Cleanup Action Plan
North Marina Redevelopment Site
Everett, Washington

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Prepared for

Port of Everett
Everett, Washington

LANDAU ASSOCIATES
130 2nd Avenue South
Edmonds, WA 98020
(425) 778-0907

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1.0 INTRODUCTION

This Cleanup Action Plan (CAP) describes the planned cleanup action for a portion of the Port of Everett (Port) North Marina Redevelopment Site located in Everett, Washington. Maritime Trust Company (MTC), in conjunction with the Port, is redeveloping the site into a mixed residential, retail, commercial, and light industrial development. The redevelopment of the site requires environmental cleanup to the degree necessary for the site to conform to current environmental regulations, taking into consideration the nature of planned site uses.

1.1 REGULATORY FRAMEWORK

Site cleanup is being accomplished to address the requirements of the Washington State Department of Ecology (Ecology) Model Toxics Control Act (MTCA; WAC 173-340) under Ecology's Voluntary Cleanup Program (VCP). Previous site reports, including the Phase I and Phase II Environmental Site Assessments (ESAs) (Landau Associates 2001, 2004), the Data Gaps Investigation Report (Landau Associates 2005), and Supplemental Data Gaps Investigation Report (Landau Associates 2006a), were submitted to Ecology for review and comment. It is the intent of the Port and MTC that site cleanup be adequate to meet MTCA requirements and to obtain a no further action (NFA) determination from Ecology.

1.2 SITE DESCRIPTION

The site, located in Everett, Washington (Figure 1), has been used for a variety of commercial, industrial, and marine-related activities since the early 1900s. The site includes approximately 65 acres of upland and is entirely owned by the Port.

Site development extends back to around the turn of the last century. From the early 1900s until about 1950, timber-product operations dominated waterfront industrial activities. Over that period, the shoreline of Port Gardner Bay was near the current location of West Marine View Drive, with shingle and lumber mills either along the shoreline or located on wharfs to the west of the shoreline. The site was filled to its current configuration between about 1947 and 1955, using dredge fill from the Snohomish River to create the site's uplands from the tidelands to the west of the original shoreline.

After the additional uplands were created, businesses transitioned from primarily the wood products industry to a broader range of industries and commercial enterprises, with a large percentage of marine services operations. Although turnover in businesses has occurred over the intervening years, the site is still dominated by businesses with a marine services orientation.

1.3 CLEANUP ACTION PLAN ACTION AREA

Because of its large size, the site was divided into 13 subareas (Investigation Areas A though M) for investigation and data management purposes. In some instances, these investigation areas constitute single leaseholds (such as Investigation Area D, the American Construction Company leasehold). In other instances, the investigation areas are composed of multiple leaseholds, such as Investigation Area F. These investigation area designations will also be used during site cleanup to define cleanup action areas.

The Cleanup Action Area addressed in this CAP includes most, but not all, of the site. The boundary of the Cleanup Action Area is shown on Figure 2. The remainder of the site will either be cleaned up by others or will be cleaned up at a later date by the Port. The portions of the site that are not included in the Cleanup Action Area and are not addressed as part of this CAP include:

- Investigation Area A – the Port's tenant (Everett Shipyard) has committed to completing cleanup prior to vacating the property.

- Investigation Area D – The American Construction Company leasehold will be addressed under a separate cleanup action plan in conjunction with Investigation Areas E and H.

- Investigation Area E – Diesel-contaminated soil and groundwater associated with the former Puget Sound Truck Lines (PSTL) underground storage tanks (USTs) will be addressed in the same cleanup action plan as Investigation Areas D and H. Arsenic soil contamination present in this area will be addressed in this CAP.

- Investigation Area H – The contamination conditions characterized in this area appear to be associated with use by former tenants during earlier lease periods and will be addressed in the same cleanup action plan as Investigation Areas D and E.

- Investigation Area G and the northern portion of Investigation Area M – These areas are occupied by a tenant (Ameron) whose lease extends through 2012. Further characterization and cleanup, as needed, will be conducted following expiration of the lease.

Based on the results of previous investigations, soil is the primary affected medium within the Cleanup Action Area that requires cleanup. Groundwater contamination is present, but limited in extent. Soil analytical results indicate that contamination is limited to the upper 3 ft of soil within the Cleanup Action Area, and arsenic and carcinogenic polycyclic aromatic hydrocarbons (cPAHs) are the primary constituents of concern. Groundwater contamination within the Cleanup Action Area Is limited to arsenic in the northern portion of Investigation Area F.

1.4 REPORT ORGANIZATION

Section 2.0 of this report presents the site conditions, including a description of previous site investigation activities, geologic and hydrogeologic conditions, development of cleanup levels, and

environmental conditions. Section 3.0 describes the proposed cleanup action, including the cleanup action objectives, the remedial actions considered, and the integration of the cleanup action with site redevelopment. Section 4.0 describes compliance monitoring for the cleanup action, and Section 5.0 describes the reporting. Section 6.0 presents allowable uses of this report. Section 7.0 lists the documents referenced in this report.

2.0 SITE CONDITIONS

This section presents the conditions at the site, including site geology and hydrogeology, and site environmental conditions. Proposed cleanup levels for the site are also developed in this section to provide a basis for characterizing the nature and extent of contamination.

2.1 PREVIOUS INVESTIGATIONS

Several environmental investigations have been conducted to determine the nature and extent of contamination at the site. These investigations include:

- A Phase I ESA conducted in 2001 (Landau Associates 2001)
- A Phase II ESA conducted in late 2003 and early 2004 (Landau Associates 2004)
- An expedited soil investigation along the 14th Street bulkhead conducted in mid-2004 [reported in the Data Gaps Investigation Work Plan (Landau Associates 2005a)]
- A Data Gaps Investigation (DGI) conducted in late 2004 and early 2005 to fill data gaps in site environmental characterization that remained following the completion of the previous site investigations (Landau Associates 2005b)
- A supplemental DGI (Landau Associates 2006a) conducted in late 2005 to provide a similar level of environmental characterization in the Craftsman District as that accomplished for other portions of the site, and to further delineate isolated areas of shallow soil contamination.

A total of about 314 soil explorations and 43 groundwater monitoring locations were completed for environmental characterization purposes within the Cleanup Action Area during these investigations. A total of about 393 soil and 47 groundwater samples collected from these locations were tested for various environmental constituents, with analytical parameters based on the nature of current and historical activities that occurred within the sampling area. The locations of environmental explorations completed within the Cleanup Action Area are shown on Figure 3.

The following sections summarize the geologic and environmental conditions encountered during previous site investigation activities. The previously noted reports should be referred to for a more complete understanding of site conditions.

2.2 GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

In general, site geologic conditions encountered within the depth range of environmental explorations consisted primarily of a pavement section or a granular fill trafficking layer overlying hydraulic fill. Hydraulic fill is typically a loose to medium dense, poorly graded fine to medium sand with silt or silty fine to medium sand. Native marine sediment consisting of soft to loose silt to silty sand

directly underlies the hydraulic fill. The hydraulic fill is about 20 ft thick throughout most of the site, but appears to thicken to 30 ft or more toward the western end, where the contact with the marine sediment slopes downward from east to west. Glacial soil, consisting of dense, granular soil of variable composition, underlies the marine sediment and slopes steeply downward from east to west, resulting in a thickening layer of marine sediment to the west. The thickness of the marine sediment ranges from about 20 ft in the eastern portion of the site to about 177 ft or more in the western portion of the site.

Organic material in the form of wood chips, bark, and related material was encountered in the hydraulic fill in many of the borings. Organic material ranged from small wood fragments intermixed with fill to distinct layers of wood debris. Wood debris is present throughout much of the site, although it is most consistently present over the northern half.

The uppermost hydrostratigraphic unit at the site consists of the fill unit that overlies the finer grained marine sediment unit. The marine sediment unit forms the uppermost aquitard throughout the site. The depth to water ranged from 3.0 to 7.5 ft below ground surface (BGS). The depth to water generally appears to be shallower toward the center of the site and deeper in the vicinity of the shoreline, which is consistent with groundwater flow toward marine surface water. The groundwater elevation contour map from the DGI report (Landau Associates 2005) presented on Figure 4 shows that groundwater flows radially outward from the center of the site toward surface water. The hydraulic conductivity for the hydraulic fill unit was estimated to be about 1×10^{-3} cm/sec (3 ft/day), and the linear velocity for groundwater was estimated to average about 0.1 ft/day in the DGI report (Landau Associates 2005).

2.3 PROPOSED CLEANUP STANDARDS

Cleanup standards must be developed to determine the nature and extent of contamination and develop the scope of the cleanup action. Cleanup standards for the constituents of concern in site soil have been developed in accordance with MTCA requirements. Cleanup standards consist of: 1) cleanup levels that are adequately protective of human health and the environment, and 2) the point of compliance at which the cleanup levels must be met. The cleanup standards presented in this section are the basis for the cleanup actions presented in Section 3.0. However, the cleanup standards will not be considered final until Ecology concurrence has been obtained for the proposed cleanup levels and points of compliance.

As allowed under WAC 173-340-703, proposed indicator hazardous substances (IHS) were also developed to separate those constituents at the site that contribute the greatest threat to human health from those that contribute little or no threat. IHS are also presented in this section.

2.3.1 CLEANUP LEVELS

Cleanup levels for site soil that are adequately protective of human health and groundwater were developed in accordance with MTCA requirements. Also, cleanup levels for groundwater that are adequately protective of marine surface water were developed in accordance with MTCA requirements. Exposure pathways and receptors based on current and likely future site uses were identified as part of cleanup level development.

2.3.1.1 Current and Likely Future Land Use

The site is currently zoned commercial and light industrial and it is not anticipated that the zoning will change following redevelopment. However, multi-family residential units in the form of condominiums will be constructed in the central portion of the site. Because of current zoning and future site use, cleanup standards were developed based on unrestricted site use.

2.3.1.2 Exposure Pathways

Potential exposure pathways were identified for human and environmental impacts based on the planned land use. The potential exposure pathways are presented by medium below.

Soil

The potential exposure pathways for site soil are:

- Human contact (dermal, incidental ingestion, or inhalation) with constituents in site soil
- Uptake of constituents in site soil by terrestrial plants and soil biota
- Contact by terrestrial wildlife (dermal, incidental ingestion, or inhalation) with constituents in the soil
- Leaching of constituents from site soil to groundwater.

Sites that contain less than 1.5 acres of contiguous undeveloped area are excluded from having to conduct a terrestrial ecological evaluation in accordance with WAC 173-340-7491(1)(c)(i). Following redevelopment, the site will be almost entirely covered with buildings and pavement, with landscaping confined to small areas around buildings, along roadways, and within parking areas; most landscaping will be contained in planters or otherwise isolated from the underlying existing soil surface. As a result, the site meets the exclusion for a terrestrial ecological evaluation, and human contact is the only applicable pathway for site soil.

Groundwater

Groundwater at or potentially affected by the site is not currently used for drinking water and is not a reasonable future source of drinking water due to its proximity to marine surface water and the availability of a municipal water supply. If groundwater were pumped for drinking water use, saltwater intrusion would likely result due to the proximity of the site to marine surface water. As a result, the potential exposure pathways for site groundwater include:

- Human ingestion of marine organisms contaminated by releases of affected site groundwater to adjacent marine surface water
- Acute or chronic effects to aquatic organisms resulting from exposure to constituents in groundwater discharging to adjacent marine surface water.

Groundwater cleanup criteria developed based on the exposure pathways identified in this subsection must be adequately protective of aquatic organisms and of humans that ingest these marine organisms.

2.3.1.3 Soil

Proposed soil cleanup levels for unrestricted land use were developed in accordance with WAC-173-340-740 using the exposure pathways identified above, based on the mixed residential and commercial uses that will be present on the site following redevelopment. Under MTCA, Method B soil cleanup levels must be as stringent as:

- Concentrations established under applicable state and federal laws
- Concentrations protective of direct human contact with soil
- Concentrations protective of groundwater.

These criteria were considered during development of proposed soil cleanup levels.

There are no soil cleanup levels established under applicable state or federal laws. Except for arsenic and TPH, standard MTCA Method B soil cleanup levels protective of direct human contact were determined in accordance with WAC 173-340-740(3) using Ecology's Cleanup Levels and Risk Calculations (CLARC) database. The MTCA Method A soil cleanup levels for unrestricted site use were used to address arsenic and TPH in soil. These proposed cleanup levels are shown in Table 1. The cleanup screening level for benzo(a)pyrene will be used for the sum of cPAHs using toxicity equivalency factors (TEFs) to calculate a toxicity equivalency quotient (TEQ) for total cPAHs in accordance with WAC 173-340-708(8)(e).

Soil cleanup levels protective of groundwater were determined using the fixed parameter three-phase partitioning model in accordance with WAC 173-340-747(4). Because groundwater is not a current or likely future source of drinking water and because it discharges to marine surface water, groundwater cleanup levels were developed based on marine surface water cleanup levels protective of human health and aquatic organisms in accordance with WAC 173-340-730. The three-phase model provides a conservative estimate of the concentration of a contaminant in soil that is protective of groundwater. Soil cleanup levels protective of groundwater as marine surface water are shown in Table 1.

Soil cleanup levels were adjusted to be no less than the practical quantitation limit (PQL) in accordance with WAC 173-340-730(5)(c). Reporting limits for the soil analytical methods were used as the PQL.

Soil cleanup levels may be adjusted to be no less than natural background levels in accordance with WAC 173-340-740(5)(c). Background concentrations for metals, based on Puget Sound 90th percentile values (Ecology 1994), were compared to soil cleanup levels protective of human direct contact and groundwater. Cleanup levels for copper, mercury, and nickel were adjusted upward to the natural background level. Soil cleanup levels adjusted to natural background levels are identified in Table 1.

For constituents present in soil at concentrations greater than the calculated soil cleanup levels protective of groundwater as marine surface water, an empirical demonstration that concentrations present in soil are not exceeding groundwater cleanup levels (based on marine surface water criteria) may be made. The Cleanup Action Area of the site meets the requirements for an empirical demonstration listed in WAC 173-340-747(9)(b) for hazardous substances tested in soil, except for arsenic. The empirical demonstration requires that:

- Measured groundwater concentrations in proposed point of compliance wells are less than the groundwater cleanup levels.
- Any hazardous substances in soil have been present for many years, allowing sufficient time for migration to the shallow groundwater.
- Future site use following redevelopment will reduce the potential for leaching from soil to groundwater due to an increase of low-permeability cover resulting from additional buildings and paved areas.

The Cleanup Action Area meets the requirements for an empirical demonstration for cadmium, copper, mercury, and zinc. As a result, the proposed cleanup levels for these constituents were based on the Method B cleanup level for direct contact instead of the calculated cleanup level for protection of groundwater as marine surface water.

2.3.1.4 Groundwater

Because human ingestion of constituents in groundwater is not a potential exposure pathway, as described in Section 2.3.1.2, potable groundwater cleanup levels were not developed for site groundwater. However, cleanup levels protective of marine surface water were developed because site groundwater discharges directly to Port Gardner Bay. Except for arsenic and TPH, MTCA Method B marine surface water cleanup levels were developed in accordance with WAC 173-340-730(3) for the detected constituents in groundwater. The MTCA Method A cleanup levels were used for arsenic and TPH. Cleanup levels were adjusted to be no less than the PQL in accordance with WAC 173-340-730(5)(c). Reporting limits for the groundwater analytical methods were used as PQLs. Proposed groundwater cleanup levels for detected constituents are shown in Table 2.

2.3.2 POINTS OF COMPLIANCE

Under MTCA, the point of compliance is the point or location on a site where the cleanup levels must be attained. It is necessary to identify proposed points of compliance to develop and evaluate the extent of contamination presented in Section 2.4 of this document, and to develop the cleanup action for the site, which is presented in Section 3.0. This section describes the proposed points of compliance for the site.

2.3.2.1 Soil

The point of compliance where proposed soil cleanup levels protective of groundwater as surface water will be attained is throughout the site in accordance with WAC 173-340-740(6)(b). The point of compliance where proposed soil cleanup levels protective of direct human contact will be attained is throughout the site from the ground surface to 15 ft BGS in accordance with WAC 173-340-740(6)(d).

2.3.2.2 Groundwater

Because groundwater cleanup screening levels are based on protection of marine surface water and not protection of groundwater as drinking water, a conditional point of compliance will be established at the point of discharge to marine surface water, which is consistent with WAC 173-340-720(8)(d)(i).

2.3.3 INDICATOR HAZARDOUS SUBSTANCES

As allowed under WAC 173-340-703, proposed IHS were identified to separate those constituents at the site that contribute the greatest threat to human health from those that contribute little

or no threat. IHS were selected by applying the factors identified in WAC 173-340-703(2) and by comparing detected constituent concentrations in soil and groundwater to applicable soil and groundwater quality criteria developed in Tables 1 and 2. Results from the Phase II ESA and DGI and Supplemental DGI investigations were used to identify soil and groundwater IHS.

Tables 3 and 4 summarize the analytical testing and results for soil and groundwater within the site, respectively. Tables 3 and 4 include data for areas of the site that are outside the Cleanup Action Area, ensuring that the IHS developed in this CAP are comprehensive and can be applied to the site as a whole. The tables include the analytical parameters that were tested, the number of detections, and the number of samples that exceeded the proposed cleanup levels. The bases for identifying IHS are described in the following sections, and the proposed IHS and their associated proposed cleanup levels are presented in Table 5.

2.3.3.1 Soil

As shown in Table 3, all but 10 of the constituents analyzed in soil were either not detected or the detected concentrations were below the proposed cleanup levels. The constituents that did not exceed the proposed cleanup levels do not pose a threat to human health or the environment and, therefore, were eliminated as indicator hazardous substances. The remaining 10 constituents were detected at least once at a concentration exceeding the proposed cleanup level. Two of these constituents, arsenic and cPAHs, were detected at concentrations exceeding the proposed cleanup level at a much greater frequency than the other constituents. Arsenic was detected at concentrations exceeding the proposed cleanup level in 94 of the 337 samples analyzed for arsenic, and cPAHs were detected at concentrations exceeding the proposed cleanup level in 58 of the 232 samples analyzed for cPAHs. Due to the frequent number of exceedances and the frequent detections of these constituents in soil, these constituents are considered to contribute the greatest threat to human health or the environment and subsequently have been identified as soil IHS. Additional IHS identified include diesel-range and motor oil-range petroleum hydrocarbons and lead. Five percent or greater of the samples with detected concentrations of these constituents exceeded the proposed cleanup level.

The frequency that the hazardous substance was detected at the site and the thoroughness of testing are two factors listed in WAC 173-340-703(2) that may be used to eliminate a constituent as an IHS. These factors were used to eliminate the remaining detected constituents (mercury, gasoline-range petroleum hydrocarbons, and tributyl tin) from the proposed list of IHS. Mercury was analyzed in 267 soil samples and was detected in 38 percent of the samples, but less than 1 percent of the samples exceeded the proposed cleanup level. The thoroughness of the testing for mercury and the low percentage of exceedances indicate that mercury contributes a small percentage of the overall threat to human health

and the environment. This constituent was therefore eliminated from the proposed list of IHS. Gasoline-range petroleum hydrocarbons were analyzed in 144 soil samples and were detected in less than 5 percent of the samples. Only one of the detected concentrations exceeded the proposed cleanup level. The laboratory reported that the gasoline result for this sample did not match an identifiable gasoline pattern and, because diesel-range petroleum hydrocarbons were also detected in the sample, it is likely that the gasoline-range petroleum hydrocarbons reported for the sample are the light fraction of the diesel-range petroleum hydrocarbons. The thoroughness of the testing for gasoline-range petroleum hydrocarbons and the low percentage of detections indicate that gasoline-range petroleum hydrocarbons contribute a small percentage, if any, of the overall threat to human health and the environment. This constituent was therefore eliminated from the proposed list of IHS. Tributyltin (TBT) was analyzed in 12 soil samples collected from areas where boat maintenance activities commonly occur. Although it was detected in nine of the samples, a concentration exceeding the proposed cleanup level occurred in only one of the samples. Because the arsenic cleanup level was also exceeded, the proposed cleanup level in the sample with the TBT exceedance using arsenic as an IHS will result in the cleanup of TBT. Therefore, TBT was eliminated from the proposed list of IHS for soil.

2.3.3.2 Groundwater

As shown in Table 4, all but seven of the constituents analyzed in groundwater were either not detected or the detected concentrations were below the proposed cleanup levels. The constituents that were not detected above the cleanup level do not pose a threat to human health or the environment and, therefore, were eliminated as IHS. The remaining eight constituents (dissolved arsenic, diesel-range petroleum hydrocarbons, oil-range petroleum hydrocarbons, dissolved copper, dissolved lead, dissolved zinc, cPAHs, and vinyl chloride) were detected at least once at a concentration exceeding the proposed cleanup levels.

Dissolved arsenic was detected at concentrations exceeding the proposed cleanup level in 22 of the 49 groundwater samples analyzed for arsenic, although the 22 exceedances include duplicate samples and multiple samplings for exceedance locations. Due to the frequent number of exceedances and the frequent detections of arsenic in groundwater, arsenic is considered to contribute the greatest threat to human health or the environment for groundwater and is identified as a groundwater IHS.

Diesel-range and motor-oil range petroleum exceeded their proposed cleanup levels in 4 of 53 and 3 of 53 samples tested, respectively. Although exceedances only occurred in about 6 to 8 percent of the samples tested, groundwater analysis was limited in areas of known petroleum hydrocarbon contamination, and both diesel- and oil-range petroleum hydrocarbons will be maintained as groundwater IHS. However, it should be noted that diesel-range petroleum hydrocarbons were not detected above the

proposed groundwater cleanup level in the Cleanup Action Area, and there was only a single exceedance of the oil-range petroleum hydrocarbon above the proposed groundwater cleanup level. As indicated in the DGI report (Landau Associates 2005), the single exceedance of the oil-range petroleum hydrocarbon proposed cleanup level within the Cleanup Action Area occurred in Investigation Area B and appears to result from particulates entrained in the geoprobe sample that exhibited the exceedance rather than from groundwater contamination.

Vinyl chloride was tested at 35 locations and detected at 3 of the locations (F-1, F-2, and M-3). The proposed vinyl chloride cleanup level (2.4 µg/L) was exceeded at locations F-2 (17 µg/L) and M-3 (13 µg/L), and was detected at a concentration below the cleanup level at Area F-1 (0.5 µg/L) directly upgradient of Area F-2. Vinyl chloride is a breakdown product of other chlorinated solvents, and no other chlorinated solvents were detected above the proposed cleanup levels, which indicates that an ongoing source of vinyl chloride is not present. Based on these data, the two vinyl chloride exceedances appear to be isolated occurrences and vinyl chloride in groundwater does not appear to be widespread. This conclusion is further supported by the low vinyl chloride concentration at upgradient Area F-2 and the lack of vinyl chloride detections downgradient of Area M-3. Although exceedances only occurred in about 6 percent of the samples analyzed, vinyl chloride will be maintained as a groundwater IHS.

Frequency and thoroughness of testing for the hazardous substance at the site are also factors used to evaluate groundwater data and to eliminate a constituent as an IHS for groundwater. As shown in Table 4, 47 groundwater samples have been analyzed for dissolved lead and 41 groundwater samples have been analyzed for dissolved zinc. Each of these metals was detected only once at a concentration exceeding the proposed cleanup level and the exceedances are associated with a groundwater sample that was collected using a defective groundwater filter (Landau Associates 2005). A follow-up sample using a properly functioning filter did not contain detectable concentrations of lead or zinc, indicating that the exceedances in the sample collected with the defective filter were due to soil particulates entrained in the sample. As a result, lead and zinc are not considered groundwater IHS for the Cleanup Action Area.

Forty-one groundwater samples have been analyzed for dissolved copper. Dissolved copper was detected in six of the samples at a concentration exceeding the proposed cleanup level. Only one of the copper exceedances occurred in groundwater collected from wells within the Cleanup Action Area addressed as part of this CAP. Due to the large number of samples analyzed for copper and the single exceedance within the Cleanup Action Area, copper is not considered an IHS for groundwater within the Cleanup Action Area.

The copper, lead, and zinc exceedances that did not occur at locations within the Cleanup Action Area addressed as part of this CAP will be addressed in a separate Cleanup Action Plan.

Twenty-three groundwater samples have been analyzed for cPAHs. CPAHs were detected in nine of these samples and only two of the detected concentrations exceeded the proposed groundwater cleanup level. Eight of the samples with detectable concentrations, which include the cPAH exceedances, are associated with groundwater samples from the Phase II ESA (Landau Associates 2004) believed to have soil particulates entrained in the samples during collection. Groundwater samples collected at the same eight locations at a later date were centrifuged by the lab to remove particulates prior to cPAH analysis. Only one of the centrifuged groundwater samples contained detectable concentrations of cPAHs and the detected concentration was below the proposed cPAH groundwater cleanup level, indicating the detected concentrations in the earlier non-centrifuged groundwater samples are likely due to constituents adsorbed to soil particulates entrained in the groundwater sample. Because of the large number of samples analyzed for cPAHs and the lack of cleanup level exceedances (excluding false positives), cPAHs are not included in the proposed list of IHS for groundwater.

2.4 NATURE AND EXTENT OF CONTAMINATION

During the Phase II ESA, the DGI, and the Supplemental DGI a total of about 393 soil samples were tested for various environmental constituents. These samples were collected from locations throughout the site, as shown on Figure 3. To maximize the probability that all areas of potential contamination within the site boundary were identified during the previous investigations, both focused and area-wide sampling methods were used for selecting soil sample locations, consistent with Ecology guidance on sampling and data analysis methods (Ecology 1995).

The focused sampling method (referred to as focus area characterization in the DGI and Supplemental DGI) was used in areas identified as historical operational work areas where contamination was considered likely (e.g., former boat maintenance and repair work yards in Investigation areas b and c, former truck and trailer staging and maintenance yards in Investigation Area E, a former heavy equipment and machinery storage area in Area F, etc.). These areas were identified based on knowledge of current and past site uses and a review of historical aerial photographs. Focused sampling was also conducted during the Phase II ESA and the DGI in areas where aboveground and underground storage tanks exist or formerly existed.

Area-wide soil sampling (referred to as "general characterization" in the DGI and Supplemental DGI) was conducted to identify whether contamination was present in areas of the site not subjected to focused investigation. Area-wide soil sampling locations were spaced approximately 100 to 150 ft apart.

During the Phase II ESA, the DGI, and the Supplemental DGI a total of 47 groundwater samples were tested for various environmental constituents. As shown on Figure 3, the groundwater sampling locations are spread throughout the site. Similar to the strategy for soil sampling, groundwater samples

were collected from areas of identified potential contamination (focused sampling) and from other site areas for general characterization purposes.

The soil and groundwater analytical results were compared against the proposed cleanup levels developed in Section 2.3. The nature and extent of contamination, based on exceedance of the proposed cleanup levels, are discussed in the following sections.

2.4.1 SOIL

The following conclusions were drawn regarding the nature and extent of soil contamination in the Cleanup Action Area, based on the results of soil analytical results from site investigation activities:

- Soil contamination is limited to heavy metals and cPAHs in shallow soil, with the exception of one isolated location in Investigation Area J where total petroleum hydrocarbon (TPH) in the oil range exceeds the cleanup level and is the only constituent of concern.

- Arsenic is the most ubiquitous metal contaminant, with a limited number of exceedances for lead and copper. Lead and copper do not exceed the proposed cleanup levels at any locations where arsenic does not exceed the cleanup level.

- Soil contamination is limited to the upper 3 ft of soil.

Figure 5 presents a soil cleanup level exceedance map, illustrating the extent of soil contamination for the Cleanup Action Area. The figure identifies the locations where soil concentrations for one or more of the IHS exceed the proposed cleanup levels to show the aerial distribution of soil contamination. The figure is not constituent-specific; a more detailed discussion of the nature and extent of contamination in exceedance areas is provided below and in Section 3.5.1 (Detailed Description of Proposed Cleanup Action) on an area-specific basis.

Contaminated soil areas are identified on Figure 5, labeled sequentially within each investigation area (e.g., B-1 is the fist contaminated soil area located within Investigation Area B). Contaminated soil areas were defined based on the distribution of cleanup level exceedances, with consideration given to the nature of contamination, its potential distribution based on known or suspected sources, and site features that provide boundaries to the extent of contamination. The following sections describe the nature and distribution of contamination within each designated contamination area.

2.4.1.1 Area B-1

Area B-1 is the work yard on the east side of Everett Bayside Marine facility. The yard is used for repair and maintenance to boats, and is unpaved. The area is bounded on all sides by pavement or buildings.

Soil contamination in Area B-1 consists of arsenic throughout the area, with more limited exceedances of cPAH, and a single exceedance of petroleum hydrocarbons in the diesel range. Contamination is limited to the upper 0.5 ft of soil. Although arsenic is the only metal that was detected above the cleanup screening level, copper, lead, mercury, and zinc were also present at elevated concentrations. The analytical data associated with Area B-1 are shown on Figure 6.

Based on the use of Area B-1 for boat maintenance activities, arsenic contamination is likely the result of boat hull sandblasting or similar activities, with arsenic potentially present in the sandblast grit or in hull paints from older vessels. The presence of cPAHs and diesel-range petroleum hydrocarbons is likely associated with the maintenance of marine engines and other vessel mechanical elements.

2.4.1.2 Area C-1

Area C-1 is the Port boatyard. The yard is used for repair and maintenance to boats, and is unpaved. The area is bounded on all sides by pavement and fencing.

Soil contamination in Area C-1 consists of arsenic throughout the area, with more limited exceedances of lead, copper, and cPAH. TPH were not analyzed in Area C-1 samples, and limited exceedances may exist in shallow soil. It is anticipated that any exceedances would be addressed by the remediation of metals and cPAH contamination; however, compliance monitoring following remediation will include analysis for TPH. Contamination is limited to the upper 0.5 ft of soil. The analytical data associated with Area C-1 are shown on Figure 7.

Based on the use of Area C-1 for boat maintenance activities, arsenic contamination is likely the result of boat hull sandblasting or similar activities, with arsenic potentially present in the sandblast grit or in hull paints from older vessels. The presence of cPAHs is likely associated with the maintenance of marine engines and other vessel mechanical elements, or it is possibly related to creosote-treated wood that may have been used to support boats during maintenance activities.

2.4.1.3 Areas C-2 and C-3

Areas C-2 and C-3 are located in parking and general traffic areas within Investigation Area C. Specific current or past activities that provide an identified source of contamination for either area have not been identified. Both areas are paved.

Soil contamination in these areas is limited to low levels of cPAH contamination (less than 1 mg/kg), and the exceedance is limited to a single sample collected for general characterization purposes. Contamination is limited to the upper 0.5 ft below the pavement and associated base course material. The analytical data associated with Areas C-2 and C-3 are shown on Figure 7.

Area C-2 is not bounded by any site features, such as buildings, fences, or defined work areas. As a result, additional delineation will be conducted to better define the extent of contamination, as discussed in Section 3.5.1.2. Area C-3 is bounded on the north by a building, and to the south, east, and west by borings completed during the Supplemental DGI, although additional delineation will be conducted to further refine the cleanup area.

2.4.1.4 Areas E-1 and E-2

Areas E-1 and E-2 are located in the northwest (Area E-1) and southwest (Area E-2) corners of Investigation Area E. The areas were used for the staging, maintenance, and operation of the PSTL fleet of trucks and trailers. Soil contamination in these areas is limited to arsenic. No cPAH or TPH exceedances occurred in conjunction with shallow soil. No activities likely to cause arsenic contamination are known to have occurred in either area, but it is possible that sandblasting or the use of arsenic-based pesticides or herbicides occurred. Additionally, the American Construction Company leasehold to the west is heavily contaminated with arsenic, which could have affected the areas by stormwater runoff or windblown deposition.

Arsenic contamination for these two areas is limited to the upper 0.5 to 2 ft of soil. The analytical data associated with Areas E-1 and E-2 are shown on Figure 8.

The areas are bounded on the west by the American Construction Company leasehold. Area E-1 is bounded on the north by the 12th Street Channel and on the east by analytical data (E-GC-1b), but is not well bounded to the south. Area E-2 is bounded on the south by 13th Street, but is not well bounded to the north or the east. As a result, additional investigation will be conducted in Areas E-1 and E-2 to better delineate the extent of contamination, as described in Section 3.5.1.3.

2.4.1.5 Areas F-1 and F-3

Areas F-1 and F-3 are located to the north of the former Everett Engineering M-11 building. The F-1 area was used to store heavy equipment and machinery for a number of years, and sandblast grit was observed on the ground surface during the Phase I ESA (Landau Associates 2001). No specific activities likely to cause observed contamination were identified for Area F-3, but available aerial photographs indicate that Area F-3 was previously a low area that was filled within the last few years. Contamination in Area F-1 appears to be related to the storage and maintenance of equipment and machinery, including sandblasting. It appears that the contamination present in Area F-3 resulted from filling, possibly associated with grading or excavation of nearby affected soil in Area F-1.

Soil contamination in Areas F-1 and F-3 consists of arsenic throughout the area, with more limited exceedances of cPAHs. Lead also exceeded the proposed cleanup level in two samples collected from Area F-3. No TPH exceedances were encountered in either area. Although they did not exceed the proposed cleanup level, copper, mercury, and zinc were also present at elevated concentrations. Contamination is limited to the upper 0.5 ft of soil in Area F-1, but extends to a depth of 3 ft in Area F-3. The analytical data associated with Areas F-1 and F-3 are shown on Figure 9.

Area F-1 is bounded by analytical data on all sides, although limited sampling was conducted in the central portion of the area because of the presence of equipment and machinery during the sampling events. Area F-2 is bounded on the north by the 12th Street Channel, on the south by the Investigation Area E fence line, and on the east by Area F-1; it is not well bounded to the south. As a result, additional soil characterization will be conducted to better delineate contamination in these areas, as discussed in Section 3.5.1.4.

2.4.1.6 Areas F-2, F-6a, and F-6b

Area F-2 is located on the west site of the former American Boiler Works (ABW) Plant II building. Areas F-6a and F-6b are located immediately outside of loading docks on the south side of the former ABW Plant II building. The F-2 area is used for parking and storage of vehicles and equipment and also contains a loading dock at the southwest corner of the building. Areas F-6a and F-6b are used for loading and off-loading of rail cars from the adjacent railroad spur and may have been subject to spills or the discharge of sweepings from the building.

The contaminated soil in Areas F-6a and F-6b appears to be associated with a pink granular material with the appearance of pink sand. This material was also found to be present in the vicinity of the loading dock in the southeast corner of Area F-2. Because the distribution of pink sand is limited to the immediate vicinity of the loading docks, it appears to be associated with the discharge or spill of feed stock or waste associated with former operations within the building. Contamination in Area F-2 may also be associated, at least in part, with the pink sand present outside the loading dock in the southeast portion of the area. The elevated levels of copper and zinc, in addition to arsenic and lead, suggest that sandblasting of boats or painted marine equipment could be a source of contamination in all three areas. The gradation of pink material suggests it could be sandblast grit.

Arsenic is the only constituent of concern that exceeds the proposed cleanup levels in Area F-2. However, copper, lead, and zinc are also highly elevated. Both arsenic and lead exceed the proposed cleanup levels in Areas F-6a and F-6b, and copper and zinc are also elevated at these locations. Analytical data for Areas F-2, F-6a, and F-6b are shown on Figure 9.

Area F-2 is unpaved and bounded on the east by the former ABW building and on the north and west sides by pavement. A security fence bounds Area F-2 on the south. Areas F-6a and F-6b are unpaved and bounded on the north side by the former ABW building; the areas are unbounded on the south, west, and east sides, but contamination is visually discernable based on the presence or absence of the pink sand material. Area F-2 is delineated based on a single soil sample within the affected area, and additional delineation is needed to determine if contamination extends throughout the potentially affected area. As a result, additional soil characterization will be conducted to better delineate contamination in Area F-2, as discussed in Section 3.5.1.5

2.4.1.7 Area F-5

Area F-5 is located to the south of the M-11 building adjacent to 13th Street. The area does not have any usage history to indicate a potential source of contamination. The location was sampled during the DGI investigation for general characterization purposes. Although there is no usage history for the area that indicates a potential source of contamination, the sample was collected in proximity to 13th Street and cPAHs are common contaminants associated with urban runoff and emissions from heavy equipment. The low level of cPAH contamination encountered at this location may be related to roadway traffic along 13th Street.

Surface soil (0 to 0.5 ft BGS) in Area F-5 is contaminated with low concentrations of cPAHs (146 µg/kg), which only slightly exceeds the proposed cleanup level for cPAHs (137 µg/kg). Analytical data for AreaF-5 are shown on Figure 9.

Area F-5 is unpaved and is generally bounded by the M-11 building to the north and 13th Street to the south. The area is unbounded to the east and west, except for paved entrances to Investigation Areas E and F. As a result, additional soil characterization will be conducted to better delineate contamination in Area F-2, as discussed in Section 3.5.1.5

2.4.1.8 Areas I-1 through I-11

Investigation Area I is located at the head of the 12th Street Channel. The area has never been developed, although a former lumber mill that burned down in the late 1960s was located immediately to the east. Investigation Area I was used for the stockpiling or placement of excess soil and/or debris. The soil stockpiles and debris largely originated from other locations within the site where boat maintenance and other marine-based commercial and industrial activities were conducted, so affected soil is likely associated with activities that occurred in the areas from which the soil originated.

Soil contamination in Investigation Area I is subdivided into Areas I-1 through I-11. Soil contamination in these areas consists of arsenic, with more limited exceedances of lead and cPAH. No petroleum hydrocarbon exceedances were detected in any of the areas. Contamination is limited to the upper 0.5 ft to 2 ft for all areas, except Area I-5, where contamination extends to 6 ft BGS. Although arsenic and lead were the only metals detected above the proposed cleanup levels, copper and zinc were also present at elevated concentrations at some locations. The analytical data associated with Areas I-1 through I-11 are shown on Figure 10.

Investigation Area I is unpaved and bounded by the 12th Street Channel to the west, a security fence and undeveloped property to the north, the former Marine Spill and Response Company (MSRC) facility to the south, and the Ameron leasehold to the east. Additional characterization is required to adequately delineate some of the individual cleanup areas within Investigation Area I, although the contaminant boundaries for Investigation Area I as a whole appear to be adequately bounded except for the east boundary with the Ameron leasehold. The visual appearance and topographic relief along the fence line between Investigation Area I and the Ameron leasehold suggest that soil on the Ameron side of the fence line is also affected. However, the Ameron leasehold will not be available until 2012, and cleanup of this area will be deferred until that time. Additional soil characterization will be conducted to better delineate contamination in Investigation Area I, as discussed in Section 3.5.1.6.

2.4.1.9 Area J-1

Area J-1 is immediately south of Investigation Area I and does not have a usage history that indicates a potential source of contamination. The area is located at the entrance to Investigation Area I, and no specific site use other than roadway access and parking are indicated by available data. As a result, Area J-1 appears to be an isolated exceedance that is not associated with a specific activity or known release.

Soil contamination is limited to the upper 0.5 ft underlying the pavement and base course section (1.5 to 2.0 ft BGS). Contamination is limited to arsenic. Other metals, such as lead, copper, and zinc, were not elevated in the single exceedance detected at this location. The analytical data associated with Area J-1 are shown on Figure 11.

Area J-1 is paved. The area is not bounded by any structures or other physical features but is bounded by analytical results on all sides.

2.4.1.10 Area J-2

Area J-2 is located at the entrance to Investigation Area I and the northern portion of Investigation Area F. It is in the middle of the roadway access immediately north of 13th Street. There is no usage history that indicates a potential source of contamination.

Contamination is limited to oil-range petroleum hydrocarbons, and the vertical extent is limited to the upper 0.5 ft beneath the pavement and base course section (1.0 to 1.5 ft BGS). The analytical data associated with Area J-2 are shown on Figure 11.

Area J-2 is paved and is bounded by 13th Street to the south. No physical features bound the area to the north, west, or east, but analytical data bound the area in these directions.

Although no specific usage history suggests a potential source of contamination, the nature of the contamination and the location of the exceedance within a roadway suggest that vehicle engine leakage is the most likely source. The limited areal extent also supports this conclusion.

2.4.1.11 Area J-3

Area J-3 is located directly east of, and beneath, a covered work area at the north end of the former MSRC building. There is no usage history that indicates a potential source of contamination. However, construction debris, including burnt wood potentially from the former saw mill that burnt down in the late 1960s, is present throughout the affected soil zone.

Area J-3 is paved and is not bounded by any structures in the immediate vicinity, although the structure for the covered work area limits access on its west side. Both arsenic and cPAHs exceeded the proposed cleanup levels for the one sample submitted for testing.

Additional borings in the vicinity were completed to delineate the extent of construction debris, which is assumed to be the source of contamination. Based on the observed extent of debris, contamination extends to a depth of greater than 12 ft BGS. Analytical data associated with Area J-3 and the observed areal extent of construction debris are shown on Figure 11.

2.4.1.12 Areas L-1, L-2, and L-3

Areas L-1, L-2, and L-3 are located along the north side of Investigation Area L adjacent to 13th Street. There is no usage history that indicates a potential source of contamination. However, Areas L-2 and L-3 are adjacent to Area B-1 and could have been affected by the boat maintenance activities conducted in that area.

Arsenic is the only constituent of concern that exceeds the proposed cleanup levels in Areas L-1 and L-2. Both arsenic and lead proposed cleanup levels are exceeded in Area L-3. Copper and zinc are elevated in all three areas. Analytical data for Areas L-1, L-2, and L-3 are shown on Figure 6.

The analytical results for contaminated soil in Areas L-1, L-2, and L-3 are consistent with slag-derived sandblast grit in conjunction with marine paints containing elevated levels of copper, lead, and zinc. The concentrations of copper, lead, and zinc relative to arsenic are also similar to those of the pink granular material present outside the loading docks at the former Plant II building in Investigation Area F previously occupied by ABW, which also occupied Investigation Area I.

Areas L-1 and L-3 are paved, and Area L-2 is unpaved. Area L-1 is bounded on the northeast side by an elevated landscape area and is bounded by analytical data to the south and west. Areas L-2 and L-3 are bounded by 13th Street on the north and a paved work yard to the south, but are not well bounded to the east or west. As a result, additional soil characterization will be conducted to better delineate contamination in Investigation Area I, as discussed in Section 3.5.1.7.

2.4.2 GROUNDWATER

The following conclusions were drawn regarding the nature and extent of groundwater contamination in the Cleanup Action Area, based on the results of groundwater analytical results from site investigation activities:

- The proposed arsenic groundwater cleanup level was exceeded in Investigation Areas F, J and L.

- The proposed arsenic groundwater cleanup level was exceeded at a number of locations within the north-central portion of Investigation Area F. The exceedance results from background levels of arsenic in soil in contact with groundwater in a reduced oxidation state, and the reduced groundwater condition appear to result from organic material in subsurface soil, not a release of hazardous substances.

- Although groundwater monitoring wells near the proposed downgradient point of compliance in Investigation Area F exceeded the arsenic cleanup screening level, the wells are located about 15 to 25 ft from the shoreline and it is anticipated that water collected from the groundwater/surface water interface will achieve the proposed arsenic groundwater cleanup level.

- The proposed arsenic groundwater cleanup level was slightly exceeded at one location (Boring J-2) in Area J. However, arsenic results for a groundwater sample collected at a nearby downgradient boring, J-1, did not exceed the groundwater cleanup screening level for arsenic.

- Groundwater in Investigation Area L does not appear to exceed the proposed groundwater cleanup level for arsenic. Although the proposed arsenic cleanup level was exceeded in a groundwater sample collected from Boring L-FA-1, subsequent testing of a groundwater

sample collected from Monitoring Well P-26 installed immediately downgradient from Boring L-FA-1 did not exceed the proposed groundwater cleanup level for arsenic.

- The proposed vinyl chloride groundwater cleanup level was exceeded at boring locations F-2 (located in the northwestern portion of Investigation Area F) and M-3 (located in the southeastern portion of Investigation Area M). The source of the vinyl chloride contamination is unknown; however, vinyl chloride is a breakdown product of other chlorinated solvents, which were not detected above the proposed cleanup levels at any locations.

- The vinyl chloride exceedance in Investigation Area F occurred approximately 100 ft from the shoreline and it is anticipated that the vinyl chloride cleanup level will be met at the proposed conditional point of compliance at the shoreline.

- The vinyl chloride exceedance in Investigation Area M is approximately 950 ft from the shoreline, and vinyl chloride was not detected in downgradient monitoring well P-12. It is anticipated that the vinyl chloride cleanup level will be met at the proposed conditional point of compliance at the shoreline.

Figure 12 is a groundwater cleanup level exceedance map, illustrating the extent of groundwater contamination for the Cleanup Action Area. The figure identifies the locations where groundwater concentrations for arsenic and vinyl chloride exceed the proposed cleanup levels to show the areal distribution of soil contamination. Please note that groundwater contamination associated with the former diesel USTs on the former PSTL leasehold (Investigation Area E) is not shown on Figure 12, and affected soil and groundwater associated with this release will be addressed as part of a separate cleanup action.

Based on the analytical results associated with groundwater monitoring conducted during the Phase II ESA and DGI investigation, arsenic in Investigation Area F groundwater is the only contamination condition warranting cleanup within the Cleanup Action Area. As shown on Figure 12, arsenic groundwater contamination is present throughout the central portion of Investigation Area F. As previously stated, the elevated concentrations of arsenic in groundwater result from background arsenic concentrations in soil in contact with reduced (low oxygen) groundwater conditions, not from a release of arsenic to site soil or groundwater associated with current or historical operational activities.

3.0 CLEANUP ACTION

Development of a cleanup action for the site is a multi-step process. First, cleanup action objectives (CAO) must be established for the site. Next, cleanup action technologies need to be evaluated to determine those technologies that are capable of achieving the various CAOs. The cleanup technologies must then be assembled into alternatives that achieve all CAOs, and the alternatives need to be compared against criteria established under MTCA to select the most practicable cleanup action for the site.

This alternative development, evaluation, and selection process is typically accomplished by conducting a feasibility study [FS; WAC 173-340-350(8)]. The FS develops alternatives that achieve the CAOs, compares the alternatives against criteria established under MTCA (WAC 173-340-360), and selects the alternative that is permanent to the maximum extent practicable. However, the need to integrate site cleanup with redevelopment focuses the cleanup on those actions that are compatible with redevelopment plans. Therefore, rather than conducting an FS, the alternatives considered for site cleanup will be described and the selected cleanup action will be compared against MTCA requirements to demonstrate compliance.

The following sections establish the CAOs (Section 3.1); identify applicable or relevant and appropriate requirements (ARARs; Section 3.2); identify the factors associated with integrating the cleanup action with site redevelopment (Section 3.3); present the response actions, cleanup technologies, and alternatives considered for site cleanup (Section 3.4); identify the selected alternative and compare it to MTCA requirements (Section 3.5); describe compliance monitoring that will be conducted in conjunction with the selected cleanup action (Section 3.6); and describe reporting for the cleanup action (Section 3.7).

3.1 CLEANUP ACTION OBJECTIVES

Based on the IHS established for site soil and groundwater quality (Section 2.3.3), the proposed cleanup standards, and the additional regulatory requirements, the CAOs for the site are established as follows:

- Prevent human contact (dermal, incidental ingestion, or inhalation) with site soil containing IHS (arsenic, lead, copper, petroleum hydrocarbons in the diesel and oil ranges, and cPAHs) above the proposed cleanup levels developed in Section 2.3.1.

- Prevent human ingestion of groundwater containing arsenic or vinyl chloride above its proposed cleanup level.

- Prevent exposure of marine organisms to site groundwater containing arsenic or vinyl chloride above its proposed cleanup levels developed in Section 2.3.1.

Although shallow groundwater is not a potential source of drinking water, CAO 2 was established to ensure that affected site groundwater will not be extracted and used for drinking water or other domestic purposes. The CAOs are of primary importance to the evaluation of cleanup action technologies, as discussed in the following section.

3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

In accordance with MTCA, all cleanup actions conducted under MTCA shall comply with applicable state and federal laws [WAC 173-340-710(1)]. MTCA defines applicable state and federal laws to include legally applicable requirements and those requirements that are relevant and appropriate. Collectively, these requirements are referred to as ARARs. This section provides a brief overview of potential ARARs for the site cleanup. The primary ARAR is the MTCA cleanup regulation (WAC 173-340) especially with respect to the development of cleanup levels and procedures for development and implementation of a cleanup under MTCA. The primary ARARs that may be applicable to the cleanup action include the following:

- Washington Water Pollution Control Act and the following implementing regulation: Water Quality Standards for Surface Waters (WAC 173-201A). These regulations establish water quality standards for surface waters of the State of Washington consistent with pubic health and the propagation and protection of fish, shellfish, and wildlife. These standards were used to develop groundwater cleanup levels for the site, as discussed in Section 2.3.

- Washington Hazardous Waste Management Act (Chapter 70.105 RCW) and the following implementing regulation: Dangerous Waste Regulations (WAC 173-303). These regulations establish a comprehensive statewide framework for the planning, regulation, control, and management of dangerous waste. The regulation designates those solid wastes that are dangerous or extremely hazardous to the public health and environment. The management of excavated contaminated soil from the site would be conducted in accordance with these regulations to the extent that any dangerous wastes are discovered or generated during the cleanup action.

- Washington Solid Waste Management Act (Chapter 70.95 RCW) and the following implementing regulations: Solid Waste Handling Standards (WAC 173-350) and Criteria for Municipal Solid Waste Landfills (WAC173-351). These regulations establish a comprehensive statewide program for solid waste management, including proper handling and disposal. The management of excavated contaminated soil from the site will be conducted in accordance with these regulations to the extent that the soil can be managed as inert or solid waste instead of dangerous waste.

- Shoreline Management Act (SMA; Chapter 90.58 RCW). Establishes permitting and other requirements for substantial development occurring within waters of the U.S. or within 200 ft of a shoreline, and requires that the activities in coastal zones be consistent with local regulations. MTCA exempts cleanup projects being conducted under an enforceable order or consent decree from the requirement of obtaining the shoreline permit; however, the cleanup must be conducted in accordance with the substantive requirements of the regulation. Site

cleanup has already been addressed in the shoreline permit for site redevelopment, so additional action relative to the SMA will not be required.

- Hazardous Waste Operations (WAC 296-843). Establishes safety requirements for workers providing investigation and cleanup operations at sites containing hazardous materials. These requirements would be applicable to onsite cleanup activities and would be addressed in a site health and safety plan prepared specifically for these activities.

3.3 INTEGRATION OF CLEANUP AND REDEVELOPMENT

As indicated above, redevelopment focuses the cleanup actions that are appropriate for the site. Figure 13 illustrates the primary site redevelopment features. The central core of the site will be largely residential condominiums. The Craftsman District is located in the northeast portion of the site and will contain water-dependent services, such as dry stack boat storage, boat repair, and marine supplies. An amphitheater for public concerts and other events will be located at the center of the west shoreline. The 12th Street Marina is currently under construction in the former 12th Street Channel to the north of the site. The remainder of the site will developed for commercial, retail, and hospitality businesses.

Site redevelopment plans result in the following considerations for cleanup:

- The Port and MTC have agreed that contaminated soil will not be contained within the residential portion of the development. The current plan to construct underground parking throughout the residential area also precludes containment of contaminated soil within this portion of the site.

- As shown on Figure 13, stone columns will be constructed throughout a large portion of the site to improve soil foundation conditions. As discussed below, contaminated soil must be removed prior to the installation of the stone columns to prevent the spread of contamination during the installation process.

- Required grade transitions between existing buildings and other site features that will remain and new infrastructure and buildings preclude significant elevation increases in non-residential areas that could potentially be used for containment of contaminated soil.

- Contaminated soil cannot be contained within 25 ft of the shoreline, as specified in the development agreement between the Port and the City of Everett.

The stone columns identified in the second bullet above are a ground improvement technique used to densify loose soils. Ground improvement will likely be used within the interior of the site to improve foundation conditions for building and roadway support. Along the north and west shorelines, stone columns will likely be used to improve slope stability of the shoreline to prevent lateral spreading under earthquake loadings. Ground improvement options continue to be evaluated, but stone columns remain the most probable solution, particularly for the western portion of the site and along the shoreline.

The stone column installation process consists of drilling a boring to the selected depth and adding gravel fill to the boring as the feed tube is vibrated during withdrawal to densify the gravel and

surrounding soils, as shown on Figure 14. Although this is a densification process rather than a replacement process, the installation of the stone columns does displace some of the native soil. As a result, contaminated soil needs to be removed prior to installing the stone columns to prevent the carry down or the spread of contaminated soil at the ground surface during the installation process.

Contaminated soil could be excavated and stockpiled prior to stone column installation, and then replaced and contained at the same location. However, much of the stone column construction will occur in the residential area, where contaminated soil cannot be contained, or within 25 ft of the shoreline (on the north and west shorelines). Additionally, the cost of stockpiling contaminated soil and then placing and compacting the material in its original location would not be significantly less than offsite disposal at an inert waste facility (discussed in Section 3.4.1.1), particularly when the additional costs associated with worker health and safety during construction and the long-term cost of compliance monitoring and maintaining institutional controls are considered.

3.4 DEVELOPMENT OF THE PROPOSED CLEANUP ACTION

The proposed cleanup action was developed for the site by first evaluating applicable response actions and cleanup technologies to identify those potentially applicable to site conditions. Next, cleanup technologies were screened against site-specific conditions to determine their feasibility. Finally, a proposed cleanup action was developed based on an evaluation of the practicability of the remaining cleanup technologies.

3.4.1 EVALUATION OF RESPONSE ACTIONS AND CLEANUP TECHNOLOGIES

Soil and groundwater response actions and cleanup technologies were screened for possible use in developing alternatives for site cleanup. Each alternative must address the CAOs presented in Section 3.1. Applicable response actions and cleanup technologies evaluated for potential use as part of the cleanup action are described below.

3.4.1.1 Soil

Two response actions were considered for cleanup of contaminated soil within the cleanup action area: 1) removal and 2) containment. The cleanup technology considered for removal of contaminated soil is excavation with offsite disposal. Soil would either be disposed of at a solid waste landfill or at an inert waste landfill, depending on the nature of contamination and the chemical concentrations. The Snohomish Health District, in consultation with Ecology, has established criteria for disposal of affected

site soil at the Rinker Materials Everett inert waste landfill. Soil cannot be disposed of at an inert waste landfill if it exhibits any of the following characteristics on a bulk testing basis:

- Both arsenic and lead exceed their respective cleanup levels.
- Arsenic exceeds 65 mg/kg, or 100 mg/kg with acceptable leachability test results.
- TPH exceeds 200 mg/kg.

The cleanup technology considered for containment is consolidation of contaminated soil and onsite containment in one or more areas that integrate well with the redevelopment site configuration (i.e., large parking lots or beneath Port-owned buildings). For planning purposes, it is assumed that any contaminated soil that is relocated for onsite containment would be placed a minimum of 1.5 ft above elevation 13.2 ft, MLLW, the maximum tide elevation for Everett over the past 20 years. However, a tidal stage within 0.5 ft of the 20-year maximum will occur in late December 2006 to early January 2007, and groundwater elevations will be measured in Site monitoring wells during a high tide at that time to evaluate groundwater elevations under extreme high tide conditions. If groundwater elevations during the extreme high tide event vary significantly from the planned minimum containment elevation of 14.7 ft, the minimum containment elevation would be modified with the review and concurrence of Ecology.

Any contaminated soil contained onsite would be capped with low-permeability surfaces to minimize surface water infiltration through affected soil. Capping would consist of asphalt or concrete pavement and/or buildings. Containment through capping would also include institutional controls, such as restrictive covenants (e.g., deed restrictions), cap maintenance, and long-term groundwater monitoring.

Containment in place (without consolidation) was not considered practicable because maintaining long-term containment of numerous contaminated soil areas that are not aligned with the post-redevelopment site configuration would be difficult to ensure long-term integrity. Additionally, a significant percentage of the contaminated soil will require excavation to accommodate stone column construction, so containing in place would incur the costs for excavation, stockpiling, replacement, and compaction.

3.4.1.2 Groundwater

Containment is the only response action that was considered for cleanup of arsenic- and vinyl chloride-contaminated groundwater. Individual response actions for vinyl chloride- and arsenic-affected groundwater were not evaluated. Instead, the response action for arsenic-affected groundwater is considered adequate for both arsenic- and vinyl chloride-affected groundwater. Therefore, further discussion of response actions and cleanup of groundwater in the remainder of this CAP is focused on

arsenic-affected groundwater with the intent that these actions will also address vinyl chloride-affected groundwater.

Groundwater arsenic contamination is caused by background concentrations of arsenic in soil subjected to reduced oxygen conditions in groundwater, with reduced oxygen conditions resulting from the presence of wood debris in site hydraulic fill. Wood debris is present as concentrated zones erratically distributed throughout the site and as disseminated material within the hydraulic fill at other locations. As indicated in the DGI report (Landau Associates 2005), wood debris is present throughout much of the site, but is most consistently present in the north half and specifically in the portion of Investigation Area F exhibiting elevated arsenic concentrations.

The wide distribution of wood debris and lack of a well-defined extent preclude the use of other response actions, such as removal. As a result, containment in conjunction with institutional controls and long-term compliance monitoring will be implemented to address arsenic-affected groundwater. Specific containment technologies considered included capping to minimize groundwater flux to surface water and capping in conjunction with groundwater hydraulic control.

3.4.2 SCREENING OF CLEANUP TECHNOLOGIES

Cleanup technologies were screened against site-specific conditions and other considerations to determine which technologies could be practicably implemented at the site and properly function as part of the cleanup action.

3.4.2.1 Soil

Two cleanup technologies, 1) excavation and offsite disposal, and 2) consolidation and onsite containment, were identified as potential cleanup actions for soil. Excavation and offsite disposal can be easily implemented and will integrate well with planned site development activities. Conversely, consolidation and onsite containment pose significant challenges and do not appear to be practicable, largely due to the cleanup constraints discussed in Section 3.2 and discussed further below.

Approximately 18,000 yd^3 of contaminated soil are present within the Cleanup Action Area, and another 20,000 yd^3 are present within other portions of the site not addressed by this CAP. The combined constraints of not containing contaminated soil within the residential portion of the redevelopment, the need to remove contaminated soil in many areas to allow installation of the stone columns, and the limited ability to raise site grades essentially prevent the consolidation and onsite containment of large volumes of contaminated soil. The limits are further exacerbated by the shallow groundwater table, which precludes excavating potential containment areas to create additional containment capacity.

Based on the above considerations, excavation/offsite disposal is considered the only viable cleanup action for contaminated soil. One exception is a limited, in-place containment that is proposed for a portion of the contamination in Area J-3, where contamination extends to significant depth and extends laterally underneath a structure that will not be removed as part of the redevelopment. Containment for this area is discussed in more detail in Section 3.5.3.3.

3.4.2.2 Groundwater

Containment in conjunction with compliance monitoring and institutional controls was identified as the only practicable approach to groundwater cleanup in Investigation Area F. Containment options considered included surface capping with low permeability surfaces (i.e., pavement and buildings) and capping in conjunction with groundwater hydraulic control. Groundwater hydraulic control would require a low permeability cutoff wall at the shoreline to prevent or reduce discharge of affected groundwater to surface water, and possibly groundwater extraction to maintain hydraulic control.

Groundwater arsenic concentrations in proximity to the shoreline within the affected groundwater area range from 9.3 µg/L to 71.3 µg/L, compared to a proposed groundwater cleanup level of 5 µg/L. The groundwater monitoring wells in the affected area are located about 15 to 25 ft from the shoreline. Groundwater arsenic concentrations will decrease significantly between the monitoring wells and shoreline due to:

- The high rate of hydrodynamic dispersion associated with surface water/groundwater interaction in proximity to tidally influenced surface water bodies, and

- The increase in oxygen level in groundwater, which results from the mixing of surface water and groundwater and the soil gas-air exchange that results from the fluctuating groundwater levels, causes the arsenic in groundwater to change its oxidation state and revert to a solid form.

The groundwater arsenic concentrations will be further reduced by soil cleanup and site development activities. Soil cleanup activities will remove arsenic-contaminated near-surface soils, eliminating any contribution that surface water infiltration through contaminated soil would add to the groundwater arsenic loading. It should be noted that arsenic contamination in shallow soil above the water table does not appear to independently cause groundwater concentrations above the cleanup level, but infiltration of surface water through these affected soils undoubtedly contributes to the total arsenic groundwater flux.

Site development will reduce groundwater flux in the affected area by capping most of the area with low permeability surfaces. The reduced groundwater flux will increase hydrodynamic dispersion near the shoreline due to greater surface water intrusion into the site; greater surface water intrusion will

result in a significant increase in the ratio of surface water to groundwater in nearshore groundwater, which will in turn significantly reduce groundwater arsenic concentrations prior to discharge to surface water.

The installation of stone columns along the shoreline in the affected groundwater area would further increase hydrodynamic dispersion. The stone columns will have a hydraulic conductivity about three to four orders of magnitude (1,000 to 10,000 times) greater than the existing hydraulic fill material in the shallow aquifer. The degree to which the stone columns affect the bulk hydraulic conductivity in the vicinity of the shoreline will depend on their final design spacing and installation pattern relative to the shoreline. However, their presence will increase the bulk horizontal hydraulic conductivity of the shallow aquifer to some degree, which will in turn increase the surface water intrusion and decrease groundwater arsenic concentrations at the point of discharge to surface water. Because the stone columns would be terminated in fine-grained marine sediment that underlies the hydraulic fill, their installation does not pose a threat to any deeper groundwater resources.

Installation of a groundwater cutoff wall, possibly in conjunction with groundwater extraction for hydraulic control, would incur significant cost. A wall about 400 ft long would be required to address the length of shoreline potentially affected by arsenic groundwater contamination. Although a detailed cost estimate was not developed, the approximate cost would be about $400,000 for the cutoff wall, assuming a wall depth of 25 ft. A groundwater extraction and treatment system would increase the capital costs significantly and would incur significant annual operation and maintenance costs if included as part of the system.

Due to the significant improvement in groundwater quality that is expected as a result of the redevelopment activities described above, groundwater hydraulic control is considered impracticable for cleanup of arsenic-affected groundwater. As a result, surface capping in conjunction with compliance monitoring and institutional controls is the only groundwater cleanup technology carried forward for the proposed cleanup action.

3.4.3 EVALUATION OF PROPOSED CLEANUP ACTION

Based on the preceding development and evaluation of response actions and cleanup technologies, the proposed cleanup action for the Cleanup Action Area consists of the following elements:

- Excavation and offsite disposal of affected soil
- In-place containment of affected soil (Area J-3 only)
- Surface capping to contain arsenic-affected groundwater in Area F

- Compliance monitoring at the conditional point of compliance for affected groundwater
- Institutional controls to prevent use of shallow groundwater within the arsenic-affected groundwater area.

MTCA requires that cleanup actions be compared to a number of criteria to evaluate their adequacy in achieving the intent of the regulations. Consistent with MTCA, the proposed cleanup action was evaluated with respect to compliance with threshold requirements, permanence, and restoration time frame. Public participation is also a requirement as discussed in Section 3.4.3.4.

3.4.3.1 Threshold Requirements

As specified in WAC 173-340-360(2), all cleanup actions are required to meet the following threshold requirements:

- Protect human health and the environment
- Comply with cleanup standards specified under MTCA
- Comply with applicable state and federal laws
- Provide for compliance monitoring.

It is assumed that compliance with MTCA cleanup standards will ensure protection of human health and the environment and that any cleanup action performed in accordance with the requirements of MTCA will be in compliance with applicable state and federal laws. Compliance monitoring is a component of the proposed cleanup action.

3.4.3.2 Requirement for a Permanent Solution to the Maximum Extent Practicable

WAC 173-340-200 defines a permanent solution as one in which cleanup standards can be met without further action being required at the site, other than the approved disposal of any residue from the treatment of hazardous substances. Ecology recognizes that permanent solutions may not be practicable for all sites and provides a procedure referred to as a disproportionate cost analysis [WAC 173-340-360(3)(e)] to determine whether a cleanup action is permanent to the maximum extent practicable.

The purpose of the disproportionate cost analysis is to determine if the incremental increase in costs of a cleanup alternative over that of a lower cost alternative is justified by providing a corresponding incremental increase in human health and environmental benefits. If the incremental increase in costs is determined to be disproportionate to the benefits, the more expensive alternative is considered impracticable and the lower cost alternative is determined to be permanent to the maximum extent

practicable. This process provides a mechanism for balancing the permanence of the cleanup action with its costs, while ensuring that human health and the environment are adequately protected.

Because all soil that is technically feasible to remove will be excavated and disposed of offsite, soil cleanup for the proposed cleanup action is considered permanent to the maximum extent practicable. A disproportionate cost analysis was essentially performed for the groundwater element of the proposed cleanup action in Section 3.4.2.2. Removal of the native soil and wood debris throughout the arsenic-affected groundwater area is clearly impracticable, and the installation of a hydraulic control system does not appear to achieve groundwater cleanup levels at the proposed conditional point of compliance. As a result, the incremental cost to construct and operate the hydraulic control system is disproportionate to the benefits gained by its implementation. As a result, both the soil and groundwater elements of the proposed cleanup action are considered permanent to the maximum extent practicable.

3.4.3.3 Requirement for a Reasonable Restoration Time Frame

WAC 173-340-360(6)(a) specifies that eight factors be considered when determining whether a cleanup action provides for a reasonable restoration time frame. These factors are evaluated for the site below:

- ***Potential risks to human health and the environment***: The proposed cleanup action will eliminate the exposure pathway for contact with affected soil, except for Area J-3, where institutional controls and other protective measures will be used to prevent human contact. Therefore, neither human health nor the environment will be impacted by site soil. Institutional controls will be implemented to prevent human consumption of affected site groundwater, and compliance monitoring will be conducted to ensure that site groundwater does not discharge to surface water at concentrations that might adversely affect aquatic organisms. As a result, the potential risks to human health and the environment are adequately addressed.

- ***Practicability of achieving shorter restoration time frame***: The proposed cleanup action will achieve cleanup within a reasonable restoration time frame, provided Ecology approves a conditional point of compliance for groundwater at the shoreline. Soil cleanup will be completed in 2006, or as soon thereafter as cleanup areas become available as tenants vacate the leaseholds. Groundwater restoration will be achieved as soon as site redevelopment progresses to the point where the arsenic-affected groundwater area is capped by buildings and pavement, which is anticipated to be within the next 2 to 3 years. A shorter restoration time frame is not practicable because capping cannot occur at the site independent of redevelopment.

- ***Current use of the site, surrounding areas, and associated resources that are, or may be affected by releases from the site***: The current site use is light industrial and commercial, and contamination is confined to areas within the property. Offsite migration of contaminants is not expected.

- ***Availability of alternate water supplies***: The site is currently supplied by municipal water.

- ***Likely effectiveness and reliability of institutional controls***: The institutional controls that are to be included in the proposed cleanup action are expected to be very effective at preventing future groundwater use and direct contact with contaminated soil.

- ***Ability to control and monitor migration of hazardous substances from the site***: Monitoring data indicate that significant migration of hazardous substances from the site is not occurring. The proposed cleanup action includes compliance monitoring to verify that migration does not occur in the future.

- ***Toxicity of hazardous substances at the site***: The main constituents of concern within the Cleanup Action Area are cPAHs and metals in soil and arsenic in groundwater. The toxicity of these constituents at the site is low under current site usage.

- ***Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the site or under similar site conditions***: Natural processes are not anticipated to reduce the concentrations of IHS in soil. However, natural processes are expected to reduce arsenic concentrations in groundwater prior to surface water discharge, as described in Section 3.4.2.2.

In summary, the proposed cleanup action will achieve site cleanup shortly after implementation, provided a conditional point of compliance is approved for site groundwater. Therefore, proposed cleanup action provides for a reasonable restoration time frame.

3.4.3.4 Requirement for Consideration of Public Concerns

Consideration of public concerns is an inherent part of the site cleanup process under MTCA (see WAC 173-340-600). The cleanup action has already been subjected to extensive public review and comment during environmental review for the redevelopment project. Both the environmental impact statement (EIS) and the shoreline permit application were subjected to public review. Additionally, the Port and MTC conducted numerous public meetings to present the project and solicit public input. Although the proposed cleanup action was not as well developed as in this CAP, the cleanup components for the proposed cleanup action were identified as potential elements of the final cleanup action. No substantive comments were received on the EIS or shoreline permit application related to the proposed site cleanup action.

3.5 DETAILED DESCRIPTION OF PROPOSED CLEANUP ACTION

This section presents a detailed description of the proposed cleanup action. The description is subdivided into soil and groundwater cleanup action elements and presented by the area designations used in Section 2.4.1.

3.5.1 SOIL

Soil removal and offsite disposal is the selected technology for cleanup of shallow soil containing concentrations of metals, petroleum hydrocarbons, and/or cPAHs above the cleanup levels. Soil cleanup action areas were grouped by the investigation area designations used for site characterization, and the location, nature and potential sources of contamination were described in Section 2.4.1. Figure 5 shows the location of each soil cleanup action area. More detailed location information regarding the nature and extent of contamination for each soil cleanup action area is presented below.

3.5.1.1 Investigation Area B

Area B-1 (Figure 6) is the only cleanup action area identified for Investigation Area B. As shown on Figure 6, five of the six soil samples analyzed from the 0 to 0.5 ft depth interval within Area B-1 exceeded the arsenic, cPAH, and/or the TPH-D proposed cleanup level. All soil samples tested from the 1 to 2 ft depth interval were below the proposed cleanup levels. The Area B-1 cleanup action area is defined as the unpaved Bayside Marine east work yard, is bounded by pavement on all sides, and is approximately 122 ft by 280 ft in plan dimension. Results for soil samples collected outside of boatyard areas (i.e., B-GC-1, L-FA-2, and L-GC-3) indicate that soil outside of the limits of the boatyard complies with the proposed soil cleanup levels.

Because the cleanup level exceedances occurred in the soil from the 0 to 0.5 ft depth interval and no exceedances occurred in the next depth interval sampled (i.e., the 1.0 to 2.0 ft depth interval), soil to 1.0 ft BGS has been designated for removal. The estimated volume of soil to be removed is about 1,250 yd^3.

3.5.1.2 Investigation Area C

As shown on Figure 7, there were three cleanup action areas identified in Investigation Area C. Cleanup Action Area C-1 is the Port Boatyard and Cleanup Action Areas C-2 and C-3 are areas of isolated contamination unrelated to any identified contaminant source.

Area C-1

Proposed soil cleanup levels were exceeded at five of the six locations sampled within Cleanup Action Area C-1, as shown on Figure 7. In this area metals (arsenic, lead, and copper) and/or cPAH cleanup levels were exceeded, but only in the samples collected from the 0 to 0.5 ft depth interval. Because the locations where concentrations exceeded the cleanup levels were spread throughout the boatyard, the entire boatyard has been established as the cleanup action area. The cleanup action area is

unpaved and is approximately 160 ft by 250 ft in plan dimension. Analytical results for samples collected at locations outside the perimeter of the boatyard (locations C-FA-6, C-FA-7, C-FA-8, and C-FA-9) indicate that soil outside the boatyard complies with the proposed soil cleanup levels.

The results for samples collected at various depth intervals at the five locations where cleanup levels were exceeded were used to define the depth of contaminated soil designated for removal within Cleanup Action Area C-1. Because the cleanup level exceedances occurred in the soil from the 0 to 0.5 ft depth interval, and no exceedances occurred in the 1.0 to 2.0 ft depth interval, soil to 1.0 ft BGS has been designated for soil removal. The estimated volume of soil to be removed is about 1,500 yd^3.

Area C-2

The proposed soil cleanup level for cPAHs was exceeded at a single location in Cleanup Action Area C-2, as shown on Figure 7. The area is paved and the exceedance occurred in the sample collected at the 1.5 to 2.0 ft depth interval at location C-GC-3, the first sample collected beneath the pavement and base course pavement section. Cleanup Action Area C-2 is approximately 90 ft by 140 ft based on available data. As indicated in Section 2.4.1.3, Area C-2 is not well delineated by existing data and additional delineation will be completed in this area prior to cleanup to better delineate the extent of contamination. The scope of the additional delineation for this area is presented in the *14th Street Bulkhead Compliance Monitoring Plan* (Landau Associates 2005), which was previously submitted to Ecology for review and concurrence, and sampling locations are shown on Figure 7.

The depth interval identified as contaminated is 1.5 to 2.0 ft BGS. Soil above this depth interval consisted of clean overburden material (i.e., pavement and crushed gravel). Analytical results for soil samples collected below this depth interval were either below reporting limits or well below the cleanup level. To maximize the potential that all contaminated soil is removed during initial excavation, the 1.0 to 2.5 ft depth interval will also be excavated for offsite disposal. The estimated volume of soil to be removed is about 450 yd^3, but this will be further refined based on additional delineation, as previously described.

Area C-3

Cleanup Action Area C-3 is adjacent to the harbor marine maintenance boat servicing building in Investigation Area C, as shown on Figure 7. The area is approximately 4,600 ft^2 and encompasses sampling location C-GC-6, where cPAHs were detected at a concentration exceeding the cleanup level. The limits of the cleanup action area are bounded by the building perimeter and samples C-GC-5, C-GC-6b, C-GC-6c, and C-GC-6d, where the proposed cPAH soil cleanup level was not exceeded. As

described in Section 2.4.1.3, additional delineation will be conducted in Area C-3 to further refine the excavation boundaries, as shown on Figure 7.

Area C-3 is paved and the contaminated soil depth interval is from 1.0 to 1.5 ft BGS. Soil above this depth interval consisted of clean overburden material (i.e., pavement and crushed gravel). Analytical results for soil samples collected below this depth interval were either below reporting limits or well below the cleanup level. Similar to Area C-2, soil will be removed 0.5 ft above and below the contaminated soil zone (0.5 ft to 2 ft BGS) to ensure the entire affected zone is excavated. The estimated volume of soil to be removed is 250 yd^3.

3.5.1.3 Investigation Area E

As shown on Figure 8, there are two cleanup action areas in Investigation Area E. Cleanup Action Area E-1 is located near the north property boundary and Cleanup Action Area E-2 is located at the southwest entrance to Investigation Area E.

Area E-1

Cleanup Action Area E-1, shown on Figure 8, is approximately 105 ft by 153 ft and encompasses sampling locations E-GC-1 and E-GC-1c. Arsenic was detected at concentrations exceeding the proposed soil cleanup level at both locations. The eastern limit of the cleanup action area is bounded by E-GC-1b, where arsenic did not exceed the proposed cleanup level, and the western limit is defined by the fence line with Investigation Area D. As indicated in Section 2.4.1.4, the northern and southern limits of Area E-1 are not well defined and will be further delineated during design of the cleanup action, as described below.

The depth interval identified as contaminated for Cleanup Action Area E-1 ranges from 0 to 0.5 ft at E-GC-1c to 0 to 2.0 ft BGS at E-GC-1. Analytical results for soil samples collected below these depth intervals were well below the proposed arsenic soil cleanup level. To maximize the potential that all contaminated soil is properly removed, soil will be removed to 1 ft BGS in the vicinity of E-GC-1c and to 2.5 ft BGS in the vicinity of E-GC-1c. The estimated volume of soil to be removed is about 850 yd^3, based in existing data.

Additional soil characterization will be conducted to better delineate shallow soil contamination in Cleanup Action Area E-1, as previously described in Section 2.4.1.4. Additional delineation will be limited to surface soil sampling and analysis for arsenic to better delineate the lateral extent of contamination. The vertical extent of contamination will be assumed to be the same as the nearest location where vertical delineation was previously conducted for design purposes, with post-excavation

soil compliance monitoring results used to verify the assumed design depth or to identify areas that require additional excavation.

Figure 8 shows the planned sampling locations for additional delineation of Cleanup Action Area E-1. All locations will be sampled, but only the samples closest to the locations where the proposed soil cleanup levels were previously exceeded will be tested initially. The remaining samples will be archived and tested sequentially outward from the area of identified contamination if the initially tested samples exceed the proposed arsenic soil cleanup level. This approach will allow the collection of sufficient samples to ensure delineation of the affected area, while limiting testing to those samples needed to delineate the extent of contamination.

Area E-2

Cleanup Action Area E-2, shown on Figure 8, is approximately 53 ft by 94 ft and encompasses sampling location E-GC-5, where arsenic was detected at a concentration exceeding the cleanup level. The area is paved with asphalt.

The depth interval identified as contaminated is 1.5 to 2.0 ft BGS. Soil above this depth interval consisted of clean overburden material (i.e., pavement and crushed gravel). Analytical results for soil samples collected below this depth interval were below reporting limit. To maximize the potential that all contaminated soil is removed during the initial excavation, the 1.0 to 2.5 ft depth interval will also be excavated for offsite disposal. The estimated volume of soil to be removed is about 300 yd^3, but this will be further refined, as previously described.

The southern limit of the cleanup action area is bounded by 13th Street. As indicated in Section 2.4.1.4, the eastern and northern limits of the cleanup action area are not well bounded and require further delineation as part of final design. The planned additional delineation locations are shown on Figure 8, and the delineation approach will be the same as that described for Cleanup Action Area E-1.

3.5.1.4 Investigation Area F

As shown on Figure 9, six cleanup action areas (F-1, F-2, F-4, F-5, F-6a, and F-6b) have been established. Please note that an area originally designated as F-3 was consolidated with F-1, so Investigation Area F cleanup action areas are not sequential. Cleanup Action Areas F-1 and F-4 are located in the northwest corner of Investigation Area F. Cleanup Action Areas F-2, F-6a, and F-6b are located in the south-central portion of Investigation Area F, and Cleanup Action Area F-5 is located near the southwest corner of Investigation Area F.

Area F-1

Cleanup Action Area F-1 encompasses sampling location F-4/F-FA-6, where arsenic and cPAHs were detected at concentrations exceeding the cleanup levels, and sampling locations F-FA-10 and F-GC-13b, where only arsenic was detected at a concentration exceeding the cleanup level.

Based on the data collected to date, the depth of arsenic and cPAHs in soil at concentrations exceeding the proposed cleanup levels is limited to the upper 0.5 ft of soil. Analytical results for soil samples collected at the depth interval of 1.0 to 2.0 ft BGS at each location indicate the arsenic and cPAHs are either not present above the reporting limit or are present at concentrations significantly below the cleanup levels. To maximize the potential that all contaminated soil is removed during initial excavation, the 0.5 to 1.0 ft depth interval will also be excavated for offsite disposal.

Based on its currently estimated area of about 47,400 ft^2 and an excavation depth of 1 ft, the estimated volume of contaminated soil for Cleanup Action Area F-1 is 1,750 yd^3. As described in Section 2.4.1.5, access to Cleanup Action Area F-1 was limited during previous site investigation activities and additional delineation is needed to adequately define the extent of contamination, which will likely change the excavation volume from the current estimate.

Planned additional delineation locations are shown on Figure 9. Additional delineation will be conducted in the same manner as previously described for Cleanup Action Area E-1. Although cPAHs have been detected in previous samples collected from Cleanup Action Area F-1, arsenic more consistently exceeds its cleanup level and cPAHs did not exceed its cleanup level at any locations where arsenic was not in exceedance. As a result, arsenic will be used as the sole IHS for additional delineation.

Area F-2

The proposed soil cleanup level for arsenic was exceeded at the single location sampled (F-5) within Cleanup Action Area F-2, as shown on Figure 9. The cleanup action area is unpaved and is irregular in shape due to the configuration of adjacent pavement.

The proposed arsenic cleanup level was exceeded in the sample collected from the 0 to 0.5 ft depth interval, but samples were only collected from 0 to 0.5 ft and 3 to 4 ft BGS, so the vertical extent of contamination is not well defined. As a result, additional characterization will be conducted to better delineate the vertical and lateral extent of contamination. The scope for additional delineation for the F-2 area was previously presented in the *Ecology Review Draft, Compliance Monitoring Plan, Cleanup Action Areas F-2, F-6a, and F-6b, North Marina Redevelopment Project, Everett, Washington* (Landau Associates 2006b), which was provided to Ecology for review and concurrence. Additional delineation locations are also shown on Figure 9.

The volume of soil to be removed is estimated to be about 400 yd^3, based on an assumed depth of contamination of 1 ft extending across the entire area. However, the lateral and vertical extent of contamination may be revised based on the results of further delineation.

Area F-4

Area F-4 is shown on Figure 9 and is approximately 78 ft by 138 ft. The area encompasses sampling locations F-GC-13c and F-GC-13d, where arsenic and cPAHs were detected at concentrations exceeding the proposed cleanup levels.

The depth interval identified as contaminated for Cleanup Action Area F-4 is from 0 to 3.0 ft BGS. Analytical results for the soil sample collected below this depth interval were below the reporting limits. To maximize the potential that all contaminated soil is removed from Cleanup Action Area F-4 during the initial excavation, the excavation will extend from 0 to 3.5 ft BGS. The estimated volume of soil to be removed is 1,400 yd^3, based on available data.

As indicated in Section 2.4.1.5, the southern limit of Area F-4 is not well defined and will be further delineated during design of the cleanup action. The planned delineation sampling locations are shown on Figure 9, and delineation sampling and testing will be conducted as previously described for Cleanup Action Area E-1.

Area F-5

Area F-5 is adjacent to the Everett Engineering Building M11 in Investigation Area F, as shown on Figure 9. The area is approximately 7,700 ft^2 and encompasses sampling location F-GC-10, where cPAHs were detected at a concentration exceeding the cleanup level.

The area is paved, and the depth interval identified as contaminated is 2.5 to 3.0 ft BGS. Soil above this depth interval consisted of clean overburden material (i.e., pavement and crushed gravel). Analytical results for soil samples collected below this depth interval were either below reporting limits or well below the cleanup level. To maximize the potential that all contaminated soil is removed as part of initial excavation, the 2.0 to 3.5 ft depth interval will also be removed. The estimated volume of soil to be removed is 400 yd^3.

As previously discussed in Section 2.4.1.5, the western and eastern limits of Cleanup Action Area F-5 are not well defined and will be further delineated during design of the cleanup action. The planned delineation sampling locations are shown on Figure 9. The area will be delineated using the sampling and testing approach previously described for Cleanup Action Area E-1, except that testing will be conducted for cPAHs instead of arsenic.

3.5.1.5 Areas F-6a and F-6b

Cleanup Action Areas F-6a and F-6b are adjacent to the former ABW Plant II building, as shown on Figure 9. Each area is approximately 8 ft by 20 ft. The analytical results, presented on Figure 9, indicate exceedances of the arsenic and lead cleanup levels, with contamination extending to a depth of about 2 ft BGS. To maximize the potential that all contaminated soil is removed during initial excavation, the excavation will extend to a depth of 2.5 ft BGS. The estimated excavation volume is 30 yd^3.

3.5.1.6 Investigation Area I

As shown on Figure 10, 11 cleanup action areas are defined in Investigation Area I. These cleanup action areas are described individually below:

Area I-1

Cleanup Action Area I-1 encompasses the soil stockpile located in Investigation Area I. Results for a composite sample collected from the soil stockpile, I-Z, indicate the presence of arsenic and lead at concentrations exceeding the proposed cleanup level. Based on these results, the entire soil stockpile has been identified as contaminated and will be removed. To maximize the potential that all contaminated soil is removed during initial excavation, the 0 to 0.5 depth interval of soil directly below the soil stockpile will also be removed. The estimated volume of soil to be removed within Area I-1 is about 200 yd^3.

Area I-2

Cleanup Action Area I-2 includes an area in the central portion of Investigation Area I where a discrete layer of discolored soil is present at a depth of 1.2 to 3.0 ft BGS. Analytical results for a composite sample of this material, I-X, indicate that the material contains arsenic at a concentration exceeding the proposed cleanup level. This layer of discolored material and the soil 0.5 ft above and below it will be removed. The estimated volume of soil to be removed within Area I-2 is about 3,900 yd^3.

Areas I-3, I-4, and I-6 through I-11

Cleanup Action Areas I-3, I-4, and I-6 through I-11 contain soils contaminated with arsenic, with a more limited number of lead and cPAH exceedances. The entire area is unpaved and contaminated soil

is limited to between 0 to 0.5 and 0 to 2.0 ft BGS. To maximize the potential that all contaminated soil is removed during initial excavation, the excavation limits will be extended to 0.5 ft below the maximum extent of identified contamination (i.e., to between 1.0 and 2.5 ft BGS). The estimated contaminated soil volumes for these areas are as follows:

Cleanup Action Area	Estimated Soil Volume (yd^3)
I-3	1,200
I-4	300
I-6	1,050
I-7	300
I-8	250
I-9	450
I-10	350
I-11	800

As indicated in Section 2.4.1.6, the extent of contamination is not well delineated along the boundaries of some of the cleanup action areas. Additional delineation will be conducted, consistent with the sampling and testing procedures previously described for Cleanup Action Area E-1. The planned delineation sampling locations are shown on Figure 10. The estimated soil volumes listed above will likely change as a result of the additional delineation activities.

Area I-5

Cleanup Action Area I-5 is located in the northeast corner of Investigation Area I. A layer of discolored material similar in appearance to the discolored material described in Cleanup Action Area I-2 was encountered at this location. The discolored material extends to a depth of about 6.5 ft BGS. The analytical results for a composite sample collected over the entire depth of discolored material exceeded the proposed cleanup level for arsenic. Analytical results for soil samples collected below the depth intervals identified as contaminated were either below the reporting limit or well below the proposed cleanup level. The soil in this area will be removed to a depth of 7.0 ft BGS.

The area is bounded on the south by a boring that did not encounter the discolored material (no samples were tested) and on the north by the property and fence line. The northern fence line is on the property boundary with non-Port-owned property, which probably limits the extent of the material in that direction. Compliance monitoring will be conducted to verify the lateral extent to the north, as described in Appendix A. The area is bounded on the east by the Ameron leasehold; although the discolored material may extend onto the Ameron leasehold, excavation will be limited to the fence line until Ameron vacates the property in 2012. The estimated volume of soil to be removed within Area I-5 is about 2,500 yd^3, based on currently available data. The area is not well bounded to the west and will be further

delineated during design of the cleanup action. Further delineation will be consistent with the sampling and testing procedures previously described for Cleanup Action Area E-1. The planned delineation sampling locations are shown on Figure 10.

3.5.1.7 Investigation Area J

As shown on Figure 11, Cleanup Action Areas J-1, J-2, and J-3 were defined for Investigation Area J. Cleanup Action Area J-1 is located in the northwest portion of the area, whereas J-2 is located in the northeast portion of the investigation area. Area J-3 is located at the south end of the area.

Area J-1

Cleanup Action Area J-1 is west of the MSRC building in Investigation Area J, as shown on Figure 11. Area J-1 encompasses soil sample location J-GC-4, where arsenic was detected in the soil at a concentration exceeding the proposed cleanup level. Cleanup Action Area J-1 is paved and the depth interval for affected soil is 1.5 to 2.0 ft BGS. Soil above this depth interval consisted of clean overburden material (i.e., pavement and crushed gravel). Analytical results for soil samples collected below this depth interval were well below the cleanup level.

To maximize the potential that all contaminated soil is removed as part of initial excavation, the excavation will extend to 2.5 ft BGS. Area J-1 has dimensions of about 48 ft by 86 ft and the estimated volume of soil to be removed is 200 yd^3.

Area J-2

Cleanup Action Area J-2 is located in the southwest corner of Investigation Area J, as shown on Figure 11. Area J-2 encompasses soil sample location J-GC-1, where oil-range petroleum hydrocarbons were detected in the soil at a concentration exceeding the proposed soil cleanup level. Cleanup Action Area J-2 is paved and the depth interval identified as contaminated is 0.5 to 1.0 ft BGS. Soil above this depth interval consisted of clean overburden material (i.e., pavement and crushed gravel), and oil-range petroleum hydrocarbons were not detected in the soil sample collected below this depth interval. To maximize the potential that all contaminated soil is properly removed, the excavation will extend from immediately below the pavement to a depth of 1.5 ft BGS. The affected area is about 30 ft by 40 ft and the estimated volume of soil to be removed is about 50 yd^3.

Area J-3

Cleanup Action Area J-3 is immediately east of, and partially beneath, a covered work area attached to the north end of the MSRC building, as shown on Figure 11. The affected area is defined by the presence of buried construction debris that appears to contain burned materials, possibly from the saw mill that was present to the east of this location until it burned down in the late 1960s. The affected soil area encompasses soil sample location J-GC-6, where arsenic and cPAHs were detected in the soil at concentrations exceeding the proposed cleanup levels. Affected soil appears to be erratically distributed within the debris material, which extends up to 17 ft BGS.

The affected area is paved, and contaminated soil is first encountered at 1 ft BGS. Soil above this depth interval consisted of a pavement section (i.e., pavement and crushed gravel). Because potentially contaminated soil extends to a depth of 17 ft BGS, and the affected area extends beneath foundations supporting the roof for the covered work area, all potentially affected soil cannot be removed. Instead, potentially contaminated soil will be excavated to the east of the covered work area to 4 ft BGS, which is sufficient depth to allow the installation of utilities for site redevelopment without workers contacting potentially contaminated soil.

The excavation will extend to the target excavation depth in the north-south direction, but will be terminated to the footings of the covered work area to avoid undermining or destabilizing the roof support foundations. Following excavation, a non-woven geotextile fabric will be placed on the base of the excavation as a marker layer, and the excavation will be backfilled with clean granular fill. The surface will be paved with asphalt as part of the redevelopment activities. Institutional controls, in the form of deed restrictions, will be placed on the area to ensure that any future contact with affected soil is properly managed. However, the area will be heavily transected by utilities (e.g., electric, gas, water, sewer) and it is unlikely that future excavations will extend to the depth of remaining contamination.

The estimated volume of soil to be removed is 1,400 yd^3. Because of the relatively low concentrations of arsenic and cPAHs detected and their tendency to partition onto soil, groundwater compliance monitoring associated with this limited containment area is not planned.

3.5.1.8 Investigation Area L

As shown on Figure 6, there are three cleanup action areas defined in Investigation Area L. Cleanup Action Area L-1 is located at the northeast corner of Investigation Area L. Cleanup Action Areas L-2 and L-3 are located along the north side of the former ABW building.

Area L-1

Cleanup Action Area L-1, shown on Figure 6, is approximately 2,824 ft^2 and encompasses soil sample locations L-GC-5, where arsenic was detected in the soil at a concentration exceeding the cleanup level. Area L-1 is paved and the contaminated soil interval is 0.5 to 1.0 ft BGS. Analytical results for soil samples collected below this depth interval were below the reporting limit or were well below the cleanup level.

To maximize the potential that all contaminated soil is removed during the initial excavation activities, the excavation will extend from immediately below the asphalt to 1.5 ft BGS. The estimated volume of soil to be removed is 100 yd^3.

Although well bounded to the north, west, and south, Cleanup Action Area L-1 is not well bounded to the southwest. As a result, additional delineation will be conducted in this area, as shown on Figure 6. Delineation will be conducted as previously described for Cleanup Action Area E-1.

Area L-2

Cleanup Action Area L-2 is located north of the building formerly occupied by ABW, as shown on Figure 6, and encompasses soil sample location L-GC-4, where arsenic was detected in the soil at a concentration exceeding the cleanup level.

The area is unpaved and the contaminated depth interval is 0 to 0.5 ft BGS. Analytical results for soil samples collected below this depth interval were below the reporting limit or were well below the cleanup level. To maximize the potential that contaminated soil is removed during initial excavation, the excavation will extend to 1.0 ft BGS. The estimated volume of soil to be removed is about 64 yd^3.

Cleanup Action Area L-2 is not well bounded in the east-west direction. As a result, additional delineation will be conducted in this area, as shown on Figure 6. Delineation will be conducted as previously described for Cleanup Action Area E-1.

Area L-3

Cleanup Action Area L-3 is also located north of the building formerly occupied by ABW, as shown on Figure 6. The area encompasses soil sample location L-GC-4b, where arsenic was detected in the soil at a concentration exceeding the proposed cleanup level.

Area L-3 is paved and the depth interval identified as contaminated is from 1.7 to 2.2 ft BGS, immediately below the pavement section. Arsenic analytical results for the soil sample collected below this depth interval were below the reporting limit. To maximize the potential that all contaminated soil is

removed during initial excavation, the soil removal will extend to 2.5 ft BGS. The estimated volume of soil to be removed is 100 yd^3.

Cleanup Action Area L-3 is not well bounded in the east-west direction. As a result, additional delineation will be conducted in this area, as shown on Figure 6. Delineation will be conducted as previously described for Cleanup Action Area E-1.

3.5.2 GROUNDWATER

As described in Section 2.4.2, arsenic- and vinyl chloride-affected groundwater in Investigation Area F and vinyl chloride-affected groundwater in Investigation Area M are the only groundwater contamination issues that will be addressed within the Cleanup Action Area. Diesel-range petroleum hydrocarbon contamination is also present within the Cleanup Action Area in Investigation Area E, but this will be addressed as part of a separate cleanup action.

As mentioned in Section 3.4.1.2, cleanup of vinyl chloride-affected groundwater will be addressed by the cleanup action proposed for arsenic-affected groundwater; therefore, only the cleanup of arsenic is referred to in any further discussion of the groundwater cleanup action.

Elevated arsenic concentrations in Investigation Area F groundwater result from arsenic in soil at background concentrations in contact with reduced groundwater, and the reduced groundwater conditions result from the presence of wood debris and other organic material in the aquifer matrix. As indicated in Section 3.4.2.2, the proposed cleanup action for addressing arsenic-affected groundwater consists of surface capping in conjunction with groundwater compliance monitoring and institutional controls.

Based on the current site development plan, about 95 percent or more of the ground surface in the arsenic-affected groundwater area will be capped with low permeability surfaces consisting of buildings, asphalt roadways and parking areas, and paved walkways and other pedestrian areas. Stormwater collected from these areas will be conveyed via tight line piping to stormwater treatment and discharged to marine surface water. Because groundwater flux is entirely the result of surface water infiltration within the affected area, the reduction in groundwater flux will be equivalent to the reduction in surface water infiltration (i.e., 95 percent or more).

Because all arsenic-contaminated soil will be removed from the affected area as part of the cleanup action, preventing human consumption of shallow groundwater and preventing discharge of extracted shallow groundwater to surface water without treatment are the only potential exposure pathways that need to be addressed in the restrictive covenant proposed as part of the cleanup action for groundwater. The restrictive covenant will be placed on the affected area shown on Figure 12. As previously indicated, because the site is served by municipal water and shallow groundwater is not a

practicable source of potable water, placing a restrictive covenant on its use will not have a practical effect on site redevelopment activities.

Groundwater compliance monitoring will be conducted to confirm that capping in conjunction with other site redevelopment activities (i.e., stone column installation) achieves the groundwater cleanup levels at the conditional point of compliance, the shoreline. As specified in WAC 173-340-720(8)(d)(i), "… a conditional point of compliance may be located within the surface water as close as technically possible to point or points where groundwater flows into the surface water subject to the following conditions:"

1. It has been demonstrated that the contaminated groundwater is entering the surface water and will continue to enter the surface water even after implementation of the selected cleanup action.

2. It has been demonstrated that it is not practicable to meet the cleanup level at a point within the groundwater before entering the surface water, within a reasonable restoration time frame.

3. Use of a mixing zone to demonstrate compliance with surface water cleanup levels shall not be allowed.

4. Groundwater discharges shall be provided with all known available and reasonable methods of treatment (AKART) before being released to surface water.

5. Groundwater and surface water monitoring shall be conducted to assess the long-term performance of the selected cleanup action, including potential bioaccumulation problems resulting from surface water concentrations below method detection limits.

6. Before approving the conditional point of compliance, a notice of the proposal shall be mailed to natural resource trustees, the Washington State Department of Natural Resources and the United States Army Corps of Engineers. The notice shall invite comments on the proposal.

Requirement 1 is met by the site hydrogeologic conditions described in Section 2.2 and the DGI report (Landau Associates 2005), which clearly demonstrates that groundwater from the affected area is discharging to surface water. None of the planned cleanup or redevelopment activities are anticipated to change the direction of groundwater flow.

Requirements 2 and 4 are addressed in Section 3.4.3.2, which describes the basis for concluding that the proposed cleanup action is permanent to the maximum extent practicable (requirement 2). Because the cleanup action is permanent to the maximum extent practicable, it also meets AKART requirements (requirement 4) since further treatment prior to discharge would not be practicable and, thus, would not be considered reasonable.

A mixing zone is not proposed to demonstrate compliance with surface water cleanup levels (requirement 3), and groundwater and surface water monitoring (requirement 5) will be addressed as part of groundwater compliance monitoring (described below). Potential arsenic bioaccumulation problems

are not anticipated to be an issue (requirement 5) due to the limited potential for exposure of marine organisms at the point of compliance. The shoreline at the conditional point of compliance is armored with large rock riprap, which precludes arsenic accumulation in sediment potentially inhabited by benthic organisms. Groundwater/surface water interaction near the shoreline is anticipated to reduce arsenic in groundwater to undetectable concentrations prior to the exposure of any epibenthic organisms (e.g., crabs, bivalves) or fishes. Requirement 6 will be addressed in conjunction with Ecology following Ecology's review and acceptance of the proposed cleanup action.

Compliance monitoring will consist of groundwater and surface water monitoring in the immediate shoreline vicinity for groundwater arsenic and vinyl chloride concentrations. As shown on Figure 12, three groundwater monitoring wells will be installed as close as practicable to the shoreline and three surface water monitoring locations will be established at the shoreline immediately downgradient from the groundwater monitoring wells. Groundwater and surface water monitoring will be initiated immediately following the completion of redevelopment activities within the affected area. Groundwater monitoring will be initiated first, and surface water monitoring will be conducted only if groundwater monitoring results indicate that capping and other redevelopment activities have not reduced arsenic groundwater concentrations to below the proposed arsenic groundwater cleanup level. Additional details regarding groundwater compliance monitoring are provided in the Compliance Monitoring Plan (Appendix A).

Redevelopment will modify site grades throughout the entire Cleanup Action Area, and protecting existing groundwater monitoring wells during redevelopment activities is not practicable. As a result, existing monitoring wells within the Cleanup Action Area will be abandoned during the cleanup action, and new groundwater monitoring wells will be installed following redevelopment construction in areas requiring long-term groundwater compliance monitoring. The wells to be abandoned as part of the cleanup action are shown on Figure 4. Note that the wells associated with diesel-range petroleum hydrocarbon contamination in Investigation Area E are not proposed for abandonment at this time. All well abandonment and installation will be accomplished in accordance with State of Washington well construction regulations (Chapter 173-160 WAC).

Groundwater monitoring wells are needed to monitor the effectiveness of the Investigation Area F arsenic groundwater contamination cleanup action. As a result, five monitoring wells will be installed as close as practicable to the proposed point of compliance (i.e., the shoreline). The shoreline nearest to Investigation Area F is located north of Investigation Area F; therefore, the new wells will be installed along the northern edge of Investigation Area F, as shown on Figure 12. No wells are planned to be installed at other potentially downgradient locations in Investigation Area F (i.e., to the west or south) because results for groundwater samples collected at locations in these directions (i.e., P-2, P-4, P-5, and

P-6) do not indicate elevated concentrations of arsenic or vinyl chloride in groundwater. Based on these data, affected groundwater in Investigation Area F is not impacting groundwater to the west or south of the impacted area and the north shoreline is the point of discharge for affected groundwater. Groundwater compliance monitoring is not required for any other portion of the cleanup action, and no other groundwater monitoring wells are proposed for installation as part of this CAP.

4.0 COMPLIANCE MONITORING

As required under MTCA, compliance monitoring will be conducted for the shallow soil cleanup action. The compliance monitoring will include the following:

- **Protection monitoring** to confirm that human health and the environment are adequately protected during construction, operation, and maintenance associated with the cleanup action.
- **Performance monitoring** to confirm that the cleanup action has attained cleanup standards and any other performance standards.
- **Confirmational monitoring** to confirm the long-term effectiveness of the cleanup action once the cleanup standards and other performance standards have been attained.

A Compliance Monitoring Plan documenting the compliance monitoring program for the shallow soil cleanup action is provided in Appendix A.

In general, compliance monitoring will consist of performance monitoring for soil and groundwater, and confirmational monitoring for groundwater. Performance monitoring for soil will consist of soil confirmation samples to determine that soil cleanup levels have been achieved. Groundwater performance monitoring will consist of groundwater compliance monitoring to determine whether capping and other redevelopment activities result in meeting the arsenic groundwater cleanup level upgradient of the shoreline, and surface water monitoring at the surface water/groundwater interface if the groundwater cleanup level for arsenic is not met in the groundwater compliance monitoring wells. Confirmational monitoring will consist of long-term groundwater and/or surface water monitoring once it has been demonstrated that groundwater cleanup standards are being achieved.

5.0 REPORTING

In accordance with WAC 173-340-515(4), a report documenting the cleanup action and compliance monitoring will be prepared and submitted to Ecology within 90 days of completion of the action. The report will include as-built drawings and compliance monitoring results, including any statistical analyses used to demonstrate compliance with cleanup levels.

6.0 USE OF THIS REPORT

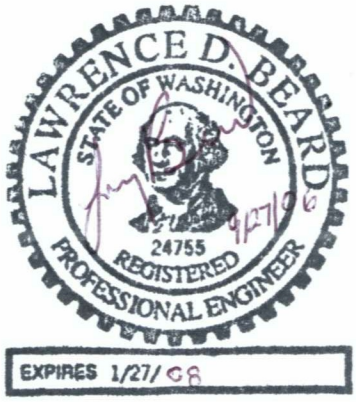
This Cleanup Action Plan has been prepared for the exclusive use of the Port of Everett for specific application to the North Marina Redevelopment Site. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

This document has been prepared under the supervision and direction of the following key staff.

LANDAU ASSOCIATES, INC.

Stacy J. Pischer, L.G.
Senior Project Geologist

Lawrence D. Beard, P.E.
Principal



SJP/LDB/jdr

7.0 REFERENCES

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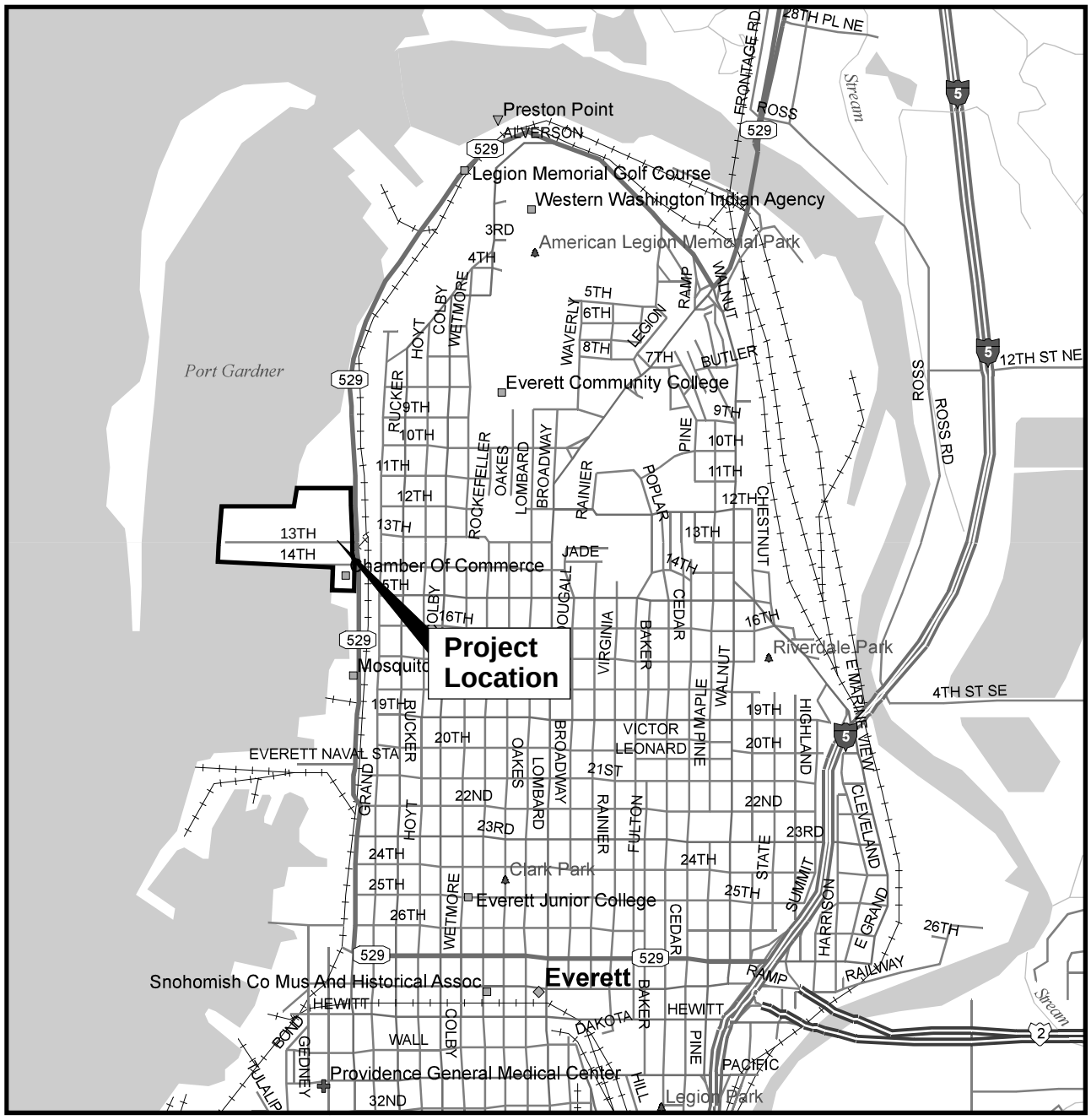
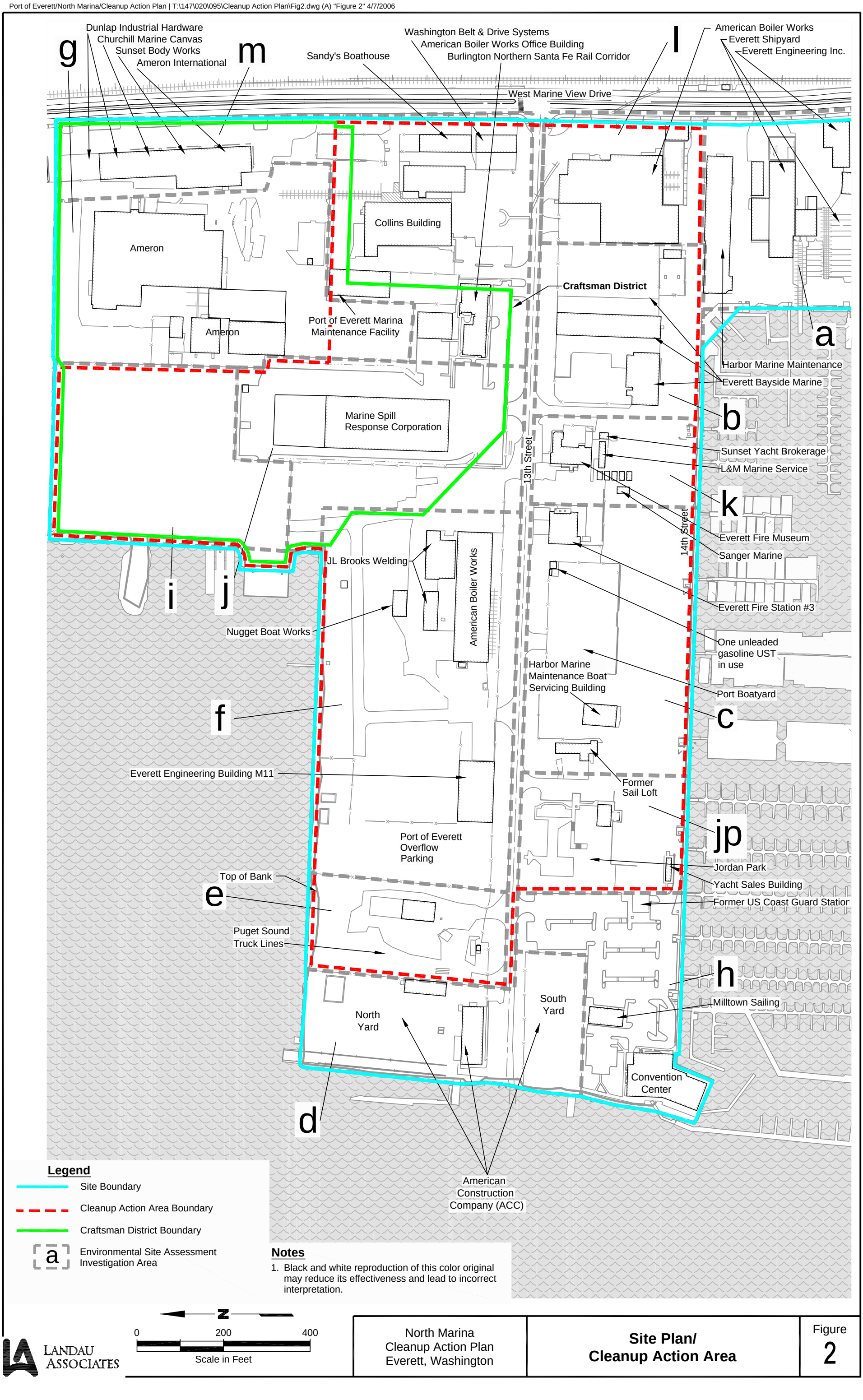


Map from DeLorme Street Atlas USA, 2002

Port of Everett/North Marina/Cleanup Action Plan | T:\147\0200995\Cleanup Action Plan\Fig1.cdr 3/16/2006

LANDAU ASSOCIATES

North Marina Cleanup Action Plan Everett, Washington	**Vicinity Map**	Figure 1



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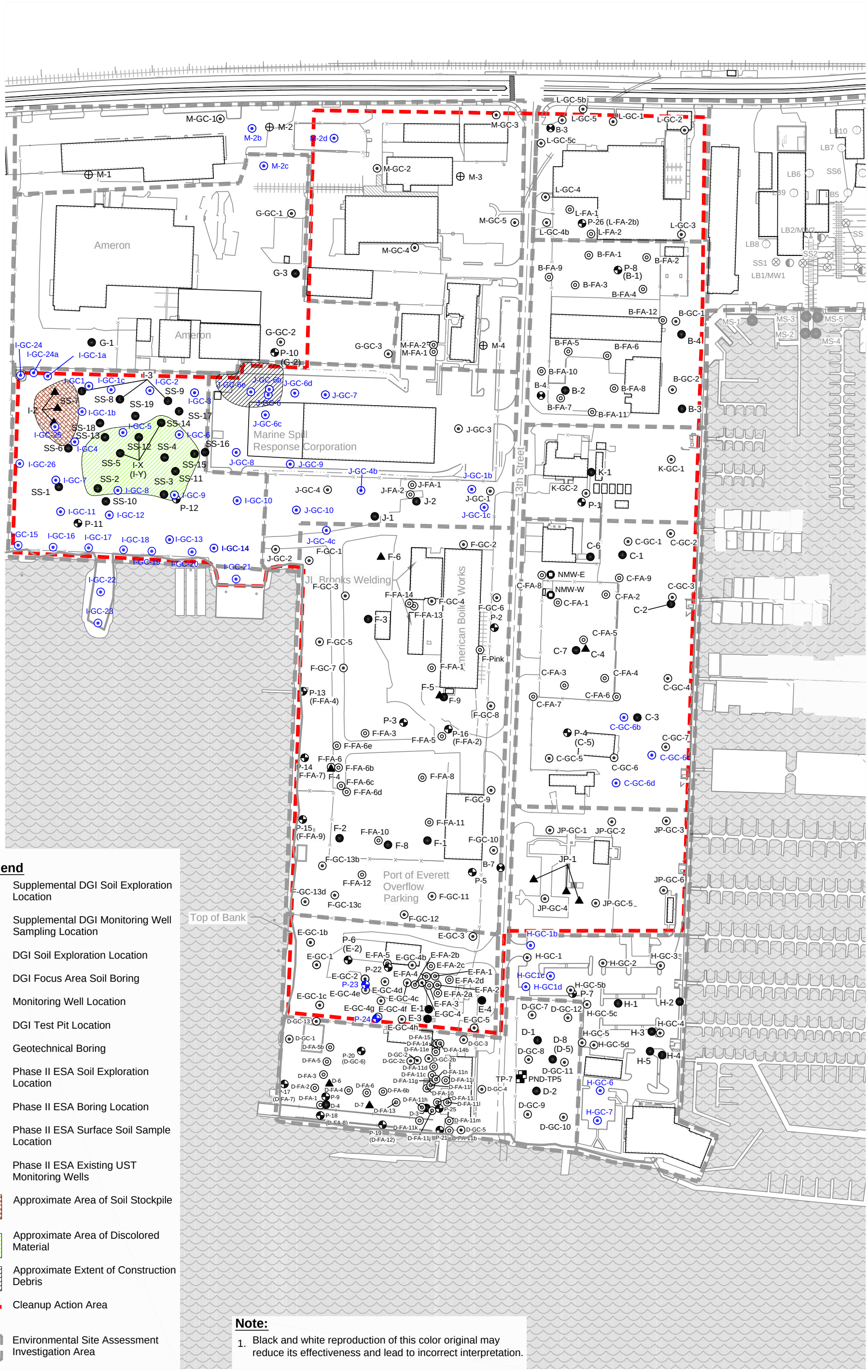
North Marina
Cleanup Action Plan
Everett, Washington

Site Plan/
Cleanup Action Area

Figure
2



Legend

- Supplemental DGI Soil Exploration Location
- Supplemental DGI Monitoring Well Sampling Location
- DGI Soil Exploration Location
- DGI Focus Area Soil Boring
- Monitoring Well Location
- DGI Test Pit Location
- Geotechnical Boring
- Phase II ESA Soil Exploration Location
- Phase II ESA Boring Location
- Phase II ESA Surface Soil Sample Location
- Phase II ESA Existing UST Monitoring Wells
- Approximate Area of Soil Stockpile
- Approximate Area of Discolored Material
- Approximate Extent of Construction Debris
- Cleanup Action Area
- [a] Environmental Site Assessment Investigation Area

Note:

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

N

0 200 400

Scale in Feet

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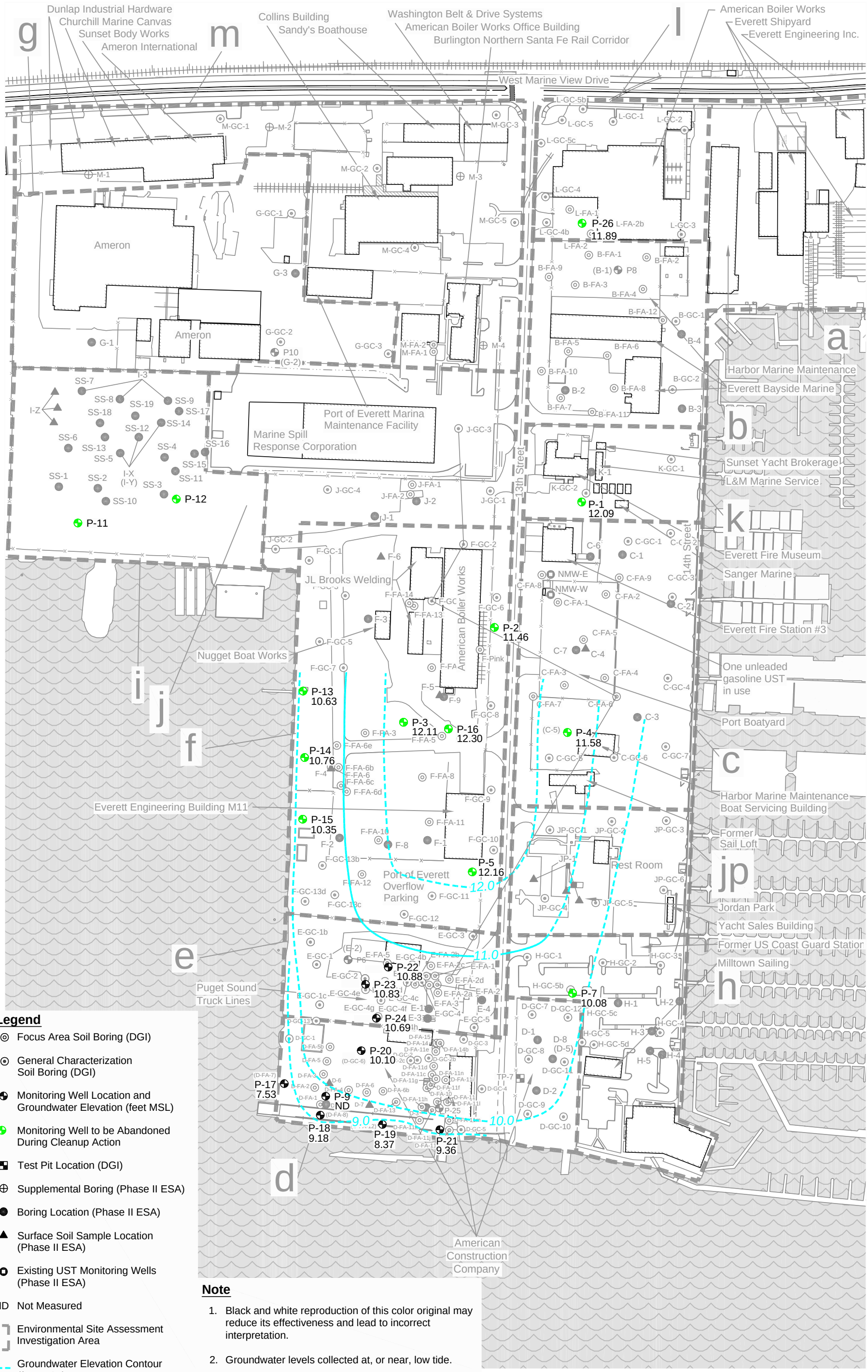
North Marina
Cleanup Action Plan
Everett, Washington

Sampling Locations

Figure 3



Legend

- Focus Area Soil Boring (DGI)
- General Characterization Soil Boring (DGI)
- P-21 9.36 — Monitoring Well Location and Groundwater Elevation (feet MSL)
- Monitoring Well to be Abandoned During Cleanup Action
- Test Pit Location (DGI)
- Supplemental Boring (Phase II ESA)
- Boring Location (Phase II ESA)
- Surface Soil Sample Location (Phase II ESA)
- Existing UST Monitoring Wells (Phase II ESA)
- ND — Not Measured
- a — Environmental Site Assessment Investigation Area
- Groundwater Elevation Contour (feet MSL)

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.
2. Groundwater levels collected at, or near, low tide.

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0 200 400

Scale in Feet

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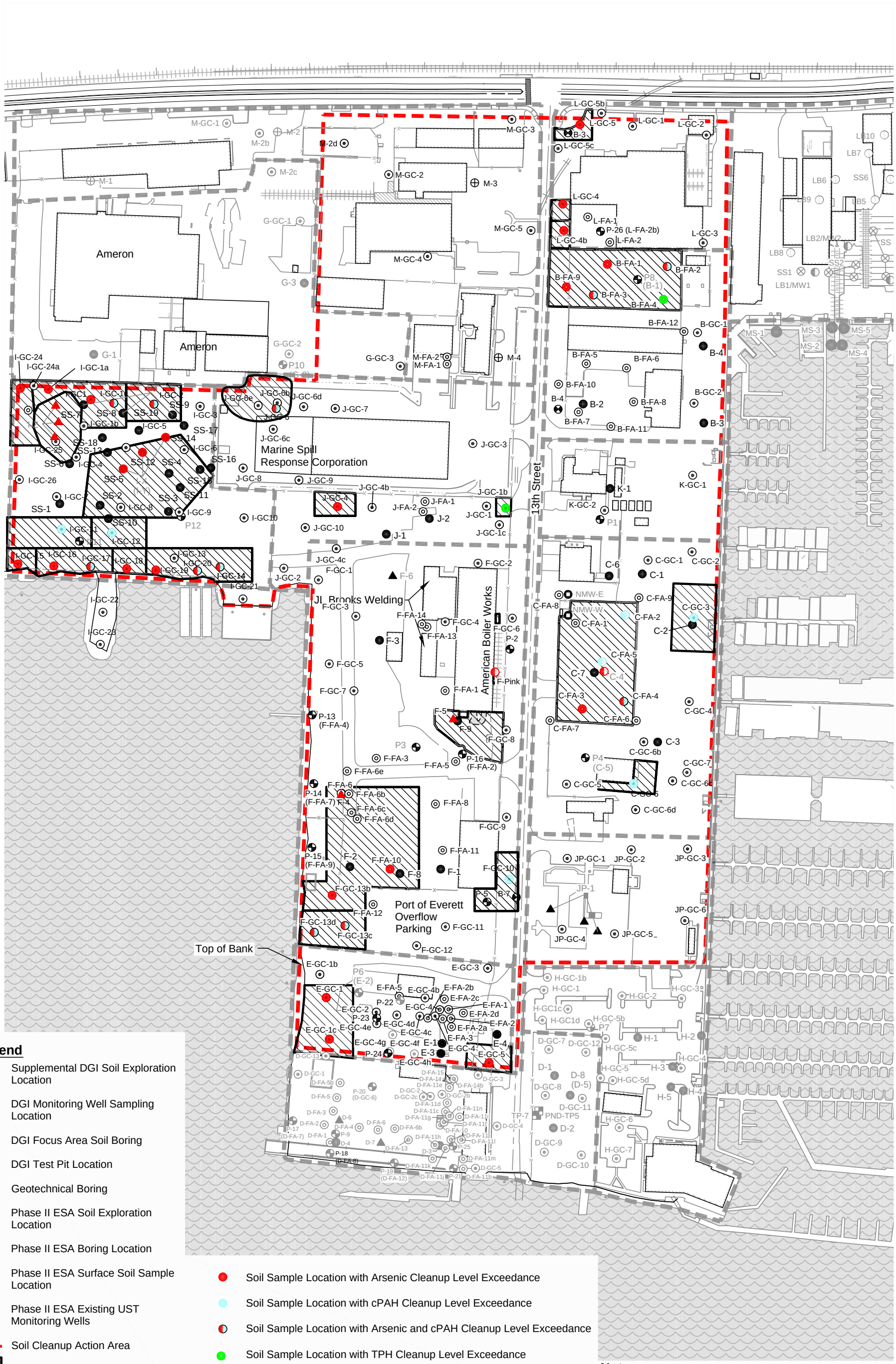
North Marina
Cleanup Action Plan
Everett, Washington

Groundwater Elevation Contour Map

Figure 4



Legend

- Supplemental DGI Soil Exploration Location
- DGI Monitoring Well Sampling Location
- DGI Focus Area Soil Boring
- DGI Test Pit Location
- Geotechnical Boring
- Phase II ESA Soil Exploration Location
- Phase II ESA Boring Location
- Phase II ESA Surface Soil Sample Location
- Phase II ESA Existing UST Monitoring Wells
- Soil Cleanup Action Area
- Excavation Cleanup Action Location
- Environmental Site Assessment Investigation Area

- Soil Sample Location with Arsenic Cleanup Level Exceedance
- Soil Sample Location with cPAH Cleanup Level Exceedance
- Soil Sample Location with Arsenic and cPAH Cleanup Level Exceedance
- Soil Sample Location with TPH Cleanup Level Exceedance
- Soil Sample Location with Lead and cPAH Cleanup Level Exceedance
- Soil Sample Location with Arsenic and Lead Cleanup Level Exceedance

Note:

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

N

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Scale in Feet

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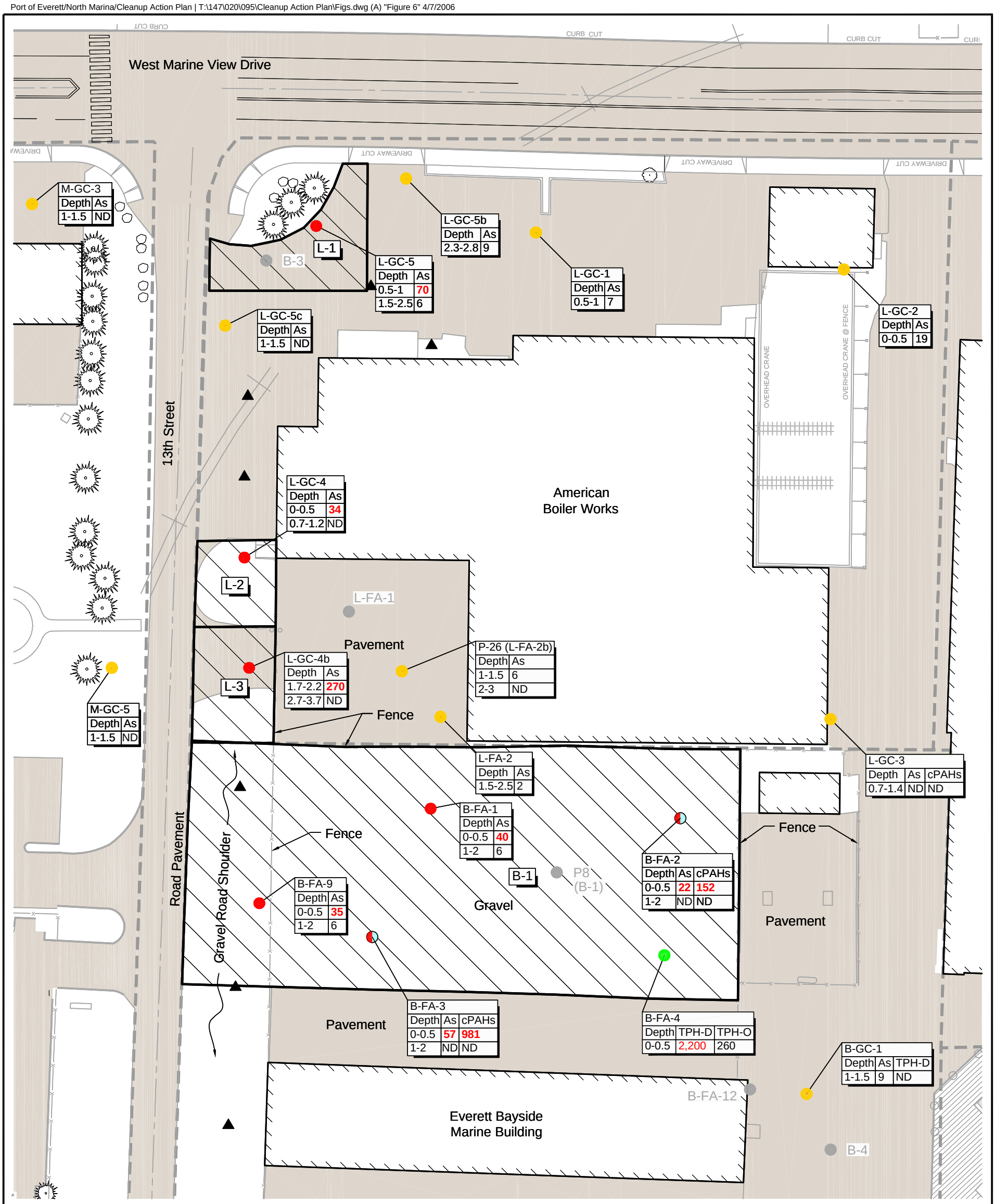
North Marina
Cleanup Action Plan
Everett, Washington

Cleanup Action Area Soil Cleanup Level Exceedance Locations

Figure 5



Legend

- Soil Sample Location with Arsenic Cleanup Level Exceedance
- Soil Sample Location with Arsenic and cPAH Cleanup Level Exceedance
- Soil Sample Location with TPH Cleanup Level Exceedance
- Soil Sample Location with No Cleanup Level Exceedance
- Soil Sample Location Not Tested for Arsenic, cPAHs, or TPH-D
- Proposed Additional Delineation Soil Sample Location
- B-1 — Soil Cleanup Action Area
- Existing Paved Areas
- ND — Not Detected
- Vegetation
- Environmental Site Assessment Investigation Area Limits

Notes:

1. Arsenic proposed cleanup level = 20 mg/kg.
2. cPAH proposed cleanup level = 137 µg/kg.
3. TPH-D proposed cleanup level = 2,000 mg/kg.
4. All Arsenic, TPH-D, and TPH-O results are reported in mg/kg. All cPAH results are reported in µg/kg.
5. All values in red exceed the proposed cleanup level.
6. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

N

0 50 100

Scale in Feet

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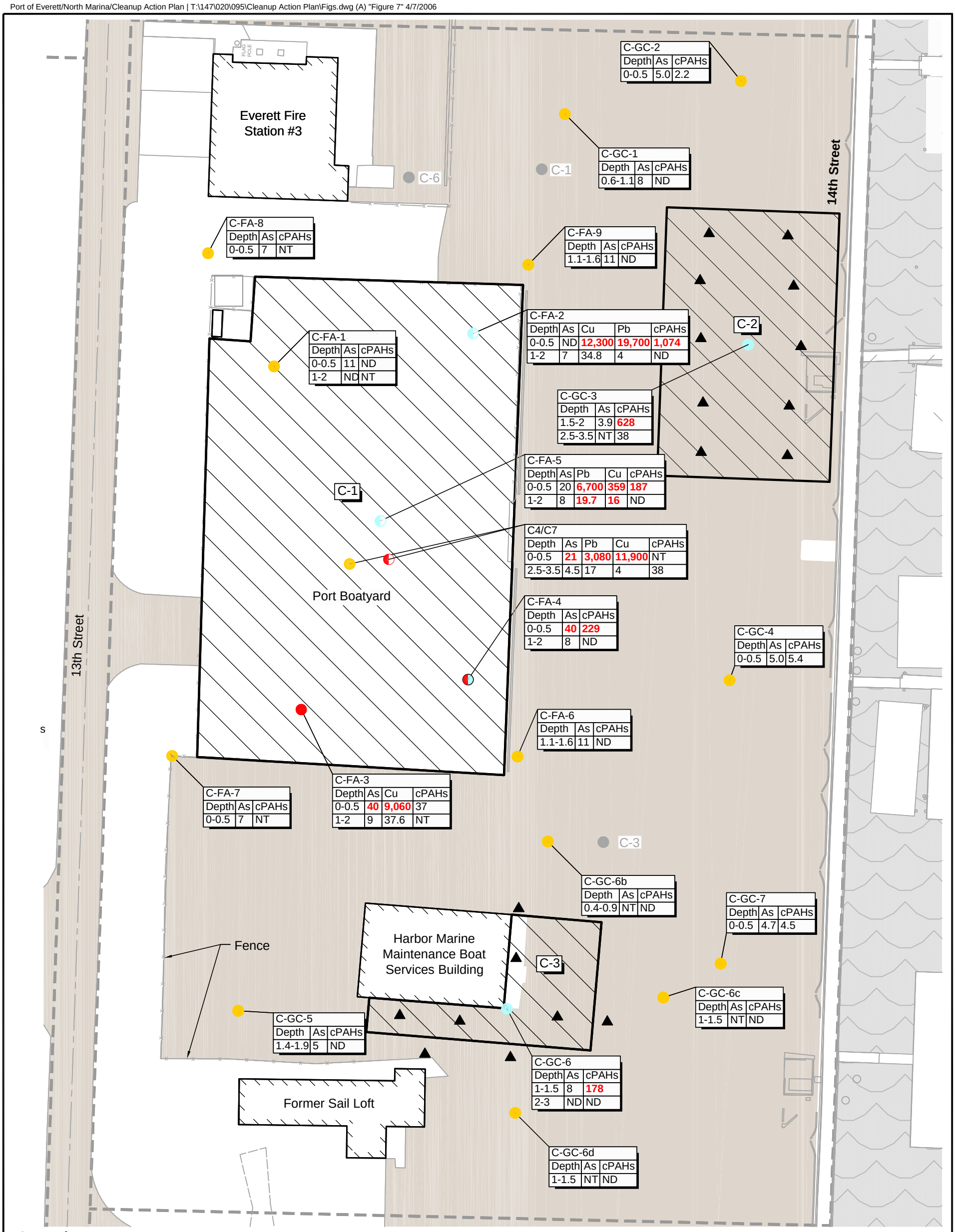
North Marina
Cleanup Action Plan
Everett, Washington

Soil Cleanup Action Areas
B-1, L-1, L-2, and L-3

Figure
6



Legend

- Soil Sample Location with Arsenic Cleanup Level Exceedance
- Soil Sample Location with Arsenic and cPAH Cleanup Level Exceedance
- Soil Sample Location with Lead and cPAH Cleanup Level Exceedance
- Soil Sample Location with Arsenic and Lead Cleanup Level Exceedance
- Soil Sample Location with cPAH Cleanup Level Exceedance
- Soil Sample with No Cleanup Level Exceedance
- Soil Sample Location Not Tested for Arsenic or cPAHs
- Proposed Additional Delineation Soil Sample Location
- C-1 Soil Cleanup Action Area
- Existing Paved Areas
- ND Not Detected
- NT Not Tested
- Environmental Site Assessment Investigation Area Limits

N

0 50 100
Scale in Feet

Notes:

1. Arsenic proposed cleanup level = 20 mg/kg.
2. Lead proposed cleanup level = 250 mg/kg.
3. Copper proposed cleanup level = 2,960 mg/kg.
4. cPAHs proposed cleanup level = 137 µg/kg.
5. All arsenic, copper, and lead results are reported in mg/kg.
6. All cPAH results are reported in µg/kg.
7. All values in red exceed the proposed cleanup level.
8. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

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North Marina
Cleanup Action Plan
Everett, Washington

Soil Cleanup Action Areas C-1, C-2, and C-3

Figure 7

Port of Everett
Overflow
Parking

Top of Bank

E-GC-1b		
Depth	As	cPAHs
0-0.5	8	NT

E-GC-1		
Depth	As	cPAHs
0-0.5	29	ND
1-2	23	NT
2-3	10	NT

E-GC-3		
Depth	As	cPAHs
0-0.5	ND	ND

Concrete Pad

Former PSTL Building

P6 (E-2)

E-FA-5

E-GC-4b

P-22

E-FA-2c

E-GC-2		
Depth	As	cPAHs
0-0.5	6	ND

E-GC-4d

E-GC-4c

P-23

E-GC-4e

E-FA-4

E-FA-1

Concrete Pad

E-FA-2d

E-FA-2

E-FA-3

E-FA-2b

E-FA-2a

E-GC-4		
Depth	As	cPAHs
0.5-1.0	5	ND
1.5-2.5	NT	ND

E-GC-4f

E-4

E-1

E-GC-4g

E-3

P-24

E-GC-4h

JP-GC-4

H-GC-1b

H-GC-1

H-GC1c

H-GC-5b

D-GC-7

D-GC-12

E-1

E-GC-1c		
Depth	As	cPAHs
0-0.5	48	NT
1-2	7	NT

D-GC-13

E-2

Building

D-GC-1

D-FA-15

D-FA-14b

D-GC-3

D-FA-14

D-FA-11e

D-1

E-GC-5		
Depth	As	cPAHs
1.5-2.0	90	ND
2.5-3.5	ND	NT

D-FA-5b

P-20 (D-GC-6)

D-GC-2c

D-GC-2b

D-GC-2

D-GC-8

D-GC-11

PND-TP5

D-FA-5

American Construction Company

D-FA-11d

Building

D-FA-3

D-FA-11c

D-FA-11h

D-FA-11i

TP-7

D-6

D-FA-11g

D-FA-11f

P-17

Legend

- Soil Sample Location with Arsenic Cleanup Level Exceedance
- Soil Sample Location with No Cleanup Level Exceedance
- Soil Sample Location Not Tested for Arsenic, or cPAHs, or Located Outside Cleanup Action Area
- Proposed Additional Delineation Soil Sample Location
- E-1 — Soil Cleanup Action Area
- Exitising Paved Area
- ND — Not Detected
- NT — Not Tested
- Vegetation
- Environmental Site Assessment Investigation Area Limits
- Cleanup Action Area Boundary

Notes:

1. Arsenic proposed cleanup level = 20 mg/kg.
2. cPAH proposed cleanup level = 137 µg/kg.
3. All Arsenic results are reported in mg/kg. All cPAH results are reported in µg/kg.
4. All values in red exceed the proposed cleanup level.
5. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

N

0 50 100

Scale in Feet

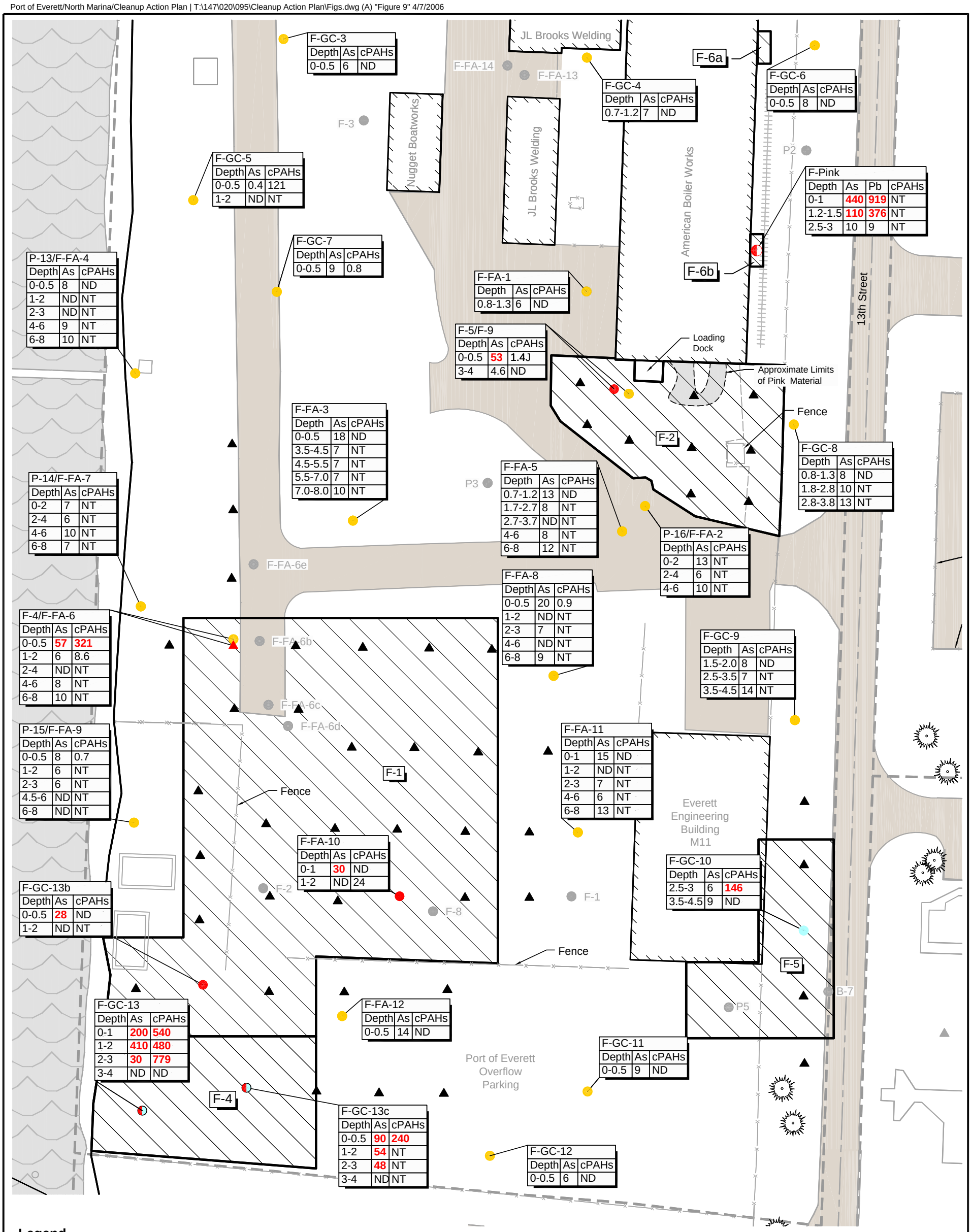
LANDAU ASSOCIATES

North Marina
Cleanup Action Plan
Everett, Washington

Soil Cleanup Action Areas E-1 and E-2

Figure 8

Port of Everett/North Marina/Cleanup Action Plan | T:\147\020\0095\Cleanup Action PlanFigs.dwg (A) "Figure 8" 4/7/2006



Legend

- Soil Sample Location with Arsenic Cleanup Level Exceedance
- Soil Sample Location with cPAH Cleanup Level Exceedance
- Soil Sample Location with Arsenic and cPAH Cleanup Level Exceedance
- Soil Sample Location with Arsenic and Lead Cleanup Level Exceedance
- Soil Sample Location with No Cleanup Level Exceedance
- Soil Sample Location Not Tested for Arsenic, Lead or cPAHs
- ▲ Proposed Additional Delineation Soil Sample Location
- F-1 Soil Cleanup Action Area
- Existing Paved Areas
- ND Not Detected
- NT Not Tested
- Vegetation
- Environmental Site Assessment Investigation Area Limits

Notes:

1. Arsenic proposed cleanup level = 20 mg/kg.
2. Lead proposed cleanup level = 250 mg/kg.
3. cPAH proposed cleanup level = 137 µg/kg.
4. All arsenic and lead results are reported in mg/kg.
5. All cPAH results are reported in µg/kg.
6. All values in red exceed the proposed cleanup level.
7. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

N

0 60 120

Scale in Feet

LANDAU ASSOCIATES

North Marina
Cleanup Action Plan
Everett, Washington

Soil Cleanup Action Areas F-1, F-2, F-4, F-5, F-6a, and F-6b

Figure 9

I-GC-24			
Depth	As	Pb	cPAHs
1.2-6	105	61	0.8
6.5-7.5	20	9	ND

I-GC-1a			
Depth	As	Pb	cPAHs
0-0.5	640	459	ND
1-2	9	7	NT

I-GC-1			
Depth	As	Pb	cPAHs
0-0.5	1,440	1,070	ND
1-2	3,690	2,560	NT
2-3	11	4	NT

I-GC-1c			
Depth	As	Pb	cPAHs
0-0.5	1,640	1,310	151
1-2	380	360	ND
2-3	10	6	NT

I-GC-2			
Depth	As	Pb	cPAHs
0-0.5	130	94	160.7
1-2	9	10	ND

I-GC-3			
Depth	As	Pb	cPAHs
0-0.5	6	18	77.1

I-GC-6			
Depth	As	Pb	cPAHs
3.5-4	7	4	ND

I-Z (Composite)			
Depth	As	Pb	cPAHs
0-0.5	240	280	25

I-GC-25			
Depth	As	Pb	cPAHs
0.5-1	9	6	ND

I-GC-4			
Depth	As	Pb	cPAHs
0-0.5	7	15	87.4
1-2	NT	NT	ND

I-GC-5			
Depth	As	Pb	cPAHs
3-3.5	6	7	ND

I-X (Composite)			
Depth	As	Pb	cPAHs
1.2-3	60	41	NT
3-4	5.3	6	NT

I-GC-26			
Depth	As	Pb	cPAHs
0-0.5	13	9	ND

I-GC-7			
Depth	As	Pb	cPAHs
0-0.5	ND	11	9.3

I-GC-8			
Depth	As	Pb	cPAHs
3.5-4	9	5	ND

I-GC-9			
Depth	As	Pb	cPAHs
3.5-4	10	6	ND

I-GC-10			
Depth	As	Pb	cPAHs
0-0.5	19	32	ND

I-GC-13			
Depth	As	Pb	cPAHs
0-0.5	15	12	ND

I-GC-14			
Depth	As	Pb	cPAHs
0-0.5	50	45	147.4
1-2	ND	2	ND

I-GC-15			
Depth	As	Pb	cPAHs
0-0.5	40	9	ND
1-2	32	29	NT
2-3	11	21	NT

I-GC-16			
Depth	As	Pb	cPAHs
0-0.5	50	17	ND
1-2	7	3	NT

I-GC-11			
Depth	As	Pb	cPAHs
0-0.5	11	10	307.6
1-2	NT	NT	690.2
2-3	NT	NT	ND

I-GC-18			
Depth	As	Pb	cPAHs
0-0.5	35	16	ND
1-2	45	33	NT
2-3	9	3	NT

I-GC-19			
Depth	As	Pb	cPAHs
0-0.5	31	18	10.2
1-2	18	11	NT

I-GC-21			
Depth	As	Pb	cPAHs
0-0.5	10	29	6.5

I-GC-20			
Depth	As	Pb	cPAHs
0-0.5	38	13	829.7
1-2	8	4	ND

I-GC-12			
Depth	As	Pb	cPAHs
0-0.5	10	32	600.4
1-2	NT	NT	99.4

I-GC-17			
Depth	As	Pb	cPAHs
0-0.5	34	15	208.5
1-2	10	4	ND

I-GC-22			
Depth	As	Pb	cPAHs
0-0.5	9	9	ND

I-GC-23			
Depth	As	Pb	cPAHs
0-0.5	10	12	ND

Legend

- Soil Sample Location with Arsenic Cleanup Level Exceedance
- Soil Sample Location with cPAH Cleanup Level Exceedance
- Soil Sample Location with Arsenic and cPAH Cleanup Level Exceedance
- Soil Sample Location with Arsenic and Lead Cleanup Level Exceedance
- Soil Sample Location with No Cleanup Level Exceedance
- Soil Sample Location Not Tested for Arsenic, cPAHs, or TPH-D, or Located Outside Investigation Area I
- ▲ Proposed Additional Delineation Soil Sample Location
- I-1 Soil Cleanup Action Area
- Existing Paved Area

ND Not Detected

NT Not Tested

Vegetation

Environmental Site Assessment Investigation Area Limits

Notes:

1. Arsenic proposed cleanup level = 20 mg/kg.
2. cPAH proposed cleanup level = 137 µg/kg.
3. Lead proposed cleanup level = 250 mg/kg.
4. All arsenic and lead results are reported in mg/kg.
5. All cPAH results are reported in µg/kg.
6. All values in red exceed the proposed cleanup level.
7. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

N

0 60 120

Scale in Feet

LANDAU ASSOCIATES

North Marina
Cleanup Action Plan
Everett, Washington

Soil Cleanup Action Areas I-1 through I-11

Figure 10

Approximate Area of Buried Construction Debris

J-3

J-GC-6e

J-GC-6b

J-GC-6d

J-GC-7

Depth	As	cPAHs
1.7-1.2	12	ND

J-GC-6

Depth	As	cPAHs
1.1-1.6	27	ND
2.0-2.7	ND	505.5
3.1-4.1	ND	ND

J-GC-6c

Marine Spill Response Corporation

Port of Everett Marina Maintenance Facility

J-GC-3

Depth	As	TPH-O
0-0.5	14	ND

J-GC-8

Depth	As	cPAHs
2.1-2.6	9	ND

J-FA-1

Depth	As	TPH-D	TPH-O
4-5	NT	ND	ND

Fence

J-GC-9

Depth	As	cPAHs
1.4-1.9	12	ND

J-1

J-GC-4b

Depth	As	cPAH
0-0.5	ND	NT

J-GC-1b

Depth	TPH-D	TPH-O
0.9-1.4	ND	ND

J-2

13th Street

J-GC-10

Depth	As	cPAHs
0-0.5	12	6.9

J-GC-4

Depth	As	cPAHs
1.5-2	30	ND
2.5-3.5	7	NT
3.5-4.5	8	NT

J-FA-2

Depth	As	TPH-D	TPH-O
4-5	NT	46	540

J-2

J-GC-1

Depth	TPH-D	TPH-O
0.5-1	310	3,700
1.5-2.5	ND	ND

J-1

J-GC-1c

Depth	TPH-D	TPH-O
0.7-1.2	ND	ND

J-GC-2

Depth	As	cPAHs
0-0.5	ND	ND

J-GC-4c

Depth	As	cPAHs
0-0.5	19	NT

Legend

- Soil Sample Location with Arsenic Cleanup Level Exceedance
- Soil Sample Location with Arsenic and cPAH Cleanup Level Exceedance
- Soil Sample Location with TPH Cleanup Level Exceedance
- Soil Sample Location with No Cleanup Level Exceedance
- Soil Sample Location Not Tested for Arsenic, cPAHs, or TPH-D
- J-2 — Soil Cleanup Action Area
- Existing Paved Area
- ND — Not Detected
- NT — Not Tested
- Vegetation
- Environmental Site Assessment Investigation Area Limits

Notes:

1. Arsenic proposed cleanup level = 20 mg/kg.
2. cPAH proposed cleanup level = 137 µg/kg.
3. TPH-D and TPH-O proposed cleanup level = 2,000 mg/kg.
4. All arsenic, TPH-D, and TPH-O results are reported in mg/kg.
5. All cPAH results are reported in µg/kg.
6. All values in red exceed the proposed cleanup level.
7. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

N

0 50 100

Scale in Feet

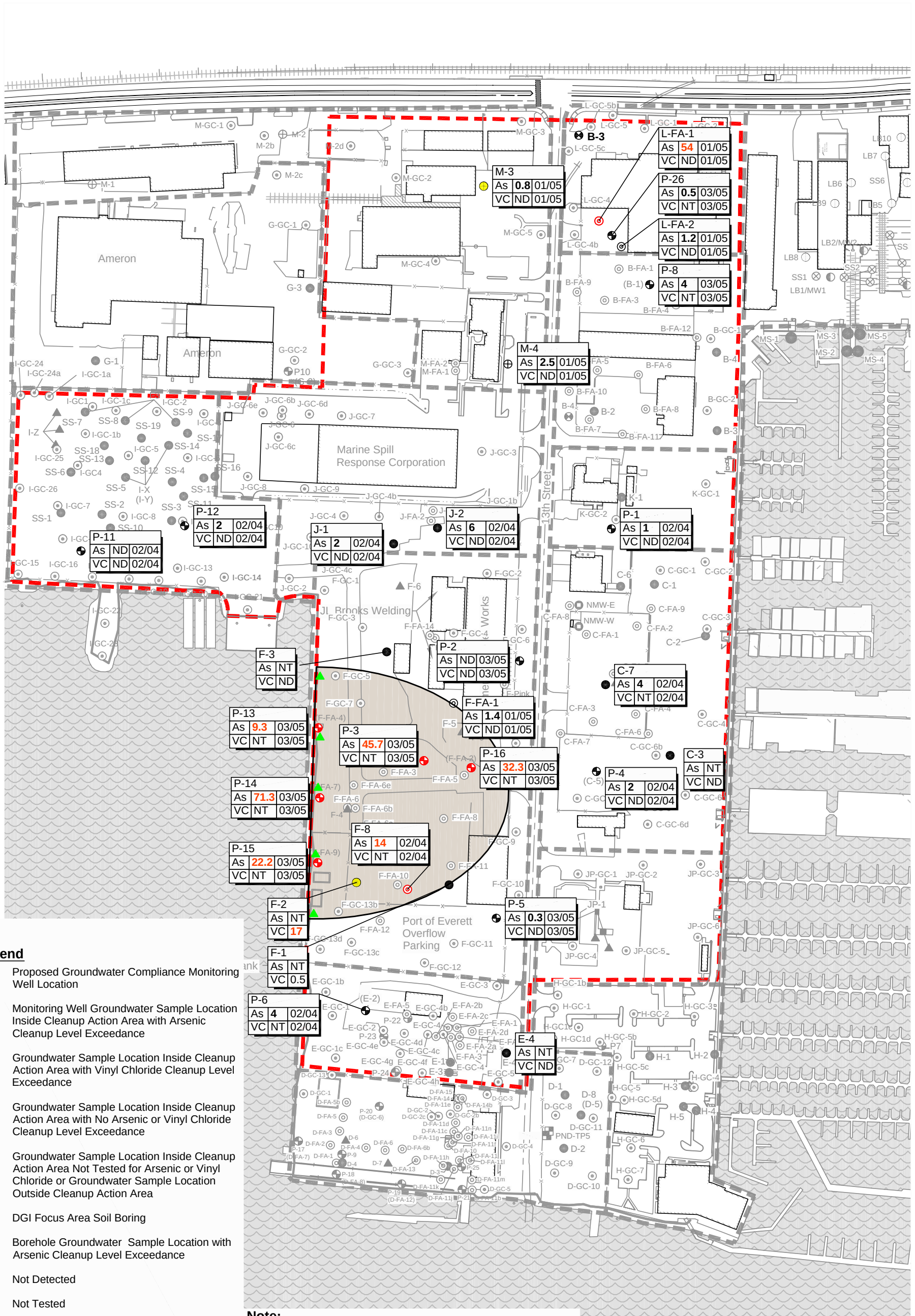
LANDAU ASSOCIATES

North Marina
Cleanup Action Plan
Everett, Washington

Soil Cleanup Action Areas J-1, J-2, and J-3

Figure 11

Port of Everett/North Marina/Cleanup Action Plan | T:\147\020095\Cleanup Action Plan\Figs.dwg (A) "Figure 11" 4/7/2006



Legend

- Proposed Groundwater Compliance Monitoring Well Location
- Monitoring Well Groundwater Sample Location Inside Cleanup Action Area with Arsenic Cleanup Level Exceedance
- Groundwater Sample Location Inside Cleanup Action Area with Vinyl Chloride Cleanup Level Exceedance
- Groundwater Sample Location Inside Cleanup Action Area with No Arsenic or Vinyl Chloride Cleanup Level Exceedance
- Groundwater Sample Location Inside Cleanup Action Area Not Tested for Arsenic or Vinyl Chloride or Groundwater Sample Location Outside Cleanup Action Area
- DGI Focus Area Soil Boring
- Borehole Groundwater Sample Location with Arsenic Cleanup Level Exceedance
- ND Not Detected
- NT Not Tested
- Cleanup Action Area
- Approximate Extent of Arsenic Groundwater Contamination
- [a] Environmental Site Assessment Investigation Area

Note:

1. Arsenic groundwater cleanup level = 8 µg/L.
2. Vinyl Chloride cleanup level = 2.4 µg/L.
3. All other gray symbols inside Cleanup Action Area indicate soil sample locations.
4. All gray symbols outside Cleanup Action Area indicate a groundwater or soil sample location not included in this CAP.
5. All values in red exceed the proposed cleanup level.
6. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

N

0 200 400

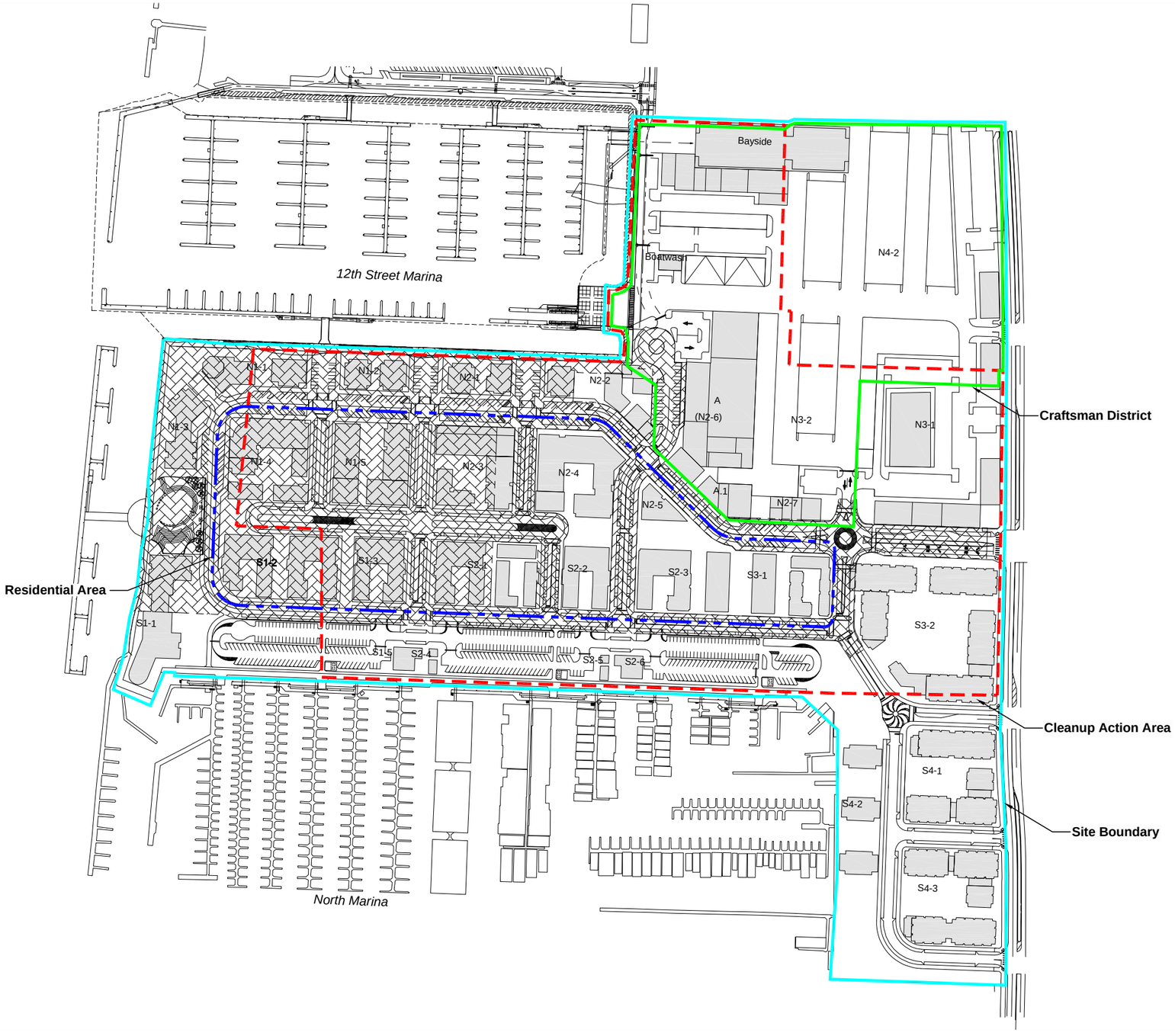
Scale in Feet

LANDAU ASSOCIATES

North Marina
Cleanup Action Plan
Everett, Washington

Groundwater Cleanup Action Locations

Figure 12



Legend

Stone Columns

Note:

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Reid Middleton 2006

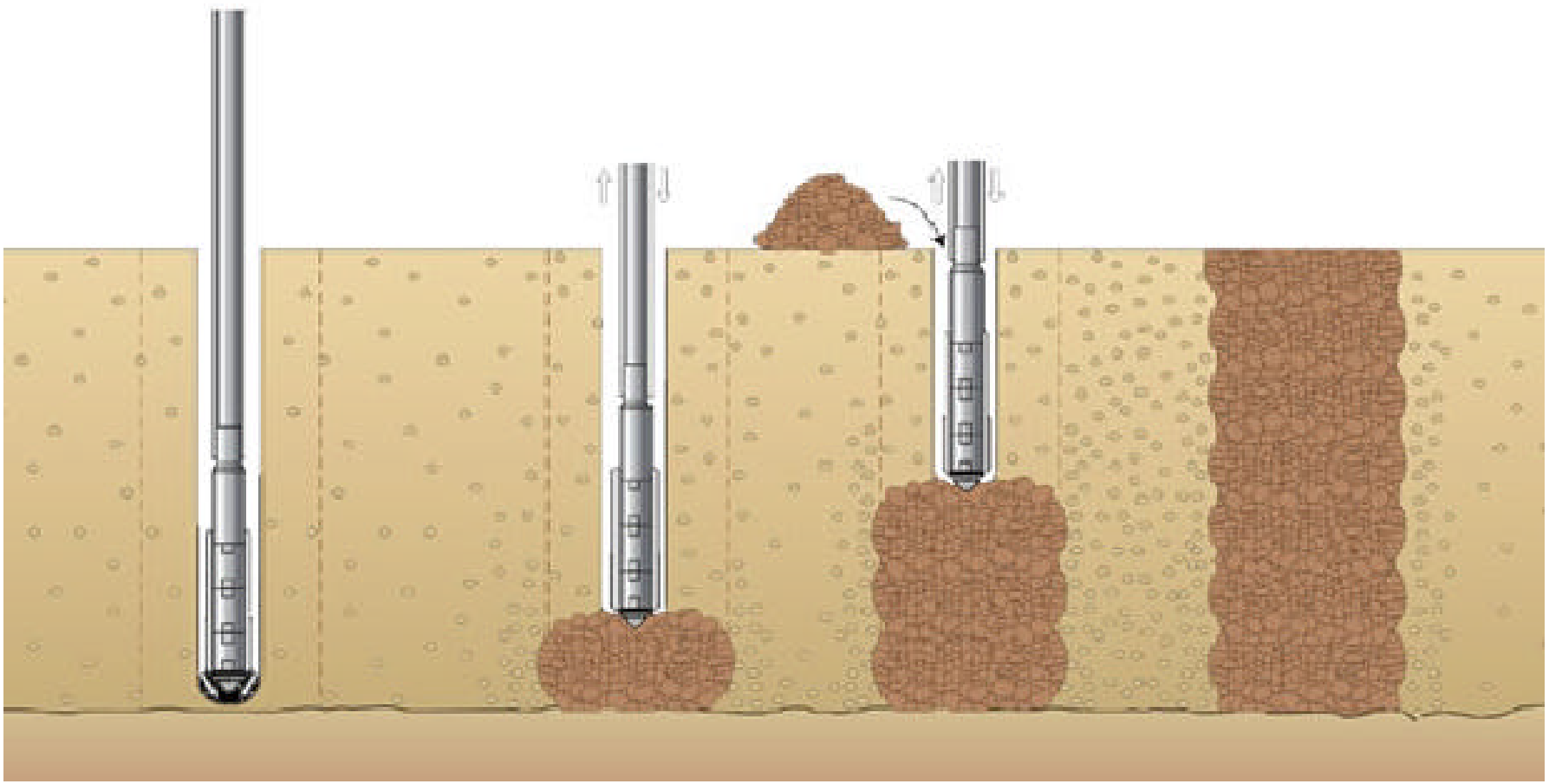
0 300 600

Scale in Feet

LANDAU ASSOCIATES

North Marina Cleanup Action Plan Everett, Washington	**Site Redevelopment Plan**	Figure 13

Port of Everett/North Marina/Cleanup Action Plan | T:\147\020\095\Cleanup Action Plan\Fig13.dwg (A) "Figure 13" 4/7/2006



Not to Scale

Source: Haywood Baker

LANDAU ASSOCIATES

North Marina
Cleanup Action Plan
Everett, Washington

Stone Column Installation Schematic

Figure
14

TABLE 1
PROPOSED SOIL CLEANUP LEVELS FOR DETECTED CONSTITUENTS
NORTH MARINA REDEVELOPMENT SITE
EVERETT, WASHINGTON

Analyte	MTCA Method B Direct Contact (a)	MTCA Protection of Groundwater as Surface Water (b)	Background (c)	Practical Quantitation Limit (d)	Proposed Cleanup Level (e)	
TOTAL PETROLEUM HYDROCARBONS (mg/kg)						
Gasoline range	30/100 (f,g)	--	--	5.00	30/100	(g)
Diesel range	2,000 (f)	--	--	10.00	2,000	
Oil range	2,000 (f)	--	--	10.00	2,000	
Mineral oil	4,000 (f)	--	--	10.00	4,000	
METALS (mg/kg)						
Arsenic	20 (i)	20 (i)	7	5.00	20	
Cadmium	80 (j)	1.28	1	0.20	80	(m)
Copper	2,960 (j)	1.38	36	0.20	2,960	(m)
Lead	250 (k)	1,620	24	2.00	250	(k)
Mercury	24 (j)	0.03	0.07	0.05	24	(m)
Zinc	24,000 (j)	101	85	0.60	24,000	(m)
Paths (mg/kg)						
Naphthalene	1,600 (j)	138	--	0.02	138	
2-Methylnaphthalene	320	--	--	0.02	--	
1-Methylnaphthalene	24	--	--	0.02	--	
Total Naphthalene	--	--	--	--	--	
Benzo(a)anthracene	TEQ (l)		--	0.02		(l)
Chrysene	TEQ (l)		--	0.02		(l)
Benzo(b)fluoranthene	TEQ (l)		--	0.02		(l)
Benzo(k)fluoranthene	TEQ (l)		--	0.02		(l)
Benzo(a)pyrene	0.14 (h)	0.60	--	0.02	0.14	
Indeno(1,2,3-cd)pyrene	TEQ (l)		--	0.02		(l)
Dibenz(a,h)anthracene	TEQ (l)		--	0.02		(l)
cPAH TEQ	0.14	--		--	0.14	

-- = Soil criteria not established.

Shaded value = selected as proposed cleanup level.

TEQ = Toxicity Equivalency Quotient. TEQ is based on individual Toxicity Equivalency Factors (TEFs) of benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, ideno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene.

(a) MTCA Method B standard formula values based on direct contact (Ecology's CLARC) unless otherwise noted.
(b) MTCA Method B values based on protection of marine surface water using MTCA equation 747-1 (February 2001), unless otherwise noted.
(c) From Ecology's Natural Background Soil Metals Concentrations in Puget Sound (1994). Used 90th percentile for Puget Sound unless noted otherwise.
(d) Practical quantitation limits (PQLs) based on analytical method reporting limits.
(e) Proposed cleanup level based on lowest soil criteria corrected for PQL and background, as indicated by shading.
(f) MTCA Method A soil cleanup levels for unrestricted land uses (February 2001). MTCA Method B criteria do not exist for this constituent.
(g) MTCA Method A cleanup level is 30 mg/kg when benzene is present and 100 mg/kg when benzene is not present.
(h) MTCA Method B soil standard formula value based on criteria as a carcinogen.
(i) MTCA Method A soil cleanup level based on direct contact using equation 740-2 and protection of drinking water using the procedures in WAC 173-340-747(4).
(j) MTCA Method B soil standard formula value based on criteria as a non-carcinogen.
(k) MTCA Method A soil cleanup level based on preventing unacceptable blood lead levels.
(l) In addition to this proposed cleanup level for individual PAHs, a TEQ will be computed for each sample containing carcinogenic PAHs above reporting limits and compared to the benzo(a)pyrene cleanup level in accordance with WAC 173-340-708(8)(e).
(m) Proposed cleanup level is the Method B direct human contact cleanup level. Empirical evidence, based on groundwater analytical results, indicate that current concentrations of cadmium, copper, mercury, and zinc in soil are protective of groundwater and, therefore, need only be compared to cleanup levels protective of direct human contact.

TABLE 2
PROPOSED GROUNDWATER CLEANUP LEVELS FOR DETECTED CONSTITUENTS
NORTH MARINA REDEVELOPMENT SITE
EVERETT, WASHINGTON

Analyte	Federal Standards (a)			State Standards			Practical Quantitation Limit (d)	Proposed Cleanup Level (e)
	Acute	Chronic	Human Health (Consumption of organisms only)	Acute (b)	Chronic (b)	MTCA Method B Surface Water Equation for Human Health (c)		
VOLATILES (µg/L)								
1,1,1-Trichloroethane	--	--	--	--	--	420,000 (f)	1	420,000
1,2-Dichloroethane	--	--	37 (x1)			59 (g)	1	37
Benzene	--	--	51 (x1)	--	--	23 (g)	1	51 (h)
Ethylbenzene	--	--	2,100 (x1)	--	--	6,900 (f)	1	6,900
m,p-Xylene	--	--	--	--	--	--	1	--
o-Xylene	--	--	--	--	--	--	1	--
Toluene	--	--	15,000 (x1)	--	--	19,000 (f)	1	19,000
Total Xylenes	--	--	--	--	--	--	1	--
Trichloroethene	--	--	30 (x1)	--	--	1.5 (g)	1	15 (i)
Vinyl Chloride	--	--	2.4 (x1)	--	--	3.7 (g)	1	2.4
1,1-Dichloroethane	--	--	--	--	--	--	1	--
1,2,4-Trimethylbenzene	--	--	--	--	--	--	1	--
1,3,5-Trimethylbenzene	--	--	--	--	--	--	1	--
Acetone	--	--	--	--	--	--	1	--
Carbon Disulfide	--	--	--	--	--	--	1	--
cis-1,2-Dichloroethene	--	--	--	--	--	--	1	--
Isopropylbenzene	--	--	--	--	--	--	1	--
n-Propylbenzene	--	--	--	--	--	--	1	--
TOTAL PETROLEUM HYDROCARBONS (mg/L)								
Gasoline-range	--	--	--	--	--	--	0.1	0.8 (j)
Diesel-range	--	--	--	--	--	--	0.1	0.5 (j)
Oil-range	--	--	--	--	--	--	0.25	0.5 (j)
METALS (µg/L)								
Arsenic	69 (j)	36 (k)	0.14 (x1)	69 (l)	36 (l)	5 (m)	0.2	5
Cadmium	40 (l,x1)	8.8 (l,x1)	--	42 (l)	9.3 (l)	20 (f)	0.2	8.8
Chromium (III)	--	--	--	--	--	240,000 (f)	1	240,000
Copper	2.4 (j)	2.4 (j)	--	4.8 (l)	3.1 (l)	2,700 (f)	1	2.4
Lead	210 (j)	8.1 (j)	--	210 (l)	8.1 (l)	--	1	8.1
Mercury	1.8 (j)	0.025 (j)	0.015 (x2) (n)	1.8	0.025	--	0.1	0.1
Zinc	90 (e)	81 (e)	26,000 (x1)	90 (l)	81 (l)	17,000 (f)	1	81
PAHs (µg/L)								
Benzo(a)anthracene	--	--	0.018 (x1)	--	--	(o)	0.1	0.1
Benzo(a)pyrene	--	--	0.018 (x1)	--	--	0.03 (o)	0.1	0.1
Benzo(b)fluoranthene	--	--	0.018 (x1)	--	--	(o)	0.1	0.1
Benzo(k)fluoranthene	--	--	0.018 (x1)	--	--	(o)	0.1	0.1
Chrysene	--	--	0.018 (x1)	--	--	(o)	0.1	0.1
Dibenz(a,h)anthracene	--	--	0.018 (x1)	--	--	(o)	0.1	0.1
Indeno(1,2,3-cd)pyrene	--	--	0.018 (x1)	--	--	(o)	0.1	0.1
Naphthalene	--	--	--	--	--	4,900 (f)	0.1	4,900
cPAH TEQ	--	--	--	--	--	--	--	0.1

Shaded value = Basis for proposed cleanup level.

--' = Water quality standard or other criteria not established.

(a) All federal standards are from 40 CFR 131.36 (November 9, 1999) or the Clean Water Act Section 304. Values shown are the lowest standard. x1 = Clean Water Act standard. x2 = 40 CFR standard

(b) Washington State acute and chronic standards from WAC 173-201A-040 (Online Source 3/16/2006: https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx)

(c) MTCA Method B standard formula values (Online Source 3/16/2006: https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx), except as noted otherwise.

(d) Practical quantitation limits (PQLs) based on analytical method reporting limits

(e) Cleanup level based on lowest water quality standard or PQL or background, indicated by shading, except as noted otherwise.

(f) MTCA Method B surface water standard formula value based on criteria as a non-carcinogen.

(g) MTCA Method B surface water standard formula value based on criteria as a carcinogen.

(h) Cleanup level deferred to federal standard because it is considered sufficiently protective of human health for carcinogens as described in WAC 173-340-730(3).

(i) Standard established under applicable federal law exceeds a cancer risk of $1C^{5}$ adjusted to cancer risk of $1x10^{-5}$;therefore, the cleanup level was adjusted downward to a cancer risk of 10^{-5}, in accordance with WAC 173-340-730(5)(b). Equation 730-2 [WAC 173-340-730(3)(iii)(B)] was used to determine the concentration associated with a cancer risk of 10^{-5}, as shown in Figure 3 of Ecology's Focus on Developing Surface Water Cleanup Standards Under the Model Toxics Control Act (revised April 2005).

(j) Proposed cleanup level based on MTCA Method A groundwater cleanup level in accordance with WAC 173-340-730(a)(b)(iii)(c).

(k) The water effect ratio was assumed to be equal to one for these metals.

(l) Indicated criteria are for dissolved fraction.

(m) Proposed cleanup level based on MTCA Method A groundwater cleanup level in accordance with WAC 173-240-730(a)(b)(iii)(c).

(n) If mercury exceeds 0.012 µg/L more than once in a 3-year period, see 40 CFR 131.36. Criterion expressed as total recoverable mercury.

(o) A toxicity equivalency quotient (TEQ) would be completed for each sample containing carcinogenic PAHs above reporting limits and compared to the benzo(a)pyrene cleanup level in accordance with 173-340-708(8)(e). However, federal criteria are adequately protective, so calculation is not required.

TABLE 3
SUMMARY OF NUMBER OF SOIL SAMPLES ANALYZED, DETECTS, AND EXCEEDANCES
NORTH MARINA REDEVELOPMENT SITE
EVERETT, WASHINGTON

Analyte	Number of Soil Samples Analyzed	Number of Samples with Detected Concentrations	Number of Soil Samples with Concentrations Exceeding Proposed Cleanup Levels
Volatile Organic Compounds			
Method 8260			
Acetone	3	1	0
Carbon Disulfide	3	1	0
1,1-Dichloroethane	3	1	0
Methylethylketone	3	2	0
1,1,1-Trichloroethane	3	1	0
Trichloroethene	3	1	0
Tetrachloroethene	3	1	0
1,3,5-Trimethylbenzene	3	1	--
1,2,4-Trimethylbenzene	3	1	--
Isopropylbenzene	3	1	0
n-Propylbenzene	3	1	--
sec-Butylbenzene	3	1	--
4-Isopropyltoluene	3	1	--
n-Butylbenzene	3	1	--
Naphthalene	3	1	0
Polychlorinated Biphenyls (PCBs)			
Method 8082			
Total PCBs	10	1	0
Semivolatile Organics			
Method 8270			
Naphthalene	31	18	0
2-Methylnaphthalene	31	16	--
1-Methylnaphthalene	31	6	--
Acenaphthene	31	8	0
Acenaphthylene	31	5	--
Anthracene	31	12	0
Benzo(g,h,i)perylene	31	13	--
Bis(2-ethylhexyl)phthalate	31	1	0
Fluoranthene	31	14	0
Fluorene	31	8	0
Phenanthrene	31	15	--
Pyrene	31	15	0
cPAHs			
Method 8270-SIM			
cPAH TEQ	232	110	58

TABLE 3
SUMMARY OF NUMBER OF SOIL SAMPLES ANALYZED, DETECTS, AND EXCEEDANCES
NORTH MARINA REDEVELOPMENT SITE
EVERETT, WASHINGTON

Analyte	Number of Soil Samples Analyzed	Number of Samples with Detected Concentrations	Number of Soil Samples with Concentrations Exceeding Proposed Cleanup Levels
Metals			
Method 6000-7000 Series			
Arsenic	337	294	94
Cadmium	254	84	0
Chromium	20	20	0
Copper	274	274	5
Lead	279	279	14
Mercury	267	103	1
Zinc	82	264	0
Tributyl Tin			
TBT Ion by SIM			
TBT Chloride	12	9	--
DBT Dichloride	12	9	--
BT Trichloride	12	9	--
TBT Tin Ion	12	9	1
Petroleum Hydrocarbons			
Method NWTPH-Dx, NWTPH-Gx, and/or NWTPH-HCID			
Gasoline-range	172	8	1
Diesel	174	72	6
Motor oil	174	66	5
Mineral oil	2	2	0
BETX			
Method 8021			
Benzene	17	1	0
Toluene	17	1	0
Ethylbenzene	17	3	0
m,p-Xylene	17	3	0
o-Xylene	17	4	0

-- = No criteria available.

Data Sources: Landau Associates 2005b, 2006a.

TABLE 4
SUMMARY OF NUMBER OF GROUNDWATER SAMPLES ANALYZED, DETECTS, AND EXCEEDANCES
NORTH MARINA REDEVELOPMENT SITE
EVERETT, WASHINGTON

Analyte	Number of Water Samples Analyzed	Number of Samples with Detected Concentrations	Number of Water Samples with Concentrations Exceeding Proposed Cleanup Levels
Volatile Organic Compounds			
Method 8260			
Vinyl Chloride	35	3	2
Acetone	35	6	--
Carbon Disulfide	34	2	--
1,1-Dichloroethane	34	1	--
1,1,1-Trichloroethane	34	1	0
cis-1,2-Dichloroethene	34	2	--
1,2-Dichloroethane	34	1	0
Trichloroethene	34	1	0
1,3,5-Trimethylbenzene	30	1	--
1,2,4-Trimethylbenzene	30	1	--
Semivolatile Organics			
Method 8270			
Naphthalene	10	1	0
cPAHs			
Method 8270-SIM			
Benzo(a)anthracene	23	8	--
Chrysene	23	8	--
Benzo(b)fluoranthene	23	7	--
Benzo(k)fluoranthene	23	8	--
Benzo(a)pyrene	23	8	--
Indeno(1,2,3-cd)pyrene	23	5	--
Dibenz(a,h)anthracene	23	2	--
cPAH TEQ	23	9	2
Metals			
Method 6000-7000 Series			
Arsenic (Dissolved)	47	40	20
Cadmium (Dissolved)	38	0	0
Chromium (Dissolved)	21	0	0
Copper (Dissolved)	40	15	2
Lead (Dissolved)	46	2	1
Mercury (Dissolved)	38	0	0
Zinc (Dissolved)	39	9	1
Petroleum Hydrocarbons			
Method NWTPH-Dx, NWTPH-Gx, and/or NWTPH-HCID			
Gasoline	58	1	0
Diesel	64	7	4
Motor Oil	64	4	3

TABLE 4
SUMMARY OF NUMBER OF GROUNDWATER SAMPLES ANALYZED, DETECTS, AND EXCEEDANCES
NORTH MARINA REDEVELOPMENT SITE
EVERETT, WASHINGTON

Analyte	Number of Water Samples Analyzed	Number of Samples with Detected Concentrations	Number of Water Samples with Concentrations Exceeding Proposed Cleanup Levels
BETX			
Method 8021			
Benzene	50	1	0
Toluene	50	8	0
Ethylbenzene	50	2	0
m,p-Xylene	50	1	--
o-Xylene	50	2	--

-- = No criteria available.

Data Sources: Landau Associates 2005b, 2006a.

TABLE 5
PROPOSED SOIL AND GROUNDWATER INDICATOR HAZARDOUS SUBSTANCES AND PROPOSED CLEANUP LEVELS
NORTH MARINA REDEVELOPMENT SITE
EVERETT, WASHINGTON

Analyte	Proposed Soil Cleanup Level (mg/kg)	Proposed Groundwater Level Cleanup (µg/L)
TOTAL PETROLEUM HYDROCARBONS		
Diesel range	2,000	500
Oil range	2,000	500
METALS		
Arsenic	20	5
Lead	250	NA
cPAHs		
cPAH TEQ	0.14	NA
VOCs		
Vinyl Chloride	NA	2.4

NA = Not Applicable

TEQ = Toxicity Equivalency Quotient. TEQ is based on individual Toxicity Equivalency Factors (TEFs) of benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, ideno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene.

APPENDIX A

Compliance Monitoring Plan

Compliance Monitoring Plan
North Marina Redevelopment Site
Everett, Washington

September 25, 2006

Prepared for

Port of Everett
Everett, Washington

LANDAU ASSOCIATES
130 2nd Avenue South
Edmonds, WA 98020
(425) 778-0907

TABLE OF CONTENTS

LIST OF TABLES

1.0 INTRODUCTION

This Compliance Monitoring Plan documents the compliance monitoring program for the cleanup action of a portion of the Port of Everett (Port) North Marina Redevelopment Site located in Everett, Washington (project), shown on Figure 1 of the Cleanup Action Plan. Maritime Trust Company (MTC), in conjunction with the Port, is redeveloping the site into a mixed residential, retail, commercial, and light industrial development. The redevelopment of the site requires environmental cleanup to the degree necessary for the site to conform to current environmental regulations, taking into consideration the nature of planned site uses.

This plan addresses compliance monitoring for three important aspects of the cleanup action: 1) protection of human health and the environment during cleanup activities, 2) performance of the remedial action in meeting cleanup standards, and 3) confirmation of the long-term effectiveness of the cleanup action. This plan was prepared on behalf of the Port to meet the requirements of the Model Toxics Control Act (MTCA; WAC 173-340) and is consistent with MTCA compliance monitoring requirements [WAC 173-340-400 (4)(b) and WAC 173-340-410]. It is the intent of the Port and MTC that site cleanup be adequate to meet MTCA requirements and to obtain a no further action (NFA) determination from the Washington State Department of Ecology (Ecology).

MTCA requires compliance monitoring for all cleanup actions, as described in WAC 173-340-410. Compliance monitoring is conducted for the following three purposes:

- **Protection monitoring** to confirm that human health and the environment are adequately protected during construction, operation, and maintenance associated with the cleanup action.

- **Performance monitoring** to confirm that the cleanup action has attained cleanup standards and any other performance standards.

- **Confirmational monitoring** to confirm the long-term effectiveness of the cleanup action once the cleanup standards and other performance standards have been attained.

The following sections of this plan present the approach and procedures for addressing these compliance monitoring requirements.

2.0 PROTECTION MONITORING

This section describes planned monitoring activities for the protection of human health and the environment during implementation of the cleanup action.

2.1 HUMAN HEALTH

Monitoring for protection of human health addresses worker safety for activities related to construction, operation, and maintenance of the cleanup action and will be addressed through a project health and safety plan (HASP). The requirements for a project HASP will be included in the project construction documents, and the contractor will prepare the HASP. The HASP will address potential physical and chemical hazards associated with site activities consistent with the requirements of WAC 173-340-810. Anticipated potential physical hazards include working in proximity to heavy equipment, heat stress or cold stress, and vehicular traffic. Anticipated potential chemical hazards include exposure to site contaminants through various exposure pathways (i.e., direct contact, inhalation, and ingestion).

2.2 ENVIRONMENT

Monitoring for protection of the environment addresses environmental receptors that may be exposed to chemical or physical hazards at levels that may cause adverse effects. For this action, the primary receptors of concern are humans and aquatic organisms in the marine environment.

Potential adverse chemical impacts associated with the cleanup action are due to exposure of humans and aquatic organisms to metals, cPAHs, and petroleum hydrocarbons in the diesel and oil ranges present in soil through direct contact, inhalation of dust, ingestion of soil (humans), or direct contact with affected surface water runoff (aquatic organisms).

Environmental protection monitoring will include visual monitoring to verify that excessive dust is not generated and that stormwater runoff is not being impacted. Dust will be visually monitored and the construction documents will require the contractor to apply dust suppression methods, such as watering and street sweeping, as needed. A stormwater pollution prevention plan will be developed as part of the construction documents that will specify the requirements to minimize and control stormwater runoff from contaminated soil cleanup areas during construction.

3.0 PERFORMANCE MONITORING

Performance monitoring will be conducted during and after construction associated with the cleanup action. Performance monitoring conducted during construction will include verifying that the lateral and vertical extent of contaminated soil is removed, as specified in the cleanup action plan (CAP). Performance monitoring of soil quality implemented after excavation and before backfilling will be used to verify that soil cleanup levels have been attained throughout each of the cleanup action areas. Performance monitoring of groundwater quality implemented following completion of redevelopment activities will be used to verify that groundwater cleanup levels have been attained at the point of discharge to marine surface water. The performance monitoring will, therefore, include confirmation soil and groundwater sampling, analysis, and a statistical evaluation of the soil data. The remainder of this section describes the performance monitoring approach to confirm that cleanup levels are achieved.

3.1 CONFIRMATION SOIL SAMPLING

Following excavation and prior to backfilling, confirmation soil samples will be collected at the base of each excavation and along the excavation sidewalls within each cleanup action area, except J-3. No confirmation soil samples will be collected from the excavation in Area J-3 because, as discussed in Section 3.5.1.7 of the CAP, all potentially affected soil cannot be removed within this area. Instead, following excavation of this area, a geotextile fabric will be placed at the base of the excavation as a marker layer, and the excavation will be backfilled with clean granular fill. Confirmation soil samples collected from the excavations in all other cleanup action areas will be submitted for analysis and evaluated to determine the need for any additional excavation. Confirmation soil samples will be analyzed for the constituent(s) that exceeded the cleanup level in each specific cleanup action area. Soil excavation and confirmation sampling will continue until concentrations remaining in the soil meet the cleanup levels or until a decision is made, with Ecology's concurrence, that any remaining contaminated soil will be contained in place, subject to appropriate institutional controls.

3.1.1 SAMPLE LOCATIONS

To collect data representative of the soil remaining at the base of the excavation in each cleanup action area, the base of each excavation will be divided into approximately equal-sized grids and one sample will be collected from the center of each grid and submitted for laboratory analysis. In general, the base of the excavation in larger cleanup action areas (e.g., B-1, C-1, E-1, F-1, I-1, and I-2) will be divided into 11 or more grids. By dividing the base of the excavations into 11 or more grids, a sufficient

number of samples will be collected to calculate a statistically valid upper confidence interval for the mean contaminant concentrations remaining at the base of the excavation.

In smaller cleanup action areas, the base of the excavation may be divided into fewer than 11 grids and excavations will not be divided into grids representing less than 500 ft^2 per grid. Where appropriate, based on the proximity of the areas and the nature of the contamination, confirmation sample data from smaller cleanup action areas will be grouped together for statistical evaluation. For example, results for samples collected from the base of the excavations at Cleanup Action Areas L-2 and L-3 will be combined for statistical evaluation.

Confirmation soil samples from the base of each excavation will be collected from the upper 6 inches of soil. If field observations of the soil at the base of an excavation indicate evidence of potential contamination either through visual observation (e.g., soil discoloration, presence of debris or sheen) or through the use of appropriate instrumentation (e.g., photoionization detector), the confirmation sample within a particular grid will be moved from the center of the grid to the area of potential contamination.
At each excavation, one sidewall sample will be collected for every 50 linear ft of sidewall with a minimum of one sample per sidewall. However, if the 50 ft spacing results in more than 10 sidewall samples in one excavation, the linear spacing will be increased to 75 ft. If a 75ft spacing results in more than 20 sidewall samples in one excavation, the linear spacing will be increased to 100 ft. In all cases, sidewall samples will be collected from the depth interval identified as contaminated for that excavation. If field observations of the soil along an excavation sidewall indicate evidence of contamination either through visual observation (e.g., soil discoloration, presence of debris or sheen) or through the use of appropriate instrumentation (e.g., photoionization detector), an additional confirmation sidewall sample will be collected within the area of potential contamination if the potentially contaminated soil is not excavated prior to compliance monitoring.

3.1.2 SAMPLE COLLECTION PROCEDURES

Confirmation samples representative of the soil remaining at the base of the excavation will be collected from the upper 6 inches of soil located at the base of the excavation. A shallow hole will be hand-dug at each sample location using decontaminated hand implements, including stainless-steel spoons and steel shovels, picks, and similar equipment. The surface of the hand-dug hole sidewalls will be scraped to expose a fresh surface for sample collection. Equal amounts of soil from the sidewalls will be collected using a decontaminated stainless-steel spoon, placed in a decontaminated stainless-steel bowl, homogenized, and transferred to the appropriate sample container. Material greater than about ¼ inch will be removed from the sample prior to placing the soil in the sample container.

Confirmation samples collected from the excavation sidewalls will be collected from a depth interval extending the full length of the contaminated soil depth. For excavations in unpaved areas, the sample will be collected from the ground surface to the base of the excavation. For excavations in paved areas, the sample will be collected from the based of the pavement/subgrade section to the base of the excavation.

The surface of the sidewall will be scraped using a decontaminated hand implement to expose a fresh surface for sample collection. Equal amounts of soil from the full length of the sidewall will be collected using a decontaminated stainless-steel spoon, placed in a decontaminated stainless-steel bowl, homogenized, and transferred to the appropriate sample container. Material greater than about ¼ inch will be removed from the sample prior to placing the soil in the sample container.

3.1.3 SAMPLE TRANSPORTATION AND HANDLING

The transportation and handling of samples will be accomplished in a manner that protects the integrity of the sample and also prevents release of hazardous substances from the samples. Samples will be kept in coolers on ice until delivery to the analytical laboratory. At the end of each day, samples will be logged on a chain-of-custody (COC) form. The COC form will accompany each shipment of samples to the laboratory.

3.1.4 SAMPLE CUSTODY

The primary objective of sample custody is to create an accurate, written record that can be used to trace the possession and handling of samples so that their quality and integrity can be maintained from collection until completion of all required analyses. Adequate sample custody will be achieved by means of approved field and analytical documentation. Such documentation includes the COC record that is initially completed by the sampler and is thereafter signed by those individuals who sequentially accept custody of the sample. A sample is in custody if at least one of the following is true:

- It is in someone's physical possession.
- It is in someone's view.
- It is secured in a locked container or otherwise sealed so that tampering will be evident.
- It is kept in a secured area, restricted to authorized personnel only.

Sample control and COC in the field and during transportation to the laboratory will be conducted in general conformance with the procedures described below:

- As few people as possible will handle samples.

- Sample bottles will be obtained new or pre-cleaned from the laboratory performing the analyses.

- The sample collector will be personally responsible for the completion of the COC record and the care and custody of samples collected until the samples are transferred to another person or dispatched properly under COC rules.

- The coolers in which the samples are shipped will be accompanied by the COC record identifying their contents. The original record and laboratory copy will accompany the shipment (sealed inside the shipping container). The other copy will be forwarded to Landau Associates along with sample collection forms.

- Coolers will be sealed with strapping tape and custody seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information will be entered in the "remarks" section of the COC record and traffic report.

When samples are transferred, the individuals relinquishing and receiving the samples will sign the COC form and record the date and time of transfer. The sample collector will sign the form in the first signature space. Each person taking custody will observe whether the shipping container is correctly sealed and in the same condition as noted by the previous custodian; deviations will be noted on the appropriate section of the COC record.

A designated sample custodian at the laboratory will accept custody of the shipped samples, verify the integrity of the custody seals, and certify that the sample identification numbers match those on the COC record. The custodian will then enter sample identification number data into a bound logbook, which is arranged by a project code and station number. If containers arrive with broken custody seals, the laboratory will note this on the COC record and will immediately notify the sampler and Landau Associates.

All documentation and other project records will be safeguarded to prevent loss, damage, or alteration. If an error is made on a document, corrections will be made by drawing a single line through the error and entering the correct information. The erroneous information will not be obliterated. Corrections will be initialed and dated and, if necessary, a footnote explaining the corrections will be included. Errors will be corrected by the person who made the entry, whenever possible.

3.1.5 CHEMICAL ANALYSES

Confirmation soil samples will be analyzed for one or more of the soil hazardous indicator substances (IHS) identified in Section 2.3.3 of the CAP [i.e., arsenic, lead, carcinogenic petroleum aromatic hydrocarbons (cPAHs), and diesel-range and motor oil-range petroleum hydrocarbons]. The determination of which IHS will be analyzed will be based on cleanup level exceedances for a particular cleanup action area. For example, arsenic, diesel-range petroleum hydrocarbons, and cPAHs were all

detected in the soil in Cleanup Action Area B-1 at concentrations exceeding the proposed cleanup level; therefore, confirmation soil samples collected from the base of the excavation and the excavation sidewalls in Cleanup Action Area B-1 will be analyzed for arsenic, diesel-range petroleum hydrocarbons, and cPAHs. Lead and arsenic were the only constituents that were detected in the soil at concentrations exceeding the proposed cleanup level in Cleanup Action Area L-2; therefore, confirmation soil samples collected from the base of the excavation and excavation sidewalls in Area L-2 will be analyzed for arsenic and lead only.

Confirmation soil sample chemical analyses for each soil cleanup action area are summarized in Table A-1. Analytical Resources, Inc. (ARI), located in Seattle, Washington, will perform laboratory analysis. Soil analytical methods and reporting limits goals are presented in Table A-2. The target reporting limits are only goals because instances may arise where sample concentration, heterogeneity of samples, or matrix interferences preclude achieving the desired reporting limits and associated quality control (QC) criteria. If this occurs, the laboratory will report the reason(s) for deviations from these reporting limits or noncompliance with QC criteria.

3.1.6 EQUIPMENT DECONTAMINATION

All sampling equipment used (e.g., stainless-steel bowls, stainless-steel spoons, shovels) will be cleaned using a three-step process, as follows:

1. Scrub surfaces of equipment that would be in contact with the sample with brushes using an Alconox solution.
2. Rinse and scrub equipment with clean tap water.
3. Rinse equipment a final time with deionized water to remove tap water impurities.

Decontamination of the reusable sampling devices will occur following collection of each sample. Decontamination of sampling equipment that contains a visible sheen will include a hexane rinse (or other appropriate solvent) prior to the tap water rinse.

3.1.7 RESIDUAL WASTE MANAGEMENT

This section describes the waste management of the soil and decontamination water generated during the confirmation soil sampling.

3.1.7.1 Soil Cuttings

Soil excavated from the hand-dug hole will be stockpiled on the ground surface next to the hole during sample collection. Following sample collection at the hole, the excavated soil will be placed back in the hole from which it was removed.

3.1.7.2 Decontamination Water

Water generated during decontamination of sampling equipment will be temporarily stored onsite (currently expected to be in 55-gal drum). A sample of the water will be collected and analyzed for arsenic, lead, cPAHs, and diesel- and motor oil-range petroleum hydrocarbons. Disposal methods will be determined based on the analytical results for the water sample.

3.1.8 QUALITY ASSURANCE/QUALITY CONTROL

The confirmation soil sample analytical results must be accurate, precise, representative, complete, and comparable.

Accuracy of the data will be determined through recovery of spiked surrogates and spiked laboratory control samples. Control limits for spike recovery will be laboratory acceptance limits generated according to U.S. Environmental Protection Agency (EPA) guidelines. For each analysis, the following quality control samples will be collected to evaluate accuracy:

- **Laboratory Control Sample.** A minimum of one laboratory control sample per 20 samples, not including QC samples, or one laboratory control sample per sample batch if fewer than 20 samples are obtained, will be analyzed for all parameters.

Precision of the data will be determined through evaluation of the relative percent difference between duplicate samples. To evaluate precision, the following QC samples will be collected and/or analyzed:

- **Laboratory Duplicates.** A minimum of one laboratory duplicate will be analyzed for metals, cPAHs, and diesel- and motor oil-range petroleum hydrocarbons. Laboratory duplicates will be performed using project samples. The laboratory duplicate will follow EPA guidance in the method.

Representativeness of the data will be optimized through appropriate selection of sampling locations and methods. Analyses will be performed promptly within established holding times identified in Table A-4.

Completeness for the project will be established as the proportion of data generated that is determined to be valid. The data quality objective for completeness is 90 percent.

Comparability is an expression of the confidence with which one data set can be compared to another. In this project, standard methods, promulgated by EPA or Ecology where available, will be used. Data generated will be reported in units consistent with Ecology or EPA guidelines.

3.2 CONFIRMATION SOIL SAMPLE DATA EVALUATION

Following completion of confirmation soil sampling activities within each excavation and validation of the analytical results for each confirmation sampling event, the confirmation soil sampling data will be compared to the proposed cleanup levels listed in Table 1 of the CAP. If soil data exceed a cleanup level, the following statistical approach may be used to demonstrate compliance with the cleanup level:

- The upper 95 percent confidence limit (UCL) on the true mean shall be less than the soil cleanup level (confidence interval test).[1]
- No single sample concentration will be greater than two times the soil cleanup level.
- Less than 10 percent of the sample concentrations will exceed the soil cleanup level.

This approach follows statistical methods from Ecology guidance documents (Ecology 1992, 1993) and MTCA [WAC 173-340-740(7)(d)]. If the statistical approach cannot be used due to an insufficient sample size or if the statistical approach is used but compliance is not demonstrated, additional soil will be excavated from the grid(s) containing the cleanup level exceedance(s) or, as determined by the Port in consultation with Ecology, the affected soil may be capped in place. If further excavation is conducted, confirmation soil samples will be collected from the base of the re-excavated grid(s) and, following receipt and validation of the analytical results, the data will be compared to the proposed cleanup level, or statistically evaluated using the approach described above. If the statistical approach is used, the new data will be substituted for the old data.

3.3 CONFIRMATION GROUNDWATER SAMPLING

Immediately following completion of the redevelopment activities, three new monitoring wells will be installed near the shoreline in Investigation Area F. Confirmation groundwater samples will be collected from each of the wells and the samples will be submitted for laboratory analysis to determine the effectiveness of the Investigation Area F arsenic groundwater contamination cleanup action and to

[1] In accordance with WAC 173-340-740(7)(c)(iii), the appropriate statistical methods for calculating the UCL will be determined based on the distribution (i.e., normal or lognormal distribution) of the sample data for each indicator hazardous substance. Ecology's statistics software package (MTCAStat, Version 2.0) will be used to determine the distribution of the sample data and to perform the confidence interval test.

determine the need for surface water monitoring. Groundwater and/or surface water confirmational samples will be collected quarterly until four consecutive quarters without an excedance of a groundwater cleanup level are obtained.

3.3.1 GROUNDWATER SAMPLE COLLECTION

Groundwater sample collection will be performed at each of the new monitoring wells using the following procedures:

- Immediately following removal of each well monument cover, the well head will be observed for damage, leakage, and staining. Additionally, immediately following removal of the well head cap, any odors will be recorded and the condition of the well opening will be observed. Any damage, leakage, or staining to the well head or well opening will be recorded.

- Prior to sampling, each well will be purged using a pump that is attached to dedicated purge and sample collection tubing (types of pumps used may vary depending on purge volume and depth and include a centrifugal pump, a peristaltic pump, and an electric submersible pump). Purging will begin with a small pumping rate. The rate will be adjusted upward slowly to minimize drawdown (with a target drawdown of less than 0.33 ft) during purging. Purging will continue until at least three casing volumes of water have been removed and specific conductance and temperature have stabilized or until the well goes dry. The purge volume will be calculated based on the following formula:

  $$1 \text{ casing volume (gallons)} = \pi r^2 h \times 7.48 \text{ gal/ft}^3$$

  where: $\pi = 3.14$
  r = radius of well casing in ft
  h = height of water column from the bottom of the well, in feet.

- Field parameters, including pH, temperature, conductivity, dissolved oxygen, and turbidity, will be continuously monitored during purging using a flow cell. Purging of the well will be considered to be complete when all field parameters become stable for three successive readings. The successive readings should be within +/- 0.1 pH units for pH, +/- 3 percent for conductivity, and +/- 10 percent for dissolved oxygen and turbidity.

- Purge data will be recorded on a Groundwater Sample Collection form including purge volume; time of commencement, and termination of purging; any observations regarding color, turbidity, or other factors that may have been important in evaluation of sample quality; and field measurements of pH, specific conductance, temperature, dissolved oxygen, and turbidity.

- Following the stabilization of field parameters, the flow cell will be disconnected and groundwater samples will be collected. Sample data will be recorded on a Groundwater Sample Collection form, including sample number and time collected; the observed physical characteristics of the sample (e.g., color, turbidity); and field parameters (pH, specific conductance, temperature, and turbidity).

- Four replicate field measurements of temperature, pH, specific conductance, dissolved oxygen, and turbidity will be obtained using the following procedures:

  - A 250-mL plastic beaker will be rinsed with deionized water followed by sample water.

  - The electrodes and temperature compensation probe will be rinsed with deionized water followed by sample water.

  - The beaker will be filled with sample water; the probes will be placed in the beaker until the readings are stabilized. Temperature, pH, specific conductance, dissolved oxygen, and turbidity measurements will be recorded on the Groundwater Sample Collection form.

  - The above step will be repeated to collect remaining replicates.

- Any problems or significant observations will be noted in the "comments" section of the Groundwater Sample Collection form.

- Groundwater samples will be collected into the appropriate sample containers using a peristaltic pump. To prevent degassing during sampling for vinyl chloride, a pumping rate will be maintained below about 100 ml/min. The vinyl chloride containers will be filled completely so that no head space remains. Samples will be chilled to 4°C immediately after collecting the sample. Clean gloves will be worn when collecting each sample.

- Groundwater for dissolved arsenic analyses will be collected last and field filtered through a 0.45 micron, in-line disposable filter. Dissolved arsenic samples will be preserved, as specified in Table 1. A note will be made on the sample label, sample collection form, and COC to indicate the sample has been field filtered and preserved, including the type of preservative used.

3.3.2 SAMPLE TRANSPORTATION AND HANDLING

The transportation and handling of groundwater samples will be accomplished in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects due to release of samples. Samples will be logged on a COC form and will be kept in coolers on ice until delivery to the analytical laboratory. The COC will accompany each shipment of samples to the laboratory.

3.3.3 SAMPLE CUSTODY AND DOCUMENTATION

Procedures, outlined in Section 4.1.4, for custody of confirmation soil samples will be used for custody of confirmation groundwater samples.

3.3.4 LABORATORY ANALYSES

Each confirmation groundwater sample will be analyzed for groundwater IHS identified in Section 2.3.3.2 of the CAP (i.e., dissolved arsenic and vinyl chloride). Dissolved arsenic will be analyzed

for using EPA Method 200.8. Vinyl chloride will be analyzed for using EPA Method 8260. All groundwater sample analyses will be performed by ARI. Groundwater analytical methods and reporting limits goals are presented in Table A-3. The target reporting limits are only goals because instances may arise where sample concentration, heterogeneity of samples, or matrix interferences preclude achieving the desired reporting limits and associated QC criteria. If this occurs, the laboratory will report the reason(s) for deviations from these reporting limits or noncompliance with QC criteria.

3.3.5 RESIDUAL WASTE MANAGEMENT

Purge water generated during groundwater sampling will be temporarily stored onsite (currently expected to be in 55-gal drums). Disposal methods will be determined based on the analytical results for the groundwater samples.

3.3.6 QUALITY ASSURANCE/QUALITY CONTROL

The groundwater analytical results must be accurate, precise, representative, complete, and comparable.

Accuracy of the data will be determined through recovery of spiked surrogates, matrix spikes, and spiked laboratory control samples. Control limits for spike recovery will be laboratory acceptance limits generated according to EPA guidelines. For each analysis, the following quality control samples will be collected to evaluate accuracy:

- **Laboratory Control Sample.** A minimum of one laboratory control sample per 20 samples, not including QC samples, or one laboratory control sample per sample batch if fewer than 20 samples are obtained, will be analyzed for all parameters.

- **Method Blank.** A minimum of one method blank sample will be performed for each analysis and each batch of samples analyzed.

Precision of the data will be determined through evaluation of the relative percent difference between duplicate samples. To evaluate precision the following quality control sample will be collected and/or analyzed:

- **Blind Field Duplicate.** One blind field duplicate groundwater sample will be collected and analyzed for arsenic and vinyl chloride. The blind field duplicate will consist of a split sample collected at a single sample location. Blind field duplicates will be collected by alternately filling sample containers for both the original and the corresponding duplicate sample at the same location to decrease variability between the duplicates.

Representativeness of the data will be optimized through appropriate selection of sampling locations and methods. Analyses will be performed promptly within established holding times identified in Table A-4.

Completeness for the project will be established as the proportion of data generated that is determined to be valid. The data quality objective for completeness is 90 percent.

Comparability is an expression of the confidence with which one data set can be compared to another. In this project, standard methods, promulgated by EPA or Ecology where available, will be used. Data generated will be reported in units consistent with Ecology or EPA guidelines.

3.4 CONFIRMATION GROUNDWATER SAMPLE DATA EVALUATION

Following collection of groundwater performance monitoring samples, the sample data will be compared to the proposed cleanup levels listed in Table 2 of the CAP. If groundwater data exceed a cleanup level confirmation surface water samples will be collected as described below in Section 3.5.

3.5 CONFIRMATION SURFACE WATER SAMPLING

Confirmation surface water samples will be collected from surface water (Port Gardner Bay) north of Investigation Area F only if confirmation groundwater monitoring results indicate that capping and other redevelopment activities have not reduced arsenic and vinyl chloride groundwater concentrations to below the proposed groundwater cleanup levels. Surface water samples will be collected at locations immediately adjacent to the shoreline and downgradient of any of the proposed groundwater monitoring compliance wells that exceed the cleanup level for arsenic and/or vinyl chloride. Surface water compliance monitoring samples will be collected from seeps, if present. If no seeps are present, compliance monitoring samples will be collected from surface water immediately adjacent to the shoreline.

Surface water compliance monitoring samples will be collected at the optimum time for detecting any water quality impacts resulting from discharge of affected groundwater. It is anticipated that the optimum time to sample will be when the tide has receded to an elevation lower than the groundwater elevation.

The samples will be analyzed for the constituent(s) that exceed the cleanup level at the closest monitoring wells.

4.0 CONFIRMATIONAL MONITORING

Long-term confirmational monitoring for soil cleanup will be implemented in areas where contaminated soil is contained onsite, if applicable. Confirmational monitoring will include annual inspections of the cap overlying the contaminated soil (e.g., asphalt pavement, concrete slabs, buildings) to identify any damaged areas of the cap that require replacement or repair. Cleanup Action Area J-3 is the only soil cleanup area where containment is planned and, as such, is the only area where soil confirmational monitoring is planned.

Long-term confirmational monitoring for groundwater will be implemented once it has been demonstrated that groundwater cleanup standards are being achieved. Groundwater conformational sampling will include periodic groundwater or surface water monitoring (as applicable) at the three new wells installed along the shoreline in Investigation Area F to confirm that arsenic and vinyl chloride concentrations remain below the proposed cleanup levels.

* * * * *

This document has been prepared under the supervision and direction of the following key staff.

LANDAU ASSOCIATES, INC.

Lawrence D. Beard, P.E.
Principal

Stacy J. Pischer, L.G.
Senior Project Geologist

SJP/LDB/jdr

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TABLE A-1
SUMMARY OF CLEANUP ACTION AREA SOIL CONFIRMATION SAMPLE ANALYSES
NORTH MARINA REDEVELOPMENT SITE
EVERETT, WASHINGTON

Cleanup Action Area	Planned Confirmation Soil Sample Analyses
Investigation Area B	
Area B1	Arsenic, cPAHs, TPH-D, TPH-0
Investigation Area C	
Area C1	Arsenic, Lead, cPAHs
Area C2	cPAHs
Area C3	cPAHs
Investigation Area E	
Area E1	Arsenic
Area E2	Arsenic
Investigation Area F	
Area F-1	Arsenic, cPAHs
Area F-2	Arsenic
Area F-3	N/A(1)
Area F-4	Arsenic, cPAHs
Area F-5	cPAHs
Area F-6a	Arsenic, Lead
Area F-6b	Arsenic, Lead
Investigation Area I	
Area I-1	Arsenic, Lead
Area I-2	Arsenic
Area I-3	Arsenic, Lead, cPAHs
Area I-4	Arsenic, cPAHs
Area I-5	Arsenic
Area I-6	cPAHs
Area I-7	cPAHs
Area I-8	Arsenic, Lead, cPAHs
Area I-9	Arsenic, Lead, cPAHs
Area I-10	Arsenic, Lead, cPAHs
Area I-11	Arsenic, Lead, cPAHs
Investigation Area J	
Area J-1	Arsenic
Area J-2	TPH-D, TPH-O
Area J-3	Arsenic, cPAHs
Investigation Area L	
Area L1	Arsenic
Area L2	Arsenic
Area L3	Arsenic & Lead

(1) Not applicable; area designation not used due to reconfiguration of cleanup areas

TABLE A-2
COMFIRMATION SOIL SAMPLE ANALYTICAL METHODS AND REPORTING LIMIT GOALS
NORTH MARINA REDEVELOPMENT SITE
EVERETT, WASHINGTON

Analyte	Analytical Method	Reporting Limit Goal (a)	Units
CARCINOGENIC POLYCYCLIC AROMATIC HYDROCARBONS (cPAHs)			
Benzo(a)anthracene	EPA-8270 SIM	0.067	mg/Kg
Chrysene	EPA-8270 SIM	0.067	mg/Kg
Benzo(b)fluoranthene	EPA-8270 SIM	0.067	mg/Kg
Benzo(k)fluoranthene	EPA-8270 SIM	0.067	mg/Kg
Benzo(a)pyrene	EPA-8270 SIM	0.067	mg/Kg
Indeno(1,2,3-cd)pyrene	EPA-8270 SIM	0.067	mg/Kg
Dibenz(a,h)anthracene	EPA-8270 SIM	0.067	mg/Kg
METALS			
Arsenic	EPA-6010	5	mg/Kg
Lead	EPA-6010	2	mg/Kg
PETROLEUM HYDROCARBONS			
Diesel-Range	NWTPH-Dx (b)	5	mg/kg
Motor Oil-Range	NWTPH-Dx(b)	10	mg/kg

SIM = Selected Ion Monitoring.

(a) Reporting limit goals are based on current laboratory data and may be modified during the investigation process as methodology is refined. Laboratory reporting will be based on the lowest standard on the calibration curve. Instances may arise where high sample concentrations, nonhomogeneity of samples, or matrix interferences preclude achieving the desired reporting limits.

(b) Acid/silica gel cleanup procedures will be applied to soil samples analyzed for NWTPH-Dx.

TABLE A-3
CONFIRMATION GROUNDWATER AND SURFACE WATER SAMPLE ANALYTICAL METHODS AND REPORTING LIMIT GOALS
NORTH MARINA REDEVELOPMENT SITE
EVERETT, WASHINGTON

Analyte	Analytical Method	Reporting Limit Goal (a)	Units
GROUNDWATER SAMPLES			
Metals			
Dissolved Arsenic	EPA 200.8	0.2	µg/L
Dissolved Lead	EPA 200.8	1	µg/L
Volatile Organic Compounds			
Vinyl Chloride	EPA 8260	0.2	µg/L
SURFACE WATER SAMPLES			
Metals			
Total Arsenic (c)	EPA 200.8	0.2	µg/L
Volatile Organic Compounds			
Vinyl Chloride	EPA 8260	0.2	µg/L

(a) Reporting limit goals are based on current laboratory data and may be modified during the investigation process as methodology is refined. Laboratory reporting will be based on the lowest standard on the calibration curve. Instances may arise where high sample concentrations, nonhomogeneity of samples, or matrix interferences preclude achieving the desired reporting limits.

TABLE A-4
SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES
NORTH MARINA REDEVELOPMENT SITE
EVERETT, WASHINGTON

Analysis	Analytical Method	Container	Preservation	Maximum Holding Time (Days)
Soil Samples				
cPAH	EPA 8270-SIM	8-oz. jar - glass	Store cool at 4°C	14
Metals	EPA 6000/7000 Series	4-oz jar - glass	Store cool at 4°C	6 months
TPH	NWTPH-Dx	4-oz jar - glass	Store cool at 4°C	14
Groundwater Samples				
Vinyl Chloride	EPA 8260-SIM	3-40ml vials	HCL to pH<2	14
Dissolved Arsenic	EPA 200.8	1-L polyethylene	5 ml- HNO3 (a)	6 months
Surface Water Samples				
Vinyl Chloride	EPA 8260	3-40ml vials	HCL to pH<2	14
Total Arsenic	EPA 200.8	1-L polyethylene	5 ml- HNO3	6 months

cPAH = Carcinogenic Polycyclic Aromatic Hydrocarbons
SIM = Selected ion monitoring

(a) Dissolved arsenic samples must be filtered prior to preservation; therefore, samples will be filtered in the field.