Unocal SMT
SIT 3.5.2

Exhibit B
Draft Cleanup Action Plan
Former Unocal
Seattle Marketing Property
Seattle, Washington

Prepared by
Seattle Art Museum

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FORMER UNOCAL SEATTLE MARKETING TERMINAL
SEATTLE, WASHINGTON

1.0 INTRODUCTION

This Cleanup Action Plan (CAP) describes remedial actions that will be performed on the former Unocal Seattle Marketing Terminal property located on the 3100 block of Elliott Avenue in Seattle, Washington (Figure 1). This CAP was prepared on behalf of the Trust for Public Land (TPL) and the Seattle Art Museum (SAM). TPL and SAM intend to enter into a Prospective Purchaser Consent Decree with the Washington State Department of Ecology (Ecology) pursuant to the MTCA, RCW 70.105D.040(5). SAM is the proposed successor in interest to a purchase and sale agreement between Unocal and TPL for the purchase of Unocal's former Seattle Marketing Terminal (Terminal) property.

This document was prepared in general accordance with requirements listed in the Washington State Model Toxics Control Act (MTCA - WAC 173-340-360). Additional information on the environmental conditions at the site and a more detailed engineering analysis of the restoration and cleanup action are presented in the Focused Feasibility Study (dated September 10, 1999).

2.0 SITE DESCRIPTION

The site of the former Unocal Seattle Marketing Terminal is located east of Elliott Bay near Pier 70 in downtown Seattle, Washington (Figure 1). It is bordered by Western Avenue on the east, Bay Street on the north, and Broad Street on the south. The western boundary extends into Elliott Bay tidelands adjacent to the former Pier 71 location.

For the purposes of the Order on Consent (Order) issued by Ecology, the Unocal site was divided into the following four compliance areas shown on Figure 2:

- Upper Yard;
- Elliott Avenue;
- Lower Yard; and
- Off-Site Area (including Alaskan Way and BNRR right of way).

The Elliott Bay tidelands owned by Unocal, which are located in the vicinity of the former Pier 71 location, were not designated as a compliance area under the Order.

No remedial actions are proposed in this CAP to address the tideland area. Unocal conducted a sediment quality investigation within the tideland area in 1994. Bioassay testing results indicated that 17 of 18 locations sampled passed sediment quality standard (SQS) biological effects criteria. In addition, the 18 samples passed the cleanup screening levels (CSLs) biological effects criteria. Based on these results, Ecology determined that surficial sediments in the Elliott Bay tidelands adjacent to the site do not pose a threat to aquatic organisms. Furthermore, Ecology designated the tidelands area as being of low concern and did not include it on the contaminated sediment site list for Elliott Bay.

2.1 Historical Site Use

The site was used by Unocal for fuel transfer and distribution from the early 1900s to 1975. The facility was expanded in several phases between 1910 and 1940. These expansions generally proceeded eastward, away from the shoreline, and included the installation of fuel storage tanks and construction of a brick office building at the intersection of Western Avenue and Broad Street. This office building was occupied by Unocal until December 1986.

When the Seattle Marketing Terminal was operating at its maximum capacity in the 1960s, the Upper Yard contained numerous above-grade product storage tanks, one underground heating oil tank, storage sheds, and above-grade and below-grade product pipelines (Figure 2). The Lower Yard was used primarily as a fuel distribution warehouse where packaged goods (drums and cans) were stored. The Lower Yard contained a railcar loading rack, truck and trailer loading racks, an asphalt mix and storage area, and a pump pit to transfer product between the Upper Yard, Lower Yard, and tanker loading dock (Pier 71).

The tanker loading dock was demolished in 1988. The structures on the Upper and Lower Yards have been removed. The pipeline tunnel beneath Elliott Avenue still remains. Abandoned underground fuel lines may still be present beneath Alaskan Way and the BNRR right of way.

2.2 Planned Site Use

SAM, in partnership with TPL and the City of Seattle, intends to create a public sculpture park on the site of the former Unocal Terminal (Figure 3). As described in Exhibit C (Proposed Conceptual Land Use Model), the park will include sculptures, pedestrian trails, and landscaped open space. The Upper Yard will

contain an underground parking garage. An exhibition building and accessory structures (e.g., restrooms, espresso stands) will also be placed on the Upper and/or Lower Yards. Buildings installed on the Lower Yard will be constructed slab-on-grade. The Upper and Lower Yards will be connected to each other and to Myrtle Edwards Park and the waterfront via a double-span or two separate pedestrian bridges.

The City of Seattle will have the primary decision-making authority over how the Off-Site Area is developed. If the Off-Site Area is not redeveloped, the existing pavement cap will be maintained. If redeveloped, the Off-Site Area will likely consist of a shoreline promenade, an extension of the Myrtle Edwards Park waterfront bike trail, landscaped open space, and possibly paved parking areas and small slab-on-grade structures. Under this redevelopment scenario, most of the existing paved parking area will be eliminated, the Metro Trolley Barn will be relocated, and the existing shoreline pedestrian sidewalk will be expanded into a broader promenade area. Planning discussions have also included installing a small floating pier or dock that would be attached to the existing seawall and used for fishing and possibly non-motorized boat launch. The Off-Site Area will be connected to the Lower Yard via a pedestrian bridge.

3.0 PREVIOUS CLEANUP ACTIONS

Over the last 10 to 15 years, Unocal has conducted numerous environmental investigations, collecting hundreds of soil and groundwater samples from the site and adjacent properties. Elevated concentrations of petroleum hydrocarbons have been encountered in soil and groundwater within the four compliance areas (the Upper and Lower Yards, Elliott Avenue, and Off-Site Area). In 1988, Unocal entered into an Order on Consent with Ecology to remediate petroleum-related contamination at the site. Ecology amended the Order four times over the years. In 1995, Ecology and Unocal entered into Amendment No. 4, which, among other things, established Remedial Action Levels (RALs) for soil and groundwater in the Lower Yard.

Pursuant to the Order and the Amended Order, Unocal has conducted extensive remedial activities on the property.

3.1 Upper Yard Cleanup Activities

Unocal has removed approximately 57,000 tons of petroleum-contaminated soil from the Upper Yard (GeoEngineers, 1997a). In general, concentrations of petroleum hydrocarbons remaining in the Upper Yard soils do not exceed the 200 mg/kg cleanup level. However, approximately 110 cubic yards of soils

exceeding the Order's petroleum cleanup levels still remain in the Upper Yard along the northwestern boundary with Elliott Avenue. Unocal was unable to excavate these soils because of their depth (approximately 16 to 26 feet below ground surface) and proximity to the shoring wall adjacent to Elliott Avenue.

3.2 Elliott Avenue Cleanup Activities

Unocal installed a soil vapor extraction and pump and treat system in 1989 to remediate petroleum-impacted soil and groundwater under Elliott Avenue. The system operated continuously for 7 months and intermittently for another 8 months. Approximately 4,700,000 gallons of water were removed and treated but, unlike the Off-Site Area (discussed below), no free product was mobilized and collected (GeoEngineers, 1997b). Four rounds of vacuum extraction also did not result in recovery of measurable amounts of free product from well MW-30. Over the past three years, only 1 liter of free product has been removed from wells MW-30 and MW-59 using oil-sorbent material.

3.3 Lower Yard Cleanup Activities

Pursuant to the Order, Unocal conducted extensive remedial actions on the Lower Yard. Unocal excavated approximately 60,000 tons of soil exceeding the petroleum RAL and removed and treated a large volume of petroleum-containing groundwater (GeoEngineers, 1998a). Petroleum-containing soils were typically excavated to depths of 15 to 20 feet below ground surface. The upper 95 percent confidence level of the mean for TPH concentrations (approximately 1,300 mg/kg) remaining in Lower Yard soils is above the cleanup target level of 200 mg/kg but is well below the 7,500 mg/kg RAL (GeoEngineers, 1998b).

The Lower Yard excavation was backfilled with clean fill material and moderately impacted petroleum-containing soils from the Upper and Lower Yards. Several feet of imported rock were placed at the base of the excavation. The excavation was backfilled to within 2 to 12 feet from pre-remedial construction grade using overburden soil from the Lower Yard and Class 1, 2, or 3 soil from the Upper Yard. According to Unocal, the average TPH concentration in these backfill soils was approximately 1,000 mg/kg. A 2-foot-thick layer of clean imported Class 1 soils was placed over the backfilled excavations to serve as an interim cap.

3.4 Off-Site Area Cleanup Activities

Petroleum contamination, including free phase product, was observed in soil and groundwater beneath portions of the BNRR right of way and Alaskan Way adjacent to the former terminal site. Unocal installed an *in situ* remediation system in 1989 to treat petroleum-containing soil and groundwater without the

need for excavation. The Off-Site Area remediation system (Trench D area) has operated almost continuously since December 1989 until the present date and has reduced the discharge of petroleum contamination to Elliott Bay (Figure 4). Approximately 76 million gallons of water have been recovered and treated, and about 4,600 gallons of petroleum product have been recovered (GeoEngineers, 1997c).

Groundwater quality in the portion of the Off-Site Area adjacent to the former pipeline corridor continues to exceed cleanup target levels. Groundwater treatment, including free product recovery, is still being performed within the Off-Site Area. In addition, the northern portion of the Off-Site Area contains petroleum-contaminated soils which exceed cleanup target levels. Petroleum-contaminated soils within the Alaskan Way corridor exist primarily within the saturated zone which includes the capillary fringe. The upper 10 feet of soil within this area (i.e., the unsaturated zone) generally do not appear to be significantly impacted by petroleum releases.

4.0 CURRENT SITE CONDITIONS

4.1 Hydrogeologic Setting

The site is located in the Puget Sound Lowland physiographic province of Washington State on a southwest-facing hillside along Elliott Bay. Soils beneath the site are predominantly sand and gravel fill materials with silts and clays being minor components. Pleistocene glacial deposits of till, outwash, sand, and gravel underlie the fill. The base of the fill ranges in depth from 25 feet or greater in the Lower Yard and Off-Site Area to 0 feet at the base of the steep slopes in the Upper Yard.

Unconfined groundwater is encountered in the fill unit throughout most of the site at depths ranging from 10 to 20 feet below ground surface (relative to pre-construction grade). Groundwater generally flows to the west toward Elliott Bay except where it is locally affected by pumping from the Trench D extraction wells and tidal influences.

4.2 Soil and Groundwater Quality

This section summarizes the environmental conditions that currently exist at the Terminal site. Our understanding of existing site conditions is based on the supplemental site characterization investigation completed in July and August of 1999 (Hart Crowser, 1999a) and results of Unocal's long-term groundwater monitoring program (GeoEngineers, 1999). A more detailed discussion of

current environmental conditions is presented in the Focused Feasibility Study (Hart Crowser, 1999b).

4.2.1 Upper Yard

The Upper Yard is currently undeveloped and is not paved except along the southern portion of the site where the former Unocal office building was located. The northwestern portion of the Upper Yard is currently at least several feet below the grade of Elliott Avenue.

Upper Yard soils are in compliance with MTCA Method A petroleum cleanup criteria. However, approximately 110 cubic yards of petroleum-containing soil are still present at depths of approximately 16 to 26 feet below ground surface along the northwestern boundary with Elliott Avenue (Figure 5). These soils could not be excavated because of their depth and proximity to the shoring wall adjacent to Elliott Avenue (GeoEngineers, 1997a).

Groundwater quality in the Upper Yard is typically within MTCA Method A and B drinking water and surface water criteria except for well MW-61A located along the northwestern boundary with Elliott Avenue (Figure 4). This well is screened within the area that still contains elevated petroleum concentrations in soil. Groundwater fate and transport modeling completed by Hart Crowser indicates that migration of dissolved hydrocarbons from well MW-61A would not significantly impact the Lower Yard and the Elliott Bay marine environment due to the affects of natural attenuation (Hart Crowser, 1999a). In addition, no dissolved hydrocarbons were detected during the latest groundwater sampling event in wells MW-66 and MW-87 located immediately downgradient of well MW-61A (Figure 5).

Results of a soil vapor investigation recently completed at the site indicated that the soil to ambient air pathway was not of concern in the Upper Yard. However, the presence of benzene in subsurface vapors sampled along the northwestern portion of the Upper Yard could potentially impact indoor air quality in a building installed in this area (Hart Crowser, 1999a).

4.2.2 Elliott Avenue

Elevated petroleum concentrations in soils appear to be primarily limited to the northern portion of Elliott Avenue. Petroleum occurrences north of the Unocal pipe tunnel consist primarily of diesel- and oil-range hydrocarbons. Free product observed in well MW-30 located in this area was very viscous (433 centistokes at 122° C) and tarry-like. Petroleum-containing soils encountered south of the tunnel generally contained relatively higher percentages of gasoline-range

hydrocarbons. None of the soil samples collected in Elliott Avenue during Hart Crowser's recent soil investigation contained BTEX at concentrations in exceedence of current MTCA Method A cleanup levels (Table 1). No benzene was detected in any of the samples.

Soils exceeding MTCA Method B residential direct contact cleanup levels (Table 1) appear to be present primarily within the northwestern portion of Elliott Avenue at depths of 10 to 20 feet below ground surface. BTEX and PAH concentrations detected in Elliott Avenue soil samples collected during this investigation are below Method A and Method B direct contact cleanup levels.

Groundwater within Elliott Avenue is impacted primarily by the presence of sheens and free product in the northwestern portion of the site. Small quantities (10 to 300 milliliters) of free product are being recovered quarterly from wells MW-30 and MW-59 (Figure 4). Modeling and groundwater monitoring performed by Hart Crowser indicate that migration of free product from this area is likely to be minimal primarily due to its high viscosity (Hart Crowser, 1999).

Exceedences of TPH surface water criteria due to dissolved-phase (gasoline-range) hydrocarbon concentrations are primarily limited to well MW-61A. Gasoline-range hydrocarbons, which include the most soluble hydrocarbon fractions, are not typically detected in Elliott Avenue area wells located to the north of the tunnel (including wells MW-30, MW-58, and MW-65), or in wells located south of well MW-61A (including wells MW-31, MW-32, MW-62A, MW-63A, and MW-64). Gasoline-range hydrocarbon concentrations in well MW-66 located downgradient of well MW-61A are typically at or below 1 mg/L. No TPH was detected in well MW-66 during the latest groundwater sampling event performed by Hart Crowser.

Fate and transport modeling performed by Hart Crowser indicated that downgradient migration of dissolved-phase hydrocarbons from the well MW-61A area is minimal due to natural attenuation. The lack of detectable hydrocarbons in wells MW-66 and MW-87 located downgradient of well MW-61A provides further evidence that dissolved-phase transport of hydrocarbons from this area is minimal.

Soil vapor monitoring and computer modeling performed for the Elliott Avenue area (including sections of the Upper and Lower Yards bordering Elliott Avenue) indicates that vapor emissions do not result in unacceptable risk via the soil to ambient air pathway. However, limited potential indoor air impacts were

identified in the Upper Yard for future buildings (if any) installed adjacent to Elliott Avenue.

4.2.3 Lower Yard

As discussed previously, most of the upper 15 to 20 feet of soil within the Lower Yard were excavated as part of petroleum cleanup activities. The upper 95 percent confidence level of the mean for TPH concentrations (approximately 1,300 mg/kg) remaining in Lower Yard soils is above the cleanup target level of 200 mg/kg but is well below the 7,500 mg/kg RAL (GeoEngineers, 1998b). The average TPH concentration in soils used to backfill the excavation was approximately 1,000 mg/kg. These soils were covered with a 2-foot-thick layer of clean imported Class 1 soils.

Petroleum hydrocarbons present in the Lower Yard soils were recently tested for Volatile Petroleum Hydrocarbons (VPH)/Extractable Petroleum Hydrocarbons (EPH). The results indicate that these soils do not pose an unacceptable risk to human health or the environment. The soil samples did not contain petroleum hydrocarbon concentrations which exceeded either Method B direct contact or soil to groundwater cleanup criteria. However, there are a number of soil samples previously collected by Unocal behind the shoring walls along the northern property boundary that likely exceed residential direct contact and/or soil to groundwater cleanup levels. BTEX and PAH compounds were generally not detected.

Potential impacts from the soil to air pathway were also evaluated. Soil to air modeling results indicate that predicted ambient air concentrations would not exceed MTCA Method B residential air cleanup criteria. Potential impacts to indoor air were identified in the southern portion of the Lower Yard and the adjacent Shakey's property due to the presence of 1,3-butadiene. The occurrence of butadiene, which is a low molecular weight (C_4) hydrocarbon present in trace quantities in fresh gasoline, may be the result of gasoline contamination on the Shakey's property. Residual petroleum occurrences present on the Unocal property are highly weathered and do not likely contain significant concentrations of very light hydrocarbons such as butadiene.

4.2.4 Off-Site Area

Petroleum-containing soils have been encountered across much of the Off-Site Area. Most of the petroleum-containing soils are located within the saturated zone which includes the capillary fringe or smear zone, at depths of 10 feet below ground surface or greater. Soil TPH concentrations within the saturated zone likely exceed Method B direct contact criteria, particularly within the

northern portion of the property. Unsaturated zone soils are generally not significantly impacted by petroleum releases except in the northeastern corner adjacent to the Lower Yard.

Free phase product, consisting of kerosene- to oil-range hydrocarbons, is still present beneath portions of the Off-Site Area. Most of the free product has been observed in the northern portion of the site. Unocal has removed approximately 4,600 gallons of product since installing the groundwater extraction system in 1989. However, only 8 gallons of product were recovered during the most recent quarter (April 2 to July 1, 1999) reported in Progress Report Number 66 (GeoEngineers, 1999).

Groundwater petroleum impacts are generally limited to the northern portion of the Off-Site Area, particularly in the vicinity of the former pipe corridor (Figure 4). Although product sheens and free phase product have been encountered in a number of wells within the northern portion of the Off-Site Area, dissolved-phase (gasoline-range) hydrocarbon concentrations are typically at or below 1 mg/L.

Potential impacts from the soil to air pathway in the Off-Site Area were evaluated during the recent focused site investigation completed by Hart Crowser (Hart Crowser, 1999a). Soil to air modeling results indicate that predicted ambient air concentrations would not exceed MTCA Method B residential air cleanup criteria.

5.0 CLEANUP OBJECTIVES AND CRITERIA

5.1 Remedial Action Objectives (RAOs)

Cleanup actions to be implemented at the Unocal site are designed to achieve the following objectives:

- **Minimize Direct Contact.** Minimize direct contact with petroleum-impacted soils and shallow groundwater.

- **Prevent Potential Indoor Air Impacts.** Minimize possible volatilization of hydrocarbons from impacted soil and groundwater to indoor air.

- **Verify that Vapor Emissions Do Not Unacceptably Impact Ambient Air Quality.** Ensure through three ambient air monitoring stations on site, that hydrocarbon vapor emissions do not impact ambient air quality above MTCA Method B criteria or background conditions (as predicted by

computer modeling). SAM will implement a Vapor Emission Contingency Plan, if needed. A detailed description of the Air Sampling/Monitoring and Contingency Plan is contained in the attached Exhibit F of the Consent Decree.

- **Minimize Leaching to Shallow Groundwater.** Minimize leaching of hydrocarbons from soil to shallow groundwater to the maximum extent practicable.

- **Minimize Free Product Migration.** Prevent free phase product from impacting adjacent sites or the marine environment.

Specific RAOs for each of the four compliance areas are summarized below.

5.1.1 Upper Yard

Upper Yard soil and groundwater are in compliance with MTCA Method A criteria except in the vicinity of well MW-61A. Because most of this petroleum occurrence extends into Elliott Avenue, remedial actions addressing this area will be discussed as part of Elliott Avenue RAOs. The only RAO identified for the Upper Yard is verifying that hydrocarbon vapor emissions from the Elliott Avenue area do not impact ambient air quality above MTCA Method B criteria or background conditions (as predicted by computer modeling) using an ambient air monitoring station.

5.1.2 Elliott Avenue

RAOs for petroleum-impacted soils and groundwater within Elliott Avenue include the following:

- **Prevent Direct Contact to the Public and Utility Construction Workers.** Although petroleum-impacted soil and groundwater are currently inaccessible to the public (based on street pavement and concrete sidewalks) and is present at least several feet below most of the utility corridors, further minimizing the potential for direct contact is an RAO for Elliott Avenue.

- **Prevent Potential Indoor Air Impacts.** Although no buildings will be placed in Elliott Avenue, potential exposures to hydrocarbon vapors by utility workers should be addressed. In addition, vapors from Elliott Avenue could potentially impact indoor air quality in proposed buildings in the Upper Yard.

- **Minimize Leaching to Shallow Groundwater.** The primary source of leachable hydrocarbons in Elliott Avenue soils appears to occur in the MW-61A area. Since most of these soils are present within the saturated zone or are already effectively capped by Elliott Avenue, potential remedial actions will be focused on minimizing the amount of groundwater recharge in the Upper Yard.

- **Minimize Free Product Migration.** Free product occurrences in the northwestern portion of Elliott Avenue appear to have low potential for migration. Continued recovery of free product from wells MW-30 and MW-59 will further minimize the migration potential of the free phase product.

5.1.3 Lower Yard

The primary RAOs for the Lower Yard are preventing potential indoor impacts in buildings and verifying that ambient air quality meets Method B cleanup levels or are within background conditions. As noted in the Upper Yard discussion, the type, location, and number of buildings that may be placed on the Lower Yard are not known at this time. Also, the only compound of concern for indoor air quality is 1,3-butadiene which is derived from an unknown source. An ambient air monitoring station will be installed in the Lower Yard to verify that hydrocarbon vapor emissions do not impact ambient air quality above MTCA Method B criteria or background conditions (as predicted by computer modeling).

A secondary RAO for the Lower Yard is to further minimize direct contact and leaching of hydrocarbons from residual petroleum-impacted soils. The potential for direct contact exposures and leaching of hydrocarbons from residual petroleum-impacted soils present within the Lower Yard is minimal. Most of the soils which exceed direct contact criteria are behind shoring walls or are present at depths greater than 15 feet below ground surface. Groundwater quality data collected from the Lower Yard during Unocal's most recent monitoring events generally do not contain dissolved-phase hydrocarbons at concentrations exceeding MTCA cleanup criteria (GeoEngineers, 1999).

5.1.4 Off-Site Area

The primary RAOs for the Off-Site Area are minimizing direct contact exposures and verifying that ambient air quality meets Method B cleanup levels or are at or below background concentrations. Although soil within the upper 10 feet are generally not significantly impacted by petroleum releases, direct contact exposures to soil and groundwater present within the 10- to 15-foot-depth

interval should be minimized. Maintaining the existing street asphalt pavement and concrete surface or replacing it with an equivalent surface will effectively minimize direct contact exposures.

An ambient air monitoring station will be installed in the Off-Site Area to verify that hydrocarbon vapor emissions do not impact ambient air quality above MTCA Method B criteria or background conditions (as predicted by computer modeling).

Although migration of free phase product and release of dissolved hydrocarbons are an issue within the Off-Site Area, these issues are currently being addressed by Unocal's groundwater treatment system. As discussed in the Focused Feasibility Study (Hart Crowser, 1999b), no RAOs have been developed to address saturated soils and groundwater.

5.2 Indicator Hazardous Substances

Indicator hazardous substances (IHSs) were identified for the UNOCAL Former Seattle Bulk Marketing Terminal site using the criteria outlined in WAC 173-340-708(2). The final list of IHSs for groundwater and soil are a subset of the contaminants detected at the site. The final soil IHSs are TPH compounds and cPAHs. The final groundwater IHSs are benzene, toluene, ethylbenzene, xylenes, TPH-gasoline, TPH-diesel, TPH-oil, cPAHs, lead, and free product.

5.3 Cleanup Levels

Soil and groundwater cleanup levels for the final IHSs were developed based on the proposed recreational land use of the site and the determination by Ecology that there is no current or planned future use of the groundwater for drinking water purposes. The beneficial use of the site groundwater is protection of the adjacent surface waters and its ecosystems, to prevent petroleum vapors from adversely impacting the intended site use and to prevent elevated dissolved petroleum hydrocarbon concentrations in groundwater from migrating off site and adversely impacting adjacent properties.

The proposed cleanup action for the site was selected based on a comparison of each cleanup action alternative with the following criteria [WAC 173-340-360(2) and (3)] and consideration of the MTCA remedy selection requirements:

- Overall Protection of Human Health and the Environment;
- Compliance with Cleanup Standards;
- Use of Permanent Solutions to the Maximum Extent Practicable;
- Compliance with ARARs;

- Provision for Compliance Monitoring; and
- Provision for Reasonable Restoration Time Frame.

5.3.1 Soils

Surface Soils. Direct contact exposures and soil to groundwater impacts associated with site surface soils are minimal. Site surface soils typically do not contain elevated TPH concentrations and/or are covered with clean soil or pavement caps. Final capping of the site (see Sections 7.1 through 7.4) will further minimize potential environmental impacts associated with surface soils. For the Upper and Lower Yards and the Off-Site Area, residual petroleum-containing soil will be isolated below 2 to 3 feet of clean soil cover, a building, or a pavement cap. Low permeability caps (or equivalent) and/or grading for drainage will be used to reduce surface water infiltration.

Subsurface Soils. Action levels and cleanup standards for TPH in subsurface soils were set to meet the remedial action objective of protecting surface water at the property boundaries, improve general groundwater conditions at the source, eliminate primary sources of petroleum vapors to adjacent areas, and enhance restoration of the impacted area through natural biodegradation. Application of subsurface soil action levels will be effective in meeting cleanup levels in groundwater at the point of compliance and will contribute substantial new resources toward cleanup of the site that otherwise would not be available.

Cleanup levels for soil are presented in Table 1 and are based on MTCA Method B direct contact residential criteria. The Method B direct contact criteria for petroleum was established using Ecology's Interim TPH Policy and VPH/EPH data collected during the focused site characterization (Hart Crowser, 1999a).

Soil to groundwater cleanup levels were not developed since the only constituent currently exceeding groundwater cleanup levels is TPH. Evaluation of soil to groundwater cleanup levels for TPH is based on the Raoult's Law calculations presented in the Interim TPH Policy. Most of the soil samples tested for VPH/EPH and evaluated using the Raoult's Law procedure did not result in predicted exceedences in groundwater of the Method A drinking water criteria of 1 mg/L. Although the Raoult's Law evaluation indicated that one soil sample (HC-SB2-S6) collected within the saturated zone could leach TPH at a concentration (4.5 mg/L) exceeding the Method A drinking water criteria, dissolved (gasoline-range) hydrocarbons have not been detected in wells installed adjacent to this location (including wells MW-30 and MW-65) during the last four quarterly groundwater monitoring events. In addition, no TPH was detected in well MW-87 installed downgradient of this area.

Soil to indoor air cleanup levels were also not established since no soil source control is planned. Benzene, which was identified as being of potential concern for the indoor air pathway in the northwestern portion of the Upper Yard, was not detected in Elliott Avenue soils tested during the recent site investigation. The indoor air pathway will be addressed using engineering controls (if necessary).

5.3.2 Groundwater

Groundwater cleanup levels are based on MTCA Method B surface water criteria (Table 1). Because there is no established Method B surface water criteria for TPH, the Method A drinking water cleanup level of 1 mg/L was used for screening purposes.

5.3.3 Air

Cleanup levels for ambient and indoor air are based on MTCA Method B cleanup levels (Table 2). In cases where no Method B criteria are available, the Puget Sound Air Pollution Control Agency (PSAPCA) Acceptable Source Impact Levels (ASILs) were used. Since no Method B or PSAPCA criteria have been established for TPH, Method B air cleanup levels were calculated for each of the petroleum equivalent carbon (EC) fractions identified in the draft revised MTCA (dated December 1998).

Inhalation reference doses used to calculate Method B cleanup levels for these hydrocarbon fractions were obtained from "Ecology Guidance Calculation of TPH Human Health Direct Contact Cleanup Levels Using Default Compositions" which was presented to the Science Advisory Board by Steve Robb in January of 1999. Since no inhalation reference doses were available for the EC 3 to EC 5 range and the EC 12+ range, no cleanup levels were calculated for these fractions.

6.0 SUMMARY OF REMEDIAL ALTERNATIVES

The Model Toxics Control Act (MTCA) requires at a minimum that all cleanup actions protect human health and the environment, comply with cleanup standards, comply with applicable state and federal laws, and provide for compliance monitoring. Given the extensive amount of remedial activities and mass removal that has already been performed by Unocal in the Upper and Lower Yards, the remedial alternative discussions in the supplemental FFS for the site focused on supplementary measures addressing residual risk.

In the Off-Site Area, Unocal continues to operate the groundwater treatment system. Since the groundwater treatment system addresses risks associated with soil to groundwater impacts within the saturated zone, the Off-Site Area remedial alternatives presented in the supplemental FFS focused on minimizing direct contact exposures.

In Elliott Avenue, a wider range of potentially applicable remedial technologies were screened to address impacted unsaturated and saturated soils as well as groundwater. We utilized Unocal's experience with several remedial technologies tested in Elliott Avenue (including bioremediation and vacuum extraction of free product) to limit the number of remedial technologies to be considered.

6.1 Upper Yard Remedial Alternatives

The primary environmental issue associated with the Upper Yard is potential impacts to indoor air along the boundary with Elliott Avenue. Because remaining soils and groundwater in the Upper Yard are in compliance with MTCA Method A cleanup levels (except for MW-61A area), no remedial actions have been identified. Remedial actions to address the MW-61A area will be discussed as part of Elliott Avenue remedial alternatives.

The only RAO identified for the Upper Yard is verifying that hydrocarbon vapor emissions from the Elliott Avenue area do not impact ambient air quality above MTCA Method B criteria or background conditions (as predicted by computer modeling) using an ambient air monitoring station. A Vapor Emission Contingency Plan will be implemented, if necessary. A detailed description of the Air Sampling/Monitoring and Contingency Plan is contained in the attached Exhibit F of the Consent Decree.

6.2 Elliott Avenue Remedial Alternatives

The TPH remaining in soil and groundwater in the vicinity of MW-61A and HC-SB-1 contains gasoline- and diesel-range compounds which could potentially recontaminate the Lower Yard and may impact indoor air in buildings constructed nearby. In addition, viscous NAPL remains in wells north of the pipe tunnel. As discussed previously, this viscous NAPL has limited mobility and therefore a low human health risk associated with it.

The following five alternatives were evaluated in the focused feasibility study. They were selected based on their ability to address all exposure pathways and to offer a range of mass removal and cost.

- Manual NAPL removal, capping, and natural attenuation with engineering and institutional controls;
- Source area sparging and SVE, capping, and natural attenuation with engineering and institutional controls;
- Hot spot excavation, capping, and natural attenuation with engineering and institutional controls;
- Sparging and SVE beneath Elliott Avenue, capping, and natural attenuation with institutional controls; and
- Elliott Avenue excavation.

Table 3 summarizes the alternatives comparison.

6.3 Lower Yard Remedial Alternatives

The primary environmental issues associated with the Lower Yard are potential impacts to indoor air caused by on-site and/or off-site vapor emissions and potential direct contact exposures and hydrocarbon leachability of residual petroleum-impacted soils. Given that the source of hydrocarbon vapors could originate from a number of potential off-property sources (e.g., Shakey's site, Bay Street), source control via mass removal is not possible. If necessary, vapor emissions to indoor structures will be addressed using engineering controls.

The three remedial alternatives that can be used to address direct contact and leachability risks associated with residual petroleum-containing soils on the Lower Yard include:

- Excavate residual petroleum-containing soils along northern property boundary by removing shoring. Perform limited excavations with dewatering in other isolated areas where direct contact or soil to groundwater exceedences have been observed.
- Place additional soil cover over existing temporary cap to further minimize potential direct contact exposures. Grade cap for efficient surface water drainage to minimize infiltration. Apply institutional controls.
- Install additional soil cover with low permeability cap to further minimize potential direct contact exposures, reduce surface water infiltration, and restrict vapor emissions to ambient air. Apply institutional controls.

6.4 Off-Site Area Remedial Alternatives

Remedial alternatives presented in this section are designed to minimize direct contact and vapor emission exposures. As discussed previously, petroleum impacts have been primarily observed in the saturated zone. Because Unocal is currently operating a groundwater treatment system in the Off-Site Area, these alternatives do not address the release and migration of free phase product or dissolved hydrocarbons.

The existing street asphalt pavement and concrete surface effectively minimizes direct contact exposures. During redevelopment, it may be desirable to remove all or a portion of the existing cap to regrade and landscape the Off-Site Area. If the existing cap is removed, the following remedial alternatives may be utilized:

- Place additional soil cover over relatively clean unsaturated zone soils to further minimize potential direct contact exposures. Grade cap for efficient surface water drainage to minimize infiltration. Apply institutional controls.

- Install additional soil cover with low permeability cap to further minimize potential direct contact exposures, reduce surface water infiltration, and restrict vapor emissions to ambient air. Apply institutional controls.

6.5 Summary of Preferred Remedies

Based on the supplementary FFS detailed evaluation, the following remedial alternatives were determined to be the most effective and practicable:

- **Upper Yard.** No remedial actions are recommended. Potential indoor air impacts will be evaluated when specific structural designs and locations are developed. MW-61A area will be addressed as part of the Elliott Avenue remedial alternatives.

- **Elliott Avenue.** Place a reduced permeability cap in the northern portion of the Upper Yard, use engineering controls in buildings constructed in the northwest corner of the Upper Yard if vapor issues are identified, manual NAPL removal in wells MW-30 and MW-59, and filing a restrictive covenant to maintain street right of way cap and notify utility workers.

- **Lower Yard.** Install a low permeability cap and evaluate indoor air impacts for each individual heated permanent building.

- **Off-Site Area.** Install a low permeability cap to supplement Unocal's on-going groundwater treatment system if existing cap is removed.

The attached ambient air monitoring program was developed for the entire site to verify that hydrocarbon vapor emissions do not impact ambient air quality above MTCA Method B criteria or background. A Vapor Emission Contingency Plan will be implemented, if necessary. A detailed description of the Air Sampling/Monitoring and Contingency Plan is contained in the attached Exhibit F of the Consent Decree.

7.0 SELECTED CLEANUP ACTION

The selected cleanup actions are described in more details below.

7.1 Upper Yard Selected Remedy, Engineering, and Other Considerations

SAM's proposed land use for the Upper Yard consists of an Exhibition Building and/or accessory structures, an underground parking garage, and landscaped area with pedestrian trails. The area in the vicinity of MW-61A will be capped as part of the Elliott Avenue cleanup action. The remainder of the Upper Yard will be capped with clean (i.e., constituent concentrations are below Method A and B residential criteria) soil material. The cap will be graded as much as possible, within the park design constraints, for efficient surface water drainage to minimize infiltration.

7.1.1 Underground Park Garage

When more information is available on the location and design of the underground parking garage, the potential for vapor migration from on-site or off-site sources will be evaluated. As part of the geotechnical exploration program, additional characterization of the subsurface soil vapors will be performed to determine the need for a system. Field organic vapor screening, including soil headspace measurements, will be conducted as part of the parking garage geotechnical exploration program. An Indoor Air Sampling and Analysis Plan will be submitted to Ecology for their review and approval. If field soil headspace screening results indicate the presence of organic vapors at levels exceeding background conditions, a decision will be made to either add engineering controls or perform additional vapor monitoring to determine if petroleum and BTEX vapor concentrations exceed MTCA Method A or B indoor air cleanup criteria. If petroleum hydrocarbon vapor concentrations exceed MTCA indoor air criteria, engineering controls will be incorporated in the building design. An indoor air impact assessment report memorandum summarizing the results of such evaluation will be submitted to Ecology for review.

Engineering controls will be incorporated in the building design, and may include design features such as a garage open to the outdoors, a heating and air conditioning system which pressurizes the building instead of creating a vacuum, the placement of a geomembrane under the slab acting as a vapor barrier, or the installation of a vapor collection and extraction system under the slab. Figure 6 depicts a conceptual vapor removal system, consisting of perforated pipes in a grid pattern with a vacuum pump system to remove collecting vapors. Depending on the concentration of hydrocarbon present, the vapors may be treated before being released to the atmosphere. Water entering the system drainage layer will move by gravity feed to the storm sewer system. Vapors would reside at the top of the piping and will be removed by the vacuum pump. Following implementation of the approved engineering controls, an indoor air compliance monitoring program will be developed as discussed in Exhibit F.

7.1.2 Ambient Air Monitoring

The attached ambient air monitoring program was developed for the entire site to verify that hydrocarbon vapor emissions do not impact ambient air quality above MTCA Method B criteria or background. A detailed description of the Air Sampling/Monitoring and Contingency Plan is contained in the attached Exhibit F of the Consent Decree.

7.2 Elliott Avenue: Manual NAPL Removal, Capping, and Natural Attenuation with Engineering and Institutional Controls

Elliott Avenue is paved, and Unocal has notified the City of Seattle of the presence of impacted soil and groundwater and the need to use engineering controls during utility work in the street. Pursuant to the Order, NAPL is being removed from impacted wells. To address potential indoor air and groundwater impacts associated with TPH in the vicinity of well MW-61A, a reduced permeability cap will be placed in the northern portion of the Upper Yard and engineering controls will be used in buildings constructed in the northwest corner of the Upper Yard (Figure 7). A restrictive covenant will be recorded.

The reduced permeability cap will decrease infiltration and groundwater recharge directly upgradient from Elliott Avenue, particularly in the MW-61A area, reducing potential leaching of impacted soils. The area will be graded with a slope of 3 percent before placing the cap and drainage layer. The reduced permeability cap will consist of a 1-foot-thick layer of granular material with at least 10 percent fines with a vertical permeability of 1.2×10^{-4} to 1.0×10^{-6} cm/sec. Above the reduced permeability layer, a 1-foot-thick drainage layer

(maintaining the 3 percent slope), with perforated pipes will be placed to collect water percolating through the topsoil (Figure 7). The collected water will be discharged to the storm sewer. The gravel layer will be overlaid with filter fabric and a minimum of 3 feet of sandy loam suitable for landscaping. This layout will reduce infiltration in the capped area by about 50 percent.

The reduced permeability cap will also decrease potential indoor air impacts. In addition, if future redevelopment plans include installing a permanent heated building along Elliott Avenue, additional soil vapor investigations will be conducted along the proposed footprint of the building to determine if engineering controls are needed. Engineering controls may include design features such as a garage open to the outdoor on the first floor or basement, a heating and air conditioning system which pressurizes the building instead of creating a vacuum, the placement of a geomembrane under the slab acting as a vapor barrier, or the installation of a vapor collection and extraction system under the slab (Figure 6).

Unocal continues to remove NAPL pursuant to Amendment No. 4, which involves regular monitoring for NAPL in monitoring wells MW-65 and MW-30, and NAPL removal by hand bailing if present. This process should continue until NAPL ceases to collect within the monitoring wells.

7.3 Lower Yard: Low Permeability Cap

A clean soil cover cap will be placed across the Lower Yard as shown on the Figure 8. A low permeability (typically 10^{-5} to 10^{-6} cm/sec) bentonite-amended soil, prefabricated liner, or equivalent will be used to reduce or prevent infiltration of surface water into the underlying impacted soils. To establish drainage, a free-draining granular backfill will be needed above the low permeability layer and below topsoil or pavement. Soil from the Upper Yard may be used as backfill material. The low permeability layer will be sloped to a drainage collection system consisting of a series of catch basins that tight-line water to the existing storm sewer system or to Puget Sound.

If permanent heated buildings with closed basements or first floors are placed in the Lower Yard, an additional soil vapor investigation will be conducted as described in Section 7.1.1. Once the location of the proposed building has been established, a soil vapor investigation will be completed using subsurface vapor probes within the footprint of the proposed structure. If unacceptable vapor impacts are predicted, engineering controls will be used to address vapor emissions, as described for the Upper Yard.

The attached ambient air monitoring program was developed for the entire site to verify that hydrocarbon vapor emissions do not impact ambient air quality above MTCA Method B criteria or background. A detailed description of the Air Sampling/Monitoring and Contingency Plan is contained in the attached Exhibit F of the Consent Decree.

Additional provisions are required in the Lower Yard due to the various components of the sculpture park to maintain cap integrity. Discussion of these provisions are provided individually as follows.

7.3.1 Pedestrian Bridges

Pedestrian bridges will connect the Lower Yard with the other properties as previously discussed. These structures will likely be supported on piling due to the anticipated foundation characteristics of the underlying site soils. Figure 9 shows the piling in relation to the cap. The low permeability layer will be physically tied to the pile cap or bonded with an adhesive, depending on the type of liner employed. To promote surface water drainage, the liner will be sloped away from the pile cap and transmit water through the drain layer above the liner to catch basins, as previously discussed.

The foundation system for the pedestrian bridges will likely consist of augercast piling. Augercast piles are preferable to other applicable pile types because they minimize the potential for petroleum vapor migration through or around the pile. Also note that structure foundations (i.e., pile caps) may be constructed directly on contaminated soil since they function as a cap. Appropriate health and safety procedures will be required during construction to prevent direct contact.

7.3.2 Sculpture Foundations

For sculptures, specific foundation design will be required. There are three possible foundation alternatives for sculptures, two of which are shown on Figures 10 and 11. For light sculptures, a moveable spread footing will be applicable. As shown on Figure 10, this type of foundation does not directly impact the low permeability liner. A compacted granular fill will be required below the foundation to provide adequate bearing capacity and avoid settlement. Settlement calculations will be performed to verify that the cap integrity will be sustained upon loading from the sculpture.

For heavy sculptures, piling or a larger embedded mat foundation will likely be required. In the areas where Lower Yard sculptures will be supported on piling, the cap will be constructed in a manner similar to the pedestrian bridges (Figure

9). Depending on the planned raise in grade, sculptures supported on large embedded mat foundations may require breaches in the low permeability cap. Where this occurs, a foundation and drainage system as shown on Figure 11 will be installed. On Figure 11, the foundation is shown constructed on a drainage layer that is backfilled with clean soil. The foundation and backfill soils are enclosed within an HDPE membrane, which abuts the surrounding low permeability layer within the cap. Infiltrating water is collected and tight-lined to the storm sewer system. The types of foundations designed and the required modifications will depend on final grades. Actions proposed to maintain cap integrity and reduce or prevent surface water infiltration will be discussed in greater detail during design.

7.3.3 Large Plantings

Figures 12, 13, and 14 illustrate conceptual alternatives for large plantings, such as trees, which may otherwise impact the cap and low permeability layer. Isolation of the planting from the cap as shown on Concepts A and B is one alternative, while Concept C shows the planting within the cap with drainage provisions consistent with reducing infiltration. The selection of capping alternatives for large plantings will be based on planned grades presented in the final design. It is likely that several or all of these alternatives will be used in various portions of the Lower Yard.

For all large plantings, infiltrating surface water will be collected and discharged to the storm water system and/or Puget Sound, if applicable.

7.3.4 Utility Excavations

Utility trenches will be constructed to state and city standards. Institutional controls will require reconstruction or repair of the cap and low permeability liner if excavations are required through the cap. Where utilities extend into petroleum-impacted soils, the trenches will be constructed such that 1 foot of overexcavation occurs, or a geofabric lining be used, to provide a clean perimeter around the outside of the utility trench.

7.4 Off-Site Area: Low Permeability Cap

Proposed land-use for the Off-Site Area will be similar to the Lower Yard. If the Off-Site Area cap is altered, final site grades are likely to correspond to, or be near, existing grades. If the Off-Site Area is developed, the cap may consist of the existing pavement, likely with the addition of a low permeability asphalt overlay across the area. An alternative low permeability lining, as discussed above, may be used, depending on the planned grades. Another possibility for

cap construction will involve removal of the existing pavement and replacement with a soil cap and low permeability lining as discussed for the Lower Yard. Because the site will be landscaped, the liner construction will need to accommodate large plantings as discussed for the Lower Yard and as shown on Figures 12, 13, and 14. The selection of capping alternatives for large plantings will be based on planned grades presented in the final design. It is likely that several or all of these alternatives will be used in various portions of the Off-Site Area.

Pedestrian bridges installed on the Off-Site Area will be constructed in a manner similar to the Lower Yard bridges (see Section 7.3.1).

Other components of the planned land use will be similar to what has been discussed for the Lower Yard. The exceptions will be that the caps will likely utilize the existing pavement to a limited degree and collected surface water will likely be discharged directly to Puget Sound.

If permanent heated buildings with closed basements or first floors are planned for the Off-Site Area, an additional soil vapor investigation will be conducted. As described in Exhibit F, work plans and vapor impact assessment reports will be submitted for Ecology review and approval. Once the location of the proposed building has been established, a soil vapor investigation will be completed using subsurface vapor probes within the footprint of the proposed structure. If unacceptable vapor impacts are predicted, engineering controls will be used to address vapor emissions.

The attached ambient air monitoring program was developed for the entire site to verify that hydrocarbon vapor emissions do not impact ambient air quality above MTCA Method B criteria or background. A detailed description of the Air Sampling/Monitoring and Contingency Plan is contained in the attached Exhibit F of the Consent Decree.

8.0 COMPLIANCE MONITORING

Compliance monitoring is performed to confirm that human health and the environment are protected during the construction, operation, and maintenance of the cleanup action. Compliance monitoring also confirms that the cleanup action has attained the cleanup standards prescribed by the cleanup plan and confirms the long-term effectiveness of the remedial action. Compliance monitoring at the site will be performed as follows:

- Protection Monitoring will be implemented during construction by ensuring that site workers are appropriately trained in health and safety and that health and safety and contingency plans for encountering hazardous materials are available during construction. Soils that are obvious waste materials will be stockpiled with appropriate contact and runoff controls.

- Performance Monitoring will be performed during construction on all soils deemed suspect during the utility excavations. Suspect soils will be stockpiled separately and chemically analyzed for previously identified constituents of concern. Appropriate treatment and/or disposal will be performed on excavated soils.

- If permanent heated buildings with closed basements or first floors are planned for the site, a soil vapor investigation will be performed along the proposed footprint of the building to determine if engineering controls are needed. An indoor air sampling and analysis plan will be submitted to Ecology for their review and approval. If petroleum hydrocarbon vapor concentrations exceed MTCA indoor air criteria, engineering controls will be incorporated in the building design. An indoor air impact assessment report summarizing the results of the vapor sampling and design of any proposed engineering controls will be submitted to Ecology for review and approval. Following implementation of the approved engineering controls (if needed), an indoor air compliance monitoring program will be developed as discussed in Exhibit F.

- To verify that the soil to ambient air pathway is not of concern, one round of air monitoring will be performed during weather conditions in which soil vapor emissions are more likely to occur. Data collected during this initial Air Sampling event will be used to help develop a long-term ambient air monitoring program. SAM will submit an ambient air compliance monitoring plan for Ecology's review prior to implementing the sampling program. If the Contingency Plan is implemented as a result of compliance monitoring, SAM will conduct vapor emission performance monitoring on the engineering control systems to ensure that they achieved the intended objectives.

A detailed description of the Air Sampling/Monitoring and Contingency Plan is contained in the attached Exhibit F of the Consent Decree.

8.1 Points of Compliance

Soil. The determination of adequate soil treatment will be based on the remedial actions' ability to comply with the groundwater cleanup standards for the site, to meet performance standards designed to minimize human health or

environmental exposure to vapors and soils above cleanup levels, and to provide practicable treatment of contaminated soils. Performance standards designed to minimize human and environmental exposure to soils above the cleanup levels set for the site shall include a covenant on the property which limits the use of the site and prohibits any activity which may interfere with the protectiveness of the remedial action.

Groundwater. The achievement of cleanup levels in groundwater shall be measured at points of performance and compliance located within the product plume area and at the downgradient edge of the site or Operable Unit boundaries. The wells at the downgradient edge of the Operable Units (Upper Yard, Elliott Avenue, and the Lower Yard) are considered conditional points of compliance wells. These points of compliance and performance consist of a network of monitoring wells located in the product plume area and on the downgradient property boundary or Operable Unit boundaries. Other wells (sentry wells) situated off site (north of Bay Street) are used to document plume migration, performance standards, and to warn of any unanticipated change in off-property groundwater conditions. Exact locations of these wells are identified in the Quarterly Groundwater Compliance Monitoring Progress Reports that Unocal submits to Ecology as required under Amendment No. 4 to the Order of Consent.

9.0 SCHEDULE

The short-term ambient air monitoring event shall be completed in October of 1999. Within 90 days of completing this sampling, a technical memorandum summarizing the sampling results and a Draft Long-Term Air Monitoring Plan will be submitted for Ecology's review.

SAM shall also submit to Ecology for review a draft engineering design report, construction plans and specifications, and an operation and maintenance plan (collectively referred to as remedial design documents). The remedial design document shall include a schedule for implementing the proposed remedial actions at the site. Ecology will endeavor to review and comment on the draft remedial design documents within forty-five days. Within sixty days of receipt of Ecology's comments, SAM shall submit to Ecology final remedial design documents. SAM shall implement the approved remedial action in accordance with the terms and schedule contained in those documents. SAM shall submit construction documentation to Ecology in accordance with the approved remedial design documents.

The attached Exhibit E, SCHEDULE, of the Consent Decree contains detailed outlines of relevant milestones, public participation timelines, from the cleanup through the construction process for the proposed sculpture park.

10.0 INSTITUTIONAL CONTROLS

Institutional controls are measures undertaken to limit or prohibit activities that may interfere with the integrity of a cleanup action or result in exposure to hazardous substances at the site. Such measures are required to assure continued protection of human health and the environment when a cleanup action results in residual concentrations of indicator hazardous substances which exceed MTCA Methods A or B cleanup levels and where conditional points of compliance are established (boundaries of each Operable Unit). These institutional controls include placement of a deed restriction on the property to preclude interfering with remedial actions implemented in this proposed CAP.

The attached proposed Draft Restrictive Covenant Language, Exhibit D of the Consent Decree negotiated between SAM, City of Seattle, Ecology, and the Attorney Generals Office, outlines the restrictions that will prevent taking groundwater for any use from the site and preventing any activities which can cause release of residual petroleum into the environment. Requirements will be put in place such that any post-capping excavation to be done in the western portion of the Upper Yard near Elliott Avenue, in Elliott Avenue, or within the Lower Yard or Off-Site Areas, will be carefully controlled.

11.0 WORK CONSTRUCTION

The Schedule to begin work under this proposed CAP and other proposed land use construction activities for the Remedial Design is contained in Exhibit E of the Consent Decree. Work construction at the site will be conducted under a Health and Safety Plan prepared under WAC 173-340-810.

12.0 JUSTIFICATION FOR SELECTING CLEANUP ACTIONS THAT USE A LOWER PREFERENCE CLEANUP TECHNOLOGY

Section 173-340-360 (4) of the MTCA regulation provides a "hierarchy" of preferred cleanup technologies. Within this hierarchy, containment options recommended in this CAP are lower preference cleanup technologies than treatment/detoxification and immobilization. However, Unocal has already completed a significant amount of contaminant source removal in the Upper and Lower Yards. Soils remaining in these areas are of relatively low risk. The

selected cleanup actions for these areas will effectively minimize exposure to these residual petroleum-containing soils.

Groundwater treatment and source removal have been performed extensively beneath the Off-Site Area and, to a lesser degree, beneath Elliott Avenue. Because these areas are currently covered with pavement and soil contamination is observed primarily within the saturated zones, the potential for direct contact exposures are minimal. Unocal's continued operation of the groundwater treatment system addresses soil to groundwater impacts in the Off-Site Area. Maintaining the existing pavement or replacing it with a low permeability cap effectively minimizes direct contact and soil to air exposures.

Excavation and *in situ* treatment technologies are not practicable for the Elliott Avenue Area. Elliott Avenue serves as a major arterial in downtown Seattle and has a number of major utilities present beneath it. Excavation and *in situ* cleanup actions within the right of way would be extremely expensive and difficult to implement and would provide limited reduction in risk. For example, sparging/SVE would minimize vapor migration and reduce groundwater impacts within the MW-61A area, but it will not significantly affect petroleum-impacted soils beyond its radius of influence. It also does not effectively reduce the heavier TPH fraction and would require implementation of institutional controls to be protective of the direct contact pathway. Sparging/SVE does not effectively address the primary exposure pathways.

Hot spot excavation will reduce vapor and impacted groundwater migration by reducing the source mass but it will not eliminate migration of potentially impacted groundwater or vapor beyond the excavation footprint. Therefore, engineering and institutional controls will still be required. The hot spot excavation option is approximately six times more expensive than the preferred option and is much more difficult to implement.

Excavation of the entire petroleum-impacted area beneath Elliott Avenue does eliminate potential risks associated with these soils but may not remediate all impacted groundwater and has severe short-term impact to downtown Seattle, as well as severe financial implications. This option is over an order of magnitude more expensive than the preferred option but is not significantly more protective of human health and the environment.

The preferred Elliott Avenue remedy, "manual NAPL removal, capping, and natural attenuation with engineering and institutional controls," is protective of human health and the environment, can be effectively implemented, and is cost effective. It is the most practicable alternative for addressing the two primary

exposure pathways of concern (direct contact and soil to indoor air). It will also further minimize potential soil to groundwater impacts by reducing infiltration and removing NAPL.

13.0 DETERMINATIONS

Section 173-340-360(10) of the MTCA regulation states that the draft Cleanup Action Plan should include a preliminary determination that the cleanup action complies with subsections (2) and (3) of 173-340-360. As specified in subsections 2 and 3, the selected cleanup action is designed to accomplish the following.

13.1 Protect Human Health and The Environment

Implementation of the preferred remedial alternatives will minimize potential exposures from each of the pathways identified as being of potential concern. Installation and/or maintaining low permeability caps at the site is the most effective alternative for minimizing direct contact, hydrocarbon leaching, and vapor emissions. The low permeability caps will reduce surface water infiltration and vapor emissions and will prevent the public from accessing residual petroleum-containing soils. If unacceptable indoor air impacts are predicted, engineering controls will be used to address vapor emissions. Ambient air monitoring will be performed to verify that soil vapor emissions will not result in unacceptable risks to park occupants. SAM will implement a Contingency Plan if necessary, as outlined in Exhibit F of the Consent Decree.

A restrictive covenant will be placed on the property to prevent taking groundwater for any use and any activities which can cause release of the residual petroleum into the environment.

13.2 Compliance with Cleanup Standards per WAC 173-340-700 through -760

The overall goal of cleaning up groundwater for the protection of surface water quality will be met through on-going groundwater pumping and treatment in the Off-Site Area and product removal in the Elliott Avenue right of way.

The goal of soil petroleum hydrocarbon cleanup standards at this site is to protect groundwater resources (surface water quality and associated ecosystem) and eliminate potential sources of vapor emissions. While the numerical soil TPH cleanup standards of 200 mg/kg (Method A) and 3,200 mg/kg (Method B) may not be reached throughout the site, cleanup actions that have or will be completed include:

- Source control of accessible petroleum-contaminated soils;
- Final capping with low permeability materials;
- Engineering controls for vapor and surface water infiltration; and
- Ambient air monitoring and contingency plans.

These actions will result in substantive compliance with soil cleanup standards. These cleanup actions are effective at reducing concentrations of contaminants in soils to levels that will support and maintain the attainment of groundwater quality standards at the points of compliance and protect human health and the environment from vapor emissions.

13.3 Compliance with Applicable State and Federal Laws per WAC 173-340-710

The cleanup action will comply with all relevant laws and requirements, as required in Section 173-340-710 of the Model Toxics Control Act. A detailed analysis of federal, state, and local laws and regulations which pertain to this project is provided in the **ARARs and Applicable Regulations** Section of the FFS.

SAM shall obtain any and all state, federal, or local permits required by applicable law before commencing remedial actions at the site. This requirement shall include preparation of a SEPA checklist.

Ecology will ensure that the cleanup action meets the substantive requirements of all state and local permits which apply to this project.

13.4 Provide Compliance Monitoring per WAC 173-340-410

The preferred remedial alternatives for the site will not interfere with the ability of Unocal to implement long-term monitoring to ensure that groundwater continues to meet cleanup standards after remedial actions have been completed. During implementation of the remedial actions, performance monitoring will be conducted to confirm that cleanup actions have attained cleanup standards and treatment goals. After remedial actions are completed, performance monitoring will be conducted to confirm and ensure that cleanup actions have attained cleanup and performance standards. Protection monitoring will be used to ensure that human health and the environment are being adequately protected during construction and operation of the cleanup actions. The specifics and details of these monitoring activities, locations, number and type of analyses, frequency, duration, and contingency plans are described in the Air Sampling/Monitoring and Contingency Plan, Exhibit F, of the Consent Decree. Details of the Groundwater Compliance Monitoring

requirements and sampling results are contained in the Quarterly Progress Reports that Unocal submits to Ecology.

13.5 Use Permanent Solutions to the Maximum Extent Practicable per WAC 173-340-360(4), (5), (7), and (8)

Excavation and *in situ* treatment technologies are not practicable for the Elliott Avenue Area. Elliott Avenue serves as a major arterial in downtown Seattle and has a number of major utilities present beneath it. Excavation and *in situ* cleanup actions within the right of way would be extremely expensive and difficult to implement.

The preferred Elliott Avenue remedy, "manual NAPL removal, capping, and natural attenuation with engineering and institutional controls," is protective of human health and the environment, can be effectively implemented, and is cost effective. It is the most practicable alternative for addressing the two primary exposure pathways of concern (direct contact and soil to indoor air). It will also further minimize potential soil to groundwater impacts by reducing infiltration and removing NAPL.

Refer to Section 12.0 for additional details.

13.6 Short-Term Effectiveness

Short-term effectiveness [WAC 173-340-360(5)(iii)] considers how the cleanup action will impact human health and the environment during implementation and prior to achievement of cleanup levels. The cleanup action will involve earth moving and excavation activities which could cause contaminated materials to be released through dust, increased erosion potential, or removal from the site on vehicles. These potential impacts will be mitigated through dust control actions and other best management practices. Environmental control measures will be described in more detail in the forthcoming Engineering Design Report.

No other short-term adverse impacts are expected.

When the preferred remedial actions are implemented (including engineering and institutional controls), they will be immediately effective in preventing human ingestion or inhalation of petroleum hydrocarbons.

13.7 Long-Term Effectiveness

Long-term effectiveness [WAC 173-340-360(5)(ii)] is measured in terms of the magnitude of residual risk and the adequacy and reliability of the cleanup action.

The proposed cleanup action effectively prevents human exposure over the long-term using engineering and institutional controls. Natural attenuation will continue to reduce the quantity of petroleum hydrocarbons in soil and groundwater over the long-term.

13.8 Permanent Reduction of Toxicity, Mobility, or Volume

Natural attenuation will decrease the toxicity, mobility, and volume of petroleum hydrocarbons in soil and groundwater over the long-term. Fate and transport modeling has indicated that natural attenuation via biodegradation is occurring at the site.

13.9 Ability to be Implemented

The proposed cleanup action involves conventional technologies (i.e., capping and engineering controls) which should be easily implemented.

13.10 Cleanup Cost

Cleanup costs for the selected alternatives are much lower than the other alternatives evaluated (see FFS for detailed cost estimates).

13.11 Consider Public Concerns per WAC 173-340-600

The public will be given the opportunity to comment during a 30-day public comment period on the following completed milestones of the cleanup process for this proposed recreational land use. The following documents are presented for public comment:

- Focused Site Characterization Report;
- Focused Feasibility Study Report;
- Cleanup Action Plan; and
- Consent Decree.

The following are attached Exhibits to the Consent Decree:

- Site Diagram showing site location and current site conditions;
- Schedule for completing relevant milestones of the cleanup process through construction of the park;
- Air Sampling/Monitoring and Contingency Plan;

- Restrictive Covenant Language for the site that restricts use of the site to the cleanup action implementation to ensure continued protection of human health and the environment; and

- Conceptual Model Land Use Plan showing what the sculpture park will look like when construction is completed.

Ecology will consider all comments received. At the end of the comment period, Ecology will prepare a responsive summary listing each comment received and Ecology's response to the comment.

Further, the public will be given an opportunity to comment on the Remedial Design when it is submitted to Ecology.

14.0 REFERENCES

Ecology, 1996. The Model Toxics Control Act Cleanup Regulation. Chapter 173-340 WAC. January 1996.

GeoEngineers, 1997a. Final Cleanup Report - Upper Yard, Unocal Former Seattle Marketing Terminal Property, December 10, 1997.

GeoEngineers, 1997b. Elliott Avenue Remedy Selection, Unocal Former Seattle Marketing Terminal Property, January 10, 1997.

GeoEngineers, 1997c. Cleanup Action Plan - Off-Site Area, Unocal Former Seattle Marketing Terminal Property, June 18, 1997.

GeoEngineers, 1998a. Final Cleanup Report - Lower Yard, Unocal Former Seattle Marketing Terminal Property, September 23, 1998.

GeoEngineers, 1998b. Summary of Residual Petroleum in Soil - Lower Yard, Unocal Former Seattle Marketing Terminal Property, December 22, 1998.

GeoEngineers, 1999. Progress Report No. 66 (April 2 Through July 1, 1999): Remedial Actions and Quarterly Groundwater Monitoring, Unocal Former Seattle Marketing Terminal Property, July 28, 1999.

Hart Crowser, 1999a. Draft Focused Supplemental Site Characterization, Former Unocal Seattle Marketing Terminal Property, Seattle, Washington. August 18, 1999.

Hart Crowser, 1999b. Draft Focused Feasibility Study, Former Unocal Seattle Marketing Terminal Property, Seattle, Washington. September 10, 1999.

Table 1 - Proposed Cleanup Criteria for Detected Constituents in Soil and Groundwater

Constituent	Proposed Cleanup Level
Groundwater in ug/L	
Benzene	43[1]
Toluene	48,500[1]
Ethylbenzene	6,910[1]
Xylenes	16,000[1]
TPH	1,000[2]
Soils in mg/kg	
Benzene	0.5[3]
Toluene	40[3]
Ethylbenzene	20[3]
Xylenes	20[3]
TPH	3,200 / 3250[4]

Notes:

[1]Based on MTCA Method B surface water cleanup levels

[2]Based on MTCA Method A drinking water cleanup level

[3]Based on MTCA Method A residential cleanup level

[4]Based on MTCA Method B direct contact cleanup level using Interim TPH Policy. Calculated Method B criteria for the Lower Yard and Elliott Avenue are 3,200 and 3,250 mg/kg, respectively.

Table 2 - Proposed Cleanup Levels for Constituents of Potential Concern in Air

Compound	MTCA Method B in ug/m^3
Benzene	0.259
Toluene	183
Ethylbenzene	457
m,p-Xylene	320
o-Xylene	320
1,3,5-Trimethylbenzene	420 (1)
1,2,4-Trimethylbenzene	420 (1)
Propylene	–
1,3-Butadiene	0.00417
Hexane	91.4
Cyclohexane	3400 (1)
4-Ethyltoluene	–
Heptane	5,500 (1)
Napththalene	170 (1)
C3 to C5 Aliphatic Hydrocarbons	–
C5 to C6 Aliphatic Hydrocarbons	9,120
C6 to C8 Aliphatic Hydrocarbons	9,120
C8 to C10 Aliphatic Hydrocarbons	136
C10 to C12 Aliphatic Hydrocarbons	136
C12+ Aliphatic Hydrocarbons	–
C6 to C8 Aromatic Hydrocarbons	–
C8 to C10 Aromatic Hydrocarbons	80
C10 to C12 Aromatic Hydrocarbons	80
C12+ Aromatic Hydrocarbons	–

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Table 3 - Detailed Evaluation of Elliott Avenue Remedial Alternatives

Criteria	Capping and Natural Attenuation with Engineering and institutional Controls	Source Area Sparging and SVE	Sparging and SVE beneath Elliott Avenue	Hot Spot Excavation	Elliott Avenue Excavation
Protection of Human Health and the Environment	This alternative protects human health by eliminating exposure routes. It reduces soil and groundwater toxicity over the very long-term using natural attenuation.	This alternative will reduce soil and groundwater toxicity over the long-term, protecting human health and the environment.	This alternative will reduce soil and groundwater toxicity over the long-term, protecting human health and the environment.	This alternative removes soils with the greatest potential for impacts therefore increasing protection of human health and the environment.	This alternative removes all impacted soils therefore resulting in the greatest protection of human health and the environment.
Meets ARARs	Complies with ARARs	Complies with ARARs	Complies with ARARs	Complies with ARARs	Complies with ARARs
Short-Term Effectiveness	Dust impacts associated with cap placement can be controlled with best management practices. No other short-term adverse impacts are expected.	Installation of the system will result in some traffic impact as one traffic lane would be closed during drilling.	Installation of the system will result in minimal impacts during horizontal well installation.	Excavation will affect traffic due to partial closure of Elliott Avenue and increased truck traffic to transport contaminated soils. Dust impacts can be controlled with best management practices.	Excavation will affect traffic severely due to closure of Elliott Avenue and increased truck traffic to transport contaminated soils. Utilities may also be affected. Dust impacts can be controlled with best management practices.
Long-Term Effectiveness	This alternative effectively prevents human exposure over the long-term using engineering and institutional controls. Soil and groundwater toxicity will be reduced by natural attenuation over the very long-term.	The system will remove the VOCs most likely to impact groundwater and indoor air quality in the source area. The injected air will enhance biodegradation in the saturated zone downgradient. However, this process would be very slow. Air emissions	The system will remove VOCs most likely to impact groundwater and indoor air quality under the entire street. Heavier compounds may not be effectively removed but may biodegrade over the long-term. Air emissions during operations will be controlled using a	Hot spot excavation is a highly effective mean of reducing the TPH source under Elliott Avenue but will not address all remaining impacted soil and groundwater under the street. A restrictive covenant will still be required to address residual TPH under the	Excavation is a highly effective mean of eliminating the TPH source under Elliott Avenue. Dewatering during excavation will reduce the remaining volume of impacted groundwater but may not remediate all of it.

Table 3 - Detailed Evaluation of Elliott Avenue Remedial Alternatives

Criteria	Capping and Natural Attenuation with Engineering and institutional Controls	Source Area Sparging and SVE	Sparging and SVE beneath Elliott Avenue	Hot Spot Excavation	Elliott Avenue Excavation
		during operations will be controlled using a catalytic oxidizer. A restrictive covenant will still be required to address residual TPH in the vadose zone under the street.	catalytic oxidizer. A restrictive covenant will still be required to address residual heavy TPH.	street.	
Permanent Reduction of Toxicity/ Mobility/ Volume	Natural attenuation will result in reduced toxicity over the very long-term.	The extraction of VOCs will result in a permanent reduction in toxicity in the source area and possibly downgradient.	The extraction of VOCs will result in a permanent reduction in toxicity under the entire street.	This alternative reduces the TPH mobility by disposing of impacted soils in a permitted landfill.	This alternative reduces the TPH mobility by disposing of impacted soils in a permitted landfill.
Implementability	Capping and engineering controls are conventional and readily implementable technologies. Natural attenuation is on going based on Hart Crowser's evaluation.	Sparging and SVE are demonstrated technologies which are easy to implement.	Sparging and SVE are demonstrated technologies which are easy to implement. However, the presence of numerous utilities under Elliott Avenue may complicate installation of the horizontal wells.	Excavation and shoring use conventional construction equipment. However, the potential of undermining utilities due to dewatering decreases the implementability of this alternative.	Excavation uses conventional construction equipment. However, the utilities reroute decreases the implementability of this alternative significantly.
Cost Estimate (1)	$250,000	$600,000	$900,000	$1,200,000	$4,000,000
Restoration Time Frame	Likely greater than 10 years	Several years for volatile TPH in the source area, at least 10 years for downgradient TPH	Several years for volatile TPH, at least 10 years for heavy TPH	A few months for the source area, at least 10 years for downgradient TPH	A few months
Community Acceptance	Moderate due to the length of remediation which is mitigated by the lack of	Moderate due to presence of a treatment compound in the park for	Moderate due to presence of a treatment compound in the park for	Moderate due to traffic impacts.	Low due to severe traffic impacts.

Table 3 - Detailed Evaluation of Elliott Avenue Remedial Alternatives

Criteria	Capping and Natural Attenuation with Engineering and institutional Controls	Source Area Sparging and SVE	Sparging and SVE beneath Elliott Avenue	Hot Spot Excavation	Elliott Avenue Excavation
	negative short-term impacts.	several years and some traffic impacts in the short-term.	several years.		
Use of Preferred Technology	Capping with engineering and institutional controls rank lowest in the Ecology hierarchy of preferred technologies. However, given the low risk associated with the remaining TPH-impacted soil and groundwater, this alternative is most cost-effective.	Sparging and SVE are preferred technologies because they actually detoxify soil and groundwater instead of transferring them to another location for containment. However, the remedial duration is expected to last many years and will address only the most volatile TPH fraction in the source area.	Sparging and SVE are preferred technologies because they actually detoxify soil and groundwater instead of transferring them to another location for containment. However, the remedial duration is expected to last several years and will address only the most volatile TPH fraction.	Excavation ranks low in the Ecology hierarchy of preferred technologies. However, it may be justified based on the shorter remedial duration and the increased effectiveness for heavier TPH fractions.	Excavation ranks low in the Ecology hierarchy of preferred technologies. However, it may be justified based on the shorter remedial duration and the increased effectiveness for heavier TPH fractions.

(1) These costs are order of magnitude estimates suitable for alternatives comparison.

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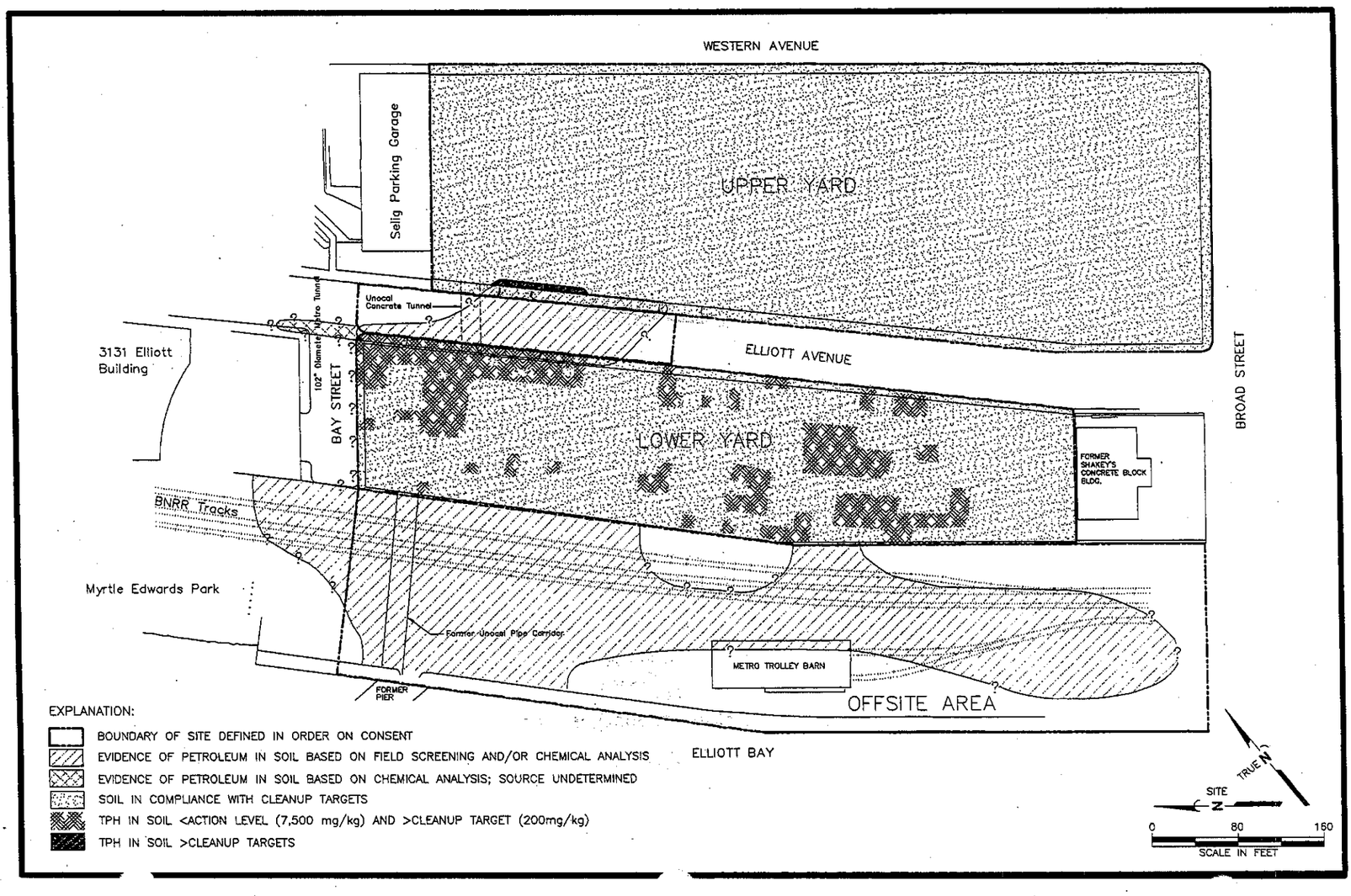
SEATTLE ART MUSEUM

Former Unocal Seattle Terminal
Prospective Purchaser Consent Decree
Current Site Conditions (Exhibit A)



Vicinity Map

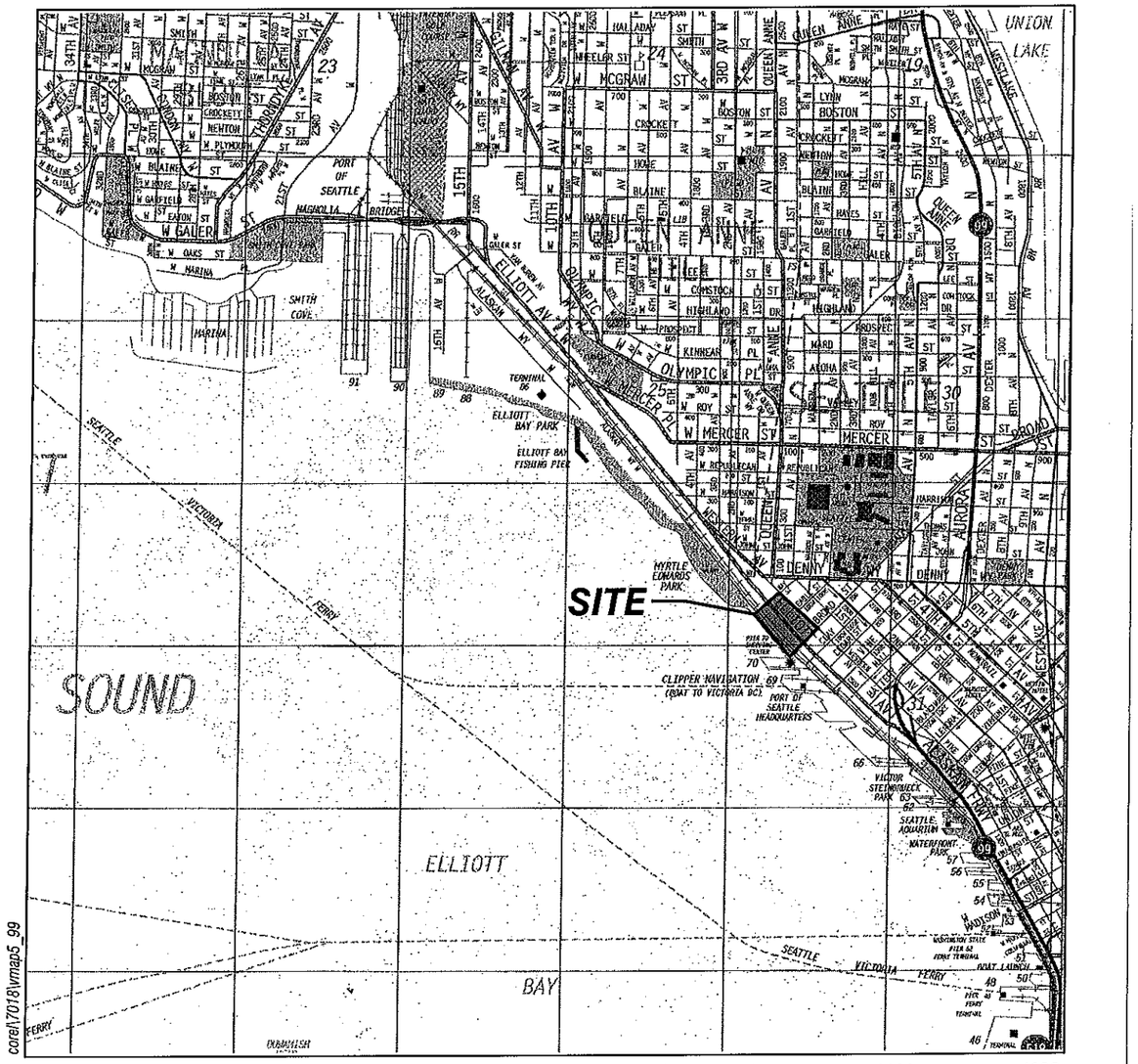


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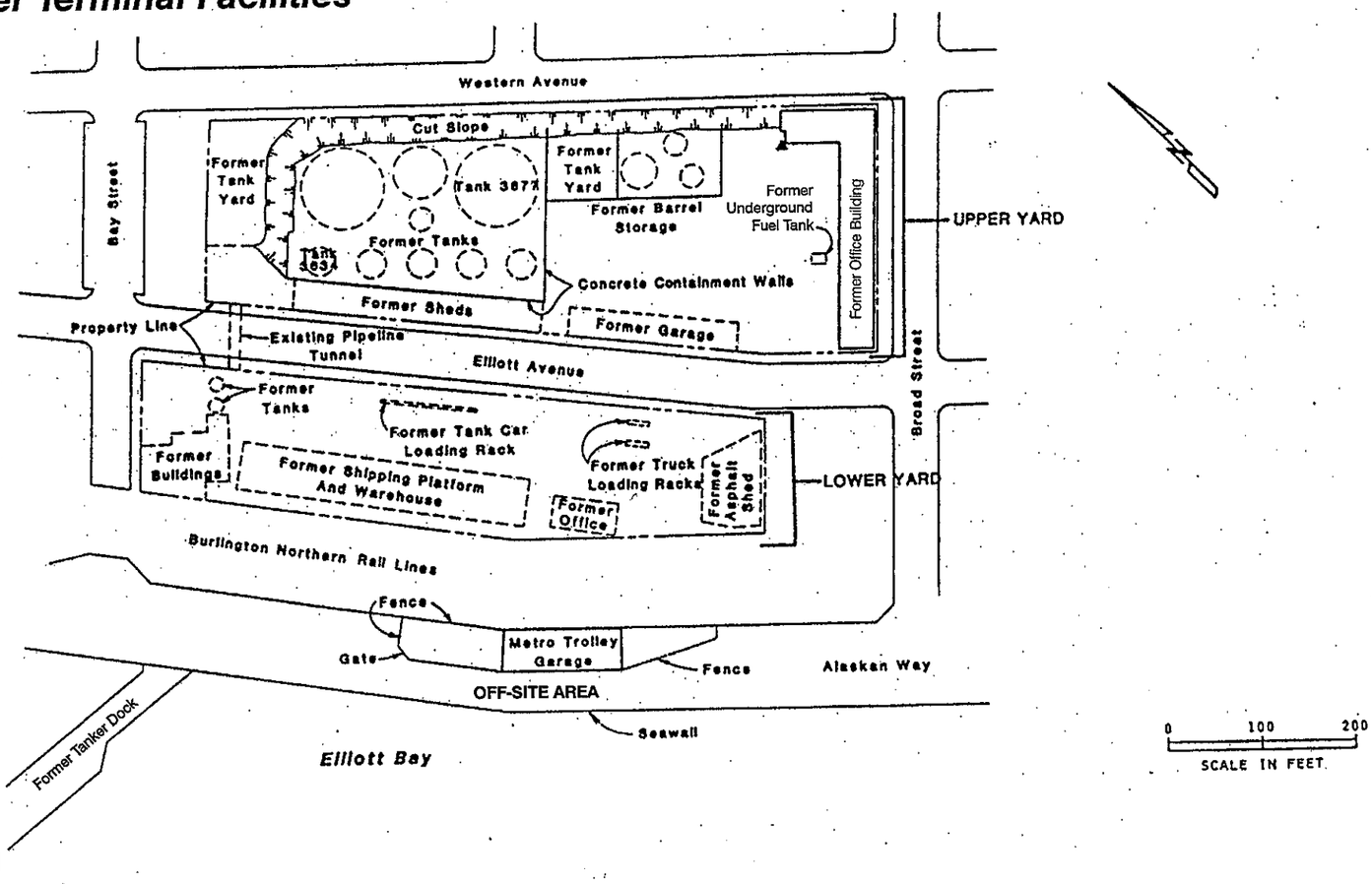
Figure 1

Former Terminal Facilities



REFERENCE: DRAWING PROVIDED BY UNOCAL ENTITLED "SEATTLE, WASHINGTON MARKETING TERMINAL", DATED 5-4-73.

Note: Drawing provided by ECOVA Corporation, dated 1989.

corel\7018\former sites

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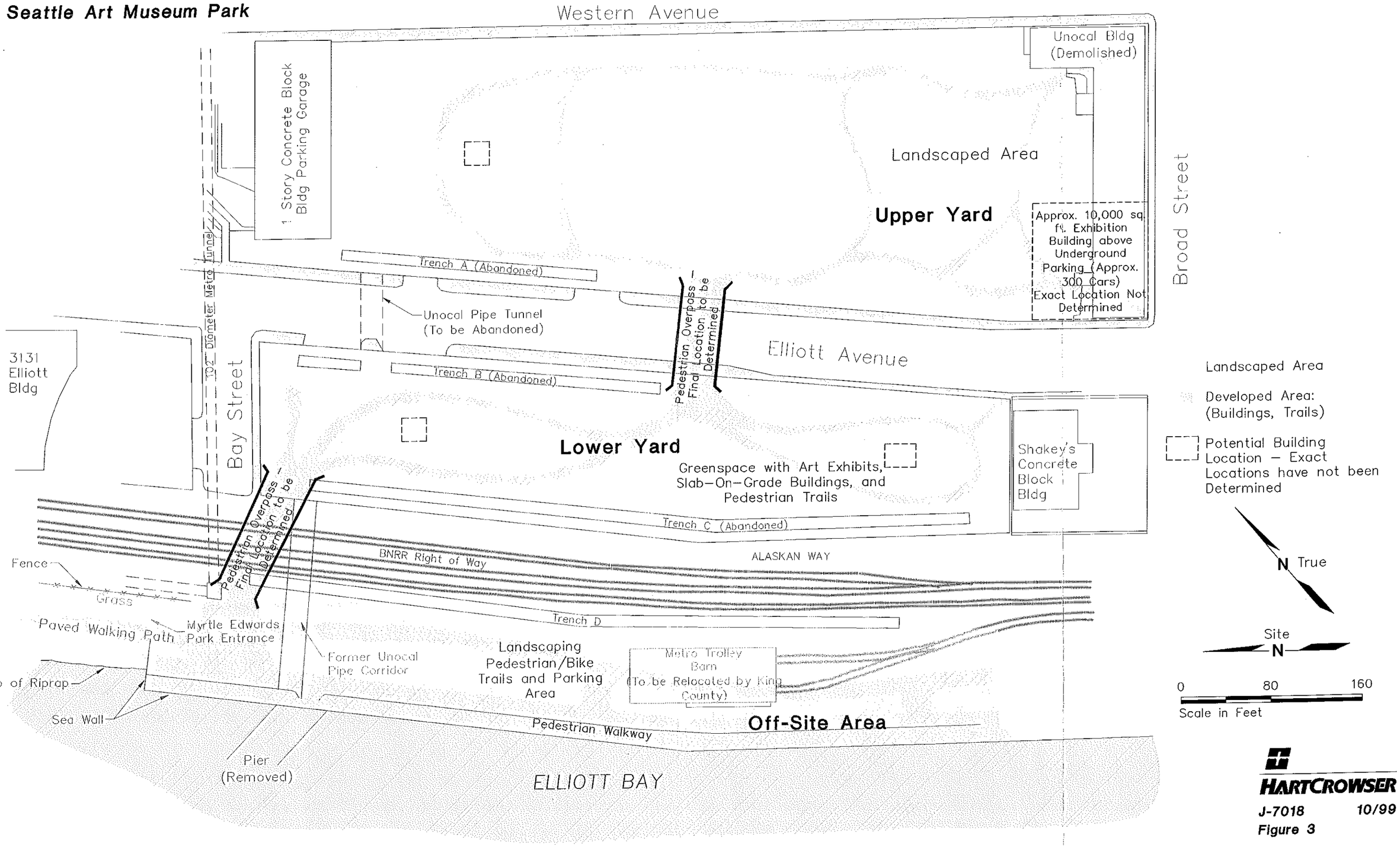
Figure 2

Preliminary Conceptual Layout

Seattle Art Museum Park



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Note: Layout is presented for conceptual purposes only.

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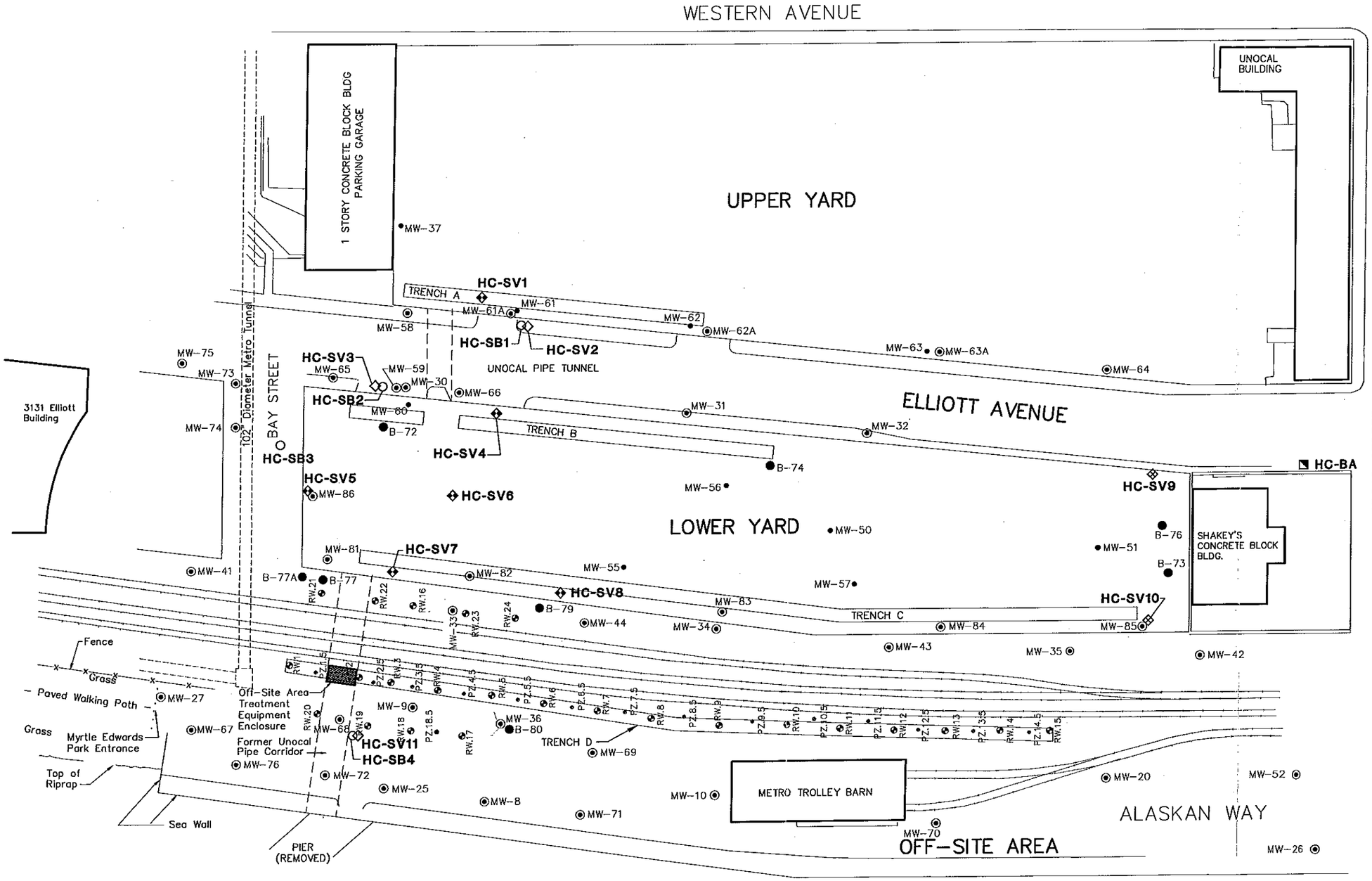
Figure 3

Site Exploration Map



Exploration Location and Number

- MW-75 ◉ Monitoring Well/Vapor Monitoring
- ○ HC-SB1 Soil Boring
- ◈ HC-SV1 Soil Vapor Probe (3')
- ◈ HC-SV-9 Soil Vapor Probe (5')
- ◇ HC-SV2 Soil Vapor Probe (3' and 7.5')
- ◥ HC-BA Preliminary Background Ambient Air

Existing Exploration Location and Number (by Others)

- ● B-76 Boring
- • MW-37 Abandoned Well
- • PZ.14.5 Piezometer
- ◈ RW.15 Recovery Well
- ◉ MW-32 Monitoring Well

TRUE N

N SITE

0 80 160

Scale in Feet

Benchmark: City of Seattle Datum.
Note: The locations of all features shown are approximate.
Reference: Drawing entitled "Unocal/Seattle Marketing Terminal," provided by Unocal, and GeoEngineers undated.

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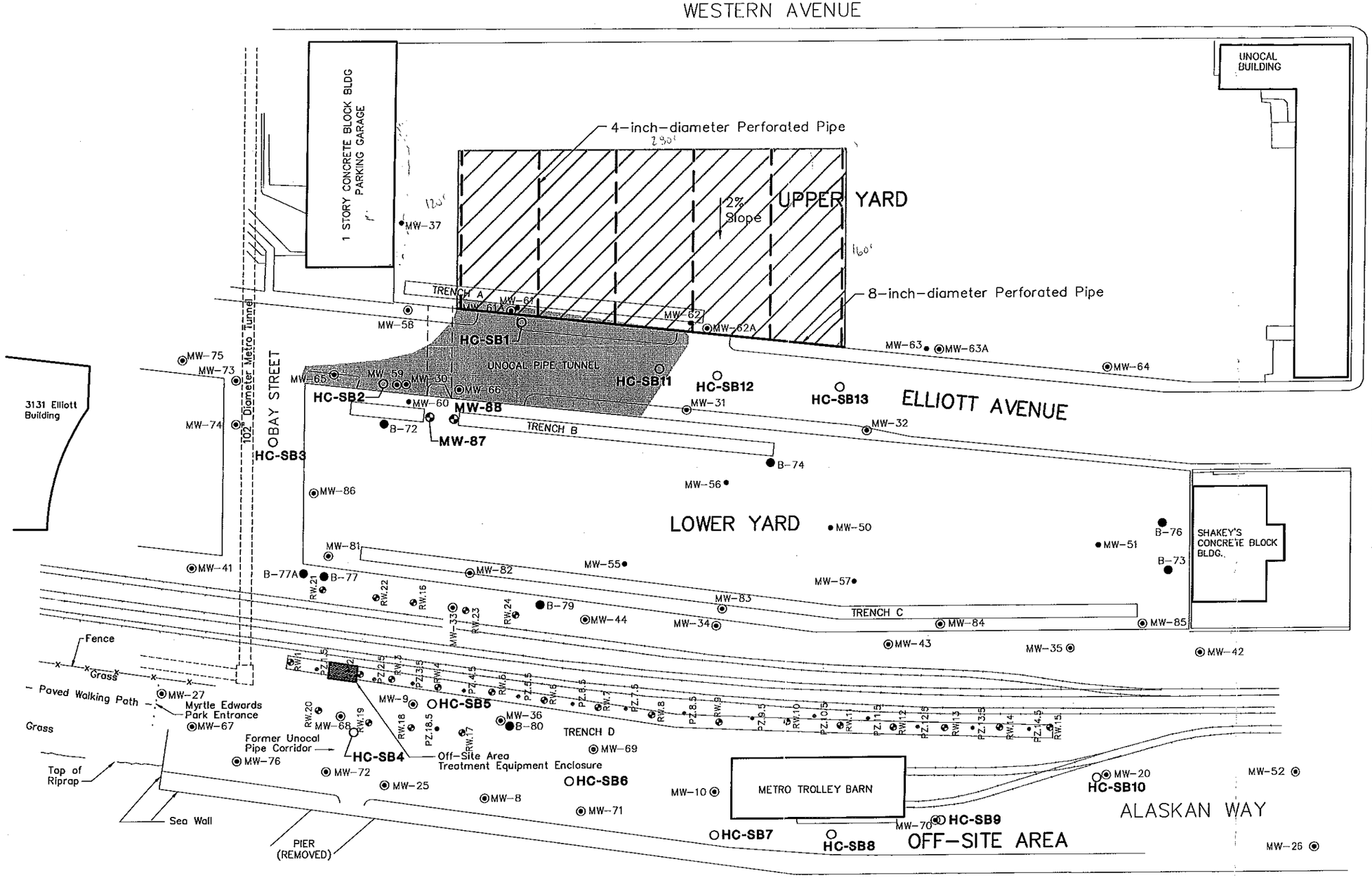
Figure 4

Capping and Natural Attenuation with Engineering and Institutional Controls Alternative



Benchmark: City of Seattle Datum.
Note: The locations of all features shown are approximate.
Reference: Drawing entitled "Unocal/Seattle Marketing Terminal," provided by Unocal, and GeoEngineers undoted.

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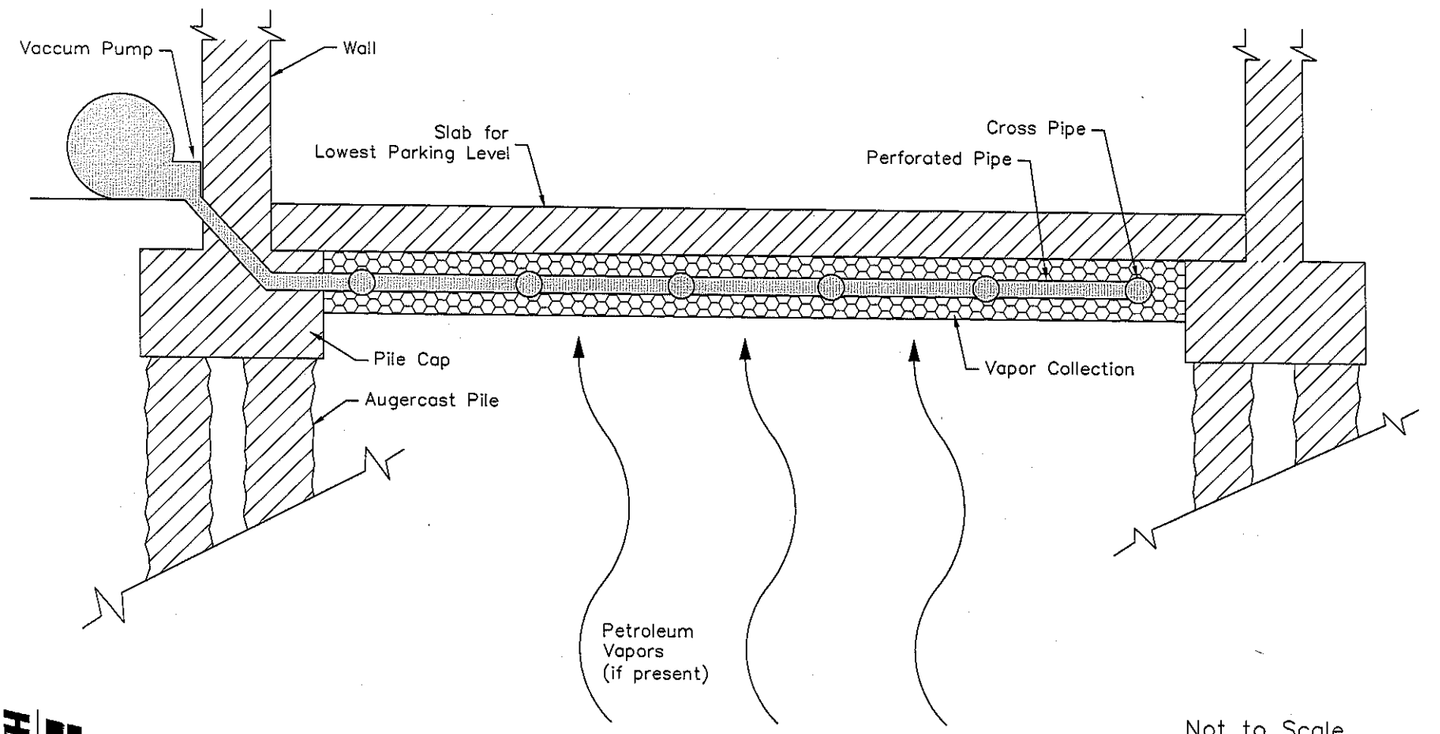
Figure 5

Optional Vapor Removal System for Subgrade Structure



Not to Scale

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Figure 6

Reduced Permeability Cap Cross Section

vapor & gw infiltration

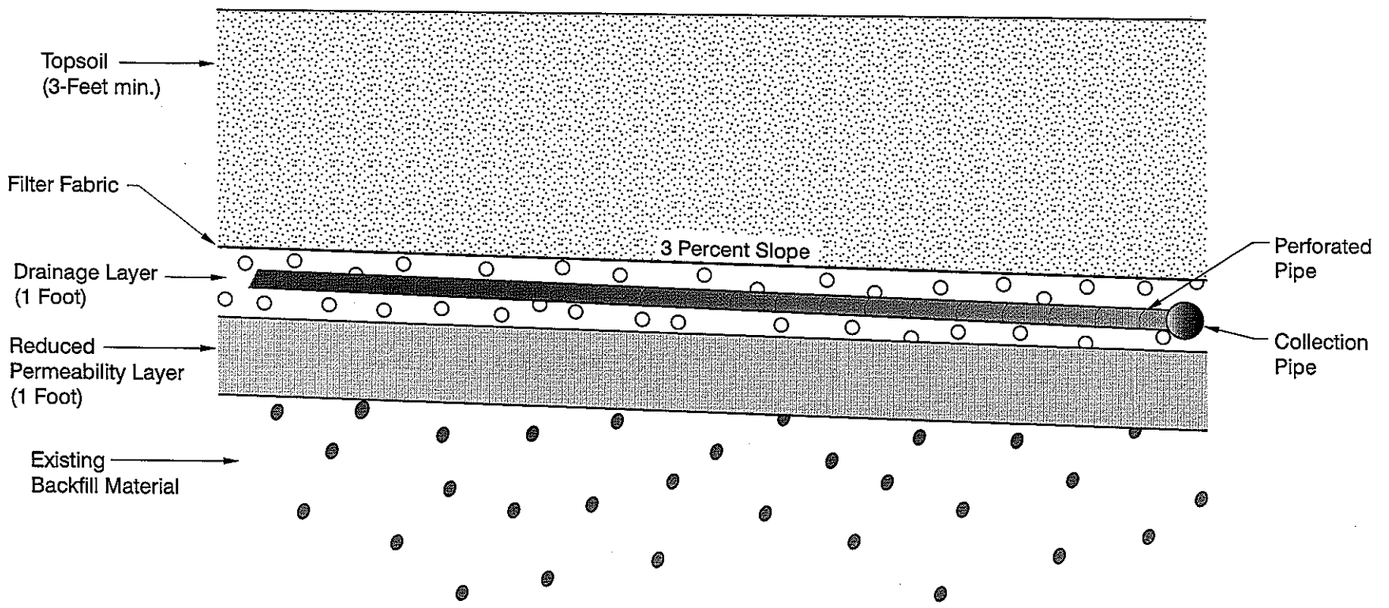

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Figure 7
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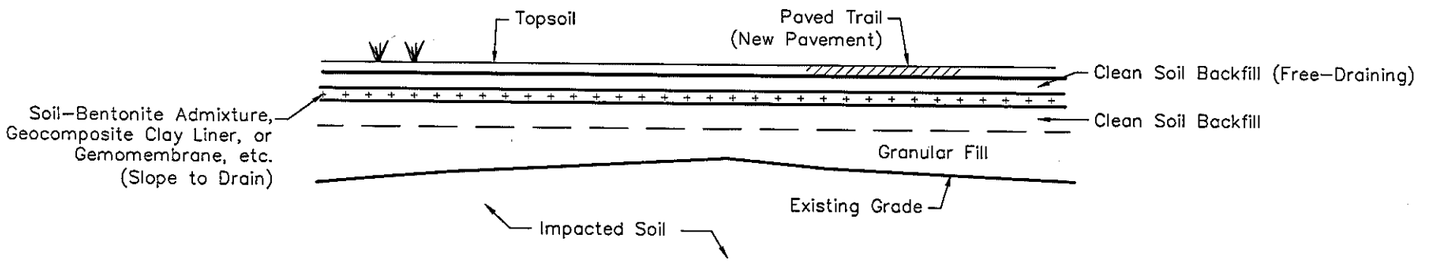
core\7018\perm cap

Anticipated Capping Scenarios

Lower Yard/Off-Site Area



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Off-Site Area

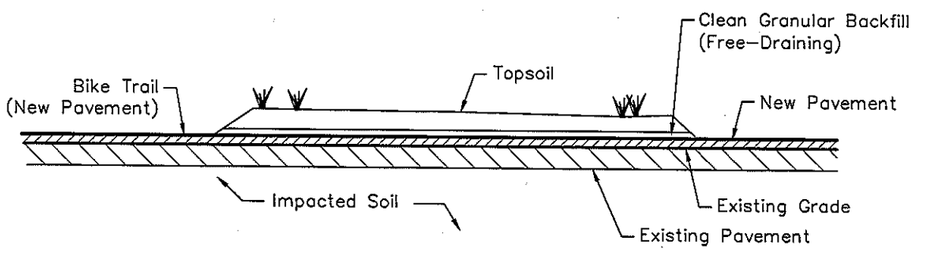

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Figure 8

Pedestrain Bridge Foundation Detail

Lower Yard

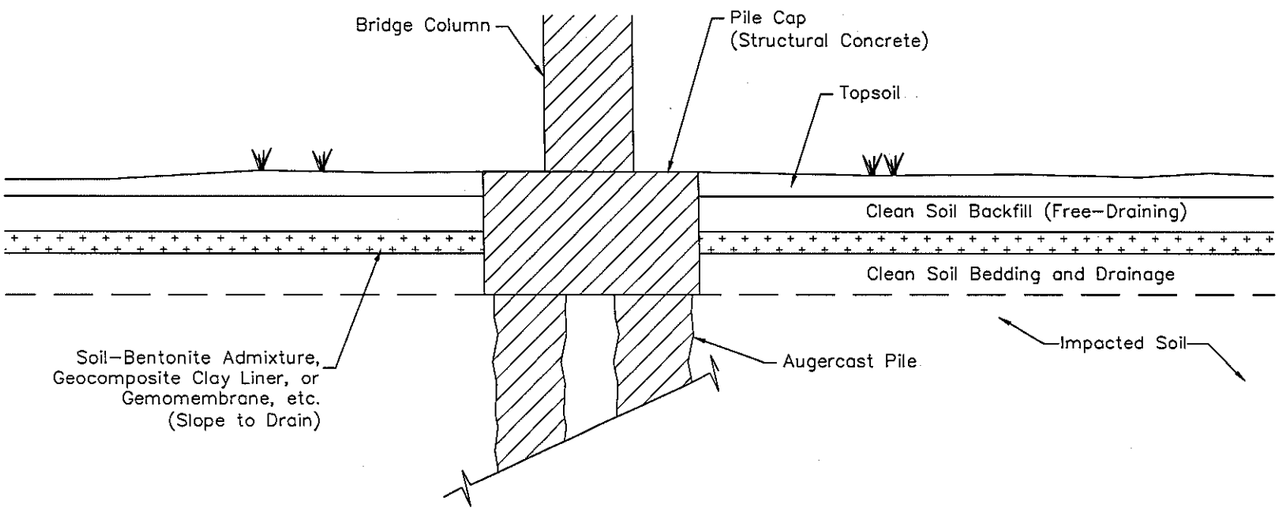

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Figure 9

Conceptual Large Sculpture Foundation Detail

Lower Yard

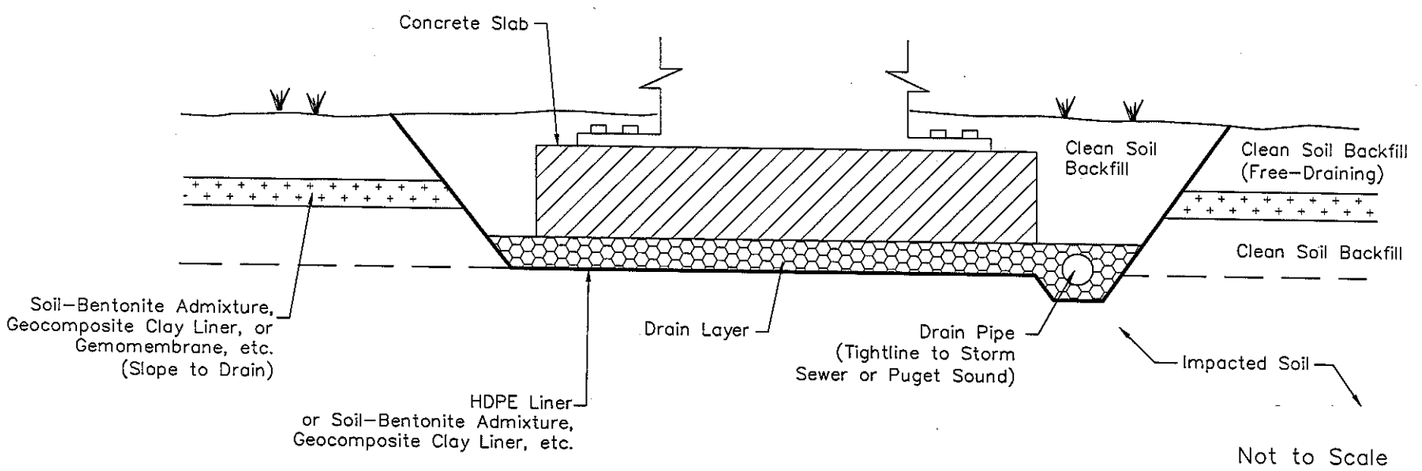

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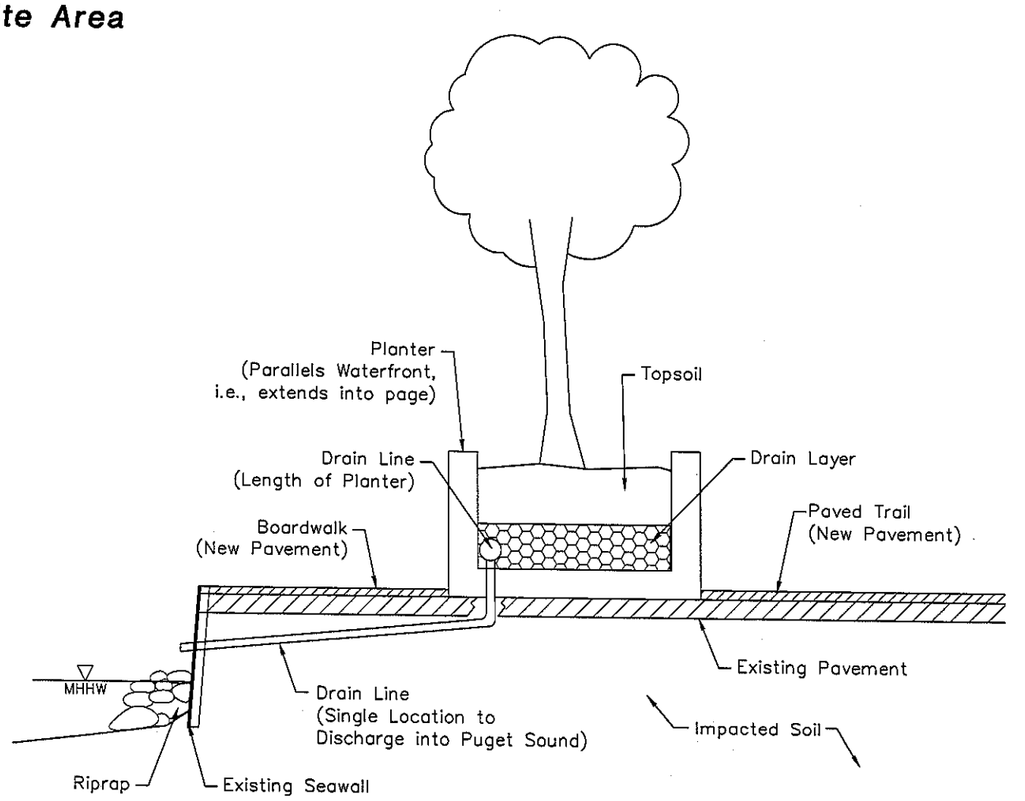
Figure 11

Tree Planting Detail - Concept A

Lower Yard/Off-Site Area



Not to Scale

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Figure 12

Tree Planting Detail - Concept B

Lower Yard/Off-Site Area

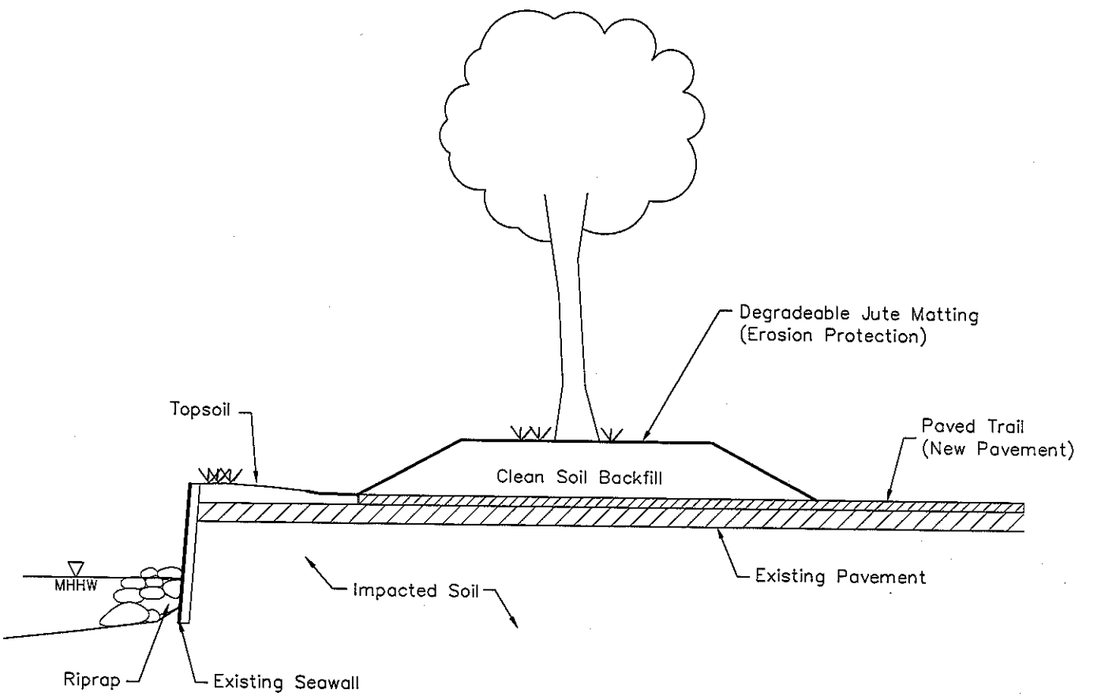

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Figure 13

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Tree Planting Detail - Concept C

Lower Yard/Off-Site Area

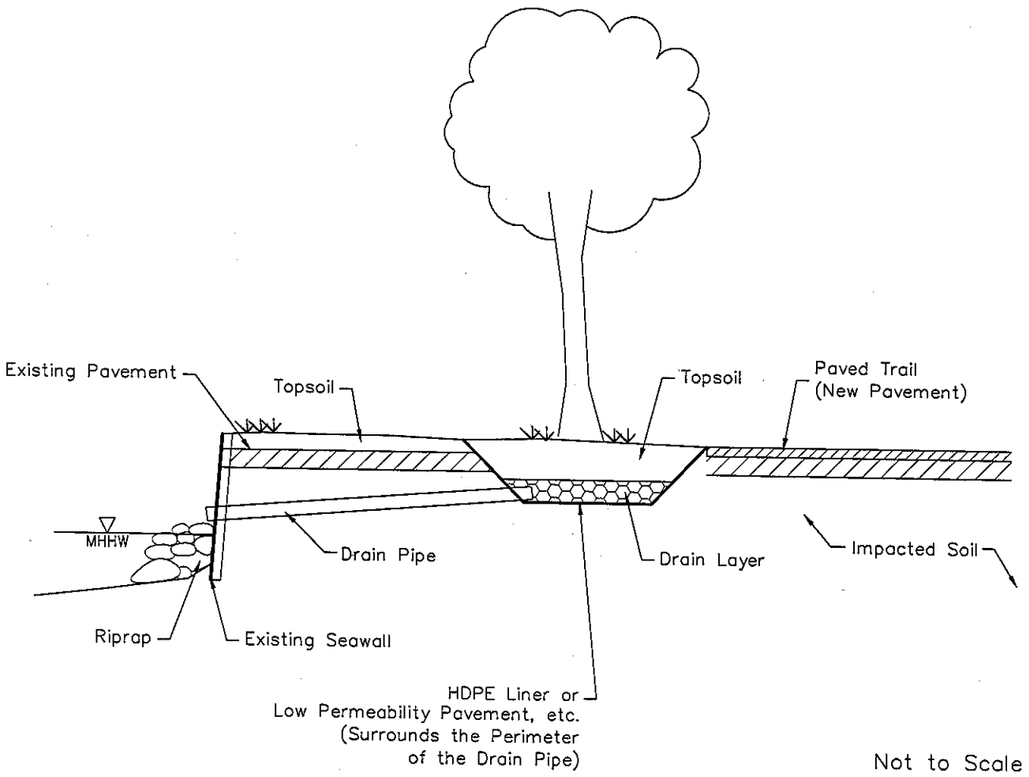

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Figure 14