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Phase I Remedial Implementation As-Built Report

Unocal Edmonds Bulk Fuel Terminal Lower Yard

11720 Unoco Road

Edmonds, Washington 98020

July 31, 2009

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1. Introduction

On behalf of Chevron Environmental Management Company (Chevron), ARCADIS U.S., Inc. (ARCADIS) is pleased to submit this Lower Yard Phase I Remedial Implementation data summary and As-Built Report for the Unocal Edmonds Bulk Fuel Terminal (Terminal) Lower Yard, located at 11720 Unoco Road, Edmonds, Washington. The site location is shown on **Figure 1**. This report presents a summary of Phase I remedial work completed in accordance with the requirements of Washington State Agreed Order No. DE 4460.

2. Background

2.1 Site Description

The Lower Yard is approximately 22 acres in area, lying east-southeast of Burlington Northern Santa Fe Railway (BNSF) property, south of the Edmonds Marsh (also known as the Union Oil Marsh) and a drainage ditch (Willow Creek), and north of the Upper Yard. The site layout is shown on **Figure 2**.

At its nearest point (the southwest corner of the Lower Yard), the Terminal boundary is approximately 160 feet from the Puget Sound shoreline. Two detention basins (DB-1 and DB-2) are located along the north and northeast boundaries of the Terminal. DB-1 borders Edmonds Marsh and Willow Creek, and DB-2 serves as a collection area from which storm water is discharged into Willow Creek.

Currently, a storm water system consisting of 12 storm drains collects runoff water and discharges directly into DB-2 via gravity flow. From DB-2, storm water is discharged into Willow Creek under an Industrial Stormwater General Permit (SO3-002953C) and excess storm water is stored in DB-1 during large storm events.

Previous structures in the Lower Yard included petroleum storage and transfer equipment (aboveground storage tanks and piping), two truck loading racks, several office buildings, a railcar loading/unloading station, a storm water conveyance system including two 10,000-gallon storm water detention tanks and two 500-gallon vapor recovery tanks, an air-blown asphalt plant, and an asphalt packaging warehouse.

2.2 Site History

Unocal operated the Terminal from 1923 to 1991. Fuel was brought to the Terminal on ships, pumped to the storage tanks in the Upper Yard, and loaded from the tanks into rail cars and trucks for delivery to customers. In addition, an asphalt plant operated at the Terminal from 1953 to the late 1970s.

In 2001, Unocal conducted an Interim Action in the Lower Yard, removing light non-aqueous phase liquid (LNAPL) and petroleum-impacted soil and groundwater from four areas of the Lower Yard. The results of the 2001 Interim Action are summarized in *Lower Yard Interim Action As-Built Report – Volume 1* (MFA 2002). Additional Interim Actions conducted in 2003 included soil excavations in the Southwest Lower Yard and Detention Basin No.1. The results of the 2003 Interim Action are summarized in *2003 Lower Yard Interim Action As-Built Report – Volume 1* (MFA, 2004). Previous excavations are shown on **Figure 3**.

In June 2007 Unocal entered into an Agreed Order with the Washington Department of Ecology (DOE) to conduct an Interim Action in the Lower Yard. Specific objectives of the Interim Action included removal of soil with petroleum impacts in excess of the soil remediation levels (RELs) established for the Terminal, removal of LNAPL, extraction of groundwater that is in contact with LNAPL, and removal of soil with arsenic concentrations in excess of the cleanup levels (CULs) within the Southwest Lower Yard. The soil RELs were calculated to provide a concentration that is protective of direct contact. The RELs are believed to be protective of groundwater as well. Groundwater monitoring, to be conducted following soil remediation to the RELs, will provide empirical evidence to assess whether RELs are protective of groundwater. Soil CULs and RELs were established in the *Interim Action Report – Work Plan for 2007 Lower Yard Interim Action* (SLR 2007a), and are summarized in **Table 1**.

2.3 Geology

Native materials encountered during 2007-2008 Phase I excavation were silty sands with gravel and sandy silts with gravel. Between 8 to 15 feet below ground surface (bgs), a clean sand formation of very fine to medium sand with fine gravel was encountered, which contained organic material such as beach debris, wood, and seashells. Excavation areas throughout the lower yard encountered a native layer approximately 6 to 12 inches thick composed of sandy silt with large amounts of peat, wood debris, and decomposing vegetation. This layer was encountered at depths of 8 to 14 feet bgs and is considered to be representative of the former marsh located at the site.

The current lithology of the Lower Yard consists primarily of backfill material from the 2007-2008 Phase I Interim Action work. The fill was placed within excavated areas to a depth of 8 to 12 feet bgs and is composed of very fine to medium sand, trace silt, and coarse gravel. Backfill in the saturated zone (approximately 1 foot above groundwater, to the bottom of each excavation) is clean coarse gravels.

3. Lower Yard Interim Action

In July 2007, Union Oil Company of California (Unocal) entered into an Agreed Order (No. DE 4460) with the DOE to conduct an interim remedial action at the Terminal.

The purposes of the interim action are to reduce potential threats to human health and the environment, to provide for completion of the feasibility study (FS) for the Lower Yard, and to provide information to design additional cleanup actions, if necessary. In accordance with Washington Administrative Code (WAC) 173-340-430(1), the interim action may constitute the cleanup action for the Lower Yard if the interim action is sufficient to comply with WAC 173-340-350 through 173-340-390. If the interim action does constitute the cleanup action for the Lower Yard, then the FS will not need to be completed.

The specific requirements of the interim action include the following:

- Remediate the petroleum hydrocarbon-impacted soil within the Lower Yard that contains petroleum hydrocarbon concentrations above the CULs or RELs based on direct contact.
- Remove remaining LNAPL beneath the Lower Yard.
- Extract petroleum hydrocarbon-impacted groundwater that is in contact with the LNAPL.
- Remediate arsenic-impacted soil within the Lower Yard that contains concentrations above the soil CUL, based on naturally occurring background concentrations.
- Remove sediment that failed the 2003 toxicity tests in the drainage ditch (Willow Creek) at locations near the Terminal's two storm water outfalls.
- Obtain data necessary to evaluate if remaining soil concentrations are sources of LNAPL on the groundwater table.
- Obtain data necessary to evaluate if remaining soil concentrations will cause an exceedance of the groundwater CULs at the groundwater points of compliance (POCs).
- Obtain data necessary to evaluate if petroleum hydrocarbon concentrations in groundwater beneath the Lower Yard will naturally attenuate to below the CULs at the groundwater POCs.
- Obtain data necessary to calculate restoration timeframes to meet the groundwater CULs at the groundwater POCs.

Methods to accomplish the objectives established in the Agreed Order were detailed in the *Interim Action Report – Work Plan for 2007 Lower Yard Interim Action* (SLR 2007a) (the Work Plan). The Work Plan described areas proposed for excavation, and estimated that 64,000 tons (43,643 cubic yards [cy]) of soil should be removed to accomplish the objectives. Once excavation activities were determined to be complete (based on confirmation soil sampling), a network of groundwater monitoring wells was proposed to complete a 2-year groundwater monitoring program. The groundwater data collected during this timeframe would be used to show that LNAPL had been successfully removed and the remaining soil concentrations would not cause continued exceedances of dissolved-phase constituents. If, at the end of the monitoring program, groundwater concentrations were below the applicable CULs at the POCs, and concentrations within the established flow-paths indicated that natural attenuation is occurring, then the cleanup would be complete. If additional remediation is required after completion of the monitoring program, then an FS will be required.

The detailed scope of work for Phase I remedial activities are available in the *Interim Action Report – Work Plan for 2007 Lower Yard Interim Action* (SLR 2007a2007a). Due to permitting delays, the proposed scope of work was split into two phases: Phase I and Phase II. Phase I consisted of the bulk of the soil excavation, LNAPL recovery, and groundwater treatment. The sediment removal was planned for Phase II. As described in the sections below, some of the work originally planned for Phase I was included with Phase II to maximize work during fair weather.

As discussed below, Phase I included the following activities:

- Utility markout to understand potential active and inactive underground utilities and unknown features prior to excavation;
- Monitoring well abandonment in the areas of planned excavation;
- Test pits to collect data prior to beginning full-scale implementation for planning purposes;
- Tank, drum and debris removal in the areas of planned excavation;
- Stockpile management to address uncertainties with imported soil to be used for site restoration;
- Soil excavation and LNAPL recovery to meet the objectives of the Interim Action;
- Off-site treatment and/or disposal of excavated soil, LNAPL and debris;
- Treatment of extracted groundwater to facilitate construction activities and to satisfy the NPDES permit;

- Confirmation borings in areas of previous excavation, inaccessible areas, and areas of interest identified by DOE; and

- Site restoration including importing and placing backfill, and replacement of the storm drain system.

3.1 Contractors

Prior to implementing remedial activities in the Lower Yard, subsurface utility locations were marked by Geomarkout Company, headquartered in Pocatello, Idaho. Soil excavations were completed by Envirocon, Inc. of Missoula, Montana using conventional excavation equipment. Water and soil samples were analyzed at TestAmerica in Bothell, Washington using the procedures identified in the Sampling and Analysis Plan (SAP; SLR 2007b). Removal of LNAPL and some removal of impacted groundwater was conducted by Emerald Services (Emerald) of Seattle, Washington. Excavation limits and sample grid locations were surveyed by Triad Associates of Kirkland, Washington.

Fluids removed from the site were transported by Emerald to their facility in Seattle for recycling. Petroleum-impacted soil was transported to Rinker Materials (Rinker), now Cemex, in Everett, Washington, for thermal destruction and recycling. Arsenic-impacted soil was transported to the Waste Management transfer facility in Seattle, Washington, to be landfilled. Impacted soil was transported to the above facilities by ECTI Trucking.

Imported soil for vadose zone backfill was provided by Rinker, and imported gravel for saturated zone backfill was provided by Envirocon. Backfill sources were approved by DOE prior to use.

Drilling activities associated with investigation in the Southwest Lower Yard, as well as monitoring well abandonment activities, were conducted by Cascade Drilling (Cascade) of Woodinville, Washington.

ARCADIS prepared the Construction Specifications, provided observation of the work completed by Envirocon, and conducted the construction monitoring and sampling. Daily work logs were prepared by Envirocon and are included in **Appendix A**.

3.2 Sampling and Analysis Plan

The Work Plan included a SAP to identify the quality assurance (QA) procedures to be implemented during sampling activities and laboratory analyses, and to ensure that sampling during the Interim Action meets the requirements of Model Toxics Control Act (MTCA) regulations for SAPs (WAC 173-340-820). The SAP is included as Appendix L of the Work Plan.

As specified in the SAP, a sampling reference grid was set up at the Terminal at 25-foot intervals. The grid was pre-surveyed and marked prior to the start of excavation activities. Collected soil excavation samples were named in reference to the grid. An example sample name is “EX-A1-H-15-15”. The sample naming convention is as follows:

- The label “EX” indicates that the sample was from an excavation
- The excavation name, for example “A1”
- The grid point on which the sample was taken, for example “H-15”
- The depth at which the sample was taken in feet, for example “15”

In excavations completed at depths greater than 4 feet bgs, samples were collected from the sidewalls of the excavations. Generally in these cases, an “N”, “E”, “S” or “W” was included with the letters “SW” indicating sidewall: for example “EX-A1-D-17-ESW-5.” This sample was collected from the east sidewall of grid point D-17 at a depth of 5 feet.

Analytical data presented in this report can be located within the DOE Environmental Information Management System (EIMS), under the User Study ID: Unocal02. EIMS is a searchable database and can be accessed through the DOE website (www.ecy.wa.gov). Sample location coordinates are also presented in EIMS using the Washington State Plane coordinate system. Analytical and location data for samples collected from temporary locations, such as stockpiles, are not included in EIMS.

The sampling grid, extent of final excavation, and sampling names and locations are shown on **Figure 5**, **Figure 6,** and **Figure 7**. Excavated soil sample analytical data are summarized in **Table 4,** and the analytical reports are included in **Appendix C**.

3.2.1 Soil Analytical Methods

Soil sampling was conducted in accordance with the SAP (Appendix L of the Work Plan), from an established grid along the excavation base and sidewalls. Sampling was conducted to confirm that soil exceeding CULs and/or RELs was removed. Samples were submitted for chemical analysis by:

- Benzene, toluene, ethylbenzene, and total xylenes (BTEX) by Environmental Protection Agency (EPA) method 8021B
- Gasoline range organics (GRO) by Northwest method NWTPH-Gx

- Diesel range organics (DRO) and heavy oil range organics (HO) by method NWTPH-Dx

- Soil samples containing detectable concentrations of DRO or HO were also submitted for chemical analysis by carcinogenic polynuclear aromatic hydrocarbons (cPAHs) by EPA method 8270 SIM

Due to the historical presence of aboveground pipelines, which were cleaned with sandblast grit likely containing arsenic, soil samples collected from excavation area B19 in the southwest Lower Yard were submitted for analysis of arsenic by EPA method 6000/7000.

GRO, DRO, and HO were summed to provide a measure of total petroleum hydrocarbons (TPH) which is one of the applicable RELs for the Terminal. If one or more TPH constituents were reported at concentrations less than the laboratory detection limit, then one-half of the detection limit was used to calculate total TPH. The seven cPAH congener concentrations were adjusted for toxicity according to the method outlined in *Air Toxics Hot Spots Program Risk Assessment Guidelines, Part II Technical Support Document for Describing Available Cancer Potency Factors* (Cal-EPA 2005). If one or more of the congener concentrations was reported at concentrations less than the laboratory detection limit, then one-half of the detection limit was used in the adjustment calculations.

3.2.2 Groundwater Analytical Methods

As part of the Phase I activities, groundwater was recovered from the open excavations, treated, and discharged to detention basin DB-2 under National Pollutant Discharge Elimination System (NPDES) permit number WA-0032150-8. In compliance with permit requirements, samples were collected weekly for laboratory analysis for the following constituents:

- BTEX by EPA method 8021B

- GRO by Northwest method NWTPH-Gx

- DRO and HO by method NWTPH-Dx

- cPAHs by EPA method 8270 SIM.

- Arsenic and lead by EPA method 200.8

- Turbidity by EPA method 180.1

4. Lower Yard Interim Action Results

4.1 Monitoring Well Abandonment

Monitoring wells MW-W, MW-14, MW-17R, MW-25, MW-103R, MW-112R, MW-116, MW-119, MW-130, MW-133, MW-140, MW-141, MW-144, and MW-148 were abandoned prior to excavation activities because they were located within the proposed limits of the excavations. The wells were abandoned in place with hydrated bentonite chips by Cascade pursuant to *Minimum Standards for Construction and Maintenance of Wells* (WAC 173-160-310). Each well was subsequently removed in its entirety with excavation equipment during remedial implementation. Because the excavations extended beyond the original proposed limits, monitoring wells MW-1, MW-3, MW-7R, MW-8, MW-22, MW-27, and MW-149 were also removed using excavation equipment during remedial excavation activities.

4.2 Test Pit Results

Two test pits were excavated between excavations B2 and B3 to characterize the subsurface between the two planned excavations. Test pit soil samples were analyzed for TPH, cPAHs, and benzene. The TPH concentration detected in sample B2-TP2-13 exceeded the REL. The test pits were temporarily backfilled and later excavated as part of soil removal activities in excavations B2 and B3 in the Southeast Lower Yard.

4.3 Stockpiled Soil Analytical Results and Use

4.3.1 Imported Stockpile Material

Prior to initiating excavation activities, two previously placed stockpiles of imported soil on site were sampled for potential on-site reuse. Approximately 8,000 cy of soil in stockpile SP-1 were from the Lake City Housing site (west side of the pile), and 4,000 cy of soil were from the Cambridge Housing Site (east side of the pile). Stockpile SP-2 consisted of an additional 6,000 cy of soil imported from the Cambridge Housing Site.

Prior to being brought to the site, Phase I Environmental Site Assessments were conducted for each stockpile source (SLR 2007a). In addition, ARCADIS assessed each stockpile pursuant to methods outlined in the SAP. Sample SP1-8-8, collected during the initial assessment of stockpile SP-1, yielded a total adjusted cPAH concentration exceeding the CUL. To better assess the potential impact in the stockpile, a portion of SP-1 was reassessed and identified as SP-3. The portion of SP-1 that was not reassessed was mixed with excavated soil for use as a drying agent prior to being shipped off site for disposal during excavation activities.

Samples collected during the additional assessment of SP-3 did not contain TPH, cPAHs, or benzene concentrations exceeding their respective RELs. Stockpile SP-3 was mixed with clean imported soil and used as backfill for excavation B15. Analytical results from the stockpile assessment are summarized in **Table 2**.

4.3.2 Non-imported Stockpile Material

Soil excavated for the construction of the truck wheel wash sump and approach road was stockpiled. Soil from this area was assessed according to procedures outlined in the SAP (SLR 2007b). Six analytical samples were collected on the sample grid from the truck wheel wash excavation, and an additional five samples were collected from the soil stockpiled from the excavation for potential re-use. The five analytical samples collected from this stockpile were analyzed for GRO, DRO, HO, BTEX, and cPAHs. None of the samples contained analyte concentrations exceeding the CULs or RELs, and this soil was subsequently used as vadose zone backfill on site.

During excavation of areas B16, B17, and B18, soil from the vadose zone was segregated and sampled for potential re-use as backfill. The excavated overburden was temporarily placed on a liner and was sampled in accordance with the SAP. Eleven analytical samples were collected from this stockpile and were analyzed for GRO, DRO, HO, BTEX, and cPAHs. None of the samples contained analyte concentrations exceeding the CULs or RELs, and this soil was subsequently used as vadose zone backfill on site.

Analytical results from the assessment of the wheel wash area and B16, B17, and B18 soil stockpiles are summarized in **Table 2**. Analytical results from samples collected during the excavation of the wheel wash area are summarized in **Table 4**.

4.4 Soil Excavations and LNAPL Recovery

4.4.1 Soil Excavations

Due to the extensive nature of Lower Yard Interim Action operations, excavation activities were staged to maintain safe traffic flow on site. Excavated soil was loaded onto articulated trucks and staged in a central location on site prior to being loaded onto dump trucks with trailers for transport off site for treatment (thermal destruction) or was transported offsite for disposal (arsenic-impacted soil only). Stockpiles were placed over areas to be excavated so as to not contaminate non-impacted areas. The stockpile area used during the final months of Phase I (and the entirety of Phase II) was constructed on a bermed, lined, and fully contained area. Subsequently, at the conclusion of Phase II activities, this area, including the liner and berms, was excavated to a depth of 2 feet bgs and transported off site. Samples were collected under the stockpile area on the pre-established sampling grid to ensure that no cross-contamination had occurred. These sample results will be included with the data provided in the Phase II As-Built report.

As noted above, excavations were staged to facilitate safe traffic flow through the site. As soil was excavated, it was transported to the stockpile locations pending removal. The excavation limits were advanced based on analytical results of soil confirmation samples and/or field observations made by ARCADIS staff (visual observation or odor indicating presence of fuel products) consistent with the Work Plan. Excavation and soil removal continued until LNAPL was not observed in the sidewalls or on the surface of the groundwater within the excavation, and the analytical results of the confirmation samples were below the applicable CULs or RELs.

Locations for which confirmation soil sample results exceeded one or more of the CULs or RELs were re-excavated to a greater depth or lateral extent and were sampled again. In general, this process continued until confirmation soil samples collected contained concentrations of TPH, cPAHs, and benzene lower than site CULs/RELs and/or visibly stained soil was no longer observed.

In a few instances, excavation sidewalls with analytical samples exceeding RELs could not be over-excavated any further due to site conditions or subsurface infrastructure. Excavation area B8 could not be over-excavated any further without extending into Willow Creek, and excavation area B18 could not be over-excavated without encroaching on BNSF property. Excavation areas A2, B11 and B20 could not be over-excavated due to the presence of a subsurface 72-inch concrete storm drain line owned by the Washington State Department of Transportation (WSDOT). This line was installed between 1972 and 1975 and is the main storm water drainage structure for State Route 104. Excavation areas B1 and B9 did not contain confirmation soil samples which were in excess of site RELs or CULs to be over-excavated, but could not be continued without extending into Willow Creek or Edmonds Marsh. The removal of remaining material within excavation areas B1, B8 and B9 was postponed until Phase II, when weather would be more favorable and water levels in Willow Creek would be controlled. Phase I remaining impacted soils are discussed in detail in Section 8.

Most of the excavations were advanced to remove LNAPL and associated petroleum impacts in soil. If LNAPL was observed leaching into the excavation from the exposed sidewalls, the excavation remained open until LNAPL was removed from the groundwater surface and was not observed re-entering the excavation. Except as previously noted, each excavation was left open until chemical analysis of the soil samples confirmed remaining TPH, cPAH, or benzene concentrations were less than their respective RELs.

The Work Plan specified that most excavations would be advanced to approximate depths of 8 ft bgs. However, based on field observations of LNAPL and/or confirmation sampling results, most of the excavations extended beyond 8 ft, up to a maximum of approximately 14 ft bgs. Final excavation depths are shown on **Figure 4** Approximately 108,000 tons of petroleum-impacted soil were removed from the Terminal for thermal destruction. Final excavation area and volume calculations were completed using AutoCAD software and are based on a two-to-one slope for the sidewalls. Final excavation areas and volumes are shown on **Figure 4** and summarized in **Table 3**. Approximately 12,000 tons of soil from stockpile SP-1 were also used as a drying agent and transported off site. An additional 3,723 tons of thermally treated soil were imported as drying agent, mixed with the excavated materials, and transported off site for thermal destruction. Bills-of-lading from the treatment facilities are included in **Appendix B**.

During remedial excavation work conducted between 2001 and 2003, arsenic-impacted soil was removed below and along former pipelines. One area in the southwest Lower Yard was not accessible due to the presence of a railway trestle which extended over the BNSF railway track. Although this trestle was later removed in 2004, arsenic-impacted soil associated with sandblasting of pipelines remained. Excavation area B19 was completed to remove arsenic impacts associated with these activities. The initial excavation was advanced to 1 ft bgs. Due to arsenic concentrations exceeding the CUL at sample point EX-B19-ZZ-1, additional excavation was done to 2.5 ft bgs. Arsenic-impacted soil was taken to the Waste Management facility in Arlington, Oregon for disposal. Arsenic analytical data are summarized in **Table 5,** and the analytical reports are included in **Appendix C**. Arsenic-impacted soil bills-of-lading are included in **Appendix B**.

4.4.2 Debris and Drum Removal

Remnants of previous Terminal operations and infrastructure were uncovered during Phase I activities. The following infrastructure and debris were uncovered and removed from the Terminal:

- A 10,000-gallon storm water detention tank (SDT) was removed from excavation SDT1 in the southwest Lower Yard. Approximately 9,600 gallons of water and sludge were removed from the tank prior to removal and disposal. Associated concrete debris was removed from around the SDT and was transported off site for disposal.

- A second 10,000-gallon SDT was removed from excavation B11. Approximately 9,000 gallons of water and sludge were removed from the tank prior to removal and disposal. Associated concrete debris was removed from around the SDT and was transported off site for disposal.

- A subgrade concrete oil-water separator (OWS) was cleaned and removed from the site as debris.

- Concrete footings and scrap metal were removed from excavation B1.
- Two concrete footings were removed from excavation B20.
- Metal debris was removed from near monitoring well MW-135 in excavation area B2.
- A 45-gallon steel drum in poor condition and leaking asphalt/LNAPL was removed from excavation B1.
- A 500-gallon vapor recovery tank was removed from excavations A2/B11.
- A crushed 30-gallon drum containing emulsified asphalt and an empty 55-gallon steel drum were removed from excavation B2.
- Four steel drums and several 5-gallon buckets containing emulsified asphalt and LNAPL were removed from excavation B6.
- Scrap metal, wood debris, and piping were removed from the northern portion of excavation B20.

An extensive network of corrugated metal, terra cotta, steel, and plastic subsurface piping was uncovered during many of the excavations. This piping was associated with waterlines for the former facility, fire foam-suppression feed lines, and storm water force main lines. Water and sludge associated with the removal of these lines was handled by Emerald Services, and was taken to their Airport Way facility for recycling. Also, all of the catch basins servicing the Lower Yard were removed with the exception of six catch basins along Unoco Road. Concrete debris removed from the Terminal was taken to United Recycling in Snohomish WA, metal debris was taken to Schnitzer Steel in Tacoma WA, and mixed debris (such as terra cotta and plastic piping) was taken to Waste Management in Seattle, WA. The locations of drum remnants, debris, and underground structures removed from the site are shown on **Figure 8**.

4.4.3 LNAPL Recovery

Several excavation areas were identified in the Work Plan as “free product excavation areas”. For these areas, the excavations were to be left open to allow for accumulation of LNAPL. The LNAPL was to be recovered and then approximately three excavation volumes of groundwater were to be removed to facilitate dissolved-phase mass removal. During Phase I activities, LNAPL was encountered in many excavations and in each instance were treated in the same manner for LNAPL recovery in accordance with the Work Plan. LNAPL recovery was conducted by Emerald. In excavation areas A1, A2, A3, A4, B6, B8, B9, B10, B11, B13, B15 and B20, LNAPL was observed on the exposed groundwater in the open excavations. LNAPL was skimmed from the groundwater using a 5,000-gallon vacuum truck and various diameter suction hoses. Skimming operations continued until LNAPL was not observed leaching from excavation sidewalls for a minimum of 1 day. Approximately 9,700 gallons of LNAPL were recovered during Phase I activities and were transported and recycled at the Emerald's facility in Seattle, WA. A summary of the volume of LNAPL recovered is included in **Table 6**. Bills-of-lading from LNAPL recovery operations are included in **Appendix D**.

4.4.4 Bird Deterrents

As a measure to protect water birds (e.g., ducks and geese) from contacting LNAPL and impacted groundwater in the open excavations, several deterrents were implemented including:

- Ropes with flagging were strung across open excavations in a criss-cross pattern.

- An automated electronic speaker system, which mimicked the sounds of predatory birds at regular intervals, was operated.

- Imitation predator birds (owls) were installed near open excavations as a deterrent.

No birds were observed entering excavation during any Phase I excavation activities.

5. Water Treatment and Discharge

The Agreed Order and Work Plan required removal and treatment of groundwater from open excavations. A water treatment system consisting of three-pod sand filtration vessels and dual carbon treatment vessels was used to treat water pumped from the excavations. A summary of the water treatment system and its operation was presented in *Operation, Maintenance, and Monitoring Plan – Temporary Treatment System* (ARCADIS 2007a).

Approximately 2 million gallons of water were treated and discharged into detention basin DB-2 shown on **Figure 2** under NPDES permit number WA-0032150-8. "NPDES-MID" samples were collected from a sampling point between the two carbon filters and "NPDES-EFF" samples were collected at the water treatment system discharge point prior to discharge to DB-2. Weekly samples were collected to analyze for GRO, DRO, HO, BTEX, PAHs, arsenic, copper, lead, zinc, turbidity, pH, and hardness. Although not required for analysis, methyl tertiary butyl ether (MTBE) was initially included as an analyte and was later discontinued (beginning November 11, 2007) because it had not been detected and was not required for analysis by the NPDES permit. The treated water was retained in a holding tank until laboratory results indicated that the treated water met the NPDES requirements for discharge. On one occasion, results indicated that concentrations exceeded the requirements, so the water was retreated through the system. Subsequent samples indicated that the water had achieved acceptable levels, and the water was discharged to DB-2. This method of holding the water pending analysis ensured that no discharge violations occurred.

NPDES samples were collected four times a month, and monthly discharge monitoring reports documenting compliance were submitted to the Washington State DOE. NPDES sample data are summarized in **Table 7**. NPDES sample laboratory analytical reports are included in **Appendix D**.

6. Confirmation Borings

Unocal conducted an interim action in 2003 that included the excavation of approximately 19,657 tons of soil from the southwestern corner of the site. The excavation was extended laterally over an area of approximately 35,900 square feet and vertically to a maximum depth of approximately 7.5 ft bgs (up to 1.5 feet below the groundwater table) (MFA 2004). Soil samples were collected from the sidewalls of the excavation, but not from the base of the excavation.

As part of the requirements of the Agreed Order, 64 soil borings were drilled at the conclusion of Phase I and were sampled within the footprint of the previous excavation area to assess the soil conditions at the base of the previous southwest Lower Yard excavation. The proposed boring locations were spaced on the same 25-foot grid pattern established for excavation sampling in the rest of the Lower Yard. Boring locations relative to the excavation are shown on **Figure 9**.

The soil borings were advanced in April 2008 using a hollow-stem auger drill rig. Soil samples were collected using a split-spoon sampler at a depth of 8.5 to 14.5 feet at each location on the 25-foot grid. Samples were collected when non-backfill material was encountered, in order to assess the IHS concentrations soils on the floor and sidewalls of the 2003 excavation. The collected soil samples were submitted for laboratory analysis for GRO, DRO, HO, BTEX, and PAHs.

The 62 borings that were completed within the footprint of the 2003 Southwest Lower Yard excavation area did not contain concentrations of the TPH, cPAHs, or benzene in excess of the RELs and CULs. Two samples (SB-63-5.5 and SB-64-2.5) exceeded TPH RELs. These borings were completed outside of the 2003 excavation area in the location of the former railroad trestle; this soil was excavated during Phase II in summer/fall 2008. Confirmation boring analytical results are summarized in **Table 8** and included in **Appendix D**. Boring logs are included in **Appendix F**.

7. Lower Yard Restoration

Upon completion, each excavation area was backfilled with clean gravel and soil. When possible, soil excavated from the site or from the existing stockpiles was used as backfill above the groundwater table (vadose zone). Approximately 7,704 tons of soil from stockpile SP-2, 7,470 tons of soil from SP-3, 630 tons of soil stockpiled from the wheel wash excavation area, and 600 tons from the top 4 feet of the B16/B17/B18 excavations were used as shallow backfill material. Soil analytical results from stockpiled soil are presented in **Table 2**.

Approximately 52,332 tons of vadose zone sand backfill and 27, 418 tons of saturated zone gravel backfill were imported from Rinker, and an additional 13,492 tons of saturated zone gravel backfill were imported for backfill by Envirocon. The soil imported by Rinker came from their facility in Everett WA, while the soil imported by Envirocon came from Green Crow Rock Products of Arlington, Washington. Clean sand and gravel that were imported for backfill adhered to the following grain size requirements:

Sieve Size	*Vadose Zone Backfill Sand (% Passing)*	*Saturated Zone Backfill Gravel (% Passing)*
1 inch	-	100
¾ inch	-	80 to 100
3/8 inch	-	10 to 40
½ inch	100	0 to 5
#4	90-100	0 to 5
#200	3-12	0 to 2

Backfill was placed in approximately 2 ft lifts and was compacted to a minimum of 90 percent relative compaction. Compaction density testing was conducted by HWA Geosciences Inc. of Lynnwood, WA. Compaction testing forms are included in **Appendix G**.

In order to re-establish the stormwater runoff collection system, 6 new storm drains was installed and connected to 6 existing on-site storm drains, at the conclusion of Phase I excavation activities. The storm water collection system of 12 on-site storm drains discharges directly into DB-2 via gravity flow; invert pipe elevations were surveyed to ensure proper slope. From DB-2, storm water is discharged into Willow Creek under an Industrial Stormwater General Permit. The new catch basins and storm water collection piping were installed as shown on **Figure 10**. The southeast, north, and south portions of the Lower Yard are currently composed of compacted backfill material and surface soil graded toward the storm water collection system. Surface soil was covered with hydroseed to prevent erosion. The southwest and southeast Lower Yards were covered in rock and graded to direct surface water toward the center of the site and into the storm water system. Roads constructed on site during Phase I were covered with clean, imported 2- to 4-inch quarry spalls. Additional site restoration was conducted at the conclusion of Phase II in summer/fall 2008.

8. Remaining Impacted Soil

Confirmation soil samples were collected from the excavation floors and sidewalls on a 25-foot grid. In many cases, excavations were deepened or extended laterally and additional samples were collected. In all, 500 confirmation soil samples were collected during Phase I, including 23 sample locations where previously failing samples were over excavated. Eight of the 500 soil samples contained concentrations of one or more of the IHS in excess of the CULs or RELs at locations that were not over-excavated during Phase I.

A table of soil samples collected during Phase I activities that exceeded site CULs and/or RELs, the IHS(s) that was in excess, and the sample collected after over-excavation of the exceeding sample location is provided below. Following the table is a description of the confirmation soil samples which exceeded the site RELs and/or CULs, but were not over-excavated.

Soil samples with CUL/REL exceedences	Exceeding IHS	Over-excavation sample (no exceedences)
B2-TP2-13	TPH, PAH	EX-B2-G-35-10
EX-A3-Y-6-8	TPH, PAH	EX-A3-Y-6-10
EX-A4-F-8-4	PAH	EX-A4-F-8-7
EX-B11-R-7-WSW-5	TPH	EX-B11-R-6-5
EX-B13-CC-1-10	TPH	EX-B13-CC-1-4*
EX-B13-CC-2-4	TPH	EX-B13-CC-2-10
EX-B14-DD-7-WSW-2.5	TPH	EX-A3-DD-6-10
EX-B14-DD-8-5	cPAH	EX-B14-DD-8-6
EX-B14-EE-WSW-4	TPH, PAH	EX-B14-EE-5-4
EX-B20-M-17-SSW-4	TPH, PAH	EX-B20-M-17-SSW-6**
EX-B20-M-6-5	TPH	EX-B9-M-6-11
EX-B20-N-16-4	TPH, PAH	EX-B20-N-16-12
EX-B2-E-35-(2)-6	TPH	EX-B2-E-35(3)-6
EX-B2-F-41-ESW-4	PAH	EX-B2-F-41-ESW(2)-5
EX-B2-G-33-6	TPH	EX-B2-G-33(2)-6
EX-B2-G-39-8	TPH, PAH	EX-B2-G-39(2)-11
EX-B2-H-37-5	TPH, PAH	EX-B2-H-37(2)-6
EX-B2-H-38-5	TPH, PAH	EX-B2-H-38(2)-10
EX-B2-H-38-WSW-5	TPH, PAH	EX-B2-H-38-WSW(2)-5
EX-B8-F-4NSW-6	TPH, PAH	EX-B8-F-4-NSW-4
Soil samples with CUL/REL exceedences	**Exceeding IHS**	**Over-excavation sample (no exceedences)**
EX-B8-F-4-NSW-6	TPH, PAH	EX-B8-F-4-NSW-4
EX-B8-J-4-4	PAH	EX-B8-J-4-5
P-B15-NW-SW	TPH	EX-B15-HH-2-4
EX-A2-N-16-SSW-6	TPH	--
EX-A2-O-15-SSW-6	TPH	--
EX-A2-Q-14-6	TPH	--
EX-B11-U-10-SSW-5	PAH	--
EX-B20-M-17-SSW-6	TPH, PAH	--
EX-B18-VV-1-6SW	TPH	--
EX-B8-H-4-WSW-4	TPH	--
EX-B8-I-4-WSW-4	TPH	--

*Discussion of apparent sample depth discrepancy below.
**Sample EX-B20-M-17-SSW-6 is the sample collected following the over-excavation of sample EX-B20-M-17-SSW-4. Sample EX-B20-M-17-SSW-6 exceeded site RELs/CULs for TPH and cPAHs.
-- = Sample was not over-excavated. Discussion of each sample below.

Sample EX-B13-CC-1-10, the initial sample collected at grid intersection CC-1, exceeded the TPH REL with a concentration of 6,100 mg/kg. This sample was collected where the sidewall and the floor of the excavation met. The topography at this sample location steeply dips towards the north to the fence, and the BNSF property. To over-excavate this sample the slope was excavated five lateral feet toward the north. This five foot lateral change corresponded with a seven foot elevation difference. When the new confirmation sample was collected it was collected at four feet bgs, which corresponds with the same elevation above mean sea level (amsl) as the confirmation sample collected at 10 feet bgs.

Five samples collected from the sidewalls of excavations B20, A2, and B11, along the WSDOT storm-drain line exceeded site CULs/RELs and were not over-excavated. Sample EX-B20-M-17-SSW-6 exceeded the site CUL for cPAHs and the site REL for TPH with concentrations of 0.166 mg/kg and 15,700 mg/kg, respectively. Samples EX-A2-N-16-SSW-6, EX-A2-O-15-SSW-6 and EX-A2-Q-14-6 exceeded the site TPH REL with concentrations of 7,550 mg/kg, 7,540 mg/kg and 3,060 mg/kg, respectively. Sample EX-B11-U-10-SSW-5 exceeded the site cPAH CUL with a concentration of 0.159 mg/kg. The southern excavation limits of excavation areas B20, A2, and B11 were restricted by the presence of a 72-inch concrete storm water line owned by WSDOT. Seventeen sidewall samples were collected along the utility easement to define the area of remaining impact. Of these 17 samples, five contained concentrations of TPH and/or cPAHs in excess of the CULs and RELs. Due to concerns about potentially compromising the storm water line, these excavations were not extended to remove the additional impacted soil. However, the excavations were left open to permit LNAPL recovery as described in Section 4.4.3, and once LNAPL was no longer observed on groundwater in this area, a 20 mil thick plastic liner was placed along the length of the southern excavation limit from approximately 10 feet bgs (2 feet below groundwater) to ground surface. The excavation was then backfilled with appropriate material as described in Section 7 above. The location of the 20-mil liner is shown on **Figure 10**.

Sample EX-B18-VV-1-6SW, collected on the excavation sidewall of area B18, exceeded the site specific TPH REL with a concentration of 4,980 mg/kg. This sample could not be over-excavated without encroaching on BNSF property and compromising the integrity of the BNSF rail line. Sidewall and floor samples collected on either side of this sample, as well as floor samples collected directly adjacent to this sample contained concentrations of TPH, cPAHs, and benzene less than the CULs and RELs. The remaining TPH concentration is less than two times the REL.

Sidewall samples EX-B8-H-4-WSW-4 and EX-B8-I-4-WSW-4 collected from the northwest sidewall of excavation area B8, contained concentrations of TPH (3,270 mg/kg and 4,640 mg/kg, respectively), exceeding the site specific TPH REL. These sample locations could not be over-excavated due to their proximity to Willow Creek. A 20 mil plastic liner was placed along the northwest sidewall between the impacted soil remaining in place and the clean backfilled soil. The remaining soil and liner were excavated during Phase II excavation activities.

The locations of sample containing IHS' exceeding one or more of the CULs or RELs, and not removed during Phase I remedial activities are shown on **Figure 5**, **Figure 6,** and **Figure 7**.

8.1 Statistical Analysis and Overall Site Status

Comparisons of Phase I confirmation soil sampling data to the RELs established for cPAHs and TPH were based on MTCA *Statistical Guidance for Ecology Site Managers* (Ecology 1992) (MTCA Guidance). The methods and approaches described in the MTCA Guidance reflect WAC 173-340-740 regarding the comparisons of observed soil concentrations to a criterion. Table 13 of the MTCA Guidance provides a flowchart summarizing the methods relevant to soil. In it, the decision process is provided for selecting the appropriate methods, and that guidance was used as a starting point for the analyses conducted herein. The methods and results are described below.

8.1.1 Data Sets

Of the 504 samples collected and analyzed for cPAHs and TPH, only those data associated with soil remaining after the Phase I excavation were included in the analyses. This choice was based on the rationale that samples collected from soil that was subsequently excavated no longer represent the site. Excavations conducted in Phase I removed soil from locations associated with 30 of the confirmation samples, for a resulting data set of 442 unique samples (duplicates were averaged). Of these remaining 442 samples, three exceeded the TPH criterion (EX-A2-N-16-SSW-6, EX-A2-O-15-SSW-6, and EX-B20-M-17-SSW-6). Note that three of these samples were associated with soil that was later removed in Phase II excavations. One of these three samples exceeded the cPAH criterion, but because this exceedance was a result of detection limit concentrations, this sample was not included in the MTCA statistical analysis; the remaining two samples were included in the analysis.

8.1.2 Methods

MTCA requires that, for comparisons to chronic cleanup criteria, the 95 percent upper confidence limit of the population mean (95 UCL) must be less than the specified criterion (WAC 173-340-740[7][c][iv][B]). WAC specifies that the calculation be based on an assumption that the data are lognormally distributed. In the event that the data are not lognormally distributed, WAC specifies that the data be tested for normality and the UCL calculation based on the determination that the data are from *either* a normal or lognormal distribution (WAC 173-340-740[7][d][i][B]). A variety of methods are specified in WAC to be "used to determine whether the data are lognormally or normally distributed…" In addition, MTCA provides methods to calculate the 95 UCL in the case of either distributional assumption. However, MTCA does not provide methods to calculate the 95 UCL in the case where neither distributional assumption is met.

MTCA has the additional requirements that no single sample has a concentration greater than two times the soil cleanup criterion (WAC 173-340-740[7][e][i]) and less than 10 percent of the samples have concentrations exceeding the criterion (WAC 173-340-740[7][e][ii]). For the requirement that no sample exceeds twice the criterion, MTCA provides for an adjustment to control the false positive error rate, but only when the criterion is based on a distribution of background concentrations.

The EPA and others have conducted a substantial amount of research in recent years into the statistical characterization of environmental data (EPA 2007b). A software package (ProUCL) developed by the EPA for the calculation of statistical tests relevant to the comparison of environmental data to criteria or background data (EPA 2007a) was used to calculate the 95 UCL. The methods implemented by ProUCL represent the current state of the practice for the calculation of 95 UCLs.

ProUCL uses the Anderson-Darling and Kolmogorov-Smirnov test statistics for comparison of the observed data to normal and gamma distributions and the Lilliefors test for comparison to the lognormal distribution. These distribution goodness-of-fit tests may be performed on data sets containing samples whose concentrations are reported at their detection or reporting limit (i.e., “non-detects”). ProUCL provides a full suite of methods for the treatment of these non-detects, and these methods were employed to control the influence of non-detects on the distribution tests.

ProUCL provides for several approaches to calculating the 95 UCL depending on whether the data are determined to be samples from a normal, lognormal, or gamma distribution, or from an undefined distribution, in approaches reflecting the guidance of EPA 2007b. Specifically, a nonparametric approach based on the theorem of Chebyshev’s inequality was used when the distribution of sample data could not be determined to be either normally or lognormally distributed, whether that distribution was determined to likely be from a gamma distribution or undefined. EPA guidance notes, “The Chebyshev’s inequality can be used to obtain a reasonably conservative but stable estimate of the UCL of the mean…” (EPA 2007b).

The requirement that no more than 10 percent of the data exceed the cleanup criterion was tested by the equivalent comparison of the 90th percentile of observed data to the criterion. If this statistic is less than the cleanup criterion, the requirement is satisfied. The 90th percentile of the sample data was calculated using SYSTAT (SYSTAT 2007).

Analytical results reported at their detection limit – “non-detects” – were treated in two different ways. For the calculation of total cPAH scaled to benzo-a-pyrene, non-detects were included at one-half their detection limit, as directed in MTCA.

However, for the statistical calculations of TPH, the non-detects were included at their detection limit. This difference in treatment was used to reflect current state of the practice, including the statistical methods used in ProUCL. This difference affects only the summary estimate of average concentration, by increasing that value, and in the calculation of the 95 UCL. EPA's ProUCL provides methodology for treating the non-detects in distributional estimates using more sophisticated uncensoring methods. The same uncensoring approach cannot be applied to the summation of PAHs to calculate cPAHs. This is because each chemical arises from a different unknown distribution, and the unique value associated with a chemical in a given sample is unknown; uncensoring methods are only used to estimate the representations of the overall distribution (e.g., the mean), and not the true uncensored value of a particular observation.

8.1.3 Results

The distributional tests of ProUCL's 95 UCL module identified the cPAHs and TPH concentration data sets in samples remaining after Phase I excavation as "not following a discernable distribution." Based on these tests, the 95 UCL estimates were calculated using the nonparametric approach described above. The summary statistics, MTCA test results for cPAHs and TPH, goodness-of-fit tests, and 95 UCL estimates are provided Table E1 and E2 in Appendix E.

The results may be summarized as follows:

- For both cPAHs and TPH, the 95 UCL estimates are below the cleanup criteria.

- For both cPAHs and TPH, less than 10 percent of the observations exceed the cleanup criteria.

- Three observations are more than two times the cleanup criterion for TPH (EX-A2-N-16-SSW-6, EX-A2-O-15-SSW-6, and EX-B20-M-17-SSW-6) (Table E1); all three samples were collected along the WSDOT storm water line.

The Phase I data sets are in compliance with the established cleanup criteria, with the exception of three sample locations exceeding the two times criterion rule. It is noted here that the TPH data set contains N=442 observations, and the three exceedances represent approximately the upper 0.5 percentile of the empirical distributions based on these data.

9. Data Validation

As outlined in the *Sampling and Analysis Plan* (SAP) (SLR, 2007), the laboratory submitted summary data and quality assurance information to permit independent and conclusive determination of data quality. The determination of data quality was performed using the Laboratory Data Validation Guidelines for Evaluating Inorganic Analyses (USEPA, 1994a) and the Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses (USEPA, 1994b), as guidelines for data review.

Laboratory deliverable requirements for the chemical analyses included the information outlined below:

- A cover letter for each sample batch that includes a summary of any quality control, sample, shipment, or analytical problems, and documentation of all internal decisions. Problems were outlined and final solutions documented. A copy of the signed chain of custody form for each batch of samples was included in the narrative packet.

- Sample concentrations reported on standard data sheets in proper units and the appropriate number of significant figures. For undetected values, the lower limit of detection for each compound was reported separately for each sample. Dates of sample extraction, preparation and analysis were included.

- A method blank summary.

- Surrogate percent recovery was calculated and reported.

- Duplicate sample analytical results.

- Matrix spike/matrix spike duplicate percent recoveries, spike level, and relative percent difference.

- A list of the detection limits calculated for the laboratory instruments for all compounds.

Sample holding times were calculated by comparing the date of sample collection (shown on the chain of custody form) with the date of sample analysis. ARCADIS completed a full data quality review of laboratory deliverables, and completed separate Data Validation Reports, which are attached as **Appendix I**.

Based on the ARCADIS review of laboratory reports, the overall system performance was acceptable, and the overall data quality was within the guidelines specified in the SAP (SLR, 2007). No data were marked as unusable.

10. Remaining Areas for Excavation

Phase II of the Work Plan was conducted during the summer and fall of 2008. This work included the excavation of sediment from approximately 400 feet of Willow Creek as well as removing material between the creek and excavations B7, B8, and B9 which remained from Phase I. Excavation B1 in the southeast Lower Yard, which was started during Phase I but deferred due to inclement weather and its proximity to Willow Creek, was also completed during Phase II.

As a result of the two failed confirmation boring samples that were installed at the end of Phase I, an additional excavation in the Former Railroad Trestle area in the southwest Lower Yard was completed in Phase II. Also, based on additional assessment work completed following Phase I (to be described under separate cover), an additional excavation was completed in the area of the former asphalt warehouse. The remaining areas planned for excavation during Phase II are shown on **Figure 11**. A report summarizing Phase II activities will be submitted in spring 2009, in accordance with the reporting requirements in the Agreed Order.

11. Summary

From July 2007 to April 2008, approximately 108,000 tons of petroleum and/or arsenic-impacted soil and approximately 9,700 gallons of LNAPL were removed from the Lower Yard as part of Phase I of the Interim Action. Also, seven crushed drums, drum remnants, and tons of concrete and piping debris were removed from the site. Approximately 68,736 tons of vadose zone sand backfill and 40,910 tons of saturated zone gravel backfill were used on site.

Of the 470 confirmation soil samples collected during Phase I, 462 contained concentrations less than the established CULs or RELs. Statistical analysis based on MTCA Guidance established that 95 UCL estimates are below the CULs and less than 10 percent of the observations exceed the CULs. However, three TPH measurements, for samples EX-A2-N-16-SSW-6, EX-A2-O-15-SSW-6 and EX-B20-M-17-SSW-6, are greater than two times their respective CULs.

Phase I activities successfully removed petroleum-hydrocarbon-impacted soil from the Terminal Lower Yard. Of the eight samples that contained concentrations above CULs or RELs, six of them are from areas not planned for additional removal efforts during Phase II. These areas are located along the WSDOT storm water line (five samples) and in excavation B18 (one sample). Due to concerns of compromising infrastructure owned by others (e.g., the rail line and the storm water line), additional excavation in excavation B18 and in the area of the WSDOT line were not completed during the Phase II excavation activities. For excavation B18, the statistical analysis for the soil remaining based on MTCA Guidance indicates that that 95 UCL estimates are below the CULs/RELs, and less than 10 percent of the observations exceed the CULs/RELs.

The single failed sample (EX-B18-VV-1-6SW, 4,980 mg/kg TPH) was less than 2 times the applicable CUL/REL. However, in the area along the WSDOT storm-drain line, one cPAH measurement and three TPH measurements are more than two times their respective CULs/RELs (EX-A2-N-16-SSW-6, EX-A2-0-15-SSW-6 and EX-B20-M-17-SSW-6).

Subsequent to Phase I remedial activities, additional assessment activities, as outlined in *Evaluation of Lower Yard Phase I Data and Work Plan for Additional Site Investigation* (ARCADIS 2008), were completed to assess the extent of remaining impacted soil around the WSDOT storm water pipe, potential soil impact in the area of the former asphalt warehouse, potential additional soil impact in the area around MW-129, and soil immediately west of Detention Basin DB1. This work was completed in summer 2008 and the results of these activities will be described in a separate report to be submitted in spring 2009 in accordance with the reporting schedule outlined in the Agreed Order.

Areas planned for excavation during Phase II included approximately 400 feet of Willow Creek, extending excavations B7, B8, and B9 toward Willow Creek, completion of excavation B1 in the southwest Lower Yard, the Former Railroad Trestle area in the southwest Lower Yard, and the area of the former asphalt warehouse. As noted above, this work was completed in summer and fall 2008; a report documenting the activities will be submitted in spring 2009 in accordance with the reporting schedule outlined in the Agreed Order.

Alternatives to address the remaining soil concentrations along the WSDOT line are currently being evaluated. The remaining concentrations will be considered along with planned future use of the property, the additional assessment data collected in spring 2008, as well as dissolved-phase concentrations in this area to determine an appropriate approach. These alternatives will be presented, in the site Feasibility Study.

12. References

ARCADIS. 2007a. *Operation, Maintenance, and Monitoring Plan – Temporary Treatment System.* ARCADIS, BBLES, Inc. August, 2007.

ARCADIS. 2007b. *Proposed Modification of Sampling and Analysis plan – Import Soil Stockpile*. ARCADIS, BBLES, Inc. September, 2007.

ARCADIS. 2008. *Evaluation of Lower Yard Phase I Data and Work Plan for Additional Site Investigation*. ARCADIS U.S., Inc. July 2008.

Cal-EPA. 2005. *Air Toxics Hot Spots Program Risk Assessment Guidelines, Part II Technical Support Document for Describing Available Cancer Potency Factors*. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. May 2005.

Ecology. 1992. *Statistical Guidance for Ecology Site Managers*. Washington State Department of Ecology: Toxics Cleanup Program. Publication 92-54.

EPA. 2007a. *ProUCL Version 4.0 User Guide*. Office of Research and Development. EPA/600/R-07/038. April.

EPA. 2007b. *ProUCL Version 4.0 Technical Guide*. Office of Research and Development. EPA/600/R-07/041. April.

MFA. 2002. *Lower Yard Interim Action Report – Volume 1*. November 30, 2002. Maul, Foster & Alongi, Inc.

MFA 2004. Draft 2003 Lower Yard interim Action As-Built Report, Unocal Edmonds Terminal. February 26, 2004. Maul, Foster & Alongi, Inc.

SYSTAT. 2007. SYSTAT Statistics. SYSTAT Software, Inc. San Jose, CA.

SLR. 2007a. *Interim Action Report - Work Plan for 2007 Lower Yard Interim Action, Unocal Edmonds Bulk Fuel Terminal*. June 25, 2007. SLR International Corporation.

SLR. 2007b. *Sampling and Analysis Plan*. July 5, 2007. SLR International Corporation.

ARCADIS

Appendix A

Daily Work Logs
Available on Attached CD

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Appendix B

Soil Waste Manifests
Available on Attached CD

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Appendix C

Laboratory Analytical Reports and Chain-of-Custody Documentation

Available on Attached CD

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Appendix D

LNAPL Waste Manifests
Available on Attached CD

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Appendix E

Statistical Analysis

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Appendix F

Confirmation Boring Logs

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Appendix G

Soil Compaction Results
Available on Attached CD

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Appendix H

Data Validation Packages
Available on Attached CD