REMEDIAL INVESTIGATION/FEASIBILITY STUDY
WORK PLAN

WESTBAY MARINA

Prepared for

West Bay Marina Associates
2100 West Bay Drive NW
Olympia, Washington 98502

Prepared by

Anchor Environmental, L.L.C.
1423 Third Avenue, Suite 300
Seattle, Washington 98101

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1 INTRODUCTION

On October 7, 1999, West Bay Marina Associates (WBMA) entered into the Washington Department of Ecology's (Ecology) Voluntary Cleanup Program (VCP) after petroleum hydrocarbons were discovered during underground storage tank (UST) system closure activities in 1999 at West Bay Marina (Site). The UST system closure was independently characterized and documented in *Tank Removal and Independent Remedial Action Report* (Stemen 1999a). In response to an opinion letter from Ecology issued November 29, 1999, Stemen Environmental, Inc. (Stemen), also installed four groundwater monitoring wells following UST removal and closure activities. The Thurston County Health Department conducted a Site Hazard Assessment to address the UST removal project and recommended a No Further Action (NFA) on July 16, 2007. The NFA designation was confirmed by Ecology's August 23, 2007, Hazardous Sites List Site Register Special Issue.

WBMA entered into Agreed Order (AO) No. DE5272 with Ecology effective March 4, 2008. In compliance with AO requirements, the purpose of this Draft Remedial Investigation/Feasibility Study (RI/FS) Work Plan (RI/FS Work Plan) is to provide for remedial action and present an evaluation process to address the potential that a "release" or "threatened release" of "hazardous substance(s)" has occurred on the Site. Specifically, this Draft RI/FS Work Plan, with the attached Sampling Analysis Plan (SAP, Appendix A) and Health and Safety Plan (HSP, Appendix B), details the steps necessary to determine the nature and extent of any potential Site soil and/or groundwater contamination, assess the potential for impacts from the Site to sediments on adjacent Washington State Department of Natural Resources (DNR) -owned aquatic lands, and lay out the framework for potential future remedial action if required.

1.1 Property History and Description

Westbay Marina is located at 2100 West Bay Drive NW, Olympia, Washington, on the western shore of Budd Inlet in Olympia, Washington (see Figures 1 and 2). Westbay Marina is comprised of an upland property (Site), as well as adjacent aquatic lands leased from DNR (Lease No. 2618) (see Figure 3 and 4). The Site is bordered on the east by Budd Inlet of Puget Sound. Other adjacent properties include a vacant commercial site to the south, Dunlap Log Storage (a log sorting operation and storage facility) to the north, and a steep raised hillside and residential properties to the west. Westbay Marina is accessed on the west by West Bay Drive NW, an asphalt-surfaced, two-lane public roadway (see Figure 4).

The uplands marina property, Thurston County Parcel 09750018002, has been owned exclusively by WBMA since 1990. The parcel encompasses 3.01 acres, is used primarily for parking and storage. The parcel was first developed by the Buchanan Lumber Company in 1919. Part of the investigative pursuit requirements of this work plan is to determine if a "release" or "threatened release" of hazardous substance has occurred under the ownership and use of the property by owners prior to that of WBMA.

Westbay Marina currently operates solely as a marina under a 30-year Aquatic Land Lease (No. 2618) from the DNR, effective January 1, 1984 through January 1, 2014. Currently, the harbor area leased by WBMA lies in front of Olympia Tidelands Blocks 385 to 388, inclusive, and comprises 13.6 acres of water dependent uses and 0.0495 acres of non-water dependent uses (the marina building that houses Tugboat Annie's Restaurant). The marina consists of structures on piles and 400 boat slips. The slips range in size from 20 to 70 feet and provide moorage for vessels up to 70 feet in length. Minor boat maintenance and repair activities occur on the Site; however, boat bottom work and major maintenance is referred to other boat yards. A small wooden building located in the northeastern corner of the property serves as the office. A larger, two-story wooded structure serves as the location for a restaurant operation (Tugboat Annie's). The restaurant is located mostly on the DNR Aquatic Lease and is an approved improvement. The harbor area to the north is currently leased by Dunlap Towing, and the area to the south is leased by the Delson Lumber Company.

1.2 Budd Inlet Regulatory Structure

Investigation and evaluation activities addressed in this RI/FS Work Plan are pursuant to the AO requirements for a RI/FS Work Plan, as outlined in WA 173-340-350, conducted in accordance with Washington Administrative Code (WAC) Chapter 173-340, the Model Toxics Control Act (MTCA). Furthermore, the activities addressed in this RI/FS Work Plan follow regulatory classifications specified by the Washington State Sediment Management Standards (SMS) for chemicals of concern (WAC 173-204-100).

1.3 Objectives and Work Plan Organization

The objectives of this Work Plan are to:

1. **Summarize historical Site uses and previous investigations and remediation activities.** Summarize historical on-site activities in order to evaluate the potential for on-site contamination and chemical migration. Summarize and evaluate remediation work and sampling previously performed on the upland component of the Site to determine compliance with MTCA.
2. **Summarize available sediment quality data.** Summarize and evaluate available sediment quality information to assess if any past or present migration of chemicals from the Site has resulted in the potential for adverse impacts to Budd Inlet sediments as defined by SMS.
3. **Summarize and evaluate potential pathways from the Site to adjacent sediments.** Summarize and evaluate available information to assess if any past or present migration of chemicals to adjacent sediments from the Site has occurred. This evaluation focuses primarily on surface water and groundwater pathways.
4. **Identify potential data gaps and summarize investigative activities to fill data gaps.** Evaluation of existing Site information, previous sediment sampling data, and potential chemical migration pathways are used to identify outstanding data gaps. Sampling and analysis activities necessary to address these data gaps, including a terrestrial ecological evaluation (TEE), are identified and outlined.
5. **Prepare a Sampling and Analysis Plan (SAP)**. The SAP (Appendix A) addresses project management responsibilities, sampling and analytical procedures, assessment and oversight, data reduction, the quality control and quality assurance process, data validation, and reporting.
6. **Prepare a Health and Safety Plan (HSP)**. The HSP (Appendix B) outlines the procedures for safely conducting field sampling and analysis for the protection of field staff and the public.

2 EVALUATION OF AVAILABLE INFORMATION

The purpose of this section is to describe historical Site activities, summarize any prior Site remediation activities, and summarize soil and groundwater sampling investigations previously performed on the Site. Results of past remedial and investigative activities are used to evaluate the potential for Site contamination and chemical migration and to determine compliance with MTCA. Furthermore, this section evaluates available sediment quality information to assess if any past or present migration of chemicals from the Site has resulted in the potential for adverse impacts to Budd Inlet sediments as defined by SMS.

2.1 Site Activity Description and History

The Site is located at 2100 West Bay Drive NW, Olympia, Washington, on the western shore of Budd Inlet in Olympia, Washington (see Figures 1 and 2). The property to the south is a vacant commercial site owned by the Delson Lumber Company. The property to the north is a log sorting operation and storage facility owned by Dunlap Log Storage. The Site is bordered on the west by a steep raised hillside and residential properties and on the east by Budd Inlet of Puget Sound. The Site is currently operating under Aquatic Land Lease No. 2618 from the DNR, effective January 1, 1984 through January 1, 2014. Currently, the harbor area leased by WBMA lies in front of Olympia Tidelands Blocks 385 to 388, inclusive, and comprises 13.6 acres of water dependent uses and 0.0495 acres of non-water dependent uses (Tugboat Annie's Restaurant building). The aquatic lands to the north are currently leased by Dunlap Towing, and those to the south are leased by the Delson Lumber Company.

The Site is accessed on the west by West Bay Drive NW, an asphalt-surfaced, two-lane public roadway (Figure 4). The Site is identified as Thurston County Parcel 09750018002. The parcel encompasses 3.01 acres and was first developed by the Buchanan Lumber Company in 1919. From 1966 to 1990, the uplands property was owned by Charles and Mildred Afdem, Buchanan Lumber Company, and WMBA, but has been owned exclusively by WBMA since 1990.

Westbay Marina is currently operating as a marina with 400 slips, which provide moorage for boats smaller than 70 feet in length. Minor boat maintenance and repair activities occur on the Site; however, boat bottom work and major maintenance is referred to other boat yards. A small wooden building located in the northeastern corner of the property serves as the office. A larger, two-story wooded structure serves as the location for a restaurant operation (Tugboat Annie's). The restaurant is located mostly on the DNR Aquatic Lease and is an approved occupancy.

The Site was first developed by the Buchanan Lumber Company in 1919. From 1919 until 1966 the Buchanan Lumber Company, Washington Veneer Company, or Olympia Oil & Wood Products Company operated a saw mill, veneer plant, or stud mill (see Figures 5, 6, 7, 8). According to an interview with former property owner Don Buchanan conducted by Hart Crowser (1993), lumber treating never occurred on what is currently the Site, and the closest lumber treating operation is located approximately 1 mile southeast of the subject property on the opposite side of Budd Inlet (Hart Crowser 1993). From 1966 until 2002, the Site was the location of a boat yard and marina. Tugs Restaurant was constructed on the subject property in 1984, but was destroyed by a fire in 1993. The restaurant was rebuilt, renamed, and is currently operating as Tugboat Annie's Restaurant.

The Site is primarily a parking lot paved with asphalt or armored with gravel. Soils at the Site, covered in asphalt, gravel, cobble, or grass, consist mainly of poorly consolidated fill materials, which includes pit run sands, cobbles, and varying sizes of wood debris. Soils surrounding the former location of the USTs consisted of typical pit run sands with 2 to 4 inch cobbles intermixed to a depth of approximately 5 feet below ground surface (bgs). Fill material below a depth of approximately 5 feet consisted of the above-described soils intermixed with varying sizes and lengths of wooden timbers/logs and other wood debris.

On May 8, 2008, Ed Berschinski and Melissa Haury of Anchor Environmental L.L.C. (Anchor) conducted a Site reconnaissance. The reconnaissance included a walk-through survey of the Site property. Locations and conditions of catch basins, outfalls, seeps, and property buildings were noted and mapped to both verify and augment mapping prepared during previous investigations (see Figure 4). Hart Crowser documented five catch basins (1993), but only three were observed during Anchor's Site visit. CB-03 was not found, and CB-04 appeared to have been filled in or paved over. The parking lot is primarily covered in asphalt, though areas in the northern portion of the property the parking lot are surfaced with gravel (see Figure 4). An aboveground waste oil storage area was located midway along the southern property boundary. Small storage sheds line the western and southern property boundaries.

The southern property boundary consists of a strip of land that runs east from the road to the shore of Budd Inlet, referred to on Figure 4 and hereafter as the Southern Ditch, where runoff from former boat yard activities could collect and drain to surface waters. A chain linked fence borders what is presumably the southern boundary of the Southern Ditch, although this fence line appears to be located south of the actual Westbay Marina property line. Photos taken as part of the Hart Crowser *Preliminary Environmental Assessment and Soil Remediation* (1993), as well as current Site photos and Site visit observations, depict the Southern Ditch as a strip of land covered with cobble, gravel, and grass. It slopes gradually downward in a southerly direction off Westbay Marina property to the parking lot on the adjacent property parcel (see Figure 9). An 8-inch flexible plastic pipe was observed extending from the area where an outfall was formerly located for drainage from the Southern Ditch (see Outfall #1, Figures 4 and 10). No flow or evidence of flow was observed from this plastic pipe during the May 8, 2008, Site visit. Outfall #2 is an 8-inch PVC pipe that drains from Catch Basin 01 (CB-01) (see Figure 4).

2.1.1 Wood Products Activities (1919 – 1966)

The Site was first developed by the Buchanan Lumber Company in 1919. From 1919 until 1966, the Buchanan Lumber Company, Washington Veneer Company, or Olympia Oil & Wood Products Company operated a saw mill, veneer plant, or stud mill. Historical maps and aerial photos show that most of the lumber mill operations were located off-site to the north (see Figures 5, 6, 7, and 8). The planning shed, mill office, and some lumber sheds were located on what is currently the Site, just east of the former Northern Pacific Railroad tracks. According to an interview with former property owner Don Buchanan conducted by Hart Crowser (1993), the existing Site was partially filled with soil that sloughed off the steep bank west of the Site, as well as wood waste from mill operations. Mr. Buchanan also indicated to Hart Crowser that lumber treating never occurred on what is currently the Site, and that the closest lumber treating operation is located approximately 1 mile southeast of the subject property on the opposite side of Budd Inlet (Hart Crowser 1993).

In a report written by DNR, dated March 27, 2008, John Bower stated that during the time Buchanan Lumber Mill was operating, "evidence indicates that the mill operated a burner to dispose of wood material"(DNR 2008). Wood product facilities generate "wood waste" consisting of outer layers of logs, bark, small branches and leaves, sawdust, and/or any type of wood rejects from lumber manufacturing processes. In general, the wood waste has been commonly called "hog fuel," and historically burned in boilers or in conical shaped "tee pee" burners as a simple waste incineration process. During the storing or transporting of logs in salt water, the outer layers absorb salt water and the salt content of the wood rises to 0.7 to 1.6 percent (Ecology 2003). When this salt-entrained hog fuel is burned, salt enters the boilers and is emitted as salt crystals or converted by chemical reaction into a variety of inorganic and organic compounds including salt cake, dioxins, and furans. Polychlorinated dibenzo-p-dioxin/furan formation is about hundred times higher for salt laden wood than for non-salty wood (Ecology 2003.) However, the amount of dioxin/furan released as a result of burning salt-laden wood is significantly lower than that released when burning creosote-treated wood (Uloth et. al. 2002).

Based on our investigation of aerial photos, the burner of interest was a conical-shaped structure possibly located, as illustrated in Figures 4, 6, and 7, in the northeast corner of the parcel of land currently owned by WBMA. However, wood residue incinerators, commonly referred to as beehive burners, teepee burners, conical wood waste combustors, and wood residue silo burners, are used to burn uncontaminated wood wastes and thus have a low risk of producing dioxins (Uloth et al. 2002). Furthermore, as stated above, Buchanan Lumber Mill was not a wood treating facility, and thus it is reasonable to conclude that the amount of dioxins generated, if any, was low. Although no sediment samples taken within the marina were analyzed for dioxins/furans, as discussed in Section 2.3, the three surface sediment samples collected closest to Westbay Marina ranged from 14.6 to 19.3 picograms per gram (pg/g) toxic equivalents (TEQ), which are at or below the mean concentration TEQ for Budd Inlet. The sediment samples collected adjacent to known sources of dioxins elsewhere in Budd Inlet demonstrated levels of dioxins/furans approximately three times higher than those analyzed in sediments adjacent to Westbay Marina.

2.1.2 Westbay Marina Activities (1966 – Present)

Prior to 2002, Westbay Marina included a small boat maintenance operation. Boat maintenance activities performed on the Site included hydroblasting (using water jets to remove loose paint and marine growth from bottoms prior to scraping), scraping, sanding, and painting boats. Until the mid-1980s, such activities were performed in the southeastern corner of the parking lot (see Figure 4).

After the mid-1980s, these boat maintenance activities moved to the southwestern corner of the parking lot away from Budd Inlet. Water flowed into the Southern Ditch (see Figure 4 and Section 2.2.1). Prior to 1991, hydroblasting, scraping, sanding, and painting activities formerly occurred directly on the pavement. After approximately 1991, solids from boat washing and maintenance activities were collected on plastic sheeting, which was used to cover the pavement below the boats. Starting in 1992, boats were suspended over a plastic-lined basin intended to capture wastewater and solids. However, some overflow may have discharged directly into the Southern Ditch.

Hart Crowser (1993) reported that Ecology visited Westbay Marina five times between June 1989 and September 1991. Ecology observed that wash water from pressure washing activities carried paint chips and possibly waste oil and other chemicals to the catch basin in the boat maintenance area. This drain was piped to the Southern Ditch and flow eventually discharged to the adjacent surface waters (see Figure 4). All of these types of waste-generating boat maintenance and repair activities on Site ceased in 2002, and Westbay Marina has operated exclusively as a marina since that time.

Subsequent to the above-mentioned Site visits, Ecology recommended that all painting activity be done in accordance with established boat yard best management practices (BMPs), that waste oil and solvents be managed in accordance with the state's dangerous waste regulations and BMPs for liquid containment, that all batteries be properly stored and recycled, that petroleum-contaminated soils be excavated, and that a spill prevention control and countermeasure (SPCC) plan should be implemented. Ecology indicated on a follow-up visit that suggested recommendations were implemented, with the exception of the SPCC plan and soil removal.

Several Environmental Report Tracking System (ERTS) releases have been reported to have taken place on the Site in addition to those associated with the UST removal. On June 12, 2004, Ecology received a report of a sheen (ERTS #541436) on the surface water from a diesel spill at Westbay Marina. The diesel release of at least 25 gallons was unrecoverable. On July 12, 2004, Ecology received a report of a release (ERTS #542054) from a hydraulic trash compactor. Approximately 3 gallons of hydraulic oil leaked out and migrated to the surface water of the marina. A surface water sheen was contained by floating boom and cleaned up. On May 29, 2006, Ecology received a report of a release (ERTS #555408) concerning a football field size sheen in Budd Inlet near Westbay Marina.

2.2 Previous Site Soil and Groundwater Investigations and Remediation Activities

The Site has been the subject of a number of soil and groundwater investigations and remediation activities. These actions include:

- *Preliminary Environmental Assessment and Soil Remediation*, which included soil and sediment sampling and analysis and soil removal (Hart Crowser 1993)
- UST Removal and Independent Remedial Action, which included the removal of three USTs in addition to contaminated soil and groundwater containment, removal, sampling and analysis (Stemen 1999a; Thurston County Public Health Department 2007)
- Groundwater Monitoring Well Installation and Groundwater Sampling for West Bay Marina, which included the installation of four groundwater monitoring wells, measurement of groundwater elevations, and groundwater sampling and analysis for gasoline range total petroleum hydrocarbons (TPH), diesel fuel range TPH, and/or benzene, toluene, ethylbenzene, and xylenes (BTEX; Stemen 1999b)

The following section summarizes these previous investigations and subsequent remedial actions performed at Westbay Marina by Hart Crowser and Stemen.

2.2.1 Preliminary Environmental Assessment and Soil Remediation (Hart Crowser 1993)

The purpose of the environmental assessment was to determine whether current and/or past Site activities may have contributed to environmental contamination on the property and to clean up identified areas of soil contamination.

In 1991, as part of the Budd Inlet/Deschutes River water quality study, the Department of Health and DNR collected and analyzed one soil sample from the Southern Ditch, an area of land running east from the road to the shore of Budd Inlet, where runoff from the Site parking lot and Catch basin 05 (CB-05) drains (see Figure 4). Results demonstrated concentrations of mercury, lead, and total carcinogenic polycyclic aromatic hydrocarbons (cPAHs; benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, and chrysene) exceeded MTCA Method A cleanup levels.

Hart Crowser (1993) also collected soil samples from the Southern Ditch in 1992. These samples were analyzed for total metals, toxicity characteristic leaching procedure (TCLP) metals, volatile organic compounds (VOC), and PAH. The upper 3 inches of soil in the ditch adjacent to the boat washdown area had concentrations of metals that exceeded state dangerous waste designation levels due to leachable lead and aquatic toxicity (WAC Chapter 173-303). The upper 3 inches of soil in three other areas of the ditch exceeded MTCA cleanup levels due to elevated concentrations of metals.

The upper 3 inches of soil were removed from these areas and disposed of at approved off-site facilities. Chemical analysis of soil verification samples collected following excavation indicated that the remaining soil was below MTCA Method B cleanup levels for metals and PAHs. An additional soil sample collected from the Southern Ditch 4 months after the above-mentioned chemical analysis indicated only copper concentrations exceeding MTCA Method B cleanup levels were still present (Hart Crower 1993). Hart Crowser (1993) recommended that every effort should be made to prevent the discharge of wastewater to this area and that placing cobbles on the surface of the ditch, filling, and/or paving could reduce the potential for chemical migration to surface waters and adjacent sediments from the boat yard.

Soil collected and analyzed from the location of a former waste oil aboveground storage tank (AST) in the southwestern corner of the Site demonstrated concentrations of TPH that exceed MTCA Method B cleanup levels. In response to this finding, 55 tons of soil was excavated from this area. Chemical analysis of verification soil samples collected following excavation indicates the remaining soil was below MTCA Method B cleanup levels for TPH (Hart Crower 1993).

The *Preliminary Environmental Assessment and Soil Remediation* conducted by Hart Crowser concludes that MTCA Method B cleanup levels for carcinogenic PAHs and MTCA Method B direct contact cleanup levels for metals and TPHs were reasonable regulations for their evaluation for the following reasons: 1) groundwater at the Site is not a drinking water source; 2) Site verification data indicate that chemical constituents are attenuated in the upper few inches of soil; and 3) results of surface sediment sampling and analysis performed by DNR as part of the Budd Inlet/Deschutes River Watershed Characterization Study indicate that adjacent marine sediments have not been adversely impacted by Site activities (Hart Crowser 1993).

2.2.2 UST Removal (Stemen Environmental)

In the spring of 1999, Stemen was contracted to remove three USTs. The 1,500-gallon leaded gasoline, 4,000-gallon unleaded gasoline, and 2,000- gallon diesel fuel USTs were buried side-by-side in the main parking area (see Figure 4). The three fuel tanks were of single wall steel construction and included submersible pumps, pressurized underground steel fuel supply lines, and remote fuel dispensers.

The tank removal project commenced on April 3, 1999. The majority of the excavation was scheduled to coincide with low tide (minus if possible) in an effort to minimize the effects of tidal fluctuations. During the UST removal activities, visible petroleum contamination was observed in soils adjacent to the 4,000-gallon UST. Specifically, petroleum-contaminated soils were discovered at shallow depths (between 0 to 3 feet below surface) near the fill port and submersible pumps, while soils at depths greater than 3 feet exhibited more uniform contamination in all areas surrounding the tank. Additionally, petroleum-contaminated soils were also discovered around the fuel supply lines, which appeared to exhibit more significant levels of contamination when compared to the tank area. An inspection of the USTs revealed significant corrosion, but no observable holes.

Due to the significant presence of petroleum-contaminated soils and observed oily sheen on the surface of excavation waters, the Site was entered into Ecology's Voluntary Clean-up Program (VCP). An on-site meeting held on April 7, 1999, to discuss further remedial action included Paul Stemen of Stemen Environmental, Inc., Martha Maggi of Ecology's VCP, Gerard Tousley from Thurston County Health Department, and Neil Faulkenburg the General Manager of West Bay Marina. In order to ensure compliance with all applicable MTCA regulations, Ecology required the containment and permitted disposal of free water within the excavation. A floating pump and portable storage tank were installed to skim petroleum products from the surface water on an as-needed basis. The products were stored temporarily on-site and eventually placed in a secure area on-site.

Additionally, in accordance with Ecology requirements, on April 10, 1999, groundwater and soil samples were collected from the perimeter of the UST excavation, the entire length of the fuel supply lines, and beneath the dispenser-mounting location. The majority of samples were collected using a Strataprobe Sampling System. Continuous cores were extended to a depth of approximately 12 feet bgs. This bottom core depth was approximately 2 feet below the lowest water table elevation. The results of this investigation confirmed the remaining presence of benzene, total xylenes, gasoline-range TPH, diesel fuel-range TPH, and heavy oil range TPH in the subsurface soils and/or waters exceeding MTCA Method A cleanup levels in the pump island area, the valve box area, and the underground fuel supply line areas. Tables listing complete results of sampling can be found in *Tank Removal and Independent Remedial Action Report* (Stemen 1999a).

Soil sample VB-1 was taken at a depth of 60 inches bgs in the valve box area and subsequent soil analysis confirmed the presence of diesel fuel range TPH at levels exceeding MTCA Method A standards. Because subsurface soils present at this location were not reasonably accessible for excavation and removal purposes, and because the estimated quantity of impacted soils was estimated to be small, in-situ bioremediation method was chosen for remediation.

Based on the above sampling results, all other known contaminated soils were removed and discrete soil samples were collected from the limits of the excavation. Additionally, excavation water remaining in the temporary storage tank was also analyzed. Final results for the selected analytes were either non-detect or detected at levels below 1999 MTCA Method A cleanup levels. Ecology determined that the excavation could be backfilled and the "site closed" (Thurston County Public Health Department 2007). A total of 675 tons of petroleum-contaminated soil was loaded and transported to TPS Technologies of Lakewood Washington for treatment/disposal using thermal desorption. A total of 56 tons of demolition debris was property transported to Jones Quarry of Olympia, Washington for proper disposal and recycling. All tank rinsing liquids and flammable and affluent liquids were pumped from the tanks and disposed of by Acrom Oil of Tacoma, Washington. The asphalt surface materials that were either damaged or removed during this project were replaced and/or restored. All tank removals and corrective actions were performed under the guidelines set forth in WAC 173-360-385 and 173-360-390.

During the excavation activities associated with the removal of the USTs, the underground fuel supply lines, and the associated impacted soils, a large quantity of impacted wood debris was removed from the excavation along with the soils. This wood debris was later permanently disposed of at the Hawks Prairie Landfill.

2.2.3 Groundwater Monitoring (Stemen Environmental)

Groundwater generally flows onto and through the Site in an easterly direction but is influenced by two factors, the volume of groundwater flow from the west and tidally influenced water from the east. Depending on tidal cycles and weather conditions, the groundwater level continually fluctuates between approximately 4 and 10 feet bgs (Stemen 1999a).

In November 1999, the UST removal final cleanup report was reviewed by Ecology. Ecology confirmed that soils surrounding the excavation area were below applicable

MTCA cleanup levels (Thurston County Public Health Department 2007). However, due to the former presence of contaminated excavation waters, Ecology expressed concern regarding the potential for remaining soil contamination. In a letter from Martha Maggi of Ecology to Neil Falkenburg dated November 29, 1999, Ecology recommended "further monitoring of site ground water. It is sufficient to locate three ground water sampling points surrounding and/or downgradient of the excavation and former fuel lines" (Thurston County Public Health Department 2007).

Per this request, four groundwater monitoring wells were installed at the Site (Figure 4). Paul Stemen supervised the installation of these four groundwater monitoring wells on December 14, 1999. The 1-inch diameter PVC monitoring wells were installed by Licensed Well Drillers/Geologists from Transglobal Environmental Geosciences using a StrataProbe system. Three of the monitoring wells were extended to depths of approximately 13 feet bgs and were screened at depths of 2 to 13 feet bgs. One monitoring well was extended to a depth of 8 feet bgs and screened at depths from 2 to 8 feet bgs. On December 16, 1999, one groundwater sample was obtained from each well and analyzed for BTEX, gasoline-range TPH, and diesel fuel-range TPH. Lab results indicated that the selected analytes were either not detected or detected at concentrations below MTCA Method A cleanup levels (Stemen 1999b). The Thurston County Health Department concluded that remedial activities associated with the 1999 UST Removal Project were completed in accordance with applicable MTCA regulations under Ecology guidance. It was recommended that the tank removal project receive a determination of NFA under MTCA, based on WAC 173-340-310(5)(d)(ii). This letter concluded that "all of the contaminated soils in previous site investigations were removed from the site" and that no "MTCA exceedances were detected in remaining soils." Furthermore, the NFA determination for all activities associated with the UST removal project concluded that, regarding the releases associated with the USTs, there was "no remaining pathway to marine waters downgradient" and "there is no pathway to groundwater" (Thurston County Public Health Department 2007, page 4).

2.2.4 Summary and Conclusions

Extensive investigative action, including soil and groundwater sampling, performed by Hart Crowser, DNR, and Stemen previously confirmed the release of hazardous substances as a result boat yard operation and marina activities on the Site. However, extensive soil and groundwater remediation activities were performed in response. These activities include:

1. Hart Crowser documented the removal and disposal of 55 tons of soil from around the former AST as well as the upper 3 inches of soil in the Southern Ditch.
2. Stemen recorded the removal and disposal of underground tanks and 675 tons of soil in the UST removal process. Stemen also contained and disposed of contaminated groundwater. The asphalt surface materials that were either damaged or removed during this project were replaced and/or restored. All tank removal and corrective actions were performed under the guidelines set forth in WAC 173-360-385 and 173-360-390.

A letter to Neil Falkenburg from Bradley A. Zulewski of the Thurston County Public Health and Services Department, dated August 14, 2007, states that the "Thurston County Health Department has completed a Site Hazard Assessment (SHA)… as required under the [MTCA]. The purpose of the SHA was to evaluate the completeness of the 1999 Underground Storage Tank remediation project. A determination of [NFA] has been made by [Ecology] based on this SHA" (Thurston County Public Health Department 2007). This letter was related exclusively to the UST removal activities and, in addition to soil and groundwater sampling subsequent to all remediation activities, confirm the remediation of contamination associated with that Site component. Other potential areas of concern were not addressed by this determination. Other soil and groundwater components of the Site have been appropriately remediated where necessary. Activities that generated the contamination are no longer performed at the Site. The Site consists of a parking lot paved with asphalt, and the areas of the Site not paved are well armored by asphalt, gravel, cobble, or riprap, which provide a significant barrier to potential future chemical migration.

On April 7, 2006, a Notice of Pending Inactivity Determination Letter was sent to Stemen Environmental providing 30 days to provide a work summary, report, or other documentation demonstrating that cleanup activities had occurred during the previous 12 months. Ecology did not receive a response to this notice and the site was removed from the VCP on May 9, 2006. Because the December 27, 1999, groundwater investigation report by Stemen Environmental was not received by Ecology until June 6, 2007, Ecology issued a determination that Westbay Marina Associates is a potentially liable party (PLP) under RCW 70.105D.040 and notified WBMA of this determination by letter dated August 6, 2007.

2.3 Previous Sediment Investigations and Available Adjacent Sediment Quality Data

The purpose of this section is to summarize and evaluate the available surface sediment chemistry information for sediments on and in the vicinity of the aquatic lands leased from DNR by Westbay Marina. Previously collected Budd Inlet sediment quality information was reviewed and compiled to assess if any past or present migration of chemicals from the Site has resulted in the potential for adverse impacts to Budd Inlet sediments as defined by SMS. The search was focused in the immediate vicinity of Westbay Marina (see Figure 11).

Available sediment chemistry data was chosen for 25 sediment samples from seven sediment investigations conducted between 1988 and 2007 (see Table 1). A significant amount of environmental data for Budd Inlet was available electronically through Ecology's Environmental Information Management (EIM) database. The vast majority of information obtained from this search consisted of sediment chemistry results; however, in many instances, environmental data obtained from the EIM database did not include the data summary report associated with the original investigation, or the data report could not be obtained within the timeframe of this RI/FS Work Plan. In these instances, the EIM database is listed as the source and reference for these studies. Additionally, a search was conducted of Ecology's Puget Sound Ambient Monitoring Program (PSMAP) for data not included in EIM. The PSAMP database contained no sediment chemistry data results within the vicinity of Westbay Marina.

The following sediment investigations collected sediment samples from directly within the boundaries of the DNR aquatic lease area at Westbay Marina:

1. **Lower Budd Inlet Sediment Characterization Study** (Study ID: BUDINLET) (Ecology 1999). This investigation was conducted to determine if the lower Budd Inlet should still be listed on Ecology's Contaminated Sediment Site List. Sediment samples were collected from 14 locations near potential sources in lower Budd Inlet

in June 1998. Two samples, WB-1 and WB-2, were obtained from sediments directly adjacent to the Southern Ditch area of the Westbay Marina. Throughout the inlet, analysis was performed for metals and organic compounds. However, butyltin concentrations were analyzed only at the marina locations, perhaps to evaluate possible impact due to boat yard discharge. At these two sites, benzoic acid and dimethylphthalate levels exceeded SMS criteria. 2,4-dimethylphenol, chlorinated benzenes, diethylphthalate, and bis(2-exylhexyl)phthalate were reported as non-detect values that exceeded criteria. Although management standards for tributyl tin (TBT) currently do not exist, sample analysis demonstrated elevated levels of TBT ion (see Table 1).

2. **Preliminary Environmental Assessment and Soil Remediation** (Study ID: BUDDHCP) (Hart Crowser 1993). Hart Crowser collected and analyzed one sediment sample from the sediments located adjacent to the Southern Ditch. Metal concentrations in this sample did not exceed SMS criteria.
3. **Budd Inlet/Deschutes River water quality study** (Study ID: BUDDES) (Davis et al. 1993). The Department of Health and DNR collected and analyzed 13 sediment samples at Westbay Marina. Seven of these samples were within the boundaries of the area leased from DNR by Westbay Marina and the remaining six samples were collected just outside the DNR aquatic lease area. Metals and TBT were analyzed. No metals were detected at concentrations exceeding SMS criteria. TBT levels were low, ranging from 2.4 through 70.6 micrograms per kilogram (μg/kg).

The remaining studies surveyed were the Budd Inlet Characterization Study (SAIC 2008), the *LOTT Budd Inlet Sample Study* (EIM 1992b), the DNR Aquatic Lands Sediment Quality Reconnaissance (EIM 1992a), and the *Olympia Harbor Planning Full Characterization Study* (EIM 1988). Metals analyzed in these studies did not exceed SMS criteria. TBT was not measured. Sediment chemistry results reported in the investigations did not further demonstrate any significant patterns of contamination as related to past or current activities at Westbay Marina. Surface sediment sampling locations in the DNR Aquatic Lands sediment quality investigation were uncertain. One location appeared to be located over land despite being classified as a sediment sample. Because it could not be determined if the coordinates provided were incorrect or if this was an actual upland sample, this location was omitted from Figure 11.

The only investigation out of those surveyed that measured dioxin/furans was the Budd Inlet Characterization Study (SAIC 2008). This investigation was conducted for Ecology to determine the nature and extent and possible sources of dioxins/furans in sediments in Budd Inlet and measured dioxin/furan congeners in 46 sediment samples. Dioxin/furan concentrations for the Budd Inlet surface sediment samples ranged from 2.9 to 60.3 pg/g TEQ, with a mean concentration of 19.1 pg/g TEQ. The study divided Budd Inlet into three main regions. The West Bay region of the study also reported a mean concentration of 19.0 pg/g TEQ. The highest dioxin/furan concentrations were in the vicinity of the Hardel Mutual Plywood/Reliable Steel on the West Bay (SAIC 2008). Dioxin/furan concentrations do not have numerical criteria under SMS for marine sediments; however, the three surface sediment samples collected closest to Westbay Marina ranged from 14.6 to 19.3 pg/g TEQ, with a mean of 16.6 pg/g TEQ, which is at or below the mean concentration TEQ for Budd Inlet.

In general, chemistry data reported in these investigations demonstrate the adverse impacts to sediments adjacent to Westbay Marina have not been substantial. Despite a few exceedances for organic compounds, levels of chemicals of concern were measured at levels within SMS criteria. There is a need for sediment collection that is more evenly distributed along the shoreline of Westbay Marina and within the DNR Aquatic Lease Area. Furthermore, analysis of collected sediment samples should be appropriate to the corresponding upland Site activities. The surface sediment samples that have been previously collected nearest to the shore of Westbay Marina are grouped towards the southern part of the property, near the Southern Ditch. Surface sediment samples collected along the shoreline from the south property boundary to the north property boundary, as well as several offshore but within the DNR Aquatic Lease boundary, would provide more complete sediment characterization results and analysis.

3 CONCEPTUAL SITE MODEL/PATHWAYS

The purpose of this section is to present a conceptual site model and describe the potential chemical migration pathways based on the available Site data. Based on this preliminary conceptual site model, this section also recommends further investigative sampling activities to evaluate chemical migration.

Chemical migration pathways from the Site to adjacent surface water and sediments are discussed in more detail below. They include:

- Stormwater to stormwater outfalls
- Groundwater to sediments
- Groundwater to seeps to sediments
- Soil to groundwater to surface water/sediments

Chemical migration pathways to the DNR Aquatic Lease Area include both direct release from the Site and deposition of contaminated sediments previously outside the Aquatic Lease boundary.

3.1 Stormwater to Stormwater Outfalls

The Site is covered almost entirely by asphalt and functions primarily as a parking lot; no major industrial processes occur on the Site. The stormwater system consists of three main catch basins, which collect any stormwater running off the parking lot (Figure 4). (A total of five catch basins were identified in the Hart Crowser Site investigation [1993], but two of these were not observed during the Site visit conducted on May 8, 2008.) Stormwater collected in CB-01 discharges through Outfall #2 (Figure 4.) An outfall discharging water from CB-02 was not observed during the Site visit. Stormwater collected in CB-05 discharges into the Southern Ditch area. An 8-inch plastic corrugated flexible pipe was observed extending from the area where an outfall was formerly located for drainage from the Southern Ditch (see Outfall #1, Figures 4 and 9.) No flow or evidence of flow was observed from either Outfall #1 or #2.

3.2 Groundwater to Sediments

Net groundwater flow is assumed to be eastward towards Budd Inlet. Groundwater at the Westbay Marina is influenced by two sources, including onshore groundwater flow from the west and tidally influenced water from the east. According to Stemen (1999a), the groundwater level continually fluctuates between approximately 4 and 10 feet bgs Depending on tidal cycles and weather conditions. It is assumed any chemicals would follow migration pathways as groundwater flows eastward off-site and resurfaces in aquatic sediments. Soils containing chemicals may impact the aquatic sediments if the chemicals leach into the groundwater and are carried as groundwater flows off-site. Any migrating chemicals could bind to sediment particles in Budd Inlet and may negatively impact the adjacent sediments within the area leased from DNR by Westbay Marina.

Previous groundwater sampling and investigations at Westbay Marina performed by Stemen demonstrated that PAHs and TPHs did not exceed MTCA Method A levels, thus confirming that the groundwater and soil removal and disposal actions associated with UST removal activities were successful in the prevention of chemical migration to the groundwater from the soils on the Site (Thurston County Health Department 2007). However, the chemicals analyzed for the groundwater samples did not include the complete SMS list. Further sampling of groundwater, both in groundwater wells and from seeps upwelling to sediments, is necessary to ensure a more comprehensive analysis and a more complete determination if any residual chemicals in the soil have leached from the soil to the groundwater.

3.3 Groundwater to Seeps and Sediments

In a process described above, chemicals may leach from Site soils to groundwater, and groundwater flows off Site in an eastward direction. Seeps were visible at low tide when this groundwater resurfaces in an adjacent mudflat in distinct areas of flow. Groundwater seeps may serve as a transport mechanism for any chemicals from soils to aquatic sediments. Six separate primary seeps were identified during the Site visit conducted on May 8, 2008 (Figure 10). Any chemicals in groundwater can potentially be transported to aquatic sediments at the seep locations.

Although Stemen (1999a) did not report metals as part of their groundwater analysis, metals have not been detected in sediments adjacent to Westbay Marina at levels that exceed SMS criteria as part of previous investigations. Sediment chemistry data for other chemicals demonstrate that chemical accumulation in sediments adjacent to Westbay Marina has not been substantial. Despite a few exceedances for organic compounds, levels of chemicals of concern were measured at levels below SMS criteria. However, further sampling of both groundwater and sediments, conducted as part of an approved work plan, could be used to evaluate whether chemicals have migrated from the groundwater to the sediments.

3.4 Soils to Groundwater to Surface Water and/or Sediments

Soils may provide a source of chemicals to adjacent surface water and/or sediments via a groundwater migration pathway similar to that described above. Chemicals that may leach into the groundwater could be carried to adjacent surface water as the groundwater flows off-site. Any transported chemicals are then released in surface water and/or could bind to sediment particles.

As discussed above, various historical Site activities may have resulted in contaminated soils.

- Investigations performed by Hart Crowser (1993) demonstrate one MTCA Method B exceedance of copper in the Southern Ditch. Available surface sediment sampling analysis data do not demonstrate copper levels exceeding SMS criteria. This suggests that the soil to groundwater to sediment pathway does not serve as mechanism of concern for metals to adjacent sediments from Southern Ditch soils. Collection and analysis of soils in the Southern Ditch is necessary to determine if copper remains at concentrations that exceed MTCA screening levels. Collection and analysis of sediments directly adjacent to the Southern Ditch would confirm that no accumulation of metals has occurred in the sediments.
- Petroleum-contaminated soils and groundwater were observed and collected during UST removal activities. Remediation activities performed in response and subsequent confirmatory testing indicated that these contaminated soils were appropriately remediated. However, Stemen reports that laboratory analyses results for soil sample VB-1 taken at a depth of 60 inches bgs in the valve box area confirmed the presence of diesel fuel range TPH at levels exceeding MTCA Method A standards. Because subsurface soils present at this location were not reasonably accessible for excavation and removal purposes, and because the estimated quantity of impacted soils was estimated to be small, in-situ bioremediation was chosen for remediation. Soil sampling and analysis for diesel fuel range TPH in the valve box

will determine if this remedy was successful. Sampling and analysis of groundwater from the four existing wells would confirm the successful remediation of all petroleum-contaminated excavation waters. Collection and analysis of sediments adjacent to the former UST containment area would confirm that no accumulation in sediments has occurred.

- As described in Section 2.1.2, several releases of diesel and hydraulic oil have occurred to the surface waters of the marina. Sediment collection and analysis would confirm that sediments adjacent to the Site have not been adversely impacted by these spills.
- There is historical record of a hog fuel burner used on site. Hog fuel burners are known to potentially result in the formation of dioxins. Both soil and sediment collection and analysis for dioxins/furans would determine if the release of any dioxins/furans has resulted in the negative impact to Site soils or adjacent sediments.

Extensive investigative action, including soil and groundwater sampling, performed by Hart Crowser, DNR, and Stemen previously confirmed the release of hazardous substances as a result of boat yard operation and marina activities on the Site. However, extensive soil and groundwater remediation activities were performed in response. Bradley Zulewski of the Thurston County Health Department issued a letter dated August 14, 2007, which described the completed SHA and indicated that "a determination of No Further Action (NFA) has been made by the Washington Department of Ecology (Ecology) based on this SHA" (Thurston County Public Health Department 2007, page 1). The NFA determination is limited to the UST removal activities and releases of hazardous substances associated with these activities. Further soil, groundwater, and sediment collection and analysis is needed to determine if contamination remains on Site.

3.5 Pathways of Concern

Based on the results of previous investigation and remediation activities performed on the Site and a preliminary evaluation of possible chemical migration pathways, the following data gaps have been identified:

- One sample taken in the Southern Ditch demonstrated levels of copper exceeding MTCA Method B. Antifouling marine boat paints contain high levels of copper, which helps to prevent or reduce fouling from biological organisms. Although 23 samples collected in surface sediments adjacent to the Site demonstrated no levels of metals that exceed SMS criteria, further sediment sampling would be necessary to determine if elevated levels of copper in Site soils have accumulated in sediments adjacent to the Southern Ditch. Because historical boat operations activities only occurred in the southern area of the Site, the probability that metals migrated to sediments other than those directly adjacent to the Southern Ditch is very low.

- Two samples collected in sediments adjacent to the Southern Ditch show elevated levels of TBT. TBT is primarily used as an antifoulant paint additive on ship and boat hulls, docks, and buoys to discourage the growth of marine organisms such as barnacles, bacteria, tubeworms, mussels, and algae. Historical boat operations activities that occurred near the Southern Ditch may have led to the release and migration of TBT to adjacent sediments. The extent of elevated TBT in sediments is unclear, and additional surface sediment sampling would be required to be more definitive. Because historical boat operations activities only occurred in the southern area of the Site, the probability that TBT migrated to sediments other than those directly adjacent to the Southern Ditch is low.
- Historical records and photos contain evidence that a conical hog fuel burner previously existed on the property currently owned by WBMA. Wood product facilities burn outer layers of logs, bark, small branches and leaves, sawdust, and/or any type of wood rejects from lumber manufacturing processes, called "hog fuel," in boilers. During the storing or transporting of logs in salt water, the outer layers absorb salt water and the salt content of the wood rises. When this hog fuel is burned, salt enters the boilers and may be emitted as salt crystals or dioxins and furans. WBMA recognizes the desire by Ecology and DNR to delineate the spatial extent and severity of dioxins/furans in Site soils and in DNR's state-owned aquatic lands.
- Although soil and groundwater sampling and analysis performed by Stemen confirmed the remediation of petroleum-contaminated soils and groundwater, collection of soils from the UST valve box, collection of groundwater from the existing groundwater monitoring wells, and collection of sediments adjacent to the former UST and analysis for PAHs would be necessary to confirm successful remediation of hazardous releases associated with the former USTs and to determine the extent of any PAH contamination.

- A TEE will be needed to characterize Site soils, identify if any chemicals are currently present that exceed MTCA criteria, and furthermore determine if these chemicals, if present, negatively impact soil biota, plants, or wildlife.

Site investigation activities that would be necessary to fill the data gaps mentioned above include:

Soil

1. Soil sampling and analysis for diesel fuel range TPH in the UST system valve box to determine if the selected remedy by Stemen was successful.
2. Soil sampling and analysis for copper in the Southern Ditch area to confirm that copper levels are less than MTCA Method B criteria and to confirm that surface water runoff in this area is not a pathway to the aquatic area.
3. Surface soil samples collection in the area of the historical hog fuel burner and analysis of the samples for dioxins/furans in order to assess whether the burner may have generated dioxin, whether soils are impacted, and whether there is a potential pathway to the aquatic area.

Groundwater

1. One discrete round of groundwater samples collection from the existing groundwater wells to determine if the remediation of petroleum-contaminated groundwater was successful, even though groundwater monitoring was performed after the UST remedial action was completed (as required by Ecology).
2. Collection and analysis of seep samples to better understand the quality of shallow groundwater discharging directly from the property to the adjacent sediments.

Sediment

1. Collection and analysis of surface sediment samples to better assess the potential that historical or ongoing activities on the property may have impacted adjacent sediments.

TEE

A TEE should be performed to determine if terrestrial plants and animals have been negatively impacted by the release of chemicals at the Site. Part of comprehensive cleanup requirements under MTCA, the TEE is required by Ecology under the WAC chapter 173-340-7490. Based on Site investigations, the need for or type of a TEE will be evaluated.

The data and previous investigations reviewed have demonstrated that the Site has been extensively characterized, and appropriate actions have been taken to remediate known problems and help prevent the migration of chemicals off the Site. However, a TEE would be needed to determine whether hazardous substances released into Site soils are present at levels that exceed MTCA criteria and, furthermore, if these chemicals negatively impact soil biota, plants, or wildlife. Soil collection will confirm that appropriate soil remediation has taken place on the Site and determine if dioxins/furans have been deposited on the Site from an historical burner. Groundwater, seep water, and surface sediment collection and analysis will confirm whether chemicals have migrated from soils to groundwater or accumulated in adjacent sediments.

4 REMEDIAL INVESTIGATION

In accordance with AO requirements, the purpose of this RI section is to provide a process to determine the nature and extent of any contamination and potential impact of soils, groundwater, and sediments adjacent to Westbay Marina.

4.1 Soils, Groundwater, and Adjacent Sediments Investigation

This section describes the initial phase of sampling and analysis activities necessary to address data gaps and to determine if soils, groundwater, and adjacent sediments have been negatively impacted by chemical migration. The sample locations and analyses are appropriate to the historical Site activities that may have led to the release of chemicals to Site soil, groundwater, and adjacent sediments. Sampling and analysis activities and key objectives are presented below and the sampling locations are presented in Figure 12.

- Collection of six soil samples at areas of the Site where potential contamination remains a concern. Collection and analysis of three soil samples from the Southern Ditch for copper will determine if copper remains in soil at levels exceeding MTCA Method B criteria. Collection and analysis of two soil samples for dioxins/furans from the area surrounding the historical burner (one location to the north and one location of the east) will determine if dioxins/furans were released into soils and whether there may be a pathway to groundwater or adjacent sediments. One soil sample collected from the former UST system valve box and analyzed for diesel fuel range TPH will determine if in-situ bioremediation was successful at remediating the TPH measured at levels greater than MTCA Method A criteria.
- Collection of one discreet sample from each of the four existing groundwater wells and analysis for total metals, dissolved metals, TBT, PCBs, SVOCs, ammonia, and TPH will determine if historical hazardous substances released on the Site are presently being transported by groundwater.
- Bimonthly monitoring (four rounds) of groundwater levels and groundwater flow direction from the four existing groundwater wells.
- Collection of four seep water samples at low tide from the flows directly adjacent to the Site boundary and analysis of total metals, dissolved metals, TBT, PCBs, SVOCs, ammonia, and TPH will determine if historical hazardous substances released on the Site are presently being transported by groundwater, potentially to adjacent sediments.

- Collection of eight surface sediment samples: four along the shoreline, co-located with three major identified seeps and one historical surface discharge point, and four offshore samples within the DNR aquatic lease boundary. All surface sediment samples will be analyzed for SMS chemicals, porewater sulfides, TBT (porewater and bulk), ammonia, grain size, and TPH (gasoline and diesel range.) WB003 and WB004 are those sediment locations closest to the historical burner and will be analyzed for dioxins/furans. This sediment investigation will further assist with the evaluation of whether seeps may carry contaminants or if chemicals are present in surface sediments at levels that exceed standards.

The two key objectives listed above not only evaluate whether chemicals are migrating from the soil to groundwater and groundwater to sediments, they also assess the potential historical magnitude and ultimate impacts to the quality of Budd Inlet sediments.

Subsurface sediment sampling will not be performed. However, based on surface sediment data, subsurface sediment sampling and bioassays (if required) may be performed during a second phase (triggered if contaminants are measured at concentrations greater than SMS criteria or appropriate screening criteria during the initial phase of sediment sampling.)

As required by the AO, both a SAP and HSP are included as Appendix A and B, respectively. The SAP addresses project management responsibilities, sampling and analytical procedures, assessment and oversight, data reduction, the quality control and quality assurance process, data validation, and reporting. The SAP also presents detailed descriptions of the sampling and analysis procedures to be used to assess the quality of the seeps and surface sediments adjacent to Westbay Marina. The SAP was prepared consistent with current Puget Sound Estuary Program (PSEP) and U.S. Environmental Protection Agency (EPA) protocols for sampling and analysis (EPA 1986; PSEP 1986, PSEP 1997a, b, and c). The contents and structure of this SAP are in line with guidance provided in Ecology's *Sediment Source Control Standards User Manual, Appendix B: Sediment Sampling and Analysis Plan Appendix* (Ecology 2008).

The HSP outlines the procedures for safely conducting field sampling and analysis for the protection of field staff and the public.

4.1.1 Sampling Program Overview

The sampling program includes the collection of six soil samples, four groundwater samples, eight surface sediment samples, and four seep samples (Figure 12).

Sufficient surface sediment from the 0 to 10-cm interval will be collected to provide material for analysis of SMS chemicals, porewater sulfides, TBT (porewater and bulk), ammonia, grain size, and TPH (gasoline and diesel range) at all eight samples. Sediment collected at stations WB003 and WB004 will be analyzed for dioxin/furan analysis as well. All samples will be visually inspected and the presence of any wood debris, and the presence or absence and type of biological organism will be noted.

Groundwater will be evaluated via two methods. One discrete sample from each of the four existing groundwater wells will be collected. From these same wells, a round of four bimonthly events will be performed to measure groundwater levels (and estimate flow direction). Six seeps have been identified along the shoreline of the property. Seeps 1, 3, 5, and 6 have been selected and are representative of shallow groundwater. No wellpoint sampling will be performed. The four groundwater well samples and four seep samples will be analyzed for total metals, dissolved metals, TBT, polychlorinated biphenyls (PCB), semivolatile organic compounds (SVOCs), ammonia, and TPH (gasoline, oil, and diesel range.)

Six soil samples will be collected from a depth up to 1 foot. Sufficient soil will be collected to analyze for the hazardous substances listed below. One sample will be collected from the former UST system valve box. This soil sample will be analyzed diesel fuel range TPH. Three soil samples will be collected in the area referred to in the Work Plan as the former Southern Ditch. These soil samples will be analyzed for copper to confirm that surface water runoff in this area is not a significant pathway to the adjacent sediments area and that copper levels do not exceed MTCA Method B soil criteria (3,000 mg/kg). Two soil samples will be collected in the area of the historical hog fuel burner. These soil samples will be analyzed for dioxins/furans in order to assess whether the burner may have generated dioxin, whether soils are impacted, and whether there is a potential pathway to the aquatic area.

All work associated with this project will follow current PSEP and EPA protocols for sampling and analysis (EPA 1986; PSEP 1986, PSEP 1997 a, b, and c). Laboratories performing any physical, chemical, or biological analyses will be certified by Ecology for the tests performed in conjunction with this project.

5 FEASIBILITY STUDY TASKS

If Site investigation information indicates that an evaluation of remedial actions is required, this section outlines the requirements of the FS. Note: Section 6 presents the steps (and schedule) necessary to meet AO obligations, including any FS. The FS would identify and evaluate remedial alternatives that protect human health and the environment by eliminating, reducing, or otherwise controlling risks posed by environmental conditions at the Site. Remedial alternatives will be developed consistent with ongoing Budd Inlet cleanup and source control activities, Site use planning and development, and DNR Aquatic Lease considerations. The FS is intended to provide sufficient data, analysis, and engineering evaluations to enable the selection of a cleanup action alternative that is protective of human health and the environment and considers local development plans. A phased approach will be taken, whereby remedial alternatives are developed and screened, followed by a detailed analysis of remedial alternatives in accordance with the MTCA cleanup regulations, WAC 173-340-360.

5.1 Alternative Screening Memorandum

Prior to the screening of alternatives for developing potentially practicable remedial alternatives for the Site, the conceptual list of alternatives will be developed and technologies will be identified for each cleanup component and combined into potential alternatives. During the screening, the extent of remedial action (e.g., quantities of media to be affected), the sizes and capacities of treatment areas, and other details of each alternative will be further defined, as needed, so that screening evaluations can be conducted. The screening will be followed by a detailed analysis of alternatives.

The objective of remedial alternatives screening is to narrow the list of potential alternatives that will be evaluated in detail. In some circumstances, the number of viable alternatives to address cleanup components may be limited, such that screening may be unnecessary or minimized. Screening is used as a tool throughout the alternative selection process to narrow the options being considered. When alternatives are being developed, individual remedial technologies should be screened primarily for their ability to meet the remedial action objective (RAO) for the Site. Preliminary RAOs will be developed as part of the screening process. Because the purpose of the screening evaluation is to reduce the number of alternatives that will undergo a more thorough and extensive analysis, alternatives should be evaluated more generally in this phase than during the detailed analysis. The result of the screening process will be to develop and present the shortlisted remedial alternatives that will be carried forward as part of the detailed evaluation of alternatives in the FS Report. Additional testing may be necessary during the screening of cleanup technologies during the FS process to evaluate how remedial technologies would be implemented.

The alternatives screening process will be documented in the Alternatives Screening Memorandum. Conceptual estimates of areas and volumes of contaminated media will be used to guide screening of potential remedial alternatives. The screening will broadly consider effectiveness, implementability, and cost, with modifying factors including agency and community acceptance. Each alternative carried forward will meet the threshold requirement of protection of human health and the environment. Levels below background will not necessarily prohibit the progress of the alternative screening process. The development and screening of alternatives will provide enough detail to differentiate between the alternatives, and the level of detail will be sufficient to ensure the cost estimates for each will be comparable. The most promising alternatives will be carried forward to the more detailed evaluation in the FS Report, while those that cannot be implemented will be eliminated from further evaluation.

5.2 Feasibility Study Report

The FS Report would contain the primary elements described in the following sections.

5.2.1 Introduction and Objectives

The first section of the FS Report will include an introduction and describe the objectives of the document. Reference will be made to previous work done at the Site. Additional work done to support the FS Report will also be described in this section.

5.2.2 Remedial Action Objectives

The purpose of this section will be to identify site-specific RAOs that will impact remedial alternatives evaluation. The section will begin with a discussion of land use planning and ongoing cleanup and source control considerations for Budd Inlet, which will influence screening of potential remedial alternatives. The RAO section will then describe the applicable and relevant or appropriate requirements (ARARs) that will be used in determining appropriate RAOs and the selected remedial alternative. RAOs will be consistent with other actions on Budd Inlet, where appropriate. The preliminary RAOs for the Site are to:

- Control or eliminate sources of chemicals of potential concern (COPCs) to the surface water and sediment of Budd Inlet
- Reduce or eliminate human and ecological exposure to any contaminated media that may lead to potential current or future unacceptable risk
- Implement remedial actions in coordination with land use planning, Site development, DNR Aquatic Lease uses, and future Budd Inlet cleanup and source control activities.

5.2.3 Determination of Cleanup Standards and Applicable Laws

This section will present and identify cleanup standards and applicable laws to be carried forward to the remedial alternatives development. Cleanup standards selected under MTCA will generally apply to the upland portion of the Site and will consist of two components: cleanup levels and points of compliance. MTCA (WAC 173-340-350) states that the purpose of the FS is to develop and evaluate cleanup alternatives to enable a cleanup action to be selected. If concentrations of hazardous substances do not exceed the cleanup level at a standard point of compliance, no further action is necessary.

The SMS specifies a process for developing cleanup standards for sediment. The SMS (WAC 173-204-570) provides for cleanup standards that may range from Sediment Quality Standards (SQS) to minimum cleanup level (MCUL) concentrations. The potential for natural recovery over a 10-year time frame may also be considered, if appropriate. Site units may be defined for different areas of the Site if physical, chemical, or biological differences (e.g., navigation lanes or intertidal areas) in these areas create requirements for using different remediation levels or technologies. Development of sediment cleanup standards will also take into consideration ongoing cleanup activities related to Budd Inlet.

5.2.4 Summary of Alternatives Screening of Cleanup Technologies

This section of the FS Report will identify and provide an executive summary of the Alternatives Screening Memorandum and present the shortlisted alternatives carried forward. Further analysis of the alternatives carried forward from this memorandum will occur as part of the detailed evaluation of alternatives in the FS Report.

5.2.5 Detailed Evaluation of Remedial Alternatives

This section in the FS Report will evaluate shortlisted alternatives. The detailed evaluation will further define the alternatives, as necessary, analyze the alternatives against MTCA and other evaluation criteria, and compare the alternatives against one another. The remedial alternatives will be evaluated for compliance with the requirements of WAC 173-340-360, "Selection of Cleanup Actions." The following 13 evaluation criteria will be considered in the detailed evaluation of remedial alternatives:

1. Compliance with Cleanup Standards and Applicable Laws
2. Protection of Human Health
3. Protection of the Environment
4. Provision for a Reasonable Restoration Time Frame
5. Use of Permanent Solutions to the Maximum Extent Practicable
6. Degree to which Recycling, Reuse, and Waste Minimization are Employed
7. Short-Term Effectiveness
8. Long-Term Effectiveness
9. Net Environmental Benefits
10. Implementability
11. Provision for Compliance Monitoring
12. Cost-Effectiveness
13. Prospective Community Acceptance

5.2.6 Cost Estimates

Detailed costs will be prepared for each alternative with consideration of daily labor and equipment costs, material costs, production rates, transportation costs, and disposal fees. The detailed cost estimates will be prepared as a unit price style cost estimate, and will break down major construction elements into individual unit prices (e.g., mobilization/demobilization, thin-layer placement, dredging, capping, and disposal) to facilitate comparison between alternatives. Detailed cost tables will be included as an appendix to the FS Report, and summary tables will be included in the body of the text.

5.2.7 Comparative Analysis of Alternatives

The comparative analysis (including disproportionality) will be prepared to assist in identifying the preferred alternative. The comparative analysis will describe the strengths and weaknesses of each alternative and associated uncertainties. The alternative evaluation criteria will be considered individually, and each alternative will be presented in order from the highest to the lowest ranking alternative for each criterion. The alternatives will be listed in a summary matrix and the costs developed for the alternatives will be included with the matrix. The intent of the matrix is to provide a quick summary of the comparative analysis for the reader.

5.2.8 Recommended Remedial Alternative

The remedial alternative that is determined to best satisfy the evaluation criteria listed in Section 5.2.5 will be identified. Justification for the selection will be provided, and the recommended remedial alternative will be further developed, either in the FS Report or in the ensuing Draft Cleanup Action Plan.

6 PROJECT ORGANIZATION AND SCHEDULE

This section describes the overall project organizational structure to meet the objectives of the AO. WBMA has the primary responsibility for complying with the AO requirements and managing the work completed at the Site. Anchor is the primary consultant for WBMA and is responsible for implementing the activities necessary to meet the AO technical objectives, including any activities identified in this RI/FS Work Plan.

Anchor is responsible for performing these activities under the direction of WBMA. These responsibilities include preparing necessary project plans and reports for submittal to Ecology and other involved parties, as well as attending project meetings, performing field work, evaluating data generated during the RI, and overseeing subcontractors as necessary to complete the AO obligation in accordance with the AO and this RI/FS Work Plan.

6.1 Project Schedule

The project schedule meeting the AO obligations is presented below and consistent with the general schedule outlined in the AO. If, at any time during the process, unanticipated or changed circumstances are discovered that may result in a schedule delay, WBMA shall bring such information to the attention of Ecology for discussion and approval.

Tasks and/or Deliverable	Completion Time
Draft RI/FS Work Plan (SAP and HASP)	July 11, 2008
Ecology comments on Draft RI/FS Work Plan	30 days after receipt of report
Final RI/FS Work Plan	February 3, 2009
Complete RI/FS Field Work	October 31, 2009
Complete RI/FS Field Work Draft RI Data Memorandum and Data Gaps Evaluation	60 days after receiving all analytical data
Ecology comments on Draft RI Data Memorandum and Data Gaps Evaluation	30 days after receipt of report
Final RI Data Memorandum and Data Gaps Evaluation	30 days after receipt of Ecology comments
Draft Alternative Screening Memorandum	90 days after Ecology approval of Final RI Data Memorandum and Data Gaps Evaluation if FS process is determined to be applicable
Ecology comments on draft Alternative Screening Memorandum	30 days after receipt of report
Draft RI/FS Report	90 days after Ecology approval of Alternatives Screening Memorandum
Draft Cleanup Action Plan	60 days after Ecology approval of RI/FS Report

Note: Days are calendar days. If due dates fall on a Saturday, Sunday, or federal or state holiday, deliverables will be submitted on the next business day.

6.2 Project Deliverables

The following is a summary of the major deliverables to be completed after approval of this RI/FS Work Plan.

1. **RI Data Memorandum and Data Gaps Evaluation:** The purpose of the memorandum will be to present the results of the RI data collection identified in this RI/FS Work Plan and identify any additional data gaps. If no data gaps are identified, the need for completing the RI/FS process will be discussed. The memorandum will include supporting data summary tables and figures to report key findings of the study tasks.
2. **Alternatives Screening Memorandum:** If the RI/FS process is required, a Alternatives Screening Memorandum will be prepared to evaluate potential cleanup technologies to be carried forward to the FS.
3. **Remedial Investigation and Feasibility Study Report:** At the conclusion of the RI/FS tasks, a RI/FS report will be prepared that summarizes the work performed under this RI/FS Work Plan and related plans.

Ecology will receive a draft and final version of each deliverable, unless otherwise specified. Comments from Ecology will be addressed in the final documents. All drafts will be submitted electronically in portable document format (PDF), as well as in other software formats (e.g., Microsoft Word and Excel), as appropriate. Hard copy submittals for draft versions of documents will determined on a case-by-case basis in consultation with Ecology. The final version of each document will be delivered in electronic and hard copy format to Ecology. Two hard copies as well as electronic copies of the Final RI/FS Work Plan will be submitted to Ecology. All data will be submitted in EIM format (see Section 6.2 of Appendix A, SAP.)

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TABLES

Table 1
Summary of Available Sediment Chemistry

Study ID:						BUDDHCP	BUDINLET	BUDINLET	BUDDDES	BUDDDES	BUDDDES	BUDDDES	BUDDDES	BUDDDES
Location ID:						S-7A	WB-1	WB-2	Marina 7A	Marina 7B	Marina 6	Marina 5	Marina 8	Marina 4
Sample Date:						8/30/92	6/9/98	6/10/98	8/21/91	8/21/91	8/21/91	8/21/91	8/21/91	8/21/91
Depth:	result unit	SQS	CSL	LAET	2LAET	0-10 cm	0-10 cm	0-10 cm	NR	NR	NR	NR	NR	NR
Sediment Grain Size (%)														
Particle/Grain Size, Gravel	%	--	--	--	--	--	**0.8**	**2**	--	--	--	--	--	--
Particle/Grain Size, Sand	%	--	--	--	--	--	**18.5**	**25.1**	--	--	--	--	--	--
Particle/Grain Size, Silt	%	--	--	--	--	--	**62.8**	**55.1**	--	--	--	--	--	--
Particle/Grain Size, Clay	%	--	--	--	--	--	**18**	**17.9**	--	--	--	--	--	--
Conventional Parameters (%)														
Total organic carbon (TOC)	%	--	--	--	--	--	**6.345**	**6.475**	**4**	**4.8**	**4.6**	**4.6**	**3.1**	**1.3**
Total solids	%	--	--	--	--	--	**32.3**	**31.5**	**33**	**34**	**31**	**33**	**45**	**69**
Total Volatile Solids	%	--	--	--	--	--	--	--	--	--	--	--	--	--
Conventionals (mg/kg)														
Ammonia	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--
Metals (mg/kg)														
Arsenic	mg/kg	57	93	--	--	12 U	**14.5**	**17.5**	**15**	**14**	**12**	**11**	**11**	**5.4**
Cadmium	mg/kg	5.1	6.7	--	--	4 U	**2.5**	**2.1**	**1.9**	**1.5**	**1.6**	**1.5**	**1.2**	0.3 U
Chromium	mg/kg	260	270	--	--	**94**	**34.2**	**31.7**	**39**	**35**	**32**	**33**	**22**	**9.9**
Copper	mg/kg	390	390	--	--	**210**	**172**	**133**	**61**	**59**	**55**	**55**	**29**	9.3 U
Lead	mg/kg	450	530	--	--	**29**	**24.3**	**26.2**	**26**	**25**	**22**	**20**	**14**	**4.3**
Mercury	mg/kg	0.41	0.59	--	--	--	**0.254**	**0.267**	--	--	--	--	--	--
Silver	mg/kg	6.1	6.1	--	--	--	**0.92**	**0.92**	--	--	--	--	--	--
Zinc	mg/kg	410	960	--	--	**100**	**130**	**114**	**94**	**91**	**94**	**91**	**58**	**23**
Aromatic Hydrocarbons (mg/kg-OC)														
Total LPAH (SMS)	mg/kg-OC	370	780	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	mg/kg-OC	99	170	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	mg/kg-OC	66	66	--	--	--	--	--	--	--	--	--	--	--
Acenaphthene	mg/kg-OC	16	57	--	--	--	--	--	--	--	--	--	--	--
Fluorene	mg/kg-OC	23	79	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	mg/kg-OC	100	480	--	--	--	--	--	--	--	--	--	--	--
Anthracene	mg/kg-OC	220	1200	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	mg/kg-OC	38	64	--	--	--	--	--	--	--	--	--	--	--
Total HPAH (SMS)	mg/kg-OC	960	5300	--	--	--	--	--	--	--	--	--	--	--
Total PAH (SMS)	mg/kg-OC	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	mg/kg-OC	160	1200	--	--	--	--	--	--	--	--	--	--	--
Pyrene	mg/kg-OC	1000	1400	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	mg/kg-OC	110	270	--	--	--	--	--	--	--	--	--	--	--
Chrysene	mg/kg-OC	110	460	--	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	mg/kg-OC	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	mg/kg-OC	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Benzofluoranthenes (SMS)	mg/kg-OC	230	450	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	mg/kg-OC	99	210	--	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	mg/kg-OC	34	88	--	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,h)anthracene	mg/kg-OC	12	33	--	--	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	mg/kg-OC	31	78	--	--	--	--	--	--	--	--	--	--	--

Table 1
Summary of Available Sediment Chemistry

Study ID: Location ID: Sample Date: Depth:	result unit	SQS	CSL	LAET	2LAET	BUDDHCP S-7A 8/30/92 0-10 cm	BUDINLET WB-1 6/9/98 0-10 cm	BUDINLET WB-2 6/10/98 0-10 cm	BUDDDES Marina 7A 8/21/91 NR	BUDDDES Marina 7B 8/21/91 NR	BUDDDES Marina 6 8/21/91 NR	BUDDDES Marina 5 8/21/91 NR	BUDDDES Marina 8 8/21/91 NR	BUDDDES Marina 4 8/21/91 NR
Chlorinated Benzenes (mg/kg-OC)														
1,2-Dichlorobenzene	mg/kg-OC	2.3	2.3	35	50	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	mg/kg-OC	3.1	9	110	120	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	mg/kg-OC	0.81	1.8	31	51	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	mg/kg-OC	0.38	2.3	22	70	--	--	--	--	--	--	--	--	--
Phthalate Esters (mg/kg-OC)														
Dimethylphthalate	mg/kg-OC	53	53	71	160	--	--	--	--	--	--	--	--	--
Diethylphthalate	mg/kg-OC	61	110	200	1200	--	--	--	--	--	--	--	--	--
Di-n-butylphthalate	mg/kg-OC	220	1700	1400	5100	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	mg/kg-OC	4.9	64	63	900	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	mg/kg-OC	47	78	1300	1900	--	--	--	--	--	--	--	--	--
Di-n-octylphthalate	mg/kg-OC	58	4500	6200	--	--	--	--	--	--	--	--	--	--
Miscellaneous (mg/kg-OC)														
Dibenzofuran	mg/kg-OC	15	58	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene	mg/kg-OC	3.9	6.2	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine	mg/kg-OC	11	11	--	--	--	--	--	--	--	--	--	--	--
PCB Aroclors (mg/kg-OC)														
PCBs	mg/kg-OC	12	65	--	--	--	--	--	--	--	--	--	--	--
Ionizable Organic Compounds (µg/kg)														
Phenol	µg/kg	420	1200	--	--	--	154 UJ	122 UJ	--	--	--	--	--	--
2-Methylphenol	µg/kg	63	63	--	--	--	51 U	51 U	--	--	--	--	--	--
4-Methylphenol	µg/kg	670	670	--	--	--	**123**	**135**	--	--	--	--	--	--
2,4-Dimethylphenol	µg/kg	29	29	--	--	--	51 U	51 U	--	--	--	--	--	--
Pentachlorophenol	µg/kg	360	690	--	--	--	**127 J**	256 UJ	--	--	--	--	--	--
Benzyl alcohol	µg/kg	57	73	--	--	--	51 U	51 U	--	--	--	--	--	--
Benzoic acid	µg/kg	650	650	--	--	--	**1900 J**	**1940 J**	--	--	--	--	--	--
Aromatic Hydrocarbons (µg/kg)														
Total LPAH (SMS)	µg/kg	--	--	5200	13000	--	**583 J**	**625 J**	--	--	--	--	--	--
Naphthalene	µg/kg	--	--	2100	2400	--	**62**	**107**	--	--	--	--	--	--
Acenaphthylene	µg/kg	--	--	1300	1300	--	**48 J**	**50 J**	--	--	--	--	--	--
Acenaphthene	µg/kg	--	--	500	730	--	**31 J**	**39 J**	--	--	--	--	--	--
Fluorene	µg/kg	--	--	540	1000	--	**48 J**	**47 J**	--	--	--	--	--	--
Phenanthrene	µg/kg	--	--	1500	5400	--	**242**	**240**	--	--	--	--	--	--
Anthracene	µg/kg	--	--	960	4400	--	**152**	**142**	--	--	--	--	--	--
2-Methylnaphthalene	µg/kg	--	--	670	1400	--	**31 J**	**37 J**	--	--	--	--	--	--
Total HPAH (SMS)	µg/kg	--	--	12000	17000	--	**4387 J**	**4501 J**	--	--	--	--	--	--
Total PAH (SMS)	µg/kg	--	--	--	--	--	**4970 J**	**5126 J**	--	--	--	--	--	--
Fluoranthene	µg/kg	--	--	1700	2500	--	**802**	**784**	--	--	--	--	--	--
Pyrene	µg/kg	--	--	2600	3300	--	**1030**	**1190**	--	--	--	--	--	--
Benzo(a)anthracene	µg/kg	--	--	1300	1600	--	**334**	**291**	--	--	--	--	--	--
Chrysene	µg/kg	--	--	1400	2800	--	**586**	**564**	--	--	--	--	--	--
Benzo(k)fluoranthene	µg/kg	--	--	--	--	--	**223**	**180**	--	--	--	--	--	--
Benzo(b)fluoranthene	µg/kg	--	--	--	--	--	**605**	**660**	--	--	--	--	--	--
Total Benzofluoranthenes (SMS)	µg/kg	--	--	3200	3600	--	**828**	**840**	--	--	--	--	--	--
Benzo(a)pyrene	µg/kg	--	--	1600	3000	--	**279**	**276**	--	--	--	--	--	--

Table 1
Summary of Available Sediment Chemistry

Study ID: / Location ID: / Sample Date: / Depth:	result unit	SQS	CSL	LAET	2LAET	BUDDHCP S-7A 8/30/92 0-10 cm	BUDINLET WB-1 6/9/98 0-10 cm	BUDINLET WB-2 6/10/98 0-10 cm	BUDDDES Marina 7A 8/21/91 NR	BUDDDES Marina 7B 8/21/91 NR	BUDDDES Marina 6 8/21/91 NR	BUDDDES Marina 5 8/21/91 NR	BUDDDES Marina 8 8/21/91 NR	BUDDDES Marina 4 8/21/91 NR
Indeno(1,2,3-cd)pyrene	µg/kg	--	--	600	690	--	**237 J**	**244 J**	--	--	--	--	--	--
Dibenzo(a,h)anthracene	µg/kg	--	--	230	540	--	**125**	**136**	--	--	--	--	--	--
Benzo(g,h,i)perylene	µg/kg	--	--	670	720	--	**166**	**176**	--	--	--	--	--	--
Chlorinated Benzenes (µg/kg)														
1,2-Dichlorobenzene	µg/kg	--	--	35	50	--	51 U	51 U	--	--	--	--	--	--
1,4-Dichlorobenzene	µg/kg	--	--	110	120	--	51 U	51 U	--	--	--	--	--	--
1,2,4-Trichlorobenzene	µg/kg	--	--	31	51	--	51 U	51 U	--	--	--	--	--	--
Hexachlorobenzene	µg/kg	--	--	22	70	--	51 U	51 U	--	--	--	--	--	--
Phthalate Esters (µg/kg)														
Dimethylphthalate	µg/kg	--	--	71	160	--	**54**	**158**	--	--	--	--	--	--
Diethylphthalate	µg/kg	--	--	200	1200	--	257 U	256 U	--	--	--	--	--	--
Di-n-butylphthalate	µg/kg	--	--	1400	5100	--	118 UJ	210 UJ	--	--	--	--	--	--
Butyl benzyl phthalate	µg/kg	--	--	63	900	--	257 U	751 U	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	µg/kg	--	--	1300	1900	--	336 UJ	362 UJ	--	--	--	--	--	--
Di-n-octylphthalate	µg/kg	--	--	6200	--	--	103 U	102 U	--	--	--	--	--	--
Miscellaneous (µg/kg)														
Dibenzofuran	µg/kg	--	--	540	700	--	**43 J**	**52**	--	--	--	--	--	--
Hexachlorobutadiene	µg/kg	--	--	11	120	--	51 U	51 U	--	--	--	--	--	--
N-Nitrosodiphenylamine	µg/kg	--	--	--	--	--	51 U	51 U	--	--	--	--	--	--
Dioxins/Furans (pg/g)														
Total Dioxin/Furan TEQ (Mammal)	pg/g	--	--	--	--	--	--	--	--	--	--	--	--	--
Total HpCDD	pg/g	--	--	--	--	--	--	--	--	--	--	--	--	--
Total HpCDF	pg/g	--	--	--	--	--	--	--	--	--	--	--	--	--
Total HxCDD	pg/g	--	--	--	--	--	--	--	--	--	--	--	--	--
Total HxCDF	pg/g	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PeCDD	pg/g	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PeCDF	pg/g	--	--	--	--	--	--	--	--	--	--	--	--	--
Total TCDD	pg/g	--	--	--	--	--	--	--	--	--	--	--	--	--
Total TCDF	pg/g	--	--	--	--	--	--	--	--	--	--	--	--	--
Metals (mg/kg)														
Antimony	mg/kg	--	--	--	--	--	3 U	3 U	--	--	--	--	--	--
Nickel	mg/kg	--	--	--	--	**33**	**26.3**	**26.6**	**19**	**21**	**16**	**19**	**8.7**	**7.5**
Selenium	mg/kg	--	--	--	--	5 U	5 U	**5.6**	1.3 U	1.2 U	0.9 U	1.5 U	**1.2**	0.59 U
Organometals (µg/kg)														
Dibutyltin Dichloride	µg/kg	--	--	--	--	--	**523 J**	**915 J**	--	--	--	--	--	--
Monobutyltin Trichloride	µg/kg	--	--	--	--	--	**508 J**	**850 J**	--	--	--	--	--	--
Tetrabutyltin	µg/kg	--	--	--	--	--	**8.705**	**8 J**	--	--	--	--	--	--
Tribultyltin (ion)	µg/kg	--	--	--	--	--	**1646.5 J**	**1094.7 J**	**18.7**	**20.1**	**35.5**	**26.9**	**8.4**	**2.4**

Table 1
Summary of Available Sediment Chemistry

Study ID: Location ID: Sample Date: Depth:	result unit	SQS	CSL	LAET	2LAET	BUDDDES Marina 3 8/21/91 NR	BUDDDES Marina 1 8/21/91 NR	BUDDDES Marina 9 8/21/91 NR	BUDDDES Marina 10 8/21/91 NR	BUDDDES Marina 2 8/21/91 NR	BUDDDES Marina 11 8/21/91 NR	BUDDDES Marina 12 8/21/91 NR	BUDD07 BI-S16-0-10cm 4/13/07 0-10 cm	BUDD07 BI-S17-0-10cm 4/13/07 0-10 cm
Sediment Grain Size (%)														
Particle/Grain Size, Gravel	%	--	--	--	--	--	--	--	--	--	--	--	**7.39 T**	**1.04**
Particle/Grain Size, Sand	%	--	--	--	--	--	--	--	--	--	--	--	--	--
Particle/Grain Size, Silt	%	--	--	--	--	--	--	--	--	--	--	--	**48.4 T**	**37.7**
Particle/Grain Size, Clay	%	--	--	--	--	--	--	--	--	--	--	--	**15.2**	**19.9**
Conventional Parameters (%)														
Total organic carbon (TOC)	%	--	--	--	--	**3.9**	**6.1**	**4.5**	**3.7**	**2.1**	**3.9**	**4.1**	**2.9**	**3.72**
Total solids	%	--	--	--	--	**39**	**32**	**30**	**38**	**50**	**32**	**28**	**35.2**	**36.9**
Total Volatile Solids	%	--	--	--	--	--	--	--	--	--	--	--	**8.69 T**	**11.4 T**
Conventionals (mg/kg)														
Ammonia	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--
Sulfide	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--
Metals (mg/kg)														
Arsenic	mg/kg	57	93	--	--	**12**	**12**	**13**	**12**	**3.8**	**15**	**13**	--	**7.16 T**
Cadmium	mg/kg	5.1	6.7	--	--	**1.3**	**1.8**	**1.7**	**1.2**	**0.88**	**1.2**	**1.4**	--	**1.87**
Chromium	mg/kg	260	270	--	--	**36**	**34**	**30**	**26**	**12**	**31**	**39**	--	**26.2 T**
Copper	mg/kg	390	390	--	--	**44**	**62**	**43**	**34**	**11**	**44**	**46**	--	**36.1 T**
Lead	mg/kg	450	530	--	--	**19**	**24**	**120**	**18**	**5**	**34**	**21**	--	**13.7**
Mercury	mg/kg	0.41	0.59	--	--	--	--	--	--	--	--	--	--	**0.119**
Silver	mg/kg	6.1	6.1	--	--	--	--	--	--	--	--	--	--	**0.41**
Zinc	mg/kg	410	960	--	--	**82**	**94**	**77**	**68**	**22**	**81**	**86**	--	**59.3 T**
Aromatic Hydrocarbons (mg/kg-OC)														
Total LPAH (SMS)	mg/kg-OC	370	780	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	mg/kg-OC	99	170	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene	mg/kg-OC	66	66	--	--	--	--	--	--	--	--	--	--	--
Acenaphthene	mg/kg-OC	16	57	--	--	--	--	--	--	--	--	--	--	--
Fluorene	mg/kg-OC	23	79	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	mg/kg-OC	100	480	--	--	--	--	--	--	--	--	--	--	--
Anthracene	mg/kg-OC	220	1200	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	mg/kg-OC	38	64	--	--	--	--	--	--	--	--	--	--	--
Total HPAH (SMS)	mg/kg-OC	960	5300	--	--	--	--	--	--	--	--	--	--	--
Total PAH (SMS)	mg/kg-OC	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoranthene	mg/kg-OC	160	1200	--	--	--	--	--	--	--	--	--	--	--
Pyrene	mg/kg-OC	1000	1400	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	mg/kg-OC	110	270	--	--	--	--	--	--	--	--	--	--	--
Chrysene	mg/kg-OC	110	460	--	--	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	mg/kg-OC	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	mg/kg-OC	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Benzofluoranthenes (SMS)	mg/kg-OC	230	450	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	mg/kg-OC	99	210	--	--	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	mg/kg-OC	34	88	--	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,h)anthracene	mg/kg-OC	12	33	--	--	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	mg/kg-OC	31	78	--	--	--	--	--	--	--	--	--	--	--

Table 1
Summary of Available Sediment Chemistry

Study ID:						BUDDDES	BUDDDES	BUDDDES	BUDDDES	BUDDDES	BUDDDES	BUDDDES	BUDD07	BUDD07
Location ID:						Marina 3	Marina 1	Marina 9	Marina 10	Marina 2	Marina 11	Marina 12	BI-S16-0-10cm	BI-S17-0-10cm
Sample Date:						8/21/91	8/21/91	8/21/91	8/21/91	8/21/91	8/21/91	8/21/91	4/13/07	4/13/07
Depth:	result unit	SQS	CSL	LAET	2LAET	NR	NR	NR	NR	NR	NR	NR	0-10 cm	0-10 cm
Chlorinated Benzenes (mg/kg-OC)														
1,2-Dichlorobenzene	mg/kg-OC	2.3	2.3	35	50	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	mg/kg-OC	3.1	9	110	120	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	mg/kg-OC	0.81	1.8	31	51	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	mg/kg-OC	0.38	2.3	22	70	--	--	--	--	--	--	--	--	--
Phthalate Esters (mg/kg-OC)														
Dimethylphthalate	mg/kg-OC	53	53	71	160	--	--	--	--	--	--	--	--	--
Diethylphthalate	mg/kg-OC	61	110	200	1200	--	--	--	--	--	--	--	--	--
Di-n-butylphthalate	mg/kg-OC	220	1700	1400	5100	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	mg/kg-OC	4.9	64	63	900	--	--	--	--	--	--	--	--	--
Bis(2-ethylhexyl)phthalate	mg/kg-OC	47	78	1300	1900	--	--	--	--	--	--	--	--	--
Di-n-octylphthalate	mg/kg-OC	58	4500	6200	--	--	--	--	--	--	--	--	--	--
Miscellaneous (mg/kg-OC)														
Dibenzofuran	mg/kg-OC	15	58	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene	mg/kg-OC	3.9	6.2	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine	mg/kg-OC	11	11	--	--	--	--	--	--	--	--	--	--	--
PCB Aroclors (mg/kg-OC)														
PCBs	mg/kg-OC	12	65	--	--	--	--	--	--	--	--	--	--	**11**
Ionizable Organic Compounds (µg/kg)														
Phenol	µg/kg	420	1200	--	--	--	--	--	--	--	--	--	--	12 U
2-Methylphenol	µg/kg	63	63	--	--	--	--	--	--	--	--	--	--	14 U
4-Methylphenol	µg/kg	670	670	--	--	--	--	--	--	--	--	--	--	**21**
2,4-Dimethylphenol	µg/kg	29	29	--	--	--	--	--	--	--	--	--	--	68 U
Pentachlorophenol	µg/kg	360	690	--	--	--	--	--	--	--	--	--	--	140 U
Benzyl alcohol	µg/kg	57	73	--	--	--	--	--	--	--	--	--	--	27 U
Benzoic acid	µg/kg	650	650	--	--	--	--	--	--	--	--	--	--	270 U
Aromatic Hydrocarbons (µg/kg)														
Total LPAH (SMS)	µg/kg	--	--	5200	13000	--	--	--	--	--	--	--	--	**44.2**
Naphthalene	µg/kg	--	--	2100	2400	--	--	--	--	--	--	--	--	**14 T**
Acenaphthylene	µg/kg	--	--	1300	1300	--	--	--	--	--	--	--	--	**5.7 T**
Acenaphthene	µg/kg	--	--	500	730	--	--	--	--	--	--	--	--	14 U
Fluorene	µg/kg	--	--	540	1000	--	--	--	--	--	--	--	--	14 U
Phenanthrene	µg/kg	--	--	1500	5400	--	--	--	--	--	--	--	--	**16**
Anthracene	µg/kg	--	--	960	4400	--	--	--	--	--	--	--	--	**8.5 T**
2-Methylnaphthalene	µg/kg	--	--	670	1400	--	--	--	--	--	--	--	--	14 U
Total HPAH (SMS)	µg/kg	--	--	12000	17000	--	--	--	--	--	--	--	--	**229**
Total PAH (SMS)	µg/kg	--	--	--	--	--	--	--	--	--	--	--	--	**273.2**
Fluoranthene	µg/kg	--	--	1700	2500	--	--	--	--	--	--	--	--	**45**
Pyrene	µg/kg	--	--	2600	3300	--	--	--	--	--	--	--	--	**48**
Benzo(a)anthracene	µg/kg	--	--	1300	1600	--	--	--	--	--	--	--	--	**18**
Chrysene	µg/kg	--	--	1400	2800	--	--	--	--	--	--	--	--	**32**
Benzo(k)fluoranthene	µg/kg	--	--	--	--	--	--	--	--	--	--	--	--	**11 T**
Benzo(b)fluoranthene	µg/kg	--	--	--	--	--	--	--	--	--	--	--	--	**34**
Total Benzofluoranthenes (SMS)	µg/kg	--	--	3200	3600	--	--	--	--	--	--	--	--	**45**
Benzo(a)pyrene	µg/kg	--	--	1600	3000	--	--	--	--	--	--	--	--	**18**

Table 1
Summary of Available Sediment Chemistry

Study ID: Location ID: Sample Date: Depth:	result unit	SQS	CSL	LAET	2LAET	BUDDDES Marina 3 8/21/91 NR	BUDDDES Marina 1 8/21/91 NR	BUDDDES Marina 9 8/21/91 NR	BUDDDES Marina 10 8/21/91 NR	BUDDDES Marina 2 8/21/91 NR	BUDDDES Marina 11 8/21/91 NR	BUDDDES Marina 12 8/21/91 NR	BUDD07 BI-S16-0-10cm 4/13/07 0-10 cm	BUDD07 BI-S17-0-10cm 4/13/07 0-10 cm
Indeno(1,2,3-cd)pyrene	µg/kg	--	--	600	690	--	--	--	--	--	--	--	--	**12 T**
Dibenzo(a,h)anthracene	µg/kg	--	--	230	540	--	--	--	--	--	--	--	--	14 U
Benzo(g,h,i)perylene	µg/kg	--	--	670	720	--	--	--	--	--	--	--	--	**11 T**
Chlorinated Benzenes (µg/kg)														
1,2-Dichlorobenzene	µg/kg	--	--	35	50	--	--	--	--	--	--	--	--	14 U
1,4-Dichlorobenzene	µg/kg	--	--	110	120	--	--	--	--	--	--	--	--	14 U
1,2,4-Trichlorobenzene	µg/kg	--	--	31	51	--	--	--	--	--	--	--	--	14 U
Hexachlorobenzene	µg/kg	--	--	22	70	--	--	--	--	--	--	--	--	14 U
Phthalate Esters (µg/kg)														
Dimethylphthalate	µg/kg	--	--	71	160	--	--	--	--	--	--	--	--	14 U
Diethylphthalate	µg/kg	--	--	200	1200	--	--	--	--	--	--	--	--	14 U
Di-n-butylphthalate	µg/kg	--	--	1400	5100	--	--	--	--	--	--	--	--	**12 T**
Butyl benzyl phthalate	µg/kg	--	--	63	900	--	--	--	--	--	--	--	--	14 U
Bis(2-ethylhexyl)phthalate	µg/kg	--	--	1300	1900	--	--	--	--	--	--	--	--	16 U
Di-n-octylphthalate	µg/kg	--	--	6200	--	--	--	--	--	--	--	--	--	14 U
Miscellaneous (µg/kg)														
Dibenzofuran	µg/kg	--	--	540	700	--	--	--	--	--	--	--	--	14 U
Hexachlorobutadiene	µg/kg	--	--	11	120	--	--	--	--	--	--	--	--	14 U
N-Nitrosodiphenylamine	µg/kg	--	--	--	--	--	--	--	--	--	--	--	--	14 U
Dioxins/Furans (pg/g)														
Total Dioxin/Furan TEQ (Mammal)	pg/g	--	--	--	--	--	--	--	--	--	--	--	**15.8673**	**14.6895**
Total HpCDD	pg/g	--	--	--	--	--	--	--	--	--	--	--	**892**	**973**
Total HpCDF	pg/g	--	--	--	--	--	--	--	--	--	--	--	**378**	**369**
Total HxCDD	pg/g	--	--	--	--	--	--	--	--	--	--	--	**220**	**212**
Total HxCDF	pg/g	--	--	--	--	--	--	--	--	--	--	--	**201**	**205**
Total PeCDD	pg/g	--	--	--	--	--	--	--	--	--	--	--	**34.4**	**32.9**
Total PeCDF	pg/g	--	--	--	--	--	--	--	--	--	--	--	**59.1**	**63.9**
Total TCDD	pg/g	--	--	--	--	--	--	--	--	--	--	--	**18.2 B**	**16.5**
Total TCDF	pg/g	--	--	--	--	--	--	--	--	--	--	--	**30.2**	**26.7**
Metals (mg/kg)														
Antimony	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	**0.13 T**
Nickel	mg/kg	--	--	--	--	**19**	**20**	**17**	**14**	**7**	**18**	**20**	--	**20.9 T**
Selenium	mg/kg	--	--	--	--	1.3 U	0.81 U	2.3 U	**0.68**	0.7 U	0.81 U	1.4 U	--	--
Organometals (µg/kg)														
Dibutyltin Dichloride	µg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--
Monobutyltin Trichloride	µg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrabutyltin	µg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--
Tributyltin (ion)	µg/kg	--	--	--	--	**15.5**	**70.2**	**7.9**	**4.2**	**7.4**	**3.7**	--	--	--

Table 1
Summary of Available Sediment Chemistry

Study ID: Location ID: Sample Date: Depth:	result unit	SQS	CSL	LAET	2LAET	BUDD07 BI-S21-0-10cm 4/13/07 0-10 cm	LOTT_92 LOTT_92LO9203XX 3/4/92 NR	OLYHAR88 OLYAR88OLYH09MC* 11/8/88 NR	OLYHAR88 OLYAR88OLYH09MC* 11/8/88 NR	OLYHAR88 OLYAR88OLYH02MC 11/8/88 NR	DNRREC92 DNREC92BUDD04XX 1/25/92 NR
Sediment Grain Size (%)											
Particle/Grain Size, Gravel	%	--	--	--	--	**2.07**	**--**	**--**	**--**	**--**	**0.02**
Particle/Grain Size, Sand	%	--	--	--	--	**--**	**--**	**37.05**	**63.69**	**53.5**	**39.42**
Particle/Grain Size, Silt	%	--	--	--	--	**44.6**	**--**	**--**	**--**	**--**	**40.07**
Particle/Grain Size, Clay	%	--	--	--	--	**23.2**	**--**	**--**	**--**	**--**	**20.74**
Conventional Parameters (%)											
Total organic carbon (TOC)	%	--	--	--	--	**4.98**	**--**	**1.21 J**	**0.63 J**	**0.87 J**	**3.5 B1**
Total solids	%	--	--	--	--	**31.8**	**26.3**	**58 J**	**71.6 J**	**71.2 J**	**35.12**
Total Volatile Solids	%	--	--	--	--	**14.2 T**	**9.94**	**4.06 J**	**2.18 J**	**2.64 J**	**15.82**
Conventionals (mg/kg)											
Ammonia	mg/kg	--	--	--	--	**--**	**17**	**4060 J**	**95.2 J**	**146 J**	**--**
Sulfide	mg/kg	--	--	--	--	**--**	**--**	**45.6 J**	5 U	5 U	**--**
Metals (mg/kg)											
Arsenic	mg/kg	57	93	--	--	**--**	**--**	**6.93**	**1.96**	**4.02**	**9.7**
Cadmium	mg/kg	5.1	6.7	--	--	**--**	**3**	**1.22**	**0.76**	**1.08**	**2.61**
Chromium	mg/kg	260	270	--	--	**--**	**36**	**75**	**85.3**	**52.1**	**32.4**
Copper	mg/kg	390	390	--	--	**--**	**67**	**30.1**	**15.2**	**2.87**	**46.7**
Lead	mg/kg	450	530	--	--	**--**	**24**	**6.1**	**5.1**	**3.1**	**18**
Mercury	mg/kg	0.41	0.59	--	--	**--**	**--**	0.016 U	**0.045**	**0.038**	**0.15**
Silver	mg/kg	6.1	6.1	--	--	**--**	**--**	**0.17**	**0.033**	**0.49**	**0.38**
Zinc	mg/kg	410	960	--	--	**--**	**91**	**57**	**47**	**41**	**95.1**
Aromatic Hydrocarbons (mg/kg-OC)											
Total LPAH (SMS)	mg/kg-OC	370	780	**--**	**--**	**--**	**--**	**7.02**	**0.63**	**0.23**	**--**
Naphthalene	mg/kg-OC	99	170	**--**	**--**	**--**	**--**	**3.31**	**0.32**	0.23 U	**--**
Acenaphthylene	mg/kg-OC	66	66	**--**	**--**	**--**	**--**	**0.5**	0.16 U	0.23 U	**--**
Acenaphthene	mg/kg-OC	16	57	**--**	**--**	--	**--**	**0.25**	0.32 U	0.23 U	**--**
Fluorene	mg/kg-OC	23	79	**--**	**--**	--	**--**	**0.33**	0.32 U	0.23 U	**--**
Phenanthrene	mg/kg-OC	100	480	**--**	**--**	**--**	**--**	**2.15**	**0.32**	**0.23**	**--**
Anthracene	mg/kg-OC	220	1200	**--**	**--**	**--**	**--**	**0.5**	0.14 U	0.11 U	**--**
2-Methylnaphthalene	mg/kg-OC	38	64	**--**	**--**	**--**	**--**	**0.58**	0.32 U	0.23 U	**--**
Total HPAH (SMS)	mg/kg-OC	960	5300	**--**	**--**	**--**	**--**	**11.9**	**0.62**	**0.21**	**--**
Total PAH (SMS)	mg/kg-OC	--	--	**--**	**--**	**--**	**--**	**18.93**	**1.25**	**0.44**	**--**
Fluoranthene	mg/kg-OC	160	1200	**--**	**--**	**--**	**--**	**2.89**	**0.16**	0.1 U	**--**
Pyrene	mg/kg-OC	1000	1400	**--**	**--**	**--**	**--**	**3.8**	**0.14**	0.09 U	**--**
Benzo(a)anthracene	mg/kg-OC	110	270	**--**	**--**	**--**	**--**	**0.66**	0.1 U	0.08 U	**--**
Chrysene	mg/kg-OC	110	460	**--**	**--**	**--**	**--**	**0.99**	**0.16**	**0.09**	**--**
Benzo(b)fluoranthene	mg/kg-OC	--	--	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Benzo(k)fluoranthene	mg/kg-OC	--	--	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Total Benzofluoranthenes (SMS)	mg/kg-OC	230	450	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
Benzo(a)pyrene	mg/kg-OC	99	210	**--**	**--**	**--**	**--**	**0.83**	**0.16**	**0.11**	**--**
Indeno(1,2,3-cd)pyrene	mg/kg-OC	34	88	**--**	**--**	**--**	**--**	**0.91**	0.1 U	0.07 U	**--**
Dibenzo(a,h)anthracene	mg/kg-OC	12	33	**--**	**--**	--	**--**	**0.91**	0.1 U	0.08 U	**--**
Benzo(g,h,i)perylene	mg/kg-OC	31	78	**--**	**--**	**--**	**--**	**0.91**	0.1 U	0.08 U	**--**

Table 1
Summary of Available Sediment Chemistry

Study ID: Location ID: Sample Date: Depth:	result unit	SQS	CSL	LAET	2LAET	BUDD07 BI-S21-0-10cm 4/13/07 0-10 cm	LOTT_92 LOTT_92LO9203XX 3/4/92 NR	OLYHAR88 OLYAR88OLYH09MC* 11/8/88 NR	OLYHAR88 OLYAR88OLYH09MC* 11/8/88 NR	OLYHAR88 OLYAR88OLYH02MC 11/8/88 NR	DNRREC92 DNREC92BUDD04XX 1/25/92 NR
Chlorinated Benzenes (mg/kg-OC)											
1,2-Dichlorobenzene	mg/kg-OC	2.3	2.3	35	50	--	--	0.74 U	1.43 U	1.03 U	--
1,4-Dichlorobenzene	mg/kg-OC	3.1	9	110	120	--	--	0.74 U	1.43 U	1.03 U	--
1,2,4-Trichlorobenzene	mg/kg-OC	0.81	1.8	31	51	--	--	0.08 U	0.13 U	0.1 U	--
Hexachlorobenzene	mg/kg-OC	0.38	2.3	22	70	--	--	0.02 U	0.02 U	0.01 U	--
Phthalate Esters (mg/kg-OC)											
Dimethylphthalate	mg/kg-OC	53	53	71	160	--	--	0.33 U	**0.03**	0.02 U	--
Diethylphthalate	mg/kg-OC	61	110	200	1200	--	--	0.33 U	**0.32**	**0.11**	--
Di-n-butylphthalate	mg/kg-OC	220	1700	1400	5100	--	--	0.25 U	**0.13**	**0.11**	--
Butyl benzyl phthalate	mg/kg-OC	4.9	64	63	900	--	--	0.91 U	**0.05**	**0.05**	--
Bis(2-ethylhexyl)phthalate	mg/kg-OC	47	78	1300	1900	--	--	**1.82**	**6.35**	**5.63**	--
Di-n-octylphthalate	mg/kg-OC	58	4500	6200	--	--	--	0.41 U	**0.08**	**0.02**	--
Miscellaneous (mg/kg-OC)											
Dibenzofuran	mg/kg-OC	15	58	--	--	--	--	0.25 U	0.02 U	0.01 U	--
Hexachlorobutadiene	mg/kg-OC	3.9	6.2	--	--	--	--	0.02 U	0.03 U	0.03 U	--
N-Nitrosodiphenylamine	mg/kg-OC	11	11	--	--	--	--	0.41 U	0.02 U	0.01 U	--
PCB Aroclors (mg/kg-OC)											
PCBs	mg/kg-OC	12	65	--	--	**10**	--	--	--	--	--
Ionizable Organic Compounds (µg/kg)											
Phenol	µg/kg	420	1200	--	--	13 U	--	**11**	**41**	**20**	**9.4 B1**
2-Methylphenol	µg/kg	63	63	--	--	16 U	--	5 U	0.6 U	**6**	6.3 U
4-Methylphenol	µg/kg	670	670	--	--	**36**	--	14 U	**5**	**5**	**32.7**
2,4-Dimethylphenol	µg/kg	29	29	--	--	79 U	--	2 U	0.4 U	0.5 U	6.3 U
Pentachlorophenol	µg/kg	360	690	--	--	160 U	--	13 U	0.2 U	0.3 U	62.7 U
Benzyl alcohol	µg/kg	57	73	--	--	32 U	--	**76 B**	**51 B**	**51 B**	6.3 U
Benzoic acid	µg/kg	650	650	--	--	320 U	--	1 U	**4**	**4**	126 U
Aromatic Hydrocarbons (µg/kg)											
Total LPAH (SMS)	µg/kg	--	--	5200	13000	**58.9**	--	**85**	**4**	**2**	**267.8 J**
Naphthalene	µg/kg	--	--	2100	2400	**9.4 T**	--	**40**	**2**	2 U	**16.7 J**
Acenaphthylene	µg/kg	--	--	1300	1300	**8.5 T**	--	**6**	1 U	2 U	**10.5 J**
Acenaphthene	µg/kg	--	--	500	730	16 U	--	**3**	2 U	2 U	**7.67 J**
Fluorene	µg/kg	--	--	540	1000	16 U	--	**4**	2 U	2 U	**19.7 J**
Phenanthrene	µg/kg	--	--	1500	5400	**26**	--	**26**	**2**	**2**	**120**
Anthracene	µg/kg	--	--	960	4400	**15 T**	--	**6**	0.9 U	1 U	**93.3**
2-Methylnaphthalene	µg/kg	--	--	670	1400	**4.5 T**	--	**7**	2 U	2 U	**9.1 J**
Total HPAH (SMS)	µg/kg	--	--	12000	17000	**478**	--	**144**	**3.9**	**1.8**	**2171.3 J**
Total PAH (SMS)	µg/kg	--	--	--	--	**536.9**	--	**229**	**7.9**	**3.8**	**2439.1 J**
Fluoranthene	µg/kg	--	--	1700	2500	**76**	--	**35**	**1**	0.9 U	**836.7 J**
Pyrene	µg/kg	--	--	2600	3300	**90**	--	**46**	**0.9**	0.8 U	**476.7 J**
Benzo(a)anthracene	µg/kg	--	--	1300	1600	**35**	--	**8**	0.6 U	0.7 U	**263.3**
Chrysene	µg/kg	--	--	1400	2800	**85**	--	**12**	**1**	**0.8**	**296.7**
Benzo(k)fluoranthene	µg/kg	--	--	--	--	**27 T**	--	--	--	--	--
Benzo(b)fluoranthene	µg/kg	--	--	--	--	**76**	--	--	--	--	--
Total Benzofluoranthenes (SMS)	µg/kg	--	--	3200	3600	**103**	--	--	--	--	--
Benzo(a)pyrene	µg/kg	--	--	1600	3000	**38**	--	**10**	**1**	**1**	**146.7**

Table 1
Summary of Available Sediment Chemistry

Study ID: Location ID: Sample Date: Depth:	result unit	SQS	CSL	LAET	2LAET	BUDD07 BI-S21-0-10cm 4/13/07 0-10 cm	LOTT_92 LOTT_92LO9203XX 3/4/92 NR	OLYHAR88 OLYAR88OLYH09MC* 11/8/88 NR	OLYHAR88 OLYAR88OLYH09MC* 11/8/88 NR	OLYHAR88 OLYAR88OLYH02MC 11/8/88 NR	DNRREC92 DNREC92BUDD04XX 1/25/92 NR
Indeno(1,2,3-cd)pyrene	µg/kg	--	--	600	690	**27**	--	**11**	0.6 U	0.6 U	**83.3**
Dibenzo(a,h)anthracene	µg/kg	--	--	230	540	16 U	--	**11**	0.6 U	0.7 U	**25.3**
Benzo(g,h,i)perylene	µg/kg	--	--	670	720	**24**	--	**11**	0.6 U	0.7 U	**42.7**
Chlorinated Benzenes (µg/kg)											
1,2-Dichlorobenzene	µg/kg	--	--	35	50	16 U	--	9 U	9 U	9 U	2.9 U
1,4-Dichlorobenzene	µg/kg	--	--	110	120	16 U	--	9 U	9 U	9 U	2.9 U
1,2,4-Trichlorobenzene	µg/kg	--	--	31	51	16 U	--	1 U	0.8 U	0.9 U	6.3 U
Hexachlorobenzene	µg/kg	--	--	22	70	16 U	--	0.2 U	0.1 U	0.1 U	12.6 U
Phthalate Esters (µg/kg)											
Dimethylphthalate	µg/kg	--	--	71	160	16 U	--	4 U	**0.2**	0.2 U	12.6 U
Diethylphthalate	µg/kg	--	--	200	1200	16 U	--	4 U	**2**	**1**	12.6 U
Di-n-butylphthalate	µg/kg	--	--	1400	5100	**11 T**	--	3 U	**0.8**	**1**	12.6 U
Butyl benzyl phthalate	µg/kg	--	--	63	900	16 U	--	11 U	**0.3**	**0.4**	12.6 UJ
Bis(2-ethylhexyl)phthalate	µg/kg	--	--	1300	1900	22 U	--	**22**	**40**	**49**	**42.3B1**
Di-n-octylphthalate	µg/kg	--	--	6200	--	16 U	--	5 U	**0.5**	**0.2**	12.6 UJ
Miscellaneous (µg/kg)											
Dibenzofuran	µg/kg	--	--	540	700	16 U	--	3 U	0.1 U	0.09 U	**10.97 J**
Hexachlorobutadiene	µg/kg	--	--	11	120	16 U	--	0.2 U	0.2 U	0.3 U	12.6 U
N-Nitrosodiphenylamine	µg/kg	--	--	--	--	16 U	--	5 U	0.1 U	0.1 U	12.6 U
Dioxins/Furans (pg/g)											
Total Dioxin/Furan TEQ (Mammal)	pg/g	--	--	--	--	**19.30395**	--	--	--	--	--
Total HpCDD	pg/g	--	--	--	--	**1240**	--	--	--	--	--
Total HpCDF	pg/g	--	--	--	--	**461**	--	--	--	--	--
Total HxCDD	pg/g	--	--	--	--	**281**	--	--	--	--	--
Total HxCDF	pg/g	--	--	--	--	**256**	--	--	--	--	--
Total PeCDD	pg/g	--	--	--	--	**42.1**	--	--	--	--	--
Total PeCDF	pg/g	--	--	--	--	**74.4**	--	--	--	--	--
Total TCDD	pg/g	--	--	--	--	**19.5**	--	--	--	--	--
Total TCDF	pg/g	--	--	--	--	**31.5**	--	--	--	--	--
Metals (mg/kg)											
Antimony	mg/kg	--	--	--	--	--	--	**0.23**	**0.14**	**0.25**	--
Nickel	mg/kg	--	--	--	--	--	**30**	**24.5**	**28.4**	**23.8**	--
Selenium	mg/kg	--	--	--	--	--	--	--	--	--	--
Organometals (µg/kg)											
Dibutyltin Dichloride	µg/kg	--	--	--	--	--	--	--	--	--	--
Monobutyltin Trichloride	µg/kg	--	--	--	--	--	--	--	--	--	--
Tetrabutyltin	µg/kg	--	--	--	--	--	--	--	--	--	--
Tributyltin (ion)	µg/kg	--	--	--	--	--	--	--	--	--	--

Table 1
Summary of Available Sediment Chemistry

Notes:

Detected concentration is greater than SMS SQS or LAET
Detected concentration is greater than SMS CSL or 2LAET
Non-detected concentration is above one or more identified screening values
Bold = Detected result
J = Estimated value
U = Compound analyzed, but not detected above detection limit
UJ = Compound analyzed, but not detected above estimated detection limit
T = Reported result below associated quantitation limit but above MDL
B1 = Analyte detected in sample and method blank. Reported result is blank-corrected.
B = Analyte detected in sample and method blank. Reported result is sample concentration without blank correction or associated quantitation limit.
NR = Not reported
*Two samples were collected and analyzed at this location with significantly different results. Both sets of values were reported
µg/kg dw = micrograms per kilogram dry weight
mg/kg-OC dw = milligrams per kilogram organic carbon
% = percent
SMS = Washington State Sediment Management Standards (WAC 173-204)
SQS = Sediment Quality Standard
CSL = Cleanup Screening Level
Total Dioxin/Furan TEQ (Mammal) calculated per methods described in the DMMP 2007 User's Manual
LAET/2LAET = lowest apparent effects threshold/second lowest apparent effects threshold
LAET/2LAET criteria are applied when organic carbon normalization is inappropriate (i.e., OC less than 0.5% or greater than 3%)
Total LPAH (SMS) = sum of naphthalene, acenaphthylene, fluorene, phenanthrene and anthracene
Total HPAH (SMS) = sum of fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene
Totals are calculated by including zero for non-detected values, unless all totaled results are not detected, where the maximum non-detected value is used.

FIGURES

Note: Aerial from Google Earth Pro, 2008.

Jun 26, 2008 1:50pm heriksen K:\Jobs\080516-West Bay Marina\080516-01\08051601-003 (VMAP).dwg F1

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
Vicinity Map
Westbay Marina

Note: Aerial from USGS National Map, 2008.

0 200
Scale in Feet

Figure 2
Site Map
Westbay Marina

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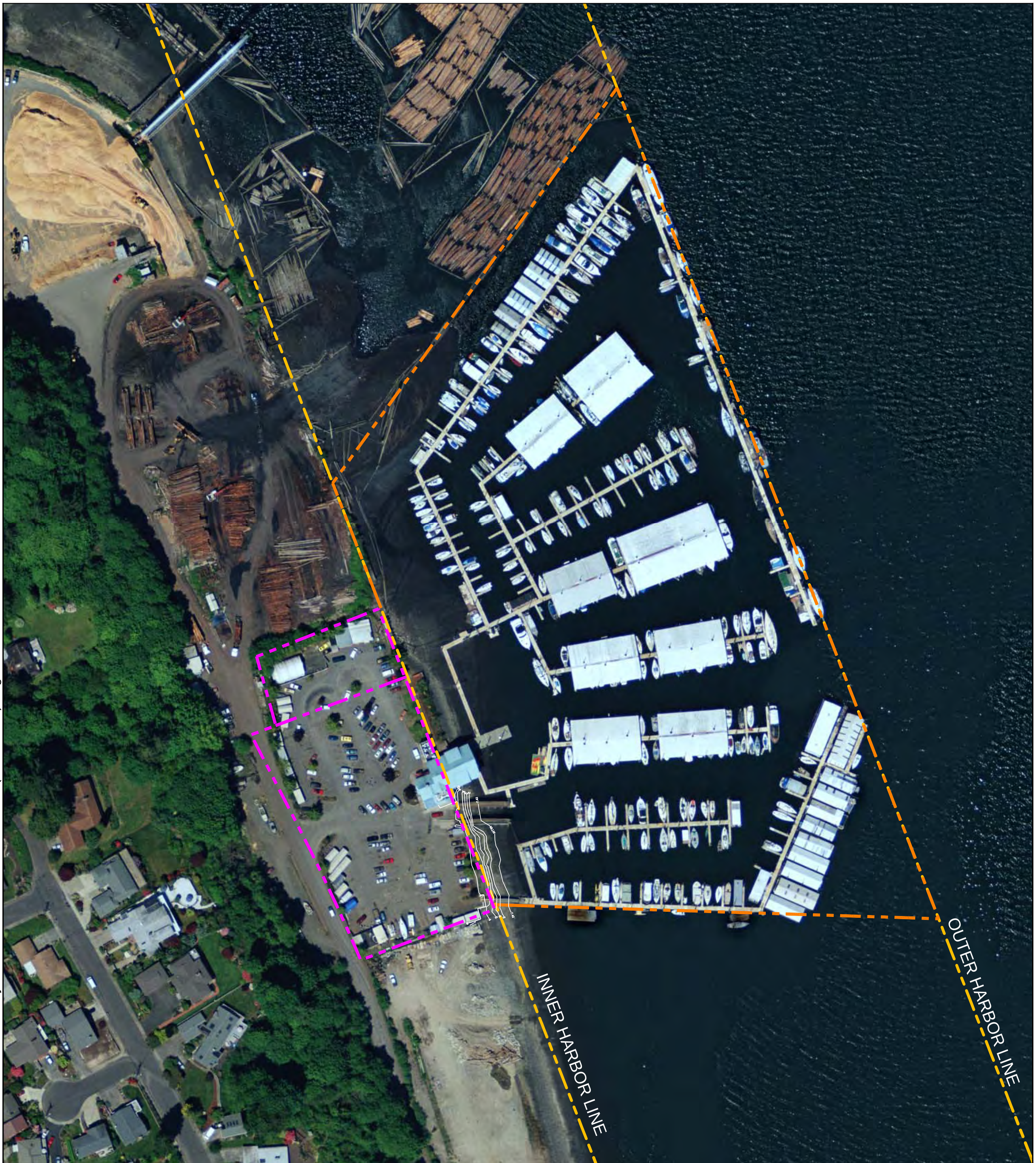

Note: Aerial from USGS National Map, 2008.

Site Boundary
DNR Aquatic Lease Boundary No. 2618
Harbor Line

0 200
Scale in Feet

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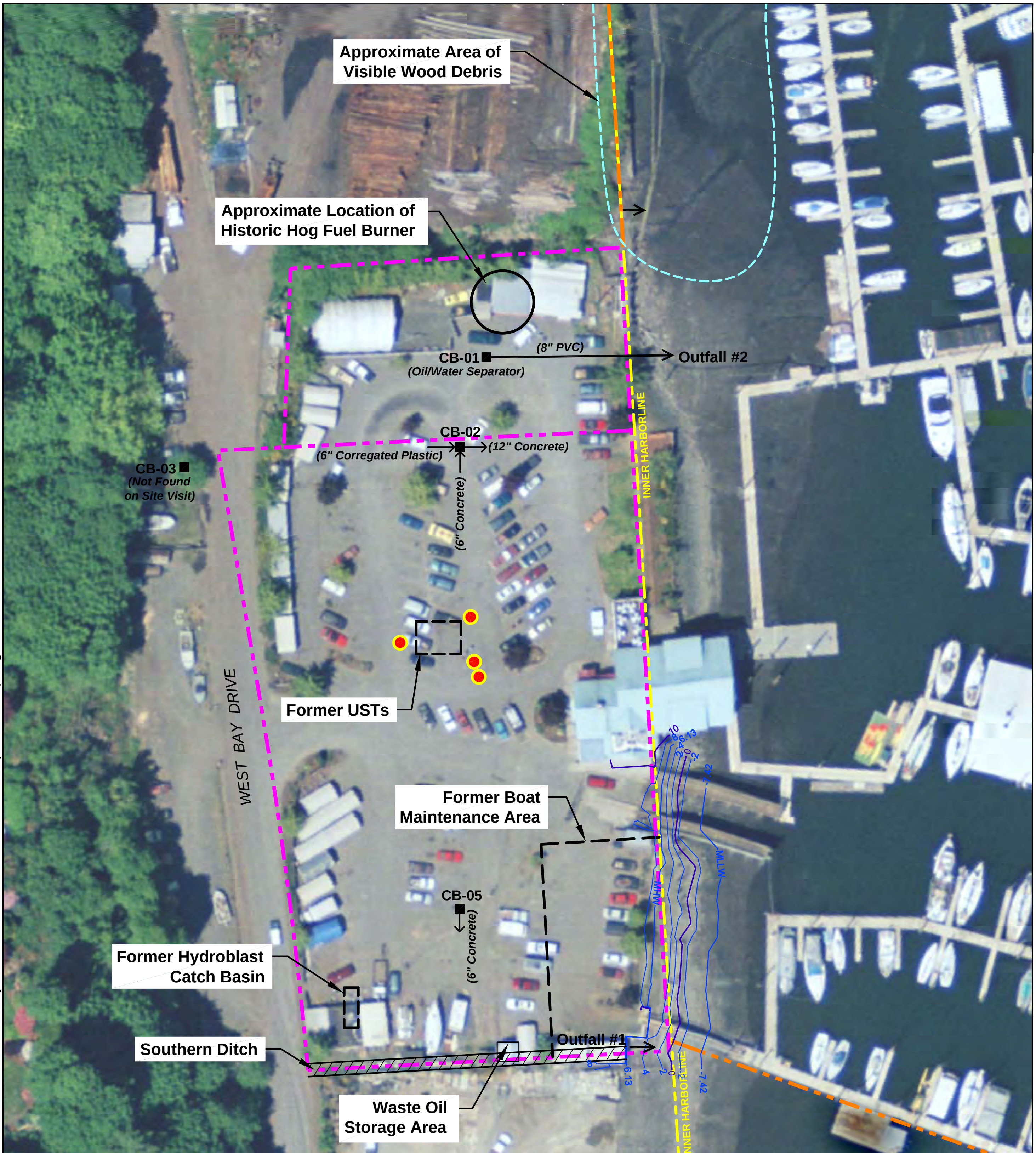
Figure 3
Property Map
Westbay Marina



Site Boundary

DNR Aquatic Lease Boundary No. 2618

Bathymetric Contour in Feet

CB-01 Catch Basin Location and Water Flow Direction

Outfall

Approximate Location of Groundwater Monitoring Wells (Stemen Environmental, 1999)

Notes:
1. Survey data from WHPacific dated June 2008.
2. Bathymetric data available for southern portion of property only.
3. Vertical Datum NGVD29.
4. Aerial from USGS National Map, 2008.

0 80
Scale in Feet

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Dec 12, 2008 12:54pm heriksen

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Figure 4
Site Conditions
Westbay Marina

Not to Scale

Approximate Current Site Boundary

Approximate Current DNR Aquatic Lease Boundary No. 2618

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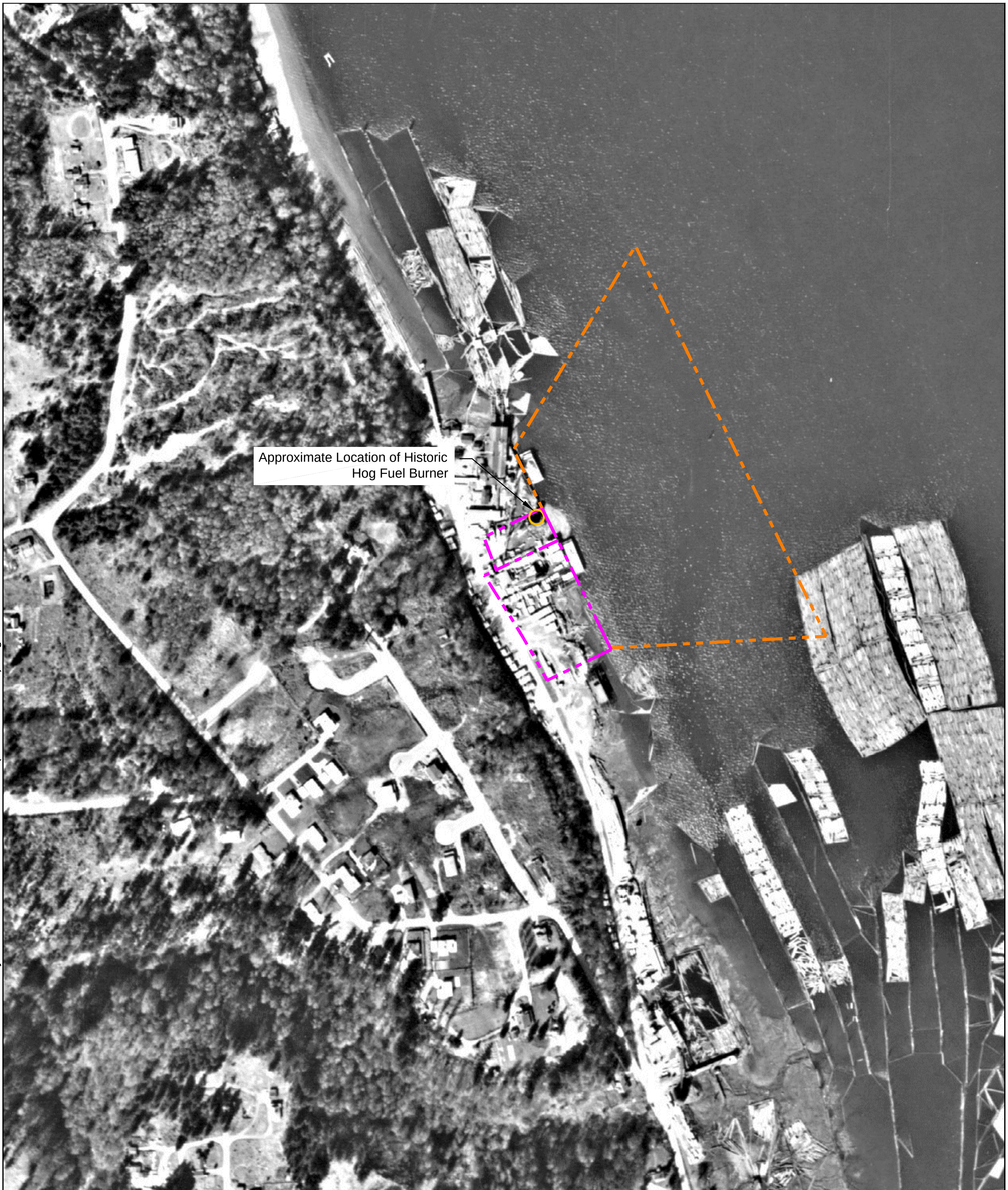
Figure 5
Historical Site Aerial - 1946
Westbay Marina



Approximate Current Site Boundary

Approximate Current DNR Aquatic Lease Boundary No. 2618

Approximate Location of Historic Hog Fuel Burner

Not to Scale

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Figure 6
Historical Site Aerial - 1958
Westbay Marina

Not to Scale

Approximate Current Site Boundary

Approximate Current DNR Aquatic Lease Boundary No. 2618

Approximate Location of Historic Hog Fuel Burner

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Jun 26, 2008 2:39pm heriksen

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Figure 7
Historical Site Aerial - 1960
Westbay Marina

Not to Scale

Approximate Current Site Boundary

Approximate Current DNR Aquatic Lease Boundary No. 2618

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Figure 8
Historical Site Aerial - 1970
Westbay Marina

Not to Scale

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Figure 9 (1 of 3)
Southern Ditch - Westerly View towards West Bay Drive NW
Westbay Marina

Not to Scale

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Figure 9 (2 of 3)
Southern Ditch - Easterly View towards Budd Inlet
Westbay Marina

Not to Scale

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Figure 9 (3 of 3)
Southern Ditch - Easterly View #2 towards Budd Inlet
Westbay Marina

Not to Scale

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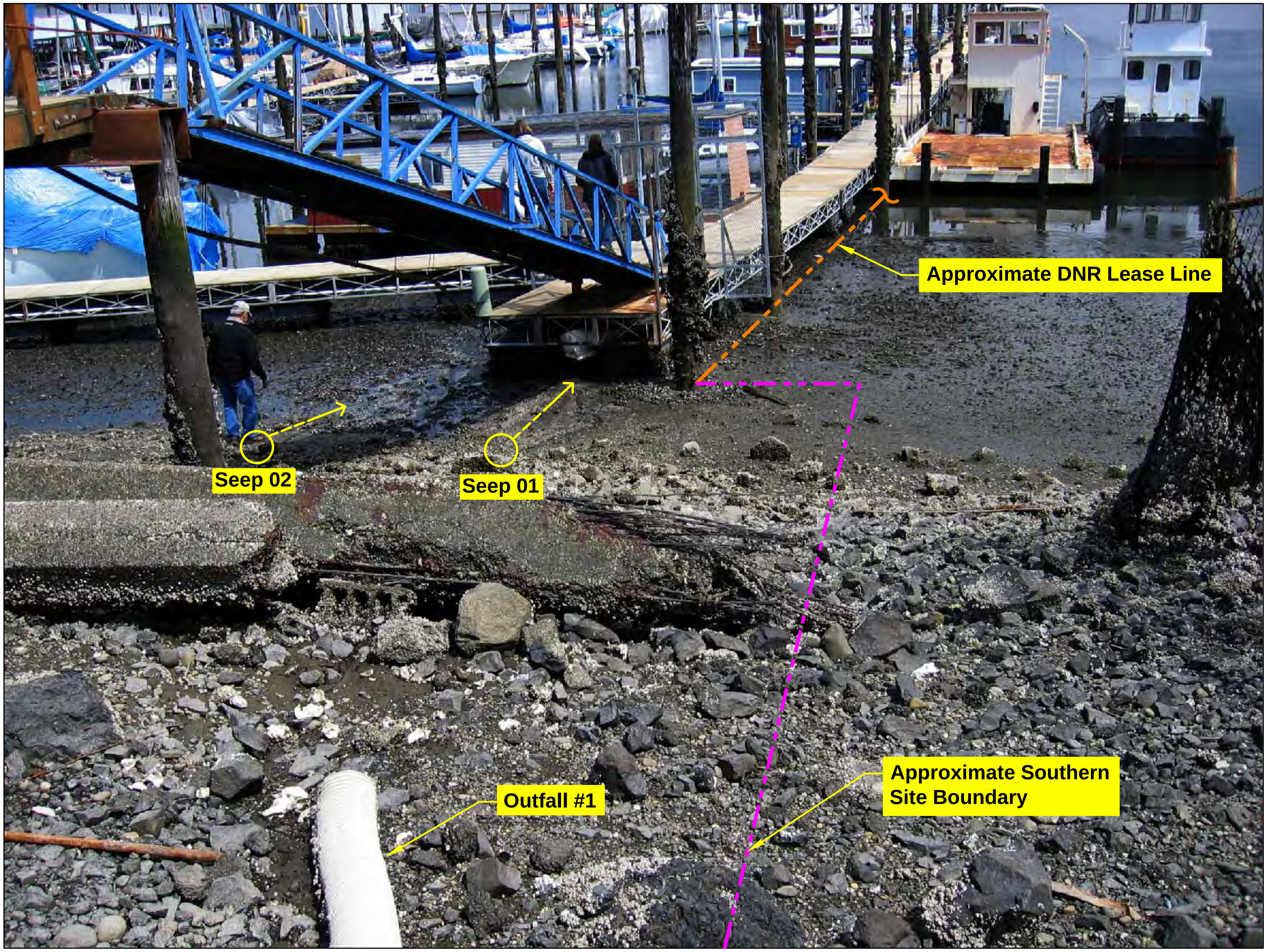
Figure 10 (1 of 4)
Shoreline and Outfall Reconnaissance Photographs
Westbay Marina

Jun 26, 2008 2:46pm heriksen K:\Jobs\080516-West Bay Marina\080516-01\08051601-008 (OUTFALL PHOTOS).dwg F10 2



Not to Scale

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Figure 10 (2 of 4)
Shoreline and Outfall Reconnaissance Photographs
Westbay Marina

Not to Scale

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Figure 10 (3 of 4)
Shoreline and Outfall Reconnaissance Photographs
Westbay Marina

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Not to Scale

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Figure 10 (4 of 4)
Shoreline and Outfall Reconnaissance Photographs
Westbay Marina

Previous Surface Sediment Sampling Location

Approximate Location of Previous Surface Sediment Sampling Location

Budd Inlet/Deschutes River Watershed Characterization Study (Davis et. al 1993)
(Sample IDs are client identification labels. See Appendix E of Hart Crowser, 1993.)

DNR Aquatic Lease Boundary No. 2618

Site Boundary

* DNR locations possibly inaccurate due to coordinate entry error

0 200
Scale in Feet

Detected concentration is greater than SMS SQS or LAET

Detected concentration is greater than SMS CSL or 2LAET

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Figure 11
Previous Surface Sediment Sampling Locations
Westbay Marina

Site Boundary
DNR Aquatic Lease Boundary No. 2618
Harbor Line
Approximate Area of Visible Wood Debris
WB010 Proposed Seep Sampling Location
WB001 Proposed Surface Sediment Sampling Location
WB015 Proposed Soil Sampling Location
MW-02 Approximate Location of Groundwater Monitoring Wells (Stemen Environmental, 1999)

Note: Aerial from USGS National Map, 2008.

0 120
Scale in Feet

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Jan 27, 2009 12:22pm heriksen

Figure 12
Proposed Soil, Surface Sediment, Groundwater, and Seep Sample Locations
Westbay Marina

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APPENDIX A

SAMPLING AND ANALYSIS PLAN

APPENDIX A
FIELD SAMPLING AND ANALYSIS PLAN
SOIL, GROUNDWATER, AND SEDIMENT CHARACTERIZATION

WESTBAY MARINA

Prepared for

West Bay Marina Associates
2100 West Bay Drive NW
Olympia, Washington 98502

Prepared by

Anchor Environmental, L.L.C.
1423 Third Avenue, Suite 300
Seattle, Washington 98101

February 2009

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1 INTRODUCTION

This Sampling and Analysis Plan (SAP) describes procedures for sampling and analysis activities associated with the proposed soil, groundwater, and sediment evaluation at the Westbay Marina (Site). Westbay Marina is located at 2100 West Bay Drive NW, Olympia, Washington, on the western shore of Budd Inlet in Olympia, Washington. A project vicinity map is provided as Figure 1.

This SAP provides methods and procedures for implementing a soil, groundwater, and surface sediment grab investigation at the Site, which will include the following field activities:

- Collection of soil samples from the Southern Ditch, from the former underground storage tank (UST) valve box, and near the historical hog fuel burner
- Collection of groundwater from four previously installed wells
- Four rounds of level and flow direction measurements on a bimonthly basis
- Collection of seep water from four major identified shoreline sediment seeps
- Collection of eight surface sediment samples

This SAP is Appendix A to the *RI/FS Work Plan* (Work Plan), includes quality assurance/quality control (QA/QC) procedures, as well as laboratory analytical methods, and is supported by a Health and Safety Plan (HASP; Appendix B to the Work Plan) specific to the collection and analysis of surface sediment grab samples and sediment seep samples.

2 SAMPLING PROCESS DESIGN

The purpose of this SAP is to provide guidance for all aspects of the fieldwork and laboratory analysis to address data gaps identified in the Work Plan. Key objectives and sampling and analysis activities proposed to address the data gaps identified in the Work Plan are:

- Collection of soil samples will determine if historical activities resulted in the release of hazardous substances to Site soils and if soils have been negatively impacted by these contaminants. Collection and analysis of three soil samples from the Southern Ditch for copper will determine if copper remains in soil at levels exceeding MTCA Method B criteria. Collection and analysis of two soil samples for dioxins/furans from the area surrounding the historical burner will determine if dioxins/furans were released into soils and whether there may be a pathway to groundwater or adjacent sediments. One soil sample collected from the former UST system valve box and analyzed for diesel fuel range total petroleum hydrocarbon (TPH) will determine if in-situ bioremediation was successful at remediating the TPH measured at levels greater than MTCA Method A criteria.
- Collection of one discreet sample from existing groundwater wells will determine if historic hazardous substances released on the Site are presently being transported by groundwater. Bimonthly monitoring (four rounds) of groundwater levels and groundwater flow direction from the four existing groundwater wells will determine the rate and direction of groundwater flow at the Site.
- Collection of seep water samples from the shoreline at low tide from the flows directly adjacent to the Site boundary will further assist with the evaluation of whether if historic hazardous substances released on the Site are presently being transported by groundwater and determine if these seeps may impact surface sediment quality.
- Collection of eight surface sediment samples: four along the shoreline, co-located with three major identified seeps and one historic surface discharge point, and four offshore samples within the DNR aquatic lease boundary. This sediment investigation will further assist with the evaluation of whether seeps may carry contaminants and if contaminants have negatively impacted associated surface sediments.

The key objectives listed above not only evaluate whether chemicals are migrating from the soil to groundwater and groundwater to sediments, they also assess the potential historical magnitude and ultimate impacts to the quality of Budd Inlet sediments.

All surface sediment samples will be analyzed for Sediment Management Standards (SMS) chemicals, porewater sulfides, tributylin (TBT; porewater and bulk), ammonia, grain size, and TPH (gasoline and diesel range). Two samples, WB003 and WB004, will be analyzed for dioxins/furans. All groundwater and sediment seep samples will be analyzed for a subset of Washington State Department of Ecology's (Ecology's) Marine Surface Water Quality parameters inclusive of the SMS parameters, TBT total suspended solids, salinity, and ammonia. Sediment seep samples will not be analyzed for total residual chlorine or pesticides. Tables 1, 2, and 3 list all parameters to be analyzed for all matrices, and provides associated regulatory standards and project specific target detection limits.

This SAP was prepared consistent with current Puget Sound Estuary Program (PSEP) and U.S. Environmental Protection Agency (EPA) protocols for sampling and analysis (EPA 1986, PSEP 1986, PSEP 1997a, b, and c). The contents and structure of this SAP are in line with guidance provided in Ecology's *Sediment Source Control Standards User Manual, Appendix B: Sediment Sampling and Analysis Plan Appendix* (Ecology 2008).

The following sections provide details for the collection, handling, and analysis of soil, groundwater, sediment, and sediment seep samples.

3 SAMPLING METHODS REQUIREMENTS

This section addresses the sampling program requirements for sample collection and processing.

3.1 Station and Sample Identification

Soil will be collected at six locations, groundwater at four locations, surface sediment samples at eight locations, and sediment seep water at four locations (Figure 2). Table 4 includes a list of all stations, sample identifiers, and analyses. The sample identification scheme is described below.

3.1.1 Surface Sediment Station and Sample Identification

Each surface sediment sample will be assigned a unique alphanumeric identifier according to the following method:

- Each location will be identified by WB, and a number 001 through 008, identifying the station identifier (e.g., WB002).
- Individual surface sediment samples at each location will be identified by the same alphanumeric used to identify the station followed by a two digit matrix identifier of SS, representing a surface sediment sample, and the six digit date code YYMMDD format (e.g., WB002-SS-090601 represents the surface sediment sample collected from Station WB002 on June 1, 2009).
- The homogenization duplicate collected from a surface sediment sample will be followed with -XXXSS-YYMMDD, where XXX is the station number plus 50, and the date is appended in the YYMMDD format (e.g., WB052-SS-090601 represents the homogenization duplicate sample collected from Station WB002 on June 1, 2009).
- For filter wipe and filter blank samples, EB or FB, respectively, will be appended to the sample identification number followed by the sampling date in YYMMDD format (e.g., WB002-SSEB-090601 represents the filter wipe of the decontaminated sample processing equipment after sediments from Station WB002 are collected on June 1, 2009).

3.1.2 Sediment Seep Water Station and Sample Identification

The sediment seep water samples will be assigned a unique alphanumeric identifier according to the following method:

- Each location will be identified by WB, and a number 009 through 012, identifying the station identifier (e.g., WB010).
- Individual seep water samples at each location will be identified by the same alphanumeric used to identify the station followed by a two digit matrix identifier of SP for sediment seep followed by the sampling date in YYMMDD format (e.g., WB010-SP-090601 represents the seep water sample collected from Station WB010 on June 1, 2009).
- The rinsate blank and deionized water blank samples, RB or DW, respectively, will be appended to the sample identification number followed by the sampling date in YYMMDD format (e.g., WB010-SPRB-090601 represents the rinsate blank of the decontaminated sampling equipment after sediment seep samples from Station WB010 are collected on June 1, 2009).
- For sediment seep water samples requiring field filtration (for dissolved metals), the rinsate blank identifier, RB, will be followed by an F and the sampling date in YYMMDD format (e.g., WB010-SPRBF-090601 represents the rinsate blank of the decontaminated sampling equipment for dissolved metals analysis after sediment seep samples from Station WB010 are collected on June 1, 2009).

3.1.3 Soil Station and Sample Identification

Soil samples will be assigned a unique alphanumeric identifier according to the following method.

- Each location will be identified by WB, and a number 013 through 018, identifying the station identifier (e.g., WB014).
- Individual soil samples at each location will be identified by the same alphanumeric used to identify the station followed by a two digit matrix identifier of SO for sediment seep followed by the sampling date in YYMMDD format (e.g., WB014-SO-090601 represents the seep water sample collected from Station WB014 on June 1, 2009).
- The homogenization duplicate collected from a surface soil sample will be followed with -XXXSO-YYMMDD, where XXX is the station number plus 50, and

the date is appended in the YYMMDD format (e.g., WB064-SO-090601 represents the homogenization duplicate sample collected from Station WB014 on June 1, 2009).

- For filter wipe and filter blank samples, EB or FB, respectively, will be appended to the sample identification number followed by the sampling date in YYMMDD format (e.g., WB014-SOEB-090601 represents the filter wipe of the decontaminated sample processing equipment after soils from Station WB014 are collected on June 1, 2009).

3.1.4 Groundwater Sample Identification

Groundwater samples will be assigned a unique alphanumeric identifier according to the following method:

- Each well will be identified by a MW, then followed by a number 01 through 04.
- Groundwater samples collected from each well will be identified by the same alphanumeric used to identify the well followed by the sampling date in MMDDYY format (e.g., MW-02-090601 represents the groundwater sample collected from monitoring well MW-02 on June 1, 2009.
- The rinsate blank and deionized water blank samples, RB or DW, respectively, will be appended to the sample identification number followed by the sampling date in YYMMDD format (e.g., MW-2-SPRB-090601 represents the rinsate blank of the decontaminated sampling equipment after groundwater samples from monitoring well MW-2 are collected on June 1, 2009).
- For groundwater samples requiring field filtration (for dissolved metals), the rinsate blank identifier, RB, will be followed by an F and the sampling date in YYMMDD format (e.g., MW-2-SPRBF-090601 represents the rinsate blank of the decontaminated sampling equipment for dissolved metals analysis after groundwater samples from monitoring well MW-2 are collected on June 1, 2009).

3.2 Horizontal Positioning and Vertical Control

Horizontal positioning will be determined by a differential global positioning system (DGPS). The horizontal datum will be North American Datum (NAD) 83, Washington State Plane. Measured geographical coordinates for station positions will be recorded and reported to the nearest 0.01 second. In addition, state plane coordinates will be reported to the nearest foot. The DGPS accuracy is less than 1 meter and generally less than 30 centimeters (cm) depending upon the satellite coverage and the number of the data points collected (i.e., sampling interval).

Vertical elevation of each sediment station will be measured using a fathometer or lead line and converted to mean lower low water (MLLW) elevation. Tidal elevations will be determined using measured data from the National Oceanic and Atmospheric Administration's (NOAA's) automated tide gage located in Budd Inlet, Washington, approximately 3 miles north of the property.

3.3 Field Documentation

Documentation will consist of a field logbook and sample collection forms. The field logbook will consist of bound, numbered pages. All data entries will be made using indelible ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, then dating and initialing the change. Blank pages or lines in the field logbook will be lined-out, dated, and initialed by the Field Coordinator (FC) at the end of each sampling day. The field logbook is intended to provide sufficient data and observations to enable readers to reconstruct events that occurred during the sampling period. Examples of information to be recorded are field personnel, weather conditions, complications, and other general details associated with the sampling effort. At a minimum, the following information will be included in this log:

- Names of FC and person(s) collecting and logging the sample
- Health and safety discussions
- The sample station number
- Date and collection time of each sediment/seep sample
- Observations made during sample collection including weather conditions, complications, vessel traffic, and other details associated with the sampling effort
- Qualitative notation of apparent resistance of surface sediments to sampling, including notes on debris
- Any deviations from the approved sampling plan

In addition to maintaining a field logbook, sample collection forms will be completed for each sample. The sample collection forms will include standards entries for station identifier, station coordinates, date and time of sample location, type of samples collected, type of analyses for each sample, and specific information pertaining to the matrix being collected. For sediment samples, the collection form will include information regarding penetration of the sampler and physical characteristics of the sediment such as texture, color, odor, stratification, sheens, and biological organism presence and type. For sediment seep samples, the collection forms will include specific information regarding field measurements (temperature, pH, conductivity, dissolved oxygen, oxidation-reduction potential, turbidity, and salinity), flow rate or seep volume, and physical characteristics of the water samples such as color, odor, or sheens.

3.4 Equipment Decontamination Procedures

To prevent sample cross-contamination, all sampling and processing equipment in contact with the sediment will undergo the following decontamination procedures prior to and between collection activities:

- Rinse with Site water and wash with scrub brush until free of sediment
- Wash with phosphate-free detergent and tap water
- Rinse with tap water
- Rinse three times with distilled water

Stainless steel well points, Teflon®, or Masterflex tubing used for collection of sediment seep samples will be dedicated equipment and will be decontaminated by the analytical laboratory.

3.5 Field Quality Assurance Samples

Field quality assurance (QA) samples will be used to evaluate the efficiency of field decontamination and processing procedures. Although validation guidelines have not been established for field QA samples, their analysis is useful in identifying possible problems resulting during sample collection or sample processing in the field. All field QA samples will be documented in the field logbook and verified by the QA/QC Manager or designee. Field quality assurance samples and techniques are consistent with the Sediment Sampling and Analysis Plan Appendix Guidance (Ecology 2008.)

3.5.1 Field Blanks

Field blank samples will be collected to evaluate the efficiency of field decontamination procedures. Based on the number of samples proposed for each media, one equipment filter wipe and one filter wipe blank will be collected during surface sediment sampling, and one equipment rinsate blank, one filter blank (if field filtering is required), and one deionized distilled water blank will be collected during sediment seep sampling.

3.5.1.1 Field Blanks for Sediment and Soil

The procedure for collecting filter wipes and blanks is as follows: for sediment and soil samples, at least one equipment filter wipe and one filter blank will be collected for every 20 samples processed in the field. The equipment filter wipe consists of wiping down the sampling equipment after sample collection and decontamination with three sheets of clean, ashless, filter paper and placing them into a sample jar. The filter blank will be prepared by placing three clean pieces of ashless filter paper directly into a sampling container prior to arriving in the field. The filter paper for wipes and blanks will be from the same lot and box. If contamination is found, data will be qualified in accordance with procedures specified in USEPA's *Contract Laboratory National Functional Guidelines* (1999, 2004.)

3.5.1.2 Field Blanks for Sediment Seeps and Groundwater

Equipment used for the collection of sediment seeps will be dedicated equipment and this equipment will be evaluated by collecting a minimum of two rinsate blanks, or a minimum of one blank for every 20 field samples. These blanks will be collected by passing laboratory water through the complete sampling apparatus. One of these rinsate blanks for the sediment seep sampling equipment will be collected after they decontaminate/clean the equipment prior to sending it out to the field.

If field filtering is determined necessary for the sediment seep sample collection efforts, a filter blank will be prepared for each type of filter used in the field. This filter blank will consist of running deionized water through an unused filter and collecting the filtered water.

3.5.2 Field Homogenization Duplicate (Split Sample)

At least one field homogenization sample will be collected and analyzed for every 20 sediment samples and for every 20 soil samples processed in the field. The field homogenization sample consists of collecting additional sediment from one location, processing that sample consistent with procedures outlined in this SAP, then submitting a blind split of that sample to the laboratory.

3.5.3 Additional Sediment/Water Volume for Lab QA/QC

Field QA samples will include the collection of additional sediment and sediment seep volume to ensure that the laboratory has sufficient sample volume to run the program-required analytical QA/QC samples for analysis. Additional sample volume to meet this requirement will be collected at a frequency of one per sampling event or one in 20 samples processed, whichever is more frequent.

3.6 Sediment Sample Collection and Processing Procedures

This section describes the sample collection, processing, and handling procedures for the collection of surface sediment samples. Surface sediment samples associated with seeps will be collected at the same time that seep water samples are collected to ensure that seep water and seep sediments are co-located.

3.6.1 Surface Sediment Sample Collection

Surface sediment samples will be collected for chemical and physical testing either by hand or using a van Veen-type grab sampler, in accordance with PSEP protocols (PSEP 1997a).

If samples are collected by hand at a tidal level that exposes the sediments, samples will be collected in the following manner:

- The station will be located.
- Sampling equipment will be decontaminated.
- A square (measuring 1 square meter) will be established.
- Roughly equal volumes of 0 to 10 cm sediment will be collected from each corner of the square using stainless steel spoon and placed in a stainless steel bowl.
- Location coordinates will be recorded.

- Observations (i.e., texture, odor, presence or absence of vegetation, debris, biological organism presence or absence and type, and any other distinguishing characteristics) will be recorded on the sample collection forms.

If a van Veen-type sampler is used, samples will be collected in the following manner:

- The vessel will maneuver to proposed location.
- The sampler will be decontaminated.
- The sampler will be deployed to the bottom.
- The winch cable to the grab sampler will be drawn taut and vertical.
- Location coordinates of the cable hoist will be recorded by the location control person.
- The sediment sample will be retrieved aboard the vessel and evaluated against the following PSEP acceptability criteria:
  - Grab sampler is not overfilled (i.e., sediment surface is not against the top of sampler).
  - Sediment surface is relatively flat, indicating minimal disturbance or winnowing.
  - Overlying water is present, indicating minimal leakage.
  - Overlying water has low turbidity, indicating minimal sample disturbance.
  - Desired penetration depth of at least 10 cm is achieved.
- Overlying water will be siphoned off.
- Observations (i.e., texture, odor, presence or absence of vegetation, debris, and any other distinguishing characteristics) will be recorded on the sample collection forms.
- A stainless steel spoon will be used to collect the top 10 cm of sediment, taking care not to collect sediment in contact with the sides of the sampling device, and placed in a stainless steel bowl.

Sediment samples that meet the above collection criteria will be processed as described below.

3.6.2 *Surface Sediment Sample Processing and Handling Procedures*

Sediments will be homogenized using a stainless steel spoon, or variable-speed drill fitted with a stainless steel mixing paddle, until the sediment appears uniform in color and texture. Homogenized sediment will then be placed into appropriate pre-labeled sample containers (certified) and stored in a cooler equipped with ice or another cold source to keep the samples at 4°±2° C prior to final packing for transport to the appropriate laboratory. Table 5 lists container size, holding times, and preservation for the categories of analytes.

At a minimum, each sample label will include the following information:

- Project name and number
- Sample identifier
- Date of collection
- Initials of field personnel responsible for sample collection
- Analyses required
- Preservative (if applicable)

3.7 Sediment Seep Sample Collection and Processing Procedures

This section describes the sample collection, processing, and handling procedures for the collection of sediment seep water samples. As noted above, the associated sediments will be collected at the same time the water samples are collected.

Sediment seep samples will be collected using a well point sampling device consisting of a 1-inch-diameter pre-cleaned stainless steel tube with a 1-foot-long screen section. The well point will be pushed into the sediment with the screen positioned within the upper zone of saturation encountered at low tide. Sampling of well points will occur near the end of the outgoing (ebb) tide cycle to characterize minimum tidal dilution conditions.

Prior to sampling, each well point will be developed by purging slowly with a peristaltic pump to improve hydraulic connection and minimize turbidity (i.e., similar to low-flow groundwater sampling techniques). At the time of sampling, a peristaltic pump and pre-cleaned tubing assembly will be installed at each well point, and water will be withdrawn at a relatively low rate (determined in the field) to reduce turbidity. At least three pore volumes will be removed from each well point in this manner prior to sampling. Flow rate or seep volume, and physical characteristics of the water sample such as color, odor, or sheens will be documented on the sample collection form.

When turbidity levels are consistently less than or equal to 5 nephelometric turbidity units (NTU), samples will be collected directly into the certified, pre-cleaned, sample containers provided by the laboratory. Sample jars designated for dissolved metals will be filtered in the field using a 0.45-μm filter to represent the dissolved fraction for comparison to Washington State Water Quality Standards. After collection, sample containers will immediately be placed on ice in a cooler. Table 5 lists container size, holding times, and preservation for each category of analytes.

If the turbidity at any well point is greater than 5 NTU, then samples will be filtered at the analytical laboratory to remove non-colloidal particles greater than 1 μm that may have been introduced into the seep water by the sampling method. This procedure is consistent with the sampling methods described in the *Quality Assurance Project Plan: Survey and Sampling of Lower Duwamish Waterway Seeps* (Windward 2004). Samples for semivolatile organic compounds (SVOCs) and polychlorinated biphenyls (PCBs) analyses would be filtered in the laboratory through a 1-μm glass fiber filter and samples for mercury would be filtered in the laboratory through a 1-μm polyethylsulfone filter. Samples for metals (except mercury) analyses would be filtered through a 0.45-μm filter to represent the dissolved fraction for comparison to Washington State dissolved water quality standards. The samples requiring laboratory filtration will be clearly labeled as such and will be identified as needing the procedure on the chain-of-custody (COC) form.

Field measurements will be performed near the end of the sampling period and will include temperature, pH, conductivity, dissolved oxygen (DO), oxidation-reduction potential, turbidity, and salinity.

3.8 Groundwater Sample Collection and Processing Procedures

This section describes the sample collection, processing, and handling procedures for the collection of groundwater samples. The full volume purge method will be used because Site monitoring wells are not currently equipped with dedicated pumps. These wells have not been sampled in recent history, and the full volume purge method will allow for better removal of sediment that may have accumulated within the well over time.

The full volume purge method will be conducted as follows:

- Based on depth to water and depth to bottom measurements, the volume of the water column within each well (casing volume) will be calculated.
- Before a well is sampled, at least three casing volumes will be purged with a peristaltic or inertial (check valve) pump fitted with silicon, Pharmed™, and/or polyethylene tubing dedicated to each specific well.
- After each well casing volume is removed, temperature, pH, specific conductance, DO, and ORP will be measured with portable meters that have been calibrated according to the manufacturer's directions. The data will be immediately recorded on the Field Sampling Data Sheet (FSDS). Specific conductance and pH must stabilize to within 10 percent of the previous reading before a sample is collected. A minimum of three parameters will be measured and recorded, unless the well purges dry.
- If any well purges dry, the well will be allowed to recover to at least 80 percent of its initial water column before samples are collected, and the well will be allowed to recover/recharge for no more than 24 hours before a sample is collected.
- Groundwater samples will be collected directly from the pump discharge line and will be collected in containers with preservatives specific to the analysis being performed.
- Samples collected for dissolved analysis will be filtered during collection, using disposable 0.45 micron, in line filters. The filters will be attached directly to the pump discharge line. Each in line filter will be used only once.
- Other equipment used for water sample collection will be decontaminated both before and after each sample is collected (see Section 3.4).
- Field activities and sampling data (well purging data, type of container used for each sample, and preservatives used) will be recorded on the FSDS. Any deviations from the general procedures will be noted on the FSDS and will be brought to the attention of the FC.
- Samples will be labeled, preserved, and shipped or hand delivered to the analytical laboratory.

3.9 Hydrology Monitoring

All wells will be opened prior to collection of measurements and left open for 30 minutes to allow for atmospheric equilibration. Once wells have been allowed to vent, water levels will be measured. Because of close proximity, water levels in all four wells will be measured within 10 minutes of each other.

Measurements will be taken with an electronic water level indicator. Levels will be measured to the nearest 0.01 foot from a surveyed notch or mark at the top of the polyvinyl chloride (PVC) casing or other reference point. Measurements will be recorded immediately on a water level sheet with the date, time (on a 24-hour clock), reference point, and initials of the person who made the measurements. Water levels measured for each Site-wide round will be obtained in as short a period as practical, to reduce the potential for external factors (e.g., rainfall, barometric pressure, and river tidal changes) to affect water levels inconsistently within the study area. The water level indicator will be decontaminated in between measurement at each well, as specified in Section 3.4.

Groundwater well elevation contours will be created using data collected at each bimonthly water level monitoring event. The scale distance between the wells will be compared to elevation changes in each well. The resulting relative changes in gradient will be used to create a water table map that will show direction of water flow on the Site

3.10 Soil Sample Collection and Processing Procedures

This section describes the sample collection, processing, and handling procedures for the collection of soil samples. Soil samples that are collected from the ground surface will be removed from the location by hand tools, auger, excavator bucket, or other reasonable devices.

Samples will be collected in the following manner:

- The station will be located.
- Sampling equipment will be decontaminated.
- A square (measuring 1 square meter) will be established.
- Roughly equal volumes of 0 to 1 foot soil will be collected from each corner of the square using stainless steel spoon and placed in a stainless steel bowl.

- Location coordinates will be recorded.
- Observations (i.e., texture, odor, presence/absence of vegetation, debris, biological organism presence/absence and type, and any other distinguishing characteristics) will be recorded on the sample collection forms.

Soils will be homogenized using a stainless steel spoon, or variable-speed drill fitted with a stainless steel mixing paddle, until the sediment appears uniform in color and texture. Homogenized soil will then be placed into appropriate pre-labeled sample containers (certified) and stored in a cooler equipped with ice or another cold source to keep the samples at 4°± 2° C prior to final packing for transport to the appropriate laboratory. Table 5 lists container size, holding times, and preservation for the categories of analytes.

At a minimum, each sample label will include the following information:

- Project name and number
- Sample identifier
- Date of collection
- Initials of field personnel responsible for sample collection
- Analyses required
- Preservative (if applicable)

Soil samples will be compared to MTCA Method B criteria for copper and MTCA Method A criteria for diesel fuel range TPH (Table 3).

3.11 Field-Generated Waste Disposal

All sediment remaining after sampling and processing will be washed overboard at the collection site prior to moving to the next sampling station. Any sediment spilled on the deck of the sampling vessel will be washed into the surface waters at the collection site.

All purge water obtained from the sediment seep collection activities will be disposed of at the collection site after samples have been collected at that location.

All disposable sampling materials and personnel protective equipment used in sample processing, such as disposable coveralls, gloves, and paper towels, will be placed in heavy duty garbage bags or other appropriate containers. Disposable supplies will be placed in a normal refuse container for disposal as solid waste.

4 SAMPLE HANDLING AND CUSTODY

The section addresses the sampling program requirements for maintaining custody of the samples throughout the sample collection and shipping process, and provides specific procedures for sample shipping.

4.1 Sample Custody Procedures

Samples are considered to be in one's custody if they are: (1) in the custodian's possession or view; (2) in a secured location (under lock) with restricted access; or (3) in a container that is secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s).

COC procedures will be followed for all samples throughout the collection, handling, and analysis process. The principal document used to track possession and transfer of samples is the COC form. Each sample will be represented on a COC form the day it is collected. All data entries will be made using indelible ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, then dating and initialing the change. Blank lines/spaces on the COC form will be lined-out and dated and initialed by the individual maintaining custody.

A COC form will accompany each cooler of samples to the analytical laboratories. Each person who has custody of the samples will sign the COC form and ensure that the samples are not left unattended unless properly secured. Copies of all COC forms will be retained in the project files.

4.2 Sample Shipping and Receipt Requirements

All samples will be shipped or hand delivered to the analytical laboratory no later than the day after collection. If samples are collected on Friday, they may be held until the following Monday for shipment, provided that this does not adversely impact holding time requirements. Specific sample shipping procedures are as follows:

- Each cooler or container containing the samples for analysis will be shipped via overnight delivery to the appropriate analytical laboratory. In the event that Saturday delivery is required, the FC will contact the analytical laboratory before 3 p.m. on Friday to ensure that the laboratory is aware of the number of coolers shipped and the airbill tracking numbers for those coolers. Following each shipment, the FC will call the laboratory and verify the shipment from the day before has been received and is in good condition.

- Coolant ice will be sealed in separate double plastic bags and placed in the shipping containers.
- Individual sample containers will be placed in a sealable plastic bag, packed to prevent breakage, and transported in a sealed ice chest or other suitable container.
- Glass jars will be separated in the shipping container by shock absorbent material (e.g., bubble wrap) to prevent breakage.
- The shipping containers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container and consultant's office name and address) to enable positive identification.
- The shipping waybill number will be documented on all COC forms accompanying the samples.
- A sealed envelope containing COC forms will be enclosed in a plastic bag and taped to the inside lid of the cooler.
- A minimum of two signed and dated COC seals will be placed on adjacent sides of each cooler prior to shipping.
- Each cooler will be wrapped securely with strapping tape, labeled "Glass – Fragile" and "This End Up," and will be clearly labeled with the laboratory's shipping address and the consultant's return address.

Upon transfer of sample possession to the analytical laboratory, the persons transferring custody of the sample container will sign the COC form, and the recipient of the samples will sign the COC form. Upon receipt of samples at the laboratory, the shipping container seal will be broken and the receiver will record the condition of the samples on a sample receipt form. COC forms will be used internally in the lab to track sample handling and final disposition.

5 ANALYTICAL METHODS

This section summarizes the target physical and chemical analyses for the various media sampled. All sample analyses will be conducted in accordance with Ecology-approved methods. Prior to analysis, all samples will be maintained according to the appropriate holding times and temperatures for each analysis (Table 5). Tables 1, 2, and 3 present the proposed analytes, the analytical methods to be used, and the targeted detection limits for the evaluation of sediment, sediment seeps and groundwater, soils, and field QA/QC samples. The analytical laboratory will prepare a detailed report to be included as an appendix in the *Draft RI Data Memorandum and Data Gaps Evaluation.*

Prior to the analysis of the samples, the laboratory will calculate method detection limits and method reporting limits for each analyte of interest, where applicable. Method reporting limits will be below the sediment, water, and soil quality criteria specified in Tables 1, 2, and 3, respectively, if technically feasible. To achieve the required reporting limits, some modifications to the methods may be necessary. These modifications from the specified analytical methods will be provided by the laboratory at the time of establishing the laboratory contract, and must be approved by Ecology prior to implementation.

Chemical/physical testing with the exception of dioxin/furans will be conducted at TestAmerica located in Tacoma, Washington. TestAmerica is an Ecology-accredited laboratory and is also accredited under the National Environmental Laboratories Accreditation Program (NELAP). All chemical and physical testing will adhere to the most recent PSEP QA/QC procedures (PSEP 1997b) and PSEP analysis protocols. If more current analytical methods are available, the laboratory will use them.

Analysis for dioxin/furans performed on soil samples and sediment samples WB003 and WB004 will be conducted at Analytical Perspectives (AP), located in Wilmington, North Carolina. AP is Ecology- and NELAP-accredited and will adhere to the most recent PSEP QA/QC procedures and protocols.

In completing chemical analyses for this project, the contract laboratory is expected to meet the following minimum requirements:

- Adhere to the methods outlined in this SAP, including methods referenced for each analytical procedure (Tables 1, 2, and 3)
- Deliver facsimile, hard copy, and electronic data as specified
- Meet reporting requirements for deliverables
- Meet turnaround times for deliverables
- Implement QA/QC procedures, including data quality objectives outlined in Table 6 and performance evaluation testing requirements
- Notify the project QA/QC Manager of any QA/QC problems when they are identified to allow for quick resolution
- Allow laboratory and data audits to be performed, if deemed necessary

5.1 Quality Assurance/Quality Control

The frequency of analysis for laboratory QA/QC samples is summarized in Table 7, and project data quality objectives for precision, accuracy, and completeness are provided in Table 6. When analyzing SVOCs, metals, and conventional parameters, SMS requires that initial calibrations must be completed before any samples are analyzed, after each major disruption of equipment, and when ongoing calibration fails to meet acceptance criteria. Ongoing calibration is required before and after every 10 samples for metals analyses, and every 12 hours for SVOC and TBT analysis.

Surrogates are required (organics only) for every sample, including matrix spike samples, blanks, laboratory control samples, and standard reference materials. Matrix spike and matrix spike duplicates are required for SVOCs and TBT for every 20 samples received. Matrix spikes and laboratory duplicates will be analyzed for samples requiring metals analyses. Laboratory duplicates will be analyzed for conventional parameters.

All samples will be diluted and reanalyzed if target compounds are detected at levels that exceed their respective established calibration ranges. Any cleanups will be conducted prior to the dilutions. R-analyses will be performed if surrogate, internal standard, or spike recoveries are outside of the data quality objective parameters. QC samples may be re-analyzed if results are not within control limits and it cannot be determined that the sample matrix is the cause.

5.2 Laboratory Report

The laboratories will prepare a detailed laboratory report documenting all activities associated with the sample analyses. Included in this report will be:

- Case Narrative – A detailed report that describes the samples received, analyses performed, and corrective actions undertaken.
- COC Documentation – Laboratory policy requires that COC documentation be available for all samples received; the COC will document basic sample demographics such as client and project names, sample identification, analyses requested, and special instructions.
- Data Summary Form – A tabular listing of concentrations and/or detection limits for all target analytes; the data report will also list other pertinent information, such as amount of sample analyzed, dilution factors, sample processing dates, extraction dates, date of analyses, extract cleanups, and surrogate recoveries.
- QA Summary – A discussion of results of all QC analyses, specifically recovery information. Laboratory control samples will be reported with each batch and additional QC analysis may include laboratory replicates, matrix spikes, and standard reference materials.
- Instrument Calibration Forms and Raw Data – Includes initial and continuing calibration summaries and instrument tuning data, sample chromatograms, laboratory bench sheets, and log book pages.

The laboratories will also provide these deliverables in EQuIS 5 electronic format. Final data generated during this sampling event will be submitted to Ecology in written and electronic format. Electronic data that are representative of post-construction conditions will be submitted using Ecology's Environmental Information Management System (EIM). Data submitted to EIM will comply with Subappendix E of the SAPA (2008).

5.3 Reporting Limits

Despite efforts to use the laboratory's lowest reporting limits, there may be some reporting limits that exceed SMS criteria after organic carbon normalization. For instance, if the total organic carbon percentage is between 0.5 to 1.75 percent, SVOC compounds 1,2,4-trichlorobenzene and hexachlorobenzene would exceed the SQS criteria. Most compounds, however, will have reporting limits well below the SMS criteria.

6 DATA SUBMITTAL AND REPORTING REQUIREMENTS

In accordance with AO requirements, all sampling, laboratory reports, and/or test results generated by any investigative activities performed on the Site on behalf of WBMA will be made available to Ecology. Pursuant to Washington Administrative Code (WAC) 173-340-840(5), all sampling data shall be submitted to Ecology in both printed and electronic formats in accordance with Section VII of the AO (Work to be Performed), Ecology's Toxics Cleanup Program Policy 840 (Data Submittal Requirements) and/or any subsequent procedures specified by Ecology for data submittal.

6.1 General Submittal Requirements

All data generated and/or collected during the Site investigation and cleanup activities conducted in accordance with this AO are considered part of an independent remedial action. These activities are considered environmental monitoring data and are required to be submitted to Ecology in accordance with general submittal requirements. These requirements and the legal basis for these requirements are established in WAC 173-340-840. These requirements include submittal of both a written and electronic format capable of being submitted into the department's data management system. Data collected as part of this SAP will be submitted in accordance with all other requirements outlined in Section 8.3 of the Sediment Sampling and Analysis Plan Appendix (Ecology 2008).

6.2 Electronic Submission of Upland and Sediment Investigation Data

All sampling data will be submitted in EIM system format. The EIM system is Ecology's main repository for electronic environmental monitoring data the purpose of which is to provide an accessible means by which to examine and evaluate environmental monitoring data. All electronic data will be submitted to EIM in accordance with Subappendix E of Sediment Sampling and Analysis Plan Appendix, revised February 2008, when entering data in EIM format (Ecology 2008).

6.3 Regulatory Framework and Screening Criteria

The sampling and analysis activities conducted at Westbay Marina will be performed in accordance with the MTCA cleanup regulations (WAC 173-340-350) and followed procedures specified by the sediment cleanup SMS for the state of Washington (Chapter 173-204 WAC).

The purpose of the SMS is to reduce and ultimately eliminate adverse effects on biological resources and significant health threats to humans from surface sediment contamination by: (a) establishing standards for the quality of surface sediments; (b) applying these standards as the basis for management and reduction of pollutant discharges; and (c) providing a management and decision process for the cleanup of contaminated sediments. For sediment in marine environments, there are numeric criteria for 47 chemicals or chemical groups and narrative criteria for chemicals not on the list. Under the tiered SMS sediment evaluation process, exceedance of a numerical Cleanup Screening Level (CSL) can be overridden by a demonstration that biological effects criteria are not exceeded. Similarly, a finding of no exceedances, based on chemical criteria, can be overridden by a demonstration of biological effects exceedances. The SMS numerical criteria are based on Puget Sound apparent effects threshold (AET) values.

The marine sediment quality standards (SQS) of WAC 173-204-320 include chemical concentration criteria (Table 1) that define the degree of sediment quality that is expected to have no adverse effects to biological resources in Puget Sound sediments significant risk to human health. The SQS serve as the cleanup objective for all cleanup actions. The CSLs (Table 1) correspond to sediment quality that may result in minor adverse effects.

If the sediment exceeds the chemical concentrations listed in Table 1, or the practical quantitation limit is above the SQS criteria, biological effects tests are needed to confirm whether or not the sediment are causing toxicity to aquatic life. Where laboratory analysis indicates a chemical is not detected in a sediment sample, the detection limit will be reported with U (Undetected) qualifier code and shall be at or below the SQS chemical criteria.

Regulatory numerical limits for TBT have not been established under Washington State’s SMS (Chapter 173-204 WAC). TBT is classified as a “deleterious substance” under the SMS and may be regulated using biological or other appropriate testing methods. "Other toxic, radioactive, biological, or deleterious substances" means contaminants that are not specifically identified in the SQS chemical criteria of WAC 173-204-320 through 173-204-340 (e.g., organic debris, TBT, DDT, etc.). Results from this study will be used by the Ecology

Sediment Management Unit, Southwest Regional Office Toxics Cleanup Program to make recommendations for cleanup of sediments in the aquatic lease boundary of the Site.

Dioxin/furan congeners do not have numerical criteria under the Washington State SMS for marine or freshwater sediments, but fall under the SMS narrative criteria, which include "other toxic or deleterious substances" (WAC 173-204-320) and are subject to evaluation by Ecology. Managing dioxin/furan contamination in sediments is done on a case-by-case basis, looking at the risk it poses to human or ecological health due to its potential to bioaccumulate.

Pending the development of programmatic guidelines, the interagency Dredged Material Management Program (DMMP) has adopted an interim approach to evaluate dioxins/furans in sediment. These interim guidelines were adopted to serve as a process for making suitability determinations until programmatic revisions are completed. For Puget Sound non-dispersive disposal sites, the guidelines dictate that "dioxin concentrations in any given dredged material management unit may not exceed the established site maximum" (DMMO 2008). Puget Sound non-dispersive disposal site sediment dioxin toxic equivalence (ng/kg-dry weight) maximums range from 5.2 to 12.2 ng/kg, depending on the disposal site. Puget Sound dispersive disposal site guidelines are based on a comparison of dioxin in test sediments to reference background, where background is defined using sediment dioxin data from the nearest reference site. Bioaccumulation testing for dioxin is currently not used to determine suitability for either dispersive or non-dispersive sites in Puget Sound. For dispersive sites in Grays Harbor, the 5 ng/kg 2,3,7,8-TCDD concentration or 15 ng/kg TEQ will be used as a trigger for the requirement to perform bioaccumulation testing (DMMO 2008).

For data presentation and evaluation purposes, the concentration of dioxin/furan congeners were normalized to the toxicity of 2,3,7,8-TCDD using toxic equivalent factors (TEFs) updated by the World Health Organization (WHO) in 2005 and published in 2006 (Van den Berg et al. 2006). The TEQ is equivalent to the sum of the concentrations of individual congeners multiplied by their TEF (potency relative to 2,3,7,8-TCDD). Non-detected values were assessed as half of the method detection limit for data evaluation purposes.

7 REFERENCES

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Tables

Table 1
Parameters for Analysis, Evaluation Criteria, Methods, and Practical Quantitation Limits—Sediment

Parameter		Unit	Sediment Quality Standards	Cleanup Screening Levels	Analytical Method	Practical Quantitation Limit
Conventional Parameters						
	Gravel	%	-	-	PSEP, 1986	0.1
	Sand	%	-	-	PSEP, 1986	0.1
	Silt	%	-	-	PSEP, 1986	0.1
	Clay	%	-	-	PSEP, 1986	0.1
	Fines	%	-	-	PSEP, 1986	0.1
	Total Solids	%	-	-	PSEP, 1986	0.1
	Ammonia	mg/kg	-	-	Plumb, 1981	1.0
	Porewater Sulfides	mg/L	-	-	Plumb, 1981	1.0
	Total organic carbon	%	-	-	9060	0.1
Metals						
	Arsenic	mg/kg dry	57	93	6010/6020	5.0
	Cadmium	mg/kg dry	5.1	6.7	6010/6020	0.20
	Chromium	mg/kg dry	260	270	6010/6020	0.50
	Copper	mg/kg dry	390	390	6010/6020	0.50
	Lead	mg/kg dry	450	530	6010/6020	1.0
	Mercury	mg/kg dry	0.41	0.59	7471A	0.050
	Nickel	mg/kg dry	-	-	6010/6020	0.50
	Selenium	mg/kg dry	-	-	6010/6020	2.0
	Silver	mg/kg dry	6.1	6.1	6010/6020	0.20
	Zinc	mg/kg dry	410	960	6010/6020	4.0
Organometallic Compounds						
	Tributyltin (as ion in pore water)	µg/L	0.15[e]	0.15[e]	Krone	0.02
	Tributyltin (bulk)	µg/kg dry wt	---	---	Krone	4.0
Nonionizable Organic Compounds[a]						
	Aromatic Hydrocarbons					
	Total LPAH[b]	mg/kg OC	370	780	8270	---
	Naphthalene	mg/kg OC	99	170	8270	20 µg/kg
	Acenaphthylene	mg/kg OC	66	66	8270	20 µg/kg
	Acenaphthene	mg/kg OC	16	57	8270	20 µg/kg
	Fluorene	mg/kg OC	23	79	8270	20 µg/kg
	Phenanthrene	mg/kg OC	100	480	8270	20 µg/kg
	Anthracene	mg/kg OC	220	1,200	8270	20 µg/kg
	2-Methylnaphthalene	mg/kg OC	38	64	8270	20 µg/kg
	Total HPAH[c]	mg/kg OC	960	5,300	8270	---
	Fluoranthene	mg/kg OC	160	1,200	8270	20 µg/kg
	Pyrene	mg/kg OC	1,000	1,400	8270	20 µg/kg
	Benz[a]anthracene	mg/kg OC	110	270	8270	20 µg/kg
	Chrysene	mg/kg OC	110	460	8270	20 µg/kg
	Total benzofluoranthenes[d]	mg/kg OC	230	450	8270	40 µg/kg
	Benzo[a]pyrene	mg/kg OC	99	210	8270	20 µg/kg
	indeno[1,2,3-c,d]pyrene	mg/kg OC	34	88	8270	20 µg/kg

Table 1
Parameters for Analysis, Evaluation Criteria, Methods, and Practical Quantitation Limits—Sediment

Parameter	Unit	Sediment Quality Standards	Cleanup Screening Levels	Analytical Method	Practical Quantitation Limit
Dibenz[a,h]anthracene	mg/kg OC	12	33	8270	20 µg/kg
Benzo[g,h,i]perylene	mg/kg OC	31	78	8270	20 µg/kg
Chlorinated Benzenes					
1,2-Dichlorobenzene	mg/kg OC	2.3	2.3	8270	20 µg/kg
1,3-Dichlorobenzene	mg/kg OC	-	-	8270	20 µg/kg
1,4-Dichlorobenzene	mg/kg OC	3.1	9	8270	20 µg/kg
1,2,4-Trichlorobenzene	mg/kg OC	0.81	1.8	8270	5 µg/kg
Hexachlorobenzene	mg/kg OC	0.38	2.3	8270	5 µg/kg
Phthalate Esthers					
Dimethyl phthalate	mg/kg OC	53	53	8270	100 µg/kg
Diethyl phthalate	mg/kg OC	61	110	8270	100 µg/kg
Di-n-butyl phthalate	mg/kg OC	220	1700	8270	100 µg/kg
Butyl benzyl phthalate	mg/kg OC	4.9	64	8270	100 µg/kg
Bis[2-ethylhexyl] phthalate	mg/kg OC	47	78	8270	100 µg/kg
Di-n-octyl phthalate	mg/kg OC	58	4500	8270	100 µg/kg
Miscellaneous Extractables					
Dibenzofuran	µg/kg dry	15	58	8270	20 µg/kg
Hexachlorobutadiene	µg/kg dry	3.9	6.2	8270	5 µg/kg
N-nitrosodiphenylamine	µg/kg dry	11	11	8270	20 µg/kg
Total PCBs	µg/kg dry	12	65	8082	4 µg/kg
Ionizable Organic Compounds					
Phenol	µg/kg dry	420	1200	8270	20 µg/kg
2-Methylphenol	µg/kg dry	63	63	8270	20 µg/kg
4-Methylphenol	µg/kg dry	670	670	8270	20 µg/kg
2,4-Dimethylphenol	µg/kg dry	29	29	8270	20 µg/kg
Pentachlorophenol	µg/kg dry	360	690	8270	100 µg/kg
Benzyl alcohol	µg/kg dry	57	73	8270	20 µg/kg
Benzoic acid	µg/kg dry	650	650	8270	200 µg/kg
Total Petroleum Hydrocarbons					
Gasoline Range	mg/kg dry	-	-	NWTPHGX	5 mg/kg
Diesel Range	mg/kg dry	-	-	NWTPHDX	5 mg/kg
Dioxin/Furans					
Dioxins					
2,3,7,8-TCDD	ng/kg dry wt	-	-	1613B	1.0 ng/kg
1,2,3,7,8-PeCDD	ng/kg dry wt	-	-	1613B	5.0 ng/kg
1,2,3,4,7,8-HxCDD	ng/kg dry wt	-	-	1613B	5.0 ng/kg
1,2,3,6,7,8-HxCDD	ng/kg dry wt	-	-	1613B	5.0 ng/kg
1,2,3,7,8,9-HxCDD	ng/kg dry wt	-	-	1613B	5.0 ng/kg
1,2,3,4,6,7,8-HpCDD	ng/kg dry wt	-	-	1613B	5.0 ng/kg
OCDD	ng/kg dry wt	-	-	1613B	10 ng/kg
Furans					
2,3,7,8-TCDF	ng/kg dry wt	-	-	1613B	1.0 ng/kg
1,2,3,7,8-PeCDF	ng/kg dry wt	-	-	1613B	5.0 ng/kg

Table 1
Parameters for Analysis, Evaluation Criteria, Methods, and Practical Quantitation Limits—Sediment

Parameter	Unit	Sediment Quality Standards	Cleanup Screening Levels	Analytical Method	Practical Quantitation Limit
2,3,4,7,8,-PeCDF	ng/kg dry wt	-	-	1613B	5.0 ng/kg
1,2,3,4,7,8-HxCDF	ng/kg dry wt	-	-	1613B	5.0 ng/kg
1,2,3,6,7,8-HxCDF	ng/kg dry wt	-	-	1613B	5.0 ng/kg
1,2,3,7,8,9-HxCDF	ng/kg dry wt	-	-	1613B	5.0 ng/kg
2,3,4,6,7,8-HxCDF	ng/kg dry wt	-	-	1613B	5.0 ng/kg
1,2,3,4,6,7,8-HpCDF	ng/kg dry wt	-	-	1613B	5.0 ng/kg
1,2,3,4,7,8,9-HpCDF	ng/kg dry wt	-	-	1613B	5.0 ng/kg
OCDF	ng/kg dry wt	-	-	1613B	10 ng/kg

Notes:

a = Concentrations are in ppm normalized on a total organic carbon basis.

b = Total LPAH criterion under the SMS represents the sum of the concentrations of the following LPAH compounds: naphthalene, acenaphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene.

c = Total HPAH criterion under the SMS represents the sum of the concentrations of the following HPAH compounds: fluoranthene, pyrene, benz[a]anthracene, chrysene, total benzofluranthenes, benzo[a]pyrene, indeno[1,2,3-c,d]pyrene, dibenzo[a,h]anthracene, and benzo[g,h,i]perylene.

d = The total benzofluoranthenes criterion represents the sum of the concentrations of the b, j, and k isomers of benzofluoranthene.

e = Criteria is based on DMMP screening levels; there is no SQS or CSL for tributytin.

mg/kg OC = milligrams per kilogram, organic carbon-normalized

μg/kg dry wt = micrograms per kilogram, dry weight basis

ng/kg dry wt = nanograms per kilogram, dry weight basis

PSEP = Puget Sound Estuary Program

Table 2
Parameters for Analysis, Evaluation Criteria, Methods, and Practical Quantitation Limits—Sediment Seeps and Groundwater

Parameter	Unit	EPA Criteria for Saltwater	Ecology Marine Chronic WQC	MTCA Method A Groundwater	Analytical Method	Practical Quantitation Limit
Conventional Parameter						
Ammonia	mg-N/L	-	-	-	350.1	0.1 mg/L
Total and Dissolved Metals						
Arsenic	µg/L	36 µg/L	190 mg/L	5 µg/L	200.8/6010	0.2 µg/L
Cadmium	µg/L	8.8 µg/L	-	5 µg/L	200.8/6010	0.2 µg/L
Chromium	µg/L	-	-	50 µg/L	200.8/6010	0.5 µg/L
Copper	µg/L	3.1 µg/L	-	--	200.8/6010	0.5 µg/L
Lead	µg/L	8.1 µg/L	-	15 µg/L	200.8/6010	2 µg/L
Mercury	µg/L	0.94 µg/L	0.012 mg/L	2 µg/L	7470A	0.1 µg/L
Nickel	µg/L	8.2 µg/L	-	-	200.8/6010	0.5 µg/L
Selenium	µg/L	71 µg/L	5.0 mg/L	-	200.8/6010	0.5 µg/L
Silver	µg/L	-	-	-	200.8/6010	0.2 µg/L
Zinc	µg/L	81 µg/L	-	-	200.8/6010	4 µg/L
Organometallic Compounds						
Tributyltin	µg/L	-	-	-	Krone	0.2 µg/L
Ionizable Organic Compounds						
Aromatic Hydrocarbons						
Total LPAH	µg/L	-	-	-	8270D	-
Naphthalene	µg/L	-	-	160 µg/L	8270D	1.0 µg/L
Acenaphthylene	µg/L	-	-	-	8270D	1.0 µg/L
Acenaphthene	µg/L	-	-	-	8270D	1.0 µg/L
Fluorene	µg/L	-	-	-	8270D	1.0 µg/L
Phenanthrene	µg/L	-	-	-	8270D	1.0 µg/L
Anthracene	µg/L	-	-	-	8270D	1.0 µg/L
2-Methylnaphthalene	µg/L	-	-	-	8270D	1.0 µg/L
Total HPAH	µg/L	-	-	-	8270D	-
Fluoranthene	µg/L	-	-	-	8270D	1.0 µg/L
Pyrene	µg/L	-	-	-	8270D	1.0 µg/L
Benz[a] anthracene	µg/L	-	-	-	8270D	1.0 µg/L
Chrysene	µg/L	-	-	-	8270D	1.0 µg/L
Total benzofluoranthenes	µg/L	-	-	-	8270D	
Benzo[a]pyrene	µg/L	-	-	0.1 µg/L	8270D	1.0 µg/L
indeno[1,2,3-c,d]pyrene	µg/L	-	-	-	8270D	1.0 µg/L
Dibenzo[a,h]anthracene	µg/L	-	-	-	8270D	1.0 µg/L
Benzo[g,h,i]perylene	µg/L	-	-	-	8270D	1.0 µg/L
Chlorinated Benzenes						
1,2-Dichlorobenzene	µg/L	-	-	-	8270D	1.0 µg/L
1,3-Dichlorobenzene	µg/L	-	-	-	8270D	1.0 µg/L
1,4-Dichlorobenzene	µg/L	-	-	-	8270D	1.0 µg/L
1,2,4-Trichlorobenzene	µg/L	-	-	-	8270D	1.0 µg/L
Hexachlorobenzene	µg/L	-	-	-	8270D	1.0 µg/L
Phthalate Esters						
Dimethyl phthalate	µg/L	-	-	-	8270D	1.0 µg/L
Diethyl phthalate	µg/L	-	-	-	8270D	1.0 µg/L
Di-n-butyl phthalate	µg/L	-	-	-	8270D	1.0 µg/L
Butyl benzyl phthalate	µg/L	-	-	-	8270D	1.0 µg/L
Bis[2-ethylhexyl]phthalate	µg/L	-	-	-	8270D	1.0 µg/L
Di-n-octyl phthalate	µg/L	-	-	-	8270D	1.0 µg/L

Table 2
Parameters for Analysis, Evaluation Criteria, Methods, and Practical Quantitation Limits—Sediment Seeps and Groundwater

Parameter	Unit	EPA Criteria for Saltwater	Ecology Marine Chronic WQC	MTCA Method A Groundwater	Analytical Method	Practical Quantitation Limit
Miscellaneous Extractables						
Dibenzofuran	µg/L	-	-	-	8270D	1.0 µg/L
Hexachlorobutadiene	µg/L	-	-	-	8270D	1.0 µg/L
Hexachloroethane	µg/L	-	-	-	8270D	1.0 µg/L
N-nitrosodiphenylamine	µg/L	-	-	-	8270D	5.0 µg/L
Total PCBs	µg/L	0.03 µg/L	0.014 mg/L	-	8082[a]	0.1 µg/L
Ionizable Organic Compounds						
Phenol	µg/L	-	-	-	8270D	1.0 µg/L
2-Methylphenol	µg/L	-	-	-	8270D	1.0 µg/L
4-Methylphenol	µg/L	-	-	-	8270D	1.0 µg/L
2,4-Dimethylphenol	µg/L	-	-	-	8270D	1.0 µg/L
Pentachlorophenol	µg/L	7.9 µg/L	0.24	-	8270D	5.0 µg/L
Benzyl alcohol	µg/L	-	-	-	8270D	5.0 µg/L
Benzoic acid	µg/L	-	-	-	8270D	10.0 µg/L
Total Petroleum Hydrocarbons						
Gasoline range	mg/L	-	-	800 µg/L*	NWTPHGX	0.03 mg/L
Diesel range	mg/L	-	-	500 µg/L	NWTPHDX	0.25 mg/L
Residual range	mg/L	-	-	-	NWTPHDX	0.50 mg/L

Notes:

a = All aroclors detected above the reporting limit must be confirmed by second column .

WQC = Water Quality Criteria

µg/L = micrograms per liter

mg/L = milligrams per liter

* = Benzene present in groundwater. If no detectable benzene, criteria is 1,000 µg/L

Table 3
Parameters for Analysis, Evaluation Criteria, Methods, and Practical Quantitation Limits—Soils

Parameter	Unit	MTCA Method A, Unrestricted Land Use (mg/kg)	MTCA Method B, Direct Contact, Unrestricted Land Use (mg/kg)	Analytical Method	Practical Quantitation Limit
Conventional Parameters					
Total Solids	%	--	--	160.3	0.1
Metals					
Copper	mg/kg dry	--	3000	6010/6020	0.50
Total Petroleum Hydrocarbons					
Diesel Range	mg/kg dry	2000	--	NWTPHDX	5 mg/kg
Dioxin/Furans					
Dioxins					
2,3,7,8-TCDD	ng/kg dry wt	--	--	1613B	1.0 ng/kg
1,2,3,7,8-PeCDD	ng/kg dry wt	--	--	1613B	5.0 ng/kg
1,2,3,4,7,8-HxCDD	ng/kg dry wt	--	--	1613B	5.0 ng/kg
1,2,3,6,7,8-HxCDD	ng/kg dry wt	--	--	1613B	5.0 ng/kg
1,2,3,7,8,9-HxCDD	ng/kg dry wt	--	--	1613B	5.0 ng/kg
1,2,3,4,6,7,8-HpCDD	ng/kg dry wt	--	--	1613B	5.0 ng/kg
OCDD	ng/kg dry wt	--	--	1613B	10 ng/kg
Furans					
2,3,7,8-TCDF	ng/kg dry wt	--	--	1613B	1.0 ng/kg
1,2,3,7,8-PeCDF	ng/kg dry wt	--	--	1613B	5.0 ng/kg
2,3,4,7,8,-PeCDF	ng/kg dry wt	--	--	1613B	5.0 ng/kg
1,2,3,4,7,8-HxCDF	ng/kg dry wt	--	--	1613B	5.0 ng/kg
1,2,3,6,7,8-HxCDF	ng/kg dry wt	--	--	1613B	5.0 ng/kg
1,2,3,7,8,9-HxCDF	ng/kg dry wt	--	--	1613B	5.0 ng/kg
2,3,4,6,7,8-HxCDF	ng/kg dry wt	--	--	1613B	5.0 ng/kg
1,2,3,4,6,7,8-HpCDF	ng/kg dry wt	--	--	1613B	5.0 ng/kg
1,2,3,4,7,8,9-HpCDF	ng/kg dry wt	--	--	1613B	5.0 ng/kg
OCDF	ng/kg dry wt	--	--	1613B	10 ng/kg

Notes:

mg/kg dry wt = millograms per kilogram, dry weight basis

ng/kg dry wt = nanograms per kilogram, dry weight basis

Table 4
Station Locations and Sample Matrix Summary for Soil, Sediment, and Water Samples

Station ID	Laboartory Sample ID[a] / Parameter	Metals	SVOCs	PCBs	TS, TOC, NH3	Sulfides (PW)	TBT (PW/Aq)	TBT bulk	Grain Size	Dioxins/Furans	GRO	DRO
	Container	8-oz WM-G	8-oz WM-G	8-oz WM-G	8-oz WM-G	32-oz WM-G	32-oz WM-G/ 2 x 500 mL Amber glass	8-oz WM-G	16-oz Plastic	8-oz WM-G	2-oz WM-G	8-oz WM-G
	Preservative	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Surface Sediments												
WB001	WB001-SS-YYMMDD	X	X	X	X	X	X	X	X		X	X
WB002	WB002-SS-YYMMDD	X	X	X	X	X	X	X	X		X	X
WB003	WB003-SS-YYMMDD	X	X	X	X	X	X	X	X	X	X	X
WB004	WB004-SS-YYMMDD	X	X	X	X	X	X	X	X	X	X	X
WB005	WB005-SS-YYMMDD	X	X	X	X	X	X	X	X		X	X
WB006	WB006-SS-YYMMDD	X	X	X	X	X	X	X	X		X	X
WB007	WB007-SS-YYMMDD	X	X	X	X	X	X	X	X		X	X
WB008	WB008-SS-YYMMDD	X	X	X	X	X	X	X	X		X	X
Filter Wipe	WB0XX-SSEB-YYMMDD	X	X	X				X		X		X
Filter Blank	WB0XX-SSFB-YYMMDD	X	X	X				X		X		X
Field Homogenization Duplicate	WB0XX(+50)-SS-YYMMDD	X	X	X	X	X	X	X	X	X	X	X
Sediment Seeps												
WB009	WB009-SP-YYMMDD						X					
WB010	WB010-SP-YYMMDD						X					
WB011	WB011-SP-YYMMDD						X					
WB012	WB012-SP-YYMMDD						X					
Equipment Rinsate	WB0XX-SPRB-YYMMDD						X					
Equipment Rinsate-Filtered	WB0XX-SPRBF-YYMMDD											
Deionized Water Blank	WB0XX-SP/STDW-YYMMDD						X					
Soils												
WB013	WB013-SO-YYMMDD	X										
WB014	WB014-SO-YYMMDD	X										
WB015	WB015-SO-YYMMDD	X										
WB016	WB016-SO-YYMMDD											X
WB017	WB017-SO-YYMMDD									X		
WB018	WB018-SO-YYMMDD									X		
Filter Wipe	WB0XX-SOFB-YYMMDD	X								X		X
Filter Blank	WB0XX-SOFB-YYMMDD	X								X		X
Field Homogenization Duplicate	WB0XX(+50)-SO-YYMMDD	X								X		X
Groundwater												
MW-01	MW-01-YYMMDD						X					
MW-02	MW-02-YYMMDD						X					
MW-03	MW-03-YYMMDD						X					
MW-04	MW-04-YYMMDD						X					
Equipment Rinsate	MW-0X-RB-YYMMDD						X					
Equipment Rinsate-Filtered	MW-0X-RBF-YYMMDD						X					
Deionized Water Blank	MW-0X-DW-YYMMDD											

Note:
a = Sample IDs are defined below:
SS = surface sediment
SP = seep water
SO = soils
WM-G = wide mouth glass jar
HDPE = high density polyethylene
TS = total solids
TOC = total organic carbon
NH3 = ammonia
TBT = tributyltin
GRO = gasoline range organics
DRO = diesel range organics
RRO = residual range organics
PCB = polychlorinated biphenyls
SVOC = semivolatile organic compounds
NA = not applicable

Table 4
Station Locations and Sample Matrix Summary for Soil, Sediment, and Water Samples

Station ID	Laboartory Sample ID[a]	Parameter / Container / Preservative	Total Metals	Dissolved Metals	PCBs	SVOCs	Ammonia	GRO	DRO/RRO
		Container	250 mL HDPE	250 mL HDPE	2 x 500 mL Amber glass	2 x 500 mL Amber glass	250 mL HDPE	2 x 40 mL Amber glass VOA vial	2 x 500 mL Amber glass
		Preservative	HNO_3	HNO_3	NA	NA	H_2SO4	NA	NA
Surface Sediments									
WB001	WB001-SS-YYMMDD								
WB002	WB002-SS-YYMMDD								
WB003	WB003-SS-YYMMDD								
WB004	WB004-SS-YYMMDD								
WB005	WB005-SS-YYMMDD								
WB006	WB006-SS-YYMMDD								
WB007	WB007-SS-YYMMDD								
WB008	WB008-SS-YYMMDD								
Filter Wipe	WB0XX-SSEB-YYMMDD								
Filter Blank	WB0XX-SSFB-YYMMDD								
Field Homogenization Duplicate	WB0XX(+50)-SS-YYMMDD								
Sediment Seeps									
WB009	WB009-SP-YYMMDD		X	X	X	X	X	X	X
WB010	WB010-SP-YYMMDD		X	X	X	X	X	X	X
WB011	WB011-SP-YYMMDD		X	X	X	X	X	X	X
WB012	WB012-SP-YYMMDD		X	X	X	X	X	X	X
Equipment Rinsate	WB0XX-SPRB-YYMMDD		X		X	X			X
Equipment Rinsate-Filtered	WB0XX-SPRBF-YYMMDD			X					X
Deionized Water Blank	WB0XX-SP/STDW-YYMMDD		X		X	X			X
Soils									
WB013	WB013-SO-YYMMDD								
WB014	WB014-SO-YYMMDD								
WB015	WB015-SO-YYMMDD								
WB016	WB016-SO-YYMMDD								
WB017	WB017-SO-YYMMDD								
WB018	WB018-SO-YYMMDD								
Filter Wipe	WB0XX-SOFB-YYMMDD								
Filter Blank	WB0XX-SOFB-YYMMDD								
Field Homogenization Duplicate	WB0XX(+50)-SO-YYMMDD								
Groundwater									
MW-01	MW-01-YYMMDD		X	X	X	X	X	X	X
MW-02	MW-02-YYMMDD		X	X	X	X	X	X	X
MW-03	MW-03-YYMMDD		X	X	X	X	X	X	X
MW-04	MW-04-YYMMDD		X	X	X	X	X	X	X
Equipment Rinsate	MW-0X-RB-YYMMDD		X		X	X		X	X
Equipment Rinsate-Filtered	MW-0X-RBF-YYMMDD			X					
Deionized Water Blank	MW-0X-DW-YYMMDD		X		X	X		X	X

Note:
a = Sample IDs are defined below:
- SS = surface sediment
- SP = seep water
- SO = soils

WM-G = wide mouth glass jar
HDPE = high density polyethylene
TS = total solids
TOC = total organic carbon
NH3 = ammonia
TBT = tributyltin
GRO = gasoline range organics
DRO = diesel range organics
RRO = residual range organics
PCB = polychlorinated biphenyls
SVOC = semivolatile organic compounds
NA = not applicable

Table 5
Container Size, Holding Time, and Preservation for Physical/Chemical Analysis

Parameter	Sample Size	Container Size and Type	Holding Time	Preservative
Soil/Sediment Samples				
SVOCs and bulk TBT	150 g	8-oz Glass	14 days until extraction	Cool/4°C
			1 year until extraction	Freeze -20°C
			40 days after extraction	Cool/4°C
Porewater TBT (as ion)	100 mL porewater	32-oz Glass	7 days until porewater extraction	Cool/4°C
			7 days until TBT extraction	Cool/4°C
			40 days after extraction	Cool/4°C
Porewater Sulfides	100 mL porewater	32-oz Glass	7 days until porewater extraction	Cool/4°C
			7 days after extraction	ZnAC/NaOH to pH>9, Cool/4°C
PCBs	150 g	8-oz Glass	14 days until extraction	Cool/4°C
			1 year until extraction	Freeze -20°C
			40 days after extraction	Cool/4°C
DRO	150 g	8-oz Glass	14 days until extraction	Cool/4°C
			1 year until extraction	Freeze -20°C
			40 days after extraction	Cool/4°C
GRO	50 g	2-oz Glass	14 days	Zero headspace, Cool/4°C
Dioxins/Furans	150 g	8-oz Glass	14 days until extraction	Cool/4°C
			1 year until extraction	Freeze -20°C
			40 days after extraction	Cool/4°C
Total metals	50 g	8-oz Glass	6 months; 28 days for Hg	Cool/4°C
			2 years (except Hg)	Freeze -20°C
TS	20 g	4-oz Glass	14 days	Cool/4°C
			6 months	Freeze -20°C
TOC	20 g	from TS container	14 days	Cool/4°C
			6 months	Freeze -20°C
Ammonia	40 g	from TS container	7 days	Cool/4°C
Grain size	500 g	16-oz Plastic	6 months	Cool/4°C
Water Samples				
SVOCs and TBT	500 mL	2 x 500 mL Amber glass	7 days until extraction	Cool/4°C
			40 days after extraction	
PCBs	500 mL	2 x 500 mL Amber glass	7 days until extraction	Cool/4°C
			40 days after extraction	
DRO/RRO	500 mL	2 x 500 mL Amber glass	7 days until extraction	Cool/4°C
			40 days after extraction	
GRO	40 mL	2 x 40 mL Amber glass	14 days	HCl to pH <2, Cool/4°C
Dioxins/Furans	500 mL	2 x 500 mL Amber glass	7 days until extraction	Cool/4°C
			40 days after extraction	Cool/4°C
Total metals	200 mL	500 mL HDPE	6 months, 28 days for Hg	HNO_3 to pH <2

Table 5
Container Size, Holding Time, and Preservation for Physical/Chemical Analysis

Parameter	Sample Size	Container Size and Type	Holding Time	Preservative
Dissolved metals	200 mL	500 mL HDPE	6 months, 28 days for Hg	HNO_3 to pH <2
Ammonia	100 mL	250 mL HDPE	28 days for analysis	H_2SO4 to pH < 2, Cool/4°C

Notes:
SVOCs = Semivolatile organic compounds
TBT = Tributyltin
PCBs = Polychlorinated biphenyls
DRO = Diesel range organics
GRO = Gasoline range organics
RRO = Residual range organics
TS = Total solids
TOC = Total organic carbon
HDPE = High density polyethylene

Table 6
Data Quality Objectives

Parameter	Precision	Accuracy	Completeness
Soils/Sediments			
Grain size	± 20% RPD	NA	95%
Total solids	± 20% RPD	NA	95%
Metals	± 20% RPD	70-130% R	95%
Sulfides	± 20% RPD	70-130% R	95%
Ammonia	± 20% RPD	70-130% R	95%
TOC	± 20% RPD	70-130% R	95%
SVOCs	± 30% RPD	50-150% R	95%
TBT	± 30% RPD	50-150% R	95%
PCBs	± 30% RPD	50-150% R	95%
DRO/GRO	± 30% RPD	50-150% R	95%
Dioxins/Furans	± 30% RPD	50-150% R	95%
Waters			
Total Metals	± 20% RPD	80-120% R	95%
Dissolved Metals	± 20% RPD	80-120% R	95%
Ammonia	± 20% RPD	80-120% R	95%
TOC	± 20% RPD	80-120% R	95%
SVOCs	± 20% RPD	60-140% R	95%
TBT	± 20% RPD	60-140% R	95%
PCBs	± 20% RPD	60-140% R	95%
GRO/DRO/RRO	± 20% RPD	60-140% R	95%

Notes:

RPD = Relative percent difference

R = Recovery

Table 7
Laboratory Quality Control Sample Analysis Summary

Analysis Type	Initial Calibration	Ongoing Calibration	Standard Reference Material[e]	Replicates	Matrix Spikes	Matrix Spike Duplicates	Method Blanks	Surrogate Spikes	Laboratory Control Samples
Grain size	Each batch[a]	NA	NA	1 per 20 samples	NA	NA	NA	NA	NA
Total solids	Daily[d]	NA	NA	1 per 20 samples	NA	NA	NA	NA	NA
Total sulfides	Each batch[a]	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	Each batch	NA	1 per 20 samples
Ammonia	Each batch[a]	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	Each batch	NA	1 per 20 samples
Metals	Daily[b]	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	Each batch	NA	1 per 20 samples
Total organic carbon	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	Each batch	NA	1 per 20 samples
TBT	As needed[c]	Every 12 hours	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	Each batch	Every sample	1 per 20 samples
SVOCs	As needed[c]	Every 12 hours	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	Each batch	Every sample	1 per 20 samples
PCBs	As needed[c]	1 per 10 samples	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	Each batch	Every sample	1 per 20 samples
DRO/RRO	As needed[c]	1 per 10 samples	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	Each batch	Every sample	1 per 20 samples
GRO	As needed[c]	1 per 10 samples	1 per 20 samples	NA	1 per 20 samples	1 per 20 samples	Each batch	Every sample	1 per 20 samples
Dioxins/Furans	As needed [c]	Every 12 hours	1 per 20 samples	NA	NA[f]	NA[f]	Each batch	Every sample	NA[f]

Notes:

a = Calibration and certification of drying ovens and weighing scales are conducted bi-annually.

b = Initial calibration verification and calibration blank must be analyzed at the beginning of each batch.

c = Initial calibrations are considered valid until the ongoing continuing calibration no longer meets method specifications. At that point, a new initial calibration is performed.

d = Scale should be calibrated with class 5 weights daily; weights must bracket the weight of sample and weighing vessel.

e = If SRM is available

f = isotope dilution required per method

NA = Not applicable

Figures

Note: Aerial from Google Earth Pro, 2008.

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ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
Vicinity Map
West Bay Marina

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Site Boundary
DNR Aquatic Lease Boundary No. 2618
Harbor Line
Approximate Area of Visible Wood Debris
WB010 Proposed Seep Sampling Location
WB001 Proposed Surface Sediment Sampling Location
WB015 Proposed Soil Sampling Location
MW-02 Approximate Location of Groundwater Monitoring Wells (Stemen Environmental, 1999)

Note: Aerial from USGS National Map, 2008.

0 120
Scale in Feet

Figure 2
Proposed Soil, Surface Sediment, Groundwater, and Seep Sample Locations
Westbay Marina

ANCHOR ENVIRONMENTAL, L.L.C.

APPENDIX B

HEALTH AND SAFETY PLAN

APPENDIX B
SITE HEALTH AND SAFETY PLAN
SOIL, GROUNDWATER, AND SEDIMENT CHARACTERIZATION

WESTBAY MARINA

Prepared for

West Bay Marina Associates
2100 West Bay Drive NW
Olympia, Washington 98502

Prepared by

Anchor Environmental, L.L.C.
1423 Third Avenue, Suite 300
Seattle, Washington 98101

February 2009

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Attachment A—Field Team HSP Review Form

1 INTRODUCTION

This Site Health and Safety Plan (HSP) describes procedures for sampling and analysis activities described in the Sampling and Analysis Plan (SAP) for the Westbay Marina site (Site), including:

- Collection of surface sediments, analysis of Sediment Management Standards (SMS) chemicals.
- Collection of surface sediment samples in the vicinity of seeps of the Site and analysis of SMS chemicals to further determine whether seeps may impact sediment quality.
- Collection of seep water samples and analysis of SMS chemicals to further assist with the evaluation of whether seeps may impact surface sediment quality.
- Collection of soil samples and groundwater monitoring well samples to evaluate potential contaminant migration pathways.
- Measurement of flow direction and water level in Site groundwater monitoring wells.

It is anticipated that sampling activities will occur during one single field activity, with the exception of four rounds of bimonthly groundwater level and flow direction measurement events. Seep sampling may require multiple field mobilizations as dictated by tidal patterns.

2 HEALTH AND SAFETY PERSONNEL

Key health and safety personnel and their responsibilities are described below. These individuals are responsible for the implementation of this HSP. At any point during field activities, if a potentially unsafe situation is identified all field personnel are authorized to discuss the situation with the Field Coordinator (FC) immediately and/or take actions to avoid the situation and facilitate resolution.

Project Manager—David Templeton: The Project Manager has overall responsibility for the successful outcome of the project. The Project Manager will ensure that adequate resources and budget are provided for the health and safety staff to carry out their responsibilities during fieldwork. The Project Manager, in consultation with the Health and Safety Manager (HSM), makes final decisions concerning implementation of the HSP.

Field Coordinator—Melissa Haury: Ms. Haury or a designee will serve as the FC. The FC will support field sampling activities and coordinate between the technical and health and safety components of the field program. The FC has the responsibility to ensure that work is performed according to this HSP. The FC also has the authority to stop work if conditions arise that pose an unacceptable health and safety risk to field crew. The FC will be responsible for ensuring the implementation of this HSP aboard the sampling vessel and on site during sample collection activities. The FC is responsible for initiating changes to the HSP, which must be approved by the HSM. The FC or designee shall be present during field sampling and handling operations.

Health and Safety Manager—David Templeton: The HSM has overall responsibility for preparation, approval, and revisions of this HSP. The HSM will not necessarily be present during fieldwork, but will be readily available for consultation, if required, regarding health and safety issues during fieldwork.

Sampling Vessel Captain—To Be Determined: The vessel captain and the FC will coordinate health and safety oversight of operations aboard the vessel. The captain will also have authority to stop work for safety reasons. Work will be resumed after the captain and the FC agree that the situation that precipitated a stop work decision has been corrected.

Field Crew: All field crew have the responsibility to report any potentially unsafe or hazardous conditions to the captain or FC immediately.

3 HAZARD EVALUATION AND CONTROL MEASURES

This section covers potential physical and chemical hazards that may be associated with the proposed project activities, and presents control measures for addressing these hazards. The activity hazard analysis, Section 3.3, lists the potential hazards associated with each Site activity and the recommended Site control to be used to minimize each potential hazard. Confined space entry will not be necessary for this project, so hazards associated with this activity are not discussed in this HSP.

3.1 Physical Hazards

3.1.1 Slips, Trips, and Falls

As with all fieldwork sites, caution should be exercised to prevent slips on slick surfaces. In particular, sampling from a floating platform and sampling of muddy sediment during low tide require careful attention to minimize the risk of falling overboard or falling down. Wearing boots with good tread, made of material that does not become overly slippery when wet, can minimize slips.

Trips are always a hazard on the uneven deck of a boat and in muddy intertidal conditions. The deck of the vessel will have moving cables, and there are numerous stationary fittings and tie-downs that present potential tripping hazards. Personnel will keep the vessel and landside work areas as free as possible from items that interfere with walking and will be aware of stationary obstacles on deck and along the shoreline.

Falls may be avoided by working as far away from exposed edges. For this project, the potential for falling is associated primarily with deployment and recovery of the van Veen over the bow of the vessel, with boarding and disembarking the vessel at the dock, and with collecting the water samples.

3.1.2 Sampling Equipment

Before surface sediment sampling activities begin, there will be a training session for all field personnel pertaining to the equipment that will be onboard the sampling vessel. The captain will review vessel-specific hazards and safety procedures and will point out the location and proper use of all safety equipment. For example, field personnel will be shown the locations of all fire extinguishers, flotation rings, and first aid kits, and their appropriate uses. In addition, prior to the collection of the sediment seep samples, the FC will hold a training session for the methods for collecting the samples and to discuss the hazards involved.

Surface sediment grabs will be collected using a modified van Veen-type grab sampler deployed and recovered from the Anchor work skiff. The van Veen sampler is very heavy. Whether full of sediment or empty, the van Veen sampler must be handled with a winch or crane.

Sediment seep samples will be collected using a well point sampling device consisting of a 1-inch-diameter pre-cleaned stainless steel tube with a 1-foot-long screen section.

3.1.3 Falling Into the Bay

All surface sediment sampling (and potentially seep sampling) will be done using a vessel for Site access. As with any work from a floating platform, there is a chance of falling overboard. A personal flotation device (PFD) for each crew person will be available in the boat at all times. PFDs will be worn while working from the vessel.

3.1.4 Surface Grab Processing Equipment

Sediment processing will require homogenization of samples. Anchor personnel will wear protective gloves and eye protection during compositing.

3.1.5 Sediment Seep Processing Equipment

Anchor personnel will wear protective gloves and eye protection during seep sample collection activities.

3.1.6 Manual Lifting

Equipment and samples must be lifted and carried both aboard the vessel and along the shoreline during sediment seep sampling activities. Back strain can result if lifting is done improperly. During any manual handling tasks, personnel should lift with the load supported by their legs, rather than their backs. For heavy loads, an adequate number of people or, if possible, a mechanical lifting/handling device will be used.

3.1.7 Heat Stress

The potential for heat stress may occur if impermeable personal protective equipment (PPE) is worn or if strenuous work is performed under hot conditions with inadequate water. When the core body temperature rises above 100.4° F, the body cannot sweat to cool down and heat stress can occur. Heat stress may be identified by the following symptoms: dizziness, profuse sweating, skin color change, vision problems, confusion, nausea, fatigue, fainting, and clammy skin. Personnel exhibiting such symptoms will be removed to a cool shady area, given water, and allowed to rest. Fresh drinking water will be provided aboard the vessel. All field team members will monitor their own condition and that of their co-workers to detect signs of heat stress.

3.1.8 Hypothermia

Hypothermia is abnormal lowering of the core body temperature caused by exposure to a cold environment. Windchill, as well as wetness or water immersion, can play a significant role. Typical signs of hypothermia include fatigue, weakness, lack of coordination, apathy, and drowsiness. Confusion is a key symptom of hypothermia. Shivering and pallor are usually absent, and the face may appear puffy and pink.

Body temperatures below 90° F require immediate treatment to restore the temperature to normal. Current medical practice recommends slow warming of the individual followed by professional medical care. Moving the person to a sheltered area and wrapping them in a blanket can accomplish this portion of the task. If possible, the person should be placed in a warm room. In emergency situations where body temperature falls below 90° F and shelter is not available, a sleeping bag, blankets, and body heat from another individual can be used to help raise body temperature.

3.1.9 Weather

In general, field team members will be equipped for the normal range of weather conditions. The FC will be aware of current weather conditions, and of the potential for those conditions to pose a hazard to the field crew. Some conditions that might force work stoppage are electrical storms, high winds, or high waves resulting from winds.

3.2 Chemical Hazards

For investigative purposes, chemicals of potential concern (COPCs) are metals polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and phthalates. In addition, there is potential for exposure to hydrogen sulfide gas from sediments.

3.2.1 Exposure Routes

Potential routes of chemical exposure include inhalation, dermal contact, and ingestion. Providing personnel with appropriate training, using safe work practices, and wearing the appropriate PPE will minimize exposure. Further discussion of PPE requirements is presented in Section 6.

3.2.1.1 Inhalation

Because wet sediments do not generate dust particles and surface water spray is expected to be minimal, inhalation of particulates is not expected to be an important route of exposure. Potential exposure via inhalation of hydrogen sulfide gas emitted from sediments is possible. However, sediment handling activities will occur outdoors, reducing the risk of inhalation exposure.

3.2.1.2 Skin Contact

Dermal exposure to potentially contaminated sediments, surface water, or equipment will be controlled by the use of PPE and by adherence to detailed sampling and decontamination procedures.

3.2.1.3 Ingestion

Ingestion is not considered a major route of exposure for this project. Accidental ingestion of sediment is possible, but proper sediment handling should prevent sediment splattering, which will ensure that sediment droplets do not become airborne. Accidental ingestion of Site water is possible. However, careful handling of equipment and containers should prevent the occurrence of water splashing or spilling during sample collection and handling activities.

3.2.2 Description of Chemical Hazards

3.2.2.1 Polychlorinated Biphenyls (PCBs)

Prolonged skin contact with PCBs may cause acne-like symptoms known as chloracne. Irritation to eyes, nose, and throat may also occur. Acute and chronic exposure can damage the liver and cause symptoms of edema, jaundice, anorexia, nausea, abdominal pains, and fatigue. PCBs are a suspected human carcinogen. Skin absorption may substantially contribute to the uptake of PCBs.

3.2.2.2 Hydrogen Sulfide

As a gas emitted from the sediments, hydrogen sulfide is a naturally produced substance that is potentially toxic via inhalation, ingestion, and skin and eye contact. Inhalation can result in respiratory irritation, rhinitis, and edema of the lungs. Subacute exposures to hydrogen sulfide may result in headache, dizziness, staggering gait, and agitation. Acute exposure at higher concentrations may result in immediate coma and possibly death as a consequence of respiratory failure.

3.3 Activity Hazard Analysis

The activity hazard analysis summarizes the field activities to be performed, outlines the hazards associated with each activity, and presents controls that can reduce or eliminate the risk of the hazard occurring. Table 1 presents the activity hazard analysis for the following activities:

- Collection of sediment grabs
- Collection of sediment seep samples
- Collection of soil samples
- Collection of groundwater samples
- Sediment sample handling, packaging, processing, and shipping
- Equipment decontamination

Table 1
Activity Hazard Analysis

Activity	Hazard	Control
Collecting sediment grabs from the vessel	Falling overboard	Avoid working near the edge of the vessel, if possible. Stay inside of perimeter barriers on the deck. Wear PFD during sample collection.
	Cuts and amputations	Use locking pins to secure the grab sampler prior to deployment, and keep fingers clear of the open jaws at all times.
	Back or muscle strain	Use appropriate lifting technique when handling pieces of potentially heavy equipment. Enlist help if necessary.
	Skin or eye contact with potentially contaminated sediments or liquids	Wear modified Level D PPE, including eye protection.
	Electric shock	Use ground fault-indicator extension cords, and seal plug connections with electrical tape.
	Slipping/tripping on slick or uneven deck	Wear steel-toed boots with gripping tread. Be aware of obstacles and wet patches on deck and select a path to avoid them.
	Injury from equipment falling or swinging	Wear a hard hat and steel-toed boots at all times; be in the appropriate position on deck when equipment is in operation.
	Fire	Avoid fueling operations near hot engines. Mop up any spilled flammable liquids and dispose of absorbent. No smoking or flame sources on the vessel. Evacuate the vessel according to procedures outlined in the training session given by the captain.
	Injury from winch line snapping	Ensure that winch line is not frayed.
Collecting groundwater and seep samples	Injury from slip/trip/falls	Exercise caution when collecting sample muddy intertidal areas.
	Back strain	Use appropriate lifting technique when lifting heavy object on the beach or on and off the vessel.
	Skin or eye contact with potentially contaminated sediments or liquids	Wear modified Level D PPE, including eye protection.
	Injury from slip/trip/falls	Exercise caution when collecting sample from the outfall and working around outfalls.

Table 1
Activity Hazard Analysis

Activity	Hazard	Control
	Back strain	Use appropriate lifting technique when lifting heavy coolers and equipment.
	Falling into the bay	Wear PFD during sample collection and transfer of sampling coolers and equipment to and from the vessel.
	Skin or eye contact with potentially contaminated sediments or liquids	Wear modified Level D PPE, including eye protection.
Collecting soil samples Handling, packaging, and shipping samples	Skin or eye contact with potentially contaminated solids, liquids, or sediments	Wear Level D or modified Level D PPE, including eye protection.
	Back strain	Use appropriate lifting technique when handling filled sample coolers, or seek help.
	Inhalation of or eye contact with airborne mists or vapors	Wear safety glasses. Perform decontamination activities outdoors or in a well-ventilated area. Stay upwind when spray-rinsing equipment.
Decontaminating equipment	Skin contact with potentially contaminated materials	Wear modified Level D PPE.
	Ingestion of contaminated materials	Decontaminate clothing and skin prior to eating, drinking, smoking, or other hand-to-mouth activities. Follow the decontamination procedure for personal decontamination.

4 WORK ZONES AND ACCESS CONTROL

The vessel captain and the FC will delineate the boundaries of the work zones aboard the vessel and will inform the field crews of the arrangement. The purpose of the zones is to limit the migration of sample material out of the zones and to restrict access to active work areas by defining work zone boundaries.

4.1 Work Zones

Only authorized personnel and vessel crew will be allowed in the established work zones. One work zone will be observed during sediment sample collection aboard the sampling vessel. The surface sediment grabs will be collected from the Anchor work skiff where the van Veen-type grab sampler will be deployed and recovered.

A single work zone will be observed during the sediment seep sampling, which will be in the direct vicinity of the collection activities. The samples will be collected and processed in the work zone.

4.2 Decontamination Area

A station will be set up for decontaminating sample processing equipment and personnel gear such as boots or PPE. The station will have the buckets, brushes, soapy water, rinse water, or wipes necessary to perform decontamination operations. Plastic bags will be provided for expendable and disposable materials.

4.3 Access Control

Security and control of access to the sampling vessel will be the responsibility of the FC and captain. Access to the vessel will be granted only to necessary project personnel and authorized visitors.

5 SAFE WORK PRACTICES

Following common sense rules will minimize the risk of exposure or accidents at a work site. These general safety rules will be followed on the Site:

- Always use the buddy system
- Be aware of overhead and underfoot hazards at all times
- Do not eat, drink, smoke, or perform other hand-to-mouth transfers in the work zones
- Get immediate first aid for all cuts, scratches, abrasions, or other minor injuries
- Report all accidents, no matter how minor, to the FC
- Be alert to your own and other workers' physical condition
- Do not climb over or under obstacles of questionable stability
- Make eye contact with equipment operators before moving into the range of their equipment
- Work during daylight hours

At any point during field activities, if a potentially unsafe situation is identified, all field personnel are authorized to discuss with the FC immediately and/or take actions to avoid the situation and facilitate resolution.

6 PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT

Appropriate PPE will be worn as protection against potential hazards. In addition, a PFD will be required when working on the Anchor work skiff, and during collection of sediment seep samples. Prior to donning PPE, the workers will inspect their equipment for any defects that might render the equipment ineffective.

Fieldwork will be conducted in Level D or modified Level D PPE, as discussed below in Sections 6.1 and 6.2. Situations requiring PPE beyond modified Level D are not anticipated for this project. Should the FC determine that PPE beyond modified Level D is necessary at a given location, the FC will notify the HSM to select an alternative.

6.1 Level D Personal Protective Equipment

Workers performing general activities in which skin contact with contaminated materials is unlikely and in which inhalation risks are not expected will wear Level D PPE. Level D PPE includes the following:

- Cotton overalls or lab coats
- Chemical-resistant steel-toed boots
- Leather, cotton, or chemical-resistant gloves, as the type of work requires
- Safety glasses
- Hard hat (if overhead hazard exists)
- Hearing protection, if necessary

6.2 Modified Level D Personal Protective Equipment

Workers performing activities where skin contact with contaminated materials is possible will wear chemical-resistant outer gloves and an impermeable outer suit. The type of outerwear will be chosen according to the types of chemical contaminants that might be encountered. Modified Level D PPE includes the following:

- Outer garb such as rain gear or rubber or vinyl aprons
- Chemical-resistant steel-toed boots
- Surgical rubber inner gloves
- Chemical-resistant outer gloves
- Safety glasses (or face shield, if significant splash hazard exists)
- Hard hat (if overhead hazard exists)

- Hearing protection, if necessary

6.3 Safety Equipment

In addition to PPE that will be worn by shipboard personnel, basic emergency and first aid equipment will also be provided. Equipment will include:

- A copy of this HSP
- PFD
- First aid kit adequate for the number of personnel
- Emergency eyewash

Anchor will provide this equipment, which must be present at the locations where field activities are being performed. Equipment will be checked daily to ensure its readiness for use.

7 MONITORING PROCEDURES FOR SITE ACTIVITIES

A monitoring program that addresses the potential Site hazards will be maintained. For this project, air and dust monitoring will not be necessary. No volatile organic carbons (VOCs) are anticipated at elevated concentrations among the expected contaminants, and the sampled media will be wet and will not pose a dust hazard. Monitoring procedures will consist of crew self-monitoring.

All personnel will be instructed to look for and inform each other of any deleterious changes in their physical or mental condition during the performance of all field activities. Examples of such changes are as follows:

- Headaches
- Dizziness
- Nausea
- Blurred vision
- Cramps
- Irritation of eyes, skin, or respiratory system
- Changes in complexion or skin color
- Changes in apparent motor coordination
- Increased frequency of minor mistakes
- Excessive salivation or changes in papillary response
- Changes in speech ability or speech pattern
- Symptoms of heat stress or heat exhaustion (Section 3.1.7)
- Symptoms of hypothermia (Section 3.1.8)

If any of these conditions develop, the affected person(s) will be moved from the immediate work location and evaluated. If further assistance is needed, personnel at the local hospital will be notified, and an ambulance will be summoned if the condition is thought to be serious. If the condition is the result of sample collection or processing activities, procedures and/or PPE will be modified to address the problem.

8 DECONTAMINATION

Decontamination is necessary to prevent the migration of contaminants from the work zone(s) into the surrounding environment and to minimize the risk of exposure of personnel to contaminated materials that might adhere to PPE. The following sections discuss personnel and equipment decontamination. The following supplies will be available to perform decontamination activities:

- Wash and rinse buckets
- Tap water and phosphate-free detergent
- Scrub brushes
- Distilled/deionized water
- Deck pump with pressurized seawater hose (aboard the vessel)
- Paper towels and plastic garbage bags

8.1 Minimization of Contamination

The following measures will be observed to prevent or minimize exposure to potentially contaminated materials.

Personnel

- Do not walk through spilled sediment
- Do not directly handle, touch, or smell sediment
- Make sure PPE has no cuts or tears prior to use
- Protect and cover any skin injuries
- Stay upwind of airborne dusts and vapors
- Do not eat, drink, chew tobacco, or smoke in the work zones

Sampling Equipment and Vessel

- Use care to avoid getting sampled media on the outside of sample containers
- If necessary, bag sample containers before filling with sampled media
- Place clean equipment on a plastic sheet to avoid direct contact with contaminated media
- Keep contaminated equipment and tools separate from clean equipment and tools
- Fill sample containers over a plastic tub to contain spillage
- Clean up spilled material immediately to avoid tracking around the vessel

8.2 Personal Decontamination

The FC will ensure that all Site personnel are familiar with personnel decontamination procedures. Personnel will perform decontamination procedures, as appropriate, when exiting work areas. Following is a description of the procedure:

1. Wash and rinse outer gloves and boots in portable buckets
2. If suit is heavily soiled, rinse it off
3. Remove outer gloves; inspect and discard if damaged; leave inner gloves on
4. Remove inner gloves and wash hands if taking a break
5. Don necessary PPE before returning to work
6. Dispose of soiled PPE before leaving for the day

8.3 Sampling and Homogenization Equipment Decontamination

The van Veen-type grab and grab sampling gear aboard the vessels will be rinsed with Site water to remove residual material stuck to the surface. Sample homogenization implements and mixing containers will be decontaminated between successive compositing operations and at the end of each work day.

The homogenization equipment decontamination procedure is as follows:

1. Rinse with Site or tap water and scrub with brush to remove sediment
2. Wash with phosphate-free soap solution
3. Rinse with Site or tap water
4. Rinse with deionized/distilled water and air dry

9 TRAINING REQUIREMENTS

Individuals performing work at locations where potentially hazardous materials and conditions may be encountered must meet specific training requirements. It is not anticipated that personnel will encounter hazardous concentrations of contaminants in sampled material, so training will consist of site-specific instruction for all personnel and oversight of inexperienced personnel for one working day. All personnel must have a valid 8-hour Hazardous Waste Certificate on file at Anchor. The following sections describe the training requirements for work at the Site.

9.1 Project Specific Training

All personnel must read the SAP and this HSP and be familiar with its contents before beginning work. They shall acknowledge reading the HSP by signing the Field Team HSP Plan Review Form contained in Attachment A. The form will be kept in the project files.

The FC or a designee will provide and document project-specific training during the project kickoff meeting and whenever new workers arrive on board or on the Site. Field personnel will not be allowed to begin work until project-specific training is completed and documented by the FC. Training will address the HSP and all health and safety issues and procedures pertinent to field operations. Training will include, but not be limited to, the following topics:

- Activities with the potential for chemical exposure
- Activities that pose physical hazards, and actions to control the hazards
- Vessel access control and procedures
- Use and limitations of PPE
- Decontamination procedures
- Emergency procedures
- Use and hazards of sampling equipment
- Location of emergency equipment on the vessel
- Vessel safety practices

9.2 Daily Safety Briefings

The FC or a designee and the captain will present safety briefings before the start of each day's activities. These safety briefings will outline the activities expected for the day, update work practices and hazards, address any specific concerns associated with the work location, and review emergency procedures and routes. The safety briefings will be documented in the logbook.

10 DOCUMENTATION AND RECORD KEEPING

The FC or a designee will record health and safety related details of the project in the field logbook. The logbook must be bound and the pages must be numbered consecutively. Entries will be made with indelible ink. At a minimum, each day's entries must include the following information:

- Project name or location
- Names of all personnel
- Level of PPE worn and any other specifics regarding PPE
- Weather conditions
- Type of fieldwork being performed

The person maintaining the entries will initial and date the bottom of each completed page. Blank space at the bottom of an incompletely filled page will be lined out. Each day's entries will begin on the first blank page after the previous work day's entries.

As necessary, other documentation will be obtained or initiated by the FC. Other documentation may include field change requests, medical and training records (40 hour and 8 hour refresher certificates), exposure records, accident/incident report forms, Occupational Safety and Health Administration (OSHA) Form 200s, and material safety data sheets.

11 EMERGENCY RESPONSE PLAN

As a result of the health and safety hazards associated with the field sampling and sample handling activities, the potential exists for an emergency situation to occur. Emergencies may include personal injury, exposure to hazardous substances, fire, explosion, or release of toxic or non-toxic substances (spills). OSHA regulations require that an emergency response plan be available for use onboard to guide actions in emergency situations.

Onshore organizations will be relied upon to provide response in emergency situations. The local fire department and ambulance service can provide timely response. Anchor personnel and subcontractors will be responsible for identifying an emergency situation, providing first aid if applicable, notifying the appropriate personnel or agency, and evacuating any hazardous area. Shipboard personnel will attempt to control only very minor hazards that could present an emergency situation, such as a small fire, and will otherwise rely on outside emergency response resources.

The following sections address pre-emergency preparation, identify individual(s) who should be notified in case of emergency, provide a list of emergency telephone numbers, offer guidance for particular types of emergencies, and provide directions and a map for getting from any sampling location to a hospital.

11.1 Pre-Emergency Preparation

Before the start of field activities, the FC will ensure that preparation has been made in anticipation of emergencies. Preparatory actions include the following:

- Verifying that an operational cellular phone(s) is readily available.
- Verifying that a copy of the map to the nearest hospital is readily available.
- Meeting with the vessel captain and equipment handlers concerning the emergency procedures in the event that a person is injured. Appropriate actions for specific scenarios will be reviewed. These scenarios will be discussed and responses determined before the sampling event commences.
- A training session will be given by the vessel captain informing all field personnel of emergency procedures, locations of emergency equipment and their use, and proper evacuation procedures.

- A training session will be given by senior staff operating field equipment, to apprise field personnel of operating procedures and specific risks associated with that equipment.
- Ensuring that field personnel are aware of the existence of the emergency response plan, its location as Section 11 of the HSP, and ensuring that a copy of the HSP accompanies the field team(s).

11.2 Site Emergency Coordinator

The FC will serve as the Project Emergency Coordinator for Anchor in the event of an emergency. The FC will designate a replacement for times when he or she is not on board or is not serving as the Project Emergency Coordinator. The designation will be noted in the logbook. The Project Emergency Coordinator will be notified immediately when an emergency is recognized. The Project Emergency Coordinator will be responsible for evaluating the emergency situation, notifying the appropriate emergency response units, coordinating access with those units, and directing interim actions onboard before the arrival of emergency response units. The Project Emergency Coordinator will notify the HSM and the Project Manager as soon as possible after initiating an emergency response action. The Project Manager will have responsibility for notifying the client.

11.3 Emergency Response Contacts

All personnel must know who to notify in the event of an emergency situation, even though the FC has primary responsibility for notification. Table 2 lists the names and telephone numbers for emergency response services and individuals.

11.4 Recognition of Emergency Situations

Emergency situations will generally be recognizable by observation. An injury or illness will be considered an emergency if it requires treatment by a medical professional and cannot be treated with simple first aid techniques.

Table 2
Emergency Response Contacts

Contact	Telephone Number
Emergency Numbers	
Ambulance	911
Police	911
Fire	911
Capital Medical Center	(360) 754-5858 or 911
Emergency Responders	
U.S. Coast Guard	
Emergency	(206) 220-7001
General information	(800) 982-8813
National Response Center	(800) 424-8802
Emergency Contacts	
Anchor Project Manager	
David Templeton	(206) 903-3312 (office)
	(206) 910-4279 (cell)
Health and Safety Manager	
David Templeton	(206) 903-3312 (office)
	(206) 910-4279 (cell)
Anchor Field Coordinator	
Melissa Haury	(206) 903-3326 (office)
	(610) 283-1426 (cell)

11.5 Decontamination

In the case of evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of Site workers. If an injured individual is also heavily contaminated and must be transported by emergency vehicle, the emergency response team will be told of the type of contamination. To the extent possible, contaminated PPE will be removed, but only if doing so does not exacerbate the injury. Plastic sheeting will be used to reduce the potential for spreading contamination to the inside of the emergency vehicle.

11.6 Fire

Shipboard personnel will attempt to control only small fires, should they occur. If an explosion appears likely, personnel will follow evacuation procedures specified by the captain in the training session. If a fire cannot be controlled with an onboard fire extinguisher that is part of the required safety equipment, personnel will either withdraw from the vicinity of the fire, use additional fire fighting equipment, or evacuate the boat as specified by the captain in the training session.

11.7 Personal Injury

In the event of serious personal injury, including unconsciousness, possibility of broken bones, severe bleeding or blood loss, burns, shock, or trauma, the first responder will immediately do the following:

- Administer first aid, if qualified.
- If not qualified, seek out an individual who is qualified to administer first aid, if time and conditions permit.
- Notify the Project Emergency Coordinator of the incident, the name of the individual, the location, and the nature of the injury.

The Project Emergency Coordinator will immediately do the following:

- Notify the captain and the appropriate emergency response organization.
- Assist the injured individual.
- Follow the emergency procedures for retrieving or disposing equipment reviewed in the training session and leave the Site en route to the predetermined land-based emergency pick-up location.
- Designate someone to accompany the injured individual to the hospital.
- If an emergency situation (i.e., broken bones or injury where death is imminent without immediate treatment) occurs, the FC or captain will call 911 and arrange to meet the response unit at the nearest accessible dock or location on the Site.
- Notify the HSM and the Project Manager.

If the Project Emergency Coordinator determines that emergency response is not necessary, he or she may direct someone to decontaminate and transport the individual by vehicle to the nearest hospital. Directions and a map showing the route to the hospital are in Section 11.10.

If a worker leaves the vessel to seek medical attention, another worker should accompany him or her to the hospital. When in doubt about the severity of an injury or exposure, always seek medical attention as a conservative approach and notify the Project Emergency Coordinator.

The Project Emergency Coordinator will have responsibility for completing all accident/incident field reports, OSHA Form 200s, and other required follow-up forms.

11.8 Overt Personal Exposure or Injury

If an overt exposure to toxic materials occurs, the first responder to the victim will initiate actions to address the situation. The following actions should be taken, depending on the type of exposure.

Skin Contact

- Wash/rinse the affected area thoroughly with copious amounts of soap and water
- If eye contact has occurred, eyes should be rinsed for at least 15 minutes using the eyewash that is part of the emergency equipment onboard the vessel and in the lab
- After initial response actions have been taken, seek appropriate medical attention

Inhalation

- Move victim to fresh air
- Seek appropriate medical attention

Ingestion

- Seek appropriate medical attention

Puncture Wound or Laceration

- Seek appropriate medical attention

11.9 Spills and Spill Containment

Sources of bulk chemicals or other materials subject to spillage are not expected to be used during this project. Accordingly, a spill containment procedure is not required for this project.

11.10 Emergency Route to the Hospital

The name, address, and telephone number of the hospital that will be used to provide medical care is as follows:

Capital Medical Center

3900 Capitol Mall Dr SW

Olympia, Washington 98502

360-754-5858

Figure 1 is a map from the Site to the Capital Medical Center. Directions are as follows:

1. Head southeast on West Bay Dr. NW toward Harbor View Dr. NW
2. At the traffic circle, take the first exit onto Harrison Ave NW
3. Turn left at Yauger Way SW
4. End at hospital

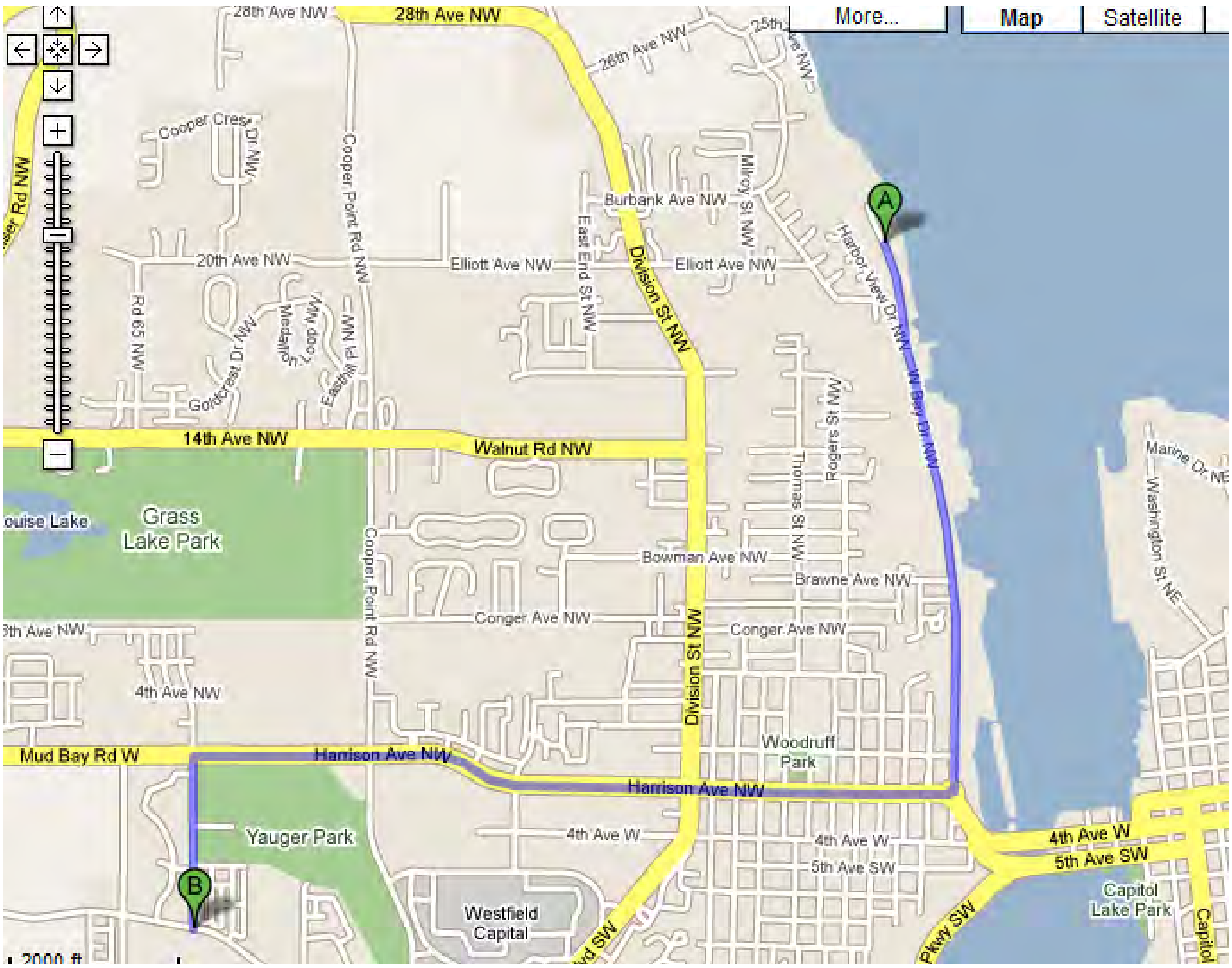

Figure 1
Map to the Hospital

12 HEALTH AND SAFETY PLAN APPROVAL RECORD

By their signature, the undersigned certify that this HSP is approved and that it will be used to govern health and safety aspects of fieldwork conducted by Anchor personnel to investigate areas associated with the sediment evaluation sampling activities at the Westbay Marina Olympia, Washington.

Anchor Project Health and Safety Manager	Date
Anchor Field Coordinator	Date
Westbay Marina Task Manager	Date

ATTACHMENT A

FIELD TEAM HSP REVIEW FORM

FIELD TEAM HEALTH AND SAFETY PLAN REVIEW
ANCHOR ENVIRONMENTAL, L.L.C.

I have read a copy of this Health and Safety Plan, which covers field activities that will be conducted to investigate specified environmental sampling activities at the Westbay Marina. I understand the health and safety requirements of the project, which are detailed in this Health and Safety Plan.

Signature Date

Signature Date

Signature Date

Signature Date

Signature Date