ENVIRONMENTAL ASSOCIATES, INC.

2122 - 112th Avenue North East, Suite B-100
Bellevue, Washington 98004
(425) 455-9025
FAX: (425) 455-2316

March 17, 1999

JN 8125

Ballard Land Management
30115 First Avenue East
Roy, Washington 98580

Attention: Mr. Dana Bostwick

Subject: **SUBSURFACE ENVIRONMENTAL STUDY**
Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

Dear Mr. Bostwick:

Environmental Associates, Inc. (EAI) has completed subsurface assessment of soil and groundwater at the subject property located in Seattle, King County, Washington. This report, prepared in general accordance with the terms of our proposals dated March 13, 1998 and October 15, 1998, summarizes our approach to the project along with results and conclusions.

The contents of this report are confidential and are intended solely for your use and the use of your representatives. Four (4) copies of this report are being distributed to you. No other distribution or discussion of this report will take place without your prior approval in writing. Additional copies are available for a small fee.

Based upon the results of this investigation, which included subsurface sampling of soil through completion of borings, test pit excavations, and soil probes, installation and sampling of four (4) groundwater monitoring wells, and laboratory analysis of selected soil samples for the presence of petroleum hydrocarbon-related contamination, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), metals, and volatile organic compounds (VOCs), and laboratory analysis of groundwater samples for petroleum hydrocarbons, VOCs, and metals, it would appear that:

- Soil and groundwater at the localities tested does not contain concentrations of metals and VOCs in excess of the appropriate Method A Industrial and/or Method B cleanup levels, and soil does not contain concentrations of PCBs and PAHs in excess of the Method A Industrial cleanup levels published in the Model Toxics Control Act (MTCA), Chapter 173-340 WAC.

- Groundwater at the localities tested does not contain concentrations of petroleum hydrocarbons in excess of the MTCA Method A cleanup level. Trace concentrations of petroleum hydrocarbons in the diesel boiling range were detected in two of the monitoring wells completed on the property, however, the concentrations reported by the laboratory are well below the Method A cleanup level.

- Shallow soil (less than approximately 5 feet in depth) at the unpaved northeastern and northwestern portions of the property, and shallow soil (less than approximately 4 feet in depth) beneath the paved portion of the property south of the marine railway contain concentrations of diesel and oil boiling range petroleum hydrocarbons in excess of the MTCA Method A cleanup level. Laboratory analysis of selected soil samples from these areas using the Washington Department of Ecology (WDOE) Interim Interpretive and Policy Statement - Cleanup of Total Petroleum Hydrocarbons (TPH) methodology (the "Method B" approach to TPH contamination) suggests that these soils do not present a significant potential for impacts to human health or groundwater using the industrial risk assessment criteria inherent in the Method B TPH cleanup approach. As noted above, groundwater was confirmed to contain concentrations of petroleum below the Method A cleanup level.

In view of these findings, it is our opinion that no additional assessment of the property would be required under current MTCA regulations and WDOE policies. We would recommend that consideration be given to paving the remaining unpaved areas of the property to reduce the potential for future leaching by infiltration of precipitation or runoff. The owner/facility operator may also wish to consider periodic (quarterly or semi-annually) groundwater monitoring for petroleum hydrocarbons to document stability of groundwater conditions over time.

Depending upon your long term planning for the property, you may wish to pursue WDOE review of the work described herein through the Voluntary Cleanup Program (VCP) in order to obtain technical opinion from WDOE in writing. It may also be possible to obtain a determination of "no further action" from the WDOE with regard to the noted petroleum impacted shallow soils present at the northwest, northeast and southern portions of the property. Additional discussion is provided for your consideration in the Conclusions/Recommendations section of the attached report.

Finally, to achieve compliance with Section 300 of the Model Toxics Control Act (MTCA), Chapter 173-340 WAC, and since the subject property is a site included on the WDOE's Confirmed and Suspected Contaminated Sites listing, a copy of this report should be forwarded to WDOE regardless of whether or not a VCP review is pursued.

We appreciate the opportunity to be of service on this assignment. If you have any questions or if we may be of additional service, please do not hesitate to contact us.

Respectfully submitted,
ENVIRONMENTAL ASSOCIATES, INC.

Don W. Spencer, M.Sc., P.G., R.E.A.
Principal

EPA-Certified Asbestos Inspector/Management Planner
I.D. # AM 48151

Registered Site Assessor/Licensed UST Supervisor
State Certification #947458636

License: W000010 (Washington)
License: 11464 (Oregon)
License: 876 (California)
License: 5195 (Illinois)
License: Pending (Mississippi)

SUBSURFACE ENVIRONMENTAL STUDY

Marine Fluid Systems
801 Northwest 42nd Street
Seattle, Washington 98107

Prepared for:

Ballard Land Management
30115 First Avenue East
Roy, Washington 98580

Questions regarding this investigation, the conclusions reached and the recommendations given should be addressed to one of the following undersigned.

David Holmes, Project Manager
Environmental Geologist

Don W. Spencer, M.Sc., P.G., R.E.A.
Principal

EPA-Certified Asbestos Inspector/Management Planner
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March 17, 1999

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SITE/PROJECT DESCRIPTION

The subject property includes an irregular-shaped parcel covering approximately 2.53 acres (110,533 square feet) of land located along the north shore of the Lake Washington Ship Canal as indicated on the Vicinity Topographic Map, Plate 1. Approximately 10,590 square feet of the parcel are inundated by the Lake Washington Ship Canal. The site is developed with several buildings as indicated on the Site Exploration Plan, Plate 2. The western-most machine and carpenter shop building, occupied by Marine Fluid Systems - a boat repair and painting company, is located partially atop a wooden wharf, is two stories in height, and was reportedly constructed in 1919. The northern-most office/warehouse building is one-story in height and was reportedly erected in 1920 of wood-frame construction. The eastern-most warehouse building is one-story in height and was reportedly erected in 1942 of wood-frame construction. The general storage building to the west of the eastern warehouse building was reportedly erected in the 1950s and is of wood-frame construction with metal siding. Additional developments include a marine railway and winch house, and a small wooden wharf along the south side of the marine railway.

The site is utilized primarily by Marine Fluid Systems, which became the master tenant in 1997, but has maintained a shop at the property since 1994, however, the northern office warehouse was occupied by a marine software company and an ornamental iron shop at the time of our site work, while an artist (welding) and general storage occupied the eastern warehouse. General storage occurred in the central warehouse building. Currently, electricity is utilized to provide heat to portions of each of the buildings with an above-ground tank providing fuel storage for the northern office-warehouse building. Formerly, the northern office/warehouse used heating fuel stored in an approximately 300-gallon capacity underground tank (UST) as indicated on the Site Plan, Plate 2, with an in-use above-ground tank located just west of the former underground storage tank location. Additionally, an approximately 1,200-gallon capacity underground storage tank was located generally at the northwest corner of the central general warehouse building as indicated on Plate 2. These underground storage tanks (USTs) were removed in 1988, following receipt of the required permits from the Seattle Fire Department.

Referring to the Site Plan, Plate 2, currently the site is predominantly covered with paving of various types. Four areas of the property are un-paved including the submerged area of the property, the northwest corner of the site, the northeast corner of the site, and a small area south of the eastern warehouse. Within the fenced area north of the concrete-paved marine railway is a large concrete pad. A concrete pad also extends several feet south of the marine railway. The southern portion of the property is paved by very tough asphaltic concrete. The eastern drive between the general storage warehouse and the eastern warehouse south to just east of the winch house is asphalt -paved, as is the extreme northwest corner of the property at the entrance to the site from Northwest 42nd Street. The drive located north of the fenced area south of the northern office/warehouse building is paved by concrete that was reportedly brought in by Salmon Bay Sand and Gravel. According to Mr. Dana

Bostwick of Marine Fluid Systems, the concrete was left-over or excess concrete that was dumped at the site in small quantities of less than a few cubic yards. This concrete paving is very rough, and is not reinforced with rebar or wire mesh. Similar "patched" areas are also located south of the marine railway overlying asphaltic concrete. A small concrete patched area is located at the northwest corner of the general storage warehouse and is thought to represent the former location of the 1,200 gallon capacity gasoline underground storage tank. A long-time (26 years) site employee, Mr. Ron Leighton, noted that the fuel pump for the tank was formerly located immediately north of the fence north of the patched area. The following paragraphs provide a brief description of land uses on neighboring properties.

North: The site is bordered on the north by the former Birmingham Steel Ballard Mill, a former manufacturer of rolled steel and re-bar. This property was recently occupied by Alaska Outport Transportation, a dry goods barge company providing services to Southeast Alaska. Bowles Company NW, a plumbing supply company is located across Northwest 42nd Street from the subject site. Northwest Nut and Bolt formerly occupied the property to the northeast of the site.

East: Trident Seafoods currently occupies the property to the east and southeast of the subject site. Salmon Bay Sand and Gravel has a small storage yard east of the northeastern portion of the eastern property line.

South: Located to the south of the subject site is the Lake Washington Ship Canal.

West: Again, the Lake Washington Ship Canal is located to the west of the site.

According to the City of Seattle Department of Construction and Land Use Zoning Map, the subject property is zoned as general industrial, which provides the basis for the use of the Method B cleanup levels used in this report in accordance with the Model Toxics Control Act (MTCA), Chapter 173-340 WAC, however, where applicable, the MTCA Method A Industrial cleanup guidelines were utilized.

BACKGROUND/SCOPE OF WORK

In November 1993, Parametrix, Inc. presented the findings of a Phase 1 Environmental Site Assessment of the Union Bay Shipbuilding Corporation Site (the subject property was occupied by Union Bay Shipbuilding at that time) to Tippett Marine Services. A summary of the findings of that report along with recommendations is presented in the following paragraphs:

- Surficial and shallow soils, asphalt and concrete in at least five localities were stained with what appeared to be petroleum hydrocarbons. Parametrix opined that elevated metal concentrations from sandblasting grit may also be present at these localities. The recommendation was to excavate and dispose of the soil or treat the soil on-site.

- Approximately thirty (30) to forty (40) 55-gallon capacity drums and ten (10) to twenty (20) one- to five-gallon containers were stored in the northwest corner of the site, and were thought to be solvents such as methyl ethyl ketone (MEK), motor oil and water. An unknown volume of these materials was thought to have occupied in this area, and the drums were not properly secured. Parametrix recommended sampling and disposal of the drums. Mr. Dana Bostwick also informed us that upon Marine Fluid Systems occupancy of the property, there was a small drum storage area located east of the winch house on the unpaved portion of the property, but that no drums were located at the northwest corner of the property.

- One 500-gallon capacity gasoline underground storage tank (UST) and one 500-gallon capacity heating oil UST were removed from the site in December 1988. Mr. Tom Dyer, a site employee at that time, stated that a release from the USTs was not apparent. Parametrix recommended subsurface sampling and testing of soil and groundwater. A review of the Fire Department permits contained in an Appendix to Parametrix's report reveals that the UST capacities were 1,200 gallons (gasoline) and 300 gallons (heating fuel).

- The Washington Department of Ecology (WDOE) had identified deficiencies with the on-site storm water system and had directed Union Bay shipbuilding to correct the system, including a method to capture water generated during sandblasting and/or washing of ships within the marine railway. Parametrix recommended completion of the new system as soon as possible. Mr. Bostwick informed us that such a system was installed in 1994.

- Sandblasting grit was observed in the dock area (beneath the surface of the ship canal), suggesting that petroleum and/or metals may have been released into the canal from the site. Parametrix recommended sampling of sediment within the boundaries of the subject site and analysis for metals, polynuclear aromatic hydrocarbons and petroleum.

- Suspected asbestos-containing materials were identified at the site including pipe wrap and floor tile, wallboard. The pipe wrap was wrapped in plastic and was not part of the subject site buildings. The Parametrix recommendation for removal of the pipe wrap and sampling of other suspected materials was made. The recommendation for disposal of the bagged pipe wrap was apparently implemented, as these materials were not noted at the site by us during our work.

- The presence of an approximately 30-year-old electric transformer (out of service) was noted on-site. Parametrix recommended sampling of the transformer oil and decommissioning of the transformer. According to Mr. Bostwick, the transformer fluid was tested and found to be free of PCBs, and the transformer was disposed of as non-hazardous waste.

- Chlorinated hydrocarbons were identified in a temporary well at the adjacent Glacier Park Company Property (currently Trident Seafoods to the southeast of the subject site). Parametrix opined that the chlorinated hydrocarbons may have originated at the subject site. Parametrix recommended installation of a monitoring well along with groundwater sampling and analysis along the common property boundary. Please note that the chlorinated hydrocarbons at this adjacent site were well <u>below</u> Method A groundwater cleanup levels.

- Approximately 220 tons of sandblasting grit was noted at the site. Parametrix recommended disposal of these materials along with follow-on soil sampling from beneath the stockpiled grit to verify that the material had not adversely impacted site soils.

- Parametrix identified Northwest Nut and Bolt, a leaking UST site located hydrologically up-gradient from the subject property. Parametrix recommended regulatory research to resolve this issue.

Additionally, Parametrix noted that Mr. Tom Dyer of Union Bay Shipbuilding Company stated to them that soil at the northeast corner of the site had been excavated and treated on-site in 1991, but that the area had been re-contaminated since the 1991 remediation effort.

At the conclusion of review of the earlier findings of Parametrix as discussed above, the following scope of work was developed through liaison with Mr. Dana Bostwick of Ballard Land Management/Marine Fluid Systems. The overall purpose of this supplemental evaluation was to attempt to resolve uncertainty regarding certain remaining environmental issues and/or unknowns.

- Completion of limited review of records including state and federal listings of contaminated sites for potential impacts to the property from adjacent sites, along with WDOE file review of adjacent properties identified by the review;

- Completion of three test pit excavations, along with soil sampling, in accessible unpaved areas at the site. Currently a very large boat is being repaired at the southeast corner of the property south of the eastern warehouse, making this portion of the site inaccessible;

- Completion of six (6) soil borings, with four (4) of the borings installed as monitoring wells across the property along with soil sampling from each boring and groundwater sampling from the four monitoring wells. Please note that due to the presence of concrete that was impenetrable by the hollow-stem auger drilling rig at one locality, only five borings and were completed. This area was subsequently evaluated using Cascade Probe technology (a Geoprobe) as described below;

- Laboratory analysis of selected soil and groundwater samples for the presence of eight metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) using EPA Method 6010/7000 series analyses;

- Laboratory analysis of selected soil and groundwater samples for the presence of petroleum hydrocarbons using WDOE Method WTPH-HCID, which provides a broad "screen" for several boiling ranges of petroleum hydrocarbon products. Follow-on analysis was to be performed using the appropriate boiling range-specific analysis depending upon the results of the WTPH-HCID analysis or analysis for appropriate hydrocarbons adjacent to USTs/tanks as follows: WDOE Method WTPH-G with analysis for benzene, toluene,

ethylbenzene, and xylenes (BTEX constituents) for gasoline range hydrocarbons, WTPH-D for diesel-range hydrocarbons, and WTPH-Dx (diesel extended) analysis for diesel and/.or oil-range hydrocarbons;

- Laboratory analysis of selected soil and groundwater samples for the presence of volatile organic compounds (VOCs) performed in accordance with EPA Method 8260B/624;

Additional follow-on work accepted by Ballard Land Management in our proposal dated October 16, 1998, following completion of the above-noted scope of work and described herein included the following tasks:

- Completion of additional soil sampling using direct-push sampling technology;

- Laboratory analysis of selected soil samples using the WDOE's Interim Total Petroleum Hydrocarbons (TPH) Policy analyses using the Volatile Petroleum Hydrocarbons and Extractable Petroleum Hydrocarbons (EPH/VPH) analyses;

- Laboratory analysis of selected soil samples for the presence of polynuclear aromatic hydrocarbons (PAHs) performed in accordance with EPA Method 8270;

- Laboratory analysis of a selected soil samples for the presence of PCBs performed in accordance with EPA Method 8081;

- Laboratory analysis of selected soil samples obtained from the vicinity of the former gasoline UST for the presence of gasoline-range petroleum hydrocarbons using WDOE Method WTPH-G along with analysis of BTEX constituents performed using EPA Method 8021B;

- Laboratory analysis of additional samples not exhibiting obvious indications of petroleum hydrocarbon contamination using the previously noted WTPH-HCID methodology;

- Preparation of this summary report documenting the methodology of the study, along with conclusions and recommendations couched in terms of applicable state and federal regulations.

Following the clients directive, no sediment sampling was conducted in submerged areas of the property at this time.

FINDINGS

GEOLOGIC SETTING

Physiographically, the site is situated on a gently rolling plain (the Seattle Drift Plain) which was formed during the last period of continental glaciation that ended approximately 13,500 years ago.

Published geologic maps for the site vicinity (Liesch, et al., 1963) suggest that much of the material underlying the subject site at some depth is glacial till, a dense heterogenous mixture of silt, sand, and gravel. Typically, the till exhibits relatively low vertical hydraulic conductivity which frequently results in formation of a "perched" water table along its upper contact. The "perched" water table (if present) is frequently seasonal and derives recharge primarily from infiltration of precipitation through more permeable overlying soils.

During subsurface sampling at the subject site by Environmental Associates, Inc. (EAI) as summarized herein, we encountered varying amounts of interpreted fill materials predominantly consisting of sand, although some silts and sand with gravel was encountered. The fill was typically less than approximately 5 to 6 feet in thickness, although at boring B-4/MW-4 (near the ship canal) and at boring B-5 (near the former heating oil UST installation), the fill is interpreted to be approximately 8 feet in thickness. Below the fill material, sand, silt and clay were encountered to the maximum depth explored of 19 feet at B-1/MW-1.

Topographically, the site is situated on a generally level surface approximately 17 feet above sea level. Based upon inference from topography and local drainage patterns, along with information developed by us as a part of this work, it appears that shallow-seated groundwater in the vicinity of the subject property flows in a southwesterly direction perpendicular to the Ship Canal. A copy of the U.S. Geological Survey Topographic Map depicting the subject property is attached to this report as Plate 1, Vicinity Topographic Map.

We encountered groundwater at depths of approximately 2 feet below ground surface in most of our explorations, although at B-1/MW-1, groundwater was not encountered until approximately 13 feet below ground surface. Groundwater stabilized at all wells completed at the site at a depth of approximately 1.5 to 3.5 feet below ground surface. During our excavation activities at the site, we also identified thin seeps in our test pit exploration at the northwest corner of the property (TP-1) at a depth of approximately 3.75 feet, and at TP-2 and TP-3, several groundwater seeps were noted at depths below approximately 3 feet. These seeps were located in coarser-grained soils (mainly sands), likely occur in lenses, and in our opinion may not represent the local "water table."

With respect to surface water resources, The Lake Washington Ship Canal is adjacent to the property on the southwest. Salmon Bay lies further to the west of the property, with both of these waterways discharging into Shilshole Bay of the Puget Sound approximately 1.5 miles to the northwest of the

subject property. The great majority of site drainage and runoff is diverted to the municipal sewer system (Metro) through catch basins. All catch basins at the site reportedly discharge to the Metro sewer system, including runoff from the marine railway.

REVIEW OF WDOE FILES AND OTHER REPORTS

On March 30, 1998, we reviewed WDOE file information regarding the subject property, including several letters and telephone logs with the former operator of Union Bay Shipbuilding, Mr. Tom Deyer. A summary of our file review follows.

- On December 2, 1986, the Washington Department of Ecology (WDOE) forwarded a letter regarding observation of housekeeping practices at Union Bay Shipbuilding Corporation (UBSC). WDOE noted that sandblasting grit should be collected to prevent leachate from entering the Ship Canal, paint and oil wastes should be stored in a bermed area with a cover, no drums should be stored on the dock, and tarps should be used to control as much paint overspray and sandblasting grit as possible. According to a follow-up inspection report in March, 1987 the grit had not been controlled, and in June 1987, a $250.00 fine was assessed to UBSC. Following the assessment of the fine, UBSC applied for a National Pollution Discharge Elimination System (NPDES) permit. It appears that the permit was not issued. As a part of the NPDES application, soil samples were obtained by Mr. Deyer and submitted to Pacific Testing Laboratories for analyses including EP Toxicity for heavy metals, and total petroleum hydrocarbons (TPH) by an unknown methodology. The following table summarizes the results of those analyses.

TABLE 1. Results of Prior Analyses[1]

Analyte	SAMPLE ID										Guide-line[2]
	1-1	2-1	3-1	4-1	5-1	6-1	7-1	8-1	1-3	2-3	
Arsenic	<1.00	1.26	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	5.0
Barium	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	100.0
Cadmium	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	1.0
Chromium	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	5.0
Copper	1.11	2.32	<1.00	178.56	<1.00	<1.00	15.75	<1.00	<1.00	<1.00	None
Lead	1.27	1.31	<1.00	<1.00	1.06	<1.00	1.72	1.14	<1.00	<1.00	5.0
Mercury	0.018	0.016	0.017	0.015	0.014	0.017	0.016	0.018	0.021	0.021	0.2
Nickel	<1.00	<1.00	<1.00	<1.00	<1.00	1.46	<1.00	<1.00	<1.00	<1.00	None
Selenium	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.0
Silver	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	5.0

TABLE 1. Results of Prior Analyses[1]

Analyte	SAMPLE ID										Guide-line[2]
	1-1	2-1	3-1	4-1	5-1	6-1	7-1	8-1	1-3	2-3	
Zinc	14.79	19.48	72.6	165.92	22.41	7.34	69.67	67.04	0.85	3.10	None
TPH	<10.00	395.16	913.49	369.80	33.42	144.4	310.78	1932.8	11.86	<10.00	200.00

Gray shading indicates a concentration above the noted guideline.

1 - All metals analyses are given in units of milligrams per liter (mg/l), while TPH results are given in units of milligrams per kilogram (mg/kg). The second number in the sample ID indicates the depth in feet at which the sample was obtained.

2 The guidelines for metals EP Toxicity are the maximum concentrations of contaminants for the Toxicity Characteristic (the value at which the material is classified as dangerous waste, if exceeded) as published in the Dangerous Waste Regulations, Chapter 173-303 WAC. The guideline given for TPH result is the Method A cleanup level published in the Model Toxics Control Act (MTCA), Chapter 173-340 WAC.

Referring the reader to Table 1 above, five of the samples Mr. Deyer obtained contained concentrations of petroleum hydrocarbons (TPH) in excess of the Method A cleanup level published in the Model Toxics Control Act (MTCA), Chapter 173-340 WAC. The location of these samples are indicated on the Site Plan attached to this report as Plate 2 and were located at the northeast, northwest and southeast corners of the property. Results of the EP Toxicity analyses for metals are all below the concentration at which the soil would be designated Dangerous Waste (in accordance with the Dangerous Waste Regulations of Washington State, Chapter 173-303-090 WAC). Please note that copper and zinc had elevated leachate levels. These levels were possibly a result of sandblasting grit being present in the sample with elevated copper and zinc concentrations. There is no published level at which these materials would be designated as Dangerous Wastes, based upon leachate tests.

- A "drop-in" visit by WDOE on December 6, 1990 revealed the presence of grit entering the Ship Canal, inadequate/improper drum storage, the presence of "fugitive dusts" from sandblasting and painting, absence of mapped storm drains (covered by grit), "unacceptable" grit accumulations, and leaking water faucets in the drum storage area. No enforcement action was taken at this time, due to improved conditions noted during a follow-up site inspection performed by WDOE personnel on February 13, 1991.

Please note that many of the issues addressed by WDOE at the facility are no longer present. Mr. Dana Bostwick of Ballard Land Management/Marine Fluid Systems has informed us that the drainage from the marine railway has been routed into the Metro sewer system, and that all catch basins now discharge into the Metro sewer system. Mr. Bostwick stated that Metro requires quarterly analysis of the drainage water entering into the sewer system, and that since Marine Fluid Systems occupied the property (in approximately 1994), there have been no violations of Metro requirements. We have reviewed laboratory results of two recent sampling events (in 1998) for the drainage analysis required by Metro (provided by Mr. Bostwick), and the concentrations were within Metro guidelines. Mr. Bostwick also stated that the material he now uses for sandblasting grit has been tested and does not leach significant concentrations of metals based upon laboratory analysis of the grit. Confirmation of this statement is provided later in this report. Finally, the grit, while at times somewhat uncontrolled at the property during sandblasting operations, is frequently swept up and

lawfully disposed. Currently, a tarp system for control of sandblasting grit, paint debris and paint overspray has been installed along the south side of the marine railway, and a similar tarp system across the north side of the railway is nearly complete.

We were also provided with copies of reports pertaining to adjacent properties by Mr. Bill Yenter, the representative of the property owner, Ms. Florence Evans. All of these reports were also available at the WDOE Northwest Regional Offices. The reports included the Cleanup Action Plan for the adjacent Birmingham Steel/Salmon Bay Steel property to the northwest of the site, and the results of sampling and testing at the adjacent property now occupied by Trident Seafoods, formerly known as Glacier Park Company Property.

With regard to the adjacent property to the northwest (the former Birmingham Steel/Salmon Bay Steel property), Environmental Associates, Inc. (EAI) has successfully obtained a finding of "no further action" (NFA) for the portion of the adjacent Birmingham Steel property recently purchased by the J.G. Ferguson Agency (Alaska Outport), which abuts the subject site on the northwest. The no further action finding for this adjacent site included a deed restriction for areas beneath the building and along the south side of the property. We have documented a limited cleanup of the portion of this adjacent site to the north of the subject property along the south side of the adjacent building, and it appears that the limited petroleum hydrocarbon-impacted soil along the southern side of the Birmingham Steel property does not impact the subject site, based upon analysis of a soil sample obtained from within approximately two feet of the subject property. Groundwater at this adjacent property did not contain exceedances of MTCA cleanup levels for metals or petroleum hydrocarbons during our sampling and analysis at this adjacent site, except for a slight exceedance of the Method A cleanup level for arsenic (EAI, December 2, 1998). We opined that this slight exceedance of the cleanup level for arsenic (which occurred over 150 feet north of the subject property) could possibly be attributable to a "background" concentration, or alternatively, represents an artifact of the sampling methodology. Based upon the information contained in our publicly available report (Environmental Associates, Inc., December 2, 1998), along with our limited supplemental cleanup oversight, sampling, and analysis (in press), it is our opinion that this adjacent property presents little potential for impacts to the subject site.

On April 27, 1992, Dames & Moore presented the findings of a Phase I Environmental Site Assessment and Phase II Investigation to the Waterfront Press Company for the adjacent Glacier Park property currently occupied by Trident Seafoods (hereafter referred to as Trident Seafoods property). The Phase II work completed by Dames & Moore included collection of six surficial soil samples , excavation of three test pits at a soil stockpile and collection of one sample for laboratory analysis, completion of three monitoring wells along with soil and groundwater sampling, and completion of six hand auger borings along with soil sampling. The soil stockpile is located along the former railroad trestle that is present on the Trident Seafoods Property and located at the extreme eastern edge of the subject site (off-site from the subject property). Three samples were also reportedly obtained from the Union Bay Shipbuilding Company property (the subject site) and composited at the laboratory for analysis. According to Mr. Yenter, this composite sample was actually <u>not</u> obtained from the subject site, but rather was obtained from the Trident Seafoods property, and was obtained from the "soil stockpile" along the former railroad trestle/tracks.

Soil samples obtained from the Trident Seafoods property by Dames & Moore were analyzed for the presence of petroleum hydrocarbons, VOCs, and metals. The results of the metals analyses revealed that soil at the adjacent property contained elevated arsenic, copper and lead concentrations, however, the results were below the MTCA Method A Industrial and/or Method B cleanup levels, except for one sample obtained from the "stockpile"/railroad trestle area, which contained concentrations of lead (1,030 mg/kg) and copper (470 mg/kg and 2,500 mg/kg) slightly in excess of the MTCA Method A Industrial cleanup level for lead (1,000 mg/kg) and the MTCA Method B cleanup level for copper (400 mg/kg). Petroleum hydrocarbons were detected in all samples submitted for analysis, but only two samples obtained from surficial soils tens of feet away from the subject property contained concentrations (12,000 mg/kg and 8,600 mg/kg) above the MTCA Method A cleanup level of 100 mg/kg (gasoline) or 200 mg/kg (diesel). Although several VOCs were detected in the "offsite" soil sample, these compounds were also present in the Method Blank, suggesting that the results were a laboratory artifact. A sample of trestle wood was also analyzed for the presence of polynuclear aromatic hydrocarbons (PAHs), however, the results were below the MTCA Method B cleanup level.

Laboratory analysis of groundwater samples obtained from the Trident Seafoods Property by Dames & Moore revealed that no exceedance of MTCA cleanup levels were identified with respect to VOCs. At one locality (MW–A1 located approximately 40 feet or more southeast of the subject property), petroleum hydrocarbons were detected in groundwater at the cleanup level of 1,000 μg/l.

Relying solely upon the information contained in the Dames & Moore 1992 report, it would appear that the potential for impacts to the subject site from the adjacent Trident Seafoods property would be very low. For the benefit of the reader, selected pages from this report including the laboratory analysis results tables and the site exploration plan are attached here as Appendix A.

A report provided by Mr. Yenter for a larger parcel east of the site including the adjacent Trident property completed by Dames & Moore on December 22, 1989 for the Glacier Park Company noted that the Northwest Nut and Bolt leaking underground storage tank site is located approximately 120 feet northeast of the subject site, is a buried railroad tank car having a capacity of approximately 10,000 gallons, contained bunker oil, and was identified as having a leak through replacement of piping in 1988. Contaminated soils were excavated for disposal. Relying upon the results presented in the referenced report by others, this property would appear to present little potential for environmental impairment of the subject site.

METHODOLOGY/SUBSURFACE INVESTIGATION

Drilling, Excavation, and Soil Sampling

SOIL BORINGS

On April 1, 1998, Environmental Associates, Inc. (EAI) completed five (5) hollow-stem auger soil borings, four (4) of which were installed as monitoring wells, at the approximate locations noted as B-1/MW-1, B-2/ MW-2, B-3/MW-3, B-4/MW-4 and B-5 on the Site Exploration Plan, Plate 3. The

location of B-1/MW-1 was selected due to its presence at the northeast corner of the property in an up-gradient position from the majority of the site, its location in an area of petroleum impacted soil, and due to the presence of the off-site Northwest Nut & Bolt Leaking Underground Storage Tank facility located to the northwest of the subject property in an inferred hydrologically up-gradient position. The location of B-2/MW-2 was selected to assess groundwater quality at a location where Mr. Bostwick stated drums had been stored, and to assess groundwater quality possibly impacted by adjacent properties to the east. The location of B-3/MW-3 was also selected to assess groundwater quality moving onto the property from properties to the north and northeast. B-4/MW-4 was located south of the marine railway to assess groundwater quality moving off the property and discharging into the Lake Washington Ship Canal. Boring B-5 was placed in close proximity to the reported location of the former heating oil underground storage tank (UST). We were prevented from completing hollow stem auger boring in the vicinity of the interpreted former gasoline UST due to the presence of heavy steel used in Marine Fluid Systems' course of business, however, we completed several soil probes (Cascade Probes) in the vicinity of the interpreted former gasoline UST at a later date as described below. The maximum depth of the hollow stem auger borings was 19 feet at boring B-1. A B-61 truck-mounted drilling unit equipped with 4-inch inner diameter hollow-stem augers was employed to accomplish drilling of the borings. Under the supervision of our staff geologist, the drilling unit was brought into position over each selected drilling location, blocked up, and leveled before drilling.

Following set-up preparations, the drilling technique consisted of advancing each boring with the auger string to the desired depth, then lowering the sampler and connecting rods through the center of the hollow-stem augers. The inner rod/sampler assembly was then driven eighteen inches at each designated sampling interval using a 140 pound hammer in general accordance with ASTM Method D-1586. The sampler was then withdrawn and opened for examination.

Samples were transferred from the sampler directly to sterilized glassware with Teflon-sealed lids furnished by the project laboratory. Samples were stored in an iced chest at the site and taken to the laboratory in this condition in an effort to preserve sample integrity. Each jar was clearly labeled as to boring and sample number, date, time, project, etc. EPA-recommended sample management protocol, including maintenance of chain-of-custody documentation was observed at each stage of the project.

During drilling, a field log was made by the project geologist for each boring. Information recorded versus corresponding depth included soil classification (Unified Soil Classification System), color, texture, apparent moisture content, odors (if present), etc.

TEST PIT EXPLORATIONS

Three test pit explorations were completed at the site on May 4, 1998 following receipt of laboratory analyses of soil samples obtained during hollow stem auger drilling. TP-1 was completed at the northwest corner of the property in the vicinity of the former drum storage area noted by Parametrix, which is also an area where Mr. Deyer had documented petroleum contamination in soil. TP-2 was located at the northeast corner of the property in an area documented by Mr. Deyer to have petroleum-impacted soil. TP-3 was completed at the southeast corner of the property in an area of historic drum storage (according to Mr. Bostwick) and in an area where uncontrolled sandblasting grit had historically been present. A rubber-tired backhoe was utilized to complete the excavations.

Samples were obtained from the center of the backhoe bucket or directly from the excavation sidewalls, and placed into laboratory-provided glassware. Sample management protocol was similar to that described above for hollow-stem auger boring soil samples.

Prior to backfilling of the excavation, a field log was made by the project geologist for each test pit exploration. Information recorded versus corresponding depth included soil classification (Unified Soil Classification System), color, texture, apparent moisture content, odors (if present), etc.

SOIL PROBE (SP) SAMPLING

Following receipt of laboratory results of samples obtained from the borings and test pit excavations and with the authorization of Mr. Bostwick, on October 23, 1998, a Geoprobe or direct-push hydraulic soil sampling apparatus (Cascade Probe) with a 175 pound hydraulic hammer was utilized to obtain samples at 13 different localities across the property as indicated on the Site Exploration Plan, Plate 3. Based upon the results of laboratory analysis of soil samples completed in April and May of 1998, three soil probes (SP-1, SP-2, and SP-3) were completed in the vicinity of known hydrocarbon-impacted soil at the northwest corner of the property in the vicinity of TP-1, and one soil probe (SP-5) was completed in the vicinity of MW-1 and TP-2. SP-4 was completed in the vicinity of the reported former location of the heating oil UST. SP-9 was completed adjacent to MW-4, based upon the presence of hydrocarbons in soil and groundwater at this locality. SP-10 and

SP-11 were completed in the vicinity of the interpreted former location of the gasoline UST at the property. Soil probes SP-6, SP-7, SP-8, SP-12 and SP-13 were completed in areas of the property that had not been evaluated by ourselves or previous workers at the site. Sampling was performed continuously with the advancement of the probe, and samples were either collected in a split spoon sampler, or in plastic tubing liners. Following removal of the sampler, the split spoon was opened for examination and sampling of selected depth intervals, while the plastic sleeves were split by knife and opened for examination and sampling of selected depth intervals. Again, sample management protocol was similar to that described above for hollow-stem auger drilling.

Upon opening of the split spoon/plastic sleeve, a field log was made by the project geologist for each boring. Information recorded versus corresponding depth included soil classification (Unified Soil Classification System), color, texture, apparent moisture content, odors (if present), etc.

A single grab soil sample (SS-1) was obtained on October 23, 1998 from the vicinity of MW-1 at the northeast corner of the property at a depth of approximately one (1) foot for later analysis for PCBs. This location of this sample is indicated on the Site Exploration Plan, Plate 3, as SS-1. This sample was obtained from close proximity to boring B-1, which contained elevated hydrocarbon concentrations at this depth.

Two surficial soil grab samples were obtained from the southeast corner of the property on September 28, 1998 at the locations at the southeast edge of the property identified as GRIT-1 and GRIT-2 on the Site Exploration Plan, Plate 3. The soil samples contained abundant sandblasting grit. These samples were obtained due to concerns raised by the adjacent Trident Seafoods that debris cleanup activities completed by Marine Fluid Systems in this area and partially involving the Trident property had possibly adversely impacted the Trident Seafoods property. Trident noted that sandblasting grit was present in this area. The consultant for Trident had stated that "old black glass", possibly ASARCO sandblasting grit that could potentially contain elevated concentrations of lead and arsenic had been noted in this area. No "older black glass" was noted by us during the course of our site work.

Well Installation & Groundwater Sampling

As the object of this preliminary effort was to provide a defensible basis for determining groundwater quality beneath the site, four (4) of the borings were completed as monitoring wells.

Following drilling and soil sampling, two-inch diameter PVC well casing with 0.010-inch slots was installed to the total depth of the boring. A blank riser casing was then used in the upper several feet. The well screen was positioned

so as to span the maximum and minimum range of the anticipated seasonal groundwater fluctuation, thus facilitating representative sampling of water at any time during the year. Based upon our previous work at a nearby property, groundwater occurs at a depth of less than approximately 5 feet below ground surface, therefore the monitoring well borings were completed to a depth of between 12 and 19 feet, with the screened interval placed from the base of the borings to within approximately 3 feet to 7 feet of the ground surface. Design and construction methods conformed to requirements and specifications outlined in revisions of WAC 173-160 for "resource protection wells" in the state of Washington.

The annulus of the well casing was sand packed one to three feet above well screens; a bentonite seal was placed above the sand and carried to within two feet of the ground surface to prevent infiltration of surface contamination along the well casing. A concrete plug stabilizes the upper two-foot section of the well. A protective casing with provisions for locking access to the well head were included.

Prior to sampling, a disposable plastic bailer was used to purge each well by removing a minimum of three well volumes of water from each well. This was performed in an effort to assure that samples obtained from the well were representative of ambient groundwater conditions.

Following developmental purge bailing, a clean, dedicated disposable plastic bailers were used to collect groundwater samples from each well. Each sample was poured directly from the bailer into preconditioned labeled glassware (one liter capacity amber jars preserved with hydrochloric acid for diesel extended analyses, three (3) 40 milliliter (ml) VOA vials preserved with hydrochloric acid for volatile organic compound analyses, 500 ml unpreserved plastic bottles for total metals analysis, and 500 ml plastic bottles preserved with nitric acid (HNO_3) for dissolved metals analyses) furnished by the project laboratory. Dissolved metals samples were collected following filtration through a 0.45 micrometer (μm or micron) membrane. Samples were stored in an iced chest on-site and transported to the project laboratory in this condition. EPA sample-management protocols including maintenance of chain-of-custody records formed an integral part of the field sampling effort.

Subsurface Conditions

Soils encountered during excavation, drilling and soil probe sampling included a surface layer of gravel, sand, and/or silt interpreted to be fill material to depths ranging between less than five feet (northeast, northwest and southeast portions of the property) and approximately 8 feet (along the ship canal). The fill was predominantly sand and gravelly sand, with some silty fill noted at B-2/MW-2. Below this surficial fill material, soils typically included interbedded silt, clay, and sand. Native soil and fill ranged in color from gray to brown,

with gray being the predominant color. Moisture content was typically high, with sand beds being wet, and silt and clays being very moist to wet. Density of the soil ranged from very soft/very loose to medium dense. At only one locality were blow counts over 20 blows for one foot of penetration by the sampler, at B-1 at a depth of 17.5 feet below ground surface where the blow count was 44 - a dense soil. In silts and clays at the site, thin beds of peat were encountered up to 2 inches thick. At boring B-1, at a depth of approximately 14 to 15 feet, we encountered silty sand with gravel interpreted to possibly be weathered glacial (lodgement) till. Soil at other boring localities below the surficial fill is interpreted to be mud flat-deposited silt and clay and "beach" sands deposited prior to the construction of the Hiram Chittenden Locks. The 1895 shoreline as shown on a Polk atlas map sheet is approximately depicted on the Site Plan, Plate 2.

Specific conditions encountered at each exploration locality are presented in the Test Boring Logs, Plates 4 through 8, the Test Pit Logs, Plate 9 and Plate 10, and the Soil Probe Logs, Plates 11 through 13. Well installation design is depicted on each of the Test boring Logs (Plates 4, 5, 6, and 7) completed as monitoring wells .

Water Table Survey

Information regarding direction of groundwater movement and hydraulic gradients is frequently found to be of value in applications such as risk assessment or evaluation of possible alternative sources for water-borne contaminants.

On May 6, 1998, a self-leveling laser-type builders level was used to determine the relative elevation of the top of each well casing to an accuracy of 0.01 foot, a standard specified for such work by the U.S. Geological Survey. An assumed temporary survey datum was a point determined at the time of the survey as the northeastern corner of a concrete slab located in front of the bay doors at the northern office/warehouse. This point was assumed solely for our convenience here to have an arbitrary elevation of 20 feet above sea level.

A Solinst electronic depth to water meter was used to ascertain the groundwater level to an accuracy of 0.01 foot referenced from the surveyed top of the casing in each well. By subtraction of the depth to water from the elevation of the top of the casing, the elevation of the water table in each well was determined. Table 2, below, summarizes the results of the survey and depth measurement data.

TABLE 2: Results of Groundwater Table Survey[1]				
Measurement	MW-1	MW-2	MW-3	MW-4
Casing elevation	19.76	19.59	18.45	18.40
Depth to water	1.34	7.72	3.29	6.19
Elevation of Water table	18.42	11.87	15.16	12.21

1 - Assumed vertical datum of 20 feet above sea level at the northeast corner of the concrete slab located south of the eastern bay door of the northern office/warehouse building. All values in feet.

Through interpolation of plotted relative water table elevations for each well on a scale map, approximate contours of equal elevation on the water table were interpreted. As groundwater is known to flow from areas of higher potential toward areas of lower potential along lines "normal" (right angles) to such contours, the direction of flow and approximate gradient was inferred. Confirming intuition in this case, the interpreted results of our water table survey suggest that groundwater at the site flows toward the southwest, nearly perpendicular to the shoreline of the Lake Washington Ship Canal.

LABORATORY ANALYSES FOR PETROLEUM HYDROCARBONS (SOIL)

Considering the prior sampling and analysis performed by Mr. Deyer documenting the presence of petroleum hydrocarbon contamination at the site, along with the former presence of heating oil and gasoline USTs at the facility, selected soil samples were submitted to the project laboratory for analysis using gas chromatography (GC) by WTPH-HCID (hydrocarbon identification), Method WTPH-D for total petroleum hydrocarbons (TPH) in the diesel range, Method WTPH-Dx (diesel extended) for TPH in the diesel and oil boiling ranges, and/or WTPH-G with analysis for benzene, toluene, ethylbenzene, and xylenes (BTEX - performed using EPA Method 8021B) for TPH as gasoline and BTEX gasoline constituents. Samples were only submitted for analysis using WTPH-HCID following our initial drilling at the property, and following soil probe sampling if there were no visual and/or olfactory indications of the presence of petroleum hydrocarbon contamination. We refer the reader to the Site Exploration Plan, Plate 3, for the locations of borings/monitoring wells, test pits, soil probes and surficial soil sample locations.

The laboratory reports for soil samples are included in Appendix B, Laboratory Reports and Chains-of-Custody for Soil Samples, at the end of this report. The following brief tables summarize the results of laboratory testing for petroleum hydrocarbons using the above-noted methodology. The soil samples selected for analysis were obtained from several different depths in an effort to assess the vertical and horizontal distribution of potential petroleum hydrocarbon contamination at the subject site.

TABLE 3: WTPH-HCID Results (Soil)[1]				
Sample ID	**Depth (feet)**	**TPH as Gasoline**	**TPH as Diesel**	**TPH as Oil**
B-1-1	2.5-4.0	ND	**Detected**	**Detected**
B-2-2	5.0-6.5	ND	ND	ND
B-3-1	2.4-4.0	ND	ND	ND
B-4-1	2.5-4.0	ND	**Detected**	**Detected**
B-5-1	2.5-4.0	ND	**Detected**	ND
SP-12-1'	1.0	ND	ND	ND
SP-12-5'	5.0	ND	ND	ND
SP-13-2.75'	2.75	ND	ND	ND
Cleanup Guideline		100	5.0	20.0

1 - All results are given on a "not detected" or "detected" basis. Please Table 4 and Table 5 below for quantification analysis results. Detection limits are presented in Appendix B, and are at or below the cleanup level.

Referring to Table 3 above, it appeared that sample B-1-1, and B-4-1 contained diesel and oil range hydrocarbons, while sample B-5-1 contained diesel range hydrocarbons. These samples were submitted for quantification analyses using WTPH-Dx and WTPH-D (sample B-5-1). Samples B-2-2, B-3-1, SP-12-1', SP-12-5', and SP-13-2.75' did not contain detectible petroleum hydrocarbons, and were not submitted for additional petroleum hydrocarbon quantification analyses. The following table summarizes the results of the follow-on quantification analyses of the samples exhibiting diesel and/or oil range analysis, along with the results of additional samples obtained later which were submitted for WTPH-Dx analyses due to the sample location's proximity to areas of known hydrocarbon contamination or suspected contamination based upon visual and olfactory observations.

TABLE 4: WTPH-Dx/WTPH-D Results (Soil)[1]

Sample	Depth (feet)	Diesel Result	Oil Result	Diesel PQL	Oil PQL
B-1-1	2.5-4.0	**303[O]**	**870**	10.0	25.0
B-4-1	2.5-4.0	**245[O]**	**2,440**	110	275
B-5-1	2.5-4.0	**1,160**	Not analyzed	10.0	Not applicable
TP-1-2.25'	2.25	167[O]	**687**	10.0	25.0
TP-1-3.25'	3.25	ND[2]	ND	10.0	25.0
TP-2-5'	5.0	ND	ND	10.0	25.0
SP-1-1.5'	1.5	76[A]	**1,200**	26	52
SP-3-2'	2.0	49[A]	**220**	28	57
SP-4-5.5'	5.5	ND	ND	30	61
SP-5-1.5'	1.5	150[A]	**510**	27	55
SP-6-8"	0.66	ND	ND	31	62
SP-7-1'	1.0	**1,600[A, S]**	**1,700**	29	58
SP-8-6"	0.5	ND[A, D]	**540**	150	120
SP-9-1'	1.0	**200[A, D]**	**1,100**	130	110
MTCA Cleanup Guideline[3]		200	200	Not applicable	Not applicable

Note: Bold typeface and gray shading indicate an exceedance of the Method A cleanup guideline.
1 - All results, practical quantitation limits (PQLs) and cleanup levels given in milligrams per kilogram (mg/kg).
2 - ND indicates that the analyte was not detected above the stated Practical Quantitation Limit (PQL).
4 - Method A soil cleanup levels are published in the Model Toxics Control Act (MTCA), Chapter 173-340 WAC.
O - The laboratory reports that the diesel result is elevated due to overlap from oil-range hydrocarbons.
A - The laboratory reports that the sample underwent acid cleanup procedures.
S - The laboratory reports that surrogate recovery data not available due to coelution of target compounds.
D - The laboratory reports that surrogate recovery data not available due to necessary dilution of the sample.

The laboratory testing results of the submitted soil samples, as summarized in the table above and as included in Appendix B, Laboratory Reports and Chains-of-Custody for Soil Samples, confirm that concentrations of diesel- and oil-range petroleum hydrocarbons were present in several samples above the WDOE Method A cleanup level. Acknowledging that the boring, test pit and soil probe samples were completed at different times and that the locations and depths of test pit and soil probe samples were based upon the results of analyses of samples obtained during earlier work, the following paragraphs summarize in some detail our findings with regard to the WTPH-Dx and WTPH-D analyses of soil samples.

- Samples obtained from the unpaved northeast corner of the property contain concentrations of diesel and oil-range hydrocarbons. Based upon the results of analysis of samples B-1-1 (at a depth of 2.5 feet), TP-2-5' (at a depth of 5 feet), and SP-5-1.5' (at a depth of 1.5 feet), it would appear that the petroleum contamination in this area is limited to soil from the ground surface to a maximum depth of 5 feet. Also, it would appear that these soils are predominantly impacted by oil-range petroleum hydrocarbons, with concentrations less than approximately 2,500 mg/kg.

- Samples obtained from the unpaved northwest corner of the property contain oil range hydrocarbons at concentrations above the Method A cleanup level (diesel results were below the cleanup level). Based upon the results of analysis of samples TP-1-2.25', TP-1-3.25', SP-1-1.5' and SP-3-2' (at the depths indicated by the last number in the sample name), it would appear that the petroleum hydrocarbons in soil exceeding the Method A cleanup level at the northwest corner of the property impact soil only at depths shallower than approximately 3.25 feet, with concentrations not exceeding approximately 1,400 mg/kg.

- Results of analysis of soils obtained from the vicinity of the heating oil UST (Samples B-5-1 at a depth of 2.5 feet and SP-4-5.5') suggest that diesel-range contamination above the Method A cleanup level may be limited to approximately the upper 5 feet of soil. The petroleum hydrocarbons present in soil at this location are predominantly diesel-range hydrocarbons. The petroleum contamination at this locality may be a result of surface spillage and/or overfill of the former UST and/or the current above-ground tank in this area

- The results of analysis of soil samples obtained from the southern portion of the property (samples B-4-1 at a depth of 2.5 feet, SP-7-1', SP-8-6", and SP-9-1') suggest that a combination of diesel and/or oil-range petroleum residues are present in shallow soil across this portion of the property at concentrations above the Method A cleanup level. Visual and olfactory observations of soil during sampling of these borings/soil probes suggests that the petroleum hydrocarbons are limited to the upper approximately 5 feet. Additional discussion and analysis of samples obtained form this area is provided later in the report.

- Soil at the southeastern edge of the property does not appear to contain detectible petroleum hydrocarbons, based upon analysis of samples B-2-2 at a depth of 5 feet and SP-6-8".

- Soil samples obtained from across the central portion of the property at depths ranging from 1 foot to 5 feet (SP-12-1', SP-12-5', and SP-13-2.75') do not appear to contain detectible concentrations of petroleum hydrocarbons based upon the results of WTPH-HCID analyses.

Acknowledging that the UST which was formerly located at the northwest corner of the general storage warehouse was used to store gasoline in the course of its useful life, selected samples from soil probes SP-1- and SP-11 completed in this area were submitted for analysis for gasoline and gasoline constituents benzene, toluene, ethylbenzene, and xylenes (BTEX) using GC performed in accordance with Method WTPH-G. Table 5 below summarizes the results of the laboratory analysis for gasoline -range hydrocarbons.

TABLE 5: WTPH-G+BTEX Results (Soil)[1]						
Sample ID	Depth (feet)	TPH as Gasoline	Benzene	Toluene	Ethylbenzene	Xylenes
SP-10-9.25'	9.25	<7.7	<0.077	<0.077	<0.077	<0.077
SP-11-6'	6	<6.4	<0.064	<0.064	<0.064	<0.064
Cleanup Guideline		100	5.0 /0.5	40.0	20.0	20.0

1 - All results given in milligrams per kilogram (mg/kg or parts per million [ppm]).)The Method A cleanup levels are published in the Model Toxics Control Act (MTCA), Chapter 173-340 WAC. The "less than" symbol (<) indicates the concentration was below the practical quantitation limit for the analysis, which is the number following the "less than" symbol.

Referring to Table 5 above, it appears that soils in the vicinity of the interpreted location of the former gasoline UST at depths of 6 feet and 9.5 feet do not contain detectible concentrations of gasoline-range petroleum hydrocarbons or BTEX constituents.

Following receipt of our initial laboratory testing of soil samples obtained from test pit excavations and borings, it was our impression that the petroleum contamination at the site was relatively low-level, and limited to diesel- and oil-range petroleum hydrocarbons. We recommended that Ballard Land Management consider implementation of the WDOE's Interim Interpretive and Policy Statement - Cleanup of Total Petroleum Hydrocarbons (WDOE, January 1997, Publication No. ECY97-600). This method is commonly referred to as the Method B TPH cleanup approach. We recommended this approach since it has been our experience at several other sites that diesel- and oil-range hydrocarbons at similar concentrations as (or even higher than) those identified at the subject site typically will pass the criteria presented in the Interim and Interpretive Policy Statement, and since it had been shown that groundwater had not been significantly impacted by the presence of petroleum in soil at the site (groundwater quality assessment at the site is presented later in the report). This risk-based approach accepted by the WDOE is accomplished by analyzing and assigning risk to the various fractions of petroleum hydrocarbon products. Under the interim TPH Policy, hydrocarbons are divided into two major fractions, aliphatic hydrocarbons (hydrocarbons with straight carbon chains), and aromatics (hydrocarbons consisting of six-carbon ring structures). Each of these fractions is then subdivided into smaller fractions defined by the number of carbon atoms in the structure, as follows:

FOR ALIPHATICS:
C5-C6
>C6-C8
>C8-C10
>C10-C12
>C12-C16
>C16-21

FOR AROMATICS:
>C8-C-10
>C10-C12
>C12-C16
>C16-C21
>C21-C35

Each of these hydrocarbon fractions is then represented by a surrogate compound for which toxicology data has been established/adopted by the WDOE. The risk posed by each of these fractions is therefore represented by the risk posed by the surrogate compound representing that fraction. The risk for direct human contact with the impacted soil and the risk to groundwater is evaluated by entering the concentration of each fraction (obtained by using the EPH and VPH

methodology set forth by WDOE for the analytical laboratories) into a worksheet provided by WDOE. Additionally, the direct human contact risk calculation evaluates the risk posed depending upon the type of land use (residential, commercial, industrial). In general the risk calculation is less tolerant with residential land uses and more tolerant with industrial land uses. The interested reader is referred directly to WDOE's Interim Interpretive and Policy Statement (January 1997) if a more technical discussion on calculating risk is desired. Finally, as a part of the WDOE Method B TPH cleanup approach, laboratory analysis for the presence of polynuclear aromatic hydrocarbons (PAHs) is required. The results of the analysis for carcinogenic PAHs (c-PAHs) for each sample are also used in calculating the risk presented by the petroleum-impacted soil. The analytical method for PAH analysis is EPA Method 8270C.

Ballard Land Management accepted our recommendation to evaluate the petroleum impacted soil discovered during our boring and test pit excavations, and several samples obtained during our subsequent soil probe sampling were submitted to the project laboratory for EPH/VPH methodology as follows:

- A sample obtained from soil Probe SP-2 at a depth of 3 feet, approximating the depth at which diesel-range petroleum hydrocarbons were detected in a soil sample obtained from test pit TP-1 at a depth of 2.25 feet (the northwest corner of the property).

- A sample obtained from SP-4 at a depth of 2 feet, in very close proximity to the locality at which diesel-range petroleum hydrocarbons were detected at a depth of approximately 2.5 feet at boring B-5. These borings/soil probes were very close to the reported former location of the heating fuel UST.

- A sample obtained from soil probe SP-9 at a depth of 3.5 feet. This sample was obtained from within six feet of boring/monitoring well MW-4, which contained elevated diesel- and oil-range petroleum hydrocarbon concentrations at a depth of approximately 2.5 feet. The soil sample submitted from SP-9 for EPH/VPH analysis also exhibited obvious visual and olfactory indications of petroleum contamination at a depth of between 3.5 and 4.0 feet.

- A sample obtained from soil probe SP-10 at a depth of 5.5 feet. This sample was obtained from within one foot of the interpreted former location of the gasoline UST. This sample was submitted for analysis by EPH/VPH methodology due to a faint to moderate odor of petroleum hydrocarbons in soil at this location from a depth of approximately 5.5 feet to approximately 6.5 feet.

- A surficial soil sample obtained from the northeast corner of the property (sample SS-1) was submitted for analysis due to the presence of petroleum hydrocarbons reported at this location by previous workers (the former site owner) and the finding of petroleum contamination in this vicinity during our test pit and hollow stem auger boring sampling and analysis performed earlier in 1998. Soils at the northeast corner of the property appear to be impacted by petroleum hydrocarbons from approximately the ground surface to a depth of approximately three feet.

The following section summarizes the results of the EPH/VPH and PAH analysis of the samples noted in the preceding paragraphs.

LABORATORY ANALYSES: EPH/VPH, PAHS & PCB (SOIL)

Following advancement and sampling of the soil probes, selected samples from depths at which hydrocarbons had been encountered at elevated concentrations during our earlier sampling and analysis work were submitted to the project laboratory for analysis performed in accordance with WDOE EPH/VPH methodology. Additionally, these samples were also analyzed for PAHs performed in accordance with EPA Method 8270C. Finally, samples obtained from the northeast, northwest, and southwest portions of the property which exhibited visual and olfactory indications of significant contamination by petroleum hydrocarbons (as noted above, typically in the oil range at these portions of the property) were analyzed for the presence of PCBs using EPA Method 8082.

The laboratory results of the samples analyzed for PCBs are summarized in Table 6 below and in Appendix B at the end of this report.

TABLE 6: EPA Method 8082 PCB Results (Soil)[1]

Analyte	Detection Limit	Sample Result		
		SP-2-3'	SP-9-3.5'	SS-1
Aroclor 1016	0.057[2]	ND	ND	ND
Aroclor 1221	0.057	ND	ND	ND
Aroclor 1232	0.057	ND	ND	ND
Aroclor 1242	0.057	ND	ND	ND
Aroclor 1248	0.057	ND	ND	ND
Aroclor 1254	0.057	0.074	ND	0.46
Aroclor 1260	0.057	0.086	ND	ND
Sum of Sample Result[3]		0.16	Not applicable	0.46
Method A (residential) Cleanup Guideline		1.0	1.0	1.0
Method A Industrial Cleanup Guideline		10.0	10.0	10.0

1 - All results, limits, and guidelines given in mg/kg (ppm).
2 - The detection limit varied for each sample between 0.055 and 0.057 for each Aroclor. Please refer to Appendix B for the precise detection limit for each sample.
3 - The cleanup level is published in the Model Toxics Control Act (MTCA), Chapter 173-340 WAC. The cleanup level is given for total PCBs, therefore the results of detected PCBs should be summed, then compared to the cleanup guideline.

0.92 close OK

As summarized in Table 6 above, it appears that concentrations Aroclor 1254 and Aroclor 1260 are present in detectible concentrations in sample SP-2-3', and Aroclor 1254 was detectible in sample SS-1. Sample SP-9-3.5' did not contain detectible concentrations of PCBs. The detected concentrations in SP-2-3' and SS-1 are both well below the Method A cleanup levels for ~~both residential and~~ industrial soils. Additionally, the total concentration of PCBs in these samples are below the Method A (residential and industrial) cleanup levels. It would appear that no additional characterization for PCBs at the site would be warranted.

As noted earlier, those samples submitted for analysis for EPH and VPH analyses for hydrocarbons were also analyzed for the presence of polynuclear aromatic hydrocarbons (PAHs). Table 7 below summarizes the results of the PAH analyses performed in accordance with EPA Method 8270C. The basis for selection of samples for analysis was described above. The laboratory report presented in Appendix B provides additional information including quality assurance and quality control data, as well as practical quantitation limits for the analysis.

TABLE 7: EPA Method 8270C PAH Results (Soil)[1]

Sample	SP-2-3'	SP-4-2'	SP-9-3.5'	SP-10-5.5'	SS-1	Method B Cleanup Guideline[2]	Method A Industrial Cleanup Guideline[2]
Depth (feet)	3.0	2.0	3.5	5.5	<1.5	na	na
Non-carcinogenic PAHs:							
Naphthalene	<0.18	<0.042	<1.9	<0.041	<0.37	3200	none
2-Methylnaphthalene	<0.18	<0.042	<1.9	<0.041	<0.37	none	none
Acenaphthylene	<0.18	<0.042	<1.9	<0.041	<0.37	none	none
Acenaphthene	<0.18	<0.042	<1.9	<0.041	<0.37	4800	none
Fluorene	<0.18	<0.042	<1.9	<0.041	<0.37	3200	none
Phenanthrene	<0.18	<0.042	<1.9	<0.041	1.0	none	none
Anthracene	<0.18	<0.042	<1.9	<0.041	<0.37	24000	none
Fluoranthene	0.29	<0.042	<1.9	<0.041	2.0	3200	none
Pyrene	0.32	<0.042	<1.9	<0.041	1.7	2400	none
Benzo[g,h,i]perylene	0.37	<0.042	<1.9	<0.041	0.70	none	none
Carcinogenic PAHs:							
Benzo[a]anthracene	**0.24**	<0.042	<1.9	<0.041	**0.92**	0.137	none
Chrysene	**0.37**	<0.042	<1.9	<0.041	**1.1**	0.137	none
Benzo[b]fluoranthene	**0.44**	<0.042	<1.9	<0.041	**1.0**	0.137	none
Benzo[k]fluoranthene	**0.37**	<0.042	<1.9	<0.041	**0.88**	0.137	none
Benzo[a]pyrene	**0.40**	<0.042	<1.9	<0.041	**1.2**	0.137	none
Indeno[1,2,3-cd]pyrene	**0.38**	<0.042	<1.9	<0.041	**0.82**	0.137	none
Dibenz[a,h]anthracene	<0.18	<0.042	<1.9	<0.041	<0.37	0.137	none
TOTAL c-PAHs:	2.20	na	na	na	5.92	0.137	20.0
Total PAHs:	3.18	na	na	na	11.32	none	none

NOTE: Bold typeface indicates an exceedance of the Method B cleanup level, however, the industrial cleanup level is not exceeded. Please note that with increasing concentration and/or matrix interferences, the detection limit or PQL increases. According to personnel at On-Site Environmental, this is unavoidable with the EPA 8270C analytical methodology.

1 - All results, practical quantitation limits (PQLs) and cleanup levels given in milligrams per kilogram (mg/kg).

2 - Method A and B soil cleanup levels are published in the Model Toxics Control Act (MTCA), Chapter 173-340 WAC. The Method A (residential) cleanup level for PAHs is 1.0 mg/kg.

Referring to Table 7 above and Appendix B, several non-carcinogenic PAHs were detected in samples SP-2-3' and SS-1. None of the non-carcinogenic PAHs exceed their respective cleanup guidelines (if any are published/available). Similarly, carcinogenic PAHs (c-PAHS) were only detected in samples SP-2-3' and SS-1. While several of the c-PAHs exceed the Method B cleanup guideline, the total (the summation) of the c-PAHs in each sample is well below the Method A

Industrial cleanup guideline. It would appear unlikely that carcinogenic PAHs are present in site soil in the study area at concentrations exceeding the Method A Industrial cleanup guideline of 20.0 mg/kg, considering that soil sample SP-2-3' would appear to represent a "worst case" scenario, based upon the WTPH-Dx data obtained during this study (see Table 4).

Finally, samples SP-2-3', SP-4-2', SP-9-3.5', SP-10-5.5' and SS-1were submitted for petroleum hydrocarbon analysis performed using WDOE's EPH/VPH methodology as previously described. Please refer to the Site Exploration Plan, Plate 3, for a depiction of the sampling localities in relation to the test pit excavations where elevated petroleum hydrocarbons were detected. The results of the EPH/VPH analyses are summarized in Tables 8, 9, 10, 11 and 12 found at the end of this report, and in Appendix B attached.

Referring to Table 8 and Appendix B, Laboratory Reports and Chains-of-Custody for Soil Samples, it would appear that the EPH/VPH analysis (Method B TPH cleanup) for sample SP-2-3' would pass only for commercial or industrial uses since the calculated residential Risk is above $1x10^{-6}$ (or 1E-06), the allowable risk for residential properties. Sample SP-4-2', as summarized in Table 9, would appear to pass for residential, commercial or industrial uses as the Hazard Quotient (HQ) is below one (1) in each case, and the Risk is below $1x10^{-6}$ (or 1E-06) for residential use and $1x10^{-5}$ (or 1E-05) commercial or industrial uses. The results for sample SP-9-3.5', presented in Table 10, would appear to fail for residential and commercial uses, as the Hazard Quotient for these uses exceeds one (1), but would pass for industrial uses. Referring to Table 11, sample SP-10-5.5' would appear to pass for all uses, similar to sample SP-4-2'. The results of sample SS-1 as presented in Table 12, would fail for residential and commercial uses since the Risk (posed by the carcinogenic PAHs) is greater than $1x10^{-6}$ for residential uses and $1x10^{-5}$ for commercial uses, but would pass for industrial uses. Also, all five samples would appear to pass the soil to groundwater pathway "test," since the concentration calculated for each sample is less than or equal to 0.1 milligrams per liter (mg/l), well below the 1.0 mg/l threshold for use of the TPH Method B cleanup.

Based upon EPH/VPH/PAH laboratory analyses and WDOE-published evaluation of the samples as summarized above, it would appear that the surficial petroleum-impacted soil at the site would require no further cleanup or assessment using the TPH Method B cleanup. This methodology does not take into account the surface water or vapor pathway for potential impacts. Considering that no enclosed basements are located on or near the subject site, the vapor pathway would not appear to be an issue at this property. Also, considering that almost the entire site is paved, the potential for impacts to surface water would also appear to be relatively low. Mr. Bostwick of Ballard Land Management/ Marine Fluid Systems has stated that should he purchase the property, his plan is to pave the remaining exposed soil areas of the site (see Plate 2), thereby further reducing any additional potential impacts to surface water quality, if any exist. Quantitative groundwater quality analyses at the site is discussed in a later section of this report, and appears to confirm the Method B "prediction" of "low risk" to groundwater quality.

LABORATORY ANALYSES: METALS (SOIL)

Several soil samples obtained from across the property were submitted to the project laboratory for analysis for total metals including arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver (RCRA Metals) using inductively coupled plasma (ICP) and atomic absorption (AA) performed in accordance with EPA Method 6000/7000 series analyses. Soil samples selected for analysis included surficial samples obtained from borings B-1 and B-2, shallow soil samples obtained from B-4, samples obtained from varying depths at TP-1, and samples obtained from TP-2 and TP-3. Additionally, attempting to respond to concerns raised by Trident Seafoods regarding cleanup of soil and sandblasting grit stored by Marine Fluid Systems on a very small portion of the adjacent Trident property, two samples (GRIT-1 and GRIT-2) of surficial soil consisting predominantly of sandblasting grit were composited at the project laboratory and analyzed for total metals. The locations of where the samples were obtained is depicted on the Site Exploration Plan, Plate 3. Table 13 below summarizes the results of the laboratory analyses for total metals.

TABLE 13: EPA Method 6000/7000 Series Metals Results (Soil)[1]

Sample	Depth (feet)	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
B-1-S	Surface	33.3	101	0.741	17.8	167	0.908	<0.500	<0.500
B-2-S	Surface	10.1	43.1	0.560	17.9	48.7	<0.100	<0.500	<0.500
B-3-1	2.25	<0.500	19.1	<0.500	7.65	0.988	<0.100	<0.500	<0.500
B-4-1	2.25	0.720	15.9	<0.500	20.4	2.67	<0.100	<0.500	<0.500
TP-1-2.25'	2.25	11.0	74.3	0.95	21.9	357	<0.100	<0.500	<0.500
TP-1-3.25'	3.25	1.37	26.9	<0.500	11.7	3.42	<0.100	<0.500	<0.500
TP-2-5'	5.0	5.06	133	<0.500	34.1	4.05	<0.100	<0.500	<0.500
TP-3-1'	1.0	157	130	1.69	38.7	291	0.638	<0.500	<0.500
GRIT-1/ GRIT-2 Composite	Surface	31	290	0.56	49	230	<0.26	<10	<0.51
MTCA Cleanup Guideline[2]		200.0[A]	5,600[B]	10.0[A]	500.0[A]	1,000.0[A]	1.0[A]	400.0[B]	400.0[B]

Notes: 1 - All detection limits, results, and cleanup levels are given in milligrams per kilograms (mg/kg) {parts per million (ppm)}.

2 - Guideline cleanup standards are published in the Model Toxics Control Act (MTCA, Chapter 173-340-740 WAC. The "A" flag indicates the Method A Industrial cleanup level, while the "B" flag indicates the Method B cleanup level. Method A Industrial given when available.

As summarized in Table 13 above, none of the samples analyzed contain concentrations of metals in excess of the applicable MTCA Method A Industrial or Method B cleanup levels. Selenium and silver were not detected in any of the analyzed samples, and mercury was detected in only two of the analyzed samples. Only one sample (TP-3-1') contained an "elevated" arsenic concentration, and two samples (TP-1-2.25' and TP-3-1') contained "elevated" lead concentrations, however, these concentrations are well below the Method A Industrial cleanup levels for arsenic and lead. Sample B-1-S obtained from the ground surface at the northeast corner of the property contained a

concentration of mercury (0.908 mg/kg) approaching the cleanup level (1.0 mg/kg), but considering that the other sample obtained from this area (TP-2-5') did not contain detectible concentrations of mercury, it is our opinion that this occurrence in sample B-1-S may not be representative of general shallow soil conditions at the northeast corner of the property.

Additionally, the two samples of soil containing abundant sandblasting grit (GRIT-1 and GRIT-2) did not contain "elevated" concentrations of any metal included in the analysis. In an effort to confirm that the sandblasting grit-containing soils would not be considered "dangerous waste" if removed from the property, the composite grit sample was submitted for analysis using the Toxics Characteristic Leachate Procedure (TCLP) performed in accordance with EPA Method 1311/6010B/ 7470A. Table 14 below summarizes the results of the TCLP analysis. The table also includes TCLP results of a sandblasting grit sample submitted by Mr. Dana Bostwick for some sandblast cleanup work performed at the property in 1997. It is our understanding through conversations with Mr. Bostwick that the results for the analysis provided were of sandblasting grit currently in use at the site, and that the material included in our grit samples may possibly be the older sandblasting grit that was used in the past by Union Bay Shipbuilding Company. The laboratory reports for these analyses are included in Appendix B. Mr. Bostwick did not provide us with the chain-of-custody documentation for the data provided to us.

TABLE 14: EPA Method 1311/6010B/7470A TCLP Results (Soil)[1]

Sample	Depth (feet)	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
GRIT-1/ GRIT 2 Composite	Surface	<0.40	<3.0	0.023	0.047	0.53	<0.010	<0.40	<0.20
No ID# provided	-	<0.5	1	<0.1	<0.5	<0.5	<0.02	<0.5	<0.5
Dangerous Waste Designation Criteria[2]		5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.0

Notes: 1 - All detection limits, results, and designation criteria are given in milligrams per liter (mg/l) {equivalent to parts per million (ppm)}. Composite sample obtained by EAI, other sample obtained by Mr. Bostwick.

2 - Dangerous waste designation criteria are published in the Dangerous Waste Regulations, Chapter 173-303- WAC.

Based upon the results of the TCLP analysis of the abundant grit-containing soils as presented in Table 14 above and in Appendix B, it would appear that the grit-containing soils at the southeast corner of the property would not be considered "dangerous waste" if removed from the property. The soils would also appear to be unregulated under the Model Toxics Control Act, as these soils also did not exhibit concentrations of metals above the MTCA cleanup level as summarized above in Table 13. Regardless, we would not recommend removal and placement of these soils on non-industrial properties, rather, we would recommend that these soils remain at the site. Similarly, it would appear that the sandblasting grit currently in use at the site would not be considered dangerous waste when removed from the property during regular maintenance/cleanup activities performed by Marine Fluid Systems.

LABORATORY ANALYSES: VOCS (SOIL)

Considering the reported drum storage areas identified by previous workers at the site (Parametrix, 1993), selected samples obtained from borings and test pits were submitted to the project laboratory for analysis for volatile organic compounds (VOCs) using gas chromatography performed in accordance with EPA Method 8260B. Samples selected for analysis were chosen based upon odor (if any), proximity to the water table/seeps, or proximity to a relatively impermeable clay layer. Table 15 below summarizes the results of the analysis for VOCs. The Method 8260B includes analysis for over 64 chlorinated and non-chlorinated compounds. Only those compounds that were detected in the analysis are presented in the following table, and we refer the reader to Appendix B for the full suite of analytes and their detection/reporting limits.

TABLE 15: EPA Method 8260B VOC Results(Soil)[1]

ANALYTE	Sample ID	B-2-2	B-2-3	B-4-2	B-5-1	TP-1-3.25'	TP-3-1'	Cleanup Guideline[2]
	Depth (feet)	5.9	7.5	7.5	2.5	3.25	1	
4-Chlorotoluene		**0.017**	<0.100	<0.100	<0.100	<0.100	<0.100	N/A
Ethylbenzene		**0.240**	<0.100	<0.100	<0.100	<0.100	<0.100	20.0[A]
Naphthalene		**0.788[S]**	<0.100	<0.100	<0.100	<0.100	<0.100	320.0[B]
1,2,4-Trimethylbenzene		**0.153**	<0.100	<0.100	<0.100	<0.100	<0.100	N/A
m,p-Xylene		**4.99**	<0.400	<0.400	<0.400	<0.400	<0.400	20.0[A]
o-Xylene		**1.90**	<0.100	<0.100	<0.100	<0.100	<0.100	20.0[A]
Total xylenes		**6.89**	-	-	-	-	-	20.0[A]

Notes: For the benefit of the reader, those samples with detected analytes have been highlighted by bold. This in no way suggests that the concentration is above the regulatory level.

1 - All results, reporting limits, and cleanup guidelines are given in milligrams per kilogram (mg/kg - parts per million {ppm}).

2 - Guideline cleanup standards are published in the Model Toxics Control Act (MTCA), Chapter 173-340 WAC. The "A" flag indicates the Method A Industrial cleanup level, while the "B" flag indicates the Method B cleanup level. Method A given when available.

N/A "N/A" indicates that the cleanup level is not available/not published.

S - The "S" flag denotes that the laboratory indicates that the concentration is a suspected laboratory contaminant, and not representative of the concentration in the sample. Naphthalene was present in the laboratory QA/QC blank sample.

As summarized Table 15 above, it would appear that with the exception of sample B-2-2, completed at the southeastern edge of the property, VOCs are not detectible in any of the samples analyzed. The concentrations detected in sample B-2-2 obtained from a depth of 5.0 feet are all well below their respective cleanup levels, if available (typically, when cleanup levels are not available, it is because there is insufficient toxicology data in the published literature to develop a reference dose used in the calculation of Method B cleanup levels). A possible candidate source for the VOCs detected in sample B-2-2 could be the reported drum storage that occurred in the area of boring B-2 during the occupancy of the property by Union Bay Shipbuilding Company. Other candidate sources could exist of which we are unaware. Relying solely upon the results presented in Table 15 above, it would appear that no additional characterization of soil at the property for the presence of VOCs would be warranted at this time.

LABORATORY ANALYSES: GROUNDWATER

As discussed earlier, the potential contaminants at the site have been identified as consisting predominantly of metals, volatile organic compounds (VOCs), and petroleum products. The following sections summarize the results of laboratory analyses of groundwater for these potential contaminants.

Petroleum Hydrocarbons

On May 6, 1998, following depth to water measurement and developmental purge bailing as described previously, groundwater samples were obtained from each well and submitted to the laboratory for analysis performed in accordance with WDOE Method WTPH-Dx, since only diesel and oil range petroleum hydrocarbons were detected in soil samples at the site. Table 16 below summarizes the results of the analysis. A copy of the laboratory report and chain-of-custody is provided in Appendix C, Laboratory Report and Chain-of-Custody for Groundwater Samples.

TABLE 16: WTPH-Dx Results (Groundwater)[1]

Sample	Diesel Result	Oil result
MW-1	ND[2]	ND
MW-2	0.468	ND
MW-3	ND	ND
MW-4	0.731	ND
Practical Quantitation Limit (PQL)	0.250	0.750
MTCA Method A Cleanup Guideline[3]	1.0	1.0

Notes: 1 - All results, practical quantitation limits (PQLs) and cleanup levels given in milligrams per liter (mg/l).
2 - ND indicates that the analyte was not detected above the stated PQL.
3 - Method A groundwater cleanup levels are published in the MTCA, Chapter 173-340 WAC.

Referring to Table 16 above, it would appear that groundwater at monitoring wells MW-1 and MW-3 do not contain detectible concentrations petroleum hydrocarbons in the diesel and oil boiling ranges. Groundwater at MW-2 and MW-4 do not contain detectible concentrations of oil boiling range hydrocarbons, however, petroleum hydrocarbons as diesel were detected at concentrations below the MTCA Method A cleanup level. Based upon these results, it would appear that groundwater at the site has not been significantly impacted by petroleum hydrocarbons in the diesel and/or oil boiling ranges possibly related to either surficial petroleum spillage or the former on-site underground storage tanks.

Metals

Groundwater samples obtained on May 6, 1998 were submitted to the laboratory for analysis for total and dissolved metals including arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver (RCRA Metals) using inductively coupled plasma (ICP) and atomic absorption (AA)

performed in accordance with EPA Method 6000/7000 series analyses. Table 17 below summarizes the results of the laboratory analyses for both total and dissolved metals in groundwater.

TABLE 17: EPA Method 6000/7000 Series Metals Results (Groundwater)[1]

Analyte	MW-1		MW-2		MW-3		MW-4		MTCA Cleanup Guideline[1,2]
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	
Arsenic	**3.98**	**1.73**	**3.32**	**3.80**	**7.59**	**3.51**	<1.00	**2.09**	5.0[A]
Barium	**33.6**	**29.4**	**41.9**	**33.8**	**44.3**	**33.3**	**86.0**	**78.1**	1,120[B]
Cadmium	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	5.0[A]
Chromium	<1.00	**3.17**	<1.00	**1.71**	<1.00	**1.81**	<1.00	**3.26**	50.0[A]
Lead	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	5.0[A]
Mercury	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	2.0[A]
Selenium	<1.00	**1.2**	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	80.0[B]
Silver	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	80.0[B]

Notes: For the benefit of the reader, those analytes that were detected have been highlighted by bold typeface. This in no way implies that the concentration is above the cleanup level for the analyte. Those samples exhibiting concentrations of analytes above the cleanup level have been shaded by gray.

1 - All detection limits, results, and cleanup levels are given in micrograms per liter (μg/l - equivalent to parts per billion (ppb)).

2 - Guideline cleanup standards are published in the Model Toxics Control Act (MTCA, Chapter 173-340-740 WAC. The "A" flag indicates the Method A cleanup level, while the "B" flag indicates the Method B cleanup level. Method A given when available.

Referring to Table 17 above, it would appear that groundwater at all four monitoring wells on the property do not contain detectible concentrations of cadmium, lead, mercury, and silver, either total or dissolved. Dissolved chromium was consistently detected at very low concentrations in all four samples, but was not detected on a totals basis. This is possibly the result of sampling methodology, which included preservation of the field-filtered (through a 0.45 micrometer [μm] membrane) sample with nitric acid (HNO_3), which could possibly leach chromium from any remaining suspended sediment following filtration. Selenium was detected only in the sample obtained from MW-1, and similar to chromium, was only identified in the dissolved sample, however, the dissolved concentration is well below the MTCA Method B cleanup level.

Arsenic and barium were consistently detected in groundwater obtained from all wells, with the exception of the total barium concentration in groundwater obtained from MW-4, which was not detected. Excluding the total arsenic concentration in groundwater at MW-3, none of the total or dissolved concentrations of arsenic and barium reported exceed the respective cleanup levels for arsenic and barium. The total concentration of arsenic at MW-3 (7.59 μg/l) is only slightly in excess of the cleanup level (5.0 μg/l), however, the dissolved concentration is below the current 5.0 μg/l MTCA Method A

cleanup level. It is our understanding through conversations with Mr. Charles San Juan of the WDOE Headquarters in August of 1998 that some consideration is being given to increasing the groundwater arsenic cleanup level. It is not known if such an increased cleanup level for arsenic will be implemented in the future. It has been our experience at several sites in King County including the adjacent Salmon Bay Steel/Birmingham Steel property, that groundwater may contain concentrations of arsenic well in excess of the Method A cleanup level, both total and dissolved, often approaching concentrations as high as 50 μg/l. During our recent work for a different client, groundwater at the adjacent Birmingham Steel property contained a dissolved concentration of arsenic of 23 μg/l, and we opined that this concentration may be a naturally occurring condition (EAI, December 2, 1998). WDOE has apparently concurred with this conclusion at the adjacent Birmingham Steel property, since the "no further action" (NFA) determination at that adjacent site did not contain mention of the presence of arsenic in groundwater. Based upon the results presented here, and relying upon our experience in the area and with the WDOE, it would appear that groundwater at the subject site has not been significantly impacted by metals. It would appear that no further characterization of site groundwater would be warranted with respect to total or dissolved metals at this time.

Volatile Organic Compounds (VOCs)

Considering the reported drum storage areas identified by previous workers at the site (Parametrix, 1992) and the use of certain paint thinners at the property currently and in the past, groundwater samples obtained were submitted to the project laboratory for analysis for volatile organic compounds (VOCs) using gas chromatography performed in accordance with EPA Method 8260B. The Method 8260B includes analysis for over 64 chlorinated and non-chlorinated compounds. None of the 64 VOCs were detected in groundwater obtained from any of the monitoring wells completed at the property. For confirmation of this finding, we refer the reader to Appendix C. Based upon the absence of detectible concentrations of VOCs in groundwater obtained from the site, it would appear that no additional characterization of groundwater with respect to VOCs would be warranted at this time.

LABORATORY DATA QUALITY REVIEW

A review of the laboratory quality assurance/quality control (QA/QC) data provided with each laboratory report and included in Appendices B and C, including method blanks, matrix spikes, matrix spike duplicates, and surrogate recovery suggests that the quality of the data may be relied upon as representative of actual conditions/concentrations in each sample. In each case where a relative percent difference or control limit was outside the established range of values, it would appear that the laboratory has established a reasonable explanation for accepting the data as valid.

Sample heterogeneity and matrix interferences were often noted or present, however, such conditions should be not be interpreted as unusual, considering the heterogeneity and variability inherent in earth/environmental materials.

CONCLUSIONS/RECOMMENDATIONS

Relying solely upon information developed during the course of this preliminary investigation, and information contained in publically available reports, it would appear that:

- Soil at the subject property has not been impacted above the MTCA Method A Industrial cleanup levels by volatile organic compounds (VOCs). Trace concentrations of several VOCs including xylenes, 4-chlorotoluene, ethylbenzene and 1,2,4-trimethylbenzene, were detected at a single locality at the property (boring B-2-2 at a depth of 5 feet, however, the concentrations were well below the MTCA Method A cleanup level.

- Soil beneath the site does not contain concentrations of metals in excess of the their respective MTCA Method A Industrial or Method B cleanup levels. Additionally, sandblasting grit in soils located predominantly at the southeast corner of the property does not appear to contain leachable concentrations of metals in excess of the Dangerous Waste Regulations, Chapter 173-303 WAC. The current sandblasting grit in use at the subject property also does not contain concentrations leachable metals. Soil and sandblasting grit at the property would not be designated as hazardous or dangerous waste if removed from the property. We do not recommend removal of soil from the property, however, since certain metals concentrations (arsenic and lead) are in excess of the MTCA Method A residential cleanup levels.

- Polynuclear aromatic hydrocarbons (PAHs) are present at several (predominantly surficial) localities across the property, and may be present at any locality exhibiting elevated hydrocarbon concentrations. The non-carcinogenic PAHs at all of the localities analyzed are well below their respective Method B cleanup levels. The carcinogenic PAHs that were detected are present at concentrations exceeding the Method B cleanup level, however, the total concentration of carcinogenic PAHs detected at two localities (SP-2 at the northwest corner of the property and SS-1 at the northeast corner of the property) are below the MTCA Method A Industrial cleanup guideline. Additionally, analysis of these samples using the MTCA Method B petroleum cleanup method suggests that the presence of these carcinogenic PAH compounds would not present a significant risk to human health or the environment or present the potential for impacts to groundwater.

- Soil at the subject property that is impacted by oil-range hydrocarbons does not appear to contain concentrations of polychlorinated biphenyls in excess of the MTCA Method A Industrial or Residential cleanup guidelines.

- Soil in the vicinity of the reported former location of a 1,200 gallon gasoline underground storage tank does not contain detectible concentrations of gasoline-range petroleum hydrocarbons or BTEX constituents.

- Groundwater at the subject property does not appear to be impacted by metals, volatile organic compounds or petroleum hydrocarbons in concentrations exceeding their respective MTCA Method A or Method B cleanup guidelines for groundwater. Volatile organic compounds were not detectible at any of the four monitoring wells at the subject property, and with the exception of arsenic at MW-3, metal concentrations (both total and dissolved) are well below the respective Method A or Method B cleanup guidelines. Dissolved arsenic was not present at a concentration exceeding the Method A cleanup guideline at MW-3 and the total concentration of arsenic was only slightly in excess (7.59 μg/l) of the Method A cleanup guideline for arsenic (5.0 μg/l). Petroleum hydrocarbons were detected at two of the monitoring wells at the property (MW-2 and MW-4), however, the concentrations reported (0.468 mg/l at MW-2 and 0.731 mg/l at MW-4) were well below the MTCA Method A cleanup guideline of 1.0 mg/l.

- Soil at the site at several localities contains concentrations of petroleum hydrocarbons in excess of the MTCA Method A cleanup level. These localities are the northeastern and northwestern unpaved areas of the property, in the immediate vicinity of the heating oil above ground storage tank/former heating oil UST location, and along the southern boundary of the property. The depth of petroleum contamination does not appear to exceed approximately four feet along the southern side of the property and in the vicinity of the heating oil above-ground tank. The contamination at the northeastern and northwestern unpaved portions of the property does not appear to extend below depths of approximately 5 feet and 3.25 feet, respectively. The contamination is predominantly in the diesel and oil boiling ranges, with primarily diesel-range hydrocarbons in soil in the vicinity of the above-ground heating fuel tank.

With regard to the presence of petroleum hydrocarbons contamination in the diesel and oil ranges at the property, it is our opinion that the source for the hydrocarbons at all localities identified is possibly the result of surface spillage/releases. This would appear to be supported by the information provided by Dana Bostwick, who related to us that diesel engines were formerly stored at both the northeastern and northwestern corners of the site. Along the southern portion of the property, it appears that surface spillage/releases and/or petroleum impacted fill material may be responsible for the hydrocarbon contamination. The maximum concentration reported using WTPH-Dx was 2,440 mg/kg at B-4-1, and the maximum concentration reported by EPH/VPH methodology was 22,000 mg/kg at SP-9, which were both located along the southern side of the property. It would therefore appear that impacts to soil by petroleum hydrocarbons are greatest south of the marine railway. The EPH/VPH laboratory results suggest that the highest concentrations occur as C21 and higher hydrocarbons, which corresponds to the oil boiling range.

Regarding future action at the site with respect to shallow petroleum-impacted soil (above approximately 6 feet in depth), several management alternatives exist including, but not limited to: (1) no further action; (2) excavation and disposal through thermal desorption of impacted soil; and (3) excavation and on-site treatment of impacted soil.

Considering that these shallow soils exhibit relatively high concentrations of oil-range petroleum hydrocarbons, it would appear that on-site treatment (alternative 3 above) of these soils would not be effective in significantly reducing hydrocarbon concentrations, since oil-range petroleum hydrocarbons are typically not effectively remediated by natural or enhanced biologic degradation in this climatic region. An additional consideration for rejecting this alternative include the space requirement to complete the remediation.

While excavation and treatment by thermal desorption and subsequent recycling of the soils could be an effective remediation alternative, the costs associated with this method (or simple excavation and landfilling following on-site treatment) could be prohibitive, considering the pavement destruction and replacement, repair of/damage to/disruption of utilities, impacts to business operations (anticipated to be considerable), etc.

Additional sampling and analysis could be utilized to further define the extent of impacted soil, resulting in tighter budgetary control of any cleanup that may be performed. However, it is our opinion that the sampling and analysis completed in accordance with the Interim and Interpretive Policy Statement - Cleanup of Total Petroleum Hydrocarbons using the industrial land risk assessment and hazard quotient has documented that these shallow-seated petroleum-impacted soils present little potential for additional impacts to groundwater or human health. For this reason, the no further action alternative with regard to the shallow petroleum-impacted soil at the property would appear to satisfy the intent of the Model Toxics Control Act, and be protective of health, and groundwater. As noted earlier, it would appear that the potential for these impacted soils to adversely impact air quality and/or surface water quality may be relatively low, also supporting the no further action recommendation for these soils.

Considering that the EPH/VPH analyses have documented little potential for impacts to health and/or the environment for the industrial land-use risk criteria, along with the fact that the property is paved or is planned to be paved (mitigating the surface water pathway), there are no basements in the vicinity of the site (thereby minimizing the potential vapor pathway), it is our opinion that additional action or further study of soil quality with respect to petroleum hydrocarbons would not be particularly useful at this time. Additionally, no further study would appear to be warranted with respect to metals, VOCs, PCBs or PAHS in soil and/or groundwater at this time, however, the owner or facility operator may wish to consider periodic (quarterly or semi-annually) monitoring of groundwater quality with respect to diesel and petroleum boiling range hydrocarbons in an effort to document and verify stability of groundwater conditions over time.

Finally, in accordance with the Model Toxics Control Act (MTCA), Chapter 173-340-300 WAC, this report should be forwarded to the WDOE, as the subject property is a site listed on WDOE's Confirmed and Contaminated Sites listing. As an alternative to simply providing the WDOE with

a copy of this report for in-house review and file information, Ballard Land Management may wish to consider submission of this report for technical review under the Voluntary Cleanup Program (VCP) in an effort to obtain WDOE's technical opinion regarding the petroleum contamination at the site, and hopefully obtain a determination of "no further action" with regard to the presence of petroleum hydrocarbons in shallow soils at the site.

LIMITATIONS

This report has been prepared for the exclusive use of Ballard Land Management, along with their several representatives, for specific application to this site. Our work for this project was conducted in a manner consistent with that level of care and skill normally exercised by members of the environmental science profession currently practicing under similar conditions in the area, and in accordance with the terms and conditions set forth in our proposal March 13, 1998 and October 15, 1998. The opinions offered here rely solely upon observations and assessment of conditions encountered at separated boring/sampling localities and/or depths. Conditions may vary between the various exploration localities or at other locations and depths. No other warranty, expressed or implied, is made. If new information is developed in future site work which may include excavations, borings, studies, etc., Environmental Associates, Inc., must be retained to reevaluate the conclusions of this report and to provide amendments as required.

REFERENCES

Environmental Associates, Inc., December 2, 1998, Supplemental Subsurface Sampling and Testing, Proposed Shoreline Parcel Purchase, Birmingham Steel Property, Northwest 42nd Street at Burns Avenue Northwest, Seattle, Washington. Prepared for J.G. Ferguson Agency, 31 pps., 4 tables, 11 plates, appendices.

Dames & Moore, April 27, 1992, Phase I Environmental Site Assessment and Phase II Investigation, Glacier Park Company Property, Seattle, Washington (adjacent to the subject site on the southeast). Prepared for Waterfront Press Co., 21 pps., 3 figures, 6 tables, appendices.

Hart Crowser, December 22, 19989, Preliminary Environmental Assessment, Glacier Park Company, Leary Avenue Property, Property Sequence No. 828, Seattle, Washington (adjacent to the east). Prepared for Glacier Park Company, 8 pps., 1 figure, appendices.

Parametrix, November 1993, Phase I Environmental Site Assessment, Union Bay Shipbuilding Corporation Site, 801 Northwest 42nd Street, Seattle, Washington 98107 (subject site). Prepared for Ms. Billie Adams, Tippett Marine Services, 17 pps., 2 figures, appendices.

United States Geologic Survey, 1983, Seattle North, Washington 7.5x15 Minute (1:25,000 scale) Topographic Quadrangle Map. From aerial photographs obtained in 1977, 1 sheet.

TABLE 8: Results of EPH/VPH Analysis: Sample SP-2-3'

All concentrations in milligrams per kilogram (mg/kg or parts per million [ppm])

				HUMAN HEALTH DIRECT CONTACT EXPOSURE PATHWAY						SOIL TO GROUNDWATER PATHWAY
1	2	3	4	5	6	7	8	9	10	13
Compound	Soil Conc. (mg/kg)	Oral Refernce Dose (mg/kg*day)	Oral Cancer Potency factor (kg*day/mg)	Residential HQ	Residential Risk	Commercial HQ	Commercial Risk	Industrial HQ	Industrial Risk	Conc.@ well (mg/l)
Aliphatics										
EC 5 - 6	0									0.000
EC >6 - 8	0									0.000
EC >8 -10	0									0.0000
EC >10 -12	0									0.00000
EC >12 -16	0									0.00000
EC >16 - 21	28									0.000000
Total aliphatic	28	0.06		0.01		0.00		0.00		
Aromatics										
EC >8 - 10	0									0.000
EC >10 - 12	0									0.000
EC >12 - 16	0									0.000
EC >16 - 21	0									0.0000
EC >21 - 35	59									0.0002
Total aromatic	59	0.03								
Benzene	0		0.029		0.00E+00		0.00E+00		0.00E+00	0.00
c-PAHs	2.2		7.3		1.61E-05		4.02E-06		1.22E-06	
Ethylbenzene	0	0.10		0.00		0.00		0.00		
Toluene	0	0.20		0.00		0.00		0.00		0.000
Xylenes	0	2.00		0.00		0.00		0.00		
Total aromatic+B-E-X	59	0.03		0.02		0.01		0.00		
Total				0.03	1.61E-05	0.01	4.02E-06	0.00	1.22E-06	0.0
RESULT				FAIL		PASS		PASS		PASS

HQ = Hazard Quotient. This quotient is calculated from the soil concentration data in Column 2 and the associated Oral Reference Dose (RfD).
RISK: the risk is calculated from the benzene and PAH concentration data in column 2 and the associated Oral Cancer Potentcy Factor (OCPF) for those compounds. The values for RfD and OCPF are selected by WDOE and may be periodically updated. Values used here reflect the values published in WDOE's most recent Interim Interpretive and Policy Statement (January 30, 1997). The reader is referred to that document for additional details.
NOTES: This worksheet calculates Methods B and C soil cleanup levels for TPH for two pathways: "direct contact human health" and "soil-to-groundwater." Other possible pathways, such as vapor and surface water must be considered (see "Interim Policy"). In addition to not exceeding a TPH level in the groundwater of 1.0 mg/L, there cannot be exceedance in the groundwater for individual substances such as the "BETX" compounds.

1. Hazard quotients for individual substances or fractions cannot exceed 1.0
2. The hazard index (sum of the hazard quotients) cannot exceed 1.0
3. The risk for individual substance or fractions cannot exceed 1x10E-06 for residential land use or 1x10E-05 for commercial or industrial.
4. The risk for the total cannot exceed 1x10E-05 for any land use.
5. The "concentration at the well" cannot exceed 1.0 mg/L total TPH.
6. If any exceedence occurs in 1-5 above, then the cleanup level for TPH has not been met.

TABLE 9: Results of EPH/VPH Analysis: Sample SP-4-2'

All concentrations in milligrams per kilogram (mg/kg or parts per million [ppm])

				HUMAN HEALTH DIRECT CONTACT EXPOSURE PATHWAY						SOIL TO GROUNDWATER PATHWAY
1	2	3	4	5	6	7	8	9	10	13
Compound	Soil Conc. (mg/kg)	Oral Refernce Dose (mg/kg*day)	Oral Cancer Potency factor (kg*day/mg)	Residential HQ	Residential Risk	Commercial HQ	Commercial Risk	Industrial HQ	Industrial Risk	Conc.@ well (mg/l)
Aliphatics										
EC 5 - 6	0									0.000
EC >6 - 8	0									0.000
EC >8 -10	0									0.0000
EC >10 -12	200									0.00013
EC >12 -16	1000									0.00001
EC >16 - 21	590									0.000000
Total aliphatic	1790	0.06		0.37		0.09		0.01		
Aromatics										
EC >8 - 10	0									0.000
EC >10 - 12	39									0.030
EC >12 - 16	210									0.033
EC >16 - 21	310									0.0033
EC >21 - 35	171									0.0000
Total aromatic	730	0.03								
Benzene	0		0.029		0.00E+00		0.00E+00		0.00E+00	0.00
c-PAHs	0		7.3		0.00E+00		0.00E+00		0.00E+00	
Ethylbenzene	0	0.10		0.00		0.00		0.00		
Toluene	0	0.20		0.00		0.00		0.00		0.000
Xylenes	0	2.00		0.00		0.00		0.00		
Total aromatic+B-E-X	730	0.03		0.30		0.08		0.01		
Total				0.68	0.00E+00	0.17	0.00E+00	0.02	0.00E+00	0.1
RESULT				PASS		PASS		PASS		PASS

HQ = Hazard Quotient. This quotient is calculated from the soil concentration data in Column 2 and the associated Oral Reference Dose (RfD).
RISK: the risk is calculated from the benzene and PAH concentration data in column 2 and the associated Oral Cancer Potentcy Factor (OCPF) for those compounds. The values for RfD and OCPF are selected by WDOE and may be periodically updated. Values used here reflect the values published in WDOE's most recent Interim Interpretive and Policy Statement (January 30, 1997). The reader is referred to that document for additional details.
NOTES: This worksheet calculates Methods B and C soil cleanup levels for TPH for two pathways: "direct contact human health" and "soil-to-groundwater." Other possible pathways, such as vapor and surface water must be considered (see "Interim Policy"). In Addition to not exceeding a TPH level in the groundwater of 1.0 mg/L, there cannot be exceedance in the groundwater for individual substances such as the "BETX" compounds.

1. Hazard quotients for individual substances or fractions cannot exceed 1.0
2. The hazard index (sum of the hazard quotients) cannot exceed 1.0
3. The risk for individual substance or fractions cannot exceed 1x10E-06 for residential land use or 1x10E-05 for commercial or industrial.
4. The risk for the total cannot exceed 1x10E-05 for any land use.
5. The "concentration at the well" cannot exceed 1.0 mg/L total TPH.
6. If any exceedence occurs in 1-5 above, then the cleanup level for TPH has not been met.

TABLE 10: Results of EPH/VPH Analysis: Sample SP-9-3.5'

All concentrations in milligrams per kilogram (mg/kg or parts per million [ppm])

Sample obtained from a depth of 15.5 feet to 16 feet at monitoring well MW-1.

				HUMAN HEALTH DIRECT CONTACT EXPOSURE PATHWAY						SOIL TO GROUNDWATER PATHWAY
1	2	3	4	5	6	7	8	9	10	13
				Residential		Commercial		Industrial		
Compound	Soil Conc. (mg/kg)	Oral Refernce Dose (mg/kg*day)	Oral Cancer Potency factor (kg*day/mg)	HQ	Risk	HQ	Risk	HQ	Risk	Conc.@ well (mg/l)
Aliphatics										
EC 5 - 6	0									0.000
EC >6 - 8	0									0.000
EC >8 -10	0									0.0000
EC >10 -12	320									0.00003
EC >12 -16	2200									0.00000
EC >16 - 21	2440									0.000000
Total aliphatic	4960	0.06		1.03		0.26		0.02		
Aromatics										
EC >8 - 10	0									0.000
EC >10 - 12	30									0.004
EC >12 - 16	200									0.005
EC >16 - 21	1480									0.0025
EC >21 - 35	11300									0.0002
Total aromatic	13010	0.03								
Benzene	0		0.029		0.00E+00		0.00E+00		0.00E+00	0.00
c-PAHs	0		7.3		0.00E+00		0.00E+00		0.00E+00	
Ethylbenzene	0	0.10		0.00		0.00		0.00		
Toluene	0	0.20		0.00		0.00		0.00		0.000
Xylenes	0	2.00		0.00		0.00		0.00		
Total aromatic +B-E-X	13010	0.03		5.42		1.36		0.12		
Total				5.45	0.00E+00	1.61	0.00E+00	0.15	0.00E+00	0.0
RESULT				FAIL		FAIL		PASS		PASS

HQ = Hazard Quotient. This quotient is calculated from the soil concentration data in Column 2 and the associated Oral Reference Dose (RfD).
RISK: the risk is calculated from the benzene and PAH concentration data in column 2 and the associated Oral Cancer Potentcy Factor (OCPF) for those compounds. The values for RfD and OCPF are selected by WDOE and may be periodically updated. Values used here reflect the values published in WDOE's most recent Interim Interpretive and Policy Statement (January 30, 1997). The reader is referred to that document for additional details.
NOTES: This worksheet calculates Methods B and C soil cleanup levels for TPH for two pathways: "direct contact human health" and "soil-to-groundwater." Other possible pathways, such as vapor and surface water must be considered (see "Interim Policy"). In Addition to not exceeding a TPH level in the groundwater of 1.0 mg/L, there cannot be exceedance in the groundwater for individual substances such as the "BETX" compounds.

1. Hazard quotients for individual substances or fractions cannot exceed 1.0
2. The hazard index (sum of the hazard quotients) cannot exceed 1.0
3. The risk for individual substance or fractions cannot exceed 1x10E-06 for residential land use or 1x10E-05 for commercial or industrial.
4. The risk for the total cannot exceed 1x10E-05 for any land use.
5. The "concentration at the well" cannot exceed 1.0 mg/L total TPH.
6. If any exceedence occurs in 1-5 above, then the cleanup level for TPH has not been met.

TABLE 11. Results of EPH/VPH Analysis: Sample SP-10-5.5'

All concentrations in milligrams per kilogram (mg/kg or parts per million [ppm])

				HUMAN HEALTH DIRECT CONTACT EXPOSURE PATHWAY						SOIL TO GROUNDWATER PATHWAY
1	2	3	4	5	6	7	8	9	10	13
Compound	Soil Conc. (mg/kg)	Oral Refernce Dose (mg/kg*day)	Oral Cancer Potency factor (kg*day/mg)	Residential HQ	Residential Risk	Commercial HQ	Commercial Risk	Industrial HQ	Industrial Risk	Conc.@ well (mg/l)
Aliphatics										
EC 5 - 6	0									0.000
EC >6 - 8	0									0.000
EC >8 -10	0									0.0000
EC >10 -12	0									0.00000
EC >12 -16	0									0.00000
EC >16 - 21	0									0.000000
Total aliphatic		0.06								
Aromatics										
EC >8 - 10	0									0.000
EC >10 - 12	0									0.000
EC >12 - 16	0									0.000
EC >16 - 21	0									0.0000
EC >21 - 35	0									0.0000
Total aromatic		0.03								
Benzene	0		0.029		0.00E+00		0.00E+00		0.00E+00	0.00
c-PAHs	0		7.3		0.00E+00		0.00E+00		0.00E+00	
Ethylbenzene	0	0.10		0.00		0.00		0.00		
Toluene	0	0.20		0.00		0.00		0.00		0.000
Xylenes	0	2.00		0.00		0.00		0.00		
Total aromatic+B-E-X		0.03								
Total				0.00	0.00E+00	0.00	0.00E+00	0.00	0.00E+00	0.0
RESULT				PASS		PASS		PASS		PASS

HQ = Hazard Quotient. This quotient is calculated from the soil concentration data in Column 2 and the associated Oral Reference Dose (RfD).

RISK: the risk is calculated from the benzene and PAH concentration data in column 2 and the associated Oral Cancer Potentcy Factor (OCPF) for those compounds. The values for RfD and OCPF are selected by WDOE and may be periodically updated. Values used here reflect the values published in WDOE's most recent Interim Interpretive and Policy Statement (January 30, 1997). The reader is referred to that document for additional details.

NOTES: This worksheet calculates Methods B and C soil cleanup levels for TPH for two pathways: "direct contact human health" and "soil-to-groundwater." Other possible pathways, such as vapor and surface water must be considered (see "Interim Policy"). In Addition to not exceeding a TPH level in the groundwater of 1.0 mg/L, there cannot be exceedance in the groundwater for individual substances such as the "BETX" compounds.

1. Hazard quotients for individual substances or fractions cannot exceed 1.0
2. The hazard index (sum of the hazard quotients) cannot exceed 1.0
3. The risk for individual substance or fractions cannot exceed 1x10E-06 for residential land use or 1x10E-05 for commercial or industrial.
4. The risk for the total cannot exceed 1x10E-05 for any land use.
5. The "concentration at the well" cannot exceed 1.0 mg/L total TPH.
6. If any exceedence occurs in 1-5 above, then the cleanup level for TPH has not been met.

TABLE 12: Results of EPH/VPH Analysis: Sample SS-1

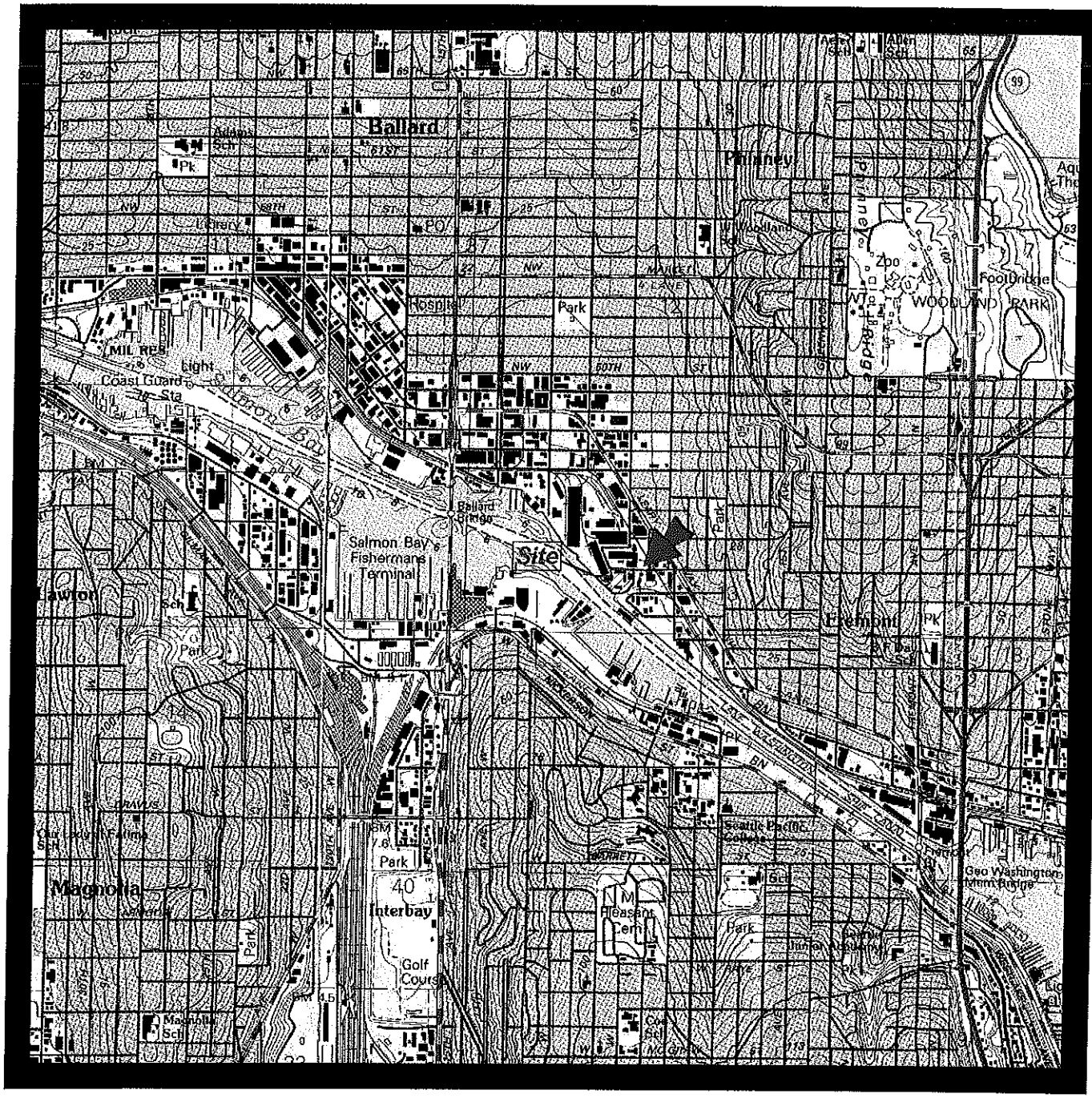
All concentrations in milligrams per kilogram (mg/kg or parts per million [ppm])

				HUMAN HEALTH DIRECT CONTACT EXPOSURE PATHWAY						SOIL TO GROUNDWATER PATHWAY
1	2	3	4	5	6	7	8	9	10	13
	Soil Conc.	Oral Refernce Dose	Oral Cancer Potency factor	Residential		Commercial		Industrial		Conc.@ well
Compound	(mg/kg)	(mg/kg*day)	(kg*day/mg)	HQ	Risk	HQ	Risk	HQ	Risk	(mg/l)
Aliphatics										
EC 5 - 6	0									0.000
EC >6 - 8	0									0.000
EC >8 -10	0									0.0000
EC >10 -12	0									0.00000
EC >12 -16	0									0.00000
EC >16 - 21	37									0.000000
Total aliphatic	37	0.06		0.01		0.00		0.00		
Aromatics										
EC >8 - 10	0									0.000
EC >10 - 12	0									0.000
EC >12 - 16	0									0.000
EC >16 - 21	14									0.0025
EC >21 - 35	126									0.0002
Total aromatic	140	0.03								
Benzene	0		0.029		0.00E+00		0.00E+00		0.00E+00	0.00
c-PAHs	5.92		7.3		4.32E-05		1.08E-05		3.29E-06	
Ethylbenzene	0	0.10		0.00		0.00		0.00		
Toluene	0	0.20		0.00		0.00		0.00		0.000
Xylenes	0	2.00		0.00		0.00		0.00		
Total aromatic+B-E-X	140	0.03		0.06		0.01		0.00		
Total				0.07	4.32E-05	0.02	1.08E-05	0.00	3.29E-06	0.0
RESULT				FAIL		FAIL		PASS		PASS

HQ = Hazard Quotient. This quotient is calculated from the soil concentration data in Column 2 and the associated Oral Reference Dose (RfD).
RISK: the risk is calculated from the benzene and PAH concentration data in column 2 and the associated Oral Cancer Potentcy Factor (OCPF) for those compounds. The values for RfD and OCPF are selected by WDOE and may be periodically updated. Values used here reflect the values published in WDOE's most recent Interim Interpretive and Policy Statement (January 30, 1997). The reader is referred to that document for additional details.

NOTES: This worksheet calculates Methods B and C soil cleanup levels for TPH for two pathways: "direct contact human health" and "soil-to-groundwater." Other possible pathways, such as vapor and surface water must be considered (see "Interim Policy"). In Addition to not exceeding a TPH level in the groundwater of 1.0 mg/L, there cannot be exceedance in the groundwater for individual substances such as the "BETX" compounds.

1. Hazard quotients for individual substances or fractions cannot exceed 1.0
2. The hazard index (sum of the hazard quotients) cannot exceed 1.0
3. The risk for individual substance or fractions cannot exceed 1x10E-06 for residential land use or 1x10E-05 for commercial or industrial.
4. The risk for the total cannot exceed 1x10E-05 for any land use.
5. The "concentration at the well" cannot exceed 1.0 mg/L total TPH.
6. If any exceedence occurs in 1-5 above, then the cleanup level for TPH has not been met.



(Source: USGS, 1983, Seattle North, WA 7.5x15 Minute {1:25,000 scale} Quadrangle. From aerial photographs obtained in 1977, 1 sheet. Contour Interval = 5 meters {16.4 feet} feet)

Probable Direction of Shallow-Seated Groundwater Flow

Scale

0 *1/2* *1 mile*

N

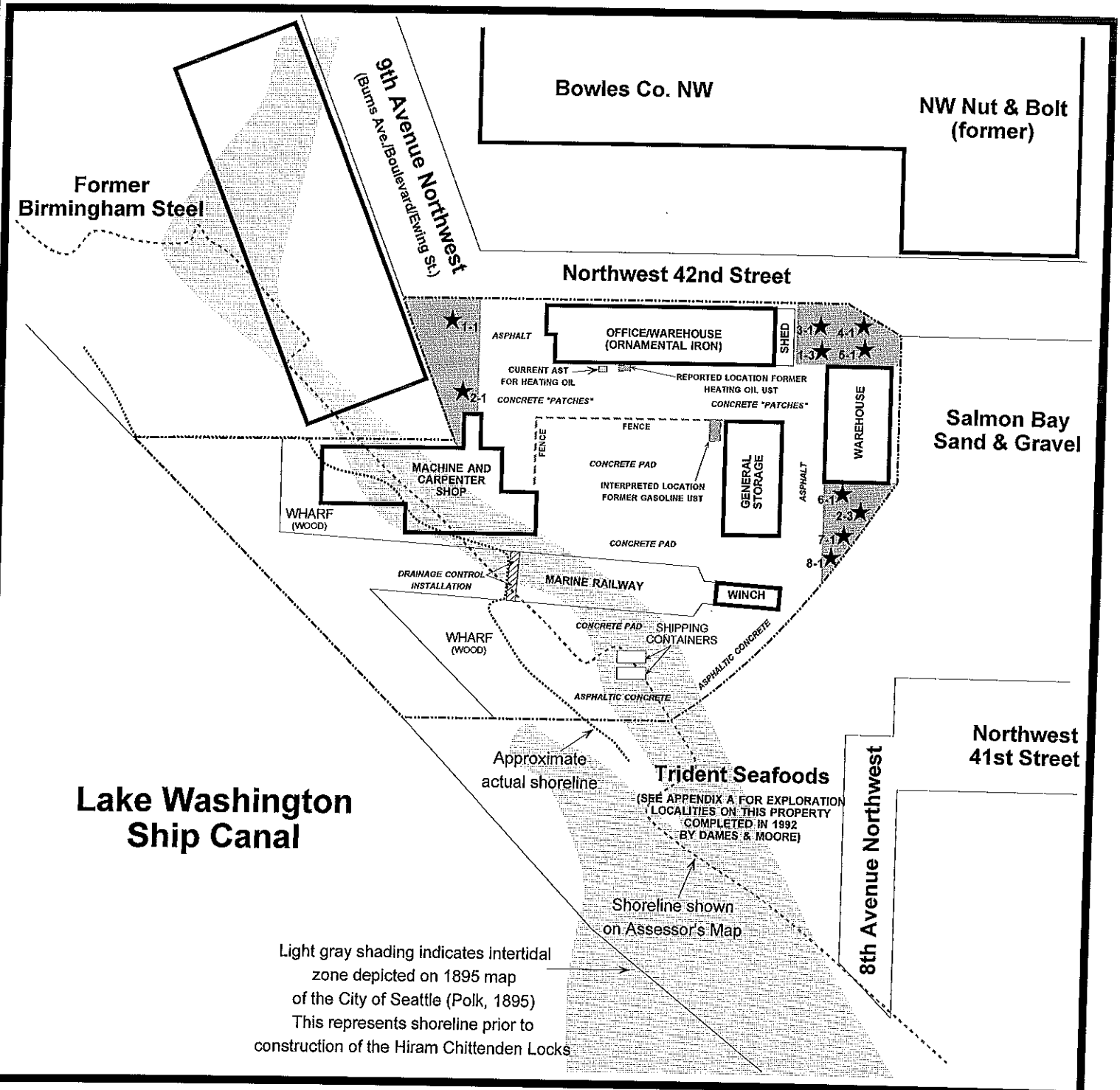
ENVIRONMENTAL ASSOCIATES, INC.

2122 - 112th Avenue N.E., Ste. B-100
Bellevue, Washington 98004

Vicinity Topographic Map

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

Job Number:	Date:		Plate:
JN 8125	March 1999		1



Legend

- Developments/buildings
- Areas of bare soil
- Subject property boundary
- ★1-1 Location of soil sample obtained by Mr. Tom Dyer of Union Bay Shipbuilding in 1989
- Approximate direction of shallow-seated groundwater flow
- N
- Approximate Scale 0 100 ft.

ENVIRONMENTAL ASSOCIATES, INC.

2122 - 112th Avenue N.E., Ste. B-100
Bellevue, Washington 98004

SITE PLAN

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

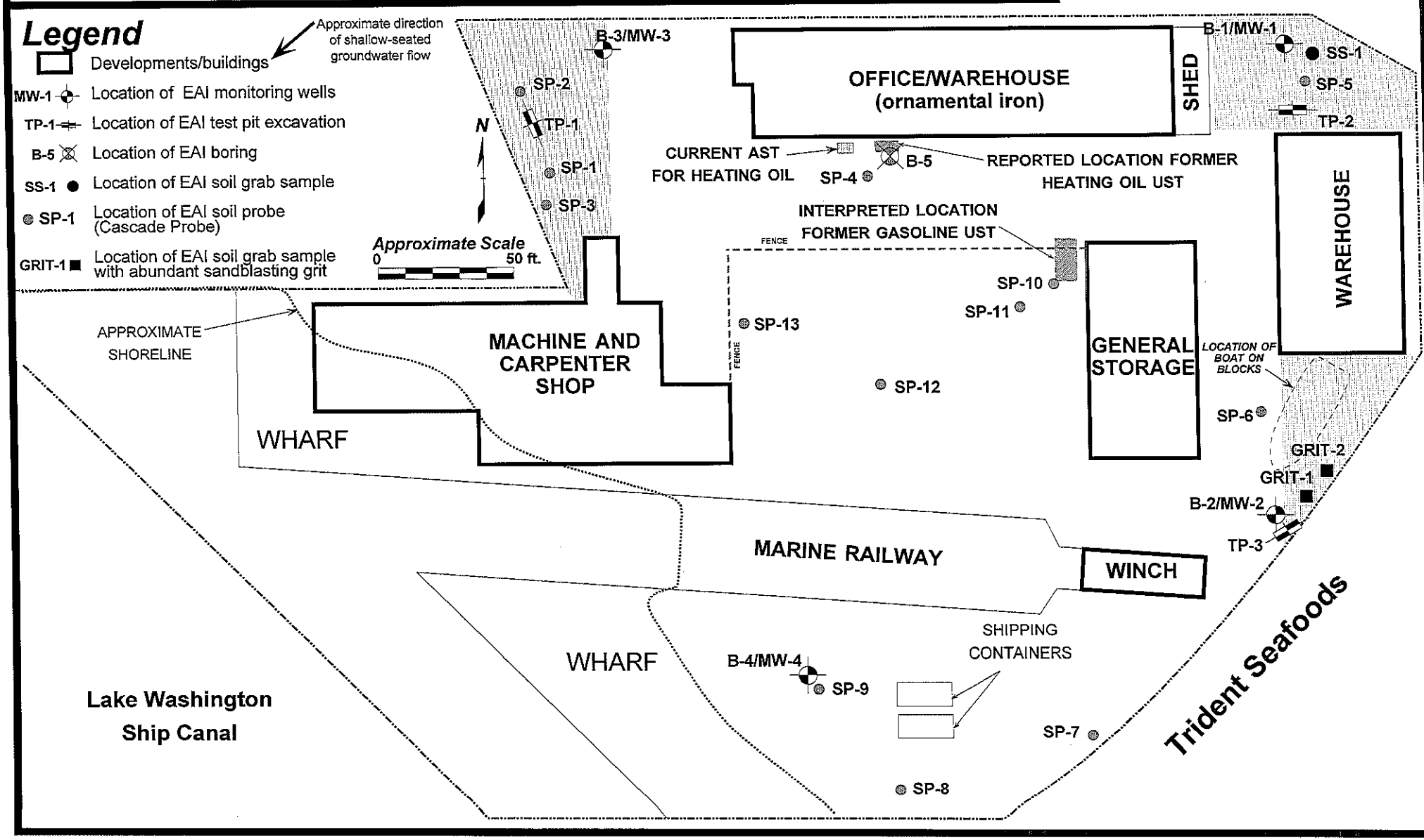
Job Number:	Date:		Plate:
JN 8125	March 1999		2

ENVIRONMENTAL ASSOCIATES, INC.
2122 - 112th Avenue N.E., Ste. B-100
Bellevue, Washington 98004

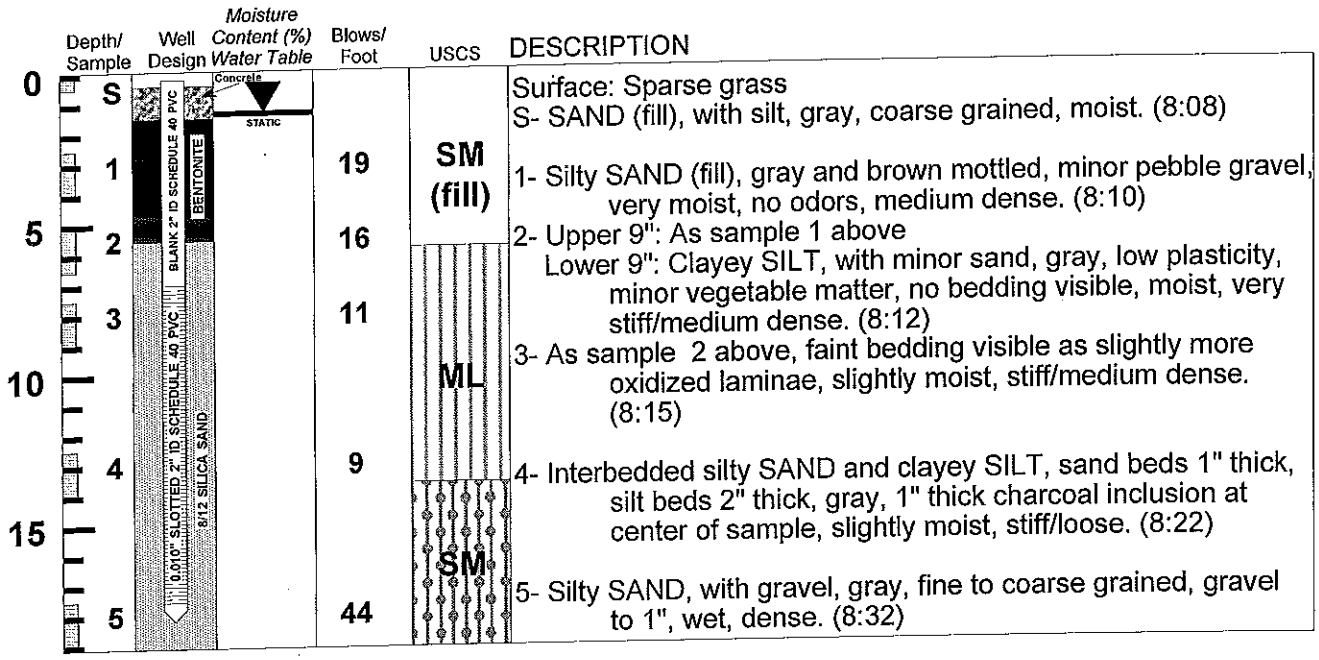
SITE EXPLORATION PLAN

Marine Fluid Systems
801 Northwest 42nd Street
Seattle, Washington

Job Number:	Date:		Plate:
JN 8125	March 1999		3



BORING B-1/MW-1



* Boring/monitoring well located at northeast corner of property, 33.5 feet north of the eastern warehouse, and 41.5 feet east of the northern office/warehouse building.
* Boring terminated at 19.5 feet on April 1, 1998.
* Monitoring well installed. Depth to groundwater approximately 13 feet at the time of drilling. Depth to groundwater measured at 1.34 feet below top of casing on May 6, 1998. Groundwater sample MW-1 obtained May 6, 1998.
* No visual or olfactory indications of contamination in soil or groundwater.
* Numbers in parentheses indicate the time the sample was obtained.

ENVIRONMENTAL ASSOCIATES, INC.

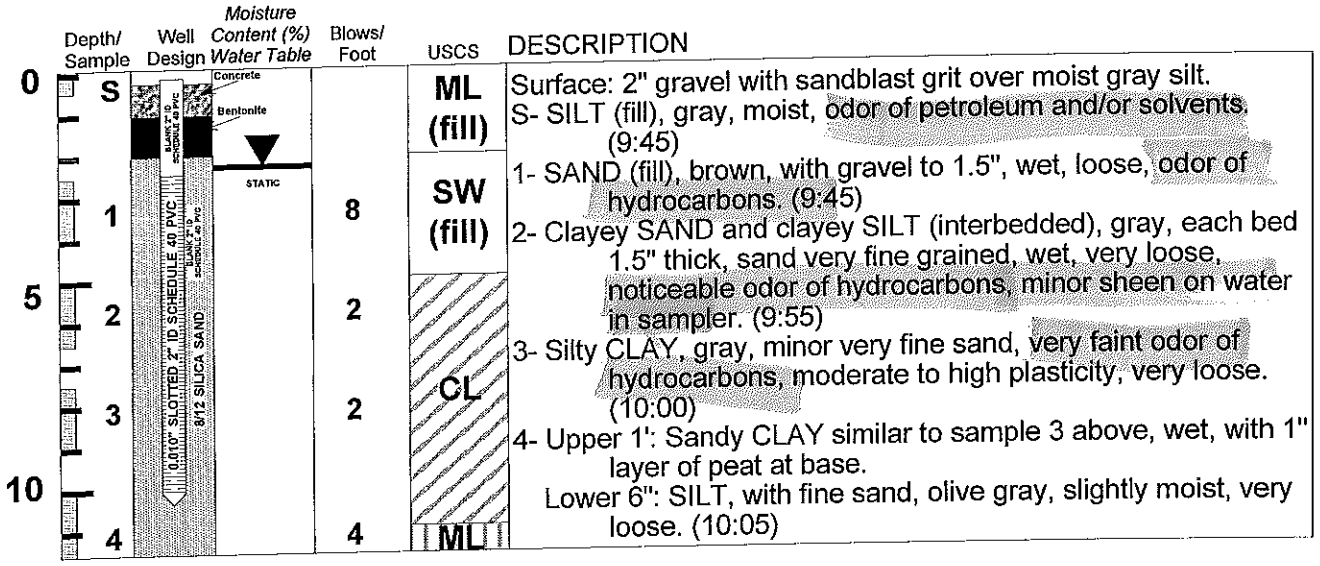
2122 - 112th Avenue N.E., Ste. B-100
Bellevue, Washington 98004

TEST BORING LOG: B-1/MW-1

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

Job Number:	Date:	Logged by:	Plate:
JN 8125	April 1, 1998	D. Holmes	4

BORING B-2/MW-2



* Boring/monitoring well located at southeast corner of property, 36 feet east of the steel shop, and 29.5 feet east of the winch.
* Boring terminated at 11.5 feet on April 1, 1998.
* Monitoring well installed. Depth to groundwater approximately 2.5 feet at the time of drilling. Depth to groundwater measured at 2.28 feet below top of casing on May 6, 1998. Groundwater sample MW-2 obtained May 6, 1998.
* Odors of solvent/hydrocarbons noted in upper few feet of boring, becoming very faint below 9 feet in depth.
* Numbers in parentheses indicate the time the sample was obtained.

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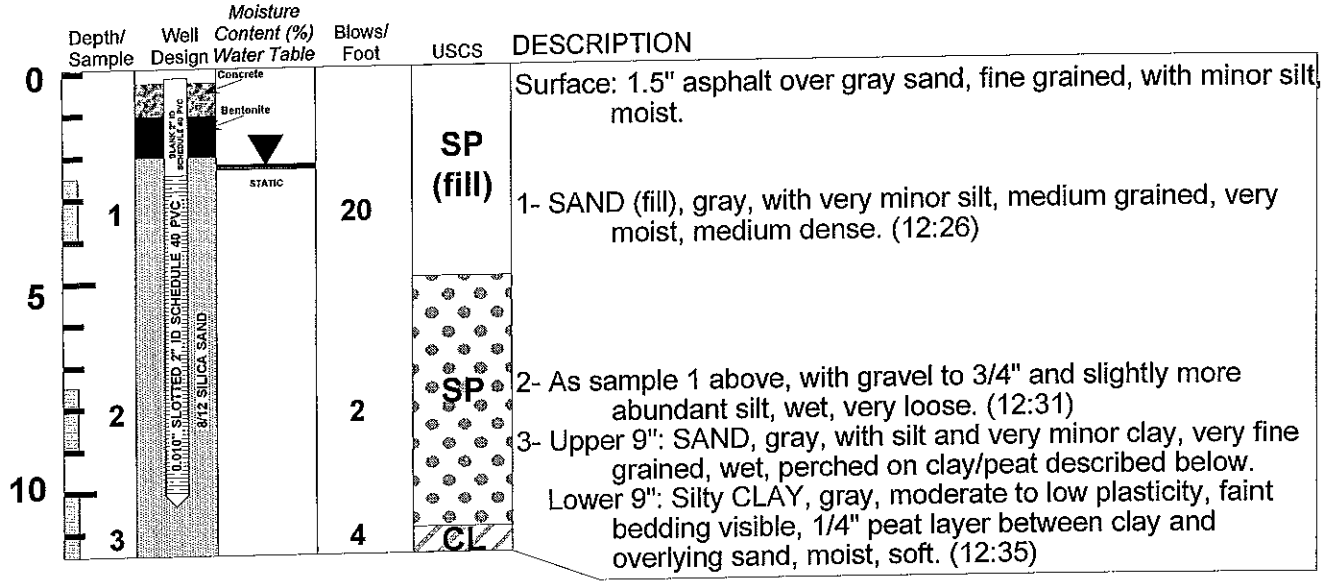
TEST BORING LOG: B-2/MW-2

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

Job Number:	Date:	Logged by:	Plate:
JN 8125	April 1, 1998	D. Holmes	5

BORING B-3/MW-3



* Boring/monitoring well located at northwest corner of property, 48 feet west of northern office/warehouse building, just south of the northern property line.
* Boring terminated at 11.5 feet on April 1, 1998.
* Monitoring well installed. Depth to groundwater approximately 4 feet at the time of drilling. Depth to groundwater measured at 3.29 feet below top of casing on May 6, 1998. Groundwater sample MW-3 obtained May 6, 1998.
* No visual or olfactory indications of contamination in soil or groundwater.
* Numbers in parentheses indicate the time the sample was obtained.

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TEST BORING LOG: B-3/MW-3

Marine Fluid Systems
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Seattle (Ballard), Washington

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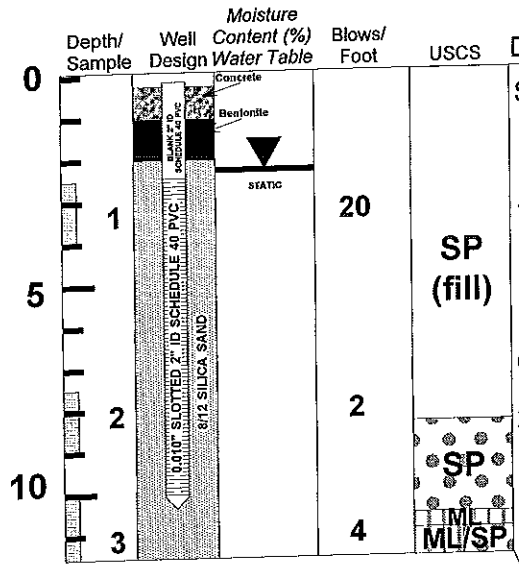
BORING B-4/MW-4



* Boring/monitoring well located 27.5 feet south of marine railway, 17 feet east of machine and carpenter shop.
* Boring terminated at 11.5 feet on April 1, 1998.
* Monitoring well installed. Depth to groundwater approximately 6 feet at the time of drilling. Depth to groundwater measured at 4.31 feet below top of casing on May 6, 1998. Groundwater sample MW-4 obtained May 6, 1998.
* Visual indications of contamination (slight sheen) noted in soil at approximately 7 feet below ground surface. No visual or olfactory indications of contamination in groundwater.
* Numbers in parentheses indicate the time the sample was obtained.

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TEST BORING LOG: B-4/MW-4

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

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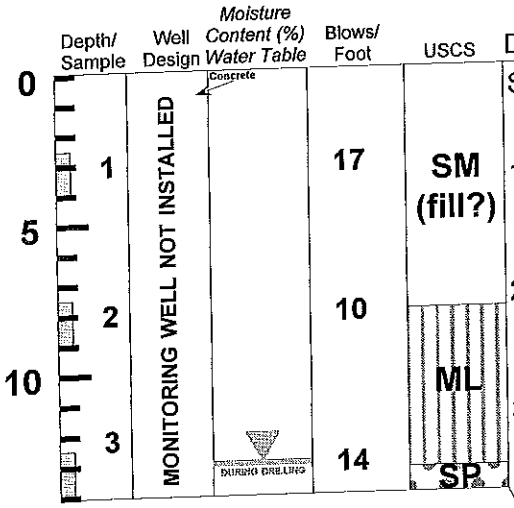
JN 8125	April 1, 1998	D. Holmes	7

BORING B-5



* Boring located 6.5 feet south of northern office/warehouse, 49 feet east of west end of building. Boring located approximately four feet from reported former location of heating oil underground storage tank.
* Boring terminated at 14.0 feet on April 1, 1998.
* Monitoring well not installed. Groundwater encountered at approximately 13.5 feet during drilling.
* Odor of hydrocarbons noted in soil from approximately 2.5 feet to 8.25 feet below ground surface. Slight "oily" sheen on soil noted at the 2.5 feet below ground surface depth.
* Numbers in parentheses indicate the time the sample was obtained.

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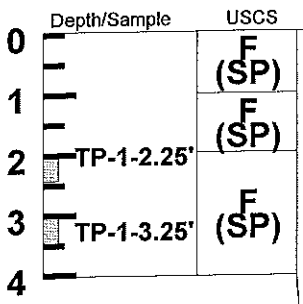
TEST BORING LOG: B-5

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

Job Number:	Date:	Logged by:	Plate:
JN 8125	April 1, 1998	D. Holmes	8

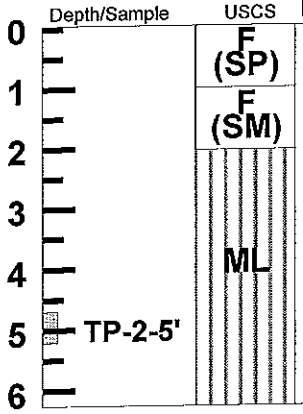
TEST PIT TP-1



USCS	DESCRIPTION
F (SP)	0' to 2': SAND (fill), with silt, brown, rebar, hydraulic hose, brick fragments noted, medium grained, moist.
F (SP)	2' to 2.7': Very dense layer of very dark gray sand with odor of petroleum.
F (SP)	**TP-1-2.25'**: SAND, fine to medium grained, very dark gray (black), faint odor of petroleum. (13:10) 2.7' to 4.0': SAND, with silt, light brown above 3.25', gray below 3.25 feet, medium grained, slight odor of petroleum hydrocarbons above 3.25', very moist. Water seepage noted at 3.75 feet above a very thin silt horizon, with slight sheen on water. **TP-1-3.25'**: SAND, gray, medium grained, wet, very faint odor of hydrocarbons. (13:20)

* Excavation located at northwest corner of property in reported drum storage area.
* Excavation terminated at 4 feet on May 4, 1998.
* Olfactory indications (odors) of petroleum contamination noted in soil from 2 feet to approximately 3.25 feet below ground surface. Slight sheen noted on a "groundwater" seep at approximately 3.75 feet.
* Numbers in parentheses indicate the time the sample was obtained.

TEST PIT TP-2



USCS	DESCRIPTION
F (SP)	0' to 1.2': Gravelly SAND, gray, with abundant debris (wood, hoses, etc.), medium to coarse grained, slightly moist. Very dark gray at lower 0.2 feet, oxidized at the contact with the overlying gray sand.
F (SM)	1.2' to 2': Silty SAND, gray and brown mottled, medium grained, moist.
ML	2' to 6.5': Clayey SILT, gray and brown mottled, very moist to wet. A thin sandy bed noted at 3.5 feet. Silt also contained minor very fine sand below 3 feet, and became gray. Seeps noted at several depths below 3 feet in sandier layers of the silt. **TP-2-5'**: Clayey SILT with very fine sand, gray, wet, low plasticity. (13:50)

* Excavation located at northeast corner of property, 8 feet north and 12 feet east of eastern warehouse.
* Excavation terminated at 6.5 feet on May 4, 1998.
* No visual or olfactory indications of petroleum contamination were noted in soil or groundwater.
* Numbers in parentheses indicate the time the sample was obtained.

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TEST PIT LOGS: TP-1 & TP-2

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

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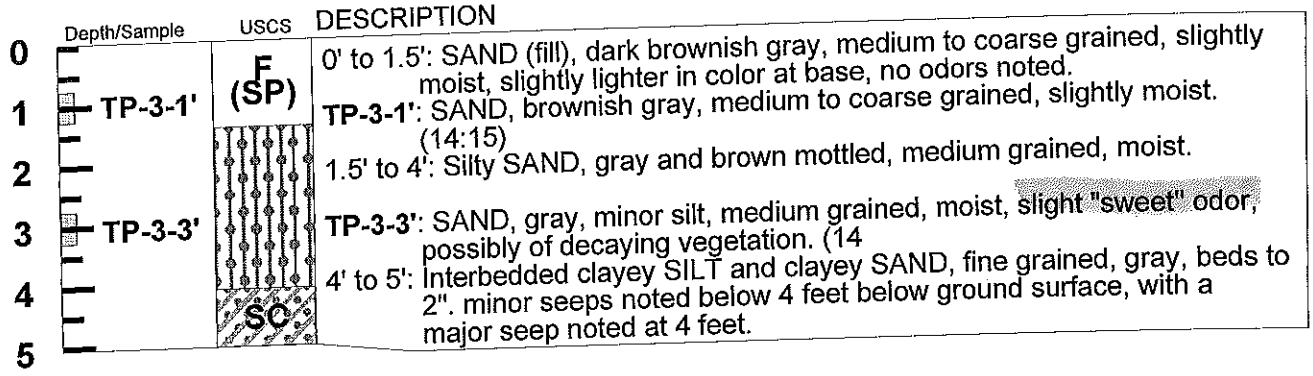
TEST PIT TP-3



* Excavation located along southeastern property line, east of B-3/MW-3.
* Excavation terminated at 5 feet on May 4, 1998.
* No visual or olfactory indications of petroleum contamination were noted in soil or groundwater. Odor of decay noted at approximately 3 feet below ground surface.
* Numbers in parentheses indicate the time the sample was obtained.

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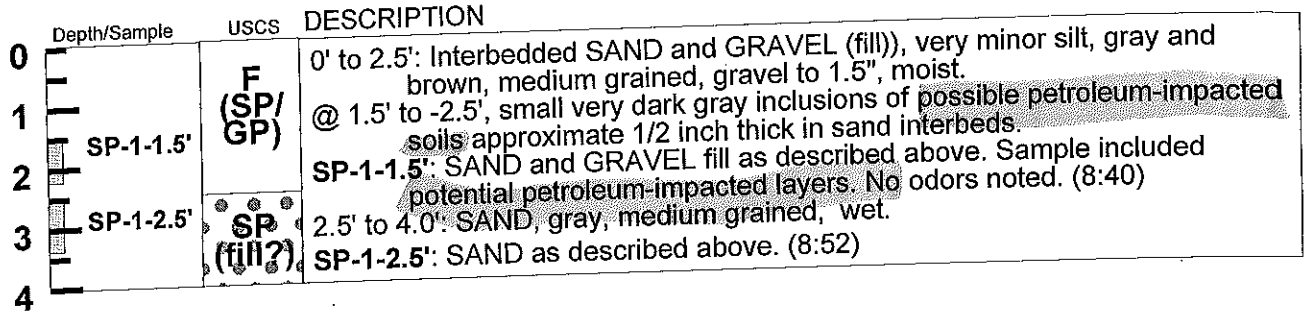
Bellevue, Washington 98004

TEST PIT LOG: TP-3

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

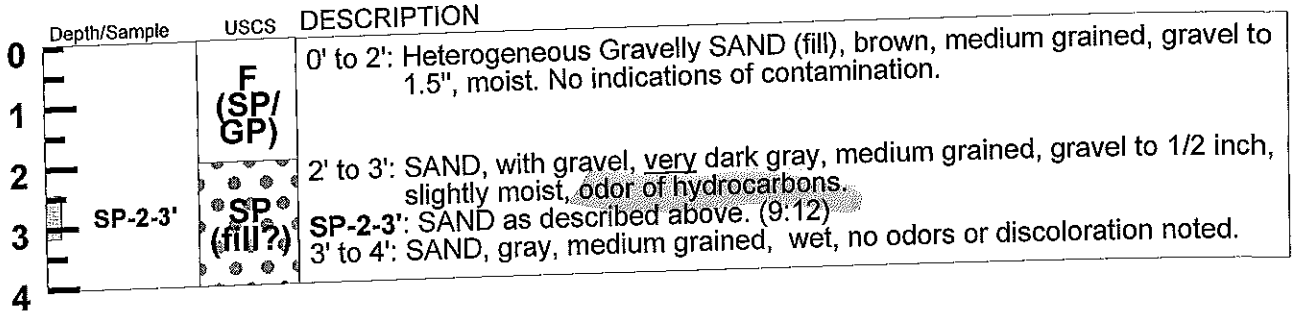
Job Number:	Date:	Logged by:	Plate:
JN 8125	May 4, 1998	D. Holmes	10

SOIL PROBE SP-1



* Soil probe located at northwest corner of property in reported drum storage area, 13 feet northeast of Birmingham Steel warehouse, 5.5 feet southeast from corner of building.
* Soil probe terminated at 4 feet.
* Visual indications of petroleum contamination in soil from 1.5 to 2.5 feet in depth. No visual or olfactory indications of contamination noted below 2.5 feet.
* Numbers in parentheses indicate the time the sample was obtained.

SOIL PROBE SP-2



* Soil probe located at northwest corner of property, 12 feet northeast of Birmingham Steel warehouse, 29 feet southeast from northern property line.
* Soil probe terminated at 4 feet.
* Visual and olfactory indications of petroleum contamination in soil from 2.0 to 3.0 feet in depth. No visual or olfactory indications of contamination noted below 3.0 feet.
* Numbers in parentheses indicate the time the sample was obtained.

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SOIL PROBE LOGS: SP-1 & SP-2

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

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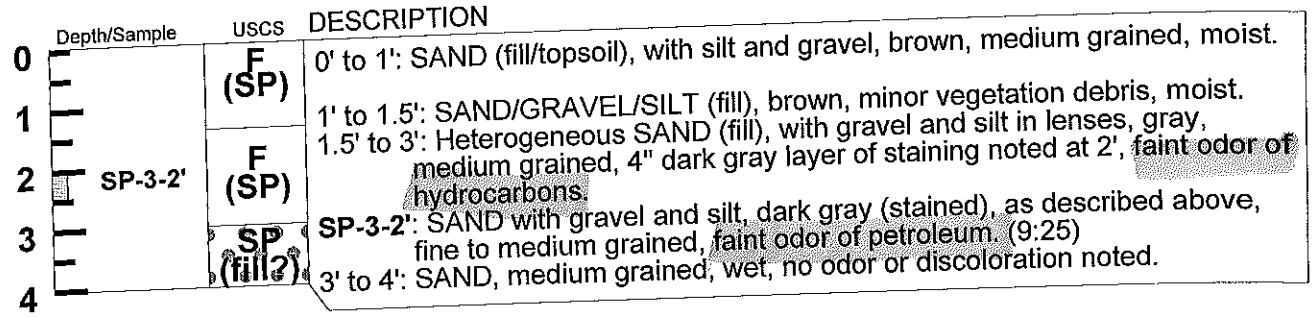
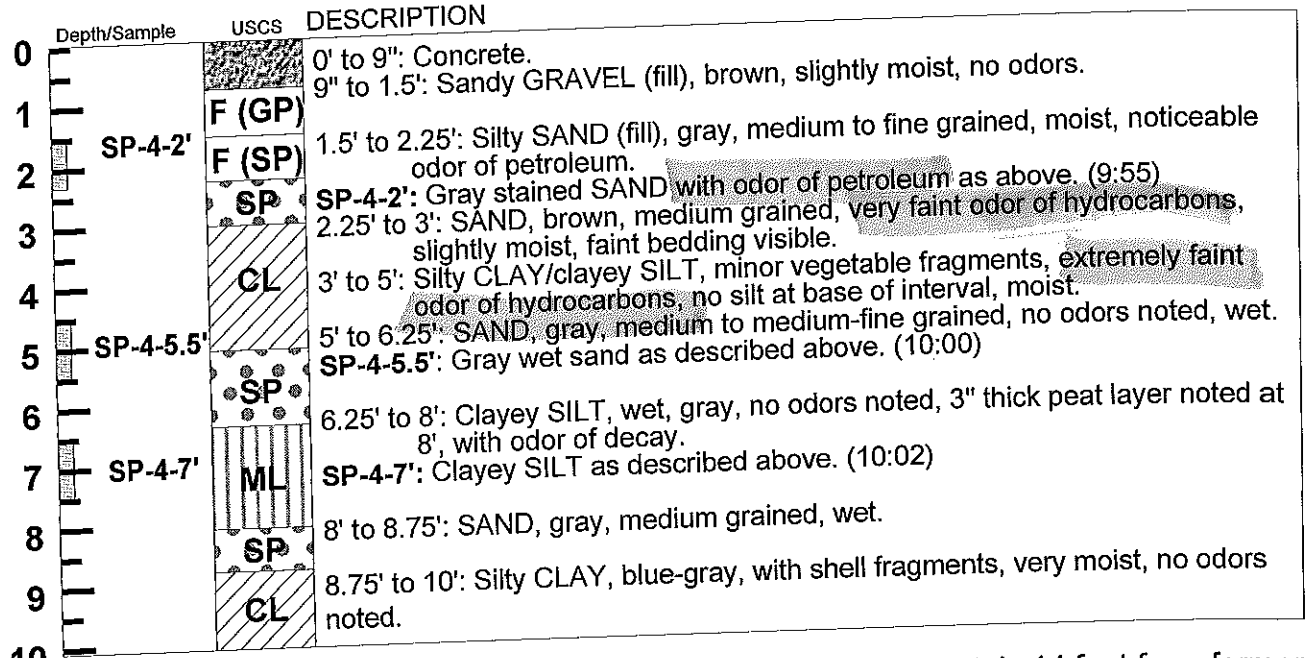
SOIL PROBE SP-3



* Soil probe located at northwest corner of property, 16.5 feet southeast of Birmingham Steel warehouse, 5.5 feet northeast from property line.
* Soil probe terminated at 4 feet.
* Olfactory indications (odors) of petroleum contamination noted in soil from 2 feet to approximately 2.33 feet below ground surface.
* Numbers in parentheses indicate the time the sample was obtained.

SOIL PROBE SP-4



* Soil probe located 10 feet southeast of boring B-5, approximately 14 feet from former eating oil UST.
* Probe terminated at 10 feet.
* Visual and olfactory indications of petroleum contamination were noted in soil from a depth of 1.5 to 2.25 feet, with faint odors noted to a depth of approximately 4 to 4.5 feet.
* Numbers in parentheses indicate the time the sample was obtained.

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SOIL PROBE LOGS: SP-3 & SP-4

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

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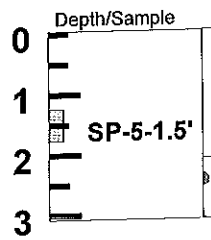
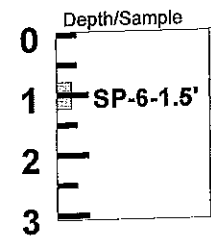
SOIL PROBE SP-5



DESCRIPTION
0' to 2': Sandy GRAVEL (fill) fining downward to gravelly SAND, medium to coarse grained, gravel to 1", moist, petroleum staining noted at 1.5 feet (4" thick). **SP-5-1.5'**: Gravelly SAND, very dark gray, petroleum stained. (10:42) 2.5' to 3': SAND, gray, medium grained, wet. Thin 2.5" thick peat layer noted at 2.5 feet.

* Soil probe located at northeast corner of property 20 feet north of east warehouse, 12 east from west edge of east warehouse.
* Soil probe terminated at 3 feet.
* Visual indications of petroleum contamination in soil noted in four inch layer at a depth of approximately 1.5 feet. No visual or olfactory indications of contamination noted below approximately 1.5 feet.
* Numbers in parentheses indicate the time the sample was obtained.

SOIL PROBE SP-6



DESCRIPTION
0' to 8": 1.5" asphalt over sandy GRAVEL (fill), gray and reddish gray, damp, medium to coarse grained, gravel to 1". No indications of contamination. 8" to 3': SAND, brown grading downward to gray, medium grained, wet below 2'. No indications of contamination. 1.5" thick layer of clayey silt was noted at base of sampled interval. **SP-6-1.5':** Brown SAND as described above. (11:35)

* Soil probe located south-southwest of eastern warehouse, 22 feet north of metal warehouse (steel shop), 17 feet north from south end of metal warehouse.
* Soil probe terminated at 3 feet.
* No visual or olfactory indications of contamination noted in soil.
* Numbers in parentheses indicate the time the sample was obtained.

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SOIL PROBE LOGS: SP-5 & SP-6

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

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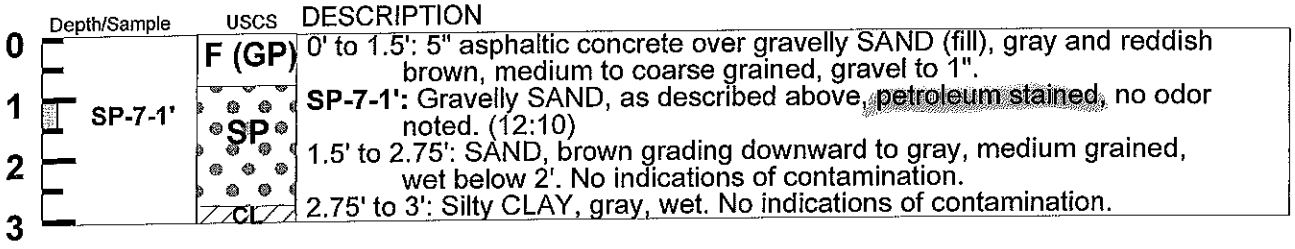
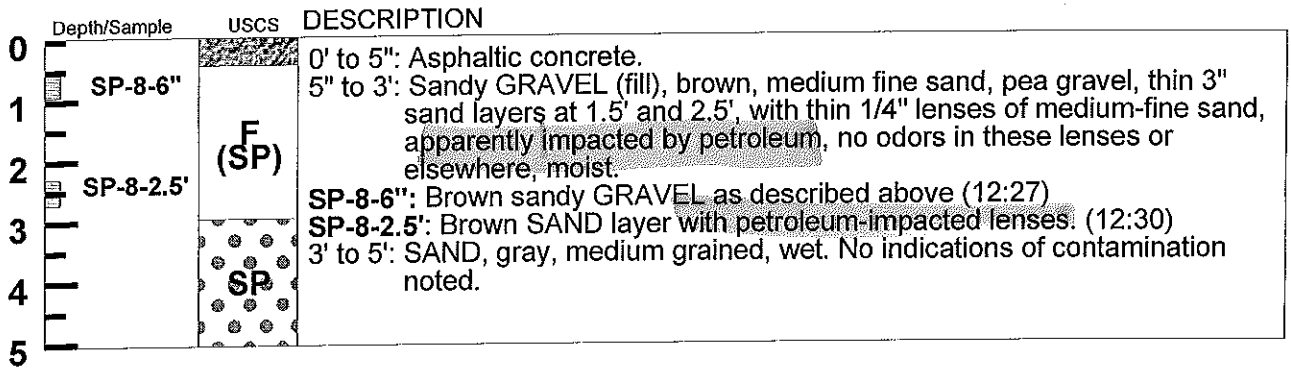
SOIL PROBE SP-7



* Soil probe located 5.5 feet northwest of southeastern property line, due south of western edge of the metal warehouse (steel shop).
* Soil probe terminated at 3 feet.
* Visual and olfactory indications of contamination noted in soil from 1.0 to 1.5 feet below ground surface. No visual or olfactory indications of contamination noted in soil below 1.5 feet.
* Numbers in parentheses indicate the time the sample was obtained.

SOIL PROBE SP-8



* Soil probe located along southern property line, 90 feet west of SP-7, 31 feet south of SP-7.
* Soil probe terminated at 5 feet.
* Visual indications of petroleum contamination (discoloration) noted in sand 4" thick sand layers noted at 1.5 and 2.5 feet. Sample SP-8-2.5' contained several of the noted thin black colored lenses. No visual or olfactory indications of contamination noted in remainder of soil column.
* Numbers in parentheses indicate the time the sample was obtained.

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SOIL PROBE LOGS: SP-7 & SP-8

Marine Fluid Systems
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Seattle (Ballard), Washington

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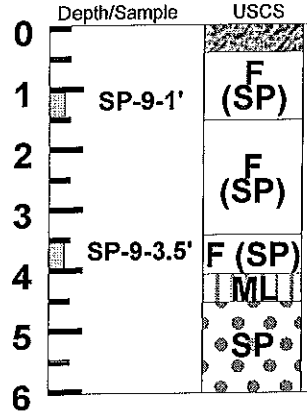
SOIL PROBE SP-9

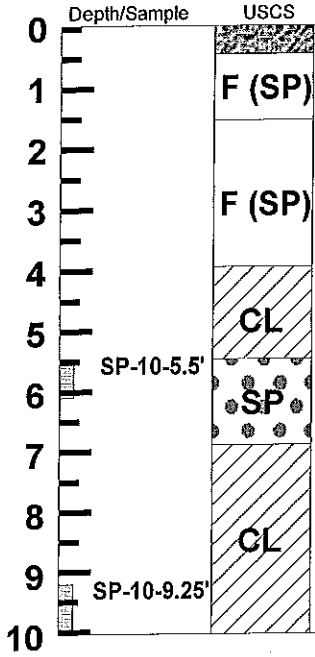


DESCRIPTION

0' to 6": Asphaltic concrete.
6" to 1.5': Gravelly SAND (fill), brown above 1', very dark brown below 1', medium grained, wood fragments noted, gravel pea sized, no discernible odor.
SP-9-1': Dark brown gravelly SAND (fill) as described above (13:05)
1.5' to 3.5': SAND (fill), brown, medium grained, slightly moist, no odors noted.
3.5' to 4': Silty SAND (fill), very dark gray , medium grained, brick fragments noted, strong odor of hydrocarbons.
SP-9-3.5': Silty SAND (fill) as above, strong odor of hydrocarbons. (13:12)
4' to 4.5': SILT with clay, gray, moist, odor of hydrocarbons in upper 3".
4.5' to 6': SAND, gray, wet, medium grained, no odor of hydrocarbons noted.

* Soil probe located 6 feet southeast from B-4/MW-4.
* Soil probe terminated at 6 feet.
* Visual and olfactory indications of petroleum contamination noted in only one 6" thick layer from 3.5 to 4 feet in depth. No other indications of contamination noted.

SOIL PROBE SP-10



DESCRIPTION

0' to 5": Concrete.
5" to 1.5': Gravelly SAND (fill), brown, damp, medium grained, gravel to 1.5", no odors.
1.5' to 4': SAND (fill), brown, medium grained, moist, no odors noted.
4' to 5.5': Silty CLAY, gray, wet, no odors noted.
5.5' to 7': SAND, gray, medium grained, wet, faint to moderate odor of hydrocarbons.
SP-10-5.5': Gray SAND as described above. (13:40)
7' to 10': Silty CLAY, gray, very moist, minor fine sand.
SP-10-9.25': Silty CLAY as described above. Sample also included 3" thick peat layer with odor of decay. (13:48)

* Soil probe located 1 foot southwest of concrete patch interpreted to lie over the former gasoline UST location. Probe located 9 feet west of metal warehouse (steel shop), 15 feet south from northern edge.
* Probe terminated at 10 feet.
* Odor of hydrocarbons noted from approximately 5.5 feet to 6 feet in depth. No visual indications of contamination noted in depth range sampled. No other olfactory indications of contamination noted.
* Numbers in parentheses indicate the time the sample was obtained.

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SOIL PROBE LOGS: SP-9 & SP-10

Marine Fluid Systems
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Seattle (Ballard), Washington

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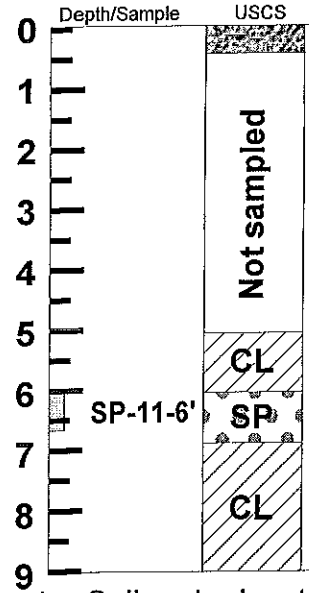
SOIL PROBE SP-11



DESCRIPTION

0' to 5': Not sampled due to observations of soil conditions at SP-10, which did exhibit indications of contamination in this depth range. 5" of concrete at top.

5' to 6': Clayey SILT/Silty Clay, gray, very moist, no odor of hydrocarbons noted.

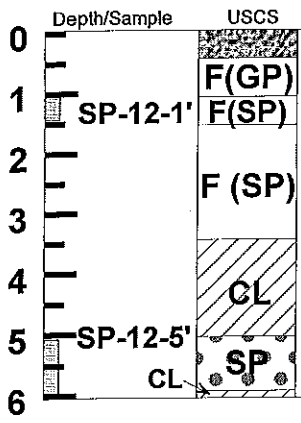
6' to 7': SAND, gray, medium grained, one 3/4" gravel clast, wet, very faint odor of hydrocarbons.

SP-11-6': Gray SAND as described above, very faint odor of hydrocarbons. (14:15)

7' to 10': Silty CLAY, gray, very moist, minor fine sand.

* Soil probe located 15 feet southwest of SP-10 and the concrete patch interpreted to lie over the former gasoline UST location. Probe located 25 feet west of metal warehouse (steel shop), 23 feet south from northern edge of warehouse/fence.
* Probe terminated at 9 feet.
* Very faint odor of hydrocarbons noted from approximately 6 feet to 6.5 feet in depth. No visual indications of contamination noted in depth range sampled. No other olfactory indications of contamination noted.
* Numbers in parentheses indicate the time the sample was obtained.

SOIL PROBE SP-12



DESCRIPTION

0' to 5": Concrete.

5" to 1': Sandy pea GRAVEL (fill), brown, sand medium, wet, no discernible odor.

1' to 1.5': Gravelly SAND (fill), dark gray, minor amounts of glass shards, wood, and sandblasting grit, slightly moist, no odor noted.

SP-12-1': Dark gray gravelly SAND (fill) as described above (14:35)

1.5' to 3.5': SAND (fill), brown, medium grained, slightly moist, no odors noted.

3.5' to 5': Silty CLAY, gray, wet, no odors noted.

5' to 5.9': Gravelly SAND, gray, gravelly at top, rapidly fines downward to medium sand, wet, no odors noted.

SP-12-5': Gravelly SAND as described above. (14:40)

5.9' to 6': Silty clay similar to that at 3.5' to 5', no odors noted.

* Soil probe located 77 feet west from metal warehouse, 52 feet south of fence.
* Soil probe terminated at 6 feet.
* No visual or olfactory indications of contamination noted.
* Numbers in parenthesis indicate the time the sample was obtained.

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SOIL PROBE LOGS: SP-11 & SP-12

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Seattle (Ballard), Washington

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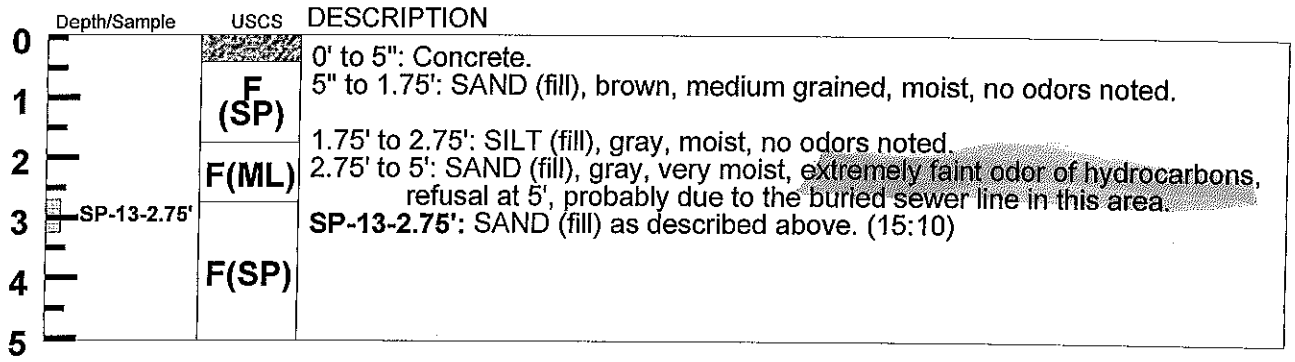
SOIL PROBE SP-13



* Soil probe located east of western warehouse (machine and carpenter shop), 22 feet north of the Marine Fluids office portion, 6.5 feet east of fence.
* Soil probe terminated at 5 feet due to refusal when sewer line encountered.
* No visual indications of petroleum contamination noted. Extremely faint odor of hydrocarbons noted in lower sand fill unit.
* Numbers in parentheses indicate the time the sample was obtained.

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SOIL PROBE LOG: SP-13

Marine Fluid Systems
801 Northwest 42nd Street
Seattle (Ballard), Washington

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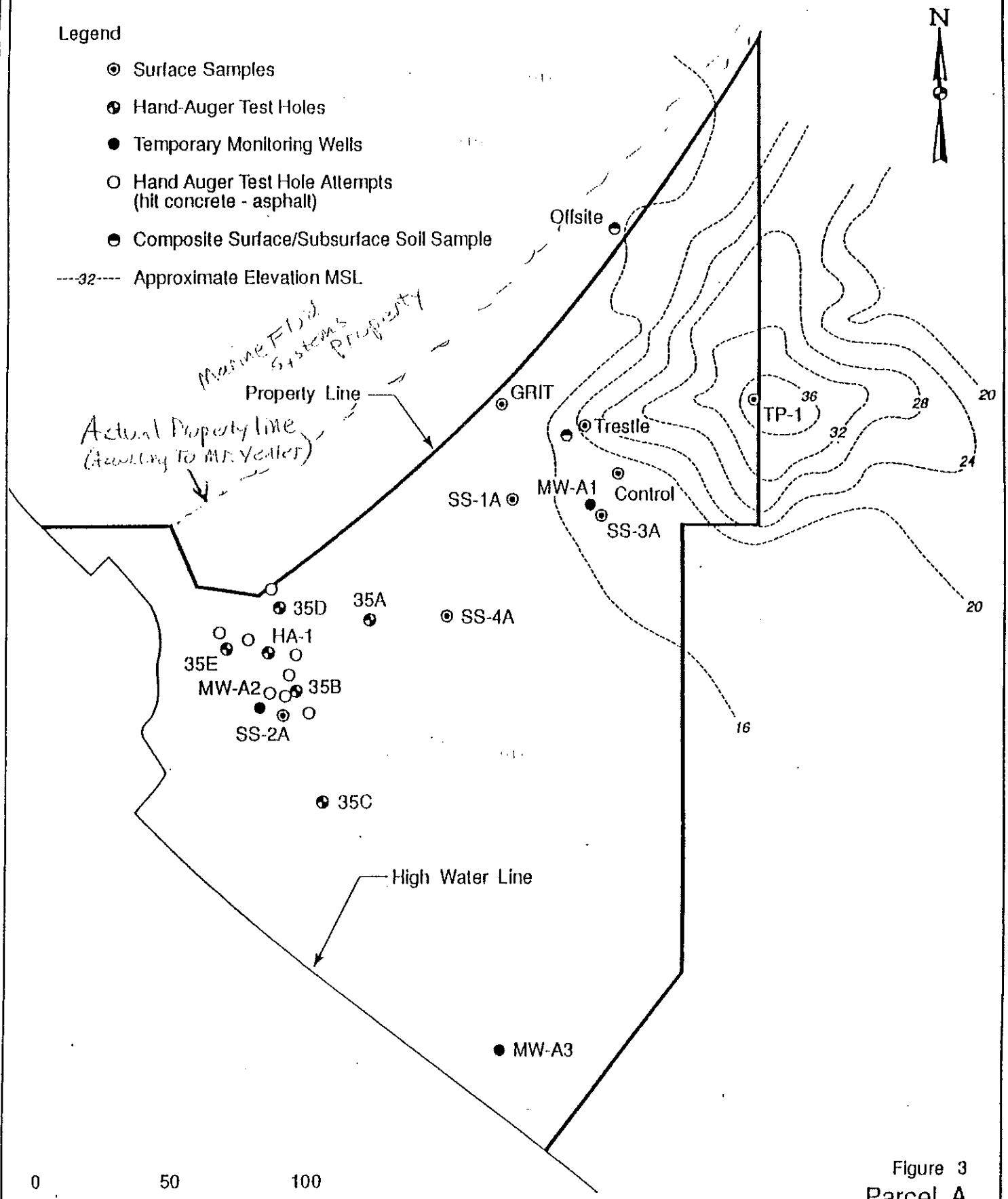
APPENDIX A

Laboratory Results and Site Exploration Plan for the Adjacent Trident Seafoods Study (Dames & Moore, 1993)



Job No. 24152-001-005

Figure 3
Parcel A
Sample, Boring and Well Locations
Waterfront Press
Dames & Moore

Table 6
Summary of Laboratory Results
Organic Compounds In Groundwater

Sample	MW-A1	MW-A2	MW-A3	MTCA Cleanup Levels
Total Petroleum Hydrocarbons (mg/l)	1.0 U	1.0	1.0 U	1.0 A
Volatile Organic Compounds (µg/l)				
Methylene Chloride	2.0 U	2.0 U	2.3	5.0 A
Acetone	5.0 U	23 P	3.8 J	800 B
Chloroform	1.0 U	5.6	0.7 J	7.17 B
2-Butanone (MEK)	7.5 U	8.9	5.6 M	400 B
4-Methyl-2-pentanone (MIBK)	2.0 U	5.2	2.0 U	4,000 B
Toluene	1.0 U	2.8	1.0 U	40.0 A

U - Compound undetected. Associated value is sample detection limit.
J - Reported value is estimated (result is less than sample detection limit).
M - Reported value is estimated (compound has low spectral match parameters
P - Compound is also present in laboratory method blank.
A - Method A
B - Method B

Table 4 (cont.)
Summary of Laboratory Results
Organic Compounds In Soil

Sample Matrix	A1-1S Soil	A2-1S Soil	Trestle Wood	T-Soil Soil	Offsite Soil	MTCA Cleanup Levels
Total Petroleum Hydrocarbons (mg/kg)	11	**12,000**	47	12	**8,600**	100/200 A
Volatile Organic Compounds (µg/kg)						
Methylene chloride	NA	NA	NA	NA	13 P	500 A
Acetone	NA	NA	NA	NA	6.8 P	8,000,000 B
Chloroform	NA	NA	NA	NA	1.0 U	164,000 B
2-Butanone (MEK)	NA	NA	NA	NA	5.0 U	4,000,000 B
1,1,1-TCA	NA	NA	NA	NA	1.0 U	20,000 A
TCE	NA	NA	NA	NA	1.0 U	500 A
PCE	NA	NA	NA	NA	1.0 U	20,000 A
Toluene	NA	NA	NA	NA	1.0 U	40,000 A
Styrene	NA	NA	NA	NA	1.0 U	16,000,000 B
Total Xylenes	NA	NA	NA	NA	2.7 P	20,000 A
Semivolatile Organic Compounds (µg/kg)						
Benzoic Acid	NA	NA	450 J	NA	NA	320,000,000 B
Phenanthrene	NA	NA	82 J	NA	NA	344,000 B
Fluroanthene	NA	NA	130	NA	NA	3,200,000 B
Pyrene	NA	NA	120	NA	NA	2,400,000 B
Benzo(a)anthracene	NA	NA	45 M	NA	NA	11,900 B
Bis(2-ethylhexyl)phthalate	NA	NA	110	NA	NA	71,400 B
Chrysene	NA	NA	62 M	NA	NA	39,180 B
Benzo(b)fluoranthene & Benzo(k)fluoranthene	NA	NA	90 M	NA	NA	4,750 B

U - Compound undetected. Associated value is sample detection limit.
NA - Sample not analyzed for particular compound.
J - Reported value is estimated (result is less than sample detection limit).
M - Reported value is estimated (compound has low spectral match parameters).
P - Compound is also present in laboratory method blank.
A - Method A (non-industrial sites)
B - Method B

Table 4
Summary of Laboratory Results
Organic Compounds in Soil

Sample Matrix	SS-1A Soil	SS-2A Soil	SS-4A Soil	TP-1 Soil	Control Soil	HA-1 Soil	MTCA Cleanup Levels
Total Petroleum Hydrocarbons (mg/kg)	**510**	**1,000**	**1,800**	15	10 U	**12,000**	100/200 A
Volatile Organic Compounds (µg/kg)							
Methylene chloride	3.2	2.1 U	3.1	9.8	7.1	3.4 B	500 A
Acetone	2.4 J	5.2 U	5.1 U	4.8 U	12	14 B	8,000,000 B
Chloroform	0.7 M	1.1 U	1.0 U	1.0 U	1.1 U	1.1 U	164,000 B
2-Butanone (MEK)	1.4 J	5.2 U	3.1 M	4.8 U	3.4 M	8.1 U	4,000,000 B
1,1,1-TCA	0.9 U	1.1 U	4.8	1.4	0.7 M	1.1 U	20,000 A
TCE	0.9 U	1.1 U	1.0 U	1.0 U	1.1 U	1.1 U	500 A
PCE	0.9 U	1.1 U	1.0 U	1.0 U	1.1 U	1.1 U	20,000 A
Toluene	0.5 M	0.6 M	32	7.0	4.4	0.9 J	40,000 A
Styrene	0.9 U	1.1 U	1.0 U	1.0 U	1.1 U	1.1 U	16,000,000 B
Total Xylenes	3.3 P	1.9 JP	7.9 P	9.6 P	4.1 P	0.9 J	20,000 A
Semivolatile Organic Compounds (µg/kg)							
Benzoic Acid	NA	NA	NA	NA	NA	NA	320,000,000 B
Phenanthrene	NA	NA	NA	NA	NA	NA	344,000 B
Fluroanthene	NA	NA	NA	NA	NA	NA	3,200,000 B
Pyrene	NA	NA	NA	NA	NA	NA	2,400,000 B
Benzo(a)anthracene	NA	NA	NA	NA	NA	NA	11,900 B
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	71,400 B
Chrysene	NA	NA	NA	NA	NA	NA	39,180 B
Benzo(b)fluoranthene & Benzo(k)fluoranthene	NA	NA	NA	NA	NA	NA	4,750 B

U - Compound undetected. Associated value is sample detection limit.
NA - Sample not analyzed for particular compound.
J - Reported value is estimated (result is less than sample detection limit).
M - Reported value is estimated (compound has low spectral match parameters).
P - Compound is also present in laboratory method blank.
A - Method A (non-industrial sites)
B - Method B

Table 5
Summary of Laboratory Results
Metals in Soil

Sample Matrix	SS-3A Soil	SS-4A Soil	Trestle Wood	T-Soil Soil	Offsite Soil	Grit Grit	MTCA Cleanup Levels
Metal	**Concentration (mg/kg)**						
Antimony	NA	NA	1.4 U	1.4 U	24	7.3	32.0 B
Arsenic	**139**	**72**	7.1	2.4 U	**108**	**250**	20.0 A
Barium	167	120	NA	NA	NA	NA	4,000 B
Beryllium	NA	NA	0.14 U	0.14	0.18	**0.45**	0.23 B
Cadmium	1.8	0.8	0.6	**2.3**	**4.7**	**6.0**	2.0 A
Chromium	53.5	39.6	4.3	24	80	16	100.0 A
Copper	NA	NA	124	7.8	**470**	**2,500**	400 B
Lead	**1,030**	117	46	9.9	**250**	**360**	250.0 A
Mercury	0.06	0.05	0.1 U	0.1 U	0.4	0.1 U	1.0 A
Nickel	NA	NA	4.5	28	35	5.8	1,600 B
Selenium	5 U	5 U	2.4 U	2.4 U	2.4 U	2.4 U	240 B
Silver	0.9	0.5	0.24 U	0.24 U	0.24 U	0.6	240 B
Thallium	NA	NA	2.4 U	2.4 U	2.4 U	2.4 U	5.6 B
Zinc	NA	NA	190	52	1,600	6,000	16,000 B

U - Metal undetected. Associated value is sample detection limit.
NA - Sample not analyzed for particular metal.
A - Method A (non-industrial sites)
B - Method B