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Chevron Environmental Management Company

Cleanup Levels and Remediation Levels Report

Former Unocal Edmonds Bulk Fuel Terminal

11720 Unoco Road

Edmonds, Washington

September 17, 2013

ARCADIS

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CULs and RELs Report

Former Unocal Edmonds Bulk Fuel Terminal

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1. Introduction

On behalf of Chevron Environmental Management Company (Chevron), ARCADIS U.S., Inc. (ARCADIS) is pleased to submit this Cleanup Levels and Remediation Levels Report (Report) for the Former Unocal Edmonds Bulk Fuel Terminal (Site), located at 11720 Unoco Road, Edmonds, Washington (**Figure 1**). This Report is being submitted under Agreed Order (No.DE 4460) which requires the Union Oil Company of California (Unocal), a wholly owned indirect subsidiary of the Chevron Corporation, to conduct an Interim Action to remediate soil, groundwater and sediments, and to monitor groundwater in the Lower Yard. This Report has been prepared to evaluate the cleanup levels (CULs) and remediation levels (RELs) previously established for the interim actions conducted at the Site for implementation of the Order (see Exhibit B of the Order). Based on this evaluation, the existing CULs for groundwater and surface water are confirmed. However, the previous soil RELs were re-evaluated and re-calculated using current guidance and tools available under Washington State's Model Toxics Control Act (MTCA). The revised soil CULs/RELs are presented in Section 3.2.4.

Previous remedial actions conducted between 2001 and 2008 have addressed potential impacts in the Upper Yard, Lower Yard and in the sediments of Willow Creek. The Conceptual Site Model Report (CSM) (ARCADIS, 2013a) evaluated remaining impacts, potential fate and transport of these remaining impacts, and potential receptors and exposure pathways. The CSM also summarizes information from historical Site documents including facility historical reports, Site investigations, and Interim Action activities. Please refer to the CSM for the summary and to the historical documents for the historical data, tables, figures, and laboratory reports.

1.1 Report Organization

This Report includes (together with this introduction, tables, and figures) the following sections:

- Section 2 – Site Description and History: Describes the three areas of the Site and historical facilities, operations, and releases. Summarizes historical property ownership and regulatory actions including the Agreed Order.

- Section 3 – Cleanup Standards: Provides an evaluation of CULs and RELs.

- Section 4 – Conclusion: Provides conclusions from the evaluation of CULs and RELs.

- Section 5 – References: Provides references for the Report.

2. Site Description and History

As defined in the Agreed Order, the Site consists of three areas, the Upper Yard, the Lower Yard and the Willow Creek Fish Hatchery (fish hatchery). Each area is currently a separate property that was once owned by Unocal. The Upper and Lower Yards were operational areas of the former terminal. The fish hatchery was included in the Agreed Order, but was not an operational or storage facility and is currently owned by the City of Edmonds. The Upper Yard is owned by Point Edwards LLC and was remediated to cleanup standards identified in the Agreed Order in 1993 and is now the location of a condominium complex. Chevron is in Escrow with the Washington State Department of Transportation (WSDOT) for the Lower Yard which was remediated in 2007 to 2008 under an Interim Action and is the subject of ongoing monitoring per the Agreed Order. The Lower Yard is the focus of this Report. Background information for the Lower Yard is provided below.

2.1 Lower Yard Description

The Lower Yard is approximately 22 acres in area, located north of the Upper Yard (**Figure 2**). The western boundary of the Lower Yard is the BNSF Railway (BNSF) property, and the northwestern boundary is Willow Creek and the BNSF Railway. Further west of the Lower Yard is the Port of Edmonds Marina and Puget Sound. North and northeast of the Lower Yard are the Edmonds Marsh (also known as the Union Oil Marsh) and Willow Creek. East of the Lower Yard is the Edmonds Marsh and Willow Creek, and southeast is the Willow Creek Fish Hatchery. At its nearest point (the southwest corner of the Lower Yard), the Lower Yard boundary is approximately 160 feet from the Puget Sound shoreline.

Historical Lower Yard features are shown on **Figure 3**. The Lower Yard is currently a vacant property with no permanent aboveground structures. A temporary storage shed is located along Unoco Road in the central portion of the Lower Yard. The ground surface is compact dirt, gravel and natural vegetative cover. The Lower Yard is currently zoned master plan hillside mixed-use zone 2 (MP2), which would allow for use as mixed general residential and commercial uses, but which prohibits residential use on the ground floor of any building.

Two stormwater detention basins [Detention Basin No.1 (DB-1) and (DB-2)] are located along the east and northeast boundaries of the Lower Yard. A stormwater system consisting of 12 storm drains collects surface water runoff and discharges collected stormwater directly into DB-2 via gravity flow. DB-2 serves as a stormwater collection

area from which Lower Yard stormwater is discharged into Willow Creek under Industrial Stormwater General Permit No. SO3-002953C. DB-1 acts as a retention pond for overflow from DB-2 during storm events. DB-1 is bounded to the northwest, northeast, and southeast by a manmade berm. The berm runs along the eastern property boundary, adjacent to Willow Creek. DB-1 and DB-2 form depressions approximately 6 feet and 4 feet deep, respectively. DB-1 is an un-lined pond with one above ground pump and a piping system to the DB-2 outfall on the bank of Willow Creek. DB-2 has an impermeable liner, and two submersible pumps and a piping system to the DB-2 outfall.

Willow Creek runs along the northern portion of the western boundary and the entirety of the eastern boundary of the Lower Yard. The creek banks on the Site property boundary are steeply sloped and vegetated with native and non-native vegetation.

A WSDOT-owned, stormwater line crosses beneath the Lower Yard and discharges to Puget Sound, at a reported depth of 9 to 12 feet below ground surface (bgs) to the top of the pipe. The stormwater line generally runs along the northern edge of Lower Unoco Road and trends west across the Lower Yard to the tidal basin leading to Puget Sound. This line was installed between 1972 and 1975 and is a major stormwater drainage structure for State Route 104. In addition, the storm drain line connecting the Point Edwards stormwater retention pond to the tidal basin leading to Puget Sound runs parallel to the WSDOT stormwater line across the Lower Yard., This line is made of corrugated metal and is located approximately 3 to 5 feet bgs. The Lower Yard is shown on **Figures 2 and 3**.

2.2 Lower Yard Regulatory and Ownership History

In 1993, Unocal entered into an Agreed Order (No. DE92TC-N328) with the Washington State Department of Ecology (Ecology). Under this Agreed Order, Interim Actions were conducted in the Lower Yard during 2001 and 2003. This Agreed Order was later superseded by the current Agreed Order (No. DE4460). In July 2007, Unocal entered into an Agreed Order (No.DE 4460) with Ecology to conduct an interim remedial action at the Lower Yard. This Agreed Order superseded Agreed Order No. DE92TC-N328. The Agreed Order required Unocal to conduct an Interim Action to remediate soil, groundwater and sediments, and to monitor groundwater in the Lower Yard. The 2007 Agreed Order Interim Actions were conducted in two phases in 2007 and 2008.

2.3 Lower Yard Property Transfer

In January 2005, WSDOT and Unocal signed an Agreement of Sale of Real Property and Escrow Instructions (Agreement). The Agreement and the two amendments to the Agreement set forth the conditions precedent to the transfer of the property. Unocal's first step was the preparation of a Proposed Interim Action Report. This report set forth the Capital Remediation Work Unocal is to perform, and was submitted to Ecology as the Interim Action Report - Work Plan for 2007 Lower Yard Interim Action. Although Ecology is not a party to the Agreement, the Interim Action Report – Work Plan for 2007 Lower Yard Interim Action is included in the 2007 Agreed Order. Once the proposed work is performed, the Agreement calls for a Proposed Remediation Plan. This plan is to take the form of a Feasibility Study (FS) and will identify a set of remedial alternatives and monitoring work. The FS may also include additional Capital Remediation Work. Once the FS is accepted by Ecology, a Cleanup Action Plan (CAP) will be prepared by Ecology. Once Ecology is satisfied that the Capital Remediation requirements of the CAP have been met, the Agreement calls for Ecology to provide a written acknowledgment that Unocal has completed the Capital Remediation Work. The Agreement states that Ecology's confirmation is deemed conclusive evidence that Unocal has satisfied its obligations to perform the Capital Remediation Work called for under the Agreement.

2.4 2007/2008 Interim Action

The 2007/2008 Interim Action excavation activities were conducted in two phases from July 2007 to April 2008 (Phase I), and July 2008 to October 2008 (Phase II), in accordance with Agreed Order No. DE 4460 (SLR Inc., 2007). Prior to remediation light non-aqueous phase liquid (LNAPL) was present in several areas of the Lower Yard. In addition, concentrations of Total Petroleum Hydrocarbon (TPH), benzene, carcinogenic poly-aromatic hydrocarbons (cPAHs), and arsenic (surface soil only) exceeded soil and/or groundwater cleanup levels across much of the Site (ARCADIS, 2013a).

Phase I Interim Action work consisted of the removal of 108,000 tons of petroleum impacted soil for offsite disposal, and the removal of approximately 9,700 gallons of LNAPL from the groundwater surface in open excavations. During Phase I excavation activities, 438 confirmation soil samples were collected from the floors and sidewalls of the excavation areas for TPH analysis. CULs/RELs were met in 430 of 438 confirmation samples, and eight of the confirmation samples contained concentrations of Indicator Hazardous Substances (IHSs) exceeding applicable CULs/ RELs. Soils in the area where those samples were taken were not over-excavated during Phase I

activities in order to preserve the integrity of onsite structures or due to Site constraints (ARCADIS, 2009). Soils in the areas of two of these eight samples were later over-excavated during Phase II activities; however, the six remaining locations were not over-excavated because of onsite structures or Site constraints. One sample location in the southwest Lower Yard (EX-B18-VV-1-6SW) contained a total TPH concentration of 4,980 milligrams per kilogram (mg/kg), exceeding the previous REL of 2,975 mg/kg. Soils in the area of this sample were not over-excavated because of its location on the property boundary between the Lower Yard and BNSF right-of-way. Soil was removed up to the property boundary, but excavation activities were ceased in order to maintain the integrity of the BNSF rail line.

The remaining five soil sample locations containing IHS concentrations greater than Site CULs/RELs are located adjacent to, and north of the WSDOT stormwater line which is located in the south-central portion of the Lower Yard, along lower Unoco Road. The remaining five soil sample locations exceeding the previous Site REL for total TPH of 2,975 mg/kg and/or CUL for cPAHs of 0.14 mg/kg are: samples EX-B11-U-SSW-5 (0.159 mg/kg, cPAH), EX-Q2-Q-14-6 (3,060 mg/kg, total TPH), EX-A2-O-15-SSW-6 (7,540 mg/kg, total TPH), EX-A2-N-16-SSW-6 (7,550 mg/kg, total TPH) and EX-B20-M-17-SSW-6 (0.166 mg/kg cPAH and 15,700 mg/kg, total TPH). These sample locations were not over-excavated in order to preserve the integrity of the WSDOT stormwater line. At the completion of Phase I excavation activities, the excavation sidewall along the WSDOT stormwater line was demarcated with 20 thousandths of an inch (20-mil) thick plastic sheeting prior to backfilling.

As part of Phase I activities, arsenic impacted soils were excavated and removed from the southwest Lower Yard, beneath the former Unocal railroad trestle. This area contained arsenic impacted soil associated with sandblasting of the pipelines prior to their removal, and was the only remaining metals-impacted area at the Site. This area was excavated to 2.5 feet bgs, where confirmation samples were collected containing concentrations of arsenic less than the arsenic CUL of 20 mg/kg.

During Phase I construction activities, approximately 9,700 gallons of LNAPL were recovered and removed from the Site, and approximately 2 million gallons of groundwater were extracted, treated onsite, and discharged under a National Pollutant Discharge Elimination System (NPDES) Permit to Willow Creek. The complete results of the 2007/2008 Phase I Interim Actions are summarized in Phase I Remedial Implementation As-Built Report, Unocal Edmonds Bulk Fuel Terminal Lower Yard (ARCADIS, 2009).

Phase II Interim Action work was performed between July and October 2008 and consisted of the removal of 14,825 tons of petroleum impacted soil for offsite disposal, removal of 131 gallons of LNAPL, removal and treatment of approximately 520,000 gallons of groundwater, and the removal of 2,000 tons of sediment from Willow Creek (ARCADIS, 2010).

During Phase I and Phase II of the 2007/2008 excavation activities, a total of 512 confirmation soil samples were collected from sample locations at the final extent of the excavation areas. Results from confirmation soil samples are as follows:

- Concentrations of all TPH constituents [TPH – diesel range organics (DRO), TPH – heavy oil range organics (HO), and TPH – gasoline range organics (GRO)] were less than laboratory detection limits in 261 of these samples. Total TPH concentrations were less than the previous TPH REL of 2,975 mg/kg in 507 of the 512 samples. Concentrations of total TPH exceeded the REL in five samples, with concentrations in two samples greater than the previous REL but less than two times the previous REL (EX-A2-Q-14-6 [3,060 mg/kg] and EX-B18-VV-1-6SW [4,980 mg/kg]), and concentrations in three samples exceeding two times the previous REL (EX-A2-O-15-SSW-6 [7,540 mg/kg], EX-A2-N-16-SSW-6 [7,550 mg/kg] and EX-B20-M-17-SSW-6 [15,700 mg/kg]).

- Two additional samples exceeded the CUL for cPAHs adjusted for toxicity with concentrations that are greater than the CUL but less than two times the CUL (EX-B11-U-10-SSW-5 [0.159 mg/kg] and EX-B1-F-44-4 [0.212 mg/kg].

- In addition to the above exceedances in confirmation soil samples, during the installation of monitoring well MW-129R, a soil sample was collected at a depth of 7 feet bgs that contained a concentration of total TPH at 3,010 mg/kg. This is 1.01 times the previous TPH REL of 2975 mg/kg.

- The 2007/2008 Interim Action excavation areas included areas from the 2003 excavations that exceeded the TPH CUL and were not over-excavated in 2003 including sample STRM. 2WALLE (4,913.3 mg/kg). However samples STRM-4WALLE (2) (15,388 mg/kg), and STRM-6FLOOR (17,439 mg/kg) were not over excavated. Both of these samples are located within the area of known soil impacts surrounding the WSDOT storm drain line.

As the result of Interim Action excavation activities and confirmation sampling, multiple Site investigations and groundwater monitoring activities, each area of the Lower Yard containing soils, groundwater or sediments with concentrations of Site IHSs greater than applicable CULs/RELs is believed to have been fully delineated as described in the CSM (ARCADIS 2013a). Remaining impacts at the Site are limited to subsurface soil and groundwater in the vicinity of DB-2, the WSDOT stormwater line, Point Edwards storm drain line, southwest Lower Yard near BNSF tracks, southeast Lower Yard upgradient of MW-136, and MW-129R location in the Lower Yard Area as shown on **Figures 4, 5 and 6**.

3. Cleanup Standards

A cleanup standard consists of the following three elements [Washington Administrative Code (WAC) 173-340-700(3)]:

- CUL, the concentration that must be met to protect human health and the environment,
- Point of compliance (POC), the location where the CUL must be achieved,
- Other regulatory requirements commonly referred to as applicable or relevant and appropriate requirements (ARARs), that apply to the Site because of the type of action or the location of the Site. ARARs were addressed as part of the Interim Action.

The cleanup standards developed for and used during interim action work are documented in the Interim Action Work Plan (IAWP, SLR Inc., 2007, which is Exhibit B to Agreed Order 4460). The cleanup standards were developed utilizing a Model Toxics Control Act (MTCA) Method B approach and included the use of RELs as part of the Interim Action soil removal. The CULs, RELs, and POCs are presented in this section.

3.1 Indicator Hazardous Substances

IHSs are the chemicals expected to account for most of the risks at a site, and cleanup standards must be developed for each IHS in each medium. The IHSs for sediment, surface water, groundwater and soil were developed in accordance with WAC 173-340-703 as documented in the IAWP. The IHSs are presented in this section.

3.1.1 Indicator Hazardous Substances for Sediment

Sediment chemistry data were compared with sediment management standards (SMS) (Chapter 173-204 WAC) to identify IHSs for sediments. Prior to the Interim Action, the only contaminant known to be present at a concentration greater than the SMS was total PCBs at a single sample location (US-07), which was located near the Terminal's stormwater outfall #002. Because of the presence of petroleum hydrocarbons in sediments and the possibility of a groundwater-to-sediments-to-surface water pathway, several additional chemicals or compound groups were designated as tentative IHSs (TPH, PAHs, and metals) (SLR Inc., 2007).

According to the SMS, sites with sediments that exceed numeric chemical criteria may go through confirmatory biological testing. In 2003, biological testing of sediment samples was completed to identify areas of sediment toxicity to help delineate the extent of sediment removal. Sediment samples were collected from 16 locations (US-01 through US-16) in all areas of Willow Creek. These samples were analyzed using a suite of chemical analyses and bulk chemistry analyses. Due to elevated TPH concentrations, bioassay toxicity testing was conducted on sediment samples from six of the locations. The results showed that the toxicity at two sample stations located near the Lower Yard outfalls into Willow Creek adjacent to the oil/water separator and DB-2 (US-05 and US-07) exceeded cleanup screening levels (CSLs), and the sediment toxicity at the upstream (background) station adjacent to the southeast Lower Yard (US-15) prevented use of this station as a reference station for two of the three bioassay test species. Based on 2003 sediment sample data, IHSs were not identified for sediments and sediment CULs were not established for Willow Creek (SLR Inc., 2007). The Interim Action included the removal of sediment that failed bioassay tests due to onsite contaminant/toxicity sources (at stations US-05 and US-07).

After the Interim Action, three sediment samples were collected from Willow Creek on July 30, 2012, to assess sediment toxicity conditions in the vicinity of 2003 sediment sampling location US-15, as described in the CSM (ARCADIS, 2013a). Chemical analytical results of the sediment samples were evaluated to determine if bioassays should be performed on the samples. This determination was made by comparing the results to the SMS (Chapter 173-204 WAC) Sediment Quality Standards (SQS) and CSLs. Based on the evaluation of the data, which showed that all results for the 2012 sediment samples were below the SMS, SQS, and the CSLs, or lowest apparent effects threshold (LAET), a recommendation was made to Ecology that bioassay testing was not necessary. On August 9, 2012, Ecology concurred that bioassay testing was not needed and that no further cleanup of Willow Creek is required unless

Willow Creek subsequently becomes contaminated by impacts currently remaining onsite. (ARCADIS, 2013a).

3.1.2 Indicator Hazardous Substances for Surface Water and Groundwater

The groundwater beneath the Site is considered non-potable. See Agreed Order 4460, Exhibit B, §5.4.1 for a discussion of this determination. The endpoint for groundwater is protection of Willow Creek, a tidally-influenced stream, and Puget Sound.

Since the endpoint for groundwater CULs is protection of surface water, a combined list of groundwater/surface water IHSs was developed (See Agreed Order 4460, Exhibit B, §5.1). TPH, benzene, chrysene, lead, zinc, and tentatively arsenic and copper were screened as potential IHSs. Concentrations of arsenic, copper, lead, and zinc in the surface water of Willow Creek were compared against screening levels to determine if the metals should be retained as surface water IHSs. The samples collected in April, 1996 and October, 2003 did not contain dissolved copper, lead, and/or zinc concentrations above their screening levels. These results support eliminating copper, lead, and zinc as surface water IHSs. The arsenic concentrations in all of the October, 2003 samples were above the screening level, therefore, arsenic was retained for further analysis. After additional evaluation of the samples, the sampling results indicated that the arsenic concentrations in all of the samples reflect the upstream concentrations that flow into the Site (background conditions), and that the groundwater beneath the Lower Yard is not increasing the arsenic concentrations in the Willow Creek. On this basis, arsenic was eliminated as an IHS for surface water.

The final list of surface water and groundwater IHSs is as follows:

- TPH (sum of GRO, DRO, and HO concentrations)
- Benzene
- Toxicity-adjusted total cPAHs [sum of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene concentrations that are

adjusted using toxicity equivalency factors to represent a total benzo(a)pyrene concentration[1]]

3.1.3 Indicator Hazardous Substances for Soil

In the IAWP, IHSs were identified for the following four endpoints considered for soil: terrestrial ecological evaluation (TEE), direct human contact (incidental ingestion), leaching to groundwater, and residual saturation.

For the TEE and residual saturation concentrations (Csat), GRO, DRO, HO, benzene, chrysene, and arsenic were considered as potential IHSs. Because residual saturation is relevant only to organic chemicals that are liquid at ambient soil temperatures, arsenic was eliminated as an IHS for residual saturation. In addition, cPAHs, which do not exist as a liquid at ambient soil temperatures,(exist as needles and platelets), were also eliminated as IHSs for residual saturation. The final soil IHSs for the TEE and residual saturation are:

- TPH constituents: GRO, DRO, and HO
- Benzene
- CPAHs (TEE only)
- Arsenic (TEE only)

For RELs and CULs based on direct human contact and for evaluating the leaching pathway, GRO, DRO, HO, benzene, and cPAHs were considered in combination so that a single TPH REL could be developed. A separate soil REL for benzene and a separate CUL for toxicity-adjusted total cPAHs were also developed to ensure compliance with the MTCA Method B risk target for individual carcinogens ($1x10^{-6}$) [WAC 173-340-705(2)(c)(ii)]. Arsenic was evaluated for direct contact but not for leaching because arsenic is not an IHS for groundwater or surface water. The final soil IHSs for direct contact and the leaching pathway are:

[1] The toxicity equivalency factors published in CLARC Version 3.1 (Ecology, 2001) are used to make the adjustments.

- TPH (sum of GRO, DRO, and HO concentrations)
- Benzene
- Toxicity-adjusted total cPAHs [sum of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene concentrations that are adjusted using toxicity equivalency factors to represent a total benzo(a)pyrene concentration[2]]
- Arsenic (direct contact only)

3.2 Cleanup Levels and Remediation Levels

This section presents the CULs and RELs for sediment, surface water, groundwater, and soils.

3.2.1 Sediment Cleanup Levels

Sediment cleanup was based on bioassay data, as discussed in §3.1.1. After the Interim Action, Ecology concurred that the cleanup of Willow Creek is complete (ARCADIS, 2013a).

3.2.2 Surface Water Cleanup Standards

3.2.2.1 Endpoints for Cleanup Levels

Method B surface water CULs are endpoints for surface and groundwater at the Lower Yard [WAC 173-340-730(3)(b)]:

- Washington State Water Quality Standards (WQS) (Chapter 173-201A WAC) for marine water,

[2] The toxicity equivalency factors published in CLARC Version 3.1 (Ecology, 2001) are used to make the adjustments.

- National Recommended Water Quality Criteria (NRWQC) for marine organisms, and humans ingesting seafood,

- National Toxics Rule related to human health [40 CFR 131.36(c)(14)],

- For hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal standards, the MTCA Method B equation values for surface water.

The CULs applicable to the Site include the Washington WQS and NRWQC based upon use for aquatic organisms and humans exposure based upon ingestion of aquatic organisms (SLR Inc., 2007; ARCADIS, 2013a), NTR, and MTCA Method B levels for TPH. Willow Creek is tidally influenced and is not a source of drinking water.

3.2.2.2 Surface Water Cleanup Levels

The surface water CULs are presented in **Table 1** and represent the lowest of Washington State WQS (WAC 173-201A-240), NRWQC and the National Toxics Rule (40 CFR 131.36). The most stringent CULs for benzene and cPAHs are the NRWQC human-health (organisms only). The NRWQC human-health (organisms only) for benzene [51 micrograms per liter (µg/L)] is associated with a cancer risk of 2×10^{-6}, and the NRWQC for cPAHs (0.018 µg/L) is associated with a cancer risk of 6×10^{-7}. Under MTCA, standards are considered sufficiently protective standards if the cancer risk for those standards is less than 1×10^{-5}. Therefore, the NRWQC for benzene and cPAHs are appropriate surface water CULs [WAC 173-340-730(5)(b)].

State WQS and NRWQC are not established for TPH mixtures. MTCA allows the use of Method A groundwater CULs (WAC 173-340-900, Table 720-1) to be used to calculate surface water CULs for petroleum mixtures [WAC 173-340-730(3)(b)(iii)(C)].

MTCA Method A CULs for TPH were derived by setting a hazard index (HI) of 1 for all three TPH constituents (DRO, GRO and HO) and adjusting the compositions of each TPH constituent for each sample, on an individual basis. The CUL ranges from 500 to 800 µg/L, depending upon the fraction composition of the sample. The CUL calculation is as follows:

Total TPH CUL = 1/ (%GRO/800+%DRO/500+%HO/500)

Where:

Total TPH CUL = Overall CUL adjusted for HI=1

%GRO = Sample-specific percentage of GRO in groundwater, expressed as a decimal (i.e., 33% is entered as 0.33).

800 = Method A groundwater CUL for GRO (µg/L)

%DRO = Sample-specific percentage of DRO in groundwater, expressed as a decimal (i.e., 33% is entered as 0.33).

500 = Method A groundwater CUL for DRO and HO (µg/L)

%HO = Sample-specific percentage of HO in groundwater, expressed as a decimal (i.e., 33% is entered as 0.33).

The surface water CULs are as follows:

Table 1. Surface Water and Groundwater Cleanup Levels

Indicator Hazardous Substance	Surface Water and Groundwater Cleanup Level (µg/L)
Total TPH	-[1]
Benzene[2]	51
Total cPAHs[2,3]	0.018

Notes:
[1] Method A (WAC 173-340-900, Table 720-1); Total TPH calculated on a sample-specific basis. The CUL will fall between 500 and 800 µg/L, depending upon the sample's composition.
[2] NRWQC for human-health (organisms only) EPA, 2012. NRWQC. http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#hhtable. Accessed on March 10, 2013.
[3]Total cPAHs adjusted for toxicity based on WAC 173-340-708(8).

3.2.2.3 Surface Water Point of Compliance

The POCs for surface water CULs are the point or points where hazardous substances are released to surface water [WAC 173-340-730(6)]. These POCs are monitored by

23 compliance monitoring wells along the downgradient (western, northwestern, northeastern and eastern) perimeter of the Lower Yard, as shown on **Figure 7**. POC monitoring wells are located from the southwestern corner of the Lower Yard to the northern corner of DB-1, to the southeastern corner of the Lower Yard. Surface water and groundwater CULs are required to be met at POC monitoring well locations. The Lower Yard POC monitoring wells are listed below:

LM-2	MW-8R	MW-20R	MW-101	MW-104	MW-108
MW-109	MW-129R	MW-135	MW-136	MW-139R	MW-147
MW-149R	MW-150	MW-500	MW-501	MW-510	MW-518
MW-522	MW-523	MW-524	MW-529	MW-530	

3.2.3 Groundwater Cleanup Standards

3.2.3.1 Endpoints for Cleanup Levels

Groundwater beneath the Lower Yard has been determined to be non-potable (ARCADIS, 2013a; SLR Inc., 2007). As such, the endpoint for CULs is based upon a groundwater to surface water interface. The groundwater beneath the Lower Yard is hydraulically connected to Puget Sound. MTCA allows groundwater that is hydraulically connected to marine surface water to be classified as non-potable if the following five criteria can be met [WAC 173-340-720(2)(d)]:

- The groundwater does not serve as a current source of drinking water.
- Ecology determines that it is unlikely that the hazardous substances will be transported from the contaminated groundwater to groundwater that is or could be a source of drinking water.
- There are known or projected points of entry of the groundwater into the surface water.
- The surface water is not classified as a suitable domestic water supply source under Chapter 173-201A WAC.

- The groundwater is sufficiently hydraulically connected to the surface water that it is not practicable to use the groundwater as a drinking water source.

There are no drinking water supply wells located at the Lower Yard or between the Lower Yard and Puget Sound (SLR Inc., 2007). The IAWP determined that it is unlikely that the hazardous substances at the Lower Yard will be transported to an aquifer that could be used for drinking water (SLR Inc., 2007). Groundwater monitoring results demonstrate that the general direction of groundwater flow beneath the eastern part of the Lower Yard is toward Willow Creek, which discharges into Puget Sound, and the general direction of groundwater flow beneath the western part of the Lower Yard is toward Willow Creek and Puget Sound (ARCADIS, 2013a). Tidal response studies and salinity concentrations in the groundwater have shown that there is a clear hydraulic connection between the groundwater beneath the Lower Yard and the surface water in Willow Creek (directly connected to Puget Sound) (ARCADIS, 2013a). The groundwater beneath the Lower Yard, thus, is hydraulically connected to the Puget Sound, a marine body of water, which is not suitable for domestic water supply.

Based upon the above, the groundwater beneath the Lower Yard is non-potable under WAC 173-340-720(2). The endpoint for groundwater is protection of surface water in Willow Creek and Puget Sound.

3.2.3.2 Groundwater Cleanup Levels

Since the endpoint for groundwater is protection of surface water, the surface water CULs presented in Section 3.2.2.2 establishes the groundwater CULs for the Lower Yard.

3.2.3.3 Groundwater Point of Compliance

Previous interim actions consisting of excavation of impacted soil in various areas of the Site has demonstrated that groundwater cleanup levels can be met in a reasonable restoration timeframe within those areas. However, in areas of the Site where it may not be practicable to remediate soil (e.g., adjacent to the WSDOT storm drain line [MW-525]), groundwater is not anticipated to meet cleanup levels within a reasonable restoration timeframe throughout the Site. Therefore, a conditional point of compliance will be established at the property boundary under WAC 173-340-720(8)(c). Groundwater monitoring wells located at the property boundary will be used for compliance monitoring. The compliance monitoring wells and point of compliance boundary are shown on **Figure 7**.

3.2.4 Soil Cleanup Standards

Method B soil CULs are endpoints for the Lower Yard [WAC 173-340-740(3)(b)]: Six possible endpoints must be considered for soil:

- TEE
- Direct human contact (incidental ingestion)
- Leaching to groundwater
- Residual saturation
- Inhalation of soil vapors
- Dermal contact with soil

Previous soil RELs for the direct contact/dermal contact and leaching to groundwater pathways were calculated using a prior version of Ecology's Workbook for Calculating Cleanup Levels for a petroleum mixture (MTCATPH11). A revised version of Ecology's Workbook for Calculating Cleanup Levels for a petroleum mixture (MTCATPH11.1) was released by Ecology in December 2007, subsequent to the submittal of the June 2007 IAWP.

The calculation formulas used for the revised Workbook MTCATPH11.1 have not changed from those used in the previous Workbook MTCATPH11. However, several changes were made to the table of physical and chemical properties and the toxicological information for several petroleum fractions and individual hazardous substances, which affect the calculation results (Washington State Department of Ecology 2007).

CULs protective of the direct contact/dermal contact and leaching to groundwater pathways were re-calculated using the revised Workbook MTCATPH11.1 and are presented in sections 3.2.4.2 and 3.2.4.3 below. The remaining endpoints are also discussed below. The final soil CULs and RELs are summarized in Section 3.2.5. POCs for soil are addressed in Section 3.2.6.

3.2.4.1 Terrestrial Ecological Evaluation for Soil

A TEE evaluation in accordance with MTCA (WAC 173-304-7490 to -7493) for the Lower Yard was conducted in 2007 (SLR Inc., 2007). The Site-specific TEE calculated ecological indicator concentrations of 5,000 mg/kg for GRO, 6,000 mg/kg for DRO, 12 mg/kg for cPAHs [benzo(a)pyrene used as surrogate], and 7 mg/kg for arsenic in unsaturated soil were applicable [WAC 173-340-7493(2)(a)(i)

The arsenic cleanup level of 7 mg/kg is lower than the arsenic soil background concentration in the state of Washington (WAC 173-340-900, Table 740-1, footnote b), which is 20 mg/kg. Hence the TEE cleanup level for arsenic is 20 mg/kg. No table values exist for HO and benzene. These ecological-based concentrations are greater than or equal to the soil RELs (proposed CULs) used for the Interim Action, based on direct human contact with soil.

The TEE performed by SLR Inc. in 2007 was reviewed to assess whether or not the information used in the evaluation was outdated or required updating. This review consisted of comparing Site-specific data to the TEE exclusion criteria in WAC 173-340-4791(1) and evaluating the information used in the Site-specific TEE performed by SLR Inc.in 2007 under WAC 173-340-7491(2), including information obtained from the following sources:

- Edmonds Crossing Final Environmental Impact Statement (EIS);
- Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species database; and
- Washington State Department of Natural Resources' Natural Heritage Information System.

The information obtained from the sources listed above and the rationale used to establish the ecological indicator concentrations in the 2007 TEE was re-evaluated and determined to still be applicable to the Site. Therefore, the ecological indicator concentrations established during the 2007 TEE are still applicable to the Site. The 2007 TEE is included as **Appendix A**.

3.2.4.2 Direct Human Contact Soil Pathway

Soil CULs for direct human contact were developed in accordance with MTCA Method B, WAC 173-340-740(3)(b)(iii), Equations 740-2 and 740-3, Ecology's MTCASGL10 spreadsheet [for benzene, toxicity-adjusted total cPAHs (benzo(a)pyrene equivalents), and arsenic] (SLR Inc., 2007) and Ecology's MTCATPH11.1 spreadsheet for petroleum mixtures. No changes were made to the default exposure assumptions in any of the equations. The option for inclusion of dermal contact was not considered as presented in Section 3.2.4.6.

Based upon results of these calculations, the Lower Yard proposed TPH soil CUL based on direct contact is 2,775 mg/kg. This CUL was calculated based upon the median of the 14 fractionated samples collected during the 2003 assessment and Interim Action (SLR Inc., 2007). The CULs for the direct contact pathway for benzene and cPAHs, are based upon MTCA Method B direct contact [WAC 173-340-740(3)(b)(iii)(B)] and for arsenic adjusted to background [WAC 173-340-740-(5)(c)]. These CULs are 18 mg/kg for benzene, 0.14 mg/kg for toxicity-adjusted total cPAHs, and 0.67 for arsenic. The direct soil contact values are presented in **Table 2**. The MTCATPH11.1 Worksheet for Soil Data Entry and Calculation and Summary of Results for the 14 fractionated samples are presented as **Appendix B**.

3.2.4.3 Soil Leaching Pathway

To evaluate the leaching to groundwater pathway for TPH, the revised Workbook MTCATPH11.1 uses the three and four-phase partitioning models described in WAC 173-340-747 to calculate a CUL protective of potable groundwater. However, because groundwater beneath the Site is considered non-potable, a soil CUL protective of surface water quality is applicable. The revised Workbook MTCATPH11.1 includes a feature that will calculate a soil CUL that is protective of surface water quality by entering a target TPH groundwater concentration.

Using the results of the 14 fractionated samples discussed in § 3.2.4.2 and using a target TPH groundwater concentration of 561.3 µg/L (the average surface water CUL at the Site) (561.3 µg/L) the revised Workbook MTCATPH11.1 calculated a median value of "100% NAPL" (**Appendix B**). This indicates the TPH soil CUL exceeds the theoretical maximum TPH that would be reached if all of the available air space in the porous medium is filled with petroleum product. When "100% NAPL" is calculated as the leaching pathway CUL, the revised Workbook MTCATPH11.1 states that "soil-to-groundwater is not a critical pathway" (Washington State Department of Ecology 2007).

Therefore, in order to demonstrate compliance with WAC 173-340-740(3)(b)(iii)(A), an empirical demonstration will be utilized to demonstrate that soil concentrations will not cause an exceedance of groundwater CULs. As defined under WAC 173-340-747(3)(f) and WAC 173-340-747(9), the following are required for the empirical demonstration:

- The measured groundwater concentration is less than or equal to the applicable groundwater cleanup level established under WAC 173-340-720; and

- The measured soil concentration will not cause an exceedance of the applicable groundwater cleanup level established under WAC 173-340-720 at any time in the future. Specifically, it must be demonstrated that a sufficient amount of time has elapsed for migration of hazardous substances from soil into groundwater to occur and that the characteristics of the site (e.g., depth to groundwater and infiltration) are representative of future site conditions. This demonstration may also include a measurement or calculation of the attenuating capacity of soil between the source of the hazardous substance and the groundwater table using site-specific data.

Compliance monitoring will assess whether the empirical demonstration has been successful. If after a reasonable restoration time frame, the empirical demonstration has not been made, the compliance monitoring plan will require additional active remedial measures be taken.

3.2.4.4 Soil Residual Saturation

When a LNAPL, such as petroleum hydrocarbons, is released to soil, some of the liquid will dissolve in the soil pore water, some will adsorb to the soil particles, some will vaporize in the soil pore air, and some will be held by capillary force in liquid form (LNAPL) in the soil pore spaces. The threshold concentration at which LNAPL becomes continuous in the soil pore space is called the Csat. At concentrations just below Csat, the LNAPL exists in small, isolated blebs. The concentration at which the isolated LNAPL blebs become connected to form streamers is called residual saturation. At concentrations below residual saturation, the isolated blebs are relatively immobile. At concentrations above residual saturation, the LNAPL streamers can migrate downward under the force of gravity, and the LNAPL can reach groundwater if a sufficient volume is present.

The IAWP included an evaluation of soil residual saturation (SLR Inc., 2007). The evaluation considered default residual Csat values of 1,000 mg/kg for GRO and 2,000 mg/kg for DRO from MTCA Table 747-5. Data for additional soil types [Ecology, 2001 (p. 343)] indicate that residual Csat values for silt to fine sand (the predominant soil type in the unsaturated zone) can range as high as 9,643 mg/kg for GRO and 22,857 mg/kg for DRO. Residual Csat values for fine to medium sand (the predominant soil type in the saturated zone) can range as high as 5,625 mg/kg for GRO and 13,333 mg/kg for DRO. The residual saturation was not used to establish soil RELs/CULs in the IAWP.

An empirical demonstration may be used to show that LNAPL in soil is not impacting groundwater, if the following three criteria can be met [WAC 173-340-747(10)(c)]:

- LNAPL is not accumulating on or in groundwater.
- The soil contamination has been present sufficiently long for LNAPL to reach groundwater.
- Site conditions will not change in the future to promote LNAPL migration.

LNAPL is no longer present onsite with exception of the area in the vicinity of and perhaps beneath DB-2, where soil impacts remain above TPH soil RELs (i.e., adjacent to DB-2) based on an evaluation of remaining soil impacts and associated LNAPL. Because LNAPL is not present where the soil RELs were met, the soil RELs appear to be protective of groundwater and hence appear to be appropriate CULs for the residual saturation pathway. Ongoing ground water monitoring will continue to assess the presence or absence of LNAPL in the monitoring wells and piezometers. For the purposes of developing the FS, the direct contact TPH concentration will be assumed to be less than Csat.

3.2.4.5 Soil Vapor Pathway

WAC 173-340-740(3)(b)(iii)(C) identifies conditions that trigger whether or not an evaluation of the soil to vapor pathway shall be required. These conditions include the following:

- For GRO, whenever the TPH concentration is significantly higher than a concentration derived for protection of groundwater for drinking water beneficial use under WAC 173-340-747(6) using the default assumptions.

- For DRO, whenever the TPH concentration is greater than 10,000 mg/kg.

- For other volatile organic compounds (VOCs), including petroleum components, whenever the concentration is significantly higher than a concentration derived for protection of groundwater for drinking water beneficial use under WAC 173-340-747(4).

DRO concentrations in Site soil have been detected above 10,000 mg/kg. Additionally, GRO and VOCs have been detected in Site soil at concentrations higher than concentrations derived for protection of groundwater for drinking water beneficial use, which under MTCA requires further evaluation of the soil to vapor pathway.

WAC 173-340-740(3)(c)(iv)(B) lists the methods available under MTCA to evaluate whether or not soil cleanup levels are protective of the indoor or ambient air. These methods include:

- Measuring site-specific soil vapor concentrations and demonstrating that they would not exceed air cleanup levels established in WAC 173-340-750.

- Measuring ambient air concentrations and/or indoor air vapor concentrations throughout buildings, using methods approved by Ecology, demonstrating air does not exceed cleanup levels established under WAC 173-340-750.

- Use of modeling methods approved by Ecology to demonstrate the air cleanup standards established under WAC 173-340-750 will not be exceeded.

- Other methods as approved by Ecology demonstrating the air cleanup standards established under WAC 173-340-750 will not be exceeded.

Soil vapor, ambient air and indoor air samples have not been collected at the Site. However, sufficient groundwater data exists to evaluate the soil to vapor pathway at the Site. This method includes comparing concentrations of substances considered to be sufficiently volatile and toxic to pose a potential threat to indoor air quality via the vapor intrusion pathway that exist in groundwater at the Site to the groundwater screening levels listed in Appendix B of Ecology's Draft "Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action" (Ecology 2009).

As discussed in Section 3.1.3, the final soil IHSs include TPH (sum of GRO, DRO, and HO concentrations), benzene, toxicity-adjusted total cPAHs, and arsenic. Of the final soil IHSs, benzene is the only substance considered to be sufficiently volatile and toxic to pose a potential threat to indoor air quality via the vapor intrusion pathway, with an established groundwater screening level protective of indoor air of 2.4 µg/L (Ecology 2009). In 2012, benzene concentrations in groundwater exceeded the screening level considered to be protective of indoor air in two monitoring wells (MW-20R [28 µg/L] and MW-525 [5,900 µg/L]). Based on these exceedances, further evaluation of the vapor intrusion pathway is warranted and will be performed during the FS.

3.2.4.6 Soil Dermal Contact Pathway

Dermal contact with the IHSs must be evaluated if changes have been made to the MTCA Method B direct contact equations, WAC 173-340-740, Tables 740-1 and 740-2 [WAC 173-340-740(3)(c)(iii)]. No changes were made to the equations for calculating CULs.

3.2.5 Summary of Soil Cleanup Levels and Remediation Levels

The revised soil REL for TPH (2,775 mg/kg) is proposed as final soil CUL for TPH based upon direct contact and is proposed as final soil REL for TPH based upon soil to groundwater leaching pathway. The soil RELs based upon direct contact for benzene (18 mg/kg), and toxicity-adjusted total cPAHs of (0.14 mg/kg) should be adopted as final CULs for the Lower Yard. The final soil CUL for arsenic of 20 mg/kg is based on natural background concentrations [WAC 173-340-740(5)(c)].

The proposed and final CULs for soil are provided in the table below:

Table 2. Soil Cleanup Levels and Remediation Levels

Indicator Hazardous Substance	Soil Cleanup Level (mg/kg)
Total TPH[1]	2,775
Benzene[1]	18
Total cPAHs[1,2]	0.14
Arsenic[3]	20

Notes:
[1] Proposed soil CUL based on soil direct contact pathway and proposed soil REL based on soil leaching pathway.
[2]Total cPAHs adjusted for toxicity based on WAC 173-340-708(8).
[3] Based on natural background concentrations [WAC 173-340-740(5)(c)].

3.2.6 Soil Points of Compliance

Soil indicator hazardous substance concentrations protective of direct contact and TEE for soil in the Lower Yard will be met within the standard soil point of compliance, which is within 15 feet of the ground surface. Soil CULs appear to be protective of the residual saturation pathway throughout the saturated and unsaturated zones.

4. Conclusion

This report evaluated the CULs and RELs presented in the IAWP (SLR Inc., 2007) for surface water, groundwater and soils, and confirmed they are still appropriate following completion of the Interim Action for benzene and toxicity adjusted cPAHs. The total TPH soil REL was re-calculated using current guidance and tools available under MTCA. Sediment cleanup is assumed to be complete and no further cleanup of Willow Creek is required at this time (ARCADIS, 2013a).

Surface water and groundwater CULs included in the IAWP will be used to develop the FS and will be included in the draft CAP for public review as proposed CULs (**Table 1**). Site-specific TPH groundwater and surface water CULs are based on protection of surface water, using a weighted average of the MTCA Method A groundwater CULs for total TPH (GRO, DRO, and HO). The groundwater CULs for benzene (51 µg/L) and total cPAHs (0.018 µg/L) are based on the NRWQC, considering human ingestion of fish.

The soil CULs for benzene (18 mg/kg) and toxicity adjusted total cPAHs (0.14 mg/kg) are based on the MTCA Method B direct contact CULs presented in **Table 2**. Monitoring data collected to date indicate these CULs are protective of the soil to groundwater pathway. Therefore, the CULs for benzene and toxicity adjusted total cPAHs will be used to develop the draft Feasibility Study and will be included in the draft CAP for public review as proposed CULs (**Table 2**).

The final soil CUL for arsenic of 20 mg/kg is based on natural background concentrations [WAC 173-340-740(5)(c)]. It will be used to develop the draft Feasibility Study and will be included in the draft CAP for public review as the proposed CUL (**Table 2**).

The proposed TPH soil CUL of 2,775 mg/kg is based on the direct contact pathway and will be used to develop the draft Feasibility Study. It will also be included in the draft CAP for public review the proposed CUL (**Table 2**).

The revised TPH soil REL of 2,775 mg/kg is based on the soil leaching to groundwater pathway. An empirical demonstration pursuant to WAC 173-340-747 (3)(f) will be utilized to demonstrate that soil concentrations will not cause an exceedance of groundwater CULs. Compliance monitoring will assess whether the empirical demonstration has been successful. If, after a reasonable restoration time frame, the

empirical demonstration has not been made, the compliance monitoring plan will require additional active remedial measures be taken.

References

ARCADIS U.S., Inc. (ARCADIS). 2009. Phase I Remedial Implementation As-Built Report, Unocal Edmonds Bulk Fuel Terminal Lower Yard. July 31, 2009.

ARCADIS. 2010. FINAL – Phase II Remedial Implementation As-Built Report, Unocal Edmonds Bulk Fuel Terminal Lower Yard. January 18, 2010.

ARCADIS. 2013a. Final Conceptual Site Model, Former Unocal Edmonds Bulk Fuel Terminal, Edmonds WA. June 7, 2013.

ARCADIS. 2013b. Final 2012 Annual Groundwater Monitoring Report. Former Unocal Edmonds Bulk Fuel Terminal, Edmonds WA. March 25, 2013.

Chapter 173-204 WAC, Sediment Management Standards.

Chapter 173-340 WAC, MTCA Cleanup Regulation.

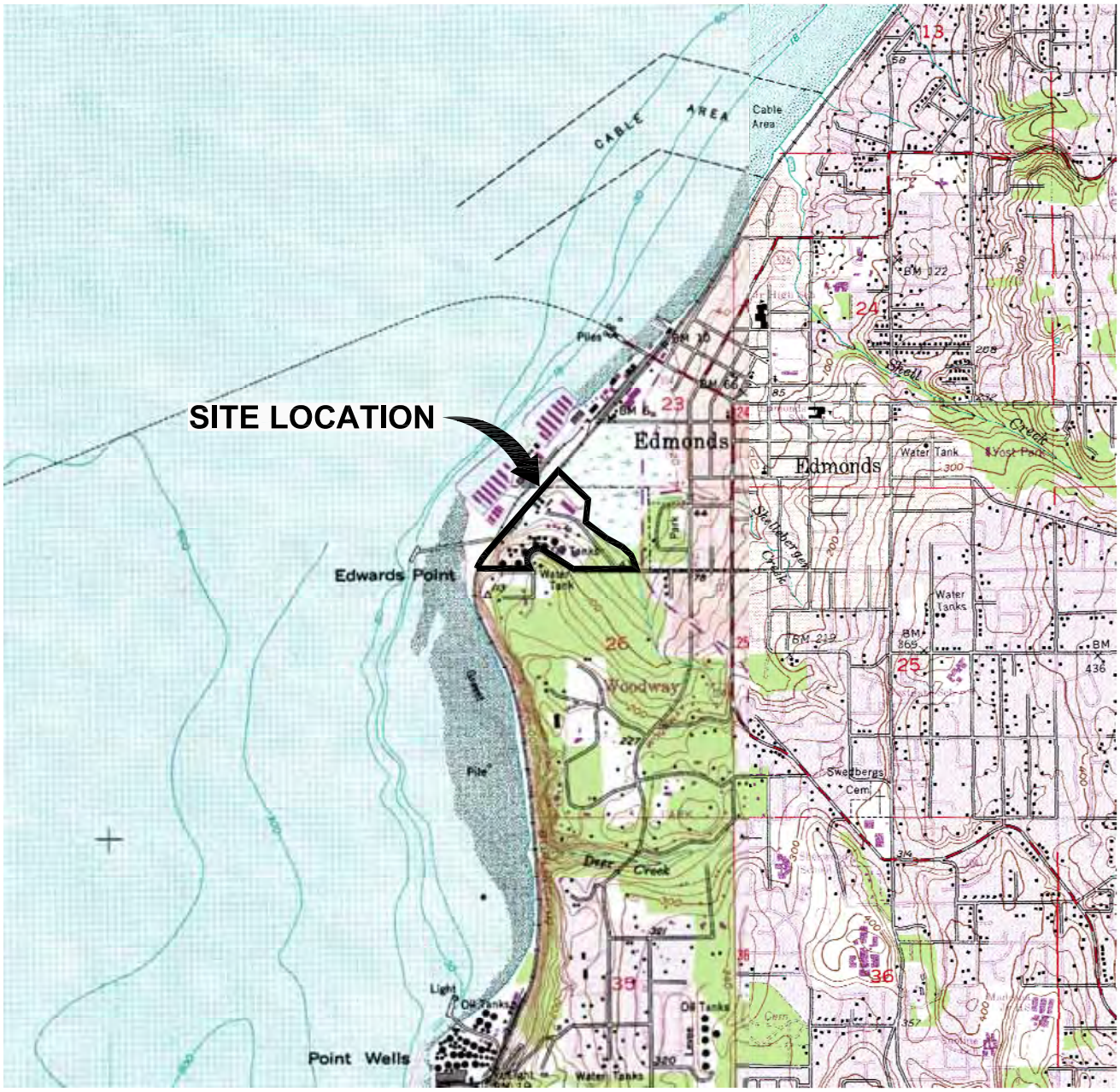
SLR Inc., 2007. Agreed Order for Remedial Action, Lower Yard of Unocal Edmonds Bulk Fuel Terminal, Edmonds Washington. June 25, 2007.

Washington State Department of Ecology. 2007. Workbook Tools for Calculating Soil and Ground Water Cleanup Levels under the Model Toxics Control Act Cleanup Regulation, User's Guide for MTCATPH 11.1 & MTCASGL 11.0, Publication No. 01-09-073. Revised December.

Washington State Department of Ecology. 2009. Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action. Review DRAFT. October, 2007.

ARCADIS

Figures



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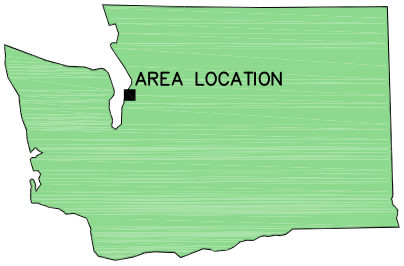
Approximate Scale: 1"=0.5 Miles



WASHINGTON

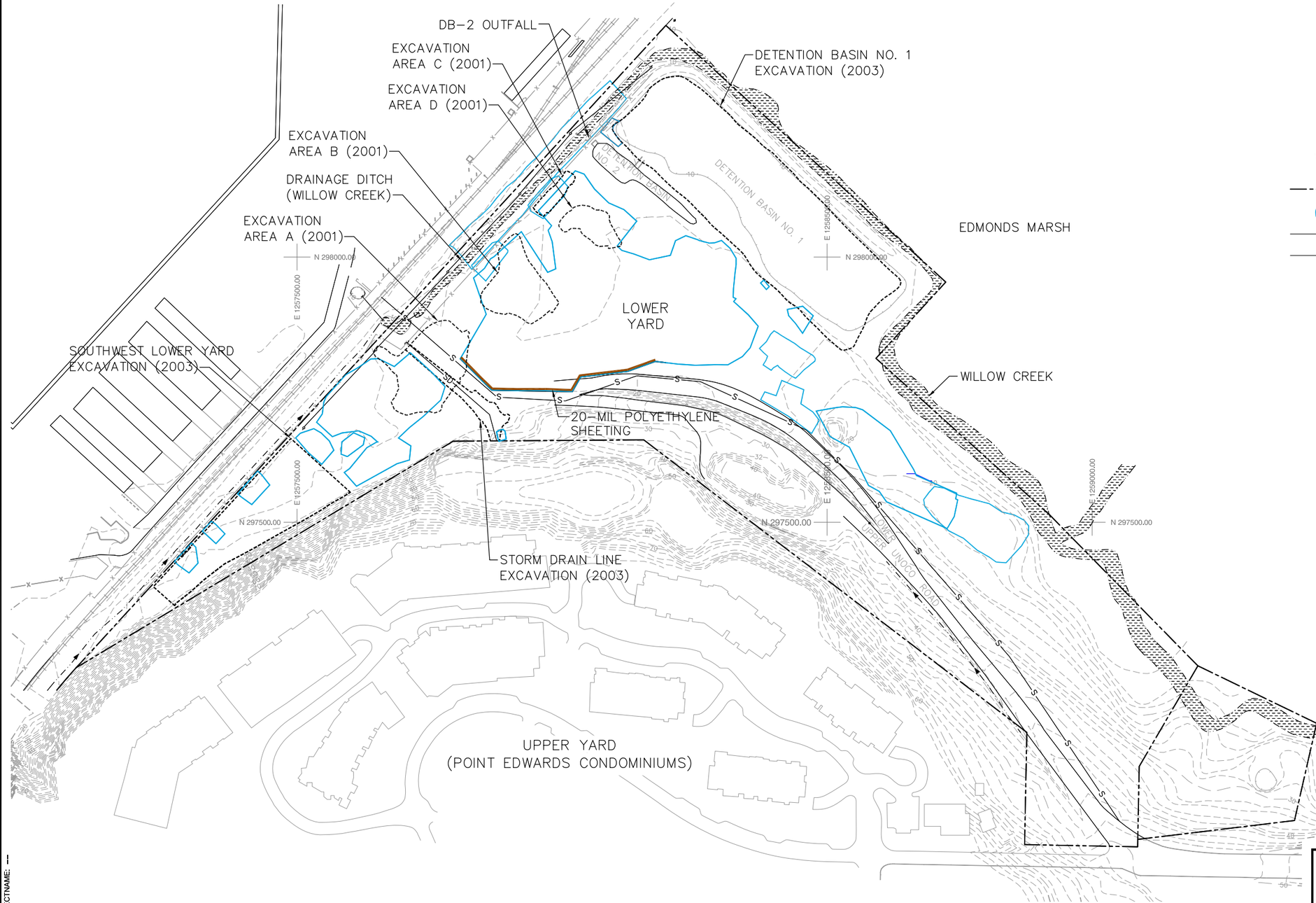
CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
FORMER UNOCAL EDMONDS TERMINAL
EDMONDS, WASHINGTON

CLEANUP LEVELS AND REMEDIATION LEVELS REPORT

SITE LOCATION MAP

ARCADIS

FIGURE 1



LEGEND:

- 2001 AND 2003 SOIL EXCAVATIONS BELOW GROUNDWATER TABLE
- LOWER YARD PROPERTY BOUNDARY
- 2007/2008 EXCAVATION BOUNDARIES
- S — WSDOT STORM DRAIN LINE
- SD — POINT EDWARDS STORM DRAIN LINE

NOTES:

1. 20-MIL POLYETHYLENE SHEETING INSTALLED UPON COMPLETION OF PHASE I OF THE 2007/2008 EXCAVATION. SHEETING REACHES TO APPROXIMATELY 7.5 FEET ABOVE MEAN SEA LEVEL.
2. SOUTHEAST PORTION OF WSDOT STORM DRAIN LINE HAS NOT BEEN SURVEYED.

0 200' 400'

GRAPHIC SCALE

CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
FORMER UNOCAL EDMONDS TERMINAL, LOWER YARD
EDMONDS, WASHINGTON
CLEANUP LEVELS AND REMEDIATION LEVELS REPORT

SITE LAYOUT

ARCADIS

FIGURE
2

CITY: SYRACUSE, NY DIV/GROUP: ENV/REM-WIM-DV DB: K. DAVIS, R. ALLEN, P. LISTER PM/TM: R. ANDRESEN TR: D. RASAR LYR: ON=*;OFF=*REF*; (FRZ)
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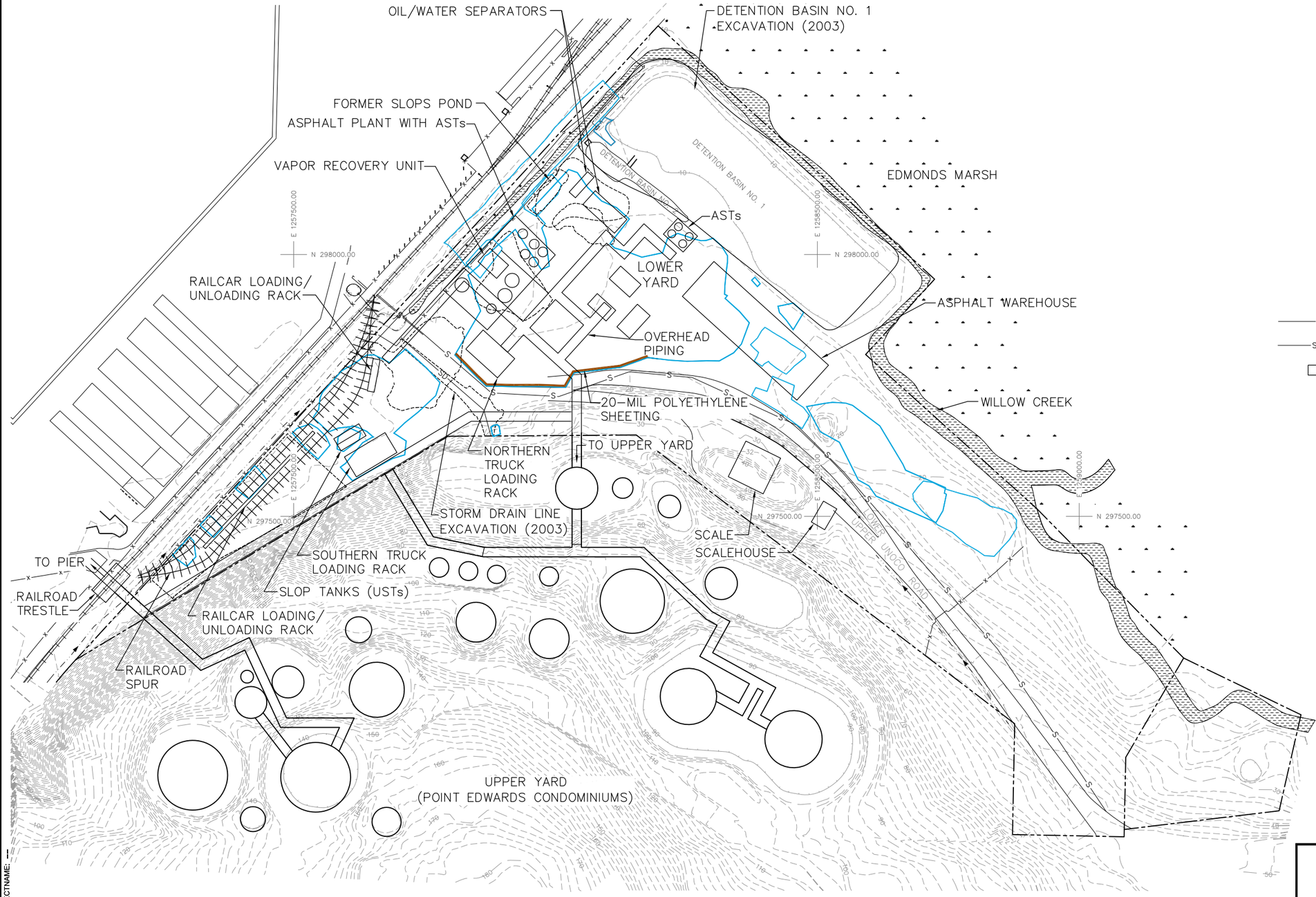

LEGEND:

- 2001 AND 2003 SOIL EXCAVATIONS BELOW GROUNDWATER TABLE
- 2007/2008 EXCAVATION BOUNDARIES
- S — WSDOT STORM DRAIN LINE
- SD — POINT EDWARDS STORM DRAIN LINE
- HISTORIC FEATURE

NOTES:

1. 20-MIL POLYETHYLENE SHEETING INSTALLED UPON COMPLETION OF PHASE I EXCAVATION. SHEETING REACHES TO APPROXIMATELY 7.5 FEET ABOVE MEAN SEA LEVEL.
2. HORIZONTAL DATUM: WASHINGTON STATE COORDINATE SYSTEM NORTH ZONE (NAD 83/98).
   VERTICAL DATUM: N.A.V.D. 88
   UNITS: U.S. SURVEY FEET
   HORIZONTAL AND VERTICAL CONTROL ESTABLISHED BY GPS VIA VERTICAL REFERENCE STATION NETWORK (VRSN).
3. SOUTHEAST PORTION OF WSDOT STORM DRAIN LINE HAS NOT BEEN SURVEYED.

0 200' 400'

GRAPHIC SCALE

CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
FORMER UNOCAL EDMONDS TERMINAL, LOWER YARD
EDMONDS, WASHINGTON
CLEANUP LEVELS AND REMEDIATION LEVELS REPORT

HISTORIC FACILITIES LOCATION MAP

ARCADIS

FIGURE 3

CITY: SYRACUSE, NY DIV/GROUP: ENV/IM-DIV DB: K. DAVIS, R. ALLEN, P. LISTER PM/TM: R. ANDRESEN TR: D. RASAR LYR: ON=*;OFF=*REF*
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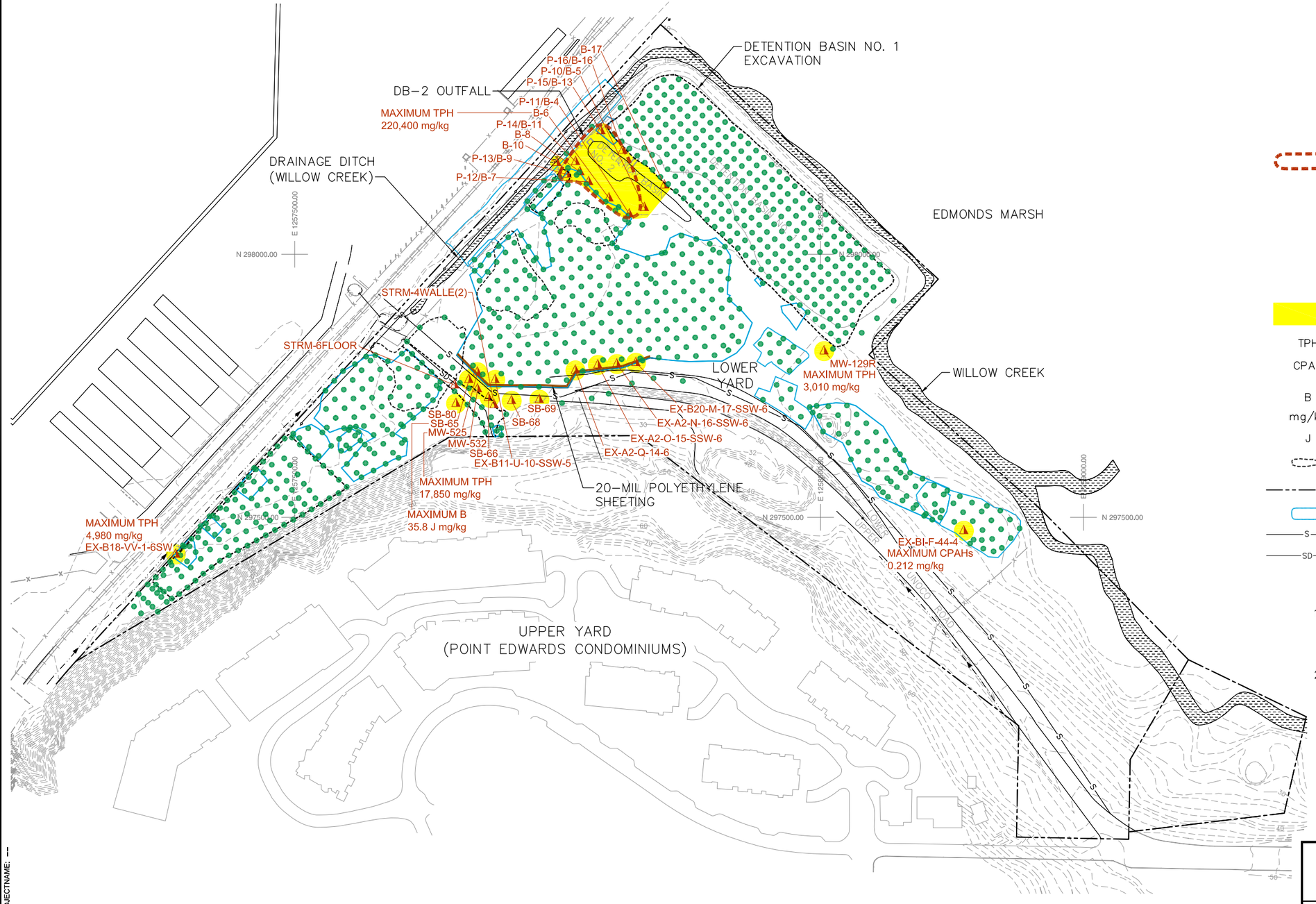

LEGEND:

- ESTIMATED LNAPL BOUNDARY
- SOIL SAMPLE COLLECTION LOCATION WITH CONCENTRATIONS OF TOTAL TPH AND / OR CPAHs NOT EXCEEDING APPLICABLE SITE CULs AND / OR RELs.
- SOIL SAMPLE COLLECTION LOCATION WITH CONCENTRATIONS OF TOTAL TPH AND/OR CPAHS EXCEEDING APPLICABLE SITE CULs AND/OR RELs.
- AREA WITH REMAINING SOIL IMPACTS EXCEEDING SITE CULs AND/OR RELs

TPH	TOTAL PETROLEUM HYDROCARBONS
CPAH	CARCINOGENIC POLYNUCLEAR AROMATIC HYDROCARBONS
B	BENZENE
mg/kg	MILLIGRAMS PER KILOGRAM
J	INDICATES AN ESTIMATED VALUE

- 2001 AND 2003 SOIL EXCAVATIONS BELOW GROUNDWATER TABLE
- LOWER YARD PROPERTY BOUNDARY
- 2007/2008 EXCAVATION BOUNDARIES
- S — WSDOT STORM DRAIN LINE
- SD — POINT EDWARDS STORM DRAIN LINE

NOTES:

1. 20–MIL POLYETHYLENE SHEETING INSTALLED UPON COMPLETION OF PHASE I EXCAVATION. SHEETING REACHES TO APPROXIMATELY 7.5 FEET ABOVE MEAN SEA LEVEL.
2. SOUTHEAST PORTION OF WSDOT STORM DRAIN LINE HAS NOT BEEN SURVEYED.

0 200’ 400’

GRAPHIC SCALE

CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
FORMER UNOCAL EDMONDS TERMINAL, LOWER YARD
EDMONDS, WASHINGTON

CLEANUP LEVELS AND REMEDIATION LEVELS REPORT

LOWER YARD REMAINING SOIL IMPACTS MAP

ARCADIS

FIGURE 4

CITY: SYRACUSE, NY DIV/GROUP: ENV/IM-DIV DB: K. DAVIS, R. ALLEN, P. LISTER PM/TM: R. ANDRESEN TR: A. PATEL LYR: ON=*;OFF=*REF*
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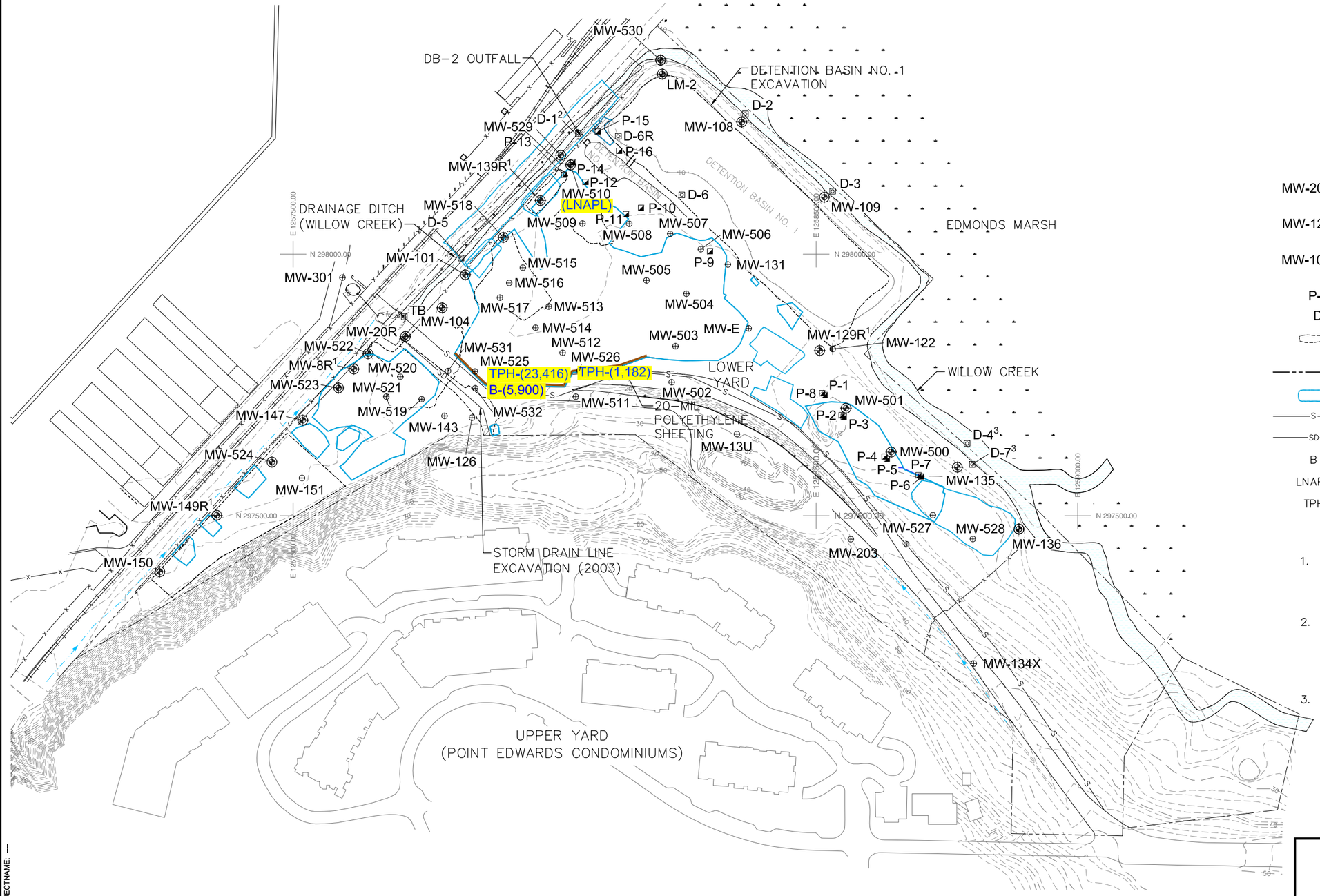

LEGEND:

MW-203 ⊕	INTERIOR MONITORING WELL LOCATION AND DESIGNATION
MW-122 ⊕	DEEP MONITORING WELL LOCATION AND DESIGNATION
MW-109 ⊕	SURFACE WATER POINT OF COMPLIANCE MONITORING WELL LOCATION
P-11 ◪	PIEZOMETER
D-1 ⊠	STAFF GAUGE
	2001 AND 2003 SOIL EXCAVATIONS BELOW GROUNDWATER TABLE
	LOWER YARD PROPERTY BOUNDARY
	2007/2008 EXCAVATION BOUNDARIES
S	WSDOT STORM DRAIN LINE
SD	POINT EDWARDS STORM DRAIN LINE
B	BENZENE
LNAPL	LIGHT NONAQUEOUS PHASE LIQUID
TPH	TOTAL PETROLEUM HYDROCARBONS

NOTES:

1. 20-MIL POLYETHYLENE SHEETING INSTALLED UPON COMPLETION OF PHASE I EXCAVATION. SHEETING REACHES TO APPROXIMATELY 7.5 FEET ABOVE MEAN SEA LEVEL.
2. HIGHLIGHTED NUMBERS ARE MAXIMUM CONCENTRATIONS OF TOTAL TPH AND/OR BENZENE (B) IN MICROGRAMS PER LITER (ug/L) IN ALL WELLS THAT EXCEEDED GROUNDWATER CULs WITHIN THE PAST FOUR MONITORING EVENTS (SEPTEMBER 2012 TO JUNE 2013).
3. SOUTHEAST PORTION OF WSDOT STORM DRAIN LINE HAS NOT BEEN SURVEYED.

0 200' 400'

GRAPHIC SCALE

CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
FORMER UNOCAL EDMONDS TERMINAL, LOWER YARD
EDMONDS, WASHINGTON
CLEANUP LEVELS AND REMEDIATION LEVELS REPORT

LOWER YARD REMAINING GROUNDWATER IMPACTS MAP

ARCADIS

FIGURE 5

CITY: SYRACUSE, NY DIV/GROUP: ENV/IM=DV DB: R. ALLEN, P. LISTER PM/TM: R. ANDRESEN TR: D. RASAR LYR: ON=*;OFF=*REF*
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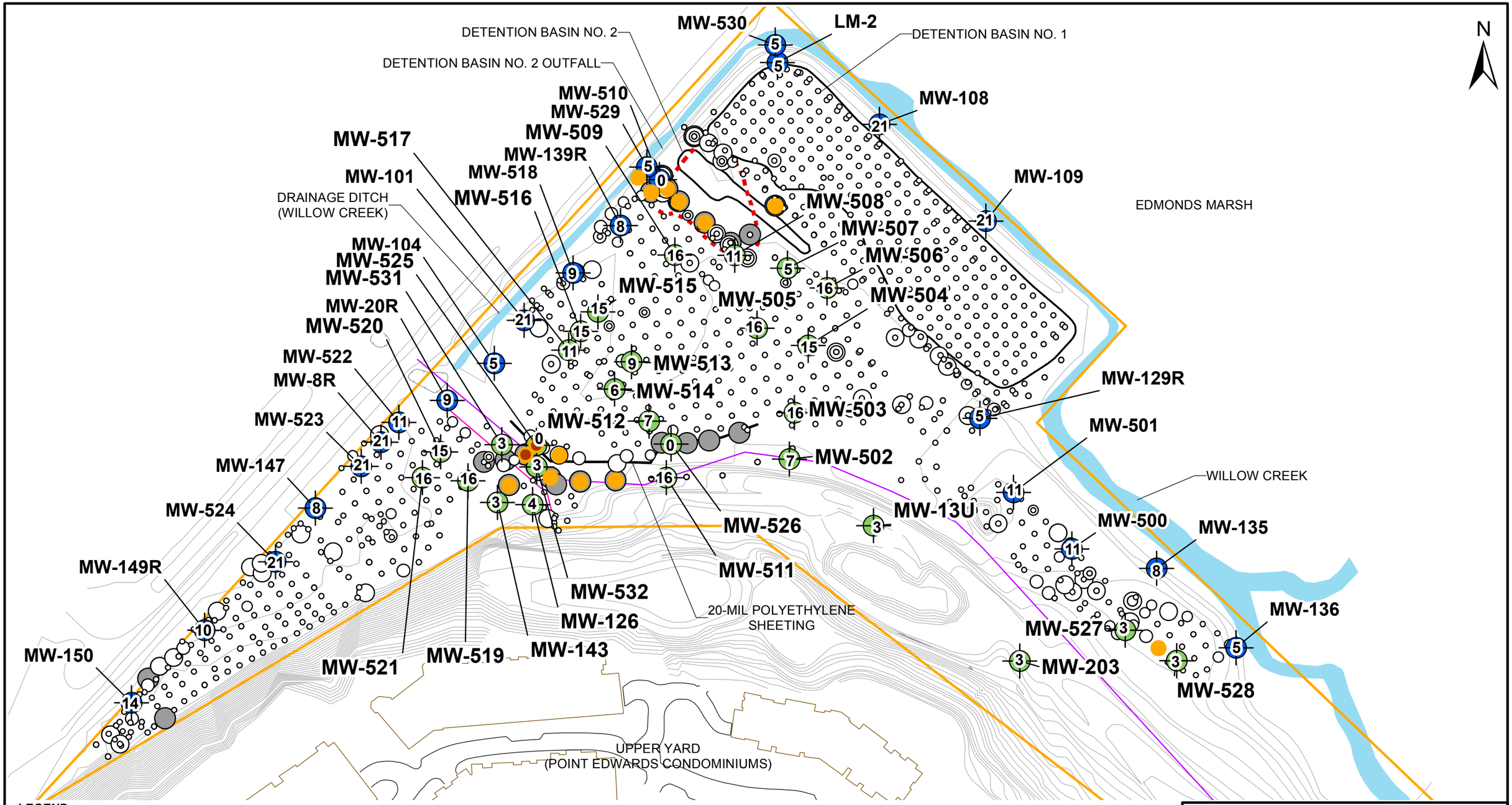
45362X02
45362X03



LEGEND

- POINT OF COMPLIANCE WELL AND NUMBER OF CONSECUTIVE SAMPLING ROUNDS SHOWING CONCENTRATIONS OF TPH LESS THAN PROPOSED GW CULS
- INTERIOR WELL AND NUMBER OF CONSECUTIVE SAMPLING ROUNDS SHOWING CONCENTRATIONS OF TPH LESS THAN PROPOSED GW CULS
- SOIL TPH CONCENTRATION <250 mg/kg
- SOIL TPH CONCENTRATION OF 250 - 500 mg/kg
- SOIL TPH CONCENTRATION OF 500 - 1,000 mg/kg
- SOIL TPH CONCENTRATION OF 1,000 - 2,775 mg/kg
- SOIL TPH CONCENTRATION > 2,775 mg/kg
- SOIL BENZENE CONCENTRATION > CUL (18mg/kg)
- SOIL cPAHs CONCENTRATION > CUL (0.14 mg/kg)
- WSDOT STORM DRAIN LINE
- POINT EDWARDS STORM DRAIN LINE
- LOWER YARD PROPERTY BOUNDARY
- ESTIMATED LNAPL BOUNDARY

NOTES:
1. 20-MIL POLYETHYLENE SHEETING INSTALLED UPON COMPLETION OF PHASE I EXCAVATION. SHEETING REACHES TO APPROXIMATELY 7.5 FEET ABOVE MEAN SEA LEVEL.
2. SOUTHEAST PORTION OF WSDOT STORM DRAIN LINE HAS NOT BEEN SURVEYED.

TPH - TOTAL PETROLEUM HYDROCARBONS
MG/KG - MILLIGRAMS PER KILOGRAM

0 140 280
SCALE IN FEET

CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
FORMER UNOCAL EDMONDS TERMINAL, LOWER YARD
EDMONDS, WASHINGTON

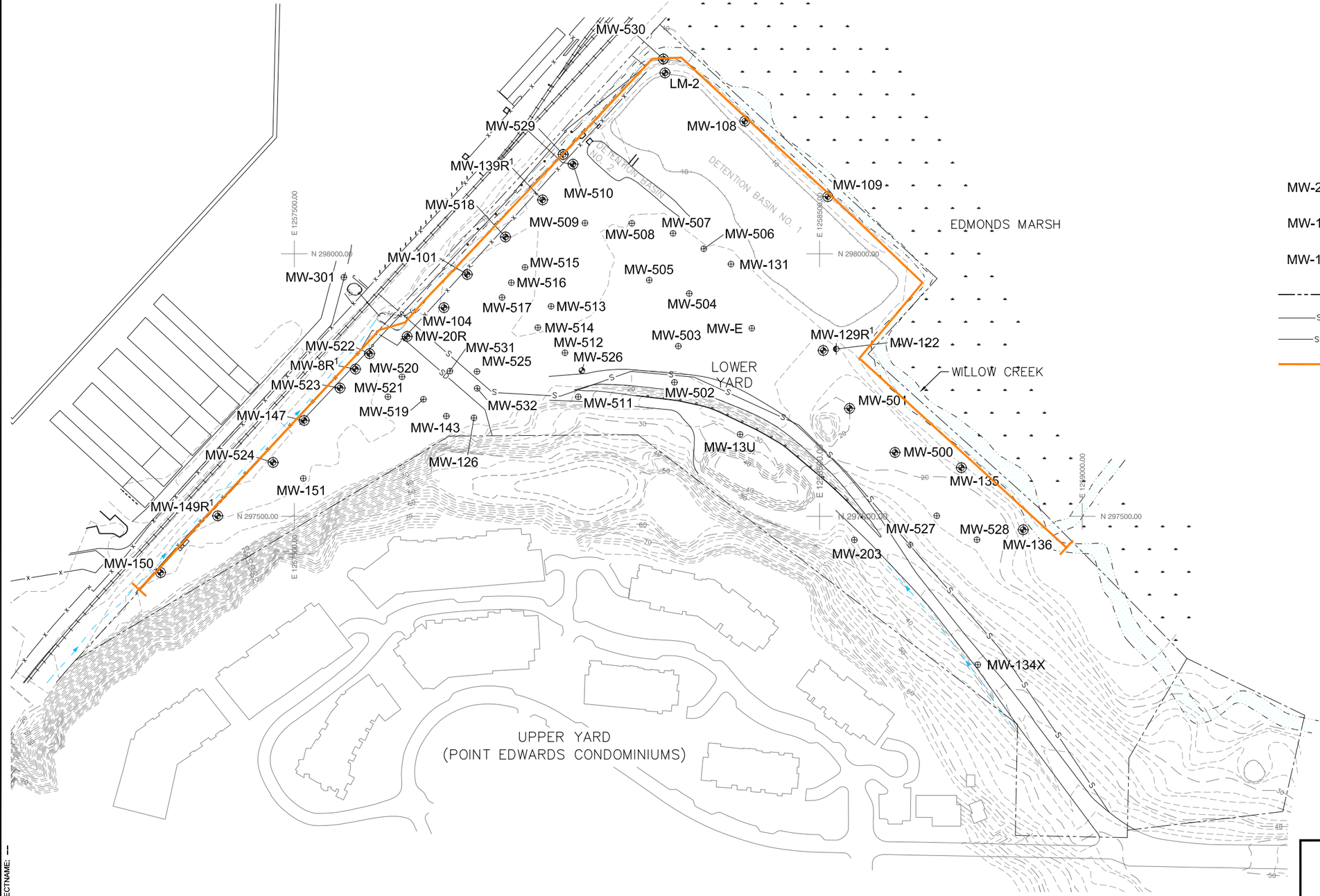
CLEANUP LEVELS AND REMEDIATION LEVELS REPORT

SITE SOIL AND GROUNDWATER REMEDIATION STATUS - JULY 2013

ARCADIS

FIGURE 6

CITY:HIGHLANDS RANCH, CO DIV/GROUP:(ENV/GIS) DB: B GRIFFITH
Path: I:\BCG_Misc\Chevron_Edmonds\MXD\CurrentSiteSoilGWRemStatus.mxd Date: 9/4/2013 Time: 8:21:19 AM



LEGEND:

- MW-203 ⊕ INTERIOR MONITORING WELL LOCATION AND DESIGNATION
- MW-122 ⊕ DEEP MONITORING WELL LOCATION AND DESIGNATION
- MW-109 ⊕ SURFACE WATER POINT OF COMPLIANCE MONITORING WELL LOCATION
- LOWER YARD PROPERTY BOUNDARY
- S — WSDOT STORM DRAIN LINE
- SD — POINT EDWARDS STORM DRAIN LINE
- POINT OF COMPLIANCE BOUNDARY

NOTE:

1. SOUTHEAST PORTION OF WSDOT STORM DRAIN LINE HAS NOT BEEN SURVEYED.

0 200' 400'

GRAPHIC SCALE

CHEVRON ENVIRONMENTAL MANAGEMENT COMPANY
FORMER UNOCAL EDMONDS TERMINAL, LOWER YARD
EDMONDS, WASHINGTON
CLEANUP LEVELS AND REMEDIATION LEVELS REPORT

POINT OF COMPLIANCE BOUNDARY

ARCADIS

FIGURE 7

CITY: SYRACUSE, NY DIV/GROUP: ENV/REM-WIM-DV DB: R. ALLEN, P. LISTER PM/TM: R. ANDRESEN TR: D. RASAR LYR: ON=*OFF=*REF*
G:\ENV\CAD\SYRACUSE\ACTIB\004536200040000011DWG\45362B10.dwg LAYOUT: 7 SAVED: 9/5/2013 1:43 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 9/5/2013 1:44 PM BY: LISTER, PAUL
XREFS: 45362X00 45362X02 45362X03
IMAGES:
PROJECTNAME: ---

ARCADIS

Appendix A

Terrestrial Ecological Evaluation
(As included in the Agreed Order, 2007)

TERRESTRIAL ECOLOGICAL EVALUATION

INTRODUCTION

This appendix presents the terrestrial ecological evaluation (TEE) for the lower yard of the Unocal Edmonds Bulk Fuel Terminal (Terminal), as required by WAC 173-340-7490. It is formatted consistent with the documentation forms provided by the Department of Ecology (Ecology) on its interactive website.

Site background and history are summarized in Section 2 of this report. Soils on site are mainly contaminated with petroleum, primarily in the diesel and oil range, from fuel storage and transfer activities. Union Oil Company (Union Oil) has performed interim actions to remove free product and soils in the areas of highest soil contamination. The completed interim actions, the planned interim action, and the nature of the future development of the lower yard minimize potential exposures to terrestrial receptors by reducing contaminant levels and controlling exposure pathways. Substantial amounts of contaminated soils have been removed, significantly reducing both the spatial extent of contamination and the concentrations of remaining contaminants.

Soils containing significant TPH concentrations remain in areas of the lower yard. Union Oil intends to complete remediation of the lower yard prior to redevelopment as a multi-modal transportation facility. After development, a large portion of the site will be covered with buildings and pavement. In covered areas, terrestrial receptors will be unable to contact soil contaminants.

RI/FS activities included sediment sampling for chemical analyses and bioassays in Willow Creek, adjacent to the lower yard. The RI also included whole effluent toxicity (WET) testing of groundwater beneath the lower yard. These data are discussed in Section 5 of this report. This appendix focuses on ecological issues related to the terrestrial environment only.

Environmental studies of the Edmonds Marsh, which is located on the opposite side of Willow Creek from the lower yard, were conducted in conjunction with the Final Environmental Impact Statement (EIS) conducted for the SR104 Edmonds Crossing Project (CH_2M Hill, 2004). Information from these studies was used in this TEE.

PRIMARY EXCLUSIONS

An answer of "Yes" to any one question in this section excludes the site from further TEE [WAC 173-340-7491(1)].

1a) Will soil contamination be located at least 6 feet beneath the ground surface and less than 15 feet [WAC 173-340-7491(1)(a)]?

No. Detectable concentrations of TPH will likely be present within 6 feet of ground surface following remediation.

1b) Will soil contamination be located at least 15 feet beneath the ground surface [WAC 173-340-7491(1)(a)]?

No. As noted above, detectable concentrations of TPH will likely be present within 15 feet of ground surface following remediation.

1c) Will soil contamination be located below the conditional point of compliance [WAC 173-340-7491(1)(a)]?

No. Union Oil does not plan to propose a conditional point of compliance.

2) Will soil contamination be covered by buildings, paved roads, pavement, or other physical barriers that will prevent plants or wildlife from being exposed [WAC 173-340-7491(1)(b)]?

No. After redevelopment as a multi-modal transportation terminal, there may be some uncapped areas that contain detectable concentrations of the IHSs.

3a) Is there less than 1.5 acres of contiguous undeveloped land on the site, or within 500 feet of any area of the site affected by hazardous substances (other than those substances listed in WAC 173-340-7491(1)(c)(ii)) [WAC 173-340-7491(1)(c)(i)]?

No. There are more than 1.5 acres of contiguous undeveloped land in a wooded area adjacent to the southwest portion of the lower yard.

3b) Is there less than 0.25 acres of contiguous undeveloped land on or within 500 feet of any area of the site affected by hazardous substances listed in WAC 173-340-7491(1)(c)(ii) [WAC 173-340-7491(1)(c)(ii)]?

Not applicable. The site is not contaminated with any of the listed substances.

4) Are concentrations of hazardous substances in the soil less than or equal to natural background concentrations of those substances at the point of compliance [WAC 173-340-7491(1)(d)]?

No. Ecology does not recognize natural background concentrations of petroleum hydrocarbons.

EXCLUSIONS CONCLUSION: The lower yard does not qualify for exclusion from the TEE.

SIMPLIFIED OR SITE-SPECIFIC EVALUATION

An answer of "Yes" to any one question below means the lower yard is required to undergo a site-specific TEE [WAC 173-340-7491(2)]. Otherwise, a simplified evaluation is allowed.

1) Is the site located on or directly adjacent to an area where management or land use plans will maintain or restore native or semi-native vegetation [WAC 173-340-7491(2)(a)(i)]?

Yes. Edmonds Marsh is directly adjacent to the eastern portion of the lower yard. According to the Final EIS for the Edmonds Crossing project [CH_2M Hill, 2004 (p. 3-41)], Edmonds Marsh has been rated by the City of Edmonds as a Category I (high quality) wetland based on its uniqueness, large size, and habitat for a state monitor species (great blue heron). It is designated by the city as a Wildlife Sanctuary on the City of Edmonds Environmentally Sensitive Areas map and as a Priority Habitat in the WDFW Priority Habitat and Species database. Category I wetlands are considered the most valuable, and their disturbance is rarely permitted.

2a) Is the site used by a threatened or endangered species [WAC 173-340-7491(2)(a)(ii)]? For animals, "used" means that individuals of a species have been observed to live, feed or breed at the site. For plants, "used" means that a plant species grows at the site or has been found growing at the site.

No. A Wildlife Habitat Study was performed in 1996 as part of the remedial investigation of the Terminal (Adolfson, 1996). Specific to threatened and endangered species, the study findings were as follows:

> Bald eagles are reported as nesting approximately one mile south of the Terminal. Bald eagle nests are not known to exist on the Terminal property or within one mile of the property boundary. During field surveys in 1995, bald eagles were observed perched in large deciduous trees located along the bluff to the south of the Terminal's pier.

No other threatened or endangered animal species were identified. Although bald eagles have been removed from the endangered list, they are still listed as threatened (www.wa.gov/wdfw/wlm/diversty/soc/threaten.htm). Observations by former site personnel indicate that bald eagle do not live at the Terminal, nor have bald eagles been seen perching in trees at the Terminal. As bald eagles are primarily fish eaters, the lower yard does not provide suitable foraging habitat. Bald eagles are seen in flight above the Terminal, but this behavior does not meet the definition of "use" (live, feed, or breed).

The Washington Department of Fish and Wildlife (WDFW) was contacted in the spring of 2002 for additional information. The Priority Habitats and Species Database and Wildlife Heritage Database show the Terminal to be in an area where priority habitats and species are unknown, or the area was not mapped. The area to the south of the Terminal is identified as a bald eagle use area (breeding occurrence).

2b) Is the site used by a wildlife species classified by the Washington State Department of Fish and Wildlife as a "priority species" or "species of concern" under Title 77 RCW [WAC 173-340-7491(2)(a)(ii)]?

No. The WDFW database (www.wa.gov/wdfw/wlm/diversty/soc/threaten.htm) was searched for mammalian, avian, reptilian, and amphibian species listed as expected to occur at the Terminal per the Wildlife Habitat Study. None of the species identified in the Wildlife Habitat Study is listed in the WDFW database as a "priority species" or "species of concern."

2c) Is the site used by a plant species classified by the Washington State Department of Natural Resources Natural Heritage Program as "endangered," "threatened," or "sensitive" under Title 79 RCW [WAC 173-340-7491(2)(a)(ii)]?

No. A review of the Washington State Department of Natural Resources' Natural Heritage Information System (www.wa.gov/htdocs/fr/nhp/refdesk/fsrefix.htm) was performed as part of the 1996 Wildlife Habitat Study. There are no records of significant natural features, rare plants, high quality native wetlands, or high quality native plant communities within the vicinity of the project area.

Additional studies have been performed for purposes of the Edmonds Crossing EIS. No endangered, threatened, or sensitive species were identified in studies performed in 2000 and 2001 (personal communication between Cathy Conolly of Adolfson Associates and Linda Dawson of Maul Foster & Alongi, Inc. on November 30, 2001).

3) Is the area of contamination located on a property that contains at least 10 acres of native vegetation within 500 feet of the area of contamination [WAC 173-340-7491(2)(a)(iii)]?

No. The lower yard (23 acres in area) was an active industrial site that has recently been subject to intensive remedial activity including excavation, backfilling, and grading, and it contains limited vegetation. A small area (approximately 2 acres) located in the southeast corner of the lower yard contains native vegetation. The lower yard will be redeveloped as a multi-modal transportation facility, so it will be primarily covered by buildings and pavement. At present, the lower yard offers limited, disturbed terrestrial habitat. The sparse vegetative cover, low species diversity, and amount of human disturbance in this area limit wildlife use of this habitat [Adolfson Associates, Inc., 1996 (p. 9)].

4) Has the department determined that the site may present a risk to significant wildlife populations [WAC 173-340-7491(2)(a)(iv)]?

No. Ecology has not determined that the lower yard may present a significant risk to wildlife populations.

SIMPLIFIED OR SITE-SPECIFIC EVALUATION CONCLUSION: A site-specific TEE is required because of the site's location next to Edmonds Marsh.

SIMPLIFIED EVALUATION

A simplified TEE is not allowed because a site-specific evaluation is required.

SITE-SPECIFIC EVALUATION

A site-specific TEE consists of two elements: problem formulation and the actual evaluation. After reviewing the problem formulation, Ecology may determine that additional evaluation is not necessary [WAC 173-340-7493(1)(d)].

Problem Formulation

Problem formulation involves identifying the following components of the site-specific TEE:

- Chemicals of ecological concern
- Exposure pathways
- Terrestrial ecological receptors of concern
- Toxicological assessment

The indicator hazardous substances (IHSs) chosen for the TEE are the following (see Section 5.1.3 of this report):

- GRO
- DRO
- HO
- Benzene
- CPAHs
- Arsenic

Following remediation, if the maximum or the upper 95 percent confidence limit concentrations of the IHSs do not exceed the ecological indicator concentrations in MTCA Table 749-3, they may be eliminated from further consideration [WAC 173-340-7493(2)(a)(i)]. Since the site will be used for commercial purposes, only the values in the wildlife column of the table are applicable [WAC 173-340-7493(2)(a)(i)]. The ecological indicator concentrations are 5,000 mg/kg for GRO, 6,000 mg/kg for DRO, 12 mg/kg for cPAHs (benzo(a)pyrene is used as a surrogate), and 132 mg/kg for arsenic in unsaturated soil. There are no table values for HO and benzene.

The petroleum indicator concentrations note that soil concentrations may not exceed residual saturation values. However, the TPH cleanup level (CUL) for the site (2,975 mg/kg; based on direct contact) exceeds the default residual saturation concentration. This higher CUL can be applied because an empirical demonstration (free product does not occur on the groundwater) will be used to show that post-remediation soil concentrations do not exceed residual saturation. The residual saturation requirements will be met at the conclusion of the remediation.

Institutional controls, in the form of deed restrictions, will be used to ensure that any soils exceeding the ecological indicator soil concentrations are capped, that the caps are maintained, and that if the coverings are disturbed, contaminated soils are handled appropriately [WAC 173-340-7493(2)(a)(ii)]. This will ensure there are no complete exposure pathways to soil concentrations of IHSs exceeding the ecological indicator soil concentrations. If there are no complete exposure pathways, no further evaluation is necessary [WAC 173-340-7493(2)(a)(ii)].

The combination of remedial actions, planned development, and institutional controls will minimize wildlife exposure to site-related contaminants. Evaluation of the first two components of problem formulation finds that additional evaluation is not necessary. Capping the soil with IHS concentrations exceeding those listed in MTCA Table 749-3 (wildlife column only) will allow the site-specific TEE to be ended.

Appendix B

MTCATPH 11.1 Calculation Worksheet

MTCATPH 11.1 Calculation Worksheet

		SB-183-2.5	SB-183-5.5	SB-184-2.5	SB-184-4.0	SB-185-4.0	SB-185-5.5	DB1-A-26wall1-4	DB1-A-1wall-2.5	DB1-A-21wall-2.5	DB1-A-25wall-3.5	SWLY-A-5wall-3.75	SWLY-A-14wall-3.75	SWLY-C-21wall-3.75	SWLY-D-3wall-3.75
Fraction/Constituent (mg/kg)															
Aliphatic	EC>5-6	4.95	2.45	44.85	22.84	37.3	31.3	2.25	2.25	2.4	9.89	4.75	9.75	45.49	68.7
	EC>6-8	5	2.5	350	83.8	178	199	2.5	2.5	2.5	10	5	10	312	826
	EC>8-10	5	24.9	530	166	137	94.9	2.5	2.5	19.5	41.7	277	66.5	287	19.6
	EC>10-12	80.7	111	649	342	287	249	2.5	2.5	81.8	80	908	173	353	16.3
	EC>12-16	641	558	1020	581	717	840	12.3	291	481	269	2500	431	732	39.1
	EC>16-21	1770	785	1270	717	858	1080	23.7	1030	973	438	1720	310	528	32.6
	EC>21-34	1400	443	500	245	306	395	51	1060	575	564	817	98.4	742	12.8
Aromatic	EC>8-10	16.49	10.38	617.5	241.38	338.9	333.1	2.43	2.43	2.43	54.34	26.36	21.46	299.51	280.1
	EC>10-12	102.79	85.4	1571.22	714.39	641.3	899.97	2.43	2.2	2.16	228.77	214.58	63.86	416.87	2.79
	EC>12-16	340	309	1420	624	325	978	19	22.5	92.5	483	1080	65.9	308	303
	EC>16-21	930.02	539.64	518.63	332.69	326.61	477.59	18.27	450.4	547.41	355.49	1679.85	158.38	326.32	28.84
	EC>21-34	698.95	452.95	345.95	212.95	215.95	294.95	82.25	642.8	337.9	565.9	886.99	67.45	573.8	7.55
	Benzene	0.015	0.015	0.554	0.15	1.15	1.15	0.015	0.015	0.015	0.046	0.032	0.06	2.42	4.47
	Toluene	0.025	0.025	4.09	1.16	2.42	3.33	0.025	0.025	0.025	0.095	0.11	0.1	1.43	6.25
	Ethylbenzene	0.171	0.086	4.19	1.49	27.1	43.9	0.025	0.025	0.025	0.572	0.298	0.523	6.39	17.9
	Xylenes	0.444	0.336	15.3	6.13	72	25	0.05	0.05	0.05	1.99	0.438	1.32	25.1	35
	Naphthalene	0.597	0.4	7	4.5	22	6.4	0.025	0.1	0.025	0.18	1	1.4	2.7	0.94
	1-methylnaphthalene	3.84	2	4.1	3	11	7.3	0.025	0.1	0.22	0.49	15	2.1	6.3	1.3
	2-methylnaphthalene	3.77	1.6	7.7	5.1	21	15	0.025	0.1	0.096	0.57	20	2.4	11	1.7
	n-Hexane	0.05	0.05	5.15	2.16	12.7	18.7	0.25	0.25	0.0965	0.113	0.25	0.25	4.51	17.9
	MTBE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EDB	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	EDC	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Benzo(a)anthrancene	0.234	0.0949	0.0976	0.0845	0.109	0.116	0.0776	0.1	0.152	0.131	0.0307	0.102	0.1	0.005
	Benzo(b)fluoranthene	0.0779	0.025	0.025	0.025	0.0617	0.0713	0.0893	0.1	0.108	0.12	0.005	0.115	0.1	0.005
	Benzo(k)fluoranthene	0	0	0	0	0	0	0.025	0.1	0.0721	0.0733	0.0166	0.124	0.1	0.005
	Benzo(a)pyrene	0.163	0.025	0.025	0.025	0.0545	0.0601	0.501	0.1	0.025	0.025	0.0108	0.0767	0.1	0.0264
	Chrysene	0.501	0.211	0.222	0.173	0.167	0.165	0.136	0.205	0.232	0.162	0.088	0.2	0.285	0.0154
	Dibenzo(a,h)anthracene	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.1	0.0721	0.0733	0.005	0.025	0.1	0.005
	Indeno(1,2,3-cd)pyrene	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.1	0.025	0.025	0.005	0.025	0.1	0.005
		6004.8379	3329.1379	8885.6536	4307.0975	4537.8722	5994.0524	222.4489	3512.55	3118.8387	3104.7556	10156.8191	1484.5207	4984.725	1722.9068

Method B Direct Contact CUL	3,049	2,996	2,673	2,617	2,789	2,761	44	2,395	3,608	3,009	2,495	1,306	2,967	6,148
Method B PoSW CUL	100% NAPL	100% NAPL	246	466	113	187	100% NAPL	100% NAPL	100% NAPL	100% NAPL	100% NAPL	100% NAPL	504	42
100% NAPL =	76,000	77,000					84,000	76,000	75,000	79,000	75,000	71,000		

Median Method B Direct Contact CUL	**2,775**
Median Method B PoSW using MTCATPH 100% NAPL values	**73,000**

Notes

"100% NAPL" = Occasionally, for the evaluation of the soil-to-groundwater exposure pathway, TPH soil CUL exceeds the theoretical maximum TPH that would be reached if all of the air space in the porous medium is filled with petroleum product. It means the risk is acceptable even at this high soil TPH concentration. In this case, the soil-to-groundwater is not a critical pathway and "100% NAPL" will appear in the protective soil TPH concentration box.