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# DRAFT
# REMEDIAL ACTION WORK PLAN

## FORMER COLUMBIA MARINE LINES SITE
## 6305 NW LOWER RIVER ROAD
## VANCOUVER, WASHINGTON

**July 30, 2008**

**Prepared for:**

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# SIGNATURE PAGE

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## LIST OF ACRONYMS

| | |
|---|---|
| TPH | Total Petroleum Hydrocarbon |
| SLR | SLR International Corp |
| bgs | below ground surface |
| mg/kg | milligrams per kilogram |
| µg/L | micrograms per liter |
| ESC | Environmental Science Corporation |
| SAP | Sampling and Analysis Plan |
| RI/FS | Remedial Investigation and Feasibility Study |

# 1.0 INTRODUCTION

SLR International Corp prepared this Remedial Action Work Plan (Work Plan) on behalf of Crowley Maritime Corporation, a successor to Columbia Marine Lines. On August 19, 1985 Columbia Marine Lines entered into Order No. DE 85-591 with the Washington State Department of Ecology to conduct remedial action at the former Columbia Marine Lines site, located at 6305 Lower River Road in Vancouver, Washington. The site location is shown on **Figure 1**.

For the purposes of this Work Plan, the site is defined as the area illustrated on **Figure 2**, which includes portions of Tax Lot 153104000 and 152800000. The approximate area that will be affected by the remediation activity is 3 acres. The site is currently vacant and covered with grass, trees, and other vegetation.

This Work Plan describes the remedial action for the site. The remedial action was developed and evaluated in the March 2008 *Focused Remedial Investigation and Feasibility Study* (RI/FS) report. The purposes of the remedial action are to:

- Clean up soil with total petroleum hydrocarbon (TPH) impacts that have the potential to leach TPH to groundwater in concentrations that exceed groundwater cleanup levels;
- Remove and treat TPH-impacted groundwater exposed during the soil removal; and
- Monitor the natural attenuation of the remaining TPH-impacted groundwater.

Diesel-impacted soil has been encountered at the site at depths between one and 15 feet below ground surface (bgs). The diesel-impacted soil will be excavated and bioremediated on-site. The clean overburden will be stockpiled on-site and used for backfill, following removal of the impacted soil. The impacted soil will be treated in an ex-situ bioremediation cell, which will consist of spreading the impacted soil in an approximately 2- to 3-foot thick layer. The biological breakdown of the diesel will be augmented by the addition of fertilizer and water and tilling/turning of the soil. Once the diesel concentrations in the bioremediation cell soil are below the site specific cleanup levels, the soil will be backfilled. The remediation area will remain undeveloped during these activities. Future commercial and industrial development is planned for this site and the surrounding area. Excavation activities are anticipated to last for 3 to 4 weeks, commencing in September 2008. The ex-situ bioremediation process is expected to last for 12 to 24 months.

Work completed under this work plan will follow sampling protocols presented in the Sampling and Analysis Plan (**Appendix A**) and the Site-Specific Health and Safety Plan (**Appendix B**).

The detailed site history and environmental setting have previously been presented in the RI/FS (SLR, 2008). A summary of the historical activities and site conditions is given below.

## 2.1 PROPERTY DESCRIPTION

The former Columbia Marine Lines property is located immediately north of the Columbia River within an industrial area that lies approximately three miles west of the city of Vancouver, Washington. The approximately 200-acre industrial area contains several separate parcels that are currently owned by Alcoa, Glencore Washington LLC [commonly known as Evergreen Aluminum (Evergreen)], and Russell Towboat and Moorage Company [commonly known as Tidewater Barge Lines (Tidewater)]. The site is located on a small portion of this industrial area. The approximate boundaries of the site and surrounding property ownership are shown on **Figure 2**.

Columbia Marine Lines formerly operated on the property that is currently owned by Tidewater Barge Lines. Columbia Marine Lines also operated three former wastewater infiltration ponds that were located to the west of its operation on property currently owned by Alcoa. Soil and groundwater contamination addressed under the Order No. DE 85-591 and this Work Plan is associated only with the former ponds; therefore, for the purpose of this Work Plan, the Columbia Marine Lines Site (the "site") consists of the former pond area.

The current zoning classification for the site is industrial. It is Crowley's understanding that Alcoa plans to implement a deed restriction to ensure that the site, as well as the surrounding Alcoa property, continues to be solely used for industrial purposes in the future. The surrounding land use patterns indicate that the neighboring properties will also continue to be used for industrial purposes. Access to the site is restricted by fencing and site security measures. Potable water is supplied to the industrial properties surrounding the site by the City of Vancouver.

Site topography is uneven and the outer edges of the former east and west ponds are noticeable as humps in the ground surface. Current site topography is illustrated on **Figure 3**. The highest point on the site lies at an approximate elevation of 35 feet above mean sea level. There have been no significant changes in the surface features since the filling of the eastern wastewater infiltration pond in 1984.

The site is vacant and the majority of the surrounding Alcoa, Evergreen, and Tidewater properties are either paved or sparsely vegetated with grasses and mosses. Cottonwoods, alders, and brush are present on portions of the site. Besides the vegetation, the surface of the site is primarily sand.

The neighboring Columbia River is tidally influenced and typically ranges from minus 5 to positive 5 feet above mean sea level near the site. Two rectangular, lined, wastewater treatment lagoons operated by Evergreen are located on Evergreen's property to the northwest of the site.

## 2.2 SITE HISTORY

From approximately 1963 to approximately 1985, Columbia Marine Lines operated a marine repair facility on the property currently owned by Tidewater. During the time Columbia Marine Lines owned the property, it periodically placed wastewater into infiltration ponds located on the adjacent Alcoa property. Wastewater that was placed in the ponds included barge slops, wash water from barge gas freeing operations, and tug bilge slops. During the approximately 20 year operating period, three different infiltration ponds were used: the South Pond, the West Pond, and the East Pond.

**Figure 2** shows the approximate locations of the former ponds. The South Pond was constructed and used from 1963 to between 1966 and 1968, when it was filled. After use of the South Pond was discontinued, the West Pond was constructed and used until 1970 or 1971, when it was filled. After use of the West Pond was discontinued, the East Pond was constructed. The East Pond was used until January 1984 when all liquids were removed and the pond was filled with dredge sand to prevent accumulation of surface water.

The site has been inactive since the East Pond was filled in 1984, and the site area is currently vacant.

## 2.3 SITE GEOLOGY AND HYDROGEOLOGY

### 2.3.1 SITE GEOLOGY

The site is located within the Columbia River Basin, approximately 250 feet north of the Columbia River. The geologic units identified at or adjacent to the site include:

- Fill soils: In general, the uppermost soils at the site are fill soils that range from approximately 2 to 17 feet in thickness. The fill soils generally consist of very loose to very dense, fine to medium sand (dredge sands) with trace to no silt.

- Fine-grained native soils: These soils formed the original surface soils beneath the site. These soils include silty sands, silts, fine sandy silts, clayey silts, and clays. In general, these soils consist of fluvial silts and fine sandy silts. In some areas, the uppermost fine-grained native soils include silty sands and silts that may have been wind-borne (aeolian) deposits. In some areas, the basal deposit of this unit is a stiff, blue-green clay. These fine-grained native soils are apparently at least 20 feet thick beneath all areas of the site, and extend above and below the typical (non-flood) stage of the adjacent Columbia River. These soils are consistently reported to contain traces of organic material or woody debris.

- Coarse-grained native soils: These soils include fluvial sands, gravelly sands, and sandy gravels. Site investigations have defined dense to very dense, fine to medium sand directly beneath the fine-grained native soils in the vicinity of monitoring well MW-20. Investigations at a neighboring site indicate that the fine to medium sands occur at elevations between mean sea level (0 feet) and approximately -70 feet, and are underlain by at least 20 feet of sandy gravels.

The original (pre-fill) topography is not known; however, investigation data suggest that one or more swales were present. The former wastewater infiltration ponds were excavated into fill soils. The bases of the infiltration ponds were generally at or near the base of the fill. After use, the ponds were backfilled with soils that are similar to the dredge sands.

### 2.3.2 SITE HYDROGEOLOGY

The hydrostratigraphic units defined for this site include the following:

- Vadose zone: The vadose zone occurs in unsaturated fill soils (fine to medium sands) and underlying unsaturated fine-grained native soils (silty sands, silts, and fine sandy silts).

- Upper saturated zone: The upper saturated zone occurs in saturated fill soils (fine to medium sands). Groundwater elevations in the upper saturated zone are consistently higher than Columbia River elevations (except possibly during significant flood events). The upper saturated zone occurs seasonally beneath the southern and western portions of the site, and continuously beneath the northeastern portion of the site.

- Silt aquitard: The silt aquitard includes saturated native fine-grained soils (silty sands, silts, fine sandy silts, clayey silts, and clays). Groundwater elevations in the silt aquitard are generally higher than Columbia River elevations (except possibly during major flood events). The silt aquitard is interpreted as having a significantly lower hydraulic conductivity than either the overlying dredge sands or the underlying coarse-grained native sands and gravels.

- Lower saturated zone: The lower saturated zone occurs in saturated native coarse-grained soils (fluvial sands, gravelly sands, and sandy gravels) beneath the silt aquitard. Investigation data suggest that groundwater elevations in lower saturated zone sands immediately below the silt aquitard are generally consistent with Columbia River elevations.

A cross section showing site geology is illustrated on **Figure 4**.

The lower saturated zone is interpreted as being part of the regional flow system within the Columbia River basin. The vadose zone, upper saturated zone, and silt aquitard are interpreted as being part of a local flow system within the regional flow system.

The local flow system is recharged by seasonal precipitation infiltrating into the dredge sands. The infiltrating precipitation accumulates within and above the silt aquitard. The groundwater table beneath the site occurs within the upper saturated zone and the silt aquitard at depths ranging from approximately 2 to 18 feet below ground surface (bgs). During seasonal high water levels, groundwater within the upper saturated zone generally flows radially from the former wastewater infiltration pond areas through the dredge sands with lesser vertical flow downward through the silt aquitard. It has been observed that as seasonal precipitation rates decrease, the groundwater table in the upper saturated zone falls.

Beneath the western and southern portions of the site, the water table typically falls below the base of the dredge sands and into the underlying fine-grained native soils. During seasonal low water levels

(July through September), groundwater in the upper saturated zone beneath the northeastern portion of the site primarily flows to the north and east through the dredge sands, with lesser vertical discharge through the silt aquitard. However, beneath the western and southern portions of the site, upper saturated zone flow during seasonal low water levels is entirely within the silt aquitard, and is expected to be primarily southward (towards the Columbia River) and downward.

### 2.3.3 CONTAMINANTS OF CONCERN

Based on the previous investigation results and remedial activities, petroleum hydrocarbons, primarily in the diesel range, are the contaminants of concern (COCs) at the site. The cleanup levels for TPH in soil and groundwater at the site were established in the RI/FS and are based on protection of groundwater as a drinking water resource.

Previous investigations indicate that the contaminant source areas are the three former wastewater infiltration ponds (see **Figure 2**). TPH concentrations typically decrease with distance away from the footprints of the former West and South Ponds, and the concentrations are usually below 100 milligrams per kilogram (mg/kg) within 20 feet of the edges of the former ponds. Impacted soil generally lies beneath 6 to 10 feet of clean soil and extends to a depth of approximately 15 feet bgs. TPH concentrations generally decrease with depth after reaching the top of the native fine-grained unit.

The site specific soil cleanup level for total TPH (combined TPH-G, TPH-D, and TPH-O concentrations) is 5,070 mg/kg based on leaching to potable groundwater. The point of compliance for the soil cleanup level is throughout the site and within the soil column from the ground surface to the top of the groundwater table.

The groundwater beneath the site is considered potable, and it is hydraulically connected to the Columbia River, which is also considered potable. Therefore, a MTCA Method A cleanup level for TPH, based on protection of drinking water, was selected for the groundwater cleanup level for the site. Since the hydrocarbons at the site are predominantly in the diesel range and the Method A cleanup level for TPH-D is 500 micrograms per liter (µg/L), the selected groundwater cleanup level for TPH (combined TPH-G, TPH-D, and TPH-O concentrations) is 500 µg/L. The point of compliance for the groundwater cleanup level is throughout the site.

The groundwater analytical results indicate that the TPH concentrations typically decrease with distance away from the footprints of the former ponds, likely due to natural attenuation. In the northern part of the site, TPH concentrations greater than 500 µg/L extend to the north of the former East Pond. In the southern part of the site, the TPH concentrations decrease to below 500 µg/L within 40 feet of the edges of the former West and South ponds. The impacted groundwater beneath the southern part of the site does not appear to be migrating towards the Columbia River.

### 2.3.4 CURRENT CONDITIONS

A site-wide groundwater monitoring event was conducted in April 2008 as part of the final design of the remedial action. The objective of the April 2008 monitoring was to evaluate the recent groundwater conditions.

#### 2.3.4.1 GROUNDWATER ELEVATIONS

On April 10, 2008, the depth to water was measured in all the accessible monitoring wells on-site. The results and calculated groundwater elevations are presented in **Table 1**. The top of casing and ground surface for all the monitoring wells were re-surveyed by Olson Engineering on April 10, 2008. The April 2008 groundwater elevations were calculated using the updated survey data. The groundwater elevations and inferred potentiometric contours are presented on **Figure 5**.

#### 2.3.4.2 GROUNDWATER SAMPLING

On April 2, 2008, groundwater samples were collected from a total of four monitoring wells (MW-2, MW-4, MW-16, and MW-19). The monitoring wells were sampled with a peristaltic pump, with dedicated polyethylene tubing. Field parameters (pH, temperature, conductivity, dissolved oxygen, and oxidation-reduction potential) were measured during purging.

Samples were submitted to Environmental Science Corporation (ESC) under chain-of-custody for analysis of diesel-range total petroleum hydrocarbons (THP-Dx) by method NWTPH-Dx. The samples were analyzed twice for TPH-Dx. The first round of analysis was performed on samples that had solids suspended in the aliquot (i.e. total TPH-Dx analysis). The second round of analysis was performed on samples that had been allowed to settle and the aliquot decanted from the sample container (i.e. Decanted TPH-Dx analysis). The second round of analysis was performed to investigate the influence of TPH sorbed to soil particles that are suspended in the sample.

The analytical results for the undecanted samples are presented in **Table 2**. The concentration of both total and decanted TPH was above the cleanup level of 500 µg/L in all four samples. The reduction in TPH-D concentrations by decanting ranged between 20% and 38%. The reduction in oil range hydrocarbons by decanting ranged between 19% and 51%. The laboratory analytical report is included in **Appendix C**.

To meet the objectives described in Section 1, the planned remedial action consists of:

- Excavating the soil containing TPH concentrations greater than 5,070 mg/kg;
- Pumping and treating groundwater in the excavations;
- Backfilling clean overburden into the excavations;
- Treating the TPH-impacted soil through on-site ex-situ bioremediation;
- Conducting groundwater sampling events to monitor the natural attenuation of the TPH-impacted groundwater; and
- Implementing institutional controls to limit the exposure and risks associated with the remaining impacted soil and groundwater beneath the site.

This section describes the scope of work for the remedial action. Detailed procedures for sampling and analysis, and quality assurance are presented in the *Sampling and Analysis Plan* (SAP, **Appendix A**). The health and safety procedures associated with the remedial action are presented in the *Site-Specific Health and Safety Plan* (**Appendix B**).

## 3.1 EXCAVATION OF TPH-IMPACTED SOIL

The objective of the soil excavation is to remove soil containing TPH concentrations above the cleanup level of 5,070 mg/kg. The approximate area to be excavated is illustrated on **Figure 6**. To effectively access the impacted soils, the excavations will extend to depths of approximately one foot below the low seasonal groundwater table (approximately 15 to 17 feet bgs). The excavations will extend laterally until the sidewall sample concentrations are below the cleanup level. The soil removal and backfilling activities will be conducted in accordance with state and local rules and regulations. Excavation sidewalls will be sloped from 1:1 to 1:3 (rise over run) to assist in avoiding potential caving.

The estimated quantity of soil that will be excavated is presented in **Table 3**. Approximately 12,500 cubic yards (cy) of clean soil overburden will be removed and stockpiled on-site. The actual amount of excavated overburden soil will depend on conditions observed in the subsurface. Approximately 4,200 cy of impacted soil will be excavated and treated on-site. The actual amount of impacted soil excavated will depend on conditions observed in the subsurface.

Some groundwater monitoring wells in the excavation area will be removed during excavation. Wells outside of the excavation area that are to be kept will be marked, their casings extended if necessary, and the wells protected with bollards to prevent damage from construction equipment, as illustrated on **Figure 7**. Silt fencing and additional erosion control measures will be installed at the site as per the Erosion Control Plan that will be included in the Grading Permit to be issued by the City of Vancouver.

The City of Vancouver has established an elevation of 30 feet relative to the 1929 national geodetic vertical datum (NGVD1929) as the flood level, and, to prevent impacts to critical flood zone areas, all bioremediation operations will be conducted at an elevation higher than 30 feet or in areas surrounded by berms at least 30 feet in elevation. Prior to conducting the excavation, the site will be regraded as illustrated on **Figure 8** to provide a larger surface that is at or above 31 feet elevation. Before regrading commences, vegetation in the area to be affected will be removed and cut or chipped for disposal off-site.

The contractor will prepare an excavation plan for the work, and that plan will be based on general principals described in this section. The extent of the proposed excavation is illustrated on **Figure 9**. Clean overburden across the entire excavation area – to a depth of 5 feet – will be moved using bulldozer or excavator to staging areas to the north. The first area of impacted soil to be removed will be in the vicinity of MW-7. Excavation will commence from the north and east, using 3:1 side slopes (or greater, as necessary) on the north and east sides of the excavation and 1:1 side slopes (or greater, as necessary) on the southern and western face of the excavation. Once impacted soil is encountered, it will be stockpiled separately from the clean overburden on polyethylene liner. The extent of the excavation at MW-7 will be determined using sampling methods, field screening techniques (visual and colorimetric), and laboratory analytical procedures discussed in the SAP included in **Appendix B** of this report. Once the extent of the excavation at MW-7 has been confirmed, pumping of groundwater from the base of the excavation will begin, and excavation of the area around GP-5A will commence. Treatment and sampling of pumped groundwater will be conducted as discussed in **Section 3.2**

If water is not accumulating in the MW-7 excavation, the excavation will be partially backfilled with clean overburden. Backfilling of soil below a base elevation of 25 feet will be compacted to 90 percent of the maximum density as determined by ASTM D 1557-00, Modified Proctor. Field testing at each excavation will be used to confirm that in-place compaction requirements have been met.

Prior to backfilling, samples of the clean overburden stockpile will be collected and analyzed for TPH-G by method NWTPH-Gx and TPH-D and TPH-O by method NWTPH-Dx. The stockpiled soil that contains total TPH concentrations (combined TPH-G, TPH-D, and TPH-O) below the cleanup level of 5,070 mg/kg will be used to backfill the excavations. The planned confirmation soil sample collection strategy is detailed in the SAP.

Excavation of the GP-5A area will start from the north, using 1:3 side slopes (or greater, as necessary) on the north side of the excavation and 1:1 side slopes (or greater, as necessary) on the eastern and southern faces of the excavation. Stockpiling and methods used to determine the extent of the excavation are discussed above. Once the extent of the excavation in the GP-5A area has been confirmed, groundwater pumping at the MW-7 area will end, and the MW-7 area will be backfilled with clean overburden. Then, groundwater will be pumped from the base of the GP-5A excavation and excavation of the South Area will commence. If water is not accumulating in the GP-5A excavation, the excavation will be partially backfilled with clean overburden.

Excavation of the South Area will start from the north, using 1:3 side slopes (or greater, as necessary) on the north side of the excavation and 1:1 side slopes (or greater, as necessary) on the eastern, southern, and western faces of the excavation. Stockpiling and methods used to determine the extent

of the excavation are discussed above. Once the extent of the excavation in the South Area has been confirmed, groundwater will be pumped from the base of the South Area excavation and excavation of the West Area will commence. If water is not accumulating in the South Area excavation, it will be partially backfilled with clean overburden.

Excavation of the West Area will start from the east, using 1:3 side slopes (or greater, as necessary) on the east side of the excavation and 1:1 side slopes (or greater, as necessary) on the southern western, and northern faces of the excavation. Stockpiling and methods used to determine the extent of the excavation are discussed above. Once the extent of the excavation in the West Area has been confirmed, groundwater will be pumped from the base of the West Area excavation and backfilling of other areas will commence. If water is not accumulating in the excavation, it will be partially backfilled with clean overburden.

The area will be graded to provide an elevation 32 feet berm around the edge of the future bioremediation cell area, then a liner will be installed and the impacted soil spread out across the bioremediation cell area. See **Section 3.3** for more detail on the ex-situ bioremediation process.

Compaction and associated control testing of soil above 25 feet elevation will be consistent with the requirements of WSDOT Section 2-03.3(14)C Method B. Per WSDOT Section 2-03.3(14)C Method B. The top 2 feet of each backfilled excavation will be compacted to 95 percent of the maximum dry density, as per ASTM Test Designation (D) 1557-00, Modified Proctor. Field testing will be used to confirm that in-place compaction requirements have been met. The results of all field and any supporting laboratory testing will be provided in a report following the completion of excavation activities. Any water used during compaction to achieve optimal moisture content will be potable water supplied from the fire hydrant adjacent to the northeast boundary of the site.

## 3.2 GROUNDWATER TREATMENT AND INJECTION

During excavation, groundwater will be pumped from the open excavations; treated on-site using an oil-water separator, bag filters, and activated carbon; and then reinjected into the inactive extraction and injection trenches or another approved injection point. Excavation activities are planned to occur during the seasonal low groundwater period (September to October), when the depth to groundwater is expected to be approximately 13 to 14 feet. Assuming that the maximum depth of groundwater above the base of the excavations will be 3 feet, the total estimated volume of extracted groundwater is 250,000 gallons.

Prior to injection, the treated water will be pumped into a temporary storage tank. Samples of the treated water will be collected and analyzed for TPH-G by method NWTPH-Gx, and TPH-D, and TPH-O by method NWTPH-Dx. The treated water will be discharged into the designated injection point after confirmation that the total TPH concentrations (combined TPH-G, TPH-D, and TPH-O) are below the groundwater cleanup level (500 µg/L). Injection will be completed under Ecology-approved injection well permit #12092.

This remedial action is designed to treat TPH-impacted soil and dissolved TPH in groundwater. Previous and investigations indicate that no free product remains at the site. However, in the event free product is encountered that exceeds the capacity of the groundwater treatment system, the free

product will be pumped to a 500-gallon tank for temporary storage. The free product will be collected from the tank using a vacuum truck and disposed of off-site. If larger quantities of free product continue to be encountered, an oil-water separator will be added to the groundwater treatment system.

## 3.3 On-Site Ex-Situ Bioremediation

Excavated soil with TPH concentrations in excess of 5,070 mg/kg will be treated on-site via ex-situ bioremediation. The planned location of the bioremediation cell is shown on **Figure 10**. The final configuration of the bioremediation cell will depend on the actual volume of impacted soil that is excavated.

A treatment cell, covering a total area of approximately 1 acre, will be constructed. The bioremediation cell will consist of a sloped base with a polyethylene liner, berms, and a drainage sump. A minimum of 6 inches of clean overburden will be placed on top of the liner to protect the liner from damage during soil turning. Details of cell construction are shown in **Figure 11**.

The impacted soil will be placed in the cell in a 2- to 3-foot thickness. As shown on **Figure 10**, the cells will be graded to have a slight slope inwards from the perimeter of the cell towards the drainage sump. Collected drainage water from the cell will be treated using the groundwater treatment system and injected into the existing groundwater extraction and injection trenches or another injection point.

The soil will be turned on a monthly schedule using a plow or other equipment designed to mix and turn the soil at the same time. Based on the performance monitoring results, the soil may be amended with nutrients and water during mixing in order to enhance the bioremediation process. If 3-foot lifts are used, soil may be turned in lifts. During the dry season, clean water may be transported to the site or obtained from the fire hydrant for irrigating the soil.

To monitor the progress of the bioremediation, samples of the bioremediation cell soil will be collected on a quarterly basis. Soil sampling procedures are discussed in the SAP in **Appendix B** of this Work Plan. When soil in a cell or portion of a cell contains TPH concentrations below the 5,070 mg/kg cleanup level, operation of the cell or portion of the cell will be stopped. A report will be prepared for submittal to Ecology describing the analytical results and rationale for decommissioning the bioremediation cell.

After all the impacted soil has been remediated, the bioremediation cell will be decommissioned by moving the impacted soil, removing the liner, and regrading. Compaction will be completed as discussed in **Section 3.1**.

## 3.4 MONITORED NATURAL ATTENUATION

Petroleum hydrocarbon concentrations in groundwater naturally attenuate relatively rapidly once source materials have been removed. The secondary groundwater cleanup component to this alternative is natural attenuation.

Five groundwater monitoring wells (MW-7, MW-8, MW-19, RW-4, and RW-6/EX-2) are located within the anticipated extent of excavation and will be destroyed during the excavation activities. These wells will be decommissioned by a licensed well driller prior to the excavation commencing. Replacement monitoring wells (with the exception of RW-6/EX-2, which is adjacent to MW-7) and two additional monitoring wells will be installed as described in the SAP (**Appendix B**). Proposed new well locations are illustrated on Figure A-4 in the SAP. Monitoring wells located in the proposed bioremediation cell will be protected from damage by installed above ground monuments and bollards. The bioremediation cell will be constructed around these wells.

The new wells will be installed to monitor the attenuation of dissolved-phase TPH. The new wells will be designed and developed to minimize silt and sediment in samples and limit the potential for artificially inflated TPH concentrations due to the presence of silt and sediment in samples.

Groundwater monitoring will be conducted on a quarterly basis for the first year, on a semi-annual basis for the second year, and then on an annual basis until the TPH concentrations are below the cleanup level. At that time, the sampling will be conducted on a quarterly basis until the concentrations are below the cleanup level for four consecutive quarterly events. The specific analyses are discussed in the SAP.

After completing the quarterly sampling events during the first year of monitoring, SLR will model the analytical data in accordance with the Ecology's *Natural Attenuation Analysis Tool Package for Petroleum-Contaminated Groundwater*. The modeling results will be used to evaluate if the groundwater plume is shrinking, stable, or expanding; to assess the attenuation rate; and to identify the wells that will be sampled during the subsequent monitoring events.

Natural attenuation monitoring is discussed in more detail in the SAP.

## 3.5 INSTITUTIONAL CONTROLS

The site is zoned for heavy industrial use by the City of Vancouver (Vancouver Municipal Code 20.160.020) and the uses allowed in this zone are consistent with MTCA's definition of industrial land use (WAC 173-340-745). To ensure that future activities do not change the exposure assumptions in the risk assessment, institutional controls will be applied to the property. A deed restriction will be applied to ensure that the property remains in industrial use, as required by MTCA (WAC 173-340-440).

## 4.1 PROGRESS REPORTS

Progress reports will be submitted to Ecology on a semi-annual basis and will consist of:

- A list of the previous six month's activities;
- A description of any deviations from this Work Plan; and
- A description of any deviations from the schedule and any planned deviations in the coming six months.

## 4.2 REMEDIAL ACTION REPORT

Following completion of the soil excavation and ex-situ bioremediation activities, a Draft Remedial Action Report will be prepared that describes the soil excavation, groundwater treatment, bioremediation, and well installation activities. The report will present the field data, the validated soil sample analytical data, and the validated groundwater sample analytical data from the first quarterly sampling event. After receiving comments from Ecology concerning the draft report, a Final Remedial Action Report will be prepared.

## 4.3 GROUNDWATER SAMPLING REPORTS

After completing the second quarterly groundwater sampling event and each of the subsequent quarterly, semi-annual, and annual sampling events, a groundwater sampling report will be prepared and submitted to Ecology. Each report will describe the field activities and present the field data and the validated sample analytical data.

After two years of groundwater monitoring, the groundwater concentrations will be evaluated to assess the affects of the remediation activities on the groundwater conditions.

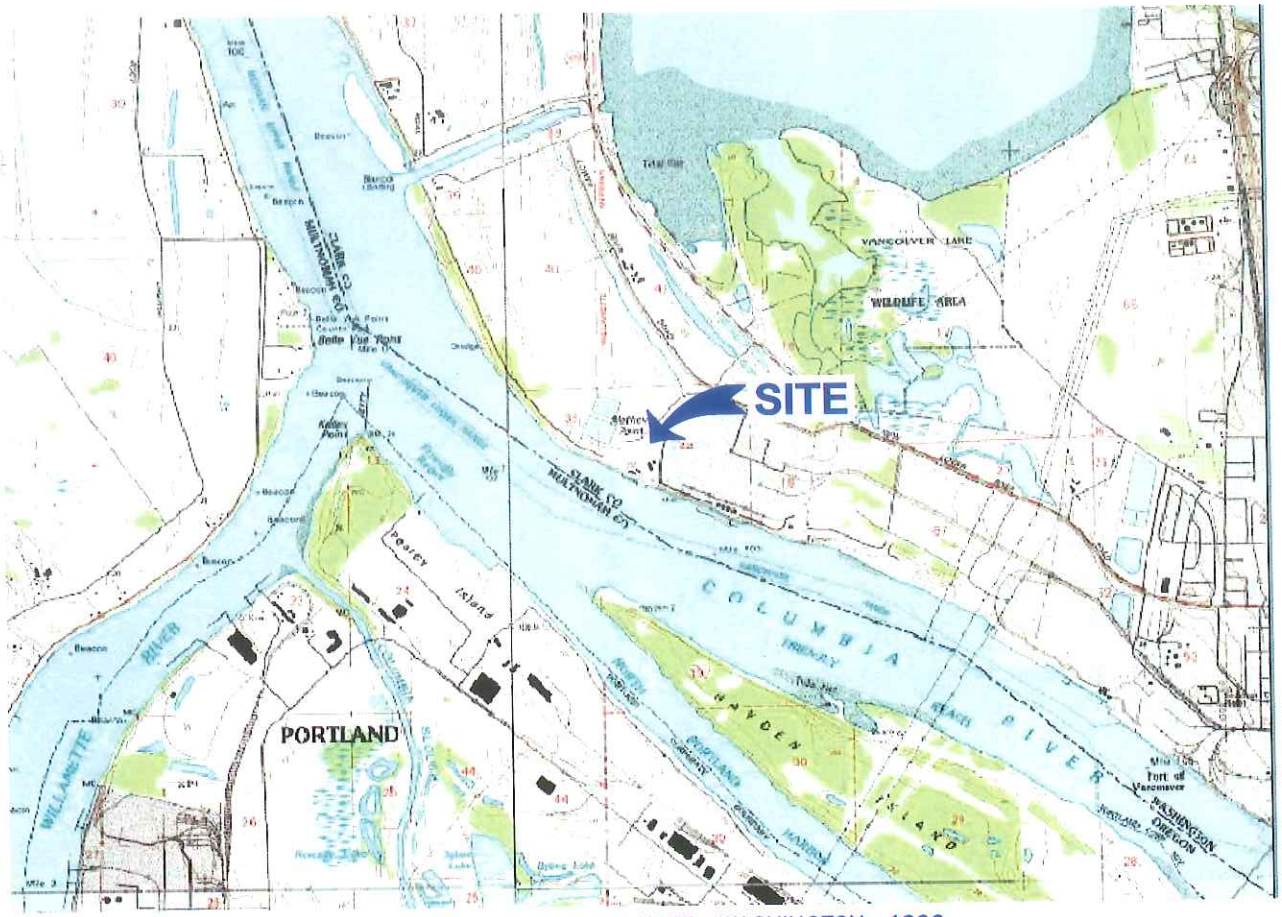
SLR International Corp, 6 March 2008, *FINAL Remedial Investigation and Feasibility Study, Former Columbia Marine Lines Site.*

# FIGURES

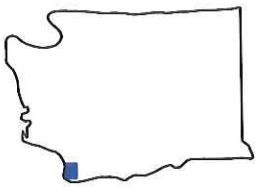


**DRAFT Remedial Action Work Plan**
**Former Columbia Marine Lines Facility**
**3605 NW Lower River Road**
**Vancouver, Washington**

July 30, 2008




REFERENCE: USGS 7.5 MINUTE QUADRANGLE; VANCOUVER, WASHINGTON; 1990



QUADRANGLE LOCATION

0 1/4 1/2 1

SCALE IN MILE

0 1000 2000

1 INCH = 2000 FEET

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

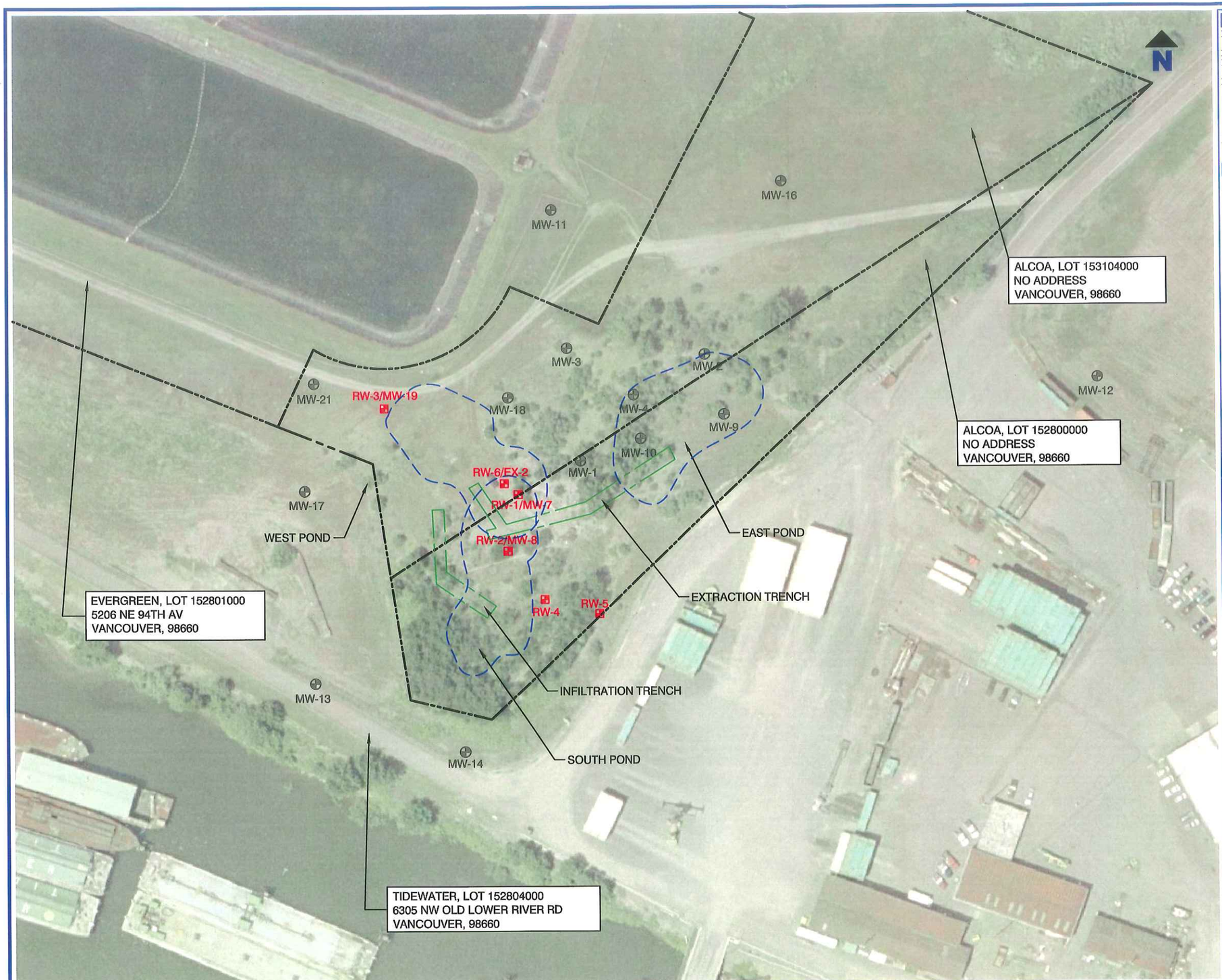
SLR

FORMER COLUMBIA MARINE LINES FACILITY
6205 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report
REMEDIAL ACTION WORK PLAN

Drawing
SITE LOCATION MAP

| | | |
|---|---|---|
| Date July 23, 2008 | Scale AS SHOWN | Fig. No. 1 |
| File Name Figure 1 - Site Location Map-1 | Project No. 008.0205.00007 | |




THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

0 100 200

SCALE IN FEET

NOTES

EXTENT OF EAST POND FROM 1971 AND 1980 AERIAL PHOTOGRAPHS

EXTENT OF WEST POND FROM HISTORICAL SITE TOPOGRAPHIC MAP AND 1968 AERIAL PHOTOGRAPH

EXTENT OF SOUTH POND FROM 1963 AND 1964 AERIAL PHOTOGRAPHS

LEGEND

- GROUNDWATER MONITORING WELL
- EXTRACTION WELL
- APPROXIMATE PROPERTY LINES
- HISTORICAL EXTENTS OF PONDS

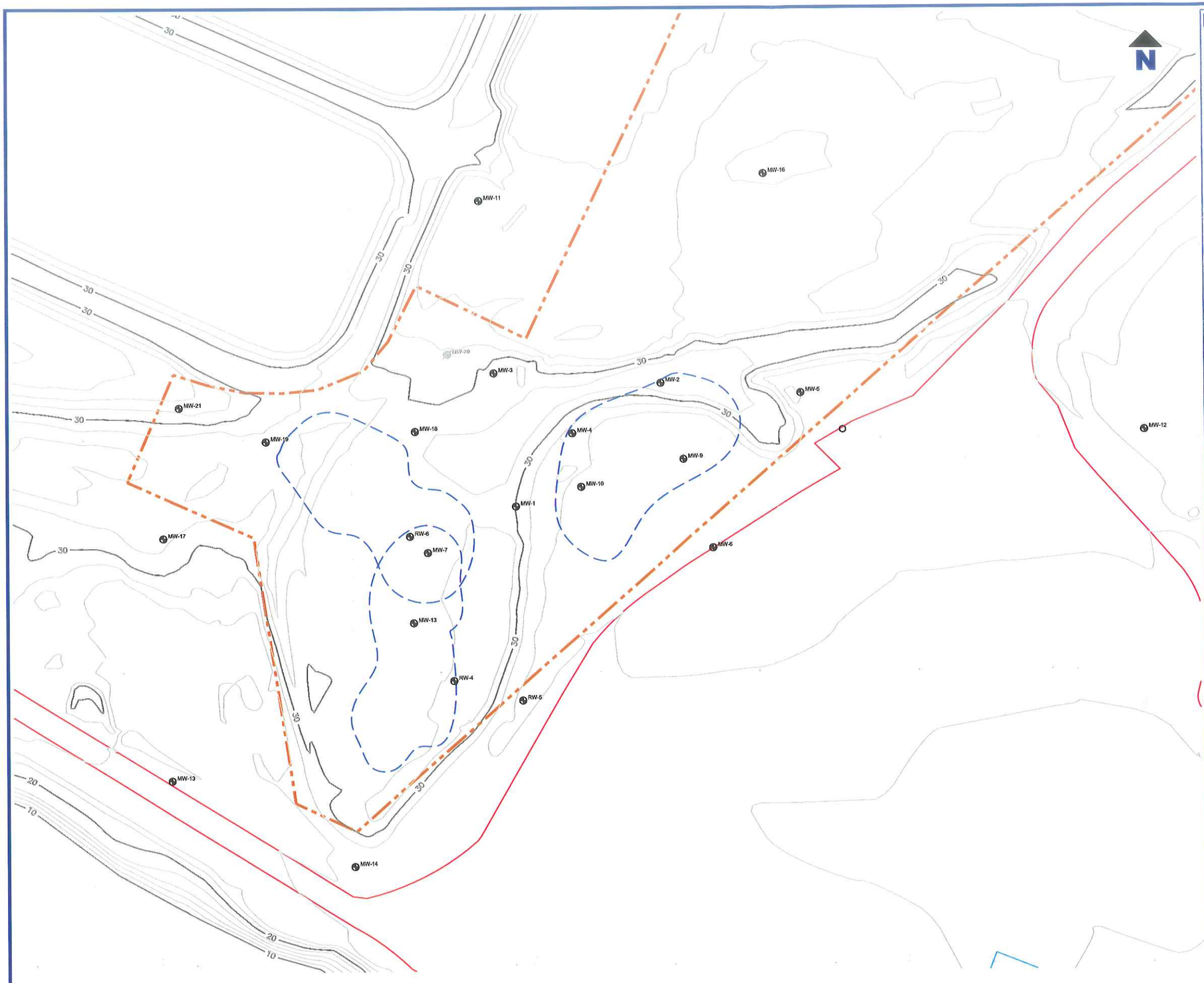
FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report: REMEDIAL ACTION WORK PLAN

Drawing: SITE PLAN

| | | |
|---|---|---|
| Date July 23, 2008 | Scale AS SHOWN | Fig. No. 2 |
| File Name Figure 2 - Site Plan-2 | Project No. 008.0205.00007 | |

SLR




NOTES

LEGEND

- PROPERTY LINE
- ASPHALT ROAD
- TOPOGRAPHIC CONTOUR – 10 FT INTERVAL
- TOPOGRAPHIC CONTROUR – 2 FT INTERVAL
- FORMER INFILTRATION POND
- BH GROUNDWATER MONITORING WELL
- BH ABANDONED GROUNDWATER MONITORING WELL

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

SCALE: 1" = 80'

0 80' 160' 240'

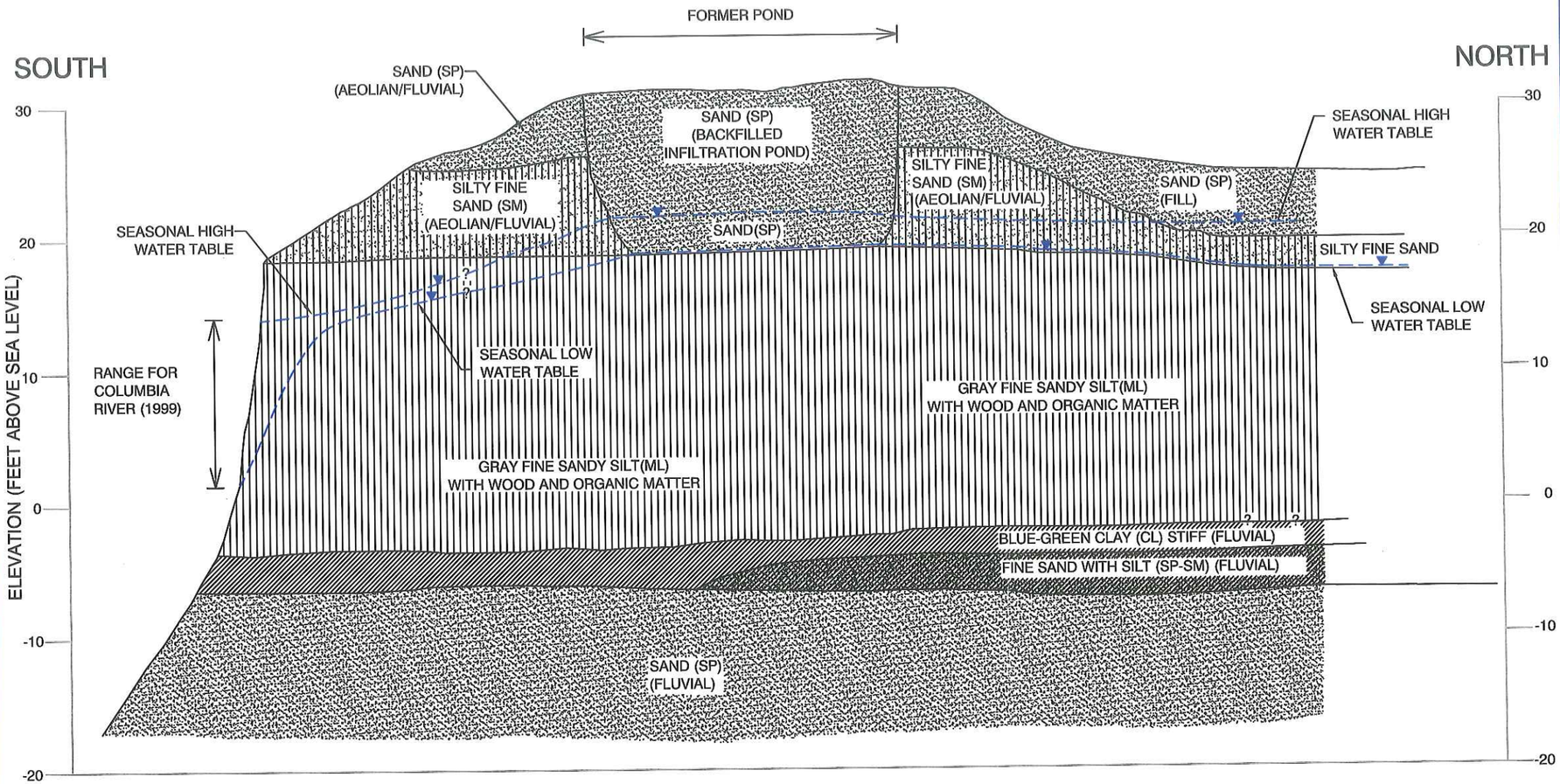
FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report
REMEDIAL ACTION WORK PLAN

Drawing
EXISTING TOPOGRAPHY

| | | |
|---|---|---|
| Date July 17, 2008 | Scale AS SHOWN | Fig. No. 3 |
| File Name 01-01-04-3 | Project No. 008.0256.00007 | |

SLR




NOTES

LEGEND

- ML - INORGANIC SILTS
- SP - CLEAN SANDS
- SP-SM - FINE SAND WITH SILT
- CL - INORGANIC CLAYS
- SM - SILTY SAND
- INTERPRETED CONTACT POSITION
- WATER LEVEL

0 10 20

APPROXIMATE VERTICAL SCALE IN FEET
VERTICAL EXAGGERATION 10:1

FORMER COLUMBIA MARINE LINES FACILITY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

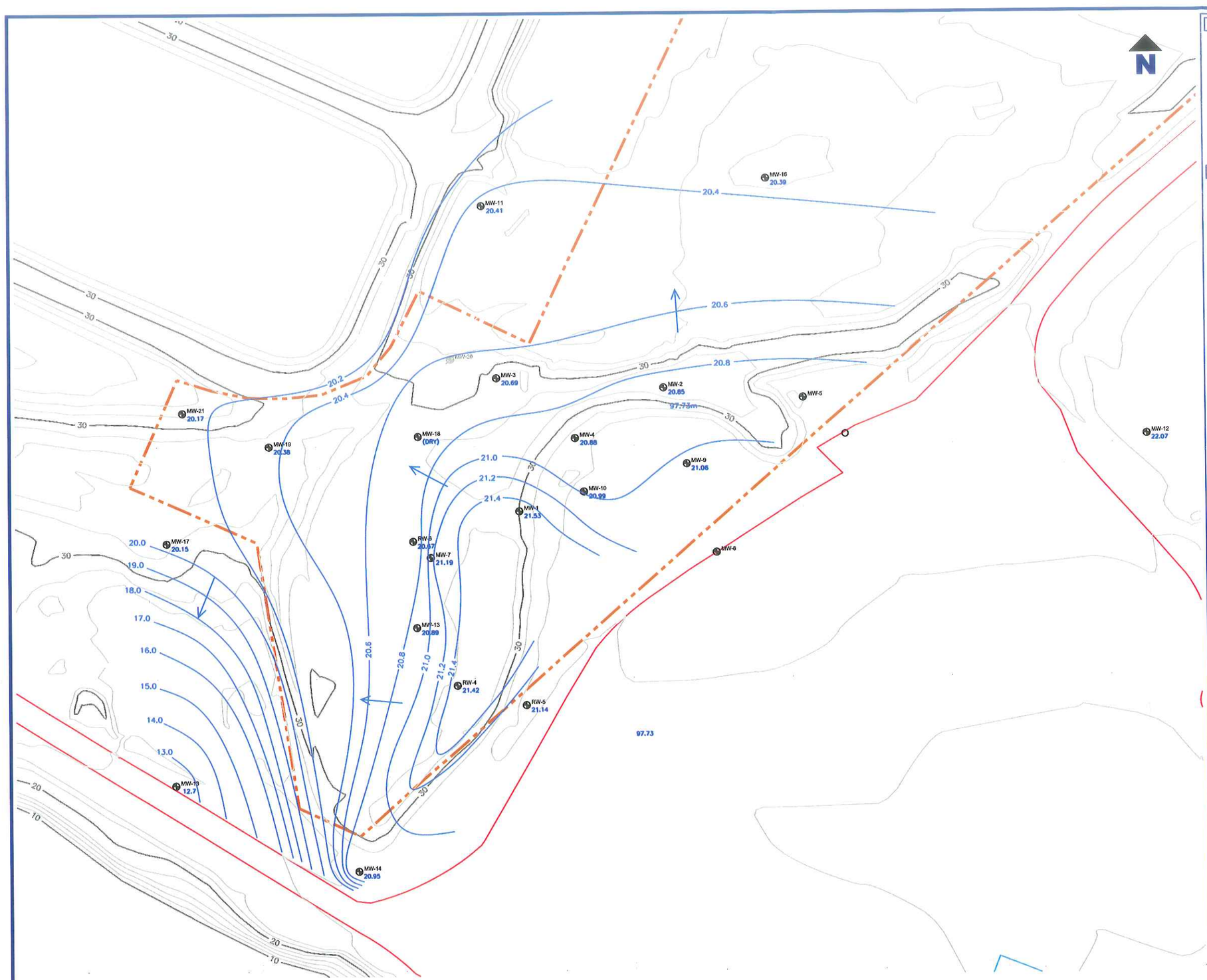
Report
REMEDIAL ACTION WORK PLAN

Drawing
CONCEPTUAL GEOLOGIC CROSS SECTION

| | | |
|---|---|---|
| Date June 6, 2008 | Scale AS SHOWN | Fig. No. 4 |
| File Name Figure 4 - Cross Section | Project No. 008.0256.00007 | |

SLR

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.




THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

SCALE: 1" = 80'

0 80' 160' 240'

NOTES

LEGEND

- PROPERTY LINE
- ASPHALT ROAD
- TOPOGRAPHIC CONTOUR – 10 FT INTERVAL
- TOPOGRAPHIC CONTROUR – 2 FT INTERVAL
- FORMER INFILTRATION POND
- BH — GROUNDWATER MONITORING WELL
- BH — ABANDONED GROUNDWATER MONITORING WELL
- 22.07 — GROUNDWATER ELEVATION (APRIL 2, 2008)
- 21.0 — INFERRED GROUNDWATER ELEVATION CONTOURS
- INFERRED GROUNDWATER FLOW DIRECTION

FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report
REMEDIAL ACTION WORK PLAN

Drawing
APRIL 2008 GROUNDWATER CONTOURS

| | | |
|---|---|---|
| Date July 17, 2008 | Scale AS SHOWN | Fig. No. 5 |
| File Name 01-01-04-3 | Project No. 008.0256.00007 | |

SLR


NOTES

LEGEND

- PROPERTY LINE
- ASPHALT ROAD
- TOPOGRAPHIC CONTOUR – 10 FT INTERVAL
- TOPOGRAPHIC CONTROUR – 2 FT INTERVAL
- FORMER INFILTRATION POND
- BH — GROUNDWATER MONITORING WELL
- BH — ABANDONED GROUNDWATER MONITORING WELL
- AREAS OF TPH GREATER THAN 5,070 MG/KG

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

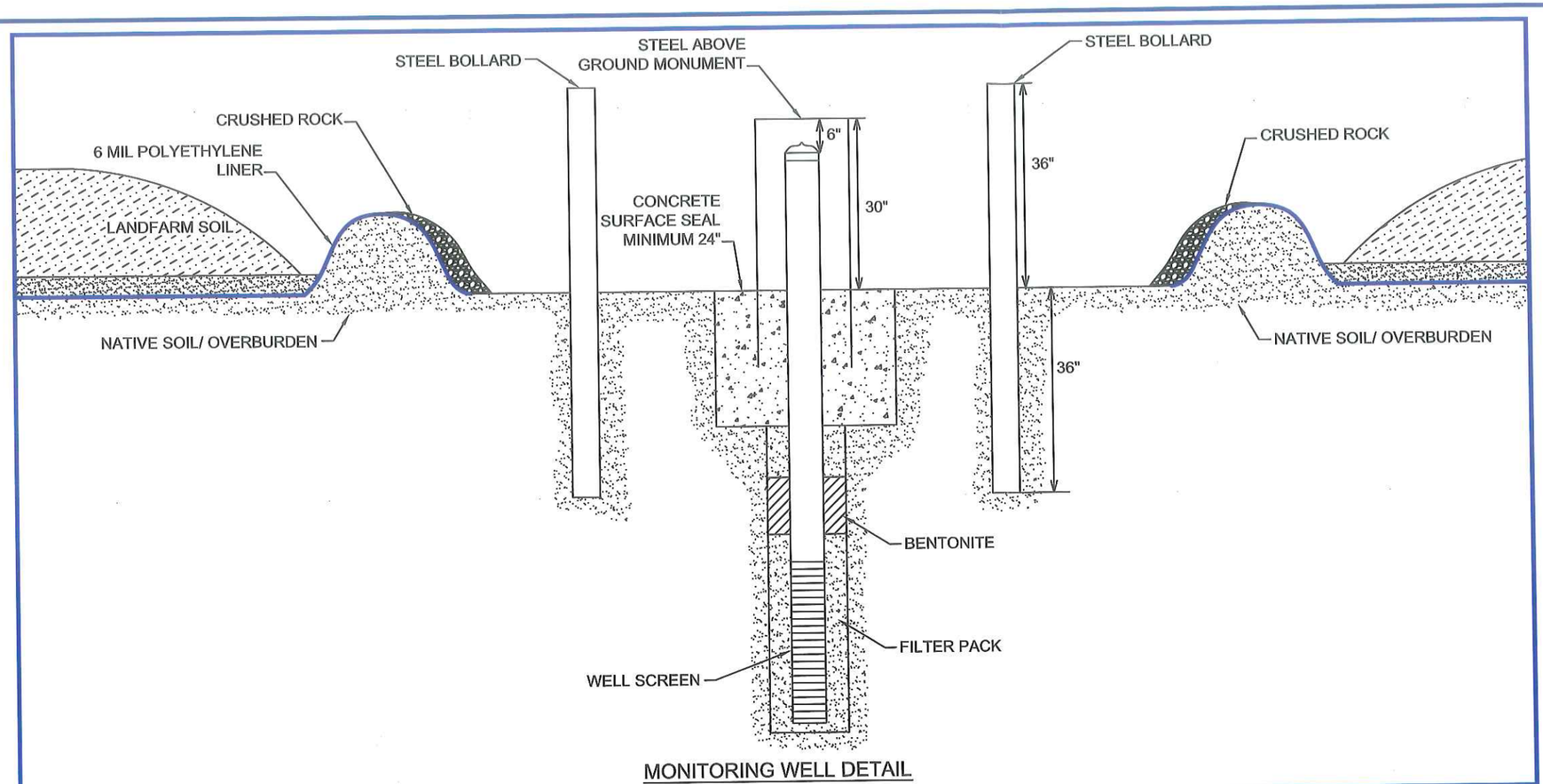
FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report: REMEDIAL ACTION WORK PLAN

Drawing: EXTENT OF TPH GREATER THAN 5,070 MG/KG

| | | |
|---|---|---|
| Date July 17, 2008 | Scale AS SHOWN | Fig. No. 6 |
| File Name 01-01-04-3 | Project No. 008.0256.00007 | |

SLR




MONITORING WELL DETAIL

NOTES

- WELL MONUMENT AND SEAL SHALL COMPLY WITH WAC 173-160 MINIMUM STANDARDS FOR CONSTRUCTION AND MAINTENANCE OF WELLS
- 3 STEEL BOLLARDS PER WELL

LEGEND

- LANDFARM SOIL
- BEDDING SAND
- NATIVE SOIL/ GRADED OVERBURDEN
- POLYETHYLENE LINER
- CONCRETE SURFACE SEAL
- CRUSHED ROCK

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

FORMER COLUMBIA MARINE LINES FACILITY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report
REMEDIAL ACTION WORK PLAN

Drawing
MONITORING WELL DETAIL

| | | |
|---|---|---|
| Date July 23, 2008 | Scale AS SHOWN | Fig. No. 7 |
| File Name BIO CELL DETAILS-3 | Project No. 008.0256.00007 | |

SLR


NOTES

LEGEND

- PROPERTY LINE
- ASPHALT ROAD
- TOPOGRAPHIC CONTOUR – 10 FT INTERVAL
- TOPOGRAPHIC CONTROUR – 2 FT INTERVAL
- FORMER INFILTRATION POND
- BH — GROUNDWATER MONITORING WELL
- BH — ABANDONED GROUNDWATER MONITORING WELL
- NEW 26–FOOT CONTOUR
- NEW 28–FOOT CONTOUR
- NEW 30–FOOOT CONTOUR
- NEW 31–FOOT CONTOUR
- SILT FENCE

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

SCALE: 1" = 50'

0 50 100 150'

FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report
REMEDIAL ACTION WORK PLAN

Drawing
SURFACE REGRADE

| | | |
|---|---|---|
| Date July 17, 2008 | Scale AS SHOWN | Fig. No. 8 |
| File Name 01-01-04-3 | Project No. 008.0256.00007 | |

SLR


NOTES

LEGEND

- PROPERTY LINE
- ASPHALT ROAD
- TOPOGRAPHIC CONTOUR – 10 FT INTERVAL
- TOPOGRAPHIC CONTROUR – 2 FT INTERVAL
- FORMER INFILTRATION POND
- BH GROUNDWATER MONITORING WELL
- BH ABANDONED GROUNDWATER MONITORING WELL
- NEW 15–FOOT CONTOUR
- NEW 20–FOOT CONTOUR
- NEW 25–FOOT CONTOUR
- NEW 26–FOOT CONTOUR
- NEW 28–FOOT CONTOUR
- NEW 30–FOOOT CONTOUR
- NEW 31–FOOT CONTOUR
- SILT FENCE

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

SCALE: 1" = 50'

0 50 100 150'

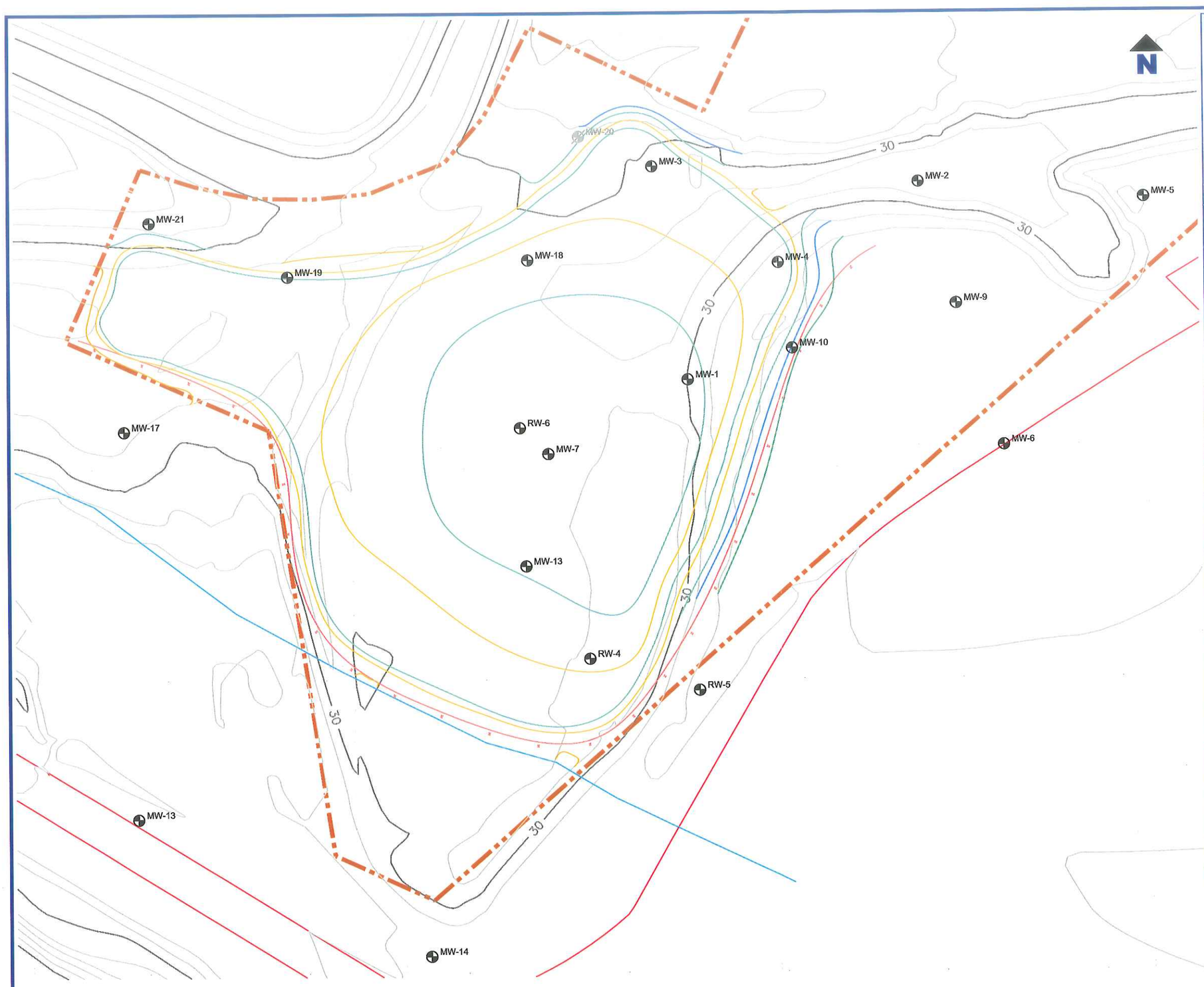
FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report
REMEDIAL ACTION WORK PLAN

Drawing
EXCAVATION CUT ELEVATIONS

| | | |
|---|---|---|
| Date July 17, 2008 | Scale AS SHOWN | Fig. No. 9 |
| File Name 01-01-04-3 | Project No. 008.0256.00007 | |

SLR




THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

NOTES

LEGEND

- PROPERTY LINE
- ASPHALT ROAD
- TOPOGRAPHIC CONTOUR – 10 FT INTERVAL
- TOPOGRAPHIC CONTROUR – 2 FT INTERVAL
- FORMER INFILTRATION POND
- BH — GROUNDWATER MONITORING WELL
- BH — ABANDONED GROUNDWATER MONITORING WELL
- NEW 26–FOOT CONTOUR
- NEW 28–FOOT CONTOUR
- NEW 30–FOOOT CONTOUR
- NEW 31–FOOT CONTOUR
- SILT FENCE

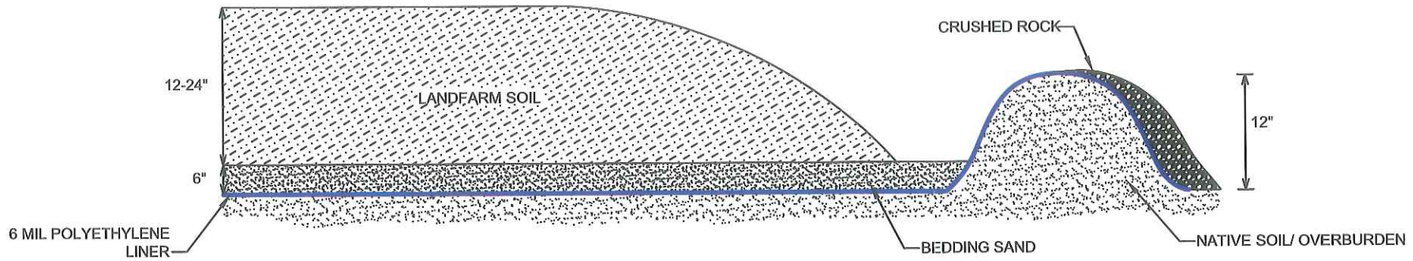
FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report
REMEDIAL ACTION WORK PLAN

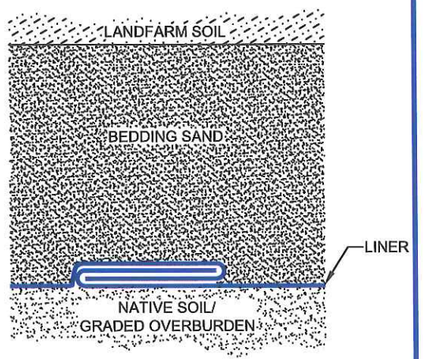
Drawing
BIOREMEDIATION CELL ELEVATIONS

| | | |
|---|---|---|
| Date July 17, 2008 | Scale AS SHOWN | Fig. No. 10 |
| File Name 01-01-04-3 | Project No. 008.0256.00007 | |

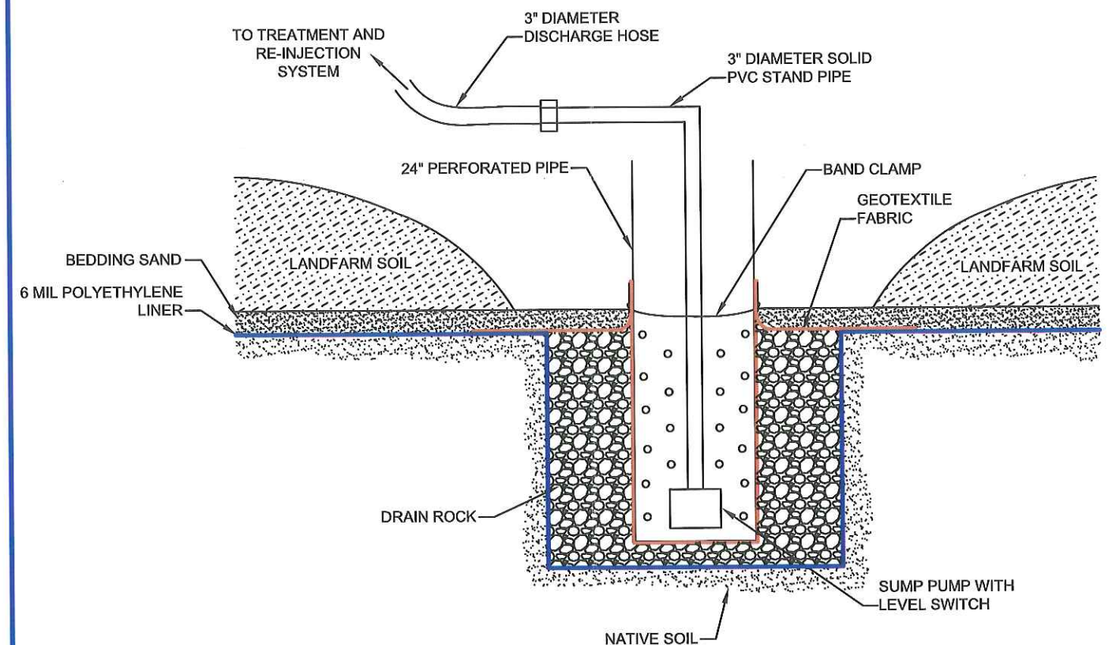
SLR




LANDFARM LINER AND BERM DETAIL




LINER SEAM DETAIL (NOT TO SCALE)




LANDFARM SUMP DETAIL

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

NOTES

LEGEND

- LANDFARM SOIL
- BEDDING SAND
- NATIVE SOIL/ GRADED OVERBURDEN
- CRUSHED ROCK
- 6 MIL POLYETHYLENE LINER
- GEOTEXTILE FABRIC

FORMER COLUMBIA MARINE LINES FACILITY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report
REMEDIAL ACTION WORK PLAN

Drawing
BIOREMEDIATION CELL DETAILS

| | | |
|---|---|---|
| Date July 23, 2008 | Scale AS SHOWN | Fig. No. 11 |
| File Name BIO CELL DETAILS-3 | Project No. 008.0256.00007 | |

SLR

# TABLES



**DRAFT Remedial Action Work Plan**
**Former Columbia Marine Lines Facility**
**3605 NW Lower River Road**
**Vancouver, Washington**

July 30, 2008

**Table 1. Groundwater Elevation Data**
**Former Columbia Marine Lines Facility**
**6305 Lower River Road, Vancouver, Washington**

| Sample Location | Measurement Date | Depth to Groundwater (feet) | Free Product Thickness (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|
| MW-1 | 11/13/1995 | 9.19 | 0.00 | 22.47 |
| 31.66 | 8/1/1996 | 10.23 | 0.00 | 21.43 |
| | 10/30/1997 | 9.54 | 0.00 | 22.12 |
| | 10/29/1998 | 12.26 | 0.00 | 19.40 |
| | 5/7/1999 | 9.51 | 0.00 | 22.15 |
| 31.69 | 10/14/1999 | 12.39 | 0.00 | 19.27 |
| | 6/28/2001 | 11.80 | 0.00 | 19.89 |
| | 2/12/2002 | 9.65 | 0.00 | 22.04 |
| | 5/13/2005 | 10.09 | 0.00 | 21.60 |
| | 10/20/2005 | 13.49 | 0.00 | 18.20 |
| 31.7 | 4/4/2008 | 10.17 | 0.00 | 21.53 |
| MW-2 | 11/13/1995 | 12.95 | 0.00 | 21.02 |
| 33.97 | 8/1/1996 | 13.75 | 0.00 | 20.22 |
| | 10/30/1997 | 13.55 | 0.00 | 20.42 |
| | 10/29/1998 | 14.92 | 0.00 | 19.05 |
| | 5/7/1999 | 12.79 | 0.00 | 21.18 |
| 33.98 | 10/14/1999 | 15.06 | 0.00 | 18.92 |
| | 6/28/2001 | 14.93 | 0.00 | 19.05 |
| | 2/12/2002 | 12.28 | 0.00 | 21.70 |
| | 5/13/2005 | 14.61 | 0.00 | 19.37 |
| | 10/20/2005 | 16.27 | 0.00 | 17.71 |
| 33.97 | 4/4/2008 | 13.12 | 0.00 | 20.85 |
| MW- 3 | 11/13/1995 | 11.24 | 0.00 | 19.66 |
| 30.90 | 8/1/1996 | 11.11 | 0.00 | 19.79 |
| | 10/30/1997 | 11.23 | 0.00 | 19.67 |
| | 10/30/1998 | 12.28 | 0.00 | 18.62 |
| | 5/7/1999 | 9.98 | 0.00 | 20.92 |
| 30.96 | 10/14/1999 | 12.33 | 0.00 | 18.63 |
| | 6/28/2001 | 12.27 | 0.00 | 18.69 |
| | 2/12/2002 | 9.42 | 0.00 | 21.54 |
| | 5/13/2005 | 11.83 | 0.00 | 19.13 |
| | 10/20/2005 | 13.50 | 0.00 | 17.46 |
| 30.96 | 4/4/2008 | 10.27 | 0.00 | 20.69 |
| MW-4 | 11/13/1995 | 8.27 | 0.00 | 20.15 |
| 28.42 | 8/1/1996 | 8.40 | 0.00 | 20.02 |
| | 10/30/1997 | 8.45 | 0.00 | 19.97 |
| | 10/29/1998 | 9.65 | 0.00 | 18.77 |
| | 5/7/1999 | 7.26 | 0.00 | 21.16 |
| 28.64 | 10/14/1999 | 9.74 | 0.00 | 18.90 |
| | 6/28/2001 | 10.68 | 0.00 | 17.96 |
| | 2/12/2002 | 6.68 | 0.00 | 21.96 |
| | 5/13/2005 | 8.12 | 0.00 | 20.52 |
| | 10/20/2005 | 10.88 | 0.00 | 17.76 |
| 28.47 | 4/4/2008 | 7.59 | 0.00 | 20.88 |
| MW-5 | 11/13/1995 | 3.07 | 0.00 | 20.30 |
| 23.37 | 8/1/1996 | 3.60 | 0.00 | 19.77 |
| | 5/7/1999 | 2.45 | 0.00 | 20.92 |
| 23.38 | 10/14/1999 | 4.85 | 0.00 | 18.53 |
| | 4/4/2008 | | 0.00 | 23.38 |
| MW-6 | 11/13/1995 | 5.23 | 0.00 | 20.91 |
| 26.14 | 8/1/1996 | 5.50 | 0.00 | 20.64 |
| | 10/30/1998 | 5.44 | 0.00 | 20.70 |
| | 5/7/1999 | 3.18 | 0.00 | 22.96 |
| 24.76 | 10/14/1999 | 5.41 | 0.00 | 20.73 |
| | 6/28/2001 | 5.28 | 0.00 | 19.48 |
| | 2/12/2002 | 2.87 | 0.00 | 21.89 |
| | 4/4/2008 | | 0.00 | 24.76 |

**Table 1. Groundwater Elevation Data**
**Former Columbia Marine Lines Facility**
**6305 Lower River Road, Vancouver, Washington**

| Sample Location | Measurement Date | Depth to Groundwater (feet) | Free Product Thickness (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|
| MW-7 | 11/13/1995 | 12.54 | 0.00 | 20.82 |
| 33.36 | 8/1/1996 | 13.55 | 0.62 | 20.31 |
| | 10/30/1997 | 13.24 | 0.17 | 20.26 |
| | 10/30/1998 | 14.51 | 0.07 | 18.91 |
| | 5/7/1999 | 11.82 | 0.02 | 21.56 |
| 33.40 | 10/14/1999 | 14.70 | 0.00 | 18.70 |
| | 6/28/2001 | 15.41 | 0.00 | 17.99 |
| | 5/13/2005 | 13.84 | 0.00 | 19.56 |
| | 10/21/2005 | 15.42 | 0.00 | 17.98 |
| 33.72 | 4/4/2008 | 12.53 | 0.00 | 21.19 |
| MW-8 | 11/13/1995 | 12.90 | 0.50 | 20.99 |
| 33.49 | 8/1/1996 | 12.98 | 0.15 | 20.63 |
| | 10/30/1997 | 13.20 | 0.21 | 20.46 |
| | 10/30/1998 | 14.94 | 0.14 | 18.66 |
| | 5/7/1999 | 12.05 | 0.37 | 21.74 |
| 33.53 | 10/14/1999 | 15.31 | 0.18 | 18.36 |
| | 6/28/2001 | 15.99 | 0.00 | 17.54 |
| | 5/13/2005 | 13.77 | 0.00 | 19.76 |
| | 10/21/2005 | 15.45 | 0.00 | 18.08 |
| 33.7 | 4/4/2008 | 12.81 | 0.00 | 20.89 |
| MW-9 | 11/13/1995 | 4.25 | 0.00 | 22.11 |
| 26.36 | 8/1/1996 | 5.81 | 0.00 | 20.55 |
| | 10/30/1997 | 1.87 | 0.00 | 24.49 |
| | 10/30/1998 | 6.31 | 0.00 | 20.05 |
| | 5/7/1999 | 5.02 | 0.00 | 21.34 |
| 26.38 | 10/14/1999 | 7.25 | 0.00 | 19.13 |
| | 6/28/2001 | 6.87 | 0.00 | 19.51 |
| | 2/11/2002 | 4.41 | 0.00 | 21.97 |
| | 5/13/2005 | 5.74 | 0.00 | 20.64 |
| | 10/20/2005 | 8.44 | 0.00 | 17.94 |
| 26.39 | 4/4/2008 | 5.33 | 0.00 | 21.06 |
| MW-10 | 11/13/1995 | 5.09 | 0.00 | 20.80 |
| 25.89 | 8/1/1996 | 5.62 | 0.00 | 20.27 |
| | 10/30/1997 | 5.64 | 0.00 | 20.25 |
| | 10/30/1998 | DRY | DRY | DRY |
| | 5/7/1999 | 4.53 | 0.00 | 21.36 |
| 25.92 | 10/14/1999 | 6.81 | 0.00 | 19.11 |
| | 6/28/2001 | 7.04 | 0.00 | 18.88 |
| | 2/11/2002 | 4.01 | 0.00 | 21.91 |
| | 5/13/2005 | 5.46 | 0.00 | 20.46 |
| | 10/20/2005 | DRY | DRY | DRY |
| 25.93 | 4/4/2008 | 4.96 | 0.00 | 20.97 |
| MW-11 | 11/13/1995 | 6.57 | 0.00 | 19.32 |
| 25.89 | 8/1/1996 | 6.71 | 0.00 | 19.18 |
| | 10/30/1997 | 6.75 | 0.00 | 19.14 |
| | 10/29/1998 | 8.12 | 0.00 | 17.77 |
| | 5/7/1999 | 5.49 | 0.00 | 20.40 |
| 25.90 | 10/14/1999 | 8.12 | 0.00 | 17.78 |
| | 6/28/2001 | 3.90 | 0.00 | 22.00 |
| | 2/11/2002 | 4.91 | 0.00 | 20.99 |
| | 5/13/2005 | 6.21 | 0.00 | 19.69 |
| | 10/21/2005 | 9.26 | 0.00 | 16.64 |
| 25.92 | 4/4/2008 | 5.51 | 0.00 | 20.41 |

**Table 1. Groundwater Elevation Data**
**Former Columbia Marine Lines Facility**
**6305 Lower River Road, Vancouver, Washington**

| Sample Location | Measurement Date | Depth to Groundwater (feet) | Free Product Thickness (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|
| MW-12 | 11/13/1995 | 6.07 | 0.00 | 22.10 |
| 28.17 | 8/1/1996 | 7.15 | 0.00 | 21.02 |
| | 10/30/1997 | 6.61 | 0.00 | 21.56 |
| | 10/29/1998 | 8.01 | 0.00 | 20.16 |
| | 5/7/1999 | 6.36 | 0.00 | 21.81 |
| 28.28 | 10/14/1999 | 8.34 | 0.00 | 19.94 |
| | 6/28/2001 | 8.24 | 0.00 | 20.04 |
| | 2/11/2002 | 5.76 | 0.00 | 22.52 |
| | 5/13/2005 | 6.61 | 0.00 | 21.67 |
| | 10/20/2005 | 9.41 | 0.00 | 18.87 |
| 28.26 | 4/4/2008 | 6.19 | 0.00 | 22.07 |
| MW-13 | 11/13/1995 | 10.60 | 0.00 | 12.18 |
| 22.78 | 8/1/1996 | 10.70 | 0.00 | 12.08 |
| | 10/30/1997 | 10.48 | 0.00 | 12.30 |
| | 5/7/1999 | 9.60 | 0.00 | 13.18 |
| 22.75 | 10/14/1999 | 11.19 | 0.00 | 11.56 |
| | 6/28/2001 | 11.18 | 0.00 | 11.57 |
| | 2/12/2002 | 9.33 | 0.00 | 13.42 |
| | 5/13/2005 | 9.91 | 0.00 | 12.84 |
| | 10/20/2005 | 11.72 | 0.00 | 11.03 |
| | 9/13/2007 | 11.72 | 0.00 | 11.03 |
| 22.72 | 4/4/2008 | 10.02 | 0.00 | 12.70 |
| MW-14 | 11/13/1995 | 8.08 | 0.00 | 18.17 |
| 26.25 | 8/1/1996 | 9.15 | 0.00 | 17.10 |
| | 10/30/1997 | 8.89 | 0.00 | 17.36 |
| | 5/7/1999 | 8.03 | 0.00 | 18.22 |
| 26.28 | 10/14/1999 | 11.73 | 0.00 | 14.55 |
| | 6/28/2001 | 11.95 | 0.00 | 14.33 |
| | 2/12/2002 | 6.56 | 0.00 | 19.72 |
| | 5/13/2005 | 7.85 | 0.00 | 18.43 |
| | 10/20/2005 | 9.56 | 0.00 | 16.72 |
| 26.28 | 4/4/2008 | 5.33 | 0.00 | 20.95 |
| MW-15 | 2/11/2002 | -- | -- | -- |
| 26.24 | Unable to locate - possibly destroyed. | | | |
| MW-16 | 11/13/1995 | 9.94 | 0.00 | 21.19 |
| 31.13 | 8/1/1996 | 10.36 | 0.00 | 20.77 |
| | 10/30/1997 | 10.26 | 0.00 | 20.87 |
| | 10/29/1998 | 11.43 | 0.00 | 19.70 |
| | 5/7/1999 | 9.33 | 0.00 | 21.80 |
| 29.67 | 10/14/1999 | 11.50 | 0.00 | 18.17 |
| | 6/28/2001 | 11.35 | 0.00 | 18.32 |
| | 2/11/2002 | 8.60 | 0.00 | 21.07 |
| | 5/13/2005 | 9.87 | 0.00 | 19.80 |
| | 10/21/2005 | 12.65 | 0.00 | 17.02 |
| 29.67 | 4/4/2008 | 9.28 | 0.00 | 20.40 |
| MW-17 | 11/13/1995 | DRY | DRY | DRY |
| 33.94 | 8/1/1996 | 14.62 | 0.00 | 19.32 |
| | 10/30/1997 | 15.61 | 0.00 | 18.33 |
| | 10/29/1998 | DRY | DRY | DRY |
| | 5/7/1999 | 13.42 | 0.00 | 20.52 |
| 33.97 | 10/14/1999 | DRY | DRY | DRY |
| | 6/28/2001 | DRY | DRY | DRY |
| | 2/11/2002 | 12.68 | 0.00 | 21.29 |
| | 5/13/2005 | 14.64 | 0.00 | 19.33 |
| | 10/20/2005 | 17.74 | 0.00 | 16.23 |
| 33.96 | 4/4/2008 | 13.81 | 0.00 | 20.15 |

## Table 1. Groundwater Elevation Data
## Former Columbia Marine Lines Facility
## 6305 Lower River Road, Vancouver, Washington

| Sample Location | Measurement Date | Depth to Groundwater (feet) | Free Product Thickness (feet) | Groundwater Elevation (feet) |
|---|---|---|---|---|
| MW-18 | 11/13/1995 | 8.47 | 0.00 | 24.72 |
| 33.19 | 8/1/1996 | 9.96 | 0.00 | 23.23 |
| | 10/30/1997 | DRY | DRY | DRY |
| | 10/29/1998 | DRY | DRY | DRY |
| | 5/7/1999 | DRY | DRY | DRY |
| 33.24 | 10/14/1999 | DRY | DRY | DRY |
| | 6/28/2001 | DRY | DRY | DRY |
| | 2/11/2002 | DRY | DRY | DRY |
| | 5/13/2005 | DRY | DRY | DRY |
| | 10/20/2005 | DRY | DRY | DRY |
| 31.48 | 4/4/2008 | DRY | DRY | DRY |
| MW-19 | 11/13/1995 | 14.77 | 0.00 | 18.90 |
| 33.67 | 8/1/1996 | 14.24 | 0.00 | 19.43 |
| | 10/30/1997 | 14.47 | 0.00 | 19.20 |
| | 10/30/1998 | 16.11 | 0.75 | 18.16 |
| | 5/7/1999 | 12.95 | 0.00 | 20.72 |
| 33.72 | 10/14/1999 | 15.43 | 0.02 | 18.31 |
| | 6/28/2001 | 15.85 | 0.00 | 17.87 |
| | 5/13/2005 | 14.08 | 0.00 | 19.64 |
| | 10/21/2005 | 16.93 | 0.00 | 16.79 |
| 34.11 | 4/4/2008 | 13.73 | 0.00 | 20.38 |
| MW-20 | 11/13/1995 | 21.99 | 0.00 | 8.37 |
| 30.36 | 8/1/1996 | 22.66 | 0.00 | 7.70 |
| | 10/30/1997 | 23.72 | 0.00 | 6.64 |
| | 10/30/1998 | 27.70 | 0.00 | 2.66 |
| | 5/7/1999 | 19.30 | 0.00 | 11.06 |
| | Well Abandoned | | | |
| MW-21 | 11/13/1995 | DRY | DRY | DRY |
| 30.06 | 8/1/1996 | 10.65 | 0.00 | 19.41 |
| | 10/30/1997 | 11.50 | 0.00 | 18.56 |
| | 10/29/1998 | DRY | DRY | DRY |
| | 5/7/1999 | 9.57 | 0.00 | 20.49 |
| 30.08 | 10/14/1999 | DRY | DRY | DRY |
| | 6/28/2001 | DRY | DRY | DRY |
| | 2/11/2002 | 7.15 | 0.00 | 22.93 |
| | 5/13/2005 | 8.91 | 0.00 | 21.17 |
| | 10/20/2005 | DRY | DRY | DRY |
| 28.36 | 4/4/2008 | 8.19 | 0.00 | 20.17 |
| RW-4 | 6/28/2001 | 16.27 | 0.00 | 18.25 |
| | 2/12/2002 | 12.38 | 0.00 | 22.14 |
| | 5/13/2005 | 14.28 | 0.00 | 20.24 |
| | 10/21/2005 | 16.40 | 0.00 | 18.12 |
| 34.52 | 4/4/2008 | 13.10 | 0.00 | 21.42 |
| RW-5 | 6/28/2001 | 9.42 | 0.00 | 19.33 |
| | 2/12/2002 | 6.7 | 0.00 | 22.05 |
| | 5/13/2005 | 8.12 | 0.00 | 20.63 |
| | 10/20/2005 | 9.74 | 0.00 | 19.01 |
| 28.75 | 4/4/2008 | 7.61 | 0.00 | 21.14 |
| EX-2 | 6/28/2001 | 14.52 | 0.00 | 19.01 |
| 33.53 | 2/12/2002 | 11.59 | 0.00 | 21.94 |
| | 5/13/2005 | 13.40 | 0.00 | 20.13 |
| | 10/20/2005 | 15.21 | 0.00 | 18.32 |
| 33.55 | 4/4/2008 | 12.88 | 0.00 | 20.67 |

**Note:**
-- = Top of casing elevation not known.

## Table 2. Groundwater Sample Analytical Data - TPH and BTEX
## Former Columbia Marine Lines Facility
## 6305 Lower River Road, Vancouver, Washington

| Sample Location | Sample Date | Silica Gel Cleanup (TPH-Dx) | TPH-Dx (µg/L) | | TPH-Gx (µg/L) | BTEX (µg/L) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Diesel | Heavy Oil | Gasoline | Benzene | Toluene | Ethyl-benzene | Total Xylenes |
| **Screening Level** | | | **500** | **500** | **800** | **5** | **1,000** | **700** | **1,000** |
| MW-1 | 11/8/1983 | No | -- | -- | -- | <20 | <20 | <20 | -- |
| | 12/13/1984 | No | -- | -- | -- | <5 | <5 | <5 | <5 |
| | 11/13/1995 | No | **12,000** | <5,000 | <80 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 10/29/1998 | No | **5,430** | **1,230** | 233 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 10/14/1999 | No | **10,400** | **2,850** | -- | -- | -- | -- | -- |
| | 10/20/2000 | No | **8,140** | **1,060** | 269 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 10/20/2000 | Yes | **1,980** | <500 | -- | -- | -- | -- | -- |
| | 6/28/2001 | Yes | **796** | <625 | 392 | <0.5 | <0.5 | <0.5 | <1.0 |
| | 2/12/2002 | Yes | 271 | <500 | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 10/20/2005 | Yes | 268 | <476 | -- | -- | -- | -- | -- |
| | 8/30/2007 | No | **5,600** | **1,250** | <80 | <1.00 | <1.00 | <1.00 | <3.00 |
| MW-2 | 11/8/1983 | No | -- | -- | -- | **510** | 450 | 100 | 770 |
| | 12/14/1984 | No | -- | -- | -- | **74** | 83 | <5.0 | 122 |
| | 2/5/1986 | No | -- | -- | -- | **69** | 390 | 110 | 900 |
| | 8/28/1990 | No | **26,400** | -- | <50 | <100 | <100 | <100 | 566 |
| | 8/2/1994 | No | **10,000** | -- | **3,100** | **6** | 3 | 35 | 110 |
| | 11/13/1995 | No | **40,000** | **7,400** | **4,000** | 2 | 2 | 22 | 110 |
| | 8/1/1996 | No | **4,700** | -- | <80 | 2 | 1 | 20 | 44 |
| | 10/29/1998 | No | **9,030** | <2,500 | **3220** | <0.50 | 1 | <0.50 | 6 |
| | 10/14/1999 | No | **9,060** | **3,460** | -- | -- | -- | -- | -- |
| | 10/20/2000 | No | **7,740** | **1,610** | **862** | 2 | <0.50 | <0.50 | <1.0 |
| | 10/20/2000 | Yes | **2,480** | **747** | -- | -- | -- | -- | -- |
| | 6/28/2001 | Yes | **8,400** | **2,240** | **900** | 1 | 1 | 1 | 3 |
| | 2/12/2002 | Yes | **5,700** | **1,750** | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | **2,070** | **836** | -- | -- | -- | -- | -- |
| | 10/20/2005 | Yes | **3,760** | **1,190** | -- | -- | -- | -- | -- |
| | 8/30/2007 | No | **9,390** | **2,850** | 180 | <1.00 | <1.00 | <1.00 | <3.00 |
| | 4/4/2008 | Yes | **7,900** | **1,600** | -- | -- | -- | -- | -- |
| MW- 3 | 11/8/1983 | No | -- | -- | -- | **95** | 64 | 15 | 90 |
| | 12/17/1984 | No | -- | -- | -- | <1 | <1 | <1 | -- |
| | 11/13/1995 | No | **4,600** | <5,000 | 290 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 10/30/1998 | No | **11,400** | **4,100** | 282 | <0.50 | 2 | <0.50 | <1.0 |
| | 10/14/1999 | No | **15,500** | **4,890** | -- | -- | -- | -- | -- |
| | 6/28/2001 | Yes | **1,560** | **<588** | 529 | <0.5 | <0.5 | <0.5 | 1 |
| | 2/12/2002 | Yes | 435 | <500 | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | **710** | <500 | -- | -- | -- | -- | -- |
| | 10/20/2005 | Yes | 428 | <476 | -- | -- | -- | -- | -- |
| | 8/30/2007 | No | **9,390** | **3,920** | <80 | <1.00 | <1.00 | <1.00 | <3.00 |
| MW-4 | 11/8/1983 | No | -- | -- | -- | **700** | 150 | 110 | 800 |
| | 12/12/1984 | No | -- | -- | -- | <1 | <1 | <1 | <1 |
| | 11/13/1995 | No | **7,800** | <5000 | 390 | 3 | 1 | 1 | 7 |
| | 8/1/1996 | No | **11,000** | -- | 380 | 2 | 5 | <0.50 | <1.0 |
| | 10/29/1998 | No | **11,200** | **2,920** | **1,120** | <0.50 | 1 | <0.50 | <1.0 |
| | 10/14/1999 | No | **17,200** | **5,180** | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | **965** | <500 | -- | -- | -- | -- | -- |
| | 10/20/2005 | Yes | 319 | <476 | -- | -- | -- | -- | -- |
| | 8/30/2007 | No | **15,600** | **3,330** | 87.6 | -- | -- | -- | -- |
| | 4/4/2008 | Yes | **4,100** | **1,100** | -- | -- | -- | -- | -- |

## Table 2. Groundwater Sample Analytical Data - TPH and BTEX
## Former Columbia Marine Lines Facility
## 6305 Lower River Road, Vancouver, Washington

| Sample Location | Sample Date | Silica Gel Cleanup (TPH-Dx) | TPH-Dx (µg/L) | | TPH-Gx (µg/L) | BTEX (µg/L) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Diesel | Heavy Oil | Gasoline | Benzene | Toluene | Ethyl-benzene | Total Xylenes |
| **Screening Level** | | | **500** | **500** | **800** | **5** | **1,000** | **700** | **1,000** |
| MW-5 | 11/8/1983 | No | -- | -- | -- | **35** | <2 | <2 | -- |
| | 12/17/1984 | No | -- | -- | -- | <20 | 380 | <20 | -- |
| | 11/13/1995 | No | **2,600** | **770** | <80 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 10/14/1999 | No | **2,380** | **680** | -- | -- | -- | -- | -- |
| | Unable to locate - possibly destroyed | | | | | | | | |
| MW-6 | 12/12/1984 | No | -- | -- | -- | <1 | <1 | <1 | <1 |
| | 11/13/1995 | No | **48,000** | <5,000 | 740 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 10/30/1998 | No | **27,000** | **6,790** | <80 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 10/14/1999 | No | **19,700** | **2,810** | -- | -- | -- | -- | -- |
| | 10/20/2000 | No | **30,200** | **2,360** | **936** | <0.50 | <0.50 | <0.50 | <1.0 |
| | 10/20/2000 | Yes | **13,500** | **1,390** | -- | -- | -- | -- | -- |
| | 6/28/2001 | Yes | **5,660** | **822** | 212 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 2/12/2002 | Yes | **31,500** | **3,380** | -- | -- | -- | -- | -- |
| | Unable to locate - possibly destroyed | | | | | | | | |
| MW-7 | 11/8/1983 | No | -- | -- | -- | <20 | <20 | <20 | -- |
| | 8/2/1994 | No | **7,700** | -- | **1,600** | <2.5 | <2.5 | <2.5 | <2.5 |
| | 11/13/1995 | No | **43,000** | <5,000 | **1,800** | 2 | 1 | <1.0 | <1.0 |
| | 10/30/1998 | No | DET | ND | DET | -- | -- | -- | -- |
| | 8/24/1999 | No | **35,800** | <10,000 | -- | -- | -- | -- | -- |
| | 8/24/1999 | Yes | **28,900** | <5,000 | -- | -- | -- | -- | -- |
| | 10/14/1999 | No | **25,800** | **3,950** | -- | -- | -- | -- | -- |
| | 10/20/2000 | No | **61,800** | <10,000 | **2,110** | <2.5 | <2.5 | <2.5 | <5.0 |
| | 10/20/2000 | Yes | **76,100** | <5,000 | -- | -- | -- | -- | -- |
| | 2/12/2002 | Yes | **1,590** | <500 | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | **1,450** | <500 | <80 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 10/21/2005 | Yes | **4,540** | <481 | <800 | <5.00 | <5.00 | <5.00 | <10.0 |
| MW-8 | 11/8/1983 | No | -- | -- | -- | **208** | <2 | <2 | -- |
| | 11/13/1995 | No | **490,000** | **41,000** | **5,400** | 2 | 2 | 2 | 5 |
| | 10/30/1998 | No | DET | DET | DET | -- | -- | -- | -- |
| | 10/14/1999 | No | **19,500** | **2,400** | -- | -- | -- | -- | -- |
| | 2/12/2002 | Yes | **2,990** | <500 | -- | -- | -- | -- | -- |
| MW-9 | 12/13/1984 | No | -- | -- | -- | <1 | <1 | <1 | <1 |
| | 11/13/1995 | No | **880** | **630** | <80 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 10/30/1998 | No | **5,760** | **2,030** | <80 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 10/14/1999 | No | **4,250** | **2,330** | -- | -- | -- | -- | -- |
| | 10/14/1999 | Yes | 446 | **811** | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | **498** | <500 | -- | -- | -- | -- | -- |
| | 10/20/2005 | Yes | **824** | **852** | -- | -- | -- | -- | -- |
| MW-10 | 11/13/1995 | No | <250 | <500 | 760 | 1 | 1 | 1 | 2 |
| | 5/13/2005 | Yes | **522** | **1,910** | -- | -- | -- | -- | -- |
| MW-11 | 12/17/1984 | No | -- | -- | -- | <1 | <1 | <1 | -- |
| | 8/2/1994 | No | <500 | -- | <200 | <0.50 | <0.50 | <0.50 | 1 |
| | 11/13/1995 | No | **11,000** | <5000 | <80 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 10/29/1998 | No | **3,160** | **698** | <80 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 10/14/1999 | No | **3,160** | <500 | -- | -- | -- | -- | -- |
| | 10/14/1999 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 10/21/2005 | Yes | <236 | <472 | -- | -- | -- | -- | -- |
| MW-12 | 12/18/1984 | No | -- | -- | -- | <1 | <1 | <1 | -- |
| | 11/13/1995 | No | <250 | <500 | <80 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 8/1/1996 | No | <250 | -- | <80 | <0.50 | <0.50 | <0.50 | <1 |
| | 10/29/1998 | No | <250 | <500 | <80 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 10/14/1999 | No | <250 | <500 | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 10/20/2005 | Yes | <236 | <472 | -- | -- | -- | -- | -- |
| | 8/30/2007 | No | <238 | <476 | <80 | -- | -- | -- | -- |

## Table 2. Groundwater Sample Analytical Data - TPH and BTEX
## Former Columbia Marine Lines Facility
## 6305 Lower River Road, Vancouver, Washington

| Sample Location | Sample Date | Silica Gel Cleanup (TPH-Dx) | TPH-Dx (µg/L) | | TPH-Gx (µg/L) | BTEX (µg/L) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Diesel | Heavy Oil | Gasoline | Benzene | Toluene | Ethyl-benzene | Total Xylenes |
| **Screening Level** | | | **500** | **500** | **800** | **5** | **1,000** | **700** | **1,000** |
| MW-13 | 12/19/1984 | No | -- | -- | -- | <1 | <1 | <1 | -- |
| | 2/5/1986 | No | -- | -- | -- | <1 | <1 | <1 | <2 |
| | 8/28/1990 | No | <50 | -- | <50 | <100 | <100 | <100 | <100 |
| | 8/2/1994 | No | **1,200** | -- | <200 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 11/13/1995 | No | **1,400** | <500 | <80 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 8/1/1996 | No | **900** | -- | <80 | <0.50 | <0.50 | <0.50 | <1 |
| | 10/30/1997 | No | **1,530** | **750** | <80 | <0.50 | <0.50 | <0.50 | <1 |
| | 10/14/1999 | No | **1,500** | **854** | -- | -- | -- | -- | -- |
| | 10/14/1999 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 6/28/2001 | Yes | <250 | <500 | <80 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 2/12/2002 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 10/20/2005 | Yes | <238 | <476 | -- | -- | -- | -- | -- |
| | 9/13/2007 | Yes | <243 | <485 | -- | -- | -- | -- | -- |
| MW-14 | 12/19/1984 | No | -- | -- | -- | <1 | <1 | <1 | -- |
| | 11/13/1995 | No | **1,000** | <500 | <80 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 8/1/1996 | No | **1,800** | -- | <80 | <0.50 | <0.50 | <0.50 | <1 |
| | 10/30/1997 | No | <250 | <500 | <80 | <0.50 | <0.50 | <0.50 | <1 |
| | 10/14/1999 | No | **3,820** | **1,810** | -- | -- | -- | -- | -- |
| | 10/14/1999 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 6/28/2001 | Yes | <294 | **<588** | 108 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 2/12/2002 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 10/20/2005 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| MW-15 | 2/5/1986 | No | -- | -- | -- | <1 | <1 | <1 | <2 |
| | 8/2/1994 | No | <500 | -- | <200 | <0.50 | <0.50 | <0.50 | <0.50 |
| | Unable to locate - possibly destroyed | | | | | | | | |
| MW-16 | 2/5/1986 | No | -- | -- | -- | 93 | <10 | <10 | 240 |
| | 8/28/1990 | No | **4,910** | -- | **1,000** | <100 | <100 | <100 | 445 |
| | 8/2/1994 | No | **11,000** | -- | **1,100** | 2 | 0.73 | 0.74 | 4.8 |
| | 11/13/1995 | No | **10,000** | **2,100** | **900** | 1 | 1 | 53 | 8 |
| | 8/1/1996 | No | <500 | -- | 740 | <0.50 | 2 | <0.50 | 3 |
| | 10/30/1997 | No | **9,010** | **2,700** | **1,220** | <0.50 | <0.50 | 8 | 4 |
| | 10/29/1998 | No | **11,600** | **2,590** | 482 | <0.50 | 4 | <0.50 | <1.0 |
| | 8/24/1999 | No | **9,900** | **2,130** | -- | -- | -- | -- | -- |
| | 8/24/1999 | Yes | **842** | <500 | -- | -- | -- | -- | -- |
| | 10/14/1999 | No | **12,300** | **2,650** | -- | -- | -- | -- | -- |
| | 10/14/1999 | Yes | **1,190** | <500 | -- | -- | -- | -- | -- |
| | 10/20/2000 | No | **13,200** | **1,530** | 463 | <0.50 | 5 | <0.50 | <1.0 |
| | 10/20/2000 | Yes | **1,510** | <500 | -- | -- | -- | -- | -- |
| | 6/28/2001 | Yes | **1,800** | <500 | 361 | <0.50 | 1 | <0.50 | <1.0 |
| | 5/13/2005 | Yes | **1,220** | <500 | -- | -- | -- | -- | -- |
| | 10/21/2005 | Yes | **572** | <472 | -- | -- | -- | -- | -- |
| | 8/31/2007 | No | **12,700** | **2,800** | 116 | <1.00 | <1.00 | <1.00 | <3.00 |
| | 4/4/2008 | Yes | **4,500** | **1,200** | -- | -- | -- | -- | -- |

## Table 2. Groundwater Sample Analytical Data - TPH and BTEX
## Former Columbia Marine Lines Facility
## 6305 Lower River Road, Vancouver, Washington

| Sample Location | Sample Date | Silica Gel Cleanup (TPH-Dx) | TPH-Dx (µg/L) | | TPH-Gx (µg/L) | BTEX (µg/L) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Diesel | Heavy Oil | Gasoline | Benzene | Toluene | Ethyl-benzene | Total Xylenes |
| **Screening Level** | | | **500** | **500** | **800** | **5** | **1,000** | **700** | **1,000** |
| MW-17 | 2/5/1986 | No | -- | -- | -- | <1 | <1 | <1 | <2 |
| | 5/13/2005 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 10/20/2005 | Yes | <236 | <472 | -- | -- | -- | -- | -- |
| | 8/30/2007 | No | <236 | <472 | <80 | -- | -- | -- | -- |
| MW-18 | 11/13/1995 | No | **4,900** | **2,100** | <80 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 8/1/1996 | No | **9,600** | -- | <80 | <0.50 | 1 | 1 | <1.0 |
| MW-19 | 12/5/1986 | No | -- | -- | -- | **140** | <10 | 30 | <20 |
| | 8/28/1990 | No | **35,200** | -- | <50 | <100 | <100 | <100 | <100 |
| | 11/13/1995 | No | **69,000** | <25,000 | **4,300** | <2.5 | <2.5 | <2.5 | <2.5 |
| | 10/30/1997 | No | **21,600** | **3,180** | **2,860** | <0.50 | <0.50 | <0.50 | 1 |
| | 10/30/1998 | No | DET | DET | DET[b] | -- | -- | -- | -- |
| | 10/14/1999 | No | **35,000** | **4,280** | -- | -- | -- | -- | -- |
| | 10/14/1999 | Yes | **5,280** | <500 | -- | -- | -- | -- | -- |
| | 2/12/2002 | Yes | **19,800** | <5,000 | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | **9,990** | **1,260** | 390 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 10/21/2005 | Yes | **35,500** | **4,140** | <800 | <5.00 | <5.00 | <5.00 | <10.0 |
| | 8/31/2007 | No | **30,700** | **4,680** | -- | -- | -- | -- | -- |
| | 4/4/2008 | Yes | **37,000** | **9,500** | -- | -- | -- | -- | -- |
| MW-20 | 2/5/1986 | No | -- | -- | -- | <1 | <1 | <1 | <2 |
| | 11/13/1995 | No | **870** | **730** | <80 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 10/30/1998 | No | <250 | <500 | <80 | <0.50 | <0.50 | <0.50 | <1.0 |
| | 10/20/2000 | No | **14,500** | **1,340** | 294 | <0.50 | 1 | <0.50 | <1.0 |
| | 10/20/2000 | Yes | **878** | <500 | -- | -- | -- | -- | -- |
| | Well Abandoned | | | | | | | | |
| MW-21 | 2/5/1986 | No | -- | -- | -- | <1 | <1 | <1 | <2 |
| | 5/13/2005 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| RW-4 | 10/20/2000 | No | **10,400** | **1,020** | 782 | <0.50 | 1 | 1 | <1.0 |
| | 10/20/2000 | Yes | <250 | <500 | -- | -- | -- | -- | -- |
| | 6/28/2001 | Yes | **806** | <588 | 550 | <0.50 | 1 | <0.50 | <0.50 |
| | 2/12/2002 | No | **2,430** | <500 | -- | | | | |
| | 5/13/2005 | Yes | **2,280** | <500 | -- | -- | -- | -- | -- |
| | 10/21/2005 | Yes | **867** | <476 | -- | -- | -- | -- | -- |
| | 8/30/2007 | No | **16,400** | **2,090** | -- | -- | -- | -- | -- |
| RW-5 | 10/20/2000 | No | **12,700** | **2,720** | 491 | <0.50 | <0.50 | <0.50 | <0.50 |
| | 10/20/2000 | Yes | **696** | <500 | -- | -- | -- | -- | -- |
| | 6/28/2001 | Yes | **29,000** | **1,580** | **2,010** | <0.5 | <0.5 | 1 | 2 |
| | 2/12/2002 | Yes | 405 | <500 | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | **2,120** | <500 | -- | -- | -- | -- | -- |
| | 10/20/2005 | Yes | **502** | <481 | -- | -- | -- | -- | -- |
| EX-2 | 2/3/1996 | No | **13,000** | **2,500** | **5,300** | 1 | 1 | 1 | 2 |
| | 6/28/2001 | Yes | **2,020** | <500 | **1,580** | <0.50 | 1 | 1 | 3 |
| | 2/12/2002 | Yes | **1,040** | <500 | -- | -- | -- | -- | -- |
| | 5/13/2005 | Yes | **1,060** | <500 | -- | -- | -- | -- | -- |
| | 10/20/2005 | Yes | 384 | <481 | -- | -- | -- | -- | -- |
| | 8/31/2007 | | **11,600** | **1,270** | 104 | <1.0 | <1.0 | <1.0 | <3.0 |
| GP1 | 5/7/1999 | No | 335 | <500 | <80 | <0.5 | <0.5 | <0.5 | <1.0 |
| GP2 | 5/7/1999 | No | **17,900** | <500 | **2,710** | <2.50 | 6 | <2.50 | <5.0 |
| GP3 | 5/7/1999 | No | **13,100** | <500 | **2,780** | <0.5 | 1 | <0.5 | <1.0 |
| GP4 | 5/7/1999 | No | 486 | <500 | <80 | <0.5 | <0.5 | <0.5 | <1.0 |
| GP5 | 5/7/1999 | No | **1,970** | <500 | <80 | <0.5 | <0.5 | <0.5 | <1.0 |
| GP6 | 5/7/1999 | No | <250 | <500 | <80 | <0.5 | <0.5 | <0.5 | <1.0 |
| GP7 | 5/7/1999 | No | **11,800** | <500 | <80 | <0.5 | <0.5 | <0.5 | <1.0 |
| GP8 | 5/7/1999 | No | **15,200** | <500 | 479 | <0.5 | <0.5 | <0.5 | <1.0 |
| GP9 | 5/7/1999 | No | **4,930** | <500 | <80 | <0.5 | <0.5 | <0.5 | <1.0 |

## Table 2. Groundwater Sample Analytical Data - TPH and BTEX
## Former Columbia Marine Lines Facility
## 6305 Lower River Road, Vancouver, Washington

| Sample Location | Sample Date | Silica Gel Cleanup (TPH-Dx) | TPH-Dx (µg/L) | | TPH-Gx (µg/L) | BTEX (µg/L) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Diesel | Heavy Oil | Gasoline | Benzene | Toluene | Ethyl-benzene | Total Xylenes |
| **Screening Level** | | | **500** | **500** | **800** | **5** | **1,000** | **700** | **1,000** |
| GPE-1-GW | 8/24/2007 | No | **2,830** | 714 | 199 | <1.00 | <1.00 | <1.00 | <3.00 |
| GPE-2-GW | 8/24/2007 | No | **1,170** | <490 | <80 | <1.00 | <1.00 | <1.00 | <3.00 |
| GPE-3-GW | 8/24/2007 | No | **5,590** | **1,660** | 162 | -- | -- | -- | -- |

**Notes:**

[a]Chapter 173-340 WAC, Model Toxics Control Act (MTCA) Cleanup Regulation, Method A Cleanup Levels. Amended Febru

[b]Detected (DET) hydrocarbons in gasoline range appear to be due to overlap of diesel-range hydrocarbons.

**Bold** - Indicates the compound was detected at a concentration exceeding the screening level.

µg/l = micrograms per liter.

NA = Not applicable.

-- = Not analyzed or not sampled.

DET = Detected as being presenrt by TPH-HCID

ND = Not detected above laboratory method reporting limit (MRL).

TPH-G = Total petroleum hydrocarbons as gasoline analysis by Washington DOE Method WTPH-G.

TPH-D = TPH as diesel and heavy oil analysis by Washington DOE Method WTPH-D (extended) with silica gel cleanup analysis based on possible biogenic intererence.

BTEX = Benzene, toluene, ethylbenzene, and total xylene analysis by EPA Method 8020.

PAHs = Polynuclear aromatic hydrocarbon analysis by EPA Method 8310.

Analytical methods prior to 1995 include Hydrocarbon Scan by EPA Methods 3510/Modified 8015, and Oil and Grease by EP/

## Table 3. Soil Excavation Volume
## Former Columbia Marine Lines Facility
## Vancouver, Washington

| Description | Square Footage of Source Area (at Depth) (ft2) | Square Footage of Source Area (at the Surface, with 1:1 Sidewall Slope) (ft2) | Thickness Non-Impacted Overburden (ft) | Thickness Impacted Soil (ft) | Total Depth of Excavation (ft) | Excavated Volume of Non-Impacted Soil (cy) | Excavated Volume of Impacted Soil (cy) |
|---|---|---|---|---|---|---|---|
| **South Area** | 2,486 | 5,642 | 6.0 | 8.5 | 14.5 | 994 | 912 |
| **MW-7 Area** | 853 | 3,190 | 9.0 | 4.5 | 13.5 | 709 | 160 |
| **West Area** | 6,909 | 12,352 | 6.5 | 7.5 | 14.0 | 2,283 | 1,879 |
| **GP-5A Area** | 430 | 2,247 | 10.0 | 5.0 | 15.0 | 555 | 109 |
| **Total Estimated Volume** | 10,677 | 23,432 | 6.8 | 7.5 | 14.3 | 4,833 | 3,425 |

Note: Volumes of impacted soil removed include all impacted soil located above the soil with the target concentration, since that soil can't be placed back in the excavation.

# APPENDIX A

## SAMPLING AND ANALYSIS PLAN

**DRAFT Remedial Action Work Plan**
**Former Columbia Marine Lines Facility**
**3605 NW Lower River Road**
**Vancouver, Washington**

July 30, 2008

SLR INTERNATIONAL CORP
1800 Blankenship Road, Suite 440
West Linn, Oregon 97068
(503) 723-4423

# DRAFT
# SAMPLING AND ANALYSIS PLAN

## FORMER COLUMBIA MARINE LINES SITE
## 6305 NW LOWER RIVER ROAD
## VANCOUVER WASHINGTON

**July 30, 2008**

**Prepared for:**

Crowley Maritime Corporation
1100 SW Massachusetts St
Seattle, WA 98134

**Prepared by:**

SLR International Corp
1800 Blankenship Road
West Linn, OR 97068

**Project Number:** 008.0205.0007

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# SIGNATURE PAGE

This document has been prepared by SLR International Corp. The material and data in this report were prepared under the supervision and direction of Steven Hammer, P.E.

| Prepared By: | Reviewed By: |
|---|---|
| _____ | _____ |
| Signature | Signature |
| Brendan Robinson | Steven R. Hammer, P.E. |
| Name | Name |
| Associate Engineer | Senior Engineer |
| Title | Title |
| _____ | _____ |
| Date | Date |

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## LIST OF FIGURES



## LIST OF TABLES



**NOTE:** FIGURES AND TABLES ARE PRESENTED AT THE END OF THE REPORT.

## List of Acronyms

| | |
|---|---|
| bgs | Below ground surface |
| DQO | Data Quality Objective |
| EPA | United States Environmental Protection Agency |
| ERD | Enhanced Reductive Dechlorination |
| ESC | Environmental Science Corp. |
| GPS | Global Positioning System |
| HVOC | Halogenated Volatile Organic Compound |
| IRAM | Interim Remedial Action Measure |
| MDL | Method Detection Limit |
| mg/kg | milligrams per kilogram |
| MRL | Method Reporting Limit |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| MTCA | Model Toxics Control Act |
| QA/QC | Quality Assurance and Quality Control |
| RPD | Relative Percent Difference |
| SAP | Sampling and Analysis Plan |
| TPH | Total Petroleum Hydrocarbon |
| USCS | Unified Soil Classification System |

# 1.0 INTRODUCTION

## 1.1 PURPOSE AND OBJECTIVE

The purposes of this Sampling and Analysis Plan (SAP) are to:

- Specify procedures for field sampling activities described in the Remedial Action Work Plan (Work Plan) for the former Columbia Marine Lines facility (site) in Vancouver, Washington;
- Identify quality assurance (QA) procedures to be implemented during sampling activities and laboratory analyses; and
- Meet the requirements of WAC 173-340-820, Model Toxics Control Act (MTCA) regulations, for sampling and analysis plans.

## 1.2 SAMPLING AND ANALYSIS PLAN ORGANIZATION

The SAP is organized in four sections. A brief description of each section is presented below:

- Section 1—Introduction. Section 1 contains an overview of the project and the SAP;
- Section 2—Field Sampling Plan. Section 2 identifies the sampling locations and depths, and presents the procedures to be used in field sampling. Included are procedures for: soil and groundwater sample collection; sample labeling, shipping, and custody; well installation, development, and sampling; surveying; decontamination; and residuals management;
- Section 3—Quality Assurance Program Plan. Section 3 identifies the project organization and includes QA procedures for field activities and laboratory analyses; and
- Section 4—Field Forms. Section 4 provides a set of forms to be used during field activities.

## 1.3 PROJECT ORGANIZATION

The activities outlined in this SAP will be conducted by personnel from SLR International Corp (SLR) on behalf of Crowley Maritime Corporation (Crowley). The project team includes:

- Mr. Stephen Wilson, Crowley Maritime Corporation: Mr. Wilson is responsible for overall coordination of consultants and negotiations with property owners and the regulatory agency.
- Steve Locke, SLR International Corp, Principal Engineer: Mr. Locke is responsible for project direction and principal review of work completed at the site.

- Steven Hammer, P.E., SLR International Corp: Mr. Hammer is responsible for project management and administration, coordination with property owners and Ecology, engineering design and review, and project health and safety.

- Scott Miller, P.E., SLR International Corp: Mr. Miller is the Civil Engineer of record for the project. He is responsible for engineering design and review.

- Brendan Robinson, SLR International Corp: Mr. Robinson is responsible for the oversight of field activities, including supervision of subcontractors, erosion and sediment control, performance monitoring, and on-site health and safety.

- Chris Kramer, SLR International Corp: Mr. Kramer is responsible for conducting field activities including soil sampling, landfarm construction, erosion and sediment control, well installation, and performance monitoring.

## 2.1 SAMPLING NEEDS AND OBJECTIVES

The remedial action sampling activities at the former Columbia Marine Lines site will be performed to provide data of sufficient quality and quantity to satisfy the following data quality objectives (DQOs):

- Confirm that the soils with total petroleum hydrocarbons (TPH) concentrations greater than the site cleanup level of 5,070 milligrams per kilogram (mg/kg) have been effectively remediated; and
- Effectively monitor the natural attenuation of the TPH in groundwater.

## 2.2 SAMPLE LOCATIONS, TYPES, AND FREQUENCY

### 2.2.1 EXCAVATION SAMPLING

The lateral and vertical extents of each soil excavation will be based on soil sample analytical results; however, the vertical extent of any excavation will not extend more than 1 to 2 feet below the groundwater table, which is approximately 15 feet below ground surface (bgs). The anticipated soil excavation area is shown in **Figure A-1** of this SAP.

During the excavation activities, SLR personnel will screen the excavated soil for the presence of petroleum hydrocarbons using visual appearance and colorimetric field screening methods (e.g., a Hanby or PetroFlag kit). When the excavated soil contains limited visible evidence of contamination (e.g., light staining, no sheen) and TPH-D concentrations are below 5,070 mg/kg as indicated by colorimetric field methods, SLR personnel will inform the excavation contractor to discontinue excavating at that location, and a confirmation soil sample will be collected for laboratory analysis.

SLR personnel will collect confirmation soil samples from excavation sidewalls and, where the excavation has been halted above the saturated zone and capillary fringe, from the bottom of the excavation. Where the excavation extends below the water table as observed during the excavation work, confirmation soil samples will not be collected from the bottom of the excavation. The confirmation soil samples will be submitted to a Washington Department of Ecology accredited laboratory for quantitative chemical analysis. All of the samples will be analyzed for total petroleum hydrocarbons as gasoline (TPH-G) by Ecology Method NWTPH-Gx and for TPH as diesel (TPH-D and TPH-O) by Ecology Method NWTPH-Dx. Samples collected for TPH-Gx analysis will be collected by an EPA 5035 compliant sampling method. The NWTPH-Dx test will include a silica gel cleanup step. The total TPH concentration (i.e. the sum of the TPH-G, TPH-D, and TPH-O concentrations) will be assessed against the site cleanup level of 5,070 mg/kg.

Excavation confirmation sampling will be conducted systematically. Prior to beginning excavation, SLR will establish a grid over the entire site. The anchor point for the grid will be marked. The X-axis coordinates will be named using numbers (starting with "1") and the Y-axis coordinates will be named using letters (starting with "A"). A handheld global positioning system (GPS) receiver will be used to establish a sampling grid. The grid nodes will be spaced at intervals equal to 25 feet (each grid cell will cover an area of up to 625 square feet), and where accessible, labeled flags and wooden stakes will be used to mark and identify the grid nodes. The proposed sampling grid layout is shown in **Figure A-2** and **Figure A-3** of this SAP.

The excavation sidewalls will be sloped at 1:1 to 1:3 (rise over run). Excavation sidewall samples will be discrete samples collected on approximately 25-foot centers along the perimeter of the excavation. Each sidewall sample will be collected in the area closest to the center of the applicable grid cell. The depth of sidewall samples will be based on the depth of the excavation and the observed depth of impacted soil.

For any portion of an excavation that does not extend to a depth below the groundwater table, excavation floor samples will be collected from the center of each applicable grid cell.

If a sidewall sample contains a TPH concentration that exceeds the site cleanup level, then the wall of the sampled grid cell will be extended laterally and re-sampled. If a floor sample contains TPH concentrations that exceed the site cleanup level, then the floor of the excavation will be deepened by and re-sampled if the excavation depth is still above the groundwater table. Each excavation will not be completed until the sidewall and available floor samples contain TPH concentrations below the soil cleanup level.

### 2.2.2 STOCKPILE SAMPLING

All stockpiled soil to be used for backfilling, i.e. clean overburden removed from the top 6 to 10 feet of soil at the site, will be sampled prior to backfilling to confirm that the TPH concentrations are below the cleanup level of 5,070 mg/kg. Samples will be submitted to an analytical laboratory for analysis by TPH-Gx and TPH-Dx. Samples collected for TPH-Gx analysis will be collected by an EPA 5035 compliant sampling method. The NWTPH-Dx test will include a silica gel cleanup step. The total TPH concentration (i.e. the sum of the TPH-G, TPH-D, and TPH-O concentrations) will be assessed against the site cleanup level of 5,070 mg/kg.

Confirmation sampling will be conducted systemically, using the same grid system set up to sample the excavation areas. The number of samples will be determined from the table following this paragraph. Sample locations will be based on the 25-foot by 25-foot grid and, where there are more grid cells than the number of samples, the grid cells from which samples will be collected will be determined randomly. The depth of the sample will also be determined randomly from one to three feet bgs. Laboratory analysis of the stockpiled soil will be performed with a rush turnaround in order to minimize delays during the excavation activities.

| Soil Volume (Cubic Yards – cy) | Number of Samples |
|---|---|
| 0 to 100 | 3 |
| 101 to 500 | 5 |

| Soil Volume (Cubic Yards – cy) | Number of Samples |
|---|---|
| 501 to 1,000 | 7 |
| 1,001 to 2,000 | 10 |
| 2,001 or more | 10 + 1 for each additional 500 cy |

Stockpiled overburden soil that has confirmed TPH concentrations below 5,070 mg/kg will be backfilled as soon as practical during the excavation activities. If any of the stockpiled overburden soil has TPH concentrations above 5,070 mg/kg, that soil will be segregated for treatment in the bioremediation cell as described in the Work Plan.

### 2.2.3 BIORMEDIATION CELL SAMPLING

The progress of the ex-situ bioremediation will be evaluated through quarterly soil sampling of the bioremediation cell. The number of samples to be collected will be determined on a volumetric basis, as per the table above. Sample locations will be based on the 25-foot by 25-foot sample grid, as illustrated on **Figure A-2** and **Figure A-3**. Where there are more grid cells than the number of samples, the grid cells from which samples will be collected will be determined randomly. Samples will be collected from approximately 12 inches below the top surface of the bioremediation cell, or approximately one to two feet above the cell liner.

### 2.2.4 GROUNDWATER TREATMENT SYSTEM SAMPLING

Groundwater recovered from open excavations will be pumped through a groundwater treatment system that will consist of an oil/water separator tank, bag filters, and carbon filters. Initially, the effluent from the treatment system will be pumped into a temporary storage tank. On a daily basis for at least the first three days of groundwater recovery operations, SLR personnel will collect samples from the influent to the separator, the influent to the carbon filtration system, and the effluent from the carbon filtration system. The samples will be submitted to an Ecology-accredited laboratory for analysis of TPH-G by Ecology Method NWTPH-Gx and TPH-D and TPH-O by Ecology Method NWTPH-Dx with silica gel cleanup.

If the effluent sample from the carbon filtration system contains TPH below the site groundwater cleanup level, then the water will be discharged for re-infiltration to the subsurface. Injection will be to either the inactive groundwater injection trench, the inactive groundwater recovery trench, or another approved injection point. If the effluent sample from the carbon filtration system contains a TPH concentration greater than the groundwater cleanup level, then the water in the storage tank will be pumped into the oil/water separator tank and re-treated. If the system effluent samples from three consecutive days of operation contain TPH concentrations below the groundwater cleanup level, then treatment system sampling frequency will be reduced to once per week and the treated water will be directly infiltrated into the subsurface rather than to the temporary storage tank.

### 2.2.5 NATURAL ATTENUATION MONITORING

Groundwater samples will be collected on a periodic basis, as discussed below. The locations of the existing and planned groundwater monitoring wells are shown in **Figure A-4** of this SAP. The

groundwater sampling program is designed to monitor the performance of the remedial action and the natural attenuation of the remaining TPH contamination in groundwater.

New monitoring wells will be installed to replace those wells destroyed during excavation activities. Wells MW-7, MW-8, MW-19, RW-4, and RW-6 will be destroyed during excavation. All of these wells, except RW-6, which is adjacent to MW-7, will be replaced. Two new monitoring wells will also be installed for the purposes of natural attenuation monitoring. The locations of the proposed new monitoring wells are shown on **Figure A-4**.

After installation of the new wells, groundwater monitoring will be conducted at the site to evaluate the performance of the excavation activities and to monitor natural attenuation of the remaining groundwater contamination. The groundwater monitoring will follow Ecology's *Guidance on Remediation of Petroleum-Contaminated Groundwater by Natural Attenuation*, dated July 2005. To evaluate the natural attenuation of groundwater contamination, Ecology recommends monitoring the groundwater conditions (contaminant and geochemical indicator concentrations) within established groundwater flow paths. Within each flow path, the guidance recommends that groundwater samples be collected from an upgradient background well (if available), a well located within the source area, two wells near the contaminated plume center line that contain concentrations greater than cleanup levels, and a non-impacted downgradient well. Because of the topography of the site and the radial groundwater flow away from the source areas (see **Figure A-4**), there are no upgradient wells at the site. The flow paths to be evaluated are shown on **Figure A-4**.

Groundwater monitoring will be conducted on a quarterly basis for the first year, on a semiannual basis for the second year, and then on an annual basis until the TPH concentrations in all of the wells are below the site cleanup level for two consecutive annual events. Groundwater monitoring would then be conducted on a quarterly basis to determine if the concentrations are below the site cleanup level for four consecutive quarters. If the concentrations are below the site cleanup level for four consecutive quarters, then the monitoring would be discontinued. If concentrations exceed the site cleanup level, then the monitoring program will be continued. SLR would determine the sampling frequency based on the analytical results.

The semi-annual sampling events will be conducted during a period of high seasonal groundwater elevations and a period of low seasonal groundwater elevations. The annual events will be conducted during the period of year that has the greatest average groundwater concentrations in the on-site wells.

During each monitoring event, SLR will measure the depths to groundwater of all of the groundwater monitoring wells to evaluate groundwater flow directions. If sufficient water is present in the wells to be sampled, the wells will be purged by using a peristaltic pump or disposable bailers. During purging, field instruments will be used to measure dissolved oxygen, redox potential, pH, specific conductivity, temperature, and dissolved ferrous iron. The groundwater samples will be submitted to an Ecology-accredited laboratory for quantitative chemical analysis. The samples will be analyzed for TPH-G by NWTPH-Gx, TPH-D and TPH-O by Ecology Method NWTPH-Dx with silica gel cleanup, sulfate by EPA Method 375.2, nitrate by EPA Method 353.2, dissolved manganese by EPA Method 200.8, alkalinity by EPA Method 310.1, and dissolved methane by EPA Method RSK 175. If the laboratory determines that the detected TPH-G and/or TPH-O concentrations in the sample from a

well are due to overlap from diesel-range hydrocarbons, then future analysis of TPH-G and/or TPH-O will be discontinued from that well.

The first year of quarterly monitoring results will be evalauted in accordance with Ecology's *Natural Attenuation Analysis Tool Package for Petroleum-Contaminated Groundwater*. The results of the evaluation will be used to assess the performance of the cleanup action; whether the groundwater plume is shrinking, stable, or expanding; attenuation rates; and whether alterations in the monitoring program are required.

### 2.2.6 Field Quality Assurance

Field QA will be maintained through compliance with this SAP, collection of duplicate samples, and documentation of sample plan alterations. Duplicate samples will be collected at a frequency of one sample per sampling event.

## 2.3 Sample Designation

Soil samples will be identified by the grid cell (shown on **Figure A-2** and **Figure A-3**) from which they were collected. Groundwater samples will be identified by the monitoring well from which they are collected. The sidewall samples from the excavations will be identified by the excavation number (EX1 for the MW-7 excavation, EX2 for the GP-5A excavation, EX3 for the South Area, and EX4 for the West Area), sidewall designation (SW), grid cell reference, sequential sample number, and sample depth. For example, the second sample collected from the northern sidewall of Excavation 1 (cell F10), at a depth of 13 feet, would be designated "EX1-SW-F10-2-13". The excavation bottom samples will be identified by the excavation number, bottom designation (BT), grid cell reference, sequential sample number, and sample depth. For example the first bottom sample collected from the northern end of Excavation 3 (cell I8), at a depth of 12 feet would be designated "EX3-BT-I8-1-12".

The soil stockpile samples will be identified by the stockpile designation (SP), the grid cell reference, the date, and the sequential sample number. For example the second sample collected in September 2008 from a stockpile located near MW-1 (cell F13) would be designated "SP-F13-0908-2". Bioremediation cell samples will be identified by the bioremediation cell designation (BC), the grid cell reference, the date, and the sequential sample number. For example the first sample collected in June 2009 from the bioremediation cell near MW-18 (cell D9) would be designated "BC-D9-0609-1".

The groundwater samples will be identified by the monitoring well name and date. For example, the groundwater sample collected from well MW-4 in June 2009 would be designated "MW-04-0609".

QA samples (field duplicates) will be submitted blind (i.e., not identified as QA samples) to the laboratory. The QA samples will be labeled with a fictitious sample name (e.g., a nonexistent sampling location). The source of the QA samples will be noted in field log book and the specific sampling data forms. Trip blanks will be identified with sequential sample number and a date suffix (e.g., TB-1-0804) on the container. Extra samples collected for laboratory duplicates and matrix spike and matrix spike duplicate (MS/MSD) analyses will be identified with the same designation as the sample.

## 2.4 DRILLING AND SOIL SAMPLING PROCEDURES

Several groundwater monitoring wells will be destroyed as part of the excavation activities. Replacement groundwater monitoring wells will be installed to restore the monitoring network.

### 2.4.1 UTILITY LOCATION

All drilling locations will be checked for underground utilities prior to the start of drilling. Boring locations may be moved due to underground or aboveground utilities. The field geologist may approve relocations within 25 feet of the original site and will notify the environmental contractor's project manager. Relocations greater than 25 feet from the original boring location will require approval by both the SLR project manager and Ecology before drilling commences.

### 2.4.2 DRILLING PROCEDURES

All soil borings will be drilled by using a hollow-stem-auger drilling rig equipped with 8-inch inside-diameter (i.d.) casing and a bit. All downhole drilling equipment will be decontaminated prior to use and between drilling locations as described in **Section 2.9**. If water must be added to the borings to control heaving conditions, only potable water will be used. All residual soil and water collected during drilling and sampling will be handled and disposed of following the procedures described in **Section 2.10**. The monitoring wells will be completed as described below.

### 2.4.3 SOIL SAMPLING

Subsurface soil samples will be collected at 5-foot intervals from soil borings for visual classification of lithology. Soil samples will be collected at the designated intervals in advance of the drill bit by using an 18-inch-long, 2-inch-diameter split-spoon sampler. No soil samples from the borings will be submitted for laboratory analysis.

## 2.5 MONITORING WELL INSTALLATION AND DEVELOPMENT

It is anticipated that four replacement groundwater monitoring wells will be installed at the site to replace those destroyed during excavation activities, and two new wells will be installed to evaluate groundwater flow paths for assessing the effectiveness of natural attenuation. The wells will be constructed so that the screens straddle the groundwater table. In general the bottom of the well screen will be placed at the top of the underlying silt unit, approximately 10 to 15 feet bgs. All monitoring wells will be installed in accordance with the requirements of Chapter 173-160 WAC, Part 3, "Resource Protection Well Guidelines." The wells will be constructed of nominal 2-inch flush-threaded Schedule 40 PVC, including a threaded end plug. They will be constructed using a nominal 10-foot-long screen with machined 0.010-inch slots.

The annular space around the screen zone of each monitoring well will be backfilled with clean Colorado 10-20 silica sand. This filter pack will extend from approximately 2 to 12 inches below the lowest slot to at least 2 feet above the uppermost slot. The annular space above the filter pack will be sealed with 3/8-inch (medium) bentonite chips that are hydrated with potable water. The bentonite seal will extend from the top of the filter pack to the base of the surface security casing in all monitoring wells. The top of each well will be secured with an above-ground lockable security

casing. Above-ground security casings will be cemented in place, with the surface of the cement sloping away from the security casing.

All annular space materials will be placed concurrent with casing withdrawal. As-built construction details, including the volumes of materials used to construct each well, will be recorded on the boring log. The total depth of each boring and the placement depths of the filter pack, the bentonite seal, and the surface completion will be measured to the nearest 0.1 foot, using a weighted fiberglass tape.

The newly installed wells will be developed by pumping, surging, or bailing. The water level in the well will be measured to the nearest 0.01 foot (from the north side of the well casing) before development by using an electric water level probe. Water depths will be recorded on a Groundwater Sampling Data Sheet and will include date, time, and developer's initials. The total pore (casing) volume of the installation will be determined using the measured water level and the as-built installation depth. Groundwater pH, specific conductance, and temperature, may be measured during development. A well will be considered developed when at least ten times the pore volume of water has been removed from the well, and the color of the discharge water does not change with additional development. If after one hour of development the discharge water does not clear, then no further development will be attempted and the suitability of sampling groundwater from the well will be evaluated by the SLR Project Manager.

Well development details, including discharge volume, discharge rate, pH, specific conductance, temperature, and appearance will be recorded on a Groundwater Sampling Data Sheet. All development water will be handled as described in **Section 2.10**.

## 2.6 EXCAVATION SOIL SAMPLING

### 2.6.1 SOIL SAMPLING PROCEDURES

During the excavations SLR personnel will record the excavation dimensions, the types of soil encountered, the depths of sample collection, and the depth to groundwater, if present, on an Excavation Log or field notebook. Soil samples will be collected from the sidewalls of the excavations by the excavation contractor using the backhoe bucket. SLR personnel will transfer the soil from the bucket to laboratory-prepared containers by using a clean stainless-steel spoon or a syringe per the EPA 5035 sampling method. Exact sample locations will be based on field screening (visual appearance and colorimetric field testing).

Soil sampling will be conducted per the following general procedures:

A. All sampling equipment and reusable materials that contact the sample will be decontaminated on-site consistent with procedures identified in **Section 2.9**.
B. The sample container labels will be filled out and attached to the appropriate containers as described in **Section 2.7**.
C. Soil from the backhoe bucket will be transferred directly into the sample jars by using a clean stainless steel spoon.
D. The sample will be logged on an Excavation Log or in a field notebook.
E. QA samples will be collected at the frequency described in **Section 2.3**.

F. After being filled, the sample container(s) will be placed in a cooler with ice and handled as described in **Section 2.7**. The sample coolers will be shipped to the laboratory within 48 hours of sampling.
G. Residuals will be handled as described in **Section 2.10**.

### 2.6.2 GROUNDWATER MONITORING WELL SAMPLING PROCEDURES

The objective of the groundwater monitoring well sampling is to obtain a sample that is representative of subsurface conditions. Low flow sampling techniques have been used at the site for the past several sampling events. Low flow sample techniques will continue to be used to collect samples from groundwater monitoring wells. The methods used for this project will follow the procedures and recommendations presented in the *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers*, published by the United States Environmental Protection Agency, dated May 2002.

A peristaltic pump is an adequate purging device to use at the site, given that the depth to groundwater in the monitoring wells has historically been less than 15 feet below the top of casing. Additionally, the well construction used in some of the wells does not allow for submersible pumps to be used. The tubing or pump inlet will be placed in the center of the screened section of the well for purging and sampling.

Low flow sampling consists of purging groundwater from within the screened section of the monitoring well, at a flow rate low enough to (usually) minimize drawdown. Due to the very low yields of the wells at this site; however, sampling may result in dewatering of wells. Therefore, for some wells at the site, minimal purging will be conducted prior to sampling, particularly during the dry season, so that samples can be collected before the well is purged dry.

Groundwater samples will be submitted to Environmental Science Corporation (ESC) under a chain-of-custody for chemical analysis.

Groundwater sampling will be conducted per the following general procedures:

A. The depth to groundwater will be measured in the well before sampling. The water level will be measured to the nearest 0.01 foot from a surveyed notch in the well casing by using an electric water level probe. Water depths will be recorded on a Groundwater Sampling Data Sheet, and will include date, time, and sampler's initials.
B. The monitoring wells will be purged with a peristaltic pump using new disposable polyethylene tubing. Water quality parameters (pH, temperature, specific conductivity, dissolved oxygen, and oxidation-reduction potential) will be measured every three to five minutes, depending on tubing and flow through cell volume. The sample will be collected once these parameters have stabilized (+/- 10%) over three consecutive readings or at least three pore volumes have been purged, whichever occurs first.
C. The sample will be collected directly from the discharge tubing and collected in pre-cleaned, appropriately preserved containers, supplied by the laboratory.
D. Samples will be labeled, handled, and shipped using the procedures described in **Section 2.7**. Sample custody will be maintained until delivery to the analytical laboratory. All sampling field activity and data will be recorded on a Groundwater Sampling Data Sheet.

E. QA samples will be collected at the frequency described in **Section 2.3**. Duplicate samples will be collected by alternately filling like containers until both containers are filled.
F. The sampler(s) will wear new, appropriate, gloves at each sample location. New polyethylene tubing will be used at each sample location.
G. All reusable purging and sampling equipment will be decontaminated by using the procedures described in **Section 2.9**.
H. Residuals will be handled as described in **Section 2.10**.

## 2.7 SAMPLE LABELING, SHIPPING, AND CHAIN-OF-CUSTODY

### 2.7.1 SAMPLE LABELING

Sample container labels will be completed immediately before or immediately after sample collection. At a minimum, sample containers will be marked with the sample ID immediately upon collection. Container labels will include the following information:

- Project name and project number;
- Sample number;
- Name of collector;
- Date and time of collection;
- Analyses requested; and
- Preservative (if any).

### 2.7.2 SAMPLE SHIPPING

Sample containers will be transported in a sealed, iced cooler. In each shipping container, glass containers will be separated by a shock-absorbing and absorbent material to prevent breakage and leakage. Ice or "blue ice," sealed in separate plastic bags, will be placed into each cooler with the samples. All sample shipments will be accompanied by a chain-of-custody form. The completed form will be sealed in a plastic bag and taped to the inside lid of the shipping container. Signed and dated chain-of-custody seals will be placed on all shipping containers. The name and address of the analytical laboratory and the environmental contractor's name and office (return) address will be placed on each shipping container prior to shipping.

### 2.7.3 CHAIN-OF-CUSTODY

Once a sample is collected, it will remain in the custody of the sampler or other the environmental contractor's personnel until shipment to the laboratory. Upon transfer of sample containers to subsequent custodians, a chain-of-custody form will be signed by each person transferring custody of the sample container. A signed and dated chain-of-custody seal will be placed on each cooler prior to shipping. Upon receipt of samples at the laboratory, the cooler seal will be broken and the condition of the samples will be recorded by the receiver. Chain-of-custody records will be included in the analytical report prepared by the laboratory.

## 2.8 SURVEYING

The locations of the new monitoring wells will be surveyed by a licensed surveyor. Each well will be surveyed for ground surface elevation (to the nearest 0.01 foot), horizontal position (to the nearest 1.0 foot), and well casing rim elevation (to the nearest 0.01 foot). Unless otherwise specified, the north side of the well casing rim will be surveyed. The ground surface and well casing rim elevations will be surveyed relative to mean sea level (NAVD 29(47)). The horizontal position of the wells will be measured relative to the Washington State Plan NAD 83.

The lateral and vertical extents of the soil excavation will be surveyed by a licensed surveyor. The inside of the excavation will be surveyed for horizontal position and for depth bgs.

## 2.9 DECONTAMINATION PROCEDURES

A decontamination area will be established for cleaning the drilling rig, excavation equipment, and soil sampling equipment. All down-hole drilling equipment will be steam-cleaned or hot water pressure-washed prior to beginning drilling and between drilling each boring. Split spoon samplers, spoons, and other sampling equipment that will contact samples will be decontaminated prior to initial use, between sampling locations, and between different sampling depths at the same location. Soil sampling equipment will be decontaminated by steam cleaning, hot water pressure washing, or by the following procedure:

A. Tap water rinse;
B. Phosphate-free detergent (Liquinox) and tap water wash;
C. Distilled water rinse;
D. Isopropyl alcohol rinse; and
E. Distilled water rinse.

All groundwater sampling equipment (tubing) will be disposed after collecting each sample. The water level probe will be rinsed with distilled water between uses in different monitoring wells. All well casings and screens will be steam-cleaned or hot water pressure-washed before installation. All labels and binding tape will be removed from well materials prior to steam cleaning or washing. Decontamination of personnel involved in sampling activities will be accomplished as described in the *Site Specific Health and Safety Plan* (**Appendix B** of the Work Plan).

## 2.10 RESIDUALS MANAGEMENT

All residual soil, water, and decontamination solutions will be handled appropriately. Used disposable clothing and equipment will be placed in plastic bags and disposed of as non-hazardous solid waste. Appropriate personal protective clothing will be worn during the transfer of residuals to protect against potential skin contact and splash hazards.

All soil generated during drilling will be incorporated into the landfarm, and backfilled following confirmation that TPH concentrations are below the site cleanup levels. Water generated from development, sampling, and decontamination will be containerized for treatment in the on-site bag filter and carbon filter treatment system for reinfiltration. If off-site treatment is chosen instead, water will be placed in properly labeled, 55-gallon drums. The drums will be labeled with the date filled and a description of the contents (including approximate quantity). The drums will be sealed and

secured. All of the drums will be stored at an on-site holding area until they are transferred off-site for disposal.

The excavated soils will be temporarily stockpiled on site. The stockpile of the soil excavated from depths within the impacted zone of (8 to 15 feet bgs) will be landfarmed and remediated, as described in the Work Plan. The stockpile of the soil excavated from depths of less than 8 feet bgs will be used to backfill the excavation, following confirmation sampling.

A record of all generated residuals will be maintained to expedite characterization and disposal upon completion of field activities. Crowley will contract with a licensed waste disposal company for appropriate disposal.

# 3.0 QUALITY ASSURANCE PROGRAM PLAN

This section details the quality assurance and quality control (QA/QC) procedures that will be used for this project.

## 3.1 DATA QUALITY OBJECTIVES

The goal of the groundwater sampling is to evaluate the performance of the remedial action and the protection of human health and the environment. The focus of the remedial action is the reduction of TPH concentrations in groundwater. The groundwater monitoring points selected are based on the known TPH-impacted areas and groundwater zones, as well as the areas that will be most affected by the remedial action.

The list of analytical constituents, physical tests, the methods to be used, and the detection limits are listed in **Table 1**.

## 3.2 FIELD EQUIPMENT CALIBRATION AND MAINTENANCE

All measuring equipment and testing equipment used in the field will be calibrated according the manufacturer's instructions. Calibration of equipment that is owned by SLR will be documented on internal certification. Leased equipment will require calibration certificates or other documentation to demonstrate acceptable calibration status of the equipment for the entire period of use. Field calibration requirements will be in accordance with the technical procedures in the manufacturer's instructions.

## 3.3 FIELD QA/QC PROCEDURES

Field QA will be maintained through compliance with the sampling plan, collection of field QA samples, and documentation of sampling plan alterations. If problems arise during field sampling, the SLR Project Manager will be notified and an alteration to the sampling plan noted in the field log book.

In order to assess the precision of field sampling procedures, field duplicates will be collected. Only groundwater field duplicates will be collected. Soil field duplicates will not be collected due to heterogeneity of the soil matrix. During groundwater monitoring well sampling, field duplicates will be collected at a frequency of one per sampling event. Duplicates of groundwater treatment system effluent will not be collected. All field duplicates will be collected using the same methods as those used for normal sample collection.

Field rinsate blanks will be collected in order to assess the effectiveness of the decontamination procedures. Field rinsate blanks will be collected at a frequency of one per groundwater sampling event. Field rinsate blanks will be collected by pumping de-ionized water through the sampling equipment.

If VOC analyses are required at some point during the project, trip blanks may be used to assess the laboratory sample container pre-cleaning, storage, and transportation procedures. Trip blanks will be analyzed at a frequency of one per shipment of containers (i.e. coolers) with VOC groundwater sample containers.

Duplicates and blanks will be labeled similar to other samples and submitted blind to the laboratory. The duplicate sample locations will be determined in the field. The results of the field QA/QC samples will be used to evaluate the data quality for decision making purposes.

## 3.4 LABORATORY QA/QC

The data quality objectives (DQOs) for the laboratory data are listed in **Table 1** and **Table 2**. These DQOs will be used to assess the validity of the analytical data reported by the laboratory.

### 3.4.1 PRECISION

Laboratory precision will be measured by assessing the results of laboratory duplicates. Based on the results of duplicate analysis, the relative percent difference (RPD) is calculated as a measure of QA/QC. RPD is defined as the difference between the duplicate results divided by the mean of the results, expressed as a percentage. Analytical error increases near the method detection limit (MDL); therefore the RPD is not normally calculated unless the concentrations of both the original and duplicate samples are greater than 5 times the MDL. If the RPD for a sample and its duplicate do not meet RPD standards for the parameters analyzed, an explanation is required to qualify the difference in values.

### 3.4.2 ACCURACY

Accuracy of laboratory analysis will be assessed through laboratory control spikes, blank spikes, matrix spikes, and method blanks. The matrix spike results will provide additional information regarding the method performance on the actual samples. Professional judgment will be used to assess the data quality and any action that should be taken based on the matrix spike results.

### 3.4.3 COMPARABILITY

Data comparability will be achieved through the consistent use of standard field sampling procedures and trained personnel, as outlined in this document. Sampling procedures will be similar to historical field procedures. The laboratory will use standard analytical methods. Adherence to the QA/QC procedures described in this SAP will provide comparable data throughout the duration of this project.

### 3.4.4 COMPLETENESS

Completeness will be evaluated through the following criteria:

1. The number of useable data points compared to the number of projected data points
2. Compliance with the data quality objectives
3. Compliance with standard method procedures (i.e. required holding times)

The goal is to achieve 100% data completeness. Where data are not complete, professional judgment will be used to either qualify the data or reject the data. Actions and remedies such as re-sampling or re-analysis may be necessary, depending on the required data quality.

# 4.0 DATA MANAGEMENT AND REPORTING

## 4.1 FIELD DOCUMENTATION

Field personnel will record daily sampling activities in a project specific field book or field reporting forms. A field sampling data sheet will be completed for each water sample. Field parameters and purging records will be documented on the field sampling data sheet. A sampling log will completed to document the confirmation samples from excavations, stockpiles, and the bioremediation cell.

A field borehole log will be completed for each borehole. Interpretation of the soil formation according the USCS will be recorded on the borehole. Soil samples for laboratory analysis will be recorded on the boring log.

All samples to be submitted for chemical or physical laboratory analysis will be entered onto a chain-of-custody form. The chain-of-custody form will include:

- Project Name
- Project Number
- Project Manager's Name
- Sampler's Name and Signature
- Sample Identification
- Sample Date and Time
- Requested Analyses
- Requested Turnaround Time
- Notes (i.e. field filtered, potential high contaminant concentrations)
- Record of Custody Chain

## 4.2 LABORATORY DATA REPORTING, REDUCTION, AND VALIDATION

Analytical data reduction, review, and reporting will be performed under the analytical laboratory's standard operating procedures. Data will reported as per the turnaround times specified on the chain-of-custody. The laboratory reports will include the analytical results, method detection limit (MDL), method reporting limit (MRL), and a QA/QC summary.

The laboratory performing sample analyses will be required to submit summary data and QA information to permit independent and conclusive determination of data quality. The determination of data quality will be performed using the following as guidelines for data review: *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA, 1988a) and *Laboratory Data Validation Guidelines for Evaluating Organics Analyses* (EPA, 1988b).

Laboratory deliverable requirements for the chemical analyses will include the information outlined below:

- A cover letter for each sample batch will include a summary of any quality control, sample, shipment, or analytical problems, and will document all internal decisions. Problems will be outlined and final solutions documented. A copy of the signed chain-of-custody form for each batch of samples will be included in the narrative packet;
- Sample receipt, chain-of-custody, and shipping documentation forms. These forms will identify the field sampling personnel, shipping personnel, and laboratory receiving personnel;
- Analytical results for each sample containing the reduced results for all analytes/constituents requested on the chain-of-custody or request for analysis. Sample concentrations will be reported on standard data sheets in proper units and to the appropriate number of significant figures. For undetected values, the lower limit of detection for each compound will be reported separately for each sample. Dates of sample extraction or preparation and analysis must be included;
- Sample results available through a laboratory information management system (LIMS) or in an electronic version (i.e. Excel) of the hardcopy report. A QA/QC summary will be provided in the hardcopy report;
- A method blank summary will be included;
- Surrogate percent recovery will be calculated and reported;
- MS/MSD percent recoveries, spike level, and relative percent difference will be included; and
- A list of the detection limits calculated for laboratory instruments for all analytes will be included.

Sample holding times will be calculated by comparing the date of sample collection (shown on the chain-of-custody) with the date of sample analysis. All laboratory deliverables will be reviewed for data validation of chemical analyses.

## 4.3 DATA MANAGEMENT

Prior to entry into the SLR data management system and subsequent use, the data will be validated. The level of data validation will be determined by the Project Manager. Procedures outlined in the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 1994) may be used as a reference during data validation.

# 5.0 STANDARD FIELD FORMS

Standard field forms or a site field log book will be used to record sampling data and field observations. The following forms may be used:

- Boring Log Form (mandatory)
- Groundwater Sampling Data Sheet (mandatory)
- Chain-of-Custody Form (mandatory)
- Excavation Log (site field log book may be substituted)
- Photograph Log (site field log book may be substituted)

SLR may alter or use variations of these forms as necessary to conduct the work.

# 6.0 REFERENCES


United States Environmental Protection Agency, May 2002, *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers.*

United States Environmental Protection Agency, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review. EPA-540/R-54-013.*

American Society for Testing and Materials. 1991. *Annual Book of ASTM Standards*. Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics.

United States Environmental Protection Agency. 1983. *Methods/or Chemical Analysis of Water and Wastes*. EPA Environmental Monitoring and Support Laboratory Office of Research and Development, Cincinnati, Ohio.

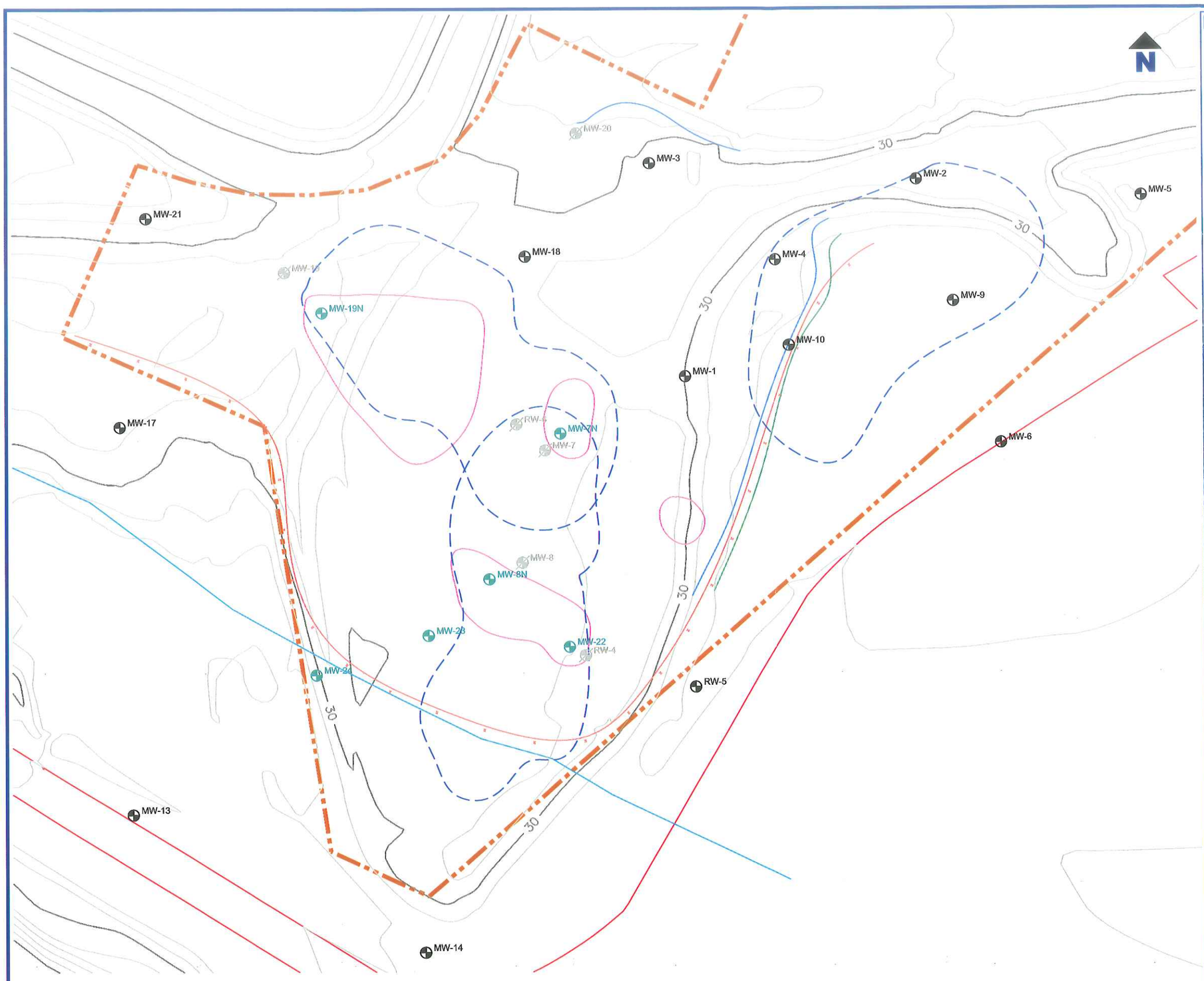
United States Environmental Protection Agency. 1988a. *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*. EPA Data Review Work Group.

United States Environmental Protection Agency. 1988b. *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*. EPA Data Review Work Group.

United States Environmental Protection Agency. 1992. *Nonconventional Pesticides in EPA-821-R-92-002. Municipal Methods for Determination of and Industrial Wastewater*. April.

United States Environmental Protection Agency. 1998. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. SW-846, Update 3.

# FIGURES




NOTES

LEGEND

- PROPERTY LINE
- ASPHALT ROAD
- TOPOGRAPHIC CONTOUR – 10 FT INTERVAL
- TOPOGRAPHIC CONTROUR – 2 FT INTERVAL
- FORMER INFILTRATION POND
- BH — GROUNDWATER MONITORING WELL
- BH — ABANDONED GROUNDWATER MONITORING WELL
- AREAS OF TPH GREATER THAN 5,070 MG/KG

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

SCALE: 1" = 50'

0 50 100 150'

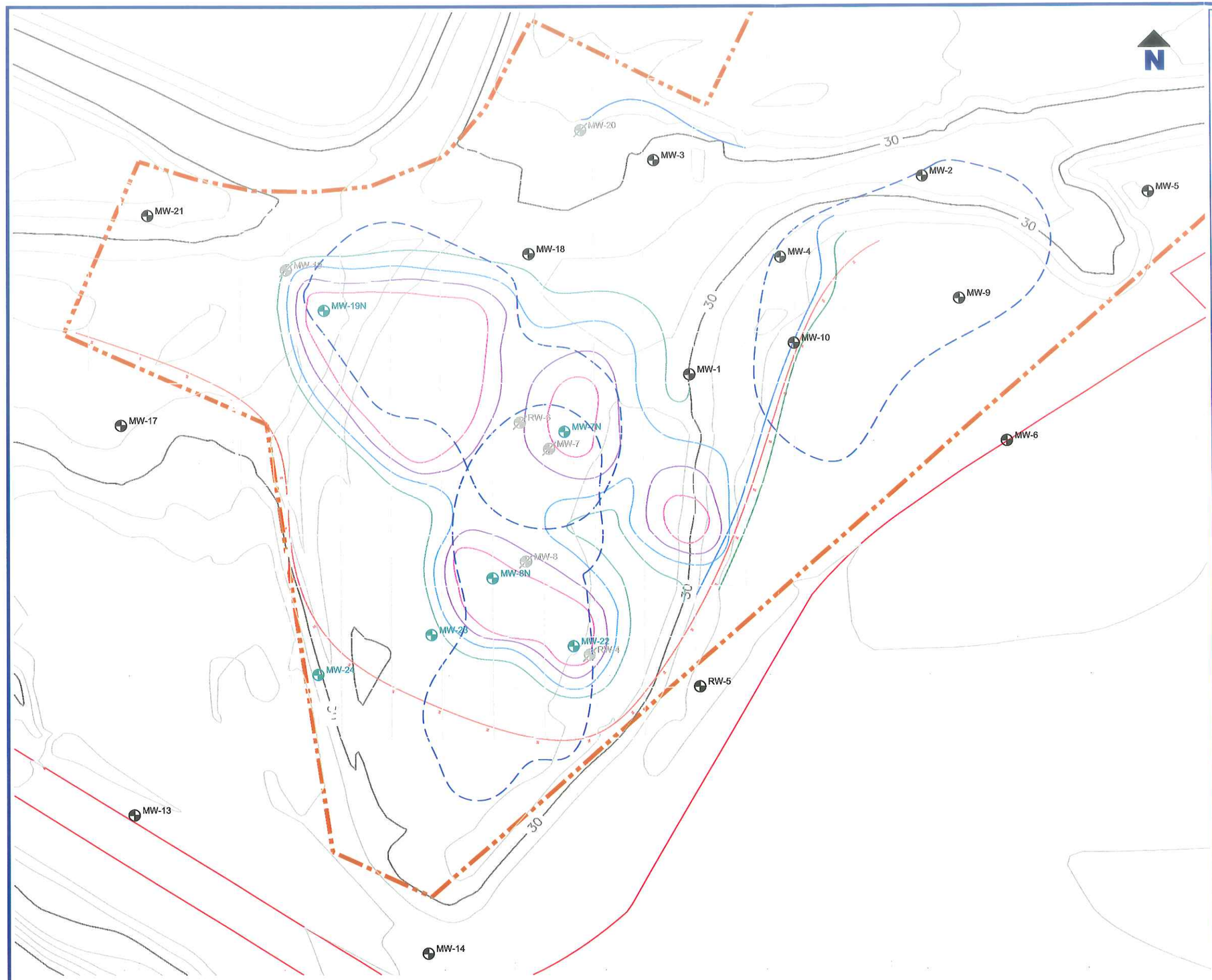
FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report
SAMPLING AND ANALYSIS PLAN

Drawing
EXTENT OF TPH GREATER THAN 5,070 MG/KG

| | | | |
|---|---|---|---|
| Date July 24, 2008 | Scale AS SHOWN | Fig. No. A-1 |
| File Name SAP Figures-3 | Project No. 008.0256.00007 | |

SLR




NOTES

LEGEND

- PROPERTY LINE
- ASPHALT ROAD
- TOPOGRAPHIC CONTOUR – 10 FT INTERVAL
- TOPOGRAPHIC CONTROUR – 2 FT INTERVAL
- FORMER INFILTRATION POND
- BH — GROUNDWATER MONITORING WELL
- BH — ABANDONED GROUNDWATER MONITORING WELL
- NEW 15–FOOT CONTOUR
- NEW 20 FOOT–CONTOUR
- NEW 25 FOOT–CONTOUR
- NEW 26–FOOT CONTOUR
- NEW 28–FOOT CONTOUR
- NEW 30–FOOOT CONTOUR
- NEW 31–FOOT CONTOUR
- SILT FENCE

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

SCALE: 1" = 50'

0 50 100 150'

FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report
SAMPLING AND ANALYSIS PLAN

Drawing
EXCAVATION SAMPLE GRID

| | | | |
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| Date July 24, 2008 | Scale AS SHOWN | Fig. No. A-2 |
| File Name SAP Figures-3 | Project No. 008.0256.00007 | |

SLR


NOTES

LEGEND

- PROPERTY LINE
- ASPHALT ROAD
- TOPOGRAPHIC CONTOUR – 10 FT INTERVAL
- TOPOGRAPHIC CONTROUR – 2 FT INTERVAL
- FORMER INFILTRATION POND
- BH GROUNDWATER MONITORING WELL
- BH ABANDONED GROUNDWATER MONITORING WELL
- NEW 26–FOOT CONTOUR
- NEW 28–FOOT CONTOUR
- NEW 30–FOOOT CONTOUR
- NEW 31–FOOT CONTOUR
- SILT FENCE

THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

SCALE: 1" = 50'

0 50 100 150'

FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report
SAMPLING AND ANALYSIS PLAN

Drawing
BIOREMEDIATION CELL SAMPLE GRID

| | | |
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| File Name SAP Figures-3 | Project No. 008.0256.00007 | |

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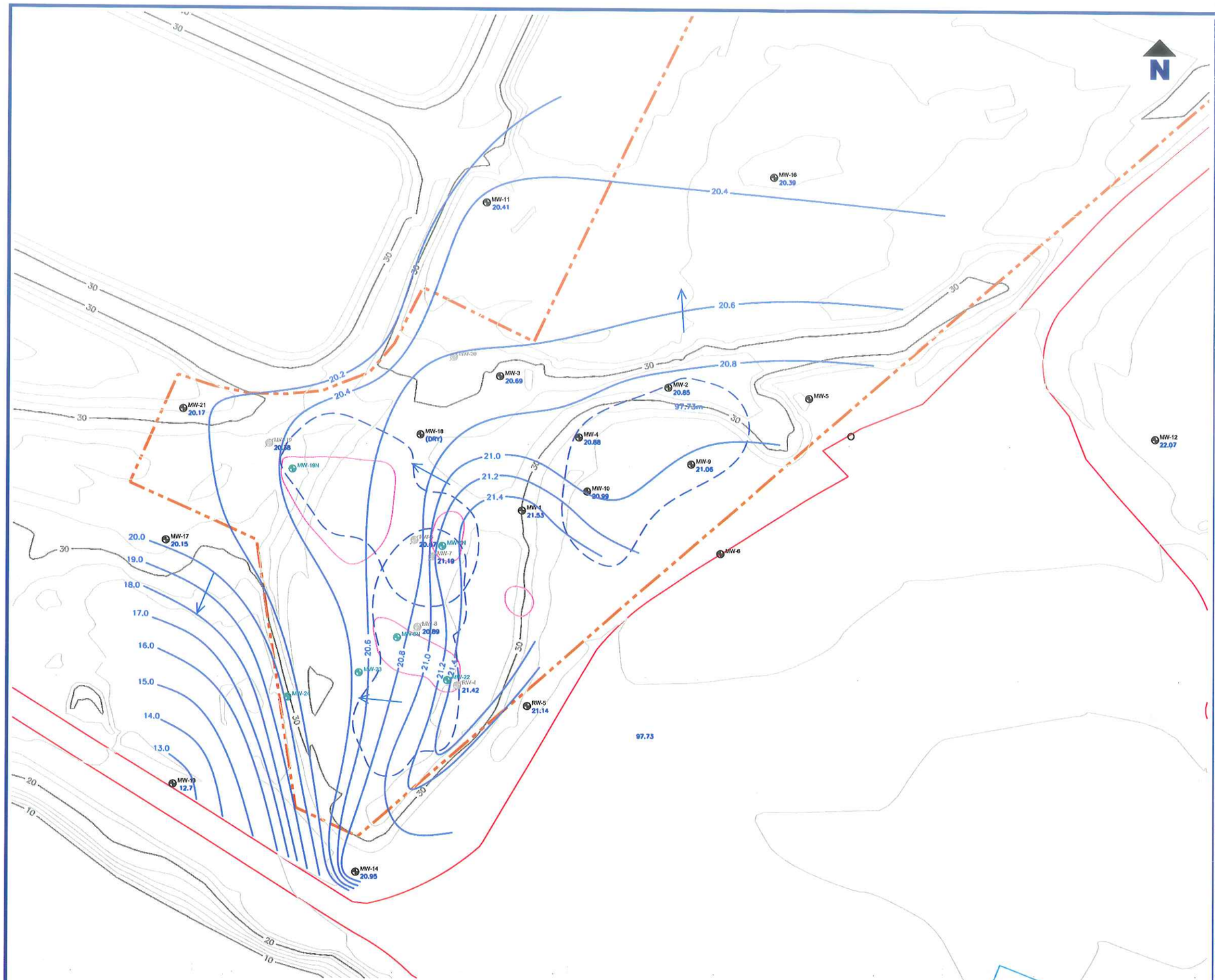



THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

SCALE: 1" = 80'

0 80' 160' 240'

NOTES

LEGEND

- PROPERTY LINE
- ASPHALT ROAD
- TOPOGRAPHIC CONTOUR – 10 FT INTERVAL
- TOPOGRAPHIC CONTROUR – 2 FT INTERVAL
- FORMER INFILTRATION POND
- BH — GROUNDWATER MONITORING WELL
- BH — PROPOSED GROUNDWATER MONITORING WELL
- BH — ABANDONED GROUNDWATER MONITORING WELL
- 22.07 — GROUNDWATER ELEVATION (APRIL 2, 2008)
- 21.0 — INFERRED GROUNDWATER ELEVATION CONTOURS
- INFERRED GROUNDWATER FLOW DIRECTION
- APPROXIMATE EXTENT OF SOIL CONTAINING >5,070 MG/KG OF TPH

FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report: SAMPLING AND ANALYSIS PLAN

Drawing: GROUNDWATER MONITORING WELLS AND FLOW PATHS

| | | | |
|---|---|---|---|
| Date: July 24, 2008 | Scale: AS SHOWN | Fig. No. | A-4 |
| File Name: SAP Figures-3 | Project No.: 008.0256.00007 | | |

SLR

# TABLES



**Remedial Design/Remedial Action Sampling and Analysis Plan**
**SELMET, Inc.**
**33992 SE Seven Mile Lane**
**Albany, Oregon 97321**

July 30, 2008

## Table 1.Sampling Requirements
## Remedial Action Work Plan - Sampling and Analysis Plan
## Former Columbia Marinelines Site, Vancouver, Washington

| Parameter | Matrix | Method | Sample Container | No. Containers | Filtered | Sample Size | Preservative | Hold Time |
|---|---|---|---|---|---|---|---|---|
| Sulfate and Nitrate | Water | EPA 9056 | 500 mL HDPE | 1 | No | 500 mL | None | 28 days |
| Alkalinity | Water | SM 2320B | 250 mL HDPE | 1 | No | 250 mL | None | 14 days |
| Dissolved Manganese | Water | EPA 6010B | 250 mL HDPE | 1 | Yes | 250 mL | $HNO_3$ | 180 days |
| Methane, Ethane, Ethene | Water | RSK175 | 40 mL Glass Vial | 1 | No | 40 mL | HCl | 14 days |
| Gasoline-Range Hydrocarbons | Water | NWTPH-Gx | 40 mL Glass Vial | 3 | No | 120 mL | HCl | 14 days |
| Diesel and Heavy Oil Range Hydrcarbons | Water | NWTHP-Dx | 1 L Amber Glass | 1 | No | 1 L | HCl | 14 days |
| Gasoline-Range Hydrocarbons | Soil | SW 5035/NWTPH-Gx | 4 oz Glass Jar | 1 | N/A | 40 g | None | 14 days |
| | | | 40 mL Pre-weighed Glass Vial | 1 | N/A | 10 g | Methanol | 14 days |
| Diesel and Heavy Oil Range Hydrcarbons | Soil | NWTHP-Dx | 8 oz Glass Jar | 1 | N/A | 250 g | N/A | 14 days |

Notes:

g = grams

L = Liters

mL = Milliliters

HDPE = High Density Polyethylene

HCl = Hydrochloric Acid

$HNO_3$ = Nitric Acid

LCS = Laboratory Control Spike

LDPE = Low Density Polyethylene

MDL = Method Detection Limit

MRL = Method Reporting Limit

N/A = Not Applicable

## Table 2. Data Quality Objectives
## Remedial Action Work Plan - Sampling and Analysis Plan
## Former Columbia Marinelines Site, Vancouver, Washington

| Parameter | Matrix | Method | Units | MRL | MDL | LCS/LCSD Control Limits | | | MS/MSD Control Limits | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper | RPD | Lower | Upper | RPD |
| Nitrate | Water | EPA 9056 | mg/l | 0.1 | 0.0151 | 90 | 110 | 20 | 80 | 120 | 20 |
| Sulfate | Water | EPA 9056 | mg/l | 5 | 0.1664 | 90 | 110 | 20 | 80 | 120 | 20 |
| Alkalinity | Water | SM 2320B | mg/l | 5 | 0.32 | 90 | 110 | N/A | N/A | N/A | N/A |
| Manganese | Water | EPA 6010B | mg/l | 0.01 | 0.009 | 85 | 115 | N/A | 75 | 125 | 20 |
| Ethene | Water | RSK175 | mg/l | 0.01 | 0.001053 | 75 | 117 | 25 | N/A | N/A | N/A |
| Ethane | Water | RSK175 | mg/l | 0.01 | 0.000917 | 64 | 117 | 25 | N/A | N/A | N/A |
| Methane | Water | RSK175 | mg/l | 0.01 | 0.000367 | 68 | 121 | 25 | N/A | N/A | N/A |
| Gasoline Range Hydrocarbons | Water | NWTPH-Gx | mg/l | 0.08 | 0.0327 | 70 | 130 | 35 | 70 | 130 | 30 |
| 4-Bromofluorobenzene | Water | NWTPH-Gx | mg/l | N/A | N/A | 50 | 150 | N/A | N/A | N/A | N/A |
| Diesel Range Hydrocarbons | Water | NWTPH-Dx | mg/l | 0.25 | 0.0179 | 50 | 150 | 35 | 50 | 150 | 35 |
| Heavy Oil Range Hydrocarbons | Water | NWTPH-Dx | mg/l | 0.5 | 0.0278 | 50 | 150 | 35 | 50 | 150 | 35 |
| 1-Chlorooctadecane | Water | NWTPH-Dx | mg/l | N/A | N/A | 50 | 150 | N/A | N/A | N/A | N/A |
| Gasoline Range Hydrocarbons | Soil | EPA 5035/ NWTPH-Gx | mg/kg | 4 | 0.54 | 70 | 130 | 40 | 65 | 130 | 35 |
| a,a,a-TFT | Soil | NWTPH-Gx | mg/kg | N/A | N/A | 50 | 150 | N/A | N/A | N/A | N/A |
| 4-Bromofluorobenzene | Soil | NWTPH-Gx | mg/kg | N/A | N/A | 50 | 150 | N/A | N/A | N/A | N/A |
| Diesel Range Hydrocarbons | Soil | NWTPH-Dx | mg/kg | 12.5 | 1.41 | 50 | 150 | 40 | 50 | 150 | 40 |
| Heavy Oil Range Hydrocarbons | Soil | NWTPH-Dx | mg/kg | 25 | 2.8 | 50 | 150 | 40 | 50 | 150 | 40 |
| 1-Chlorooctadecane | Soil | NWTPH-Dx | mg/kg | N/A | N/A | 50 | 150 | N/A | N/A | N/A | N/A |

Notes:

mg/l = Milligrams per liter

mg/kg = Milligrams per kilogram

EPA - United States Environmental Protection Agency

N/A = Not Applicable

MDL = Method Detection Limit

MRL = Method Reporting Limit

LCS = Laboratory Control Spike

LCSD = Laboratory Control Spike Duplicate

MS = Matrix Spike

MSD = Matrix Spike Duplicate

RPD = Relative Percent Difference

# APPENDIX B

## HEALTH AND SAFETY PLAN

**DRAFT Remedial Action Work Plan**
**Former Columbia Marine Lines Facility**
**3605 NW Lower River Road**
**Vancouver, Washington**

July 30, 2008

SLR International Corp

# Health and Safety Plan
# Environmental Assessment, Monitoring, and Excavation Work
# Crowley Marine Services, Vancouver, Washington

## 1.0 REVIEW AND APPROVAL

This Health and Safety Plan (HASP) has been written for the use of SLR International Corp and its employees. It may also be used as a guidance document by properly trained and experienced SLR subcontractors. However, SLR does not guarantee the health or safety of any person entering this site. Questions regarding the applicability of this HASP to personnel other than SLR employees should be referred to Steve Locke at (503) 723-4423.

Due to the potential hazardous nature of this site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards which may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury at this site. The health and safety guidelines in this HASP were prepared for the environmental assessment at the Crowley Marine Services property located in Vancouver, Washington and should not be used on any other site without prior research by trained health and safety specialists.

SLR claims no responsibility for the use of this HASP by others. The HASP was written for the specific site conditions, purposes, dates, and personnel specified and must be amended if these conditions or work scope change.

**Client:** _____

**Site Name:** _____

**Project Name:** _____

**Project Number:** _____

**Start Date:** _____

**Project Manager:** _____

**Signature:** _____

**Date:** _____

**Site Health and Safety Officer:** _____

**Signature:** _____

**Date:** _____

## 2.0 HEALTH AND SAFETY PERSONNEL

### 2.1 Project Manager

The Project Manager (PM) for the environmental assessment at the Crowley Marine Services property is Steve Hammer. The PM has the following responsibilities:

- Ensure the HASP is complete prior to beginning field work.
- Ensure that all equipment and supplies to perform the items in the HASP are available.
- Manage all contract requirements, including ensuring the availability of the health and safety resources.
- Coordinate all project activities with the client, subcontractors, and SLR staff.

### 2.2 Site Health and Safety Officer

The Site Health and Safety Officer (SHSO) for environmental assessment at the Crowley Marine Services property is Brendan Robinson. The SHSO has the following responsibilities:

- Ensure the HASP is completed and enforced on the first day of on-site work.
- Day to day on-site implementation of the HASP. The SHSO has the authority to stop work or prohibit any personnel from working on the site at any time for not complying with any aspect of the Plan.
- Day to day communication with the PM and any other pertinent staff to ensure efficient coordination of health and safety activities with other planned field activities.

The SHSO should have the following training:

- 40-hour Health and Safety Training
- First Aid and CPR Training
- Supervisor Training
- Medical Surveillance

### 2.3 Site Personnel

Each person on the site has responsibility for their own health and safety, as well as assisting others in carrying out the items in the HASP. Any person observed to be in violation of the HASP should be assisted in complying with the requirements, or reported to the SHSO. Any site personnel may shut down field activities if there is a real or perceived immediate danger to life or health.

## 3.0 GENERAL SITE REQUIREMENTS AND BACKGROUND INFORMATION

### 3.1 Location, Operations, and Approximate Size of Site

| | |
|---|---|
| Site Name and Address: | Crowley Marine Services<br>6305 NW Old Lower River Road<br>Vancouver, WA 98660 |
| Current Site Owners: | Alcoa Inc. |
| Current Site Operators: | None |
| Legal Description: | 45 38' 24"<br>122 39' 35" |
| Approximate Size of Site: | Approximately 18 acres |

### 3.2 Description of Planned Field Work

SLR will be completing the proposed field work in accordance with the Remedial Action Work Plan. The field activities to be performed by SLR will include the following:

- Observe soil excavation and groundwater extraction/treatment;
- Groundwater Monitoring and Sampling; and
- Confirmation soil sampling
- Monitoring well decommissioning and replacement

### 3.3 Schedule of Planned Field Work

All field work will be performed during daylight hours. Excavation and treatment activities are scheduled to begin in September 2008, and will likely be completed within one month. Monitoring well decommissioning and replacement are also scheduled for September 2008. Ex-situ bioremediation and monthly confirmation soil sampling is expected to continue until September 2010.

### 3.4 Excavation and Trenching

SLR personnel will not enter excavations greater than 4 feet in depth. Site personnel will not enter excavations greater than 4 feet in depth without appropriate protective systems such as benching, sloping, or shoring. Side slopes will not be steeper than 1½:1 without a written report from a qualified civil or geotechnical engineer. Entry is only permitted when no other means to accomplish project objectives are available. For example, samples may be recovered from excavations using excavation equipment, rather than by personnel.

A competent person will inspect excavations daily. If there is evidence that a cave-in or slide is possible, work will cease until the necessary safeguards have been taken. Excavated materials will be loaded directly into trucks or containers. At the end of each day's activities, open excavations will be clearly marked and secured to prevent nearby workers or unauthorized personnel from entering them. Remote sampling techniques will be preferred methods of sample collection in excavations.

### 3.5 Landfills and Other Areas of Potential Explosive Gas or Vapor

The site is not located in an area containing a current or former landfill, and the geology of the area is not known or suspected to contain pockets of explosive gases or vapors.

### 3.6 Hazardous Materials

No hazardous materials will be used at the site during field activities.

### 3.7 Waste Generation

SLR anticipates both solid and liquid waste generation as a part of the field work at the site. The waste will be characterized and properly disposed of off-site in accordance with State and Federal regulations.

## 4.0 SITE HEALTH AND SAFETY HAZARDS

Site health and safety hazards include known or potential chemical contaminants and physical hazards that may occur during field activities. Overall, the health and safety hazards of the anticipated activities at the site have a rating of low. The greatest potential hazards are expected to be from heavy equipment and field conditions (slips, trips, and falls).

### 4.1 Chemical Hazards

Based on historical activities, the following have been designated as the primary chemical contaminants of human health concern.

- Total Petroleum Hydrocarbons – Diesel Range (TPH-Dx) and Gasoline Range (TPH-G)
- Benzene, toluene, ethylbenzene and xylenes (BTEX)
- Polynuclear Aromatic Hydrocarbons (PAHs) such as naphthalene

The following tables summarize the potential hazards from the above listed primary chemical contaminants of human health concern.

| **Contaminant of Concern:** | TPH-G (Total Petroleum Hydrocarbons – Gasoline Range) |
|---|---|
| **PEL:** | 0.2 ppm 8-hour TWA |
| **TLV:** | 0.2 ppm 8-hour TWA |
| **IDLH:** | N.D. (not determined) |
| **Warning Properties:** | Characteristic gasoline odor |
| **Routes of Exposure:** | Inhalation, dermal contact, ingestion |
| **Acute Health Effects:** | Eye, skin, and mucus membrane irritation; blurred vision, dizziness, confusion and slurred speech. |
| **Chronic Health Effects:** | Kidney and liver damage, central nervous system damage, and benzene can cause blood changes including leukemia and anemia. |

| **Contaminant of Concern:** | TPH-Dx (Total Petroleum Hydrocarbons – Diesel Range) |
|---|---|
| **PEL:** | 25 ppm 8-hour TWA |
| **TLV:** | 100 mg/m3 8-hour TWA |
| **IDLH:** | Not Applicable |
| **Warning Properties:** | Diesel odor |
| **Routes of Exposure:** | Inhalation, dermal contact, ingestion |
| **Acute Health Effects:** | Coughing, dizziness, nausea, skin and eye irritation, diarrhea, vomiting, abdominal discomfort |
| **Chronic Health Effects:** | Dermatitis, benzene can cause blood changes including leukemia and anemia |

| | |
|---|---|
| **Contaminant of Concern:** | Toluene (assumed for all BTEX) |
| **PEL:** | 100 ppm 8-hour TWA |
| **TLV:** | 500 ppm (10-minute maximum peak) |
| **IDLH:** | 500 ppm (10% LEL) |
| **Warning Properties:** | Sweet, pungent benzene-like odor |
| **Routes of Exposure:** | Inhalation, dermal contact, ingestion |
| **Acute Health Effects:** | Eye and nose irritation; weakness, dilated pupils, discharge of tears, dizziness, and confusion. |
| **Chronic Health Effects:** | Damage to eyes, skin, repository system, and kidneys; central nervous system damage. |

PAHs are a group of chemicals that are formed during the incomplete combustion of coal, oil, and gas. Most PAHs do not dissolve easily. Typically, PAHs tend to attach to particulates in water or absorb to soil. Naphthalene is the most common PAH and benzo(a)pyrene is the most studies PAH and is ranked as an A2 suspected human carcinogen. The following table summarizes the potential hazards of PAHs:

| | |
|---|---|
| **Contaminant of Concern:** | Naphthalene and benzo(a)pyrene (assumed for all PAHs) |
| **PEL:** | 50 mg/m3 8-hour TWA (naphthalene) |
| **TLV:** | 50 mg/m3 8-hour TWA (naphthalene) |
| **IDLH:** | 500 ppm (naphthalene) |
| **Warning Properties:** | None |
| **Routes of Exposure:** | Inhalation, incidental ingestion, and dermal contact (PAHs have low volatilization potentials, therefore inhalation usually occurs through intake of PAHs absorbed to particulates) |
| **Acute Health Effects:** | Skin, respiratory and eye irritant, change color and properties of skin |
| **Chronic Health Effects:** | Bladder, skin and lung cancer, and reproductive damage |

## 4.2 Physical Hazards

The following table summarizes the potential physical hazards that could occur during field work at the site:

| Physical Hazard | Yes | No |
|---|---|---|
| Overhead/underground hazards | | |
| • Overhead | X | |
| • Underground | X | |
| Equipment hazards | | |
| • Drilling | X | |
| • Excavation | X | |

| Physical Hazard | Yes | No |
|---|---|---|
| • Machinery | X | |
| Heat exposure | X | |
| Cold exposure | | X |
| Oxygen deficiency | | X |
| Confined space * | | X |
| Noise | X | |
| Ionizing radiation | | X |
| Non-ionizing radiation | | X |
| Fire/Explosion | | X |
| Biological | X | |
| Safety | | |
| • Holes/ditches | X | |
| • Steep grades | | X |
| • Slippery surfaces | X | |
| • Uneven terrain | X | |
| • Unstable surfaces | X | |
| • Elevated work surfaces | | X |
| Shoring/Scaffolding | | X |

* SLR personnel are forbidden from entering any confined space, including excavation pits.

### 4.3 Task Specific Hazards

The following table summarizes the potential hazards from each specific tasks:

| Task | Hazard Rating | Identified/Anticipated Hazards |
|---|---|---|
| Excavation Oversight and Sampling | Low | Heavy equipment, noise, heat stress, open excavation pit, bugs, snakes, bees etc., chemical hazards |
| Monitoring Well Decommissioning and Replacment | Low | Heavy equipment, noise, heat stress, bugs, snakes, bees etc., chemical hazards |
| Groundwater Monitoring | Low | Chemical hazards, heat stress, safety, possible truck traffic, bugs, snakes, bees etc. |
| Confirmation Soil Sampling | Low | Chemical hazards, heat stress, safety, possible truck traffic, bugs, snakes, bees etc. |

SLR International Corp

### 4.4 Utilities

Before drilling and excavating at the site, it is necessary to contact the area utility locator to determine the location of all utilities lines at the site. The completed Utility Clearance Log (6176032) has been included as Attachment 1. The following precautions will be followed to prevent injuries due to utilities:

- All located utility lines at the site will be noted and emphasized on the boring logs, location plans, and boring assignment plans.
- All electrical wires at the site will be considered live and dangerous. If any questions concerning the safety of excavating or drilling in the vicinity of a power line, the power company will be contacted.
- At least twenty feet of clearance will be maintained from overhead power lines, or ten feet if the lines are padded.

# 5.0 SITE HEALTH AND SAFETY PROCEDURES

## 5.1 Daily Site Safety Meetings

Site safety meetings will be held daily before initiating any field activity. The safety meetings will be mediated by the SHSO. Site safety meetings will also be held at any other time, as necessary, to ensure the safety and health of the employee on-site. A Daily Safety Meeting Log has been included as Attachment 2.

Prior to beginning any work at the site, each worker will be given an informal training on how the project will progress. The SHSO will inform the workers of the following information:

- Proposed work activities for the day and the potential hazards
- Provisions of this Plan
- Dry runs of the emergency procedures, including location of the medical facility
- Dry runs of the decontamination procedures, if applicable
- Chemical exposures expected at the site
- Site lay-out and zone delineation
- Warning signals and evacuation procedures

## 5.2 Site Security

The SHSO is responsible for preventing unauthorized entry into the work area and for knowing who is on-site at all times. Access to the work site will be controlled in the following manner:

- Cones, barricades, and/or caution tape will be used to delineate work area.
- Excavation will be completed in one day and no deep excavations will be remaining at the site.

## 5.3 Work Limitations and Restrictions

The following work limitation and restrictions will be employed by the SHSO:

- No eating, drinking, or smoking on-site.
- No contact lenses on-site. Workers requiring vision correction must wear glasses in environments with chemicals.
- No facial hair that would interfere with respirator fit.
- The SHSO will monitor weather broadcasts before the start of outdoor work each day, and more frequently as necessary. No work will be done outdoors in inclement weather (snow, sleet, etc.) without authorization from the SHSO.

## 5.4 Decontamination Procedures

The following decontamination procedures will be followed:

- Personnel: Personnel will wash with soap and water before leaving the site.
- Field Equipment: Field equipment will be decontaminated prior to and after use by following these procedures:
    1. Wash equipment with detergent.
    2. Rinse with tap water.
    3. Rinse with isopropanol.
    4. Triple rinse with de-ionized water.
    5. Air dry.
    6. Wrap in clean polyethylene plastic, when necessary.
- Heavy Equipment: Heavy equipment will be steam cleaned, if necessary.

## 5.5 General Health and Safety Procedures

The following general health and safety procedures will be followed at the site:

- The Utility Clearance Log will be completed prior to beginning any subsurface work.
- Determine wind direction and try to remain upwind when collecting samples.
- Daily safety meetings will be held by the SHSO.
- Potable water must always be available at the work site.
- If toilet facilities are not located within a 5-minute walk from the decontamination facilities, either provide a chemical toilet and hand washing facilities or have a vehicle available (not the emergency vehicle) for transport to nearby facilities.
- Provide dust control by spraying soils with water or a surfactant/water solution.
- Use ground fault circuit interrupters for plug-in electrical devices and extension cords (3-pin plugs only).
- Be aware of tripping hazards with extension cords, tools, hoses, augers, etc.
- If an on-site command post is necessary, ensure that it is located upwind from sources, give prevailing winds, and locate/identify on Site Map.
- On-site personnel must be able to call off site via a telephone within 150 feet of work.
- Post emergency telephone numbers.
- Designate at least one vehicle for emergency use.

## 5.6 Perimeter Identification

The perimeters of the different field activities are included on the figure in Attachment 3. There are four classifications of "zones" or "boundaries" that could be required at a job site:

1. **Exclusion Zone**: Required when workers within that zone must wear personal protective equipment (PPE).
2. **Contamination Reduction Zone**: Required when decontamination of people and equipment leaving the Exclusion Zone is required.
3. **Support Zone**: The location where administrative and other support activities are conducted.
4. **Work Area Boundary**: Excludes non-workers from entering a potentially hazardous environment.

All tasks that are being proposed at the site are classified as Work Area Boundaries.

## 5.7 Personnel Protective Equipment

Personnel protective equipment (PPE) is designed to protect the body against contact with known or anticipated toxic chemicals. PPE has been designated into four different levels:

1. **Level A:** Self-contained breathing apparatus (SCBA), totally encapsulating suit, two-way radio communications.
2. **Level B:** SCBA or supplied-air respirator with an escape bottle, chemically resistant PPE, two-way radio communications.
3. **Level C:** Full- or half-face air respirator (with safety goggles), chemically resistant PPE.
4. **Level D:** No respiratory protection. Safety glasses, hard hat, steel-toe boots, long-sleeved shirt and pants. Hearing protection, gloves, and other PPE as required.

The Crowley Vancouver site is classified as a Level D PPE site. There is little to no risk of workers being in contact with contaminants. Level D PPE includes:

- Hard Hat (ANSI Z89.1 approved)
- Steel Toed and Shank Boots (ANSI Z41.1 approved)
- Safety Glasses (ANSI Z87.1 approved)
- Gloves
- Close Fitting Clothing
- Hearing Protection (optional)

Environmental and personnel monitoring will be conducted to evaluate the level of contamination to which site personnel or the surrounding environment are being exposed. The results of the monitoring will form the basis by which the SHSO will determine the level of PPE required for a particular operation. A photo ionization detector (PID) will be used to monitor the presence of organic vapors or gases. The PID will be used during borings and test pit excavations according to the following guide:

- 0 to 20 units above background – Continue work
- 20 to 50 units above background – Investigate cause and continue work if PPE adequate
- Over 50 units above background – Stop work and investigate; use ventilation to reduce levels

## 5.8 Safety Equipment

The following safety equipment and supplies will be available at the site at all times during field work:

- Reflective vests to be available to wear around moving vehicles, if any
- First Aid Kit
- Emergency eyewash
- 2-Hudson-type sprayers for decontamination (TSP/detergent solution and $H_2O$ rinse)
- Hearing protection in the form of disposable ear plugs to be worn around heavy equipment, machinery, or when two individuals five feet or less apart need to shout to be heard
- Soap gel or disposable wipes
- Disposable towels
- Plastic sheeting
- Cleaning brushes and tubs

## 6.0 CONTIGENCY PLAN

In the unlikely event of a fire or explosion, or uncontrolled release of a contaminant, prompt action to limit the extent of the impact will be required. The SHSO shall evaluate all emergency situations and inform personnel by use of a signal horn, visual, or verbal contact, as appropriate. All personnel must know ahead of time what their duties would be in the event of an emergency.

### 6.1 Injury or Illness

If an injury of illness occurs at the job site, take the following action:

- Get first aid for the person immediately. Call 911 if needed.
- Notify the SHSO. The SHSO is responsible for preparing and submitting the Incident Report within 24 hours.
- The SHSO will assume charge during an emergency situation.

The location of the nearest hospital, with driving instruction, has been included as Attachment 4 to this plan. The hospital is located at:

Memorial Health Center
3400 Main Street
Vancouver, WA 98663
Phone: (360) 256-2000

### 6.2 Emergency Telephone Numbers

**Project Personnel**

| Name | Title | Cell Phone | Work Phone |
|---|---|---|---|
| Steve Hammer | SLR Project Manager | (503) 752-3776 | (503) 723-4423 |
| Brendan Robinson | SLR SHSO | (503) 310-8463 | (503) 723-4423 |

**Governmental Agency Contacts**

| Agency | Phone Number |
|---|---|
| Office of Emergency Services | (800) 852-7550 |
| National Response Center | (800) 424-8802 |
| One Call (Utility Locate) | (800) 332-2344 |
| Locates Down Under (Private Locater) | (503) 654-2637 |

# Attachment 1

Site Map


THIS DRAWING IS FOR CONCEPTUAL PURPOSES ONLY. ACTUAL LOCATIONS MAY VARY AND NOT ALL STRUCTURES ARE SHOWN.

0 100 200

SCALE IN FEET

NOTES

EXTENT OF EAST POND FROM 1971 AND 1980 AERIAL PHOTOGRAPHS

EXTENT OF WEST POND FROM HISTORICAL SITE TOPOGRAPHIC MAP AND 1968 AERIAL PHOTOGRAPH

EXTENT OF SOUTH POND FROM 1963 AND 1964 AERIAL PHOTOGRAPHS

LEGEND

- GROUNDWATER MONITORING WELL
- EXTRACTION WELL
- APPROXIMATE PROPERTY LINES
- HISTORICAL EXTENTS OF PONDS

FORMER COLUMBIA MARINE LINES FACILTIY
6305 LOWER RIVER ROAD
VANCOUVER, WASHINGTON

Report: REMEDIAL ACTION WORK PLAN

Drawing: SITE PLAN

| | | |
|---|---|---|
| Date July 23, 2008 | Scale AS SHOWN | Fig. No. 2 |
| File Name Figure 2 - Site Plan-2 | Project No. 008.0205.00007 | |

SLR

# Attachment 2

Utility Clearance Log

# ATTACHMENT 2

## PRE-DRILLING/EXCAVATION CHECKLIST AND UTILITY CLEARANCE LOG

| | | | |
|---|---|---|---|
| PROJECT: | | DATE: | |
| LOCATION: | | UTILITY LOCATOR PHONE: | |
| UTILITY LOCATOR: | | LOCATOR CALL REFERENCE: | |
| DATE OF LOCATOR REQUEST: | | SLR FIELD TECHNICIAN: | |

Instructions: This checklist is to be completed by SLR personnel prior to initiation of filed activites as a safety measure to insure that underground structures and aboveground power lines are clearly marked in the area selected for boring or excavation. **Drilling or excavation work may not proceed until One Call has been contacted and this checklist has been completed. If any of the questions answered below are answered "no," then the project manager must be contacted and concerns/issues discussed.** "No" answers should be documented on the back of the form.

| Type of Utilities and Structures | Not Present | Present | Marking (Flags, Paint, Stakes) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

| YES | NO | PRE-MOBILIZATION |
|---|---|---|
| | | Is a scaled site plan, map, or drawing showing the proposed borehole locations attached? |
| | | Does each location allow for clear entry and exit, adequate workspace, and a clear path for raising and lowering all equipment? 20 feet minimum clearance must be maintained between raised equipment and electrical lines. |
| | | Are all of the locations and associated areas of pavement cutting at least 3 feet from any subsurface or aboveground utilities shown on client's building plans? |
| | | Are all of the locations and associated areas of pavement cutting at least 3 feet from any subsurface or aboveground utilities shown on public right-of-way street improvement or other public property plan or site map? |
| | | Has the Site Representative indicated no knowledge of any subsurface or aboveground utilities within 3 feet of the proposed locations? Is the Site Representative qualified to make such a determination? |
| | | Are all of the proposed locations and associated areas of pavement cutting at least 3 feet from any subsurface utilities identified during a geophysical survey? |
| | | Have all Utility Locating Service providers notified by the public line locator marked out their facilities in the vicinity of the locations or otherwise notified SLR that they do not have any facilities near the proposed locations? |
| | | Are all proposed locations and associated areas of pavement cutting at least 3 feet from a visual line connecting two similar looking manhole covers? |
| | | Are all proposed locations and associated areas of pavement cutting at least 3 feet from a visual line perpendicular to the street from the water, gas, and electrical meters? |
| | | Are all proposed locations and associated areas of pavement cutting clear of pavement joints, curbs, crash posts, or other engineered structures? |
| | | Does the pavement lack signs of previous excavation (e.g. no pavement subsidence, difference in pavement texture or relief, or pavement patching)? If there are signs, determine the purpose of the previous excavation. |
| | | Before drilling, has an exploratory hole been dug to 5 feet below grade with a hole diameter greater than the outer diameter of the drilling auger? |
| | | Does the soil encountered in the hand-dug hole appear to be native material (i.e. free of gravel, clean sand, aggregate base, or other non-native looking material)? |
| | | Have all expected utilities been identified and all missing utilities explained? |

| | | |
|---|---|---|
| Have any concerns noted above been discussed with the SLR Project Manager? | **Yes** | **No** |
| Have any concerns noted above been discussed with the client? | **Yes** | **No** |

| | | | |
|---|---|---|---|
| Approval to proceed: | Client Rep Name: | Title and Date: | |
| Approval to proceed: | SLR Rep Name: | Title and Date: | |

# Attachment 3

Daily Safety Meeting Log

# ATTACHMENT 3

## DAILY SAFETY MEETING LOG

| PROJECT: | | DATE: | |
|---|---|---|---|
| LOCATION: | | START TIME: | |

| ISSUES DISCUSSED: | |
|---|---|
| 1. | |
| 2. | |
| 3. | |
| 4. | |
| 5. | |
| 6. | |
| 7. | |
| 8. | |
| 9. | |
| 10. | |

| ATTENDEES: | | | |
|---|---|---|---|
| | PRINTED NAME | COMPANY | SIGNATURE |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| 12. | | | |
| 13. | | | |
| 14. | | | |
| 15. | | | |
| 16. | | | |
| 17. | | | |

| MEETING CONDUCTION BY: | SIGNATURE: |
|---|---|
| | |
| SITE HEALTH AND SAFETY OFFICER: | SIGNATURE: |
| | |

# Attachment 4

Location of Hospital and Driving Instructions

MAPQUEST

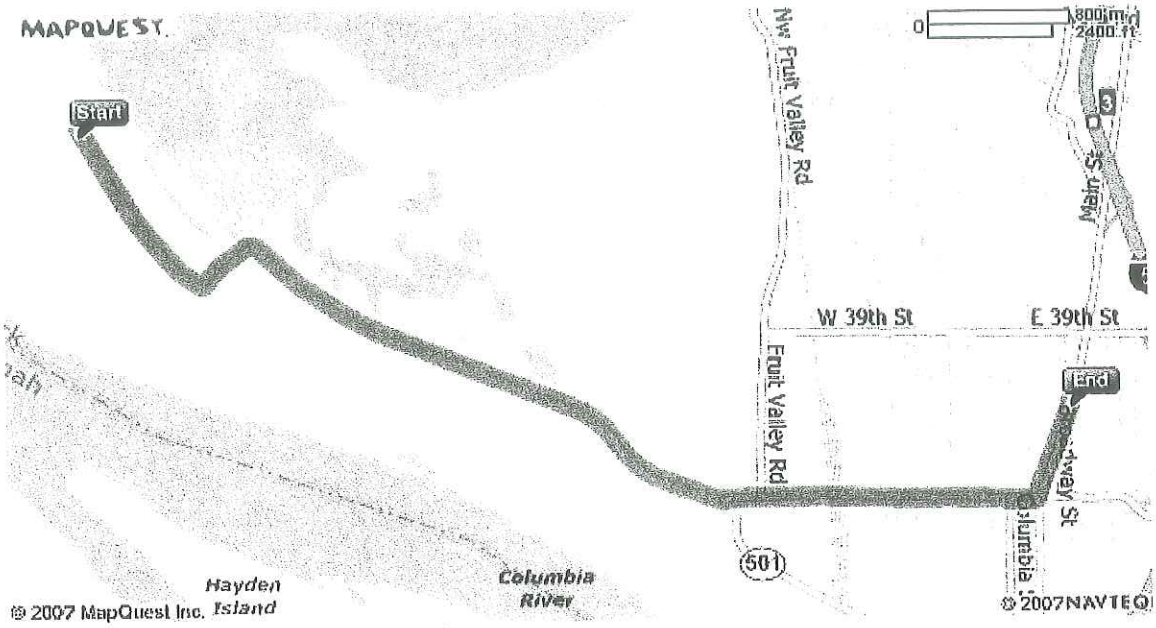
**Start:** **6305 Nw Old Lower River Rd**
Vancouver, WA 98660-1068, US

**End:** **Memorial Health Ctr:**
360-256-2000
3400 Main St, Vancouver, WA 98663, US

**Notes:**
Only text visible within note field will print.

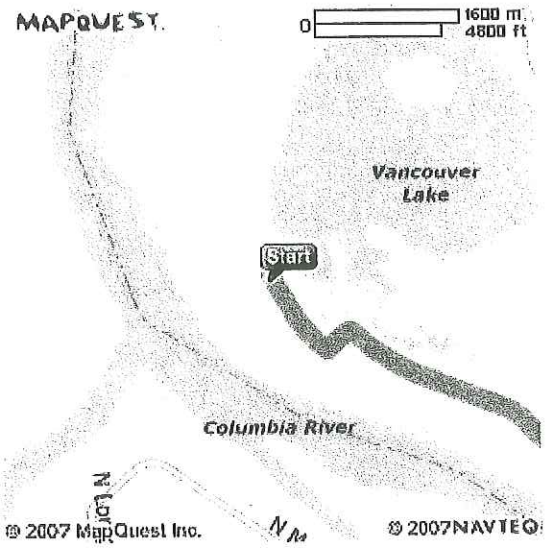


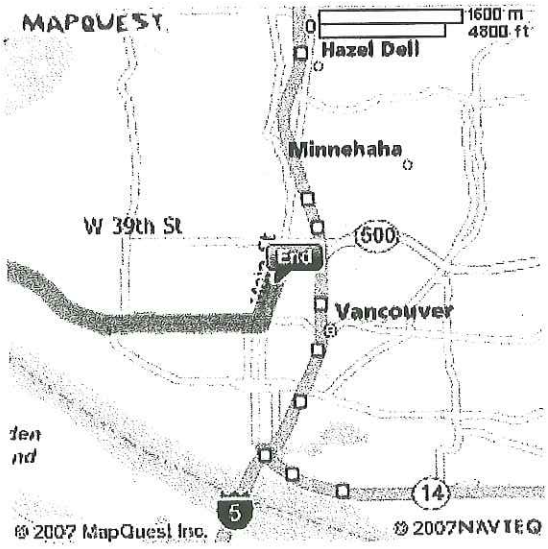
| Directions | Distance |
|---|---|
| **Total Est. Time:** 10 minutes **Total Est. Distance:** 4.69 miles | |
| START **1:** Start out going SOUTHEAST on NW OLD LOWER RIVER RD. | 1.0 miles |
| **2:** Turn SLIGHT RIGHT onto NW LOWER RIVER RD / WA-501. | 2.0 miles |
| **3:** Turn LEFT onto W FOURTH PLAIN BLVD. | 1.1 miles |
| **4:** Turn LEFT onto MAIN ST. | 0.4 miles |
| END **5:** End at **Memorial Health Ctr:** 3400 Main St, Vancouver, WA 98663, US | |
| **Total Est. Time:** 10 minutes **Total Est. Distance:** 4.69 miles | |




**Start:**
**6305 Nw Old Lower River Rd**
Vancouver, WA 98660-1068, US

**End:**
**Memorial Health Ctr:** 360-256-2000
3400 Main St, Vancouver, WA 98663, US



# APPENDIX C

## LABORATORY ANALYTICAL REPORT FOR APRIL 4, 2008 SAMPLING EVENT

**DRAFT Remedial Action Work Plan**
**Former Columbia Marine Lines Facility**
**3605 NW Lower River Road**
**Vancouver, Washington**

July 30, 2008

ENVIRONMENTAL
SCIENCE CORP.

12065 Lebanon Rd.
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Fax (615) 758-5859

Tax I.D. 62-0814289

Est. 1970

Emily Goodwin
SLR International Corp. - West Linn, OR
1800 Blankenship Road, Suite 440

West Linn, OR 97068

# Report Summary

Thursday April 10, 2008

Report Number: L339466
Samples Received: 04/04/08
Client Project: 008.0205.00007

Description: Crowley Marine Services

The analytical results in this report are based upon information supplied by you, the client, and are for your exclusive use. If you have any questions regarding this data package, please do not hesitate to call.

Entire Report Reviewed By:

Jarred Willis, ESC Representative

*Laboratory Certification Numbers*

A2LA - 1461-01, AIHA - 09227, AL - 40660, CA - I-2327, CT - PH-0197, FL - E87487
GA - 923, IN - C-TN-01, KY - 90010, KYUST - 0016, NC - ENV375,DW21704, ND - R-140
NJ - TN002, SC - 84004, TN - 2006, VA - 00109, WV - 233
AZ - 0612, MN - 047-999-395, NY - 11742, WI - 998093910

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REPORT OF ANALYSIS

April 10, 2008

Emily Goodwin
SLR International Corp. - West Linn
1800 Blankenship Road, Suite 440
West Linn, OR 97068

ESC Sample # : L339466-01

Date Received : April 04, 2008
Description : Crowley Marine Services

Site ID :

Sample ID : MW-2 NON-DECANTED

Project # : 008.0205.00007

Collected By : EG/JZ
Collection Date : 04/02/08 12:57

| Parameter | Result | Det. Limit | Units | Method | Date | Dil. |
|---|---|---|---|---|---|---|
| Diesel Range Organics (DRO) | 7.9 | 0.15 | mg/l | NWTPHDX | 04/09/08 | 1.5 |
| Residual Range Organics (RRO) | 1.6 | 0.38 | mg/l | NWTPHDX | 04/09/08 | 1.5 |
| Surrogate Recovery | | | | | | |
| o-Terphenyl | 93.3 | | % Rec. | NWTPHDX | 04/09/08 | 1.5 |

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.


Reported: 04/10/08 17:27 Printed: 04/10/08 17:27

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REPORT OF ANALYSIS

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ESC Sample # : L339466-02

Date Received : April 04, 2008
Description : Crowley Marine Services

Site ID :

Sample ID : MW-4 NON-DECANTED

Project # : 008.0205.00007

Collected By : EG/JZ
Collection Date : 04/02/08 12:33

| Parameter | Result | Det. Limit | Units | Method | Date | Dil. |
|---|---|---|---|---|---|---|
| Diesel Range Organics (DRO) | 4.1 | 0.17 | mg/l | NWTPHDX | 04/09/08 | 1.7 |
| Residual Range Organics (RRO) | 1.1 | 0.42 | mg/l | NWTPHDX | 04/09/08 | 1.7 |
| Surrogate Recovery | | | | | | |
| o-Terphenyl | 67.6 | | % Rec. | NWTPHDX | 04/09/08 | 1.7 |

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.


Reported: 04/10/08 17:27 Printed: 04/10/08 17:27

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REPORT OF ANALYSIS

April 10, 2008

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West Linn, OR 97068

ESC Sample # : L339466-03

Date Received : April 04, 2008
Description : Crowley Marine Services

Site ID :

Sample ID : MW-16 NON-DECANTED

Project # : 008.0205.00007

Collected By : EG/JZ
Collection Date : 04/02/08 13:22

| Parameter | Result | Det. Limit | Units | Method | Date | Dil. |
|---|---|---|---|---|---|---|
| Diesel Range Organics (DRO) | 4.5 | 0.17 | mg/l | NWTPHDX | 04/09/08 | 1.7 |
| Residual Range Organics (RRO) | 1.2 | 0.42 | mg/l | NWTPHDX | 04/09/08 | 1.7 |
| Surrogate Recovery o-Terphenyl | 73.5 | | % Rec. | NWTPHDX | 04/09/08 | 1.7 |

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.


Reported: 04/10/08 17:27 Printed: 04/10/08 17:27

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REPORT OF ANALYSIS

April 10, 2008

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West Linn, OR 97068

ESC Sample # : L339466-04

Date Received : April 04, 2008
Description : Crowley Marine Services

Site ID :

Sample ID : MW-19 NON-DECANTED

Project # : 008.0205.00007

Collected By : EG/JZ
Collection Date : 04/02/08 13:57

| Parameter | Result | Det. Limit | Units | Method | Date | Dil. |
|---|---|---|---|---|---|---|
| Diesel Range Organics (DRO) | 37. | 0.85 | mg/l | NWTPHDX | 04/10/08 | 8.5 |
| Residual Range Organics (RRO) | 9.5 | 0.42 | mg/l | NWTPHDX | 04/09/08 | 1.7 |
| Surrogate Recovery | | | | | | |
| o-Terphenyl | 67.7 | | % Rec. | NWTPHDX | 04/09/08 | 1.7 |

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 04/10/08 17:27 Printed: 04/10/08 17:27

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REPORT OF ANALYSIS

April 10, 2008

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West Linn, OR 97068

ESC Sample # : L339466-05

Date Received : April 04, 2008
Description : Crowley Marine Services

Site ID :

Sample ID : MW-2 DECANTED

Project # : 008.0205.00007

Collected By : EG/JZ
Collection Date : 04/02/08 12:57

| Parameter | Result | Det. Limit | Units | Method | Date | Dil. |
|---|---|---|---|---|---|---|
| Diesel Range Organics (DRO) | 5.5 | 0.29 | mg/l | NWTPHDX | 04/09/08 | 2.9 |
| Residual Range Organics (RRO) | 1.0 | 0.72 | mg/l | NWTPHDX | 04/09/08 | 2.9 |
| Surrogate Recovery | | | | | | |
| o-Terphenyl | 72.4 | | % Rec. | NWTPHDX | 04/09/08 | 2.9 |

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 04/10/08 17:27 Printed: 04/10/08 17:27

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ESC Sample # : L339466-06

Date Received : April 04, 2008
Description : Crowley Marine Services

Site ID :

Sample ID : MW-4 DECANTED

Project # : 008.0205.00007

Collected By : EG/JZ
Collection Date : 04/02/08 12:33

| Parameter | Result | Det. Limit | Units | Method | Date | Dil. |
|---|---|---|---|---|---|---|
| Diesel Range Organics (DRO) | 3.3 | 0.25 | mg/l | NWTPHDX | 04/09/08 | 2.5 |
| Residual Range Organics (RRO) | 0.89 | 0.62 | mg/l | NWTPHDX | 04/09/08 | 2.5 |
| Surrogate Recovery | | | | | | |
| o-Terphenyl | 76.0 | | % Rec. | NWTPHDX | 04/09/08 | 2.5 |

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.


Reported: 04/10/08 17:27 Printed: 04/10/08 17:27

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REPORT OF ANALYSIS

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West Linn, OR 97068

ESC Sample # : L339466-07

Date Received : April 04, 2008
Description : Crowley Marine Services

Site ID :

Sample ID : MW-16 DECANTED

Project # : 008.0205.00007

Collected By : EG/JZ
Collection Date : 04/02/08 13:22

| Parameter | Result | Det. Limit | Units | Method | Date | Dil. |
|---|---|---|---|---|---|---|
| Diesel Range Organics (DRO) | 3.4 | 0.22 | mg/l | NWTPHDX | 04/09/08 | 2.2 |
| Residual Range Organics (RRO) | 0.83 | 0.55 | mg/l | NWTPHDX | 04/09/08 | 2.2 |
| Surrogate Recovery | | | | | | |
| o-Terphenyl | 70.5 | | % Rec. | NWTPHDX | 04/09/08 | 2.2 |

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 04/10/08 17:27 Printed: 04/10/08 17:27

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REPORT OF ANALYSIS

April 10, 2008

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West Linn, OR 97068

ESC Sample # : L339466-08

Date Received : April 04, 2008
Description : Crowley Marine Services

Site ID :

Sample ID : MW-19 DECANTED

Project # : 008.0205.00007

Collected By : EG/JZ
Collection Date : 04/02/08 13:57

| Parameter | Result | Det. Limit | Units | Method | Date | Dil. |
|---|---|---|---|---|---|---|
| Diesel Range Organics (DRO) | 23. | 0.33 | mg/l | NWTPHDX | 04/09/08 | 3.3 |
| Residual Range Organics (RRO) | 4.7 | 0.82 | mg/l | NWTPHDX | 04/09/08 | 3.3 |
| Surrogate Recovery | | | | | | |
| o-Terphenyl | 74.2 | | % Rec. | NWTPHDX | 04/09/08 | 3.3 |

BDL - Below Detection Limit
Det. Limit - Practical Quantitation Limit(PQL)
Note:
The reported analytical results relate only to the sample submitted.

.
Reported: 04/10/08 17:27 Printed: 04/10/08 17:27

Summary of Remarks For Samples Printed
04/10/08 at 17:27:32

TSR Signing Reports: 358
R5 - Desired TAT

All SELMET projects will need LOW LEVEL 8260 analysis.

Sample: L339466-01 Account: SLRWLOR Received: 04/04/08 12:00 Due Date: 04/11/08 00:00 RPT Date: 04/10/08 17:27
Non-Decanted
Sample: L339466-02 Account: SLRWLOR Received: 04/04/08 12:00 Due Date: 04/11/08 00:00 RPT Date: 04/10/08 17:27
Non-Decanted
Sample: L339466-03 Account: SLRWLOR Received: 04/04/08 12:00 Due Date: 04/11/08 00:00 RPT Date: 04/10/08 17:27
Non-Decanted
Sample: L339466-04 Account: SLRWLOR Received: 04/04/08 12:00 Due Date: 04/11/08 00:00 RPT Date: 04/10/08 17:27
Non-Decanted
Sample: L339466-05 Account: SLRWLOR Received: 04/04/08 12:00 Due Date: 04/11/08 00:00 RPT Date: 04/10/08 17:27
Decanted
Sample: L339466-06 Account: SLRWLOR Received: 04/04/08 12:00 Due Date: 04/11/08 00:00 RPT Date: 04/10/08 17:27
Decanted
Sample: L339466-07 Account: SLRWLOR Received: 04/04/08 12:00 Due Date: 04/11/08 00:00 RPT Date: 04/10/08 17:27
Decanted
Sample: L339466-08 Account: SLRWLOR Received: 04/04/08 12:00 Due Date: 04/11/08 00:00 RPT Date: 04/10/08 17:27
Decanted

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Emily Goodwin
1800 Blankenship Road, Suite 440

West Linn, OR 97068

Quality Assurance Report
Level II

L339466

April 10, 2008

Laboratory Blank

| Analyte | Result | Units | Date Analyzed | Batch |
|---|---|---|---|---|
| Diesel Range Organics (DRO) | < .1 | ppm | 04/10/08 09:54 | WG354172 |

Laboratory Control Sample

| Analyte | Units | Known Val | Result | % Rec | Limit | Batch |
|---|---|---|---|---|---|---|
| Diesel Range Organics (DRO) | mg/l | .75 | 0.667 | 89.0 | 50-150 | WG354172 |
| Residual Range Organics (RRO) | mg/l | 1.5 | 0.705 | 47.0 | 0-0 | WG354172 |

Laboratory Control Sample Duplicate

| Analyte | Units | LCSD Res | Ref Res | RPD | Limit | %Rec | Batch |
|---|---|---|---|---|---|---|---|
| Diesel Range Organics (DRO) | mg/l | 0.656 | 0.667 | 1.75 | 20 | 87 | WG354172 |
| Residual Range Organics (RRO) | mg/l | 0.664 | 0.705 | 6.08 | 0 | 44 | WG354172 |

Batch number /Run number / Sample number cross reference

WG354172: R361933: L339466-01 02 03 04 05 06 07 08

* * Calculations are performed prior to rounding of reported values .

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Quality Assurance Report
Level II

L339466

April 10, 2008

The data package includes a summary of the analytic results of the quality control samples required by the SW-846 or CWA methods. The quality control samples include a method blank, a laboratory control sample, and the matrix spike/matrix spike duplicate analysis. If a target parameter is outside the method limits, every sample that is effected is flagged with the appropriate qualifier in Appendix B of the analytic report.

Method Blank - an aliquot of reagent water carried through the entire analytic process. The method blank results indicate if any possible contamination exposure during the sample handling, digestion or extraction process, and analysis. Concentrations of target analytes above the reporting limit in the method blank are qualified with the "B" qualifier.

Laboratory Control Sample - is a sample of known concentration that is carried through the digestion/extraction and analysis process. The percent recovery, expressed as a percentage of the theoretical concentration, has statistical control limits indicating that the analytic process is "in control". If a target analyte is outside the control limits for the laboratory control sample or any other control sample, the parameter is flagged with a "J4" qualifier for all effected samples.

Matrix Spike and Matrix Spike Duplicate - is two aliquots of an environmental sample that is spiked with known concentrations of target analytes. The percent recovery of the target analytes also has statistical control limits. If any recoveries that are outside the method control limits, the sample that was selected for matrix spike/matrix spike duplicate analysis is flagged with either a "J5" or a "J6". The relative percent difference (%RPD) between the matrix spike and the matrix spike duplicate recoveries is all calculated. If the RPD is above the method limit, the effected samples are flagged with a "J3" qualifier.

Chain of Custody
Page 1 of 1

Prepared by:

**ENVIRONMENTAL SCIENCE CORP.**
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SLR
1800 Blankenship Road, Suite 440
West Linn, OR 97068

Alternate billing information:

Report to: Steve Hammer

Email to: shammer@slrcorp.com

Project Description: Crowley Marine Services

City/State Collected: Vancouver, Washington

Phone: (503) 723-4423
FAX:

Client Project #: 008.0205.00007

ESC Key:

Site/Facility ID#:

P.O.#:

Collected by: EG/JZ

Collected by (signature):

Packed on Ice N Y

Rush? ( Lab MUST Be Notified )
____ Same Day.....200%
____ Next Day.....100%
____ Five Day .....25%

Date Results Needed:

Email? __No ✓Yes
FAX? __No __Yes

CoCode SLRWLOR (lab use only)
Template/Prelogin
Shipped Via:

Analysis/Container/Preservative

| Sample ID | Comp/Grab | Matrix* | Depth | Date | Time | No. of Cntrs | TPH-D w/ Silica Gel Cleanup | TPH-D w/ Silica Gel Cleanup Sediment Removed | Remarks/Contaminant | Sample # (lab only) |
|---|---|---|---|---|---|---|---|---|---|---|
| MW-2 | Grab | GW | | 4/2/08 | 12:57 | 2 | x | x | | L339466-01 |
| MW-4 | Grab | GW | | 4/2/08 | 12:33 | 2 | x | x | | 02 |
| MW-16 | Grab | GW | | 4/2/08 | 13:22 | 2 | x | x | | 03 |
| MW-19 | Grab | GW | | 4/2/08 | 13:57 | 2 | x | x | | 04 |
| | | | | | | | | | | 05 |
| | | | | | | | | | | 06 |
| | | | | | | | | | | 07 |
| | | | | | | | | | | 08 |

*Matrix SS - Soil/Solid GW - Groundwater WW - WasteWater DW - Drinking Water OT - Other _____

pH _____ Temp _____

Flow _____ Other _____

Remarks: Please reference April 1, 2008 letter from Lisa Dominigini for proper lab procedure regarding removal of sediment from sample.

| | Date: | Time: | |
|---|---|---|---|
| Relinquished by: (Signature) | 4/3/08 | 10.00am | Received by: (Signature) |
| Relinquished by: (Signature) | Date: | Time: | Received by: (Signature) |
| Relinquished by: (Signature) | Date: | Time: | Received for lab by: (Signature) |

Samples returned via: ☐ UPS ☐ FedEx ☐ Courier ☐ _____

Temp: 4.9°C | Bottles Received: 5 (GB)

Date: 4-4-08 | Time: 1200

Condition: (lab use only)

pH Checked: | NCF:

963262458135