South Park Marina
Seattle, Washington

Additional Site Characterization Activities
Data Report

FINAL

Prepared for

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Toxics Cleanup Program
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List of Acronyms

bgs	below ground surface
CAS	Columbia Analytical Services
CSL	Cleanup Screening Levels
EAA	Early Action Area
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
HCID	Hydrocarbon Identification
LDW	Lower Duwamish Waterway
mg/kg	milligrams per kilogram
MTCA	Model Toxics Control Act
NAPL	Non-aqueous phase liquid
NW-HCID	Northwest Hydrocarbon Identification Analysis Method
NWTPH-Dx	Northwest Diesel- and Oil-Range Petroleum Hydrocarbon Analysis Method
NWTPH-Gx	Northwest Gasoline-Range Petroleum Hydrocarbon Analysis Method
PCB	Polychlorinated biphenyl
PCE	tetrachloroethene
PID	photoionization detector
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SEIDG	Summary of Existing Information and Data Gaps
SMS	Sediment Management Standards
SPM	South Park Marina
SQS	Sediment Quality Standards
SRP	Site Reconnaissance Plan
SVOC	semi-volatile organic compound
TPH	total petroleum hydrocarbons
VOC	volatile organic compound
µg/L	micrograms per liter

1.0 Introduction

This data report was prepared by Science Applications International Corporation (SAIC) on behalf of the Washington State Department of Ecology (Ecology). This report presents the results of environmental sampling carried out at the South Park Marina (SPM), as outlined in the *Sampling and Analysis Plan for Site Reconnaissance Investigation* (SAP) (SAIC 2007a).

The SPM is located at 8604 Dallas Avenue South in Seattle, Washington. The facility lies within the Lower Duwamish Waterway (LDW) Superfund site and is adjacent to the waterway and the Terminal 117 Early Action Area (EAA) (Figure 1). Because of the presence of contamination, Terminal 117 was identified as a high priority site by the Environmental Protection Agency (EPA) as a candidate for early sediment cleanup action. SPM is located adjacent to the northern boundary of the Terminal 117 site. Historical information and sampling results suggest that soil and groundwater contamination may also be present at the SPM site.

The *Summary of Existing Information and Identification of Data Gaps, South Park Marina* (SEIDG) report and the *Site Reconnaissance Plan* (SRP) were prepared in June 2007 (SAIC 2007b,c). These reports summarize information relevant to the potential for sediment recontamination from the SPM site and identify several data gaps. The SRP further outlined a plan for performing initial investigations at the site. Activities outlined in the SAP were intended to address some of the data gaps identified in the SEIDG and SRP, and to provide reconnaissance level characterization information.

The previous site uses of the SPM property have been identified as far back as the 1940s. The A&B Barrel Company, a drum reconditioning operation, occupied the southeastern part of what is now the SPM (Figure 2). This facility operated between 1946 and 1961 and included a square building located about 50 feet north of Dallas Avenue, a waste disposal pond located between the building and the waterway, and an outdoor yard area, apparently used for storage.

Based on historical photographs, it appears that the pond operated between at least the mid-1950s and 1961. Oils, grease, and sodium hydroxide were reportedly discharged to the pond. It is likely that other types of waste residues remaining in the drums during cleaning were also disposed of in the pond. Aerial photographs show what appear to be drums stored on the property to the north and west of the square building and also possibly surrounding the disposal pond.

In 1961 the site was completely vacated; the building was removed, the pond was filled in, and the area was regraded. The site was subsequently occupied by the SPM, which has been in operation since 1970 and currently includes boat repair and maintenance facilities, upland boat storage, boat haul-out services, a boat-launch ramp, and moorage slips in the Duwamish Waterway.

The portion of the SPM formerly occupied by the A&B Barrel Company now includes five buildings that are used for boat-building, repair, maintenance, and other activities such as an art studio and storage unit. The buildings contain from one to three work bays each, for a total of eight bays; the bays are designated as buildings “0” through “7” (Figure 2).

2.0 Field Activities

2.1 Field Schedule

Investigation field activities included sampling and analysis of subsurface soil, groundwater, bank soil, and intertidal sediment. Specific activities and field schedule are listed below:

- Site walk and underground utilities location: September 25, 2007
- Soil borings and monitoring well installation: September 26–28, 2007 and October 1, 2007
- Well surveying and short-term tidal study: October 1, 2007
- Groundwater sampling and bank soil sampling: October 8–9, 2007
- Intertidal sediment sampling: March 12, 2008
- Second groundwater sampling: March 12, 2008

2.2 Soil Borings

Sixteen soil borings (SB-1 to SB-16, Figure 2) were advanced to total depths ranging from 2.5 to 20 feet below ground surface (bgs). Soil borings were hand-cleared to 5 feet bgs to avoid possible utility damage by using a hand auger. After each soil boring location was hand-cleared, a portable direct-push rig was set on each boring location to continue down-hole advancement. Six borings were completed inside buildings or other locations where access by the drill rig was not possible (SB-11 to SB-16). These six borings were advanced using a hand auger, shovel, and other hand tools.

Soil samples were collected from each soil boring by direct-push cores or hand tools (hand auger, shovel, and trowel). Soil cores from the drill rig were collected in 4-foot long acetate liners. Soil collected in cores or with hand tools were logged using standard techniques described below.

Each soil boring was logged for the following features:

- Color
- Moisture content (dry, damp, moist, or wet)
- Lithology (using the modified Unified Soil Classification System)
- Anthropogenic material
- Geological interpretation, if pertinent (e.g., fill, topsoil, till, etc.)
- Presence of sheen or non-aqueous phase liquid (NAPL)
- Presence of odor or other indicators of contaminants
- Field screening results for organic vapor (using photoionization detector [PID])
- The boring logs for this investigation are provided in Appendix A.

Based upon field screening results, soil samples were collected for laboratory analysis. If field screening techniques did not indicate the presence of contamination, a soil sample was collected from near the water table for laboratory analysis. Validated analytical results are presented in Appendix B.

Between each borehole, all soil sampling equipment (hand auger, trowel, etc.) and field screening equipment (metal bowls, spoons, sheen pan) were decontaminated using a three-part wash/rinse process consisting of a Liquinox™ wash, a tap water rinse and a de-ionized water rinse. Downhole equipment such as push rods were pressure-washed between each boring.

Soil borings SB-1 through SB-10 were located in areas with sufficient working space to be accessible with the portable direct-push rig. Soil borings SB-11, SB-12, and SB-14 through SB-16 were located inside Building 0 and Building 1 at the site (Figure 2). Building 0 is occupied by a large boat and therefore offered a limited working area, which made the task of soil sampling difficult. Additionally, the underlying lithology (backfill) was too dense and rocky to reach the desired depths. Building 1 is used as a workshop, which offered more working space; however, the underlying lithology (backfill) once again hampered efforts to reach the desired depths.

At a minimum, one soil sample from each soil boring was submitted for laboratory analysis. As summarized in Table 1, each sample was analyzed for the following:

- Semi-volatile organic compounds (SVOCs) by EPA Method 8270C
- Polychlorinated biphenyls (PCBs) by EPA Method 8082
- Eight Resource Conservation and Recovery Act (RCRA) metals by EPA Method 6020/7470
- Chlorinated pesticides by EPA Method 8081
- Hydrocarbon identification (HCID) by Ecology Method NW-HCID

Additionally, total petroleum hydrocarbons in the gasoline range and diesel range were analyzed only if the HCID analysis indicated constituent concentrations within the respective range. These analytical methods included the following:

- Total petroleum hydrocarbons (TPH) for the gasoline range by Ecology Method NWTPH-Gx
- Total petroleum hydrocarbons for the diesel range by Ecology Method NWTPH-Dx extended, with silica gel cleanup

In addition to the proposed soil samples collected, one field duplicate soil sample was also collected from one sampling location.

2.3 Monitoring Well Installation

Three of the sixteen soil borings were completed as groundwater monitoring wells. Soil borings SB-1 to SB-3 were completed as monitoring wells MW-1 to MW-3, respectively (Figure 2). After each borehole was advanced to 20 or 21 feet bgs, a determination was made on the interval to set the well. The wet zone above a silt layer was too thin to set the well screen above this silt, so the screen was set below the silt or within sandy zones of the silt (see Section 3.1 below).

Each monitoring well was constructed of factory sealed 0.75-inch diameter polyvinyl chloride (PVC) pipe. Each well includes 10 feet of 0.010-inch slotted screen surrounded by the pre-pack

20/40 silica sand for a filter pack. The remaining annular space in the borehole around the pre-pack well screen was backfilled with 8/12 sand, up to approximately 3 feet bgs. The interval from 2 to 3 feet bgs was backfilled with hydrated bentonite powder. Each monitoring well was completed with a watertight cap and flush-grade well vault, which was secured with concrete from ground surface to 2 feet bgs.

Following installation, each monitoring well was developed by pumping water and any fine sediment using a peristaltic pump. Turbidity rapidly cleaned up in all three wells due to the presence of pre-pack sand.

The locations and top-of-casing elevations of the three new monitoring wells (MW-1, MW-2, and MW-3) were surveyed by Bush, Roed & Hitchings, Inc. (Table 2).

2.4 Tidal Study

A short-term tidal study was conducted for several hours on October 1, 2007. The purpose of this survey was to evaluate the groundwater level relationship to the surface water tidal changes in the Duwamish Waterway. Specifically, the time lag was evaluated for groundwater in the three wells following a peak in the surface water of the tidally influenced waterway. Due to the schedule and the season, it was not possible to conduct the study during a low tide, but instead a daily high-tide period was evaluated. Water levels in the three new monitoring wells (MW-1, MW-2, and MW-3) were measured with a water-level meter at approximately one-hour intervals (Table 2). The comparable tidal levels in the Duwamish Waterway were downloaded from a nearby monitoring station and plotted together with the groundwater levels. The results enabled the tidal lag to be understood, which is discussed below in Section 3.1.

2.5 River Bank Soil and Sediment Sampling

River bank soil and intertidal sediment samples were collected in two transects perpendicular to the shoreline at the SPM (Figure 2). Transect A was located several feet northwest of the SPM property boundary with Terminal 117. Transect B was located approximately 25 feet northwest (downstream) of Transect A. At each transect, a soil sample was collected immediately above the top of the retaining wall, and another just below the base of the wall. An intertidal sample was collected from a few inches below the water surface at low tide in the waterway. All samples were collected at depths from 0 to 4 inches below the surface of the soil or sediment. Samples were collected using a pre-cleaned stainless steel scoop and were analyzed for the parameters shown on Table 1. Soil samples were collected on October 8, 2007. Due to the lack of a major daytime low tide during the fall and winter, the intertidal sediment sampling was delayed until March 12, 2008.

The sediment samples were collected from material deposited between the lowermost rip rap, below the low-tide water level. Sediment was sparse and somewhat difficult to find in enough volume to sample. Based on its depositional presence in pockets between blocks of rip rap, it is likely that this sediment is not eroded bank soil, but rather is sediment that has settled out of the waterway from upstream.

2.6 Groundwater Sampling

Groundwater was sampled on two occasions during low-tide periods, on October 8–9, 2007, and again on March 12, 2008. The groundwater sampling events took place during and following a significant low tide, based on the timing results of the tidal study. During the two sampling events, groundwater samples were collected from each of the three newly installed monitoring wells. Each of the monitoring wells was purged using standard low-flow procedures. Groundwater was purged and sampled using a peristaltic pump with disposable silicon and polyethylene tubing.

Groundwater samples were collected and submitted to Columbia Analytical Services (CAS) for laboratory analysis. As shown in Table 1, each groundwater sample from the first event was analyzed for the following constituents:

- SVOCs by EPA Method 8270C
- PCBs by EPA Method 8082
- Eight RCRA metals (total and dissolved) by EPA Method 6020/7470
- Chlorinated pesticides by EPA Method 8081
- Hydrocarbon identification by Ecology Method NW-HCID
- Total petroleum hydrocarbons for the gasoline range by Ecology Method NWTPH-Gx
- Total petroleum hydrocarbons for the diesel range by Ecology Method NWTPH-Dx extended, with silica gel cleanup

During the second event, the list of analyses was streamlined, based on the analytical results of the first event (Table 1). It should be noted that groundwater samples from the first event were submitted as both filtered and unfiltered for the eight RCRA metals. The groundwater samples were filtered using an in-line, 0.45-micron nitrocellulose filter. Based on the very low turbidity in the groundwater from the first event, filtering was not conducted on the second event samples.

2.7 Seep Investigation

The banks of the Lower Duwamish Waterway were inspected for seeps at low-tide periods on several days during field reconnaissance and sampling activities. No seepages were witnessed on the SPM property. However, some seepage zones were noted just to the southeast of the property, adjacent to the Terminal 117 property. Consequently, no seep samples were collected as part of this site characterization at the SPM.

3.0 Investigation Results Summary

The following results pertain to the geology and hydrogeology of the site, including the tidal survey, in addition to the analytical results for soil boring sampling, river bank and sediment sampling, and groundwater sampling.

3.1 Geology and Hydrogeology

During direct-push sampling and hand-augering activities, the following geologic units were identified at the site (from top to bottom):

1. An upper unit of fill identified throughout the site; this includes road base material below the large asphalt portion of the site. This material is rocky or gravelly, with some sand and silt, and is up to 1 foot thick.
2. A localized unit of silty sand and gravelly silt, with common anthropogenic debris. This material has a maximum thickness of at least 3.25 feet, and it corresponds to the disposal pit fill material.
3. A layer of fine- to medium-grained sand identified throughout the site; it has a maximum thickness of up to 10.5 feet.
4. A layer of silt and sandy silt identified throughout the site; it is up to 9 feet thick. This layer also grades into a silty sand; by including this silty sand material, the total unit has a maximum thickness of at least 12 feet.
5. A lower layer of fine- to medium-grained sand; this unit has a maximum thickness of at least 9.5 feet (identified only at SB-1, SB-4, and SB-8).

The relationships between geologic units are shown in a cross section extending across the site (Figure 3). Note that the material forming geologic unit 2 (silt, sand, gravel, and anthropogenic debris) corresponds to the waste pond fill material. This pond area used by the former A&B Barrel Company was apparently filled with this varied debris upon closure. This pond fill material was easily recognizable in the field, and it also had a moderately strong solvent and/or fuel odor during sampling.

During soil boring activities, the water table typically was located near the interface between geologic units 3 and 4. As a result, the three wells were screened either in the sand of unit 5, or in the sandier portions of unit 4. Although the cross section (Figure 3) shows up to about 3 feet of groundwater above unit 4, this was measured during a period of high tide. Therefore, during most of the tidal cycle, there would be little or no groundwater present above this fine-grained unit.

Overall, three main hydrogeologic units are recognized: an upper sand (geologic unit 3) that is occasionally saturated in its lower part; a middle silt, sandy silt, and silty sand (unit 4); and a lower sand (unit 5) that is virtually entirely saturated. The material forming unit 4 was mostly described as wet or saturated, and it may be considered a leaky aquitard. However, due to the amount of sand and the high moisture content of unit 4, the entire soil column (below the water table) could be considered a single aquifer.

The results of the short-term tidal survey are depicted as a hydrograph in Figure 4. This figure shows that, during a high tide, groundwater in wells MW-2 and MW-3 has a tidal peak that lags behind the waterway surface level by about one-half hour. Groundwater in well MW-1 lags behind the waterway tidal peak by about 2 hours; this well is located farther from the shore than the other two. The water levels in these three wells also are lower in elevation than the water level in the waterway during and preceding the high-tide period. Thus, groundwater would reverse flow during this part of the tidal cycle. Overall, groundwater is expected to flow toward and discharge to the Duwamish Waterway.

3.2 Soil Boring Analytical Results

Validated laboratory analysis results for soil boring samples are presented in Appendix B; the data validation report is included in Appendix C. A summary of chemicals detected in the soil boring samples is presented in Table 3. This table includes only those chemical parameters that were detected at least once in any onsite soil or sediment samples. For screening purposes, the sample results are compared to Model Toxics Control Act (MTCA) Method A and B Soil Cleanup Levels, as well as the Sediment Protection screening levels for soil (SAIC 2006). Chemical values that exceed these levels are highlighted and/or bolded in Table 3. A summary of exceedances for each chemical parameter is provided in Table 4. The following text briefly summarizes the major findings of the chemical analysis exceedances, listed by major chemical group.

Metals. As shown in Tables 3 and 4, results for seven metals exceed screening levels in one or more samples. All samples exceed the Method B Cleanup Level for arsenic, although none of the values exceed Method A or the Sediment Protection levels. The maximum concentration of mercury (29.5 milligrams per kilogram [mg/kg]) was identified in a sample from the former disposal pond area, which exceeds the Sediment Protection level by a factor of 983 times and also exceeds the Method A level by 15 times. The maximum concentration of lead (3,180 mg/kg) was also identified in a sample from the disposal pond area, which amounts to 47 times the Sediment Protection level and 13 times the Method A level.

PCBs. Aroclor 1254 and/or Aroclor 1260 exceed MTCA Cleanup Levels and Sediment Protection screening levels in all samples collected from the disposal pond area, with a maximum concentration of 36 mg/kg. This corresponds to a factor of 554 times the Sediment Protection level and 36 times the Method A level. A sample outside the pond area from SB-13 at 7 feet bgs identified Aroclor 1254 at 13 mg/kg, but none was detected at shallow depths; this is the location where a previous sample (associated with the Terminal 117 investigation) identified PCBs at shallow soil depth.

Pesticides. The chlorinated pesticides 2,4’-DDT, 4,4’-DDT, aldrin, and dieldrin exceed MTCA Cleanup levels in samples collected from the disposal pond area. The highest identified concentration was for aldrin with a concentration of 9.4 mg/kg, which corresponds to a factor of 159 times the Method B Cleanup Level.

SVOCs. A number of semi-volatile organic compounds were identified as exceeding screening levels in all but one of the samples collected from the former disposal pond area. The highest concentration relative to screening criteria is for bis(2-ethylhexyl)phthalate (7.0 mg/kg) at a factor of 90 times the Sediment Protection level. Concentrations of pentachlorophenol also exceed this level by up to a factor of 76 times, and 2-methylnaphthalene exceeds by up to 62 times.

TPH. Gasoline-range, diesel-range, and heavy oil (residual)-range petroleum hydrocarbons exceed screening levels in samples collected from the former disposal pond area. Concentrations exceed the Method A Cleanup Levels by a factor of 14 times the heavy oil-range hydrocarbons and 12 times the gasoline-range hydrocarbons.

VOCs. Several volatile organic compounds (VOCs) exceed screening levels in two samples from the southeastern portion of the disposal pond area. VOC analyses were limited to five samples from the pond area. The greatest exceedance is for concentrations of 1,2-dichlorobenzene (up to 0.31 mg/kg), at a factor of 82 times the Sediment Protection level.

3.3 River Bank Soil and Sediment Analytical Results

River bank soil and intertidal sediment samples were collected in two transects (A and B) approximately perpendicular to the shoreline, with three samples in each transect. Validated laboratory analysis results for bank soil and sediment samples are presented in Appendix B; the data validation report is included in Appendix C. A summary of chemicals detected in these samples is presented in Table 5. This table includes only those chemical parameters that were detected at least once in any bank soil or sediment samples. For screening purposes, the bank soil sample results are compared to MTCA Method A and B Soil Cleanup Levels and the Sediment Protection screening levels for soil (SAIC 2006). The intertidal sediment samples are compared to the Sediment Management Standards (SMS), including the Sediment Quality Standards (SQS) and Cleanup Screening Levels (CSL). Chemical values that exceed these levels are highlighted and/or bolded in Table 5. A summary of these exceedances for each chemical parameter is provided in Table 4. Note that intertidal sediment sample results only exceed SMS criteria for two analytes (total PCBs and benzyl alcohol). The following text briefly summarizes the major findings of the chemical analysis exceedances, listed by major chemical group.

Metals. As shown in Tables 4 and 5, results for six metals exceed screening levels in one or more bank soil samples; none of the sediment sample results showed exceedances. All soil sample results exceed the Method B Cleanup Level for arsenic, although none of the values exceed Method A or the Sediment Protection levels. Arsenic concentrations in the intertidal sediment samples (up to 18.5 mg/kg) are higher than in any soil samples onsite; however, the sediment sample results did not exceed the SMS levels. The maximum exceedance of any metal over the Sediment Protection levels for soil is copper, by a factor of 26 times the copper criteria in a river bank soil sample (1,020 mg/kg, Transect B); the concentration in the intertidal sediment for Transect B is much lower (66.9 mg/kg).

PCBs. Aroclor 1260 was detected in both bank soil and sediment samples. Aroclor 1248 was detected only in one sediment sample. Concentrations were higher in sediment samples than in bank soil samples. The highest concentration is for Aroclor 1260 (1.7 mg/kg) in the Transect A sediment sample; this is equivalent to 85 mg/kg OC (organic carbon normalized), which exceeds the SMS levels for total PCBs by a factor of 7.1 times the SQS. The highest concentration for

Aroclor 1260 in bank soil is 0.32 mg/kg, which is a factor of 4.9 times the Sediment Protection levels for soil.

Pesticides. No exceedances of pesticide criteria are identified in results from bank soil or sediment samples.

SVOCs. A total of nine semi-volatile organic compounds plus total carcinogenic PAHs are identified as exceeding screening levels in up to three bank soil samples. The highest concentration relative to screening criteria is for dimethylphthalate (3.7 mg/kg) at a factor of 39 times the Sediment Protection level. The only exceedance of intertidal sediment results is for benzyl alcohol (0.087 mg/kg), corresponding to a factor of 1.5 times the SQS.

TPH. No exceedances of petroleum hydrocarbons are identified in results from bank soil or sediment samples.

VOCs. Volatile organic compounds were not analyzed for in samples from the bank soil/ sediment transects.

3.4 Groundwater Analytical Results

Validated laboratory analysis results for groundwater samples are presented in Appendix B; the data validation report is included in Appendix C. A summary of chemicals detected in these samples is presented in Table 6. This table includes only those chemical parameters that were detected at least once in any groundwater samples. For screening purposes, the sample results are compared to MTCA Method A and B Groundwater Cleanup Levels, as well as the Sediment Protection screening levels for groundwater (SAIC 2006). Chemical values that exceed these levels are highlighted in Table 6, which also summarizes exceedances for each chemical parameter. The following text briefly summarizes the major findings of the chemical analysis exceedances, listed by major chemical group.

Note that non-aqueous phase liquid (NAPL) was not encountered during the sampling of any of the monitoring wells. A resampling of these wells is planned for the near-future in order to analyze for mercury with a lower detection limit.

Metals. As shown in Table 6, arsenic is the only metal that exceeds screening levels. Results from all samples exceed the Method B Cleanup Level for arsenic. One sample (MW-2) at 8.07 micrograms per liter (µg/L) also exceeds the Method A level, corresponding to a factor of 139 times the Method B level and 1.6 times the Method A level.

PCBs. PCBs were not detected in any groundwater samples from SPM.

Pesticides. Dieldrin is the only pesticide to show exceedances in groundwater sample results, only from MW-3. Concentrations of dieldrin (up to 0.063 µg/L) exceed the Method B Cleanup Level by a factor up to 11 times.

SVOCs. No exceedances of semi-volatile organic compounds are identified in results from groundwater samples.

TPH. No exceedances of petroleum hydrocarbons are identified in results from groundwater samples.

VOCs. Four volatile organic compounds were detected in groundwater samples, but only one exceeds any criteria. Tetrachloroethene (PCE) was detected at 0.16 to 0.20 µg/L in MW-2 and MW-3. The maximum concentration exceeds the MTCA Method B Cleanup Level by a factor of 2.5 times.

3.5 Summary of Analytical Results

A number of contaminants are identified at concentrations exceeding screening levels in soil, sediment, and groundwater samples at the South Park Marina site. By far, the most significant exceedances originate from soil samples in five shallow borings within the outline of the former disposal pond area. Exceedances for metals, PCBs, chlorinated pesticides, SVOCs, and TPH are greater for soil sample results in the disposal pond area than in other portions of the site, including the river bank and intertidal sediment areas. VOC exceedances also are noted in samples from the disposal pond area, but VOCs were not analyzed in solid samples at other site areas. The analytical results confirm that the disposal pond area is a source of a variety of chemical contaminants that could potentially reach the waterway.

Results from river bank soil and intertidal sediment samples also show exceedances of screening levels for metals, PCBs, and SVOCs; however, only three individual exceedances are noted from sediment results. It is uncertain if the intertidal sediment originates from erosion of the bank or via deposition of suspended material from upstream. The lower bank soil that was sampled is separated from the intertidal sediment sampling area by a zone of rip rap that extends down into the low-tide zone. At the time of low-tide sampling, sediment was sparse near the water line and was only found in some pockets between rocks just below the water level. The source of this limited sediment appears to be from settling of waterway-transported material rather than erosion and transport of bank soil across the rip-rap zone, although a combination of the two sources cannot be ruled out. Higher concentrations of PCBs in the sediment than in the bank soil, and higher arsenic in sediment than in any site soils, also suggest that bank soil may not be the source of the sediment and its contaminants.

Groundwater sample results from the site show exceedances of screening levels for three chemicals. These exceedances include: arsenic in all three wells, dieldrin in MW-3, and PCE in MW-2 and MW-3. By comparison to soil results, arsenic was identified above the Method B Cleanup Level in soil throughout the site; dieldrin was identified above the Method B level in one soil sample in the disposal pond area; and PCE was identified above the Method A level in two soil samples in the disposal pond area. Thus, at least for dieldrin and PCE, there seems to be a connection between the disposal pond soil chemistry and the downgradient groundwater chemistry. Although mercury was detected in pond area soil and intertidal sediment samples, mercury was not detected in groundwater. Analysis of mercury in groundwater at lower detection limits is needed to determine if there is a current pathway for mercury from the pond area to the Lower Duwamish Waterway.

There does not appear to be a good correlation between the sample chemistry of the soil in the former disposal pond and the bank soil/sediment sample chemistry. Aroclor 1254 was found to be more prevalent and at higher concentrations than Aroclor 1260 in soil samples from the disposal pond area, but only Aroclor 1260 was detected in bank soil and sediment samples (with one minor exception in sediment). In addition, for results of pesticides, SVOCs, and TPH, there is not a good correlation between the disposal pond soil and bank soil/sediment sample results.

In conclusion, a number of screening level exceedances for contaminants were identified at the South Park Marina site, particularly in soil of the former disposal pond area. However, the pathway for these contaminants to reach the Duwamish Waterway is not clearly established. Groundwater only shows limited exceedances of contaminants. River bank soil samples also show a number of exceedances of standards, but the link between these contaminants and those in the intertidal sediment samples is uncertain.

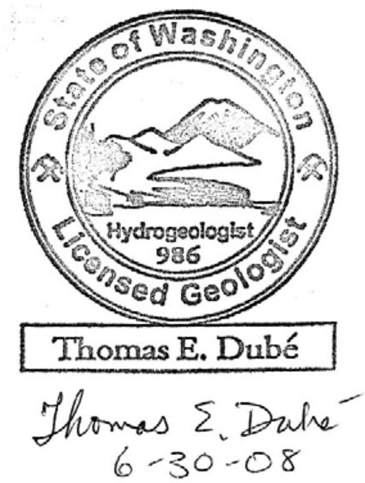
4.0 References

SAIC. 2006. Source Control Action Plan, Slip 4, Lower Duwamish Waterway. Task 2.3 – Soil and Groundwater Screening Criteria. Draft. Prepared for the Washington State Department of Ecology. Prepared by SAIC, Bothell, WA. August 2006 (Revised February 2007).

SAIC. 2007a. Sampling and Analysis Plan for Site Reconnaissance Investigation, South Park Marina, Seattle, Washington. Prepared for the Washington State Department of Ecology. Prepared by SAIC, Bothell, WA. September 2007.

SAIC. 2007b. Site Reconnaissance Plan, Lower Duwamish Waterway, South Park Marina. Prepared for the Washington State Department of Ecology. Prepared by SAIC, Bothell, WA. June 2007.

SAIC. 2007c. Summary of Existing Information and Identification of Data Gaps, Lower Duwamish Waterway, South Park Marina. Prepared for the Washington State Department of Ecology. Prepared by SAIC, Bothell, WA. June 2007.



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LIMITATIONS

As part of this report, SAIC's investigation was restricted to collection and analyses of a limited number of environmental samples, visual observations and field data, in addition to summarizing available information from previous site documents. Because the current investigation consisted of evaluating a limited supply of information, SAIC may not have identified all potential items of concern. This report is intended to be used in its entirety; taking or using excerpts from this report is discouraged.