--	11,000	nc	1,100	--	4,800	nc	--	20 (8270)
Carbazole	**3.4**		--	--	3.4	c	--	--	4.4	c	--	10 (8270)
Dibenzofuran	**1.2**		--	--	12	nc	1.2	--	32	nc	--	10 (8270)
1,2-Diphenylhydrazine	**0.036**		--	--	0.084	c	--	--	0.11	c	0.036	20 (8240)
Semivolatile, Nitroaromatic (ug/L)												
2,4-Dinitrotoluene	**0.11**		--	--	73	nc	7.3	--	32	nc	0.11	10 (8270)
2,6-Dinitrotoluene	**3.7**		--	--	37	nc	3.7	--	16	nc	--	10 (8270)
N-Nitrosodimethylamine	**0.00042**		--	--	0.00042	c	--	--	0.00086	c	0.00069	2 (607)
N-Nitroso-di-n-Propylamine	**0.005**		--	--	0.0096	c	--	--	--	--	0.005	10 (8270)
N-Nitrosodiphenylamine	**3.3**		--	--	14	c	--	--	--	--	3.3	10 (8270)
Semivolatile, Organochlorine (ug/L)												
Aldrin	**0.000049**		--	--	0.004	c	--	--	0.0026	c	0.000049	0.04 (8080)
Chlordane	**0.00057**		2.0	zero	0.19	c	--	2.0	0.25	c	0.00057	0.14 (8080)
2-Chloronaphthalene	**49**		--	--	490	nc	49	--	--	--	1,000	10 (8270)
DDD	**0.00031**		--	--	0.28	c	--	--	0.36	c	0.00031	0.1 (8150)
DDE	**0.00022**		--	--	0.20	c	--	--	0.26	c	0.00022	0.04 (8150)
DDT	**0.00022**		--	--	0.20	c	--	--	0.26	c	0.00022	0.1 (8150)
DDT Total	**--**		--	--	--	--	--	--	--	--	--	--
Dieldrin	**0.000052**		--	--	0.0042	c	--	--	0.0055	c	0.000052	0.02(8080)
Endosulfan	**0.056**		--	--	220	nc	22	--	96	nc	0.056	0.1 (8080)
Endrin	**0.0023**		2.0	2.0	11	nc	1.1	--	4.8	nc	0.0023	0.06 (8080)
Endrin Aldehyde	**--**		--	--	--	--	--	--	--	--	--	--
Heptachlor	**0.000079**		0.4	zero	0.015	c	--	0.4	0.019	c	0.000079	0.03 (8080)
Heptachlor Epoxide	**0.000039**		0.2	zero	0.0074	c	--	0.2	0.0048	c	0.000039	0.8 (8080)
Hexachlorobenzene	**0.00028**		1.0	zero	0.042	c	--	1.0	0.055	c	0.00028	10 (8270)
Hexachlorobutadiene	**0.44**		--	--	0.86	c	--	--	0.56	c	0.44	10 (8270)
Hexachlorocyclohexane (BHC) Tec	**0.012**		--	--	0.037	c	--	--	--	--	0.012	--

Table 5-2
Summary of Preliminary Remediation Goals - Groundwater

Groundwater (ug/L)	Most Conservative ARAR Screening Value	Preliminary Cleanup Screening Level	Federal Applicable Requirements					State Applicable Requirements				
			NPDWR MCL	NPDWR MCLG	Region 6 Tap Water Screening Level (7)		Region 6 Tap Water Screening Level (nc HQ = 0.1)	WAC 246-290-310 Water Quality MCL	MTCA Method B Groundwater Criteria		Most Restricive Surface Water Screening Criteria	PQLs (by EPA Method)
alpha-BHC	**0.0026**		--	--	0.011	c	--	--	0.014	c	0.0026	0.03 (8080)
beta-BHC	**0.0091**		--	--	0.037	c	--	--	0.049	c	0.0091	0.06 (8080)
delta-BHC	**0.012**		--	--	--	--	--	--	--	--	0.012	0.09 (8080)
gamma-BHC (Lindane)	**0.019**		0.2	0.2	0.052	c	--	0.2	0.067	c	0.019	0.04 (8080)
Hexachlorocyclopentadiene	**22**		50	50	220	nc	22	50	48	nc	40	10 (8270)
Hexachloroethane	**1.4**		--	--	4.8	c	--	--	3.1	c	1.4	10 (8270)
Methoxychlor	**0.03**		40	40	180	nc	18	40	80	nc	0.03	10 (8270)
Mirex	**0.001**		--	--	0.037	c	--	--	0.049	c	0.001	10 (8270)
Pentachloroenzene	**1.4**		--	--	29	nc	2.9	--	13	nc	1.4	10 (8270)
1,2,4,5-Tetrachlorobenzene	**0.97**		--	--	11	nc	1.1	--	4.8	nc	0.97	10 (8270)
Toxaphene	**0.0002**		3.0	zero	0.061	c	--	3.0	0.08	c	0.0002	2 (8080)
Semivolatile, Organophosphate (ug/L)												
Chlorpyrifos	**0.041**		--	--	110	nc	11	--	48	nc	0.041	--
Malathion	**0.1**		--	--	730	nc	73	--	320	nc	0.1	50 (8270)
Parathion	**0.013**		--	--	220	nc	22	--	96	nc	0.013	10 (8270)
Semivolatile, Phenolic (ug/L)												
2-Chlorophenol	**3.0**		--	--	30	nc	3.0	--	40	nc	97	10 (8270)
2,4-Dichlorophenol	**11**		--	--	110	nc	11	--	24	nc	77	10 (8270)
2,4-Dimethylphenol	**73**		--	--	730	nc	73	--	160	nc	380	10 (8270)
2-Methyl-4,6-Dinitrophenol	**13**		--	--	--	--	--	--	--	--	13	--
2,4-Dinitrophenol	**7.3**		--	--	73	nc	7.3	--	32	nc	69	50 (8270)
2-Methylphenol	**180**		--	--	1,800	nc	180	--	--	--	--	--
4-Methylphenol	**18**		--	--	180	nc	18	--	--	--	--	--
4-Nitrophenol	**29**		--	--	290	nc	29	--	--	--	--	50 (8270)
3-Methyl-4-Chlorophenol	**--**		--	--	--	--	--	--	--	--	--	--
Pentachlorophenol	**0.27**		1.0	zero	0.56	c	--	1.0	0.73	c	0.27	50 (8270)
Phenol	**1,100**		--	--	11,000	nc	1,100	--	4,800	nc	21,000	10 (8270)
2,3,4,6-Tetrachlorophenol	**110**		--	--	1,100	nc	110	--	480	nc	--	--
2,3,4-Trichlorophenol	**--**		--	--	--	--	--	--	--	--	--	--
2,4,5-Trichlorophenol	**370**		--	--	3,700	nc	370	--	800	nc	1,800	10 (8270)
2,4,6-Trichlorophenol	**1.4**		--	--	6.1	c	--	--	4.0	c	1.4	10 (8270)
Semivolatile, Phthalate (ug/L)												
Butyl Benzyl Phthalate	**730**		--	--	7,300	nc	730	--	3,200	nc	1,300	10 (8270)
Bis (2-Ethylhexyl) Phthalate	**1.2**		6.0	zero	4.8	c	--	6.0	6.3	c	1.2	10 (8270)
Diethyl Phthalate	**2,900**		--	--	29,000	nc	2,900	--	13,000	nc	17,000	10 (8270)
Dimethyl Phthalate	**16,000**		--	--	370,000	nc	37,000	--	16,000	nc	72,000	10 (8270)
Di-N-Octyl Phthalate	**320**		--	--	--	--	--	--	320	nc	--	10 (8270)
Di-N-Butyl Phthalate	**2,000**		--	--	--	--	--	--	--	--	2,000	4 (606)
Semivolatile, Polycyclic Aromatic Hydrocarbons (ug/L)												
Acenaphthene	**37**		--	--	370	nc	37	--	960	nc	640	10 (8270)
Acenaphthylene	**--**		--	--	--	--	--	--	--	--	--	10 (8270)
Anthracene	**180**		--	--	1,800	nc	180	--	--	nc	8,300	10 (8270)
Benzo(a)anthracene	**0.0028**		--	--	0.029	c	--	--	0.012	c	0.0028	10 (8270)
Benzo(a)pyrene	**0.0028**		0.2	zero	0.0029	c	--	0.2	0.012	c	0.0028	10 (8270)
Benzo(b)fluoranthene	**0.0028**		--	--	0.029	c	--	--	0.012	c	0.0028	10 (8270)
Benzo(k)fluoranthene	**0.0028**		--	--	0.29	c	--	--	0.012	c	0.0028	10 (8270)
Benzo(g,h,i)perylene	**--**		--	--	--	--	--	--	--	--	--	10 (8270)

Table 5-2
Summary of Preliminary Remediation Goals - Groundwater

Groundwater (ug/L)	Most Conservative ARAR Screening Value	Preliminary Cleanup Screening Level	Federal Applicable Requirements					State Applicable Requirements				
			NPDWR MCL	NPDWR MCLG	Region 6 Tap Water Screening Level (7)		Region 6 Tap Water Screening Level (nc HQ = 0.1)	WAC 246-290-310 Water Quality MCL	MTCA Method B Groundwater Criteria		Most Restricive Surface Water Screening Criteria	PQLs (by EPA Method)
Chrysene	**0.0028**		--	--	2.9	c	--	--	0.012	c	0.0028	10 (8270)
Dibenzo(a,h)anthracene	**0.0028**		--	--	0.0029	c	--	--	0.012	c	0.0028	10 (8270)
Fluoranthene	**90**		--	--	1,500	nc	150	--	640	nc	90	10 (8270)
Fluorene	**24**		--	--	240	nc	24	--	640	nc	1,100	10 (8270)
Indeno(1,2,3-cd)pyrene	**0.0028**		--	--	0.029	c	--	--	0.012	c	0.0028	10 (8270)
2-Methylnaphthalene	**32**		--	--	--	--	--	--	32	nc	--	10 (8270)
Naphthalene	**0.62**		--	--	6.2	nc	0.62	--	160	nc	4,900	10 (8270)
Phenanthrene	**--**		--	--	--	--	--	--	--	--	--	10 (8270)
Pyrene	**18**		--	--	180	nc	18	--	480	nc	830	10 (8270)
Total PAH	**--**		--	--	--	--	--	--	--	--	--	--
PCBs (ug/L)												
Total PCBs	**0.000064**		0.5	zero	0.034	c	--	0.5	0.044	c	0.000064	--
Dioxin (ug/L)												
2,3,7,8-TCDD	**5.0E-09**		3.0E-08	0	4.5E-07	c	--	3.0E-08	5.8E-07	c	5.0E-09	0.003 (8290)
Volatile, Aromatic and Halogenated (ug/L)												
Acetone	**550**		--	--	5,500	nc	550	--	800	nc	--	10 (8240)
Benzene	**0.35**		5.0	zero	0.35	c	--	5.0	0.8	c	1.2	5 (8240)
Bromoform	**4.3**		80	80	8.5	c	--	80	5.5	c	4.3	5 (8240)
Bromomethane	**0.87**		--	--	8.7	nc	0.87	--	11	nc	47	--
2-Butanone	**--**		--	--	--	--	--	--	--	--	--	--
Carbon Tetrachloride	**0.17**		5.0	zero	0.17	c	--	5.0	0.34	c	0.23	5 (8240)
Chlorobenzene	**9.1**		100	100	91	nc	9.1	100	160	nc	130	5 (8240)
Chlorodibromomethane	**0.41**		--	--	--	--	--	--	--	--	0.41	5 (8240)
Chloroform	**0.17**		80	zero	0.17	c	--	80	7.2	c	5.7	5 (8240)
Dibromomethane	**--**		--	--	--	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	**0.0002**		0.2	zero	0.0002	c	--	0.2	0.031	c	--	--
1,2-Dichlorobenzene	**4.9**		600	600	49	nc	4.9	600	720	nc	420	10 (8270)
1,3-Dichlorobenzene	**0.83**		--	--	8.3	nc	0.83	--	--	--	320	
1,4-Dichlorobenzene	**0.47**		75	75	0.47	c	--	75	1.8	c	4.9	10 (8270)
Dichlorobromomethane	**--**		--	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane	**39**		--	--	390	nc	39	--	1,600	nc	--	5 (8240)
1,1-Dichloroethane	**7.0**		7.0	7.0	1,200	nc	120	7.0	800	nc	--	5 (8240)
1,2-Dichloroethane	**0.12**		5.0	zero	0.12	c	--	5.0	0.48	c	0.38	5 (8240)
1,1-Dichloroethylene	**0.057**		7.0	7.0	340	nc	34	7.0	0.073	c	0.057	5 (8240)
1,2-cis Dichloroethylene	**6.1**		70	70	61	nc	6.1	70	80	nc	--	5 (8240)
1,2-trans Dichloroethylene	**11**		100	100	110	nc	11	100	160	nc	33,000	5 (8240)
1,2-Dichloropropane	**0.16**		5.0	zero	0.16	c	--	5.0	0.64	c	0.5	5 (8240)
1,3-Dichloropropene	**0.24**		--	--	0.40	c	--	--	0.24	c	0.34	5 (624)
Ethylbenzene	**130**		700	700	1,300	nc	130	700	800	nc	530	5 (8240)
2-Hexanone	**--**		--	--	--	--	--	--	--	--	--	50 (8240)
Methyl Bromide	**48**		--	--	--	--	--	--	--	--	48	10 (8011)
Methyl Chloride	**--**		--	--	--	--	--	--	--	--	--	--
Methylene Chloride	**4.3**		5.0	zero	4.3	c	--	5.0	5.8	c	4.6	5 (8240)
4-Methyl-2-pentanone	**--**		--	--	--	--	--	--	--	--	--	--
Pentachloroethane	**--**		--	--	--	--	--	--	--	--	--	--
Propylene Dichloride	**--**		--	--	--	--	--	--	--	--	--	--
Styrene	**1.5**		100	100	1,600	nc	160	100	1.5	c	--	5 (8240)

Table 5-2
Summary of Preliminary Remediation Goals - Groundwater

Groundwater (ug/L)	Most Conservative ARAR Screening Value	Preliminary Cleanup Screening Level	Federal Applicable Requirements					State Applicable Requirements				
			NPDWR MCL	NPDWR MCLG	Region 6 Tap Water Screening Level (7)		Region 6 Tap Water Screening Level (nc HQ = 0.1)	WAC 246-290-310 Water Quality MCL	MTCA Method B Groundwater Criteria		Most Restricive Surface Water Screening Criteria	PQLs (by EPA Method)
Tetrachloroethane	**--**		--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	**0.055**		--	--	0.055	c	--	--	0.22	c	0.17	5 (8240)
Tetrachloroethylene	**0.081**		5.0	zero	0.10	c	--	5.0	0.081	c	0.39	5 (8240)
Toluene	**230**		1,000	1,000	2,300	nc	230	1,000	640	nc	1,300	5 (8240)
1,2,4-Trichlorobenzene	**0.82**		70	70	8.2	nc	0.82	70	80	nc	35	10 (8270)
1,1,1-Trichloroethane	**84**		200	200	840	nc	84	200	7,200	nc	420,000	5 (8240)
1,1,2-Trichloroethane	**0.2**		5.0	3	0.20	c	--	5.0	0.77	c	0.59	5 (8240)
Trichlorethylene	**0.028**		5.0	zero	0.028	c	--	5.0	0.11	c	1.5	5 (8240)
Trichlorofluoromethane	**130**		--	--	1,300	nc	130	--	2,400	nc	--	--
Vinyl Chloride	**0.015**		2.0	zero	0.015	c	--	2.0	0.029	c	0.025	10 (8240)
m,p-Xylene	**21**		--	--	210	nc	21	--	16,000 (m-xylene)	nc	--	--
o-Xylene	**140**		--	--	1,400	nc	140	--	16,000	nc	--	--
Total Xylene	**20**		10,000	10,000	200	nc	20	10,000	1,600	nc	--	5 (8240)
Volatile, Nitrile (ug/L)												
Acrolein	**0.0042**		--	--	0.042	nc	0.0042	--	160	nc	190	7 (8030)
Acrylonitrile	**0.039**		--	--	0.039	c	--	--	0.081	nc	0.051	5 (8030)
Aniline	**7.7**		--	--	12	c	--	--	7.7	c	--	10 (8270)
4-Chloroaniline	**15**		--	--	150	nc	15	--	32	nc	--	20 (8270)

Notes:

Most Stringent Screening Level

c - Carcinogen

nc - Noncarcinogen

-- = Not Available

Groundwater PQLs presented above are PQLs listed by Washington Department of Ecology and applicable to accredited laboratories. Method detection limits and additional analytical methods may acquire values below reported PQLs.

Attachment 2

Analytical Resources,Incorporated
Analytical Chemists and Consultants

Spike Recovery Control Limits Hydrocarbon Identification (NWTPH-HCID) and Diesel Range Petroleum Hydrocarbons (NWTPH-D & AK-102) [1]

Effective 4/2/08

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Method:	NWTPH-HCID [2]	NWTPH-D AK102	
Sample Matrix:	Water & Soil	Water	Soil
Sample Amount / Final Volume:	500 / 1 mL	500 / 1 mL	10g / 1 mL
LCS Spike Recovery [3]			
Diesel	-- - --	57 - 108	52 - 106
Diesel with Acid & Silica Clean-up	-- - --	48 - 100	53 - 100
Method Blank/LCS Surrogate Recovery			
o-Terphenyl	-- - --	63 - 115	52 - 121
o-Terphenyl with Acid & Silica Clean-up	-- - --	49 - 118	62 - 118
Sample Surrogate Recovery			
o-Terphenyl	50 - 150	64 - 111	48 - 119
o-Terphenyl with Acid & Silica Clean-up	-- - --	45 - 112	49 - 125

1. Control Limits calculated using all data generated 1/1/08 through 3/28/08
2. Method specified, non-prescriptive limits. The NWTPH-HCID Method does not include LCS or MS analyses.
3. Laboratory Control Sample (LCS) spike recovery control limits also used as advisory control limits for sample matrix spike (MS) analyzes. MS recovery values are advisory and not used to assess the acceptability of an analytical batch.

Analytical Resources,Incorporated
Analytical Chemists and Consultants

Spike Recovery Control Limits BTEX – EPA Method 8021 & Gasoline – Methods NWTPH-G and AK101[1,2]

Effective 12/20/07

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Sample Matrix:	**Aqueous Samples**		**Soil / Sediment Samples**	
Analytical Method:	Method 8021B	NWTPH-G AK-101	Method 8021B	NWTPH-G AK-101
LCS Spike Recovery [3]				
Benzene	73 - 122		74 - 123	
Toluene	75 - 121		76 - 122	
Ethyl benzene	75 - 130		76 - 130	
m,p-Xylenes	76 - 120		75 - 121	
o-Xlyene	78 - 122		76 - 123	
MTBE	59 - 153		56 - 163	
Gasoline		78 - 119		77 - 121
Method Blank/LCS Surrogate Recovery				
Trifluorotoluene (TFT)	**80 - 120**	**80 - 120**	**80 - 120**	**80 - 120**
Bromobenzene	**80 - 120**	**80 - 120**	**80 - 120**	**80 - 120**
Sample Surrogate Recovery				
Trifluorotoluene (TFT)	**80** - 120	**80** - 120	61 - 137	65 - 137
Bromobenzene	**80 - 120**	**80** - 120	58 - 139	54 - 144

(1) Control Limits calculated using all data generated 1/1/07 through 12/1/07.
(2) Highlighted control limits (bold font) are adjusted from the calculated values as follows:
a) ARI does not use control limits < 10
b) Control limits for analyzes with no separate preparation procedure are adjusted to reflect the minimum uncertainty in the calibration of the instrument allowed by the referenced analytical method.
(3) Laboratory Control Sample (LCS) spike recovery control limits also used as advisory control limits for sample matrix spike (MS) analyzes. MS recovery values are advisory and not used to assess the acceptability of an analytical batch.

Analytical Resources,Incorporated
Analytical Chemists and Consultants

Spike Recovery Control LimitsAnalysis of Chlorinated Herbicides
EPA SW-846 Method 8151A [1]

Effective 12/24/07

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Sample Matrix: **Extraction Method:** **Sample / Final Volume:**	**Water** **Liquid / Liquid** **500 mL / 50 mL**	**Soil / Sediment** **Sonication** **15g / 50 mL:**
LCS Spike Recovery [3]		
Dalapon	30 - 160[2]	41 - 134
Dicamba	30 - 160[2]	56 - 113
MCPA	30 - 160[2]	34 - 120
Dichloroprop	30 - 160[2]	52 - 102
2,4-D	54 - 96	34 - 104
MCPP	30 - 160[2]	30 - 160[2]
2,4,5-TP (Silvex)	48 - 126	11 - 169
2,4,5-T	64 - 120	64 - 121
2,4-DB	68 - 111	58 - 120
Dinoseb	30 - 160[2]	30 - 160[2]
MB/LCS Surrogate Recovery		
2,4-Dichlorophenylacetic acid	61 - 112	55 - 118
Sample Surrogate Recovery		
2,4-Dichlorophenylacetic acid	51 - 118	40 - 135

(1) ARI's Control limits calculated using all available spike recovery data from 1/1/06 through 12/1/07
(2) 30 – 160 are default, advisory control limits used when there is insufficient data to calculate historic control limits. **DO NOT** use these limits as the sole reason to reject the data from a batch of analyses.
(3)Laboratory Control Sample (LCS) spike recovery control limits also used as advisory control limits for sample matrix spike (MS) analyzes. MS recovery values are advisory and not used to assess the acceptability of an analytical batch.

Analytical Resources,Incorporated
Analytical Chemists and Consultants

Summary of Laboratory Control Limits Metals Analyses (All Methods & Sample Matrices)

Effective 12/24/07

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Element	Matrix Spike Recovery	LCS Recovery	Replicate RPD
Aluminum	75 - 125	80 - 120	≤ 20%
Antimony	75 - 125	80 - 120	≤ 20%
Arsenic	75 - 125	80 - 120	≤ 20%
Barium	75 - 125	80 - 120	≤ 20%
Beryllium	75 - 125	80 - 120	≤ 20%
Boron	75 - 125	80 - 120	≤ 20%
Cadmium	75 - 125	80 - 120	≤ 20%
Calcium	75 - 125	80 - 120	≤ 20%
Chromium	75 - 125	80 - 120	≤ 20%
Cobalt	75 - 125	80 - 120	≤ 20%
Copper	75 - 125	80 - 120	≤ 20%
Iron	75 - 125	80 - 120	≤ 20%
Lead	75 - 125	80 - 120	≤ 20%
Magnesium	75 - 125	80 - 120	≤ 20%
Manganese	75 - 125	80 - 120	≤ 20%
Mercury	75 - 125	80 - 120	≤ 20%
Nickel	75 - 125	80 - 120	≤ 20%
Potassium	75 - 125	80 - 120	≤ 20%
Selenium	75 - 125	80 - 120	≤ 20%
Silica	75 - 125	80 - 120	≤ 20%
Silver	75 - 125	80 - 120	≤ 20%
Sodium	75 - 125	80 - 120	≤ 20%
Strontium	75 - 125	80 - 120	≤ 20%
Thallium	75 - 125	80 - 120	≤ 20%
Vanadium	75 - 125	80 - 120	≤ 20%
Zinc	75 - 125	80 - 120	≤ 20%

Analytical Resources,Incorporated
Analytical Chemists and Consultants

Spike Recovery Control Limits - Analysis of PCB / Aroclors in Soil & Sediment Samples - EPA SW-846 Methods 8081 & 8082 (1)

Effective 12/24/07

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Extraction Method:	**Sonication**	**Soxhlet**	**PSEP**	**Low Level**	**Medium Level**
Sample Weight / Final Volume:	12 g / 4 mL	10 g / 10 mL	25 g / 5 mL	25 g / 1 mL	5 g / 40 mL
LCS Spike Recovery (2)					
Aroclor 1016	56 - 100	30 - 160(3)	57 - 101	31 - 106	60 - 111
Aroclor 1260	56 - 127	30 - 160(3)	57 - 126	40 - 124	42 - 185
Method Blank / LCS Surrogate Recovery					
Tetrachloro-*meta*-xylene (TCMX)	61 - 118	30 - 160(3)	63 - 119	30 - 119	70 - 126
Decachlorobiphenyl	59 - 122	30 - 160(3)	65 - 117	36 - 130	66 - 137
Sample Surrogate Recovery					
Tetrachloro-*meta*-xylene (TCMX)	49 - 120	30 - 160(3)	48 - 123	32 - 121	46 - 135
Decachlorobiphenyl	40 - 139	30 - 160(3)	43 - 148	33 - 149	46 - 153

(1) Control Limits calculated using all data generated 1/1/07 through 12/1/07.
(2) Laboratory Control Sample (LCS) spike recovery control limits also used as advisory control limits for sample matrix spike (MS) analyzes. MS recovery values are advisory and not used to assess the acceptability of an analytical batch.
(3) 30 – 160 are default, advisory control limits used when there is insufficient data to calculate historic control limits. **DO NOT** use these limits as the sole reason to reject the data from a batch of analyses.

Analytical Resources,Incorporated
Analytical Chemists and Consultants

Spike Recovery Control Limits Analysis of PCB / Aroclors in Aqueous Samples - EPA SW-846 Methods 8081 & 8082 (1)

Effective 12/24/07

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Analytical Method:	**Standard Analysis**	**MTCA Analysis**	**Low Level Analysis**	**Manchester Extraction**
Sample Weight / Final Volume:	500 / 5 mL	500 / 1 mL	1000 / 0.5 mL	3000 / 1 mL
LCS Spike Recovery (3)				
Aroclor 1016	60 - 96	33 - 98	36 - 110	30 - 160(2)
Aroclor 1260	63 - 122	36 - 128	45 - 123	30 - 160(2)
Method Blank/LCS Surrogate Recovery				
Tetrachloro-*meta*-xylene (TCMX)	61 - 104	39 - 105	34 - 93	30 - 160(2)
Decachlorobiphenyl	47 - 101	44 - 116	36 - 102	30 - 160(2)
Sample Surrogate Recovery				
Tetrachloro-*meta*-xylene (TCMX)	55 - 102	22 - 118	30 - 98	30 - 160(2)
Decachlorobiphenyl	42 - 120	27 - 117	19 - 121	30 - 160(2)

(1) Control Limits calculated using all data generated 1/1/07 through 12/1/07.
(2) 30 – 160 are default, advisory control limits used when there is insufficient data to calculate historic control limits. **DO NOT** use these limits as the sole reason to reject the data from a batch of analyses.
(3) Laboratory Control Sample (LCS) spike recovery control limits also used as advisory control limits for sample matrix spike (MS) analyzes. MS recovery values are advisory and not used to assess the acceptability of an analytical batch.

Analytical Resources,Incorporated
Analytical Chemists and Consultants

Spike Recovery Control Limits for Chlorinated Pesticides
EPA Method SW-846-8081B Analysis of Soil / Sediment Samples [1]

Effective 12/24/07

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Sample Dry Weight / Final Vol.	**12 g to 4 mL**		**25 g to 5 mL**	
LCS Spike Recovery [4]	**Control Limits**	**ME Limits[2]**	**Control Limits**	**ME Limits[2]**
α-BHC	41 - 125	27 - 139	51 - 118	40 - 129
β-BHC	50 - 123	38 - 135	57 - 122	46 - 133
δ-BHC	44 - 130	30 - 144	53 - 121	42 - 132
γ-BHC (Lindane)	49 - 122	37 - 134	58 - 117	48 - 127
Heptachlor	51 - 125	39 - 137	60 - 124	49 - 135
Aldrin	53 - 122	42 - 134	57 - 124	46 - 135
Hepachlor Epoxide	54 - 129	42 - 142	62 - 121	52 - 131
Endosulfan I	55 - 127	43 - 139	42 - 148	24 - 166
Dieldrin	57 - 122	46 - 133	57 - 123	46 - 134
4,4'-DDE	56 - 129	44 - 141	58 - 126	47 - 137
Endrin	58 - 122	47 - 133	57 - 124	46 - 135
Endosulfan II	50 - 128	37 - 141	55 - 126	43 - 138
4,4'-DDD	64 - 120	55 - 129	59 - 125	48 - 136
Endosulfan Sulfate	48 - 127	35 - 140	52 - 119	41 - 130
4,4'-DDT	56 - 140	42 - 154	65 - 125	55 - 135
Methoxychlor	58 - 126	47 - 137	54 - 128	42 - 140
Endrin Ketone	40 - 134	24 - 150	50 - 129	37 - 142
Endrin Aldehyde	26 - 96	14 - 108	25 - 103	12 - 116
γ-Chlordane	55 - 121	44 - 132	58 - 122	47 - 133
α-Chlordane	54 - 120	43 - 131	60 - 119	50 - 129
MB / LCS Surrogate Recovery				
Tetrachloro-*m*-xylene (TCMX)	48 - 106	(3)	53 - 112	(3)
Decachlorobiphenyl	57 - 128	(3)	65 - 125	(3)
Sample Surrogate Recovery				
Tetrachloro-xylene (TCMX)	40 - 113	(3)	43 - 128	(3)
Decachlorobiphenyl	48 - 137	(3)	52 - 143	(3)

(1) ARI's Control limits calculated using all available spike recovery data from 1/1/07 or 12/1/07.
(2) **ME** = A **marginal exceedance** defined in the NELAC Standard [5] as beyond the LCS-CL but still within the ME limits. ME limits are between 3 and 4 standard deviations around the mean. A maximum of one marginal exceedance is acceptable. Two or more marginal exceedances require corrective action.
(3) Marginal Exceedances not allowed for a surrogate standard.
(4) Laboratory Control Sample (LCS) spike recovery control limits also used as advisory control limits for sample matrix spike (MS) analyzes. MS recovery values are advisory and not used to assess the acceptability of an analytical batch.
(5) **2003 NELAC Standard (EPA/600/R-04/003), July 2003**, Chapter 5, pages 251-252.

Analytical Resources,Incorporated
Analytical Chemists and Consultants

Spike Recovery Control Limits for Analysis of Soil & Sediment Semi-Volatile Organic Compounds (SVOA) EPA SW-846 Method 8270D[1,8]

Effective: 1/8/08

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Extraction / Analytical Method:	**Sonication / 8270D**	**Sonication / 8270D ME[2]**	**Sonication / PSEP [3]**	**Sonication / PSEP ME[2,3]**
Sample Weight / Final Volume:	7.5 g to 0.5 mL	7.5 g to 0.5 mL	50 to 1 mL	50 to 1 mL
LCS Spike Recovery [10]				
Phenol	49 - 89	42 - 96	37 - 92	28 - 101
Bis-(2-chloroethyl) ether	45 - 86	38 - 93	40 - 83	33 - 90
2-Chlorophenol	49 - 83	43 - 89	42 - 80	36 - 86
1,3-Dichlorobenzene	42 - 79	36 - 85	39 - 75	33 - 81
1,4-Dichlorobenzene	42 - 78	36 - 84	40 - 75	34 - 81
Benzyl Alcohol	26 - 89	16 - 100	25 - 90	14 - 101
1,2-Dichlorobenzene	43 - 80	37 - 86	40 - 76	34 - 82
2-Methylphenol	48 - 91	41 - 98	40 - 86	32 - 94
2,2'-oxybis(1-chloropropane)	31 - 102	19 - 114	26 - 100	14 - 112
4-Methylphenol	51 - 94	44 - 101	40 - 92	31 - 101
N-Nitroso-di-n-propylamine	44 - 94	36 - 102	29 - 95	18 - 106
Hexachloroethane	39 - 78	33 - 85	37 - 73	31 - 79
Nitrobenzene	47 - 85	41 - 91	37 - 85	29 - 93
Isophorone	52 - 92	45 - 99	42 - 91	34 - 99
2-Nitrophenol	47 - 91	40 - 98	40 - 86	32 - 94
2,4-Dimethyphenol	45 - 87	38 - 94	23 - 85	13 - 95
Bis-(2-chloroethoxy) methane	48 - 88	41 - 95	40 - 87	32 - 95
Benzoic Acid [4]	42 - 111	31 - 123	29 - 104	17 - 117
2,4-Dichlorophenol	48 - 91	41 - 98	42 - 88	34 - 96
1,2,4-Trichlorobenzene	44 - 85	37 - 92	40 - 81	33 - 88
Naphthalene	46 - 85	40 - 92	41 - 80	35 - 87
4-Chloroaniline [4]	17 - 98	**10** - 112	14 - 80	**10** - 91
2-Chloronaphthalene	48 - 88	41 - 95	42 - 82	35 - 89
Hexachlorobutadiene	36 - 91	27 - 100	37 - 85	29 - 93
4-Chloro-3-methylphenol	51 - 96	44 - 104	40 - 94	31 - 103
2-Methylnaphthalene	50 - 87	44 - 93	44 - 82	38 - 88
Hexachlorocyclopentadiene	19 - 109	**10** - 124	**10** - 98	**10** - 113
2,4,6-Trichlorophenol	44 - 98	35 - 107	42 - 88	34 - 96
2,4,5-Trichlorophenol	47 - 97	39 - 105	41 - 89	33 - 97
2-Nitroaniline	46 - 105	36 - 115	35 - 101	24 - 112
Dimethylphthalate	56 - 95	50 - 102	44 - 91	36 - 99
Acenaphthylene	52 - 91	46 - 98	44 - 84	37 - 91
2,6-Dinitrotoluene	48 - 106	38 - 116	42 - 97	33 - 106
3-Nitroaniline [4]	25 - 118	10 - 134	25 - 93	14 - 104
Acenaphthene	50 - 90	43 - 97	42 - 85	35 - 92
2,4-Dinitrophenol	**10** - 198	**10** - 235	**10** - 179	**10** - 211

Analytical Resources,Incorporated
Analytical Chemists and Consultants

Spike Recovery Control Limits for Analysis of Soil & Sediment Semi-Volatile Organic Compounds (SVOA) EPA SW-846 Method 8270D[1,8]

Effective: 1/8/08

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Extraction / Analytical Method:	**Sonication / 8270D**	**Sonication / 8270D ME[2]**	**Sonication / PSEP [3]**	**Sonication / PSEP ME[2,3]**
Sample Weight / Final Volume:	7.5 g to 0.5 mL	7.5 g to 0.5 mL	50 to 1 mL	50 to 1 mL
Dibenzofuran	54 - 91	48 - 97	46 - 84	40 - 90
4-Nitrophenol	19 - 111	**10** - 126	26 - 97	14 - 109
2,4-Dinitrotoluene	47 - 113	36 - 124	41 - 101	31 - 111
Fluorene	52 - 95	45 - 102	44 - 88	37 - 95
Diethylphthlalate	56 - 100	49 - 107	46 - 94	38 - 102
4-Chlorophenyl-phenyl ether	49 - 96	41 - 104	44 - 87	37 - 94
4-Nitroaniline	32 - 106	20 - 118	24 - 89	13 - 100
4,6-Dinitro-2-Methylphenol	21 - 151	**10** - 173	22 - 128	**10** - 146
N-Nitrosodiphenylamine	48 - 129	35 - 143	40 - 111	28 - 123
4-Bromophenyl-phenyl ether	51 - 97	43 - 105	43 - 91	35 - 99
Hexachlorobenzene	52 - 96	45 - 103	42 - 90	34 - 98
Pentachlorophenol	34 - 107	22 - 119	34 - 94	24 - 104
Phenanthrene	54 - 96	47 - 103	45 - 90	38 - 98
Anthracene	53 - 95	46 - 102	42 - 87	35 - 95
Carbazole	52 - 102	44 - 110	43 - 93	35 - 101
Di-n-butylphthalate	60 - 104	53 - 111	48 - 99	40 - 108
Fluoranthene	53 - 106	44 - 115	43 - 98	34 - 107
Pyrene	51 - 103	42 - 112	39 - 99	29 - 109
Butylbenzylphthalate	54 - 108	45 - 117	41 - 105	30 - 116
Benzo(a)Anthracene	53 - 100	45 - 108	42 - 94	33 - 103
3,3'-Dichlorbenzidine [4]	11 - 110	**10** - 127	14 - 84	**10** - 96
Chrysene	54 - 100	46 - 108	45 - 92	37 - 100
Bis(2-Ethylhexyl) phthalate	43 - 124	30 - 138	34 - 111	21 - 124
Di-n-octylphthalate	47 - 115	36 - 126	32 - 107	20 - 120
Benzo(b)Fluoranthene	56 - 108	47 - 117	43 - 105	33 - 115
Benzo(k)Fluoranthene	53 - 110	44 - 120	40 - 108	29 - 119
Benzo(a)Pyrene	57 - 102	50 - 110	41 - 95	32 - 104
Indeno(1,2,3-cd)Pyrene	42 - 106	31 - 117	28 - 101	16 - 113
Dibenz(a,h)anthracene	45 - 107	35 - 117	32 - 104	20 - 116
Benzo(g,h,i)Perylene	35 - 109	23 - 121	18 - 106	**10** - 121
Aniline [4]	10 - 92	**10** - 106	**10** - 71	**10** - 82
1,2-Diphenylhydrazine (Azobenzene)	48 - 103	39 - 112	40 - 94	31 - 103
N-Nitrosodimethylamine	42 - 80	36 - 86	31 - 75	24 - 82
1-Methylnaphthalene	50 - 90	43 - 97	43 - 87	36 - 94
Tributyl Phosphate	30 - 160[9]	30 - 160[9]	30 - 160[9]	30 - 160[9]
Dibutyl Phenyl Phosphate	30 - 160[9]	30 - 160[9]	30 - 160[9]	30 - 160[9]
Butyl Diphenyl Phosphate	30 - 160[9]	30 - 160[9]	30 - 160[9]	30 - 160[9]

Spike Recovery Control Limits for Analysis of Soil & Sediment Semi-Volatile Organic Compounds (SVOA) EPA SW-846 Method 8270D[1,8]

Effective: 1/8/08

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Extraction / Analytical Method:	**Sonication / 8270D**	**Sonication / 8270D ME[2]**	**Sonication / PSEP [3]**	**Sonication / PSEP ME[2,3]**
Sample Weight / Final Volume:	7.5 g to 0.5 mL	7.5 g to 0.5 mL	50 to 1 mL	50 to 1 mL
Triphenyl Phosphate	30 - 160[9]	30 - 160[9]	30 - 160[9]	30 - 160[9]
Butylated Hydroxytoluene (BHT)	30 - 160[9]	30 - 160[9]	30 - 160[9]	30 - 160[9]
MB/LCS Surrogate Recovery				
d4-2-Chlorophenol	46 - 88	(5)	41 - 81	(5)
d4-1,2-Dichlorobenzene	38 - 84	(5)	33 - 79	(5)
2,4,6-Tribromophenol	45 - 111	(5)	40 - 96	(5)
2-Fluorophenol	45 - 111	(5)	20 - 93	(5)
d5-Phenol [4]	**10** - 115	**10** - 133	40 - 85	42 - 93
d5-Nitrobenzene	45 - 87	(5)	37 - 85	(5)
2-Fluorobiphenyl	44 - 91	(5)	39 82	(5)
d14-p-Terphenyl	50 - 111	(5)	38 - 105	(5)
Sample Surrogate Recovery				
d4-2-Chlorophenol	32 - 91	(5)	30 - 84	(5)
d4-1,2-Dichlorobenzene	35 - 85	(5)	25 - 82	(5)
2,4,6-Tribromophenol	25 - 117	(5)	25 - 103	(5)
2-Fluorophenol	11 - 106	(5)	**10** - 114	(5)
d5-Phenol [4]	31 - 91	21 - 101	29 - 85	20 - 94
d5-Nitrobenzene	34 - 91	(5)	29 - 87	(5)
2-Fluorobiphenyl	37 - 94	(5)	32 - 88	(5)
d14-p-Terphenyl	33 - 106	(5)	21 - 97	(5)

(1) Control Limits calculated using all data generated 1/1/07 through 12/1/07.
(2) **ME** = A **marginal exceedance** defined in the NELAC Standard [6] as beyond the CL but still within the ME limits. ARI defines ME limits as between 3 and 4 standard deviations around the mean with upper limit ≥ 100% A maximum of four marginal exceedances are acceptable. Five or more marginal exceedances in an analysis require corrective action.
(3). Preparation includes Gel Permeation Chromatography (GPC) clean-up.
(4) These are "**poor performers**" defined in the DoD QSM [8] as compounds that "produce low mean recoveries and high standard deviations, resulting in wide LCS control limits with particularly low lower control limits (sometimes-negative values). ARI does not control batch acceptance based on these compounds because since there is a high level of uncertainty in their recovery."
(5) Marginal Exceedances not allowed for surrogate unless it is a "poor performer".
(6) **2003 NELAC Standard (EPA/600/R-04/003), July 2003**, Chapter 5, pages 251-252.
(7) Page 182 of: **Department of Defense Quality Systems Manual for Environmental Laboratories, Version 3 Final, March 2005** Prepared By Environmental Data Quality Workgroup, Department of Navy, Lead Service (Based On National Environmental Laboratory Accreditation Conference (NELAC) Chapter 5 (Quality Systems) NELAC Voted Version − 5 June 2003
(8) Highlighted control limits (**bold font**) adjusted to demonstrate that ARI does not use control limits < 10
(9) 30 – 160 are default, advisory control limits used when there is insufficient data to calculate historic control limits. **DO NOT** use these limits as the sole reason to reject the data from a batch of analyses.
(10) Laboratory Control Sample (LCS) spike recovery control limits also used as advisory control limits for sample matrix spike (MS) analyzes. MS recovery values are advisory and not used to assess the acceptability of an analytical batch.

Analytical Resources,Incorporated
Analytical Chemists and Consultants

Spike Recovery Control Limits for Analysis of Aqueous Samples
Semi-Volatile Organic Compounds (SVOA) EPA SW-846 Methods 8270D

Effective: 1/3/08

Control limits are updated periodically. Assure that you have ARI's current control limits by downloading the files at the time of use. http://www.arilabs.com/portal/downloads/ARI-CLs.zip

Extraction Method:	**Liquid-Liquid Extract** [1]	**Liquid-Liquid ME**[1,2]	**Separatory Funnel** [1]	**Separatory Funnel - ME**[1,2]
Sample Weight / Final Volume:	500 to 0.5 mL	500 to 0.5 mL	500 to 0.5 mL	500 to 0.5 mL
LCS Spike Recovery [8]				
Phenol [3]	42 - 102	32 - 112	10 - 88	**10** - 101
Bis-(2-chloroethyl) ether	62 - 100	56 - 106	55 - 100	48 - 108
2-Chlorophenol	54 - 102	46 - 110	53 - 97	46 - 104
1,3-Dichlorobenzene	18 - 85	**10** - 96	35 - 86	27 - 95
1,4-Dichlorobenzene	20 - 85	**10** - 96	35 - 87	26 - 96
Benzyl Alcohol	30 - 118	15 - 133	43 - 98	34 - 107
1,2-Dichlorobenzene	25 - 86	15 - 96	37 - 89	28 - 98
2-Methylphenol	55 - 104	47 - 112	52 - 96	45 - 103
2,2'-oxybis(1-chloropropane)	48 - 109	38 - 119	49 - 103	40 - 112
4-Methylphenol	55 - 109	46 - 118	53 - 103	45 - 111
N-Nitroso-di-n-propylamine	57 - 107	49 - 115	53 - 109	44 - 118
Hexachloroethane	**10** - 82	**10** - 95	30 - 80	22 - 88
Nitrobenzene	56 - 103	48 - 111	53 - 103	45 - 111
Isophorone	63 - 111	55 - 119	59 - 111	50 - 120
2-Nitrophenol	58 - 106	50 - 114	53 - 102	45 - 110
2,4-Dimethyphenol	40 - 92	31 - 101	35 - 102	24 - 113
Bis-(2-chloroethoxy) methane	62 - 104	55 - 111	57 - 104	49 - 112
Benzoic Acid [3]	13 - 124	**10** - 143	**10** - 71	**10** - 81
2,4-Dichlorophenol	50 - 112	40 - 122	53 - 107	44 - 116
1,2,4-Trichlorobenzene	22 - 91	11 - 103	36 - 92	27 - 101
Naphthalene	43 - 95	34 - 104	45 - 98	36 - 107
4-Chloroaniline [3]	**10** - 177	**10** - 211	32 - 146	13 - 165
2-Chloronaphthalene	43 - 99	34 - 108	48 - 99	40 - 108
Hexachlorobutadiene	**10** - 96	**10** - 113	27 - 87	17 - 97
4-Chloro-3-methylphenol	52 - 114	42 - 124	54 - 113	44 - 123
2-Methylnaphthalene	36 - 100	25 - 111	46 - 99	37 - 108
Hexachlorocyclopentadiene	**10** - 82	**10** - 97	17 - 95	**10** - 108
2,4,6-Trichlorophenol	44 - 116	32 - 128	51 - 109	41 - 119
2,4,5-Trichlorophenol	57 - 110	48 - 119	51 - 109	41 - 119
2-Nitroaniline	56 - 112	47 - 121	57 - 113	48 - 122
Dimethylphthalate	63 - 109	55 - 117	63 - 106	56 - 113
Acenaphthylene	55 - 101	47 - 109	54 - 104	46 - 112
2,6-Dinitrotoluene	53 - 118	42 - 129	54 - 114	44 - 124
3-Nitroaniline [3]	**10** - 185	**10** - 216	67 - 120	58 - 129
Acenaphthene	46 - 104	36 - 114	54 - 101	46 - 109
2,4-Dinitrophenol	**10** - 227	**10** - 272	**10** - 207	**10** - 245

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Extraction Method:	**Liquid-Liquid Extract** [1]	**Liquid-Liquid ME**[1,2]	**Separatory Funnel** [1]	**Separatory Funnel - ME**[1,2]
Sample Weight / Final Volume:	500 to 0.5 mL	500 to 0.5 mL	500 to 0.5 mL	500 to 0.5 mL
Dibenzofuran	58 - 100	51 - 107	56 - 102	48 - 110
4-Nitrophenol [3]	42 - 112	30 - 124	10 - 80	**10** - 92
2,4-Dinitrotoluene	53 - 118	42 - 129	57 - 110	48 - 119
Fluorene	57 - 105	49 - 113	54 - 109	45 - 118
Diethylphthlalate	63 - 109	55 - 117	61 - 110	53 - 118
4-Chlorophenyl-phenyl ether	54 - 106	45 - 115	52 - 109	43 - 119
4-Nitroaniline	44 - 113	33 - 125	44 - 116	32 - 128
4,6-Dinitro-2-Methylphenol	**10** - 160	**10** - 185	22 - 153	**10** - 175
N-Nitrosodiphenylamine	47 - 136	32 - 151	50 - 131	37 - 145
4-Bromophenyl-phenyl ether	58 - 108	50 - 116	60 - 104	53 - 111
Hexachlorobenzene	57 - 107	49 - 115	59 - 104	52 - 112
Pentachlorophenol	34 - 126	19 - 141	40 - 119	27 - 132
Phenanthrene	62 - 103	55 - 110	62 - 102	55 - 109
Anthracene	61 - 101	54 - 108	61 - 101	54 - 108
Carbazole	60 - 110	52 - 118	58 - 108	50 - 116
Di-n-butylphthalate	67 - 111	60 - 118	66 - 110	59 - 117
Fluoranthene	60 - 114	51 - 123	57 - 113	48 - 122
Pyrene	55 - 113	45 - 123	51 - 115	40 - 126
Butylbenzylphthalate	56 - 117	46 - 127	54 - 121	43 - 132
Benzo(a)Anthracene	59 - 107	51 - 115	59 - 110	51 - 119
3,3'-Dichlorbenzidine [3]	**10** - 144	**10** - 168	43 - 127	29 - 141
Chrysene	58 - 106	50 - 114	56 - 109	47 - 118
bis(2-Ethylhexyl) phthalate	46 - 136	31 - 151	50 - 124	38 - 136
Di-n-octylphthalate	52 - 123	40 - 135	60 - 114	51 - 123
Benzo(b)Fluoranthene	61 - 111	53 - 119	61 - 110	53 - 118
Benzo(k)Fluoranthene	59 - 113	50 - 122	59 - 114	50 - 123
Benzo(a)Pyrene	62 - 105	55 - 112	62 - 105	55 - 112
Indeno(1,2,3-cd)Pyrene	44 - 114	32 - 126	47 - 114	36 - 125
Dibenz(a,h)anthracene	48 - 115	37 - 126	50 - 112	40 - 122
Benzo(g,h,i)Perylene	37 - 120	23 - 134	47 - 116	36 - 128
Aniline [3]	**10** - 79	**10** - 100	20 - 83	10 - 94
1,2-Diphenylhydrazine /Azobenzene	57 - 114	48 - 124	55 - 112	46 - 122
N-Nitrosodimethylamine	45 - 100	36 - 109	34 - 84	26 - 92
1-Methylnaphthalene	47 - 99	38 - 108	48 - 104	39 - 113
Tributyl Phosphate	56 - 110	47 - 119	30 - 160 [4]	30 - 160 [4]
Dibutyl Phenyl Phosphate	55 - 114	45 - 124	30 - 160 [4]	30 - 160 [4]
Butyl Diphenyl Phosphate	49 - 121	37 - 133	30 - 160 [4]	30 - 160 [4]

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Extraction Method:	**Liquid-Liquid Extract** (1)	**Liquid-Liquid ME**(1,2)	**Separatory Funnel** (1)	**Separatory Funnel - ME**(1,2)
Sample Weight / Final Volume:	500 to 0.5 mL	500 to 0.5 mL	500 to 0.5 mL	500 to 0.5 mL
Triphenyl Phosphate	48 - 113	37 - 124	30 - 160 (4)	30 - 160 (4)
Butylated Hydroxytoluene (BHT)	21 - 107	**10** - 121	30 - 160 (4)	30 - 160 (4)
MB / LCS Surrogate Recovery				
d4-2-Chlorophenol	54 - 99	(5)	51 - 97	(5)
d4-1,2-Dichlorobenzene	39 - 86	(5)	40 - 92	(5)
2,4,6-Tribromophenol	49 - 117	(5)	56 - 110	(5)
2-Fluorophenol	49 - 94	(5)	17 - 98	(5)
d5-Phenol (3)	45 - 100	36 - 109	20 - 62	13 - 69
d5-Nitrobenzene	54 - 102	(5)	50 - 104	(5)
2-Fluorobiphenyl	47 - 99	(5)	49 - 98	(5)
d14-p-Terphenyl	50 - 119	(5)	48 - 120	(5)
d8-1,4-Dioxane	30 - 160 (4)	(5)	30 - 160 (4)	(5)
Sample Surrogate Recovery				
d4-2-Chlorophenol	40 - 98	(5)	42 - 93	(5)
d4-1,2-Dichlorobenzene	28 - 85	(5)	41 - 87	(5)
2,4,6-Tribromophenol	37 - 120	(5)	51 - 105	(5)
2-Fluorophenol	36 - 93	(5)	23 - 74	(5)
d5-Phenol	32 - 99	21 - 110	**10** - 66	**10** - 76
d5-Nitrobenzene	40 - 103	(5)	45 - 98	(5)
2-Fluorobiphenyl	35 - 98	(5)	53 - 89	(5)
d14-p-Terphenyl	21 - 122	(5)	46 - 119	(5)
d8-1,4-Dioxane	30 - 160 (4)	(5)	30 - 160 (4)	(5)

(1) Control Limits calculated using all data generated 1/1/07 through 12/1/07.
(2) **ME** = A **marginal exceedance** defined in the NELAC Standard (6) as beyond the CL but still within the ME limits. ARI defines ME limits as between 3 and 4 standard deviations around the mean with upper limit ≥ 100%. A maximum of four marginal exceedances are acceptable. Five or more marginal exceedances in an analysis require corrective action.
(3) These are "**poor performers**" defined in the DoD QSM[7] as compounds that "produce low mean recoveries and high standard deviations, resulting in wide LCS control limits with particularly low lower control limits (sometimes-negative values). ARI does not control batch acceptance based on these compounds because since there is a high level of uncertainty in their recovery."
(4) 30 – 160 are default, advisory control limits used when there is insufficient data to calculate historic control limits. **DO NOT** use these limits as the sole reason to reject the data from a batch of analyses.
(5) Marginal Exceedances not allowed for surrogate unless it is a "poor performer".
(6) **2003 NELAC Standard (EPA/600/R-04/003), July 2003**, Chapter 5, pages 251-252.
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(8) Laboratory Control Sample (LCS) spike recovery control limits also used as advisory control limits for sample matrix spike (MS) analyzes. MS recovery values are advisory and not used to assess the acceptability of an analytical batch.