APPENDICES

GeoEngineers

APPENDIX A
Sampling and Analysis Plan

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APPENDIX A
SAMPLING AND ANALYSIS PLAN

1.0 INTRODUCTION

Previous investigations at the Port Angeles Rayonier Mill Site (Site) assessed soil, groundwater, and surface water conditions and the extent of chemical contamination at the Site. Coupled with an understanding of past operations at the mill, the data from these previous investigations provide the basis for the additional sampling and data collection efforts presented in this Sampling and Analysis Plan (SAP) for characterizing soil, groundwater, surface water, and process piping contents. The planned sampling activities will fill existing data gaps so that a comprehensive characterization of the constituents of potential concern (COPCs) associated with the former mill operations can be completed. This SAP constitutes Appendix A of the *Supplemental Upland Data Collection Work Plan* (Work Plan; GeoEngineers, 2010). The Work Plan describes the sampling objectives and rationale, as well as the general sequence of the planned field investigation.

2.0 OBJECTIVE OF THE SUPPLEMENTAL INVESTIGATION

The objective of the supplemental upland data collection field investigation is to collect and analyze scientifically valid data to assess soil chemistry, current groundwater conditions beneath the mill property, and surface water conditions in Ennis Creek. The data collected will supplement existing information derived from the EPA's 1997 Expanded Site Inspection (ESI), Rayonier's 2003 Upland Remedial Investigation (RI), previous interim actions, and previous groundwater studies. The supplemental data will be used to complete the characterization of the upland portion of the Site by filling existing data gaps related to the extent and potential sources of soil and groundwater contamination and potential transport of contaminated groundwater to the marine environment.

The supplemental investigation will be conducted in accordance with the Work Plan, this SAP, the Quality Assurance Project Plan (QAPP) contained in Appendix B of the Work Plan, the Health and Safety Plan (HASP) contained in Appendix C of the Work Plan, and the Archaeological Monitoring Plan contained in Appendix D of the Work Plan. Field measurements will be performed in a manner that is scientifically valid, legally defensible, and of known and acceptable quality to meet data quality objectives specified in the QAPP.

2.1 Overall Design

The field investigation will be completed in five phases as described in the Work Plan and detailed in Table 1. The five investigation phases are as follows:

- Phase 1 – Baseline groundwater sampling, groundwater seep survey, surface water sampling.
- Phase 2 – Groundwater grab sampling, soil borings, and monitoring well installation and sampling.
- Phase 3 – Seep sampling, process piping contents sampling, targeted soil sampling/soil removal in interim action areas and potential soil-to-groundwater source areas.

- Phase 4 – "Infill" monitoring well installation and sampling, additional groundwater characterization for volatile organic compounds (VOCs) if needed.
- Phase 5 – Quarterly groundwater and seep monitoring.

2.2 Chemical Analytes

Soil, groundwater, surface water, and piping contents samples will be selectively analyzed for the presence of COPCs using the following laboratory analytical methods:

- Gasoline-, diesel-, and heavy oil-range total petroleum hydrocarbons (TPH) by Northwest TPH-gasoline extended (NWTPH-Gx) and diesel extended (NWTPH-Dx).
- Semivolatile organic compounds (SVOCs) by EPA Methods 8270, 8270 (low level), 8270-SIM, 8270-SIM (low level), and 8041.
- VOCs by EPA Method 8260 and 8260 (low level).
- Polychlorinated biphenyls (PCBs – seven Aroclors) by EPA Method 8082 (low level).
- Organochlorine pesticides by EPA Method 8081A (low level).
- Selected metals (EPA Methods 6010B/7000, 6020, 7421, 7740, and 200.8).
- Dioxins/furans (17 congeners) by EPA Method 1613 Modified (low level).
- Ammonia by EPA Method 350.1.

In addition, selected soil samples will be analyzed for grain size using ASTM Method D422 and for permeability using ASTM Method D5084 or ASTM Method D2434.

2.3 Sampling Locations

Soil, groundwater, surface water, and piping contents (if applicable) will be sampled as part of the supplemental upland field investigation. The rationale for the proposed sampling locations is presented in the Work Plan. Sampling locations are depicted in Figure 28 of the Work Plan and include the following:

- At least 17 test pits.
- 9 soil borings.
- 24 existing monitoring wells.
- At least 4 new monitoring wells.
- At least 9 groundwater grab sample locations.
- 5 surface water sample locations.
- Up to 7 groundwater seep sample locations.
- At least 1 pipe contents sample location (RI location SR23).

3.0 FIELD METHODOLOGY

The following sections summarize sample collection procedures for soil samples obtained from drilled borings and test pits; groundwater samples obtained from monitoring wells and drilled borings; surface water samples obtained from Ennis Creek and White Creek; pore water samples obtained from seep monitoring stations; and piping contents samples obtained from underground process piping, if present. Table 1 provides details regarding the planned sampling and analytical program.

3.1 Underground Utilities Clearance

Prior to the start of any intrusive activities (i.e., drilling/well installation, test pit excavation), exploration locations will be marked in the field using stakes, white marking paint, or similar techniques. The following general procedures will be followed for utility clearances. First, the locations of proposed explorations will be visually inspected to determine whether debris or other objects may need to be removed to allow access to the subsurface. Next, the location coordinates of the proposed explorations will be determined using a portable global positioning system (GPS) unit. A commercial utility locating service will then inspect the proposed exploration locations and mark any underground utilities in the vicinity. In addition, a call will be placed to the Utilities Underground Location Center (1-800-424-5555) at least 48 hours prior to intrusive activities to arrange for location of municipal and commercial utility lines that may be present. The exploration locations may be modified if necessary to stay clear of utilities.

3.2 Borehole Drilling and Borehole/Test Pit Logging

Drilling activities will conform to State and local regulations including WAC 173-160, *Minimum Standards for Construction and Maintenance of Wells*. Notices of intent to construct wells (start cards) will be submitted to Ecology prior to installing any new monitoring wells.

The drill rig will be inspected by the field geologist or engineer prior to beginning drilling activities to ensure that it has been cleaned and decontaminated before entering the work area, to prevent potential cross-contamination from other sites. The drill rig shall not leak any fluids that may enter the borehole or contaminate equipment placed in the borehole. The use of rags or absorbent materials to absorb leaking fluids is unacceptable. Any leaks found on the drill rig will be repaired prior to starting or resuming drilling activities.

A log of exploration activities will be documented in field reports. Information in the field reports will include dates/times of field work and sample collection, exploration locations, personnel and equipment present, down time, materials used, samples collected, measurements taken, and any other observations or information that would be necessary to generally reconstruct field activities at a later date. At the end of each day of drilling, the drilling supervisor shall complete a daily drilling/field log.

The lithology/stratigraphy encountered in drilled borings and test pits will be logged by the field geologist or engineer on field forms. At drilled boring locations, unconsolidated samples for lithologic description will generally be obtained at 5-foot intervals during drilling and/or at depths specified for analytical (physical and/or chemical) sample collection. Information on the boring/test pit logs will include the exploration location; general information about drilling/excavation field activities; sampling information such as sample intervals/depths, sample recoveries (for dilled borings), and drilling hammer blow counts; and sample description information. Lithologies encountered will generally be described in accordance with ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). In addition, identification of the Unified Soil Classification System (USCS) group symbol will be recorded on the field logs.

Besides the information noted above, additional information to be recorded on field logs includes depth to groundwater/saturated soil, extent of borehole/test pit caving or sloughing (if observed), the presence of heaving sand, changes in drilling rate, and other noteworthy observations or conditions, such as the apparent depths of lithologic contacts.

Management of investigation-derived waste (IDW) generated during drilling/test pit excavation (e.g., soil cuttings, stockpiled contaminated soil) is discussed in Section 3.14.

3.2.1 Field Screening

Soil samples will be field-screened for evidence of possible contamination. Field screening results will be recorded on the field logs and the results will be used as a general guideline to delineate areas of possible contamination. Screening results will be used to aid in the selection of soil samples that will be be submitted for chemical analysis, but will not serve as the only criteria; other factors to be considered include sample locations relative to other known or suspected contamination in the area. The following field screening methods will be used: (1) visual screening, (2) water sheen screening, and (3) headspace vapor screening.

3.2.1.1 VISUAL SCREENING

The soil will be observed for unusual color or staining that may be indicative of contamination.

3.2.1.2 WATER SHEEN SCREENING

This is a qualitative field screening method that can help identify the presence or absence of petroleum hydrocarbons. A portion of the soil sample will be placed in a pan containing distilled water. The water surface will be observed for signs of sheen. The following sheen classifications will be used:

Classification	Identifier	Description
No Sheen	(NS)	No visible sheen on the water surface
Slight Sheen	(SS)	Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly
Moderate Sheen	(MS)	Light to heavy sheen; may have some color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on the water surface
Heavy Sheen	(HS)	Heavy sheen with color/iridescence; spread is rapid; entire water surface may be covered with sheen

3.2.1.3 HEADSPACE VAPOR SCREENING

This is a semi-quantitative field screening method that can help identify the presence or absence of volatile chemicals. As soon as possible after collecting a soil sample, a portion of the sample is placed in a resealable plastic bag for headspace vapor screening. Ambient air is captured in the bag; the bag is sealed, left for approximately 5 minutes, and then shaken gently for approximately 10 seconds to expose the soil to the air trapped in the bag. Vapors present within the sample bag's headspace are measured by inserting the probe of a photoionization detector (PID) through a small opening in the bag. A PID measures the concentration of organic vapors ionizable by a 10.6 electron volt lamp (standard) in parts per million (ppm) and quantifies organic vapor concentrations in the range between 0.1 ppm and 2,000 ppm (isobutylene-equivalent) with an accuracy of 1 ppm between 0 ppm and 100 ppm. The maximum ppm value will be recorded on the field report for each sample. The PID will be calibrated to 100 ppm isobutylene.

3.3 Soil Sampling

Soil samples will be collected from borings (drilled with a hollow stem auger [HSA] rig) and from test pits excavated with a backhoe or excavator. The following subsections describe each type of soil sampling.

3.3.1 Hollow Stem Auger Borings

Soil samples will be collected from the HSA borings for lithologic logging and chemical analysis using a decontaminated split-barrel sampler. The first two samples collected from each boring, will be obtained at depths of approximately 2 feet and 5 feet below ground surface (bgs). The remaining soil samples will be collected at approximately 5-foot intervals to the.bottom of the boring. The split-barrel sampler will be driven into undisturbed soil by a 140-pound or 300-pound hammer falling a vertical distance of approximately 30 inches. The number of hammer blows required to advance the sampler the final 18 inches will be recorded on the boring logs.

Soil samples to be submitted for chemical analysis will be removed from the sampler, placed into laboratory-supplied containers, lightly packed, and capped with a plastic lid (with the exception of sample aliquots for VOCs analysis, which will be collected using EPA Method 5035A). The sand-sized and finer fractions of the soil will be targeted for collection. Samples will be selected for analysis based on field screening results and/or sample depth relative to the ground surface or depth of groundwater. The sample containers will be retained on ice and delivered under chain-of-custody (COC) to the analytical laboratory.

At select boring locations, an attempt will be made to collect samples of the glacial deposits underlying surficial fill and native beach deposits from select borings (see Table 1). Samples of the glacial deposits will be submitted for chemical and/or grain size (sieve) analysis (ASTM D422). In addition, one or more samples of the glacial deposits obtained from boring GWG-6 will be submitted for constant-head permeability analysis if sufficient undisturbed sample volume can be obtained (if cohesive soil, ASTM D5084 [flexwall analysis]; if sandy soil, ASTM D2434 [rigidwall analysis]).

Depending of the volume of soil sample required at each location, multiple drives with the sampler may be required. In this case, the auger flights will be advanced at least to the depth reached by the sampler prior to collection of the next drive sample. Multiple sampler drives will not be conducted over the same depth interval.

Subsurface debris or structures may be encountered in the subsurface, resulting in drilling refusal. Based upon the initial field inspection of planned boring locations, if it is impractical to relocate a boring where obstructions are observed or expected, special sampling equipment may be required to complete the boring at the planned location. This may include a concrete coring device, special drill rig, or excavator equipped with a breaker bar. Procedures for these operations are typically equipment-specific, and will be incorporated into the plan as necessary. In no case should foreign material (such as surface asphalt residue or concrete coring cuttings) be included in a collected sample that is not obviously a part of the in situ soil matrix.

Reusable equipment used to obtain soil samples (e.g., split-barrel samplers) will be decontaminated prior to each use using an aqueous Alconox® or Liqui-Nox® solution and a distilled water rinse as described in Section 3.11.

3.3.2 Test Pits

Subsurface conditions at the subject property will be evaluated by completing test pits using a rubber-tire backhoe or track-mounted excavator. The field geologist or engineer will observe subsurface conditions in the test pits and document observed lithologies in general accordance with ASTM D-2488. A test pit log will be prepared for each test pit exploration. The log will include a summary of the soil and groundwater conditions observed and field screening results as described in Section 3.2.

Soil samples will be obtained from the test pit excavations and a minimum of two soil samples will be submitted for analysis from each test pit based on field screening results (one sample from less than 2 feet bgs and one sample from greater than 2 feet bgs). Additional samples will be collected as needed based on observed conditions in the field. If possible, samples will be collected from the backhoe or excavator bucket without entering the test pit. Samples may be collected directly from the walls or floor of the test pit, provided that the HASP (Appendix C of Work Plan) is adhered to and Occupational Safety and Health Administration (OSHA) regulations are followed when entering an excavation.

Soil samples obtained from test pits shallower than 4 feet bgs will be obtained directly from the test pit sidewalls using a stainless steel sampling spoon or a hand trowel. Soil on the exposed test pit sidewall will not be sampled, because it has been contacted by the backhoe/excavator bucket. This surficial soil will be removed using a stainless steel sampling spoon or trowel, and the underlying undisturbed soil exposed during this process will then be sampled.

Test pit soil samples obtained from depths greater than 4 feet bgs will be obtained directly from the backhoe/excavator bucket. These samples will be obtained from the center of the bucket using the procedures described above.

The samples will be placed into laboratory-supplied containers, lightly packed and capped with a plastic lid (sample aliquots for VOCs analysis will be collected using EPA Method 5035A). The sand-sized and finer fractions of the soil will be targeted for collection. The sample containers will be retained on ice and delivered under COC to the analytical laboratory.

Equipment used to obtain soil samples (e.g., backhoe/excavator bucket, spoons, trowels) will be decontaminated prior to each use using an aqueous Alconox® or Liqui-Nox® solution and a distilled water rinse as described in Section 3.11.

If evidence of significant soil contamination (e.g., heavy staining/sheens or high PID readings) is not observed in soil excavated from the test pits, the soil will be returned to the test pit in the reverse order in which it was excavated, and compacted using the backhoe or excavator bucket. If evidence of significant soil contamination is observed, the excavated soil will either be segregated and stockpiled for subsequent waste characterization and off-property disposal or transported directly to an off-property, permitted disposal facility based on the results of previous soil analytical testing at the location of the test pit. As described in the Work Plan, no more than 100 cubic yards of contaminated material will be removed for off-property disposal during the supplemental investigation. Test pits from which contaminated material is removed for disposal will be backfilled with clean fill material.

3.4 Monitoring Well Construction

Monitoring wells will be installed using HSA drilling methods. Monitoring well construction details will be recorded on field forms/logs. Well construction elements are discussed below.

3.4.1 Borehole

Borehole diameters and the inside diameter of the HSA augers will be at least 4 inches larger than the outside diameter of the well casing and screen.

3.4.2 Well Casing

The monitoring wells will be constructed using 2-inch diameter, Schedule 40, threaded, polyvinyl chloride (PVC) casing that meets the following requirements: (1) casing will be new/previously unused and will be decontaminated if necessary as described in Section 3.11; (2) glue will not be used to join casing sections; casing sections will be joined only by tightening of threaded couplings; and (3) casing will be straight and plumb.

3.4.3 Well Screen

Monitoring wells will generally be screened to the top of the glacial deposits, with screen intervals not to exceed 20 feet in length. Some monitoring wells may be screened across the water table to monitor for the presence of light non-aqueous phase liquid (LNAPL) in portions of the property where LNAPL is encountered or suspected to be present based on previous exploration activities. Depending on the time of year of well installation, between 1 and 3 feet of well screen will be installed above the groundwater table as observed during drilling. Well screen lengths will not exceed 20 feet.

Well screens will consist of 2-inch diameter, Schedule 40, 0.010-inch machine-slotted, PVC well screens. PVC end caps will be installed on the bottom of the well screens.

The 0.010-inch slot size was selected based on review of boring logs from the existing monitoring wells, which indicate that the shallow water-bearing zone consists primarily of silty, fine to medium sands with minor amounts of gravel. Because of the fine-grained nature of this material, a larger slot size could allow more fine-grained material to enter the well than desired.

3.4.4 Filter Pack

The filter pack for the wells will consist of silica sand with the appropriate grain size distribution to limit entry of fine-grained particulates from the surrounding formation into the wells (e.g., 10-20 or 20-40 sand). The filter pack will extend from the bottom of the well screen to at least 1 foot above the top of the well screen. In areas where groundwater is less than 4 feet bgs, the filter pack may be installed flush with the top of the well screen. The top of the sand pack will be sounded to verify its depth during placement.

3.4.5 Annular Seal

The annular seal will consist of a minimum 1-foot thick layer of hydrated bentonite pellets or chips installed between the filter pack and the concrete surface seal.

3.4.6 Surface Completion

Depending on the location of each well, the surface completions will consist of either flush completions or aboveground completions. These two types of surface completions are described below.

For flush completions, the well casing will be cut approximately 3 inches bgs, and a locking j-plug (compression) or similar well cap will be installed to prevent surface water from entering the well. The well monument will be installed in a concrete surface seal. The well number will be marked on the well monument lid and/or the well cap. Where vehicular traffic may pass over the well, the concrete surface seal and well monument will be constructed to meet the strength requirements of surrounding surfaces.

Aboveground completions will consist of steel or aluminum outer protective casing installed in a concrete surface seal and extending at least 4 inches above the top of the PVC well casing. A lockable monument cap will be installed on top of the protective casing. A weep hole will be drilled in the side of the protective casing, several inches above the ground surface, to allow for water drainage. Three steel protective posts (3 inches minimum diameter) will be placed in a triangular pattern around the protective casing. The posts will be installed at least 2 feet away from the protective casing and will extend at least 3 feet above and below the ground surface.

Monitoring wells will be secured with locks as soon as possible after drilling. Corrosion-resistant locks will be used. Wherever possible, keyed-alike locks will be used.

3.5 Monitoring Well Development

The new monitoring wells will be developed no sooner than 24 hours after installation to allow the bentonite annular seals to cure. In addition, prior to the baseline groundwater monitoring event, the existing wells (MW-23, MW-28, MW-29, MW-51 to MW-59, PZ-2 to PZ-7, PZ-9 to PZ-13, and PA-19) will be redeveloped using the methods described below. At least 48 hours will be allowed to pass after well development before the first round of sampling is conducted to allow the surrounding water-bearing zone to recover from well installation and development.

Before each well is developed, the depth to water in the well and the total well depth will be measured, and the well will be checked for the presence of LNAPL. The new and existing monitoring wells will be developed using a combination of surging and purging. The wells will be purged until at least five well casing volumes have been removed and turbidity has stabilized. The target turbidity is less than 10 nephelometric turbidity units (NTU). (Note that this is only a target, and may not be achieved in all wells.) Water quality parameters (e.g., temperature, pH, conductivity, turbidity) will be measured and recorded on field logs during well purging.

3.6 Groundwater Monitoring

Groundwater monitoring events will be timed with the tidal cycle to minimize the effects of saltwater intrusion (e.g., the wells will be sampled at approximately low-tide or the beginning of incoming tide).

During the baseline groundwater monitoring event, each of the wells in the existing monitoring well network will be sampled for the analytes shown on Table 1. Table 1 also shows the planned analyses for groundwater samples to be collected from new monitoring wells during the first year of quarterly groundwater monitoring.

During each groundwater monitoring event, the wells will be inspected for signs of tampering or other damage. If tampering is suspected (i.e., casing is damaged, lock or cap is missing), this will be recorded in the field report and on the well sampling form and reported to the Project Manager. Wells that are suspected to have been tampered with will not be sampled until the Field Geologist/Engineer has discussed the matter with the Project Manager.

Groundwater monitoring activities will be recorded in field reports, and well purging/sampling data will be recorded on groundwater sampling forms.

The following sections describe the activities to be conducted during each groundwater monitoring event.

3.6.1 LNAPL Thickness/Water Level Measurement

LNAPL/water level measurements will be performed during each groundwater monitoring event. Standing water inside the outer protective casing or monument around each well casing will be removed prior to opening the well. Wells will be opened and allowed to vent for at least 10 minutes prior to water level measurement.

A decontaminated interface probe will be used to check for the presence of LNAPL in each well. The groundwater level and thickness of any LNAPL layer in the well will then be measured to the nearest 0.01 feet using the interface probe. Water levels will be measured from a permanent mark located at the top of the well casing.

If LNAPL is encountered in a well, the thickness of the LNAPL layer will be calculated by subtracting the depth to LNAPL from the depth to groundwater. The water level measurements (and LNAPL thickness, if applicable) will be recorded on the groundwater sampling form.

Following water level measurement, the total depth of the well from the top of the casing will be measured using a weighted measuring tape or electronic sounding device and recorded on the groundwater sampling form. The depth to groundwater will then be subtracted from the total depth of the well to determine the height of the water column present in the well casing.

During each groundwater monitoring event, water level measurements will be taken at all monitoring wells at least once within a single 24-hour period to determine the elevation of the groundwater table and provide the data needed to prepare groundwater contour (potentiometric) maps for each monitoring event. Any known conditions (e.g., unusually low or high barometric pressure) that may affect groundwater levels will be recorded in the field report.

LNAPL/water level measuring equipment will be decontaminated between each well according to the procedures described in Section 3.11.

3.6.2 Well Purging Prior to Sampling

Monitoring wells will be purged prior to sampling using low-flow methods, to evacuate standing water in the well that may not be representative of groundwater in the surrounding formation.Before the start of purging/sampling activities, plastic sheeting will be placed on the ground surrounding the well, if necessary, to provide a clean working area around the well and to reduce the possibility of soil contaminants contacting groundwater sampling equipment.

Well purging will be accomplished using new dedicated tubing and a portable peristaltic pump, submersible pump, or bladder pump. The pump intake will be placed near the middle of the well screen interval, and the well will be purged at a target rate of 250 to 500 milliliters (mL) per minute. A flow-through cell and portable water quality meter(s) will be used to monitor water quality parameters during purging. Shoreline wells will be purged and sampled during or immediately after low tide to minimize saltwater intrusion. The wells will be purged until water quality parameters have stabilized. Stabilization goals are as follows:

- Temperature ± 1°C
- pH ± 0.1 pH units
- Salinity and/or conductivity/specific conductance ± 3 percent
- Dissolved oxygen ± 0.3 milligrams per liter
- Redox potential (Eh) ± 10 mV
- Turbidity <10 NTU (if 10 NTU cannot be achieved, then ± 10 percent)

The calibration of the portable water quality meter will be checked in accordance with manufacturer specifications prior to use.

3.6.3 Groundwater Sample Collection

Groundwater samples will be collected after water quality parameters have stabilized as discussed above.

Groundwater samples at each well will be collected using a peristaltic pump, submersible pump, or bladder pump and analyzed for the constituents listed in Table 1. Both unfiltered (total) and field-filtered (dissolved) groundwater samples will be collected for metals analysis. Groundwater samples will be collected directly from the pump discharge tubing after disconnecting the tubing from the flow-through cell. Samples for dissolved metals will be field-filtered by attaching a 0.45 micron filter directly in-line with the discharge tubing. Groundwater samples will be collected in labeled, precleaned sample bottles provided by the analytical laboratory. The sample containers will be retained on ice and delivered under COC to the analytical laboratory.

Required sample containers, preservation methods, volumes, and holding times are summarized in Table 4 of the QAPP.

Reusable sampling equipment will be decontaminated prior to commencing sampling activities, and between each well, as discussed in Section 3.11.

3.7 Groundwater Grab Sampling

Groundwater grab samples will be collected using a HSA rig equipped with a Hydropunch® or similar discrete-depth groundwater sampling device. At most locations, the groundwater sampling device will be advanced approximately 2 to 3 feet below the first encountered groundwater and then the shroud/sleeve will be pulled back to expose the screened section of the device. At sample location GWG-6 (and possibly other, subsequent locations in this area, depending on the VOC analytical results at GWG-6), multiple discrete-depth groundwater samples will be collected. At these locations, groundwater will be sampled at first encountered groundwater and at roughly 5-foot intervals thereafter to the depth of the glacial deposits. In addition, an attempt will be made to obtain a groundwater sample from approximately 6 feet below the top of the glacial deposits.

Groundwater grab samples will be obtained using a portable peristaltic pump after measuring water quality parameters with a portable water quality meter. After the requisite groundwater samples are collected from each boring, the sampling device and rod/augers will be removed and the boring abandoned by filling with bentonite or a bentonite/cement grout. New polyethylene pump tubing will be used for each sample, and rods and the sampling device and rod/augers will be decontaminated between borings.

Prior to collecting samples, the pump tubing will be purged for several minutes. Water quality parameters (temperature, pH, salinity and/or conductivity/specific conductance, dissolved oxygen, redox potential, and/or turbidity) will be measured with a portable water quality meter immediately before samples are collected. Groundwater samples will be collected in labeled, precleaned sample bottles provided by the analytical laboratory. The sample bottles will be sealed, retained on ice, and delivered under COC to the analytical laboratory.

Grab groundwater samples will be analyzed for the constituents listed in Table 1. Both unfiltered (total) and field-filtered (dissolved) groundwater samples will be collected for metals analysis. Groundwater samples will be collected directly from the pump discharge tubing after disconnecting the tubing from the flow-through cell. Samples for dissolved metals will be field-filtered by attaching a 0.45 micron filter directly in-line with the discharge tubing.

Required sample containers, preservation methods, volumes, and holding times are summarized in Table 4 of the QAPP.

Reusable sampling equipment will be decontaminated prior to commencing sampling activities, and between each groundwater grab sampling location, as discussed in Section 3.11.

3.8 Groundwater Seep Survey and Sampling

Field reconnaissance will be conducted to look for groundwater seeps along the shoreline adjacent to the mill property. An attempt will be made to identify seeps emanating from the intertidal zone sediments as described in the Work Plan.

If groundwater seeps are observed, up to seven seep monitoring stations will be installed. The monitoring station locations will be selected during field reconnaissance based on field observations (Table 1). It is anticipated that one seep monitoring station per seep zone will be adequate, but adjustments may need to be made following the seep survey. The seep monitoring stations will consist of 6- to 7-foot long, 2-inch diameter PVC wells manually installed approximately 5 feet below the exposed sediment surface at low tide. The wells will be installed in shallow boreholes excavated using spades, post-hole diggers, hand augers, or similar hand tools. The annular space around the screens will be filled with clean filter pack sand and a quick-setting concrete surface seal. The aboveground portion of the well will be protected by an outer steel casing, and the annular space between the PVC and steel casings will be filled with quick-setting concrete. A well variance will be obtained from Ecology as necessary due to certain construction details that differ from Washington State Well Construction Standards (i.e., no bentonite annular seal and no protective bollards).

Sediment pore water samples will be collected from the monitoring stations at low tide. The pore water samples will be collected using the same methods used to collect groundwater grab samples (see Section 3.7). Pore water samples will be collected in labeled, precleaned sample bottles provided by the analytical laboratory. The sample bottles will be sealed, retained on ice, and delivered under COC to the analytical laboratory.

Reusable sampling equipment will be decontaminated prior to commencing sampling activities, and between each groundwater seep sampling location, as discussed in Section 3.11.

3.9 Surface Water Sampling

A total of five surface water samples will be collected. Three surface water samples will be collected from Ennis Creek, on the north side of the bridge at the mouth of the creek. One sample will be collected from the west bank of creek, one sample will be collected from the middle of the creek, and one sample will be collected from the east bank of the creek. Surface water sampling at the mouth of Ennis Creek will be conducted at low tide to the extent possible to minimize saltwater dilution.

Farther upstream, near the southeastern property boundary, one surface water sample will be collected from Ennis Creek and one surface water sample will be collected from White Creek.

The surface water samples will be obtained using a precleaned Teflon or glass cup or jar affixed to the end of a long wooden or metal handle. The samples will be collected immediately below the water surface, in areas that are visually free of floating debris or suspended sediment (to the extent possible). A portion of the collected sample will be poured slowly into labeled, precleaned sample bottles provided by the analytical laboratory. The sample bottles will be sealed, retained on ice, and delivered under COC to the analytical laboratory. Surface water samples will be analyzed for the constituents listed in Table 1.

A second aliquot of each surface water sample will be transferred to a clean jar for measurement of water quality parameters (salinity and/or conductivity/specific conductance, temperature, pH, dissolved oxygen, redox potential, and/or turbidity) using a portable water quality meter. Surface water sampling activities and measured water quality parameter values will be recorded on field forms and summarized in field reports.

Reusable sampling equipment will be decontaminated prior to commencing sampling activities, and between each surface water seep sampling location, as discussed in Section 3.11.

3.10 Pipe Contents Sampling

Underground piping previously encountered at Upland RI sampling location SR23 will be exposed using a backhoe, excavator, or vactor truck. A sample of the pipe contents (referred to in the 2007 Upland RI Report as "black liquid") will be collected and analyzed for the parameters shown in Table 1.

In addition to the sampling at location SR23, if groundwater grab sampling results indicate possible piping releases in other areas, targeted test pits may be excavated in those areas using a backhoe, excavator, or vactor truck to expose underground piping (if present) that could potentially contain hazardous substances. Samples of pipe contents (if contents are present) will be collected by carefully cutting open the top of the exposed pipe and using a peristaltic pump (if the contents are liquids) or a stainless steel sampling spoon or hand trowel (if the contents are sludges or solids) to obtain the samples. Samples will be transferred to labeled, precleaned sample bottles provided by the analytical laboratory. The sample bottles will be sealed, retained on ice, and delivered under COC to the analytical laboratory. Pipe contents samples will be collected and analyzed for the parameters shown in Table 1.

3.11 Decontamination Procedures

To prevent cross-contamination of collected samples, reusable equipment used to collect samples will be decontaminated prior to sample collection using the following procedures. Deviations from these procedures, if any, will be documented in field notes/logs.

3.11.1 Drilling Equipment

For large pieces of drilling equipment (such as augers, drill rods, drill bits, and those portions of the drill rig that may be positioned directly over a boring location), the following procedure will be used to decontaminate the equipment between borings and upon completion of drilling activities. The equipment will be pressure-washed and, if necessary, scrubbed to remove visible dirt, grime, grease, oil, loose paint, rust flakes, etc. The equipment will then be rinsed with potable water.

Soil and groundwater sampling devices (e.g., split-barrel soil sampler, Hydropunch® groundwater sampler) will be cleaned using an aqueous Alconox® or Liqui-Nox® solution and a distilled water rinse before each sample is collected.

3.11.2 Excavation Equipment

The backhoe bucket, excavator bucket, or vactor truck collector pipe will generally be pressure-washed before each test pit and upon completion of excavation activities. If pressure-washing is not used, decontamination of the backhoe/excavator bucket or vactor truck collector pipe will consist of: (1) washing with an aqueous Alconox® or Liqui-Nox® solution; and (2) rinsing with potable water.

3.11.3 Reusable Sampling Equipment

Whenever possible, disposable sampling equipment will be used to minimize the need for decontaminating equipment. Prior to and between sample collection, reusable sampling equipment that comes in contact with soil, pipe contents, sediment, surface water, or groundwater will be decontaminated. Reusable sampling equipment may include split-barrel soil samplers, groundwater sampling pumps, interface probes, sounding tapes, surface water samplers, trowels, spoons, and other hand tools or sampling/measuring devices.

For soil sampling equipment, excess soil will first be removed from the equipment. The equipment will then be pressure-washed or washed using an aqueous Alconox® or Liqui-Nox® detergent solution and a brush. Detergent will be used to clean surfaces of sampling tools that directly contact samples (e.g., split-barrel core sampler); equipment that does not directly contact samples (e.g., augers or backhoe buckets) will be pressure-washed. Following washing, the equipment will be rinsed with distilled water. Decontaminated equipment will be temporarily staged on clean plastic sheeting, wrapped or covered with aluminum foil, and/or stored in a clean, dry place.

Oil-water interface probes and electronic water level indicators/well sounders used for well gauging will be decontaminated before and after use at each well. Decontamination will be performed as follows:

1. Wipe off any visible LNAPL with disposable towels.
2. Clean measurement probe and tape with an aqueous Alconox® or Liqui-Nox® solution.
3. Rinse with distilled water.
4. If necessary to ensure complete removal of residual LNAPL, measuring devices may also be cleaned with acetone or isopropyl alcohol (IPA) at this stage. If acetone or IPA is used, steps 2 and 3 (with fresh solutions) will be repeated.

If submersible (centrifugal) or bladder-type groundwater purging and sampling pumps are used, they will be decontaminated before and after each use by washing the exterior with an aqueous Alconox® or Liqui-Nox® solution and a brush. The interior of the pump and may be cleaned by first pumping an aqueous Alconox® or Liqui-Nox® solution through the system, followed by distilled water. Dedicated pumps, if used, will not be decontaminated or removed from the wells.

3.11.4 Monitoring Well Casing/Screen and Well Development Equipment

Unless brought to the work site in sealed plastic wrappers, new, visually-clean well casings and screens will be pressure-washed before they are installed. Additionally, well development equipment (surge block, development pump) will be pressure-washed before use at each well.

3.11.5 Sample Containers

Precleaned sample bottles and jars will be supplied by the subcontracted analytical laboratory. The sample containers will be protected from contact with dust, dirt, and other potential sources of cross-contamination. Sample containers will not be reused.

3.11.6 Used Decontamination Water

Used decontamination water will be stored on-property in labeled 55-gallon drums for subsequent characterization and off-property disposal at a permitted facility. IDW management is discussed in Section 3.14.

3.12 Field Documentation

Three primary types of field documentation will used for this project: field reports (and field forms), sample container labels, and chain-of-custody (COC) forms. A description of each of these documentation methods is provided in the following sections.

3.12.1 Field Reports

Field reports are intended to provide a sufficient record of observations and data to enable participants to reconstruct events that occur during project field activities. They contain factual, detailed, and objective information.

Field reports will be used to document the field and sampling activities performed at the project site for each day of field work. Field reports will include the date, time, description of field activities performed, names of personnel and site visitors, weather conditions, areas where photographs were taken (if applicable), and any other data pertinent to the project. Field reports will also contain sample collection and identification information and (if appropriate) a drawing of each area sampled, along with the locations (coordinates) where samples were collected. Sample data recorded in field reports will include the sample date, time, location, identification number, matrix, collection method, analyses to be performed, any comments, and the sampler's name. Locations and unique identification of soil samples collected from excavations or stockpiles will be recorded in the field report or an attached site map, and/or other appropriate form. Field reports will also document any safety issues; quality control samples collected (e.g., duplicate samples, equipment rinsate blanks); calibration checks of field monitoring/measuring instruments (e.g., PID, water quality meter); field measurements; and IDW disposition (e.g., number of drums generated and their contents and location).

Soil boring and well installation information will be recorded on boring logs and well logs attached to the field report. A groundwater/well sampling and/or development record will be used for each well to record the information collected during water sampling and/or well development.

Following review by the project manager, the original field records will be kept in the project file.

3.12.2 Sample Labels

Sample containers will be clearly labeled with waterproof black ink at the time of sampling. Sample labels will include the following information:

- Project/site name;
- Sampling date;
- Sampling time;
- Sample identification number;
- Preservation used, if any; and
- Initials of sampler.

The same information entered on the sample label will be recorded on the COC form and in the field report.

3.12.3 Chain-of-Custody Forms

Samples will be retained in the field crew's custody until samples are delivered to the analytical laboratory. After samples have been collected and labeled, they will be maintained under COC procedures. These procedures document the transfer of custody of samples from the field to the laboratory. Each sample sent to the laboratory for analysis will be recorded on a COC form.

The COC form documents sample names, dates, times, and analyses to be performed for each sample, as well as all transfers of sample custody from the field to the analytical laboratory. The COC form will be completed using waterproof ink. Any corrections will be made by drawing a line through and initialing and dating the change, then entering the correct information.

When transferring custody of samples, the individuals relinquishing and receiving them will sign, date, and note the time on the COC form. Sample coolers shipped by common carrier will have the COC form enclosed in a resealable plastic bag and placed in the sample cooler prior to sealing the cooler for shipping. Custody seals will be used on sample coolers that are shipped by common carrier or delivered by courier to the laboratory. The sample shipping receipt will be retained in the project files as part of the COC documentation. The shipping company will not sign the COC forms as a receiver; instead the laboratory will sign as a receiver when the samples are received. Internal laboratory records will document custody of the samples from the time they are received through final disposition.

3.13 Surveying

Exploration locations will be surveyed by GeoEngineers field crews or a professional land surveyor.

3.13.1 Surveying by Field Crews

3.13.1.1 VERTICAL CONTROLS – LASER LEVEL SURVEYING

Each exploration location or monitoring well casing rim and ground surface elevation will be surveyed by GeoEngineers field personnel using a laser level. Elevations will be referenced to a known elevation, such as a permanent survey benchmark or a nearby well that has been surveyed. The vertical datum for elevation data will be North America Vertical Datum 1988 (NAVD88). The vertical survey will have an accuracy of 0.01 feet.

3.13.1.2 HORIZONTAL CONTROLS – GPS

The horizontal coordinates of exploration locations will be determined using a hand-held Trimble GeoXT® GPS unit or similar equipment. GeoEngineers field personnel will log the exploration location names and coordinates in the GPS unit for subsequent downloading to a computer. GPS data collected in the field will be processed in the office using measurements from the nearest reference station to each data collection point.

3.13.2 Surveying by Professional Land Surveyor

The exploration locations will be marked using stakes and/or flagging to allow surveying of the locations by a Washington-licensed professional land surveyor. The surveyors will measure and record the vertical and horizontal coordinates or each exploration location. Elevations will be measured to the nearest 0.01 feet. Horizontal coordinates will be referenced to the Washington State Plane North coordinate system. The horizontal survey will have an accuracy of 0.10 feet.

3.14 Investigation Derived Waste

IDW will be placed in marked storage containers (e.g., 55-gallon drums). The IDW containers will be staged on-property pending waste characterization for subsequent off-property disposal at a permitted facility. IDW will be managed and disposed according to applicable local, State, and Federal regulations.

3.14.1 Soil

Soil removed from the test pit excavations will be replaced in the excavations if no evidence of significant contamination (e.g., heavy staining/sheens or high PID readings) is observed in the soil. As described in the Work Plan, if evidence of significant contamination is observed, up to 100 cubic yards (total) of contaminated material may be removed for off-property disposal during the field investigation. Soil removed for possible off-property disposal will either be segregated and stockpiled for subsequent waste characterization or transported directly to an off-property, permitted disposal facility based on the results of previous soil analytical testing at the location of the test pit. If utilized, soil stockpiles will be placed on top of, and covered with, plastic sheeting. The soil stockpiles will be staged in a secure location on the property pending receipt of waste characterization analytical results. If the waste characterization results indicate that the soil contains COPC concentrations below the screening levels in Table 1 of the Work Plan, the soil may be utilized as fill at the property. If the waste characterization results indicate that COPCs are present above screening levels, the soil will be disposed of at a permitted facility.

Soil cuttings from borings will be placed in 55-gallon drums marked with the contents, date, and contact information. The drums will be temporarily staged on the mill property pending waste characterization and identification of appropriate disposal options. If the waste characterization analytical results indicate that the soil contains COPC concentrations below the screening levels in Table 1 of the Work Plan, the soil may be utilized as fill at the property. If the waste characterization results indicate that COPCs are present above screening levels, the soil will be disposed of at a permitted facility.

3.14.1 Groundwater and Decontamination Water

Well development and purge water removed from seep stations, monitoring wells and groundwater grab sample locations, and decontamination water generated during sampling activities, will be placed in 55-gallon drums marked with the contents, date, and contact information. The drums will be temporarily staged on the mill property pending waste characterization and identification of appropriate disposal options. If the waste characterization analytical results indicate that the water contains COPC concentrations below the screening levels in Table 2 of the Work Plan, the water may be discharged to the ground surface at the property. If the waste characterization results indicate that COPCs are present above screening levels, the water will be disposed of at a permitted facility.

3.14.2 Incidental Waste

Incidental waste generated during field activities includes items such as disposable personal protective clothing, gloves, and sampling supplies such as aluminum foil, paper towels, plastic bags/sheeting, and similar discarded materials. These materials are considered deminimis and will be placed in plastic garbage bags or other appropriate containers. These containers will be removed from sampling areas daily and placed in a central staging area at the mill property. At the completion of the field investigation, incidental waste will be removed from the staging area and disposed of as municipal waste at a local trash receptacle or county disposal facility.

4.0 SAMPLE HANDLING PROCEDURES

4.1 Sample Containers and Preservation

Requirements for sample containers, sample preservation, and sample holding times for the planned laboratory analyses are discussed in the QAPP (Appendix B of the Work Plan).

4.2 Sample Packaging and Shipping

Each sample submitted for laboratory analysis will be assigned a unique identification number, and will be labeled and recorded on field forms and the COC form, as discussed in Section 3.12. Labels for sample containers will be filled out completely with all appropriate information. Samples will then be packed on ice in a cooler for delivery to the analytical laboratory. The samples will be either hand-delivered to the laboratory by field personnel or courier, or shipped via a commercial carrier. Custody seals will be used on sample coolers that are not hand-delivered by field personnel.

Upon receipt of the sample coolers at the laboratory, the custody seals (if present) will be broken, the condition and temperature of the samples will be recorded, and the COC forms will be signed to document transfer of sample custody. The COC forms will be used internally in the laboratory to track sample handling and final disposition.

5.0 LABORATORY ANALYTICAL METHODS

The analytical methods to be used for sample analysis are listed in Table 1. Details regarding analytical methods, sample containers, sample preservatives, and sample holding times are discussed in the QAPP (Appendix B of the Work Plan).

6.0 QUALITY ASSURANCE AND QUALITY CONTROL REQUIREMENTS

The QAPP (Appendix C of the Work Plan) discusses quality assurance and quality control (QA/QC) requirements in detail.

Field QC samples will be used to evaluate the effectiveness of equipment decontamination procedures, potential cross-contamination of samples during transport to the laboratory, reproducibility of laboratory results, and sample heterogeneity. Field QC samples will consist of equipment rinsate blanks, trip blanks, and field duplicates, and will be documented in the field report. Details regarding the field QC samples to be collected and analyzed are provided in Section 7.1 of the QAPP.

TABLE 1
FIELD INVESTIGATION SUMMARY
PORT ANGELES RAYONIER MILL SITE
PORT ANGELES, WASHINGTON

Investigation Phase	Agreed Order Exhibit B Data Gap Number(s)	Location [1]	Planned Activities	Number of Sampling Locations	Sample Location ID	Sampling Depth	Analytes [2]										
							TPH-Gx	TPH-Dx	SVOCs (incl. cPAHs)	VOCs	PCBs	Pesticides	Metals			Dioxins/ Furans	Ammonia
													Large Suite [3]	Small Suite [4]	Lead		
							Ecology NWTPH-Gx	Ecology NWTPH-Dx	EPA 8270/8270-SIM (Standard & Low-Level), EPA 8041	EPA 8260/8260-Low level [5]	EPA 8082-Low level	EPA 8081A-Low level [6]	EPA 6000/7000 series (incl. 7740 for selenium), EPA 200.8			EPA 1613 Modified-Low level	EPA 350.1
Phase 1 - Baseline Groundwater Sampling, Seep Survey, Surface Water Sampling	10	Existing monitoring wells installed during and prior to RI; City of Port Angeles CSO investigation well PA-19	Redevelop monitoring wells	24	MW-23, MW-28, MW-29, MW-51 to MW-59, PZ-2 to PZ-7, PZ-9 to PZ-13, PA-19	–		NA									
			Collect baseline groundwater samples from monitoring wells [8]			–	x	x	x	x	x	x	x			x	x
	1	Beach area (intertidal zone) along shoreline	Conduct seep survey	–	–	–		NA									
	1	Ennis Creek, downgradient of Finishing Room Area	Collect surface water samples (one from middle of creek, one from east bank, and one from west bank)	3	SW-1 to SW-3	Approximately 6 inches below the water surface	x	x	x		x	x		x		x	x
	–	Ennis Creek and White Creek, near southeastern property boundary	Collect surface water samples.	2	SW-4 and SW-5	Approximately 6 inches below the water surface	x	x	x		x	x	x			x	x
Phase 2 - Groundwater Grab Sampling, Soil Borings, and Monitoring Well Installation and Sampling	3	Adjacent to wastewater drain piping	Collect groundwater grab samples	5	GWG-1 to GWG-5	First-encountered GW		TBD									
	2		Collect soil samples	1	GWG-1	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]										x	
	2		Collect soil samples	1	GWG-4	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]		x			x	x					
	2		Collect soil samples	1	GWG-5	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]			x		x	x	x				
	9	Former MW-13 location	Collect discrete-depth groundwater grab samples	1	GWG-6	Sample GW every 5 ft to glacial deposits. In addition, attempt to obtain a GW sample approximately 6 ft below fill/glacial deposits contact.				x							
			Collect soil samples			Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7] In addition, attempt to obtain a soil sample approximately 6 ft below the fill/glacial deposits contact.				x [9]							
	–	Near City of Port Angeles CSO investigation well PA-19	Collect groundwater grab samples	3	GWG-7 to GWG-9	First-encountered GW		x	x		x		x				
			Collect soil samples			Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, etc., to first-encountered GW.		x	x		x		x				
	5, 8	Downgradient of Fuel Oil Tanks 1 and 2 Area and Hog Fuel Pile Area	Install monitoring wells (and collect soil samples)	2	MW-60 and MW-61	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7] Wells to be screened to top of glacial deposits with screen interval not to exceed 20 ft.		x	x		x				x		
			Collect groundwater samples from monitoring wells [8]			–	x	x	x	x	x	x	x			x	x
	4, 7	Downgradient of Finishing Room Area	Install monitoring well (and collect soil samples)	1	MW-62	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7] Well to be screened across the water table.		x	x		x						
			Collect groundwater sample from monitoring well [8]			–	x	x	x	x	x	x	x			x	x
	1, 2	Between the Finishing Room Area and existing well PZ-9	Install monitoring well (and collect soil samples)	1	MW-63	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7] Wells to be screened to top of glacial deposits with screen interval not to exceed 20 ft.		x	x		x	x	x				
			Collect groundwater sample from monitoring well [8]			–	x	x	x	x	x	x	x			x	x
	2	Upgradient	Install monitoring wells (and collect soil samples)	Up to 4	MW-XX to MW-XX	TBD		TBD									
			Collect groundwater samples from monitoring wells [8]			–		TBD									
	2	Between previous sampling locations AP02 and AP03	Collect soil samples	1	SSB-1	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]			x		x	x	x			x	
	2	Adjacent to well MW-23	Collect soil samples	1	SSB-2	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]		x	x		x	x	x				
	2	Adjacent to previous sampling location MS20	Collect soil samples	1	SSB-3	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]			x								

Investigation Phase	Agreed Order Exhibit B Data Gap Number(s)	Location [1]	Planned Activities	Number of Sampling Locations	Sample Location ID	Sampling Depth	Analytes [2]										
													Metals				
							TPH-Gx	TPH-Dx	SVOCs (incl. cPAHs)	VOCs	PCBs	Pesticides	Large Suite [3]	Small Suite [4]	Lead	Dioxins/ Furans	Ammonia
							Ecology NWTPH-Gx	Ecology NWTPH-Dx	EPA 8270/8270-SIM (Standard & Low-Level), EPA 8041	EPA 8260/8260-Low level [5]	EPA 8082-Low level	EPA 8081A-Low level [6]	EPA 6000/7000 series (incl. 7740 for selenium), EPA 200.8			EPA 1613 Modified-Low level	EPA 350.1
Phase 2 (continued)	2	Adjacent to previous sampling location MCH0007	Collect soil samples	1	SSB-4	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]					x		x				
	2	Adjacent to previous sampling location LC-2	Collect soil samples	1	SSB-5	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]					x						
	2	Near previous sampling locations BL01 and BL02 and MW-58	Collect soil samples	1	SSB-6	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]					x	x					
	2	Near previous sampling locations RB01, RB02, and RB04	Collect soil samples	1	SSB-7	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]		x	x		x	x	x			x	
	2	Adjacent to previous sampling location GB08	Collect soil samples	1	SSB-8	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]							x				
	2	Adjacent to previous sampling location PF02	Collect soil samples	1	SSB-9	Obtain soil samples at 2 ft, 5 ft, 10 ft, 15 ft, 20 ft, etc., to glacial deposits. [7]							x				
Phase 3 - Seep Sampling, Process Piping Contents/Soil Sampling, Targeted Soil Sampling/Soil Removal in Interim Action Areas and Potential Source Areas	1	Intertidal sediments	Install seep monitoring stations	Up to 7	SEEP-X to SEEP-X	TBD		NA									
			Collect pore water samples from seep monitoring stations			TBD	x	x	x	x	x	x	x			x	x
	3	RI sampling location SR23	Expose process piping and sample pipe contents	1	PIPE-1-SR23	Approx. 6 ft bgs		x	x	x	x	x	x			x	x
	3	Wastewater drain piping	Expose wastewater drain piping and sample pipe contents	TBD	PIPE-X to PIPE-X	TBD		TBD									
	3	Adjacent to wastewater drain piping	Dig targeted test pits and collect soil samples	TBD	TP-X to TP-X	Minimum of two soil samples per TP based on field screening results (< 2 ft bgs, > 2 ft bgs)		TBD									
	4, 6	Fuel Oil Tanks 1 and 2, Hog Fuel Pile, Machine Shop, and Wood Mill Areas (including former well MW-11 location)	Dig targeted test pits and collect soil samples	17	TP-1 to TP-17	Minimum of two soil samples per TP based on field screening results (< 2 ft bgs, > 2 ft bgs)		x	x		x				x		
	2, 4	Hot spots/potential soil-to-groundwater source areas	Dig targeted test pits and collect soil samples	TBD	TP-X to TP-X	Minimum of two soil samples per TP based on field screening results (< 2 ft bgs, > 2 ft bgs)		TBD									
Phase 4 - "Infill" Monitoring Well Installation and Sampling, Additional Groundwater Characterization for VOCs	1, 2, 4, 6	TBD	Install and sample "infill" monitoring wells [8]	TBD	MW-XX to MW-XX	TBD		TBD									
	9	Near former well MW-13	Complete additional groundwater characterization for VOCs	TBD	GWG-X to GWG-X	TBD		TBD									
Phase 5 - Quarterly Groundwater and Seep Monitoring	10	Property-wide	Collect quarterly groundwater samples from monitoring wells [10]	≥28	MW-23, MW-28, MW-29, MW-51 to MW-59, PZ-2 to PZ-7, PZ-9 to PZ-13, PA-19, MW-60 to MW-XX [10]	--		TBD									
	1	Intertidal sediments	Collect quarterly pore water samples from seep monitoring stations [10]	Up to 7	SEEP-X to SEEP-X	TBD		TBD									

Notes:

Gray shading indicates field activities that will be conducted contingent on results of preceding investigation phases.
TBD = To be determined based on results of sampling completed during preceding investigation phases.
NA = Not applicable
TPH-Gx = Gasoline-range total petroleum hydrocarbons
TPH-Dx = Diesel- and heavy oil-range total petroleum hydrocarbons
SVOCs = Semivolatile organic compounds
cPAHs = Carcinogenic polycyclic aromatic hydrocarbons
VOCs = Volatile organic compounds
PCBs = Polychlorinated biphenyls
TP = Test pit
GW = Groundwater
bgs = Below ground surface
1) Proposed sampling locations are shown in Figure 28 of the Work Plan.
2) Target PQLs are listed in the QAPP.
3) Large suite of metals = confirmed COPCs in soil (antimony, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc).
4) Small suite of metals = confirmed COPCs in groundwater (arsenic, cadmium, copper, lead, manganese, mercury, nickel, selenium, and silver).
5) VOCs analysis to include acrolein and acrylonitrile.
6) Pesticides in water to be analyzed by EPA Method 8081A-Low level with Manchester Extraction.
7) An attempt will be made to collect a sample of the glacial deposits for chemical analysis. Selected samples of glacial deposits will also be submitted for grain size analysis (ASTM D422) and permeability testing (ASTM D5084 or ASTM D2434).
8) Groundwater monitoring wells will be sampled using low-flow purging/sampling methods. Both unfiltered and field-filtered groundwater samples will be collected for metals analysis.
9) Soil samples from glacial deposits will be analyzed for VOCs. Soil samples from fill horizon will be placed on hold at the laboratory for possible follow-up VOC analysis contingent on groundwater and initial soil analytical results from location GWG-6.
10) Monitoring of wells/seep stations and/or analytes with no exceedances of target PQLs for four consecutive quarters will be discontinued.

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Quality Assurance Project Plan

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APPENDIX B
QUALITY ASSURANCE PROJECT PLAN

1.0 PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPP) has been prepared for the Port Angeles Rayonier Mill Site (Site) as part of the Supplemental Upland Data Collection Work Plan (Work Plan). The purpose of the proposed supplemental sampling is to fill existing data gaps in the characterization of the nature and extent of contamination at the Site. This QAPP serves as the primary guide for the integration of quality assurance (QA) and quality control (QC) functions into field activities. It presents the objectives, procedures, organization, functional activities, and specific QA/QC activities designed to achieve data quality objectives (DQOs) established for the project. This QAPP is based on guidelines specified in the Washington State Model Toxics Control Act Cleanup Regulation (Washington Administrative Code [WAC] Chapter 173-340) and on Ecology guidance contained in Ecology Publication #04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology, 2004).

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 the precision, accuracy, representativeness, completeness, and comparability (PARCC) of the data generated meet the specified DQOs to the maximum extent possible.

1.1 Site Description and Background

The Site is a former pulp mill facility located in the city of Port Angeles, Clallam County, Washington, along the north coast of the Olympic Peninsula. Its physical setting includes the southern shore of Port Angeles Harbor adjacent to the Strait of Juan de Fuca. The upland mill property occupies approximately 80 acres, bounded by a high bluff to the south and the harbor shoreline to the north.

The area experienced historical tribal activity until the late 1800s. A sawmill was constructed on the property and briefly operated around 1917. The mill then remained idle until 1929, when Olympic Forest Products (predecessor to Rayonier) purchased the property and began construction of a pulp mill. The pulp mill operated an ammonia-based acid sulfite process to produce dissolving-grade pulps. The mill closed in 1997, and between 2001 and 2004, it was dismantled and demolished. In 1997 to 1998, the U.S. Environmental Protection Agency (EPA) conducted an Expanded Site Inspection (ESI) (E&E, 1998) as part of an evaluation for a possible listing as a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site. An Upland Remedial Investigation (RI) was conducted in 2003 (Integral, 2006). Further information about the Upland Study Area, including potential chemical releases and associated contamination, is presented in the Work Plan.

1.2 Objectives

The main objective of the supplemental upland data collection field investigation is to resolve data gaps regarding potential contaminant sources and the nature and extent of contamination in soil, groundwater, surface water, and groundwater seeps. The specific purpose of this QAPP is to ensure that the data collected are of sufficient quality to support the project objectives.

Project activities, findings, and results will be governed by this QAPP and will be documented accordingly. Significant changes to the QAPP will be provided to Ecology's Cleanup Project Manager for review, with the opportunity to comment on and approve revisions.

1.3 Sampling Design and Schedule

The supplemental investigation will be conducted in five phases. Details of the investigation design, including locations and frequency of sampling, are presented in the Work Plan and the Sampling and Analysis Plan (SAP; Appendix A of the Work Plan).

A preliminary project schedule is included in the Work Plan, and will be revised, as appropriate, as details of the field program are developed.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Key positions associated with project quality are described as follows.

2.1 Principal-in-Charge and Project Manager

The Principal-in-Charge has overall responsibility for executing the project in accordance with contractual requirements. Kurt Anderson is the Principal-in-Charge. The Project Manager is responsible for coordinating and scheduling project activities, implementing the terms and conditions of this QAPP, interfacing with Ecology and other agency personnel, selecting project team members, assigning and coordinating project tasks, determining subcontractor participation, establishing and adhering to budgets and schedules, providing technical oversight, and coordinating production and review of project deliverables. Rob Leet is the Project Manager.

2.2 Field Coordinator

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

- 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.

Robert Miyahira or an alternate designee will be the Field Coordinator.

2.3 Quality Assurance Leader

The QA Leader is responsible for coordinating QA/QC activities as they relate to the acquisition of field data. Specific responsibilities include the following:

- Serves as the official contact for laboratory data QA concerns.
- Reviews and approves the laboratory QA Plan.
- Responds to laboratory data QA needs, answers laboratory requests for guidance and assistance, and resolves issues.
- Monitors laboratory compliance with data quality requirements.
- Ensures that appropriate sampling, testing, and analysis procedures are followed and that proper QC checks are implemented.
- Reviews the implementation of the QAPP and the overall quality of the analytical data generated.
- Maintains the authority to implement corrective actions as necessary.
- Ensures proper implementation of this QAPP.
- Ensures that GeoEngineers and subcontractor personnel have been properly trained as applicable.
- Reviews project policies, procedures, and guidelines and reviews the project activities to ensure the QA program is being properly implemented.
- Responsible for project-related quality aspects related to the collection and chemical analysis of samples, as delegated by the Project Manager.
- Provides oversight of the data development and review process and of subcontracting laboratories.
- Develops detailed scopes of work for the subcontracting laboratories that incorporate the DQOs described in Section 3.0.
- Conducts laboratory audits, as necessary, and data validation activities.
- Enters data into Ecology's Environmental Information Management (EIM) system.

Mark Lybeer is the QA Leader.

2.4 Laboratory Management

The subcontracted laboratories conducting sample analyses for this project are required to obtain approval from the QA Leader before the initiation of sample analysis to assure that the laboratory QA plan complies with the project QA objectives. The Laboratory QA Coordinator administers the Laboratory QA Plan and is responsible for QC. Specific responsibilities of the Laboratory QA Coordinator include:

- Ensure implementation of the laboratory QA plan.
- Serve as the laboratory point of contact.
- Activate corrective action as necessary when analytical control limits are exceeded.
- Issue the final laboratory QA/QC report.
- Administer QA sample analysis.
- Comply with the specifications established in the project plans as related to laboratory services.
- Participate in QA audits and compliance inspections.

The Laboratory's QA Coordinator will be determined once an Ecology-accredited laboratory is chosen.

2.5 Health and Safety

The site-specific Health and Safety Plan (HASP) for the project is contained in Appendix C of the Work Plan. The requirements for health and safety precautions are described in the HASP, including daily health and safety tailgate meetings before the start of work. Tailgate meetings will be documented in the field reports.

The Field Coordinator will be responsible for implementing the HASP during sampling activities. The Project Manager will discuss health and safety issues with the Field Coordinator on a routine basis during the completion of field activities.

The Field Coordinator will terminate any GeoEngineers work activities that do not comply with the HASP. Companies providing services for this project on a subcontracted basis will be responsible for developing and implementing their own HASP.

3.0 DATA QUALITY OBJECTIVES

The overall DQO for the project is to collect environmental sampling data of known, acceptable, and documentable quality. The specific objectives established for the project are:

- Implement the procedures outlined herein for field sampling, sample custody, equipment operation and calibration, laboratory analysis, and data reporting to ensure consistency and thoroughness of data generated.
- Achieve the level of QA/QC required to produce scientifically valid analytical data of known and documented quality. This will be accomplished by establishing criteria for data precision, accuracy, representativeness, completeness, and comparability, and by evaluating project data against these criteria.

In general, the sampling design, field procedures, laboratory procedures, and QC procedures established for this project were developed to provide defensible data. Specific data quality factors that may affect data usability include quantitative factors (precision, bias, accuracy, completeness, and reporting limits) and qualitative factors such as representativeness and comparability. The specific DQOs associated with these data quality factors are discussed below. Method-specific DQOs for laboratory analyses are presented in Tables 1 and 2.

3.1 Analytes and Matrices of Concern

Samples of soil, surface water, groundwater, and process pipe contents (if present) will be collected during field activities. Tables 1 and 2 summarize the analyses to be performed for soil and water. Pipe contents solids will be analyzed by the methods listed for soil (Table 1); pipe contents liquids will be analyzed by the methods listed for water (Table 2).

The constituents of potential concern (COPCs) for this project include:

- Total petroleum hydrocarbons (TPH), analyzed by Ecology Methods Northwest Total Petroleum Hydrocarbons – Gasoline Extended and Diesel Extended (NWTPH-Gx/NWTPH-Dx);
- Semivolatile organic compounds (SVOCs), analyzed by EPA Methods 8270, 8270 (low level), 8270-SIM, 8270-SIM (low level), and 8041;
- Volatile organic compounds (VOCs), analyzed by EPA Methods 8260 and 8260 (low level);
- Polychlorinated biphenyls (PCBs – seven Aroclors), analyzed by EPA Method 8082 (low level);
- Organochlorine pesticides, analyzed by EPA Method 8081A (low level);
- Selected metals, analyzed by EPA Methods 6010B/7000, 6020, 7740, and 200.8;
- Dioxins/furans (17 congeners), analyzed by EPA Method 1613 Modified (low level); and
- Ammonia, analyzed by EPA Method 350.1.

3.2 Analytical Detection Limits

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Individual instruments often can detect but not accurately quantify compounds at limits lower than the MDL, referred to as the instrument detection limit (IDL). Although results reported near the MDL or IDL provide insight regarding site conditions, QA dictates that analytical methods achieve a consistently reliable level of detection known as the practical quantitation limit (PQL). The contract laboratory will provide numerical results for all analytes and report them as detected above the PQL or not detected at or above the PQL.

Achieving a stated detection limit for a given analyte is helpful in providing statistically useful data. Intended data uses, such as comparison to numerical criteria or risk assessments, typically dictate specific project target reporting limits (TRLs) necessary to fulfill stated objectives. The TRLs for Site COPCs are presented in Tables 1 and 2 for soil and water, respectively. These TRLs will serve as the target laboratory PQLs for this project. It may be possible to achieve PQLs less than the TRLs under ideal conditions. However, the TRLs presented in Tables 1 and 2 are considered targets because several factors may influence final PQLs. First, moisture and other physical conditions of soil samples can affect PQLs. Second, analytical procedures may require sample dilutions or other practices to accurately quantify a particular analyte at concentrations above the range of the instrument. The effect of this is that other analytes could be reported as not detected, but at a PQL significantly higher than a specified TRL. Data users must be aware that elevated PQLs can bias statistical data summaries, and careful interpretation is required when using data sets with PQLs exceeding TRLs.

3.3 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 and field duplicate comparisons of various matrices. The RPD is calculated as:

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

Where

D_1 = Concentration of analyte in primary sample.

D_2 = Concentration of analyte in duplicate sample.

The RPD will be calculated for samples and compared to the project RPD QC control limits. Project RPD QC control limits are listed in Tables 1 and 2. The RPD QC control limits listed in Tables 1 and 2 are only applicable if the primary and duplicate sample concentrations are greater than five times the PQL. For results less than five times the PQL, the difference between the primary and duplicate samples should be less than two times the PQL for soil samples and one times the PQL for water samples.

3.4 Accuracy

Accuracy is a measure of bias in the analytical process. The closer the measurement value is to the true value, the greater the accuracy. Accuracy is typically evaluated by adding a known spike concentration of a target or surrogate compound to a sample prior to analysis. The detected concentration or percent recovery (%R) of the spiked compound reported in the sample provides a quantitative measure of analytical accuracy. Since most environmental data collected represent single points spatially and temporally rather than an average of values, accuracy is generally more important than precision in assessing the data. In general, if %R values are low, non-detect results may be reported for compounds of interest when in fact these compounds are present (i.e., false negative results), and results for detected compounds may be biased low. The reverse is true when %R values are high. In this case, non-detect values are considered accurate, whereas detected values may be higher than true values.

For this project, accuracy will be expressed as the %R of a known surrogate spike, matrix spike, or laboratory control sample (blank spike), concentration:

$$Recovery\,(\%R) = \frac{Spiked\ Result - Unspiked\ Result}{Known\ Spike\ Concentration}\ X\ 100$$

Accuracy (%R) criteria for surrogate spikes, matrix spikes, and laboratory control samples (blank spikes) are presented in Tables 1 and 2.

3.5 Representativeness, Completeness, and Comparability

Representativeness expresses the degree to which data accurately and precisely represent the actual site conditions. Representativeness of the data will be evaluated by:

- Comparing actual sampling procedures to those specified in this QAPP.
- Reviewing analytical results for field duplicates to determine the variability in the analytical results.
- Invalidating non-representative data or identifying data to be classified as questionable or qualitative in nature. 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 objectives. The number of samples and results expected establishes the comparative basis for completeness. The completeness goal is 90 percent useable data for the samples/analyses planned. If the completeness goal is not achieved, an evaluation will be performed 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. Although numeric goals do not exist for comparability, a statement on comparability will be prepared to assess overall usefulness of data sets generated during the project, following the evaluation of precision and accuracy.

3.6 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 recommended holding time for analysis only. For many methods, recommended holding times may be extended by sample preservation techniques in the field. If a sample exceeds a recommended holding time, then the results may be biased low. For example, if the extraction holding time for volatile analysis of soil samples is exceeded, then the possibility exists that some of the organic constituents may have volatilized from the sample or degraded. Results for that analysis would be qualified as estimated to indicate that the reported results may be lower than actual site conditions. Recommended holding times are presented in Table 4.

3.7 QC Blank Samples

According to the *National Functional Guidelines for Organic Data Review* (EPA, 2008), "The purpose of laboratory (or field) blank analysis is to assess 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)." Trip blanks are placed with samples during shipment; method blanks are created during sample preparation and follow samples throughout the analysis process.

QC blanks are discussed further in Section 7.0. Analytical results for QC blanks will be interpreted in general accordance with EPA's *National Functional Guidelines for Organic and Inorganic Data Review* and professional judgment.

4.0 SAMPLE COLLECTION, HANDLING, AND CUSTODY

The SAP (Appendix A of the Work Plan) discusses sample collection, handling, and custody procedures. Topics addressed in the SAP include, but are not limited to, sampling equipment to be used; equipment decontamination procedures; field screening procedures; sample containers and labeling; sample storage; sample delivery to the analytical laboratory; chain-of-custody procedures; laboratory custody procedures; and field documentation.

5.0 CALIBRATION PROCEDURES

5.1 Field Instrumentation

Field instrument calibration and calibration checks facilitate accurate and reliable field measurements. The calibration of the instruments will be checked and adjusted as necessary in general accordance with manufacturers' recommendations. Methods and frequency of calibration checks and instrument maintenance will be based on the type of instrument, stability characteristics, required accuracy, intended use, and environmental conditions. The basic calibration check frequencies are described below.

If a photoionization detector (PID) is used for headspace vapor screening, its calibration will be checked at the start of each day it is used. If necessary (based on the calibration check results), the instrument will be calibrated in general accordance with the manufacturer's specifications. Calibration check and calibration results will be recorded in the field report.

The calibration of the water quality meter (e.g., Horiba U-22) will be checked, and if necessary, the instrument will be calibrated, prior to each water sampling event. The instrument will be calibrated in general accordance with the manufacturer's specifications. Calibration check and calibration results will be recorded in the field report.

5.2 Laboratory Instrumentation

For chemical analytical testing, calibration procedures will be performed in general accordance with the analytical methods used and the laboratory's Standard Operating Procedures (SOPs). Calibration documentation will be retained at the laboratory.

6.0 LABORATORY DATA REPORTING AND DELIVERABLES

Laboratories will report data in formatted hardcopy and electronic form to the Project Manager and QA Leader. Upon completion of analyses, the laboratory will prepare electronic deliverables for data packages in accordance with the specifications in the agreed-upon *Special Conditions for Lab Analysis* document. The laboratory will provide electronic data deliverables (EDDs) within two business days after GeoEngineers' receipt of printed-copy analytical results, including the appropriate QC documentation. Analytical laboratory measurements will be recorded in standard formats that display, at a minimum, the client/field sample identification, the laboratory sample identification, reporting units, analytical methods, analytes tested, analytical results, extraction and analysis dates, quantitation limits, and data qualifiers. Each sample delivery group will be accompanied by sample receipt forms and a case narrative identifying data quality issues.

GeoEngineers will establish EDD requirements with the contract laboratory. In general, EQuIS four-file format EDDs will be required.

Chromatograms will be provided for samples analyzed using Ecology Method NWTPH-Gx and NWTPH-Dx. The laboratory will assure that the full height of all peaks appear on the chromatograms and that the same horizontal time scale is used for all chromatograms to allow for comparisons between chromatograms.

7.0 QUALITY CONTROL SAMPLES AND PROCEDURES

QC samples will be analyzed to ensure the precision, accuracy, representativeness, comparability, and completeness of the data. Table 3 summarizes the types and frequency of QC samples to be analyzed during the investigation, including both field QC and laboratory QC samples.

7.1 Field Quality Control Samples

Field QC samples serve as a control and check mechanism to monitor the consistency of sampling methods and the influence of off-site factors on environmental samples. Examples of potential off-site factors include airborne VOCs and potable water used in drilling activities. As shown in Table 3, three types of field QC samples will be processed: trip blanks, field duplicates, and equipment rinsate blanks. The field duplicates and equipment rinsate blanks are collected in the field, and the trip blanks are provided by the analytical laboratory. Descriptions of these types of QC samples are provided in the following subsections.

7.1.1 Field Duplicates

Field duplicates serve as measures for precision. They are created by placing aliquots of the collected sample in separate containers, and identifying one of the aliquots as the primary sample and the other as the duplicate sample. Field duplicates measure the precision and consistency of laboratory analytical procedures and methods, as well as the consistency of the sampling techniques used by field personnel and/or the relative homogeneity of sample matrices. The duplicate sample is submitted to gain precision information on sample homogeneity, handling, shipping, storage and preparation, and analysis. Field duplicates will be analyzed for the same parameters as the associated primary samples.

For the supplemental upland data collection field investigation, one field duplicate will be collected for every twenty primary soil samples and every twenty primary water samples (i.e., a frequency of 5% for each matrix). The duplicate samples will be collected at the same locations and as close as possible to the same times as the associated primary samples.

7.1.2 Equipment Rinsate Blanks

Equipment rinsate blanks will be used to evaluate the effectiveness of decontamination procedures for preventing possible cross-contamination of project samples. Equipment rinsates are the final rinse waters from the equipment decontamination procedure. The rinsate blanks will be collected by slowly pouring the distilled water used for sampling equipment decontamination over or through the decontaminated equipment (such as split-barrel core samplers) and collecting the rinsate in appropriate sample containers for analysis. Rinsate blanks will be analyzed for the same parameters as the associated project samples.

For the supplemental upland data collection field investigation, one rinsate blank will be collected for every twenty primary soil samples and every twenty primary water samples (i.e., a frequency of 5% for each matrix). A minimum of one equipment rinsate blank will be collected for each day of sampling activities.

7.1.3 Trip Blanks

Trip blanks are samples of reagent (analyte-free) water taken from the laboratory to the sampling site and returned to the laboratory with the samples to be analyzed for VOCs. Trip blanks accompany samples for VOC analysis during field sampling and delivery to the laboratory. One trip blank will accompany each cooler containing samples that will be submitted for VOC analysis. The trip blanks are used to assess potential VOC contamination of project samples related to sample preservation, packing, shipping, and storage procedures.

7.1.4 Other QC Samples

Discretionary QC samples include field blanks. Field blanks will be used at the discretion of the QA Leader if there is a reason to suspect contamination introduced by ambient conditions in the field. Field blanks are samples of distilled water poured directly into sample containers in the field. Field blanks are analyzed for the same parameters as the associated project samples.

7.2 Laboratory Quality Control

The analytical laboratory will follow standard analytical method procedures that include specified QC monitoring requirements. These requirements will vary by method, but generally include:

- Method blanks;
- Internal standards;
- Instrument calibrations;
- Matrix spikes/matrix spike duplicates (MS/MSDs);
- Laboratory control samples/laboratory control sample duplicates (LCS/LCSDs);
- Laboratory replicates or duplicates; and

- Surrogate spikes.

7.2.1 Laboratory Blanks

Laboratory procedures employ the use of several types of blanks but the most commonly used blanks for QA/QC assessments are method blanks. Method blanks are laboratory QC samples that consist of either a soil-like material that has undergone a contaminant destruction process, or a sample of reagent water. Method blanks are extracted and analyzed with each batch of environmental samples undergoing analysis. Method blanks are particularly useful during volatiles analysis since VOCs can be transported in the laboratory through the vapor phase. If a substance is found in the method blank, it indicates that one (or more) of the following occurred:

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

It is difficult to determine which of the above scenarios took place if method blank contamination occurs. However, it is assumed that the conditions that affected the blanks also likely affected the project samples. If method blank contamination occurs, validation guidelines assist in determining which substances detected in associated project samples are likely truly present in the samples and which ones are likely attributable to the analytical process.

7.2.2 Matrix Spikes/Matrix Spike Duplicates

MS/MSDs are used to assess influences or interferences caused by the physical or chemical properties of the sample itself. For example, extreme pH can affect the results of SVOC analyses. Or, the presence of a particular analyte in a sample may interfere with accurate quantitation of another analyte. MS/MSD data is reviewed in combination with other QC monitoring data to evaluate matrix effects. In some cases, matrix effects cannot be determined due to dilution and/or high levels of related substances in the sample. An MS is created by spiking a known amount of one or more of the target analytes into a project sample, ideally at a concentration at least 5 to 10 times higher than the concentration in the un-spiked sample. A %R value is calculated by subtracting the un-spiked sample result from the spiked sample result, dividing by the spike amount, and multiplying by 100.

The samples designated for MS/MSD analysis should be obtained from a boring or sampling location that is suspected to not be highly contaminated. A sample from an area of low-level contamination is needed because the objective of MS/MSD analyses is to assess possible matrix interferences, which can best be achieved with low levels of contaminants. For the supplemental upland data collection field investigation, additional sample volume will be collected for MS/MSD analysis for every twenty primary soil samples and every twenty primary water samples (i.e., a frequency of 5% for each matrix).

7.2.3 Laboratory Control Spikes/ Laboratory Control Spike Duplicates

Also known as blank spikes, laboratory control spikes (LCS) and laboratory control spike duplicates (LCSDs) are similar to MS/MSD samples in that a known amount of one or more of the target analytes is spiked into a prepared medium and a %R value is calculated for the spiked substance(s). The primary difference between an MS and LCS is that the LCS spike medium is considered "clean" or contaminant-free. For example, reagent water is typically used for LCS water analyses. The purpose of an LCS is to help assess the overall accuracy and precision of the analytical process including sample preparation, instrument performance, and analyst performance. LCS data must be reviewed in context with other laboratory QC data to determine if corrective action is necessary for laboratory control limit exceedances.

7.2.4 Laboratory Replicates/Duplicates

Laboratories often utilize MS/MSDs, LCS/LCSDs, and/or replicates to assess precision. Replicates are a second analysis of a field-collected environmental sample. Replicates can be split at varying stages of the sample preparation and analysis process, but most commonly consist of a second analysis on the extracted media.

7.2.5 Surrogate Spikes

Surrogate spikes are used to verify the accuracy of the analytical instrument and extraction procedures used. Surrogates are substances similar to the target analytes. A known concentration of surrogate is added to each project sample and passed through the instrument, noting the surrogate recovery. Each surrogate used has an acceptable range of %R. If a surrogate recovery is low, sample results may be biased low, and, depending on the %R value, a possibility of false negatives may exist. Conversely, when surrogate recoveries are above the specified range of acceptance, a possibility of false positives exists, although non-detected results are considered accurate.

7.2.6 Instrument Calibrations

Several types of instrument calibrations are used, depending on the method, to determine whether the methodology is 'in control' by verifying the linearity of the calibration curve and to assure that the sample results reflect accurate and precise measurements. This is done by verifying that the percent relative standard deviations (%RSD) and/or the correlation coefficients are within the control limits specified in the validation documents. The main calibrations used are initial calibrations, daily calibrations, and continuing calibration verification.

8.0 DATA REDUCTION AND ASSESSMENT PROCEDURES

This section describes the process for generating and checking data, as well as the process for producing reports for field and analytical laboratory data.

8.1 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 QA Leader and

Project Manager. This will involve both hard-copy forms and EDDs. Both forms of data will be compared with each other to verify that the data are reliable and error-free.

8.2 Review of Field Documentation and Laboratory Receipt Information

Documentation of field sampling data will be reviewed periodically for conformance with project QC requirements described in this QAPP. At a minimum, field documentation will be checked for proper documentation of the following:

- Sample collection information (date, time, location, matrices, etc.);
- Field instruments used and calibration data;
- Sample collection protocol;
- Sample containers, preservation, and volume;
- Field QC samples collected at the frequency specified;
- Chain-of-custody protocols; and
- Sample shipment information.

Sample receipt forms provided by the laboratory will be reviewed for QC exceptions. The final laboratory data package will describe (in the case narrative) the effects that any identified QC exceptions have on data quality. The laboratory will review transcribed sample collection and receipt information for correctness prior to delivering the final data package.

8.3 Data Verification/Validation

Project decisions, conclusions, and recommendations will be based upon verified (validated) data. The purpose of data verification is to ensure that data used for subsequent evaluations and calculations are scientifically valid, of known and documented quality, and legally defensible. Field data verification will be used to eliminate data not collected or documented in accordance with the protocols specified in the SAP. Laboratory data verification will be used to eliminate data not obtained using prescribed laboratory procedures.

The QA Leader will validate data collected during the supplemental upland data collection field investigation to ensure that the data are valid and usable. Data will be validated in general conformance with EPA functional guidelines for data validation (EPA, 2004 and 2008). At a minimum, the following items will be reviewed to verify the data as applicable:

- Documentation that a final review of the data was completed by the Laboratory QA Coordinator;
- Documentation of analytical and QC methodology;
- Documentation of sample preservation and transport;
- Sample receipt forms and case narratives; and
- The following QC parameters:
  - Holding times and sample preservation
  - Method blanks
  - MS/MSDs

- LCS/LCSDs
- Surrogate spikes
- Duplicates/replicates

When sample analytical data are received from the analytical laboratory, they will undergo a QC review by the QA Leader. The accuracy and precision achieved will be compared to the laboratory's analytical control limits. Example control limits are presented in Tables 1 and 2. Calculations of RPDs will follow standard statistical conventions and formulas as presented in Section 3.0. Additional specifications and professional judgment by the QA Leader may be incorporated when appropriate data from specific matrices and field samples are available.

A data quality assessment will be prepared to document the overall quality of the data relative to the DQOs. The major components of the data quality assessment are as follows:

- *Data Validation Summary*. Summarizes the data validation results for all sample delivery groups by analytical method. The summary identifies any systematic problems, data generation trends, general conditions of the data, and reasons for any data qualification.
- *QC Sample Evaluation*. Evaluates the results of QC sample analyses, and presents conclusions based on these results regarding the validity of the project data.
- *Assessment of DQOs*. An assessment of the quality of data measured and generated in terms of accuracy, precision, and completeness relative to objectives established for the project.
- *Summary of Data Usability*. Summarizes the usability of data, based on the assessment performed in the three preceding steps.

The data quality assessment will help to achieve an acceptable level of confidence in the decisions that are to be made based upon the project data. The project analytical data will be submitted to Ecology's EIM system after the data quality assessment is completed.

9.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 2008. Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, EPA-540-R-08-01. June.

EPA. 2004. Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, OSWER 9240.1-45, EPA 540-R-04-004. October.

Washington State Department of Ecology (Ecology). 2004. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. July.

Washington Administrative Code (WAC) 173, Chapter 173-340-820.

TABLE 1
TARGET PRACTICAL QUANTITATION LIMITS
AND QUALITY CONTROL LIMITS FOR SOIL SAMPLES
PORT ANGELES RAYONIER MILL SITE
PORT ANGELES, WASHINGTON

Analyte	CAS Number	Target Practical Quantitation Limits for Soil	Quality Control Limits for Soil	
			RPD*	% R
Total Petroleum Hydrocarbons by NWTPH-Gx and NWTPH-Dx (mg/kg)				
Gasoline-Range Petroleum Hydrocarbons	NA	5	0-30	50-150
Diesel-Range Petroleum Hydrocarbons	NA	5	0-30	50-150
Heavy Oil-Range Petroleum Hydrocarbons	NA	10	0-30	50-150
Metals by EPA Methods 6000/7000 series (mg/kg)				
Aluminum	7429-90-5	5	0-20	75-125
Antimony	7440-36-0	0.2	0-20	75-125
Arsenic	7440-38-2	0.2	0-20	75-125
Barium	7440-39-3	0.3	0-20	75-125
Beryllium	7440-41-7	0.1	0-20	75-125
Cadmium	7440-43-9	0.2	0-20	75-125
Chromium III	7440-47-3	2	0-20	75-125
Chromium VI	18540-29-9	5	0-20	75-125
Cobalt	7440-39-3	0.3	0-20	75-125
Copper	7440-50-8	0.2	0-20	75-125
Lead	7439-92-1	1	0-20	75-125
Manganese	7439-96-5	0.1	0-20	75-125
Mercury	7439-97-6	0.02	0-20	75-125
Nickel	7440-02-0	0.5	0-20	75-125
Selenium (Graphite Furnace EPA 7740)	7782-49-2	0.2	0-20	75-125
Silver	7440-22-4	0.2	0-20	75-125
Thallium	7440-28-0	0.2	0-20	75-125
Vanadium	7440-39-3	0.2	0-20	75-125
Zinc	7440-66-6	1	0-20	75-125
Volatile Organic Compounds by EPA Method 8260 (ug/kg)				
1,1-Dichloroethene	75-35-4	1	0-30	67 - 135
1,1-Dichloroethane	75-34-3	1	0-30	75 - 124
1,1,1-Trichloroethane	71-55-6	1	0-30	70 - 128
1,1,2-Trichloroethane	79-00-5	1	0-30	75 - 122
1,1,2,2-Tetrachloroethane	79-34-5	1	0-30	66 - 128
1,2-Dichloroethane	107-06-2	1	0-30	69 - 123
1,2-Dichloroethene	540-59-0	1	0-30	30-160
1,2-Dichloropropane	78-87-8	1	0-30	30-160
Trans-1,2-Dichloroethene	156-60-5	1	0-30	74 - 126
Cis-1,3-Dichloropropene	542-75-6	1	0-30	67 - 125
Trans-1,3-Dichloropropene	542-75-6	1	0-30	57 - 125
2-Butanone (MEK)	78-93-3	5	0-30	62 - 127
4-Methyl-2-Pentanone	108-10-1	5	0-30	59 - 125
Acetone	67-64-1	5	0-30	48 - 143
Benzene	71-43-2	1.4	0-30	80 - 126
Bromodichloromethane	75-27-4	1	0-30	70 - 128
Bromoform	75-25-2	1	0-30	50 - 128
Bromomethane	74-83-9	1	0-30	44 - 149
Carbon Disulfide	75-15-0	1	0-30	61 - 139
Carbon Tetrachloride	56-23-5	1	0-30	70 - 130
Chlorobenzene	108-90-7	1	0-30	82 - 120
Chloroethane	75-00-3	1	0-30	53 - 142
Chloroform	67-66-3	1	0-30	74 - 123
Chloromethane	74-87-3	1	0-30	54 - 135
Cis-1,2-Dichloroethene	156-59-2	1	0-30	76 - 123
Dibromochloromethane	124-48-1	1	0-30	55 - 128
Ethylbenzene	100-41-4	25	0-30	80 - 134
Methyl tert-butyl ether (MTBE)	1634-04-4	1	0-30	62 - 128
Methylene Chloride (Dichloromethane)	75-09-2	2	0-30	61 - 132
Styrene	100-42-5	1	0-30	78 - 130
Toluene	108-88-3	25	0-30	79 - 120
m,p-Xylene	179601-23-1	1	0-30	80 - 131
o-Xylene	95-47-6	1	0-30	71 - 126
Xylenes (Total)	1330-20-7	1	NA	NA
Tetrachloroethene	127-18-4	1	0-30	79 - 127
Trichloroethene	79-01-6	1	0-30	77 - 123
Vinyl Acetate	108-05-4	5	0-30	47 - 149
Vinyl Chloride	75-01-4	1	0-30	51 - 149
Polycyclic Aromatic Hydrocarbons by EPA 8270-SIM (ug/kg)				
Acenaphthene	83-32-9	5	0-30	31 - 100
Acenaphthylene	208-96-8	5	0-30	26 - 102
Anthracene	120-12-7	5	0-30	30 - 117
Benzo(a)anthracene	56-55-3	5	0-30	36 - 125
Benzo(a)pyrene	50-32-8	5	0-30	33 - 122
Benzo(b)fluoranthene	205-99-2	5	0-30	42 - 124

Analyte	CAS Number	Target Practical Quantitation Limits for Soil	Quality Control Limits for Soil	
			RPD*	% R
Benzo(g,h,I)perylene	191-24-2	5	0-30	27 - 107
Benzo(k)fluoranthene	207-08-9	5	0-30	37 - 129
Chrysene	218-01-9	5	0-30	42 - 115
Dibenzo(a,h)anthracene	53-70-3	5	0-30	30 - 128
Fluoranthene	206-44-0	5	0-30	43 - 119
Fluorene	86-73-7	5	0-30	33 - 106
Indeno(1,2,3-cd)pyrene	193-39-5	5	0-30	29 - 126
Naphthalene	91-20-3	5	0-30	27 - 107
Phenanthrene	85-01-8	5	0-30	38 - 108
Pyrene	129-00-0	5	0-30	36 - 122
Total cPAHs TEC	NA	3.8	NA	NA
Chlorophenols by EPA 8041 (mg/kg)				
Pentachlorophenol	87-86-5	0.00625	0-30	10-162
2,4,6-Trichlorophenol	88-06-2	0.00625	NA	NA
Semivolatile Organic Compounds by EPA 8270-Low level (ug/kg)				
1,2,4-Trichlorobenzene	120-82-1	20	0-30	35 - 100
1,2-Dichlorobenzene	95-50-1	20	0-30	36 - 100
1,3-Dichlorobenzene	541-73-1	20	0-30	33 - 100
1,4-Dichlorobenzene	106-46-7	20	0-30	34 - 100
2,6-Dinitrotoluene	121-14-2	100	0-30	46 - 108
2-Chloronaphthalene	91-58-7	20	0-30	42 - 100
2-Chlorophenol	95-57-8	20	0-30	37 - 100
2-Methylphenol	95-48-7	20	0-30	37 - 100
2,4-Dichlorophenol	120-83-2	100	0-30	41 - 100
2,4-Dimethylphenol	105-67-9	20	0-30	34 - 100
2,4-Dinitrophenol	51-28-5	200	0-30	10 - 170
2,4-Dinitrotoluene	121-14-2	100	0-30	49 - 114
2,4,5-Trichlorophenol	95-95-4	100	0-30	43 - 103
3,3'-Dichlorobenzidine	91-94-1	100	0-30	10 - 129
4-Chloroaniline	106-47-8	100	0-30	10 - 113
4-Methylphenol	106-44-5	20	0-30	37 - 100
Benzyl Alcohol	100-51-6	20	0-30	10 - 100
Bis(2-chloroethyl)ether	111-44-4	20	0-30	22 - 104
Bis(2-chloro-1-methylethyl)ether	108-60-1	20	0-30	10 - 107
Bis(2-ethylhexyl)phthalate	117-81-7	20	0-30	48 - 124
Butyl benzyl phthalate	85-68-7	20	0-30	35 - 122
Carbozole	86-74-8	20	0-30	34 - 122
Diethyl phthalate	84-66-2	20	0-30	44 - 108
Dimethylphthalate	131-11-3	20	0-30	46 - 103
Di-n-butyl phthalate	84-74-2	20	0-30	47 - 115
Di-n-octyl phthalate	117-84-0	20	0-30	49 - 107
Hexachlorobutadiene	87-68-3	20	0-30	33 - 100
Hexachlorocyclopentadiene	77-47-4	100	0-30	10 - 130
Hexachloroethane	67-72-1	20	0-30	28 - 100
Isophorone	78-59-1	20	0-30	39 - 105
Nitrobenzene	98-95-3	20	0-30	15 - 115
N-Nitroso-di-n-propylamine	621-64-7	100	0-30	27 - 101
N-Nitrosodiphenylamine	86-30-6	20	0-30	27 - 162
Phenol	108-95-2	20	0-30	41 - 100
Pesticides by EPA 8081A-Low level (mg/kg) (25 g Initial mass)				
Aldrin	309-00-2	0.001	0-30	30-160
Alpha-BHC	319-84-6	0.001	0-30	30-160
Alpha-Chlordane	5103-71-9	0.001	0-30	30-160
Beta-BHC	319-85-4	0.001	0-30	30-160
Gamma-BHC (Lindane)	58-89-9	0.001	0-30	30-160
Gamma-Chlordane	5103-74-2	0.001	0-30	30-160
4,4'-DDD	72-54-8	0.002	0-30	30-160
4,4'-DDE	72-55-9	0.002	0-30	30-160
4,4'-DDT	50-29-3	0.002	0-30	30-160
Dieldrin	60-57-1	0.002	0-30	30-160
Endosulfan I	959-98-8	0.001	0-30	30-160
Endosulfan II	33213-65-9	0.002	0-30	30-160
Endosulfan sulfate	1031-07-8	0.002	0-30	30-160
Endrin	72-20-8	0.002	0-30	30-160
Endrin Aldehyde	7421-36-3	0.002	0-30	30-160
Endrin Ketone	53494-70-5	0.002	0-30	30-160
Heptachlor	76-44-8	0.001	0-30	30-160
Heptachlor epoxide	1024-57-3	0.001	0-30	30-160
Hexachlorobenzene	118-74-1	0.001	0-30	30-160
Methoxychlor	72-43-5	0.01	0-30	30-160
Toxaphene	8001-35-2	0.1	0-30	30-160

Analyte	CAS Number	Target Practical Quantitation Limits for Soil	Quality Control Limits for Soil	
			RPD*	% R
PCBs by EPA 8082-Low level (mg/kg) (25 g Initial mass)				
Aroclor 1016	12674-11-2	0.004	0-30	30-160
Aroclor 1221	11104-28-2	0.004	NA	NA
Aroclor 1232	11141-16-5	0.004	NA	NA
Aroclor 1242	53469-21-9	0.004	NA	NA
Aroclor 1248	12672-29-6	0.004	NA	NA
Aroclor 1254	11097-69-1	0.004	NA	NA
Aroclor 1260	11096-82-5	0.004	0-30	30-160
Total PCBs (sum of Aroclors)	12767-79-2	0.004	NA	NA
Dioxins/Furans by EPA 1613 Modified-Low level (ng/kg)				
2,3,7,8-TCDD	1746-01-6	0.1	NA	67-158
1,2,3,7,8-PeCDD	40321-76-4	0.5	NA	70–142
1,2,3,4,7,8-HxCDD	39227-28-6	0.5	NA	70-164
1,2,3,6,7,8-HxCDD	57653-85-7	0.5	NA	76-134
1,2,3,7,8,9-HxCDD	19408-74-3	0.5	NA	64-162
1,2,3,4,6,7,8-HpCDD	35822-46-9	0.5	NA	82-132
OCDD	3268-87-9	1	NA	78-144
2,3,7,8-TCDF	51207-31-9	0.1	NA	75-158
1,2,3,7,8-PeCDF	57117-41-6	0.5	NA	70–142
2,3,4,7,8-PeCDF	57117-31-4	0.5	NA	68-160
1,2,3,4,7,8-HxCDF	70648-26-9	0.5	NA	70-164
1,2,3,6,7,8-HxCDF	57117-44-9	0.5	NA	76-134
2,3,4,6,7,8-HxCDF	60851-34-5	0.5	NA	70–156
1,2,3,7,8,9-HxCDF	72918-21-9	0.5	NA	78-130
1,2,3,4,6,7,8-HpCDF	67562-39-4	0.5	NA	82-132
1,2,3,4,7,8,9-HpCDF	55673-89-7	0.5	NA	78-138
OCDF	39001-02-0	1	NA	63-170
Total Dioxins/Furans TEC (in ng/kg)	NA	0.57	NA	NA
Total Dioxins/Furans TEC (in mg/kg)	NA	5.7E-07	NA	NA

Notes:

CAS = Chemical Abstract Services

RPD = Relative percent difference

% R = Percent recovery

* Listed RPD is for laboratory replicates and duplicate spiked samples; RPD goal for field duplicates is 0-50.

NWTPH = Northwest Total Petroleum Hydrocarbons

Gx = Gasoline extended range

Dx = Diesel extended range

mg = Milligrams

ug = Micrograms

kg = Kilograms

ng = Nanograms

NA = Not applicable

TEC = Toxic equivalent concentration; PQL calculated as prescribed in WAC 173-340 using one-half the PQL for individual constituents.

TABLE 2
TARGET PRACTICAL QUANTITATION LIMITS
AND QUALITY CONTROL LIMITS FOR WATER SAMPLES
PORT ANGELES RAYONIER MILL SITE
PORT ANGELES, WASHINGTON

Analyte	CAS Number	Target Practical Quantitation Limits for Water (ug/L)	Quality Control Limits for Water	
			RPD*	% R
Total Petroleum Hydrocarbons by NWTPH-Gx and NWTPH-Dx				
Gasoline-Range Petroleum Hydrocarbons	NA	250	0-30	50-150
Diesel-Range Petroleum Hydrocarbons	NA	250	0-30	50-150
Heavy Oil-Range Petroleum Hydrocarbons	NA	400	0-30	50-150
Metals by EPA Methods 200.8 and 7470				
Antimony	7440-36-0	0.2	0-20	75-125
Arsenic	7440-38-2	0.2	0-20	75-125
Beryllium	7440-41-7	0.2	0-20	75-125
Cadmium	7440-43-9	0.2	0-20	75-125
Chromium III	7440-47-3	0.5	0-20	75-125
Chromium VI	18540-29-9	20	0-20	75-125
Copper	7440-50-8	0.5	0-20	75-125
Lead	7439-92-1	1	0-20	75-125
Manganese	7439-96-5	0.5	0-20	75-125
Mercury	7439-97-6	0.02	0-20	75-125
Nickel	7440-02-0	0.5	0-20	75-125
Phosphorus	7723-14-0	16	0-20	75-125
Selenium	7782-49-2	0.5	0-20	75-125
Silver	7440-22-4	0.2	0-20	75-125
Thallium	7440-28-0	0.2	0-20	75-125
Zinc	7440-66-6	4	0-20	75-125
Volatile Organic Compounds by EPA Method 8260-Low level				
1,1-Dichloroethene	75-35-4	0.2	0-30	64 - 127
1,1,1-Trichloroethane	71-55-6	0.2	0-30	69 - 123
1,1,2-Trichloroethane	79-00-5	0.2	0-30	74 - 120
1,1,2,2-Tetrachloroethane	79-34-5	0.2	0-30	64 - 127
1,2-Dichloroethane	107-06-2	0.2	0-30	68 - 124
1,2-Dichloropropane	78-87-8	0.2	0-30	75 - 120
Trans-1,2-Dichloroethene	156-60-5	0.2	0-30	70 - 120
Cis-1,3-Dichloropropene	542-75-6	0.2	0-30	72 - 121
Trans-1,3-Dichloropropene	542-75-6	0.2	0-30	68 - 124
Acrolein	107-02-8	5	0-30	10 - 194
Acrylonitrile	107-13-1	1	0-30	60 - 146
Benzene	71-43-2	0.45	0-30	73 - 120
Bromodichloromethane	75-27-4	0.2	0-30	73 - 120
Bromoform	75-25-2	0.2	0-30	63 - 128
Bromomethane	74-83-9	0.5	0-30	40 - 164
Carbon Tetrachloride	56-23-5	0.2	0-30	61 - 135
Chlorobenzene	108-90-7	0.2	0-30	73 - 120
Chloroform	67-66-3	0.2	0-30	72 - 121
Chloromethane	74-87-3	0.5	0-30	57 - 133
Dibromochloromethane	124-48-1	0.2	0-30	71 - 125
Ethylbenzene	100-41-4	0.42	0-30	71 - 128
Methylene Chloride (Dichloromethane)	75-09-2	0.5	0-30	61 - 133
Toluene	108-88-3	0.48	0-30	74 - 120
m,p-Xylene	179601-23-1	0.4	0-30	54 - 140
o-Xylene	95-47-6	0.2	0-30	69 - 127
Xylenes (Total)	1330-20-7	0.78	NA	NA
Tetrachloroethylene	127-18-4	0.2	0-30	65 - 125
Trichloroethene	79-01-6	0.2	0-30	72 - 122
Vinyl Chloride	75-01-4	0.2	0-30	59 - 130
Polycyclic Aromatic Hydrocarbons by EPA 8270-SIM-Low level				
Acenaphthene	83-32-9	0.01	0-30	33 - 114
Acenaphthylene	208-96-8	0.01	0-30	25 - 104
Anthracene	120-12-7	0.01	0-30	18 - 113
Benzo(a)anthracene	56-55-3	0.01	0-30	31 - 125
Benzo(a)pyrene	50-32-8	0.01	0-30	10 - 109
Benzo(b)fluoranthene	205-99-2	0.01	0-30	31 - 134
Benzo(g,h,I)perylene	191-24-2	0.01	0-30	17 - 133
Benzo(k)fluoranthene	207-08-9	0.01	0-30	39 - 128
Chrysene	218-01-9	0.01	0-30	50 - 121
Dibenzo(a,h)anthracene	53-70-3	0.01	0-30	30 - 126
Fluoranthene	206-44-0	0.01	0-30	37 - 135
Fluorene	86-73-7	0.01	0-30	42 - 112
Indeno(1,2,3-cd)pyrene	193-39-5	0.01	0-30	32 - 124
Naphthalene	91-20-3	0.01	0-30	31 - 111
Phenanthrene	85-01-8	0.01	0-30	46 - 118
Pyrene	129-00-0	0.01	0-30	36 - 132
Total cPAHs TEC	NA	0.0076	NA	NA

Analyte	CAS Number	Target Practical Quantitation Limits for Water (ug/L)	Quality Control Limits for Water	
			RPD*	% R
Chlorophenols by EPA 8041				
Pentachlorophenol	87-86-5	0.25	0-30	27-115
2,4,6-Trichlorophenol	87-86-5	0.25	NA	NA
Semivolatile Organic Compounds by EPA 8270				
1,2,4-Trichlorobenzene	120-82-1	1	0-30	25 - 107
1,2-Dichlorobenzene	95-50-1	1	0-30	24 - 104
1,3-Dichlorobenzene	541-73-1	1	0-30	22 - 103
1,4-Dichlorobenzene	106-46-7	1	0-30	22 - 103
2-Chloronaphthalene	91-58-7	1	0-30	26 - 131
2-Chlorophenol	95-57-8	1	0-30	32 - 122
2,4-Dichlorophenol	120-83-2	5	0-30	30 - 134
2,4-Dimethylphenol	105-67-9	1	0-30	15 - 118
2,4-Dinitrophenol	51-28-5	10	0-30	10 - 202
2,4,5-Trichlorophenol	95-95-4	5	0-30	36 - 134
3,3'-Dichlorobenzidine	91-94-1	5	0-30	37 - 141
Bis(2-chloroethyl)ether	111-44-4	5	0-30	29 - 124
Bis(2-chloro-1-methylethyl)ether	108-60-1	1	0-30	14 - 133
Bis(2-chloroisopropyl)ether	39638-32-9	1	0-30	14 - 133
Bis(2-ethylhexyl)phthalate	117-81-7	1	0-30	44 - 146
Butyl benzyl phthalate	85-68-7	1	0-30	14 - 172
Diethyl phthalate	84-66-2	1	0-30	36 - 134
Di-n-butyl phthalate	84-74-2	1	0-30	46 - 132
Hexachloroethane	67-72-1	1	0-30	13 - 100
Phenol	108-95-2	1	0-30	6 - 100
Dimethyl phthalate	131-11-3	1	0-30	38 - 132
Hexachlorobutadiene	87-68-3	1	0-30	12 - 108
Hexachlorocyclopentadiene	77-47-4	5	0-30	10 - 122
Isophorone	78-59-1	1	0-30	44 - 130
Nitrobenzene	98-95-3	1	0-30	35 - 116
N-Nitroso-di-n-propylamine	621-64-7	5	0-30	25 - 128
N-Nitrosodiphenylamine	86-30-6	1	0-30	44 - 155
Pesticides by EPA 8081A-Low level (Manchester Extraction)				
Aldrin	309-00-2	0.00083	0-30	30-160
Alpha-BHC	319-84-6	0.00083	0-30	30-160
Alpha-Chlordane	5103-71-9	0.00083	0-30	30-160
Beta-BHC	319-85-4	0.00083	0-30	30-160
Delta-BHC	319-86-8	0.00083	0-30	30-160
Gamma-BHC (Lindane)	58-89-9	0.00083	0-30	30-160
Gamma-Chlordane	5103-74-2	0.00083	0-30	30-160
4,4'-DDD	72-54-8	0.0017	0-30	30-160
4,4'-DDE	72-55-9	0.0017	0-30	30-160
4,4'-DDT	50-29-3	0.0017	0-30	30-160
Dieldrin	60-57-1	0.0017	0-30	30-160
Endosulfan I	959-98-8	0.00083	0-30	30-160
Endosulfan II	33213-65-9	0.0017	0-30	30-160
Endosulfan sulfate	1031-07-8	0.0017	0-30	30-160
Endrin	72-20-8	0.0017	0-30	30-160
Endrin Aldehyde	7421-36-3	0.0017	0-30	30-160
Endrin Ketone	53494-70-5	0.0017	0-30	30-160
Heptachlor	76-44-8	0.00083	0-30	30-160
Heptachlor epoxide	1024-57-3	0.00083	0-30	30-160
Hexachlorobenzene	118-74-1	0.00083	0-30	30-160
Methoxychlor	72-43-5	0.0083	0-30	30-160
Toxaphene	8001-35-2	0.083	0-30	30-160
Polychlorinated Biphenyls by EPA 8082-Low level				
Aroclor 1016	12674-11-2	0.01	0-30	30-160
Aroclor 1221	11104-28-2	0.01	NA	NA
Aroclor 1232	11141-16-5	0.01	NA	NA
Aroclor 1242	53469-21-9	0.01	NA	NA
Aroclor 1248	12672-29-6	0.01	NA	NA
Aroclor 1254	11097-69-1	0.01	NA	NA
Aroclor 1260	11096-82-5	0.01	0-30	30-160
Total PCBs (sum of Aroclors)	12767-79-2	0.01	NA	NA
Conventionals by EPA 350.1				
Ammonia	7664-41-7	10	0-20	75-125

Analyte	CAS Number	Target Practical Quantitation Limits for Water (ug/L)	Quality Control Limits for Water	
			RPD*	% R
Dioxins/Furans by EPA 1613 Modified-Low level (pg/L)				
2,3,7,8-TCDD	1746-01-6	1	NA	67-158
1,2,3,7,8-PeCDD	40321-76-4	5	NA	70–142
1,2,3,4,7,8-HxCDD	39227-28-6	5	NA	70-164
1,2,3,6,7,8-HxCDD	57653-85-7	5	NA	76-134
1,2,3,7,8,9-HxCDD	19408-74-3	5	NA	64-162
1,2,3,4,6,7,8-HpCDD	35822-46-9	5	NA	82-132
OCDD	3268-87-9	10	NA	78-144
2,3,7,8-TCDF	51207-31-9	1	NA	75-158
1,2,3,7,8-PeCDF	57117-41-6	5	NA	70–142
2,3,4,7,8-PeCDF	57117-31-4	5	NA	68-160
1,2,3,4,7,8-HxCDF	70648-26-9	5	NA	70-164
1,2,3,6,7,8-HxCDF	57117-44-9	5	NA	76-134
2,3,4,6,7,8-HxCDF	60851-34-5	5	NA	70–156
1,2,3,7,8,9-HxCDF	72918-21-9	5	NA	78-130
1,2,3,4,6,7,8-HpCDF	67562-39-4	5	NA	82-132
1,2,3,4,7,8,9-HpCDF	55673-89-7	5	NA	78-138
OCDF	39001-02-0	10	NA	63-170
Total Dioxins/Furans TEC (in pg/L)	NA	5.7	NA	NA
Total Dioxins/Furans TEC (in ug/L)	NA	5.7E-06	NA	NA

Notes:

CAS = Chemical Abstract Services

RPD = Relative percent difference

% R = Percent recovery

* Listed RPD is for laboratory replicates and duplicate spiked samples; RPD goal for field duplicates is 0-35.

NWTPH = Northwest Total Petroleum Hydrocarbons

Gx = Gasoline extended range

Dx = Diesel extended range

mg = Milligrams

ug = Micrograms

kg = Kilograms

ng = Nanograms

pg = Picograms

NA = Not applicable

TEC = Toxic equivalent concentration; PQL calculated as prescribed in WAC 173-340 using one-half the PQL for individual constituents.

TABLE 3
QUALITY CONTROL SAMPLES TYPE AND MINIMUM FREQUENCY
PORT ANGELES RAYONIER MILL SITE
PORT ANGELES, WASHINGTON

Parameter	Field QC Samples			Laboratory QC Samples			
	Field Duplicates	**Trip Blanks**	**Rinsate Blanks**	**Method Blanks**	**LCS or OPR**	**MS/MSD**	**Lab Duplicates**
Gasoline-Range Total Petroleum Hydrocarbons	1 per 20 primary groundwater/soil samples	1 per sample cooler	1 per 20 primary groundwater/soil samples (1 per day minimum)	1 per batch*	1 per batch*	NA	1 per batch*
Diesel- and Heavy Oil-Range Total Petroleum Hydrocarbons (with acid/silica gel cleanup)		NA		1 per batch*	1 per batch*	NA	1 per batch*
SVOCs (incl. cPAHs)		NA		1 per batch*	1 per batch*	1 per batch*	NA
VOCs		1 per sample cooler		1 per batch*	1 per batch*	1 per batch*	NA
PCBs		NA		1 per batch*	1 per batch*	1 per batch*	NA
Pesticides		NA		1 per batch*	1 per batch*	1 per batch*	NA
Metals		NA		1 per batch*	1 per batch*	1 per batch*	1 per batch*
Dioxins/Furans		NA		1 per batch*	1 per batch*	NA	NA
Ammonia		NA		1 per batch*	1 per batch*	NA	1 per batch*

Notes:

*An analytical batch is defined as a group of samples taken through a preparation procedure and sharing a method blank, LCS, and MS/MSD (or MS and lab duplicate). No more than 20 field samples are contained in one batch.

LCS = Laboratory control sample

OPR = Ongoing precision and recovery

MS = Matrix spike

MSD = Matrix spike duplicate

SVOCs = Semivolatile organic compounds

VOCs = Volatile organic compounds

cPAHs = Carcinogenic polycyclic aromatic hydrocarbons

PCBs = Polychlorinated biphenyls

NA = Not applicable

TABLE 4
TEST METHODS, SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES
PORT ANGELES RAYONIER MILL SITE
PORT ANGELES, WASHINGTON

Analysis	Method [1]	Soil				Water			
		Minimum Sample Size	Sample Containers	Sample Preservation	Holding Times [2]	Minimum Sample Size	Sample Containers	Sample Preservation	Holding Times [2]
Gasoline-Range Total Petroleum Hydrocarbons	Ecology NWTPH-Gx	15 g	2 oz glass widemouth with Teflon-lined Septa lid and 5035 kit with two methanol preserved vials	Methanol; cool ≤6°C	14 days	80 mL	Two 40 mL VOA Vials	Cool ≤6°C HCl - pH<2	14 days preserved 7 days unpreserved
Diesel- and Heavy Oil-Range Total Petroleum Hydrocarbons	Ecology NWTPH-Dx with acid/silica gel cleanup	25 g	8 oz widemouth with Teflon-lined lid	Cool ≤6°C	14 days to extraction (1 year if frozen), 40 days from extraction to analysis	500 mL	Two 500 mL amber glass with Teflon-lined lid	Cool ≤6°C	7 days to extraction 40 days from extraction to analysis
VOCs	EPA 8260 (low-level purge for water samples) [3]	15 g	2 oz glass widemouth with Teflon-lined Septa lid and 5035 kit with one methanol preserved vial and two sodium bisulfate vials	Methanol/sodium bisulfate; cool ≤6°C	14 days	120 mL	Three 40 mL VOA Vials	Cool ≤6°C HCl - pH<2	14 days preserved 7 days unpreserved
SVOCs	EPA 8270 (soil at PSEP levels)	50 g	(2) 8 oz glass widemouth with Teflon-lined lid	Cool ≤6°C	14 days to extraction (1 year if frozen), 40 days from extraction to analysis	500 mL	Two 500 mL amber glass with Teflon-lined lid	Cool ≤6°C	7 days to extraction 40 days from extraction to analysis
Chlorophenols (Pentachlorophenol & 2,4,6-Trichlorophenol)	EPA 8041	50 g	(2) 8 oz glass widemouth with Teflon-lined lid (share same jar as SVOC)	Cool ≤6°C	14 days to extraction (1 year if frozen), 40 days from extraction to analysis	500 mL	Two 500 mL amber glass with Teflon-lined lid	Cool ≤6°C	7 days to extraction 40 days from extraction to analysis
cPAHs	EPA 8270 SIM (Request "low level" for water samples)	30 g	(2) 8 oz glass widemouth with Teflon-lined lid (share same jar as SVOC)	Cool ≤6°C	14 days to extraction (1 year if frozen), 40 days from extraction to analysis	500 mL	Two 500 mL amber glass with Teflon-lined lid	Cool ≤6°C	7 days to extraction 40 days from extraction to analysis
Aroclor PCBs	EPA 8082-Low level (Request that the laboratory use 25 g initial mass)	50 g	8 oz glass widemouth with Teflon-lined lid	Cool ≤6°C	14 days to extraction (1 year if frozen), 40 days from extraction to analysis	500 mL	Two 500 mL amber glass with Teflon-lined lid	Cool ≤6°C	7 days to extraction 40 days from extraction to analysis
Pesticides	EPA 8081-Low level [4] (Request that the laboratory use 25 g initial mass)	50 g	8 oz glass widemouth with Teflon-lined lid (same jar as PCBs)	Cool ≤6°C	14 days to extraction (1 year if frozen), 40 days from extraction to analysis	3 L	Six 1 L amber glass with Teflon-lined lid	Cool ≤6°C	7 days to extraction 40 days from extraction to analysis
Metals [5]	EPA 6010B/6020/200.8/7740/7471	100 g	4 or 8 oz glass widemouth with Teflon-lined lid	Cool ≤6°C	180 days (28 days for mercury)	500 mL	1 L HDPE	HNO_3 - pH<2 (Dissolved metals preserved after filtration)	180 days (28 days for mercury)

Analysis	Method [1]	Soil				Water			
		Minimum Sample Size	Sample Containers	Sample Preservation	Holding Times [2]	Minimum Sample Size	Sample Containers	Sample Preservation	Holding Times [2]
Hexavalent Chromium [6]	EPA 7196A/3500-CR-B01 3060A extraction	25 g	4 oz glass widemouth with Teflon-lined lid	Cool ≤6°C	28 days	100 mL	500 mL HDPE	Field filter, adjust pH to 9.3-9.7 (buffer sol'n), cool ≤6°C	28 days (24 hours upreserved)
Dioxins/Furans	EPA 1613 Modified	100 g	8 oz glass widemouth with Teflon-lined lid	Cool ≤6°C	1 year	1 L	Two 1 L amber glass with Teflon-lined lid	Cool ≤6°C	1 year
Ammonia	EPA 350.1	4 oz	4 oz glass widemouth with Teflon-lined lid	Cool ≤6°C	7 days	500 mL	500 mL HDPE	H_2SO_4 - pH<2; Cool ≤6°C	28 days

Notes:

cPAHs = Carcinogenic polycyclic aromatic hydrocarbons
PCBs = Polychlorinated biphenyls
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds
PSEP = Puget Sound Estuary Program
HCl = Hydrochloric acid
HNO_3 = Nitric acid
H_2SO_4 = Sulfuric acid
HDPE = High density polyethylene
oz = Ounce
mL = Milliliter
L = Liter
g = Gram
1) Target practical quantitation limits are listed in QAPP Tables 1 and 2.
2) Holding times are based on elapsed time from date of sample collection.
3) VOCs analysis in water will be conducted using EPA Method 8260 lowest level reporting limits (20 ml purge) and must include acrolein and acrylonitrile in suite of VOCs analyzed.
4) Pesticides analysis in water will be conducted using EPA Method 8081 with Manchester Extraction.
5) Metals to be selectively analyzed include antimony, arsenic, barium, cadmium, chromium (total), cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc.
Groundwater samples to be analyzed for metals will be analyzed for both dissolved (field-filtered samples) and total (unfiltered samples) fractions.
6) Hexavalent chromium to be analyzed as necessary based on chromium (total) results.

Appendix C
Site Health and Safety Plan

SITE HEALTH AND SAFETY PLAN
SUPPLEMENTAL UPLAND DATA COLLECTION
FIELD INVESTIGATION
PORT ANGELES RAYONIER MILL SITE
PORT ANGELES, WASHINGTON

JULY 20, 2010

PREPARED BY: GEOENGINEERS, INC.

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GEOENGINEERS, INC.
SITE HEALTH AND SAFETY PLAN
SUPPLEMENTAL UPLAND DATA COLLECTION FIELD INVESTIGATION
PORT ANGELES RAYONIER MILL SITE
FILE NO. 000137-015-03

This Site Health and Safety Plan (HASP) was developed in conjunction with the GeoEngineers Safety Program Manual. The HASP is to be used by GeoEngineers personnel on this site and must be available on site. If the work entails potential exposures to hazardous substances or unusual situations that are not addressed in this HASP, the HASP will be amended with additional safety and health information, and the amended document will need to be approved by the GeoEngineers Health and Safety Manager.

Liability Clause: If requested by subcontractors, this HASP may be provided for informational purposes only. In this case, Form C-3 shall be signed by the subcontractor. Please be advised that this HASP is intended for use by GeoEngineers Employees only. Nothing herein shall be construed as granting rights to GeoEngineers' subcontractors or any other contractors working on this site to use or legally rely on this HASP. GeoEngineers specifically disclaims any responsibility for the health and safety of any person not employed by GeoEngineers.

1.0 GENERAL PROJECT INFORMATION

Project Name:	Supplemental Upland Data Collection Field Investigation Port Angeles Rayonier Mill Site
Project Number:	000137-015-03
Type of Project:	Subsurface investigation and groundwater, soil, and surface water sampling
Start/Completion:	2010-2011
Subcontractors:	Utility Locate Contractor Drilling Contractor Excavation Contractor Survey Contractor Analytical Laboratory

2.0 WORK PLAN

GeoEngineers will conduct an environmental investigation within the upland portion of the Port Angeles Rayonier Mill Site (Site). The purpose of the investigation is to fill specific data gaps so that a comprehensive characterization of the contaminants of potential concern (COPCs) associated with former Rayonier operations can be completed. Information obtained from this investigation will be used to evaluate cleanup action alternatives for the Site. The investigation scope is expected to include:

- Subsurface investigation including drilling and excavation of test pits. Soil samples will be obtained, field screened, and submitted to a laboratory.
- Installation and development of groundwater monitoring wells; redevelopment of existing groundwater monitoring wells, low-flow groundwater sampling from monitoring wells, and groundwater grab sampling from borings.
- Surface water sampling in Ennis Creek and White Creek.
- Shoreline reconnaissance for groundwater seeps, installation of groundwater seep monitoring stations, and quarterly seep sampling in intertidal sediments along the shoreline.
- Pipe contents sampling at selected piping locations.
- Analytical testing for COPCs in collected samples may include: metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) (including carcinogenic polycyclic aromatic hydrocarbons [cPAHs]), polychlorinated biphenyls (PCBs), ammonia, gasoline-range, diesel-range, and heavy oil-range total petroleum hydrocarbons, pesticides, and dioxins and furans.
- Surveying of exploration locations.

2.1 SITE DESCRIPTION

The Site is in the city of Port Angeles, Clallam County, Washington, along the northern coast of the Olympic Peninsula on the southern shore of Port Angeles Harbor, in the Strait of Juan de Fuca. The mill property comprises approximately 80 acres and is located in the northwest quarter of Section 11, Township 30 North, Range 6 West, at latitude 48° 07’ 00” North and longitude 123° 24’ 25” West.

The mill property is bounded on the south by a high bluff and gently slopes north toward Port Angeles Harbor. Residential and commercial properties are located to the south of the property. Ennis Creek flows from the Olympic Mountains through the property and discharges into Port Angeles Harbor.

The full nature and extent of the Site has not yet been determined. A Study Area within the larger Site has been defined to allow cleanup work to be expedited without waiting for the full nature and extent of the Site to be defined. The “Study Area” refers to the former Rayonier Mill property owned or leased by Rayonier and the adjacent marine environment. Previous investigations have generated a considerable amount of data relating to soil and groundwater quality within the upland portion of the Study Area. However, further work is needed to define the full nature and extent of contamination in the Study Area. The purpose of the supplemental upland data collection effort is to fill data gaps necessary to fully define the nature and extent of contamination in the upland portion of the Study Area.

2.2 SITE HISTORY

Prior to 1930, a portion of the Rayonier Mill property was occupied by a saw mill. The Rayonier Pulp Mill operated between 1930 and 1997, producing dissolving-grade pulps from wood chips. The mill was owned by Olympic Forest Products from 1930 until 1937, when it merged with Rayonier. Mill ownership shifted to ITT Rayonier, Inc., between 1968 and 1994, after which it returned to Rayonier. Rayonier permanently ceased production at the mill in 1997 and dismantled the mill facilities between 1997 and 1999. The various process areas used to conduct mill operations are depicted in Figure 2 of the Supplemental Upland Data Collection Work Plan (Work Plan).

2.3 List of Field Activities

Anticipated field activities include:

X	Site Reconnaissance	X	Field Screening of Soil Samples
X	Exploratory Borings	X	Seep Survey/Sampling
	Construction Monitoring	X	Groundwater Sampling
X	Surveying	X	Groundwater Depth/Free Product Measurement
X	Test Pit Exploration	X	Pipe Contents Sample Collection
X	Monitoring Well Installation	X	Soil Stockpile Testing
X	Monitoring Well Development	X	Remedial Excavation
X	Soil Sample Collection	X	Surface Water Sampling

3.0 LIST OF FIELD PERSONNEL AND TRAINING

Name of Employee on Site	Level of HAZWOPER Training (24-/40-hr)	Date of 8-Hr Refresher Training	Date of HAZWOPER Supervisor Training	First Aid/ CPR	Date of Other Trainings	Date of Respirator Fit Test
Rob Leet	40	12/12/07	12/12/07	11/17/07	11/22/94	--
Robert Miyahira	40	11/1/09	02/22/01	03/25/10	--	03/17/10
Brian Anderson	40	12/11/08	12/04/02	09/18/08	08/15/08	--
Abhijit Joshi	40	6/19/09	--	3/11/08		--
Jessica Smith	40	08/15/08	--	03/25/10	01/22/08	08/15/08

CHAIN of COMMAND	TITLE	NAME	TELEPHONE NUMBERS
1	Project Manager	Rob Leet	206-239-3230 (o) 206-850-2351 (c)
2	HAZWOPER Supervisor	Rob Leet	206-239-3230 (o) 206-850-2351 (c)
3	Field Engineer/Geologist	Robert Miyahira	425-861-6067 (o) 425-941-2055 (c)
4	Site Safety and Health Supervisor*	Robert Miyahira Brian Anderson	425-861-6067 (o) 425-941-2055 (c) 425-750-1326 (c)
5	Client-Assigned Site Supervisor	TBD	
6	Health and Safety Program Manager	Wayne Adams	253 383-4940 (o) 253 350-4387 (c)
N/A	Subcontractor(s)	TBD	
N/A	Current Owner	Warren Snyder (Rayonier)	904-321-5558 (o) 904-716-9666 (c)

[*] **Site Safety and Health Supervisor --** The individual present at a hazardous waste site who has the authority and knowledge necessary to implement the HASP and verify compliance with applicable safety and health requirements.

4.0 EMERGENCY INFORMATION

Hospital Name and Address:

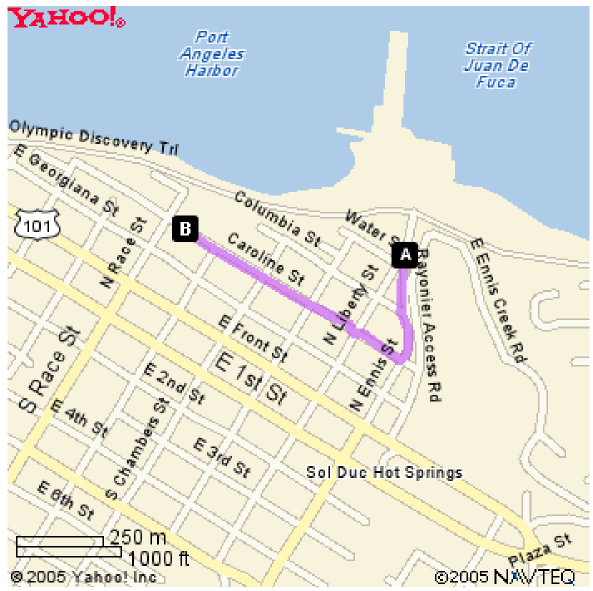
Olympic Medical Center
(360) 417-7000
939 Caroline Street
Port Angeles, WA 98362

Phone Numbers (Hospital ER): Phone: **(360) 417-7000**

Distance:

Route to Hospital:

1. Start at **700 N ENNIS ST, PORT ANGELES** going toward **COLUMBIA ST** - go **0.2** mi
2. Turn Right on **CAROLINE ST** - go **0.5** mi
3. Arrive at **939 CAROLINE ST, PORT ANGELES,** on the Right



Ambulance: 9-1-1
Poison Control: (800) 732-6985
Police: 9-1-1
Fire: 9-1-1
Location of Nearest Telephone: Cell phones are carried by field personnel.
Nearest Fire Extinguisher: Located in the GeoEngineers vehicle on site.
Nearest First-Aid Kit: Located in the GeoEngineers vehicle on site.

4.1 STANDARD EMERGENCY PROCEDURES

Get Help

- Send another worker to phone 9-1-1 (if necessary)
- As soon as feasible, notify GeoEngineers' Project Manager

Reduce Risk to Injured Person

- Turn off equipment
- Move person from injury location (if in life-threatening situation only)
- Keep person warm
- Perform CPR (if necessary)

Transport Injured Person to Medical Treatment Facility (if necessary)

- By ambulance (if necessary) or GeoEngineers vehicle
- Stay with person at medical facility
- Keep GeoEngineers' Project Manager apprised of situation and notify Human Resources Manager of situation

5.0 HAZARD ANALYSIS

5.1 PHYSICAL HAZARDS

x	Drill rigs (includes concrete coring)
x	Backhoe
x	Trackhoe
	Crane
x	Front end loader
x	Excavations/trenching (1:1 slopes for Type B soil)
	Shored/braced excavation if greater than 4 feet of depth
x	Overhead hazards/power lines
x	Tripping/puncture hazards (debris on-site, steep slopes or pits)
x	Overwater hazards
x	Heavy lifting
x	Pinch points
x	Sharp edges
x	Noise
	Misc. construction equipment
x	Heat/cold, humidity
x	Underground utilities

- A utility locate will be completed as required to reduce the chances of drilling or digging into underground utilities.
- Work areas will be marked with reflective cones, barricades and/or caution tape as necessary. Field personnel should wear high-visibility vests to ensure they can be seen by vehicle and equipment operators.
- Field personnel will be aware at all times of the location and motion of heavy equipment in the area of work to ensure a safe distance between personnel and the equipment. Personnel should be visible to the operator at all times and remain out of the swing radius of the equipment apparatus. Personnel will approach operating heavy equipment only when they are certain the operator has

indicated that it is safe to do so through hand signal or other acceptable means. Eye contact with drill rig operators or other signaling methods will be used near operating equipment.

- Heavy equipment and/or vehicles used on the Site will not work within 20 feet of overhead utility lines without first ensuring that the lines are not energized. This distance may be reduced to 10 feet depending on the client and the use of a safety watch.
- Excessive levels of noise (exceeding 85 dBA) are anticipated during construction, drilling and sheet pile installation (if conducted). Personnel potentially exposed will wear ear plugs or muffs with a noise reduction rating (NRR) of at least 25 dB whenever it becomes difficult to carry on a conversation 6 feet away from a co-worker or whenever noise levels become bothersome. (Increasing the distance from the source will decrease the noise level noticeably.)
- Personnel entry into unshored or unsloped excavations deeper than 4 feet is not allowed. Any trenching and shoring requirements will follow guidelines established in WAC 296-155, the Washington State Construction standards or OSHA 1926.651 Excavation Requirements. In the event that a worker is required to enter an excavation deeper than 4 feet, a trench box or other acceptable shoring will be employed or the side walls of the excavation will be sloped according to the soil type and guidelines as outlined in DOSH/OSHA regulations. If the shoring/sloping deviates from that outlined in the WAC, it will be designed and stamped by a Professional Engineer. Prior to entry, personnel will conduct air monitoring as described later in this plan. All hazardous encumbrances and excavated material will be stockpiled at least 2 feet from the edge of a trench or open pit. If concentrations of volatile gases accumulate within an open trench or excavation, the means of entering shall adhere to confined space entry and air monitoring procedures outlined under the air monitoring recommendations in this plan and the GeoEngineers Safety Program Manual.
- Personnel will avoid tripping hazards, steep slopes, pits and other hazardous encumbrances. If it becomes necessary to work within 6 feet of the edge of a pit, slope, pier or other potentially hazardous area, appropriate fall protection measures will be implemented by the Site Safety and Health Supervisor in accordance with OSHA/DOSH regulations and the GeoEngineers Safety Program manual.
- Heat stress control measures will be implemented as necessary, in accordance with the GeoEngineers Safety Program Manual, with water provided on site.
- Safety glasses will be worn during sampling to protect against splashing or other potential eye injuries.
- Caution will be taken near the drill rig to avoid moving parts of the drill rig, as well as falling or flying objects.
- Field personnel will minimize time spent near drill rig; will not wear loose clothing; will use safety glasses, hard hat, and steel-toed boots.
- When around vehicles and heavy equipment used at the Site, field personnel will be alert to their surroundings and will wear a brightly colored safety vest.
- Field personnel will make eye contact with operators prior to entering work zones.
- To avoid slips, trips, and falls, personnel will be alert to their surroundings and will perform clean housekeeping work practices.

5.2 ENGINEERING CONTROLS

x	Workers remain upwind of explorations to extent possible
x	Soil covers (as needed)
x	Dust control (as needed)

5.3 CHEMICAL HAZARDS POTENTIALLY PRESENT AT SITE

Confirmed and unconfirmed COPCs in soil and groundwater are listed in Tables 4 and 5 of the Work Plan. The table below summarizes chemical hazards for selected COPCs listed in Tables 4 and 5.

Summary of Chemical Hazards Potentially Present at Site

Compound/ Description	Exposure Limits/IDLH	Exposure Routes	Toxic Characteristics
Petroleum Hydrocarbons			
Gasoline	None established by OSHA	Inhalation, skin, absorption, ingestion, direct dermal contact	Irritation to eyes, skin, mucus membranes, dermatitis, headache, exhaustion, blurred vision, dizziness, slurred speech, confusion, convulsions, liver or kidney damage.
Diesel	None established by OSHA, but ACGIH has adopted 100 mg/m^3 for a TWA (as total hydrocarbons)	Ingestion, inhalation, skin absorption, skin and eye contact	Irritated eyes, skin, and mucous membrane; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; and headache, and dermatitis
Waste oil – may contain metals, gas, antifreeze and PAHs	Depends on the ancillary contaminants	Ingestion, inhalation, skin absorption, skin and eye contact	Depends on the ancillary contaminants.
Lube Oil/Mineral Oil – as a mist	The current OSHA PEL for mineral oil mist is 5 mg/m^3 of air as an 8-hr TWA	If the oil is not a mist, then route of exposure is skin and eye contact	Exposure to oil mists can cause eye, skin and upper respiratory tract irritation.
Semivolatile Organic Compounds (SVOCs)			
Pentachlorophenol	IDLH 2.5 mg/m3 OSHA PEL: TWA 0.5 mg/m3	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, nose, throat; sneezing, cough; lassitude (weakness, exhaustion), anorexia, weight loss; sweating; headache, dizziness; nausea, vomiting; dyspnea (breathing difficulty), chest pain; high fever; dermatitis
bis(2-Ethyl-hexyl)phthalate	IDLH: Ca [5000 mg/m3] OSHA PEL: TWA 5 mg/m3	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, mucous membrane; in animals: liver damage; teratogenic effects; [potential occupational carcinogen]

Compound/ Description	Exposure Limits/IDLH	Exposure Routes	Toxic Characteristics
Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs)			
Carcinogenic polycyclic aromatic hydrocarbons	PEL 0.01 mg/m3 IDLH 80 mg/m3	Inhalation, ingestion, dermal and eye contact	Nausea, vomiting, low blood pressure, abdominal pain, convulsions, and coma
Pesticides			
Endosulfan	PEL: Not Available TLV: 0.1 mg/m^3 (8-hour)	Inhalation, skin absorption, ingestion, skin and/or eye contact.	Endosulfan is highly toxic via the oral route, and may be only slightly toxic via inhalation, with a reported inhalation LC50 of 21 mg/L for 1 hour, and 8.0 mg/L for 4 hours. Stimulation of the central nervous system is the major characteristic of endosulfan poisoning. Symptoms noted in acutely exposed humans include those common to the other cyclodienes, such as incoordination, imbalance, difficulty breathing, gagging, vomiting, diarrhea, agitation, convulsions and loss of consciousness.
DDT	PEL for DDT is 1 mg/m^3 for an 8-hour average with a skin notation	Inhalation, skin absorption, ingestion, skin and/or eye contact.	Irritation to eyes, skin; paresthesia in the tongue, lips, face; tremor; anxiety, dizziness, confusion, malaise (vague feeling of discomfort), headache, lassitude (weakness, exhaustion); convulsions; paresis in the hands; vomiting; [potential occupational carcinogen].
DDE	TLV 0.1 mg/m^3 (8 hour exposure)	Inhalation, skin absorption, ingestion, skin and/or eye contact.	
Endosulfan Sulfate	TLV 0.3 mg/m^3 (15 minute exposure) RFD 0.00005 mg/kg/day (EPA); 0.0015 mg/kg/day (OPP) LEL 0.75 mg/kg/day (rat) lowest effect level	Inhalation, skin absorption, ingestion, skin and/or eye contact.	Highly toxic chlorinated hydrocarbon insecticide and carries the signal word DANGER on the label. Undiluted endosulfan is slowly and incompletely absorbed into the body, whereas absorption is more rapid in the presence of alcohols, oils and emulsifiers.
Aldrin	PELs for aldrin and dieldrin are 0.25 mg/m^3 (ACGIH) for an 8-hour average	Inhalation, skin absorption, ingestion, skin and/or eye contact.	Headache, dizziness; nausea, vomiting, malaise (vague feeling of discomfort); myoclonic jerks of limbs; clonic, tonic convulsions; coma; hematuria (blood in the urine), azotemia; potential occupational carcinogen.

Compound/ Description	Exposure Limits/IDLH	Exposure Routes	Toxic Characteristics
Chlordane	PEL for Chlordane is 0.5 mg/m^3 (8-hour).	Inhalation, skin absorption, ingestion, skin and/or eye contact.	Acute effects of chlordane in humans consist of gastrointestinal distress and neurological symptoms, such as tremors and convulsions. Chronic (long-term) inhalation exposure of humans to chlordane results in effects on the nervous system. Poisoning victims may appear agitated or excited, but later they may become depressed, uncoordinated, tired or confused. Other symptoms reported in cases of chlordane poisoning include headaches, dizziness, vision problems, irritability, and weakness or muscle twitching. In severe cases, respiratory failure and death may occur.
Lindane	PEL for Lindane is 0.5 mg/m^3 (ACGIH) for an 8-hour average with a skin notation.	Inhalation, skin absorption, ingestion, skin and/or eye contact.	Irritation to eyes, skin, nose, throat; headache; nausea; clonic convulsions; respiratory difficulty; cyanosis; aplastic anemia; muscle spasm; in animals: liver, kidney damage.
Metals			
Arsenic	PEL 0.05 mg/m3 IDLH 5.0 mg/m3	Inhalation, skin absorption, skin and eye contact, ingestion	Ulceration of nasal septum; dermatitis; GI disturbances; peripheral neuropathy; respiratory irritation; hyperpigmentation of skin
Copper	PEL 1 mg/m3 IDLH 100 mg/m3	Inhalation, ingestion, skin and eye contact	Irritated eyes, nose, pharynx; nasal septum perforation; metallic taste; dermatitis
Chromium	PEL 1 mg/m3 IDLH 250 mg/m3	Inhalation, ingestion, skin and eye contact	Irritated eyes, skin respiratory system
Lead	PEL 0.05 mg/m3 IDLH 100 mg/m3	Inhalation, ingestion, skin and eye contact	Lassitude; insomnia; facial pallor; abnormalities; weight loss, malnutrition, constipation, abdominal pain; colic; anemia; gingival lead line; tremors; paralysis of the wrist and ankles; encephalopathy; kidney disease; irritated eyes; hypertension

Compound/ Description	Exposure Limits/IDLH	Exposure Routes	Toxic Characteristics
Mercury	PEL 0.05 mg/m3 IDLH 10 mg/m3	Inhalation, skin absorption, skin and eye contact, ingestion	Irritated eyes, skin; cough, chest pain, dyspnea, bronchitis, pneumonia; tremors, insomnia, irritability, indecision, headache, lassitude; stomatitis, salivation; GI disturbances, abnormalities, low weight; proteinuria
Nickel	IDLH 10 mg/m3	Inhalation, skin and eye contact	Sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]
Zinc	TLV/PEL – none Treat as particles not otherwise specified and maintain levels below 3 mg/m3respirable and 10mg/m3 inhalable	Inhalation	Metal fume fever (usually onsets at 77-600 mg zinc/m3).
PCBs, Dioxins/Furans			
PCBs (as Aroclor 1254)	PEL 0.5 mg/m^3 TLV 0.5 mg/m^3 REL 0.001 mg/m^3 IDLH 5.0 mg/m^3	Inhalation (dusts or mists), skin absorption, ingestion, skin and/or eye contact	Irritated eyes, chloracne, liver damage, reproductive effects, potential carcinogen
Dioxins/furans	See below		

Notes:
IDLH = immediately dangerous to life or health
OSHA = Occupational Safety and Health Administration
ACGIH = American Conference of Governmental Industrial Hygienists
mg/m^3 = milligrams per cubic meter
TWA = time-weighted average
PEL = permissible exposure limit
TLV = threshold limit value
STEL = short-term exposure limit
ppm = parts per million

Dioxins/Furans

Very little human toxicity data from exposure to tetrachlorodibenzodioxins (TCDDs) and/or polychlorinated dibenzodioxins (PCDDs) are available. Health-effect data obtained from occupational settings in humans are based on exposure to chemicals contaminated with dioxins. It produces a variety of toxic effects in animals and is considered one of the most toxic chemicals known. Most of the available toxicity data are from high-dose oral exposures to animals (including tumor production, immunological dysfunction, and teratogenesis). Very little dermal and inhalation exposure data are available in the literature. It is important for field personnel to remember that although dioxins are toxic and carcinogenic, most of the information is based on exposure to high doses of liquid product. These products are not very volatile, so the major concern is on skin protection and inhalation/ingestion of soil particles. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a 20 ppm threshold limit value (TLV) for 1,4-dioxane (an example of numerous dioxin compounds), lists it as being absorbed through the skin, and lists it as potentially carcinogenic as well as toxic to liver and kidneys. This is typical of health effects for dioxin/furan compounds. Care should be taken especially in sampling product from drums and wells known to contain detectable levels of dioxins. Emphasis will be on working outside in well-ventilated areas using proper PPE (as discussed later in this plan). There is significant variability in dioxin lethality in animals. The signs and symptoms of dioxin poisoning in humans, however, are analogous to those observed in animals.

5.4 Biological Hazards and Procedures

Y/N	Hazard	Procedures
N	Poison ivy or other vegetation	
Low Potential	Insects or snakes, including bees	Don't reach blindly into holes, rubble; open well monuments carefully; be alert for bee hives or spider lairs
Low Potential	Used hypodermic needs or other infectious hazards	**Do not pick up or contact**
	Others	

Site personnel shall avoid contact with or exposures to potential biological hazards encountered.

5.5 Additional Hazards (Update in Daily Report)

Include evaluation of:

- *Physical Hazards* (excavations and shoring, equipment, traffic, tripping, heat stress, cold stress and others)
- *Chemical Hazards* (odors, spills, free product, airborne particulates and others present)
- *Biological Hazards* (snakes, spiders, other animals, discarded needles, poison ivy, pollen, bees/wasps and others present)

6.0 AIR MONITORING PLAN

Work upwind if at all possible.

Check instrumentation to be used:

__X__ Photoionization detector (PID)

______ Other (i.e., detector tubes): ____

Check monitoring frequency/locations:

______ 15 minutes
______ 30 minutes
__X__ Hourly (in breathing zone during excavations, drilling, sampling)

In addition to performing air monitoring for VOCs using a PID, field personnel will notify the Site Safety and Health Supervisor immediately if drilling or excavation activities generate visible dust, and the need for air monitoring and lab analysis for inhalable and respirable particulates will be assessed.

The PID must be properly maintained, calibrated and charged (refer to the instrument manuals for details). Zero the PID in the same approximate relative humidity as the area in which it will be used and allow at least a 10-minute warm-up prior to zeroing. Do not zero in a contaminated area. The PID can be tuned to measure a specific VOC if there are not multiple VOCs present on site, but the PID will respond to multiple VOCs if present. For a particular VOC to be detectable by the PID, the ionization potential (IP) of the chemical has to be less than that of the PID lamp (11.7 or 10.6 eV standard). The PID does not detect methane. The PID is calibrated using isobutylene calibration gas.

Vapor measurements in the worker breathing zone should be conducted at least hourly or more often if persistent organic vapor odors are detected. As indicated in the table below, if vapor concentrations exceed 5 ppm above background continuously for a 5-minute period as measured in the breathing zone, workers should upgrade to Level C personal protective equipment (PPE) (i.e., air-purifying respirator) or move to a non-contaminated area.

Air Monitoring Action Levels

Contaminant	Activity	Monitoring Device	Frequency of Monitoring Breathing Zone	Action Level	Action
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; every 15 minutes to 1 hour depending on activity; also in event of noticeable odors	Background to 5 ppm in breathing zone	Use Level D or Modified Level D PPE.
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; every 15 minutes to 1 hour depending on activity; also in event of noticeable odors	5 to 25 ppm in breathing zone	Upgrade to Level C PPE (air-purifying respirator).
Organic Vapors	Environmental Remedial Actions	PID	Start of shift; every 15 minutes to 1 hour depending on activity; also in event of noticeable odors	> 25 ppm in breathing zone	Stop work and evacuate the area. Contact Certified Industrial Hygienist (CIH) for guidance.

7.0 SITE CONTROL PLAN

The site control plan has been developed to minimize employee exposure to hazardous substances. Site maps showing proposed exploration locations are included in the Work Plan. The hospital route map is included with this HASP.

7.1 TRAFFIC OR VEHICLE ACCESS CONTROL PLANS

Traffic or vehicle access control plans are not expected to be needed for the investigation work. If interim actions will be conducted, traffic or vehicle access control plans will be prepared as necessary.

7.2 SITE WORK ZONES

The proposed exploration locations are shown in Figure 28 of the Work Plan. In general, exclusion zones will be established around each exploration location using traffic cones/delineators and caution tape.

7.3 BUDDY SYSTEM

Field personnel should use the buddy system (pairs), particularly whenever communication is restricted. If only one GeoEngineers employee is on site, a buddy system can be arranged with subcontractor/contractor personnel.

7.4 SITE COMMUNICATION PLAN

Positive communications (within sight and hearing distance or via radio) should be maintained between buddy system pairs on site, with each person in the pair remaining in close proximity to assist each other in case of emergencies. The team should prearrange hand signals or other emergency signals for communication when voice communication becomes impaired (including lack of radios or radio malfunctions). In these instances, the team should consider suspending work until communication can be restored. The following are examples of hand signals that can be used for communication:

1. Hand gripping throat: Out of air, can't breathe.
2. Gripping partner's wrist or placing both hands around waist: Leave area immediately.
3. Hands on top of head: Need assistance.
4. Thumbs up: Okay, yes, I'm all right, or I understand.
5. Thumbs down: No; no good.

7.5 PERSONNEL DECONTAMINATION PROCEDURES

Personnel decontamination that may be employed consists of removing outer protective (e.g., Tyvek®) clothing (if used) and washing boots and rubber/vinyl gloves using soapy water, bucket and brush provided on site. If used, respirators will then be washed with a separate soapy water solution in the support zone. Employees will perform personnel decontamination procedures and wash hands prior to eating, drinking or leaving the property.

7.6 WASTE DISPOSAL OR STORAGE

PPE disposal: Used disposable PPE (gloves, Tyvek®) will be placed in plastic trash bags and disposed as solid waste.

Drill cuttings/excavated soil disposal or storage:

X On site, pending analysis and further action

X Secured (list method) Drums, covered/lined stockpiles

___ Other (describe destination, responsible parties): ______

8.0 PERSONAL PROTECTIVE EQUIPMENT

- PPE will consist of standard Level D equipment.
- Air monitoring will be conducted as described above.
- Field crews will have half-face combination organic vapor/high-efficiency particulate air (HEPA) or P100 cartridge respirators available on site to be used as necessary. P100 provide protection against dusts, metals and asbestos, while the combination organic vapor/HEPA cartridges protect against both dusts and vapors. P100 cartridges are to be used only if PID (organic vapor) readings are below action limits (Section 6.0). Ensure that the PID will detect the COPCs on site.
- Level D PPE will be worn at all times on site. Potentially exposed personnel will wash gloves, hands, face and other pertinent items to prevent hand-to-mouth contact. This will be done prior to hand-to-mouth activities including eating, smoking, etc. Personnel and equipment decontamination procedures will be used to decrease potential ingestion and inhalation of COPCs. Individual permissible exposure limits (PELs) or action limits are not expected to be exceeded given the planned activities. If conditions are damp, airborne dust is not likely to be an issue. If conditions are dry and dust is visible during field activities, personnel will use P100 cartridges on their respirators.

Minimum Level of Personal Protective Equipment. The minimum level of PPE to be used during this project is Level D. Task-specific levels of PPE will be reviewed with field personnel during daily tailgate safety briefings, and PPE levels will be elevated as appropriate (e.g., to Level C PPE) to protect worker health.

Check applicable PPE to be used:

__X__ Hardhat
__X__ Steel-toed boots
__X__ Safety glasses
__X__ Hearing protection (earplugs)
__X__ Rubber boots (if wet conditions)
______ Lifejackets (for over-water work)

Gloves (specify):

__X__ Nitrile or
__X__ Latex
______ Liners
__X__ Leather (optional)
______ Other (specify) ____________________________________

Protective clothing:

__X__ Tyvek® (if upgrade to Level C PPE)
______ Saranex® (if potentially hazardous liquids are handled or splashing may be an issue)
__X__ Rain gear (as needed)
__X__ Layered warm clothing (as needed)

Inhalation hazard protection:

X Level D (no air-purifying respirator)

X Level C (air purifying respirator with organic vapor/HEPA or P100 filters – only if needed as indicated by air monitoring)

Limitations of Protective Clothing

PPE clothing ensembles designated for use during field activities will be selected to provide protection against known or anticipated hazards. However, no protective garment, glove or boot is entirely chemical-resistant, nor does any PPE provide protection against all types of hazards. To obtain optimum performance from PPE, field personnel shall be trained in the proper use and inspection of PPE.

- Inspect PPE before and during use for imperfect seams, non-uniform coatings, tears, poorly functioning closures or other defects. If the integrity of the PPE is compromised in any manner, replace the PPE.
- Inspect PPE during use for visible signs of chemical permeation such as swelling, discoloration, stiffness, brittleness, cracks, tears or punctures. If the integrity of the PPE is compromised in any manner, replace the PPE.
- Disposable PPE should not be reused after breaks unless it has been properly decontaminated.

Respirator Selection, Use and Maintenance

If respirators are required, field personnel shall be trained before use in the proper use, maintenance and limitations of respirators. Additionally, they must be medically qualified to wear respiratory protection in accordance with 29 CFR 1910.134. Field personnel who will use a respirator must have passed a qualitative or quantitative fit test conducted in accordance with an OSHA-accepted fit-test protocol. Fit testing must be repeated annually or whenever a new type of respirator is used. Respirators will be stored in a protective container.

Respirator Cartridges

If field personnel are required to wear air-purifying respirators, the appropriate cartridges shall be selected to protect personnel from known or anticipated COPCs. The respirator/cartridge combination shall be certified and approved by the National Institute for Occupational Safety and Health (NIOSH). A cartridge change-out schedule shall be developed based on known COPCs, anticipated concentrations, and data supplied by the cartridge manufacturer related to the absorption capacity of the cartridge for specific contaminants. Field personnel shall be made aware of the cartridge change-out schedule prior to the initiation of field activities. Field personnel shall also be instructed to change respirator cartridges if they detect increased resistance during inhalation or vapor breakthrough by smell, taste or feel, although breakthrough is not an acceptable method of determining the change-out schedule. At a minimum, cartridges should be changed at least once daily.

Respirator Inspection and Cleaning

Field personnel will inspect respirators prior to each use in accordance with the manufacturer's instructions. In addition, field personnel wearing a respirator will perform a positive- and negative-pressure seal check each time they put on a respirator, to ensure proper fit and function. User seal checks shall be performed in accordance with the GeoEngineers respiratory protection program or the respirator manufacturer's instructions.

9.0 ADDITIONAL ELEMENTS

9.1 HEAT STRESS PREVENTION

State and federal OSHA regulations provide specific requirements for minimizing worker exposure to heat stress. GeoEngineers' heat stress prevention program complies with these requirements and will be implemented when heat stress is identified as a potential health hazard. Heat stress will be identified as a potential health hazard when outdoor temperatures exceed the worker clothing-dependent action levels listed in Table 1.

Table 1. Heat Stress Action Levels

Type of Worker Clothing	Outdoor Temperature Action Levels
Non-breathable clothing including vapor barrier clothing or PPE such as chemical resistant suits	52°
Double-layer woven clothes including coveralls, jackets and sweatshirts	77°
All other clothing	89°

Keeping workers hydrated in a hot outdoor environment is critical for preventing heat stress. When temperatures exceed the action levels listed in Table 1, Project Managers will ensure that:

- A sufficient quantity of drinking water is readily accessible to workers; and
- Workers have the opportunity to drink at least one quart of drinking water per hour.

9.2 EMERGENCY RESPONSE

- Field personnel should use the "buddy system" (pairs).
- Visual contact should be maintained between "pairs" on site, with the team remaining in proximity to assist each other in case of emergencies.
- If any member of the field crew experiences any adverse exposure symptoms while on site, the entire field crew should immediately halt work and act according to the instructions provided by the Site Safety and Health Supervisor.
- The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated should result in the evacuation of the field team, contact of the PM, and reevaluation of the hazard and the level of protection required.
- If an accident occurs, the Site Safety and Health Supervisor and any field personnel involved are to complete, within 24 hours, an Accident Report for submittal to the PM, the Health and Safety Program Manager and Human Resources. The PM should ensure that follow-up action is taken to correct the situation that caused the accident or exposure.

9.3 CONFINED SPACE ENTRY

Confined space entry is not anticipated during the supplemental upland data collection field investigation. GeoEngineers employees shall not enter confined spaces to perform work unless they have been properly trained, to include hands-on training in the use of retrieval equipment. If confined space entry becomes necessary, this HASP will be amended with a copy of the confined space permit and confined-space training documentation.

Excavations greater than 4 feet in depth with the potential for buildup of a hazardous atmosphere are considered confined spaces.

9.4 PERSONNEL MEDICAL SURVEILLANCE

GeoEngineers employees are not in a medical surveillance program because they do not fall into the category of "Employees Covered" in OSHA 1910.120(f)(2), which states a medical surveillance program is required for the following employees:

> (1) All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;
>
> (2) All employees who wear a respirator for 30 days or more a year or as required by state and federal regulations;
>
> (3) All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; and
>
> (4) Members of HAZMAT teams.

9.5 SANITATION

Public restrooms are assumed to be available within a short driving distance of the project site. If necessary, portable toilets and hand-washing stations will be provided during work activities.

9.6 LIGHTING

Field work will be generally conducted during daylight hours; artificial lighting is not anticipated to be necessary.

9.7 EXCAVATION, TRENCHING AND SHORING

Excavations greater than 4 feet in depth (test pits) are anticipated during this project. If worker entry into excavations is required, the worker(s) shall be trained in excavation safety and shall utilize appropriate safety procedures. OSHA designates a 5-foot depth for instituting excavation safety procedures; however, GeoEngineers uses the more conservative depth of 4 feet as specified by Washington State. This program is for the protection of employees while working in excavations; however, employees should not enter excavations if there is an alternative.

GeoEngineers employees often do not have stop-work authority on projects controlled by other contractors. However, any GeoEngineers employee, regardless of job title, working in the field will be responsible for contacting the Project Manager if they observe practices on the project site that are serious safety violations and that are not under their control. They will document the unsafe practices and will contact the Client-Assigned Site Supervisor. If the Client-Assigned Site Supervisor is not on site, the Project Manager, once notified, will contact the client. This action establishes GeoEngineers' commitment to site health and safety on all project sites as our duty of care to the public, contractors and clients.

GeoEngineers is responsible for its subcontractors and will also be providing inspections and corrections of any work that subcontractors perform around excavations.

10.0 DOCUMENTATION TO BE COMPLETED

The following forms shall be completed:

- FORM C-1: HEALTH AND SAFETY BRIEFING
- FORM C-2: HASP – GEOENGINEERS EMPLOYEE ACKNOWLEDGMENT
- FORM C-3: SUBCONTRACTOR AND SITE VISITOR SITE SAFETY FORM

In addition, field logs are to contain the following information:

- Updates on hazard assessments and safety-related field decisions and conversations with subcontractors, client, or other parties;
- Air monitoring/PID calibration check results, including: personnel present, locations monitored, and field activities at the time of monitoring;
- Safety-related actions taken, including PPE upgrades and rationale; and
- Meteorological conditions (temperature, approximate wind speed and direction, cloud cover, precipitation type/intensity, relative humidity, etc.).

11.0 APPROVALS

1. Plan Prepared	Zanna Satterwhite Signature	______ Date
2. Plan Approval	Rob Leet PM Signature	______ Date
3. Health & Safety Officer	Wayne Adams Health & Safety Program Manager	______ Date

FORM C-1
HEALTH AND SAFETY BRIEFING
SUPPLEMENTAL UPLAND DATA COLLECTION FIELD INVESTIGATION
PORT ANGELES RAYONIER MILL SITE
FILE NO. 000137-015-03

Inform employees, contractors and subcontractors or their representatives about:

- The nature, level, and degree of exposure to hazardous substances they're likely to encounter;
- Emergency response procedures; and
- Any identified potential fire, explosion, or other health or safety hazards, and associated safe work practices.

Date	Topics	Attendee	Company Name	Employee Initials

FORM C-2
HASP – GEOENGINEERS EMPLOYEE ACKNOWLEGMENT
SUPPLEMENTAL UPLAND DATA COLLECTION FIELD INVESTIGATION
PORT ANGELES RAYONIER MILL SITE
FILE NO. 000137-015-03

(All GeoEngineers field personnel shall complete this form, which should remain attached to the HASP and filed with other project documentation.)

I hereby verify that a copy of the current HASP has been provided by GeoEngineers, Inc., for my review and personal use. I have read the document and acknowledge an understanding of the safety procedures and protocol for my responsibilities on site. I agree to comply with all required and specified safety regulations and procedures.

Print Name	Signature	Date

FORM C-3
SUBCONTRACTOR AND SITE VISITOR SITE SAFETY FORM
SUPPLEMENTAL UPLAND DATA COLLECTION FIELD INVESTIGATION
PORT ANGELES RAYONIER MILL SITE
FILE NO. 000137-015-03

I verify that a copy of the current HASP has been provided by GeoEngineers, Inc. to inform me of the hazardous substances on site and to provide safety procedures and protocols that will be used by GeoEngineers' staff at the site. By signing below, I agree that my safety/the safety of my employees is my responsibility/the responsibility of the undersigned company.

Print Name	Signature	Company	Date

Appendix D
Archaeological Monitoring Plan

ARCHAEOLOGICAL MONITORING PLAN FOR PROPOSED SUBSURFACE INVESTIGATION ACTIVITIES AT THE FORMER RAYONIER MILL, PORT ANGELES, CLALLAM COUNTY, WASHINGTON

Prepared by:

Margaret A. Nelson

For:

Rayonier, Inc.
Fernandina Beach, FL

Submitted to:
GeoEngineers, Inc.
Seattle, WA

July 20, 2010

Cascadia Archaeology
P.O. Box 51058
Seattle, WA 98115

ARCHAEOLOGICAL MONITORING PLAN FOR PROPOSED SUBSURFACE INVESTIGATION ACTIVITIES AT THE FORMER RAYONIER MILL, PORT ANGELES, CLALLAM COUNTY, WASHINGTON

INTRODUCTION

Rayonier, Inc. (Rayonier) is in the process of completing a Remedial Investigation (RI) at the former Port Angeles Mill site. After the pulp mill was closed in 1997, the buildings and other structures were dismantled to ground level. Supplemental RI activities will be completed as part of the Agreed Order (signed March 25, 2010) developed by Rayonier and the Washington State Department of Ecology pursuant to the Model Toxic Control Act. Because a known historic period Klallam village and prehistoric archaeological resources are located on and in the vicinity of the Rayonier property, the Lower Elwha Klallam Tribe (LEKT) and Rayonier have an agreement specifying that an archaeological monitor will be present during ground-disturbing activities that could encounter intact native sediments. The following sections of this plan discuss the proposed subsurface investigations, potential for encountering significant historic or prehistoric archaeological deposits, and protocols for archaeological monitoring. Included in the monitoring plan are protocols to be followed in the event of an inadvertent discovery of archaeological material or human remains.

Project Location and Description

The former Rayonier mill is located on the waterfront on the east side of Port Angeles, in Township 30 North, Range 6 West, Sections 2, 11, and 12 (Figures 1 and 2). The site faces Port Angeles Harbor on the southern shore of the Strait of Juan de Fuca. The mill was built on the Ennis Creek delta, which extended out from the bluff as much as 500 feet (Robbins et al. 1997). The mill area is approximately 11 feet above sea level (asl), built partially on fill.

Rayonier is proposing to complete a series of borings (approximately 2 to 8 inches in diameter) and test pits at the former mill site (Figure 3). The purpose of the subsurface investigation is to test soil and groundwater for contaminants remaining from operation of the mill. Limited removal of contaminated soil may also be completed (up to 100 cubic yards total).

The proposed exploration locations are shown in Figure 3. The borings are expected to be completed to depths ranging from approximately 10 to 40 feet below ground surface (bgs) and the test pits to approximately 5 to 10 feet bgs.

Figure 1. Project vicinity, T. 30 N., R. 6 W. (USGS 7.5 min. Port Angeles, WA., 1985).

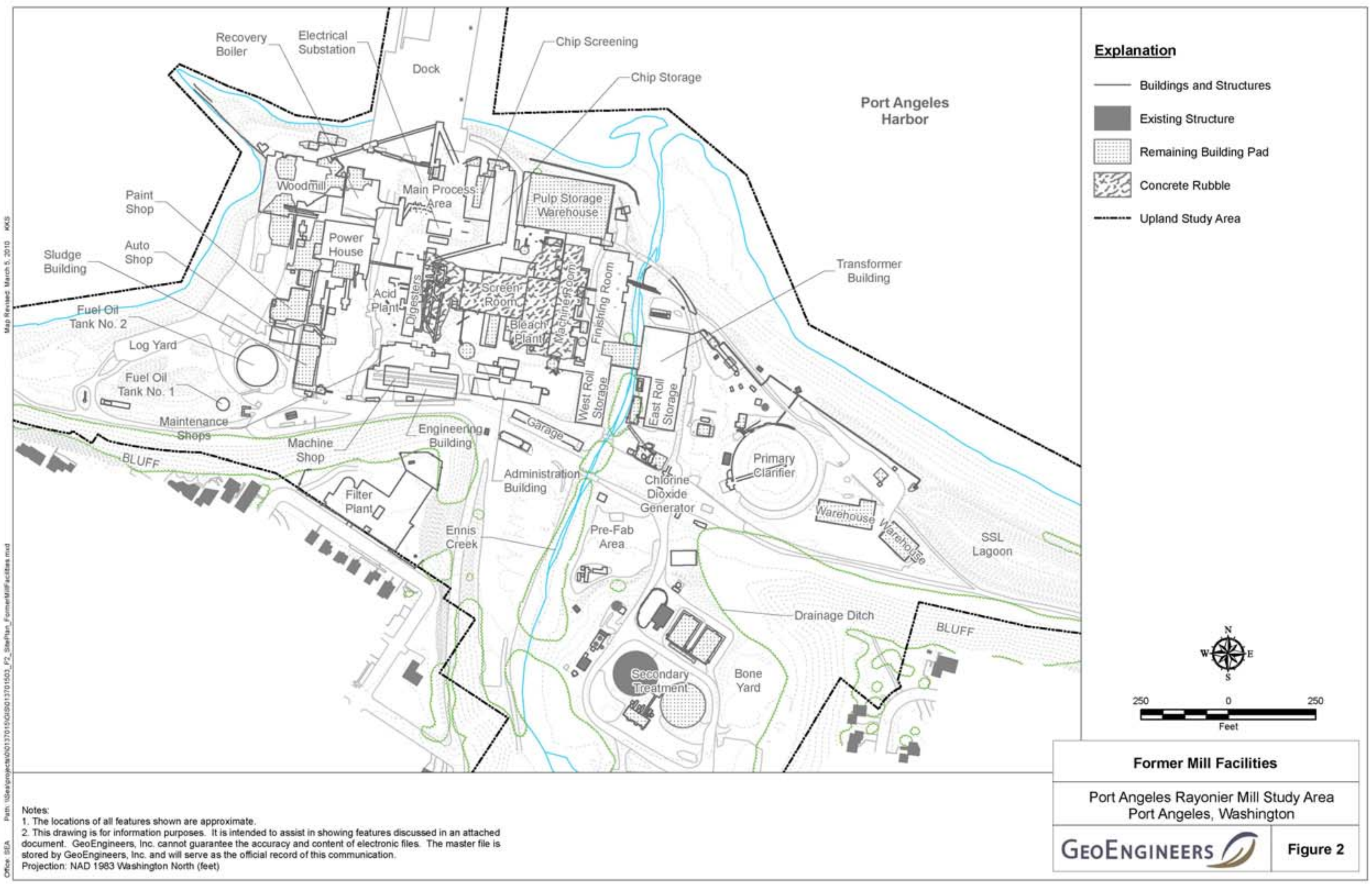


Figure 2. Port Angeles Rayonier mill site showing location of former facilities.

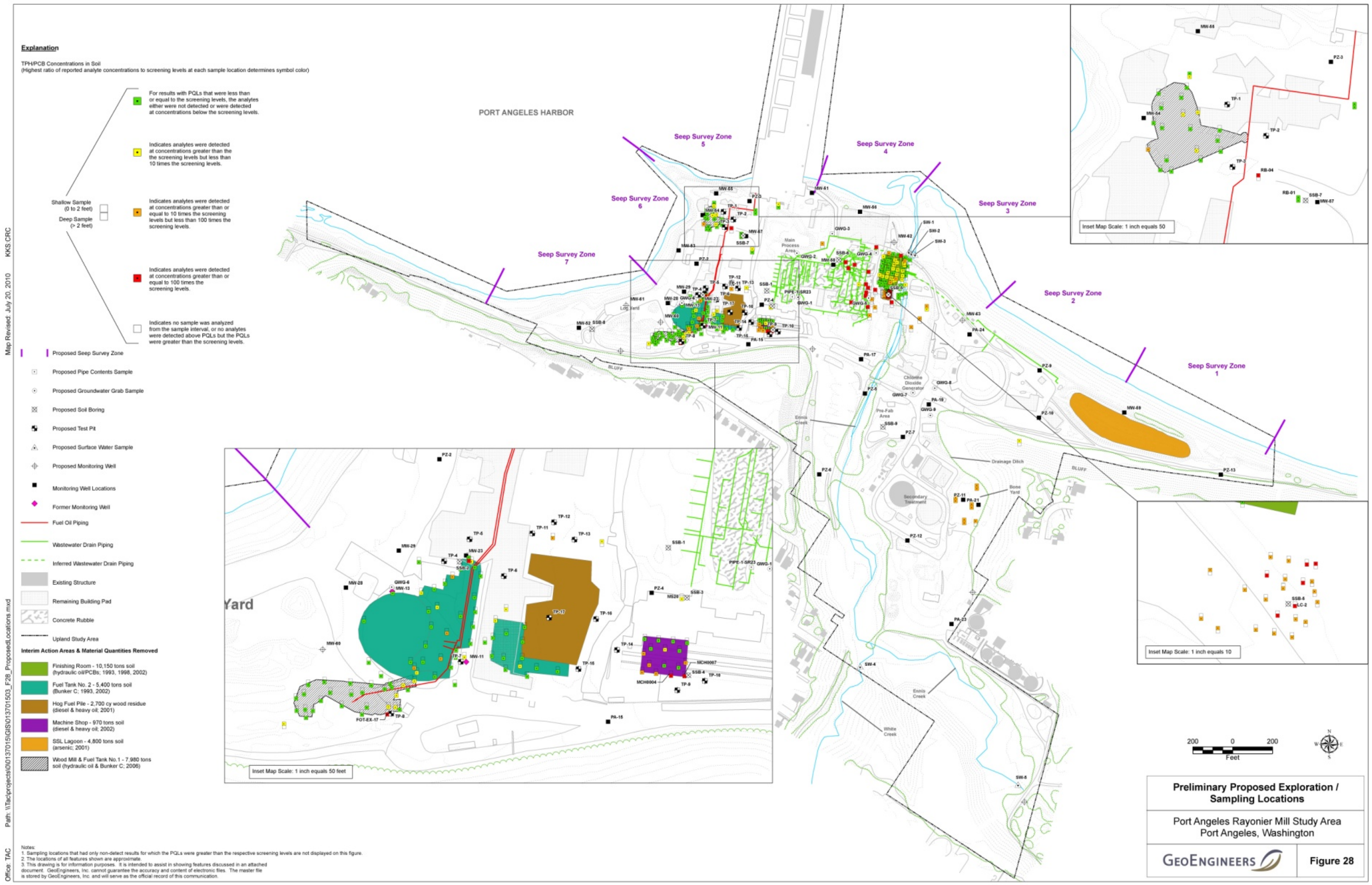


Figure 3. Plan of proposed exploration/sampling locations.

CULTURAL SETTING

The Rayonier Port Angeles Mill was constructed near a nineteenth century Klallam village, *I'e'nis (*or *I-eh-nus,* or *Y'innis).* According to late nineteenth century accounts by members of the Puget Sound Cooperative Colony (PSCC) who settled on the west side of the creek, the village was on the east side of the mouth of Ennis Creek (LeWarne 1975:33). The artist Paul Kane, who traveled through the region in 1847, arrived at I'e'nis on May 9 of that year. He described I'e'nis as a "Clallum village or fort" consisting of a large roofed structure with "compartments or pens" for 30 or 40 families, surrounded by a double row of sharpened pickets (Harper 1971). At that time, the Klallam were intermittently engaged in hostilities with the Makah, whose territory was to the west of Klallam territory. A painting made from one of the sketches Kane made while he was there shows the stockaded village and several graves a short distance to its east. The graves were not in the original sketch but do appear in a separate sketch by Kane entitled *"Graves at I-eh-nus"* (Harper 1971:304; Robbins et al. 1997:11).

Sustained Euroamerican use of lower Ennis Creek began when the PSCC, the first of several utopian communities built in the Puget Sound region during the late nineteenth and early twentieth centuries, was established in 1887 (LeWarne 1975). Buildings, including a sawmill, were initially constructed on the west side of the creek. At that time, the Klallam village on the east side of the creek was still occupied. The sawmill was located some distance west of the other major buildings of the PSCC; to the north and slightly west of Chambers Street, according to historic maps and photographs. A 1892 map showing the mouth of Ennis Creek and PSCC buildings is included as Figure 4. The sawmill burned down in 1893 and shortly afterward, the PSCC went into receivership. In 1904 the site was abandoned.

During World War I, the U.S. Army's Spruce Production Division built a large new mill at the former PSCC site for the production of aircraft for the war effort. The mill complex was constructed on pilings on the beach just west of Ennis Creek; it included a sawmill and other buildings covering an area over 700 feet by 350 to 400 feet (Robbins et al. 1997:Figures 14-16). In 1929, the abandoned mill was purchased by the Olympic Forest Products Company for a pulp and paper mill operation. The company expanded the site to the north with the addition of fill and riprap to raise the intertidal zone to an elevation of 11 feet asl. Many of the old buildings were razed and new ones constructed on fill and on pilings in the early 1930s (Robbins et al. 1997:23). In 1933, the lower Ennis Creek channel was diverted eastward some 200 feet In 1937, Olympic Forest Products merged with other mill companies to form Rayonier. Rayonier operated the mill until it closed in 1997.

Figure 4. 1892 map showing mouth of Ennis Creek and PSCC buildings. Arrow points to mouth of the creek. Most PSCC buildings are directly west of the creek; sawmill is at west end of Water Street with long wharf (North Olympic Library System, Port Angeles).

Potential for Discovery

Previous archaeological investigations in the vicinity, including a survey along the east bank of Ennis Creek at the Port Angeles Rayonier Mill (Robbins et al. 1997), which identified prehistoric site 45CA468, and data recovery excavations at *Tse-whit-sen*, a village at Ediz Hook that was occupied from ca. a 2,700 years before present (B.P.) into the historic period, as well as information on the historic Klallam village of I'e'nis (site 45CA235), suggest a moderate to high probability of prehistoric to historic period Native American cultural resources within the project area.

Presently, the mouth of Ennis Creek is 200 to 225 feet east of its location before it was diverted in the 1930s, and it may have been even farther west during the late 1880s, if Robbins et al.'s interpretation of an historical photo is correct (Robbins et al. 1997:Figure 12). The lower channel likely had also shifted its course at earlier times as its delta prograded. During the 19th century, the village of I'e'nis was on the east side of the creek, so the primary locus of cultural activity during that period is east of the main mill area. Earlier occupation around the mouth of the creek could have been on either or both banks, although given the steeply incised channel cut through the bluff, the creek probably would have been no nearer than about 300 feet from the former wood mill location near the south end of the mill dock (Wood Mill area in Figure 2).

During previous interim actions in two areas at the mill site, monitored by Cascadia Archaeology in 2006, native sediments pre-dating the mill were encountered below 5 feet bgs at the Fuel Tank 1 (south) location, and below 16 to 35 feet bgs at the wood mill (north) location (Figure 2). Native sediments in the north location were interpreted as intertidal or subtidal. Fill at the south location was 5 to 8 feet thick, directly overlying sandy beach sediments. No evidence of prehistoric or historic Native American cultural material was observed at either location, but pilings from the wood mill, possibly including some from the Spruce Mill, were common at the north location, and logs that appeared to have been used for cribbing were encountered at the south location. These logs were below about 7 feet of fill and just above sandy beach sediments. They were interpreted as cribbing or decking set on the beach. Their location was some distance from known structures of both the PSCC and Spruce Mill, but could have been related to milling by the PSCC, perhaps part of a log yard, but they did not appear to be part of a permanent structure. No evidence of associated buildings or other historic period structures was observed and the timbers were not considered to be contributing elements to a potentially significant historic property, such as the PSCC, which is listed on the Washington Heritage Register (Nelson 2006).

The southwestern portion of the proposed study area is within the high probability area delineated by Robbins et al (1997:33); however, no evidence of potentially significant cultural material, including evidence of prehistoric or historic Native American occupation, was identified anywhere within the area during several recent episodes of monitoring (Beery, pers comm. 2010; Nelson 2006). Evidence of pre-mill activities is less likely to be encountered in the northern portion of the mill site because of the deposition of large amounts of fill on top of intertidal and subtidal deposits in this area.

MONITORING AND INADVERTENT DISCOVERY PROCEDURES

General Guidelines

The on-site archaeological monitor will be either a person meeting the Secretary of the Interior's standards for a Professional Archaeologist or an archaeological technician with experience, including monitoring experience, that meets or exceeds that listed in the *Supervisory Plan for Archaeological Monitoring*, attached to this document. If the archeological monitor is an archaeological technician, he or she will be under the supervision of the project Professional Archaeologist.

Prior to the commencement of the proposed borings and test pit excavations, the archaeological monitor should be present at a pre-construction meeting to explain the monitor's role and to describe the nature of potential subsurface cultural deposits, where they are most likely to be found, and archaeological monitoring procedures.

The archaeological monitor will be present during all explorations that could extend below modern (i.e., less than 50 years old) fill. If information from previous subsurface testing provides evidence that the work will not penetrate beneath modern fill into any intact historic or prehistoric cultural material, the archaeological monitor need not be present at each boring or test pit where target depths will likely be within only fill material. The monitor will be present when both the borings and test pit excavations begin, and will remain until he or she is confident that the potential for encountering cultural resources is low (e.g., if the borings/test pits will be terminated within modern fill material). At that point, the work may be allowed to continue without the archaeological monitor present, but ONLY in areas so designated by the archaeological monitor, in consultation with the archaeological project manager. The archaeological monitor must be present during all other excavations, i.e., in areas and at depths that have not been deemed low probability.

The archaeological monitor must be able to observe both the freshly exposed surfaces of test pits and the excavated material. Depending on the conditions and expected proximity to native sediments or cultural material, the monitor may request that the backhoe excavations be done in shallow scrapes at a rate that allows for close observation of excavated material. Soil from drilled borings also will be made available for the monitor's inspection.

Field Procedures

The monitoring and inadvertent discovery procedures described herein will be followed during the project. These procedures have been developed to follow Washington State laws (RCW 27.53 and 27.44) regarding archaeological and cultural resources protection, and also consider protocols established in the Lower Elwha Klallam Tribe's Monitoring and Discovery Plan. The LEKT should be informed in writing of the proposed work well in advance and invited to have a monitor ("Tribal monitor") present during the work as per policies of the City of Port Angeles (City). Contact numbers for the LEKT are included in the Contacts list at the end of this document. The following procedures apply specifically to the archaeological monitor for Rayonier ("archaeological monitor" or "archaeologist" hereafter).

1. The archaeological monitor will be given at least 48 hours advance notice of the need to be on site. If the LEKT has stated that it wishes to have a Tribal monitor present for the project, notification of the schedule will be made to the LEKT monitoring supervisor according to the Tribe's protocols.

2. The archaeological monitor will brief the contractor's crew of the potential for archaeological resources and of the monitoring and inadvertent discovery procedures.

This will take place on site each day that new construction crew members are present before the monitoring work begins. The supervisor of the construction crew involved in the subsurface investigation is responsible for notifying the archaeological monitor if a new crew member will be present.

3. The archaeological monitor will examine excavated material from the borings and test pits, and stratigraphic profiles in the backhoe pits. Uncontaminated soil may be screened at the discretion of the archaeological monitor. The archaeological monitor will inform the construction supervisor if there is a need to temporarily gain closer access to the work area to examine it so that safe working conditions can be maintained.

4. If possible cultural material such as artifacts, fragmented shell, bone, fire-modified rock, charcoal, or organically enriched soil are discovered by someone other than the archaeological monitor during the work, they will immediately report the find to the archaeologist. Work in that area will be suspended to prevent further damage to the deposit and so that the archaeologist can examine the find to determine whether it constitutes cultural remains, and if so, to document and assess the finds. The archaeological monitor will consult with the archaeological project manager regarding identification and assessment procedures appropriate to the find. If the find constitutes potentially significant cultural remains, the construction supervisor, in consultation with the archaeological project manager, will also ensure that the appropriate individuals and agencies are notified as soon as possible (see attached contact list). Ground-disturbing activities in the immediate area of the find will be suspended until notifications are made and the documentation and assessment completed. Notification will be made to the Department of Archaeology and Historic Preservation (DAHP) and the Lower Elwha Klallam Tribe's archaeologist. As a courtesy, the City of Port Angeles archaeologist also will be notified of the find.

5. Any archaeological material found will be recorded by the archaeologist using standard techniques including photographs, scaled drawings, and written descriptions. A site or isolate form will be filled out and provided to the DAHP, along with preliminary assessments of significance.

6. If the assessment determines that the cultural material is potentially significant and impacts cannot be avoided by the project, and if the DAHP concurs with this determination, it will be necessary to develop an archaeological treatment plan before any work in the area continues. Interested parties to be consulted about development of the treatment plan include the DAHP, LEKT, and Rayonier. The City may also choose to join the consultations as an interested party through the City Archaeologist or other City representative.. Data recovery excavations would require an archaeological excavation permit from the DAHP under RCW 27.53.

7. If possible human remains, including burials, isolated bones/teeth, or mortuary items are exposed, construction in the vicinity will be stopped and the area secured. The archaeologist will notify the archaeological project manager. The construction supervisor, in consultation with the archaeological project manager, will follow the

protocol outlined by DAHP, as required by state law (RCW 22.44; 68.50; 68.60), by immediately notifying the Clallam County Coroner, Port Angeles Police, and the State Physical Anthropologist, of the find. The following guidelines have been provided by the DAHP:

1. All persons who know of the existence and location of human skeletal remains must, by law, **notify the county coroner and local law enforcement**. This must be done in the most expeditious manner possible. (RCW 22.44; 68.50; 68.60)
2. Any person engaging in ground disturbing activity that encounters skeletal human remains must **cease all activity which may cause further disturbance to the remains, make a reasonable effort to protect the area from further disturbance, and report the presence of those remains to the county coroner and local law enforcement.** (RCW 22.44; 68.50; 68.60)
3. The county coroner will assume jurisdiction over the human skeletal remains and make a determination of whether those remains are forensic or non-forensic. (RCW 22.44; 68.50; 68.60)
4. If the county coroner determines the remains are non-forensic, then the DAHP will take jurisdiction over those remains from non-Federal and non-Tribal land and report them to any appropriate cemeteries and affected tribes. (RCW 22.44; 68.50; 68.60)
5. The State Physical Anthropologist will make a determination of whether the remains are Indian or non-Indian and report that finding to the any [sic] appropriate cemeteries and affected tribes. (RCW 22.44; 68.50; 68.60)
6. The DAHP will handle all consultation with the affected parties as to the future preservation, excavation, and disposition of the remains. (DAHP 2010)

If the remains are not removed and if they are Native American, they will be covered and protected in place until a treatment plan can be developed in consultation with interested Tribes. Protection of the remains will be maintained by 24-hour security, and no further excavation will take place until consultation is completed. If the remains are not Native American, a treatment plan will be developed to document the remains and associated cultural material, and for their disposition in consultation with the DAHP (RCW 27.44.055).

8. Artifacts or other cultural materials (e.g., shell, non-human bone) from disturbed contexts will be noted and may be collected. Artifacts or other cultural materials from possibly intact contexts will not be collected unless they are in danger of being removed by unauthorized personnel or damaged, but will be recorded and protected in place until a plan for dealing with the site is completed. Any cultural material (other than human remains or mortuary items) that is removed will be handled only by the archaeologist, and Tribal monitor, if present. The archaeologist will place the material in plastic bags with the site number, bag number, item description, location, date collected, and monitor's initials written on the bag. Once the assessment has been completed, any Native American cultural material collected, with the exception of human remains or associated mortuary items, will be turned over to the LEKT, who will curate the material at the University of Washington Burke Museum. Non-Native American historic cultural material collected will be turned over to Rayonier, which may choose to donate them to the Clallam County Historical Museum or other appropriate facility. The disposition of human remains will be determined under the jurisdiction of the state physical anthropologist.

Once the monitoring is completed, an interim report will be submitted by the Archaeological Consultant to Rayonier summarizing the results of the work. Depending on the length of the project, weekly (or more frequent) summaries may be provided to Rayonier while the monitoring work is in progress. A final report that meets DAHP standards will be prepared and submitted to Rayonier, for submission to the DAHP and LEKT. Interim and final reports will be completed on a schedule to be determined by Rayonier and the Archaeological Consultant.

REFERENCES CITED

Beery, Derek
2010 City of Port Angeles Archaeologist. Personal communication, March 17, 2010.

Department of Archaeology and Historic Preservation
2010 Guidelines for the Inadvertent Discovery of Human Skeletal Remains on Non-Federal and Non-Tribal Lands in the State of Washington. Electronic Document http://www.dahp.wa.gov/pages/Archaeology/documents/GuidelinesfortheDiscoveryofHumanRemains_000.pdf, accessed February 16, 2010

Harper, J.Russell (editor)
1971 *Paul Kane's Frontier.* University of Toronto Press, Toronto.

LeWarne, Charles P.
1975 *Utopias on Puget Sound, 1885-1915.* University of Washington Press, Seattle.

Lower Elwha Klallam Tribe
n.d. *Monitoring and Discovery Plan*. Lower Elwha Klallam Tribe, Port Angeles, WA. PDF document provided to Cascadia Archaeology by Derek Beery, City of Port Angeles Archaeologist, 2008.

Nelson, Margaret A.
2006 Cultural Resource Monitoring at Two Remediation Sites at the Former Rayonier Port Angeles Mill, Clallam County, Washington. Prepared for Rayonier Properties, LLC, Jacksonville, FL by Cascadia Archaeology, Seattle.

Robbins, J.R., L.A. Forsman, and L.L. Larson
1997 *Rayonier, Incorporated Port Angeles Mill, Port Angeles, Clallam County, Washington, Dismantling and Remediation Project Cultural Resource Asssessment.* LAAS Technical Report 97-15. Submitted to Rayonier, Inc., Port Angeles, WA.

SUPERVISORY PLAN FOR ARCHAEOLOGICAL MONITORING

Archaeological monitoring will be conducted by any of the professional archaeologists listed, or by one of the listed archaeological monitors under the supervision of a professional archaeologist. If neither of the listed monitors is available for the proposed work, other monitors with equivalent experience may be substituted.

Project Manager: Margaret Nelson
Archaeological Monitors: Sarah Thompson, Mikk Kashko
Monitoring Supervisors (Professional Archaeologists): Margaret Nelson, Teresa Trost

Summary of Archaeological Monitor's Qualifications:

At least 4 years of archaeological field experience
Experience in archaeological excavation
Experience in archaeological laboratory analysis
Experience in archaeological monitoring
Experience with historical and prehistoric artifacts
Experience with identifying human remains

Supervisory Procedures:

1. The archaeological monitor will have a cell phone and a digital camera.

2. The supervisor will confer with the archaeological monitor by telephone at least once each day during monitoring to discuss excavation methods and findings.

3. The archaeological monitor will telephone the supervisor if any cultural deposits or artifacts are discovered and will discuss treatment or management decisions. The archaeological monitor will have the capability of sending electronic photographs of artifacts or deposits.

4. The archaeological monitor will complete a Cascadia Archaeology monitoring form for each day of monitoring and will take at least one photograph each day to record the work. The supervisor will review the monitoring forms on a weekly, or more frequent, basis.

5. The supervisor will be available to visit the site within 24 hours if a find needs immediate attention.

CONTACTS

Cascadia Archaeology

Project Manager (Meg Nelson): Office: 206-366-0337 Cell: 206-226-9474
Monitoring Supervisor (Teresa Trost): 206-366-0337

City of Port Angeles

Archaeologist (Derek Beery): Office: 360-417-4704 Cell: 360-461-9131
Deputy Police Chief (Brian Smith): 360-417-4902, 360-912-0184

Clallam County

Clallam County Coroner (Deborah S. Kelly): Office: 360-417-2368, 360-417-2297
Clallam County Sheriff (Bill Benedict): Office: 417-2262

Construction and Project Management

GeoEngineers (Rob Leet): Office: 206-239-3230 Cell: 206-850-2351
Construction: TBD
On-site Construction Superintendent: TBD

Department of Archaeology and Historic Preservation

Assistant State Archaeologist (Stephenie Kramer): 360-586-3088
State Physical Anthropologist (Guy Tasa): Office: 360-586-3534 Cell: 360-790-1633

Lower Elwha Klallam Tribe

Council Chair (Frances Charles): Office: 360-452-8471 ext. 106
Tribal archaeologist (Bill White): Office: 360-8471 ext. 163 Cell: 360-460-1617
CEO/Monitoring Supervisor (Sonia Tetnowski): Office: 360-452-8471 ext. 115

APPENDIX E
Analytical Data Summary (on CD-ROM)

Exhibit 1

Figure from Shea et al. (1981) Showing Historical Outfall Locations (1930-1979)

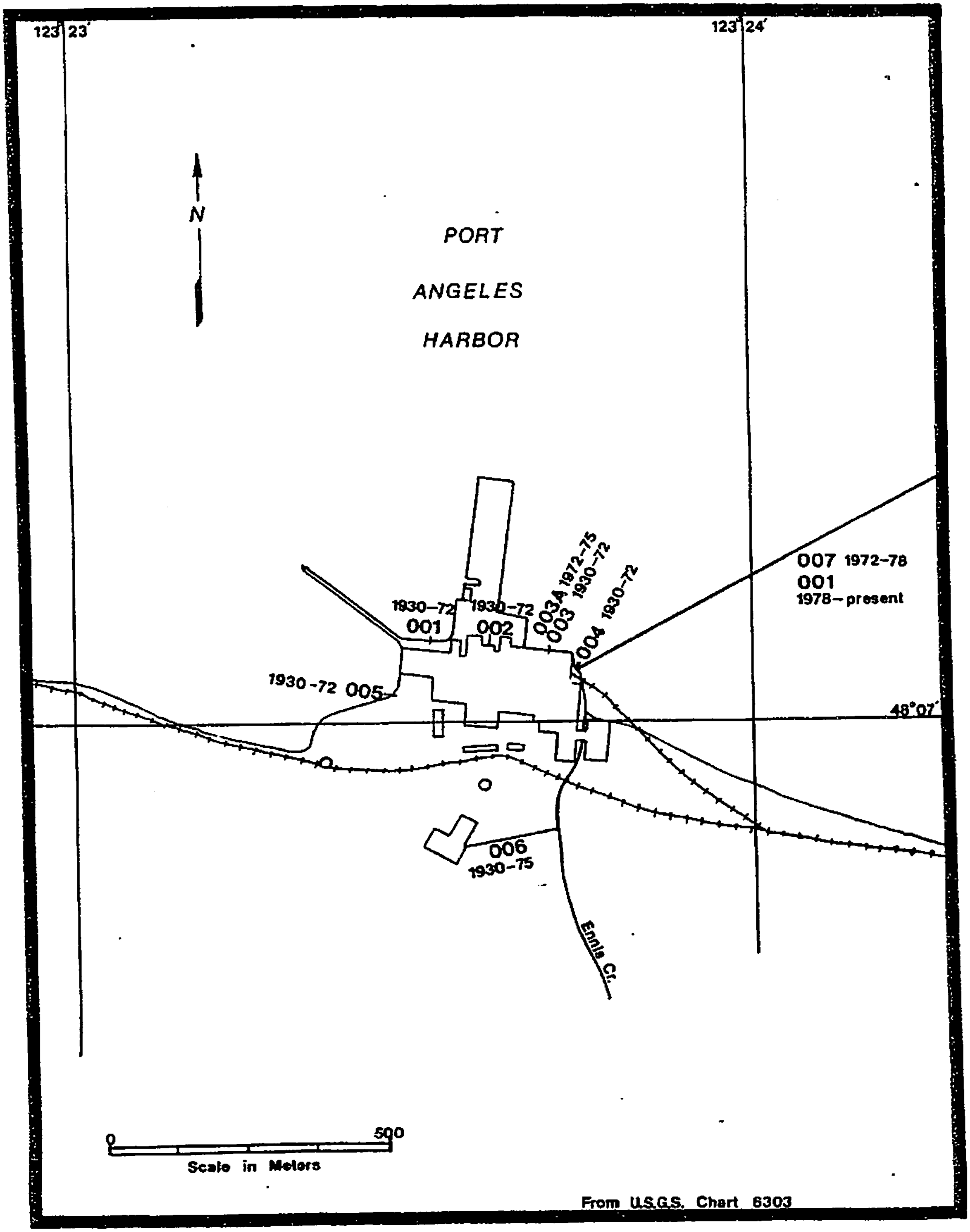


Figure I-3 ITT-Rayonier Discharge Locations 1930 - 1979
(Application 071-OYB-2-000038)

EXHIBIT 2

Fernandina Beach Mill NPDES Permit Excerpts (Wastewater Characterization Information)

Department of Environmental Protection

Northeast District
7825 Baymeadows Way, Suite B-200
Jacksonville Florida 32256-7590

Jeb Bush
Governor

Colleen M. Castille
Secretary

ELECTRONIC CORRESPONDENCE

STATE OF FLORIDA
INDUSTRIAL WASTEWATER FACILITY PERMIT

PERMITTEE:

Rayonier Performance Fibers, LLC
P. O. Box 2002
Fernandina Beach, Florida 32035-2002

PERMIT NO.:	**FL0000701**
ISSUANCE DATE:	**December 1, 2004**
EXPIRATION DATE:	**November 30, 2009**
PA FILE NO.:	**FL0000701-005-IW1S**

RESPONSIBLE AUTHORITY:

Mr. Jack Perrett, General Manager
Rayonier Performance Fibers, LLC

FACILITY:

Rayonier Performance Fibers, LLC
Fernandina Beach, Florida
Nassau County

Latitude: 30°39'44" N Longitude: 81°28'13" W

This permit is issued under the provisions of Chapter 403, Florida Statutes, and applicable rules of the Florida Administrative Code and constitutes authorization to discharge to waters of the state under the National Pollutant Discharge Elimination System. The above named permittee is hereby authorized to operate the facilities shown on the application and other documents attached hereto or on file with the Department and made a part hereof and specifically described as follows:

TREATMENT FACILITIES/FACILITY DESCRIPTION:

For the operation renewal of an industrial wastewater treatment system with a 26.31 MGD design capacity consisting of grit removal, neutralization, primary clarifier and a 34-acre mechanical aeration lagoon with effluent discharge through D-001 only on outgoing tides. Rayonier Performance Fibers, LLC is a chemical cellulose pulp mill (sulfite process) and is located on Foot of Gum Street, Fernandina Beach, Nassau County, Florida.

EFFLUENT DISPOSAL:

Surface Water Discharge: Outfall D-001 discharges to the Amelia River, a Class III marine surface water of the State. Outfall D-001 discharges through a 48 inch diameter pipe, which projects 800 ft and has a 200 ft. diffuser. Outfall D-001 is located approximately at latitude 30°39'21" N, longitude 81°29'02" W.

IN ACCORDANCE WITH:

The limitations, monitoring requirements and other conditions set forth in Part I, Part II, Part III, Part IV, Part V, Part VI, Part VII, and Part VIII on pages 1 through 21 of this permit.

I. Effluent Limitations and Monitoring Requirements

A. Surface Water Discharges

1. During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the permittee is authorized to:

Discharge from Outfall D-001, treated process wastewater and treated storm water, rinse water and regenerate water from the water treatment plant zeolite softening units. Such discharge shall be limited and monitored by the permittee as specified below:

Parameters	Effluent Sampling Location	Discharge Limitations			Measure Frequency	Sample Method/Type
		Other	Daily Max.	Daily Average		
Flow combined (former D-001 and former D-002), MGD	EFF-1, See I.A.4	--	26.31	Report	Continuous	Calculated,
Flow (clear sewer discharge, former D-002), MGD	EFF-2, See I.A.4	--	Report	Report	Continuous	Recorder
Flow (treated process wastewater and treated storm water; former D-001), MGD	EFF-3, See I.A.4	--	Report	Report	Continuous	Recorder
Biochemical Oxygen Demand 5-day (lbs/day)	EFF-1, See I.A.4	--	47,250	27,000	Daily	24-hour composite, See I.A.8
Total Suspended Solids (lbs/day)	EFF-1, See I.A.4	--	55,000	38,278	Daily	24-hour composite, See I.A.8
pH (S.U.)**	EFF-1, See I.A.4	***6.0, Daily Min	8.5	--	Continuous	Recorder, See I.A.8.
Total Ammonia, as N (mg/L)	EFF-1, See I.A.4	11.0 annual average, 20.0 monthly average, report daily maximum, See Part I.A.7			1/week	24-hour composite, See I.A.8
Un-ionized Ammonia, N (mg/L)	EFF-1, See I.A.4	--	Report	--	1/week	Calculated, See I.A.8
Temperature, (°F)	EFF-1, See I.A.4	--	Report	--	Continuous	Recorder, See I.A.8
2,3,7,8 -tetrachloro-dibenzo-p-dioxin (TCDD), pg/l	EFF-1, See I.A.4 and Sludge	--	0.014 and See Parts I.A.9, I.E. 5.	--	1/quarter See Parts I.A.9, I.E. 5.	72-hour composite, See I.A.8, I.A.9

Part I.A.1. continued

Parameters	Effluent Sampling Location	Discharge Limitations			Measure Frequency	Sample Method/Type
		Other	Daily Max.	Daily Average		
Whole Effluent Toxicity, Acute	EFF-1, See I.A.4	The 96-hour LC50 shall not be less than 30% effluent, See I.D.1&2			See Specific Conditions I.D.1 & I.D.2	Grab, See I.A.8
Silver (μg/L)	EFF-1, See I.A.4	--	2.3	--	1/month	Grab, See I.A.8
Nickel (μg/L)*	EFF-1, See I.A.4	--	***66.4	--	1/month	Grab, See I.A.8
Aluminum (mg/L)	EFF-1, See I.A.4	--	***3.0	--	1/month	Grab, See I.A.8
Copper (μg/L)*	EFF-1, See I.A.4	--	***11.5	--	1/month	Grab , See I.A.8
Iron (mg/L)	EFF-1, See I.A.4	--	***2.4	--	1/month	Grab, See I.A.8
Lead (ug/L)*	EFF-1, See I.A.4	--	***27.2	--	1/month	Grab, See I.A.8
Zinc (ug/L)*	EFF-1, See I.A.4	--	***410.0	--	1/month	Grab, See I.A.8

* applied based on the total recoverable fraction pursuant to Rule 62-302.500(2)(d) FAC
** except as allowed by Rule 62-660.400(1)(e)1 FAC and 40 CFR 401.17
***mixing zones apply to these effluent limitiation in accordance with Part I.E.3 of this permit.

2. There shall be no discharge of floating solids or visible foam in other than trace amounts.
3. The discharge shall not cause a visible sheen on the receiving water.
4. Unless specified elsewhere in the permit, samples taken in compliance with the monitoring requirements specified in I.A.1. shall be taken at the nearest accessible point after final treatment but prior to the actual discharge with the receiving water. Specifically, EFF-1 represents the combined discharge of treated process wastewater and treated storm water from the secondary treatment system and rinse water and regenerate water from the water treatment plant zeolite softening units (formerly D-002, clear sewer discharge). EFF-2 represents the sampling station from the clear sewer discharge from former outfall D-002 (rinse water and regenerate water from the water treatment plant zeolite softening units), prior to mixing with discharges from the secondary treatment system. EFF-3 represents the treated process wastewater and treated storm water discharge from the secondary treatment system (former outfall D-001).
5. All grab samples shall be taken at time of discharge.
6. The effluent discharge from Outfall D-001 is allowed on the ebb tide only with the exception of discharges associated with the clear sewer discharge (former outfall D-002). 24-hour composite samples shall be calculated from aliquots obtained during the periods of effluent discharge. In order to ensure adequate dilution, the discharge shall commence not earlier than 1.5 hours after predicted high tide, based on tide tables published by NOAA, and must cease no later than 6 hours after high tide begins. The time discharge begins, the time discharge ends, and the corresponding tide heights must be recorded and retained.
7. Compliance with the annual average limit shall be based on a 12-month rolling average concentration using the monthly average results for total ammonia as N. During the first year the annual average limit is in the permit, the Permittee shall calculate the average using zeros for all months prior to the permit limit