ECOLOGY TOXICS CLEANUP PROGRAM
EPA BROWNFIELDS PROGRAM

DRAFT FINAL REPORT

Little Squalicum Park
Remedial Investigation
Bellingham, WA

Prepared for

City of Bellingham
Parks and Recreation Department
3424 Meridian Street
Bellingham, WA 98225

Prepared by

integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225

December 19, 2008

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
BaPE	benzo[a]pyrene equivalent
bgs	below ground surface
BNSF	Burlington Northern Santa Fe Railway
BTC	Bellingham Technical College
CLARC	cleanup levels and risk calculations
CoPEC	chemicals of potential ecological concern
CPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL	cleanup screening level
Creek	Little Squalicum Creek
CSM	conceptual site model
CUL	cleanup level
DAF	dilution attenuation factor
DEA	David Evans and Associates
DRO	diesel-range organic hydrocarbons
Ecology	Washington State Department of Ecology
EIC	ecological indicator concentration
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EPH	extractable petroleum hydrocarbon
FCR	field change request
gpd/ft	gallons per day per foot
GRO	gasoline-range organic hydrocarbons
GW	groundwater (sample name prefix)
HA	site hazard assessment (sample name prefix)
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
ICP/MS	inductively coupled plasma/mass spectrometry

ICP/RAS	inductively coupled plasma/Russian Academy of Sciences
IHS	indicator hazardous substance
LDPE	low-density polyethylene
LNAPL	light nonaqueous-phase liquid
LOAEL	lowest-observed-adverse-effect level
LPAH	low-molecular-weight polycyclic aromatic hydrocarbon
MCL	maximum contaminant level
MTCA	Model Toxics Control Act
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NAPL	nonaqueous-phase liquid
NAVD	North American Vertical Datum
NOAEL	no-observed-adverse-effect-level
NWTPH	Northwest Total Petroleum Hydrocarbons (laboratory method)
OCDD	octachlorodibenzo-*p*-dioxin
OCDF	octachlorodibenzofuran
Oeser	Oeser Company
OPC	Olympic Portland Cement Company
PAH	polycyclic aromatic hydrocarbon
Park	Little Squalicum Park
PCP	pentachlorophenol
PRG	preliminary remediation goal
QAPP	quality assurance project plan
RI/FS	remedial investigation and feasibility study
RTP	reconnaissance test pits
SAP	sampling and analysis plan
SHA	site hazard assessment
SIM	selective ion monitoring
SMS	Washington State Sediment Management Standards
SOP	standard operating procedure

SQS	Sediment Quality Standard
SW	surface water (sample number prefix)
SVOC	semivolatile organic compound
TCDD	tetrachlorodibenzo-*p*-dioxin
TEE	terrestrial ecological evaluation
TEF	toxicity equivalency factor
TEQ	toxicity equivalent
TOC	total organic carbon
TP	test pit (sample name prefix)
TPAH	total polycyclic aromatic hydrocarbon
TPH	total petroleum hydrocarbons
TRV	toxicity reference value
µg/L	micrograms per liter
U&I	Utah and Idaho Sugar Company
USGS	U.S. Geological Survey
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
WAC	Washington Administrative Code
WHO	World Health Organization
WQC	water quality criteria

CERTIFICATION

I, Mark J. Herrenkohl, a professional engineering geologist in the State of Washington, certify that I have reviewed the geosciences portions of this document.

Signature of Geologist:_______________________Name:_________________Date:_______

ACKNOWLEDGMENTS

This document was compiled by Integral Consulting Inc. under contract with the City of Bellingham in accordance with the requirements of Contract 2004-014D and the project work plans (Integral 2005a,b,c,d). This project was funded by U.S. Environmental Protection Agency Brownfields and Washington State Department of Ecology Remedial Action grants. Mr. Tim Wahl is the City project manager; Ms. Mary O'Herron is the Ecology project manager; Mr. Ravi Sanga is the EPA Region 10 project manager; and Mr. Mark Herrenkohl is the Integral project manager.[1]

The primary authors of this report were Mr. Mark Herrenkohl, Ms. Priscilla Zieber, Mr. Eron Dodak, and Mr. Peter Mattison. Individuals contributing to the sampling, data analysis and interpretation, and report writing efforts are listed below.

Mr. Mark Herrenkohl	Project manager, field sampling, data interpretation, report writing, and technical review
Ms. Priscilla Zieber	Deputy project manager, human health risk assessment, data interpretation, and reporting
Mr. Eron Dodak	Project field supervisor, field sampling, health and safety officer, data interpretation, and reporting
Mr. Peter Mattison	Ecological risk assessment and reporting
Dr. Les Williams	Ecological risk assessment, reporting, and technical review
Mr. Stefan Wodzicki	Field sampling, data interpretation, and reporting
Ms. Kim Magruder	Field sampling, data interpretation, and reporting
Ms. Maja Tritt	Quality assurance, data interpretation, and reporting
Ms. Maya Desseva	Data management
Mr. Thomas Crosslin	GIS and graphics support

Key subcontractors supporting the field investigation and sample analysis include:

Boretec Drilling	Drilling operations

[1] In June 2007, Mark Herrenkohl became an independent consultant but continues to provide a lead technical role on the project.

Cascade Drilling	Drilling operations
Wilder Construction	Test pit excavations
Analytical Resources, Inc.	Physical and chemical testing of samples
STL, Inc.	Dioxin/furan analysis of samples

EXECUTIVE SUMMARY

The Little Squalicum Park (the Park) site consists of approximately 21 publicly owned acres located next to the Birchwood neighborhood in Bellingham, Washington. The Park is bordered by Bellingham Bay to the south, residences and Bellingham Technical College (BTC) to the east, Morse Steel Services (including an active railroad spur) and undeveloped lots to the north, and the Oeser Company (Oeser) and residences to the west.

Potential sources of contamination at the Park include the Oeser site, which is a wood-treatment facility that has operated since the early 1940s. Wood-treating operations at Oeser first used creosote and in the mid-1950s began using both pentachlorophenol (PCP) and creosote. By about 1985, Oeser ceased using creosote but currently uses PCP for wood treating on the site. The chemicals associated with wood-treating operations that potentially pose a threat to either human health or the environment include polycyclic aromatic hydrocarbons (PAHs, the primary constituents of creosote), PCP, and dioxins and furans, which are commonly found in technical-grade PCP as a by-product of manufacturing. Other sources of potential contamination at the Park are related to stormwater discharges from nearby roads and residences and to historical operations (e.g., sand and gravel mining) on Park property. Stormwater drainage from surrounding areas is likely a source of petroleum hydrocarbons and heavy metals to the project site. Sand and gravel operations could also have been a source of petroleum hydrocarbons from the use of motorized equipment (e.g., diesel fuel and motor oil).

A remedial investigation of the Park was conducted to characterize the extent of contamination in soils, groundwater, surface water, and sediments, and to assess the impacts of the contaminants to human health and the environment. The results of this study are reported in this document and will be used in preparation of the feasibility study for the site at a future date. The remedial investigation was conducted under the terms of an Agreed Order signed between the City of Bellingham and the Washington State Department of Ecology on March 22, 2005.

The remedial investigation included seven field events between November 2005 and January 2008. The field events consisted of the following activities:

- Sampling of surface water in Little Squalicum Creek (the Creek) and a background location to assess potential contaminant impacts on water quality
- Sampling of soils in upland areas of the site to assess contaminant impacts on soil quality, including potential impacts from an historical Landfill discovered in the northeast section of the Park
- Sampling of groundwater in the Park and at a background location to assess potential contaminant impacts to groundwater beneath the site

- Sampling of sediments in the bed and banks of the Creek to characterize contamination that may be related to discharges from the Oeser facility and surrounding neighborhoods.

The Park was characterized based on information obtained from 221 surface soils or spoils pile samples, 213 subsurface soil samples, 71 sediment samples[2], 18 surface water stations, 27 groundwater stations, and 4 blackberry samples. Sources of data include the remedial investigation sampling results and historical sources deemed acceptable for use based on the age and quality of the data.

The data were evaluated to determine soil types that occur in sediments of the Creek and upland soils, the nature and extent of contamination, sources of contamination, and the fate and transport of widely detected chemicals.

The remedial investigation distinguished three primary geologic units in the ravine of the Park. A surficial sand and gravel unit was observed to be thickest along the former railroad grade where sand and gravel mining activities did not occur. This layer is generally thinner on the southeast side of the Creek where historical mining was common from the 1930s to 1960s. Numerous thin discontinuous silt and sand layers are present near the current creek channel, which may represent recent alluvium deposited by the Creek. A gray clay unit underlies much of the Upper Creek area. The thickness of the clay layer varies greatly and ranges from less than 0.1 to over 6 ft. A silty sand to clean sand unit underlies the gray clay and is assumed to be laterally continuous beneath the Park.

Groundwater flow above the gray clay unit is generally to the southwest toward Bellingham Bay, with some small local variations on the southeastern side of the Creek north of the Marine Drive Bridge. Hydraulic gradients ranged from approximately 0.01 to the northeast of the Park site to approximately 0.017 across the Park site. The hydraulic gradient is relatively flat in one area of the Park, located along a portion of the Upper Creek, north of the Marine Drive Bridge.

The Creek flows across the site from the northeast to the southwest. The open channel of the Creek begins at the 36-in. diameter stormline that issues from the south side of the active railroad tracks immediately north of the Park. This stormline conveys water from both the Oeser site and the Birchwood neighborhood. The Creek terminates at the south end of the site through an approximate 36-in. diameter concrete culvert and onto the beach at Bellingham Bay. A permanent wetland area is present to the northeast of the headwaters of the Creek. Most of the wetland area is present year round. The wetland is not currently connected with the Creek but may have been in the past based on review of aerial photographs. An ephemeral wetland is

[2] Sediments were identified as soils saturated by water most of the year (e.g., creek and wetland sediments). However, soils and sediments were evaluated similarly in the remedial investigation because of the potential for redevelopment of the site which could result in soils becoming sediments or vise versa (e.g., rerouting the creek).

present over much of the eastern portion of the Park. This wetland was once a prominent meander of the Creek before it was rerouted to its current position in about 1961 or 1962.

There are obvious differences in contamination patterns and fate and transport processes across the site. Therefore, for the purpose of discussion and analysis, the site was divided into 10 areas including Wetland, Upper Creek, Historical Creek, Lower Creek, Beach, South Slope, Landfill, Railroad, Illinois Street extension, and General Site areas. In addition to site samples, background samples were also evaluated in the remedial investigation.

The field investigation and physical and chemical data evaluations conducted as part of the remedial investigation result in the following findings:

- Soil, groundwater, sediment, and surface water contain contaminants associated with wood-treating activities from Oeser. The principal transport mechanism of these chemicals to the Park is historical stormwater discharges from the Oeser facility via the Oeser/Birchwood outfall. Contaminants migrated from surface waters into the surficial sand and gravel unit observed over much of the site.
- The highest levels of creosote- and PCP-related contaminants are located in subsurface soils and groundwater in the Upper Creek and Historical Creek areas of the site.
- The lateral distribution of wood-treating chemical contamination in the Upper Creek area is about 1.2 acres, located from the Oeser/Birchwood stormwater drainage pipe to the confluence with the BTC/Birchwood stormwater drainage pipe, and downstream in the Creek for approximately 500 ft.
- The vertical distribution of the contamination in the Upper Creek is such that the highest concentrations are found within the groundwater saturation zone from near the ground surface in some locations to a depth of about 10 ft below ground surface (bgs) in other locations. The vertical extent of contamination generally is limited by the presence of a silty clay of variable thickness (aquitard).
- The spatial distribution of the contamination in the Historical Creek is found in the upper 2 to 3 ft bgs, in the once active creek bed that meandered through this part of the site before about 1961 to 1962.
- The contamination exists in soils and sediments primarily as sorbed chemicals, with some occurrences of residual nonaqueous phase liquid (NAPL).
- Creosote- and PCP-related contaminants are also found in sediments in the Upper Creek and Lower Creek areas. Contaminated sediment is more extensive in the Upper Creek area and associated with groundwater discharging to this area of the Creek. The extent of contamination is mostly localized in the Lower Creek, generally confined to surface sediments and bank soils transported from areas upstream.

- Trace metals and organic chemicals (e.g., petroleum hydrocarbons, phthalates) were detected in the current creek and Historical Creek areas. These contaminants may be associated with stormwater discharges from runoff of local roadways and BTC.
- Elevated levels of heavy metals were detected in soils of a 1930s landfill in the northeastern portion of the Park. The lateral extent of contamination is about 7,000 ft^2. The vertical distribution of contaminants is about 3 to 4 ft bgs.
- Elevated levels of arsenic were detected in soils along the Illinois Street extension area. The highest concentrations were detected in the upper 2 to 3 ft of soils in this site area.
- An archaeological site (i.e., shell midden) was discovered on the west side of the Lower Creek. The area of the site was estimated to be approximately 1,200 ft^2. A second site was discovered to the west of the Creek, on the upper level of the Park. On investigation, it was determined to be a significant archaeological site and was left undisturbed during construction of the parking lot and access trails to the Park.

The sampling and data evaluations conducted during the remedial investigation provide information sufficient to conduct a risk evaluation and to evaluate the need for remedial action in the Park. Risks were evaluated separately for human, terrestrial ecological, and aquatic ecological receptors. The evaluations were conducted to identify a preliminary list of indicator hazardous substances (IHSs) and chemicals of potential ecological concern (CoPECs). Cleanup levels were developed for the IHSs and CoPECs. The risk evaluation conducted as part of the remedial investigation resulted in the following findings:

- **Threats to human health and the environment**—Some contaminants found in the Upper Creek, Historical Creek, Lower Creek, and Wetland areas present significant threats to human health and/or the environment. Chemical contaminants found in other areas of the site present less significant threats (e.g., Illinois Street extension and Landfill areas), but they still merit consideration in the feasibility study for potential cleanup. Human health IHSs were selected for every area of the site. Chemical concentrations in soil, surface water, and sediment exceed one or more ecological indicator concentrations in every area of the site evaluated.
- **Human health IHSs**—Five metals (arsenic, cadmium, chromium, lead, and zinc) were selected as human health IHSs in one or more matrices and site areas. Illinois Street extension and the Landfill have more metals IHSs than do the other areas. PCP, carcinogenic PAHs, petroleum, and dioxins/furans, all associated with wood treating operations, were selected as IHSs in most site areas. Bis(2-ethylhexyl)phthalate, associated with urban runoff, was selected as an IHS in groundwater in Upper Creek and Lower Creek areas. Dinitrotoluenes, possibly due to use of dynamite during quarry activities, were selected as IHSs in Upper Creek, Historical Creek, and South Slope areas.

- **Terrestrial ecological receptors**—PAHs, PCP, and dioxins/furans pose risks to terrestrial ecological receptors, particularly in the Upper Creek and Historical Creek areas, and possibly also in the Lower Creek area.
- **Aquatic ecological receptors—**There are potential risks from magnesium, copper, zinc, phenols, dioxins/furans, and alkalinity to aquatic ecological receptors in the Park, particularly in the Upper Creek, Lower Creek, and Wetland areas. CoPECs for benthic communities, including benzyl alcohol, benzoic acid, dibenzofuran, PAHs, phenols, and phthalates, are of particular concern in the Upper Creek, Lower Creek, Historical Creek, and Wetland areas. Dioxins/furans and PAHs pose risks to avian receptors feeding on emerging aquatic insects, primarily in the Upper Creek, Lower Creek, and Historical Creek areas.

This remedial investigation document will be followed by a feasibility study, provided under separate cover, that presents cleanup levels and an evaluation of remedial alternatives for the site. Cleanup actions should be planned and undertaken so as not to preclude plans for improvement of the park site and, whenever feasible, should be coordinated with provision of future accommodation of features to be provided in the park site. The feasibility study alternative assessment will include consideration/coordination with City plans for improvements to the Park.

1 INTRODUCTION

This document is the remedial investigation for Little Squalicum Park (the Park) located in Bellingham, Washington (Figure 1-1). The remedial investigation presents and evaluates the results of field investigations in the Park in accordance with the Washington State Model Toxics Control Act (MTCA) (WAC 173-340). The results of the remedial investigation will be used in a feasibility study to evaluate cleanup levels (CULs) and remedial alternatives for the site.

Previous investigations by the U.S. Environmental Protection Agency (EPA; E&E 2002a,b) and the Washington State Department of Ecology (Ecology) (Ecology 2004) have shown that soils, surface water, and sediments[3] in or near Little Squalicum Creek (the Creek) within the Park are contaminated with polycyclic aromatic hydrocarbons (PAHs) and pentachlorophenol (PCP). Ecology reported that sediments within segments of the Creek exceed risk-based numerical values and fail one or more biological tests. Potential sources of contamination include the Oeser Company (Oeser) site, which is a wood-treatment facility that has operated since the early 1940s. The chemicals associated with wood-treating operations that had been previously identified at the Park include PAHs (the primary constituents of creosote), PCP, dioxins and furans (both commonly found in technical-grade PCP as a by-product of manufacturing). Other potential sources of contaminates found in the Park were linked to stormwater discharges from nearby roads and residences and to historical operations (e.g., sand and gravel mining) on Park property. Stormwater drainage from surrounding areas was identified as a probable source of petroleum hydrocarbons and heavy metals to the project site. Gravel operations could have been a source of petroleum hydrocarbons from the use of motorized equipment (e.g., diesel fuel and motor oil).

The field investigation was conducted according to the work plans for the Park (Integral 2005d), which include the sampling and analysis plan (SAP) (Integral 2005c), the quality assurance project plan (QAPP) (Integral 2005b), and the project health and safety plan (Integral 2005a).[4] Additional field activities were completed supplementary to the field activities presented in the work plans, as described in Addendums 1[5] (Integral 2005e), 2[6] (Integral 2006a), and 3[7] (Integral 2006b).

---

[3] Sediments are defined in this report as soils that are saturated with water most of the year as found in Little Squalicum Creek, at the mouth of the Creek, and in wetland areas.

[4] Funding for this work was received by the City of Bellingham (City) through the Washington State Department of Ecology (Ecology) Remedial Action Grant Program (City of Bellingham 2005) and the U.S. Environmental Protection Agency (EPA) Region 10 Brownfields Program (City of Bellingham 2003). Integral Consulting Inc. (Integral) conducted this work under Contract No. 2004-014 with the City Parks and Recreation Department, with direction from both Ecology Toxics Cleanup and EPA Region 10 Brownfields Programs.

[5] Addendum No. 1 provided information on the rationale and objectives for supplementary sampling and testing to identify the location and boundaries of the Historical Creek channel within Little Squalicum Park, and to determine

1.1 PROJECT BACKGROUND

Ecology conducted an initial investigation of the combined Oeser/Little Squalicum Creek site in the late 1980s. Parametrix conducted a site hazard assessment (SHA) for Ecology in 1991. Regulatory oversight of the site was transferred from Ecology to EPA in 1995. In 1997, EPA placed the Oeser site on the Superfund list of the nation's most contaminated hazardous waste sites. The EPA completed a priority cleanup of the Oeser site to address the areas of highest contamination in 1999 and a remedial investigation and feasibility study (RI/FS) of the site in 2002 (E&E 2002a,b). The Oeser site is located approximately 500 ft upgradient from the Park and portions of the Park were included in the EPA study. However, EPA did not find contamination on Park property at concentrations that would require cleanup actions under the Superfund Program, and informed the City that it would be its responsibility to conduct any additional environmental studies necessary for any future Park development.

Whatcom County Health and Human Services completed an updated SHA of the Park in February 2004, as required under MTCA. The site's hazard ranking, which is an estimation of the potential threat to human health and/or the environment relative to other Washington State sites assessed at that time, was determined to be a 1, where 1 represents the highest relative risk and 5 the lowest (Ecology 2004). Based on the results of the SHA, Ecology determined that an RI/FS should be developed for the Park pursuant to WAC 173-340-350 and WAC 173-204-560. The Park was renamed and listed by Ecology as a separate site ("Little Squalicum Park" instead of "Oeser/Little Squalicum Creek") in January 2004. Ecology negotiated an Agreed Order and Statement of Work (dated March 22, 2005) with the City to conduct an RI/FS for the Park. An RI/FS is intended to provide sufficient data, analysis, and evaluations to enable Ecology to select a cleanup action alternative for the site.

The City applied for EPA Brownfields assessment grants in 2002 and 2003. This funding was to be used to determine the nature and extent of contamination within the Park area as it related to actual park development plans. As part of the assessment, four potential sources of contamination would be investigated as a subset of and in conjunction with the larger MTCA site evaluation:

---

the extent of the petroleum contamination in soils identified at Station TP-6. Sampling under Addendum 1 was completed in November 2005.

[6] Addendum No. 2 provided information on the rationale and objectives for the supplementary sampling and testing to delineate the extent of municipal landfill materials in the northeastern portion of the site and petroleum observed in both the current and historical channels of Little Squalicum Creek. It also detailed how work described in the original project work plans—terminated on November 17, 2005—was to recommence in concert with the sampling event. Sampling under Addendum 2 was completed in May 2006.

[7] Addendum No. 3 outlined an environmental site assessment (ESA) in support of the West Illinois Street Extension project. It provided information on the rationale and objectives for supplementary sampling and testing to delineate the extent of petroleum contamination adjacent to the Oeser/Birchwood stormline north of the Park.

- Wastewater and stormwater discharges from Oeser
- Non-point stormwater discharges from the Birchwood neighborhood and Marine Drive
- Reported pesticide and herbicide use along the Burlington Northern Santa Fe (BNSF) railroad right-of-way
- Former gravel mining in the Creek ravine.

The City was awarded Brownfields assessment funding in September 2003.

EPA specified that environmental assessment work on City-owned properties extended beyond the granting authority of the Brownfields program. Consequently, the City limited the use of the Brownfields grant funds to the portions of the project area that were not owned by the City, such as the properties owned by Whatcom County, Port of Bellingham, Morse Steel Services, and BNSF (see Figure 1-1). Brownfields-eligible properties under this approach represent approximately 65 percent of the designated Park area with the remaining (ineligible) 35 percent owned by the City.

The RI included an assessment of all properties within the Park, both eligible and ineligible under the Brownfields grant. Consequently, the City needed to find other (non-EPA Brownfields) sources of funding to complete the project. In March 2005, the City applied for and received an Ecology Remedial Action Grant to complete the RI/FS tasks for this project. Ecology approved the grant application on April 27, 2005. The EPA Brownfields award and other City funds were the sources of matching funds required under the Ecology grant.

1.2 REGULATORY FRAMEWORK

The RI/FS[8] for the Park was conducted under MTCA (WAC 173-340), which addresses identification and cleanup of contamination in soils, surface water, and groundwater. For contamination in sediments, MTCA refers to the Sediment Management Standards (SMS) (WAC 173-204), which includes standards for marine sediments. Since standards for freshwater sediment are “Reserved” under WAC 173-204-340, the City coordinated with Ecology to clarify site-specific requirements.

Additional regulations representing applicable or relevant and appropriate requirements (ARARs) include the following:

- Federal Clean Water Act and National Toxics Rule (40 CFR 131), which provide water quality criteria (WQC) for protection of human health and aquatic organisms.

[8] The FS for the Park will be provided under separate cover.

- Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A), which also provides WQC for protection of aquatic organisms[9].
- Ecology's (2003) Freshwater Sediment Quality Values (SQVs), which cover contamination of freshwater sediments. The SQVs are currently guidelines and do not replace bioassays as the definitive determination of sediment toxicity.
- Federal Safe Drinking Water Act (40 CFR 141), which provides maximum contaminant levels (MCLs) for protection of drinking water.
- Washington State Department of Health Rules for Public Water Supplies (WAC 246-290-310), which also provides MCLs.

Additional ARARs that may apply to the site because of its location or the nature of remedial actions will be discussed in the feasibility study.

MTCA addresses sites with contaminated soils, groundwater, or surface water in Washington State. The regulation establishes a process for managing contaminated sites, from the discovery phase through cleanup. The RI/FS process generates the data necessary to confirm whether the site requires cleanup and to determine the most appropriate cleanup action (if necessary). If it is determined during the RI/FS that cleanup is warranted, the next step is to develop a cleanup action plan that must comply with several requirements, including protection of human health and the environment, cleanup standards and ARARs, and provisions for compliance monitoring. The cleanup phase involves design, construction, operation, and monitoring of cleanup activities. At the Park, the City has proposed that the cleanup phase be performed in conjunction with park enhancement activities.

The SMS establish standards for the quality of surface sediments, apply those standards as the basis for management and reduction of pollutant discharges, and provide a management and decision process for the cleanup of contaminated sediments. Part V of the SMS, Sediment Cleanup Standards, establishes procedures and criteria to identify, prioritize, and clean up contaminated surface sediment sites.

1.3 PROJECT OBJECTIVES

The primary objectives of the overall Park RI/FS effort are to provide critical data necessary to understand the nature and extent of any environmental problems at the site, to assess potential risk to human health and the environment, to determine if cleanup actions are required, and to determine how these actions, if feasible, may be coordinated with other actions to enhance the Park. The field work involved sampling surface water, groundwater, soil, and sediments.

---

[9] The SMS are also federally approved water quality standards.

Specific project objectives include the following:

- Provide critical data necessary to understand the nature and magnitude of environmental problems at the site, to determine if cleanup actions are required, and to determine, if feasible, how these actions may be coordinated with other actions to enhance the Park[10]
- Provide pre-remedial design data, evaluate these data, develop and evaluate potential remediation alternatives, and generate final design/cleanup recommendations
- Provide a preferred remedial alternative by which the area can be cleaned up and, potentially, site redevelopment objectives can be achieved
- Inform the landowners (BNSF Railway, Whatcom County, and Morse Steel), stakeholders, and the public of the results of assessment work and solicit comments regarding the remediation of environmental problems and redevelopment of the area
- Provide information for decision-making by the City, landowners, stakeholders, and the public as a framework for future planning activities
- Identify additional potentially liable parties (PLPs) in order to facilitate their participation in the decision-making, planning, and cost-sharing process.

The questions under study are three-fold. First is the nature and extent of contamination. Second is whether the contamination presents a threat to human health and/or the environment. Third is how it might be remediated so that humans and wildlife can use the Park safely.

1.4 REPORT ORGANIZATION

The remaining sections and appendices of this remedial investigation include the following:

- **Section 2: Site Description**—summarizes the site history and previous investigations conducted at the site.
- **Section 3: Summary of Field Activities**—summarizes the field activities conducted under this study used to meet the data needs of the Park RI/FS.
- **Section 4: Physical and Ecological Characteristics of Little Squalicum Park**—describes the physical and ecological setting of the Park and surrounding areas including site geology, hydrogeology, topography, and flora and fauna.

[10] The City has considered rerouting the Creek and wetland development to enhance the ecological and human value of the Park.

- **Section 5: Nature and Extent of Detected Chemicals**—presents the results of chemical, biological, and geotechnical tests performed on samples collected and evaluated for the RI/FS.
- **Section 6: Conceptual Site Model**—describes and synthesizes available information on sources, transport pathways, potential receptor populations, and potential exposure pathways for widely detected chemicals in sediments, soils, groundwater, and surface water in the Park.
- **Section 7: Risk Evaluation**—evaluates the risk to human, terrestrial ecological, and aquatic ecological receptors and identifies indicator hazardous substances (IHSs) for the site.
- **Section 8: Summary of Remedial Investigation and Recommendations for Feasibility Study**—presents a summary of results and recommendations for evaluating cleanup levels and the analysis of remedial alternatives as part of the feasibility study for the site.
- **Section 9: References**—lists documents cited in the remedial investigation.
- **Appendix A: Legal Description**
- **Appendix B: Field Sampling Report; Boring and Test Pit Logs**
- **Appendix C: Data Validation Report (CD)**
- **Appendix D: Project Access Database (CD; Biological Testing Results)**
- **Appendix E: Archaeological Report (CD)**
- **Appendix F: Human Health Screening Details (CD)**
- **Appendix G: Ecological Risk Screening Details (CD)**
- **Appendix H: Figures from Oeser Remedial Investigation (E&E 2002a)**
- **Appendix I: Background Evaluation (CD).**

2 SITE DESCRIPTION

This section identifies the location and current land use of the site followed by a summary of its history and previous investigations conducted at the site.

2.1 SITE LOCATION AND LAND USE

Little Squalicum Park consists of approximately 21 publicly owned acres[11] located next to the Birchwood and Alderwood neighborhoods of northeast Bellingham and its Urban Growth Area. The Park is bordered by Bellingham Bay, the BNSF mainline, several homes and Bellingham Technical College (BTC) to the south and east, and by several residences, an interim BTC building and Oeser on the north and west (see Figure 1-1 and Appendix A). The Park consists of five tracts of land designated as the Olympic Portland Cement Company (OPC) Pier Railroad Parcel, the OPC Creek Parcel, the Eldridge Heir's Creek Parcel, the Eldridge Industrial Sites lots, and the original County Park property. One additional property (Morse Steel railroad spur) was determined to be within the designated remedial investigation boundary but is not within the Park (Ecology 2005). Appendix A provides legal descriptions for the various properties addressed by the remedial investigation.

The property to the north/northwest of the trail and adjacent to Marine Drive (on the OPC Pier Railroad Parcel, which runs just west of Little Squalicum Creek), is zoned for Light Impact Industrial use. A portion of this area was recently developed into a parking lot by the City to provide improved access to the Park and area trails. The rest of the property is zoned for Recreational Open Space.

The Creek corridor and the Park are currently used for recreational activities such as walking, bicycling, play, and birding. The site provides open space, wildlife habitat, and stormwater conveyance services that are important elements of the City's and County's area parks and public works infrastructure. Since the 1980s, development plans by the County and City have called for enhancing the recreational activities in the Park by constructing trails, water features, and park amenities, and by realigning and day-lighting Creek and stormwater flows within the Park. Plans have also called for enhancing fish and wildlife habitat (including construction of wetlands, ponds, and channels to increase water storage and water release periods) and for incorporating stormwater treatment elements into the site (Whatcom County 1991). Public investments have been limited to improvements involving two major trails, both of which have been used by the public for over 25 years. One of these passes through the Park on the OPC pier railroad and the other on the old road between Lindbergh Avenue and the BNSF Bridge. Since

[11] Acreage does not include the beach areas owned by Port of Bellingham, the Morse railroad tract, and BNSF mainline tract.

the 1990s, local, state, and federal funds have also been budgeted for additional improvements on the floor of the ravine, but these improvements were put on hold due to concerns raised by EPA, Ecology, Whatcom County Health Department, and the public that the Creek and adjacent areas may be contaminated.

2.2 SITE HISTORY

Site historical information was obtained from the Oeser Company remedial investigation report (E&E 2002a and references therein), aerial photographs (Mack 1998), and personal communication with City and Whatcom County personnel. Supplemental aerial photographs were obtained from the Whatcom Museum of History and Art (dated 1955, 1963) and Tim Wahl of the City (dated late 1930s, 1961, 1975) and used to evaluate the site. The approximate locations of relevant historical activities within the Park boundaries are shown on Figure 2-1.

Sampling activities in the Park by Ecology (2004) disclosed a previously unknown shell midden deposit. The extent of the shell midden was investigated during the Park remedial investigation. Another cultural deposit was found and documented during construction of the City parks trailhead near the intersection of Timpson Way and Krabbe Drive (Figure 2-1).

Prehistorically, the Little Squalicum ravine was known as Wh-mahl'-ut-choo, a Central Salish word indicating "a place of many springs" (Wahl 2006, pers. comm.). The first historic period land use on the Creek was by Edward Eldridge around 1853, in conjunction with the 320-acre Eldridge Donation Claim. During the late 1800s and early 1900s, most of the area was used by the Eldridge family for dairy farming, ranching, and hay cropping. The mainline BNSF railway that extends along the shoreline of Bellingham Bay was first developed around 1890. The Eldridge family deeded portions of the uplands and tidelands to OPC in 1911 (now the Lehigh Cement Company). These deeds included land for the pier and a railway extending along the west side of the Creek ravine, now a multiuse trail. The pier spur was used to transport processed cement products to barges moored offshore until the 1950s when an over water pipeline was constructed to convey product directly from the plant to barges moored at the pier. An old pump house that supplied water from a spring on the Creek for cement plant use is located downstream of the Marine Drive Bridge stormwater discharge point. The plant discontinued pumping of spring water in the 1950s. The 1911 deed also conveyed the more heavily used "plant spur" to OPC. OPC used the plant spur to transport coal from the Bellingham coal mine to its plant, along with limestone from its pit near Silver Lake.

In 1925, the Eldridge family sold the property now occupied by Oeser to the Utah and Idaho Sugar Company (U&I). The sale included a deeded easement to convey sugar-processing wastes through the Creek into the tidelands of Bellingham Bay. A center line traverse recited in the easement appears to mark the thalweg[12] of the original creek channel. The plant remained in operation into the early 1940s, reportedly closing in 1942. During the 1940s and 1950s, a commercial plant nursery was located to the west of the Creek on Marine Drive.

Localized sand and gravel mining and sorting occurred in the park area between the 1910s and the 1960s. In 1932, the Eldridge family granted the Marietta Township mining rights to the gravel within the ravine west of Marine Drive. Prior to about 1961 or 1962, when the Creek was first straightened, gravel mining occurred only at and downstream of a prominent bank feature extending south from the area where Krabbe Drive and the OPC pier spur intersect. The only exception was minor removals and regrading near the city landfill on the Tiscornia property. From about 1961 until the late 1960s, sand and gravel were extensively mined by the Eiford family. In some places within the ravine over 20 ft of native soils were mined for their sand and gravel. Some of the ditches that were excavated to facilitate drainage remain in place today. Much of the Creek's original course was diverted into these ditches. The entire ravine was altered substantially from natural conditions with rerouting of the original creek bed and significant changes to the soils and lithology (e.g., backfilling of gravel pit and wash pond excavations, temporary road maintenance, and rail bed and track placement). Temporary basins were dug for gravel washing and reportedly filled with groundwater, both seasonally and, in some cases, year-round. The rerouting of the Creek to its current location occurred in 1961–1962 based on available aerial photos. After mining, the land was leased to Mt. Baker Plywood for raw log storage during the early 1970s. Logs were transported to and from the ravine via the beach.

In 1933, the Eldridge family sold a portion of the upper area of the Creek ravine to the Tiscornia family, who used the land for truck farming and a sanitary landfill (Figure 2-1). In the mid to late 1930s, a portion of this area was used as a City "sanitary landfill" for burying of local waste hauled by a garbage collection contractor. The landfill was operated by the Razore family for only a few years before ceasing operations (Superior Court of Washington 1936). The remains of the landfill are located west of the BTC campus parking lot, covering an area of approximately 7,100 ft^2.

A portion of this property in the ravine was acquired by the Eiford family and the upland portion was obtained by the Bellingham School District in 1955, which subsequently deeded the land in 1993 to the Washington State Board for Community Colleges and Technical Colleges. BTC, formerly the Bellingham Vocational Technical Institute established here in 1957, is currently located on this 21-acre site.

[12] The line joining the deepest points of a stream channel.

In 1976, the Whatcom County Park Board acquired 13 acres from the Eiford family, including the majority of the ravine and the 1930s landfill site. About 0.7 acre was sold to BTC by the County, partly in exchange for trail easements through the BTC campus.

Hugh Eldridge deeded the tidelands onto which the Creek flows to the Port of Bellingham in 1927. A 60-ft right-of-way west of the Marine Drive Bridge was deeded to the Port in 1956, but was never developed or used by the Port. The fee to this area (the Eldridge Heirs' Creek Parcel) was purchased by the City in 2001 from the Eldridge heirs.

In the mid 1960s, construction debris and old furnishings were reportedly dumped in a small area near the east boundary of the ravine, which is now a BTC parking lot. Minor amounts of residential and commercial garbage and refuse also may have been placed in this area based on personal communication with City employees and information suggested by a 1963 aerial photo.

In 1977, the City constructed an underground stormwater pipeline through the upper part of the ravine. Stormwater from approximately 3 square miles of the Birchwood neighborhood, including the BTC parking lot, is conveyed through the 36-in. underground pipeline and discharged into the Creek. Since 2002, stormwater from the BTC parking lot is directed through a filtering system (reportedly composted leaf media) before discharging into the Creek. Although water is diverted directly into the Birchwood neighborhood stormwater pipeline during larger rainstorms (greater than 6-month storm), most BTC runoff (approximately 90 percent) is treated before discharging to the Creek (Hunter 2004, pers. comm.).

The City owns 8.7 acres of the Park and leases 12.3 acres of County-owned property at the site. Currently, a lease agreement between the City Parks and Recreation Department and Whatcom County Parks Department stipulates that the City will manage and operate the area as a park site for 35 years (to about 2025), with a renewal provision for another 35 years. This lease was negotiated during the time of EPA's investigation of the Oeser site which included the park site. Due to evidence of contamination, the County retained liability for environmental issues as a provision of the lease.

The Oeser Cedar Company (currently known as the Oeser Company) purchased the nearby U&I property in 1943 and has continuously manufactured poles for utility companies since that date. In records dating back to 1953, the process included segregating poles by length and class, incising some or all of the poles, and subjecting them to "oil treatment" using creosote. Finished poles were shipped offsite by rail on tracks adjacent to the OPC plant spur. In the mid 1950s, the company also started treating wood using 5 percent PCP in an oil-based solvent (Diesel No. 2) (Orthmeyer 2006, pers. comm.). Oeser stopped using creosote to treat wood in the early 1980s; however, PCP treatment continues to be utilized at the facility. A detailed description of the wood-treatment processes used by Oeser is presented in the Oeser remedial investigation (E&E 2002a).

The Oeser site has discharged processed wastewater and/or contaminated stormwater to the Creek since operations began in the late 1940s. The water enters an underground stormwater line that crosses Oeser property and then discharges into the Creek. Storm flows in the Oeser/Birchwood culvert originate in a portion of the residential Birchwood/Alderwood neighborhood lying northeast of the Oeser plant. The Oeser/Birchwood culvert and the flows received from above the plant follow an old creek channel that was apparently filled during construction of the sugar beet plant or for the site's conversion by the Oeser Company. This Oeser/Birchwood neighborhood drainage enters the Creek adjacent to the outfall from the BTC/Birchwood neighborhood drainage to the east (see Figure 2-1). In addition to water, discharges from Oeser have historically been known to contain contaminants such as creosote, PCP, dioxins/furans (associated with PCP), diesel fuels, and related oil products. The wastewater/stormwater permit history for the Oeser site is presented in the Oeser remedial investigation (E&E 2002a). At this time, Oeser has a National Pollutant Discharge Elimination System Waste Discharge Permit (NPDES No. WA 003081-3) that currently allows low levels of PCP and petroleum hydrocarbons in effluent discharged to local stormwater.[13]

In addition to the Oeser outfall, surface water runoff has been observed on at least one occasion to be originating from the Oeser yard and pooling in an area upstream of the "head" of the Creek on the north edge of the Park (Wahl 2004, pers. comm.). The event occurred approximately 18 years ago, and soils and vegetation appeared at the time to be impacted (e.g., stressed vegetation) from the contents of the runoff.

Stormwater drainage from the Birchwood neighborhood (via the Oeser/Birchwood and BTC/Birchwood drainages as well as several small, localized stormwater outfalls) may also be a preferential pathway for petroleum hydrocarbons and heavy metals to reach the Creek. A likely source of these contaminants is from motor vehicle and mixed commercial/residential use throughout this drainage area.

2.3 PREVIOUS INVESTIGATIONS

Historical data that were evaluated for possible inclusion in the current remedial investigation originated from the following investigations (refer to project SAP for more information [Integral 2005c]):

- Site Inspection Report (E&E 1987)
- Site Hazard Assessment (Parametrix 1991)
- Wetland Mitigation Plan at Little Squalicum Creek (DEA 1993)

[13] The daily maximum effluent limitation is 9 µg/L for PCP and 10 mg/L for petroleum hydrocarbons.

- Site Inspection Prioritization Report (URS 1994)
- Expanded Site Investigation (E&E 1996)
- Removal Assessment, Phase II (E&E 1998a,b)
- Oeser RI/FS (E&E 2002a,b)
- Little Squalicum Creek Screening Level Assessment (Ecology 2004).

2.3.1 Site Inspection Report (E&E 1987)

In 1987, four sediment and two unfiltered surface water samples were collected in the vicinity of the Creek (locations JC-351 through JC-355, and JC-358) as part of an Oeser site inspection report performed for EPA (E&E 1987). Semivolatile organic compounds (SVOCs) were analyzed in both media using EPA method 8270. A data quality summary presented in the Oeser remedial investigation indicated that there were only minor problems affecting data usability. The data were not included in the remedial investigation because the data are approximately 20 years old, and conditions in the Creek may have changed.

2.3.2 Site Hazard Assessment (Parametrix 1991)

In 1991, seven soil/sediment and five unfiltered groundwater/porewater samples were collected in the vicinity of the Creek (locations PMX-GW-10 through 15, PMX-SD-01 through 03, and PMX-SS-06 through 09) as part of the SHA (Parametrix 1991). SVOCs (EPA methods 8270 and 8040) and total petroleum hydrocarbon (TPH) (EPA methods 8015 and 418.1) were analyzed in both media. A data quality summary presented in the Oeser remedial investigation indicated that there were several problems that affected data usability, including exceeded holding times and method blank detection limits above sample detection limits. For these reasons, and because the data are approximately 17 years old, they were not used in the remedial investigation.

2.3.3 Wetland Mitigation Plan at Little Squalicum Creek (DEA 1993)

In 1993, a total of 36 test or hand soil pits were dug within the boundaries of the Park as part of the Wetland Mitigation Plan (DEA 1993). Strata in each pit were classified and described using the Unified Soil Classification System. A note was made for each pit regarding whether groundwater was encountered and, if so, at what soil depth and relative volume (see below). In 11 of the pits, soils from at least one stratum were analyzed for moisture content and percent fines. These data were carried forward for use in the remedial investigation because soil strata and groundwater elevation levels are not likely to have changed since the data were collected. The only limiting factors regarding data interpretation are that location maps were hand drawn, and sample location coordinates were not provided in the report.

As part of the Creek Wetlands Compensation Project, Landau Associates conducted a geotechnical evaluation to assist in wetlands and stream channel design within the Park as compensation for wetlands lost during a planned expansion of the Bellingham International Airport (DEA 1993). Landau was a subconsultant to David Evans and Associates (DEA), who was contracted with the Port of Bellingham.

Subsurface conditions were evaluated on the site by excavating 22 backhoe test pits and six hand explorations in October 1992 (Figure 2-4). The depth of these excavations ranged from 1 to 6 ft bgs. Selected soil samples were analyzed for grain size and moisture content. The following observations and conclusions were made by Landau:

- Soil conditions were variable and included clean (low silt/clay content) sand and gravel, silty sand and gravel, and occasional silt and clay units.
- Fill materials including wood, metal, glass, and ash debris were encountered at several locations in the northeast to central portion of the site.
- One location, test pit SC-20, contained significant amounts of glass and other household refuse. This location is near the BTC parking lot.
- Groundwater was encountered at six test pit locations in the northeastern portion of the site ranging from approximately 2 to 5.5 ft bgs.

Most soil appeared to be moderately to highly permeable. As a result, Landau recommended a low permeability liner within the new stream channel location and applicable wetland cells to reduce water loss by infiltration (DEA 1993).

2.3.4 Site Inspection Prioritization Report (URS 1994)

In 1994, 11 sediment samples were collected in the vicinity of the Creek (locations SI-BB01 through -03 and SI-LS01 through -08) as part of the Site Inspection Prioritization Report (URS 1994). SVOCs (EPA method 8270) were analyzed. A data quality summary presented in the Oeser remedial investigation indicated that there were no problems that affected data usability. The data are approximately 14 years old, however, and conditions in the Creek may have changed over time. Furthermore, the depth of sediment collected was not indicated. For these reasons, the data were not used in the remedial investigation.

2.3.5 Expanded Site Investigation (E&E 1996)

Seven sediment, four unfiltered surface water, and three filtered surface water samples were collected in the vicinity of the Creek (locations OS01 through OS07) as part of the expanded site investigation in 1996 (E&E 1996). SVOCs (Method Base Neutral Acid) and metals (Methods Atomic Adsorption [AA], Inductively Coupled Plasma/Mass Spectrometry [ICP/MS], and ICP-RAS [Russian Academy of Sciences]) were analyzed in all media. A data quality summary presented in the Oeser remedial investigation indicated that there were no problems that affected data usability. These data were included in the remedial investigation.

2.3.6 Removal Assessment, Phase II (E&E 1998a,b)

In 1998, three unfiltered surface water samples were collected in the vicinity of the Creek (locations 256, 320, and 343) as part of the Phase II Removal Assessment (E&E 1998a,b) conducted at the Oeser site. SVOCs (EPA methods 8270 and 8270 Selective Ion Monitoring [SIM]) and TPH (Method Northwest Total Petroleum Hydrocarbon [NWTPH]) were analyzed. A data quality summary presented in the Oeser remedial investigation indicated that there were no problems that affected data usability. These data were included in the remedial investigation.

2.3.7 Oeser RI/FS (E&E 2002a,b)

The Oeser remedial investigation (E&E 2002a) was the source for most of the historical data contained within the Park database (Figures 2-2 and 2-3). This study was conducted from 1998 to 2002. Types of data collected in the vicinity of the Creek during the Oeser remedial investigation included groundwater (five locations), berries (two locations), seeps (two locations), springs (one location), subsurface soil leachate (one location), surface water (seven locations), sediment (11 locations), bioaccumulation testing (three locations), surface soil (87 locations), and subsurface soil (12 locations). Most of these media were analyzed for a full suite of analytes, including dioxins, extractable and volatile hydrocarbon fractions (EPH/VPH), TPH, volatile organic compounds (VOCs), SVOCs, metals, and conventionals. The data quality evaluation in the remedial investigation report indicated that all precision, accuracy, representativeness, completeness, and comparability (PARCC) goals were achieved for the remedial investigation field and analytical investigation. Validated analytical precision and accuracy showed that more than 99 percent of all target compound and target analyte data were acceptable for use. These data were used for the Park remedial investigation.

In addition to conventional and chemical analysis, biological testing was conducted as part of the Oeser site remedial investigation (E&E 2002a,) including a 10-day toxicity test with the amphipod *Hyalella azteca* and a 28-day bioaccumulation test with the aquatic oligochaete *Lumbriculus variegatus*. Data quality of the biological testing results was deemed acceptable for use in the remedial investigation by EPA. These data were also used for the risk evaluation in the current remedial investigation.

Groundwater wells (MW-LSC-01 through MW-LSC-04)[14] were installed along the old railroad grade located west of the Creek, and quarterly groundwater samples from these wells were evaluated during the Oeser remedial investigation (E&E 2002a) (Figure 2-3). Groundwater was observed in MW-LSC-01 through MW-LSC-03 a few feet below the ground surface (bgs) and was characterized as a continuous aquifer with connections to the deeper of two zones identified on the Oeser site, located upgradient (north) of this Park area. Soils were described as primarily composed of coarse materials (i.e., sands and gravels).

Groundwater was measured over three sampling events in September 1999, December 1999, and February 2000. The data show that groundwater elevations were significantly higher in the middle well (MW-LSC-02), representing an anomalous mounding of groundwater. MW-LSC-02 appears to be located at the present terminus of the natural overland flow path toward the Creek. This area may represent a preferential groundwater flow path, such as a former stream bed to the Creek.

As part of the Oeser site remedial investigation, a mass balance of surface and storm drain water flowing into and out of the Creek was also conducted by E&E (2002a). They concluded the following:

- The headwaters of the Creek originate with the storm drain outflows from the combined Oeser/Birchwood outfall to the west (north) and the Birchwood/BTC outfall from the east.
- The creek terminates with the culvert that empties onto the beach at Bellingham Bay.
- During the dry season, tapped spring flows account for about one-third of the flow from the Creek.
- During the rainy season, virtually all flow from the Creek can be traced back to stormwater runoff entering the Creek through the three storm drain systems that service the surrounding area (the third being the Marine Drive storm drain).

2.3.8 Little Squalicum Creek Screening Level Assessment (Ecology 2004)

In 2003, Ecology (2004) conducted the most recent pre-remedial investigation, evaluating six surface sediment samples (locations LSC01 through LSC06) and two surface soil samples (LSCS1 and LSCS2) in the vicinity of the Creek. All samples were analyzed for SVOCs using EPA method 8270. Additionally, sediment samples were submitted for bioassay testing, including 10-day amphipod (*Hyalella azteca*), 20-day midge (*Chironomus tentans*), and Microtox®

[14] MW-LSC-04 was installed within 5 ft of MW-LSC-03 but screened at a shallow depth. Groundwater was neither encountered nor sampled in MW-LSC-04 for this or previous investigations.

sediment porewater tests. The chemical data quality was acceptable, though some precision was lost in the analysis of SVOCs because of sample dilutions required due to hydrocarbon interference. Bioassay data were also of acceptable quality. These data were used for the remedial investigation.

3 SUMMARY OF FIELD ACTIVITIES

The following sections briefly summarize the field activities performed to meet the data needs of the Little Squalicum Park remedial investigation. A detailed summary of the field activities and deviations from the work plans and addenda are presented in the field sampling report (Appendix B). A detailed summary of all samples collected and analyzed during the Park remedial investigation field program is presented in Table B-3 of the field sampling report (Appendix B). Figure 3-1 shows all sampling locations completed through January 2008.

3.1 SOIL INVESTIGATION

A total of 31 test pits were excavated, and 42 soil borings and nine hand-auger borings were advanced during the remedial investigation field program in November 2005, February to October 2006, and January 2008 (stations shown along with historical sampling locations on Figure 2-2). Table 3-1 summarizes the number of soil samples collected and analyzed from the test pit stations, hollow-stem auger stations, and hand-auger stations during the soil investigation. Samples not analyzed were archived at the laboratory for possible future analysis.

During the soil investigation, five field change request (FCR) forms summarizing deviation from the work plans or addenda were submitted for approval and accepted. Of these five deviations, two of the more significant changes are discussed in this section (all deviations are discussed in Appendix B). Soil samples were only collected every 5 ft down to 20 ft bgs at station SB-24 because field observations from stations SB-21, SB-22, and SB-23 indicated no contamination above the water table. Soil samples collected from the 0 to 1 ft interval at stations SB-26, SB-27, SB-30, and SB-32 were not analyzed because the stations were located within approximately 100 ft of the Creek in areas where it was determined that sufficient surface soil data existed.

3.2 GROUNDWATER INVESTIGATION

Groundwater samples were collected from three monitoring well or piezometer stations in November 2005, 14 stations in February 2006, and seven stations in May 2006 (Figure 2-3). Table 3-2 summarizes the total number of samples collected and analyzed during each sampling event.

During the groundwater investigation, six FCR forms were submitted for approval and accepted. Of these six deviations from the work plans, three of the more significant changes are discussed in this section (all deviations are discussed in Appendix B). No dioxin/furan samples were collected from piezometers SB-26, SB-27, SB-28, and SB-30 due to the lack of other groundwater contaminants observed in these wells. An equipment rinsate blank was not collected for groundwater sampling equipment because new, disposable, Teflon®-lined low-density polyethylene (LDPE) tubing and silicone tubing and/or disposable Teflon® bailers were used at each station. A groundwater sample was not collected from well LSCMW-01 because the well casing was filled with sand and gravel.

3.3 SURFACE WATER INVESTIGATION

Surface water samples were collected from eight stations in November 2005 and 10 stations from April to May 2006 (Figure 2-3). Samples were collected at locations along the Creek, from a storm water manhole upgradient of the Oeser property, and from a local reference station (Cemetery Creek). Table 3-3 summarizes the total number of surface water samples collected and analyzed during each sampling event.

During the surface water investigations, one FCR form was submitted for approval and accepted. Equipment rinsate blanks were not collected because surface water samples were collected either using new disposable Teflon®-lined LDPE tubing at each station or the sample bottles were filled directly from a stream of water (e.g., outfall).

3.4 SEDIMENT INVESTIGATION

A total of 13 sediment borings (six vibracore stations and seven hollow-stem auger stations) were advanced during the Park remedial investigation fieldwork in February and April 2006 (Figure 2-2). Table 3-4 summarizes the total number of sediment samples collected and analyzed during the Park remedial investigation field program.

During the sediment investigation, three FCR forms were submitted for approval and accepted. A significant deviation from the work plans was that no surface sediment samples were collected as originally planned. Samples were not collected at stations LSC-10, LSC-11, and LSC-12 (at the mouth of the Creek) because fine-grained sediments, which tend to sequester organic contaminants, were not observed at these station locations. Samples were also not collected at stations LSC-07, LSC-08, and LSC-09 because of the extensive sheen observed in the upper reach of the Creek. Surface sediments from these locations were expected to be impacted by a continuous source of petroleum seeping from this area of the Creek.[15]

---

[15] Surface sediment sampling for compliance purposes may be required as part of any remediation of the Creek.

3.5 SHELL MIDDEN BOUNDARY SURVEY

In November 2005, a total of 13 shovel test pits (STP) were dug to delineate the boundaries of a shell midden observed at the site (see Figure 2-2). There were no deviations from the work plans during the shell midden boundary survey.

An archaeological report describing the investigation is provided in Appendix E.

3.6 HISTORICAL LANDFILL BOUNDARY DELINEATION

In November 2005, three test pits (TP-1, TP-2, TP-3) were excavated in the northeastern portion of the Park. Municipal waste was observed in test pits TP-1 and TP-2. In January 2006, a historical landfill was delineated by excavating 25 reconnaissance test pits (RTPs) approximately 2 to 6.5 ft deep (see Figure 2-2). The RTP survey results are presented in the field sampling report (Table B-2 of Appendix B).

Based on the results of the RTP survey, three additional test pits (TP-22, TP-23, TP-24) were excavated within or near the boundaries of the historical landfill for collection of soil samples for analysis (see Figure 2-2). Table 3-5 summarizes the total number of soil samples collected and analyzed during the historical landfill investigation.

There were no deviations from the work plans or addenda during the historical landfill investigation.

4 PHYSICAL AND ECOLOGICAL CHARACTERISTICS OF LITTLE SQUALICUM PARK

This section describes the physical and ecological characteristics of the Park and surrounding areas including meteorology, topography, surface water hydrology, geology, and hydrogeology. These site features are important in the context of nature and extent of contamination and contaminant fate and transport discussed in later sections of the report.

4.1 REGIONAL ENVIRONMENTAL SETTING

The following sections describe the regional environmental setting, including the climate, geology, hydrogeology, topography, and water supply wells.

4.1.1 Climate

Bellingham's climate is influenced by its location between the Olympic Mountains and the Vancouver Island Range to the west and the Cascades Mountain Range to the east, as well as its location on the Strait of Georgia. The Pacific Ocean is the source of moist air masses, which has a moderating effect on all four seasons. The monthly average maximum temperature for January, historically the coldest month of the year, is 6.3°C (43°F) and the average January minimum temperature is –0.2°C (32°F). August is the warmest month of the year with an average maximum of 21.9°C (71°F) and average minimum of 11.8°C (53°F) (WRCC 2006).

The average annual precipitation for Bellingham is 89.7 cm (35.3 in.). The maximum annual rainfall was 119.9 cm, (47.2 in.) which occurred in 1971; the minimum annual rainfall was 56.8 cm (22.3 in.), which occurred in 1952 (WRCC 2006). July is historically the driest month with an average precipitation of 1.18 cm (0.5 in.), and January is the wettest month with an average of 12.9 cm (5.1 in.). Measurable snowfall generally occurs between November and March, averaging 34.8 cm (13.7 in.) per year, with a maximum of 109 cm in 1971 (42.9 in.) (WRCC 2006). The average annual wind directions are predominantly from the southwest and southeast (E&E 2002a).

4.1.2 Regional Geology and Geological History

The geologic units underlying the Park site are Pleistocene glacial outwash deposits resulting from a series of glaciations that occurred between 10,000 and 2 million years ago. During this time, the Puget lobe of the Cordilleran glacier covered the Puget Sound lowlands at least six times. The Quaternary history of Puget Sound Lowlands is marked by three early Pleistocene to late Pliocene glaciations. They are referred to as the Orting, the Stuck, and Salmon Springs, which are separated by interglacial periods represented by the Alderton and Puyallup Formations (Easterbrook 1994). There were two pre- to late-Wisconsin glaciations, the Double

Bluff and Possession, which are separated by an interglacial period called the Whidbey Formation (Easterbrook 1994). The most recent (ending approximately 13,650 (+/- 550) years ago in the Seattle, Washington area) and best understood of these six glacial periods is the Vashon Stage of the Fraser Glaciation (E&E 2002; Booth and Goldstein 1994)

Each glacial advance and retreat, or episode, is characterized by a drift sequence. A complete drift sequence, from bottom to top, typically comprises advance outwash, glacial till, and recessional outwash. Advancing and retreating glaciers have meltwater streams issuing from the front and margins. These stream deposits are predominantly sand and gravel. Due to the nature of glaciers advancing and retreating in response to climatic and other changes, these outwash deposits cover large areas (E&E 2002a).

Advance outwash is deposited from streams originating from the glacier as it advances, and conversely, recessional outwash is deposited by retreating glaciers. Recessional outwash is similar to advance outwash except that it has not been overridden by the advancing ice. Thus, recessional outwash is less compact than advance outwash. Based on the results of soil borings performed by E&E at the Oeser site, it was determined that the underlying outwash deposits observed at the site are most likely to be recessional because they are not well compacted (E&E 2002a). This was confirmed in borings drilled during the Park remedial investigation.

4.1.3 Regional Hydrogeologic Units

The Puget Sound Lowland is divided into three large subareas: the Fraser-Whatcom Basin, the north-central Puget Sound Lowland, and the southern Puget Sound Lowland (Jones 1999). The Park site lies within the southern portion of the Fraser-Whatcom Basin.

The hydrogeologic units of the Puget Sound Aquifer system primarily include unconsolidated Quaternary deposits, which consist of alluvium, glacial and interglacial deposits. The Puget Sound Aquifer system was divided by the U.S. Geological Survey (USGS) into regional hydrogeologic units: the alluvial valley aquifers, the surficial semiconfining unit, the Fraser aquifer unit, the confining unit and the Puget aquifer (Jones 1999).

The regional hydrogeologic units in the Bellingham area, from youngest to oldest, are primarily (Jones 1999):

- Alluvial deposits
- Bog, marsh, and peat deposits
- Vashon recessional outwash deposits
- Till deposits
- Vashon advance outwash deposits

- Pre-Fraser undifferentiated non-glacial deposits
- Pre-Fraser undifferentiated glacial deposits
- Bedrock.

The Puget Sound Aquifer system is composed of highly variable layers of alluvial, glacial, and interglacial deposits. The USGS has designated regional hydrogeologic units in order to describe groundwater flow on a regional basis. The units are the alluvial valley aquifers, the surficial semiconfining unit, the Fraser aquifer, the confining unit and the Puget aquifer (Jones 1999). The hydrogeologic unit beneath the Bellingham area and more specifically that which appears to underlie the Park site is the Fraser aquifer. The Fraser aquifer generally consists of the Vashon advance outwash and proglacial deposits, and generally represents the uppermost water-table aquifer. This aquifer unit also includes the surficial recessional outwash deposits and other local coarse-grained hydrogeologic units. In the Fraser-Whatcom basin, the Fraser aquifer consists predominantly of the Sumas drift.

4.1.4 Topography of Site and Surrounding Area

Most of the Park is located within a ravine, with the top of the ravine at about 65 ft North American Vertical Datum (NAVD 88) and the bottom ranging from 20 to 30 ft NAVD 88. The ravine extends west-northwest for about 550 ft, and then turns to the southwest for about 700 ft, runs south-southwest for about 950 ft beneath the Marine Drive Bridge, and ends at Squalicum Beach on Bellingham Bay (E&E 2002a).

The ravine is bounded on the south and east by Bellingham Bay, multiple-residential, single-residential, and public (BTC) developed lands. The head of the ravine is bounded on the north by an undeveloped light impact industrial area. The area northwest of the ravine to the Marine Drive Bridge is mostly undeveloped, but zoned as light impact industrial. The area south and west of the bridge is a developed urban residential zone (E&E 2002a). A broad relatively flat area extends within the ravine, which was the location of a series of former gravel mining operations.

The Creek used to receive the majority of inflow from the south and easterly parts of today's Birchwood neighborhood via a channel that originated near today's Bakerview Road and I-5 intersection. This creek (shown on the 1908 U.S. Geological Survey [USGS] map) was apparently diverted in the 1910s or 1920s, perhaps involving operations of the Bellingham coal mine. Extensive mining and groundwater conveyance at the nearby Pacific Concrete Company site may also have contributed to dewatering of the lower reaches of the Creek.

The present headwaters of the Creek originate at the 36-in. diameter Oeser/Birchwood stormline that issues from the south side of the active railroad tracks immediately north of the Park (see Figure 2-3, surface water stations 256, 320, and 343). The Creek runs along a ravine and travels through a large square concrete culvert beneath the former railroad grade (now a park trail) and turns southwest near the BTC/Birchwood neighborhood outfall. The Creek runs southwest for about 800 ft and then turns south-southwest for about 950 ft and ends at Squalicum Beach on Bellingham Bay (E&E 2002a). An ephemeral wetland located in the southeastern portion of the Park was once the location of the "big bend" of the Creek before it was rerouted to its current course in the early 1960s.

4.1.5 Public and Private Water Supply Wells

A well log search of a 1-mile radius around the Park site was conducted using Ecology's well search engine at http://apps.ecy.wa.gov/welllog/. No water supply wells were identified and all homes and businesses are believed to be connected to the municipal water supply. The City of Bellingham supplies its customers with water from Lake Whatcom, located about 6.5 miles east of the Park.

Prior to the late 1980s, OPC supplied drinking water to approximately seven employees and 14 nearby residents (E&E 2002a). OPC (currently Lehigh Cement Co.) discontinued supplying water to nearby homes in early 1988. The use of two tapped springs located on the north side of the Creek, near the Marine Drive Bridge, was discontinued in the 1950s. Water flowing from the springs into the Creek was observed during field operations in support of the remedial investigation.

4.2 SITE SOILS AND GEOLOGY

The site has been used for a number of operations since it was developed in the 1850s, including sand and gravel mining from the 1910s to the 1960s on the southeast side of the Creek (Section 2.2). As a result of the mining activities, the topography on the southeast side of the Creek is relatively flat and lower than the northwest side of the Creek. In some places within the ravine, over 20 ft of native soils were mined for sand and gravel. A shell midden was discovered on the northwest side of the Creek between the Marine Drive Bridge and the mouth of the Creek, indicating that this area has not been disturbed (see Section 4.6 and Appendix E).

A total of 50 soil/sediment borings were advanced as part of the Park remedial investigation field program at depths ranging from 2 to 44 ft bgs using a hand auger, vibracorer, standard hollow-stem auger drill rig, track hollow-stem auger drill rig, and a portable hollow-stem auger drill rig (see Figure 2-2). A total of 31 test pits were excavated for sample collection using a mini track-excavator at depths ranging from approximately 3 to 6 ft bgs (see Figure 2-2). In addition, a total of 25 reconnaissance test pits were excavated to delineate the extent of the historical landfill in the northeastern portion of the site (see Figure 2-2). A detailed description of the methods that were used for the soil borings is presented in the field sampling report (Appendix B).

4.2.1 Stratigraphic Units

A generalized description of the major lithologic units observed at the Park site is presented in Table 4-1. Cross-section location lines are shown on Figure 4-1. Cross-sections A-A′ through C-C′ show the lithologic units in the upper portion of the Creek (Figures 4-2 through 4-4). Borehole and test pit logs are provided in Appendix B.

The sand and gravel unit is thickest along the former railroad grade where sand and gravel mining activities have not been conducted and is generally thinner on the southeast side of the Creek where historical mining has occurred (cross-sections A-A′ through C-C′; Figures 4-2 to 4-4). Numerous, thin, discontinuous silt and sand layers are present near the current creek channel, which may represent recent alluvium deposited by the Creek.

A gray clay layer underlies much of the Upper Creek area. The thickness of the clay layer varies greatly and ranges from less than 0.1 ft at station SB-31 to over 6 ft at well MWLSC03 (see cross-sections A-A′ through C-C′; Figures 4-2 to 4-4). The top of the clay layer generally slopes to the southwest (Figure 4-5). The clay layer thickens and an apparent mound is present in the vicinity of borehole SB-15 (Figure 4-5). Based on review of aerial photographs, this mound is likely the remnants of a ridge that was removed for its sand and gravel in the late 1930s. The clay layer thins and an apparent depression is present in the vicinity of piezometer SB-27. The clay layer was not encountered in any borings in the Lower Creek area.

4.2.2 Underground Utilities

Seven culverts extend across the site that discharge stormwater to the Creek (see Section 4.4.2). In addition, two major underground utilities have been identified at the Park site. A water main is present beneath and trending parallel to the Marine Drive Bridge. A fiber optics cable is present beneath and trending parallel to the BNSF Railroad trestle near Bellingham Bay.

4.3 GROUNDWATER

The following sections describe groundwater flow and natural springs at the Park site, and aquifer tests and infiltration rate calculations performed by E&E (2002a) for the Oeser site.

4.3.1 Groundwater Flow

Groundwater maps for February and May 2006 are presented in Figures 4-6 and 4-7, respectively. A number of additional piezometers were installed on the southeast side of the Upper Creek between the February and May 2006 monitoring events. Accordingly, the discussion will focus on the May 2006 monitoring event because of the additional data points covering a larger area of the site (Figure 4-7).

In May 2006, groundwater was generally present from approximately 38 to 41 ft bgs beneath the Oeser site, from 20 to 30 ft bgs beneath the former railroad grade, and from 0 to 8 ft bgs near and to the southeast of the Creek. In May 2006, groundwater elevations ranged from 43.83 ft at upgradient well MW-06D to 11.82 ft NAVD 88 at SB-18. Groundwater was observed flowing slowly over the top of the casing of piezometer SB-19, which is approximately 0.2 ft bgs. Hydraulic gradients ranged from approximately 0.01 to the northeast of the Park site (i.e., between MW-06D and MW-33D) to approximately 0.017 across the Park site in May 2006. The hydraulic gradient is relatively flat between wells LSCMW-2 and SB-24, just north of the Marine Drive Bridge, and between wells MW-30D and MW-33D on the Oeser site. Groundwater flow is generally to the southwest toward Bellingham Bay, with some small local variations on the southeastern side of the Creek north of the Marine Drive Bridge.

In February 2006, groundwater elevations were generally slightly higher than in May 2006, but the hydraulic gradients and flow directions were similar. The higher groundwater elevations in February are explained by the greater rainfall during this time of year.

The hydraulic gradients and flow directions in deep zone groundwater (i.e., the groundwater zone present at the Park site) reported by E&E for the Oeser site were generally similar to those observed during the Park investigation (E&E 2002a; Figures 3-26 through 3-29; Appendix H). Note that additional wells on the Oeser site were used by E&E for the groundwater maps in the Oeser remedial investigation report that were not accessible during the Park remedial investigation. Also note that the elevation of well LSCMW-03 reported by E&E (2002a) (50.17 ft NAVD 88) was approximately 3.5 ft lower than the top of casing elevation surveyed during the Park remedial investigation (53.65 ft NAVD 88). This well was surveyed twice during the Park remedial investigation to confirm the correct elevation. This discrepancy significantly affects the groundwater contours on the E&E (2002a) groundwater maps in the vicinity of well LSCMW-03 (Appendix H).

4.3.2 Natural Groundwater Springs

Two natural springs located on the north side of the Creek may have been tapped and used for the historical cement operation at the Park site. One spring is located just north of the Marine Drive Bridge (Tapped Spring 1 in Figure 1-8 of E&E 2002a) and the other possible tapping point of spring water is located in the Lower Creek adjacent to SB-19 and SB-20 (Tapped Spring 2 in Figure 1-8 of E&E 2002a). The use of the spring water was discontinued in the 1950s, and the springs presently discharge to the Creek (E&E 2002a). Flow from both springs was observed during field operations in support of the Park remedial investigation.

Flow from the tapped springs was estimated by E&E (2002a) on three occasions (September 1999, December 1999, and March 2000). The flow from Tapped Spring 1 ranged from 3 to 30 gallons per minute (gpm) and the flow from Tapped Spring 2 ranged from 8 to 60 gpm. The low flow rates were measured during the dry season (i.e., September 1999) and the high flow rates were measured during the wet season (i.e., on March 2000).

4.3.3 Infiltration Rate Calculations for the Oeser Site

Infiltration rate calculations were conducted for the Oeser site to estimate the quantity and timing of recharge to the deep aquifer (E&E 2002a). A spreadsheet model based on algorithms used in the USGS Deep Percolation Model (Bauer and Vaccaro 1987) was used to estimate deep aquifer recharge at the Oeser site. Infiltration to the water table beneath the site was estimated to be about 16 in. per year (E&E 2002a). Groundwater at the Park site is expected to be recharged upgradient and at the site at rates similar to those calculated for the Oeser site.

4.3.4 Aquifer Tests and Groundwater Flow Velocity at the Oeser Site

E&E (2002a) performed hydraulic conductivity tests in several wells screened in the deep groundwater zone at the Oeser site, which is the groundwater zone present at the Park site. Hydraulic conductivity is a measure of the permeability of an aquifer for a specific fluid (i.e., groundwater). The tests consisted of short-term (i.e., approximately 30-minute), constant-rate pump tests. Transmissivity values were collected for a total of seven deep groundwater zone wells (MW05-D, MW17-D, MW23-D, MW24-D, MW25-D, MW33-D, and MW35-D). Transmissivity is a measure of the flow rate of groundwater through a vertical strip of aquifer one unit wide, extending the full saturated thickness of the aquifer, under a unit hydraulic gradient. The units of transmissivity are length^2/time. Transmissivity is defined by the following relationship:

Eq. 1 $$T = K*b$$

Where K is the hydraulic conductivity (units of length/time; sometimes reported in units of gallons per day per ft^2) and b is the aquifer thickness (units of length).

Transmissivity values were calculated for each short-term pump test conducted at the site. The transmissivity values ranged from about 800 gallons per day per foot (gpd/ft) to >5,000 gpd/ft, with a geometric mean of approximately 2,900 gpd/ft (E&E 2002). The geometric mean of the hydraulic conductivity values is approximately 300 gpd/ft^2 (E&E 2002a). A hydraulic conductivity value of 300 gpd/ft^2 (40 ft/day) is in the range of clean sand (i.e., sand with little or no fines) (Freeze and Cherry 1979).

E&E (2002a) calculated an average linear groundwater velocity for the Oeser site. The average linear velocity is defined by the following relationship:

Eq. 2 $v_{ave} = (-K/n)*(dh/dl)$

Where n is the effective porosity (unitless) and dh/dl is the hydraulic gradient (unitless).

An average linear velocity of groundwater of approximately 2 ft per day was calculated for the deep groundwater zone at the Oeser site using an average hydraulic conductivity value of 300 gpd/ft^2 (40 ft/day), an average hydraulic gradient of 0.009, and an effective porosity of 0.2.

An average linear velocity of groundwater was not calculated for the Park site because aquifer tests were not performed on the Park wells. The groundwater velocity for the Park site is expected to be similar or lower than the value calculated for the Oeser site since the Park site generally has finer-grained soils than the Oeser site.

4.4 SURFACE WATER

A permanent wetland area is present to the northeast of the headwaters of the Creek (see Figures 2-3 and 4-1; surface water sampling station SW-07 is located near the eastern portion of the wetland). Most of the wetland area is present year round. The wetland is not currently connected with the Creek but may have been in the past based on review of aerial photographs. The wet area south of the Creek is considered a palustrine wetland with standing surface water observed during much of the year except in the summer months. This area was the Historical Creek channel, before the waterway was diverted to its present course in the early 1960s.

The Creek flows across the site from northeast to southwest. The headwaters of the Creek originate at the 36-in. diameter stormline that issues from the south side of the active railroad tracks immediately north of the Park (see Figure 2-3, see surface water stations 256, 320, and 343). This stormline conveys water from the Oeser site and the Birchwood neighborhood. The Creek terminates at the south end of the site through an approximate 36-in. diameter-concrete culvert and onto the beach at Bellingham Bay (see Figures 2-3 and 4-4).

The following sections describe the history and surface water hydrology of the Creek.

4.4.1 Current and Historical Creek Channels

Prior to development of the surrounding area, the Creek was fed by springs and natural waterways (E&E 2002a). The Creek has been rerouted twice in the past, in approximately 1907 and in the early 1960s. Sometime after 1907, the easterly and main branch of Little Squalicum Creek, originating near today's Bakerview I-5 interchange, was diverted from its historical channel near Birchwood Avenue, probably to Squalicum Creek or to the operations of the Bellingham Coal Mine (USEPA 1997). A vestige of the flow from the historical easterly channel currently enters the open channel of Little Squalicum Creek in a concrete culvert from the Oeser/Birchwood neighborhood. This diversion would have significantly reduced the volume of water flowing in the Creek. The native materials observed beneath the historical landfill (particularly the organic-rich silts) suggest this area may have been a meander or bend of the pre-1907 creek channel (see log for test pit TP-23 in Appendix B).

Based on aerial photographs taken in 1955, 1961, and 1963, the remaining (shortened) creek channel was straightened north of the Marine Drive Bridge to its current configuration in 1961 or 1962 (see Figure 3-1 for the current and approximate Historical Creek channel locations). The new creek channel was apparently excavated, and the excavation spoils were placed in piles on the southeast side of the channel, which was relatively flat. The creek channel was likely straightened to accommodate gravel mining in areas north of the Marine Drive Bridge. A small amount of water was observed flowing through the Historical Creek channel during the Park remedial investigation field work.

4.4.2 Outfalls Flowing into the Creek

Within the remedial investigation site area, the creek is presently fed by nine known outfalls that convey either stormwater or surface water to the Creek (see Figure 2-3). Five of the outfalls were identified in the Oeser remedial investigation report. These outfalls include the Oeser/Birchwood outfall (upstream of station SW-05) and BTC/Birchwood neighborhood outfall (station SW-06) located near the headwaters of the Creek, an outfall or spring discharge located upstream of the Marine Drive Bridge, the Marine Drive Bridge outfall (station SW-04) located immediately north of the Bridge which conveys stormwater from Bennett Drive and Birchwood neighborhood, and the outfall located near piezometers SB-19 and SB-20 and a spring in the Lower Creek area.

Four additional outfalls were confirmed in the Park during the remedial investigation field program. Two of the outfalls are located just north of Lindbergh Avenue, discharging to an area thought to represent the Historical Creek channel prior to 1961 or 1962 (see Figure 2-3). It was concluded that these outfalls were connected to catch basins on Lindbergh Avenue and the portion of BTC near the outfalls (see station SW-12, Figure 2-3). The third outfall was identified on the southeast side of the Creek just north of the Marine Drive Bridge. This outfall conveys water from the Historical Creek channel to the present location of the Creek (SW-11). The outfall conveys water beneath the gravel access road. A fourth outfall is located near the BTC parking lot and has been observed to periodically discharge stormwater into the permanent wetland located in the northeast area of the site (near surface water station SW-07).

4.4.3 Groundwater Discharge/Recharge to the Creek

The creek flows year round in its lower reaches (URS 1994) where groundwater discharge occurs (E&E 2002a and observations made during the field investigation). Springs discharge in the lower reaches of the Creek; one just north of the Marine Drive Bridge was historically tapped and piped about 250 ft south of the Marine Drive Bridge to a pumping station

(Section 4.3). As part of the Oeser remedial investigation, stilling wells[16] were placed in the Creek adjacent to wells MWLSC03 (LSC SW01) and MWLSC02 (LSC SW02). At stilling well LSC SW01, the stream stage varied between 1.5 and 4 ft above the groundwater elevation at nearby well MWLSC03, suggesting this portion of the Creek is a losing stream (E&E 2002a; Appendix H). At stilling well LSC-SW-02, the stream stage was typically 5 ft below groundwater levels in nearby well MWLSC02, suggesting this portion of the Creek is a gaining stream (E&E 2002a).

4.4.4 Creek Mass Balance

A mass balance of surface and storm drain water flowing into and out of the Creek was conducted as part of the Oeser remedial investigation. The mass balance concluded that during the dry season, tapped spring water accounts for about one-third of the flow from the Creek (E&E 2002a). During the wet season, nearly all flow from the Creek can be traced back to stormwater runoff through the storm drain systems that convey water from the surrounding area (E&E 2002a). Additional details on the mass balance calculations are presented in the Oeser remedial investigation report (E&E 2002a).

4.5 SEDIMENT

A total of 13 sediment borings (i.e., SB-2, -3, -5, -10, -15, -16, -19, and -34 through -39) were advanced as part of the Park remedial investigation to depths ranging from 1.5 to 8 ft bgs using a hand auger, track hollow-stem auger drill rig, portable hollow-stem auger drill rig, and a portable vibracore sampling device (see Figure 2-2). A detailed description of the methods that were used for the sediment borings is presented in the field sampling report (Appendix B). Borehole logs are also provided in Appendix B.

Sediment observed in the present creek channel consists primarily of sands and gravels, with some fine-grained, organic-rich deposits in the Lower Creek area. Sediment in the Historical Creek channel consists of fine-grained sands, silts, and clays (some organic-rich) that are presumably underlain by sand and gravel deposits based on information from other borings in the area. The shallow, fine-grained materials likely represent recent alluvium deposited by the current or Historical Creek.

[16] Stilling wells were constructed by laterally imbedding a slotted PVC pipe across the stream channel and by connecting it by an elbow to a stilling well on the bank of the stream (E&E 2002a).

4.6 SHELL MIDDEN BOUNDARY SURVEY

A shell midden deposit was first discovered by Ecology staff in 2003 along the western bank of the Creek. The presence of a potentially significant archaeological site requires that cultural resources be addressed before starting any intrusive activities. An archaeological site survey was conducted from November 3 to 5, 2006, within the Creek ravine of the Park by Dr. Gary C. Wessen, of Wessen & Associates, Inc. The archaeological survey was conducted in accordance with the work plan. A detailed report of the findings was prepared by Wessen & Associates and is included in Appendix E. The following is a brief summary of the findings and conclusions from the survey.

Much of the Holocene soil, form, and character of the ravine were removed and altered by historic gravel mining and other industrial activities. Based upon the disturbed nature of the site, the possibility of discovering potentially significant archaeological resources in this area is considered very low. From the archaeological survey, which included 13 shovel test pit excavations (see Figure 2-2), it was determined that the only area with archaeological significance was the shell midden site discovered by Ecology staff in 2003. The site boundaries were determined to be approximately a 16-m (52.5-ft) by 7-m (23-ft) area marked by shell debris.

The shell midden site has been assigned the Smithsonian Number 45WH740. The Archaeological Site Form for 45WH740 is included in Appendix E. This form provides the location and a brief narrative description of site 45WH740. It was determined that prehistoric archaeological materials representing a shell midden deposit, dating about 1,500 years ago or possibly sooner, are clearly present in the shell midden site area. However, important questions about its significance remain and are not resolvable with the current data.

Based on the field observations of the shell midden site, Wessen &Associates, Inc. determined that the area of 45WH740 was relatively small and recommended that the environmental assessment would need to avoid the area. They also recommended that any future plans for the Park should avoid disturbance of this area. With these protections in place, further study of the site would not be needed at this time. If, however, future plans for the Park call for impacts to site 45WH740, further study would be needed. The remaining areas of the Park ravine have been extensively disturbed, and the archaeologists believe that the remaining deposits in these areas have virtually no prospect of containing significant archaeological resources[17].

[17] A second archaeological site was discovered during the construction of the parking lot and access trails to the Park. This shell midden site has been assigned the Smithsonian Number 45WH726.

4.7 HISTORICAL LANDFILL BOUNDARY SURVEY

The following sections provide background information and summarize the results of the historical landfill boundary survey.

4.7.1 Background

City records indicate that in 1936 the Marietta Township litigated against the City of Bellingham, the City Sanitary Service, and the Razore family over the effect of the landfill, located in the vicinity of the Park, on nearby residential areas and potable spring water (No. 23970; filed June 20, 1936, in the Superior Court in the State of Washington). According to court documents, the landfill material consisted of garbage and tin cans and was operating when the case was litigated in 1936. According to the Findings of Fact and Conclusions of Law (filed August 1, 1936 in the Superior Court in the State of Washington), the garbage in the landfill was to be covered immediately with approximately 2 ft of earth, leaving an exposed end of the landfill not to exceed 25 ft in length and 6 or 7 ft in width.

An article in the Bellingham Herald, dated July 21, 1936, reported that during the proceedings of the lawsuit, landfill owner Jose Razore testified that roughly 25 to 30 cubic yards (cy) of municipal garbage were dumped daily by the company (E&E 2002a). The article also stated that refuse from the nearby sugar plant was also being dumped into the ravine.

4.7.2 Boundary Survey

In November 2005, test pits TP-1 and TP-2, located at the northeast corner of the Park near the BTC parking lot, were excavated, and municipal garbage and debris were observed in the upper 4 ft of soils in both test pits (see Figure 2-2; test pit logs are provided in Appendix B). Materials encountered included intact bottles possibly dating back to the 1920s and 1930s, unidentifiable metal fragments, ash materials, and construction debris, among other materials. Material typical of municipal waste was observed to be more extensive in TP-1, including a distinct "garbage odor" in the upper portions of the excavation. After consultation with Tim Wahl of the City, this area of the Park was tentatively identified as the Razore City Landfill.

In January 2006, a total of 25 RTPs were excavated to delineate the boundary of the historical landfill (see Figure 2-2). The RTPs were initially excavated on 50-ft centers around test pit TP-01, where evidence of municipal garbage was first discovered. Additional test pits were excavated at the discretion of the field geologist to delineate the lateral extent of the historical landfill, including the area around test pit TP-2. The RTPs were excavated to a depth of approximately 2 to 6.5 ft bgs. Field notes were taken with regard to whether or not municipal garbage or debris was encountered, but the soils were not logged or collected for chemical analysis. Observations from the reconnaissance test pits are presented in Table B-1 of the field sampling report (Appendix B).

Evidence of municipal garbage was found in RTP-2, -3, -5, -6, -10, -16, -17, -18, -19, -22, and -24 (see Figure 2-2). The types of municipal garbage observed consisted of glass bottles, metal scraps, drywall, rust, charcoal, ash, and ceramics. Municipal garbage was observed from approximately 0.5 to 5 ft bgs. The area of the historical landfill is estimated to be approximately 7,000 ft^2, based on visual observations of the contents from the reconnaissance test pits.

In January 2006, test pits TP-22 and TP-23 were excavated within the estimated boundaries of the historical landfill for collection of soil samples for analysis (see Figure 2-2; test pit logs are provided in Appendix B). Metal and glass debris were encountered from 0.5 to 4.5 ft bgs and 2.5 to 4 ft bgs in test pits TP-22 and TP-23, respectively. A third test pit TP-24 was excavated outside the limits of the Landfill area for confirmation purposes. No debris was observed in TP-24.

4.8 FLORA AND FAUNA

The Park is an undeveloped tract of land bordered by Bellingham Bay, industrial sites including the Oeser facility, BTC, municipal roads, and abandoned and active railroad tracks. Currently, the Park is managed by the City for recreational use. The Park contains upland, lotic,[18] palustrine,[19] and intertidal habitats. These habitats are discussed in detail in the following sections. While these habitats vary in characteristics such as water regimes and soils, they support similar potential ecological receptors.

No state or federal listed Endangered Species Act (ESA) endangered, threatened, or candidate species of concern (e.g., bald eagle) were observed in the Park. The potential presence of other species cannot be ruled out.

4.8.1 Upland Habitat

The upland habitat is represented in most areas of the Park, including the South Slope area and non-lotic portions of the Lower Creek. It is vegetated with grasses, forbs, horsetails, blackberry and snowberry brush, and dogwood, hawthorn, alder, cherry, and apple trees. Increased light levels in areas near the railroad support thistles (*Cirsium* spp.), goldenrod (*Solidago* spp.), burdock (*Arctium minus*), and other successional vegetation. A plant species list was compiled in 1990 and incorporated into the Whatcom County Park Board's Little Squalicum Park Site Management Plan.

---

[18] Lotic refers to flowing freshwater systems such as rivers and streams.

[19] Palustrine refers to non-tidal wetlands dominated by trees, shrubs, persistent emergent macrophytes, emergent mosses, or lichens.

The upland habitat provides cover, shelter, and food for wildlife; several bird and mammal species were observed in this habitat during 2005 and 2006 site visits, including American robins, barred owls, red-winged blackbirds, swallows, cottontail rabbits, grey squirrels, raccoons, and black-tail deer.

4.8.2 Lotic Habitat

The lotic area of the Park is defined by the Creek channel, which occupies a forested ravine. The creek channel width varies between approximately 1 m (3.3 ft) and 2 m (6.6 ft), and the Creek is generally less than a third of a meter (1 ft) deep (E&E 2002a). Four stormwater outfalls, two springs, and several seeps feed the stream; the Upper Creek (upstream of the Marine Drive overpass) is a losing stream while the Lower Creek (downstream of the Marine Drive overpass) is a gaining stream. The creek's minimum and maximum flows were measured as less than 0.1 cfs and 4.1 cfs, respectively (E&E 2002a). Where the Creek's current is noticeable, the substrate is typically composed of gravels; in slower parts of the stream, the substrate is muddy. Aquatic insects abound in the Creek and captive pools; examples include water striders (family Gerridae) and mosquitoes (family Culicidae). Similarly the Creek supports a benthic invertebrate community containing amphipods, snails, caddisfly larvae, midge larvae, and oligochaetes (E&E 2002a). Use of the Creek by fish is thought to be limited, though salmon fingerlings have been spotted periodically in the Creek's lower reaches (E&E 2002a). The forested channel is predominantly vegetated by alder, willow, sycamore maple, bigleaf maple, and black cottonwood trees; grasses; and horsetails. Notable invasive species are Himalayan blackberry, English clematis, holly, and hawthorn. Less common species include cherry laurel, western red cedar, and *Viburnum* sp. The lotic area of the Park provides cover, shelter, food, and drinking water for wildlife.

4.8.3 Palustrine Wetland

A portion of the Creek channel was historically designated a palustrine, scrub-shrub/emergent, seasonally-flooded wetland in the National Wetland Inventory (USFWS 1987). Additionally, much of the lower area of the Park comprises other types of palustrine wetlands, including saturated alder/cottonwood-forested wetland, seasonally flooded alder/cottonwood-forested wetland, semi-permanently flooded, alder/cottonwood-forested wetland, saturated dogwood/blackberry-scrub/shrub wetland, persistent, saturated rush/sedge/grass-emergent wetland, and non-persistent, permanently flooded rush/sedge/grass-emergent wetland (E&E 2002a). Other vegetation noted in wetland areas during 2005 and 2006 site visits included ferns, morning glory, and various herbaceous pioneer species. The moist, organic soils within the palustrine areas of the Park support several invertebrate species, including arthropods such as insects, spiders, millipedes, earthworms, and other soil invertebrates. Although public footpaths cross the palustrine areas of the Park, many areas remain undisturbed and likely provide cover, food, and shelter to a variety of avian and mammalian wildlife. Species reported or seen in the palustrine area include Cooper's hawks (*Accipiter cooperii*), barred owls (*Strix* *varia*), crows (*Corvus brachyrhynchos*), gulls (family Laridae), American robins and other song birds, deer, raccoons, and squirrels. Sites included in the palustrine classification are the Historical Creek, the forested wetland, the Landfill, and non-lotic portions of the Creek.

4.8.4 Intertidal Habitat

The Park is bordered by intertidal beach habitat and saline water of adjacent Bellingham Bay. This beach is characterized by a gravelly substrate and it supports backshore grasses, forbs, and willow (probably *Salix alba*). Eelgrass (*Zostera marina*) grows in the intertidal sediments directly offshore. The trees and nearby concrete company dock provide perches for several bird species, including gulls, terns, crows, songbirds, and swallows. Few data were collected from this area.

5 NATURE AND EXTENT OF DETECTED CHEMICALS

This section presents the results of chemical, biological, and geotechnical tests performed on samples collected and evaluated for the remedial investigation. Tests for chemical and physical properties were performed on groundwater, soil, surface water, and sediment samples within the boundaries of the Park and from background locations. Biological tests were conducted on selected surface sediment samples located in the Creek during previous investigation of the site. These analyses are necessary to evaluate the type, distribution, transport, and fate of chemicals as well as the risks to human health and the environment associated with these chemicals. Geotechnical tests were conducted to evaluate the engineering properties of soils and sediments in the Park for remedial alternatives analysis and design in the feasibility study.

Validation of the analytical laboratory data was completed by EcoChem using EPA's Laboratory Data Validation Functional Guidelines for evaluating both organic and inorganic analyses (USEPA 1999, 2002) and followed data quality requirements presented in the QAPP (Integral 2005b). Additional guidance for validation of the dioxin/furan data is documented in EPA Region 10 SOP [Standard Operating Procedure] for the Validation of Polychlorinated Dibenzodioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) Data (USEPA 1996). A brief evaluation of data quality is presented in Section 5.1. This section also includes a brief evaluation of field quality control samples (e.g., field and equipment rinsate blanks and field duplicates). Data quality evaluation reports, which provide detailed information on the quality of data, are presented in Appendix C. Section 5.2 summarizes the sources of data used in the remedial investigation and delineates site areas based on field observations and testing results. Sections 5.3 through 5.6 describe the nature and extent of detected chemicals in soil, groundwater, surface water, and sediments, respectively.

5.1 DATA QUALITY AND USABILITY

This section discusses the overall data quality and usability for the samples collected as part of the Park remedial investigation. Data quality indicators, such as the PARCC parameters (i.e., precision, accuracy, representativeness, completeness, and comparability), are initially described, followed by summaries of the field quality assurance results and the qualified data.

Data generated in the field and at the laboratories were verified and validated according to the criteria and procedures described in the QAPP (Integral 2005b). Data quality and usability were evaluated based on the results of the data validation and the measurement quality objectives (MQOs) described in the QAPP. The performance criteria in the QAPP included project analytical goals for the PARCC parameters of the data, which were assessed during data validation and are briefly discussed below.

Precision reflects the reproducibility between individual measurements of the same property, and is assessed using the results of matrix spike duplicates, laboratory duplicates, and field replicates. Accuracy, or bias, represents the degree to which a measured concentration conforms to the reference value, and is assessed using the results of matrix spikes, laboratory control samples, laboratory method blanks, and field blanks. Representativeness is the degree to which data represent a characteristic of an environmental condition, and is assessed by evaluating the sampling design and collection procedures. Completeness represents the calculated ratio of usable data to requested data, and is expressed as a percentage. Comparability is an evaluation of the extent to which different data sets can be combined for use, and is assessed through the evaluation of sample collection and analytical methods and procedures used.

During the data validation process for the Park, precision and accuracy were assessed and qualifiers were assigned to data points, as appropriate, based on laboratory exceedances of the project-defined MQOs. The validation report (Appendix C) provides detailed information on the data quality issues and data validation qualifiers for each parameter group for each laboratory data package. Qualified chemistry data for all matrices collected are included in Appendix D. A complete list of qualified results with reason codes is provided in the data validation reports in Appendix C.

The Park remedial investigation work plans were designed to ensure the collection of representative data. All samples were collected in accordance with the work plans and addendums, and any deviations were found to be acceptable and did not adversely impact the representativeness of the data collected. Additional information on representativeness of the field program is presented in the field sampling report (Appendix B).

Completeness is calculated by comparing the total number of acceptable data (non-rejected data) to the total number of data points generated. Completeness for the Park chemistry data was greater than 99 percent overall, which exceeds the QAPP completeness objective of 95 percent. Completeness for the Park data is summarized by parameter group and matrix in Table 5-1. Completeness ranged from 99 to 100 percent for the various parameter groups.

The Park work plans were designed to ensure that all data collected throughout the various remedial investigation sampling events and historical sampling events would be comparable. All samples were collected using accepted standard methods, and any deviations were found to be acceptable and did not adversely impact the comparability of any data collected (see field sampling report; Appendix B). Comparability of the data set was also assessed during the data validation effort through the review of laboratory analytical methods and procedures. The analytical methods and procedures used by the laboratories were consistent with those specified in the QAPP.

5.1.1 Field Quality Control Samples

Quality control samples were prepared in the field in accordance with the QAPP to monitor the bias and precision of the sample collection and analysis procedures. Five equipment rinsate blanks and 17 field duplicates were collected throughout the sampling program. Equipment rinsate blanks were generated by rinsing decontaminated sampling equipment with laboratory-generated deionized distilled water, and collecting the rinsate directly into the sampling containers. Low levels of copper, zinc, bis(2-ethylhexyl)phthalate, and phenol were present individually in some of the equipment rinsate blanks collected from the soil collection equipment. However, these analytes/compounds were not present at concentrations that impacted any of the sample results (e.g., associated sample concentrations were well above the low levels detected in the blanks).

Field duplicate and replicate samples were generated by collecting an additional sample at a designated station, processing this sample in the same manner, and submitting the duplicate as a separate sample for analysis at the laboratory. The field duplicate/replicate sample results for all matrices are summarized in Appendix C.

5.1.2 Summary of Qualified Data

Selected data not meeting the data quality criteria were qualified as undetected, estimated, tentatively identified, or rejected during validation, in accordance with the QAPP. A complete list of qualified results with reason codes is provided in Appendix C (on CD). Data qualified as undetected are usable for all intended purposes. Data qualified as estimated or tentatively identified are usable for all intended purposes, with the knowledge that these data may be less precise or less accurate than unqualified data. Rejected data are not usable for any purpose in the remedial investigation. Concentrations associated with rejected data have been removed from the database, and an "R" qualifier is retained to flag the results that were removed.

5.2 DATA SOURCES AND DELINEATION OF SITE AREAS

The sources of data evaluated in this section include the remedial investigation sampling results summarized in Section 3 and the following historical sources summarized in Section 2.3:

- Expanded Site Investigation (E&E 1996)
- Phase II Removal Assessment (E&E 1998a,b)
- Oeser Remedial Investigation (E&E 2002a)
- Ecology (2004).

Sampling locations from the current and historical studies are shown in Figures 2-2, 2-3, and 3-1. Detected analytes are summarized in Tables 5-2 to 5-6. A complete summary of all data used in the remedial investigation is provided in Appendix D. All data included in the remedial investigation were validated, as discussed in Section 5.1 and Appendix C.

Additional information essential to evaluating the nature and extent of contamination included historical aerial photographs of the site and surrounding areas. An aerial photographic analysis was completed in support of the Oeser remedial investigation, covering the time period from 1943 to 1998 (Mack 1998). Supplemental aerials (later 1930s, 1975) were obtained and used for evaluation of the site from the Whatcom Museum of History and Art (1955, 1963) and Tim Wahl of the City (1930s, 1961).

There are obvious differences in contaminant patterns and fate and transport processes across the site, as discussed in this section and Section 6. To facilitate understanding of these patterns and processes, the site was divided into the following 10 areas (Figures 4-1 and 5-1):

- **NE Wetland**—Located in the northeastern portion of the Park. This wetland feature was constructed in the 1960s and 1970s to drain the floor of the ravine for gravel mining and log storage. Spring-released water stands year-around here, possibly supplemented by some overflows from the BTC parking lot to the southeast.
- **Upper Creek**—Located northeast of the Marine Drive Bridge, consisting of both open-channel creek and a filled and culverted segment of the Oeser/Birchwood stormwater outfall beneath the OPC pier railroad. Surface flows are largely fed by stormwater discharges from the Birchwood neighborhood, BTC, and Oeser plant, but also partially from springs. Below the Oeser/Birchwood outfall most of this creek channel was created around 1961 and 1962 to create drier working conditions in the mined portions of the ravine. The upper extent of this site area is not clearly distinguished from the Illinois Street extension area, where a portion of the creek bed below sampling stations SB-40 and SB-41, and adjacent to station SB-42, was filled in the late 1960s.
- **Historical Creek**—Located southeast of the Upper Creek and consisting of what was once the main channel of Little Squalicum Creek prior to diversion of creek flows to the present alignment in the early 1960s. This area has fluctuating water levels and ephemeral surface waters and much of it has been designated as wetland.
- **Lower Creek**—Located south of the Marine Drive Bridge; includes stormwater inputs from the Upper Creek and the Marine Drive outfall, in addition to spring waters. Historical maps and the midden discovery indicate this is an original channel of the Creek below Marine Drive.

- **Beach**—Located along northeast shores of Bellingham Bay. This portion of the Park is owned by the Port of Bellingham and BNSF Railway and is regularly frequented by the public. Because of its exposure to the southwest and Bellingham Bay's long fetch, the backshore and exposed substrate of this area is primarily composed of coarse-grained sediments including sand, gravels, and cobbles. This site area excludes and is bisected by the shorelines and bedland of the Lower Creek.
- **South Slope**[20]—Located northeast of the Upper Creek and the public trail on the OPC rail spur; includes areas of low growth vegetation and the recently constructed parking lot for the Park. This area of the site was historically used for hay cropping, ranching, and shrub nursery (the Eldridge Industrial Site Lots).
- **Landfill**—Located in the eastern portion of the Park and south of the Wetland area; represents an area of approximately 7,000 ft^2 containing municipal wastes disposed of during the 1930s.
- **Railroad (Mainline)**—Located north of the Beach within the BNSF railway right-of-way represents soils potentially impacted by historical railroad activities (e.g., control of vegetation).
- **Illinois Street Extension**—Located along the railway corridor defining the north boundary of the Park and the Little Squalicum Creek ravine and extending between existing West Illinois Street and the Timpson Way right-of-way (including the Morse Steel railroad spur tract). The City plans to construct a roadway here for improved traffic flow to and from BTC and Morse Steel Services and to reduce nearby traffic problems. Historical environmental impacts along this corridor are largely related to railroad activities and the adjacent Oeser industrial site. A portion of this site area includes a filled and culverted segment of the Oeser/Birchwood stormwater discharge, recently evaluated by sampling station SB-42.
- **General Site**—Located between the Upper Creek and the Historical Creek, including sampling stations outside of these defined areas. The principal historical activity impacting these areas of the ravine was likely sand and gravel mining.

Sampling locations are shown by site area in Figures 5-2 to 5-7.

In addition to site samples, background samples are available and included in this evaluation as follows:

[20] The site area "South Slope" was defined in the Oeser Company remedial investigation (E&E 2002a).

- **Soil Background**—Includes 20 residential locations in the Columbia Neighborhood sampled as part of the Oeser remedial investigation that are unlikely to be impacted by the Oeser site. These surface soil sampling locations might be impacted by other sources in Bellingham (e.g., operations at Georgia Pacific). Background subsurface samples were collected from the monitoring well MW-06, located northeast of the Oeser site near Cedarwood Avenue. This well is also considered background for groundwater.
- **Groundwater Background**—Represented by monitoring well MW-06D, located upgradient of the Oeser site. Eighteen groundwater samples have been collected and analyzed as part of the Oeser and Park remedial investigations.
- **Surface Water Background**—Represented by Cemetery Creek, an inflow tributary to Whatcom Creek with no known point sources but street and residential runoff similar to Little Squalicum Creek. Two sampling events (SW Reference) were completed in support of this remedial investigation.

Background sediment samples were collected by both EPA (E&E 2002a) and Ecology (2004), but neither sample is considered an adequate background or reference sample because of their proximity to the Creek (Wetland area) and potential influences from the same sources (i.e., Oeser and local area stormwater overflows from BTC).[21]

The following sections evaluate the spatial and vertical distribution of analytes detected in background samples and in each site area, with a focus on key constituents detected in each area. The analytes detected most frequently in media throughout the Park included heavy-end petroleum hydrocarbons (diesel-range organics [DRO] and motor oil), PAHs, PCP, and dioxins/furans. These chemicals and petroleum hydrocarbon gasoline-range organics (GRO) are graphically presented site-wide for soils/sediments and waters on Figures 5-8 to 5-23. Site areas with the most extensive chemical contamination in each media were the Upper Creek and Historical Creek areas. In addition to the descriptions in the following sections, chemical data are graphically presented for the Illinois Street extension and Landfill areas on Figure 5-24 and the Upper Creek and Historical Creek areas on Figures 5-25 to 5-32.[22]

5.3 SOIL

Surface[23] and subsurface soil samples are available for background and each of the 10 site areas except the Beach, which is composed of coarse-grained sediments not soil. The principal chemicals detected in soils onsite include petroleum hydrocarbons (DRO and motor oil), PAHs,

---

[21] Background sediment samples will be collected from Cemetery Creek with additional sediment sampling in the Park, as necessary for the feasibility study or compliance sampling as part of remediation.

[22] Data for all media are presented on Figures 5-25 through 5-32.

[23] Surface soil or sediment is defined in this section as all samples with the upper depth at ground surface.

PCP and other phenolic compounds, dioxins/furans, and metals. The most extensive soil contamination was found in the Upper Creek and Historical Creek areas of the site. These areas have elevated levels of organic compounds in surface and subsurface soils, including petroleum hydrocarbons, PAHs, PCP, and dioxin/furans. Subsurface soil contamination in these areas appears to be impacted by localized groundwater and the discharge of stormwater to the Creek. Heavy metals were detected in most soil samples but the highest levels were found in soils associated with municipal waste in the Landfill area (cadmium, lead, zinc) and the upper 3 ft of soils in the Illinois Street extension area (arsenic) (refer to Figure 5-24).

The nature and extent of soil contamination is evaluated for each individual site area in the subsections below.

5.3.1 Background Soil

Background soil samples were collected in support of the Oeser RI/FS at 20 surface sampling locations in the Columbia neighborhood located south of the Park and one subsurface location (borehole) located north and upgradient of the Oeser site (E&E 2002a and figures therein) (Appendix H). Ten of the surface samples were collected from open areas (primarily parks or greenways), and 10 were collected from residences. The upper 2 in. of soil over a maximum area of 6 by 6 in. was collected and analyzed for selected metals (arsenic, calcium, chromium, and magnesium), SVOCs, and dioxins/furans. Chemicals detected in background soils include the four metals, PAHs, dioxins/furans, carbazole, retene, dibenzofuran, and benzoic acid. PAHs were detected in 18 of 20 background samples, with the highest concentrations detected at station RES-B-10. Dioxins/furans were detected in all background samples, with the highest concentrations detected at stations RES-B-5 and RES-B-11. PCP and other phenolic compounds were not detected in the background surface samples.

Two subsurface samples were collected at greater than 5 ft bgs at monitoring well MW-06D and analyzed for metals, VOCs, and SVOCs. All metals analyzed in the samples were detected. Four PAH compounds were also detected in the samples but at levels near the detection limit. PCP and other phenolic compounds were not detected in the background subsurface soil samples.

Background locations RES-B-10 and RES-B-11 were collected from residences located closer to the waterfront and the downtown area of Bellingham (Appendix H). This portion of the Columbia neighborhood may be impacted by past and present industrial activities and potential sources along the waterfront (e.g., Georgia Pacific). There were no other obvious patterns in the spatial distribution of chemicals detected in these samples or the subsurface background location.

5.3.2 South Slope Soil

The South Slope area soil has been characterized in previous studies (E&E 2002a) based on results from 27 surface and five subsurface station locations (see Figure 5-2). Surface soils were collected at 20 locations and analyzed for TPH using a standard EPA field-screening technique to provide an indication of the presence or absence of contamination from creosote and/or PCP carrier oils (E&E 2002a). TPH field-screening results for surface soil samples ranged from 50 to 475 mg/kg. However, no visible or olfactory evidence of petroleum contamination was observed in the soil samples. The other seven surface samples were analyzed for metals, SVOCs, and dioxins/furans. PAHs, including related compounds such as dibenzofuran, were detected in six of seven soil samples, with detected total PAH (TPAH) concentrations ranging from 0.059 (B-BB5) to 1.9 J mg/kg (RES-46). PCP was detected in three surface soil samples (B-AA2, B-AA4, B-AA6), with concentrations ranging from 0.0085 J to 0.015 J mg/kg. One or more dioxin or furan compounds were detected in each of the seven surface soil samples including those with detectable PCP. The highest toxicity equivalent (TEQ) [24] concentration was 7.814E-5 mg/kg located at station RES-43 and nearest to the Oeser site. Other chemicals detected at relatively low levels (below, at, or near the detection limit) include phthalates (e.g., bis[2-ethylhexyl]phthalate), benzoic acid, benzyl alcohol, 2,4- and 2,6-dinitrotoluene, and phenol.

Ten subsurface soil samples were collected from five borings located on the South Slope (B-AA2, BAA4, B-AA6, B-BB3, B-BB5). The deepest sample collected and analyzed was 36 to 38 ft bgs at station B-AA4. Although metals were detected, organic chemicals were not detected in most of the subsurface samples. The highest metals concentrations were observed at stations B-AA4 and B-BB5. PAHs were only detected in two subsurface samples (B-BB5 and B-AA6) but only at levels near the detection limit. Dioxins/furans were detected in two samples (B-AA2 and B-AA4) with the highest TEQ at 5.608E-6 mg/kg (6 to 8 ft bgs B-AA2).

There are no obvious spatial patterns of chemicals detected in South Slope soil samples.

5.3.3 NE Wetland Soil

Soil was evaluated at two locations (HA-07 and HA-08) in the Wetland area of the site (see Figures 2-2 and 3-1). Hand augers were advanced 2 ft into the soft soils located in the northeastern portion of the Park in an area that periodically receives surface water runoff from surrounding areas but is not currently connected to the Creek. Surface water runoff has been observed originating from the Oeser yard and pooling in this area of the site (Wahl 2004, pers. comm.) Surface soil was analyzed for metals and petroleum hydrocarbons. Concentrations of

---

[24] TEQ_{DFs} were calculated for all media using 2005 mammalian TEFs.

petroleum hydrocarbons were below the screening value of 200 mg/kg[25]. Metals were detected in surface soils at station HA-08, including elevated levels of lead (100 mg/kg) and zinc (257 mg/kg).

The 1 to 2 ft subsample from each hand auger was analyzed for metals only. Metals concentrations were lower in the subsurface soils for both stations. No other spatial patterns were observed in the soils.

5.3.4 Upper Creek Soil

The Upper Creek area soil has been characterized based on information obtained from 15 borings, 4 test pits, and 59 surface and spoils pile locations (see Figure 5-3). A total of 59 surface and spoils pile samples and 47 subsurface soil samples collected in this study and historical investigations were available for evaluation in the remedial investigation.

5.3.4.1 Surface Soils

Surface soils represented by the upper 1 ft in borings, test pits, grabs, and hand augers contained elevated levels of petroleum hydrocarbons along both banks of the Creek. Some of the highest concentrations were observed in soils represented as spoil piles located on either side of the Creek. For example, the upper 2 ft of soils collected at SB-11 contained elevated levels of petroleum (2,400 and 2,900 mg/kg motor oil) and PAHs (687 J and 2,068 J mg/kg TPAHs). PAHs detected in the upper 2 ft of soils from SB-11 were predominantly high-molecular-weight PAHs (HPAHs) (668 J and 1,990 mg/kg) (refer to Figures 5-25 to 5-30).

This prominent spoils pile, which was also characterized by boring SB-29, is approximately 200 ft long beginning near the discharge of the BTC/Birchwood outfall in the upper portion of the Creek. It was likely constructed as a berm during the rerouting and straightening of the Creek in 1961 or 1962 (from aerial photos 1930s, 1955, 1957, 1961, 1963 and others shown in Mack 1998). Other soil mounds or spoils piles were observed at various locations along the banks of the Upper Creek and characterized during the Oeser remedial investigation (samples “SP-”). At that time, TPH was detected in all “SP-” samples analyzed from these locations ranging in concentration from 22 mg/kg to 2,080 J mg/kg (SP-FS10); the highest concentration located approximately 100 ft upstream of the Marine Drive Bridge.

---

[25] The screening level for diesel-range and residual-range petroleum hydrocarbons in sediments is 200 mg/kg and is the MTCA TEE for soil (Integral 2005c). Since soils could become sediments as part of remediation or park development (in the event the creek was redirected along another route), this lower screening level was used for both solids.

Other elevated TPH concentrations detected in surface soils, from upstream moving downstream, include the following (see Figures 5-25 and 5-26):

Station	TPH–DRO[26] Concentration (mg/kg)	
SP-FS20	1,300	*J*
SP-FS19	1,400	*J*
SP-FS01	2,000	*J*
SP-FS17	1,490	*J*
SP-FS30	1,940	*J*
SP-FS25A	2,000	*J*
SP-FS25B	1,150	*J*

Thirteen surface soil samples were also analyzed for SVOCs. PAHs were detected in all samples, and PCP was detected in 11 samples at concentrations ranging from 0.0056 to 1.8 mg/kg (SP03) (see Figures 5-27 to 5-31). Dioxins/furans were analyzed in 11 surface soil samples with calculated TEQ concentrations ranging from 1.486E-06 mg/kg to 1.372E-03 mg/kg (SP02) (see Figure 5-32). Surface soils with detectable dioxins/furans also contained varying levels of PCP except for SP02 (see Figure 5-31). Other chemicals detected less frequently in surface soils include phenol, methylphenols, benzoic acid, benzyl alcohol, and phthalate compounds (Table 5-2).

Total organic carbon (TOC) concentrations ranged from 2.91 to 9.37 percent (SB-25).

5.3.4.2 Subsurface Soils

Subsurface soils showed widespread petroleum contamination over much of the Upper Creek area (see Figures 5-25 and 5-26). Beginning with station SB-22 located near the headwaters of the Creek to stations SB-25 and SB-31 approximately 450 ft downstream, extensive petroleum hydrocarbon contamination was observed in subsurface soils to a depth of about 10 ft bgs (~28 ft bgs for SB-22 located above the ravine on the old railroad grade). Petroleum contamination in subsurface soils appears to be associated with the depth of groundwater and underlying gray clay layer in this area of the site. The highest concentrations of petroleum hydrocarbons in soils were detected in the following stations (also see Figures 5-25 and 5-26):

[26] TPH results for spoil pile samples collected during the Oeser remedial investigation were assumed to be in the DRO range.

Station	Depth (ft bgs)	TPH-DRO Concentration (mg/kg)	TPH-Motor Oil Concentration (mg/kg)
SB-09	8–9	3,200	380
SB-11	1–2	710	2,900
SB-12	4–5	1,900 *J*	250
SB-29	7–7.3	1,300	460
SB-29	10–10.6	1,300	140
SB-31	8–9	5,200	620
SB-31	9–9.6	1,600	130

In addition to testing results, visible and olfactory evidence of petroleum contamination was observed in the following subsurface borings (moving from upstream to downstream in the Upper Creek area).[27]

- SB-22 (27 to 31 ft bgs)
- SB-09 (5 to 10 ft bgs)
- SB-13 (8 to 10 ft bgs)
- LSC Bank (creek bank grab sample)
- SB-29 (6 to 10.5 ft bgs)
- SB-11 (10 to 12 ft bgs)
- SB-14 (5 to 11 ft bgs)
- SB-12 (3 to 8 ft bgs)
- SB-25 (4 to 8 ft bgs)
- SB-31 (3 to 10 ft bgs).

Figures 5-25 to 5-31 also show the approximate lateral boundary of subsurface soil contamination in the Upper Creek area based on subsurface borings (refer to boring logs in Appendix B). In most locations, the bottom depth interval is at the boundary of the clay layer. No obvious sign of petroleum contamination was observed in soils collected from borings SB-16, SB-17, SB-21, SB-23, SB-24, MWLS01, MWLSC02, MWLSC03, MWLSC04, SB-26, SB-27, SB-28, SB-30, and SB-32. Only a few soil samples were collected for confirmation analysis in these borings with levels of DRO/motor oil near the detection limit of 20 mg/kg. In some

[27] These sample depths showed obvious, and sometimes gross visual and/or olfactory evidence of contamination in the field. Samples that were collected and not analyzed were archived in the event that they would be needed to more fully characterize site conditions.

borings (e.g., SB-17), native clay was encountered at depths of 1 to 2 ft bgs and no further sampling or testing was required.

SVOCs were analyzed in soil samples where petroleum hydrocarbon concentrations exceeded the screening level of 200 mg/kg DRO or motor oil (Integral 2005c). Soil samples where petroleum hydrocarbon concentrations had not exceeded the screening level were assumed to contain little to no SVOC contamination (refer to Integral 2005c).

Soil samples with elevated DRO/motor oil also contained high levels of PAHs and related chemicals dibenzofuran and carbazole. The highest PAH concentrations were detected in samples from borings SB-11 and SB-31 (see Figures 5-27 to 5-30). The highest low-molecular-weight PAH (LPAH) concentration was detected in SB-31 at 8 to 9 ft bgs (1,044 mg/kg)[28]. The highest HPAH concentration was detected in SB-11 at 1 to 2 ft bgs (1,990 mg/kg).

Pentachlorophenol was detected in 17 of the 39 samples (44 percent of this subset) tested in the Upper Creek area. The highest concentrations of PCP were detected in SB-09 at 8 to 9 ft bgs (6.4 mg/kg) and SB-31 at 8 to 9 ft bgs (6.3 mg/kg) (Figure 5-31). Selected samples were analyzed for dioxins/furans based on whether the sample exceeded the screening level of 0.360 mg/kg for PCP (Integral 2005c). A total of seven subsurface samples were analyzed with TEQ concentrations ranging from 8.499E-07 to 4.038E-04 mg/kg (SB-31 at 8 to 9 ft bgs) (Figure 5-32). In general, subsurface soils with the highest PCP concentrations also had the highest TEQ values (SB-09, SB-12, SB-29, SB-31).

One or more metals were detected in 29 subsurface soil samples. The most frequently detected metals were arsenic, chromium, copper, lead, mercury, nickel, and zinc (Table 5-2). Some of the highest concentrations of metals were detected in SB-11, including:

- Cadmium (0.5 mg/kg at 6 to 7 ft bgs)
- Chromium (61.4 mg/kg at 6 to 7 ft bgs)
- Copper (290 mg/kg at 2 to 3 ft bgs)
- Mercury (0.45 mg/kg at 2 to 3 ft bgs)
- Nickel (61 mg/kg at 6 to 7 ft bgs)
- Zinc (153 mg/kg at 6 to 7 ft bgs).

Other locations with elevated metals included SB-14 (chromium, nickel) and SB-29 (mercury, zinc). SB-11 and SB-29 are located in the large berm or spoil pile at the head of the Creek.

[28] A higher LPAH concentration of 2,204 mg/kg was detected in TP-6 at 1 to 2 ft bgs but this station is located in the Historical Creek area, although shown on Figures 5-12 to 5-18.

Other chemicals less frequently detected in subsurface soils included phthalate compounds, benzoic acid, and benzyl alcohol (Table 5-2).

TOC concentrations ranged from 0.085 to 6.97 percent (SB-25 at 1 to 2 ft bgs).

Subsurface soil contamination in the Upper Creek area of the site covers approximately 450 ft of the Creek bed, including 50 ft north of the Creek, and up to 100 ft south of the Creek for a total area of approximately 52,000 ft^2 or 1.2 acre[29] (see Figures 5-25 to 5-32). Soils containing high levels of DRO/motor oil have a distinct creosote odor with elevated levels of PAHs and variable levels of PCP and dioxins/furans. The vertical and horizontal boundaries of the soil contamination appear to be associated with the elevation of a gray clay layer encountered at most locations onsite (refer to Section 4.2). The most grossly contaminated soils were found within a low spot of the clay (SB-25, SB-31)[30] where wood-treating chemicals may have pooled over some unknown period of time. The downstream outer edge of the contamination is marked by where the clay layer rises to the surface found at or near the ground surface (SB-16, SB-17, SB-32). This may explain the absence of this material in subsurface soils/sediments downstream of this area (refer to Lower Creek section).

It was concluded that a vapor intrusion study would not be required at this time for the Upper Creek and Historical Creek areas. Concentrations of petroleum hydrocarbons were generally below 10,000 mg/kg (only two of 175 samples exceeded this amount) and they appear to be of residual character and low volatility based on field testing.

5.3.5 Historical Creek Soil

Prior to the early 1960s, the Creek followed a different route (see Figure 5-4). The Creek was wider to the north, narrowing as it meandered to the south and southwest of the Park. A late 1930s aerial photograph shows the Creek meandering around a prominent ridge, which by the late 1950s was excavated for its sand and gravel. About 1961 or 1962, the Creek was rerouted to its present location. At this time, the upper portion of the Historical Creek area (near TP-6 and TP-15) continued to be mined for sand and gravel with much of the land disturbed by these activities (Mack 1998 and other aerial photos). This upper portion of the Historical Creek remains relatively dry, unlike the southern (or lower) part, which for most of the year is partially covered with water. The southern area of the Historical Creek was disturbed less by

[29] This is the minimum impacted area. Soils and groundwater are likely impacted upgradient of this location and include the area below the Oeser/Birchwood stormline discharge.

[30] Although subsurface soils in SB-25 were determined to be grossly contaminated based on field observations, only surface samples (0 to 1 and 1 to 2 ft bgs) were chemically analyzed from this boring. No subsurface samples were analyzed from SB-25 to minimize analytical costs for the project. However, extensive petroleum contamination and strong creosote odor were observed in subsurface soils. Samples that were collected and not analyzed were archived in the event that they would be needed to more fully characterize site conditions.

sand and gravel activities (Mack 1998 and other aerial photos). Test pits (TP-06, TP-15, TP-16, TP-27, TP-21, TP-25) and soil borings (SB-11, SB-29, SB-30) were advanced in the upper (north) area to delineate the extent of contamination at the confluence with the current creek route. Sediment samples collected in the lower part (southern wetter area) of the Historical Creek (including SB-34 through SB-38) are described in Section 5.6.[31]

5.3.5.1 Surface Soils

Surface soils were collected from eight locations in the northern Historical Creek area (see Figure 5-4), and were analyzed for petroleum hydrocarbons by the NWTPH method. The screening level of 200 mg/kg was exceeded in samples from three stations, SB-11 (460 mg/kg diesel and 2,400 motor oil), TP-16 (490 mg/kg diesel and 760 mg/kg motor oil), and TP-21 (390 mg/kg motor oil) (see Figures 5-25 and 5-26). Four samples were analyzed for metals (SB-11, SB-29, TP-06, TP-25) and SVOCs (SB-11, TP-06, TP-16, TP-21). Chromium, copper, lead, nickel, and zinc were detected in each sample analyzed. PAHs were detected in all four samples with the highest concentrations detected in SB-11 (668 mg/kg HPAH, 15 mg/kg LPAH, 687 J mg/kg TPAH) (see Figures 5-27 to 5-30). PCP was detected in three of four samples (SB-11, TP-06, TP-16), with concentrations ranging from 0.24 J to 7.1 mg/kg (TP-16) (see Figure 5-31). Because of the elevated concentration of PCP, the surface soil sample from TP-16 was also analyzed for dioxins/furans. The calculated TEQ for this sample was 1.333E–03 mg/kg (Figure 5-32).

TOC concentrations ranged from 3.04 to 6.78 percent (TP-25).

5.3.5.2 Subsurface Soils

Nineteen subsurface soil samples were analyzed for petroleum hydrocarbons including:

- SB-11 (1 to 2 ft, 2 to 3 ft, 4 to 5 ft, 6 to 7 ft bgs)
- SB-29 (1 to 2 ft, 5 to 5.5 ft, 7 to 7.3 ft, 10 to 10.6 ft bgs)
- TP-06 (1 to 2 ft, 2 to 3 ft, 3 to 4 ft, >4 ft bgs)
- TP-15 (3 to 4 ft bgs)
- TP-16 (2 to 4 ft bgs)
- TP-17 (1 to 2 ft, 2 to 3 ft, 3 to 4 ft bgs)
- TP-21 (2 to 4 ft bgs)
- TP-25 (0.6 to 2 ft bgs).

[31] Due to constant saturation in the lower part of the Historical Creek area, surface soils were considered to be sediments and are discussed in the sediment section.

Of those analyzed, the following samples exceeded the screening level of 200 mg/kg for diesel- or residual-range hydrocarbons (see Figures 5-25 and 5-26):

Station	Depth(ft bgs)	TPH-DRO Concentration (mg/kg)		TPH-Motor Oil Concentration (mg/kg)
TP-06	1–2	8,400	*J*	*not quantified*
TP-06	2–3	2,800		860
SB-11	1–2	710		2,900
SB-29	7–7.3	1,300		460
SB-29	10–10.6	1,300		140

Gas-range hydrocarbons were also analyzed and detected in TP-6 at 1 to 2 ft bgs (1,600 mg/kg), 2 to 3 ft bgs (170 mg/kg), and 3 to 4 ft bgs (110 mg/kg). SVOCs were analyzed in 10 samples with PAHs detected in all of the samples including[32]:

- SB-11 (1 to 2 ft, 6 to 7 ft bgs)
- SB-29 (5 to 5.5 ft, 7 to 7.3 ft, 10 to 10.6 ft bgs)
- TP-06 (1 to 2 ft, 2 to 3 ft, 3 to 4 ft, >4 ft bgs)
- TP-17 (1 to 2 ft bgs).

Elevated PAHs were detected in each sample, with the highest concentrations detected in TP-6 (1,191 mg/kg HPAH, 2,204 mg/kg low molecular weight [LPAH], 3,395 mg/kg TPAH at 1 to 2 ft bgs). LPAHs (e.g., naphthalene and phenanthrene) were the principal components of PAHs in TP-6 compared with other locations in the Upper Creek and Historical Creek areas, where HPAHs (e.g., fluoranthene, pyrene) dominated the total concentration (see Figures 5-27 to 5-30).

Other SVOCs detected in the samples included PCP, dibenzofuran, carbazole, benzoic acid, benzyl alcohol, retene, 2,4-dinitrotoluene, and phthalates (Table 5-2). Dibenzofuran and carbazole are chemicals similar in structure to PAHs and are components of creosote (USEPA 2006c). PCP was detected in six of 10 samples, ranging in concentration from 0.18 to 3.5 mg/kg (TP-06 at 1 to 2 ft bgs) (see Figure 5-31). Dioxins/furans were analyzed and detected in two subsurface samples (SB-29 at 7 to 7.3 ft bgs and TP-17 at 1 to 2 ft) with a TEQ calculated to be 1.036E-04 J mg/kg and 3.589E-04 J mg/kg, respectively (Figure 5-32). The PCP concentrations for these samples were 1.1 mg/kg and 0.54 J mg/kg.

TOC concentrations ranged from 0.31 to 5.32 percent (SB-11 at 1 to 2 ft bgs).

Surface and subsurface soil contamination in the Historical Creek area of the site covers approximately 58,000 ft^2 or 1.3 acre (includes some overlap with the Upper Creek area) (see

[32] SB-11 and SB-29 are located at the confluence of the historical and current creek. The results of these stations are also discussed in Section 5.3.4.

Figures 5-25 to 5-32). Soils in the upper portion of the Historical Creek appear to have been impacted by two different sources or events of petroleum contamination over two depth ranges. The first source appears to have impacted the upper 4 ft of soils centered in the vicinity of TP-06 but including SB-11 and TP-21. This area has elevated concentrations of petroleum hydrocarbons containing PAHs, dibenzofuran, carbazole, and PCP, and although not specifically analyzed, suspected to contain dioxins/furans.[33] Sediment samples collected in the southern (wetter) portion of the Historical Creek shows similar patterns of contamination (refer to Section 5.6.2). The second depth range to be impacted is located near the confluence of the historical and current creeks (see Figure 5-4). This second source of contamination to a depth of approximately 10 ft bgs has impacted subsurface soils (and groundwater) represented by SB-29 and SB-11, near the current creek channel. Again, soils have been observed to contain elevated petroleum hydrocarbons, PAHs, PCP, and dioxins/furans.

5.3.6 Lower Creek Soil

The Lower Creek area (see Figure 5-5) extends downstream of the Marine Drive Bridge to the mouth of the Creek with connection to Bellingham Bay by a 36-in. concrete culvert. The course of this portion of the Creek has not changed much over the years as shown on aerial photographs of the area. The discovery of an archaeological site (i.e., shell midden, see Figure 2-1) is further evidence that this area has had little disturbance from past historical uses of the site (e.g., sand and gravel mining). Soils were collected from seven surface locations, five spoils piles, and eight soil borings in the Lower Creek area. An additional four sediment borings were advanced in the Creek and discussed in Section 5.6.

5.3.6.1 Surface Soil

Surface soil or spoils pile samples were collected from 13 locations in the Lower Creek area including (see Figure 5-5):

- LSC-S1
- SB-01
- SB-04
- SB-06
- SB-07
- SB-08

[33] Dioxins/furans were not analyzed for soils at TP-6 because the samples contained heavy sheen and NAPL, and there was concern its analysis—even in a diluted form—would damage the analytical instrument. However, dioxins/furans are expected in soils with elevated PCP (3.5 mg/kg in TP-6) (refer to Section 6).

- SB-18
- SB-20
- SP-FS50
- SP-FS51
- SP-FS52
- SP-FS53
- SP-FS54.

Twelve of 13 samples were analyzed for petroleum hydrocarbons by either the NWTPH method or TPH field screening method (Table 5-2).

The screening level of 200 mg/kg was only exceeded in samples collected from the five spoils piles:

Station	TPH-DRO Concentration[34] (mg/kg)	
SP-FS50	2,150	*J*
SP-FS51	425	*J*
SP-FS52	2,070	*J*
SP-FS53	418	*J*
SP-FS54	651	*J*

The highest TPH concentrations were detected in the lower portion of the Creek, closest to the mouth. Only spoils piles collected during the Oeser RI showed elevated levels of TPH. No surface soil samples exceeded the screening level of 200 mg/kg for diesel but SB-20 (0 to 1 ft) exceeded the screening level based on residual range organics (230 mg/kg).

Surface soil samples collected for the Park RI were analyzed for metals (seven locations: SB-01, -04, -06, -07, -08, -18, -20) and SVOCs (three locations: LSC-S1, SB-18, SB-20). Chromium, copper, lead, nickel, and zinc were detected in each sample analyzed. The highest concentrations of metals were detected in SB-18 and SB-20 located on the west bank of the Creek. PAHs were detected in all three of the samples analyzed for SVOCs with the highest concentrations detected in LSC-S1 (22 J mg/kg HPAH, 4.8 mg/kg LPAH, 27 J mg/kg TPAH). Pentachlorophenol was also detected in all three samples with concentrations ranging from 0.4 mg/kg (SB-20) to 5.96 J mg/kg (LSC-S1). Other SVOCs were detected in soil collected at station LSC-S1 including benzoic acid, phthalates, methylphenols, phenols, and dibenzofuran.

[34] TPH results for spoil pile samples collected during the Oeser remedial investigation were assumed to be in the DRO range.

The surface soil samples from SB-18 and SB-20 were analyzed for dioxins/furans because corresponding PCP concentrations exceeded the screening level of 0.360 mg/kg (Integral 2005c). The calculated TEQ for the two samples was 1.133E-03 J and 1.581E-03 J mg/kg, respectively.

TOC concentrations ranged from 2.26 to 21.1 percent (SB-18).

5.3.6.2 Subsurface Soil

Nine subsurface soil samples were analyzed for petroleum hydrocarbons and metals including (Table 5-2):

- SB-01 (1 to 2 ft bgs)
- SB-04 (1 to 2 ft, 5 to 6 ft bgs)
- SB-06 (1 to 2 ft, 4 to 5 ft bgs)
- SB-07 (1 to 2 ft bgs)
- SB-08 (1 to 2 ft bgs)
- SB-18 (1 to 2 ft bgs)
- SB-20 (1 to 2 ft bgs).

No subsurface samples exceeded the screening level of 200 mg/kg for petroleum hydrocarbons. Based on the tiered testing approach (Integral 2005c), samples were not analyzed for SVOCs.

Chromium, copper, lead, nickel, and zinc were detected in each sample analyzed. The highest concentrations of metals were detected in SB-01, SB-18, and SB-20. Metals concentrations were lower with increasing depth for all stations. No other spatial patterns were observed in the soils.

TOC concentrations ranged from 1.38 to 20.2 percent (SB-18 at 1 to 2 ft bgs).

5.3.7 Landfill Soil

In addition to delineating the extent of landfill materials with reconnaissance test pits, soil samples were collected from six test pit locations within the Landfill area as shown on Figure 5-6. The approximate area of the historical landfill is a little over 7,000 ft^2 (or 0.16 acre). The upper 3 to 4 ft of soils were mixed with layers of municipal waste, including bottles, glass, metal debris, and unrecognizable burned materials. Petroleum hydrocarbons were relatively low in concentration, generally below the screening level of 200 mg/kg, but several soil samples contained elevated levels of lead, mercury, and zinc (Table 5-2). Lead concentrations in soils are presented on Figure 5-24. The nature and extent of detected chemicals in surface and subsurface soil within the Landfill area are discussed below.

5.3.7.1 Surface Soil

Six surface soil samples were collected from six test pits within the Landfill area and analyzed for petroleum hydrocarbons and metals. Only one surface soil sample, from TP-23, exceeded the screening level of 200 mg/kg for motor oil (230 mg/kg). This sample was analyzed for SVOCs. Low levels of PAHs, benzoic acid, phthalates, and PCP (0.350 mg/kg) were detected in the soil sample from TP-23.

Surface soils in TP-23 also had some of the highest detected metals concentrations including cadmium (1.2 mg/kg), lead (285 mg/kg), and zinc (505 mg/kg) (lead concentrations shown on Figure 5-24).

TOC concentrations ranged from 2.66 to 6.09 percent (TP-01).

5.3.7.2 Subsurface Soil

Seventeen subsurface soil samples were analyzed from six test pits excavated in the Landfill area. Sixteen of the 17 samples were analyzed for petroleum hydrocarbons with one sample (TP-23 at 3.5 to 4 ft bgs) above 200 mg/kg. This sample was analyzed for SVOCs. Low levels of PAHs and phthalate compounds were detected in the sample (Table 5-2).

Chromium, copper, lead, nickel, and zinc were detected in each sample analyzed (lead concentrations shown on Figure 5-24). Elevated metals were detected in one or more samples from TP-01, TP-22, and TP-23. In general, the highest concentrations of metals (cadmium, copper, lead, mercury, and zinc) were detected in soils from 1 to 4 ft bgs in these test pits. Soils at this depth were composed of ash (burnt) and "rusted" granular materials. Numerous bottles and other municipal wastes were also observed at this depth.

The highest concentrations of cadmium, copper, lead, mercury, and zinc were detected in the following stations:

Station	Depth (ft bgs)	Cadmium	Copper	Lead	Mercury	Zinc
TP-01	1–2	3.1	124	1,270	0.36	1,230
TP-22	1.7–2.2	8.0	282	1,290	1.20	2,960
TP-23	3.5–4	10	409	3,970	1.62	3,060

Note: Concentrations in mg/kg.

The samples from TP-22 and TP-23 with elevated total metals were further evaluated using the toxicity characteristic leaching procedure (TCLP)[35] to determine the leachability of these metals and their potential impacts to surface water and groundwater. Cadmium (0.02 mg/L in both),

[35] This test is intended to represent situations where acidic conditions are present due to biological degradation such as in municipal solid waste landfills.

copper (0.025 and 0.04 mg/L), lead (0.66 and 0.28 mg/L), nickel (0.07 and 0.08 mg/L), and zinc (8.005 J and 5.37 J mg/L) were detected in the tests, respectively.

TOC was detected in nine soil samples with concentrations ranging from 0.953 to 9.04 percent (TP-01 at 2 to 3 ft bgs).

5.3.8 Railroad (Mainline) Soil

Six surface soil (0 to 1 ft bgs) and six subsurface soil (1 to 2 ft bgs) samples were collected in the Railroad area as part of this remedial investigation to evaluate historical application of vegetation control (e.g., petroleum hydrocarbons, pesticides, herbicides) along the BNSF right-of-way (see Figure 5-7). The samples were analyzed for heavy metals, chlorinated pesticides, and petroleum hydrocarbons.

Heavy metals, petroleum products, and 4-4′-DDT were detected in one or more soil samples in the Railroad area (Table 5-2). Surface soil sampled in the southern most stations of this area (HA-02, HA-05, and HA-06) contained the highest arsenic, chromium, and nickel concentrations. Concentrations were up to 10 mg/kg (HA-02, HA-05, and HA-06), 59.9 mg/kg (HA-06), and 50.5 mg/kg (HA-06), respectively. Other metals such as cadmium, copper, lead, mercury, and zinc were also detected but there was no obvious spatial patterns in the soils. Petroleum hydrocarbons (identified as DRO and motor oil) were detected in surface soil at concentrations up to 210 mg/kg (HA-02) and 290 mg/kg (HA-04), respectively. DDT was detected in only one surface sample (0.0032 mg/kg at HA-01) and none of the subsurface samples. Each analyte was found at lower concentrations in the subsurface than in the surface soils. No other pesticides or herbicides were detected in representative soil samples.

5.3.9 Illinois Street Extension Soil

Two boreholes and six test pits were advanced on October 9 and 12, 2006, respectively, to assess the surface and subsurface soil quality and to specifically examine material associated with the culvert historically conveying stormwater/wastewater from the Oeser plant site across the proposed alignment of West Illinois Street extension (see Figure 5-2)[36]. The boreholes (SB-40 and SB-41) were advanced immediately adjacent to the east and west sides of a ca. 1912 concrete box culvert that conveys water from the Oeser site and from residential areas in the Birchwood and Alderwood neighborhoods into the open channel of Little Squalicum Creek.

---

[36] Sampling and testing in this area supported both this remedial investigation and preliminary design work for the City of Bellingham's West Illinois Street extension project.

A representative coal sample was collected from the banks of Squalicum Creek[37] on October 27, 2006. The coal sample was collected to determine whether the coal debris observed in the test pits could be responsible for the elevated metal concentrations detected in some soil samples (see below).

Soils lying beneath fill material and a ca. 1969 culvert extension that was placed in the Creek ravine downstream of the 1912 box culvert were assessed with another boring, SB-42, advanced in January 2008 (see Figure 5-2).

5.3.9.1 Surface Soils

Seven soil samples were collected from test pits (TP-26 to TP-31), SB-40, and SB-42 (metals only) and analyzed for petroleum hydrocarbons and metals. The DRO concentrations ranged from below detection (detection limit of 5.4 mg/kg) to 150 mg/kg. The motor oil concentrations ranged from below detection (detection limit of 11 mg/kg) to 180 mg/kg. No surface soil samples analyzed for petroleum hydrocarbons exceeded the screening level of 200 mg/kg. Metals concentrations were detected in all samples with the highest levels of most metals (e.g., arsenic, chromium, zinc) observed in surface soils from SB-40 (Figure 5-24). A data summary of selected metals is presented below.

Station	Depth (ft bgs)	Arsenic	Chromium	Copper	Lead	Zinc
TP-26	0-1	27	30.2	61	42	254
TP-26	1-2	10 U	50	23.9	0.3 U	87
TP-27	0-1	0.9 U	45.3	33.6	7	114
TP-28	0-1	40	25	60.8	48	276
TP-29	0-1	36	34.4	59.2	94	313
TP-30	0-1	11.5	42.1	43	41	105.7
TP-30	1-2	1 U	45.2	28.3	6	72.5
TP-31	0-1	70	44	76.5	169	316
SB-40	0-1	130	24	170	151.5	1158.5
SB-40	1-2	150	33	165	164	1030
SB-40	2-3	235	30.5	187.3	538	1368.5
SB-40	3-4	13	43.9	32.8	11	107
SB-42	1-2.5	36.5	24.3	77	42.5	196
SB-42	2.5-4	30	23	107	50	193
Coal	Surface	6 U	8.2	26.6	4	19.1

[37] Squalicum Creek is located to the south of Little Squalicum Creek. Squalicum Creek water was used historically to wash coal and wastes excavated from the Bellingham Coal Mine. All coal found locally is presumed to be from the same source—the nearby Bellingham Coal Mine—and to be relatively uniform in its composition.

5.3.9.2 Subsurface Soils

Subsurface soil samples were collected from TP-26 (1 to 2 ft bgs), TP-31 (1 to 2 ft bgs), SB-40 (1 to 2 ft, 2 to 3 ft, 3 to 4 ft, 11.5 to 13 ft, 38.5 to 39.5 ft bgs), SB-41 (11 to 12.5 ft, 34.5 to 36 ft bgs), and SB-42 (34 to 35.5 ft, 36.5 to 38 ft bgs). Most samples were analyzed for petroleum hydrocarbons and metals (Table 5-2). The highest TPH concentrations (150 mg/kg DRO and 180 mg/kg motor oil) were observed in the 1 to 2 ft bgs sample collected from borehole SB-40. All subsurface samples analyzed for TPH were below detection, except for the 1 to 2 ft and 11.5 to 13 ft bgs samples collected from borehole SB-40 and the 36.5 to 38 ft bgs sample from borehole SB-42.

Metals concentrations (e.g., arsenic) were the highest in the 2 to 3 ft bgs sample from SB-40. Metals concentrations were lower in the 3 to 4 ft bgs sample from this boring possibly indicating that the metals are associated with bedding or fill materials in the upper 3 ft of this area.

Samples from TP-28, TP-31, and SB-40 with elevated arsenic were further evaluated using the synthetic precipitation leaching procedure (SPLP)[38] and TCLP to determine the leachability of these metals and their potential impacts to surface water and groundwater. Arsenic was detected in the leachate from the following samples:

		Test Concentration (µg/L)	
Station	Depth (ft)	SPLP	TCLP
SB-40	0-1	6	NA
SB-40	1-2	12	3
TP-31	0-1	11	25
TP-28	0-1	2 *U*	NA

5.3.10 General Site Soil

Soil samples were collected from other locations within the Park boundaries outside of the designated areas (see Figures 2-2 and 3-1). Twelve surface soil or spoils pile samples and three subsurface samples from 13 stations were collected in the General Site area for evaluation in the remedial investigation including:

- RES-47A
- RES-48
- RES-49
- SP-07
- TP-04

[38] The SPLP test is recommended by MTCA to estimate groundwater impacts from arsenic in soil exposed to acid rain in the western United States (WAC 173-340-747).

- TP-05
- TP-07
- TP-08
- TP-09
- TP-10
- TP-11
- TP-12
- TP-19.

Most of these stations are located in the wooded areas between the historical and present creek routes which was historically mined for sand and gravel.

Surface soils were analyzed for petroleum hydrocarbons and metals (Table 5-2). Only one sample (SP-SF28) contained TPH levels (665.5 mg/kg) above the screening level of 200 mg/kg. No other General Site area surface soils collected and tested in the remedial investigation exceeded the screening level. Cadmium, chromium, copper, lead, nickel, and zinc were detected in all samples analyzed with the highest levels found in SP-07. Sample SP-07 also had elevated levels of some PAHs (17 J mg/kg HPAHs, 1.8 mg/kg LPAHs, 19 J mg/kg TPAHs), PCP (2.2 mg/kg), and dioxins/furans (1.877E-03 mg/kg TEQ). SP-SF28 and SP-07 are located near the upper limits of the Creek near where the BTC/Birchwood neighborhood stormline is buried (see Figure 3-1).

Two subsurface soil samples (1 to 2 ft bgs) were analyzed from test pits located in the General Site area (TP-10 and TP-19). Petroleum hydrocarbons were below screening levels in these samples. Metals were analyzed for one sample (TP-10 at 1 to 2 ft bgs), and concentrations were lower than the surface sample from this location. There were no other obvious patterns in the data.

TOC concentrations ranged from 1.34 to 7.4 percent (TP-05 at 0 to 1 ft bgs).

5.4 GROUNDWATER

Groundwater samples are available for background and three site areas including the Upper Creek, Historical Creek, and Lower Creek (see Figure 2-3). Two spring samples were previously collected from station SW-03 located in the Upper Creek just upstream of the Marine Drive Bridge. Three seep samples are available in the Upper Creek area at stations SEEP-1 and SW-08, about 200 ft upstream of SW-03. The spring and seep samples represent transition points in the Upper Creek between groundwater and surface water.

Organics and metals were detected in wells located in each site area within the Park. The primary organic chemicals detected in groundwater were petroleum hydrocarbons (DRO), PAHs, PCP, and dioxins/furans. The highest concentrations were detected in wells representing the Upper Creek and Historical Creek areas of the site. Metals were also detected in most wells with the highest concentrations of some metals (i.e., cadmium, chromium, copper, lead, mercury, and zinc) detected in the Upper Creek (e.g., SB-23, SB-24).

The nature and extent of groundwater contamination is evaluated for each individual site area in the subsections below.

5.4.1 Background Groundwater

Background groundwater was measured at MW-06D located in the Birchwood neighborhood, north of the Oeser site. Eighteen samples have been collected from this well since September 1995. Two of the 18 samples were collected in November 2005 and February 2006 to support the Park remedial investigation. Samples were analyzed for conventional parameters (e.g., hardness), total and dissolved metals, VOCs, SVOCs, PAHs, petroleum hydrocarbons (EPH), and dioxins/furans.

Barium, calcium, magnesium, potassium, and sodium were detected in all background water samples. Other frequently detected metals (>50 percent in background groundwater samples) include arsenic, chromium, iron, manganese, vanadium, and zinc (Table 5-3). Five samples were analyzed for petroleum hydrocarbons by EPH. Low levels of petroleum hydrocarbons were detected in one of the five samples at the detection limit of 50 µg/L. PAHs were detected in some of the water samples but at relatively low levels (<1 µg/L). Other SVOCs detected in background groundwater included:

- PCP in two of 18 samples analyzed (0.084 µg/L, 0.39 µg/L)
- Benzoic acid in two of 16 samples analyzed (0.02 µg/L, 1.8 µg/L)
- Benzyl alcohol in one of 16 samples analyzed (0.041 µg/L)
- 1,3-Dichlorobenzene in one of 16 samples (0.04 µg/L)
- Phthalate compounds (near detection limit).

VOCs were infrequently detected in MW-06D, including:

- Acetone (96.4 µg/L)
- Chloroform (0.36 µg/L)
- 1,2-Dichloroethane (1.6 µg/L)
- 1,1-Dichloroethene (0.55 µg/L)
- Toluene (0.24 µg/L)

- 1,1,1-Trichloroethane (4.5 µg/L)
- *m,p*-Xylene (0.87 µg/L).

The elevated acetone in one sample may be a result of laboratory contamination.

Seven samples were analyzed for dioxins/furans with TEQ concentrations ranging from below detection (two samples) to 2.275E-05 µg/L (December 1999).

5.4.2 Upper Creek Groundwater (Includes Historical Creek)

Thirty groundwater samples were collected and analyzed from 20 wells or piezometers in the Upper Creek area (which also includes the upper part of the Historical Creek area). Most of the samples were analyzed for SVOCs and petroleum hydrocarbons. Some samples were also analyzed for conventional parameters, metals, VOCs, and/or dioxins/furans. A few samples were analyzed for metals only (Table 5-3).

Monitoring well MWLSC01 was sampled three times between fall 1999 and spring 2000 as part of the Oeser remedial investigation. Monitoring wells MWLSC02 and MWLSC03 were also sampled three times between fall 1999 and spring 2000 and two times between fall 2005 and spring 2006 as part of the Park investigation. Well points WP1 and WP2 were each sampled once in fall 1999. WP1 and WP2 were temporarily installed in the Upper Creek during the Oeser remedial investigation (see Figure 2-3).

Filtered and unfiltered samples were collected for the analysis of metals during the two 1999 sampling events for wells MWLSC01, MWLSC02, and MWLSC03 and most wells sampled during the Park remedial investigation. All other groundwater samples were unfiltered to allow for metals analysis. The highest metals concentrations were detected in wells SB-21, SB-22, SB-23, and SB-24 and included cadmium (1 µg/L), chromium (121 µg/L), copper (204 µg/L), lead (25 µg/L), mercury (0.24 µg/L), nickel (221 µg/L), and zinc (304 µg/L). These wells are located on the upper railroad grade path, west of the Creek. Metals concentrations were generally lower in wells located in the ravine.

Patterns of petroleum hydrocarbons detected in groundwater suggest a plume first encountered at SB-09 (2,500 µg/L), near the confluence of the Oeser/Birchwood and BTC/Birchwood outfalls, and generally following the course of the Upper Creek, with a maximum detected concentration at WP1 (53,000 JN µg/L) about 500 ft downstream of the Oeser/Birchwood outfall (see Figure 5-8). The WP1 groundwater sample was collected approximately 3 ft below the Creek bed in 1999 as part of the Oeser RI/FS. The petroleum hydrocarbon concentration in the next well downstream from WP1 is markedly lower (1,900 µg/L at WP2). Petroleum was detected in wells near the Creek (SB-9, -29, -11, -14, -25, WP1, and WP2), but not in wells farther from the Creek (SB-21, -22, -23, -24, -28, -30, -32, MWLSC02, and MWLSC03, all with detection limits of 20 µg/L) (see Figures 5-25 and 5-26).

Petroleum hydrocarbons identified as motor oil were detected only below the bed of the Creek at WP1 (9,200 JN µg/L) and WP2 (2,400 JN µg/L) (see Figure 5-26). Detection limits for motor oil were 500 µg/L, except at SB-09 (1,000 µg/L). GRO was detected in six of the samples ranging in concentration from 325 to 4,400 µg/L (SB-29).

Patterns of GRO detections in groundwater suggest two possibly separate plumes (see Figure 5-16). One plume is north of the Oeser/Birchwood outfall around SB-21 (4,200 µg/L) and SB-22 (350 µg/L). The other plume generally follows the Creek with a maximum detected concentration at SB-29 (4,400 µg/L). GRO was detected in wells along the northern portion of the Creek (SB-29, -11, -14, and -25) but not in wells between the two plumes (SB-28, -09, -23, and -13), not in wells farther from the Creek (SB-24, -30, -32), and not in WP2. Detection limits for GRO were 70 µg/L, except at WP1 (580 µg/L) and WP2 (100 µg/L).

PAHs were detected more broadly than petroleum, with the highest TPAH concentrations occurring along the course of the Creek at SB-09 (1,441 J µg/L), SB-29 (3,853 J µg/L), and WP1 (8,132 J µg/L) (see Figures 5-27 to 5-30). The primary PAH compounds detected in these water samples were LPAHs including naphthalene and phenanthrene. LPAHs are generally more mobile in groundwater than HPAHs (refer to Section 6).

PCP occurs in two possibly separate plumes (see Figure 5-31). The first plume is east of the Oeser/Birchwood outfall, with a maximum detected concentration at SB-09 (90 µg/L). The second plume is within the Upper Creek area about 100 ft southwest of the first plume, with a maximum detected concentration at SB-25 (460 µg/L). PCP was not detected in wells between these plumes (SB-24, -14, and -11), not in wells north of the first plume (SB-22, -21, and -28) nor in wells farther from the Creek (SB-30, -27, -26, and -32). Most detection limits for PCP were at or below 0.91 µg/L, except at WP1 (2.7 µg/L). Several other methylated and chlorinated phenolic compounds were also detected in Upper Creek groundwater wells containing PCP. These compounds are associated with the manufacturing and degradation of PCP (refer to Section 6).

Dioxin/furan congeners were detected in most samples in which they were analyzed, but the highest concentrations of TEQs occurred near the Oeser/Birchwood outfall at SB-22 (1.851E-04 J µg/L) and along the north side of the Creek at SB-24 (5.325E-05 J µg/L), SB-14 (2.773E-05 J µg/L), MWLSC03 (1.326E-05 µg/L), and MWLSC02 (1.228E-05 µg/L) (see Figure 5-32).

Several phthalates were detected in Upper Creek groundwater. Bis(2-ethylhexyl)phthalate was detected in 17 percent of the samples, with a maximum concentration of 32 µg/L at SB-23. Diethylphthalate was detected in 7 percent of the samples, with a maximum concentration of 3.4 µg/L at SB-27. Di-*n*-octylphthalate was detected in 7 percent of the samples, with a maximum concentration of 0.27 µg/L at WP2. Other volatile organic compounds (VOCs) and SVOCs detected in Upper Creek groundwater are shown in Table 5-3.

5.4.3 Lower Creek Groundwater

There were three groundwater samples collected and analyzed from three piezometers (SB-18, SB-19, SB-20) in the Lower Creek area (Figure 5-5). SB-19 is located at the confluence of the Creek and a stormwater outfall/ditch coming from the Marine Drive neighborhood to the west. SB-18 is located downstream of SB-19/SB-20, approximately 50 ft west of the Creek. Samples were analyzed for SVOCs and conventional parameters (e.g., TOC) (Table 5-3).

PAHs, including dibenzofuran, were detected in well SB-19 at the edge of the Creek (8.8 J µg/L HPAHs, 9.8 µg/L LPAHs, 19 J µg/L TPAHs). Phenol (2.1 µg/L), 4-methylphenol (1.8 µg/L), benzoic acid (120 µg/L), and benzyl alcohol (4.8 µg/L) were detected in well SB-20. Bis(2-ethylhexyl)phthalate (1.8 µg/L) was only detected in SB-18. PCP was not detected in the groundwater samples. Because of its proximity to the Creek, groundwater sampled and analyzed from SB-19 may be influenced by creek surface water.

5.4.4 Seep Water

Seep water samples were collected from two locations (SW-08 and SEEP-1) in the Upper Creek area (see Figures 2-3 and 5-3). A total of three samples were analyzed for conventional parameters, metals, VOCs, SVOCs, PAHs, petroleum, and/or dioxins/furans. SVOCs were analyzed for all samples. Petroleum hydrocarbons (EPH) and one or more PAHs were detected in all seep water samples with the highest TPAH concentrations detected in SW-08 (1.25 J µg/L in December 1999) (see Figures 5-25 to 5-30). Other chemicals detected in SW-08 include:

- PCP (0.33 µg/L)
- Phenol (0.058 µg/L)
- Tetrachlorphenols (0.07 µg/L)
- Benzyl alcohol (0.11 µg/L)
- Di-*n*-Butylphthalate (0.4 µg/L)
- 4-Chloroaniline (0.042 µg/L)
- Dioxins/furans (TEQ = 3.876E-05 µg/L).

PCP and TEQ concentrations are shown on Figures 5-31 and 5-32, respectively.

5.4.5 Spring Water

Spring water samples were collected from one location (SW-03) in the Upper Creek area during the Oeser remedial investigation (see Figure 2-3). A total of two samples were collected during two sampling events in 1999 and analyzed for conventional parameters, metals, VOCs, SVOCs, PAHs, petroleum hydrocarbons, and dioxins/furans.

Metals, VOCs, SVOCs, and dioxins/furans were detected in one or both samples at relatively low concentrations. Petroleum hydrocarbons (7.9 μg/L), PAH (anthracene—0.035 μg/L, phenanthrene—0.02 μg/L, pyrene—0.02 μg/L), and TEQ (7.365E-06 μg/L) concentrations for SW-03 are presented on Figures 5-25 to 5-32.

5.5 SURFACE WATER

Surface water samples are available for background and five site areas including the Upper Creek, Historical Creek, Lower Creek, Beach, and wetlands. A total of 38 surface water samples collected from 18 stations were evaluated in the remedial investigation (Figure 2-3).

Organics and metals were detected in surface water located in each site area within the Park. The primary organic chemicals detected in surface water were PAHs (50 percent detection), PCP (39 percent), and dioxins/furans (78 percent). The highest concentrations were detected in surface water representing the Upper Creek (SW-05) area of the site. Surface water collected from SW-05 is representative of discharges from the Oeser/Birchwood outfall. Metals were also detected in most samples with the highest concentrations of some metals (i.e., cadmium, chromium, copper, lead, mercury, and zinc) detected in the Historical Creek (e.g., SW-11 and SW-12[39]). In general, chemical concentrations in surface water decrease with increasing distance downstream in the Creek.

The nature and extent of surface water contamination is evaluated for each individual site area in the subsections below.

5.5.1 Background

Background or reference surface water (SW Reference) was collected during two sampling events from Cemetery Creek, an in-flow tributary to Whatcom Creek. The sampling location was chosen to resemble flow and bottom conditions of the Creek. Non-point sources of stormwater from local residences are the major contributions of flow and content to Cemetery Creek. This location has no known point sources (Integral 2005c). Samples were collected in November 2005 and April 2006 and analyzed for conventional parameters, dissolved and total metals, petroleum hydrocarbons (DRO, GRO), SVOCs, and dioxins/furans (Table 5-4). Dioxins/furans were not analyzed in the second sample collected in April 2006.

Metals were the only chemicals detected in the background sample but at relatively low levels. Concentrations are presented in Table 5-4.

---

[39] SW-12 was collected from a stormwater culvert that drains portions of the Birchwood neighborhood and BTC before discharging to the Historical Creek (see Figure 5-3). Another culvert discharges water collected in the Historical Creek area to the current creek (SW-11).

5.5.2 Upper Creek Area (Includes Historical Creek)

Twenty-one surface water samples were collected and analyzed from nine locations in the Upper Creek area (which also includes the upper portion of the Historical Creek area). Most of the samples were analyzed for metals and SVOCs. Some samples were also analyzed for conventional parameters, petroleum hydrocarbons (NWTPH or EPH), VOCs, and/or dioxins/furans (Table 5-4).

Arsenic, calcium, copper, lead, magnesium, nickel, and zinc were the most frequently detected metals in surface water. In general, the highest concentrations of these metals were detected at locations SW-11 and SW-12 (Historical Creek area). SW-11 and SW-12 conveys stormwater from the residential areas south of the Park including BTC and Lindbergh Avenue. The highest lead concentration was detected in SW-04 located at the Marine Drive outfall.

The most frequently detected SVOCs include PAHs (57 percent), PCP (48 percent), and tetrachlorophenols (45 percent). The highest concentrations of these organics were found in SW-05, representing the Oeser/Birchwood outfall (see Figures 5-27 to 5-30). PCP was detected at 140 µg/L in surface water from SW-05 (November 2005) located at the culvert below the railroad grade (trail) and 17 µg/L at station 320 (1998) located at the discharge of the Oeser/Birchwood outfall (Figure 5-31). These chemicals were not detected in surface water sample SW-10 located upgradient of the Oeser site.[40]

VOCs were infrequently detected in surface water of the Upper Creek area and include:

Chemical	Station	Concentration (µg/L)
Benzene	SW-05	0.15
Chloroform	SW-06	0.42
Methyl tert-butyl ether	SW-05	3.4
Toluene	SW-06	0.08
m,*p*-Xylene	SW-05	0.12
o-Xylene	SW-05	0.78

Dioxins/furans were detected in 11 of 12 samples analyzed, with the TEQ ranging from 1.273E-05 to 5.768E-04 µg/L (SW-05) (see Figure 5-32).

In general, organic (e.g., PCP) and metals (e.g., lead, zinc) concentrations in surface water of the Upper Creek area were higher during the rainy season (October to May). This would be expected since stormwater discharges of point and non-point sources from the Oeser/Birchwood, BTC/Birchwood, and Marine Drive stormlines are the principal contribution of flow to the Upper Creek during this time period (refer to Section 4.4.4).

[40] Oeser currently has an NPDES permit to discharge low levels of petroleum hydrocarbons and PCP to the Creek.

5.5.3 Lower Creek Area

Eight surface water samples were collected and analyzed from three locations in the Lower Creek area. All samples were analyzed for conventional parameters, metals, and SVOCs. A few samples were also analyzed for petroleum hydrocarbons (NWTPH or EPH), VOCs, and/or dioxins/furans (Table 5-4).

Arsenic, calcium, copper, magnesium, nickel, and zinc were the most frequently detected metals in surface water. The highest concentrations of arsenic, chromium, copper, lead, and nickel were detected in SW-09, located approximately halfway between the Marine Drive Bridge and the BNSF railroad bridge (Figure 5-4). The highest zinc concentration was detected in SW-01, located at the culvert leading to Bellingham Bay.

Petroleum hydrocarbons were not detected in the Lower Creek water samples. The most frequently (≥50 percent) detected SVOCs include PAHs (50 percent), PCP (50 percent), and tetrachlorophenols (50 percent). The highest concentrations of these organics were found in SW-01, representing the mouth of the Lower Creek. PCP was detected at 15 μg/L in surface water from SW-09 (November 2005) and 13 μg/L at SW-01 (November 2005).

VOCs were infrequently detected in surface water of the Lower Creek area. Detections in surface water included chloroform (0.023 μg/L at SW-01), methyl tert-butyl ether (2.7 μg/L at SW-01), and *o*-xylene (0.69 μg/L at SW-01). These compounds were analyzed at this station as part of the Oeser remedial investigation.

Dioxins/furans were detected in two of three samples analyzed, with the TEQ ranging from 1.598E-05 to 5.100E-05 μg/L (both for SW-01).

Similar to the Upper Creek, organic and metals concentrations in surface water of the Lower Creek area were higher during the rainy season.

5.5.4 NE Wetland Area

Five surface water samples were collected and analyzed from two locations in the wetland area of the site, located along the northeast boundary of the Park. All samples were analyzed for conventional parameters, metals, and SVOCs. A few samples were also analyzed for petroleum hydrocarbons (NWTPH or EPH), VOCs, and/or dioxins/furans (Table 5-4).

Arsenic, calcium, and magnesium were the most frequently detected metals in surface water. The highest concentrations of metals were detected in SW-07, located in the northeast corner of the site bordering the BTC parking lot. This area receives infrequent overflow stormwater discharges from the BTC parking lot.

Petroleum hydrocarbons were not detected in the water samples. SVOCs and VOCs were infrequently detected in surface water of the wetland area. Detections include:

Chemical	Station	Concentration (µg/L)
PAHs	OS07	3.23
PCP	SW-07	0.065
Phenol	OS07	2.6
4-Methylphenol	OS07	6.5
Methyl *tert*-butyl ether	SW-07	2.4
Toluene	SW-07	0.051
o-Xylene	SW-07	0.73

Dioxins/furans were analyzed for stations OS07 and SW-07 in support of the Oeser remedial investigation. Only SW-07 had detectable dioxins/furans (1.902E-05 µg/L).

5.5.5 Beach Area

One surface water sample was collected and analyzed from one location (OS01) in the Beach area (see Figure 2-2). The sample was collected in 1996 and analyzed for metals and SVOCs (Table 5-4). Metals, PAHs (4.76 J µg/L TPAH), and carbazole were detected in the sample.

5.6 SEDIMENT

Surface and subsurface sediment samples were collected in the Upper Creek, Historical Creek, Lower Creek, wetland, and Beach areas of the site (see Figure 3-1). A total of 33 surface samples and 13 borings (SB-2, -3, -5, -10, -15, -16, -19, -34, -35, -36, -37, -38, -39) were advanced to evaluate sediment quality in the Park. In addition to chemical testing, 16 surface samples were also evaluated using one or more bioassay tests (discussed in Section 5.7). Most sediment stations are located in the Upper Creek and Historical Creek areas of the site.

The principal chemicals detected in sediments onsite included petroleum hydrocarbons (DRO and motor oil); PAHs, including dibenzofuran and carbazole; PCP and other phenolic compounds; dioxins/furans; and metals (Table 5-5). The most extensive sediment contamination was found in the Upper Creek and Historical Creek areas of the site (Figures 5-8 to 5-15 and 5-25 to 5-32). These areas have elevated levels of organic compounds in surface and subsurface sediments, including petroleum hydrocarbons, PAHs, PCP, and dioxin/furans. Subsurface sediment contamination in these areas appears to be impacted by localized groundwater and the discharge of stormwater to the Creek (refer to Section 6.3). Surface sediments in the Historical Creek contain elevated metals concentrations, possibly due to stormwater discharges to this area of the site.

The nature and extent of sediment contamination is evaluated for each individual site area in the subsections below.

5.6.1 Upper Creek Area

Sediment in the Upper Creek area has been characterized based on information obtained from 13 surface locations and two borings (see Figure 5-3). A total of 18 surface samples and two subsurface soil samples collected during this study and historical investigations were available for evaluation in the remedial investigation. Additional subsurface investigation of this area of the Park was accomplished by boring into soils along the Creek banks (refer to Section 5.3.4).

All samples were analyzed for metals and SVOCs. A few samples were also analyzed for conventional parameters (e.g., TOC), petroleum hydrocarbons, and dioxins/furans. The primary chemicals detected in surface sediments of the Upper Creek area include metals, petroleum hydrocarbons, PAHs including dibenzofuran, PCP and other phenolic compounds, dimethylphthalate, and dioxins/furans. Only metals were detected in subsurface sediments (1 to 2 ft bgs) from borings SB-15 and SB-16.

The highest metals concentrations (e.g., arsenic, cadmium, lead, mercury, zinc) in surface sediments were detected in SD06 and OS06 located in the middle of the Upper Creek. Petroleum hydrocarbons were detected in all samples analyzed, with the highest concentrations detected in the upper portions of the Creek, near the confluence of the Oeser/Birchwood and Birchwood outfalls. In this area, petroleum sheen was observed during the field investigation seeping from the bank or covering surface sediments in several locations (see Figure 5-33). A representative sample from the seeps along the Creek bank, “LSC Bank,” was collected approximately 75 ft downstream of the confluence between the Oeser/Birchwood and BTC/Birchwood outfalls. The petroleum hydrocarbon concentrations were reported at 3,700 mg/kg (DRO). This sample also contained elevated levels of PAHs (1,510 mg/kg TPAH, 859 mg/kg HPAH, 651 mg/kg LPAH) and PCP (1.8 J mg/kg). Diesel-range and residual-range hydrocarbons are presented on Figures 5-25 and 5-26.

The most frequently detected SVOCs in surface sediments of the Upper Creek area was PAHs, including dibenzofuran (100 percent), PCP (100 percent), and dimethylphthalate (77 percent). Other SVOCs detected in the samples include carbazole, benzoic acid, benzyl alcohol, retene, phenolic compounds, and phthalates (Table 5-5). Concentrations of PAHs in surface sediments are presented on Figures 5-27 to 5-30. PCP concentrations ranged from 0.015 to 4.27 J mg/kg (LSC-06) (see Figure 5-31).

Dioxins/furans were detected in all six samples analyzed. TEQ concentrations ranged from 1.259E-05 to 7.305E-04 mg/kg (SD10) (Figure 5-32). Elevated dioxins/furans concentrations were generally associated with high levels of PCP (PCP of 2.9 mg/kg at SD10).

TOC concentrations ranged from 0.54 to 11.0 percent (SD06).

5.6.2 Historical Creek Area

Sediment in the Historical Creek area has been characterized based on information obtained from six coring locations (see Figure 5-4). Vibracores were advanced at each location approximately 100 ft apart in the wetter portion (i.e., with overlying water) of this area. A total of six surface samples and eight subsurface soil samples collected during this study were available for evaluation in the remedial investigation. Additional subsurface investigation was accomplished by boring into soils of the upper portion of the Historical Creek (refer to Section 5.3.5).

5.6.2.1 Surface Sediment

All surface samples were analyzed for metals and petroleum hydrocarbons. A few samples were also analyzed for TOC, SVOCs, and dioxins/furans. The primary chemicals detected in surface sediments of the Historical Creek area include metals, petroleum hydrocarbons (DRO, motor oil), PAHs, PCP, phthalates, and dioxins/furans.

The highest metals concentrations (e.g., cadmium [2.5 mg/kg], chromium [986 mg/kg], lead [319 mg/kg], mercury [0.4 mg/kg], nickel [75 mg/kg], zinc [358 mg/kg]) were detected in SB-37, located near the confluence with the current creek channel. Petroleum hydrocarbons were detected in all samples analyzed with a range of DRO of 120 to 1,100 mg/kg (SB-36) and motor oil of 280 to 1,650 mg/kg (SB-38) (see Figures 5-25 and 5-26). SB-38 also contained elevated levels of PAHs (354 mg/kg TPAH, 343 mg/kg HPAH, 10.8 mg/kg LPAH) and PCP (3.6 mg/kg) (see Figures 5-27 to 5-31). The highest PCP concentration of 7.9 mg/kg was detected in SB-36.

The most frequently detected SVOCs in surface sediments were:

- PAHs (100 percent)
- PCP (67 percent)
- Bis(2-ethylhexyl)phthalate (67 percent)
- Butylbenzylphthalate (67 percent)
- Di-*n*-butylphthalate (85 percent).

Other SVOCs detected in the samples included carbazole, benzoic acid, benzyl alcohol, 4-methylphenol, and di-methylphthalate (Table 5-5). PCP concentrations detected in the sediments ranged from 1.3 to 7.9 mg/kg (SB-36).

Dioxins/furans were detected in all three samples analyzed. TEQ concentrations ranged from 6.860E-04 to 3.292E-03 mg/kg (SB-36) (see Figure 5-32).

TOC concentrations ranged from 2.1 to 11.9 percent (SB-37).

5.6.2.2 Subsurface Sediment

Eight subsurface sediment samples were analyzed for metals and petroleum hydrocarbons (Table 5-5, Figure 5-4). Only zinc was detected in all subsurface samples with the highest levels of most metals detected at stations SB-35 and SB-38. Of those samples analyzed for petroleum hydrocarbons, SB-35 (910 J mg/kg DO and 2,700 mg/kg motor oil at 1 to 1.8 ft), SB-37 (570 mg/kg motor oil at 1.2 to 2 ft), and SB-38 (240 mg/kg motor oil at 1 to 1.9 ft) exceeded the screening level of 200 mg/kg[41] (see Figure 5-25 and 5-26). Petroleum hydrocarbons were tested in samples below these depths, but all were reported below the screening level.

SVOCs were analyzed in three samples with PAHs detected in each sample. The highest PAH concentrations were detected in SB-35 (70.9 J mg/kg TPAH, 8.6 J mg/kg LPAH, 62.2 mg/kg HPAH at 1 to 1.8 ft bgs). HPAHs (e.g., chrysene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene) were the principal components of PAHs in SB-35 and other subsurface samples analyzed in this area (see Figure 5-27 to 5-30).

Other SVOCs detected in the samples included PCP, phthalates, retene, and carbazole (Table 5-2). Pentachlorophenol was detected in two of three samples, ranging in concentration from 0.15 to 7.3 mg/kg (SB-35 at 1 to 1.8 ft bgs) (see Figure 5-31). Dioxins/furans were analyzed and detected in SB-35 (1 to 1.8 ft bgs) with a TEQ calculated to be 2.451E-03 J mg/kg (see Figure 5-31).

TOC concentrations ranged from 1.02 to 6.66 percent (SB-35 at 1 to 1.8 ft bgs).

The upper 2 to 3 ft of sediment in the southeastern portion of the Historical Creek area has been impacted by metals, phthalates, petroleum hydrocarbons, PAHs, PCP, and dioxins/furans. There may be two different sources. The source of metals, phthalates, and some portion of petroleum hydrocarbons may be from stormwater discharges associated with the Lindbergh

---

[41] Similar to soils, the screening level for diesel-range and residual-range petroleum hydrocarbons in sediments is 200 mg/kg and is the MTCA TEE for soil (Integral 2005c). Since sediments could become soils as part of remediation or park development (in the event the creek was redirected along another route), this lower screening level was used for both solids.

Avenue outfall (SW-12). During high flows, this overflow outfall discharges stormwater from the BTC campus and residential streets in the area. The second source of petroleum hydrocarbons, PAHs, PCP, and dioxins/furans is likely associated with wood-treating operations. The collocation of these chemicals in surface sediments may be associated with discharges from the Oeser site in the 1950s, when the Creek flowed through this area (refer to Section 6.3). This second source of contamination has impacted subsurface soils in most locations. Chemical concentrations decreased with increasing sediment depth, indicating the sources were likely deposited from surface water rather than from groundwater.

5.6.3 Lower Creek Area

Sediments were collected from 12 surface locations and five sediment borings in the Lower Creek area. Few borings were advanced into the Creek bed because of the difficulty in drilling through coarse materials and the steepness of the banks in this part of the Park. An additional eight soil borings were advanced along the banks of the Creek and are discussed in Section 5.3.4.

5.6.3.1 Surface Sediment

Surface sediment samples were collected from 12 locations in the Lower Creek area (see Figure 5-5). Nine samples were analyzed for metals and four samples were analyzed for petroleum hydrocarbons (Table 5-2). The screening level of 200 mg/kg was exceeded in samples collected from two locations, SB-02 (305 mg/kg motor oil) and SB-19 (490 mg/kg motor oil). No surface sediment samples exceeded the screening level of 200 mg/kg for diesel.

Surface sediment samples were analyzed for metals (nine locations) and SVOCs (10 locations). Chromium, copper, lead, nickel, and zinc were detected in each sample analyzed. The highest concentrations of metals were detected in OS02, SB-02, and SB-19. PAHs were detected in all samples, with the highest concentrations detected in LSC-03 (324 J mg/kg HPAH, 105 J mg/kg LPAH, 429 J mg/kg TPAH). PCP was detected in all 10 samples with concentrations ranging from 0.0037 J to 4.5 mg/kg (SB-02). Sediments collected from LSC-03 also had high levels of PCP (4.33 J mg/kg). Other SVOCs were frequently detected in sediment, including benzoic acid, phthalates, methylphenols, phenols, and dibenzofuran (Table 5-5).

The surface soil samples from five locations were also analyzed for dioxins/furans. The calculated TEQ ranged from 1.170-05 J to 5.936E-03 J mg/kg (SB-02). SB-02 also had the highest PCP concentration in Lower Creek sediments.

TOC concentrations ranged from 0.28 to 13 percent (SB-02).

5.6.3.2 Subsurface Sediment

Thirteen subsurface soil samples were analyzed for petroleum hydrocarbons (Table 5-5). Five subsurface samples exceeded the screening level of 200 mg/kg for petroleum hydrocarbons, including (upstream to downstream):

Station	Depth (ft bgs)	TPH-DRO Concentration (mg/kg)	TPH-Motor Oil Concentration (mg/kg)
SB-19	1-2	240	740
SB-19	2-3	5,400	380
SB-19	3–3.6	11,000	670
SB-10	2–3	290	98
SB-02	1–2	130	220

Based on the TPH results, these samples were also analyzed for SVOCs.

Chromium, copper, nickel, and zinc were detected in each sample analyzed, with the highest concentrations in the upper sediments of the borings (i.e., 1 to 2 ft bgs). The highest concentrations of chromium (41.9 mg/kg) and zinc (224 mg/kg) were detected in SB-19 at 1 to 2 ft bgs. There was no obvious lateral pattern for the other metals tested in the sediments.

PAHs, PCP, carbazole, and dimethylphthalate were detected in each of the five samples tested for SVOCs (Table 5-5). Elevated concentrations of these compounds and other SVOCs (e.g., phenolic and phthalate compounds) were detected in subsurface sediment in SB-19, located on the edge of the Creek at the confluence with a small drainage ditch from the Marine Drive area (see Figure 5-5). Petroleum contamination was not observed in boring SB-20 located farther upstream in the drainage ditch, indicating the source of these chemicals is likely associated with the Creek. The highest concentrations of PCP, methylphenols, and tetrachlorophenols were detected in SB-02 at 1 to 2 ft bgs. SB-02 is located near the mouth of the Creek, approximately 25 ft upstream of the BNSF railroad bridge. Fine-grained, organic-rich sediment was observed to be deposited in the areas of the Lower Creek represented by SB-19 and SB-02.

Dioxins and furans were analyzed and detected in three samples. The highest TEQ concentrations were detected in SB-2 at 1 to 2 ft bgs (4.705E-03 mg/kg) and SB-19 at 1 to 2 ft bgs (1.492E-03 mg/kg).

TOC concentrations ranged from 1.4 to 9.7 percent (SB-02 at 1 to 2 ft bgs).

5.6.4 NE Wetland Area

Three surface sediment samples (OS07, SD11, LSC-05) were collected and analyzed for metals and SVOCs in the wetland area (see Figure 2-2). One sample was also analyzed for TOC, petroleum hydrocarbons, and dioxins/furans. The primary chemicals detected in surface sediments of the wetland area (located in the northeastern boundary of the site) included were metals.

With the exception of chromium and nickel detected in OS07 (217 and 106 mg/kg), relatively low concentrations of metals were detected in the sediment samples (e.g., cadmium [0.6 mg/kg], lead [18.5 mg/kg], mercury [0.052 mg/kg], copper [83.5 mg/kg], lead [18.5 mg/kg], and zinc [125 mg/kg]). SVOCs were generally low in concentration for two of three samples (OS07 and SD11) (Table 5-5). PCP was detected in one sample (LSC-05) at 1.27 mg/kg. Sediment collected at LSC-05 also contained PAHs (1.79 J mg/kg TPAH), phenol, methylphenols, benzoic acid, benzyl alcohol, and phthalates. Only SD11 was analyzed for dioxins and furan, with a calculated TEQ concentration of 7.564E-06 mg/kg. PCP was not detected in SD11.

Sediments in the wetland area were observed to be highly organic with a TOC concentration of 12.5 percent measured in SD11.

5.6.5 Beach Area

Surface sediment has been collected historically in the Beach area of the project site. One surface sediment sample (OS01) was collected and analyzed from the Beach area in support of the Oeser remedial investigation (see Figure 5-7). The sample was analyzed for metals and SVOCs. PAHs (0.88 J mg/kg), PCP (0.0391 mg/kg), and all metals were detected in the sample (Table 5-5). Other SVOCs detected in the sample included phenol, 4-methylphenol, and dibenzofuran.

Additional samples were planned for collection in support of this remedial investigation (Integral 2005c). However, fine-grained sediments were not observed in the Beach area or near the mouth of the Creek, at the time of each sampling event. Little Squalicum Beach is an openly exposed area of Bellingham Bay with significant seasonal erosion from southwesterly winds and waves. Fine-grained sediments are eroded from the Beach, leaving behind coarse-grained materials (e.g., gravels and cobbles), which cannot be chemically analyzed by the laboratory. Finer-grained sediments have been observed hundreds of feet offshore of the creek mouth, but likely in locations outside of the influence of discharges from the Creek mouth.

5.7 BIOLOGICAL EFFECTS DATA

This section summarizes results of biological analysis that include sediment toxicity testing, sediment bioaccumulation testing, and berry analysis conducted as part of the Oeser site remedial investigation (E&E 2002a), and sediment toxicity testing that was conducted more recently by Ecology (2004). Results are presented in Appendix D.

5.7.1 Sediment Toxicity and Bioaccumulation (Oeser Remedial Investigation)

Biological analytical results were conducted as part of the Oeser site remedial investigation (E&E 2002a) and included a 10-day toxicity test with the amphipod *Hyalella azteca* and a 28-day bioaccumulation test with the aquatic oligochaete *Lumbriculus variegatus*.

Sediment toxicity testing with *H. azteca* was conducted on samples from eight locations (SD01 through SD08) distributed along the Creek, one location in the channel that leads from the Oeser/Birchwood outfall to the Creek (SD10), and one location at the BTC/Birchwood outfall (SD09), which was considered at the time a site-specific background sample. The BTC/Birchwood neighborhood outfall was considered to be upstream from the confluence of the Oeser/Birchwood outfall channel with the Creek. Results are contained in Appendix D, Table D-1.

The two test endpoints evaluated were survival and growth. The average percent survival in samples from the Creek and Oeser outfall channel ranged from 78 to 93 percent; average percent survival in the background station was 91 percent. None of the site survival results differed significantly from the survival results in the background sample (SD09). The average dry-weight per organism (amphipod growth) in samples from the Creek and Oeser outfall channel ranged from 0.13 to 0.20 mg; average dry weight per organism in the background station (SD09) was 0.24 mg. It is not known if the growth results in the site samples were significantly different from the growth in the background sample because it was not reported in the Oeser remedial investigation, and the raw data are not available to make this comparison. It should be noted, however, that average amphipod growth in the laboratory control was only 0.10 mg per organism.

Sediment bioaccumulation testing with *L. variegatus* was conducted on sediment from three locations in the Creek (SD02, SD05, and SD06). SD05 and SD06 are located upstream of the Marine Drive Bridge, and SD02 is located downstream (see Figure 3-1). Results are contained in Appendix D, Tables D-2 and D-3. Following the 28-day exposure period, the oligochaetes were removed from the sediment and analyzed for bioaccumulative chemicals, which included several SVOCs (phenols, PAHs, benzoic acid, and benzyl alcohol), and dioxins/furans. At test termination, the average biomass per replicate in the site samples was 3.7 g, 2.9 g, and 11.2 g, respectively, for samples SD02, SD05, and SD06. The average biomass per replicate in the laboratory control was 8.9 g, and biomass at test initiation for all samples was 10 g. These data indicate that growth only occurred in sample SD06; the other two site samples and the control each lost weight during the test. The weight loss in samples SD02 and SD05 was significantly greater than the weight loss in the control, suggesting either a toxic effect at these two locations or significantly reduced food availability. Over the 28-day test period, the worms are not fed and instead must rely on available organic carbon in the sediment to sustain their dietary requirements. The percent TOC in the site samples was 1.3 percent (SD02), 1.8 percent (SD05), and 11 percent (SD06), suggesting that differences in food availability may have contributed to the differences in biomass between the site samples.

The limited biomass obtained from each of the site samples at test termination prevented the analysis of the entire analytical suite at each location, with the exception of the control sample. Rather, analyses were split between the samples: sample SD06 was analyzed for SVOCs, and the biomass from samples SD02 and SD05 was pooled and analyzed for dioxins/furans. Results are summarized in Appendix D along with the corresponding sediment concentrations. Eleven PAHs, six phenol compounds, and two other SVOCs (benzoic acid and benzyl alcohol) were detected in organisms exposed to sediment from location SD06, the station located closest to the Oeser/Birchwood outfall. However, five of these analytes (2,4,6-trichlorophenol, 2-methylphenol, phenol, benzoic acid, and benzyl alcohol) were not detected in sediment from SD06. Seven dioxin/furan congeners were detected in the organisms exposed to sediment from locations SD02 and SD05. As compared to sediment dioxin concentrations at these two locations, each of the seven dioxin congeners was also detected in sediment at SD02 and SD05 and other surface sediments in the Creek.

5.7.2 Berry Testing (Oeser Remedial Investigation)

Four composite berry samples from Himalayan blackberry (*Rubus discolor*) bushes were collected from the following locations:

- **Berry 1**—Collected by the railroad tracks immediately south of the Oeser facility (off the Park property)
- **Berry 2**—Collected along the old railbed/path above the Creek (Upper Creek area)
- **Berry 3**—Collected from the ravine on the south side of the Creek (Historical Creek area)
- **Berry 4**—Collected from a residential background area approximately at the intersection of Squalicum Parkway and Meridian Street in Bellingham.

From all four locations, washed (rinsed with distilled water) and unwashed berries were analyzed for VOCs, SVOCs, and dioxins/furans. Analytes that were detected at least once are presented in Appendix D (Table D-4) and include six PAHs, three other SVOCs (1,2,3-trichlorobenzene, benzoic acid, and benzyl alcohol), two VOCs (*p*-isopropyltoluene and styrene), and three dioxin/furan congeners (1,2,3,4,6,7,8-HpCDD, octachlorodibenzo-*p*-dioxin [OCDD], and octachlorodibenzofuran [OCDF]). As expected, in general, concentrations of all analytes in unwashed berries were greater than concentrations in washed berries. The SVOC 1,2,3-trichlorobenzene was only detected in the washed background sample. All other SVOCs, except from fluoranthene and phenanthrene, were only detected in site samples. Concentrations of fluoranthene and phenanthrene in the berry samples from the site were within the range of concentrations observed in the background sample. The two VOCs were detected in all samples, and concentrations in berry samples from the site bracketed concentrations observed in the background sample. The compounds *p*-isopropyl toluene, benzoic acid, and benzyl alcohol are naturally occurring in berries. Of the three dioxin congeners detected, two (1,2,3,4,6,7,8-HpCDD and OCDF) were only detected in the site samples. OCDD was detected in all samples except for the washed berries from the background station; site concentrations bracketed the background concentration. TEQ concentrations in unwashed berries consistently exceeded concentrations in washed berries, and site concentrations exceeded background concentrations.

5.7.3 Sediment Toxicity (Ecology 2004)

In September of 2003, Ecology collected six surface sediment samples (locations LSC01 through LSC06) distributed over the length of the Creek bed (Ecology 2004, Figure 3-1). Three toxicity tests with three different species were conducted on the sediment samples including 10-day amphipod (*Hyalella azteca*), 20-day midge (*Chironomus tentans*), and Microtox® tests. Sediment toxicity results are presented in Appendix D (Table D-5).

Results indicated that five (LSC02, LSC03, LSC04, LSC05, and LSC06) of the six sediment samples showed toxicity when compared to the control sediment, as follows (upstream to downstream):

- **LSC04 (Oeser/Birchwood stormline discharge)**—Mean survival was significantly reduced in the 10-day *H. azteca* test as compared to survival in the control sample (an exceedance of Ecology's freshwater Sediment Quality Standard [SQS] endpoint).
- **LSC06 (Confluence of Oeser/Birchwood and BTC/Birchwood stormline drainages)**—Mean survival was significantly reduced in the 10-day *H. azteca* test as compared to survival in the control sample. Microtox® light output was significantly reduced as compared to light output in the control sample. The results for LSC06 represent a cleanup screening level (CSL) exceedance based on the combined results from the *H. azteca* and Microtox bioassays.
- **LSC03 (Midway between Marine Drive Bridge and BNSF Railroad Bridge)**—Mean survival was significantly reduced in the 10-day *H. azteca* test as compared to survival in the control sample. Mean survival and growth were significantly reduced in the 20-day *C. tentans* test as compared to survival and growth in the control sample. Microtox® light output was significantly reduced as compared to light output in the control sample. The bioassay results at this station indicate exceedances of the recommended freshwater CSL endpoint.
- **LSC02 (Lower Creek area)**—Mean survival was significantly reduced in the 20-day *C. tentans* test as compared to survival in the control sediment. Growth, however, was greater in this sample than in the control. The bioassay results at this station indicate exceedances of the recommended freshwater CSL endpoint.

- **LSC05 (Wetland area, northeast corner of Park)**—Microtox® light output was significantly reduced as compared to light output in the control sample (an exceedance of the freshwater SQS endpoint).

The impact to benthic organisms observed in the bioassay tests is likely a result of chemicals detected in surface water and sediments in the Creek. Elevated concentrations of wood-treating chemicals (PAHs, PCP, dioxins/furans) and stormwater runoff (petroleum hydrocarbons and metals) were detected in collocated samples (refer to Sections 5.5 and 5.6).

5.8 GEOTECHNICAL TESTING RESULTS

Another purpose of the field investigation was to provide sufficient geotechnical data to evaluate the engineering properties of soils and sediments in the Park for remedial alternatives analysis and design in the feasibility study. The field samples were tested to evaluate soil/sediment characteristics that will be used to determine the type of excavation equipment and the capacity of the soils to support equipment and fill material. In addition, the suite of geotechnical laboratory tests will be used to evaluate excavation and filling/capping methods, excavation material transport and placement, and capacity of existing soils and sediments to provide foundation support for filling/capping material.

Geotechnical testing methods are described in the project SAP and QAPP (Integral 2005b,c). A total of 64 field samples were analyzed for one or more geotechnical tests.

The results of geotechnical laboratory testing are included in Appendix D (Access database on CD).

5.8.1 Grain Size

Grain-size tests were performed on 64 field samples by the hydrometer and sieve method following American Society for Testing and Materials (ASTM) Method D422-63. Grain-size data provides information on site geologic character and engineering properties of soil/sediment proposed for remediation. Fifty-three of the samples were predominantly sand and/or gravel, the remainder of the samples were composed of mostly fines (silt and clay).

Twenty-three of 29 field samples collected in surface and subsurface soils/sediments of the Upper Creek area were composed of more than 50 percent sand/gravel. All soil samples in the South Slope (eight samples) and Landfill (three samples) areas were composed of mostly sand and gravel with only some fines. Nine of 10 samples collected in the Lower Creek were predominantly sand and gravel. Only samples from the Historical Creek area were composed of mostly fine-grained material. Four of six samples contained approximately 60 percent or more fines.

5.8.2 Atterberg Limits

Atterberg limits were determined for seven field samples in accordance with ASTM D4318-00 (includes organic determination). Atterberg limits, which include the liquid limit, plastic limit, and the plasticity index, are used to define plasticity characteristics of clays and other cohesive sediments. The liquid limits ranged from 23.7 to 63.2 percent, with a mean and median of 40.1 and 38.5 percent, respectively. The plastic limits ranged from 15 to 64.3 percent, with a mean of 32.1 percent and a median of 33.5 percent. The plasticity indexes ranged from 5 to 38.6 percent, with a mean and median of 19 and 15.5 percent, respectively.

Atterberg limits were not determined on more samples in the Park because most soils and sediments collected were predominantly sands and gravels.

5.8.3 Specific Gravity

Specific gravity tests were analyzed for 15 field samples in accordance with ASTM D854-02. The specific gravity of soil/sediment samples is used to determine sediment removal and the bed consolidation after filling/capping. Specific gravity ranged from 2.47 to 2.77, with an average of 2.68 and median of 2.71.

Specific gravity tends to increase with a combination of increasing depth of the sample and increasing grain size.

5.8.4 Moisture Content

Tests for moisture content were performed on 25 field samples in accordance with ASTM D-2216. Moisture content is used to determine the initial *in situ* void ratio of the soil/sediment and to estimate the short-term bulking (or increase in volume) during excavation activities. Moisture contents ranged from 7.2 to 89 percent, with an average of 25 percent and a median of 20 percent. Soil samples tend to have lower moisture content while sediment samples have higher moisture content. Also, samples primarily were composed of sand and gravel, which generally have lower moisture content than fine-grained solids.

6 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) describes sources of contaminants, transport pathways in the environment, and potential exposure pathways for human and ecological receptors. The CSM was developed from data collected historically, data collected during the remedial investigation, and general knowledge of site conditions and contaminant transport behavior. The CSM for the Park site is illustrated in Figures 6-1 and 6-2 for human and ecological receptors, respectively.

This section discusses potential sources of chemicals detected in the Park and identification of the primary chemicals of interest (Section 6.1), fate and transport processes relevant to these chemicals (Section 6.2), and the potential receptors and the pathways by which the receptors could be exposed (Section 6.3).

6.1 SOURCE CHARACTERIZATION

Several primary contamination sources have been identified for soils, sediments, surface water, and groundwater in the Park. These sources are likely to continuously impact the media in the site and vicinity. These include current and historical industrial operations in and near the Park (Figure 2-1), and stormwater and industrial discharges into the Park (Figure 2-3). Some of these primary sources have created secondary sources in the soils, sediments, and groundwater of the Park.

Historically, Oeser reportedly disposed of wood-treating wastes in the South Slope and Upper Creek areas near the Oeser site boundary. In some cases, discharge of process wastewater or contaminated stormwater may have been conveyed directly into the Creek bed and surrounding areas (refer to Section 2). A stormwater pipe combining discharge from Oeser and portions of the Birchwood neighborhood (another potential source) discharges to the upper reaches of the Creek from the north side, near sample locations 343, SB-22, and SW-05. Likely contaminants from these activities include the following:

- PCP, a wood-treating chemical
- DRO, used as a carrier for PCP
- Dioxins/furans, common contaminants of PCP
- PAHs, components of both DRO and the wood-treating mixture creosote.

The primary contaminants observed in the Upper Creek and Historical Creek areas are consistent with this list (Sections 5.3.4 and 5.3.5).

As discussed in Section 5.3.4, petroleum residual nonaqueous-phase liquid (NAPL) (or heavy sheen) with a distinct creosote odor has been observed on top of a clay layer at or below the

Creek bed near sampling stations SB-22, SB-09, LSC Bank, SB-11, SB-29, among other stations in the Upper Creek area. The residual NAPL appears to have come from the area below the Oeser/Birchwood outfall pipe, where stormwater (and process wastewater) has been discharged since the 1940s. The data support a scenario in which contaminants in the stormwater have infiltrated permeable soils, migrating downward until trapped by the relatively impermeable clay layer. This residual NAPL serves as an ongoing secondary source of contaminants to groundwater and subsurface soils below the upper reaches of the current creek bed and to surface water and sediments in the Creek at the seep (e.g., LSC Bank).

A stormwater pipe combining discharge from the BTC campus and portions of the Birchwood neighborhood discharges to the Creek from the south side at sample location SW-06. A culvert discharges from the BTC parking lot into the southeast corner of the Park (NW Wetland area) near sample location SW-07. An outfall at the south end of the Marine Drive Bridge (near sample location SW-12) conveys non-point source runoff from BTC and the Lindbergh Avenue area into the Creek via the wet southern portion of the Historical Creek area. An outfall also conveys non-point source runoff from the Birchwood neighborhood at the north end of the Marine Drive Bridge (SW-04). Petroleum released from vehicle runoff from these drainage areas may be composed of GRO (gasoline), DRO (diesel fuel), and motor oil. Additional potential contaminants from these drainage areas include a variety of SVOCs such as PAHs and phthalates, both of which are common in urban runoff, and metals (e.g., zinc, lead, copper) from vehicular activities and general urban runoff.

Petroleum hydrocarbons, PAHs, PCP, and dioxins/furans in the Historical Creek bed presumably originated from historical Oeser releases before the Creek was re-routed to its present course. Additional sources of petroleum hydrocarbons and PAHs to this area could be from stormwater runoff. The contaminated soils and sediments in the Creek bed serve as a secondary source of contaminants to surface water in the Historical Creek and Lower Creek areas. This would explain the petroleum contamination observed in surface sediments located at various locations downstream in the Creek (e.g., SB-19).

A gravel pit operated south of the Creek, both east and west of Marine Drive. Historical gravel operations could have been a source of DRO and motor oil from the use of motorized equipment. However, patterns of petroleum contamination in the Park appear to be related more to current and historical discharges to the Creek rather than sand and gravel operations.

Historically, a construction material landfill operated beneath what is now a portion of the BTC parking lot. Based on previous sampling, a debris field was documented in the southeast corner of the Park near BTC. During sampling of this area, a layer of debris containing metals, ash, and garbage was observed between approximately 1 and 3 ft bgs. This waste material is believed to be the remains of a 1930s municipal landfill and not the construction material landfill. Elevated metals present in soils of the Landfill area could serve as a secondary source of contaminants to groundwater, particularly during the wet season when the groundwater table rises and debris may be in direct contact with the groundwater (Section 6.3.3.1).

The BNSF railroad tracks could have been a source of metals (e.g., arsenic), pesticides and DRO, including PAHs, to the soils in the vicinity of the tracks. Pesticides and oily products reportedly have been used to treat the wood in the ties and to control vegetation along the tracks. As discussed in Section 5.3.8, pesticide, herbicide, and petroleum concentrations in the Railroad area were not elevated. However, elevated arsenic concentrations were observed in the upper 3 ft of soils within the Illinois Street extension area, which is adjacent to an active BNSF rail line and spur used by Morse Steel.

Additional evaluations on source characterization are provided below.

6.1.1 PAH Source Evaluation

PAH composition was evaluated for 51 surface and subsurface soil samples collected from 20 locations as part of the sampling and analysis program completed for the Park remedial investigation. The samples were collected from the Upper and Lower Creek areas and the Historical Creek area.

PAH analyses included the standard suite of 16 priority pollutant PAHs, 2-methylnaphthalene, and 7,12-dimethylbenz[a]anthracene, as described in the project SAP (Integral 2005c). The evaluation of PAH sources provided in this section is based on the priority pollutant PAHs and 2-methylnaphthalene. 7,12-Dimethylbenz(a)anthracene was not detected in any sample collected for the Park remedial investigation and was therefore excluded from this evaluation. All chemical data are provided in Appendix D.

General characteristics and PAH compositions of potential source materials are described below, followed by results for PAH source evaluations for each of the areas of interest.

6.1.1.1 Characteristics of Potential PAH Source Materials to the Park

PAHs are ubiquitous in the environment and are released from a variety of sources. Pyrogenic PAHs are produced during combustion of any carbon-based fuel, such as wood, gasoline, diesel, heating oil, and coal. Pyrogenic PAH distributions are typically dominated by HPAHs and are present in crude oil and in refinery products such as gasoline, diesel, heating oil and motor oil. Creosote, a coal tar distillate, has a PAH content that is intermediate in character between pyrogenic and petrogenic.

PAHs constitute about 85 percent of the weight of creosote (Bestari et al. 1998). The chemical composition of creosote reflects the composition of the source (i.e., the coal tar from which it is distilled) and the conditions of manufacture. Creosote has historically been produced as a straight-run distillate or a reformulated product, with some reformulations containing byproducts such as anthracene oil or phenanthrene (Emsbo-Mattingly et al. 2001). Examples of the distributions of PAHs in creosote (Burns et al. 1997; Bestari et al. 1998) are provided in Figure 6-3. The most abundant priority pollutant PAHs in creosote are phenanthrene, fluoranthene, and pyrene, with lesser abundance of chrysene and fluorene, and varying abundance of naphthalene and acenaphthene.

A diesel fuel-like solvent was used as a PCP carrier for treatment of logs at the Oeser facility (E&E 2002a). The PAH content of fresh diesel and of this PCP carrier solvent is predominantly composed of naphthalene, methylnaphthalenes, fluorene, and phenanthrene (see Figure 6-3). Naphthalene and methylnaphthalenes are more volatile and soluble in water than the heavier PAHs, and therefore weather more rapidly than the heavier PAHs. The relative proportion of these PAHs in samples containing weathered product will be lower than in samples with fresh product, as illustrated for diesel in Figure 6-3. In general, 2- and 3-ring PAHs weather more quickly than the heavier PAHs and the relative abundance of heavier PAHs increases over time as the lighter PAHs degrade (Stout et al. 2001).

The PAH composition of soil samples from the vicinity of the creosote storage tanks at the Oeser site (E&E 1996) and downgradient of the tanks reveal potential local sources of both creosote and the PCP carrier solvent (see Figure 6-3). The PAH composition of samples OS45SB03 and OS49SB08, in particular, show characteristics of the diesel-like PCP carrier solvent, with a higher level of 2-methylnaphthalene than naphthalene and the LPAHs fluorene and phenanthrene in the characteristic diesel pattern. The samples from station MW04 on the Oeser site (i.e., samples MW04SB11 and MW04SB15), on the other hand, contain higher levels of fluoranthene and pyrene than the other two samples, and lower levels of 2-methylnaphthalene than naphthalene, consistent with creosote. However, the LPAH pattern indicates that the PCP carrier may also be making a PAH contribution to these samples.

A ubiquitous source of PAHs in the environment is urban particulates (i.e., dust), which contain PAHs from a variety of predominantly pyrogenic sources, such as soot and exhaust from automobiles and trucks. Urban particulates fall to the ground by wet and dry deposition, are entrained in runoff during storm events, and are transported by runoff to storm sewers. The PAH composition of stormwater therefore may reflect the composition of urban particulates (Stein et al. 2006). HPAHs predominate the PAH profile of urban particulates and stormwater. National Institute of Standards and Technology, standard reference material number 1649a (May and Trahey 2001) is included in Figure 6-3 as an example of urban particulates. Sediment collected near the combined sewer outfall at Denny Way, Seattle, WA (Metro 1988) is also provided in Figure 6-3 as an example of the PAH composition in sediment impacted by an urban combined sewer outfall. An additional example of a source dominated by HPAHs is bottom ash and clinker from a coal-fired power plant (Stout and Wasielewski 2004), also shown in Figure 6-3.

6.1.1.2 Upper Creek Area

PAH analyses were completed on samples collected from eight locations in the upper area of the current creek, including two locations in the area where the Upper Creek bed and the Historical Creek bed diverge (i.e., locations SB-29 and SB-11) (see Figure 5-3). Sample information and a summary of data for PAHs, TPH, and PCP are provided in Table 6-1. Many of the soil borings evaluated for the current creek area are included in geologic cross-section C-C′ (see Figure 4-4).

PAH composition patterns (i.e., profiles) in most of the samples from the current creek area are similar to the patterns found in creosote. PAH profiles for creosote are provided in Figure 6-3. Figure 6-4 provides PAH profiles for the samples from the soil borings and the surface sediment sample from the Upper Creek area. Creosote was evident in the deeper intervals of all of the soil borings that were tested with the exception of boring SB-11 (described below). The following samples contained PAH profiles that were consistent with creosote:

- Boring SB-22: 25.5 to 30 ft bgs (four intervals)
- Boring SB-09: 6 to 10 ft bgs (four intervals)
- Boring SB-29: 7 to 10.6 ft bgs (two intervals)
- Boring SB-14: 5 to 11 ft bgs (six intervals)
- Boring SB-12: 4 to 5 ft bgs (one interval)
- Boring SB-31: 8 to 11 ft bgs (four intervals).

The PAH profile for bank sample “LSC Bank,” collected from the bank of the Upper Creek area near soil borings SB-13 and SB-29, was also consistent with creosote.

Corroborating evidence for the presence of creosote in the soil borings was provided by observations made in the field during sample collection and identification procedures during analysis by ARI. Creosote odor was observed during sample collection, as indicated in Table 6-1. The odor was usually distinct as noted in the logs. In addition, ARI identified and quantified creosote in subsurface soil samples from borings SB-22, SB-09, SB-14, and SB-12 during the NWTPH-Dx analysis (Table 6-1).

An HPAH pattern not resembling creosote dominated the PAH pattern in sample SB-09 (0 to 1 ft), the only surface soil sample from the Upper Creek area analyzed for PAHs,[42] as well as many of the surface soil samples from the Historical Creek area. A similar pattern was present in all intervals analyzed from boring SB-11. As described in Section 6.1.2.1, HPAH-dominant patterns are found in materials such as urban particulates and runoff, ash, and soot (Stein et al.

---

[42] Petroleum hydrocarbon results were below screening levels for other surface soils analyzed in this area of the site.

2006; Stout and Wasielewski 2004; Stout et al. 2001). The TPAH concentrations in the surface soil sample from location SB-09 was 83 mg/kg, much lower than concentrations found in the creosote-impacted soil depths. The PAHs in the surface soil may have accumulated from urban dust, runoff, or ash fallout and related runoff from the Oeser facility and/or Birchwood neighborhood. Samples with the HPAH pattern are characterized by very low LPAH/HPAH ratios, generally below 0.1 (Table 6-1).

At location SB-11, PAH analyses were completed on soil samples from the 0 to 1, 1 to 2, and 6 to 7 ft intervals. The TPAH concentrations were much higher in these samples than in the surface soil sample from SB-09 and in surface soil samples from the Historical Creek area described below. A maximum of 2,100 mg/kg was found in the 1 to 2 ft interval of boring SB-11. Boring SB-11 was located in the spoils area at the upstream end of the Upper Creek/Historical Creek bed. The soil samples were collected from fill material placed there when the Creek was rerouted in the late 1950s and/or during construction of the underground BTC/Birchwood stormline in the 1970s. The HPAH pattern is also consistent with ash that may have been generated during heating steps of wood preservation (Stout and Wasielewski 2004). The TPAH levels and signature in SB-11 indicate that the source was likely related to coal tar and creosoting, possibly a tarry residue from the creosoting process.

The TPH data support the classification of samples as creosote or HPAH-dominant according to PAH composition. Diesel-range hydrocarbons are more abundant in chromatograms for samples with the creosote PAH pattern, and oil-range hydrocarbons are more abundant in samples with an HPAH-dominant pattern (Table 6-1). Creosote elutes in the same range as diesel in the TPH analyses. When present, creosote is quantified against the diesel standard and reported as diesel-range hydrocarbons.[43] The concentration of diesel and oil-range hydrocarbons and the ratio of diesel-range hydrocarbons to oil-range hydrocarbons are provided in Table 6-1.

6.1.1.3 Historical Creek Area

PAH analyses were completed on samples collected from 10 locations in the Historical Creek area. Two locations in the area where the Upper Creek bed and the Historical Creek bed diverge (i.e., locations SB-29 and SB-11) were discussed in Section 6.1.1.2. Sample information and a summary of data for PAHs, TPH, and PCP are provided in Table 6-1.

The PAH composition of creosote is somewhat variable and reflects the PAH composition of the coal tar that was used to distill the creosote. Similarly, the diesel-like carrier used for the PCP solution reflects the crude oil from which it is distilled. The PAH composition of both materials

[43] Creosote was quantified by the laboratory when it was identified; however, the absence of identification for creosote does not indicate that creosote was not present.

is additionally affected by the specific conditions used during their manufacture. After release of the source material, weathering processes alter the PAH composition over time. In an area such as the Historical Creek bed, which was likely subjected to releases of creosote and PCP carrier solvent as well as to weathering over a long period of time (since 1961 or 1962), the PAH composition is expected to vary somewhat between sampling locations. These differences between samples are evident in the profiles shown in Figure 6-5, as well as in the samples collected from the Oeser facility (see Figure 6-3).

PAH patterns in the surface soil samples from the historic creek area show a predominance of HPAHs, consistent with urban runoff or ash (see Figure 6-3), or another unidentified pyrogenic source. Surface soil locations showing the HPAH pattern include TP-21 (0 to 2 ft bgs) and TP-06 (0 to 1 ft bgs) in the wide area at the upstream section of the Historical Creek channel, and locations TP-16 (0 to 2 ft bgs), TP-17 (1 to 2 ft bgs), SB-39 (0–0.7 ft bgs), SB-38 (0 to 1 and 1 to 1.9 ft bgs), SB-34 (0 to 1.1 ft bgs), SB-35 (0 to 1 and 1 to 1.8 ft bgs), SB-36 (0 to 0.8 ft bgs), and SB-37 (1 to 1.2 and 1.2 to 2 ft bgs) in the downstream sections of the Historical Creek channel. Variations in the HPAH patterns were evident in several of these samples. For example, samples SB-39 (0 to 0.7 ft bgs), SB-35 (1 to 1.8 ft bgs), and SB-36 (0 to 0.8 ft bgs) contained higher proportions of anthracene and indeno(1,2,3-c,d)pyrene than samples from other locations. Variations such as these most likely reflect the variable nature of materials used at the Oeser facility, the variable nature of urban dust and runoff, and weathering processes.

Several samples in the Historical Creek area appear to contain creosote or the diesel-like carrier solvent used for PCP treatment, in addition to the HPAH-dominant signature. Surface soil samples SB-34 (0 to 1.1 ft bgs) and SB-35 (0 to 1 ft bgs) contain phenanthrene, fluoranthene, and pyrene in the creosote pattern. Surface soil sample TP-16 (0 to 2 ft bgs) contains the HPAH pattern and fluoranthene and pyrene. This pattern is consistent with weathered creosote. The subsurface soil samples from location TP-06 (1 to 2 ft, 2 to 3 ft, 3 to 4 ft, and 4 ft bgs) contain an LPAH pattern that is consistent with diesel fuel or the PCP carrier solvent. This PAH pattern consists of naphthalene, 2-methylnaphthalene, acenaphthene, fluorene, and phenanthrene (see Figure 6-5). Three intervals from test pit TP-06 additionally contain the creosote pattern of phenanthrene, fluoranthene, and pyrene. Phenanthrene, a significant constituent of both diesel fuel and creosote, is abundant in these samples relative to other PAHs. This characteristic is consistent with subsurface soil samples collected from the Oeser facility (see Figure 6-3).

Creosote odor was noted in the field log at depths of 2 to 4 ft bgs in test pit TP-06, and diesel-range hydrocarbon concentrations of 3,400 and 1,000 mg/kg were reported by ARI for the 1 to 2 and 2 to 3 ft intervals, respectively. As discussed in the previous section, the TPH analysis confirms the presence of diesel or creosote, but generally does not differentiate between the substances.

No creosote odor was reported for any of the surface soil samples or at any location in the Historical Creek area except TP-06, described above. However, PCP was detected at relatively high concentrations in most of these samples with the highest concentration of 7.9 mg/kg detected at station SB-36 (0 to 0.8 ft bgs). The TPH data generally support the classification of samples as creosote or HPAH-dominant according to PAH composition (Table 6-1), with HPAH-dominant samples showing lower ratios of diesel-range to oil-range hydrocarbon concentrations in most cases.

6.1.1.4 Lower Creek

Samples from locations SB-19 and SB-20 in the Lower Creek area were analyzed for PAHs and evaluated for PAH composition (see Figure 6-6). The samples from the upper soil intervals at these locations, SB-19 (0 to 1 ft and 1 to 2 ft bgs) and SB-20 (0 to 1 ft bgs), predominantly contained an HPAH pattern similar to ash or urban runoff. The TPAH concentrations in these samples were low (Table 6-1). Oil-range hydrocarbon concentrations were higher than diesel-range hydrocarbons, supporting the presence of a source other than creosote. No creosote odor was reported for these samples. However, PCP was detected in each sample.

Fluoranthene and pyrene dominated the PAH fingerprint in the lower intervals at location SB-19 (2 to 3 ft and 3 to 3.6 ft bgs). This pattern is consistent with weathered creosote. Creosote was identified and quantified by ARI in these samples during the NWTPH-Dx analysis, and a creosote odor was observed in the field as described on the boring log (Table 6-1, Appendix B).

6.1.1.5 Summary

In general, PAH patterns in soil and sediment samples from the Upper and Lower Creek area areas are consistent with creosote. Many of the surface soil samples in both the Upper and Lower Creek areas show an HPAH pattern and relatively low TPAH levels that are consistent with a pyrogenic source such as urban runoff or ash. The exception is soil collected from SB-11 where higher TPAH concentrations were present in most depth intervals. Because the TPAH concentrations in samples from SB-11 are higher than those resembling an urban runoff source, the source is also likely related to the creosote wood-preserving process (i.e., tarry residue). Samples collected in the Historical Creek area showed varying PAH patterns. The patterns are consistent with creosote and PCP carrier solvent, allowing for creosote and PCP carrier lots of varying composition and weathering. The detection of PCP in these samples is further evidence the source of contamination is likely associated with wood-preserving activities.

6.1.2 PCP and Dioxin/Furan Source Evaluation

The source of PCP and dioxins/furans were evaluated for media sampled and analyzed in the Park. In general, elevated levels of dioxins/furans were observed to be associated with elevated PCP concentrations (refer to Section 5). Elevated PCP and dioxins/furans concentrations were observed in solid and water samples collected from the Historical Creek, Upper Creek, and Lower Creek areas of the site. The source of PCP is the Oeser facility, which began using this wood treatment process in the mid-1950s (Orthmeyer 2006, pers. comm.). The detection of both PCP and dioxins/furans in samples collected in the Park would be expected since technical grade PCP used for treating wood contains approximately 0.1 percent dioxins/furans (USEPA 1982; Rosenfeld & Plumb 1991). The high temperatures encountered in the production of PCP are favorable to the condensation of tri- and tetrachlorophenols to form hexa-, septa-, and octachlorodibenzo-*p*-dioxin and various chlorinated dibenzofurans.

A distribution plot of detectable concentrations of PCP and dioxins/furans[44] in samples evaluated for the remedial investigation is shown in Figure 6-7. In samples where PCP was detected, concentrations of PCP and dioxins/furans appeared to have a positive linear relationship. A linear regression was performed and a significant (at alpha=0.05) but weak (R^2=0.55) linear relationship was confirmed. This relationship means that changes in dioxin/furan concentrations may be partially explained by changes in PCP concentrations. The variability or scatter on the plot may be explained by differences in the fate and transport of the chemicals. The fate and transport of PCP and dioxins/furans in the environment are somewhat different (see Section 6.2), so relative concentrations may change depending on the time of discharge, distance from the source, and media type (e.g., soil, water) (refer to Section 6.2).

6.2 FATE AND TRANSPORT OF CHEMICALS

The physical and chemical characteristics of key chemicals detected at the site, potential transport mechanisms, and a conceptual model of contaminant transport at the site is discussed in the following sections.

6.2.1 Physical and Chemical Characteristics of Key Contaminants at the Site

This section presents the physical and chemical characteristics of key contaminants detected at the Park site. The following chemicals or chemical groups are briefly discussed below:

- Pentachlorophenol
- Petroleum hydrocarbons
- Creosote
- PAHs
- Dioxins/furans
- Selected metals including arsenic, cadmium, chromium, copper, lead, mercury, and zinc.

[44] The sum of total homologs and OCDD/OCDF were calculated and plotted for dioxins/furans in each sample.

Selected physical and chemical properties of these contaminants are presented in Table 6-2. Unless otherwise noted, the information presented in this section was obtained from the Agency for Toxic Substances and Disease Registry toxicological profiles (http://www.atsdr.cdc.gov/). Additional information on some of the key chemicals and chemical groups can be found in the Oeser remedial investigation report (E&E 2002a).

6.2.1.1 Pentachlorophenol

PCP was once the most heavily used and widespread biocide in the United States. The purchase and use of PCP has been restricted to certified applicators since 1984. It was widely used as a wood preservative before use restrictions were implemented. PCP is now used industrially as a wood preservative for power line poles, cross arms, fence posts, and other similar wood products.

The solubility of pure PCP in water is relatively low (14 mg/L at 20° C), but is readily soluble in a number of organic solvents, including diesel oil. The Henry's law constant value reported for PCP indicates that volatilization of the solvated anionic form from an aqueous system is not considered to be a significant transport mechanism under ambient conditions.

In surface water, PCP undergoes photolysis and biotransformation and is adsorbed to sediments. Hydrolysis, oxidation, and volatilization do not appear to significantly affect PCP concentrations in surface water.

In soils or sediments, PCP is metabolized by acclimated microbes under both aerobic and anaerobic conditions, is adsorbed, or is transported in the aqueous or NAPL phases. Adsorption of PCP is highly dependent on the organic content of the adsorbent. Adsorption of PCP in soils and sediments is pH dependent; adsorption decreases in neutral and basic soils and is strongest in acidic soils. However, the presence of co-solvents, such as petroleum hydrocarbons, decreases the adsorption of PCP in soils by increasing its solubility in the soil solution. Volatilization and photolysis do not appear to be important transport and transformation processes for PCP in soils and sediments.

6.2.1.2 Creosote

Coal tar creosote is a thick, oily liquid that is typically amber to black in color. Coal tar and coal tar pitch are made during the high-temperature treatment of bituminous coal to make coke or natural gas. Coal tar creosote has been used as a wood-treatment pesticide since the turn of the 20th century and is the most widely used wood preservative in the United States. It is also a restricted-use pesticide.

Approximately 300 organic chemicals have been identified in coal tar creosote, but there may be as many as 10,000 other chemicals present that have not been identified. Coal tar creosotes consist of aromatic hydrocarbons, anthracene, naphthalene, and phenanthrene derivatives. At least 75 percent of the coal tar creosote mixture consists of PAHs.

The fate and transport processes affecting creosote can be very complex since it is a mixture of chemicals. Coal tar creosote constituents released to surface waters will differentially partition to the water column or sediments based on their water solubility and sorptive properties. Creosote components are degraded in aquatic environments primarily by microfaunal metabolism. Given the viscous nature of creosote and creosote-containing wastes, significant migration into groundwater supplies is rarely encountered, except where soils are very porous.

In soils and sediments, PAHs, the major constituents of creosote, generally tend to sorb strongly to soil and sediment particles and have low aqueous solubilities. Many components of the PAH fraction, especially HPAHs, will remain in the soil or sediments in a stationary tar-like mass where they were deposited. Additional discussion on the fate and transport of PAHs is presented in the following section.

6.2.1.3 PAHs

The transport and partitioning of PAHs in the environment is largely determined by physiochemical properties (e.g., solubility, vapor pressure, organic carbon partition coefficient, etc.). PAHs are broken into three general groups, LPAHs, medium molecular weight PAHs, and HPAHs.

PAHs generally have a low solubility in water. Sorption of PAHs to soil and sediments increases with increasing organic carbon content and with increasing surface area of the sorbent particles. HPAHs tend to be sorbed more strongly than LPAHs. Volatilization may be substantial for the LPAHs, but is generally not an important mechanism for the HPAHs. Microbial metabolism is a major process for degradation of PAHs in soils. Photolysis, hydrolysis, and oxidation are not considered to be important degradation processes in soil.

The most important processes contributing to the degradation of PAHs in water are photooxidation, chemical oxidation, and biodegradation by aquatic microorganisms. Because of their low solubility and high affinity for organic carbon, PAHs in water are primarily found sorbed to particles that are suspended or have settled to the bottom of the water column. PAHs have been detected in groundwater either as a result of migration from surface water or from soil.

6.2.1.4 Petroleum Hydrocarbons

"Petroleum hydrocarbons" is a term used to describe a broad family of chemical compounds that originally come from crude oil. Petroleum hydrocarbons are mixtures of chemicals. Petroleum products released to the environment migrate through soil as a bulk oil infiltrating a soil column and infiltrating soil as a NAPL, and as individual compounds separating from the bulk petroleum mixture and dissolving in air or water.

Bulk petroleum hydrocarbons migrate through soils by the processes described in Section 6.2.3. As the bulk product migrates through the soil column, individual chemicals may separate from the mixture and migrate independently. Chemical transport properties such as volatility, solubility, and sorption potential are used to evaluate which compounds will be likely to separate from the mixture.

Lighter petroleum products such as gasoline contain chemicals that have higher solubility, volatility, and lower sorption potential than heavier petroleum products. Petroleum products with heavier molecular weight constituents, such as fuel oil, are generally more persistent in soil, due to their relatively low water solubility and volatility and high sorption capacity.

Petroleum hydrocarbons can undergo biodegradation as indigenous microbes use the compounds a source of energy. Biodegradation can eliminate contaminants without transferring across media; the final products of microbial degradation are water, carbon dioxide, and microbial biomass.

6.2.1.5 Polychlorinated Dibenzo-*p*-Dioxins and Polychlorinated Dibenzofurans

Polychlorinated dibenzo-*p*-dioxins (dioxins) and polychlorinated dibenzofurans (furans) were never produced as commercial end products, rather they were trace contaminants formed during the production of chlorinated organic compounds (E&E 2002a). Dioxins and furans are formed through many processes, including the manufacture of chlorophenols such as PCP. Dioxins and furans have similar physiochemical processes and are highly persistent compounds in the environment.

Dioxins

Dioxins are generally characterized by low vapor pressure, low aqueous solubility, and high hydrophobicity, suggesting that these compounds strongly adsorb to soil and that their vertical mobility in soils is low. Generally, higher chlorinated dioxins volatilize more slowly from soil and water than the lower chlorinated varieties.

In surface water, significant partitioning of dioxins from the water column to suspended particulate organic matter may occur. Dioxins are removed from the water column to a minor extent by volatilization to the atmosphere. Dissolved dioxins will partition to suspended solids and dissolved organic matter, and are likely to remain sorbed once they are in the aquatic environment. Dioxins bound to sediments may be resuspended in the water column if the sediments are disturbed.

Adsorption is an important process affecting the transport of dioxins, and the organic carbon fraction of the soil is thought to be the most important factor affecting the degree of adsorption. Dioxins adsorb more strongly in soils with high organic carbon content than soils with low organic carbon content. Dioxins found below the surface soil (top few millimeters) are strongly adsorbed and show little vertical migration, particularly in soils with a high organic carbon content. The mobility of dioxins will increase if a co-solvent is present that can solubilize them.

Furans

The fate and transport properties of furans are essentially the same as those for dioxins. As with dioxins, furans in water partition to the particulate phase and settle into sediment. As a result, most literature provides concentrations of furans in sediment rather than water. Sediment is considered the ultimate sink of atmospheric and aquatic furans. No data in the literature indicate that biodegradation of furans in water is significant. The loss of furans by abiotic processes, such as hydrolysis and oxidation, is unlikely to be significant.

6.2.1.6 Metals

This section briefly presents the physical and chemical characteristics of selected metals that were widely detected in media sampled in the Park.

Arsenic

Arsenic typically exists in one of three oxidation states, –3, +3, and +5. Arsenic compounds can be categorized as inorganic, compounds without an arsenic-carbon bond, and organic, compounds with an arsenic-carbon bond. In surface soil, either naturally occurring or from anthropogenic releases of arsenic forms insoluble complexes with iron, aluminum, and magnesium oxides, and in this form, arsenic is relatively immobile. However, under reducing conditions, arsenic can be released from the solid phase, resulting in soluble mobile forms of arsenic, which may potentially leach into groundwater or result in runoff of arsenic into surface waters. Soil microorganisms may convert inorganic arsenic to organic forms and may reduce small amounts to arsine that would volatilize into the atmosphere.

Cadmium

Cadmium exists in the +2 state and is more mobile in waters than most heavy metals (e.g., lead). In soils, the most important factors affecting the mobility of cadmium are pH, oxidation-reduction (redox) reactions, and the formation of complexes. Cadmium tends to be more mobile under acidic conditions. Cadmium in soils may leach into water, particularly under acidic conditions. Precipitation and sorption to mineral surfaces, hydrous metal oxides, and organic matter are the most important processes for the removal of cadmium from water.

Chromium

Chromium is commonly found in environmental samples in the +3 and +6 states. The speciation of chromium is a function of the pH and redox potential of the soil. In most soils, chromium in the +3 state predominates, which often occurs as a cation that has a very low solubility and low mobility. Chromium is present mainly as an insoluble oxide in soils and is not very mobile. Chromium in the +6 state is relatively soluble and mobile. Chromium may change its oxidation state through redox reactions and may precipitate out of solution.

Copper

Copper is classified as a noble metal and can occur in the environment in the elemental form. The most important oxidation state of copper is +2. In soil, the movement of copper is affected by a number of physical and chemical interactions with the soil components. Copper will generally adsorb to organic materials, carbonate and clay minerals, and hydrous iron and manganese oxides. Sandy soils with a low pH have the greatest potential for leaching copper. In soils with a high organic matter content, copper binds strongly, and the distribution of copper in solution is less affected by pH than other metals.

In water and sediments, copper adsorbs to organic matter, clay, and hydrous iron and manganese oxides. In surface water, equilibrium adsorption is generally obtained within 24 hours.

Lead

Lead is primarily found in the environment in the +2 oxidation state. In soils, the fate of lead is governed by adsorption at mineral interfaces, precipitation of low solubility forms of the lead compounds, and the formation of stable organic-metal complexes or chelates with organic material. The downward migration of inorganic and elemental lead compounds by leaching from soil to groundwater is very slow unless acidic conditions exist. Leaching of lead can be induced by several conditions, including lead concentrations that approach or exceed the cation exchange capacity (CEC) of the soil, a decrease of the pH of the leaching solution, and the presence of minerals that can form soluble chelates with lead.

In surface waters, the amount of soluble lead depends on the pH of the water and the dissolved salt content. The concentration of dissolved lead in most surface waters and groundwater is low because lead forms compounds with anions (e.g., hydroxides, carbonates, sulfates, and phosphates) in water that will precipitate out of the water due to their low solubilities. In freshwater, a significant fraction of lead is expected to be carried in the undissolved form.

Mercury

Mercury has three valance states and is found in the environment in various organic and inorganic complexes as well as in the metallic form. The valance state found in the environment is dependent on a number of factors, including the redox potential and pH of the soil. Mercury has been shown to volatilize from the surface of acidic soil (i.e., soil pH less than 3). Mercury is strongly sorbed to humic materials and sesquioxides[45] in soil at a pH higher than 4 and to peat (i.e., organic-rich soils). The adsorption of mercury in soil decreases with increasing pH and/or chloride ions. Sorbed mercury on particulates may be mobilized through chemical or biological reduction to elemental mercury and bioconversion to volatile organic forms.

Zinc

Zinc occurs primarily in the +2 oxidation state in the environment. In soils, the mobility of zinc depends on the solubility of the form of zinc and on a number of soil properties including CEC, pH, redox potential, and chemical species present in the soil. Zinc tends to strongly sorb onto soil particles. The soluble forms of zinc (e.g., zinc sulfate) are moderately mobile in most soils; however, little land-disposed zinc at waste sites is in a soluble form.

In surface water, zinc can occur in both suspended and dissolved forms. Suspended zinc may be dissolved with changes in water conditions (e.g., pH, redox potential) or may sorb to suspended materials. Dissolved zinc can occur as the free zinc ion or as dissolved complexes and compounds. In aerobic waters, zinc is partitioned to sediments through sorption onto clay minerals, hydrous iron and manganese oxides, and organic matter. The efficiency of sorption to these materials depends on their concentrations, pH, redox potential, salinity, concentration and nature of complexing ligands,[46] CEC, and the concentration of zinc.

6.2.2 Potential Contaminant Transport Mechanisms at the Site

The following sections describe potential historical and/or current contaminant transport mechanisms relevant to the Park site.

6.2.2.1 Dissolved Phase Transport in Groundwater

Contaminant transport in the dissolved phase in groundwater is the result of advection, hydrodynamic dispersion, and biological/chemical reactions (including oxidation, biodegradation, sorption, etc.). Dissolved-phase constituents may also volatilize into the vadose zone. The following sections discuss advection, hydrodynamic dispersion, and sorption.

Advection

Advection is the movement of groundwater as a result of a hydraulic gradient. Advection is described by Darcy’s law, which states that the flow rate through a porous medium is

---

[45] An oxide containing three atoms of oxygen with two atoms (or radicals) of some other substance.
[46] An ion, molecule, or molecular group that binds to another chemical to form a larger complex.

proportional to the hydraulic gradient (Eq. 2, Section 4.3.4). Advection is essentially the average linear groundwater velocity without dispersion or chemical reactions.

Hydrodynamic Dispersion

Mechanical dispersion and molecular diffusion are commonly combined into a quantity called hydrodynamic dispersion because they cannot be evaluated independently in flowing groundwater (Fetter 1993). Dispersivity is a mixing length and is an intrinsic property of the porous medium. It results from variations in flow velocity at the pore and field scales (Wang and Anderson 1982). If dispersion did not occur, there would be an abrupt interface between the solute and uncontaminated groundwater (i.e., the solute would move like a plug). Molecular diffusion is a result of concentration gradients. Solutes in water spontaneously travel from areas of high concentrations toward areas of low concentration.

Sorption

Sorption-desorption retards the velocity of contaminant transport relative to the groundwater flow velocity. Chemicals that are not retarded are transported at the rate of groundwater flow.

A retardation factor, R_d, quantifies the contaminant transport velocity relative to the groundwater flow. R_d is estimated by the following equation:

Eq. 4. $$R_d = 1 + (\rho_b K_d)/n$$

where ρ_b is the dry bulk density of the aquifer material, K_d is the partition coefficient, and n is the porosity.

The bulk dry density and porosity are properties of the aquifer media. K_d describes equilibrium partitioning between the water and the aquifer material. K_d depends on the contaminant chemical properties, soil properties (particularly organic carbon content), temperature, and pH. The retardation factor is 1.0 for chemicals that are not retarded.

The K_d for partitioning of organic contaminants in soil and groundwater correlates to the organic carbon content of the soil. K_d can be estimated as:

Eq. 5. $$K_d = f_{oc} \times K_{oc}$$

Where f_{oc} is the mass fraction of organic carbon, and K_{oc} is the soil organic carbon partition coefficient.

K_{oc} is a measure of an individual chemical's tendency to partition into organic carbon in soil. The K_d value for the bulk soil is a function of the organic carbon fraction of the soil, f_{oc}, which is expressed as a ratio. If the K_{oc} of a compound and the organic carbon content of the aquifer are known, then R_d can be calculated.

6.2.2.2 NAPL Transport in Soil and Groundwater

NAPL movement in the subsurface is driven by gravity and pressure forces. The most important process influencing the downward migration of the liquid is movement due to a potential gradient. In the vadose zone, the NAPL may partition into the air as a vapor phase (Fetter 1993). If the NAPL is partially soluble in water, a dissolved phase may also be present.

After the NAPL is released to the environment, it will travel downward through the vadose zone (if present) to the capillary fringe zone (tension saturated zone where the pressure head is less than atmospheric pressure). At the top of the capillary fringe, light NAPL (LNAPL), which has a density less than water, will spread laterally. At the bottom of the capillary fringe, dense NAPL (DNAPL), which has a density greater than water, will displace the soil porewater and continue to migrate downward to the saturated zone.

The movement of NAPL in the subsurface is affected by heterogeneities in the soil. Migration may be temporarily slowed, completely halted, or redirected, depending on the heterogeneities that are encountered. Soil heterogeneities that offer resistance to continued downward migration can cause NAPL to spread laterally (assuming capillary resistance to lateral flow is less than that for continued vertical flow).

As NAPL migrates through the soil pores, a portion of the NAPL will be trapped within the soil pores due to surface tension. The NAPL that is trapped in the soil pores is referred to as residual NAPL, and will remain essentially immobile in the soil pores. Downward migration of NAPL will continue until the NAPL source is depleted or until it reaches a barrier layer. If there is a sufficient volume of NAPL, it may continue to migrate downslope on top of the barrier under gravity and pressure forces. The NAPL will continue to migrate until it reaches a topographically low area on top of a barrier layer.

DNAPL migration is generally not affected by groundwater flow, except in those cases in which hydraulic gradients are high enough to overcome the gravity and pressure forces that otherwise dominate the migration of DNAPL.

6.2.2.3 Contaminant Transport in Surface Water

Surface water transport characteristics are highly dependent on the type of water body present. In flowing water, the direction of chemical transport is typically downstream. In the case of marshes or wetlands, chemical transport may be directed inland as well as downstream. Dispersion is a rapid process because of turbulent eddying (advection) and diffusion along concentration gradients. The amount of dilution can be approximated by comparing rates of chemical introduction to creek discharge rates. In stagnant water bodies, such as wetlands, advective forces are less important, and primary attenuation may be through diffusion.

The water solubility of a chemical partly determines how that substance is transported by surface waters. Because water is a polar solvent, polar covalent and ionic compounds are more likely to dissolve than nonpolar compounds. If a chemical dissolves in surface water, its chemical transport properties will be identical to those of water. Conversely, an immiscible liquid phase (e.g., NAPL) will either sink or float on water depending on its specific gravity. Nonaqueous-phase liquids with a specific gravity of less than one will tend to remain close to, or "float" on the surface and may become susceptible to attenuation by volatilization and photolysis. Immiscible liquids more dense than water will move along the Creek bottom or become absorbed onto sediment particles.

Substances dissolved in surface waters can also partition out of the dissolved phase to a liquid phase or adsorb onto particles suspended in the water or onto bottom sediment. The latter process transfers the substances from the water to the sediment matrix. Conversely, chemicals may desorb from sediment and enter solution.

Chemicals in creek sediment can be transported downgradient as part of the bed or suspended load, depending on particle size and surface water energy. They may settle and accumulate in creek-bed sediment (e.g., behind natural dams) and become buried over time. Resuspension can occur during large storm events. In general, flowing water transport mechanisms in the Creek would tend to move contaminated sediment downstream to Bellingham Bay.

6.2.2.4 Contaminant Transport in Sediments

Sediment transport is one of the primary transport mechanisms for some chemicals of interest after they enter the Creek. Because of their low solubilities in water, chemicals such as PAHs tend to be adsorbed to fine-grained organic material in the water column and are either deposited on the bottom or transported by physical processes such as downstream flow. After deposition, bottom sediments are subject to resuspension by transport as bedload; mostly fine-grained material will be entrained in the water column as suspended load. The other important processes that affect long-term contaminant presence are biological, including bioturbation of sediments, bioaccumulation, and biomagnification. Sediment bioturbation will improve degradation rates of PAHs through oxygenation of surface sediments but will not greatly affect metals (i.e., lead) concentrations. The latter two processes are important in exposure pathways and are discussed in the risk assessment (see Section 7).

Once contaminants are adsorbed to fine-grained sediments and organics, the material may be transported in suspension or bedload by downstream flows. It is probable that these flows may be sufficient to move coarse-grained material (medium to coarse-grained sand or larger) at particular times of the year (e.g., winter) and during storm events.

6.2.2.5 Contaminant Transport in Soil

Contaminants in vadose zone soil can migrate by gravity flow of NAPL (described above), by infiltration of chemicals in solution, and by leaching of contaminants in soil by infiltrating precipitation or surface water. Infiltration transport in soil is downward with localized lateral movement resulting from heterogeneities in the subsurface. Leachate may be formed by the leaching of solid waste at a landfill by rainwater (Fetter 1993).

6.2.3 Conceptual Model of Contaminant Transport at the Site

The following sections discuss the fate and transport of chemicals at the Park site. The information presented below is segregated by Park area. Generalized CSMs of contaminant transport in the vicinity of the Creek, historical Landfill, and Illinois Street extension areas are shown in Figures 6-8 to 6-10, respectively.

6.2.3.1 Little Squalicum Creek

The Creek has been rerouted twice in the past, in approximately 1907 and 1961 or 1962. The current and Historical Creek routes are shown in Figure 3-1. A CSM diagram of contaminant transport in the vicinity of the current and Historical Creek is presented in Figure 6-8.

The following sections discuss the fate and transport of contaminants in the historical and current creek channels.

6.2.3.2 Historical Creek Channel

Before 1962, the upper portion of the Creek flowed through the Historical Creek channel north of the Marine Drive Bridge. The water in the Historical Creek reportedly contained process waters and stormwater from the Oeser site, Birchwood neighborhood runoff, and natural runoff from the Park. The Historical Creek channel contains fine-grained sediments that are generally underlain by sand and gravel deposits.

The primary transport mechanism of contaminant transport through the Historical Creek channel is surface water flow. The primary sources of contamination to the Creek prior to 1961 or 1962 were process waters and stormwater from the Oeser site containing creosote, diesel-range petroleum hydrocarbons, PCP, and associated dioxins/furans. The Birchwood neighborhood overland runoff water (station SW-12) is a current source of contamination to the Historical Creek and current creek via the Historical Creek. Stormwater discharges to the Creek may contain automotive wastes and household chemicals associated with street runoff and residential houses in the area. The organic contaminants may have included both dissolved and NAPL phases.

A portion of the water flowing through the Historical Creek channel may have infiltrated into the sediments beneath the channel. Hydrophobic petroleum hydrocarbons present in the water would have had a tendency to adsorb onto the organic carbon in the sediments or suspended particles. Most of the DNAPL that may have been present in the Historical Creek channel would have settled out in low velocity areas and migrated downward into the sediment until a topographically low barrier layer is encountered. If roots, cracks, or other conduits are present in the low permeability layer, some of the DNAPL may have been able to migrate through the layer.

Visible creosote-like contamination (i.e., sheen and residual NAPL globules) was observed in the upper portion of the Historical Creek at test pit TP-6. The contamination extended from ground surface to an organic silty clay layer at 4 ft bgs. Based on an aerial photograph taken in 1955, this test pit appears to be in a portion of the Historical Creek channel with a bar deposit in the center of the channel. The contamination around test pit TP-6 was relatively localized, indicating that the test pit may have been located in a low velocity zone where historical releases of petroleum settled out of the Creek and infiltrated into the sediments.

Some petroleum contamination was detected at stations farther downstream along the Historical Creek channel (i.e., at TP-16, TP-17, and SB-34 through SB-39). The contamination included petroleum hydrocarbons, PAHs (mostly HPAHs), PCP, and associated dioxins/furans that may be a result of the materials used at the Oeser site, urban runoff, and the weathering process (see Section 6.1). These contaminants were likely transported with surface waters flowing through the Creek. The contaminants were likely transported through the Creek channel in the dissolved and LNAPL phases, with some sorption and limited portioning to the vapor phase. The mobility of the petroleum hydrocarbons, PCP and associated dioxins/furans in the lower portion of the Historical Creek channel is probably limited due to the relatively high organic carbon content of the sediments (i.e., due to adsorption processes) (~12 percent TOC measured in some sediments).

6.2.3.3 Present Creek Channel

Since approximately 1962, the Creek has occupied its current channel. The water in the Creek likely continued to receive process waters and stormwater from the Oeser site, stormwater from the Birchwood neighborhood, and runoff and sheet flow from within the Park and from the northeasterly part of the Oeser storage yard. The primary sources of contamination in surface water are from the Oeser site (wood-treatment chemicals—creosote, petroleum hydrocarbons, PCP, and associated dioxins/furans) and the Birchwood neighborhood stormwater runoff (petroleum hydrocarbons and metals from automobiles and residential properties). In addition, residual NAPL has been observed oozing from silty sand on top of a clay layer that daylights in the upper reaches of the Creek (Figure 5-33; LSC Bank).

Petroleum contamination (i.e., sheen and/or residual NAPL globules) with a creosote-like odor was observed in the silt, sand, and sandy gravel sediments along most of the current creek channel during a reconnaissance survey in December 2005 (see Figure 5-33). The bulk of the residual NAPL was observed in the upper reaches of the Creek north of the Marine Drive Bridge, with very minor amounts of laterally discontinuous sheens observed from the shell midden area in the Lower Creek area to the Marine Drive Bridge. The transport mechanism of the residual NAPL in the upper reaches of the Creek appears to be from surface water flow and groundwater discharge to surface water. The transport mechanism of the residual NAPL in the lower reaches of the Creek appears to be from surface water flow from upstream sources.

Petroleum contamination (i.e., sheen, residual NAPL globules) with a creosote-like odor was observed in groundwater on top of a gray clay layer in a number of borings and piezometers in the Upper Creek area (i.e., SB-9, SB-11, SB-12, SB-22, SB-25, SB-29, SB-31; Figures 4-4 and 5-3). At many of these locations, the clay layer and the petroleum contamination were observed at elevations below the current creek channel, indicating that the contamination is migrating in groundwater on top of the clay layer beneath the Creek channel in some locations. The gray clay layer was observed at one location in the Upper Creek adjacent to piezometer SB-13 (see Figure 4-4). As mentioned above, a NAPL seep was observed at this location (sample LSC Bank).

The source of the petroleum observed in groundwater is likely stormwater discharges from Oeser (see Figures 4-4 and 6-8). This is evidenced by the presence of petroleum contamination on top of the clay layer at boring SB-42[47] and well SB-22, located immediately downslope of the 36-in. stormline, and the absence of similar petroleum contamination in SB-40 and SB-41 in the Illinois Street extension area and at nearby wells SB-21 and SB-23 (see Figure 4-2). Petroleum hydrocarbons (GRO) was detected in well SB-21, but the source appears to be different given the absence of DRO, PCP and distinct creosote odor detected in SB-22 and locations observed downstream (downgradient). Petroleum hydrocarbons were not detected in well SB-23, located downgradient of well SB-22, but PCP was detected at the detection limit, likely due to the greater mobility of PCP (refer to Section 5).

Groundwater generally flows to the southwest across the site (see Figures 4-6 and 4-7). Dissolved petroleum hydrocarbons, PCP, and associated dioxins/furans are expected to be transported from the source area to the southwest by processes described in Section 6.2.2.

[47] SB-42 is located south of and adjacent to the railroad spur servicing Morse Steel Services. The railroad spur was constructed in the 1970s, and construction included filling a portion of the ravine and extending the culvert underground to its present location.

6.2.3.4 Historical Landfill

As discussed in Section 4.7, a municipal landfill was in operation on the northeastern portion of the site during the 1930s. Based on information obtained from test pits excavated during the Park remedial investigation, the historical landfill materials are covered with approximately 0.5 to 3 ft (generally 2 ft) of soil. Native soils are generally present at the base of the landfill materials (~3 to 4 ft bgs). No impermeable liner was observed at the base of the landfill materials and no impermeable cap was observed on top of the landfill materials.

A CSM diagram of contaminant transport in the vicinity of the historical landfill is presented in Figure 6-9. During the dry season, the water table is expected to be beneath the bottom of the historical landfill materials. When precipitation occurs, contaminants (principally metals) may be leached from the landfill materials by infiltrating water and transported to the capillary fringe and groundwater zones. During the wet season, the water table is expected to be in direct contact with the lower portion of the historical landfill materials.

Contaminants present in overland runoff (i.e., industrial/homeowner chemicals, automotive waste) may also be transported downward toward groundwater. Once the leachate and overland runoff contaminants reach groundwater, they will likely be transported downgradient (presumably to the southwest toward Bellingham Bay) by the processes described for dissolved contaminant transport in groundwater in Section 6.2.2.

Two soil samples with the highest detected metal concentrations collected from the historical Landfill area were analyzed using the TCLP method. The TCLP test was designed to model a theoretical scenario in which municipal solid waste is placed in an unlined landfill. The acetic acid solution used in the TCLP method is designed to simulate the result of rainwater infiltrating the Landfill, reacting with the municipal solid waste, and then leaching through the waste being tested.

Table 6-3 compares the total and TCLP metal concentrations. The TCLP concentrations are 2 to 4 orders-of-magnitude lower than the total metals concentrations, indicating a relatively weak tendency of the metals in the historical Landfill area to leach to surface water and groundwater.

6.2.3.5 Railroad Trestle Area (BNSF Mainline Trestle)

The BNSF trestle area could be a source of pesticides and DRO, including PAHs, to the soils in the vicinity of the trestle. Pesticides, herbicides, and oily products have reportedly been used to treat the wood in the ties and to control vegetation along the tracks.

Groundwater is expected to be very shallow in the vicinity of the railroad trestle since it is located in a low-lying area adjacent to Bellingham Bay. When precipitation and/or overland runoff occur, contaminants in the soil as well as those in the runoff may be transported downward by infiltrating water to the capillary fringe and groundwater zones. Once the contaminants reach groundwater, the contaminants will be transported downgradient (presumably toward Bellingham Bay).

The mobility of petroleum hydrocarbons in soils in the railroad trestle area is expected to be limited due to the high organic carbon content of the soils (i.e., due to adsorption processes).

6.2.3.6 Beach Area

Many of the contaminants that reach the mouth of the Creek are likely to be dispersed into Bellingham Bay because the Beach is a highly exposed area with a great deal of erosion, especially during the winter months. The shallow portions of the Beach are primarily cobbles and gravel, with little fine-grained sediments or organic carbon to adsorb chemicals.

6.2.3.7 Illinois Street Extension Area

As discussed previously, the City plans to extend West Illinois Street to Marine Drive in order to better accommodate traffic flow to BTC and local industries in the area (e.g., Morse Steel). An old railroad grade/public trail, railroad spur to Morse Steel, and undeveloped land currently occupy this area. Based on information obtained from test pits and borings excavated during the Park remedial investigation, the upper 3 ft of fill materials were determined to contain elevated levels of arsenic above the screening level of 20 mg/kg. The arsenic appears to be associated with fill materials used for railroad bedding or historical application of herbicides. Other trace metals exceeded screening levels but exceedances were not widespread in this area.

A CSM diagram of contaminant transport in the vicinity of the Illinois Street extension area is presented in Figure 6-10. When precipitation occurs, metals (principally arsenic) may be leached from the soil/fill by infiltrating water and transported to the capillary fringe and groundwater zones. Overland runoff of surface water may also be transported downward toward groundwater or into the ravine below, which marks the head of the Creek. Once the leachate and overland runoff contaminants reach groundwater, they will likely be transported downgradient (presumably to the southwest toward Bellingham Bay) by the processes described for dissolved contaminant transport in groundwater in Section 6.2.2.

Four soil samples with higher arsenic concentrations collected in this area were analyzed using the SPLP method. The SPLP test is recommended by MTCA to estimate groundwater impacts from arsenic in soil exposed to acid rain in the western United States. Two of the four samples were also analyzed for TCLP arsenic.

Table 6-4 compares the total and SPLP/TCLP arsenic concentrations. The leachate concentrations are several orders of magnitude lower than the total arsenic concentrations, indicating a relatively weak tendency of the metals in surface soils of the Illinois Street extension area to leach to surface water and groundwater. However, the leachate for three of four samples exceeds the screening level for arsenic in groundwater of 5 μg/L.

6.3 POTENTIAL RECEPTORS AND EXPOSURE PATHWAYS

Receptors that could be exposed to chemicals present in the Park include humans visiting the Park, plants growing in the Park, and a variety of aquatic and terrestrial animal species living in the Park and in Bellingham Bay. Exposure can occur through direct contact with soil, sediment, or water; intentional or incidental ingestion of water; uptake from soil by plant roots; and consumption of berries, other vegetation, or prey (e.g., amphipods, small fish). Inhalation exposures are not expected to be significant at this site, as discussed below.

6.3.1 Human Exposures

Potential human receptors include the following (see Figure 6-1):

- Recreational Park users, some of whom may be residents near the Park or workers at BTC, Oeser, or other work sites nearby
- Maintenance workers working in the Park
- Transients living in the Park.

Hunting is not allowed in the Park, so exposures associated with hunting are not included in Figure 6-1. Fishing may occur in the receiving waters at the mouth of the Creek.

Children using the Park constitute a group of special concern because they tend to have higher exposures on a body-weight basis than do adults, particularly for direct contact with soil. Direct contact includes soil contact with skin, with the possibility of chemicals crossing the skin to enter the bloodstream, and incidental or intentional ingestion of soil on the hands. Children usually experience the same exposure pathways as adults but with higher rates of exposure. MTCA Method B soil cleanup levels (CULs) are designed to reflect a child receptor.

Park maintenance workers, users, and transients could be exposed to contaminants in surface soil by direct contact (unintentional ingestion and absorption across the skin). Soil vapors are not considered a route of exposure because VOCs were rarely detected in soil. Windblown dust transport within and out of the Park is expected to be insignificant because the Park is heavily vegetated and it lies in a ravine. Park users, maintenance workers, and transients could be exposed to contaminants by ingesting local plants (e.g., berries) that have taken up chemicals from the soil.

If park development or maintenance activities uncovered subsurface soil, Park maintenance workers, users, and transients could be exposed to the subsurface soil through direct contact or inhalation of particulates. The subsurface soil would become available for windblown transport to residents and workers near the Park. These routes of exposure are considered minor, because little digging is expected to occur in the Park. If the Creek is re-routed, surface and subsurface soils could be converted to sediments and vice versa, though the exposure routes would remain essentially the same.

No drinking water wells exist in the Park, so human receptors are not exposed to groundwater at present. Ecology considers most groundwater to be potable and protects groundwater for potential future uses. The most likely future use of groundwater in the Park is for irrigation of public land. People using irrigated land could be exposed through incidental dermal contact with water or through inhalation of vapors from the water. If a drinking water well were drilled in the Park, users could be exposed through ingestion of the water, dermal contact with the water, and inhalation of vapors generated during household activities such as showering.

Park maintenance workers, users, and transients could be exposed to contaminants in surface water and/or sediments through direct contact. Transients could be exposed to surface water through intentionally drinking the water. Maintenance workers and Park users might also (intentionally or not) drink the water in small amounts during water contact activities.

If groundwater or surface water contaminants reach Bellingham Bay, humans could be exposed through direct contact with water and sediments while collecting shellfish or wading recreationally or exposed through ingestion of shellfish caught locally.

6.3.2 Ecological Exposures

Potential ecological receptors include the following (see Figure 6-2):

- Terrestrial and aquatic plants
- Soil-dwelling invertebrates (e.g., worms)
- Terrestrial animals, including birds, mammals, and domesticated animals (e.g., dogs)
- Aquatic invertebrates (e.g., snails)
- Various fish species (e.g., salmonids)
- Semi-aquatic birds and mammals (e.g., ducks, raccoons).

Terrestrial animals (birds, mammals, and domestic animals) could be exposed to contaminants in surface soil by direct contact (unintentional ingestion and absorption across the skin) with the soil. Soil vapors are not considered a route of exposure because VOCs were rarely detected in soil. Windblown dust transport within and out of the Park is expected to be insignificant because the Park is heavily vegetated and it lies in a ravine. Terrestrial plants could take up contaminants from surface and shallow subsurface soils. Terrestrial animals could consume contaminated plants or soil-dwelling invertebrates while foraging for food in the Park.

If Park development or maintenance activities uncovered subsurface soil, terrestrial animals could be exposed to the subsurface soil through direct contact or inhalation of particulates. The subsurface soil would become available for windblown transport to terrestrial animals near the Park. These routes of exposure are considered minor, because little digging is expected to occur in the Park. If the Creek is re-routed, surface and subsurface soils could be converted to sediments with associated sediment/biota exposure routes.

Ecological receptors are not likely to be exposed directly to groundwater, because groundwater is deeper than the active zone for plant roots and burrowing animals (typically 6 ft).

Terrestrial animals, aquatic plants and invertebrates, fish, and semi-aquatic birds and mammals could be exposed to contaminants in surface water and/or sediments through direct contact. Terrestrial animals could be exposed to surface water by intentionally drinking the water. Terrestrial and semi-aquatic animals could be exposed by eating contaminated prey in the Creek.

If groundwater or surface water contaminants reach Bellingham Bay, terrestrial animals and semi-aquatic birds and mammals preying on shellfish living at the Beach and fish migrating into the Creek could be exposed through direct contact with the surface water and the sediments and through ingestion of the shellfish and fish.

7 RISK EVALUATION

Risks were evaluated separately for human, terrestrial ecological, and aquatic ecological receptors. As an initial step, the metals detected in site soils, groundwater, surface water, and sediments were evaluated to determine if they were present at levels above natural background concentrations (Section 7.1)[48]. Metals that are present at or below natural background concentrations were not evaluated for human or ecological risks. The evaluations for human (Section 7.2), terrestrial (Section 7.3), and aquatic ecological receptors (Section 7.4) involved a site-wide screening based on maximum detected concentrations to identify a preliminary list of IHSs, followed by an area-specific screening step based on conservative estimates of mean concentrations to identify IHSs for humans and chemicals of potential ecological concern (CoPECs) for terrestrial and aquatic receptors. Recommendations for development of CULs for the IHSs and CoPECs are discussed in Section 8.

7.1 METALS CONCENTRATION PATTERNS

Metals were analyzed in all media sampled at the Park (soils, sediments, groundwater, and surface water). There were 23 metals detected at least once in at least one medium: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc. A summary of sample counts for metals analyses is provided in Appendix I, Table I-1.

Metals concentrations detected in soil, groundwater, and sediment were evaluated in a two-step process to determine if they varied significantly within the site and if they were elevated above natural or site background concentrations. For surface water, the two steps were combined into a single analysis. Natural background is defined as the concentration of a substance present in the environment that has not been influenced by localized human activities (WAC 173-340-200). In this discussion, the term "natural background" refers to soil metals concentrations identified by Ecology (1994) as natural background concentrations in the Puget Sound region. The term "site background," which is not a term defined by MTCA, refers to soil, groundwater, and surface water samples that were collected during remedial investigations for the Park and Oeser sites in areas that were believed not to be impacted by either site or by any known metals sources.

[48] The approach for background screening of metals presented in this section and Appendix I is not consistent with Ecology policy and guidance (Ecology 1992). However, this approach was approved by Ecology for this site only, under the case-by-case scenario regulated by SMS/MTCA.

In the first step of the evaluation (Section 7.1.1), the patterns of metals concentrations among site areas were evaluated statistically to determine if the site areas were different from each other or if they could be combined for the purposes of the natural background evaluation. If metals concentrations in the various site areas were significantly different, it would be inappropriate to combine them into one data set when comparing to background concentrations. The results of the first step, however, indicated that most site areas were not statistically different from each other, so all site areas except the Landfill and the Illinois Street extension were combined for the second step. The Landfill and the Illinois Street extension areas were evaluated separately in recognition of large variability in concentrations of some metals within these areas, to support interim actions specific to these areas, and because of known historical practices in these areas.

In the second step of the evaluation (Section 7.1.2), metals concentrations in the Landfill, Illinois Street extension, and in the other site areas combined were compared statistically with natural background concentrations (Ecology 1994) to determine which metals were elevated above background and should be considered further in the human health and ecological risk evaluations (Sections 7.2 through 7.4). Natural background concentrations are available for soil for 12 metals only.

Metals concentrations in the Landfill were also evaluated statistically[49] to determine what metals were co-located with each other (Section 7.1.3).

Silver was not compared to background in any medium and mercury was not compared to background in groundwater because of low detection frequencies in all site areas, which limits the usefulness of statistical analyses. Beryllium, mercury, and thallium were never detected in surface water and were therefore not included in comparisons for surface water. Calcium, potassium, and sodium were excluded from the evaluation because they are trace nutrients not typically associated with human or ecological toxicity. The remaining metals were analyzed in each site area for all media in which sufficient data exist.

Based on the statistical evaluations discussed below, the following metals were eliminated from further consideration in the human health and ecological risk evaluations in all site areas: aluminum, antimony, barium, cadmium, cobalt, iron, manganese, nickel, selenium, silver, thallium, and vanadium. The following metals were retained for further consideration in the human health and ecological risk evaluations in all media in all site areas: arsenic, beryllium, copper, lead, magnesium, mercury, and zinc. Cadmium was also retained for further evaluation in the Landfill and Illinois Street extension but not in other site areas. Chromium was retained for sediment only and nickel was retained for surface water only.

---

[49] All statistical plotting and testing was performed using Statistica software (Statsoft, Inc., Tulsa, OK) assuming nondetected values are present at half the detection limit.

7.1.1 Differences among Site Areas

Metals concentrations among site areas were evaluated to determine whether they are similar and could be combined for further analyses. Two approaches were used: box-and-whisker plots and the Kruskal-Wallis test.

Box-and-whisker plots are shown in Appendix I for surface and subsurface soil (Figures I-1 to I-19), groundwater (Figures I-20 to I-37), and surface and subsurface sediment (Figures I-38 to I-56). Each plot shows the median value with a box representing the 25th and 75th percentiles and bars representing the range. Outlier values, those more than 1.5 times the interquartile range (i.e., 25th to 75th percentiles), are not included in the plots. Plots for soil in the Illinois Street extension (Figures I-57 to I-64) and for surface water across the site (Figures I-65 to I-79) are shown using means, standard errors, and confidence limits (see Section 7.1.2). These visual representations allow for a broad, preliminary assessment of similarities among the site areas for each metal. Because of differences among sampling events, some metals were analyzed in all site areas and others were analyzed in only some of the areas. For example, the plots for aluminum in soil (Figure I-1) show site background and three site areas, while the plots for arsenic in soil (Figure I-3) show site background and eight site areas.

Because no site background samples were collected for sediment, the box-and-whisker plots show background soil results for comparison purposes. Comparing site sediment results with background soil results is reasonable for this site because the Creek has been rerouted in the past causing materials that were previously sediment to become soil and vice versa. Furthermore, the Creek could be rerouted in the future and once again cause soils and sediments to be interchanged. Some metals (e.g., arsenic, cadmium) tend to form complexes with fine-grained material and organic matter in soils and sediments, so materials with higher organic content tend to have higher concentrations of these metals. Sediments in the Park range from gravelly (in areas of free running water) to silty (in areas with pooled water). Comparison of background soil concentrations with site sediment concentrations is expected to be conservative for silty sediments but not necessarily for gravelly sediments. When sediments are considered overall, this issue is not expected to be a significant source of uncertainty.

Metals concentrations appear generally to be similar throughout site areas with the following possible exceptions:

- The range of surface soil concentrations of arsenic in the wetland is larger than in other site areas, but this is likely an artifact due to small sample size (n=2) (Figure I-3).
- The ranges of surface soil concentrations of copper in the Lower Creek area and lead in the Railroad area are larger than in other site areas, but interquartile range concentrations are similar to other site areas (Figures I-9 and I-11).

- The ranges of subsurface soil concentrations of cadmium, lead, mercury, nickel, and zinc in the Landfill are larger than in other site areas, but mid-range concentrations are similar to other site areas (Figures I-6, I-11, and I-19). The fact that Landfill concentrations look similar to other site areas is possibly an artifact of the sampling design in this area, which focused on defining the edges of contamination rather than characterizing the high concentrations seen in the few samples collected in the interior of the Landfill.
- Surface and subsurface concentrations of arsenic in the Illinois Street extension are higher and have a larger range than other areas on the site (Figures I-3 and I-57). Surface concentrations of cadmium at the Illinois Street extension are also higher than other locations on the site (Figures I-6 and I-58). Subsurface copper concentrations in the Illinois Street extension have a wider spread but a similar midpoint concentration (Figures I-9 and I-60). Zinc concentrations in subsurface soil showed a wider range than other site areas (Figures I-19 and I-64).
- The ranges of groundwater concentrations of chromium, lead, and nickel in the Upper Creek are larger than in other site areas, but mid-range concentrations are similar to other site areas (Figures I-26, I-30, and I-33).
- The ranges of surface sediment concentrations of antimony, cadmium, manganese, selenium, and thallium in the wetland are larger than in other site areas, but this is likely an artifact due to small sample sizes (n=2 for all but cadmium for which n=3) (Figures I-39, I-43, I-50, I-53, and I-54).
- Surface water concentrations of arsenic, copper, nickel, and zinc have a wider range and higher midpoint in the Historical Creek than in other areas (Figures I-67, I-71, I-76, and I-79).

The patterns observed in the box-and-whisker plots were evaluated statistically using the Kruskal-Wallis test, which is a nonparametric test using ranks to test the hypothesis that all locations within the site have the same range of concentrations. For each metal in each medium, the analysis was conducted comparing all sites, including background, to all other sites. The results for metals showing statistical differences are shown in Appendix I for surface soil (Tables I-2 and I-3), subsurface soil (Table I-4), surface water (Table I-5) and surface sediment (Table I-6). The Kruskal-Wallis test was not run for groundwater because visual inspection of the box-and-whisker plots indicated no differences requiring testing. The Kruskal-Wallis test was run for subsurface sediments but results are not shown because there were no statistically significant differences among any site areas.

Metals concentrations in surface and subsurface soil, surface sediment, and surface water are not statistically different among site areas and site background with the following exceptions:

- Surface soil concentrations of beryllium, cobalt, thallium, and vanadium in the South Slope are significantly different ($p<0.05$) from concentrations in the Upper Creek area (Table I-2).
- Surface soil concentrations of magnesium in the South Slope, Upper Creek, and General Site areas are significantly different ($p<0.05$) from site background (Table I-2).
- Surface soil concentrations of arsenic in the Illinois Street extension area are significantly different ($p<0.05$) from the Landfill and site background (Table I-3).
- Subsurface soil concentrations of lead and zinc in the South Slope area are significantly different ($p<0.05$) from concentrations in the Landfill area; concentrations of lead in the South Slope area are also different from the Railroad area (Table I-4).
- Surface sediment concentrations of arsenic, copper, lead, and mercury in the Historical Creek area are significantly different ($p<0.05$) from concentrations in the Upper Creek area (Table I-6).
- Surface water concentrations of zinc in the Wetland area are statistically significantly different ($p<0.05$) from the Upper Creek area (Table I-5).

The overall weight of evidence of the two statistical evaluations (box-and-whisker plots and Kruskal-Wallis test) does not indicate consistent differences among site areas for any metals in any media. It was noted, however, that the ranges of concentrations of cadmium, lead, and zinc in subsurface soils in the Landfill and the ranges of concentrations of arsenic, copper, and zinc in subsurface soils in the Illinois Street extension are larger than in other site areas (Figures I-3, I-6, I-9, I-11, I-19, I-57, I-58, I-60, and I-64). Maximum concentrations of some of these metals may not have been included in box plots if considered outliers, though they were included in the Kruskal-Wallis test. Considering the historical practices in the Landfill and the Illinois Street extension and the patterns observed in the box-and-whisker plots, these areas were considered separately for the purposes of comparisons with natural background concentrations. All other site areas were combined for comparisons with natural background concentrations.

7.1.2 Comparisons with Background

Site concentrations were compared to natural background concentrations using two approaches: the Kruskal-Wallis test discussed above in Section 7.1.1 and box-and-whisker plots. The Kruskal-Wallis test was conducted for all metals and media with background sample results (either site background or natural background). The box-and-whisker plots were more limited because Ecology (1994) has published natural background concentrations for only 12 metals in soils. Natural background values from Ecology were 90^{th} percentiles.

In the Kruskal-Wallis test, the only metals showing significant differences between site areas and site background samples were magnesium in surface soils of the South Slope, Upper Creek, and General Site and arsenic in the Illinois Street extension.

The box-and-whisker plots used to compare site concentrations with natural background are different from those discussed previously (Section 7.1.1) in two respects. First, rather than comparing site areas with one another, all site areas except the Landfill and the Illinois Street extension were combined and compared against the natural background concentration for the Puget Sound region (Ecology 1994). Concentrations in the Landfill and Illinois Street extension were compared against Puget Sound natural background separately. Second, rather than showing medians and percentiles, each plot shows the mean value with a box representing the standard deviations around the mean and bars representing the 95 percent confidence limits around the mean, assuming normal distributions. Box-and-whisker plots comparing site areas combined against natural background are shown in Appendix I for surface soil (Figures I-80 to I-91), subsurface soil (Figures I-92 to I-103), surface sediment (Figures I-104 to I-115), and subsurface sediment (Figures I-116 to I-123). Plots comparing the Landfill against natural background are shown in Appendix I for surface soil and subsurface soil (Figures I-57 to I-64).

The visual patterns shown in the box-and-whisker plots for all site areas combined except Landfill and the Illinois Street extension are quite consistent among media:

- Site concentrations of copper, mercury, and zinc are greater than the Puget Sound natural background concentration in surface and subsurface soil and surface and subsurface sediment.
- Site concentrations of beryllium are greater than the Puget Sound natural background concentration in surface and subsurface soil and surface sediment.
- Site concentrations of chromium are greater than the Puget Sound natural background concentration in surface sediment only.
- Site concentrations of lead are greater than the Puget Sound natural background concentration in surface soil and surface sediment but not subsurface soil.

Although concentrations of arsenic in soils and sediments were not determined to be significantly different from natural background, concentrations in the wetland do appear to be higher than site background, though this might be an artifact of small sample size. Considering these uncertainties, arsenic was not eliminated on the basis of the background evaluation. Additional statistical evaluation during the feasibility study might support eliminating arsenic.

In the Landfill, concentrations of cadmium are greater than the Puget Sound natural background concentration in subsurface soil but not in surface soil. This is consistent with known historical practices in the Landfill area. Copper, lead, mercury, and zinc are elevated above Puget Sound background in both surface and subsurface soils.

For the Illinois Street extension area, arsenic, copper, lead, and zinc are elevated above Puget Sound natural background in both surface and subsurface soils. Cadmium and mercury are elevated in surface soils only.

The following table summarizes the metals considered to be present above background concentrations, based on the overall weight of evidence from the box-and-whisker plots and the Kruskal-Wallis tests.

Metal	Evaluate Site-Wide	Evaluate in Landfill	Evaluate in Illinois Street Extension
Aluminum			
Antimony			
Arsenic	X		X
Barium			
Beryllium	X	NA	NA
Cadmium		X	X
Chromium	Sediment only		
Cobalt			
Copper	X	X	X
Iron			
Lead	X	X	X
Magnesium	X	NA	NA
Manganese			
Nickel	Surface water only		
Mercury	X	X	X
Selenium			
Silver			
Thallium			
Vanadium			
Zinc	X	X	X

NA - Data not available for Landfill or Illinois Street extension. Because these metals are elevated above background in other areas of the site, they may also be elevated above background in the Landfill or Illinois Street extension.

7.1.3 Co-location of Metals in the Landfill

Metals concentrations in the Landfill were evaluated using the Pearson correlation, a simple parametric correlation test, to identify which metals tend to be co-located with each other. The results indicate that mercury concentrations are significantly positively correlated ($p<0.05$) with concentrations of cadmium, and lead and nickel concentrations are significantly positively correlated ($p<0.05$) with chromium concentrations (Table 7-1). Although nickel was not selected for additional evaluation in the Landfill, a cleanup action addressing chromium and lead would likely capture nickel as well.

7.2 HUMAN HEALTH SCREENING LEVEL EVALUATION

Site-wide IHSs were selected using a broad screening approach that considered the following issues (WAC 173-340-703):

- Toxicological characteristics
- Status as an essential element
- Persistence
- Mobility
- Thoroughness of testing
- Frequency of detection
- Presence of a known source in the vicinity of the site (as discussed in Section 6.1)
- Degradation byproducts of, or other chemicals associated with, the key constituents.

Toxicological characteristics were considered in the form of risk-based screening levels, discussed in Section 7.2.1 below. The essential elements calcium, magnesium, potassium, and sodium were not evaluated because screening levels are not available and they are not typically associated with human toxicity. Persistence and mobility were not addressed directly in the human health screening, but they are discussed in relation to fate and transport in Section 5. Many of the chemicals detected in the Park appear to be persistent chemicals from historical releases in the Park or in nearby areas. Frequency of detection and thoroughness of testing were evaluated in combination, as discussed in Section 7.2.2 below. The predominant chemicals selected as IHSs are consistent with the historical practices within the Park, known sources near the Park, and degradation products associated with such chemicals, as discussed in Section 7.2.5.

7.2.1 Screening Levels

Human health screening levels were developed consistent with MTCA requirements (WAC 173-340-720 through -740). Tables 7-2 and 7-3 provide the screening levels for soil and sediment and for water, respectively. Appendix I provides detailed documentation of the screening process for human health IHSs (Tables F-1 through F-10).

7.2.1.1 Soil and Sediment

Soil and sediment screening levels address direct human contact with soil and protection of groundwater through leaching (Table 7-2). MTCA Method B soil screening levels for direct contact were obtained from Ecology’s on-line database cleanup levels and risk calculations (CLARC, https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx) in July 2007. For chemicals with values for both cancer effects and non-cancer effects, the minimum of the two values was used.

If no value was available in CLARC, the USEPA (2004) Region 9 preliminary remediation goal (PRG)[50] for residential soil was used.

The screening levels for leaching were obtained from Region 9 PRGs, considering two different dilution attenuation factors (DAFs). The DAF represents the amount of dilution assumed to occur during the leaching process. Soil pore water in the unsaturated zone will be diluted when it reaches the aquifer, whereas no such dilution occurs when soils are in direct contact with water (either soils in the saturated zone or sediments). Soils in the Illinois Street project area are on the top of a hill and soils in the South Slope area are on the hillside; these soils are unsaturated, so screening levels based on a default DAF of 20 were used (WAC 173-340-747(4)(b), Equation 747-1). Screening levels based on a default DAF of 1 were used for all other site areas (WAC 173-340-747(4)(e)) because soils in other site areas are often saturated during the rainy season and soils that are not currently in contact with water could be in contact with water in the future if the Creek is re-routed. Although the PRGs for leaching were used for screening because of their ready availability for multiple chemicals, the leaching CULs for final IHSs should be developed in the feasibility study using Ecology's spreadsheets MTCASGL10 and MTCATPH11.

The final screening level for soil and sediment was the minimum of either the screening level for direct human contact or the screening level for leaching to groundwater. The screening levels for lead, gasoline range hydrocarbons, diesel range hydrocarbons, and motor oil were Method A values (MTCA Table 720-1). If no screening level was available from any of the above sources for a detected analyte, the screening level for a surrogate chemical was used, if it was possible to identify a suitable surrogate, as so noted in Table 7-2.

7.2.1.2 Groundwater and Surface Water

Groundwater and surface water screening levels address human exposures through drinking water and through consumption of fish accumulating chemicals from the water (Table 7-3). Groundwater can discharge to surface water in portions of the site, so groundwater must be protective of surface water. The surface water in the Creek is designated by default as potable (WAC 173-201A-600[1]), so it must be protected for drinking water. This means that the groundwater and surface water screening levels are the same because each must consider protection of both surface water and drinking water.

For protection of surface water, the National Recommended Ambient Water Quality Criterion for protection of human health through ingestion of both water and organisms (WQC-W+O; USEPA 2006a) was the preferred value (WAC 173-340-730(3)(b)(i)). If the WQC-W+O was associated with a cancer risk greater than 1 x 10^{-5} or a hazard quotient greater than 1, it was

---

[50] http://www.epa.gov/region09/waste/sfund/prg/index.html

adjusted to meet these risk targets (WAC 173-340-730(5)(b)). If no WQC-W+O was available, a MTCA Method B surface water screening level was obtained from the CLARC on-line database[51] in July 2007 (WAC 173-340-730(3)(b)(iii)). For chemicals with values for both cancer effects and non-cancer effects, the minimum of the two values was used.

For protection of drinking water, the maximum contaminant level (MCL) was the preferred value (WAC 173-340-720(4)(b)(i)). The minimum of the Washington Department of Health (WDOH 2004) MCL and the USEPA (2006b) MCL was used. If the minimum MCL was associated with a cancer risk greater than 1 x 10^{-5} or a hazard quotient greater than 1, it was adjusted to meet these risk targets (WAC 173-340-720(7)(b)). If no MCL was available, a MTCA Method B groundwater screening level was obtained from the CLARC on-line database in July 2007 (WAC 173-340-720(3)(b)(iii)). For chemicals with values for both cancer effects and non-cancer effects, the minimum of the two values was used. If no value was available from CLARC, the Region 9 PRG for tap water was used.

The final screening level for groundwater and surface water was the minimum of the screening level for protection of surface water and the screening level for protection of drinking water. The screening levels for lead, gasoline range hydrocarbons, diesel range hydrocarbons, and motor oil were Method A values (MTCA Table 740-1). If no screening level was available from any of the above sources for a detected analyte, the screening level for a surrogate chemical was used, if it was possible to identify a suitable surrogate, as so noted in Table 7-3.

7.2.2 Screening Process

Screening for human health IHSs was conducted in a two step process. In the first step, the maximum concentration of each analyte detected anywhere on site, in any of the 10 areas, was compared with the screening level. If the maximum site concentration exceeded the screening level, the analyte was retained as a preliminary IHS and was considered further in the second step. Otherwise it was eliminated from further consideration. The first step was conducted for all soils combined (surface and subsurface) (Table F-1), all sediments combined (Table F-2), groundwater (Table F-3), and surface water (including springs and seeps) (Table F-4). Soil leaching screening levels for saturated soil (DAF of 1), which are more conservative than screening levels for unsaturated soil, were used for the first step because no distinction was made among site areas. Maximum concentrations of metals present at background levels (Section 7.1) were compared with screening levels in the first step but were not carried into the second step. Maximum detection limits for analytes never detected on site were compared with screening levels in the first step but were not carried into the second step.

---

[51] https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx

To facilitate the second step of the human health screening process, a data set was constructed for each preliminary IHS in each site area and was evaluated to determine the size of the data set and the shape of the distribution. With the exception of noncarcinogenic PAHs (discussed below), upper one-sided 95 percent confidence limits on the means (95UCLs) were calculated for data sets with at least 11 samples and were used for the second screening step. When the 95UCL exceeded the maximum detected value in the data set, or when the data set had fewer than 11 samples, the maximum value was used for the second screening step.

To calculate 95UCLs, distributions were tested for normality and lognormality using the Shapiro Wilkes test. If a sample set had a lognormal distribution, the 95UCL was the H-statistic using Land's method. If not, and the distribution was normal, the 95UCL was calculated using Student's *t* statistic. If the distribution fit neither a normal nor a lognormal distribution, the 95UCL was chosen based on the recommendation indicated in EPA's statistical software, ProUCL. EPA's Users Guide for ProUCL (Singh et al. 2004) notes that the use of Land's H-statistic can yield unrealistically large UCL values, particularly when the sample size is small and the standard deviation of the log-transformed data is large, which is the case with some of the data sets evaluated for the Park (e.g., benzo[a]pyrene equivalent [BaPE] in surface soils in the Upper Creek). Some of these data sets fit the gamma distribution as well as the lognormal distribution, and they might have been more accurately represented by statistics for the gamma distribution. Use of lognormal statistics for these data sets was sufficiently protective, however, because when the 95UCL was unrealistically high, the maximum detected value was used for screening.

95UCL values were not calculated for noncarcinogenic PAHs because the level of effort was not considered appropriate, considering the expected role of noncarcinogenic PAHs in the development of CULs during the feasibility study. Noncarcinogenic PAHs were selected as preliminary IHSs in one or more media in Upper Creek, Historical Creek, and Lower Creek. In every instance in which noncarcinogenic PAHs were selected as IHSs, motor oil, diesel range hydrocarbons, or both were also selected as IHSs. It is expected that CULs for petroleum will be developed using Ecology's MTCATPH spreadsheet, which includes noncarcinogenic PAHs when calculating the CUL for TPH. It is not necessary to have separate CULs for noncarcinogenic PAHs when TPH CULs are developed using the MTCATPH spreadsheet. The noncarcinogenic PAHs were screened in the second step using maximum detected values.

In the second step of the human health screening process, preliminary IHSs were evaluated on an area-specific basis, considering frequency of detection and the three-part statistical rule, discussed below. If the frequency of detection was less than 5 percent, the preliminary IHS was eliminated from further consideration. A 5-percent detection frequency requires a minimum data set of 20 samples. Data sets with fewer samples cannot have detection frequencies less than 5 percent and, therefore, fail the criterion. This criterion addresses both frequency of detection and thoroughness of testing (WAC 173-340-703(2)(e) and –(f)).

Preliminary IHSs with detection frequencies of at least 5 percent were evaluated based on the three-part statistical rule. If the data set met all of the following criteria, the preliminary IHS was eliminated from further consideration (WAC 173-340-740(7)(d)(i), -(e)(i), and –(e)(ii)):

- The 95UCL was less than the soil screening level
- No single sample concentration was greater than two times the soil screening level
- Fewer than 10 percent of the sample concentrations exceeded the soil screening level.

If the data set failed the three-part statistical rule, the preliminary IHS was retained as a final IHS. The second step was conducted for surface soils (Table F-5), subsurface soils (Table F-6), surface sediments (Table F-7), subsurface sediments (Table F-8), groundwater (Table F-9), and surface water (including springs and seeps) (Table F-10) separately in each area of the Park in which these media were sampled.

The data set used to calculate the frequency with which the screening level was exceeded (third bullet above) included both detected and nondetected results. In a few cases, a large portion of the results causing the 10 percent criterion to be exceeded were nondetected results. Examples include TEQ in subsurface soil in the South Slope (Table F-6) and PCP in surface water in the wetland (Table F-10). Including nondetected results in the calculation of frequency of exceedance is a conservative approach to screening that includes consideration of the adequacy of detection limits.

During the second screening step, soil leaching screening levels for unsaturated soil (DAF=20) were used for the Illinois Street extension and the South Slope and screening levels for saturated soil (DAF=1) were used for the other site areas, as discussed in Section 7.2.1.

Because groundwater and surface water concentrations tend to vary over time, calculating a 95UCL for a data set including older data may not accurately represent current conditions. An additional concern for groundwater is that calculations using a data set with multiple wells may not accurately represent conditions within an individual drinking water well. No preliminary surface water IHSs were eliminated on the basis of the three part statistical rule. Of six preliminary groundwater IHSs eliminated because of the three-part statistical rule, the maximum detected concentrations of five (acenaphthene, fluorene, fluoranthene, and pyrene in the Historical Creek and the Lower Creek and dibenzofuran in the Lower Creek) were below the screening level. The ratio of the maximum concentration of lead in Upper Creek groundwater to the screening level is 1.67. Of 23 samples analyzed for lead, 1 detected result and no nondetected results exceeded the screening level. Calculating 95UCLs by using the complete groundwater and surface water data sets was sufficiently protective for the Park.

7.2.3 Analytes Not Screened

Several analytes were not screened for human health IHSs. Conventional parameters (e.g., alkalinity and TOC) were not screened because screening levels are not available and these parameters are not usually associated with human toxicity.

Individual dioxin/furan congeners were not screened because they are included in the TEQ sum. The dioxin/furan TEQs calculated using the 2005 toxicity equivalency factors (TEFs) from the World Health Organization (WHO) (Van den Berg et al. 2006) were screened in preference to the TEQs calculated using the 1998 WHO TEFs (Van den Berg et al. 1998) because the more recent TEFs represent the current scientific consensus on dioxin/furan carcinogenicity. Dioxin/furan TEQs calculated using the 1998 TEFs are shown in the screening tables for the first step (Tables F-1 through F-4) for the purpose of comparison but they were not carried into the second step.

GRO, DRO, motor oil, and TPH results were screened in preference to the individual aliphatic and aromatic carbon chain ranges reported by the VPH/EPH analyses. GRO, DRO, motor oil, and TPH analyses were conducted routinely while VPH/EPH analyses were conducted on a limited basis to provide information on petroleum composition. The VPH/EPH results will be useful for calculating site-specific petroleum CULs in the feasibility study. GRO, DRO, and motor oil were screened separately rather than by summing them because summing would introduce uncertainties due to overlapping hydrocarbon ranges among the analyses. No petroleum analytes were selected as IHSs in seven site areas (Wetland, Beach, South Slope, General Site, Landfill, Railroad, and Illinois Street extension). In each of the listed areas, if the maximum results for DRO and motor oil in soil or sediment are summed, they do not exceed the screening level of 2,000 mg/kg. GRO was not detected in any of the listed areas. Petroleum analytes were either not analyzed or not detected in water media in these areas. The decision not to sum petroleum analytes did not cause petroleum to be eliminated inappropriately as an IHS from these site areas.

Individual carcinogenic PAHs were not screened because they are included in the BaPE sum. The extended list PAHs (e.g., benzo[j]fluoranthene and dibenzo[a,e]pyrene) were not included in the calculation of BaPE because they are not routinely available for all of the samples analyzed for carcinogenic PAHs (CPAHs). BaPE values calculated including the extended list PAHs would not be comparable to those calculated without the extended list analytes. In addition, the extended list PAHs are usually associated with combustion sources rather than the wood-treating operations and urban runoff seen to be typical of this site. Individual carcinogenic PAHs are shown in the screening tables for the first step (Tables F-1 through F-4) for informational purposes but they were not carried into the second step

7.2.4 Evaluation of Berry Samples

Ten chemicals were detected in two washed and two unwashed blackberry samples collected by USEPA (E&E 2002a): four non-carcinogenic PAHs, four single-ring benzene derivatives, bis(2-ethylhexyl)phthalate, and dioxin/furan TEQ. Because screening levels for berries are not available in the sources consulted for soil and water screening levels, they were calculated assuming an adult blackberry consumption rate of 12 lb/yr (Appendix F, Table F-11). Detected concentrations of dioxin/furan TEQ in all four berry samples exceed the TEQ screening level (Appendix F, Table F-12). Detected concentrations of the other chemicals are below their screening levels. Dioxin/furan TEQ was selected as an IHS for blackberries.

7.2.5 Human Health IHSs

The human health IHSs selected for soil/sediment and water matrices are summarized in Table 7-4. In addition to the IHSs listed in Table 7-4, dioxin/furan TEQ was selected as an IHS in blackberries.

Five metals (arsenic, cadmium, chromium, lead, and zinc) were selected as IHSs in one or more matrices and site areas. Illinois Street extension and Landfill have more metals IHSs than do the other areas. Arsenic is an IHS in most of the matrices and site areas, but it might be eliminated as a natural background chemical in some areas if additional statistical evaluation is performed during the feasibility study (see Section 7.1). Chromium was assumed to be hexavalent for screening. It was selected as an IHS in sediments in Upper Creek, Historical Creek, Lower Creek, Wetland, and Beach areas. The possibility that chromium is present in trivalent form, which is less toxic, could be investigated in the feasibility study.

PCP was selected as an IHS in at least one matrix in every site area except Illinois Street extension and Railroad areas. Two other SVOCs likely associated with wood-treating chemicals (carbazole and 2,4,6-trichlorophenol) were also selected as IHSs in Upper Creek, Historical Creek, and Lower Creek areas.

Bis(2-ethylhexyl)phthalate, which is common in urban runoff, was selected as an IHS in groundwater in Upper Creek and Lower Creek areas. It was not selected as an IHS for soil or sediment matrices.

2,4-Dinitrotoluene was selected as an IHS in soils in Upper Creek, Historical Creek, and South Slope areas. 2,6-Dinitrotoluene was also selected as an IHS in soils in South Slope. Dibenzofuran was selected as an IHS in groundwater in Upper Creek and Historical Creek. Two additional SVOCs (2-methylphenol and *n*-nitrosodiphenylamine) were selected as IHSs in sediments in Upper Creek and Lower Creek.

CPAHs were selected as IHSs in multiple matrices in most of the site areas except Illinois Street extension, Landfill, Wetland, and Railroad areas. Noncarcinogenic PAHs were also selected as IHSs in Upper Creek, Historical Creek, and Lower Creek areas.

DRO and motor oil were selected as IHSs in multiple matrices in Upper Creek, Historical Creek, and Lower Creek areas. GRO was selected as an IHS in groundwater in Upper Creek and Historical Creek and in subsurface soil in Historical Creek.

Dioxin/furan TEQ was selected as an IHS in multiple matrices in every site area in which dioxins/furans were analyzed: Upper Creek, Historical Creek, Lower Creek, South Slope, General Site, and Wetland.

Many of the IHSs are consistent with chemicals used at the Oeser facility. These include PCP and 2,4,6-trichlorophenol, PAHs, petroleum, and dioxins/furans. Other IHSs are consistent with urban runoff from neighboring residential areas and roads, including metals, bis(2-ethylhexyl)phthalate, and petroleum. The presence of 2,4- and 2,6-dinitrotoluene are possibly due to the use of dynamite during quarry activities, though historical information is not available to confirm this.

7.3 SITE-SPECIFIC TERRESTRIAL ECOLOGICAL EVALUATION

MTCA regulations provide a decision framework to determine whether a site is excluded from a terrestrial ecological evaluation (TEE) process, is subject to a simplified TEE, or is subject to a site-specific TEE. The Park site does not qualify for any exclusion (WAC 173-340-7491(1)) because it is a City Park that encompasses more than 10 acres and is located in a natural setting containing upland and palustrine (non-tidal) wetland habitat. Pursuant to the MTCA regulatory framework, a site-specific approach was selected for the Park site (WAC 173-340-7491(2)). A summary of the decision criteria that led to the selection of the site-specific approach is provided in Appendix G.

The following site-specific TEE comprises sections on problem formulation, selection of evaluation methods for site cleanup, uncertainty analysis, and summary and conclusions.

7.3.1 Problem Formulation

Much of the pertinent information concerning sampling locations and distribution of chemicals in relevant environmental media is provided in the preceding sections for site ecological characteristics, nature and extent of detected chemicals, and CSM. This problem formulation section distills the available site information further to identify chemicals of potential ecological concern, characterize their environmental distribution and exposure pathways relevant to ecological receptors of concern, and assess their potential toxicity.

7.3.1.1 Chemicals of Ecological Concern

Maximum detected values in soil and water chemistry data were screened against minimum available ecological indicator concentrations (EICs) in primary or alternative media of interest to develop a preliminary list of IHSs. Soil, water, and sediment EICs are listed in Tables 7-5 to 7-7. For the Park site, media of concern included soils and water. Due to the ephemeral nature of the site's wetlands, sediments (most of which could be soils for part of the year) were screened as well. Soil and sediment data were screened against both soil and sediment EICs. Comparisons of maximum chemical concentrations to EICs for each matrix are included in Appendix G, Tables G-1 to G-3.

Chemicals with maximum detected values exceeding an EIC in any medium were designated IHSs (Table 7-8). Chemicals in soils that exceeded sediment EICs are noted in Table 7-8, but are not relevant to the TEE under current site conditions. For soil, chemicals exceeding soil EICs included metals (arsenic, cadmium, chromium, magnesium, and zinc), phenols (2,4-dimethylphenol and PCP), and benzo[a]pyrene. Maximum detected concentrations in samples designated as sediments, which may become soils seasonally or as a result of remediation[52], exceeded soil EICs for metals (arsenic, chromium, lead, mercury, and zinc), dioxins/furans (mammal, fish, and avian TEQs), and diesel-range hydrocarbons.

IHSs in water included metals (copper, lead, and magnesium), dioxins/furans (2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), and mammal, fish, and avian TEQs), phenols (2,3,4,6-tetrachlorophenol and PCP), PAHs (anthracene, benzo[a]anthracene, benzo[a]pyrene, and pyrene) and alkalinity.

7.3.1.2 Exposure Pathways

As indicated in Section 4.8, the site is located in the Puget Lowland Ecoregion and contains a diversity of habitats capable of supporting terrestrial plant and animal communities. Sources of contamination and fate and transport mechanisms associated with historical Landfill, current and Historical Creek beds, Railroad area, and Beach area are described in Section 6.3 above. Historical land-use practices near the Park site and current patterns of contamination indicate that terrestrial receptors may be exposed via ingestion or direct contact with surface soil as well as via consumption of forage plants or prey.

To distinguish spatial patterns and gradients of contamination that may be important at the site, it was divided into a number of discrete areas for evaluation in the TEE:

---

[52] Given that surface sediments onsite also have the potential to become soil in the event that the Creek is rerouted or from other remedial/restoration activities, screening benchmarks for soil were considered in addition to screening benchmarks for sediment.

- South Slope upland soils
- Upper Creek soils and surface water
- Lower Creek soils and surface water
- Historical Creek soils and surface water
- Landfill soils
- Wetland surface water.

The Illinois Street extension area was not included in the TEE because it will be paved in the future, and therefore will not provide appreciable ecological habitat. Locations of soil and surface water samples for the South Slope, Landfill, and Wetland areas are described in Section 5. The Upper Creek and Lower Creek areas included most of the former "general site area samples" that were collected in an elevated hummocky area, which is unlikely to be flooded, between the current creek bed and the Historical Creek. Some "general samples" were collected at a lower elevation near the Historical Creek bed and were grouped with the other Historical Creek samples. The Historical Creek area is an ephemeral forested wetland that is seasonally dry. Consequently, all of the solids samples that were designated as either sediment or soil were treated as a soil for the TEE.[53]

A statistical summary of chemical concentrations of the IHSs in soils in each of these areas is provided in Table 7-9. Chemical data for each area were evaluated for normality and lognormality by Shapiro-Wilkes tests, and both parametric and lognormal 95UCLs were calculated using Student's *t*-test and Land's method, respectively. Appropriate exposure point concentrations (EPCs) for CoPECs in each area were chosen based on the distribution of the data and the maximum detected concentrations; maximum concentrations were used for EPCs in those cases where appropriate UCLs exceeded maximum detected values. Comparisons of site chemical concentrations with EICs are provided below in Section 7.2.1.4 (Toxicological Assessment).

7.3.1.3 Terrestrial Ecological Receptors of Concern

All areas within the Park (except the Illinois Street extension area; see above) were evaluated in the TEE because they share soil invertebrates, emergent insects, insectivorous mammals, and insectivorous birds as the most relevant model ecological receptors. Consequently, this site-specific TEE has adopted Ecology's wildlife exposure model and surrogate receptors for each of the following trophic guilds:

---

[53] All of these samples are also treated as sediment in Section 7.3 to account for risks to aquatic receptors during those seasons when the Historical Creek bed is flooded.

- Local upland and palustrine vascular plants that serve as forage to herbivorous birds and mammals
- A small mammalian herbivore that may forage on local plants—represented by a vole (*Microtus* spp.)
- Soil-dwelling invertebrates—represented by earthworms
- A small mammal that preys on soil invertebrates—represented by a shrew (*Sorex* spp.)
- A small bird that also preys on soil invertebrates—represented by the American Robin (*Turdus migratorius*).

A CSM showing site-related sources, release mechanisms, exposure media, and uptake routes for each of these receptors is shown in Figure 6-2.

7.3.1.4 Toxicity Assessment

Potential risks to plants, soil biota, and wildlife in the South Slope, Upper Creek, Lower Creek, Historical Creek, Landfill, Wetland, Railroad, and Background areas were evaluated through comparisons of soil concentrations of CoPECs with EICs listed in MTCA.[54] Historical Creek area sediment and soil data were combined for comparisons to soil EICs to account for seasonal changes in water levels in the site's ephemeral wetland. Hazard quotients were calculated by dividing EPCs by available EICs for each receptor. The results of all soil EPC comparisons and hazard quotient calculations are summarized in Appendix G, Table G-4. A summary of EPCs and hazard quotients for those CoPECs in each area is presented in Table 7-9.

Spatial Patterns

Trace metal concentrations exceeded EICs for plants, soil invertebrates, or wildlife in all site areas. A combination of arsenic, copper, lead, and zinc exceeded EICs in the Lower Creek, Historical Creek, Wetland, and Railroad areas. Zinc exceeded EICs in all other site areas as well, and arsenic exceeded EICs in the South Slope and Upper Creek areas. Additionally, copper and lead exceeded EICs in the Landfill. Mercury exceeded EICs in the South Slope, Upper Creek, Lower Creek, and Historical Creek, and Landfill areas.

Organic compounds exceeded EICs in the Upper Creek, Lower Creek, and Historical Creek areas. Pentachlorophenol was the only organic compound to exceed EICs in the Lower Creek area; it also exceeded EICs in the Historical Creek area. Two LPAH compounds (acenaphthene and fluorene) exceeded EICs only in the Upper Creek area. The HPAH benzo(a)pyrene exceeded an EIC in both the Upper and Historical Creek areas. Total chlorinated dibenzofurans (summed as mammalian and avian TEQs) and petroleum, in the form of diesel-range hydrocarbons, exceeded soil EICs only in the Historical Creek area.

[54] MTCA Table 749-3 in WAC 173-340-7493 (2)(a)(i).

Affected Receptors—Metals

Plant benchmarks were exceeded by trace metal CoPEC concentrations in all areas of the Park, and therefore metals could be adversely affecting plants throughout the site. Many metals only exceeded plant EICs in some areas, however. For example, arsenic exceeded the plant EIC only in the Upper Creek, Lower Creek and wetland. Similarly, mercury only exceeded the plant EIC in the Upper Creek.

Trace metals exceeded soil invertebrate EICs in all areas of the site. Mercury was a widespread CoPEC for soil invertebrates, exceeding the benchmark in South Slope, Upper Creek, Lower Creek, and Historical Creek, and Wetland areas. No other metals exceeded EICs in the South Slope and Upper Creek areas. Copper exceeded the soil invertebrate EIC in Lower Creek, Historical Creek, Landfill, Wetland, and Railroad areas. Lead only exceeded the soil invertebrate EIC in the Railroad area, and zinc only exceeded the EIC in the Landfill.

Trace metals, arsenic, lead, and zinc exceeded wildlife EICs at all areas of the Park site. Arsenic was the most widespread CoPEC, exceeding EICs in the South Slope, Upper Creek, Lower Creek, and Historical Creek, Wetland, and Railroad areas. Concentrations of arsenic exceeded the wildlife EIC of 7 mg/kg by factors of 1.1 (in the Historical Creek) to 6.7 (in the wetland). Lead exceeded the wildlife EIC in the Historical Creek, Landfill, and Railroad areas. Zinc only exceeded the EIC in the Landfill area.

The levels of wildlife exceedances for metals were low. Wildlife arsenic hazard quotients were 3.0 or less in all areas except the wetland. Furthermore, the arsenic EIC (7 mg/kg) was equivalent to 90^{th} percentile statewide background levels (Ecology 1994); three EPCs were near this value. Lead hazard quotients were 2.0 or lower. Zinc exceeded its EIC in the Landfill area by a factor of 1.2 with an EPC of 45 mg/kg.

Affected Receptors—Organic Compounds

Organic compounds exceeded EICs for plants and soil invertebrates in the Upper Creek, Lower Creek, and Historical Creek areas. LPAHs constituted the sole organic plant CoPEC in the Upper Creek area, with acenaphthene exceeding the plant EIC by a factor of 3.6.

Pentachlorophenol exceeded the plant EIC in both the Lower and Historical Creek areas by a factor of 2.0 and 2.6, respectively. Soil invertebrate EICs were only exceeded by fluorene in the Upper Creek (hazard quotient = 1.9) and by PCP and DRO in the Lower Creek (hazard quotient = 1.3 and 4.2, respectively).

For wildlife, the HPAH benzo[a]pyrene exceeded the EIC by a factor of 9.2 in the Upper and Historical Creek areas. Pentachlorophenol exceeded the EIC in Lower Creek and Historical Creek areas by factors of 1.3 and 1.8, respectively. The remaining CoPECs in the Historical Creek area comprised chlorinated dibenzofurans. Piscine, avian, and mammalian TCDD TEQs were exceeded by factors of 680, 690, and 1,600, respectively.

7.3.2 Evaluation Methods

Following the problem formulation stage of the TEE, MTCA guidance provides two options for further evaluation if EIC concentrations are exceeded at the site:

- Selection of one or more candidate methods for additional risk assessment and characterization
  - Survey relevant literature
  - Conduct soil bioassays
  - Revise the wildlife exposure model
  - Measure biomarkers in tissues of receptors of concern
  - Conduct ecological field studies
- Cleanup to the soil concentrations listed in Table 749-3 of MTCA.

Based on the results of the problem formulation, additional site-related studies to assess risk in further detail are not recommended by any of the candidate methods. It is proposed that further site assessment and evaluation of site remedial alternatives be based on the EIC values provided by MTCA and summarized above in Section 7.2.1.

7.3.3 Conclusions

Overall, the risk to ecological receptors posed by most metals seems low for the majority of the site in the context of high background metal concentrations. Arsenic is prevalent throughout the site, but concentrations might not be above background. The wetland and Historical Creek areas have the highest metals concentrations in general. Zinc may be of ecological concern at the Landfill.

Risks posed by organic compounds are present in the Upper Creek, Lower Creek, and Historical Creek areas. PAHs, PCP, and chlorinated dibenzofurans in the Upper Creek and Historical Creek areas, in particular, may pose risks to ecological receptors. The level of PCP in the Lower Creek soils suggests that some risk to terrestrial wildlife may exist here, and greater risk may be present for plants.

7.4 AQUATIC ECOLOGICAL EVALUATION

MTCA provides methods for evaluation of risk to aquatic receptors via comparisons to surface water standards for aquatic organisms that live in the water column and via comparisons with the SMS for organisms that live in sediments. However, MTCA does not provide standardized methods for evaluation of risk and cleanup levels to terrestrial or semi-terrestrial birds and mammals via direct exposure to sediments, water, or via consumption of aquatic prey.

Consequently, screening level values for sediments that represent potential risk to birds via consumption of emergent insects were developed for selected chemicals from methods described by EPA (E&E 2002a).

7.4.1 Chemicals of Ecological Concern

Maximum detected values in sediment and water chemistry data were screened against minimum available EICs in primary or alternative media of interest to develop a preliminary list of IHS values. Soil, sediment, and water EICs are listed in Tables 7-5, 7-6, and 7-7, respectively. Sediment and water were both media of concern for the aquatic assessment at the Park and were compared with EICs in Tables 7-6 and 7-7. Due to the ephemeral nature of much of the site's wetlands, site soils may be seasonally flooded. Consequently, soil and sediment data were screened against both soil (Table 7-5) and sediment (Table 7-6) EICs for the development of preliminary IHSs. Comparisons of maximum chemical concentrations to EICs for each matrix are included in Appendix G.

Chemicals with maximum detected values exceeding an EIC in any medium were designated IHSs (Table 7-8). Chemicals in soils that exceeded sediment EICs are noted in Table 7-8, but are not relevant to the aquatic ecological assessment under current site conditions. Chemicals in sediment exceeding sediment EICs included three metals, two substituted phenols, three phthalate esters, eight LPAHs including total LPAH, nine HPAHs including total benzofluoranthenes, and three SVOCs. Maximum detected concentrations in samples designated as soils, but which may become sediments seasonally or as a result of remediation and redevelopment of the site, exceeded sediment EICs for a single metal (copper), phenol and 2-methylphenol, three phthalates, seven LPAH, three HPAHs and three miscellaneous SVOCs.

IHSs in water included total or dissolved species of three metals, chlorinated dioxins/furans expressed as individual congeners or TEQs, several substituted phenols, one LPAH and three HPAH compounds. Additionally, water samples also exceeded the NRWQC value for alkalinity.

7.4.2 Exposure Pathways

As indicated in Section 4.8, the site contains lotic, palustrine, and intertidal habitats, all of which have aquatic components. These three habitats are capable of supporting aquatic plant and animal communities. Sources of contamination and fate and transport mechanisms associated with springs, seeps, and municipal and industrial outfalls are described in Section 6. Concrete culverts and other outfall pipes block light in small portions of the Creek, but most aquatic habitat is accessible to ecological receptors. Historic land uses near the Park site and current patterns of contamination indicate that aquatic receptors may be exposed via ingestion or direct contact with surface water and sediments as well as via consumption of aquatic plants and prey.

The site was divided into discrete areas for evaluation in the aquatic risk assessment to distinguish spatial patterns and gradients of contamination. These areas and media were:

- Upper Creek surface sediment and surface water
- Lower Creek surface sediment and surface water
- Historical Creek surface sediment, soils, and surface water
- Wetland surface sediment and surface water
- Beach surface sediment and surface water.

Locations of the sediment and surface water samples for all areas are described in Section 5. The Historical Creek area is an ephemeral forested wetland that is seasonally flooded. Consequently, solids samples that were designated as either sediment or soil were treated as sediments for the aquatic risk assessment.

Summary statistics for IHSs that exceed EIC values are summarized in Table 7-10 for water and Table 7-11 for sediments.[55] Chemical data for each area and medium were evaluated for normality and lognormality through Shapiro-Wilkes tests, and both parametric and lognormal 95UCLs were calculated using Student's *t*-test and Land's method, respectively. Appropriate EPCs for CoPECs in each area were chosen based on the data distributions and maximum detected concentrations; maximum concentrations were used for EPCs in those cases where appropriate UCLs exceeded maximum detected values. Comparisons of site chemical concentrations with EICs are provided below in Section 7.3.4 (Toxicological Assessment).

7.4.3 Aquatic Ecological Receptors of Concern

Ecological receptors of concern in the Park aquatic risk assessment include water column fish and invertebrates, and benthic invertebrates exposed to sediments. Additionally, avian receptors such as swallows, which feed on emerging aquatic insects, may be affected by CoPEC concentrations in sediment through their diets. The assessment endpoint for water column receptors is sustained community structure typical of streams similar to the Creek. This endpoint was measured through comparisons of concentrations of CoPECs in surface water at the Park with published EICs that are protective of water-column aquatic receptors. The assessment endpoint for benthic invertebrates is also sustained community structure typical of streams similar to the Creek. Again, this endpoint was measured through comparisons of concentrations of CoPECs in the Park sediments with published EICs that are protective of benthic invertebrate communities.

[55] Complete summary statistics for all IHS chemicals are provided in Appendix G (Table G-5 for water and Table G-6 for sediments).

E&E (2002a) identified bioaccumulation in sediment-dwelling aquatic invertebrates as a pathway of concern for insectivorous birds that may forage on emergent aquatic insects. The barn swallow was identified as the receptor of concern for this foraging guild. To evaluate effects of CoPEC concentrations on avian receptors, EPA's (E&E 2002a) risk assessment model for the Oeser site was used, which estimates indirect exposure of barn swallows to site sediments via consumption of emergent aquatic insects. CoPECs of interest for the EPA (E&E 2002a) risk assessment were PCP, TPAH, and the avian TEQ for dioxins and furans. For TPAH and dioxin/furan TEQ concentrations in sediments, the EPA risk assessment derived two hazard quotients—one for a toxicity reference value (TRV) based on a no-observed-adverse-effects level (NOAEL) and the other for a TRV based on a lowest-observed-adverse-effects level (LOAEL). Hazard quotients were not calculated for PCP because TRVs were not available for this chemical. Sediment EICs were derived for these substances by dividing the EPCs by the hazard quotients to give sediment concentrations that correspond to a hazard quotient of 1. Sediment concentrations for these CoPECs for each area within the site were then compared to the calculated EIC values to determine hazard quotients for swallows in each area.

7.4.4 Toxicological Assessment

Potential risks to aquatic communities in the Upper Creek, Lower Creek, Historical Creek, Wetland, Beach, and Background areas were evaluated through comparisons of sediment and water EPCs of CoPECs with EICs.[56] Historical Creek area sediment and soil data were combined for comparisons to soil EICs to account for seasonal changes in water levels in the site's ephemeral wetland. Hazard quotients were calculated by dividing EPCs by available EICs for each receptor. Summaries of EPCs and hazard quotients for CoPECs in each area for water and sediment are presented in Tables 7-10 and 7-11, respectively.

In addition to site-specific comparisons of sediment and water chemistry with EIC values, sediment toxicity testing was conducted in the past by E&E (2002a) using the amphipod *Hyalella azteca* and by Ecology (2004) using *Hyalella azteca*, the midge *Chironomus tentans*, and a luminescent bacterium.[57] Results of the sediment toxicity testing are described in Section 5.7.

---

[56] For sediment, EICs were taken from the SQS and CSL values for freshwater, or in the absence of freshwater values from the available marine SQS and CSL values. Water EICs were taken from the following sources, in order of preference: WAC 173-201a—240, Table 240(3) chronic value, USEPA National Recommended Water Quality Criteria (WQC) continuous exposure value, USEPA/ORNL Tier II Secondary Chronic Value, minimum value of USEPA Region 5 ESL or EPA Region 6 Freshwater SB, WAC acute value, WQC maximum exposure value, and the USEPA/ORNL Tier II SAV.

[57] The bacterium was tested using the patented Microtox® procedure.

7.4.4.1 Spatial Patterns

Water

Trace metals in water exceeded EICs for aquatic communities in all site areas and in Background stations. The Background, Beach, and Wetland areas had the fewest trace metals exceeding EICs (one), while in other areas, three metals exceeded EICs. Magnesium (total and dissolved) was ubiquitous, exceeding EICs in all areas of the Park and Background stations. Copper and lead exceeded EICs in the waters of the Upper Creek, Lower Creek, and the Historical Creek areas. Comparisons of magnesium concentrations between background and site levels revealed that concentrations were 2 to 6 times higher at site areas than in Background areas.

Organic CoPECs similarly exceeded EICs in all areas of the Park and in Background areas. The HPAHs benzo(a)anthracene and benzo(a)pyrene exceeded EICs in all site areas and Background stations. Phenols, specifically 2,3,4,6-tetrachlorophenol, exceeded EICs at Background, Upper Creek, Lower Creek, and Wetland stations; PCP exceeded an EIC in the Upper Creek. EPCs of 2,3,4,6-tetrachlorophenol at the Park areas, except the Upper Creek, were the same as at Background stations (2.5 µg/L), so this chemical was removed as a CoPEC from all areas but the Upper Creek. Polychlorinated dioxins and furans, in the forms of 2,3,7,8-TCDD, and the fish TEQ exceeded EICs in Upper Creek, Lower Creek, Wetland, and Background areas. Concentrations of benzo(a)anthracene and benzo(a)pyrene exceeded EICs; however, these concentrations were close to (and in one case below) measured background levels. Consequently, these compounds were not retained as CoPECs in surface water.

Finally, the UCL for alkalinity exceeded its EIC in the Upper Creek and Wetland areas, but was below the EIC in the Lower Creek.

In summary, metals were most prominent CoPECs in Upper Creek, Lower Creek, and Historical Creek waters. HPAHs, phenols, and dioxins and furans are CoPECs throughout the Park.

- **Affected Receptors—Metals.** In Park waters, magnesium appeared to be the most widespread CoPEC, and could be having adverse effects on aquatic communities. Magnesium and dissolved magnesium concentrations exceeded the EIC by a factor of 6 at Background stations and by factors of 11 to 33 within the Park. Total and dissolved copper exceeded EICs in the wetland by factors of 3.8 and 3.2, respectively. Lead hazard quotients were 2.2 or less. Overall, trace metals could be adversely affecting aquatic communities at the Park.

- **Affected Receptors—Organics and Conventionals.** Organic compounds, including PAHs, phenols, and polychlorinated dioxins and furans, could be having adverse effects on aquatic communities. Hazard quotients for PAH compounds ranged from a low of 1.1 (for pyrene in the Upper Creek) to a high of 16 (for benzo(a)pyrene in the Upper Creek and Lower Creek). Concentrations of PAHs in all site areas produced hazard quotients for PAHs above 8.0; however, these were similar to Background PAH hazard quotients, which ranged from 6.1 to 11. PAHs in Park surface water, therefore, are unlikely to be causing risks higher than those at Background sites.

  Phenols produced hazard quotients for aquatic life ranging from 3.8 for 2,3,4,6-tetrachlorophenol to 4.7 for PCP in the Upper Creek. Phenols were not considered water CoPECs in other site areas.

  Of all the CoPECs, dioxins and furans pose the highest risks to fish life in the waters of the Upper Creek, Lower Creek, and Wetland. Hazard quotients for dioxins and furans ranged from 1,600 for 2,3,7,8-TCDD in the Lower Creek to 20,000 for the fish TEQ in the Upper Creek. The EIC is based on the most conservative available water screening benchmark for 2,3,7,8-TCDD for fish (USEPA Region 5 Ecological Screening Levels).

  Finally, alkalinity, with hazard quotients of 7.5 and 4.0 in the Upper Creek and wetland, respectively, could also be having adverse effects on water-column communities.

Sediment

Trace metal concentrations in sediments exceeded EICs for aquatic communities in all site areas. Exceedances of both SQS and CSL criteria occurred for chromium and zinc. The Lower Creek and wetland sediments contained the most metal exceedances (two), while other areas each contained one exceeding metal. Zinc exceeded EICs in the Upper Creek, Lower Creek, and Historical Creek. Copper exceeded its EIC in the Lower Creek and the wetland, and chromium exceeded its EIC in the Wetland and the Beach areas.

Organic compounds exceeded both SQS and CSL EICs in sediments in all areas. The fewest exceedances occurred in Beach sediments (5), while the most occurred in Upper Creek sediments (26). Phenols (2,4-dimethylphenol), phthalates (dimethylphthalate), and SVOCs (benzoic acid and benzyl alcohol) exceeded EICs in all areas, though no phthalates exceeded CSLs in the Wetland or Beach areas. At the Beach, 2-methylphenol was the only other organic compound to exceed EICs; it also exceeded EICs at the Upper Creek, Historical Creek, and Wetland areas. Pentachlorophenol exceeded EICs at the Upper Creek, Lower Creek, Historical Creek, and Wetland areas. Similarly, bis(2-ethylhexyl)phthalate exceeded its EIC in those areas. Additional phenols exceeded EICs in the Upper Creek, Historical Creek, and wetland, and additional phthalates exceeded EICs in the Upper Creek and Historical Creek areas.

The Upper Creek, Lower Creek, and Historical Creek sediments all contained concentrations of PAHS that exceeded EICs. Nine HPAHs and total LPAHs exceeded EICs in these three areas. Six LPAHs exceeded EICs in the Upper Creek and Lower Creek. Acenaphthylene and anthracene exceeded EICs in the Historical Creek.

Overall, the metals copper, zinc, and chromium are CoPECs in sediments at the Park. Organic CoPECs are widespread, with SVOCs, phenols, phthalates, and PAHs exceeding EICs throughout the site. However, PAH compounds appear to be the primary risk drivers for the Upper Creek and Historical Creek, whereas other substances appear to dominate risks in the wetland and Lower Creek areas.

The prevalence of chemical concentrations in sediments that exceed EICs based on SQS and CSLs is confirmed by past sediment toxicity testing, which also shows that both the Upper and Lower Creek exceeds SQS and CSL levels of concern. A summary of the sediment toxicity testing results is provided in Section 5.7.

- **Affected Receptors—Metals.** Trace metals could be affecting benthic organisms in the Park. Chromium is of interest at the Wetland and Beach, with SQS hazard quotients of 2.3 and 2.6 and CSL hazard quotients of 2.2 and 2.5, respectively. Copper is of concern in the Lower Creek with an SQS hazard quotient of 3.0; the SQS hazard quotient was 1.0 in the wetland, and no CSL hazard quotient exceeded 1.0. Zinc SQS and CSL hazard quotients in the Upper Creek, Lower Creek, and Historical Creek areas were 1.7 or less.
- **Affected Receptors—Organic Chemicals.** Organic CoPECs were widespread at the Park at concentrations that might cause adverse effects to benthic communities. Of the organic compounds that exceeded EICs, the SVOC benzyl alcohol has the highest apparent potential to cause adverse effects in benthic organisms in the Upper Creek and wetland with SQS hazard quotients of 230 and 110, respectively. Elsewhere, benzyl alcohol concentrations were lower, producing SQS hazard quotients of 1.5 (in the Beach) to 3.5 (in the Historical Creek) Additionally, benzoic acid and dibenzofuran produced the highest SQS hazard quotients in the Upper Creek (8.2 and 83, respectively, vs. a maximum of 3.2 and <1.0, respectively, elsewhere). Both LPAHs and HPAHs may be causing adverse effects in the Upper Creek, Lower Creek, and Historical Creek. In general, benthic communities in the Upper Creek are most likely to be experiencing adverse effects from PAHs, with SQS hazard quotients for PAHs ranging from 2.5 to 120, and 11 out of 15 exceeding 10. The Lower Creek and Historical Creek also had high SQS hazard quotients for PAHs: these ranged from 1.7 to 31 in the Lower Creek and from 1.1 to 49 in the Historical Creek. The Beach and Wetland experienced no measured risks from PAHs.

  Phenols and phthalates were widespread risk factors for benthic life at the Park, exceeding sediment SQS and CSL EICs in all areas. The highest SQS hazard quotient (22; PCP) for phenols was found in the Historical Creek; the Upper and Lower Creeks both had maximum SQS hazard quotients of 13 for 2-methyl phenol and PCP, respectively. 2,4-Dimethylphenol and PCP in the Upper Creek produced SQS hazard quotients of 7.6 and 5.8, respectively; 2,4-dimethylphenol, phenol, and PCP in the wetland produced SQS hazard quotients of 4.6, 5.0, and 3.5 respectively. All remaining phenol SQS hazard quotients were 3.1 or below, with most (5/8) never exceeding 2.0. Effects of phthalates were most likely in the Upper Creek and Lower Creek; maximum SQS hazard quotients for phthalates in these sediments were 42 and 59 (CSL hazard quotients were 4.4 and 6.1), respectively, with remaining SQS hazard quotients in these areas ranging from 2.0 to 7.3. SQS hazard quotients for phthalates in the Historical Creek, wetland, and Beach ranged from 1.8 to 3.5; phthalates did not exceed CSL criteria at the Beach.

Effects on avian receptors were measured by methods discussed in Section 7.3.3.2 above. A summary of calculated hazard quotients for swallows for site-relevant CoPECs (PAHs and 2,3,7,8-TCDD TEQ [birds]) is presented in Table 7-12. For swallows, the NOAEL hazard quotients for both PAHs and dioxin/furan TEQ were greater than 1.0 in the Upper Creek, Lower Creek, and the Historical Creek. The LOAEL hazard quotient exceeded 1.0 for dioxin/furan TEQ in the Lower Creek and Historical Creek. The NOAEL and LOAEL EICs are probably conservative in that they assume the entirety of a swallow's diet comprises emerging aquatic insects from respective areas of the Creek; nevertheless, insectivorous avian receptors may be at risk in the Lower Creek and Historical Creek areas of the site.

7.4.5 Evaluation Methods

The foregoing evaluation of aquatic ecological risk is based on the following lines of evidence:

- **Aquatic biota**—Comparisons of chemical concentrations in water with water quality standards
- **Benthic biota**—Comparisons of chemical concentration in sediments with sediment quality standards (i.e., SQS and CSL values)
- **Benthic biota**—Sediment toxicity tests conducted by E&E (2002a) and Ecology (2004)
- **Insectivorous birds**—Comparisons with risk-based sediment screening values for birds exposed indirectly to sediments via bioaccumulation in emerging insects.

The SMS (WAC 173-204) provide for additional confirmatory toxicity testing for sites where chemical concentrations exceed levels of concern based on comparisons with SQS and CSL values. However, sediment toxicity testing was conducted by EPA (E&E 2002a) and Ecology (2004) and is considered sufficient for this risk characterization. Risks to insectivorous birds are based on only a few substances (PAHs and polychlorinated dibenzodioxins and dibenzofurans), which appear to be chemical drivers associated with other lines of evidence. Sediment-driven risks to insectivorous birds could be evaluated further pursuant to the TEE in Section 7.2 above. However, based on the results of various lines of evidence currently available for the site, additional site-related studies to assess risk in further detail are not recommended by any of the candidate methods.[58] It is proposed that further site assessment and evaluation of site remedial alternatives be based on the EIC values, including the SMS, provided by MTCA and summarized above in Sections 7.3.1 and 7.3.4.

7.4.6 Conclusions

Overall, there are potential risks from trace metals, organic compounds, and alkalinity to aquatic ecological receptors at the Park. Of the metals, magnesium is the most widespread CoPEC for water-column receptors, and, copper may pose a risk to water-column receptors in the Upper Creek, Lower Creek, and Historical Creek areas. In these same areas, sediment receptors may be at risk from zinc, and copper may be a concern in the Lower Creek and Wetland areas.

Of the organic compounds, PAHs in Park waters appear to be comparable to background levels, and are not considered CoPECs for water-column receptors. Phenols, dioxins and furans, and alkalinity, however, may pose risks to water- column communities in Park waters. Phenols are of most concern in the Upper Creek, and dioxins and furans drive surface water risks in the Upper Creek, Lower Creek, and Wetland areas. Alkalinity may also be a concern for water column receptors in the Upper Creek and Wetland areas.

For benthic communities, sediment concentrations of the SVOCs, benzyl alcohol, benzoic acid, and dibenzofuran, produced the highest potential risks, particularly in the Upper Creek and Wetland areas. PAHs were of most concern to benthic communities in the Upper Creek, Lower Creek, and Historical Creek areas. Phenols too produced potential risks in the Upper Creek, Lower Creek, Historical Creek, and wetland, while phthalates were of concern in the Upper Creek and Lower Creek areas.

For avian receptors feeding on emerging aquatic insects in the Park, the primary risk driver was dioxin/furan TEQ. Risks from dioxin/furan TEQ were highest in the Lower Creek and Historical Creek areas. Lower level risks for avian receptors from dioxin/furan TEQ and PAH were also present in the Upper Creek, Lower Creek, and Historical Creek areas of the Park.

---

[58] Survey relevant literature, conduct soil bioassays, revise the wildlife exposure model, measure biomarkers in tissues of receptors of concern, and conduct ecological field studies.

8 SUMMARY OF REMEDIAL INVESTIGATION AND RECOMMENDATIONS FOR FEASIBILITY STUDY

This remedial investigation at Little Squalicum Park was conducted 1) to fill data gaps identified from earlier studies in the SAP (Integral 2005c) and thus complete site characterization, including chemical distribution and fate, and 2) to estimate the potential risks to human health and the environment posed by chemicals detected in each area of the site.

The site characterization information is required to estimate the human health and environmental risks and to prepare a feasibility study, which will examine CULs and alternatives for site remediation. The calculation of CULs will be used to support the decision-making process regarding which remedial actions are required for a site area.

Concentrations of chemicals in soils, sediments, surface water, and/or groundwater in many of the site areas are associated with significant risk to human health and/or the environment. These site areas include the Upper Creek, Lower Creek, Historical Creek, Landfill, NE Wetland, and Illinois Street extension areas. These site areas will need additional evaluation in preparation for or as part of the feasibility study.

8.1 SUMMARY OF PROJECT OBJECTIVES

The project work plans (Integral 2005c,d) identified specific data gaps for the Park that needed to be addressed for the field and analytical portions of the remedial investigation. These data gaps were used in defining the objectives of the remedial investigation and helped scope the field efforts and focus the investigation and analytical methods used in data analysis and interpretation. Additional field activities were completed supplementary to the field activities presented in the original work plans, as described in Addendums 1 (Integral 2005e), 2 (Integral 2006a), and 3 (Integral 2006b).

All required project objectives specified in the project work plan (Integral 2005d) and addendums (Integral 2005e, 2006a,b) for the remedial investigation were attained[59]. Any deviations were a direct result of changed conditions in the field or were based on information received after the work plans were approved. None of the deviations from the work plans impacted the overall purpose of the investigation, which was to characterize the site and the

[59] A significant deviation from the work plans was that no surface sediment samples were collected as originally planned. Samples were not collected at stations LSC-10, LSC-11, and LSC-12 (at the mouth of the Creek) because fine-grained sediments, which tend to sequester organic contaminants, were not observed at these station locations. Samples were also not collected at stations LSC-07, LSC-08, and LSC-09 because of the extensive sheen observed in the upper reach of the Creek. Due to the presence of sheen, surface sediments from these locations were presumed to be impacted by a continuous source of petroleum seeping from this area of the Creek.

potential risks to human health and the environment. The feasibility study will complete the project objectives for the site.

8.2 SUMMARY OF FINDINGS

Findings for the remedial investigation, including conclusions regarding human health and ecological risk, are presented below on an area-by-area basis.

8.2.1 South Slope

The South Slope area is located west of the railroad trail and includes the parking area for the Park. This area was characterized from the results of 27 surface and 5 subsurface soil samples collected during previous studies (E&E 2002a). Most samples were screened in the field for TPH with a few representative samples analyzed in the laboratory for metals, SVOCs, and dioxins/furans. TPH field-screening results for surface soil samples ranged from 50 to 475 mg/kg; however, no visible or olfactory evidence of petroleum contamination was observed in the samples. Metals, PAHs, PCP, phthalates, and dioxins/furans were detected in several surface and subsurface soil samples at levels lower than other areas of the Park. There are no obvious spatial patterns of these chemicals in South Slope soil samples.

Human health IHSs include arsenic, 2,4- and 2,6-dinitrotoluene, PCP, CPAHs, and dioxins/furans. Ratios of dioxin/furan TEQs to the human health screening level range up to 12 in surface soil and 0.8 in subsurface soil. Hazard quotients for terrestrial ecological receptors range up to 2 (nickel for invertebrates).

8.2.2 NE Wetland Area

The Wetland area is located at the northeast boundary of the Park and was constructed in the 1960s and 1970s to drain the floor of the ravine for gravel mining and log storage. This area was characterized based on the results of four soil, five surface water, and three surface sediment samples.

Soil was evaluated in the Wetland area from two hand auger locations. Soil in this area may have been impacted by surface water runoff originating from the Oeser yard (Wahl 2004, pers. comm.). It may also have been connected previously with the Upper Creek. Samples were analyzed for metals and petroleum hydrocarbons. Concentrations of petroleum hydrocarbons were below the screening value of 200 mg/kg. Lead and zinc levels were elevated at one location but levels are below risk-based screening values. Arsenic was selected as the only human health IHS for soil. Hazard quotients for terrestrial ecological receptors range up to 7 (arsenic for wildlife).

Surface water samples were collected from two locations, OS07 and SW-07, and analyzed for petroleum hydrocarbons, metals, VOCs, SVOCs, and dioxins/furans. Trace metals, PAHs, PCP and related compounds, toluene, and xylene were detected in one or more samples. Dioxins/furans were detected in one sample collected from SW-07. Human health IHSs for surface water include arsenic, PCP, and dioxins/furans. Ratios of dioxin/furan TEQs to the human health screening level range up to 3,800. Ecological hazard quotients for water range up to 10,600 (dioxin/furan TEQ for fish).

Sediment samples were collected from three locations along the Wetland area and analyzed for one or more of the following: petroleum hydrocarbons, metals, SVOCs, and dioxins/furans. Human health IHSs for sediment include arsenic, chromium, PCP, and dioxins/furans. The maximum ratio of dioxin/furan TEQs to the human health screening level slightly exceeds 1. Sediment CoPECs include five metals, PCP, and seven other SVOCs. Ecological hazard quotients for sediments range up to 110 (benzyl alcohol SQS).

8.2.3 Upper Creek

The Upper Creek area has been characterized based on information obtained from 15 soil borings, 4 test pits, 59 surface and spoil pile locations, 30 groundwater samples, 21 surface water samples, 2 sediment borings, and 13 surface sediment locations. Selected samples were analyzed for metals, petroleum hydrocarbons, SVOCs, and dioxins/furans. Visible and olfactory evidence of petroleum contamination was observed in many of the samples collected, with subsurface soils and groundwater showing localized petroleum contamination. Samples had a distinct creosote odor with residual NAPL observed within the groundwater saturation zone and underlying gray clay layer in this area of the site. The contamination overlaps with the Historical Creek area and covers about 450 ft of the Upper Creek bed, including 50 ft north of the Creek, and up to 100 ft south of the Creek, for a total estimated area of approximately 1.2 acres.

Petroleum hydrocarbons (e.g., diesel- and residual-range hydrocarbons), PAHs (LPAHs and HPAHs), PCP, and dioxins/furans were detected in soils, groundwater, surface water, and sediments collected in this area, the source of which is likely from historical stormwater and process water discharges from the Oeser site located to the north of the Park. This conclusion is supported by the results of PAH fingerprinting analysis, which showed a chemical composition of creosote in many of the samples. Creosote was used previously by Oeser for treatment of wood materials (e.g., telephone poles) from the 1940s to the early 1980s. Pentachlorophenol was also detected frequently in each medium sampled within the Upper Creek area. The Oeser facility has been using PCP for treatment of wood products from the 1950s to the present. In general, higher levels of dioxins/furans were observed to be associated with higher PCP concentrations. Technical grade PCP used for treating wood contains dioxins/furans.

Contaminant distribution indicates that these wood-treating chemicals were historically discharged by Oeser into the Creek via the Oeser/Birchwood stormwater outfall located at the head of the Creek. Over time, creosote and PCP-containing diesel in the waste stream infiltrated through the permeable sands and gravels of the Creek bed and spread along the Creek to the area of the present day junction of the Creek with its historical channel. An underlying layer of stiff, gray clay appears to have prevented the contamination from spreading into groundwater and soil at greater depths and into other areas of the Park.

At the close of the remedial investigation, it is still unclear how far and to what extent this waste stream impacted the creek bed soils and sediments between the two Upper Creek culverts (see "Approximate Area of Soil and Groundwater Contamination," Figures 5-24 to 5-32) and in the adjoining parts of the General Site area associated with the historically open creek. Additional sampling may be needed in this area in order to complete the feasibility study.

The human health IHSs selected for one or more media in the Upper Creek include two metals, PCP and eight other SVOCs, CPAHs and eight noncarcinogenic PAHs, petroleum (gasoline and diesel range hydrocarbons and motor oil), and dioxins/furans. Ratios of dioxin/furan TEQs to the human health screening levels range up to 205 in surface soil, 60 in subsurface soil, 109 in surface sediment, 37,000 in groundwater, and 115,000 in surface water. Ecological hazard quotients for terrestrial receptors range up to 9 (benzo(a)pyrene for wildlife) and for water up to 19,700 (dioxin/furan TEQ for fish). CoPECs for sediment include three metals, PCP and nine other SVOCs, LPAHs, and 14 individual PAHs. Ecological hazard quotients for sediments range up 228 (benzyl alcohol SQS).

8.2.4 Historical Creek

The Creek was rerouted in 1960 or 1961 when it was diverted to its current course to accommodate the sand and gravel mining operation in the Park. From the 1940s until the Creek was diverted, process water and stormwater discharges from Oeser and the Birchwood neighborhood to the north discharged into the Historical Creek area, meandering around a prominent bank as the Creek traveled downstream to the Bay. Since this portion of the Creek was rerouted away from the Historical Creek channel, stormwater discharges from the local neighborhood have been the primary source of runoff to this area of the Park.

The Historical Creek area has been characterized based on information obtained from three soil borings, six test pits, two surface water samples, and six sediment cores. Selected samples were analyzed for metals, petroleum hydrocarbons, SVOCs, and dioxins/furans. Visible and olfactory evidence of petroleum contamination was observed in the upper portion of the Historical Creek area at test pit TP-6. The contamination around TP-6 was relatively localized, extending from the ground surface to an organic silty clay layer at 4 ft bgs. Based on an aerial photograph taken in 1955, this test pit location appears to be in a portion of the Historical Creek channel with a bar deposit in the center of the channel.

Petroleum hydrocarbons (e.g., diesel- and residual-range hydrocarbons), PAHs (LPAHs and HPAHs), PCP, and dioxins/furans were detected in soils in the upper portion of the area and sediments collected in the lower portion of the area, currently designated as a palustrine wetland area with seasonal standing water present. Sediment contamination extends to a depth of 3 ft bgs over the lower portion of the Historical Creek area. Similarly to the Upper Creek, the likely source of this contamination is historical stormwater and process water discharges from the Oeser site. This conclusion is supported by fingerprinting analysis. Local stormwater discharges may also be a contributing source of metals and petroleum hydrocarbons to sediments of the lower Historical Creek area.

The human health IHSs selected for one or more media in the Historical Creek include three metals, PCP and four other SVOCs, CPAHs and eight noncarcinogenic PAHs, petroleum (gasoline and diesel range hydrocarbons and motor oil), and dioxins/furans. Ratios of dioxin/furan TEQs to the human health screening levels range up to 199 in surface soil, 54 in subsurface soil, 491 in surface sediment, 366 in subsurface sediment, and 1,780 in groundwater. Hazard quotients for terrestrial ecological receptors range up 1,650 (dioxin/furan TEQ for mammals). Ecological hazard quotients for water range up to 11 (magnesium and benzo(a)pyrene). Sediment CoPECs include two metals, PCP and eight other SVOCs, LPAHs, and 11 individual PAHs. Ecological hazard quotients for sediment range up to 49 (dibenz(a,h)anthracene SQS).

8.2.5 Lower Creek

The Marine Drive Bridge marks the designated boundary between the Upper Creek and the Lower Creek in the Park. At this boundary, there is significant stormwater discharge to the Creek with contributions from Marine Drive, Bennett Road, and surrounding neighborhoods. Unlike the Upper Creek, the Lower Creek has not changed much over the years as evidenced by the discovery of an archaeological site along its western bank.

The Lower Creek area has been characterized based on information obtained from 3 soil borings, 13 surface soil and spoil pile samples, 3 groundwater samples, 8 surface water samples, 5 sediment borings, and 12 surface sediment samples. Selected samples were analyzed for metals, petroleum hydrocarbons, SVOCs, and dioxins/furans. In general, chemicals analyzed in soil samples in the upper bank area of the Lower Creek were relatively low in concentration, with few exceedances of screening levels. However, several spoils pile samples located along the lower banks of the Creek exceeded the screening level for petroleum hydrocarbons, with concentrations ranging from 418 to 2,150 mg/kg. Localized petroleum contamination was also observed in sediment samples collected throughout the Lower Creek area. PCP (and associated compounds) and dioxins/furans were also detected in surface sediment samples at concentrations above screening levels. Bioassay data for surface sediments collected during previous studies showed surface sediments in the Lower Creek were toxic to test organisms, exceeding freshwater CSLs.

The likely source of the localized sediment and spoils bank soil contamination is from discharges of residual NAPL and dissolved phase petroleum in the Upper Creek. The creosote and PCP-diesel contamination observed in Upper Creek soils and groundwater is hydraulically connected to surface water. This would explain the detection, and exceedance of screening levels in some samples, of PAHs, PCP, and dioxins/furans in surface water samples in the Lower Creek area.

Human health IHSs selected for one or more media in the Lower Creek include three metals, PCP and five other SVOCs, CPAHs and one noncarcinogenic PAH, diesel range hydrocarbons, and dioxins/furans. The ratios of dioxin/furan TEQs to human health screening levels range up to 236 in surface soil, 886 in surface sediment, 702 in subsurface sediment, and 10,200 in surface water. Ecological hazard quotients for terrestrial receptors range up to 3 (mercury for invertebrates) and for water up to 10,600 (dioxin/furan TEQ for fish). Sediment CoPECs include six metals, PCP and five other SVOCs, LPAH, and 15 individual PAHs. Ecological hazard quotients for sediments range up to 59 (dimethyl phthalate SQS).

8.2.6 Landfill

A 1930s Landfill was discovered in the northeast section of the Park during sampling activities in support of the remedial investigation. The approximate area of the historical Landfill is 7,000 ft^2 based on a reconnaissance survey. The upper 3 to 4 ft of soils were mixed with layers of municipal waste, including bottles (dating to the 1930s), glass and metal debris, and unrecognizable burned materials.

The Landfill area soils were characterized based on six test pits excavated within its boundaries. Selected soil samples were analyzed for petroleum hydrocarbons, metals, and PCBs. Petroleum hydrocarbon concentrations were below screening levels and PCBs were not detected in the samples. However, several metals including cadmium (maximum concentration 10 mg/kg), copper (409 mg/kg), lead (3,970 mg/kg), mercury (1.62 mg/kg), and zinc (3,060 mg/kg) were detected at elevated concentrations and above risk-based screening levels. Selected soil samples were analyzed with the TCLP test to determine the leachability of these metals to surface water and groundwater. Metals were detected in the leachate tests indicating a potential impact to waters.

Human health IHSs selected for the Landfill include arsenic, cadmium, lead, zinc, and PCP. Hazard quotients for terrestrial ecological receptors range up to 5 (zinc for plants). CULs for metals should be evaluated for the Landfill in the feasibility study.

8.2.7 Beach

A 36-in. concrete culvert located at the mouth of the Creek discharges stormwater from the Creek to Bellingham Bay. Sediments in the Beach area are generally coarse grained (sand to cobble size material) with little fines due to the prevailing southwest winds and waves eroding this portion of the Bay. Consequently, fine-grained sediment was difficult to collect in this area for characterization. During the remedial investigation, no fine-grained material was observed at the three proposed stations near the mouth of the Creek. One surface sediment and one surface water sample were collected during previous studies. The samples were analyzed for metals and SVOCs.

Human health IHSs selected for the Beach include arsenic, chromium, PCP, and CPAHs. Ecological hazard quotients for water range up to 13 (antimony SQS) and for sediment up to 33 (magnesium). Sediment CoPECs include three metals and five SVOCs.

8.2.8 Railroad (Mainline)

BNSF railway has an active rail line that crosses the southern portion of the Park near the mouth of the Creek. The rail line is elevated above the Park with about a 100-ft wide right-of-way. Six hand auger borings were advanced along this right-of-way to evaluate soil quality. Selected soil samples were analyzed for metals, petroleum hydrocarbons, chlorinated pesticides, and chlorinated herbicides. Human health IHSs selected for the railroad include arsenic and lead. Hazard quotients for terrestrial ecological receptors range up 5 (lead for plants).

8.2.9 Illinois Street Extension

The Illinois Street extension area is located between the South Slope area and Oeser to the north of the Park. The City is planning to construct an extension of Illinois Street to Marine Drive for increased traffic flow to local industry and BTC. Three boreholes and six test pits were advanced to assess the surface and subsurface soil quality within this area. Two boreholes were advanced immediately adjacent to the east and west sides of a concrete box culvert that conveys water from Oeser and the Birchwood neighborhood to the Creek. Another boring was advanced between the box culvert and the current location of the Oeser/Birchwood discharge. The boreholes were drilled to assess subsurface soil quality in the vicinity of the box culvert and downgradient of the culvert. The test pits were excavated to assess the shallow soil quality of the portion of the proposed road extension that trends east-west, parallel to the active and inactive railroad tracks/spurs.

Analysis of the borehole samples indicate that the extent of wood treatment infiltration along the Upper Creek area extends upstream to a point below the original railroad box culvert at sampling locations SB-40/SB-41, the historical discharge of the Oeser/Birchwood storm flow into the open creek channel (until the 1970s when the original culvert was extended and this portion of the creek was filled in). This was confirmed by the presence of wood treatment chemicals observed in subsurface soils at boring SB-42.

Selected soil samples were collected and analyzed for metals, petroleum hydrocarbons, and SVOCs. No samples exceeded the screening level for petroleum hydrocarbons or SVOCs. However, metals (particularly arsenic) exceeded the risk-based screening levels in soil samples to a depth of 3 ft bgs in this area. Selected soil samples were analyzed for the SPLP and TCLP tests to determine the leachability of arsenic to surface water and groundwater. Arsenic was detected in the leachate tests, indicating a potential impact to waters. There is some uncertainty of the source but it is may be associated with previous railroad activities.

Human health IHSs selected for the Illinois Street extension include arsenic, cadmium, lead, and zinc. Selection as IHSs was based on screening levels for the leaching pathway. None of the metals except arsenic exceeds screening levels based on direct human contact. With the exception of arsenic, these metals were not selected as IHSs for groundwater downgradient in the Upper Creek, which indicates that soil concentrations in the Illinois Street extension are protective of groundwater. An arsenic CUL should be evaluated for the Illinois Street extension area in the feasibility study, considering protection of both direct human contact and groundwater. The Illinois Street extension was not evaluated for ecological receptors because it will be mostly paved, providing negligible habitat value.

8.2.10 General Site

Soil samples were collected from other locations within the boundaries of the study area but outside the designated areas. Twelve surface or spoils pile samples and three subsurface samples from 13 stations were collected in these areas of the site. Most of these stations are located in the wooded areas between the historical and present creek routes which was historically mined for sand and gravel.

Samples were analyzed for metals, petroleum hydrocarbons, SVOCs, and dioxins/furans. Human health IHSs selected for the General Site include arsenic, PCP, CPAHs, and dioxins/furans. The maximum ratio of dioxin/furan TEQ in surface soil to the human health screening level is 280.

8.3 RECOMMENDATIONS FOR FEASIBILITY STUDY

During the feasibility study, the screening levels used in the remedial investigation will be refined and developed into CULs, and one or more cleanup actions will be evaluated. A permanent cleanup solution is preferred under MTCA (WAC 173-340-200).

The following will be addressed prior to or as part of the feasibility study.

- The Upper Creek, Historical Creek, Lower Creek, and Wetland areas need to be evaluated for potential cleanup based on significant threats to human health and the environment. Other areas of the site may present less significant threats (Illinois Street extension and Landfill areas), but they still merit further consideration in the feasibility study. Human health IHSs were selected for every area of the site. Chemical concentrations in soil, surface water, and sediment exceed one or more EICs in every area of the site evaluated.
- The CULs developed in the feasibility study for soil, surface water, and groundwater need to be developed using MTCA, the principal chemical-specific ARAR for the site. Freshwater sediment screening levels used in the remedial investigation under MTCA are only guidelines. Ecology has concluded that per WAC 173-204-520(d), concurrently collected bioassay and chemical data will be used to determine site-specific cleanup levels for protection of the benthic community in sediments for the various contaminants of concern. More specific expectations on the approach to be used are identified below. Bioassays and site specific sediment cleanup levels will also be used to determine the area, depth, and volume of sediment requiring cleanup.
- Issues that should be investigated prior to and during the feasibility study include whether arsenic is present at background concentrations and whether chromium is present in the trivalent form. Site concentrations of arsenic appeared to be consistent with background concentrations in most areas except the Illinois Street extension area and possibly the Upper Creek and Wetland, and a more rigorous statistical evaluation might confirm that it is present at background levels throughout the Park. Chromium was assumed to be present in the more toxic hexavalent form for screening. Chromium might be eliminated from further consideration for one or more site areas if it were determined that screening levels for the trivalent form are appropriate.
- CULs for the leaching pathway should be calculated using Ecology's MTCASGL and MTCATPH spreadsheets. A modified version of MTCATPH that includes PCP has been developed by Ecology. The screening levels used in the remedial investigation should be developed into cleanup levels by considering the following issues (WAC 173-340-720(7), -730(5), and -740(5)):
  - Presence of multiple chemicals
  - Presence of multiple exposure pathways
  - Practical concentration limits
  - Natural background concentrations
  - Water solubility limits
  - Residual saturation limits in soils and sediments
  - Equilibrium partitioning from water to sediments.

- In the feasibility study, each area will be evaluated using inverse distance-weighted contour maps that show chemical contractions with depth that exceed CULs. For sediments and soils, the contour maps must be coupled with bioassay data[60] that is regressed against contaminant concentrations so that site-specific CULs can be determined for sediments and cleanup boundaries can be established. It is expected that the determination of cleanup levels for protection of the benthic community in sediments would follow the data collection methods and statistical evaluation approach used in the Gas Works Sediment Area Cleanup Standard Determination (RETEC 2005). This evaluation needs to be completed for both soils and sediments because of the potential for rerouting the Creek and development of other water features within the Park.
- Surface soils need to be collected from a depth of 0 to 3 in., either as part of defining the boundaries of soils exceeding CULs, or as a part of the compliance evaluation after remediation is completed.
- The extent and nature of contamination between the two ca. 1912 railroad box culverts along and associated with the historically open but unsampled creek channel between them needs to be more clearly determined. (The “Approximate Area of Soil and Groundwater Contamination” shown in figures 5-24 through 5-32 indicates the unknown upper extent of the creek related contamination.) The area in question includes a segment of the Creek filled during the late 1970s for a 36-in. diameter culvert extended downstream from the upper 1912 culvert.
- Remedial alternatives evaluated in the feasibility study need to consider plans to reroute the Creek and to develop other water features including park amenity ponds, wetlands for wildlife and stormwater treatment facilities.

[60] Historical bioassay data (E&E 2002a, Ecology 2004) could be used in this evaluation. However, more data may be needed to complete the CUL evaluation for sediments in the Park.

9 REFERENCES

ATSDR. 2006. Finalized toxicological profiles. Agency for Toxic Substances and Disease Registry. United States Department of Health and Human Services, Washington, DC, Atlanta, GA.

Bauer, H.H., and J.J. Vaccaro. 1987. Documentation of a deep percolation model for estimating ground-water recharge. United States Geological Survey, Open File Report 86-536.

Bellingham, City of. 2003. Cooperative Agreement for Brownfields Assessment. U.S. Environmental Protection Agency, Region 10. Date of Award: September 16, 2004.

Bellingham, City of. 2005. Remedial Action Grant for Little Squalicum Park RI/FS. Washington State Department of Ecology.

Bestari, K.T.J., R.D. Robinson, K.R. Soloman, T.S. Steele, K.E. Day, and P.K. Sibley. 1998. Distribution and composition of polycyclic aromatic hydrocarbons within experimental microcosms treated with liquid creosote. *Environ. Toxicol. Chem.* (17)12:2359–2368.

Booth, D.K., and B. Goldstein. 1994. Patterns and Processes of Landscape Development by the Puget Lobe Ice Sheet, Washington Division of Geology and Earth Resources Bulletin, Vol. 80, pp. 207-218.

Burns, W.A., P.J. Mankiewicz, A.E. Bence, D.S. Page, and K.R. Parker. 1997. A principal-component and least-squares method for allocating polycyclic aromatic hydrocarbons in sediment to multiple sources. *Environ. Toxicol. Chem.* (16)6:1119–1131.

DEA. 1993. Final off-site wetland mitigation plan at Little Squalicum Creek for the Port of Bellingham International Airport runway extension, Bellingham, WA. David Evans and Associates, Inc., Bellingham, WA.

Easterbrook, D.J. 1994. Chronology of pre-pre-late Wisconsin Pleistocene sediments in the Puget Lowland, Washington. Washington Division of Geology and Earth Resources Bulletin, Vol. 80, pp. 191-206.

Ecology. 1992. Statistical guidance for Ecology site managers. Publ. No. 93-54. Washington State Department of Ecology, Olympia WA.

Ecology. 1994. Natural background soil metals concentrations in Washington State. Publ. No. 94-115. Washington Department of Ecology, Olympia WA.

Ecology. 1995. Sediment management standards. Chapter 173-204 WAC. Washington State Department of Ecology, Toxics Cleanup Program, Olympia, WA.

Ecology. 2001. Model Toxics Control Act cleanup regulation. Chapter 173-340 WAC. Amended February 12, 2001. Publication No. 94-06. Washington State Department of Ecology, Toxics Cleanup Program, Olympia, WA.

Ecology. 2004. Little Squalicum Creek screening level assessment. Publ. No. 04-03-014. Washington State Department of Ecology, Olympia, WA.

Ecology. 2005. Agreed Order for RI/FS, Little Squalicum Park. Washington State Department of Ecology and the City of Bellingham. Document No. DE 2016. March 22, 2005.

Ecology. 2007. Cleanup levels and risk calculations (CLARC). https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx. Accessed in July 2007. Washington State Department of Ecology, Olympia, WA.

E&E. 1987. Site inspection report for Oeser Company, Bellingham, Washington. Contract No. GB-01-7347. TDD No. F10-8704-17. Prepared for U.S. Environmental Protection Agency, Field Investigation Team. Ecology and Environment, Seattle, WA.

E&E. 1996. Expanded site inspection report—Oeser Company facility. Contract No. 68-W9-0020. Work Assignment No. 20-43-OJZ4. Prepared for the U.S. Environmental Protection Agency, Region 10, Alternative Remedial Contracts Strategy, Seattle, WA. Ecology and Environment, Seattle, WA.

E&E. 1998a. Oeser Company PCP-enclosure draft site removal assessment report, Seattle, Washington. Ecology and Environment, Inc., Seattle, WA

E&E. 1998b. Oeser Company site final removal assessment report, Seattle, Washington. Ecology and Environment, Inc., Seattle, WA.

E&E. 2002a. The Oeser Company Superfund site remedial investigation report Bellingham, Washington. Ecology and Environment, Inc., Seattle, WA.

E&E. 2002b. The Oeser Company Superfund site feasibility study report, Bellingham, WA. Ecology and Environment, Inc., Seattle, WA. TDD: 01-03-0016.

Emsbo-Mattingly, S.D., A.D. Huler, S.A. Stout, and K.J. McCarthy. 2001. Identifying creosote at contaminated sites: An environmental forensics overview. *Soil Sed. Water*. Available at: http://aehsmag.com/issues/2001/February/forensics.htm.

Fetter, C.W. 1993. *Contaminant hydrogeology*. Macmillan Publishing Company, New York. 458 pp.

Freeze and Cherry. 1979. *Groundwater.* Prentice Hall Inc., Englewood Cliffs, N.J.

Hunter, W. 2004. Personal communication with William Hunter of Wilson Engineering.

Integral. 2005a. Health and safety plan, Little Squalicum Park, Bellingham, Washington. Prepared for the Washington State Department of Ecology, Bellingham, WA; U.S. Environmental Protection Agency Region 10, Seattle, WA; and City of Bellingham, Departments of Parks & Recreation, Planning, and Community Development, Bellingham, WA.

Integral. 2005b. Quality assurance project plan, Little Squalicum Park, Bellingham, Washington. Prepared for the Washington State Department of Ecology, Bellingham, WA; U.S. Environmental Protection Agency Region 10, Seattle, WA; and City of Bellingham, Departments of Parks & Recreation, Planning, and Community Development, Bellingham, WA.

Integral. 2005c. Sampling and analysis plan, Little Squalicum Park, Bellingham, Washington. Prepared for the Washington State Department of Ecology, Bellingham, WA; U.S. Environmental Protection Agency Region 10, Seattle, WA; and City of Bellingham, Departments of Parks & Recreation, Planning, and Community Development, Bellingham, WA.

Integral. 2005d. Work plan for the RI/FS of Little Squalicum Park, Bellingham, Washington. Prepared for the Washington State Department of Ecology, Bellingham, WA; U.S. Environmental Protection Agency Region 10, Seattle, WA; and City of Bellingham, Departments of Parks & Recreation, Planning, and Community Development, Bellingham, WA.

Integral. 2005e. Addendum 1 to the Sampling and Analysis Plan. Little Squalicum Park Remedial Investigation/Feasibility Study, Bellingham, Washington. Prepared for the Washington State Department of Ecology, Bellingham, WA and City of Bellingham, Parks & Recreation Department, Bellingham, WA. Prepared by Integral Consulting Inc., Bellingham, WA. November 14, 2005.

Integral. 2006a. Addendum 2 to the Sampling and Analysis Plan. Little Squalicum Park Remedial Investigation/Feasibility Study, Bellingham, Washington. Prepared for the Washington State Department of Ecology, Bellingham, WA and City of Bellingham, Parks & Recreation Department, Bellingham, WA. Prepared by Integral Consulting Inc., Bellingham, WA. January 24, 2006.

Integral. 2006b. Addendum 3 to the Sampling and Analysis Plan. Little Squalicum Park Remedial Investigation/Feasibility Study, Bellingham, Washington. Prepared for the Washington State Department of Ecology, Bellingham, WA and City of Bellingham, Parks & Recreation and Pubic Works Departments, Bellingham, WA. Prepared by Integral Consulting Inc., Bellingham, WA. October 2, 2006.

Jones, M.A. 1999. Geologic framework for the Puget Sound aquifer system, Washington and British Columbia. United States Geological Survey Professional Paper 1424-C.

Mack, W.M. 1998. Aerial photographic analysis, Oeser Company, Inc., Bellingham, Washington. EPA Document No. TS-PIC-9810005S. Prepared for the U.S. Environmental Protection Agency, Environmental Sciences Division, Las Vegas, NV. Lockheed Environmental Systems & Technologies Company, Environmental Sciences Division, Las Vegas, NV.

May, E.W., and N.M. Trahey. 2001. Certificate of analysis. Standard reference material® 1649a, urban dust. Department of Commerce, National Institute of Standards and Technology, Gaithersburg, MD.

Metro. 1988. Final 1988 combined sewer overflow control plan. Plan for secondary treatment facilities and combined sewer overflow control. An amendment to Metro's comprehensive water pollution abatement plan. Prepared by CWC-HDR, Inc., Consulting Engineers, Ott Water Engineers, Centrac Associates, and Anne C. Symonds & Associates. Municipality of Metropolitan Seattle, Seattle, WA.

Orthmeyer. 2006. Personal communication with Tom Orthmeyer of the Oeser Company.

Parametrix. 1991. Facility hazard assessment summary report for Little Squalicum Creek, Bellingham, Washington. Contract No. C0089006. Prepared for Washington State Department of Ecology, Olympia, WA. Parametrix, Bellevue, WA.

Retec Group. 2005. Gas Works Sediment Area Cleanup Standard Determination, Gas Works Sediment Area, Seattle, WA. Prepared for Puget Sound Energy, Bellevue, WA. Prepared by Retec Group Inc., Seattle, WA. September 26, 2005.

Rosenfeld, J.K., and R.H. Plumb, Jr. 1991. Groundwater contamination at wood treatment facilities. Groundwater monitoring report. Winter 1991. pp. 133-140.

Singh, A., A.K. Singh, and R.W. Maichle. 2004. ProUCL version 3.0 user guide. EPA/600/R04/079. April.

Stein, E.D., L.L. Tiefenthaler, and K. Schiff. 2006. Watershed-based sources of polycyclic aromatic hydrocarbons in urban storm water. *Environ. Toxicol. Chem.* 25(2) pp. 373–385.

Stout, S.A., V.S. Magar, R.M. Uhler, J. Ickes, J. Abbott, and R. Brenner. 2001. Characterization of naturally-occurring and anthropogenic PAHs in urban sediments—Wycoff/Eagle Harbor Superfund Site. *Environ. Forensics* (2001)2:287–300.

Stout, S.A., and T.N. Wasielewski. 2004. Historical and chemical assessment of the sources of PAHs in soils at a former coal-burning power plant, New Haven, Connecticut. *Environ. Forensics* 5:195–211.

Superior Court of Washington. 1936. Marietta Township (Plaintiff) vs. the City of Bellingham and the City Sanitary Service, and Josie Rezore and Agostino Rezore (Defendants). Superior Court of the State of Washington in and for Whatcom County. June 20, 1936.

URS. 1994. Facility inspection prioritization report for Oeser cedar. Contract No. 68-W9-0054. Prepared for the U.S. Environmental Protection Agency, Region 10, Alternative Remedial Contracts Strategy, Seattle, WA. URS Consulting, Inc., Seattle, WA.

USEPA. 1982. Wood preservative pesticides—creosote, pentachlorophenol, and the inorganic arsenicals (wood uses). Position Document 2/3.

USEPA. 1996. EPA Region 10 SOP for the validation of polychlorinated dibenzodioxin (PCDD) and polychlorinated dibenzofuran (PCDF) data. Revision 2.0.data. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

USEPA. 1997. Potentially responsible party search—Oeser Company Superfund site. United States Environmental Protection Agency, Office of Environmental Cleanup, Region 10, Seattle, WA.

USEPA. 1999. USEPA contract laboratory program national functional guidelines for organic data review. Document OSWER 9240.1-05A-P, EPA 540-R-99-008. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.

USEPA. 2002. USEPA contract laboratory program national functional guidelines for inorganic data review. Document OSWER 9240.1-35, EPA 540-R-01-008. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington. DC.

USEPA. 2004. Region 9 preliminary remediation goals. Accessed September 2006 at http://www.epa.gov/region09/waste/sfund/prg/index.htm. U.S. Environmental Protection Agency, Region 9, San Francisco, CA.

USEPA. 2006a. National ambient water quality criteria. Accessed August 2006 at http://www.epa.gov/waterscience/criteria/wqcriteria.html. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA. 2006b. Maximum contaminant levels. Accessed August 2006 at http://www.epa.gov/safewater/mcl.html#mcls. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA. 2006c. Fact sheet. Creosote and its use as a wood preserver. http://www.epa.gov/pesticides/factsheets/chemicals/creosote_main.htm.

USFWS. 1987. Ferndale quandrangle, Washington. National Wetlands inventory map. U.S. Fish and Wildlife Service.

Van den Berg, M., L. Birnbaum, A.T.C. Bosveld, B. Brunström, P. Cook, M. Feeley, J.P. Giesy, A. Hanberg, R. Hasegawa, S.W. Kennedy, T. Kubiak, J.C. Larsen, F.X. R. van Leeuwen, A.K. Djien Liem, C. Nolt, R.E. Peterson, L. Poellinger, S. Safe, D. Schrenk, D. Tillitt, M. Tysklind, M. Younes, F. Wærn, and T. Zacharewski**.** 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. *Environ. H. Perspect.* 106(12):775-792.

Van den Berg, M., L.S. Birnbaum, M. Denison, M. De Vito, W. Farland, M. Feeley, H. Fiedler, H. Hakansson, A. Hanberg, L. Haws, M. Rose, S. Safe, D. Schrenk, C. Tohyama, A. Tritscher, J. Tuomisto, M. Tysklind, N. Walker, and R.E. Peterson. 2006. The 2005 World Health Organization re-evaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds. *Toxicol. Sci.* Advance access e-published July 7, 2006.

Wahl, T. 2004. Personal communication with Tim Wahl of the City of Bellingham, Parks & Recreation Department. City of Bellingham Parks and Recreation Department, Bellingham, WA.

Wahl, T. 2006. Personal communication with Tim Wahl of the City of Bellingham, Parks & Recreation Department. City of Bellingham Parks and Recreation Department, Bellingham, WA.

Wang, H.F., and M.P. Anderson. 1982. *Introduction to groundwater modeling: Finite difference and finite element methods.* W.H. Freeman and Company, New York. 237 pp.

WDOH. 2004. Public water supplies. WAC 246-290-310. Accessed August 2006 at http://apps.leg.wa.gov/WAC/default.aspx?cite=246-290-310. Washington Department of Health, Olympia, WA.

Whatcom County. 1991. Little Squalicum Park Site Management Plan. Prepared by the Whatcom County Parks Board, Bellingham, WA.

WRCC. 2006. Western Regional Climate Center http://www.wrcc.dri.edu/. Western Regional Climate Center, Reno, NV.

APPENDIX A

LEGAL DESCRIPTION

Public property comprising Little Squalicum Park
& lying along Squalicum Beach
With pre-1974 Assessor's File Numbers for Deed Reference
See Map

Park Properties owned by the City of Bellingham

A1 Acquired by City in 1998. "Vanderpol" under AFN 1980804192. Chain of title: USA--Eldridge--United Freight--Vanderpol--City. *Vanderpols were, and still are, owners of Oak Harbor Freight, who assumed ownership of the freight terminal located adjacent to this property from previous trucking interests or family members. The first of these was United Terminal Co., who obtained the property from the Eldridge heirs on May 16, 1956 in satisfaction of a deed of trust dated Aug. 28, 1952. These deeds are not on hand bit can be located, along with others providing for the continuous operation of the trucking terminal site.*

A2 Acquired by City in 2001. "Parberry" (AFN 2010602384; June 15, 2001) Chain of title: Lot 7: USA-Eldridge--Parberry (AFN ??; March 17, 1963)--City. Lot 8: USA--Eldridge--Cunnigham--Christenson--Goddard--Parberry (AFN ??; Sept. 9, 1963)--City.

A3 Acquired by City in 1995. "Eldridge I". Chain of title: USA--Eldridge--City. Previous Right-of-way interest granted Nov. 20, 1911 under AFN 153387 to Olympic Portland Cement (& successors, finally Lehigh) and extinguished in 2002 under AFN 2020400482 and in 1998 and 1999 under AFN's 1990402699, 1990402700, 1981200289, 1990203638, 1990203639, 1990203640, 1990203641 and 1990203642. *Owner prior to City was Eldridge, who received title from the USA. Lehigh Cement and its predecessors had a right-of-way interest for a railway. This interest reverted to the Eldridge heirs, who deeded the fee land to the City in 1995, with Lehigh quit claiming all interest, if any, to City in 2001.*

A4 Acquired by City in 2002. "Lehigh". Chain of title: USA--Eldridge--Olympic Portland Cement (Nov. 16, 1956 under AFN 827666) and successors--Lehigh--City (April 2, 2002; AFN 2020400482.) *Olympic Portland Cement acquired title from Eldridge on Nov. 16, 1956 under AFN 827666. OPC's assets were transferred to Lehigh through several cement company conveyances.*

A5 Acquired by City in 1995. "Eldridge II". Chain of title: USA--Eldridge--City. Settlement 1855; patent 1860's. Unexercised right-of-way interest held by Port of Bellingham. Fee acquired by City under AFN's 1990402699, 1990402700, 1981200289, 1990203638, 1990203639, 1990203640, 1990203641 and 1990203642. *City acquired from Eldridge in 1995; Eldridge had acquired from the USA in his ca. 1855 Donation Land Claim. There is an overlaying right-of-way interest held by the Port, who acquired it from the Eldridge heirs, which has never been occupied or improved.*

Park Properties owned by the County of Whatcom

B1 Acquired by County in 1975 “Eiford”. Chain of title: USA-Eldridge--Tiscornia mortgage contract (October 14, 1933) satisfied October 11, 1943 (AFN 582571)--Bellingham School District (May 25, 1955; AFN 796254)--Eiford/Reinholt (??)--County (Sept. 5, 1975; AFN 1208788.)

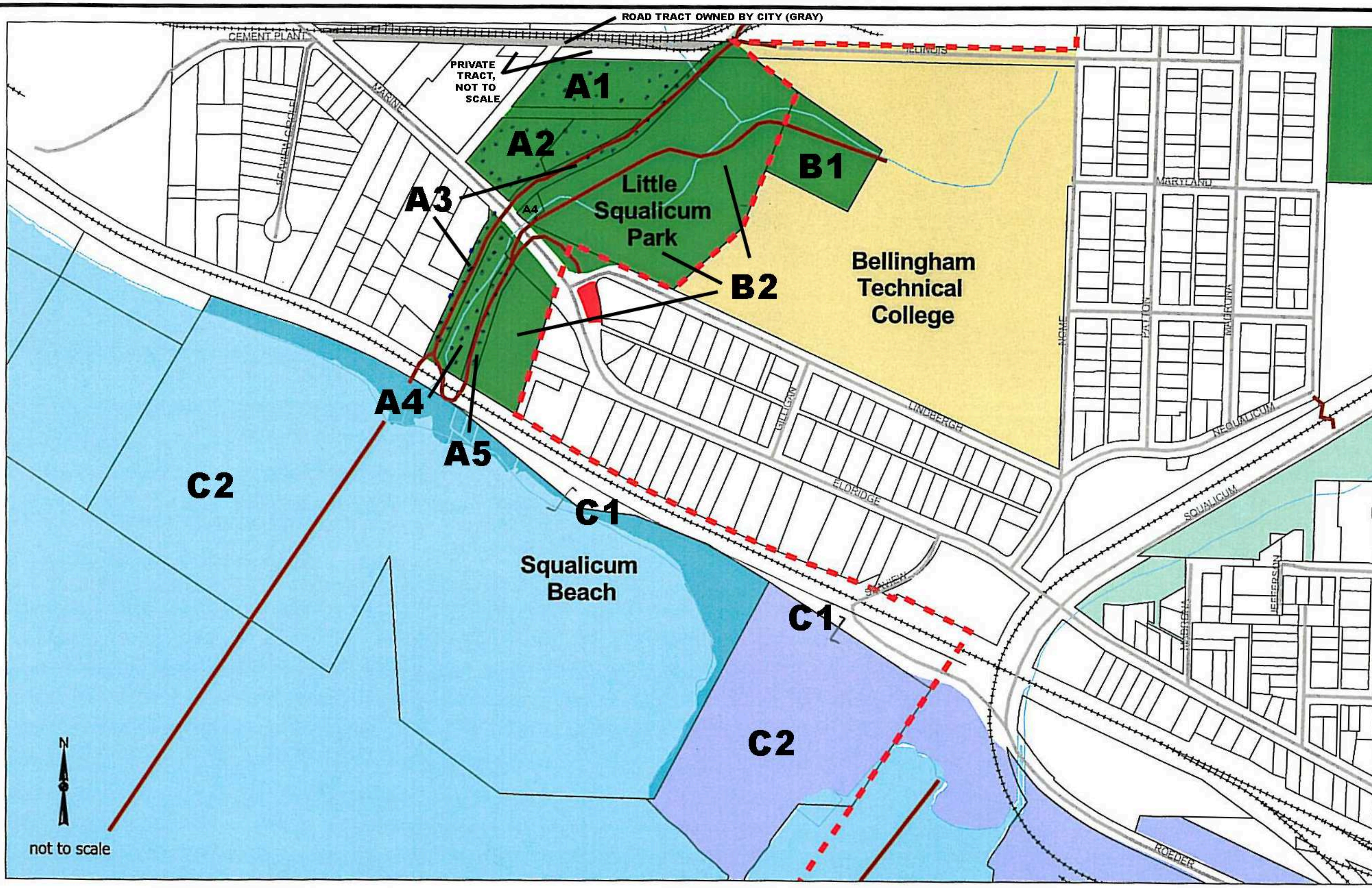
(In possession of Tiscornia at the time of the 1936-ca. 1939 sanitary landfill.)

B2 Acquired by County in 1975 “Eiford” in same conveyance as B1. Previous owners: USA--Eldridge--Eiford/Reinholt (1960; AFN 899955)--County.

Tideland Properties owned by the Port of Bellingham

C1 Acquired by Port in 1927. Portion of Eldridge DLC above meander line purchased from Eldridge heirs. Chain of title: USA--Eldridge--Port.

C2 Acquired by Port in 1927. Tideland lots purchased from Eldridge heirs. Chain of title: USA--State of WA--Eldridge--Port.



Stipled green "A" parcels are City-owned tracts comprising Little Squalicum Park

Unstipled green "B" parcels are County-owned tracts comprising Little Squalicum Park

See list for City acquisition dates & other public ownerships.

APPENDIX B

FIELD SAMPLING REPORT

BORINGS AND TEST PIT LOGS

APPENDIX B

Field Sampling Report
Little Squalicum Park
Remedial Investigation

Prepared for
City of Bellingham
Parks & Recreation Department
3424 Meridian Street
Bellingham, WA 98225

Prepared by

integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225

June 30, 2008

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
bgs	below ground surface
CAB	cellulose acetate butyrate
City	City of Bellingham Parks and Recreation Department
DC	direct current
DNAPL	dense nonaqueous phase liquid
Ecology	Washington State Department of Ecology
EDM	Electronic Distance Meter
EPA	U.S. Environmental Protection Agency
FCR	field change request
FID	flame-ionization detector
FSR	Field Sampling Report
gpm	gallons per minute
GPS	global positioning system
GRO	gasoline-range organic hydrocarbons
HASP	health and safety plan
HSA	hollow-stem auger
ID	inside diameter
LDPE	low density polyethylene
LNAPL	light nonaqueous phase liquid
NAD	North American Datum
NAPL	nonaqueous phase liquid
NAVD	North American Vertical Datum
NTU	nephelometric turbidity units
NWTPH	Northwest Total Petroleum Hydrocarbons
OD	outside diameter
Park	Little Squalicum Park

PID	photoionization detector
PVC	polyvinyl chloride
RTP	reconnaissance test pit
SPT	standard penetrometer test
STP	shovel test pit
TPH	total petroleum hydrocarbons
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon

1 INTRODUCTION

This field sampling report (FSR) describes the sampling methods for the remedial investigation of Little Squalicum Park (Park) located in Bellingham, Washington, as described in the September 30, 2005 remedial investigation work plans prepared for the site (Integral 2005a). This FSR also describes additional fieldwork conducted as part of Addenda 1, 2, and 3 to the work plans (Integral 2005b and 2006a,b). All fieldwork associated with the work plans and Addenda 1, 2, and 3 was conducted between November 2005 and January 2008. Deviations from the work plans and the addenda are also described herein.

The fieldwork related to Addenda 1, 2, and 3 was conducted to:

- Delineate sediment quality within the historical creek channel
- Further delineate the vertical and lateral extent of petroleum seeps observed in the upper reaches of the creek
- Further investigate the shallow petroleum contamination associated with observations from Test Pit TP-6
- Determine the extent of contamination associated with the historical municipal landfill located in the northeastern portion of the site
- Evaluate the surface and subsurface soil quality along the proposed extension of West Illinois Street.

Integral is conducting this work under contract No. 2004-014 with the City of Bellingham Parks and Recreation Department (City), with direction from both the Washington State Department of Ecology (Ecology) Toxics Cleanup program and the U.S. Environmental Protection Agency (EPA) Region 10 Brownfields program. This work is being conducted under the March 2005 Agreed Order between the City and Ecology and, for select portions of the site, an EPA Brownfields agreement with the City.

2 FIELD SAMPLING CHRONOLOGY

The remedial investigation fieldwork was conducted between November 2005 and January 2008 and consisted of seven sampling events.

During the first sampling event (November 1 to 10, 2005), a round of surface water sampling was completed at eight locations (Stations SW-01, SW-04, SW-05, SW-06, SW-07, SW-09, SW-10, and the reference location) and test pits were excavated at Test Pits TP-1 through TP-12 (Figure B-1). This phase of the fieldwork was terminated because odors resembling petroleum contamination were observed at Test Pit TP-6, petroleum seeps were identified in the upper portion of the creek, and municipal garbage was observed in the northeastern portion of the site.

The second sampling event (November 16 to 17, 2005) was conducted as part of the Addendum 1 investigation. Test Pits TP-13 through TP-21 were excavated during this investigation (Figure B-1). Seven of these test pits (TP-13, TP-14, TP-15, TP-18, TP-19, TP-20, and TP-21) were excavated to delineate the extent of contamination in the vicinity of Test Pit TP-6 and the historical creek channel. Two additional test pits (TP-16 and TP-17) were excavated in the historical creek channel, located in the southern portion of the site. A fourth test pit was not advanced during the Addendum 1 investigation because of standing water and risk of disturbing the area, but it was sampled during the April 2006 field event (Station SB-39; see details for fourth sampling event below).

The third sampling event (January 30 to February 23, 2006) was conducted as part of the (interrupted original) remedial investigation work plans and the Addendum 2 investigation. A total of 25 reconnaissance test pits were excavated to delineate the historical landfill boundary (Figure B-1). Following the landfill boundary delineation, three test pits (TP-22, TP-23, and TP-24) were excavated within the boundary of the historical landfill to collect representative soil samples for analysis. In addition, Test Pit TP-25 was excavated in the vicinity of the historical creek channel to further delineate the presence of sandy material observed at Test Pits TP-05 and TP-14 and the boundaries of the historical creek channel. Boreholes SB-1 through SB-24 were advanced using a hollow-stem auger (HSA) to delineate the vertical and lateral extent of contamination in the present creek bed, collect soil samples of the spoils pile adjacent to the upper reaches of the creek, and delineate petroleum contamination observed in seeps in the upper reaches of the creek. Of these borings, seven were completed as 1-in. diameter piezometers (Stations SB-9, SB-11, SB-13, SB-14, SB-18, SB-19, and SB-20), and four were completed as 2-in. diameter monitoring wells (Stations SB-21 through SB-24). All of the newly installed piezometers and monitoring wells were developed and sampled.

The fourth sampling event (April 4 to 13, 2006) was conducted as a continuation of the Addendum 2 investigation and the remedial investigation work plans (Integral 2005a) proposed for the site. Nine HSA borings (Stations SB-25 through SB-33) were advanced to further delineate the nonaqueous phase liquid (NAPL) observed in the upper reaches of the creek. Seven of the nine HSA borings (Stations SB-25 through SB-30 and SB-32) were completed as 1-in. diameter piezometers. All of the piezometers were developed. Six vibracores were advanced (Stations SB-34 through SB-39) to delineate sediment quality in the historical creek channel in areas where standing water was observed.[1] Six hand auger borings (Stations HA-01 through HA-06) were advanced on the Burlington Northern Sante Fe Railroad right-of-way to delineate historical use of waste oils and pesticides to control vegetation in the area.

The fifth sampling event (April 25 to May 2, 2006) consisted of sampling the seven piezometers installed in April 2006 (Stations SB-25 through SB-30 and SB-32) and a second round of surface water sampling that included two new outfall sampling locations adjacent to Lindbergh Avenue (Stations SW-11 and SW-12; Figure B-1).

The sixth sampling event (October 9 and 12, 2006) was conducted in order to assist the City in evaluating the surface and subsurface soil quality along the proposed extension of West Illinois Street and provide supplementary environmental information for the Park remedial investigation (Addendum 3). Six test pits (Stations TP-26 through TP-31) were excavated using a mini track-mounted excavator along an active rail line spur. Two HSA soil borings (Stations SB-40 and SB-41) were advanced adjacent to the concrete box culvert that conveys water from the Birchwood neighborhood and the Oeser property to Little Squalicum Creek.

The seventh sampling event (January 29, 2008) was conducted as a continuation of the Addendum 3 investigation and the remedial investigation work plans (Integral 2005a) proposed for the site. One soil boring (Station SB-42) was advanced between the concrete box culvert and the 36-in. diameter stormline discharge that conveys water from the Birchwood neighborhood and the Oeser property to Little Squalicum Creek.

[1] At the time of sampling, there was no standing water at Station SB-35.

3 FIELD SAMPLING ACTIVITIES AND METHODS

The following sections describe the sampling activities conducted at the Park as part of the remedial investigation fieldwork led by Integral.

3.1 LOCATION CONTROL

Prior to commencing intrusive field activities, Integral used the regional One-Call service (1-800-424-5555) for locating underground utilities at the Park. Sampling locations within the Park were first marked by locating them using either a handheld global positioning system (GPS)[2] or a Hip-Chain® and Brunton® compass. A clearly marked stake with orange flagging material was driven into the soil or sediment at each location. None of the proposed sample locations interfered with underground or overhead utilities.

Upon completion of each phase of fieldwork, the sampling stations were located by a contracted land surveyor (Larry Steele & Associates) using a Leica Model TCR703 Electronic Distance Meter (EDM) Total Station positioning method[3]. At the conclusion of sampling, the land surveyors surveyed the station locations and provided horizontal (North American Datum [NAD] 1983 with 1991 corrections) and vertical (North American Vertical Datum [NAVD] 1988) data for all sampling locations. The boundaries of the shell midden archaeological site were also surveyed by Larry Steele & Associates.

To maintain system accuracy, several accessible and recoverable survey control points were established near or within the Park. Northing and easting coordinates were provided in both NAD 27 and NAD 83/91 with 0.1-ft accuracy (City of Bellingham currently uses NAD 27 datum). The elevation of each sample point was determined by differential leveling using control points established by the land surveyor. Station elevations were referenced to both NAVD 88 and City of Bellingham coordinate system. Survey data for all stations in the Park are presented in Attachment 1[4].

3.2 EQUIPMENT DECONTAMINATION

Mixing bowls, sampling spoons and pastry blenders, and samplers (i.e., California Modified and standard penetrometer test [SPT] samplers), and other stainless steel equipment were

[2] The use of GPS was not always possible because of the restricted satellite line-of-sight caused by elevation differences and the tree canopy.
[3] Soil borings SB-40 through SB-42 and test pits TP-26 through TP-31 were located by Wilson Engineering surveyors in support of the West Illinois Street extension project. Horizontal and vertical coordinates were provided for each station.
[4] Survey data for borings SB-40 through SB-42 and test pits TP-26 through TP-31 are presented on field logs in attachments 5 and 6, respectively.

washed using either a Liquinox® or Alconox® detergent solution, rinsed with tap water, followed by a final distilled water rinse. If the soil or sediment was visibly contaminated, a separate wash/rinse station was set up and a hexane wipe-down was generally necessary. Hexane wipe-down procedures consisted of saturating a clean paper towel with hexane and wiping down the equipment once the water was removed by drying with a paper towel or displaced using methanol. After the hexane wipe-down, a final distilled water rinse was applied to the equipment. Once decontaminated, each piece of equipment was wrapped in aluminum foil to prevent contamination by airborne contaminants during transportation to the next sampling location. Section 3.9 describes the handling of investigation-derived waste.

3.3 HEALTH AND SAFETY

The fieldwork led by Integral followed the site health and safety plan (HASP, Integral 2005a), with modifications described in Addenda 1 and 2 to the work plans (Integral 2005b,c). The modifications were due to changes in the scope of work based on field observations and conditions.

The following health and safety changes were implemented during the Addendum 1 work:

- Continuous air monitoring was conducted during all excavation and sample processing activities. A portable photoionization detector (PID) and flame-ionization detector (FID) was used to accomplish this task with action levels identified in the project HASP (Integral 2005a).
- Caution tape completely surrounded the exclusion zone, including excavation and processing areas for the test pit excavation work. No site workers or visitors were allowed in the exclusion zone without appropriate training and equipment as described in the project HASP.
- Several inches of straw were applied to backfilled excavations when petroleum hydrocarbons were encountered.
- No test pits were excavated in areas with standing surface water or shallow groundwater due to the potential for transport to other areas of the site.

The following health and safety changes were implemented during the Addendum 2 work:

- Vibracore stations in the historical creek channel included some areas with standing water up to 1.5 ft deep. Field personnel used the buddy system and proceeded slowly into the wetland area using a walking stick or similar device to probe the depth of water and firmness of the sediment. In addition, hardhats were used by personnel operating the vibracore equipment.

- The shallow boreholes on the north side of the creek were advanced with a portable HSA drill rig. The equipment was either carried or wheeled to each station. The drilling personnel exercised caution when lifting and carrying heavy materials across the creek.
- Because the former railroad grade in the vicinity of Boreholes SB-21 through SB-24 is very narrow, the exclusion zone required the former railroad grade trail to be closed in the vicinity of the drilling activities. This closure was clearly marked with signs at the trail heads and caution tape delineating the exclusion zone.

The following health and safety changes were implemented during the Addendum 3 work:

- The test pits and borehole locations are adjacent to active railroad tracks that are used by the Oeser facility immediately north of the proposed West Illinois Street extension. Personnel were required to wear traffic safety vests at all times and stopped, looked both ways, and listened for trains crossing the tracks. An Oeser representative was notified when Integral personnel and subcontractors were working near the active rail line.

Health and safety field forms are presented in Attachment 2.

3.4 SAMPLE COLLECTION AND PROCESSING

The following sections describe the procedures used for sample collection and processing. All samples were submitted blind to the analytical laboratory under chain-of-custody protocol with sequential sample numbers starting with LSP0001. Each sample label contained a unique tag number that was used to track individual sample containers. Field forms and sampling station logs can be found in attachments 3 through 6.

3.4.1 Groundwater Sample Collection

Each well or piezometer was purged using a 12 volt direct current (DC) peristaltic pump with new, disposable, Teflon®-lined, low density polyethylene (LDPE) tubing or a new disposable Teflon® bailer. Bailers were used to purge monitoring wells in which depth to water was beyond the typical capabilities of a peristaltic pump (approximately 25 ft below ground surface [bgs]).

Each well or piezometer was purged until at least three casing volumes were evacuated and field parameters (i.e., pH, temperature, dissolved oxygen, redox potential, specific conductivity, and turbidity) had stabilized (generally four to six casing volumes). The water quality meter was equipped with a flow-through cell for measuring parameters during purging activities using a peristaltic pump (except for the November 2005 groundwater sampling event, because the flow-through cell malfunctioned). Water quality parameters were not collected from piezometers SB-9 and SB-29 because petroleum sheens that could have damaged the water quality meter probes were present. Groundwater field sample collection forms are provided in Attachment 3.

Groundwater sample containers were filled for all analytes except volatile organic compound (VOC) sample containers (i.e., Northwest total petroleum hydrocarbon gasoline-range organics [NWTPH-GRO] and volatile petroleum hydrocarbon [VPH] follow-up) using the peristaltic pump after cutting the Teflon®-lined LDPE tubing to remove the flow-through cell. VOC sample containers were filled using a new, disposable Teflon® bailer. For wells with depths to water too deep to effectively use the peristaltic pump, the wells were purged and groundwater samples were collected using a new, disposable Teflon® bailer for each location. Photographs of purging activities using a peristaltic pump and Teflon® bailer are provided in Attachment 7.

3.4.2 Surface Water Sample Collection

Surface water samples were collected from the outfall stations (SW-01, SW-04, SW-05, and SW-12) by directly filling the prelabeled sample containers with the stream of water from the outfall. Surface water from Station SW-11 was collected by placing a clean stainless-steel bowl underneath the stream of water seeping from the rusted corrugated pipe, and pouring directly from the bowl into the sampling containers. Surface water samples from all other stations were collected using a peristaltic pump with new, disposable, Teflon®-lined LDPE tubing. Field parameters (i.e., pH, temperature, dissolved oxygen, redox potential, specific conductivity, and turbidity) were collected immediately after the sample containers were filled. Surface water sample collection forms are provided in Attachment 4. A photograph of the collection of a surface water sample using a peristaltic pump is provided in Attachment 7.

3.4.3 Soil and Sediment Sample Collection and Processing

Soil and sediment samples were collected using an HSA drill rig, vibracore sampler, hand auger, or directly from the sidewalls of the test pits using a stainless steel spoon or shovel. Samples from stations located adjacent to the present day creek were collected using 3-in. outside diameter (OD) California Modified samplers with a portable track-mounted HSA drill rig or 2-in. OD shovel test pit samplers with a portable Acker® HSA drill rig. Soil samples collected from borings on the former railroad grade were collected using 3-in. OD California Modified samplers with a standard rubber-tire mounted HSA drill rig (i.e., Model CMF 75). Sediment samples from the historical creek channel were collected using a portable vibracore sampling mechanism. Sample logs for soil boreholes and piezometer/well development are provided in Attachment 5, and test pit logs are provided in Attachment 6.

3.4.3.1 Sample Processing Procedures

Sample processing closely followed procedures described in the remedial investigation work plans (Integral 2005a) and Addenda 1 and 2 (Integral 2005b,c). The samplers were placed on a new, clean sheet of aluminum foil to minimize the potential for cross-contamination. Each sample was immediately screened for the presence of VOCs using a PID and/or FID prior to being logged and then placed in a decontaminated stainless-steel bowl for compositing. If there were detections with the PID and/or FID above background levels, a discrete sample was collected for possible VOC analysis prior to logging and compositing. A small quantity of soil or sediment was placed in a small Ziploc® bag for additional VOC screening after allowing the material to volatilize for approximately 10 minutes. Each sample was logged in accordance with American Society for Testing and Materials guidelines (i.e., ASTM D2488). Sample intervals were chosen by the geologist according to lithology or interval length (e.g., 1 ft).

All sampling equipment was decontaminated prior to use. Each sample was thoroughly mixed in a stainless-steel bowl with a stainless-steel spoon (and for some stiff clays, a stainless steel pastry blender) until the color and texture were consistent. All rocks greater than approximately 0.75 in. in diameter were removed from the soil or sediment (except for the physical testing sample jars). The samples were transferred to prelabeled sample jars using the stainless-steel spoon. Sample jars planned for archive were filled approximately three-quarters to avoid breakage when frozen. Each jar was put in its own Ziploc® bag and placed immediately in a cooler with ice. All samples were maintained in coolers on ice throughout the duration of sample collection and transport to the laboratory. Samples were submitted to the laboratory under chain-of-custody protocol as described in the remedial investigation work plans.

If no visible contamination was observed, any remaining sample material was returned to the location where it was collected. If visible contamination was observed, the remaining sample material was placed in a labeled 55-gal. drum for characterization and proper disposal.

3.4.3.2 Hollow-Stem Auger Sample Collection (Soil and Sediment)

Samples were collected with a 3-in. diameter California Modified sampler advanced ahead of the augers using a 140-pound hammer, generally in 1-ft increments. Blow counts were recorded every 6 in. and noted on the field log. Once the sampler was advanced 1 ft or to refusal, it was pulled up, the shoe and mounting nut were removed, and the spoons were split apart for logging and sampling. The split spoons containing the sample were immediately placed on new, clean aluminum foil and were processed in accordance with the procedures described in Section 3.4.3.

3.4.3.3 Vibracore Sample Collection (Sediment)

The vibracore sampling mechanism (modified from a cement mixer) consisted of a stainless-steel shoe and sediment catcher that was attached to a 4-in. diameter aluminum tube. A new, disposable, and decontaminated cellulose acetate butyrate (CAB) tube was fitted inside the aluminum tube to collect the sample. The shoe and CAB tube were riveted to the aluminum tube using disposable aluminum rivets. The vibrating mechanism was attached to a bracket and half-tube assembly using U-bolts. The bracket assembly was attached to the aluminum tube using either hose clamps or U-bolts. The vibrating mechanism was powered by a 3-kW gasoline-powered generator. Once the mechanism was assembled and placed at the station location, the vibrating mechanism was started and a field crew of two people pushed the mechanism down until the target depth or refusal was reached.

The vibracore mechanism was then unplugged from the generator and taken to the sediment processing area for logging and sampling. The aluminum rivets were removed with a cold-chisel and the shoe and CAB tubing were removed from the aluminum tube. The CAB tube was carefully cut in half using a hook utility knife. The sediment core was placed on new, clean aluminum foil and was processed in accordance with Section 3.4.3. A photograph of the vibracore sampling mechanism is provided in Attachment 7.

3.4.3.4 Hand Auger Sample Collection (Soil and Sediment)

Surface samples (i.e., 0 to 1 and 1 to 2 ft bgs) were collected using a decontaminated stainless-steel 3.25-in. diameter hand auger at soil sampling stations where recovery was insufficient using the 2-in. diameter SPT or 3-in. diameter California Modified samplers. In addition, samples were collected from eight hand auger stations (HA-1 through HA-8) and one sediment boring (SB-16) to a depth of approximately 2 ft bgs using the hand auger sampling device.

Soil and sediment samples were collected with a decontaminated stainless-steel hand auger and directly place in a stainless steel mixing bowl. The samples were then logged and processed in accordance with Section 3.4.3. The hand auger was decontaminated between each sample interval collected. A photograph of the stainless-steel hand auger is provided in Attachment 7.

3.4.3.5 Test Pit Sample Collection (Soil)

Each test pit was excavated using either a rubber-tire backhoe or a mini track-mounted excavator. The upper 1 to 2 ft of soil from the test pit area (approximately 5 by 5 ft) was removed and placed to one side of the excavation. The excavation was continued using the excavator, placing the soils on the opposite side of the excavation until the appropriate depth and width were obtained (generally 3 to 4 ft deep and approximately 5 ft wide).

Samples were generally collected at 1-ft intervals to a depth of 3 to 4 ft and from the bottom of the pit using a decontaminated stainless steel shovel or spoon. Samples were collected in the order of deepest samples first, so that the top 1-ft interval was collected last. For test pits that were excavated deeper than 4 ft, the backhoe bucket was used to collect the samples. The samples were logged and processed in accordance with Section 3.4.3.

After the sampling was completed, the excavation was backfilled, beginning with the deeper material excavated from the test pit. Once the backfilling activities were completed, a labeled stake was inserted in the middle of the test pit. A photograph of the track excavator used to excavate some of the test pits is provided in Attachment 7.

3.5 WELL AND PIEZOMETER INSTALLATION AND DEVELOPMENT

Two-inch diameter monitoring wells were installed using a standard rubber-tire HSA drill rig. One-inch diameter piezometers were installed using either a small track-mounted HSA drill rig or an Acker® portable HSA drill rig. Photographs of the drill rigs are provided in Attachment 7.

A lithologic log was generated for each piezometer and monitoring well based on the soil samples collected from the borehole and the drilling conditions noted by the drillers (i.e., change in drilling penetration rate). Well and piezometer completion logs are presented in Attachment 5.

The monitoring well installation procedures closely followed Addendum 2 to the project work plans (Integral 2006a). Slightly different techniques were used to install the piezometers with the track-mounted drill rig and the portable Acker® drill rig due to the small inside diameter (ID) of the augers (3.25 and 2.25 in. ID, respectively) and shallow groundwater conditions near and to the southeast of the creek. The installation procedures are briefly described below.

3.5.1 Monitoring Well Installation

A rubber tire HSA drill rig (i.e., Model CMF 75) was used for the installation of the monitoring wells on the former railroad grade. Drilling was conducted using 8.25-in. OD by 4.25-in. ID hollow-stem augers.

The monitoring well casings consisted of 2-in. diameter Schedule-40 polyvinyl chloride (PVC) with flush-threaded couplings. A 10-ft section of 0.010-in. slot PVC well screen with an end plug (i.e., sump) was used for each well except SB-22 (a Type 315 stainless-steel well screen was used at this station due to petroleum contamination observed in the saturated zone during drilling activities). The casing extended from the top of the screen to the ground surface. Stainless-steel centralizers were attached at the top and bottom of the well screen to keep the well in the center of the filter pack. Due to an oversight, centralizers were not used in Well SB-21; however, centralizers are not required by the Washington Administrative Code.

Each monitoring well was assembled and set inside the hollow-stem augers once the target depth had been reached. The annular space was backfilled with No. 10–20 Colorado silica sand to approximately 2 ft above the top of the screen. The silica sand filter pack material was added to the augers as they were pulled out, keeping several feet of silica sand in the augers to fill the void created by the augers as they were retracted. Only Well SB-24 had a sufficient water column to necessitate surging to promote settling of the filter pack. Well SB-24 was surged with a 12-volt submersible centrifugal pump.

An approximately 2-ft-thick bentonite chip filter pack seal was placed on top of the filter pack as the augers were retracted. The seal was hydrated with clean, potable water until sufficiently hydrated. Bentonite grout was mixed according to the manufacturer's specifications and pumped into the hole to approximately 2.5 ft bgs. When necessary, an approximately 1-ft-thick layer of bentonite chips was placed on top of the grout to create a stable surface for the concrete surface seal, which extended from the ground surface to approximately 1 ft bgs. Each well was completed with an 8-in. diameter flush-mount, traffic-rated, watertight monument.

On February 14, 2006, a hydraulic oil line on the drill rig's air compressor broke during drilling activities at well SB-22. Approximately 2 gal. of hydraulic oil spilled onto the gravel on the former railroad grade before the leak was stopped. The hydraulic oil was cleaned up using absorbent pads and the affected gravel was excavated using shovels. The spent absorbent pads and oily gravel were disposed of by the drilling contractor. The hydraulic oil did not leak on the augers or samplers.

3.5.2 Piezometer Installation

One-inch diameter piezometers were installed using either a small track-mounted HSA drill rig (with 6.5-in. OD by 3.25-in. ID augers) or an Acker® portable HSA drill rig (with 4.63-in. OD by 2.25-in. ID augers). The piezometers consisted of 1-in. ID Schedule 80 PVC casing and 1-in. ID Schedule 80 PVC 0.010-in. slot screen, each with flush threads. A flush threaded PVC end cap or a PVC slip cap was used on the bottom of the piezometer.

If the screen length was trimmed (to achieve a screen length that was not a multiple of 5 ft or to put the screen slots as close to the bottom of the piezometer as possible), a PVC slip cap was used on the bottom of the screen (no glue was used on the slip cap). The piezometer screens were generally extended as close to the top of the water table as possible to intersect any light NAPL (LNAPL) that may be present (generally 3 ft below ground surface so there was room for the filter pack and surface seals) and as close to the gray clay (where present) to intersect any dense NAPL (DNAPL) that may be present.

The installation procedure for the track-mounted HSA drill rig was nearly identical to the well installation procedure described in Section 3.5.1. However, centralizers were not used on the piezometers in order to reduce the chance of the filter pack sand or bentonite chips bridging in the annulus between the piezometer pipe and the inside of the augers.

Piezometers installed with the Acker® rig did not have sufficient room in the annulus between the piezometer and inside of the augers to add the filter pack sand and bentonite without the risk of bridging. As a result, the piezometer pipes were placed inside the augers and the augers were removed prior to adding the filter pack and bentonite chip seal. In most cases, the borings remained open to the bottom of the PVC pipe.

3.5.3 Monitoring Well and Piezometer Development

Each monitoring well was developed by overpumping using a 1.5-in. diameter centrifugal pump (i.e., "whale pump") capable of pumping approximately 1 to 2 gal. per minute (gpm). Piezometers were developed using a high-capacity peristaltic pump capable of pumping approximately 0.75 to 1 gpm. The wells and piezometers were repeatedly surged and pumped. Turbidity measurements were collected periodically, and overpumping and surging continued until the measurements were below 50 nephelometric turbidity units (NTUs).

A minimum of 50 well casing volumes were removed from each well or piezometer during development, with exceptions due to the low productivity of some wells and piezometers. The piezometers installed with the portable Acker® hollow-stem auger drill rig (i.e., SB-9, SB-13, SB-14, SB-18, SB-19, and SB-20) had low productivity and were aggressively surged repeatedly using new, dedicated PVC surge blocks manufactured from 0.5-in. diameter PVC pipe. Monitoring wells SB-21, SB-22, and SB-23 were low producing wells. These wells were repeatedly surged, pumped with the centrifugal pump, and allowed to recover. Photographs of the piezometer and well development equipment are provided in Attachment 7.

3.6 FIELD QUALITY CONTROL

Field duplicates were collected at a frequency of at least one per 20 samples analyzed. Equipment rinsate blanks were collected once per sampling method for soil and sediment. Equipment rinsate blanks were not collected for groundwater and surface water sampling because only new, disposable materials were used in the sampling (Section 4)[5].

Soil and sediment field duplicates were split samples collected from the same parent sample (i.e., same mixing bowl) after the soil or sediment was homogenized. Groundwater and surface water duplicates were collected by alternating the filling of the prelabeled sample and field duplicate bottles (Section 4).

Equipment rinsate blanks were collected by pouring laboratory-supplied deionized water over decontaminated sampling devices/processing materials and catching the water in prelabeled sample bottles. The equipment was rotated throughout the process so that the deionized water came into contact with all surfaces of the equipment.

[5] Surface water from SW-11 was collected using a new, clean stainless-steel bowl because of low flow. Once collected in the bowl, the water was poured into sample bottles for analysis. An equipment rinsate blank was not collected representing this sampling method.

3.7 SHELL MIDDEN BOUNDARY SURVEY

The boundaries of archaeological sites (shell midden) were evaluated within the Park on November 3 to 5, 2005, by Dr. Gary Wessen of Wessen & Associates, Inc. and Integral in accordance with the remedial investigation work plans (Integral 2005a). A series of shovel test pits (STP) with shovel test pit samplers was used to delineate the shell midden as shown on Figure B-1. An archeological report will be provided as an appendix in the draft remedial investigation report.

3.8 HISTORICAL LANDFILL BOUNDARY SURVEY

The historical landfill was delineated by excavating 25 small reconnaissance test pits (RTP) approximately 2 to 6.5 ft deep and the width of the track-hoe bucket (approximately 18 in.). Each test pit was excavated using a mini track-mounted excavator.

The excavated material was examined by a field geologist for the presence of municipal garbage and debris. The reconnaissance test pits were initially excavated on 50-ft centers around Test Pit TP-01. Additional test pits were excavated at the discretion of the field geologist to delineate the lateral extent of the historical landfill, including the area around Test Pits TP-1 and TP-2. Field notes were taken with regard to whether or not municipal garbage or debris was encountered, but the soils were not logged or collected for chemical analysis from the reconnaissance test pits. Observations from the reconnaissance test pits are provided in Table B-1. Photographs of selected reconnaissance test pits are provided in Attachment 7.

Once each reconnaissance test pit was completed, it was backfilled and a labeled stake was placed at the location indicating whether or not the landfill was encountered. Each location was surveyed following methods described in Section 3.1. Based on the results of the reconnaissance test pit survey, three test pits (TP-22, TP-23, and TP-24; Figure B-1) were excavated for the collection of samples for analysis.

Table B-1. Reconnaissance Test Pit Survey Results

Recon. Test Pit No.	Depth Excavated (ft bgs)	Depth Subsurface Municipal Garbage/Debris Observed (ft bgs)	Subsurface Municipal Garbage/Debris Description	Notes
RTP-1	5	None observed.	None observed.	Test pit located on a shelf that is a few feet higher in elevation than TP-01.
RTP-2	2.5	0.5–2.5	Bottles (22 recovered intact), rust, charcoal.	
RTP-3	3	2–3	Metal and glass debris.	Orange soil at bottom

Table B-1. Reconnaissance Test Pit Survey Results

Recon. Test Pit No.	Depth Excavated (ft bgs)	Depth Subsurface Municipal Garbage/Debris Observed (ft bgs)	Subsurface Municipal Garbage/Debris Description	Notes
				of test pit
RTP-4	3	None observed.	None observed.	
RTP-5	3	Not noted.	One broken bottle observed.	Groundwater at 2.5 ft bgs.
RTP-6	3	Approx 2.5	Rust, possible ash, a small amount of metal, two bottles, and one brush.	Groundwater at 2.5 ft bgs.
RTP-7	3	Not noted.	One small piece of glass and metal.	Groundwater at 2-2.5 ft bgs.
RTP-8	3	None observed.	None observed.	Groundwater at 2.3 ft bgs.
RTP-9	3	None observed.	None observed.	Groundwater at 2 ft bgs.
RTP-10	3	Not noted.	One small bottle, trace of glass and metal.	Orange layer observed at 1.5 ft bgs.
RTP-11	3	None observed.	None observed.	Groundwater observed at 2 ft bgs.
RTP-12	3	None observed.	None observed.	Groundwater observed at 1.8 ft bgs.
RTP-13	3.5	None observed.	None observed.	Groundwater observed at 3 ft bgs.
RTP-14	3	None observed.	None observed.	Groundwater observed at 2.5 ft bgs.
RTP-15	4	Not noted.	One piece of black slag observed.	Groundwater observed at 4 ft bgs.
RTP-16	4	1.8–4	Orange soil, ash, bottles (12 intact), brick, mirror, ceramics, metal.	Groundwater observed at 4 ft bgs.
RTP-17	4.5	Not noted. Orange soil and ash observed at approx. 3–3.5 ft bgs.	Bottles (seven intact), ceramics, metal, melted glass, ash, and orange soil.	Groundwater observed at 4.5 ft bgs.
RTP-18	3.5	2.5–3.5	Mostly metal debris, with some glass (including one intact bottle).	Groundwater observed at 3.5 ft bgs. Orange soil/ash layer 2.8–3 ft bgs. Slight diesel/oil-like odor observed.

Table B-1. Reconnaissance Test Pit Survey Results

Recon. Test Pit No.	Depth Excavated (ft bgs)	Depth Subsurface Municipal Garbage/Debris Observed (ft bgs)	Subsurface Municipal Garbage/Debris Description	Notes
RTP-19	5	2.8–5	Glass (10 intact bottles), some metal.	Orange soil and rust observed 1.8 to 5 ft bgs.
RTP-20	3	None observed.	None observed.	Groundwater observed at 3 ft bgs.
RTP-21	4.5	None observed.	None observed.	Groundwater observed at 3 ft bgs.
RTP-22	6.5	3.0–4.5	Drywall, ash, and metal.	
RTP-23	4.7	0–3.5	Some asphalt and one red brick.	Organic-rich silt observed at 4 ft bgs (native).
RTP-24	2.4	None observed.	None observed.	Organic-rich silt observed at 2 ft bgs (native).
RTP-25	2	0–1.5	Three small pieces of glass.	Organic-rich silt observed at 1.5 ft bgs (native).

3.9 INVESTIGATION-DERIVED WASTE

Investigation-derived waste was handled according to the remedial investigation work plans (Integral 2005a) and Addendum 2 to the work plans (Integral 2006a). All visibly contaminated soils, sediments, decontamination water, purge water, and development waters were containerized in labeled 55-gal. drums for characterization in accordance with applicable local, state, and federal regulations prior to disposal.

When methanol and hexane were used to decontaminate sampling materials with visible NAPL contamination, they were used sparingly on paper towels in well-ventilated areas. Following use, the decontamination chemicals on the paper towels were allowed to evaporate prior to disposal at a solid waste landfill.

4 DEVIATIONS FROM SAMPLING AND ANALYSIS PLAN

Thirteen deviations from the sampling and analysis plan were implemented during the field program. Table B-2 briefly describes each of the deviations. The field change request (FCR) forms are provided in Attachment 8.

Table B-2. Deviations from the Sampling and Analysis Plan

Field Change Request No.	Date	Description of Change	Reason for Change
FCR-1	11-3-05	Did not collect equipment rinsate blanks for surface water sampling.	Equipment rinsate blanks are not necessary because the sample bottles either are directly filled with the surface water or with a peristaltic pump with new, disposable Teflon®-lined tubing.
FCR-2	11-3-05	Did not collect equipment rinsate blanks for groundwater sampling.	Equipment rinsate blanks are not necessary because the sample bottles either filled using a new, disposable Teflon® bailer or with a peristaltic pump with new, disposable Teflon®-lined tubing.
FCR-3	11-3-05	Did not collect groundwater samples from LSCMW-1.	The well is full of sand and gravel material.
FCR-4	11-7-05	Did not collect surface sediment samples at Stations LSC-10, LSC-11, and LSC-12, located at the mouth of Little Squalicum Creek.	No fine grained materials observed at these stations.
FCR-5	11-11-06	Did not collect total organic carbon rinsate blank sample for test pit sampling.	Inadvertent omission. Conventional analyses are not typically an issue or required for rinsate blanks.
FCR-6	2-14-06	Placed all visually contaminated materials (soil/sediment and water) in 55-gal. drums.	Avoid leaving visually contaminated materials at sample stations.
FCR-7	2-14-06	Dried water from sampling equipment using paper towels rather than using methyl alcohol to displace water prior to a hexane wipe when NAPL contaminated soils or sediments were encountered.	Field crew concerned about the health hazards of methyl alcohol.

Table B-2. Deviations from the Sampling and Analysis Plan

Field Change Request No.	Date	Description of Change	Reason for Change
FCR-8	2-14-06	Reduced the number of samples collected from SB-24 below 20 ft bgs.	This will speed up the drilling process. Field observations from SB-21, SB-22, and SB-23 indicated no contamination above the water table.
FCR-9	2-17-06	Pumped fewer than 50 casing volumes to develop many of the piezometers and wells that produced very little water.	Repeatedly surge, pump, and allow wells/piezometers to recover. Develop each well or piezometer for a minimum of 4 hours.
FCR-10	2-20-06	Did not collect field parameters on purge water from piezometer SB-09.	The petroleum sheen observed from SB-09 purge water could have damaged the water quality meter probes.
FCR-11	5-11-06	Did not analyze surface soil samples collected from Stations SB-26, 27, 30, and 32.	These stations are located 100 ft or more from the creek in areas where sufficient surface soil data already exists.
FCR-12	5-11-06	Did not collect dioxin/furan groundwater samples from piezometers SB-26, SB-27, SB-28, and SB-30.	No visual evidence of contamination at these stations.
FCR-13	5-11-06	Did not collect field parameters on purge water from piezometer SB-29.	The petroleum sheen observed from SB-29 purge water could have damaged the water quality meter probes.

5 SUMMARY OF DATA COLLECTED

Table B-3 presents an analysis summary for all sample matrices collected as part of this investigation (Table B-3 follows the text).

6 REFERENCES

Integral. 2005a. Final work plans. Little Squalicum Park remedial investigation/feasibility study, Bellingham, Washington. Prepared for the City of Bellingham, Parks and Recreation Department, Bellingham, WA. Integral Consulting Inc., Bellingham, WA. September 30, 2005.

Integral. 2005b. Addendum 1 to the sampling and analysis plan. Little Squalicum Park remedial investigation/feasibility study, Bellingham, WA. Prepared for the City of Bellingham, Parks and Recreation Department, Bellingham, WA. Integral Consulting Inc., Bellingham, WA. November 14, 2005.

Integral. 2006a. Addendum 2 to the sampling and analysis plan. Little Squalicum Park remedial investigation/feasibility study, Bellingham, Washington. Prepared for the City of Bellingham, Parks and Recreation Department, Bellingham, WA. Integral Consulting Inc., Bellingham, WA. January 24, 2006.

Integral. 2006b. Addendum 3 to the sampling and analysis plan and health and safety plan. Little Squalicum Park remedial investigation/feasibility study, Bellingham, WA. Prepared for the City of Bellingham, Parks and Recreation Department and Public Works Department, Bellingham, WA. Integral Consulting, Inc., Bellingham, WA. October 2, 2006.

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Surface Water (SW) Samples

Sample Number	Sample Location	Sample Depth (ft)	Date	Time	Total Organic Carbon	Total Suspended Solids	Hardness	Total Metals	Dissolved Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Notes
Nov-05																
LSP0009	Reference	Surface	2-Nov-05	13:30	X	X	X	X	X	X		X		X	X	
LSP0001	SW01	Surface	1-Nov-05	11:25	X	X	X	X	X	X		X		X		
LSP0003	SW04	Surface	1-Nov-05	13:45	X	X	X	X	X	X		X		X		
LSP0004	SW05	Surface	1-Nov-05	14:50	X	X	X	X	X	X		X		X	X	
LSP0005	SW05-DUP	Surface	1-Nov-05	15:00	X	X	X	X	X	X		X		X	X	
LSP0006	SW06	Surface	1-Nov-05	15:30	X	X	X	X	X	X		X		X	X	
LSP0007	SW07	Surface	2-Nov-05	11:15	X	X	X	X	X	X		X		X		
LSP0002	SW09	Surface	1-Nov-05	12:30	X	X	X	X	X	X		X		X		
LSP0008	SW10	Surface	2-Nov-05	9:15	X	X	X	X	X	X		X		X	X	
Apr-06																
LSP0582	Reference	Surface	27-Apr-06	7:50	X	X	X	X	X	X		X		X		
LSP0583	SW-01	Surface	27-Apr-06	11:05	X	X	X	X	X	X		X		X		
LSP0585	SW-04	Surface	27-Apr-06	13:15	X	X	X	X	X	X		X		X		
LSP0587	SW-05	Surface	27-Apr-06	16:15	X	X	X	X	X	X		X		X	X	Requested Dioxins/Furans analysis 05/03/06
LSP0588	SW-05dup	Surface	27-Apr-06	16:15	X	X	X	X	X	X		X		X	X	Requested Dioxins/Furans analysis 05/03/06
LSP0586	SW-06	Surface	27-Apr-06	15:20	X	X	X	X	X	X		X		X		
LSP0589	SW-07	Surface	27-Apr-06	18:10	X	X	X	X	X	X		X		X		
LSP0584	SW-09	Surface	27-Apr-06	12:15	X	X	X	X	X	X		X		X		
LSP0590	SW-10	Surface	27-Apr-06	9:30	X	X	X	X	X	X		X		X		
LSP0599	SW-11	Surface	27-Apr-06	13:45	X	X	X	X	X	X		X		X		
LSP0601	SW-12	Surface	1-May-06	10:30	X	X	X	X	X	X		X				

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Groundwater (GW) Samples

Sample Number	Sample Location	Sample Depth (ft btoc)	Date	Time	Total Organic Carbon	Total Suspended Solids	Hardness	Total Metals	Dissolved Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Notes
Nov-05																
LSP0010	MWLSP02	21	3-Nov-05	13:00	X	X	X	X	X	X		X		X	X	
LSP0012	MWLSP02-DUP	21	3-Nov-05	13:15	X	X	X	X	X	X		X		X	X	
LSP0013	MWLSP03	30-32	3-Nov-05	16:05	X	X	X	X	X	X		X		X	X	
LSP0014	MW06D	32.5-35.5	3-Nov-05	18:45	X	X	X	X	X	X		X		X	X	
Feb-06																
LSP0367	SBGW-18	3.5	20-Feb-06	9:30	X	X				X		X		X		
LSP0368	SBGW-19	2	20-Feb-06	11:50	X	X				X		X		X		
LSP0369	SBGW-20	6.7	20-Feb-06	13:35	X	X				X		X		X		
LSP0370	SBGW-13	9	20-Feb-06	16:10	X	X				X		X		X		
LSP0371	SBGW-21	28.73-31.40	21-Feb-06	11:30	X	X	X	X	X	X		X		X	X	
LSP0372	SBGW-09	9.5	21-Feb-06	11:05	X	X				X		X		X		
LSP0373	SBGW-22	27.40-29.20	21-Feb-06	15:30	X	X	X	X	X	X		X		X	X	
LSP0374	SBGW-14	9.5	21-Feb-06	15:50	X	X	X	X	X	X		X		X	X	
LSP0375	SBGW-11	9	22-Feb-06	9:00	X	X	X	X	X	X		X		X	X	
LSP0376	SBGW-11-dup	9	22-Feb-06	9:15	X	X	X	X	X	X		X		X	X	
LSP0377	SBGW-24	27.75-30.75	22-Feb-06	13:40	X	X	X	X	X	X		X		X	X	
LSP0378	SBGW-23	27.50-30.05	22-Feb-06	16:10			X	X	X			X		X		Insufficient volume
LSP0379	LSCMW-03	25.0-28.0	22-Feb-06	17:35	X	X	X	X	X	X		X		X	X	
LSP0380	MW-06D	31.0-34.0	23-Feb-06	14:35	X	X	X	X	X	X		X		X	X	
LSP0381	LSCMW-2	21	23-Feb-06	17:10	X	X	X	X	X	X		X		X	X	
May-06																
LSP0591	SBGW-25	3	2-May-06	10:30	X	X	X	X	X	X		X	X	X	X	Requested Dioxins/Furans analysis 05/08/06; requested EPH analysis 05/15/06
LSP0592	SBGW-25 dup	3	2-May-06	10:45	X	X	X	X	X	X		X	X	X		Requested EPH analysis 05/15/06
LSP0593	SBGW-26	3.5	1-May-06	12:50	X	X	X	X	X	X		X		X		
LSP0594	SBGW-27	4	1-May-06	17:15	X	X	X	X	X	X		X		X		
LSP0595	SBGW-28	7.5	2-May-06	13:30	X	X	X	X	X	X		X		X		
LSP0596	SBGW-29	8	2-May-06	15:15	X	X	X	X	X	X	X	X	X	X	X	Requested Dioxins/Furans analysis 05/08/06; requested VPH analysis 05/12/06; requested EPH analysis 05/15/06
LSP0597	SBGW-30	5.5	2-May-06	13:30	X	X	X	X	X	X		X		X		
LSP0598	SBGW-32	2.5	1-May-06	16:00	X	X	X	X	X	X		X		X	X	Requested Dioxins/Furans analysis 05/08/06

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Hand-Auger (HA) Soil Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Tag Number	Analysis	Analyzed	Total Organic Carbon	Total Solids	Physical Testing	Total Metals	NWTPH-DRO+RRO	EPH	SVOCs	Pest/ PCBs	Archived	Notes
Nov-05																	
LSP0015	HA-7	0-1	4-Nov-05	14:45	2759	TOC	X	X	X		X	X					
LSP0016	HA-7	1-2	4-Nov-05	15:00	2764	TOC			X		X						
LSP0017	HA-8	0-1	4-Nov-05	15:50	2769	TOC	X	X	X		X	X					
LSP0018	HA-8	1-2	4-Nov-05	16:00	2774	TOC			X		X						Requested Total Metals analysis 12/02/05
LSP0051	LSC Bank	Creek Bank	7-Nov-05	16:45	1749	SVOCS	X		X			X	X	X			Requested 72-hour analysis 11/09/05
Feb-06																	
LSP0119	HA-09	0-2.5	1-Feb-06	16:45	5101	TOC										X	
Apr-06																	
LSP0569	HA-01	0-1	12-Apr-06	8:45	6778	Pest/PCBs	X	X	X		X	X			X		
LSP0570	HA-01	1-2	12-Apr-06	8:50	6783	Pest/PCBs	X	X	X		X	X			X		
LSP0571	HA-02	0-1	12-Apr-06	9:30	6788	Pest/PCBs	X	X	X		X	X			X		
LSP0571	HA-02	0-1	12-Apr-06	9:30	6791	Pest/PCBs*****	X										***** Requested Herbicide analysis 5/10/07
LSP0572	HA-02	1-2	12-Apr-06	9:35	6793	Pest/PCBs	X	X	X		X	X			X		
LSP0573	HA-03	0-1	12-Apr-06	10:50	6803	Pest/PCBs	X	X	X		X	X			X		
LSP0574	HA-03	1-2	12-Apr-06	10:55	6798	Pest/PCBs	X	X	X		X	X			X		
LSP0575	HA-04	0-1	12-Apr-06	11:10	6813	Pest/PCBs	X	X	X		X	X			X		
LSP0576	HA-04	1-2	12-Apr-06	11:15	6808	Pest/PCBs	X	X	X		X	X			X		
LSP0577	HA-05	0-1	12-Apr-06	10:15	6818	Pest/PCBs	X	X	X		X	X			X		
LSP0578	HA-05	1-2	12-Apr-06	10:20	6823	Pest/PCBs	X	X	X		X	X			X		
LSP0579	HA-06	0-1	12-Apr-06	9:00	6833	Pest/PCBs	X	X	X		X	X			X		
LSP0580	HA-06	1-2	12-Apr-06	9:10	6828	Pest/PCBs	X	X	X		X	X			X		
LSP0581	HA-06	0-1	12-Apr-06	9:05	6839	Pest/PCBs	X	X	X		X	X			X		Duplicate/split of HA-06 0-1' interval
LSP0568	NA	NA	11-Apr-06	14:20	6772	SVOCS					X	X			X		Rinsate blank (hand-auger, bowl, and mixing spoons)

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Test Pit (TP) Soil Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Physical Testing	Total Metals	TCLP Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	PCBs	Archived	Notes
Nov-05																		
LSP0059	TP-01	0-1	9-Nov-05	14:35	X	X	X	X		X		X						
LSP0060	TP-01 DUP	0-1	9-Nov-05	14:40	X	X	X	X		X		X						
LSP0061	TP-01	1-2	9-Nov-05	14:50	X	X		X		X		X				X		Requested PCB analysis 12/08/2005
LSP0062	TP-01	2-3	9-Nov-05	14:55	X	X		X		X		X				X		Requested PCB analysis 12/08/2005
LSP0063	TP-01	3-4	9-Nov-05	14:47	X	X		X		X		X						
LSP0064	TP-01	4-5	9-Nov-05	14:45	X	X		X		X		X						
LSP0065	TP-02	0-1	10-Nov-05	8:30	X	X		X		X		X						
LSP0066	TP-02 DUP	0-1	10-Nov-05	8:40	X	X		X		X		X						
LSP0067	TP-02	1-1.6	10-Nov-05	8:50	X	X		X		X		X						
LSP0071	TP-02	1.6-2.9	10-Nov-05	10:00	X	X		X		X		X						
LSP0070	TP-02	2.9-3.7	10-Nov-05	9:50	X	X		X		X	X	X						
LSP0069	TP-02	3.7-4.2	10-Nov-05	9:40	X	X		X		X		X						
LSP0068	TP-02	4.2-5.3	10-Nov-05	8:55	X	X	X	X		X		X						
LSP0075	TP-03	0-1	10-Nov-05	13:00	X	X		X		X		X						
LSP0074	TP-03	1-2	10-Nov-05	12:50		X		X										Requested Total Metals analysis 12/02/2005
LSP0073	TP-03	2-3	10-Nov-05	12:40													X	
LSP0072	TP-03	3-Bottom	10-Nov-05	12:30			X										X	
LSP0076	RINSE BLANK	NA	10-Nov-05	15:15				X		X		X		X				
LSP0055	TP-04	0-1	9-Nov-05	11:15	X	X		X				X						
LSP0056	TP-04	1-2	9-Nov-05	11:25													X	
LSP0057	TP-04	2-3	9-Nov-05	11:35													X	
LSP0058	TP-04	3-Bottom	9-Nov-05	11:45													X	
LSP0050	TP-05	0-1	9-Nov-05	9:10	X	X		X				X						
LSP0052	TP-05	1-2	9-Nov-05	9:15		X	X										X	
LSP0053	TP-05	2-3	9-Nov-05	9:20		X	X										X	
LSP0054	TP-05	3-Bottom	9-Nov-05	9:25													X	
LSP0044	TP-06	0-1	8-Nov-05	15:10	X	X		X		X		X	X	X				Requested rush 72-hour EPH analysis 11/09/05
LSP0045	TP-06	1-2	8-Nov-05	15:15		X				X		X	X	X				Requested rush 72-hour EPH analysis 11/09/05
LSP0046	TP-06	2-3	8-Nov-05	16:10		X				X		X		X				
LSP0047	TP-06	3-4	8-Nov-05	16:30		X				X		X		X				
LSP0048	TP-06	4-Bottom	8-Nov-05	16:40		X	X					X		X				
LSP0040	TP-07	0-1	8-Nov-05	10:15	X	X		X				X						
LSP0041	TP-07	1-2	8-Nov-05	10:20													X	
LSP0042	TP-07	2-3	8-Nov-05	10:25													X	
LSP0043	TP-07	3-Bottom	8-Nov-05	10:30													X	
LSP0037	TP-08	0-1.4	8-Nov-05	8:30	X	X		X				X						
LSP0038	TP-08	1.4-3	8-Nov-05	8:35													X	
LSP0039	TP-08	3-Bottom	8-Nov-05	8:40													X	
LSP0031	TP-09	0-1	7-Nov-05	16:00	X	X	X	X		X		X						
LSP0032	TP-09	1-2	7-Nov-05	16:05													X	
LSP0033	TP-09	2-3	7-Nov-05	16:10													X	
LSP0034	TP-09	3-4	7-Nov-05	16:15													X	
LSP0036	TP-09	4-Bottom	7-Nov-05	16:20													X	
LSP0028	TP-10	0-1	7-Nov-05	13:00	X	X	X	X				X						

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Test Pit (TP) Soil Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Physical Testing	Total Metals	TCLP Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	PCBs	Archived	Notes
LSP0029	TP-10	1-2	7-Nov-05	13:05		X		X				X						Requested Total Metals and NWTPH-DRO+RRO analysis 11/14/05
LSP0030	TP-10	2-3	7-Nov-05	13:10													X	
LSP0035	TP-10	3-4	7-Nov-05	13:15													X	
LSP0023	TP-11	0-1	7-Nov-05	11:15	X	X		X				X						
LSP0024	TP-11	1-2	7-Nov-05	11:25								X						
LSP0027	TP-11	1.4-2.0	7-Nov-05	11:40													X	
LSP0019	TP-12	0-1	7-Nov-05	9:20	X	X	X	X				X						
LSP0020	TP-12	1-2	7-Nov-05	9:25													X	
LSP0021	TP-12	2-3	7-Nov-05	9:30		X	X											
LSP0022	TP-12	3-Bottom	7-Nov-05	9:35													X	
LSP0083	TP-13	0-1	16-Nov-05	8:20													X	
LSP0084	TP-13	1-5	16-Nov-05	8:25													X	
LSP0085	TP-14	0-0.5	16-Nov-05	9:25													X	
LSP0086	TP-14	0.5-4.2	16-Nov-05	9:30													X	
LSP0078	TP-15	0-1	16-Nov-05	11:10		X						X						
LSP0079	TP-15	1-2	16-Nov-05	11:05													X	
LSP0080	TP-15	2-3	16-Nov-05	11:00													X	
LSP0081	TP-15	3-4	16-Nov-05	11:20		X						X					X	
LSP0088	TP-16	0-2	16-Nov-05	13:45		X						X		X	X			Requested SVOC analysis 11/25/05; requested Dioxins/Furans analysis 12/08/05
LSP0087	TP-16	2-4	16-Nov-05	13:55		X						X						
LSP0089	TP-17	0-1	16-Nov-05	15:10		X						X						
LSP0090	TP-17	1-2	16-Nov-05	15:15		X						X		X	X			Requested SVOC analysis 11/25/05; requested Dioxins/Furans analysis 12/08/05
LSP0091	TP-17	2-3	16-Nov-05	15:20		X						X						Requested NWTPH-DRO+RRO analysis 11/25/05
LSP0092	TP-17	3-4	16-Nov-05	15:25		X						X						Requested NWTPH-DRO+RRO analysis 11/25/05
LSP0093	TP-18	0-1	17-Nov-05	8:15													X	
LSP0094	TP-18	1-2.5	17-Nov-05	8:20													X	
LSP0095	TP-18	2.5-3.5	17-Nov-05	8:25													X	
LSP0096	TP-19	0-1	17-Nov-05	10:00		X						X						
LSP0097	TP-19	1-2	17-Nov-05	10:05		X						X						
LSP0098	TP-19	2-3	17-Nov-05	10:10													X	
LSP0099	TP-20	0-2	17-Nov-05	11:30													X	
LSP0100	TP-20	2-4	17-Nov-05	11:30													X	
LSP0101	TP-20	2-2.6	17-Nov-05	12:35													X	
LSP0102	TP-21	0-2	17-Nov-05	13:10		X						X		X				Requested SVOC analysis 11/25/05
LSP0103	TP-21 DUP	2-4	17-Nov-05	13:15		X						X						Requested NWTPH-DRO+RRO analysis 11/25/05

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Test Pit (TP) Soil Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Physical Testing	Total Metals	TCLP Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	PCBs	Archived	Notes
LSP0104	TP-21	2-4	17-Nov-05	13:20		X						X						Requested NWTPH-DRO+RRO analysis 11/25/05
Jan-06																		
LSP0105	TP-22	0-0.5	31-Jan-06	9:50		X		X				X						
LSP0106	TP-22	0.5-1.7	31-Jan-06	9:40		X		X				X						
LSP0107	TP-22	1.7-2.2	31-Jan-06	9:30		X		X	X	X		X						Requested TCLP analysis 04/22/06
LSP0108	TP-23	0-2	31-Jan-06	12:10		X		X				X		X				
LSP0109	TP-23	2-3.5	31-Jan-06	11:55		X		X				X						
LSP0110	TP-23	3.5-4	31-Jan-06	11:45		X		X	X			X		X				Requested TCLP analysis 04/22/06
LSP0111	TP-23	4	31-Jan-06	11:40		X		X				X						
LSP0112	TP-23	4.5-5.0	31-Jan-06	13:10		X		X				X						
LSP0113	TP-24	0-1.5	31-Jan-06	14:10		X		X				X						
LSP0114	TP-24	1.5	31-Jan-06	14:15		X		X				X						
LSP0115	TP-25	0-0.6	31-Jan-06	8:40	X	X		X				X						
LSP0116	TP-25	0.6-2	31-Jan-06	8:35	X	X		X				X						
LSP0117	TP-25	2-3	31-Jan-06	8:25													X	
LSP0118	TP-25	3-4	31-Jan-06	8:20													X	
Oct-06																		
LSP0649	TP-26	0-1	12-Oct-06	15:55				X				X					X	
LSP0650	TP-26	1-2	12-Oct-06	16:00				X				X					X	
LSP0651	TP-26	2-3	12-Oct-06	16:05													X	
LSP0652	TP-26	3-4	12-Oct-06	16:10													X	
LSP0653	TP-27	0-1	12-Oct-06	14:45				X				X					X	
LSP0654	TP-27	1-2	12-Oct-06	14:50													X	
LSP0655	TP-27	2-3	12-Oct-06	14:55													X	
LSP0656	TP-27	3-4	12-Oct-06	15:00													X	
LSP0657	TP-28	0-1	12-Oct-06	13:35				X				X					X	Requested SPLP arsenic analysis on 08/21/07
LSP0658	TP-28	1-2	12-Oct-06	13:40													X	
LSP0659	TP-28	2-3	12-Oct-06	13:45													X	
LSP0660	TP-28	3-4	12-Oct-06	13:50													X	
LSP0661	TP-29	0-1	12-Oct-06	11:25				X				X					X	
LSP0662	TP-29	1-2	12-Oct-06	11:30													X	
LSP0663	TP-29	2-3	12-Oct-06	11:35													X	
LSP0664	TP-29	3-4	12-Oct-06	11:40													X	
LSP0665	TP-30	0-1	12-Oct-06	10:00				X				X					X	
LSP0673	TP-30	0-1	12-Oct-06	10:05				X				X					X	
LSP0666	TP-30	1-2	12-Oct-06	10:10													X	
LSP0667	TP-30	2-3	12-Oct-06	10:15													X	
LSP0668	TP-30	3-4	12-Oct-06	10:20													X	
LSP0669	TP-31	0-1	12-Oct-06	8:35				X				X					X	Requested SPLP and TCLP arsenic analysis on 08/21/07
LSP0670	TP-31	1-2	12-Oct-06	8:40													X	
LSP0671	TP-31	2-3	12-Oct-06	8:45													X	
LSP0672	TP-31	3-4	12-Oct-06	8:50													X	

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Soil Boring (SB) Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Grain Size	Physical Testing	Total Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Archived	Notes
Feb-06																	
LSP0121	SB-1	0-1	2-Feb-06	10:05	X	X			X			X					
LSP0122	SB-1	1-2	2-Feb-06	10:15	X	X			X			X					
LSP0123	SB-1	2-3	2-Feb-06	NA													No recovery
LSP0124	SB-1	3-4	2-Feb-06	10:35		X			X								Requested Total Metals analysis 02/22/06
LSP0125	SB-1	4-5	2-Feb-06	10:45												X	
LSP0126	SB-1	5-6	2-Feb-06	10:55												X	
LSP0127	SB-2	1-2	2-Feb-06	13:15	X	X			X			X		X	X		Requested SVOC analysis 02/14/06; requested Dioxins/Furans analysis 04/21/06
LSP0128	SB-2	2-3	2-Feb-06	13:25		X			X			X					Requested TPH-DRO+RRO analysis 02/14/06; requested Total Metals analysis 02/22/06
LSP0129	SB-2	3-4	2-Feb-06	13:35												X	
LSP0130	SB-2	4-5	2-Feb-06	13:40												X	
LSP0131	SB-2	6-7	2-Feb-06	14:00												X	
LSP0132	SB-2	0-1	2-Feb-06	14:45	X	X		X	X			X		X			Requested SVOC analysis 02/14/06
LSP0133	SB-2	0-1 dup	2-Feb-06	15:00	X	X		X	X			X		X	X		Requested SVOC analysis 02/14/06
LSP0120	SB-3	2-3	2-Feb-06	14:55		X			X								Requested Total Metals analysis 02/22/06
LSP0134	SB-3	3-4	2-Feb-06	15:05												X	
LSP0136	SB-3	4-5	2-Feb-06	15:15												X	
LSP0137	SB-3	5-6	2-Feb-06	15:25												X	
LSP0138	SB-3	1-2	2-Feb-06	15:55	X	X			X			X					
LSP0168	SB-3	0-1	3-Feb-06	15:45	X	X			X			X					Hand-auger
LSP0139	SB-4	1-2	3-Feb-06	8:30	X	X			X			X					
LSP0140	SB-4	2-3	3-Feb-06	8:40												X	
LSP0141	SB-4	3-4	3-Feb-06	8:50												X	
LSP0142	SB-4	4-5	3-Feb-06	9:00												X	
LSP0143	SB-4	5-6	3-Feb-06	9:10		X						X				X	
LSP0144	SB-4	6-7	3-Feb-06	9:20												X	
LSP0169	SB-4	0-1	3-Feb-06	15:15	X	X			X			X					Hand-auger
LSP0170	SB-4	0-1 dup	3-Feb-06	15:30	X	X			X			X					Hand-auger
LSP0145	SB-5	0-1	3-Feb-06	9:40	X	X			X			X					
LSP0146	SB-5	1-2	3-Feb-06	9:55	X	X			X			X					
LSP0147	SB-5	2-3	3-Feb-06	10:05		X	X										Requested Grain Size analysis 04/21/06
LSP0148	SB-5	3-4	3-Feb-06	10:15												X	
LSP0149	SB-5	4-5	3-Feb-06	10:25												X	
LSP0150	SB-6	0-1	3-Feb-06	12:00	X	X			X			X					
LSP0151	SB-6	1-2	3-Feb-06	12:10	X	X			X			X					
LSP0152	SB-6	2-3	3-Feb-06	10:25												X	
LSP0153	SB-6	4-5	3-Feb-06	12:40	X	X				X		X					
LSP0154	SB-6	5-6	3-Feb-06	12:50												X	
LSP0155	SB-6	6-7	3-Feb-06	13:05												X	
LSP0156	SB-6	7-8	3-Feb-06	13:20												X	
LSP0157	SB-7	0-1	3-Feb-06	13:45	X	X			X			X					
LSP0158	SB-7	1-2	3-Feb-06	13:50	X	X			X			X					
LSP0159	SB-7	2-3	3-Feb-06	13:55												X	
LSP0160	SB-7	3-4	3-Feb-06	14:05												X	
LSP0161	SB-7	4-5	3-Feb-06	14:10												X	
LSP0162	SB-8	0-1	3-Feb-06	14:50	X	X			X			X					
LSP0163	SB-8	1-2	3-Feb-06	15:05	X	X			X			X					
LSP0164	SB-8	2-3	3-Feb-06	15:15												X	
LSP0165	SB-8	3-4	3-Feb-06	15:25												X	
LSP0166	SB-8	4-5	3-Feb-06	15:35				X								X	
LSP0167	SB-8	5-6	3-Feb-06	15:45												X	
LSP0213	SB-9	0-1	8-Feb-06	13:40	X	X			X			X		X			Requested SVOC analysis 02/21/06
LSP0214	SB-9	0-1 dup	8-Feb-06	13:50	X	X			X			X		X	X		Requested SVOC analysis 02/21/06; requested Dioxins/Furans analysis 04/21/06

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Soil Boring (SB) Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Grain Size	Physical Testing	Total Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Archived	Notes
LSP0215	SB-9	1-2	8-Feb-06	14:00	X	X			X			X					
LSP0171	SB-9	0-2	6-Feb-06	10:20												X	
LSP0172	SB-9	2-3	6-Feb-06	10:25		X			X								Requested Zinc analysis 03/21/06
LSP0173	SB-9	3-4	6-Feb-06	10:30				X									Requested Physical Testing analysis 04/21/06
LSP0174	SB-9	4-5	6-Feb-06	10:45												X	
LSP0175	SB-9	5-6	6-Feb-06	10:55		X						X					Requested NWTPH-DRO+RRO analysis 04/21/06
LSP0176	SB-9	6-7	6-Feb-06	11:00	X	X	X					X		X			Requested TOC, Grain Size, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0177	SB-9	7-8	6-Feb-06	11:05	X	X			X			X	X	X	X		Requested TOC, Total Metals, and Dioxins/Furans analysis 04/21/06; requested EPH analysis 05/15/06
LSP0178	SB-9	8-9	6-Feb-06	11:30		X						X		X			Requested NWTPH-DRO+RRO and SVOC analysis 04/21/06
LSP0179	SB-9	9-10	6-Feb-06	11:40		X						X		X			Requested NWTPH-DRO+RRO and SVOC analysis 04/21/06
LSP0180	SB-10	0-1	6-Feb-06	14:05			X										Requested Grain Size analysis 04/21/06
LSP0181	SB-10	2-3	6-Feb-06	14:20		X						X		X			Requested SVOC analysis 02/21/06
LSP0182	SB-10	3-4	6-Feb-06	14:30		X	X		X			X					Requested Grain Size analysis 04/21/06
LSP0183	SB-10	4-5	6-Feb-06	14:35												X	
LSP0184	SB-10	5-6	6-Feb-06	14:40			X										Requested Grain Size analysis 04/21/06
LSP0185	Rinse Blank	NA	6-Feb-06	16:30	X				X			X		X		X	Rinsate blank
LSP0186	SB-11	0-1	7-Feb-06	8:15												X	
LSP0187	SB-11	2-3	7-Feb-06	8:30		X			X			X				X	Requested NWTPH-DRO+RRO analysis 02/24/06; requested Total Metals analysis 03/21/06
LSP0188	SB-11	3-4	7-Feb-06	8:35												X	
LSP0189	SB-11	4-5	7-Feb-06	8:40		X			X			X					
LSP0190	SB-11	5-6	7-Feb-06	8:45		X			X								Requested Total Metals analysis 03/21/06
LSP0191	SB-11	6-7	7-Feb-06	8:50		X			X			X		X			Requested SVOC analysis 03/13/06
LSP0192	SB-11	7-8	7-Feb-06	8:55		X			X								Requested Total Metals analysis 03/21/06
LSP0193	SB-11	8-9	7-Feb-06	9:00												X	
LSP0194	SB-11	9-10	7-Feb-06	9:10												X	
LSP0195	SB-11	10-11	7-Feb-06	9:30												X	
LSP0196	SB-11	12-13	7-Feb-06	9:55												X	
LSP0274	SB-11	0-1	11-Feb-06	14:30	X	X			X			X		X			Hand-auger; requested SVOC analysis 02/24/06
LSP0275	SB-11	1-2	11-Feb-06	14:45	X	X			X			X	X	X			Hand-auger; requested SVOC and EPH analysis 02/24/06
LSP0197	SB-12	0-1	7-Feb-06	13:05	X	X			X			X					
LSP0198	SB-12	1-2	7-Feb-06	13:10		X						X					
LSP0199	SB-12	2-3	7-Feb-06	13:15												X	
LSP0200	SB-12	3-4	7-Feb-06	13:20												X	
LSP0201	SB-12	4-5	7-Feb-06	13:25	X	X	X					X		X	X		Requested TOC, Grain Size, and Dioxins/Furans analysis 04/21/06
LSP0202	SB-12	5-6	7-Feb-06	13:55												X	
LSP0203	SB-12	6-7	7-Feb-06	14:10												X	
LSP0204	SB-12	Bottom	7-Feb-06	15:00				X									Requested Physical Testing analysis 04/21/06
LSP0224	SB-13	0-1	9-Feb-06	8:05	X	X			X			X					
LSP0225	SB-13	1-2	9-Feb-06	8:20	X	X			X			X					
LSP0205	SB-13	0-1	8-Feb-06	10:15												X	
LSP0206	SB-13	1-2	8-Feb-06	10:25												X	
LSP0207	SB-13	2-3	8-Feb-06	10:50		X			X								Requested Total Metals analysis 03/21/06
LSP0208	SB-13	3-4	8-Feb-06	11:00												X	
LSP0209	SB-13	5-6	8-Feb-06	11:10												X	
LSP0210	SB-13	6-7	8-Feb-06	11:25		X						X				X	
LSP0211	SB-13	7-8	8-Feb-06	11:40												X	
LSP0212	SB-13	8.5-9.5	8-Feb-06	11:40												X	
LSP0216	SB-14	1-2	8-Feb-06	15:05												X	
LSP0217	SB-14	2-3	8-Feb-06	15:15		X			X								Requested Total Metals analysis 03/21/06
LSP0218	SB-14	3-4	8-Feb-06	15:35												X	
LSP0219	SB-14	4-5	8-Feb-06	15:40	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Soil Boring (SB) Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Grain Size	Physical Testing	Total Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Archived	Notes
LSP0220	SB-14	5-6	8-Feb-06	15:55	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0221	SB-14	6-7	8-Feb-06	16:10		X						X	X	X			Requested EPH analysis 05/15/06
LSP0222	SB-14	8-9	8-Feb-06	16:35	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0223	SB-14	9-10	8-Feb-06	17:00	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0226	SB-14	10-11	9-Feb-06	8:20	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0227	SB-14	0-1	9-Feb-06	8:25	X	X			X			X					Hand-auger
LSP0228	SB-14	1-2	9-Feb-06	8:40	X	X			X			X					Hand-auger
LSP0229	SB-15	0-1	9-Feb-06	11:50	X	X	X		X			X					Hand-auger; requested Grain Size analysis 04/21/06
LSP0230	SB-15	1-2	9-Feb-06	12:20	X	X			X			X					Hand-auger
LSP0231	SB-15	2-3	9-Feb-06	12:50		X			X								Requested Total Metals analysis 03/21/06
LSP0232	SB-15	3-4	9-Feb-06	13:00				X									Requested Physical Testing analysis 04/21/06
LSP0233	SB-15	4-5	9-Feb-06	13:15												X	
LSP0234	SB-16	0-1	9-Feb-06	13:40	X	X			X			X					Hand-auger
LSP0235	SB-16	1-2	9-Feb-06	13:50												X	Hand-auger
LSP0236	SB-16	2-3	9-Feb-06	14:00												X	Hand-auger
LSP0237	SB-17	1-2	9-Feb-06	16:00	X	X			X			X					
LSP0238	SB-17	2-2.3	9-Feb-06	16:10												X	
LSP0239	SB-17	2.3-3	9-Feb-06	16:15												X	
LSP0240	SB-17	3-4	9-Feb-06	16:20												X	
LSP0241	SB-17	4-4.75	9-Feb-06	16:25												X	
LSP0242	SB-17	4.75-5	9-Feb-06	16:30												X	
LSP0243	SB-17	5-5.5	9-Feb-06	16:40												X	
LSP0244	SB-17	5.5-6	9-Feb-06	16:45												X	
LSP0245	SB-17	0-1	10-Feb-06	8:15	X	X			X			X					Hand-auger
LSP0246	SB-18	1-2	10-Feb-06	8:35												X	
LSP0247	SB-18	2-3	10-Feb-06	8:40		X			X								Requested Total Metals analysis 03/21/06
LSP0248	SB-18	3-4	10-Feb-06	8:50												X	
LSP0249	SB-18	4-5	10-Feb-06	9:00												X	
LSP0250	SB-18	0-1	10-Feb-06	9:40	X	X			X			X		X	X		Hand-auger; requested SVOC analysis 02/21/06; requested Dioxins/Furans analysis 04/21/06
LSP0251	SB-18	0-1-dup	10-Feb-06	9:45		X						X		X			Hand-auger; requested NWTPH-DRO+RRO and SVOC analysis 02/21/06
LSP0252	SB-18	1-2	10-Feb-06	10:00	X	X			X			X					Hand-auger
LSP0253	SB-19	2-3	10-Feb-06	11:25		X			X			X		X			Requested SVOC analysis 02/21/06; requested Total Metals analysis 03/21/06
LSP0254	SB-19	3-3.6	10-Feb-06	11:30		X						X		X	X		Requested SVOC analysis 02/21/06; requested Dioxins/Furans analysis 04/21/06
LSP0255	SB-19	3.6-4	10-Feb-06	11:35		X						X					Requested NWTPH-DRO+RRO analysis 02/21/06
LSP0256	SB-19	4-5	10-Feb-06	11:50		X						X					Requested NWTPH-DRO+RRO analysis 02/21/06
LSP0257	SB-19	5-5.5	10-Feb-06	11:55												X	
LSP0258	SB-19	5.5-6	10-Feb-06	12:00												X	
LSP0259	SB-19	6-6.5	10-Feb-06	12:40												X	
LSP0260	SB-19	6.5-7	10-Feb-06	12:45												X	
LSP0261	SB-19	7-7.6	10-Feb-06	13:00												X	
LSP0262	SB-19	7.6-8	10-Feb-06	13:05												X	
LSP0263	SB-19	0-1	10-Feb-06	14:15	X	X			X			X		X			Hand-auger; requested SVOC analysis 02/21/06
LSP0264	SB-19	1-2	10-Feb-06	14:20	X	X			X			X		X	X		Hand-auger; requested SVOC analysis 02/21/06; requested Dioxins/Furans analysis 04/21/06
LSP0265	SB-20	2-3	10-Feb-06	14:35												X	
LSP0266	SB-20	3-4	10-Feb-06	14:40												X	
LSP0267	SB-20	4-5	10-Feb-06	14:55												X	
LSP0268	SB-20	5-5.6	10-Feb-06	15:00												X	

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Soil Boring (SB) Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Grain Size	Physical Testing	Total Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Archived	Notes
LSP0269	SB-20	5.6-6	10-Feb-06	15:05												X	
LSP0270	SB-20	7-8	10-Feb-06	15:30												X	
LSP0271	SB-20	0-1	10-Feb-06	16:10	X	X			X			X		X	X		Hand-auger; requested SVOC analysis 02/21/06; requested Dioxins/Furans analysis 04/21/06
LSP0272	SB-20	1-2	10-Feb-06	16:25	X	X			X			X					
LSP0273	SB-20	1-2-dup	10-Feb-06	16:30	X	X			X			X					
LSP0276	SB-21	0-1.9	13-Feb-06	9:15												X	
LSP0277	SB-21	1.9-3	13-Feb-06	9:30												X	
LSP0278	SB-21	3-4.5	13-Feb-06	9:45												X	
LSP0279	SB-21	4.5-5	13-Feb-06	9:55												X	
LSP0280	SB-21	5-6	13-Feb-06	10:00												X	
LSP0281	SB-21	6-7.5	13-Feb-06	10:10												X	
LSP0282	SB-21	7.5-9	13-Feb-06	10:15												X	
LSP0283	SB-21	9-10.5	13-Feb-06	10:20												X	
LSP0284	SB-21	10.5-12	13-Feb-06	10:25												X	
LSP0285	SB-21	12-13.5	13-Feb-06	10:30												X	
LSP0286	SB-21	13.5-14.6	13-Feb-06	10:35												X	
LSP0287	SB-21	14.6-15	13-Feb-06	10:37												X	
LSP0288	SB-21	15-16.5	13-Feb-06	10:40												X	
LSP0289	SB-21	16.5-18	13-Feb-06	10:45												X	
LSP0290	SB-21	18-19.5	13-Feb-06	10:50												X	
LSP0291	SB-21	19.5-21	13-Feb-06	11:05												X	
LSP0292	SB-21	21-22.5	13-Feb-06	11:10												X	
LSP0293	SB-21	22.5-24	13-Feb-06	11:15												X	
LSP0294	SB-21	24-25.5	13-Feb-06	11:20												X	
LSP0295	SB-21	25.5-27	13-Feb-06	11:25												X	
LSP0296	SB-21	27-28.5	13-Feb-06	11:40												X	
LSP0297	SB-21	28.5-30	13-Feb-06	11:45												X	
LSP0298	SB-21	30-31	13-Feb-06	11:50												X	
LSP0299	SB-21	31-31.5	13-Feb-06	12:00												X	
LSP0300	SB-21	31.5-32	13-Feb-06	13:00												X	
LSP0301	SB-21	32-33	13-Feb-06	13:05												X	
LSP0302	SB-21	33-34.5	13-Feb-06	13:30												X	
LSP0303	SB-22	0-1.5	13-Feb-06	15:30												X	
LSP0304	SB-22	1.5-2.6	13-Feb-06	15:40												X	
LSP0305	SB-22	2.6-3	13-Feb-06	15:45												X	
LSP0306	SB-22	3-4.5	13-Feb-06	15:50												X	
LSP0307	SB-22	4.5-4.9	13-Feb-06	16:00												X	
LSP0308	SB-22	4.9-6	13-Feb-06	16:11												X	
LSP0309	SB-22	6-8	13-Feb-06	16:15												X	
LSP0310	SB-22	8-9	13-Feb-06	16:25												X	
LSP0311	SB-22	9-10.1	13-Feb-06	16:40												X	
LSP0312	SB-22	10.1-10.5	13-Feb-06	16:45												X	
LSP0313	SB-22	10.5-12	13-Feb-06	16:50												X	
LSP0314	SB-22	12-13.5	14-Feb-06	8:00												X	
LSP0315	SB-22	13.5-14	14-Feb-06	8:10												X	
LSP0316	SB-22	14-15	14-Feb-06	8:15												X	
LSP0317	SB-22	15-16.5	14-Feb-06	8:20												X	
LSP0318	SB-22	16.5-18	14-Feb-06	8:25												X	
LSP0319	SB-22	18-19-.5	14-Feb-06	8:30												X	
LSP0320	SB-22	19.5-21	14-Feb-06	8:40												X	
LSP0321	SB-22	21-22.5	14-Feb-06	8:50												X	
LSP0322	SB-22	22.5-24	14-Feb-06	9:00												X	
LSP0323	SB-22	24-25.5	14-Feb-06	9:05												X	
LSP0324	SB-22	25.5-27	14-Feb-06	9:10	X	X	X					X		X			Requested TOC, Grain Size, NWTPH-DRO+RRO, and SVOC analysis 04/21/06

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Soil Boring (SB) Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Grain Size	Physical Testing	Total Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Archived	Notes
LSP0325	SB-22	27-28.5	14-Feb-06	9:15	X	X			X			X		X			Requested TOC and Total Metals analysis 04/21/06
LSP0326	SB-22	28.5-29.6	14-Feb-06	9:30	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0327	SB-22	29.6-30	14-Feb-06	9:40	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0328	SB-22	30-31	14-Feb-06	10:05	X	X		X				X		X			Requested TOC, Physical Testing, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0329	SB-23	0-1.5	14-Feb-06	13:05												X	
LSP0330	SB-23	1.5-2.5	14-Feb-06	13:10												X	
LSP0331	SB-23	2.5-3	14-Feb-06	13:15												X	
LSP0332	SB-23	3-4.5	14-Feb-06	13:20												X	
LSP0333	SB-23	4.5-6	14-Feb-06	13:30												X	
LSP0334	SB-23	6-7.5	14-Feb-06	13:35												X	
LSP0335	SB-23	7.5-9	14-Feb-06	13:40												X	
LSP0336	SB-23	9-10.5	14-Feb-06	13:50												X	
LSP0337	SB-23	10.5-12	14-Feb-06	13:55												X	
LSP0338	SB-23	12-13.5	14-Feb-06	14:00												X	
LSP0339	SB-23	13.5-15	14-Feb-06	14:10												X	
LSP0340	SB-23	15-16.5	14-Feb-06	14:15												X	
LSP0341	SB-23	16.5-18	14-Feb-06	14:20												X	
LSP0342	SB-23	18-19.5	14-Feb-06	14:25												X	
LSP0343	SB-23	19.5-21	14-Feb-06	14:30												X	
LSP0344	SB-23	24-25.5	14-Feb-06	14:40												X	
LSP0345	SB-23	25.5-27	14-Feb-06	14:45												X	
LSP0346	SB-23	27-28.5	14-Feb-06	14:50												X	
LSP0347	SB-23	28.5-30.2	14-Feb-06	15:00												X	
LSP0348	SB-23	30.2-31.5	14-Feb-06	15:05												X	
LSP0349	SB-23	31.5-32.3	14-Feb-06	15:30												X	
LSP0350	SB-23	32.3-33	14-Feb-06	15:40												X	
LSP0351	SB-24	0-0.75	15-Feb-06	10:30												X	
LSP0352	SB-24	0.75-1.5	15-Feb-06	10:35												X	
LSP0353	SB-24	5-6.1	15-Feb-06	10:40												X	
LSP0453	SB-26	0-1	6-Apr-06	9:30												X	
LSP0354	SB-24	6.1-6.5	15-Feb-06	10:45												X	
LSP0355	SB-24	10-11.5	15-Feb-06	10:50												X	
LSP0356	SB-24	15-16.5	15-Feb-06	10:55												X	
LSP0357	SB-24	20-21.5	15-Feb-06	11:05												X	
LSP0358	SB-24	23-24.5	15-Feb-06	11:10												X	
LSP0359	SB-24	24.5-26	15-Feb-06	11:15												X	
LSP0360	SB-24	27.5-29	15-Feb-06	11:30												X	
LSP0361	SB-24	29-30.5	15-Feb-06	11:40												X	
LSP0362	SB-24	30.5-32	15-Feb-06	11:45												X	
LSP0363	SB-24	32-33.5	15-Feb-06	11:50												X	
LSP0364	SB-24	33.5-35	15-Feb-06	11:55												X	
LSP0365	SB-24	35.5-36	15-Feb-06	12:10												X	
LSP0366	SB-24	36-36.5	15-Feb-06	14:33												X	Auger bit cutting
May-06																	
LSP0382	SB-25	0-1	4-Apr-06	10:05												X	
LSP0451	SB-25	0-1	6-Apr-06	9:15	X	X			X			X				X	Hand-auger
LSP0383	SB-25	1-2	4-Apr-06	10:10												X	
LSP0452	SB-25	1-2	6-Apr-06	9:20	X	X			X			X				X	Hand-auger
LSP0384	SB-25	2-3	4-Apr-06	10:25												X	
LSP0385	SB-25	3-4	4-Apr-06	10:30												X	
LSP0386	SB-25	4-5	4-Apr-06	10:35												X	
LSP0387	SB-25	5-6	4-Apr-06	10:45												X	
LSP0388	SB-25	6-6.6	4-Apr-06	11:00												X	

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Soil Boring (SB) Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Grain Size	Physical Testing	Total Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Archived	Notes
LSP0389	SB-25	6.6-7	4-Apr-06	11:05												X	
LSP0390	SB-25	7-7.8	4-Apr-06	11:10												X	
LSP0391	SB-25	7.8-8	4-Apr-06	11:15												X	
LSP0392	SB-25	8-8.5	4-Apr-06	11:20												X	
LSP0393	SB-26	0-1	4-Apr-06	13:20												X	
LSP0394	SB-26	1-2	4-Apr-06	13:25												X	
LSP0454	SB-26	1-2	6-Apr-06	9:40												X	Hand-auger
LSP0455	SB-26	1-2	6-Apr-06	9:45												X	Split of LSP0454 hand-auger
LSP0395	SB-26	2-3	4-Apr-06	13:30												X	
LSP0396	SB-26	3-4	4-Apr-06	13:35												X	
LSP0397	SB-26	4-5	4-Apr-06	13:55												X	
LSP0398	SB-26	5-5.6	4-Apr-06	14:00												X	
LSP0399	SB-26	5.6-6	4-Apr-06	14:05												X	
LSP0400	SB-26	6-6.6	4-Apr-06	14:10												X	
LSP0401	SB-26	6.6-7	4-Apr-06	14:15												X	
LSP0402	SB-26	7-8	4-Apr-06	14:25												X	
LSP0403	SB-26	8-9	4-Apr-06	14:30												X	
LSP0404	SB-26	9-10	4-Apr-06	14:35												X	
LSP0405	SB-26	10-10.8	4-Apr-06	14:40												X	
LSP0406	SB-26	10.8-11	4-Apr-06	14:45												X	
LSP0407	SB-27	0-1	4-Apr-06	16:40												X	
LSP0456	SB-27	0-1	6-Apr-06	10:00												X	Hand-auger
LSP0457	SB-27	1-2	6-Apr-06	10:10												X	Hand-auger
LSP0408	SB-27	1-1.7	4-Apr-06	16:45												X	
LSP0409	SB-27	1.7-2	4-Apr-06	16:50												X	
LSP0410	SB-27	2-3	4-Apr-06	16:55												X	
LSP0411	SB-27	3-3.4	4-Apr-06	17:00												X	
LSP0412	SB-27	3.4-4	4-Apr-06	17:05												X	
LSP0413	SB-27	4-5	5-Apr-06	7:55												X	
LSP0414	SB-27	5-6	5-Apr-06	8:00												X	
LSP0415	SB-27	6-7	5-Apr-06	8:05												X	
LSP0416	SB-27	7-8	5-Apr-06	8:10												X	
LSP0417	SB-27	8-8.5	5-Apr-06	8:15												X	
LSP0418	SB-27	8.5-9	5-Apr-06	8:20												X	
LSP0419	SB-27	9-10	5-Apr-06	8:35												X	
LSP0420	SB-27	10-11	5-Apr-06	8:40												X	
LSP0421	SB-27	11-12	5-Apr-06	8:55												X	
LSP0422	SB-27	12-13	5-Apr-06	9:20												X	
LSP0423	SB-27	13-14	5-Apr-06	9:25												X	
LSP0424	SB-27	14-15	5-Apr-06	9:30												X	
LSP0425	SB-27	15-16	5-Apr-06	10:45												X	
LSP0426	SB-27	16-17	5-Apr-06	11:00												X	
LSP0427	SB-27	17-18	5-Apr-06	11:05												X	
LSP0428	SB-27	18-18.5	5-Apr-06	11:10												X	
LSP0429	SB-27	18.5-19	5-Apr-06	11:15												X	
LSP0430	SB-27	19-20	5-Apr-06	11:30												X	
LSP0431	SB-27	20-20.5	5-Apr-06	12:05												X	
LSP0432	SB-27	20.5-21	5-Apr-06	12:10												X	
LSP0433	SB-27	21-22	5-Apr-06	12:25												X	
LSP0434	SB-27	22-23	5-Apr-06	12:35												X	
LSP0435	SB-28	0-1	5-Apr-06	16:00	X	X			X			X				X	
LSP0436	SB-28	1-2	5-Apr-06	16:05	X	X			X			X				X	
LSP0437	SB-28	2-3	5-Apr-06	16:10		X			X								Requested Total Metals analysis 04/21/06
LSP0438	SB-28	3-4	5-Apr-06	16:15		X			X								Requested Zinc analysis 05/01/06
LSP0439	SB-28	4-5	5-Apr-06	16:20					X								Requested Zinc analysis 05/16/06

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Soil Boring (SB) Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Grain Size	Physical Testing	Total Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Archived	Notes
LSP0440	SB-28	5-6	5-Apr-06	16:25					X								Requested Zinc analysis 05/16/06
LSP0441	SB-28	6-7	5-Apr-06	16:35												X	
LSP0442	SB-28	7-8	5-Apr-06	16:40												X	
LSP0443	SB-28	8-9	5-Apr-06	16:50												X	
LSP0444	SB-28	9-10	5-Apr-06	16:55												X	
LSP0445	SB-28	10-11	5-Apr-06	17:00												X	
LSP0446	SB-28	11-12	5-Apr-06	17:10												X	
LSP0447	SB-28	12-13	6-Apr-06	8:00												X	
LSP0448	SB-28	13-14	6-Apr-06	8:05												X	
LSP0449	SB-28	14-14.3	6-Apr-06	8:10												X	
LSP0450	SB-28	14.3-15	6-Apr-06	8:15												X	
LSP0458	SB-29	0-1	6-Apr-06	10:55	X	X			X			X				X	
LSP0459	SB-29	1-2	6-Apr-06	11:00	X	X			X			X				X	
LSP0460	SB-29	2-2.5	6-Apr-06	11:05												X	
LSP0461	SB-29	2.5-3	6-Apr-06	11:10		X			X								Requested Total Metals analysis 04/21/06
LSP0462	SB-29	3-4	6-Apr-06	11:15		X			X								Requested Zinc analysis 05/01/06
LSP0463	SB-29	4-5	6-Apr-06	11:20					X								Requested Zinc analysis 05/16/06
LSP0464	SB-29	5-5.5	6-Apr-06	11:25	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0465	SB-29	5.5-6	6-Apr-06	11:30					X								Requested Zinc analysis 05/16/06
LSP0466	SB-29	6-6.7	6-Apr-06	11:35												X	
LSP0467	SB-29	6.7-7	6-Apr-06	11:40												X	
LSP0468	SB-29	7-7.3	6-Apr-06	11:45	X	X						X	X	X	X		Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06; requested EPH analysis 05/15/06; Dioxins on 5/19/06
LSP0469	SB-29	7.3-8	6-Apr-06	11:50												X	
LSP0470	SB-29	8-8.7	6-Apr-06	12:10												X	
LSP0471	SB-29	8.7-9	6-Apr-06	12:15												X	
LSP0472	SB-29	9-9.6	6-Apr-06	12:30												X	
LSP0473	SB-29	9.6-10	6-Apr-06	12:35												X	
LSP0474	SB-29	10-10.6	6-Apr-06	12:40	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0475	SB-29	10.6-11	6-Apr-06	12:45												X	
LSP0492	SB-30	0-1	7-Apr-06	8:30	X	X			X			X				X	Hand-auger
LSP0493	SB-30	0-1	7-Apr-06	8:35	X	X			X			X				X	
LSP0494	SB-30	1-2	7-Apr-06	8:40												X	Hand-auger
LSP0476	SB-30	2-2.5	6-Apr-06	15:40												X	
LSP0477	SB-30	2.5-3	6-Apr-06	15:45												X	
LSP0478	SB-30	3-4	6-Apr-06	15:50												X	
LSP0479	SB-30	4-5	6-Apr-06	15:55												X	
LSP0480	SB-30	5-6	6-Apr-06	16:00												X	
LSP0481	SB-30	6-7	6-Apr-06	16:05												X	
LSP0482	SB-30	7-8	6-Apr-06	16:10												X	
LSP0483	SB-30	8-8.4	6-Apr-06	16:20												X	
LSP0484	SB-30	8.4-9	6-Apr-06	16:25												X	
LSP0485	SB-30	9-10	6-Apr-06	16:30												X	
LSP0486	SB-30	10-11	6-Apr-06	16:35												X	
LSP0487	SB-30	11-12	6-Apr-06	16:55												X	
LSP0488	SB-30	12-13	6-Apr-06	17:15												X	
LSP0489	SB-30	13-14	6-Apr-06	17:25												X	
LSP0490	SB-30	14-15	7-Apr-06	8:00												X	
LSP0491	SB-30	15-16	7-Apr-06	8:10												X	
LSP0495	SB-30	16-16.4	7-Apr-06	8:55												X	
LSP0496	SB-30	16.4-16.9	7-Apr-06	9:05												X	
LSP0497	SB-30	16.9-17	7-Apr-06	9:10												X	
LSP0498	SB-31	0-0.9	7-Apr-06	11:00												X	Hand-auger

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Soil Boring (SB) Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Grain Size	Physical Testing	Total Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Archived	Notes
LSP0499	SB-31	0-0.9	7-Apr-06	11:05												X	Duplicate of LSP0498 hand-auger
LSP0500	SB-31	0-1	7-Apr-06	11:35												X	
LSP0501	SB-31	1-2	7-Apr-06	11:45												X	
LSP0502	SB-31	2-3	7-Apr-06	11:55												X	
LSP0503	SB-31	3-3.8	7-Apr-06	12:00												X	
LSP0504	SB-31	3.8-4	7-Apr-06	12:05												X	
LSP0505	SB-31	4-4.25	7-Apr-06	12:10												X	
LSP0506	SB-31	4.25-5	7-Apr-06	12:15												X	
LSP0507	SB-31	5-6	7-Apr-06	12:25												X	
LSP0508	SB-31	6-7	7-Apr-06	12:30												X	
LSP0509	SB-31	7-8	7-Apr-06	12:35	X	X	X					X		X			Requested TOC, Grain Size, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0510	SB-31	8-9	7-Apr-06	13:10	X	X						X		X	X		Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0511	SB-31	9-9.6	7-Apr-06	13:20	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06; Dioxins on 5/19/06
LSP0512	SB-31	9.6-10	7-Apr-06	13:25	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0513	SB-31	10-10.2	7-Apr-06	13:30												X	
LSP0514	SB-31	10.2-11	7-Apr-06	13:35	X	X						X		X			Requested TOC, NWTPH-DRO+RRO, and SVOC analysis 04/21/06
LSP0515	SB-31	11-12	7-Apr-06	13:50			X										Requested Grain Size analysis 04/21/06
LSP0516	SB-31	12-13	7-Apr-06	14:05												X	
LSP0517	SB-31	13-14	7-Apr-06	14:15												X	
LSP0518	SB-31	14-15	7-Apr-06	14:20												X	
LSP0519	SB-31	15-16	7-Apr-06	14:30												X	
LSP0520	SB-32	0-1	8-Apr-06	7:55												X	
LSP0521	SB-32	1-2	8-Apr-06	8:00												X	
LSP0522	SB-32	2-3	8-Apr-06	8:10			X										Requested Grain Size analysis 04/21/06
LSP0523	SB-32	3-3.5	8-Apr-06	8:15												X	
LSP0524	SB-32	3.5-4	8-Apr-06	8:20												X	
LSP0525	SB-32	4-5	8-Apr-06	8:30			X										Requested Grain Size analysis 04/21/06
LSP0526	SB-32	5-5.7	8-Apr-06	8:40												X	
LSP0527	SB-32	5.7-6	8-Apr-06	8:45												X	
LSP0528	SB-32	6-6.8	8-Apr-06	8:50			X										Requested Grain Size analysis 04/21/06
LSP0529	SB-32	6.8-7	8-Apr-06	8:55												X	
LSP0530	SB-32	7-7.8	8-Apr-06	9:00				X									Requested Physical Testing analysis 04/21/06
LSP0531	SB-33	1-1.3	8-Apr-06	10:15												X	
LSP0532	SB-33	1.3-2	8-Apr-06	10:20												X	
LSP0533	SB-33	2-3	8-Apr-06	10:25												X	
LSP0534	SB-33	3-4	8-Apr-06	10:30												X	
LSP0535	SB-33	4-4.4	8-Apr-06	10:35												X	
LSP0536	SB-33	4.9-5	8-Apr-06	10:40												X	
LSP0537	SB-33	4.4-4.9	8-Apr-06	10:37												X	
LSP0538	SB-33	5-5.3	8-Apr-06	11:05												X	
LSP0539	SB-33	5.3-6	8-Apr-06	11:10												X	
LSP0540	SB-33	6-7	8-Apr-06	11:15												X	
LSP0541	SB-33	7-8	8-Apr-06	11:20												X	
LSP0542	SB-33	8-9	8-Apr-06	11:25												X	
LSP0543	SB-33	9-9.2	8-Apr-06	11:30												X	
LSP0544	SB-33	9.2-10	8-Apr-06	11:35												X	
LSP0545	SB-35	0-1	10-Apr-06	14:00	X	X			X			X		X			Requested SVOC analysis 04/21/06
LSP0555	SB-34	0-1	11-Apr-06	9:45	X	X			X			X		X			Requested SVOC analysis 04/21/06
LSP0546	SB-35	1-1.8	10-Apr-06	14:05	X	X			X			X	X	X	X		Requested SVOC analysis 04/21/06; requested EPH analysis 05/15/06; Dioxins on 5/19/06

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Soil Boring (SB) Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Grain Size	Physical Testing	Total Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Archived	Notes
LSP0547	SB-35	1.8-3.2	10-Apr-06	14:10		X			X			X					Requested NWTPH-DRO-RRO 04/21/06; requested As, Pb, Hg, and Zn 04/25/06
LSP0548	SB-36	0-0.8	10-Apr-06	15:30	X	X			X			X		X	X		Requested SVOC analysis 04/21/06; Dioxins on 5/19/06
LSP0549	SB-36	0.8-1.8	10-Apr-06	15:35	X	X	X		X			X					Requested Grain Size analysis 04/21/06
LSP0550	SB-36	1.8-2.55	10-Apr-06	15:40												X	
LSP0551	SB-36	2.55-3.5	10-Apr-06	15:45				X									Requested Physical Testing analysis 04/21/06
LSP0552	SB-37	0-1.2	10-Apr-06	16:30	X	X			X			X		X	X		Requested SVOC analysis 04/21/06; Dioxins on 5/19/06
LSP0553	SB-37	1.2-2	10-Apr-06	16:35	X	X			X			X		X			Requested SVOC analysis 04/21/06
LSP0554	SB-37	2-3.1	10-Apr-06	16:40		X						X					Requested NWTPH-DRO-RRO 04/21/06
LSP0556	RINSE	NA	11-Apr-06	10:30					X			X		X			Rinsate blank (core CAB liners and core catcher)
LSP0557	SB-38	0-1	11-Apr-06	10:20	X	X		X	X			X					Requested Physical Testing and SVOC analysis 04/21/06
LSP0561	SB-38	0-1	11-Apr-06	10:40	X	X		X	X			X	X	X	X		LSP0561 is a split of LSP0557; requested Physical Testing and SVOC analysis 04/21/06; requested EPH analysis 05/15/06; Dioxins on 5/19/06
LSP0558	SB-38	1-1.9	11-Apr-06	10:25	X	X			X			X		X			Requested SVOC analysis 04/21/06
LSP0562	SB-38	1-1.9	11-Apr-06	10:45	X	X			X			X					LSP0562 is a split of LSP0558
LSP0559	SB-38	1.9-2.4	11-Apr-06	10:30		X		X	X			X					Requested Physical Testing and NWTPH-DRO-RRO 04/21/06; requested As, Cu, Hg, and Zn 04/25/06
LSP0560	SB-38	2.4-3.2	11-Apr-06	10:35		X		X	X								Requested Physical Testing 04/21/06; requested As, Cu, Hg, and Zn 05/03/06
LSP0563	SB-39	0-0.7	11-Apr-06	13:00	X	X			X			X		X			Requested SVOC analysis 04/21/06
LSP0564	SB-39	0.7-2	11-Apr-06	13:05	X	X			X			X				X	
LSP0565	SB-39	2-3	11-Apr-06	13:10												X	
LSP0566	SB-39	3-3.6	11-Apr-06	13:15												X	
LSP0567	NA	NA	11-Apr-06	14:05					X			X		X			Rinsate (pastry blender and bowl)
Oct-06																	
LSP0607	SB-40	0-1	9-Oct-06	9:23					X			X				X	Requested SPLP arsenic analysis on 08/21/07
LSP0608	SB-40	1-2	9-Oct-06	9:26					X			X				X	Requested SPLP and TCLP arsenic analysis on 08/21/07
LSP0609	SB-40	2-3	9-Oct-06	9:34					X							X	Requested metals analysis on 10/31/06
LSP0610	SB-40	3-4	9-Oct-06	9:42					X							X	Requested metals analysis on 10/31/06
LSP0611	SB-40	4-5.5	9-Oct-06	9:47												X	
LSP0612	SB-40	5.5-7	9-Oct-06	9:52												X	
LSP0613	SB-40	8.5-10	9-Oct-06	10:14												X	
LSP0614	SB-40	10-11.5	9-Oct-06	10:18												X	
LSP0615	SB-40	11.5-13	9-Oct-06	10:31								X				X	
LSP0616	SB-40	13-14.5	9-Oct-06	10:38												X	
LSP0617	SB-40	14.5-16	9-Oct-06	10:48												X	
LSP0618	SB-40	16-17	9-Oct-06	11:01												X	
LSP0619	SB-40	17-17.5	9-Oct-06	11:03												X	
LSP0620	SB-40	17.5-19	9-Oct-06	11:14												X	
LSP0621	SB-40	19-20.5	9-Oct-06	11:18												X	
LSP0622	SB-40	20.5-22	9-Oct-06	11:30												X	
LSP0623	SB-40	22-23.5	9-Oct-06	11:34												X	
LSP0624	SB-40	25-26.5	9-Oct-06	11:48												X	
LSP0625	SB-40	29.5-31	9-Oct-06	12:11												X	
LSP0626	SB-40	32.5-34	9-Oct-06	12:18												X	
LSP0627	SB-40	34-35.5	9-Oct-06	12:41												X	
LSP0628	SB-40	38.5-39.5	9-Oct-06	13:02								X				X	
LSP0629	SB-40	39.5-40	9-Oct-06	13:04												X	
LSP0630	SB-41	11-12.5	9-Oct-06	14:20								X				X	
LSP0631	SB-41	12.5-14	9-Oct-06	14:24												X	
LSP0632	SB-41	14-15.2	9-Oct-06	14:31												X	
LSP0633	SB-41	15.2-15.5	9-Oct-06	14:32												X	
LSP0634	SB-41	15.5-16.5	9-Oct-06	14:43												X	
LSP0635	SB-41	16.5-17	9-Oct-06	14:45												X	

Table B-3. Sample Collection and Analysis Summary — Little Squalicum Park RI/FS

Soil Boring (SB) Samples

Sample Number	Sample Location	Sample Depth (ft bgs)	Date	Time	Total Organic Carbon	Total Solids	Grain Size	Physical Testing	Total Metals	NWTPH-GRO	VPH	NWTPH-DRO+RRO	EPH	SVOCs	Dioxins/ Furans	Archived	Notes
LSP0636	SB-41	19.5-21	9-Oct-06	14:51												X	
LSP0637	SB-41	24.5-26	9-Oct-06	14:58												X	
LSP0638	SB-41	29.5-31	9-Oct-06	15:13												X	
LSP0639	SB-41	34.5-36	9-Oct-06	15:17								X				X	
LSP0640	SB-41	38.5-39.5	9-Oct-06	15:25												X	
LSP0641	SB-41	39.5-41	9-Oct-06	15:29												X	
LSP0642	SB-41	41-42.5	9-Oct-06	15:35												X	
LSP0643	SB-41	42.5-44	9-Oct-06	15:53												X	
Jan-08																X	
LSP0674	SB-42	1-2.5	29-Jan-08	10:43					X							X	
LSP0679	SB-42	2.5-4	29-Jan-08	10:46					X							X	
LSP0675	SB-42	4-5.5	29-Jan-08	10:53												X	
LSP0676	SB-42	9-10.5	29-Jan-08	10:57												X	
LSP0677	SB-42	14-15.5	29-Jan-08	11:05												X	
LSP0678	SB-42	19-20.5	29-Jan-08	11:09												X	
LSP0680	SB-42	24-25.5	29-Jan-08	11:12												X	
LSP0681	SB-42	26.5-28	29-Jan-08	12:05												X	
LSP0682	SB-42	29-30.5	29-Jan-08	12:10												X	
LSP0683	SB-42	31.5-33	29-Jan-08	12:15												X	
LSP0684	SB-42	34-35.5	29-Jan-08	12:18								X				X	
LSP0685	SB-42	36.5-38	29-Jan-08	12:40								X		X		X	

ATTACHMENT 1

SAMPLING STATION COORDINATES

Attachment 1

Survey Locations (December 12, 2005)
Little Squalicum Park Remedial Investigation
Larry Steele and Associates Land Surveyors (#12905)

Point Number	NAD 83/91 Northing (Ft)	NAD 83/91 Easting (Ft)	NAVD 88 Elevation (Ft)	Description
6041	649325.59	1235251.68	35.44	HA-07
6042	649359.48	1235277.73	36.60	HA-08
6034	649100.51	1234997.60	26.39	LSC-07
6031	648948.15	1234764.31	21.43	LSC-08
6023	648729.58	1234502.01	15.41	LSC-09
6058	648904.34	1234536.10	41.15	MWLSCO1-TOP PVC
6059	649006.13	1234694.59	46.38	MWLSCO2-TOP PVC
6060	649125.43	1234935.07	53.65	MWLSCO3-TOP PVC
6022	648436.11	1234326.67	12.22	SHEEN AREA
6013	648311.56	1234300.10	13.16	STP-01
6015	648300.03	1234300.98	13.00	STP-02
6002	648289.89	1234298.46	12.58	STP-03
6006	648315.31	1234282.80	14.16	STP-04
6001	648295.40	1234287.83	13.67	STP-05
6008	648385.32	1234305.64	15.03	STP-06
6011	648400.61	1234309.17	14.33	STP-07
6005	648351.68	1234313.24	13.11	STP-08
6003	648330.31	1234316.06	13.28	STP-09
6009	648331.82	1234325.73	14.28	STP-10
6004	648353.27	1234322.60	14.71	STP-11
6016	648283.95	1234316.31	12.61	STP-12
6010	648432.65	1234320.01	13.43	STP-13
6021	648590.65	1234399.07	15.30	STP-14
6000	648150.83	1234263.30	8.26	SW-01
6028	648833.69	1234553.09	18.62	SW-04
6040	649296.12	1235164.66	39.22	SW-05
6039	649247.48	1235193.96	32.97	SW-06
6049	649094.86	1235795.30	36.32	SW-07
6020	648549.60	1234383.87	12.60	SW-09
6048	649016.90	1235609.38	38.24	TP-01
6046	648930.22	1235708.04	40.61	TP-02
6070	649053.78	1235712.67	38.42	TP-03 REVISED
6044	649316.98	1235338.57	40.57	TP-04
6036	649122.32	1235209.15	33.40	TP-05
6035	649033.38	1235087.80	30.16	TP-06
6032	648836.71	1235050.25	28.71	TP-07
6030	648819.66	1234837.58	26.95	TP-08
6024	648641.99	1234552.91	24.55	TP-09
6072	648455.94	1234485.41	19.18	TP-10
6073	648454.98	1234581.92	20.66	TP-11
6017	648299.38	1234434.29	16.35	TP-12
6069	649118.15	1235099.31	31.78	TP-13
6068	649095.94	1235115.79	31.23	TP-14
6067	649050.98	1235148.03	31.20	TP-15
6064	648944.72	1235185.97	29.00	TP-16
6065	648860.83	1235211.83	27.73	TP-17
6066	648782.44	1235141.76	27.08	TP-18

Attachment 1

Survey Locations (February 9, 16, 17, 2006)
Little Squalicum Park Remedial Investigation
Larry Steele and Associates Land Surveyors (#12905)

Point Number	NAD 83/91 Northing (Ft)	NAD 83/91 Easting (Ft)	NAVD 88 Elevation (Ft)	Description
6124	648056.67	1234166.06	4.08	Centerline Creek
6125	648125.09	1234239.43	6.58	Centerline Creek
6127	648218.25	1234311.42	9.19	Centerline Creek
6128	648329.44	1234307.07	10.33	Centerline Creek
6129	648424.37	1234328.30	11.11	Centerline Creek
6140	648530.07	1234374.09	12.49	Centerline Creek
6141	648571.30	1234402.85	12.90	Centerline Creek
6142	648642.73	1234454.91	14.39	Centerline Creek
6143	648717.08	1234494.65	15.07	Centerline Creek
6144	648804.97	1234541.78	15.89	Centerline Creek
6145	648877.45	1234612.51	17.06	Centerline Creek
6146	648917.67	1234702.41	18.26	Centerline Creek
6148	648953.66	1234773.35	21.26	Centerline Creek
6150	648981.42	1234847.54	24.37	Centerline Creek
6152	649048.05	1234945.47	25.68	Centerline Creek
6153	649088.40	1234988.73	26.06	Centerline Creek
6154	649134.03	1235053.64	27.16	Centerline Creek
6155	649179.40	1235097.52	28.10	Centerline Creek
6156	649233.59	1235177.39	33.00	Centerline Creek
6157	649248.50	1235195.08	32.34	Culvert Invert 32" CMP
6126	648151.35	1234264.11	8.35	Culvert Invert 36" Conc.
6130	648439.11	1234320.02	13.52	Ground
6131	648439.57	1234318.56	13.73	WELL RIM SB-18
6132	648439.51	1234318.55	13.23	PVC TOP SB-18
6136	648574.64	1234394.34	14.52	Ground
6138	648574.14	1234396.29	14.70	WELL RIM SB-19
6139	648574.19	1234396.30	14.38	PVC TOP SB-19
6133	648591.51	1234395.86	15.40	Ground
6134	648590.04	1234395.45	15.62	WELL RIM SB-20
6135	648590.06	1234395.47	15.41	PVC TOP SB-20
6165	649125.84	1235019.24	32.33	Ground
6166	649125.11	1235020.31	32.34	WELL RIM SB-14
6164	649125.02	1235020.37	32.13	PVC TOP SB-14
6170	649179.16	1235000.55	55.66	Ground
6172	649180.32	1234998.34	55.43	WELL RIM SB-24
6171	649180.41	1234998.41	54.94	PVC TOP SB-24
6158	649196.47	1235108.10	35.14	Ground
6160	649197.46	1235106.67	35.26	WELL RIM SB-13
6159	649197.31	1235106.67	34.95	PVC TOP SB-13
6173	649242.25	1235072.29	58.81	Ground
6175	649244.02	1235070.98	58.63	WELL RIM SB-23
6174	649243.97	1235071.01	58.19	PVC TOP SB-23
6161	649244.67	1235153.75	39.59	Ground
6163	649243.93	1235152.93	39.85	WELL RIM SB-09
6162	649243.97	1235152.92	39.47	PVC TOP SB-09
6176	649308.98	1235140.41	61.37	Ground
6178	649311.16	1235138.33	61.03	WELL RIM SB-22
6177	649311.11	1235138.47	60.56	PVC TOP SB-22
6179	649374.14	1235209.39	64.48	Ground
6181	649375.41	1235210.06	64.38	WELL RIM SB-21
6180	649375.81	1235210.33	63.90	PVC TOP SB-21

Attachment 1

Survey Locations (February 9, 16, 17, 2006)
Little Squalicum Park Remedial Investigation
Larry Steele and Associates Land Surveyors (#12905)

Point Number	NAD 83/91 Northing (Ft)	NAD 83/91 Easting (Ft)	NAVD 88 Elevation (Ft)	Description
6104	649016.26	1235580.92	38.44	RTP-5
6114	648967.98	1235608.53	42.88	RTP-1
6108	649027.75	1235605.20	38.69	RTP-10
6100	649018.57	1235656.47	37.16	RTP-11
6101	649018.38	1235634.01	38.09	RTP-12
6110	649018.24	1235620.86	38.72	RTP-13
6116	648986.23	1235646.42	38.70	RTP-14
6119	648953.95	1235685.35	39.74	RTP-15
6115	648968.03	1235636.44	38.92	RTP-16
6118	648944.51	1235663.49	40.31	RTP-17
6120	648931.20	1235679.02	41.15	RTP-18
6122	648907.85	1235706.96	43.90	RTP-19
6111	648992.67	1235606.84	38.76	RTP-2
6099	649051.40	1235624.27	37.88	RTP-20
6107	648994.44	1235564.92	39.84	RTP-21
6117	648940.03	1235639.99	42.58	RTP-22
6123	648951.12	1235726.56	41.60	RTP-23
6103	649033.79	1235581.99	38.08	RTP-24
6102	649055.36	1235560.54	36.99	RTP-25
6113	648980.93	1235609.75	40.08	RTP-3
6106	649016.45	1235558.92	39.20	RTP-4
6105	649016.35	1235587.71	38.27	RTP-6
6096	649067.89	1235604.74	38.27	RTP-7
6097	649058.71	1235603.84	38.22	RTP-8
6109	649038.07	1235603.77	38.04	RTP-9
6081	648247.35	1234334.27	13.12	SB-1 [1]
6080	648246.41	1234336.59	13.47	SB-1 [2]
6078	648556.97	1234389.24	12.56	SB-10
6092	649118.09	1235068.59	35.79	SB-11 GND
6093	649117.77	1235067.91	35.88	SB-11 RIM
6091	649117.85	1235067.96	35.49	SB-11 TOP PIPE
6090	649074.30	1234993.07	29.44	SB-12
6149	648975.97	1234861.57	27.55	SB-15
6151	649003.30	1234869.62	25.50	SB-16
6147	648927.74	1234770.39	26.62	SB-17
6082	648251.47	1234319.52	12.53	SB-2
6086	648248.22	1234303.84	12.30	SB-3 0-1
6084	648256.16	1234303.03	12.39	SB-3[1]
6085	648252.58	1234302.58	12.40	SB-3[2]
6088	648256.16	1234291.55	14.16	SB-4
6087	648251.41	1234291.41	14.08	SB-4 0-1
6083	648254.66	1234309.74	9.49	SB-5
6077	648420.45	1234351.85	16.93	SB-6
6076	648424.39	1234337.64	14.73	SB-7
6079	648552.76	1234398.49	15.26	SB-8
6094	649108.43	1235153.96	32.57	TP 25
6095	649116.46	1235171.53	32.94	TP 26
6112	648990.85	1235612.97	38.70	TP-22
6121	648928.50	1235685.09	40.59	TP-23
6098	649061.59	1235609.45	38.00	TP-24

Attachment 1

Survey Locations (April 26, 2006)
Little Squalicum Park Remedial Investigation
Larry Steele and Associates Land Surveyors (#12905)

Point Number	NAD 83/91 Northing (Ft)	NAD 83/91 Easting (Ft)	NAVD 88 Elevation (Ft)	Description
6249	648110.84	1234474.56	15.38	HA 1
6250	648169.29	1234375.86	12.27	HA 2
6253	648253.39	1234242.75	15.53	HA 3
6252	648231.38	1234234.49	13.80	HA 4
6251	648159.70	1234349.45	11.69	HA 5
6248	648093.36	1234457.60	13.33	HA 6
6222	649198.79	1235107.51	35.08	SB 13 GND
6223	649197.45	1235106.67	35.27	SB 13 RIM
6224	649197.31	1235106.67	34.96	SB 13 TOP PVC
6219	649126.62	1235020.95	32.24	SB 14 GND
6220	649125.09	1235020.31	32.35	SB 14 RIM
6221	649125.08	1235020.36	32.13	SB 14 TOP PVC
6241	648439.38	1234320.19	13.50	SB 18 GND
6242	648439.55	1234318.59	13.73	SB 18 RIM
6243	648439.52	1234318.54	13.24	SB 18 TOP PVC
6237	648573.94	1234394.25	14.56	SB 19 GND
6246	648574.13	1234396.30	14.69	SB 19 RIM
6247	648574.21	1234396.30	14.38	SB 19 TOP PVC
6238	648589.46	1234396.87	15.21	SB 20 GND
6239	648590.07	1234395.44	15.60	SB 20 RIM
6240	648590.03	1234395.47	15.41	SB 20 TOP PVC
6192	649019.41	1234946.31	27.96	SB 25 GND
6194	649018.51	1234947.00	28.14	SB 25 RIM
6193	649018.56	1234946.99	27.83	SB 25 TOP PVC
6200	648927.13	1234984.91	28.21	SB 26 GND
6202	648928.26	1234984.21	28.48	SB 26 RIM
6201	648928.31	1234984.30	28.22	SB 26 TOP PVC
6209	648981.97	1235037.93	29.07	SB 27 GND
6210	648982.07	1235039.32	29.28	SB 27 RIM
6211	648982.25	1235038.62	28.91	SB 27 TOP PVC
6233	649280.80	1235209.55	40.08	SB 28 GND
6234	649279.27	1235211.16	40.27	SB 28 RIM
6235	649279.36	1235211.12	39.74	SB 28 TOP PVC
6225	649171.28	1235110.28	35.45	SB 29 GND
6226	649172.56	1235111.52	35.76	SB 29 RIM
6227	649172.54	1235111.51	35.48	SB 29 TOP PVC
6213	649012.03	1235105.54	30.42	SB 30 GND
6214	649011.26	1235106.98	30.81	SB 30 RIM
6215	649011.36	1235106.93	30.49	SB 30 TOP PVC
6198	648999.45	1234989.64	28.14	SB 31 GND
6195	648944.02	1234917.55	27.09	SB 32 GND
6197	648942.97	1234918.39	27.24	SB 32 RIM
6196	648943.02	1234918.35	26.95	SB 32 TOP PVC
6217	649079.08	1235090.65	30.94	SB 33
6205	648756.84	1234985.76	26.01	SB 34 GND
6206	648759.18	1234894.85	25.91	SB 35 GND
6207	648795.21	1234806.58	23.44	SB 36 GND
6208	648831.87	1234716.98	22.32	SB 37 GND
6204	648712.79	1235076.07	25.40	SB 38 GND
6203	648782.21	1235145.84	27.08	SB 39 GND
6230	649242.42	1235153.36	39.44	SB 9 GND
6231	649243.92	1235152.90	39.84	SB 9 RIM
6232	649243.96	1235152.88	39.48	SB 9 TOP PVC
6212	648992.97	1235072.11	29.97	TP 19 GND
6216	648982.56	1235130.08	30.87	TP 20
6218	649085.54	1235062.19	30.80	TP 21

SB 9 GRD Station location re-surveyed after monument replacement.

Attachment 1

Survey Locations October 2006 and January 2008)
Little Squalicum Park Remedial Investigation
Integral Field Team and Wilson Engineering Surveyors

NAD 83/91 Northing (Ft)	NAD 83/91 Easting (Ft)	NAVD 88 Elevation (Ft)	Description
649449.12	1234694.70	72.09*	TP-26
649464.73	1234815.66	71.15*	TP-27
649443.76	1234939.84	70.93*	TP-28
649462.99	1235173.46	70.38*	TP-29
649455.07	1235257.71	69.10*	TP-30
649445.57	1235414.31	68.41*	TP-31
649453.02	1235072.69	70.25*	SB 40
649459.10	1235072.86	70.33*	SB 41
649435.25	1235089.91	69.62	SB 42

72.09* Elevation estimated by Wilson Engineering from topographic map using known horizontal coordinates.

ATTACHMENT 2

HEALTH AND SAFETY FORMS

HEALTH AND SAFETY PLAN APPROVAL

This health and safety plan has been reviewed and approved for surface water sampling, groundwater sampling, surface sediment sampling, hand auger borings, hollow-stem auger borings, test pit excavations, and archaeological boundary surveying at the Little Squalicum Park site in Bellingham, Washington.

Project Manager	September 30, 2005 Date
Corporate Health and Safety Officer	September 30, 2005 Date

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT

I have reviewed the health and safety plan prepared by Integral Consulting, dated 30-Sep-05 for the Little Squalicum Park (the Park) fieldwork. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines while an employee of Integral or its subcontractors.

Employee signature	Company	Date
[signature]	Integral Consulting	01-Nov-05
[signature]	Integral Consulting	1 Nov 2005
[signature]	Integral Consulting	01-Nov 2005
[signature]	Wessen & Associates, Inc	4-Nov-2005
[signature]	INTEGRAL CONSULTING	7-Nov-05
[signature]	Wilder construction	11-7-05
[signature]	WDOE	11-8-05
[signature]	INTEGRAL CONS.	11/16/05
[signature]	JLt	1/30/06
[signature]	Integral	1/30/06
[signature]	Integral	2/8/06
[signature]	ECOLOGY	1/30/06
[signature]	Boretec INC	
[signature]	BORETEC INC	2-2-06
[signature]		2-2-06
Jacob Swain	Boretec Inc	2-2-06
[signature]	Boretec Inc	2-6-06
[signature]	Boretec Inc	2-6-06

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT

I have reviewed the health and safety plan prepared by Integral Consulting, dated ________________ for the Little Squalicum Park (the Park) fieldwork. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines while an employee of Integral or its subcontractors.

Employee signature	Company	Date
[signature]	CDI	2/13/06
[signature]	CDI	2/13/06
[signature]	CDI	2/13/06
[signature]	Boretec Inc	4-4-06
[signature]	BORETEC INC.	04/04/06
[signature]	Boretec Inc	04/04/06
[signature]	JHC	4/4/06
[signature]	Integral	4 April 06
[signature]	Integral	4-Apr-06
[signature]	Integral	7-APR-06

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT

I have reviewed the health and safety plan prepared by Integral Consulting, dated ________________ for the Little Squalicum Park (the Park) fieldwork. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines while an employee of Integral or its subcontractors.

Employee signature	Company	Date
	RETEC	10/9/06
	CDF	10/9/06
	CDI	10-9-06
	Integral	10/9/2006
	COB	10/9/2006
	Integral	10/9/06
	CDF	10-9-06
	Wilder	10-12-06
	Integral	10/12/06

ATTACHMENT 3

GROUNDWATER
FIELD FORMS

GROUNDWATER SAMPLE COLLECTION FORM

Well Number MWLSP02-DUPLICATE
Sample No. LSP0012
Date 03-NOV-05

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: ____

Well Information

Monument Condition ☐Good ☐Needs Repair ____
Well Cap Condition ☐Good ☐Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☐ Yes ☐ Added ☐other
Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☐Other
☐Odor Comments ____

Purge Data

Total Well Depth ____ ft ☐ Clean Bottom ☐Muddy Bottom ☐Not Measured
Depth to Water ____ ft
Casing Volume ____ ft (H20) X ____ gpf = ____ X 3 = ____ gallons
3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: Peristaltic Tubing: Disposable, dedicated LDPE Total volume purged ____
Sample Intake Depth ____ Purge Rate ____
Purge Start Time ____ Purge Stop Time ____ Sample Rate ____

See Sheet for MWLSP02

Field Parameters

Time	Gallons	pH	Temperature	Conductivity	D.O.	Comments

Sampling Device

Filter Type: ____. Size: ____.

Sample Containers

Collection Time 1315

Tag No.	Type		Preservative	Analytical Method	QA Remarks
2716	☐Amber	☒Poly 500 mL	H_2SO_4	TOC (EPA 415.1)	
2717	☐Amber	☒Poly 1	None	TSS (EPA 160.2)	
2718	☐Amber	☒Poly 1	HNO_3	Hardness / metals	
2719	☐Amber 40 mL vial	☐Poly	HCl	NWTPH-GRO	
2720	☐Amber 40 mL vial	☐Poly	↓	↓	
2721	☐Amber 40 mL vial	☐Poly	↓	↓	
2722	☐Amber 40 mL vial	☐Poly	↓	VPH Followup	
2723	☒Amber 500 mL	☐Poly	None	NWTPH-DRO	
2724	☒Amber 500 mL	☐Poly	↓	EPH Followup	
2725	amber 500 mL		↓	SVOCS	
2726	amber 500 mL		↓	↓	
2727	amber 1 l		↓	Dioxins/Furans	
2728	↓		↓	↓	
2729	poly - 1 l		↓	Hold for Diss. Metals	

Samplers' Signature ____ Date ____

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number MWLSP02
Sample No. LSP0010
Date 03-Nov-05

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: EJD/BNP

Well Information

Monument Condition ☒Good ☐Needs Repair

Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement

Elevation Mark ☐ Yes ☒ Added ☐other

Well Diameter ☒ 2-inch ☐4-inch ☐6-inch ☐Other

☐Odor Comments Replaced lock

Purge Data

Total Well Depth 29.0 ft ☐ Clean Bottom ☒Muddy Bottom ☐Not Measured

Depth to Water 19.99 ft

Casing Volume 9.01 ft (H20) X 0.16 gpf = 1.44 X 3 = 4.32 gallons

3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: Peristaltic Tubing: Disposable, dedicated LDPE Total volume purged ~15 gal

Sample Intake Depth 21.0 ft btoc Purge Rate 0.125 GPM

Purge Start Time 1049 Purge Stop Time 12:50 Sample Rate 0.125 GPM

Field Parameters

Time	Gallons	pH	Temperature	Redox	Conductivity	D.O.	Turbidity	Comments
1104	2.5	6.08	11.0 °C		0.39 mS/cm	14.29* mg/L		clear, no odor/no sheen
1115	4.0	6.13	11.3 °C		0.39 mS/cm	13.30*		" " " "
1128	5.5	6.22	11.3 °C		0.39 mS/cm	14.28*		" " "
1138	7.0	6.22	11.3 °C	210 mV	0.39 mS/cm	12.03*	1.7 NTU	
1155	8.5	6.21	11.2 °C	213 mV	0.39 mS/cm	12.23*	1.2 NTU	" "
1209	10.0	6.38	11.2 °C	212 mV	0.39 mS/cm	12.99*	1.8 NTU	" "
1227	12.0	6.34	11.1 °C	212 mV	0.39 mS/cm	14.12*	1.6 NTU	" "

Sampling Device New disposable Teflon bailer for NWTPH-Gro; peristaltic pump for all other analytes.

Filter Type: None Size: N/A

Sample Containers

Collection Time 1300

	Tag No.	Type		Preservative	Analytical Method	QA Remarks
2703	~~1103~~ 03-Nov-05	☐Amber	☐Poly 500 mL	H2SO4	TOC (EPA 415.1)	
2704	~~1104~~		1 L Poly	None	TSS (EPA 160.2)	
2705	~~1105~~	☐Amber	☐Poly 1 L Poly	HNO3	Hardness (SM 2340B) / Metals (EPA 200.8/6010B/7470)	
2706	~~1106~~	40 mL vial	1 L Poly	HCl	NWTPH-GRO	
2707	~~1107~~	☐Amber ↓	☐Poly	↓	↓	
2708	~~1108~~				EPH Followup	
2709	~~1109~~	☐Amber 500 mL amber	☐Poly		NWTPH-DRO	
2710	~~1110~~			None		
2711	~~1111~~	☐Amber	☐Poly		EPH Followup	
2712	~~1112~~	☐Amber	☐Poly		SVOCs (EPA SW 8270C, low levels)	
2713	~~1113~~	☐Amber ↓	☐Poly		↓	
2714		☐Amber 1 L amber	☐Poly		Dioxins/Furans (EPA 1613B)	
2715		☐Amber ↓	☐Poly	↓	↓	
2730		1 L poly		NONE	Hold for Diss. Metals	

Samplers' Signature [signature] [signature] Date 03-Nov-05

GROUNDWATER SAMPLE COLLECTION FORM

Well Number MWLSP03
Sample No. LSP0013
Date 03-Nov-03

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: EJD/BAP

Well Information

Monument Condition ☒Good ☐Needs Repair
Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☐ Yes ☒ Added ☐other
Well Diameter ☒ 2-inch ☐4-inch ☐6-inch ☐Other
☐Odor Comments Replaced lock. well monument buried under ~4" gravel on trail.

Purge Data

Total Well Depth 33.9 ft ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured
Depth to Water 27.33 ft
Casing Volume 6.57 ft (H20) X 0.16 gpf = 1.05 X 3 = 3.15 gallons (initialed 03-Nov-03)
3/4 " = 0.02 gpf 1" = 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: Peristaltic Tubing: Disposable, dedicated LDPE Total volume purged ~5.5 gal
Sample Intake Depth ~30 ft (some drawdown while pumping ~2 ft) Purge Rate 0.12 GPM
Purge Start Time 1459 Purge Stop Time 1605 Sample Rate 0.12 GPM

Field Parameters

Time	Gallons	pH	Temperature	Redox	Conductivity	D.O.	Turbidity	Comments
~~1508~~	~~1508~~ ~1	6.33	10.3°C	121 mV	0.35 mS/cm	15.14 mg/L	9.0	v. lt brown, no odor or sheen
1528	~2	6.43	10.4°C	121 mV	0.35 mS/cm	14.95 mg/L	3.6	~clear, no odor or sheen
1538	~3	6.53	10.6°C	121 mV	0.35 mS/cm	15.20 mg/L	1.1	" " "
1548	~4	6.39	10.7°C	121 mV	0.35 mS/cm	14.88	0.2	" " "
1558	~5	6.37	10.7°C	121 mV	0.35 mS/cm	13.73	-0.7	" " "

(margin notes: pump battery went dead; trace of fine organic material (small roots?))

Note: Obstruction noted when sampling well with bailer (likely roots that came through screen slots; see p.14 logbook)

Sampling Device New disposable Teflon bailer for NWTPH-GRO; peristaltic pump for all other analytes
Filter Type: None Size: N/A

Sample Containers Collection Time 1605

Tag No.	Type		Preservative	Analytical Method	QA Remarks
2731	☐Amber	☒Poly 500 mL	H_2SO_4	TOC	
2732	☐Amber	☒Poly 1 L	None	TSS	
2733	☐Amber	☒Poly 1 L	HNO_3	Hardness/metals	
2734	☐Amber 40 mL VOA	☐Poly	HCl	NWTPH-GRO	
2735	☐Amber ↓	☐Poly	↓	↓	
2736	☐Amber ↓	☐Poly	↓	↓	
2737	☐Amber ↓	☐Poly	↓	VPH Followup	
2738	☒Amber 500 mL	☐Poly	None	NWTPH-DRO	
2739	☐Amber	☐Poly	↓	EPH Followup	
2740				SVOCs	

Samplers' Signature________________ Date ________

2741	↓	↓	↓
2742	1 L amber		Dioxins/Furans
2743	↓		↓
2744	1 L Poly	↓	Hold for dissolved metals

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number MW 06D
Sample No. LSP0014
Date 11-3-05

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: EJD/GHP

Well Information

Monument Condition ☒Good ☐Needs Repair
Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☐ Yes ☐ Added ☐other
Well Diameter ☒ 2-inch ☐4-inch ☐6-inch ☐Other
☐Odor Comments Replaced Lock

Purge Data

Total Well Depth ~45.4 ft ☐ Clean Bottom ☒Muddy Bottom (poor sounding) ☐Not Measured
Depth to Water 32.44 ft
Casing Volume 12.96 ft (H20) X 0.16 gpf = ~2.1 X 3 = ~6.3 gallons
3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method bailer (new disposable Teflon) → unweighted (Depth to water beyond limits of peristaltic pump)
Pump Type: ~~Peristaltic~~ Tubing: Disposable, dedicated LDPE Total volume purged 10 gal
Sample Intake Depth 32.5-35.5 (bailer) Purge Rate ~0.17 GPM
Purge Start Time 1730 Purge Stop Time 1830 Sample Rate NA-bailer

Field Parameters

Time	Gallons	pH	Temperature	Conductivity	D.O.	Eh	Comments	Turbidity
1740	2	6.25	11.7°C	0.30 mS/cm	12.55 mg/L	197 mV	lt. grayish brown, turbid, no odor or sheen	71.7 NTU
1755	4	6.25	11.5°C	0.30 mS/cm	12.72 mg/L	208 mV	" "	142.0 "
1805	6	6.41	11.6°C	0.30 mS/cm	14.93 mg/L	210 mV	" "	254.0 NTU
1817	8	6.54	11.5°C	0.30 mS/cm	14.42 mg/L	221 mV	" "	165.0 NTU
1830	10	6.46	11.4°C	0.30 mS/cm	15.18 mg/L	224 mV	" "	68.9 NTU

Sampling Device New disposable Teflon bailer used to collect all samples
Filter Type: None. Size: NA.

Sample Containers Collection Time 1845

Tag No.	Type		Preservative	Analytical Method	QA Remarks
2745	☐Amber	☒Poly 500ml	H2SO4	TOC	
2746	☐Amber	☒Poly 1L	—	TSS	
2747	☐Amber	☒Poly 1L	HNO3	Hardness/Metals	
2748	☐Amber 40ml vial	☐Poly	HCl	NWTPH-GRO	
2749	☐Amber ↓	☐Poly	↓	↓	
2750	☐Amber ↓	☐Poly	↓	↓	
2751	☐Amber ↓	☐Poly	↓	VPH follow-up	
2752	☒Amber 500ml	☐Poly	None	NWTPH-DRO	
2753	☐Amber ↓	☐Poly	↓	EPH follow-up	
2754	↓		↓	SVOC's	

Samplers' Signature ______ Date ______

2755 500ml Amber None ↓
2756 1L Amber . . . . Dioxins/Furans
2757 " "
2758 1L poly . . . . . . Hold for Diss. Metals

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number LSCMW-03
Sample No. LSP0379
Date 22 FEB 06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: E. [illegible] / K. [illegible]

Well Information

Monument Condition	☒ Good	☐ Needs Repair		
Well Cap Condition	☒ Good	☐ Locked	☐ Replaced	☐ Needs Replacement
Elevation Mark	☒ Yes	☐ Added	☐ other	
Well Diameter	☒ 2-inch	☐ 4-inch	☐ 6-inch	☐ Other
☐ Odor	Comments			

Purge Data

Total Well Depth 34.2 ft ☒ Clean Bottom ☐ Muddy Bottom ☐ Not Measured
Depth to Water 25.16 ft
Casing Volume 9.04 ft (H20) X 0.16 gpf = ~1.5 X 3 = ~4.5 gallons
3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method 1.5" Ø new, disposable Teflon bailer
Pump Type: Peristaltic Tubing: Disposable, dedicated LDPE Total volume purged 9 gal
Sample Intake Depth 25-28' Purge Rate
Purge Start Time 1642 Purge Stop Time 1729 Sample Rate

Field Parameters

Time	Gallons	pH	TURB	Temperature	Conductivity	D.O.	ORP	Comments
1650	1.5	7.06	>999 NTU	9.67 °C	0.266 mS/cm	6.68 mg/L	+220 mV	No sheen, no odor, light yellow brown, some v. fine roots
1655	3	6.76	>999 NTU	10.0 °C	0.275 mS/cm	6.85 mg/L	+224 mV	Same
1700	4.5	6.68	405 NTU	10.05 °C	0.273 mS/cm	7.54 mg/L	+225 mV	Same
1707	6.0	6.66	408 NTU	10.08 °C	0.273 mS/cm	6.33 mg/L	+228 mV	V. lt. brown, some v. fine roots, no odor or sheen
1718	7.5	6.66	805 NTU	9.67 °C	0.274 mS/cm	7.31 mg/L	+235 mV	larger root strands on 1st bailer of this volume
1729	9.0	6.62	721 NTU	9.98 °C	0.274 mS/cm	7.14 mg/L	+240 mV	Same

Sampling Device
Filter Type: N/A Size: N/A

Sample Containers Collection Time 1735

Tag No.	Type		Preservative	Analytical Method	QA Remarks
5646	☒ Amber 250ml	☐ Poly	H_2SO_4	TOC	1.5" Ø teflon bailer, new, disposable
5647	☐ Amber	☒ Poly 1L	—	TSS	
5648	☐ Amber	☒ Poly 500ml	HNO_3	METALS – TOTAL/HARDNESS	
5649	☐ Amber	☒ Poly 1-L	—	METALS – DISSOLVED	TO BE FILTERED BY LAB
5650, 5651	☒ Amber 500ml	☐ Poly		SVOCs (x2)	
5652, 5653	☒ Amber 1-L	☐ Poly		DIOXIN/FURAN (x2)	
5654, 5655	☒ Amber 500ml	☐ Poly		NWTPH-DRO/ARO (x2)	
5656	☒ Amber 500ml	☐ Poly		EPH FOLLOW UP	
5657-5659	☐ Amber	☐ Poly VOA	HCl	NWTPH-GRO (x3)	
5660-5661		VOA	HCl	VPH FOLLOW UP (x2)	

Feb. 2006 vials

Samplers' Signature [signature] Date 22 Feb 06

integral consulting inc.

Sample collection completed at 1810.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number LSCMW-2
Sample No. LSP0381
Date 23-Feb-06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: E Dedak

Well Information

Monument Condition ☒Good ☐Needs Repair

Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement

Elevation Mark ☐ Yes ☐ Added ☒other measured on high side of casing

Well Diameter ☒ 2-inch ☐4-inch ☐6-inch ☐Other

☐Odor Comments

Purge Data

Total Well Depth 28.7 ft ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured

Depth to Water 19.24 ft

Casing Volume 9.46 ft (H20) X 0.16 gpf = 1.5 X 3 = 4.5 gallons

3/4 " = 0.02 gpf 1"= 0.04 (2" = 0.16 gpf) 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: (Peristaltic) Tubing: (Disposable, dedicated teflon-lined LDPE) Total volume purged 6.5 gal

Sample Intake Depth 21 ft btoc Purge Rate 0.125 gal/min

Purge Start Time 1607 Purge Stop Time Sample Rate 0.10 gal/min

Field Parameters

Time	Gallons	pH	ORP	Temperature	Conductivity	D.O.	Turb	Comments
1620	1.5	6.35	+259 mV	10.38°C	0.318 mS/cm	6.73 mg/L	0.0 NTU	clear, no odor or sheen.
1633	3.0	6.34	+308 mV	10.36°C	0.318 mS/cm	5.03 mg/L	0.0 NTU	" " " "
1645	4.5	6.35	+315 mV	10.36°C	0.318 mS/cm	4.65 mg/L	12.9 NTU	" " " "
1658	6.0	6.35	+320 mV	10.32°C	0.318 mS/cm	4.52 mg/L	0.0 NTU	" " " "

Sampling Device

Filter Type: NA Size: NA

Sample Containers Collection Time 1710

Tag No.	Type		Preservative	Analytical Method	QA Remarks
5678	☒Amber 250 mL	☐Poly	H_2SO_4	TOC	Peristaltic pump
5679	☐Amber	☒Poly 0.5L	——	TSS	
5680	☐Amber	☒Poly 500 mL	HNO_3	Total metals + hardness	
5681	☐Amber	☒Poly 1L	——	Dissolved metals	Lab to filter
5682-3	☒Amber 500 mL	☐Poly	——	SVOCs (x2)	
5684-5	☒Amber 1L	☐Poly	——	Dioxins/Furans (x2)	
5686-7	☒Amber 500 mL	☐Poly	——	NWTPH-DRO/RRO (x2)	
5688	☒Amber 500 mL	☐Poly	——	EPH Follow up	
5689-91	☐Amber	☐Poly VOA	HCl	NWTPH-GRO (x3)	1.5" Ø new, disposable teflon bailer
5692-3		VOA	HCl	VPH Followup (x2)	

Samplers' Signature [signature] Date 23-Feb-06

VOA vials from Feb. 2006 batch

Sample collection completed at 1750.

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number MW-06D
Sample No. LSP0380
Date 23-Feb-06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: E Dodd...

Well Information

Monument Condition ☒Good ☐Needs Repair
Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒Yes ☐Added ☒other measured on high side of casing
Well Diameter ☒2-inch ☐4-inch ☐6-inch ☐Other
☐Odor Comments

Purge Data

Total Well Depth 45.1 ft ☐ Clean Bottom ☒Muddy Bottom ☐Not Measured
→ very soft sounding - difficult to get exact TD
Depth to Water 30.85 ft
Casing Volume 14.25 ft (H20) X 0.16 gpf = 2.3 X 3 = 6.9 gallons
3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method 1.5" Ø new disposable Teflon bailer (3 ft long)
Pump Type: ~~Peristaltic~~ Tubing: ~~Disposable, dedicated LDPE~~ Total volume purged 12.5
Sample Intake Depth Purge Rate
Purge Start Time 1341 Purge Stop Time 1427 Sample Rate

Field Parameters

Time	Gallons	pH	Temperature	Conductivity	ORP	D.O.	Turb.	Comments
1353	2.5	5.82	10.01°C	0.267 mS/cm	+190 mV	5.20 mg/L	283 NTU	V. lt. grayish brown, no odor or sheen
1402	5.0	6.25	10.66°C	0.280 mS/cm	+214 mV	4.98 mg/L	182 NTU	" " "
1411	7.5	6.35	10.77°C	0.283 mS/cm	+238 mV	4.84 mg/L	268 NTU	" " "
1418	10.0	6.39	10.73°C	0.285 mS/cm	+251 mV	4.70 mg/L	261 NTU	" " "
1427	12.5	6.40	10.76°C	0.285 mS/cm	+261 mV	4.88 mg/L	352 NTU	" " "

Sampling Device

Filter Type: N/A. Size: N/A.

Sample Containers Collection Time 1435

Tag No.	Type		Preservative	Analytical Method	QA Remarks
S662	☒Amber 250 mL	☐Poly	H_2SO_4	TOC	1.5" Ø new, disposable teflon bailer
S663	☐Amber	☒Poly 0.5L	——	TSS	
S664	☐Amber	☒Poly 500 mL	HNO_3	Total metals + hardness	
S665	☐Amber	☒Poly L	——	Dissolved metals	Lab to filter
S666-7	☒Amber 500 mL	☐Poly	——	SVOCs (x2)	
S668-9	☒Amber L	☐Poly	——	Dioxins/Furans (x2)	
S670-1	☒Amber 500 mL	☐Poly	——	NWTPH-DRO/RRO (x2)	
S672	☒Amber 500 mL	☐Poly	——	EPH Followup	
S673-5	☐Amber	☐Poly VOA	HCl	NWTPH-GRO (x3)	
S676-7		VOA	HCl	VPH Followup (x2)	

Samplers' Signature [signature] Date 23-Feb-06

VOA vials from Feb. 2006 batch
(500) Sample collection completed.

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SB-09 COC # D398
Sample No. LSP0372
Date 21 FEB 06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: K. MAGRUDER

Well Information

Monument Condition ☐Good ☒Needs Repair CONCRETE NEEDS REPLACING
Well Cap Condition ☒Good ☒Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒Yes ☐ Added ☐other
Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☒Other 1" Ø
☒Odor CREOSOTE-LIKE Comments

Purge Data

Total Well Depth 10.22 ft ☐ Clean Bottom ☐Muddy Bottom ☒Not Measured
Depth to Water 6.35 ft
Casing Volume 3.87 ft (H20) X 0.04 gpf = 0.1548 X 3 = 0.4644 gallons
3/4 " = 0.02 gpf (1" = 0.04) 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method VOAS VIA BAILER (DISPOSABLE DEDICATED)
Pump Type: (Peristaltic) Tubing: Disposable, (dedicated LDPE) Total volume purged 0.45 gal
Sample Intake Depth 9.5 FT COMPLETED SAMPLE COLL @ 1350 Purge Rate 0.044 gal/min
Purge Start Time 9:57 Purge Stop Time 1045 Sample Rate 0.04 gal/min

**** Field Parameters**

WAIT 20 MIN BTWN PURGE VOLUMES

Time	Gallons	pH	(VISUAL) TURB EST. Temperature	STRONG Conductivity	D.O.	Comments
* 1002	0.159		VERY TURBID	CREOSOTE-LIKE ODOR	MOD. SHEEN	>600ml VOL. WELL DRY MEDIUM YELLOW BRN
1020 (1024 KAM)	0.32		SAME AS ABOVE	SAME	SAME	>550ml VOL DRY COLOR = SAME
1040	0.45		SAME TURBIDITY	SAME ODOR	SAME SHEEN	>500ml VOL DRY COLORS SAME =1.3 gal

Sampling Device

Filter Type: N/A Size: N/A

Sample Containers Collection Time 1105

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6431	☒Amber 250	☐Poly	H2SO4	TOC	Collected w/ peristaltic pump
6432	☐Amber	☒Poly 1L	—	TSS	↓
6433 & 6434	☒Amber 500ml	☐Poly	—	SVOCs (x2)	↓
6435 & 6436	☒Amber 500ml	☐Poly	—	NWTPH-DRO/ARO (x2)	↓
6437	☒Amber 500ml	☐Poly	—	EPH FOLLOWUP	↓
6438, 6439, 6440	☐Amber	☐Poly VOA*	HCl	NWTPH-GRO (x3)	Collected w/ new disposable 0.75" Ø bailer
6441, 6442	☐Amber	☐Poly VOA*	HCl	VPH FOLLOWUP (x2)	
	☐Amber	☐Poly			
	☐Amber	☐Poly			

Samplers' Signature [signature] Date 21 Feb 06

NOTES: * VOA JARS ARE FROM NOV 2005 JAR ORDER
** Did not collect field parameters due to presence of moderately heavy sheen.

integral consulting inc.

128 oz/gallon
3.8L/gallon

GROUNDWATER SAMPLE COLLECTION FORM

COC# 0399

Well Number SB-11
Sample No. LSP0375
Date 22 FEB 06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: ERON DODAK & KIM MAGRUDER

Well Information

Monument Condition ☐Good ☒Needs Repair CONCRETE NEEDS REPAIR
Well Cap Condition ☒Good ☒Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒Yes ☐Added ☐other
Well Diameter ☐2-inch ☐4-inch ☐6-inch ☒Other
☐Odor Comments 1" DIAMETER

Purge Data

Total Well Depth 12.22 ft btoc ☐Clean Bottom ☐Muddy Bottom ☒Not Measured
Depth to Water 7.25 ft
Casing Volume 4.97 ft (H20) X 0.04 gpf = 0.1988 X 3 = 0.596 gallons
3/4 " = 0.02 gpf (1" = 0.04) 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method VOAS COLLECTED VIA DISPOSABLE/DEDICATED BAILER
Pump Type: (Peristaltic) Tubing: ~~Disposable, dedicated LDPE~~ teflon-lined Total volume purged ~2.75 gal
Sample Intake Depth 9' Purge Rate 0.062 gpm
Purge Start Time 0807 Purge Stop Time 08:55 Sample Rate 0.062 gpm

Field Parameters

22Feb06 KM ~~Slight~~ to moderate creosote odor — light 22Feb06

Time	Gallons	pH	TURB	Temperature	Conductivity	D.O.	ORP	Comments
8:18	0.5	5.88	5.9 NTU	8.71°C	0.215 mS/cm	—	+24 mV	Clear / yellowish KM
8:24	~~1.00~~ 0.87	5.88	7.1 NTU	8.70°C	0.203 mS/cm	—	+23 mV	clear / yellowish KM
8:28	1.12	5.88	8.2 NTU	8.71°C	0.198 mS/cm	—	+21 mV	Same
8:32	1.37	5.89	8.5 NTU	8.72°C	0.193 mS/cm	—	+20 mV	Same
8:36	1.62	5.90	9.1 NTU	8.74°C	0.190 mS/cm	—	+18 mV	Same
8:40	1.87	5.90	9.6 NTU	8.79°C	0.187 mS/cm	—	+17 mV	Same — ERROR 3 MESSAGE ON METER
8:44	2.62	5.90	9.4 NTU	8.76°C	0.187 mS/cm	—	+15 mV	Same — SAME

Sampling Device

Filter Type: NA Size: NA

Sample Containers Collection Time 900 COMPLETED 1035

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6479	☒Amber 250mL	☐Poly	H_2SO_4	TOC	collected w/ peristaltic pump
6480	☐Amber	☒Poly 0J		TSS	
6481	☐Amber	☒Poly 500mL	HNO3	METALS-TOTAL + HARDNESS	
6482	☐Amber	☒Poly 1-L	—	METALS-DISSOLVED	LAB TO FILTER
6483 & 6484	☒Amber 500mL	☐Poly	—	SVOCs (x2)	
6485 & 6486	☒Amber 1-L	☐Poly	—	DIOXIN/FURANS (x2)	
6487 & 6488	☒Amber 500mL	☐Poly	—	NWTPH DRO/RRO (x2)	
6489	☒Amber 500mL	☐Poly	—	EPH FOLLOW UP	
6490, 6491, 6492, 6493, 6494	☐Amber	☐Poly VOA*	HCl	NWTPH-GRO (x3)	Collected w/ new, disposable 0.75"Ø teflon bailer
	VOA*		HCl	VPH FOLLOW UP (x2)	

Samplers' Signature [signature] Date 22 Feb 06

integral consulting inc.

NOTE: * VOA VIALS USED ARE FROM FEB 2006 BOTTLE ORDER

CONTINUOUS PUMPING THROUGHOUT PURGING & SAMPLE COLLECTION
Sample & duplicate sample collection completed at 1030

CDGH D399 & D191

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SB-11 → Duplicate (dup. of LSP0375) Project Name: Little Squalicum Park
Sample No. LSP0376 Project Number: C075-02
Date 22-Feb-06 Collector: E. [illegible] / K. Magnuson

Well Information

Monument Condition ☐Good ☐Needs Repair ______
Well Cap Condition ☐Good ☐Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☐ Yes ☐ Added ☐other
Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☐Other
☐Odor Comments ______

Purge Data

Total Well Depth ______ ft ☐ Clean Bottom ☐Muddy Bottom ☐Not Measured
Depth to Water ______ ft See SB-11 sample sheet
Casing Volume ______ ft (H20) X ______ gpf = ______ X 3 = ______ gallons
3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: Peristaltic Tubing: Disposable, dedicated LDPE Total volume purged ______
Sample Intake Depth ______ Purge Rate ______
Purge Start Time ______ Purge Stop Time ______ Sample Rate ______

Field Parameters

Time	Gallons	pH	Temperature	Conductivity	D.O.	Comments

Sampling Device

Filter Type: ______ Size: ______

Sample Containers Collection Time 0915

Tag No.	Type		Preservative	Analytical Method	QA Remarks
5572	☒Amber 250 mL	☐Poly	H_2SO_4	TOC	collected w/ peristaltic pump
5573	☐Amber	☒Poly QT	—	TSS	
5574	☐Amber	☒Poly 500 mL	HNO_3	Total metals / hardness	
5575	☐Amber	☒Poly L	—	Dissolved metals	Lab to filter
5576 & 5577	☒Amber 500 mL	☐Poly	—	SVOCs (x2)	
5578 & 5579	☒Amber L	☐Poly	—	Dioxins / furans (x2)	
5580 & 5581	☒Amber 500 mL	☐Poly	—	NWTPH-DRO/RRO (x2)	
5582	☒Amber 500 mL	☐Poly	—	EPH Follow up	↓
5583, 5584, 5585	☐Amber	☐Poly VOA	HCl	NWTPH-DRO (x3)	Collected w/ new disposable 0.75" Ø teflon bailer
5586, 5587	VOA		HCl	VPH follow up (x2)	

Samplers' Signature [signature] Date 22-Feb-06

[signature]

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

COC #0393 & 0394

Well Number SB-13
Sample No. LSP0370
Date 20-Feb-06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: E. Drake / K. Magnuson

Well Information

Monument Condition	☐Good	☒Needs Repair Concrete needs repaired		
Well Cap Condition	☒Good	☐Locked	☐Replaced	☐Needs Replacement
Elevation Mark	☒ Yes	☐ Added	☐other	
Well Diameter	☐ 2-inch	☐4-inch	☐6-inch	☒Other 1"Ø
☐Odor	Comments			

Purge Data

Total Well Depth 9.55 ft ☐ Clean Bottom ☐Muddy Bottom ☒Not Measured
Depth to Water 5.65 ft ↗ 21 08
Casing Volume 3.90 ft (H20) X 0.04 gpf = 0.16 X 3 = 0.48 gallons
3/4 " = 0.02 gpf (1"= 0.04) 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: Peristaltic Tubing: Disposable, dedicated teflon-lined LDPE Total volume purged ~1 gal
Sample Intake Depth 9' btoc Purge Rate 0.045 GPM
Purge Start Time 1520 Purge Stop Time 1558 Sample Rate ~0.04 GPM

Field Parameters

Time	Gallons	pH	Temperature	Conductivity	ORP	D.O.	Turb	Comments
1526	~0.2	6.62	7.72°C	0.560 mS/cm	+105 mV	3.87 mg/L	>999	V. lt. yel. brown, no odor or sheen.
1530	~0.35	6.54	7.80°C	0.541 mS/cm	+66 mV	2.11 mg/L	>999	" " " " turbid
1539*	~0.65	6.49	7.88°C	0.496 mS/cm	+24 mV	0.90 mg/L	>999	lt. yel. brown, turbid, no odor or sheen
1545*	~0.8	6.46	7.85°C	0.475 mS/cm	+15 mV	0.00 mg/L	>999	" " " " " sulfur odor
1557*	~0.95	6.45	7.59°C	0.453 mS/cm	+17 mV	0.00 mg/L	>999	As above

*Purged dry (0.5' from bottom of piezo). Stopped pump and allowed to recharge. GW visibly turbid. Attempted to reduce turbidity by additional pumping (pumped dry three times).

Sampling Device

Filter Type: N/A. Size: N/A.

Sample Containers Collection Time 1610

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6405	☐Amber	☒Poly 500mL	H_2SO_4	TOC	Collected w/ peristaltic pump
6406	☐Amber	☒Poly 1-L	—	TSS	↓
6407	☒Amber 500mL	☐Poly	—	SVOC	↓
6408	☒Amber ↓	☐Poly	—	SVOC	↓
6409	☒Amber ↓	☐Poly	—	NWTPH-DRO	↓
6410	☒Amber ↓	☐Poly	—	EPH	↓
6411	☐Amber VOA	☐Poly	HCl	NWTPH-GRO	Collected w/ 0.75" Ø new disposable teflon bailer
6412	☐Amber ↓	☐Poly	HCl	↓	↓
6413	☐Amber ↓	☐Poly	HCl	↓	↓
6414	↓		HCl	VPH	↓

Used vials from Nov. 2005 (6411–6414)

Samplers' Signature [signature] Date 20-Feb-06
[signature: Kimberly Magnuson]

integral consulting inc.

Note! Pumped well dry a number of times during sampling due to poor producing wells.
DUE TO POOR PRODUCING WELL, THE PUMP WAS TURNED OFF A NUMBER OF TIMES DURING SAMPLING TO ALLOW THE WELL TO RECHARGE.

GROUNDWATER SAMPLE COLLECTION FORM

COC# 0396 & 0397

Well Number SB-14
Sample No. LSP0374
Date 21 FEB 06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: K. Magruder

Well Information

Monument Condition ☐Good ☒Needs Repair
Well Cap Condition ☒Good ☒Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒Yes ☐Added ☐other
Well Diameter ☐2-inch ☐4-inch ☐6-inch ☒Other 1" Ø
☐Odor Comments

Purge Data

Total Well Depth 10.50 ft ☐Clean Bottom ☐Muddy Bottom ☒Not Measured
Depth to Water 4.83 ft = 860 mL
Casing Volume 5.67 ft (H20) X 0.04 gpf = 0.2268 X 3 = 0.6804 gallons
3/4" = 0.02 gpf (1" = 0.04) 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf

TTH 11 = 1400 mL + 500 = 0.5 + 500 + 250

Purge Method VOCs COLLECTED VIA DISPOSABLE/DEDICATED BAILER
Pump Type: (Peristaltic) 21 Feb 06 KM Tubing: (Disposable/dedicated LDPE) Total volume purged 0.7 gal
Sample Intake Depth 9.5 ~~FEET~~ FT Purge Rate
* Purge Start Time ~~1425~~ 1440 Purge Stop Time 1540 Sample Rate

NEEDED LOWER TUBING

Field Parameters

Time	Gallons	pH	TURB	Temperature	Conductivity	ORP	D.O.	Comments
1515	0.5	6.71	>999 NTU	7.96°C	0.308 mS/cm	-13 mV	—	LIGHT TO MED BROWN
1530	0.7	~~7.84~~ 6.63	968 NTU	7.81°C	0.312 mS/cm	-52 mV	—	SAME w/ MOD TO STRONG CREOSOTE ODOR

~~SLIGHT~~ TO MODERATE CREOSOTE ODOR 21 Feb 06

Sampling Device
Filter Type: N/A Size: N/A

Sample Containers Collection Time 1550

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6463	☒Amber 250mL	☐Poly	H2SO4	TOC	Collected w/ peristaltic pump
6464	☐Amber	☒Poly 1L	—	TSS	
6465	☐Amber	☒Poly 500mL	HNO3	METALS - TOTAL/HARDNESS	
6466	☐Amber	☒Poly 1-L	—	METALS - DISSOLVED	Lab to filter
6467 & 6468	☒Amber 500mL	☐Poly	—	SVOCs (x2)	
6469 & 6470	☒Amber 1-L	☐Poly	—	DIOXIN/FURANS (x2)	
6471 & 6472	☒Amber 500mL	☐Poly	—	NWTPH-DRO/ORO (x2)	
6473	☒Amber 500mL	☐Poly	—	EPH FOLLOW UP	
6474, 6475, 6476, 6477, 6478	☐Amber	☐Poly VOA**	HCl	NWTPH-GRO (x3)	Collected w/ new, disposable 0.75" Ø bailer
		VOA**	HCl	VPH FOLLOW UP (x2)	

Samplers' Signature [signature] Date 21 Feb 06

integral consulting inc.

NOTE: * PURGED 10 MIN @ LOW FLOW RATE BEFORE WELL VOLUME DROPPED. WAITED 10 MIN FOR WELL TO RECHARGE
** VOA JARS ARE FROM NOV 2005 JAR ORDER
Sample collection completed at 1820.

GROUNDWATER SAMPLE COLLECTION FORM

COC # 0392

Well Number SB-18
Sample No. LSP0367
Date 20-Feb-06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: E. O'Dell / K. Magnuson

Well Information

Monument Condition ☒Good ☐Needs Repair
Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒ Yes ☐ Added ☐other
Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☒Other 1" Ø
☐Odor Comments

Purge Data

Total Well Depth 4.25 ft ☐ Clean Bottom ☐Muddy Bottom ☒Not Measured
Depth to Water 1.40 ft
Casing Volume 2.85 ft (H20) X 0.04 gpf = 0.11 (↙ 14 oz) X 3 = 0.33 gallons
3/4 " = 0.02 gpf (1"= 0.04) 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: (Peristaltic) Tubing: Disposable, dedicated teflon-lined LDPE Total volume purged ~0.55 gal
Sample Intake Depth 3.5' btoc Purge Rate 7 oz/min
Purge Start Time 0842 Purge Stop Time 0925 Sample Rate 8 oz/min

Field Parameters pump started at 0842

Time*	Gallons	pH	Temperature	Conductivity (mS/cm)	D.O. ORP	Comments	Turbidity
0840	~12 oz	6.22	8.13 °C	0.430 mS/cm	0.97 mg/L +169 mV	V. lt yel. brown, no odor or sheen	157 NTU
0852	~26 oz	6.36	8.47°C	0.427 mS/cm	0.00 mg/L +132 mV	Same	190 NTU
0904	~40 oz	6.41	8.53°C	0.428 mS/cm	0.00 mg/L +118 mV	As above	210 NTU
0914	~54 oz	6.42	8.46°C	0.427 mS/cm	0.00 mg/L +117 mV	As above	156 NTU
0925	~70 oz	6.45	8.52°C	0.428 mS/cm	0.00 mg/L +124 mV	As above	188 NTU

* Note: Allowed parameter to recharge between pumping events

Sampling Device

Filter Type: N/A. Size: N/A.

Sample Containers Collection Time 0930

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6371	☐Amber	☒Poly 500mL	H_2SO_4	TOC	Collected w/ peristaltic pump
6372	☐Amber	☒Poly 1L	—	TSS	↓
6373	☒Amber 500mL	☐Poly ~~500mL~~ KAM 20Feb06	—	SVOC	
6374	☒Amber 500mL	☐Poly	—	SVOC	
6375	☒Amber 500mL	☐Poly	—	NWTPH-DRO	
6376	☒Amber ↓	☐Poly	—	EPH	↓
6377	☐Amber VOA	☐Poly	HCl	NWTPH-GRO	VOA vials collected w/ 0.75" Ø teflon bailer (new, disposable)
6378	☐Amber VOA	☐Poly	HCl	↓	
6379	☐Amber VOA	☐Poly	HCl		
6380	VOA		HCl	VPH	↓

Used vials from Nov. 2005 (6377–6380)

Samplers' Signature [signature] Date 20-Feb-06
[signature]

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

COC#0392 & 0393

Well Number SB-19
Sample No. LSP0368
Date 20-Feb-06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: E. Dodak/K. Wagner

Well Information

Monument Condition ☐Good ☒Needs Repair Concrete needs repaired (around monument)
Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒ Yes ☐ Added ☐other
Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☒Other 1"Ø
☐Odor Comments * water is slowly flowing over top of well casing. Lt. iridescent sheen observed

Purge Data

Total Well Depth 7.48 ft ☐ Clean Bottom ☐Muddy Bottom ☒Not Measured
Depth to Water 0.00 ft *
Casing Volume 7.48 ft (H20) X 0.04 gpf = 0.3 X 3 = 0.9 gallons
3/4 " = 0.02 gpf (1"= 0.04) 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: Peristaltic Tubing: Disposable, dedicated teflon-lined LDPE Total volume purged ~1.8 gal.
Sample Intake Depth 2' btoc. Purge Rate 0.08 GPM
Purge Start Time 11:20 Purge Stop Time 1145 Sample Rate 0.08 GPM

Field Parameters

Time	Gallons	pH	Temperature	Conductivity	ORP	D.O.	Turbidity	Comments
1125	0.3	6.87	9.40 °C	0.492 mS/cm	-76 mV	0.00 mg/L	380 NTU	lt. grayish-brown, weak petroleum odor, v. lt. sheen
1129	0.6	6.90	9.48 °C	0.495 mS/cm	-82 mV	0.00 mg/L	237 NTU	as above
1134	0.9	6.95	9.58 °C	0.498 mS/cm	-93 mV	0.00 mg/L	125 NTU	clear to lt. grayish brown, weak petroleum odor, v. lt sheen
1138	1.2	6.96	9.60 °C	0.498 mS/cm	-97 mV	0.00 mg/L	113 NTU	" " "
1142	1.5	6.96	9.61 °C	0.499 mS/cm	-99 mV	0.00 mg/L	107 NTU	" " "

Sampling Device

Filter Type: N/A. Size: N/A.

Sample Containers Collection Time 1150

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6381	☐Amber	☒Poly 500mL	H_2SO_4	TOC	Collected w/ peristaltic pump
6382	☐Amber	☒Poly 1L	—	TSS	↓
6383	☒Amber 500mL	☐Poly	—	SVOC	↓
6384	☒Amber ↓	☐Poly	—	SVOC	↓
6385 & 6386	☒Amber ↓	☐Poly	—	NWTPH-DRO (2)	↓
6387	☒Amber ↓	☐Poly	—	EPH	↓
6388	☐Amber VOA	☐Poly	HCl	NWTPH-GRO	Collected w/ new, disposable 0.75" Ø teflon bailer
6389	☐Amber ↓	☐Poly	HCl	↓	↓
6390	☐Amber ↓	☐Poly	HCl	↓	↓
6391 & 6392	↓		HCl	VPH (2)	↓

used vials from Nov. 2005 (6388–6392)

Samplers' Signature [signatures] Date 20-Feb-06

Note: Pump was turned off between purging and sampling. When pump was turned on prior to sampling, the water was visibly turbid. Water was pumped for approx. 5 min. until water was not visibly turbid before filling sample bottles.

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

COC #0393

Well Number SB-20
Sample No. LSP0369
Date 20-Feb-06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: E. Dodak / K. Magnuder

Well Information

Monument Condition ☐Good ☒Needs Repair Concrete needs replaced
Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒Yes ☐Added ☐other
Well Diameter ☐2-inch ☐4-inch ☐6-inch ☒Other 1"Ø
☐Odor Comments

Purge Data

Total Well Depth 7.23 ft ☐Clean Bottom ☐Muddy Bottom ☒Not Measured
Depth to Water 0.24 ft
Casing Volume 6.99 ft (H20) X 0.04 gpf = 0.28 X 3 = 0.84 gallons
3/4 " = 0.02 gpf (1"=0.04) 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: Peristaltic (from 20FEB06 5.5' btoc) Tubing: Disposable, dedicated teflon-lined LDPE Total volume purged ~0.6 gal.
Sample Intake Depth ~~5.5' btoc~~ 6.7' btoc
Purge Rate 0.06 GPM
Purge Start Time 1245 Purge Stop Time 1327 Sample Rate

Field Parameters

Time	Gallons	pH	Temperature	Conductivity	ORP	D.O.	TURB	Comments
1305	~0.3	7.00	8.71°C	0.610 mS/cm	-79 mV	0.00 mg/L	831 NTU	lt. grayish-brown, slightly turbid, no odor or sheen
1326	~0.6*	7.02	8.85°C	0.597 mS/cm	-86 mV	0.00 mg/L	551 NTU	As above

* Pushed tubing approx 6" from bottom of piezo and purged dry at a pump rate 06 ~0.06 GPM.

Sampling Device

Filter Type: N/A Size: N/A

Sample Containers Collection Time 1335

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6393	☐Amber	☒Poly 500mL	H_2SO_4	TOC	Collected w/ peristaltic pump
6394	☐Amber	☒Poly 1L	—	TSS	↓
6395	☒Amber 500mL	☐Poly	—	SVOC	↓
6396	☒Amber ↓	☐Poly	—	SVOC	↓
6397	☒Amber ↓	☐Poly	—	NWTPH-DRO	↓
6398	☒Amber ↓	☐Poly	—	EPH	↓
6400	☐Amber VOA	☐Poly	HCl	NWTPH-GRO	Collected w/ new disposable 0.75"Ø teflon bailer
6401	☐Amber ↓	☐Poly	HCl	↓	↓
6402	☐Amber ↓	☐Poly	HCl	↓	↓
6403	↓		HCl	VPH	↓
6404				↓	↓

Used vials from Nov. 2005 (6400–6404)

Samplers' Signature [signatures] Date 20-Feb-06

integral

Note: Due to poor ~~???~~ producing well, the pump was stopped a number of times to allow the well to recharge during sampling activities. The TSS a plastic bottle had HNO_3 preservative, but it was rinsed twice with SB-20 GW prior to filling.

COC# 0395

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SB-21
Sample No. LSP0371
Date 21 FEB 06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: ERIN DODAK

Well Information

Monument Condition ☒Good ☐Needs Repair
Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒ Yes ☐ Added ☐other
Well Diameter ☒ 2-inch ☐4-inch ☐6-inch ☐Other
☐Odor Comments

Purge Data

Total Well Depth 31.4 ft btoc ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured
Depth to Water 28.73 ft
Casing Volume 2.67 ft (H20) X 0.16 gpf = 0.4272 x 3 = 1.28 gallons
3/4 " = 0.02 gpf 1"= 0.04 (2" = 0.16 gpf) 4"=0.65 gpf 6"=1.47 gpf

Purge Method 1.5" Ø new disposable teflon bailer
Pump Type: ~~Peristaltic~~ ~~Tubing:~~ ~~Disposable, dedicated LDPE~~
Sample Intake Depth Entire water column
Purge Start Time 1036 Purge Stop Time 1106
Total volume purged 2 gal
Purge Rate bailed ~0.067 GPM
Sample Rate

Field Parameters

Time	Gallons	pH	Temperature	Conductivity ORP	D.O.* Turb	Comments
1045	0.5	6.53	9.91°C	0.386 mS/cm +235	9.20 mg/L >999 NTU	med. yel. brown, turbid, no odor or sheen.
1053	1.2	6.69	10.11°C	0.361 mS/cm +265	9.61 mg/L >999 NTU	" " " " "
1100	1.8	6.82	10.00°C	0.351 mS/cm +285	9.72 mg/L >999 NTU	" " " " "
1106	2.0**	6.89	9.63°C	0.376 mS/cm +292	9.36 mg/L >999 NTU	less turbid, " " " " "

Sampling Device

Filter Type: N/A. Size: N/A.

Sample Containers Collection Time 1130

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6415	☒Amber 250ml	☐Poly	H_2SO_4	TOC	Collected w/ 1.5" Ø new disposable Teflon bailer
6416	☐Amber	☒Poly 1L	—	TSS	
6417	☐Amber	☒Poly 500ml	HNO_3	METALS — TOTAL / HARDNESS	
6418	☐Amber	☒Poly 1-L	—	METALS — DISSOLVED	LAB TO FILTER
6419 & 6420	☒Amber 500ml	☐Poly	—	SVOC (x2)	
6421 & 6422	☒Amber 1-L	☐Poly	—	DIOXIN/FURAN (x2)	
6423 & 6424	☒Amber 500ml	☐Poly	—	NWTPH-DRO/RRO (x2)	
6425	☒Amber 500ml	☐Poly	—	EPH FOLLOW UP	
6426-28 ~~6458, 6459, 6460~~	☐Amber	☐Poly VOA	HCl	NWTPH - GRO (x3)	
6429 & 30 ~~6461 & 6462~~		VOA	HCl	~~NWTPH~~ VPH (x2)	

EM 21-Feb-06

Samplers' Signature [signature] Date 21-Feb-06

[signature] 21 Feb 06

integral consulting inc.

Nov. 2005 vials.

* Error of dummy DO calibration. Reading likely incorrect.
** Bailed the well dry at 2.0 gal. Allow to recover before sampling.
Note: Sampled well dry after ~2.5 liters. Allowed to recover. Sampled dry after second 2.5 liters. Allowed to recharge. Sample collection completed at 1330

COC# 0395 & 0396

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SB-22
Sample No. ~~LSP0374~~ LSP0373 (KAM 21Feb06)
Date 21-Feb-06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: E. Dodak

Well Information

Monument Condition	☒Good	☐Needs Repair		
Well Cap Condition	☒Good	☐Locked	☐Replaced	☐Needs Replacement
Elevation Mark	☒ Yes	☐ Added	☐other	
Well Diameter	☒ 2-inch	☐4-inch	☐6-inch	☐Other
☐Odor	Comments			

Purge Data

Total Well Depth 29.2 ft ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured
Depth to Water 27.4 ft
Casing Volume 1.8 ft (H20) X 0.16 gpf = 0.288 X 3 = 0.864 gallons
3/4 " = 0.02 gpf 1"= 0.04 (2" = 0.16 gpf) 4"=0.65 gpf 6"=1.47 gpf

Purge Method 1.5" Ø new ~~disposable~~ disposable Teflon bailer
Pump Type: ~~Peristaltic~~ Tubing: Disposable, dedicated LDPE
Sample Intake Depth Entire water column
Purge Start Time 1423 Purge Stop Time 1507
Total volume purged ~2.3 gal
Purge Rate bailed ~0.06 GPM
Sample Rate ______

Field Parameters

Time	Gallons	pH	Temperature	Conductivity	ORP	D.O.*	Turb.	Comments
1428	0.3	6.13	8.42°C	~~102~~ 0.534 mS/cm	+180 mV		102 NTU	v. lt. gray ish brown, moderate creosote-like odor, no sheen.
1443	0.6	6.52	9.11°C	0.490 mS/cm	+153 mV	—	279 NTU	" " "
1452	0.9	6.63	9.13°C	0.489 mS/cm	+156 mV	—	403 NTU	" " "
1455	1.2	6.68	9.18°C	0.488 mS/cm	+154 mV	—	479 NTU	As above w/ very lt. sheen (trace).
1500	1.5	6.70	9.18°C	0.488 mS/cm	+152 mV	—	441 NTU	As above.
1503	1.8	6.72	9.16°C	0.488	+143 mV	—	355 NTU	As above
1507	2.1	6.73	9.14°C	0.486	+134	—	340 NTU	As above

Sampling Device

Filter Type: N/A Size: N/A

Sample Containers Collection Time 1530

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6447	☒Amber 250mL	☐Poly	H2SO4	TOC	Collected w/ new, disposable 1.5" Ø Teflon bailer
6448	☐Amber	☒Poly OJ	—	TSS	
6449	☐Amber	☒Poly 500mL	HNO3	METALS - TOTAL / hardness	
6450	☐Amber	☒Poly 1-L	—	METALS - DISSOLVED	LAB TO FILTER
6451 & 6452	☒Amber 500mL	☐Poly	—	SVOC (x2)	
6453 & 6454	☒Amber 1-L	☐Poly	—	DIOXIN/FURAN (x2)	
6455 & 6456	☒Amber 500mL	☐Poly	—	NWTPH - DRO/RRO (x2)	
6457	☒Amber 500mL	☐Poly	—	EPH FOLLOW UP	
6458, 6459, 6460	☐Amber	☐Poly VOA	HCl	NWTPH - GRO (x3)	
6461, 6462		VOA	HCl	~~NWTPH~~ VPH (x2) (21Feb06 KAM)	

From NW: 2005 batch of vials

Samplers' Signature [signature] Date 21-Feb-06

* DO probe not working (error message #6)

Sample collection completed at 1600.

[signature] 21Feb06

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SB-23
Sample No. LSP0378
Date 22-Feb-06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: E. Dudak / K. Majumder

Well Information

Monument Condition ☒Good ☐Needs Repair
Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒ Yes ☐ Added ☐other
Well Diameter ☒ 2-inch ☐4-inch ☐6-inch ☐Other
☐Odor Comments

Purge Data

Total Well Depth 30.05 ft ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured
Depth to Water 27.50 ft
Casing Volume 2.55 ft (H20) X 0.16 gpf = 0.4 X 3 = 1.2 gallons
3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method 1.5" Ø New disposable teflon bailer
Pump Type: ~~Peristaltic~~ Tubing: ~~Disposable, dedicated LDPE~~ Total volume purged ~0.66 gal
Sample Intake Depth Entire water column Purge Rate
Purge Start Time 1517 Purge Stop Time 1555 Sample Rate

Field Parameters

Time	Gallons	pH	Temperature	Conductivity	Redox	D.O.	Turb	Comments
1520	0.5	6.79	9.65°C	0.258 mS/cm	+199 mV	6.05 mg/L	>999 NTU	Med. yel. brown, turbid, no odor or sheen
1555	~~0.50~~	6.90	—	0.195 mS/cm		—	—	insufficient volume purged/bailed dry
	0.66 ER	Refilled						

NOTE: After 1 hr of sampling, well had ~0.2' of water. Collected ~150 mL in a 500 mL amber bottle. Allow to recover overnight and attempt sampling (see below).

Sampling Device
Filter Type: N/A Size: N/A

Sample Containers Collection Time 1610

Tag No.	Type		Preservative	Analytical Method	QA Remarks
~~5632~~	☒Amber 250 mL	☐Poly	H_2SO_4	TOC	All samples collected w/ new, disposable 1.5" Ø Teflon bailer.
~~5633~~	☐Amber	☒Poly 0J	—	TSS	
5634	☐Amber	☒Poly 500 mL	HNO_3	METALS - TOTAL / HARDNESS	
5635	☐Amber	☒Poly 1-L	—	METALS - DISSOLVED	Lab filtered → ~100 mL only
5637	☒Amber 500 mL	☐Poly	—	SVOCs ~~(x2)~~ (1) ER 23-Feb-06	
5639	☒Amber 500 mL	☐Poly	—	NWTPH - DRO/RRO ~~(x2)~~ (1)	
5640	☒Amber 500 mL	☐Poly	—	EPH FOLLOWUP	Save for dissolved metals if not needed for EPH follow up
5641, 5642, ~~5643~~	☐Amber	☐Poly VOA	HCl	NWTPH - GRO (x3)	
5644, ~~5645~~	☐Amber	☐Poly VOA	HCl	VPH FOLLOWUP (x2)	

Margin notes: Insuff. vol. ER 23-Feb-06 (5632, 5633); INSUFFICIENT VOLUME (~~5638~~, ~~5636~~); Insuf. vol. ER 22-Feb-06; Used February 2008 Vials

Samplers' Signature [signature] Date 22-Feb-06

integral

Note: bailed dry at ~0.6 gal. Allowed to recover, bailed dry 2nd time @ ~~0.50~~ 0.66 gal ER 22-Feb-06. Started sampling, completed sampling at 0750 23-Feb-06 (sampled until well was dry)

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SB-24
Sample No. LSP0377
Date 22 FEB 06

Project Name: Little Squalicum Park
Project Number: C075-02
Collector: E. DODAK / K. MAGRUDER

Well Information

Monument Condition ☒Good ☐Needs Repair
Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒ Yes ☐ Added ☐other
Well Diameter ☒ 2-inch ☐4-inch ☐6-inch ☐Other
☐Odor Comments

Purge Data

Total Well Depth 34.40 ft ☒ Clean Bottom ☐Muddy Bottom ☒Not Measured
Depth to Water 27.75 ft
Casing Volume 6.65 ft (H20) X 0.16 gpf = 1.06 X 3 = 3.2 gallons
3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method Bailer (1.5" Ø new, disposable teflon bailer)
Pump Type: Peristaltic Tubing: Disposable, dedicated LDPE Total volume purged 7.0 gal
Sample Intake Depth Top 3' of water column Purge Rate
Purge Start Time 1300 Purge Stop Time 1328 Sample Rate

Field Parameters

Time	Gallons	pH	Turb	Temperature	Conductivity	*D.O.	ORP	Comments
1305	1.0	6.41	440 NTU	9.35°C	0.287 mS/cm	6.2 mg/L	+150 mV	LIGHT YEL. BRN NO ODOR NO SHEEN
1309	2.0	6.59	699 NTU	9.29°C	0.293 mS/cm	5.78 mg/L	+156 mV	Same
1312	3.0	6.60	538 NTU	9.26°C	0.295 mS/cm	7.3 mg/L	+158 mV	↓
1315	4.0	6.65	550 NTU	9.82°C	0.294 mS/cm	5.4 mg/L	+157 mV	
1319	5.0	6.66	587 NTU	9.85°C	0.293 mS/cm	5.9 mg/L	+158 mV	
1322	6.0	6.66	639 NTU	9.85°C	0.292 mS/cm	5.54 mg/L	160 mV	
1328	7.0	6.67	633 NTU	9.79°C	0.293 mS/cm	5.40 mg/L	164 mV	↓

Sampling Device

Filter Type: N/A Size: N/A

Sample Containers Collection Time 1340

Tag No.	Type		Preservative	Analytical Method	QA Remarks
5588-5590	☒Amber 250 ml	☐Poly	H2SO4	TOC (x3)	
5591-5593	☐Amber	☒Poly QT	—	TSS (x3)	
5594	☐Amber	☒Poly 500 ml	HNO3	METALS - TOTAL / HARDNESS	
5595	☐Amber	☒Poly 1-L	—	METALS - DISSOLVED ~~(x3)~~	TO BE FILTERED @ LAB
5596-5601	☒Amber 500 ml	☐Poly	—	SVOCs ~~(x2)~~ (x6) KM 22 Feb 06	
5602-5607	☒Amber 1-L	☐Poly	—	DIOXIN / FURANS ~~(x2)~~ (x6)	
5608-5613	☒Amber 500 ml	☐Poly	—	NWTPH - DRO/RRO ~~(x2)~~ (x6)	
5614-5616	☒Amber 500 ml	☐Poly	—	EPH FOLLOW UP (x3)	
5617-5625	☐Amber	☐Poly VOA	HCl	NWTPH - GRO ~~(x3)~~ (x9)	
5626-5631		VOA	HCl	VPH FOLLOW UP ~~(x2)~~ (x6)	

Collected w/ 1.5" Ø teflon bailer (new, disposable)

(used Feb. 2006 Vials)

Samplers' Signature [signature] Date 22 Feb 06
[signature]

integral

NOTE: * DO MEASURED USING NEW YSI 550 DO METER. READINGS ARE ERRATIC JUMPING 2-4 mg/L IN A SINGLE MEASUREMENT.
Sample collection completed at 1435.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SBGW-25
Sample No. LSP0591
Date 2 MAY 06

Project Name: Little Squalicum Park
Project Number: C075.0211
Collector: K MALKRUDER

Well Information

Monument Condition ☒Good ☐Needs Repair
Well Cap Condition ☒Good ☒Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒ Yes ☐ Added ☐other
Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☒Other 1"
☐Odor Comments

Purge Data

Total Well Depth 7.85 ft ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured
Depth to Water 2.02 ft 0.88L 80mls/min target for sampling
Casing Volume 5.83 ft (H20) X 0.04 gpf = 0.233 X 3 = 0.67 gallons
3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: (Peristaltic) Tubing: (Disposable) TEFLON-LINED dedicated LDPE Total volume purged 1.5 gal
Sample Intake Depth ~3' Purge Rate 0.06 gpm
Purge Start Time 1000 Purge Stop Time 1030 Sample Rate 0.06 gpm

2020 (black) meter

Field Parameters

Time	Gallons	pH	Temperature °C	ORP mV	Conductivity mS/cm	D.O. mg/L	Comments	Turbidity
1005	~0.25	6.95	9.57	60.6	0.392	2.55	MOD STRONG CREOSOTE ODOR, CLEAR, NO SHEEN	NM
1009	0.5	6.96	9.56	57.3	0.392	2.20	Same	0.4
1013	0.75	6.98	9.54	51.6	0.392	1.72	"	0.20
1017	1.0	6.98	9.53	51.3	0.392	1.50	"	0.20
1021	1.25	6.99	9.52	49.5	0.392	1.36	"	0.15
1025	1.5	6.97	9.54	48.1	0.392	1.24	"	0.15

Sampling Device

Sampled NWTPHGx & VPH w/ new disposable teflon bailer

Filter Type: ______ Size: ______

Sample Containers

Collection Time 1030

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6965	☒Amber 250ml	☐Poly	H2SO4	TOC (EPA 418.1)	
6966	☐Amber	☒Poly 1-L	—	TSS (EPA 160.2)	
6967	☐Amber	☒Poly 500ml	—	DISSOLVED METALS (EPA 200.8/6010B/7470)	FILTERED @ LAB
6968	☐Amber	☒Poly 1-L	HNO3	TOTAL METALS & HARDNESS (SM 2340B) (")	
6968-6971	~~☐Amber~~	~~☐Poly~~ 40ml VOA	HCl	NWTPH-GRO	
6972 & 6973	☐Amber	☐Poly ↓	↓	VPH FOLLOWUP	
6974 & 6975	☒Amber 500ml	☐Poly	—	NWTPH-DRO+RRO	
6976	☒Amber	☐Poly		EPH FOLLOWUP	
6977 & 6978	☒Amber ↓	☐Poly	↓	SVOCs (8270C-LL)	

6979 & 6980 Amber 1-L DIOXIN/FURAN (EPA 1613B)

Samplers' Signature [signature] Date 2 May 06

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SBGW-25 dup
Sample No. LSP0592
Date 1 May 06

Project Name: Little Squalicum Park
Project Number: C075.0211
Collector: K. Magruder

Well Information

Monument Condition ☐Good ☐Needs Repair

Well Cap Condition ☐Good ☐Locked ☐Replaced ☐Needs Replacement

Elevation Mark ☐ Yes ☐ Added ☐other

Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☐Other

☐Odor Comments

Purge Data

See SBGW-25 LSP0591 sheet

Total Well Depth ____ ft ☐ Clean Bottom ☒Muddy Bottom ☐Not Measured

Depth to Water ____ ft

Casing Volume ____ ft (H20) X ____ gpf = ____ X 3 = ____ gallons

3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: Peristaltic Tubing: Disposable, dedicated LDPE Total volume purged ____

Sample Intake Depth ____ Purge Rate ____

Purge Start Time ____ Purge Stop Time ____ Sample Rate ____

Field Parameters

Time	Gallons	pH	Temperature	ORP	Conductivity	D.O.	Comments	Turbidity

Sampling Device

Sampled NWTPHGx & VPH using new disposable teflon bailer

Filter Type: ____. Size: ____.

Sample Containers

Collection Time 1045

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6981	☒Amber 250ml	☐Poly	H_2SO_4	TOC (EPA 415.1)	
6982	☐Amber	☒Poly 1-L	—	TSS (EPA 160.2)	
6983	☐Amber	☒Poly 500ml	—	DISSOLVED METALS (EPA 200.8/6010B/7471)	
6984	☐Amber	☒Poly 1-L	HNO3	TOTAL METALS (" / " / ") HARDNESS (SM 2340B)	
6985-6987	~~☐Amber~~	~~☐Poly~~ 40ml VIAL	HCl	NW TPH-GRO	
6988 & 6989	~~☐Amber~~	~~☐Poly~~ ↓	↓	VPH FOLLOW UP	
6990 & 6991	☒Amber 500ml	☐Poly	—	NW TPH - DRO - RRO	
6992	☒Amber	☐Poly	—	EPH FOLLOW UP	
6993 & 6994	☒Amber ↓	☐Poly	—	SVOCS (EPA 8270C-LL)	
~~Amber 1-L~~			—	~~DIOXIN/FURAN (EPA 16~~	

Samplers' Signature K. Magruder Date 2 May 06

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number GW SB-26
Sample No. LSP0593
Date 1 May 06

Project Name: Little Squalicum Park
Project Number: C075.0211
Collector: K. Magruder

Well Information

Monument Condition ☒Good ☐Needs Repair
Well Cap Condition ☒Good ☒Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒ Yes ☐ Added ☐other
Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☒Other 1"
☐Odor Comments

Purge Data

Total Well Depth 10.2' ft ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured
Depth to Water 2.09 ft
Casing Volume 8.11 ft (H20) X 0.04 gpf = 0.32 X 3 = 0.97 gallons = 3.7 L
3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Target purge rate = 250 ml/min – 370 ml/min

Purge Method

Pump Type: (Peristaltic) Tubing: (Disposable) Teflon-lined dedicated LDPE Total volume purged ~5.5 gal
Sample Intake Depth ~3.5' Purge Rate ~~333 ml/min~~ = 0.088 gal/min; 1hr ~333 ml/min
Purge Start Time 11:40 Purge Stop Time 1330 Sample Rate ~~212 ml/min~~

Field Parameters

Time	Gallons	pH	Temperature °C	ORP mV	Conductivity mS/cm	D.O. mg/L	Comments	Turbidity NTU
11:50	0.88	6.27	9.2°C	231.4	0.271	2.77	no color or odor	~0.31
1200	1.76	6.27	9.16°C	238.9	0.272	1.96	↓	
1210	2.64	6.27	9.16°	244	0.272	1.07	↓	~0.22
1220	3.52	6.27	9.18	244	0.272	0.93	↓	
1230	4.0	6.27	9.33	237.8	0.272	0.82	↓	2.0
1240	4.88	6.27	9.29	232.1	0.272	0.83	↓	0.00

(Turbidity notes: using 2020 meter (Bag); using 2020 meter (black))

1250 Started Sample collection @ 212 ml/min flow rate

Sampling Device

Collected NWTPH-Gx sample w/ new, disposable 0.75" Ø teflon bailer

Filter NA Type: Size:

Sample Containers Collection Time 1250

Tag No.	Type		Preservative	Analytical Method	QA Remarks
6995	☒Amber 250	~~☒Poly~~	H2SO4	TOC 415.1	
6996	☐Amber	☒Poly 1-L	DJ ——	TSS 160.2	
6997	☐Amber	☒Poly 500ml	——	DISS METALS (200.8/6010B/7470)	
6998	~~☒Amber 500ml~~	☒Poly 1-L	HNO3	TOTAL METALS (" " ") HARDNESS (SM 2340B)	FILTERED @ LAB
7004 & 7005	☒Amber 500ml	☐Poly	——	NWTPH-DRO + RRO	
7006	☒Amber 500ml	☐Poly		EPH FOLLOWUP	
7007 & 7008	☒Amber 500ml	☐Poly		SVOCs (EPA 8270C-LL)	
6999-7001	~~☐Amber~~	~~☐Poly~~ 40ml VIAL	HCl	NWTPH-GRO	COLLECTED W/ BAILER
7002 & 7003	~~☐Amber~~	~~☐Poly~~ ↓	↓	VPH FOLLOWUP	" "

Samplers' Signature K. Magruder Date 1/May/06

PLEASE NOTE TIME ON SAMPLE JARS = 11:30AM; WHEN SAMPLES WERE ACTUALLY COLLECTED AT 1250

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SB-27
Sample No. LSP0594
Date 01-May-06

Project Name: Little Squalicum Park
Project Number: C075.0211
Collector: Eron Dodak

Well Information

Monument Condition	☒Good	☐Needs Repair		
Well Cap Condition	☒Good	☐Locked	☐Replaced	☐Needs Replacement
Elevation Mark	☒ Yes	☐ Added	☐other	
Well Diameter	☐ 2-inch	☐4-inch	☐6-inch	☒Other 1"Ø

☐Odor Comments Note: used Gray 2020e turbidimeter, "AG" YSI 556 meter

Purge Data

Total Well Depth 20.65 ft ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured
Depth to Water 2.48 ft
Casing Volume 18.17 ft (H20) X 0.04 gpf = 0.73 X 3 = 2.18 gallons
3/4 " = 0.02 gpf (1"= 0.04) 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: (Peristaltic) Tubing: (Disposable, dedicated teflon lined LDPE) Total volume purged ~4.25 gal
Sample Intake Depth 9 ft btoc Purge Rate 0.074 GPM
Purge Start Time 1620 Purge Stop Time 1720 Sample Rate 0.06 GPM (flow reduced)

Field Parameters

Time	Gallons	pH	Temperature (°C)	ORP (mV)	Conductivity (µS/cm)	D.O. (mg/L)	Comments	Turbidity (NTU)
1632	0.75	6.17	9.66	+24.7	208	2.28	lt. gray, no odor, no sheen	14.3
1642	1.5	6.40	9.62	+6.8	217	1.95	v. lt. gray, " " "	4.19
1652	2.25	6.44	9.60	+6.0	211	0.93	" " " " " "	1.92
1702	3.0	6.45	9.58	+7.2	211	0.77	" " " "	0.67 NTU
1712	3.75	6.47	9.56	+7.1	211	0.70	" " " "	0.50 NTU

Sampling Device Sampled for NWTPH-Gx w/ new, disposable 0.75"Ø teflon bailer.

Filter Type: NA. Size: NA.

Sample Containers Collection Time 1715

Tag No.	Type		Preservative	Analytical Method	QA Remarks
7009	☒Amber 250mL	☐Poly	H_2SO_4	TOC	
7010	☐Amber	☒Poly l	—	TSS	
7011	☐Amber	☒Poly 500mL	—	Dissolved metals	Lab to filter
7012	☐Amber	☒Poly l	HNO_3	Total metals	
7013-15	☐Amber clear 40 mL	☐Poly	HCl	NWTPH-GRO	
7016-17	☐Amber clear 40 mL	☐Poly	HCl	VPH Followup	
7018-19	☒Amber 500mL	☐Poly	—	NWTPH-DRO+RRO	
7020	☒Amber 500mL	☐Poly	—	EPH Followup	
7021-22	☒Amber 500mL	☐Poly	—	SVOCs	

Samplers' Signature [signature] Date 01-May-06

integral consulting inc.

Night line 206-695-6243 Eric 2200

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SB-28
Sample No. LSP0595
Date 02-May-06

Project Name: Little Squalicum Park
Project Number: C075.0211
Collector: E. Dodak

Well Information

Monument Condition ☒Good ☐Needs Repair

Well Cap Condition ☒Good ☐Locked ☐Replaced ☐Needs Replacement

Elevation Mark ☒ Yes ☐ Added ☐other

Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☒Other 1"Ø

☐Odor Comments Used black turbidimeter (#2020 e) and "AG" YSI meter (#556)

Purge Data

Total Well Depth 14.25 ft ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured

Depth to Water 6.34 ft

Casing Volume 7.91 ft (H20) X ~~0.32~~ 0.04 ED 02-May-06 gpf = 0.32 X 3 = 0.96 gallons

3/4 " = 0.02 gpf (1"= 0.04) 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: Peristaltic Tubing: Disposable, dedicated LDPE Total volume purged ~2.5 gal

Sample Intake Depth 7.5 ft btoc. Purge Rate 0.06 GPM

Purge Start Time 1246 Purge Stop Time 1330 Sample Rate 0.06 GPM

Field Parameters

Time	Gallons	pH	Temperature (°C)	ORP (mV)	Conductivity (µS/cm)	D.O. (mg/L)	Comments	Turbidity
1254	0.35	6.18	9.50	+122.3	307	3.42	V. lt. brown, no odor, no sheen	3.2 NTU
1302	0.70	6.15	9.41	+89.5	302	0.63	~clear, no odor, no sheen	3.2 NTU
1308	1.05	6.14	9.41	+80.2	303	0.47	" " "	0.85 NTU
1314	1.40	6.14	9.42	+77.7	303	0.40	" " "	2.9 NTU
1320	1.75	6.14	9.46	+72.9	304	0.36	" " "	3.0 NTU

Sampling Device

Filter NA Type: ______ Size: ______

Note: collected NWTPH-Gx sample w/ new, disposable 0.75" Ø bailer.

Sample Containers Collection Time 1330

Tag No.	Type		Preservative	Analytical Method	QA Remarks
7023	☒Amber 250mL	☐Poly	H_2SO_4	TOC	
7024	☐Amber	☒Poly 1 L	—	TSS	
7025	☐Amber	☒Poly 500mL	—	Dissolved metals	Lab to filter
7026	☐Amber	☒Poly 1 L	HNO_3	Total metals / hardness	
7027-29	☐ ~~Amber~~ clear 40mL	☐Poly	HCl	NWTPH-GTO	
7030-31	☐ ~~Amber~~ clear 40mL	☐Poly	HCl	VPH followup	
7032-33	☒Amber 500mL	☐Poly	—	NWTPH-Dx + RRO	
7034	☒Amber 500mL	☐Poly	—	EPH followup	
7035-36	☒Amber 500mL	☐Poly	—	SVOCs	

Samplers' Signature [signature] Date 02-May-06

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SB-29
Sample No. LSP0596
Date 02-May-06

Project Name: Little Squalicum Park
Project Number: C075.0211
Collector: Eron Dodak

Well Information

Monument Condition	☒Good	☐Needs Repair		
Well Cap Condition	☒Good	☐Locked	☐Replaced	☐Needs Replacement
Elevation Mark	☒ Yes	☐ Added	☐other	
Well Diameter	☐ 2-inch	☐4-inch	☐6-inch	☒Other 1"Ø

☒Odor Comments ** Parameters not collected due to sheen. Note: Purged dry at 1.2 gal. Able to sample ~1 liter every 10 minutes.

Purge Data

Total Well Depth 10.75 ft ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured

Depth to Water 6.52 ft

Casing Volume 4.23 ft (H20) X 0.04 gpf = 0.17 X 3 = 0.51 gallons

3/4 " = 0.02 gpf (1"= 0.04) 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: Peristaltic Tubing: Disposable, dedicated LDPE Total volume purged ~1.2 gal

Sample Intake Depth 8.0 ft btoc Purge Rate 0.06 GPM

Purge Start Time 1450 Purge Stop Time 1514 Sample Rate 0.06 GPM

Field Parameters

Time	Gallons	pH	Temperature	ORP	Conductivity	D.O.	Comments	Turbidity
1455	0.2	—	—	—	—	—	Strong creosote-like odor, lt. sheen, lt yel. brown	
1459	0.4	—	—	—	—	—	" " " "	—
1503	0.6	—	—	—	—	—	V. lt. sheen (?), strong creosote-like odor.	—
1507	0.8	—	—	—	—	—	" " " " "	—
1511	1.0	—	—	—	—	—	" " " " "	—
1514	1.2	—	—	—	—	—	" " " " Purged dry. Slightly turbid.	

Sampling Device

Filter NA Type: ______. Size: ______. Note: collected NWTPH-Gx sample with new, disposable 0.75"Ø teflon bailer.

Sample Containers Collection Time 1515

Tag No.	Type		Preservative	Analytical Method	QA Remarks
7037	☒Amber 250 mL	☐Poly	H_2SO_4	TOC	
7038	☐Amber	☒Poly 1 L	—	TSS	
7039	☐Amber	☒Poly 500 mL	—	Dissolved metals	Lab to filter
7040	☐Amber	☒Poly 1 L	HNO_3	Total metals/hardness	
7041-43	☐~~Amber~~ clear 40 mL	☐Poly	HCl	NWTPH - GRO	
7044-45	☐~~Amber~~ clear 40 mL	☐Poly	HCl	VPH Followup	
7046-47	☒Amber 500 mL	☐Poly	—	NWTPH - DRO+RRO	
7048	☒Amber 500 mL	☐Poly	—	EPH Followup	
7049-50	☒Amber 500 mL	☐Poly	—	SVOCs	
7050-51	☒Amber 1 L		—	Dioxins/Furans	

Samplers' Signature [signature] Date 02-May-06

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SBGW-30
Sample No. LSP0597
Date 2 MAY 06

Project Name: Little Squalicum Park
Project Number: C075.0211
Collector: K. MAGRUDER

Well Information

Monument Condition ☒Good ☐Needs Repair
Well Cap Condition ☒Good ☒Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒ Yes ☐ Added ☐other
Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☒Other 1"
☐Odor Comments

Purge Data

Total Well Depth 16.45 ft ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured
Depth to Water 3.64 ft
Casing Volume 12.81 ft (H20) X 0.04 gpf = 0.512 X 3 = 1.536 gallons
3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: (Peristaltic) Tubing: (Disposable) TEFLON-LINED, dedicated LDPE Total volume purged ~3.6 gal
Sample Intake Depth ~5.5' Purge Rate ~~0.0512 gal/min~~ 0.06 gal/min
Purge Start Time 1235 Purge Stop Time 1330 Sample Rate 0.06 gal/min

Field Parameters

Time	Gallons	pH	Temperature °C	ORP mV	Conductivity mS/cm	D.O. mg/L	Comments	Turbidity NTU (LAMOTTE 2020 (black) meter)
1240	~~0.75~~ 0.5 KW	6.19	9.29	127.9	0.168	2.62	CLEAR, SLIGHT FE OXIDE & SULFUR ODORS	—
1248	~~1.25~~ 1.0	6.23	9.37	108.5	0.245	1.64	"	0.55
1256	~~1.75~~ 1.5	6.36	9.43	78.7	0.294	1.30	"	0.40
1304	2.0	6.42	9.48	65.2	0.313	1.13	"	0.35
1312	2.5	6.44	9.58	62.9	0.326	1.03	"	0.25
1320	3.0	6.46	9.70	56.3	0.333	0.93	"	0.20
1328	3.5	6.46	9.79	55.0	0.338	0.85	"	0.85

Sampling Device Sampled NWTPH-Gx & VPH using new disposable teflon bailer
Filter Type: ______. Size: ______.

Sample Containers Collection Time 1330 (on jar)

Tag No.	Type		Preservative	Analytical Method	QA Remarks
7053	☒Amber 250mL	☐Poly	H_2SO_4	TOC (EPA 415.1)	
7054	☐Amber	☒Poly 1-L	—	TSS (EPA 160.2)	
7055	☐Amber	☒Poly 500mL	—	DISSOLVED METALS (EPA 200.8/6010B/7470) LAB FILTER	
7056	☐Amber	☒Poly 1-L	HNO_3	TOTAL METALS (" / " / ") HARDNESS (2340B)	
7057-7059	~~☐Amber~~	~~☐Poly~~ 40 mL VIAL	HCl	NWTPH-GRO	
7060 & 7061	~~☐Amber~~	~~☐Poly~~ ↓	↓	VPH FOLLOWUP	
7062 & 7063	☒Amber 500mL	☐Poly	—	NWTPH-DRO-RRO	
7064	☒Amber	☐Poly		EPH FOLLOWUP	
7065 & 7066	☒Amber ↓	☐Poly	↓	SVOCs (EPA 8270C-LL	

Samplers' Signature [signature] Date 2 May 06

integral consulting inc.

GROUNDWATER SAMPLE COLLECTION FORM

Well Number SBGW - 32
Sample No. LSPD598
Date 1 MAY 06

Project Name: Little Squalicum Park
Project Number: C075.0211
Collector: K. [illegible]

Well Information

Monument Condition ☒Good ☐Needs Repair
Well Cap Condition ☒Good ☒Locked ☐Replaced ☐Needs Replacement
Elevation Mark ☒ Yes ☐ Added ☐other
Well Diameter ☐ 2-inch ☐4-inch ☐6-inch ☒Other 1"
☐Odor Comments

Purge Data

Total Well Depth 6.85 ft ☒ Clean Bottom ☐Muddy Bottom ☐Not Measured
Depth to Water 0.95 ft
Casing Volume 5.9 ft (H20) X 0.04 gpf = 0.236 gal X 3 = 0.708 gallons 2.68 l

0.0472 gal - target purge rate = 0.0708 g/min - 180 - 268 ml/min

3/4 " = 0.02 gpf 1"= 0.04 2" = 0.16 gpf 4"=0.65 gpf 6"=1.47 gpf

Purge Method

Pump Type: (Peristaltic) Tubing: (Disposable), dedicated LDPE TEFLON-LINED
Sample Intake Depth 2.5'
Purge Start Time 14:45 Purge Stop Time
Total volume purged ~5.5 gal
Purge Rate ~~212ml/ft~~ 250 ml/min
Sample Rate 212ml/min

Slight FeOxides sulfur

Field Parameters

Time	Gallons	pH	Temperature °C	ORP mV	Conductivity	D.O. mg/L	Comments WELL WATER TYPE ODOR	Turbidity
1452	~1 gal	6.16	9.95	61.9	0.172	1.86	YELLOWISH, CLEAR	1.7
1503	1.71	6.14	10.01	71.2	0.176	0.82	CLEAR	3.1
1514	2.42	6.14	10.08	76.5	0.176	0.67	CLEAR, SLIGHT SULFUR ODOR STILL	3.3
1525	3.13	6.14	10.10	80.7	0.176	0.56	SAME	2.7
1536	3.84	6.13	9.98	80.4	0.175	0.53	SAME	2.5
1550 ~~1547~~	~~4.55~~ 4.77	6.12	10.07	81.0	0.175	0.47		2.3
1 ~~655~~								

Sampling Device

Filter NA Type: Size:

collected NWTPH-Gx sample w/ new, disposable 0.75" teflon bailer

Turb meas. using 2020 (black) meter

Sample Containers Collection Time 1600

Tag No.	Type		Preservative	Analytical Method	QA Remarks
7067	☒Amber 250ml	☒Poly	H_2SO_4	TOC (EPA 415.1)	
7068 & 7083	☐Amber	☒Poly 1-L	—	TSS (" 160.2)	
7069 & 7084	☐Amber	☒Poly 500ml	—	DISS METALS (EPA 200.8/6010B/7470)	FILTER @LAB
7070 & 7085	☐Amber	☒Poly 1-L	HNO_3	TOTAL METALS (" / " / ") HARDNESS (SM2340B)	
7076 & 7077, 7090 & 7091	☒Amber 500ml	☐Poly	—	NWTPH-DRO + RRO	
7078 & 7092	☒Amber 500ml	☐Poly	—	EPH FOLLOW UP	
7079 & 7080, 7093 & 7094	☒Amber 500ml	☐Poly	—	SVOCs (EPA 8270C-LL)	
7071-7073, 7086-7088	~~☐Amber~~	~~☐Poly~~ 40ml VIAL	HCl	NWTPH-GRO	
7074 & 7075, 7089	~~☐Amber~~	~~☐Poly~~ ↓	↓	VPH FOLLOW UP	
7081 & 7082, 7095 & 7096	Amber 1-L		—	DIOXIN/FURANS (EPA 1613B)	

Samplers' Signature [signature] Date 1 May 06

integral consulting inc.

ATTACHMENT 4

SURFACE WATER
FIELD FORMS

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP

SAMPLE NO. ~~LSP-SW-01~~ LSP0001 (BP 01-Nov-05)

DATE 01-Nov-05 TIME 1125

SAMPLED BY EJD/BHP

WEATHER CONDITIONS Light rain, calm to lt. winds, ~50-55 °F.

SAMPLE LOCATION SW01 (mouth of creek (at end of pipe)

SAMPLE DEPTH NA - Sampled water flowing out of pipe

SURFACE WATER FLOW RATE Pipe has ~1 ft of water - swift flow (see photos)

SURFACE WATER TYPE Grab

SAMPLE CONDITION (i.e. turbidity, odor, oily) Lt. grayish brown, slightly to moderately turbid, no odor or sheen.

SAMPLE COLLECTION

COLLECTION METHOD Filled containers directly w/ flowing water

COLLECTION TIME 1125

Turbidity 23.3 NTU

SAMPLE INFORMATION pH 5.40 COND. 0.11 mS/cm T(C) 11.0 D.OXYGEN 17.58 mg/L*

Tag #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
2330	TOC (EPA 415.1)	500 mL Poly	H_2SO_4
2331	TSS (EPA 160.2)	1 L poly	None
2332	Hardness (SM2340B)/metals (EPA 200.8/6010B/7470)	1 L poly	HNO_3
2333	NWTPH-GRO	40 mL Vial	HCl
2334	↓	↓	↓
2335	↓	↓	↓
2336	VPH Followup	↓	↓
2337	NWTPH-DRO	500 mL Amber	None
2338	EPH Followup	↓	↓
2339	SVOCs (EPA SW 8270C low levels)	↓	↓
2340	↓	↓	↓

CHAIN OF CUSTODY FORM ______ COC TAPE ______

SHIPPING CONTAINER ______

COMMENTS *DO meter calibrated w/o error and read 10.41 mg/L in ambient air following calibration.

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP

SAMPLE NO. ~~LSP-SW-03~~ LSP0003 (EJ 01-NOV-05)

DATE 01-NOV-05 TIME 1345

SAMPLED BY EJD/BHP

WEATHER CONDITIONS lt. rain, calm winds, ~50-55°F

SAMPLE LOCATION SW04 (Marine Drive outfall immediately upstream of bridge)

SAMPLE DEPTH NA - Filled bottles directly from stream of outfall

SURFACE WATER FLOW RATE Water from outfall ~1-2' wide, 3-4" deep, SW/NA

SURFACE WATER TYPE Grab

SAMPLE CONDITION (i.e. turbidity, odor, oily) lt. grayish brown, slightly turbid, no odor or sheen.

SAMPLE COLLECTION

COLLECTION METHOD Fill containers directly from stream of water from outfall

COLLECTION TIME 1345

Turbidity 51.6 NTU

SAMPLE INFORMATION pH 6.11 COND. 0.19 mS/cm T(C) 10.9 °C D.OXYGEN 19.99 mg/L *

Tag #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
2352	TOC (EPA 415.1)	500 mL Poly	H_2SO_4
2353	TSS (EPA 160.2)	1 l Poly	None
2354	Hardness (SM2340B)/Metals (EPA 200.8/6010B/7470)	1 l Poly	HNO_3
2355	NWTPH-GRO	40 mL Vial	HCl
~~2356~~ 2443 (EJ 01-Nov-05)	↓	↓	↓
2357	↓	↓	↓
2358	VPH Followup	↓	↓
2359	NWTPH-DRO	500 mL Amber	None
2360	EPH Followup	↓	↓
2361	SVOCs (EPA SW 8270C low levels)	↓	↓
2362	↓	↓	↓

CHAIN OF CUSTODY FORM ________ COC TAPE ________

SHIPPING CONTAINER ________

COMMENTS * See Sheet for Sample LSP0003.

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP0004
DATE 01-Nov-05 TIME 1450 SAMPLED BY EJD/BHP
WEATHER CONDITIONS lt. rain, calm winds, ~50°F

SAMPLE LOCATION SW05
SAMPLE DEPTH NA - Sample collected directly from outfall stream
SURFACE WATER FLOW RATE Discontinuous flow from square outfall, swift flow (see photos)
SURFACE WATER TYPE Grab
SAMPLE CONDITION (i.e. turbidity, odor, oily) lt. grayish brown, slightly turbid, no odor or sheen.

SAMPLE COLLECTION
COLLECTION METHOD Samples collected directly from outfall stream.
COLLECTION TIME 1450

SAMPLE INFORMATION pH 6.04 COND. 0.17 mS/cm T(C) 11.6°C D.OXYGEN ~~19.99~~ 16.46 * Turbidity 61.0 NTU

Tag #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
2363	TOC (EPA 415.1)	500 mL poly	H_2SO_4
23634 (filtered)	TSS (EPA 160.2)	1 l poly	None
2365	Hardness (SM2340B)/metals (EPA 200.8/6010B/7470)	1 l poly	HNO_3
2366	NWTPH-GRO	40 mL vial	HCl
2367	↓	↓	↓
2368	↓	↓	↓
2369	VPH Followup	40 mL vial	HCl
2370	NWTPH-DRO	500 mL amber	None
2371	EPH Followup	↓	↓
2372	SVOCs (EPA SW 8270C low levels)	↓	↓
2373	↓	↓	↓
2374	Dioxins/Furans (EPA 1613B)	l amber	None
2375	↓	↓	↓

CHAIN OF CUSTODY FORM ______ COC TAPE ______
SHIPPING CONTAINER ______

COMMENTS * See purge sheet for SW01.

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP
SAMPLE NO. LSP0005
DATE 01-Nov-05 TIME 1500
SAMPLED BY EJD/BHP
WEATHER CONDITIONS

SAMPLE LOCATION SW05-DUPLICATE
SAMPLE DEPTH
SURFACE WATER FLOW RATE
SURFACE WATER TYPE
SAMPLE CONDITION (i.e. turbidity, odor, oily)

See field sheet for LSP0004

SAMPLE COLLECTION
COLLECTION METHOD
COLLECTION TIME 1500

See field sheet for LSP0004

SAMPLE INFORMATION pH COND. T(C) D.OXYGEN

Tag #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
2376	TOC (EPA 415.1)	500 mL poly	H_2SO_4
2377	TSS (EPA 160.2)	1 l poly	None
2378	Hardness (SM 2340B)/Metals (EPA 200.8/6010B/7470)	1 l poly	HNO_3
2379	NWTPH-GRO	40 mL vial	HCl
2380	↓	↓	↓
2381	↓	↓	↓
2382	VPH Followup	40 mL vial	HCl
2383	NWTPH-DRO	500 mL ambers	None
2384	EPH Followup	↓	↓
2385	SVOCs (EPA SW 8270C low levels)	↓	↓
2386	↓	↓	↓
2387	Dioxins/Furans (EPA 1613B)	l amber	None
2388	↓	↓	↓

CHAIN OF CUSTODY FORM
COC TAPE
SHIPPING CONTAINER

COMMENTS

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP — SAMPLE NO. LSP0006 (P. 1 of 3)

DATE 01-Nov-05 — TIME 1530 — SAMPLED BY EJD/BHP

WEATHER CONDITIONS V. lt. rain, Calm winds, ~50°F

SAMPLE LOCATION SW06

SAMPLE DEPTH ~1-2" below water surface. Collected immediately downstream of outfall pipe (within 1 ft).

SURFACE WATER FLOW RATE Moderate - ~5 mph.

SURFACE WATER TYPE Grab

SAMPLE CONDITION (i.e. turbidity, odor, oily) lt. gray brown, occasional organic-like sheen (~1" dia.), no odor or sheen noted on sample

SAMPLE COLLECTION

COLLECTION METHOD Peristaltic pump w/ dedicated new, disposable Teflon-lined LDPE tubing

COLLECTION TIME 1530

↳ NWTPH-GRO samples collected w/ slow pumping rate

Turbidity 10.6

SAMPLE INFORMATION pH 6.57 COND. 0.17 ms/cm T(C) 12.0° D.OXYGEN 17.18*

Tag #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION	
2389	TOC (EPA 415.1)	500 mL poly	H_2SO_4	
2390	TSS (EPA 160.1)	1 l poly	None	
2391	↓	↓	↓	MS/MSD
2392	Hardness (2340B)/metals (EPA 200.8)/6010B/7470)	1 l poly	HNO_3	
2393	↓	↓	↓	MS/MSD
2394	NW TPH-GRO	40 mL vial	HCl	
2395	↓	↓	↓	
2396	↓	↓	↓	
2397	↓	↓	↓	MS/MSD
2398	↓	↓	↓	↓
2399	↓	↓	↓	↓
2400	↓	↓	↓	↓

CHAIN OF CUSTODY FORM ____________ COC TAPE ____________

SHIPPING CONTAINER ____________

COMMENTS * See sample sheet for LSP0001.

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP0006 (P. 2 of 3)

DATE 01-Nov-05 TIME 1530 SAMPLED BY EJD/BHP

WEATHER CONDITIONS

SAMPLE LOCATION SW06

SAMPLE DEPTH [see p. 1 of 3]

SURFACE WATER FLOW RATE

SURFACE WATER TYPE

SAMPLE CONDITION (i.e. turbidity, odor, oily)

SAMPLE COLLECTION

COLLECTION METHOD

COLLECTION TIME [see p. 1 of 3]

SAMPLE INFORMATION pH COND. T(C) D.OXYGEN

Tag #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION	
~~2400~~ 01-Nov-05				
2401	VPH Followup	40 mL vials	HCl	
2402	↓	↓	↓	MS/MSD
2403	↓	↓	↓	↓
2404	↓	↓	↓	↓
2405	↓	↓	↓	↓
2406	NWTPH-DRO	500 mL amber	None	
2407	↓	↓	↓	MS/MSD
2408	↓	↓	↓	↓
2409	EPH Followup	500 mL amber	None	
2410	↓	↓	↓	MS/MSD
2411	↓	↓	↓	↓

CHAIN OF CUSTODY FORM COC TAPE

SHIPPING CONTAINER

COMMENTS

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP0006 (P.3 of 3)

DATE 01-Nov-05 TIME 1530 SAMPLED BY

WEATHER CONDITIONS

SAMPLE LOCATION SW06

SAMPLE DEPTH

SURFACE WATER FLOW RATE [see p.1 of 3]

SURFACE WATER TYPE

SAMPLE CONDITION (i.e. turbidity, odor, oily)

SAMPLE COLLECTION

COLLECTION METHOD

COLLECTION TIME

[see p. 1 of 3]

SAMPLE INFORMATION pH COND. ~~T(C)~~ D.OXYGEN

Tag #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION	
~~2411~~ BD 01-Nov-05				
2412	SVOCs (EPA SW 8270C low levels)	500 mL Amber	None	
2413	↓	↓	↓	
2414	↓	↓	↓	MS/MSD
2415	↓	↓	↓	↓
2416	Dioxins/Furans	l amber	None	
2417	↓	↓	↓	
2418	↓	↓	↓	~~MS/MSD~~ lab duplicate BD 01-Nov-05
1422	↓	↓	↓	Lab dup

CHAIN OF CUSTODY FORM COC TAPE

SHIPPING CONTAINER

COMMENTS

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

BJP 11-2-05

PROJECT LSP SAMPLE NO. LSP0007

DATE ~~01~~ 02-Nov-05 TIME 1115 SAMPLED BY BJD/BHP

WEATHER CONDITIONS Cloudy, lt. winds, ~50°F

SAMPLE LOCATION SW07

SAMPLE DEPTH ~1-2" below water surface. Water ~15' across, unknown depth

SURFACE WATER FLOW RATE No flow apparent (appears to be ponded water)

SURFACE WATER TYPE Grab

SAMPLE CONDITION (i.e. turbidity, odor, oily) lt. brown, no sheen or odor

SAMPLE COLLECTION

COLLECTION METHOD Peristaltic pump w/new disposable siltone and teflon-lined LDPE tubing. NWTPH-GRO bottles filled w/very low pumping rate

COLLECTION TIME 1115

Turbidity = 2.7 NTU

SAMPLE INFORMATION pH 6.28 COND. 0.23 mS/cm T(C) 10.5 °C D.OXYGEN 15.79 mg/l

Tag #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
2419	TOC (EPA 415.1)	500 mL poly	H_2SO_4
2420	TSS (EPA 160.2)	1 l poly	None
2421	Hardness (SM2340B) / metals (EPA 200.8/6010B/7470)	1 l poly	HNO_3
2422	NWTPH-GRO	40 mL vial	HCl
2423	↓	↓	↓
2424	↓	↓	↓
2425	VPH Followup	40 mL vial	HCl
2426	NWTPH-DRO	500 mL amber	None
2427	EPH Followup	↓	↓
2428	SVOCs	↓	↓
2429	↓	↓	↓

CHAIN OF CUSTODY FORM ______ COC TAPE ______

SHIPPING CONTAINER ______

COMMENTS Station Coordinates

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP

SAMPLE NO. ~~LSP-SW-02~~ ~~LSP0002~~ LSP0002 (initialed, 01-NOV-05)

DATE 01-NOV-05 TIME 1230 SAMPLED BY BJD/BHP

WEATHER CONDITIONS lt. rain, calm winds, ~55°F

SAMPLE LOCATION SW09

SAMPLE DEPTH ~1-2" below water surface

SURFACE WATER FLOW RATE Creek ~5-6' wide, 1 ft deep, moving ~5 mph

SURFACE WATER TYPE Grab

SAMPLE CONDITION (i.e. turbidity, odor, oily) lt. grayish brown, slightly turbid, no odor or sheen.

SAMPLE COLLECTION

COLLECTION METHOD Peristaltic Pump (very slow pump rate for NWTPH-GRO vials)

COLLECTION TIME 1230 → used Teflon lined LDPE tubing, silicone tubing in pump head (new disposable tubing).

Turbidity 33.9 NTU

SAMPLE INFORMATION pH 5.74 COND. 0.14 mS/cm T(C) 11.1° D.OXYGEN 18.75* mg/L

Tag #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
2341	TOC (EPA 415.1)	500 mL Poly	H_2SO_4
2342	TSS (EPA 160.2)	1 L Poly	None
2343	Hardness (SM 2340B)/metals (EPA 200.8/6010B/7470)	1 L Poly	HNO_3
2344	NWTPH-GRO	40 mL vial	HCl
2345	↓	↓	↓
2346	↓	↓	↓
2347	VPH Followup	40 mL Vial	HCl
2348	NWTPH-DRO	500 mL amber	None
2349	EPH Followup	↓	↓
2350	SVOCs (EPA SW8270c low levels	↓	↓
2351	↓	↓	↓

CHAIN OF CUSTODY FORM ______ COC TAPE ______

SHIPPING CONTAINER ______

COMMENTS ______

* See note from sheet for Station SW01

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP0008

BP 11-2-05 DATE ~~2~~ 2 Nov 2005 TIME 0915 SAMPLED BY BHP/ EJD

WEATHER CONDITIONS Cloudy, H-humids, Occasional lt. rain, ~50°F

SAMPLE LOCATION SW10 (manhole in front of 3110 Cedarwood)

SAMPLE DEPTH Top of water in pipe is 5.0 ft bgs.

SURFACE WATER FLOW RATE ~3-5 mph, water 1-2" deep, 1-1.5 ft wide in pipe

SURFACE WATER TYPE Grab

SAMPLE CONDITION (i.e. turbidity, odor, oily) Clear, no odor or sheen.

SAMPLE COLLECTION

COLLECTION METHOD Peristaltic pump w/ new disposable Teflon-lined LDPE tubing & new disposable silicone tubing (NWTPH-GRO samples collected using a very slow flow rate).

COLLECTION TIME 0915

SAMPLE INFORMATION pH ~~5.85~~ 6.32 Turbidity 0.6 NTU COND. 0.37 mS/cm T(C) 12.7°C D.OXYGEN 15.42°C

Tag #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
2430	TOC (EPA 415.1)	500 mL Poly	H_2SO_4
2431	TSS (EPA 160.2)	1 L poly	None
2432	Hardness (~~EPA~~ SM 2340B) / Metals (EPA 200.8/6010B/7470)	1 L poly	HNO_3
2433	NWTPH - GRO	40 mL vial	HCl
2434	↓	↓	↓
2435	↓	↓	↓
2436	VPH Followup	↓	↓
2437	NWTPH - DRO	500 mL Amber	none
2438	EPH Followup	↓	↓
2439	SVOC's (EPA SW 8270c low levels)	↓	↓
2440	↓	↓	↓
2441	Dioxin/Furan (EPA 1613 B)	1 L amber	none
2442	↓	↓	↓

CHAIN OF CUSTODY FORM ______ COC TAPE ______

SHIPPING CONTAINER ______

COMMENTS ______

INTEGRAL CONSULTING INC.

SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP0009

DATE 02-NOV-05 TIME 1330 SAMPLED BY EJD/BHP

WEATHER CONDITIONS Cloudy, calm to lt. winds, ~50°F.

SAMPLE LOCATION Reference Station - Near intersection of Modoc Dr. & Clearbrook Dr.

SAMPLE DEPTH Collected from top 1-2" of water. ↳ 70' wide greenway between W Clearbrook Dr. & E Clearbrook Dr.

SURFACE WATER FLOW RATE ~~3-6 MPH~~ ~3-6 MPH

SURFACE WATER TYPE Grab

SAMPLE CONDITION (i.e. turbidity, odor, oily) v. lt. brown, indistinct odor, slightly turbid, no sheen.

SAMPLE COLLECTION

COLLECTION METHOD Peristaltic pump w/new disposable Teflon-lined and Silicone tubing.

COLLECTION TIME 1330

Turbidity 3.2 NTU

SAMPLE INFORMATION pH 6.53 COND. 0.16 mS/cm (C) 10.4°C D.OXYGEN 16.50 mg/L

Tag #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
2675	TOC (EPA 415.1)	500 mL poly	H_2SO_4
2676	TSS (EPA 160.2)	1 L poly	None
2677	Hardness (SM2340B)/Metals (EPA 200.8/6010B/7470)	1 L poly	HNO_3
2678	NWTPH-~~D~~ GRO	40 mL Vial	HCl
2679	↓		
2680	↓	↓	↓
2681	VPH Followup		
2682	NWTPH-DRO	500 mL amber	None
2683	EPH Followup	↓	↓
2684	SVOCs (EPA SW8270C) → low levels		
2685	↓	↓	↓
2686	Dioxins/Furans (EPA 1613B)	1 L amber	None
2687	↓	↓	↓

CHAIN OF CUSTODY FORM ______ COC TAPE ______

SHIPPING CONTAINER ______

COMMENTS Coordinates: (Ref. Station) N48°44'44.1" W122°26'16.1" East Cemetery Creek

Sample collected near confluence of two streams (~2' and ~4' wide respectively) in a greenway ~70 ft wide between W. Clearbrook Dr. and E. Clearbrook Dr. Small (2' wide) stream is coming out of a corrugated culvert ~2' dia with an 8" Ø plastic pipe ~2' above it w/ trickle of water.

SW-R1

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP0583
DATE 27 APRIL 06 TIME 11:00 SAMPLED BY KM
WEATHER CONDITIONS

SAMPLE LOCATION SW-R1
SAMPLE DEPTH SAMPLED DIRECTLY FROM OUTFALL PIPE
SURFACE WATER FLOW RATE SWIFT FLOW
SURFACE WATER TYPE GRAB
SAMPLE CONDITION (i.e. turbidity, odor, oily) NO ODOR, CLEAR

SAMPLE COLLECTION
COLLECTION METHOD DIRECTLY INTO JARS
COLLECTION TIME 1105

Turbidity: 2.8 NTU
SAMPLE INFORMATION pH 7.24 COND. 0.337 mS/cm T(C) 11.49 D.OXYGEN 9.81 mg/L

TAG #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
5969	TOC (EPA 415.1)	250-mL AMBER GLASS	H_2SO_4
5970	TSS (EPA 160.2)	~1-L PLASTIC	—
5971	METALS (DISSOLVED* EPA METHODS 200.8/6010B/7470)	500-mL POLY	* TO BE FILTERED @ LAB
5972	METALS (TOTAL; EPA 200.8/6010B/7470) HARDNESS (SM 2340B)	1-L POLY	HNO_3
5973-5975	NWTPH-GRO ~~????~~ KM	40-mL GLASS VIAL	HCl
5976 & 5977	VPH FOLLOWUP	40-mL GLASS VIAL	HCl
5978 & 5979	NWTPH-DRO+RRO	500-mL AMBER GLASS	—
5980	EPH FOLLOWUP	500-mL AMBER GLASS	—
5981 & 5982	SVOCs (EPA 8270C-LL)	500-mL AMBER GLASS	—

CHAIN OF CUSTODY FORM 35 & 74 COC TAPE
SHIPPING CONTAINER

COMMENTS

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP 0585
DATE 27 APRIL 06 TIME 1305 SAMPLED BY KM
WEATHER CONDITIONS OVERCAST W/SLIGHT SUN BREAKS; ~50-55°F; SLIGHT BREEZE

SAMPLE LOCATION SW-04
SAMPLE DEPTH NA DIRECTLY FROM OUTFALL PIPE
SURFACE WATER FLOW RATE MODERATE
SURFACE WATER TYPE GRAB
SAMPLE CONDITION (i.e. turbidity, odor, oily) CLEAR, NO ODOR, SLIGHT YELLOW COLOR

SAMPLE COLLECTION
COLLECTION METHOD DIRECTLY INTO JARS
COLLECTION TIME 1315
Turbidity 0.80 NTU

SAMPLE INFORMATION pH 7.45 COND. 0.492 mS/cm T(C) 11.73°C D.OXYGEN 8.19 mg/L

TAG#	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
5983	TOC (EPA 415.1)	250-mL AMBER GLASS	H_2SO_4
5984	TSS (EPA 160.2)	~1-L POLY	—
5985	METALS (DISSOLVED*; EPA 200.8/6010B/7470)	500-mL POLY	* TO BE FILTERED @ LAB
5986	HARDNESS (SM 2340B) METALS (TOTAL; EPA 200.8/6010B/7470)	1-L POLY	HNO_3
5987-5989	NW-TPH-GRO	40-mL GLASS VIAL	HCl
5990 & 5991	VPH FOLLOWUP	40-mL GLASS VIAL	HCl
5992 & 5993	NWTPH-DRO + RRO	500-mL AMBER GLASS	—
5994	EPH FOLLOWUP	500-mL AMBER GLASS	—
5995 & 5996	SVOCs (EPA 8270C-LL)	500-mL AMBER GLASS	—

CHAIN OF CUSTODY FORM 74572 COC TAPE
SHIPPING CONTAINER

COMMENTS

SW-Ø5

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP 0587

DATE 27 APRIL TIME ~~1505~~ 1615 KM SAMPLED BY KM

WEATHER CONDITIONS CLOUDY, SLIGHT BREEZE, 58°F

SAMPLE LOCATION SW-Ø5

SAMPLE DEPTH NA - DIRECTLY FROM OUTFALL

SURFACE WATER FLOW RATE DISCONTINUOUS FLOW FROM SLUDGE OUTFALL

SURFACE WATER TYPE GRAB

SAMPLE CONDITION (i.e. turbidity, odor, oily) CLEAR, NO ODOR

SAMPLE COLLECTION

COLLECTION METHOD DIRECTLY INTO JARS

COLLECTION TIME 1615 KM

TURB = 1.6 NTU

SAMPLE INFORMATION pH 7.80 COND. 0.321 mS/cm T(C) 11.92°C D.OXYGEN 8.09 mg/L

ANALYSIS		CONTAINERS	SAMPLE PREP/PRESERVATION
6843	TOC (EPA 415.1)	250-mL AMBER GL	H_2SO_4
6844	TSS (EPA 160.2)	~1L POLY	—
6845	METALS (DISSOLVED* EPA 200.8/6010B/7470)	500mL POLY	* TO BE FILTERED @ LAB
6846	HARDNESS (SM 2340) METALS (TOTAL; EPA 200.8/6010B) 7470)	1-L POLY	HNO_3
6847-6849	NWTPH-GRO	40mL VIAL	HCl
6850 & 6851	VPH FOLLOWUP	↓	↓
6852 & 6853	NWTPH- DRO + RRO	500mL AMGL	—
6854 KM	EPH FOLLOWUP	↓	↓
6855 & 6856	(SVOCs EPA 8270C -1L)	↓	↓
6857 & 6858	(DIOXIN/FURANS 1613B)	1-L AM GL	↓

CHAIN OF CUSTODY FORM 72 & 31 COC TAPE

SHIPPING CONTAINER

COMMENTS

SW-Ø5 dup

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP0588
DATE 27 APR 06 TIME 1600 SAMPLED BY KM
WEATHER CONDITIONS CLOUDY, SLIGHT BREEZE ~58°F

SAMPLE LOCATION SW-Ø5 DUP
SAMPLE DEPTH NA - SAMPLE COLLECTED DIRECTLY FROM OUTFALL
SURFACE WATER FLOW RATE DISCONTINUOUS FLOW FROM SQUARE OUTFALL
SURFACE WATER TYPE GRAB
SAMPLE CONDITION (i.e. turbidity, odor, oily) SEE SW-Ø5 SHEET LSP0587

SAMPLE COLLECTION
COLLECTION METHOD
COLLECTION TIME 1615

Seefield Sheet SW-05 LSP0587

~~SAMPLE INFORMATION pH COND. T(C) D.OXYGEN~~

TAG #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
6859	TOC (EPA 415.1)	250 mL GLASS AMBER	H_2SO_4
6860	TSS (EPA 160.2)	~1-L POLY	—
6861	METALS (DISSOLVED*; EPA 200.8/6010B/7470)	500-mL POLY	*TO BE FILTERED @ LAB
6862	HARDNESS (SM 2340B) METALS (TOTALS; EPA 200.8/6010B/7470)	1-L POLY	HNO_3
6863-6865	NWTPH-GRD	40 mL VIAL	HCl
6866 & 6867	VPH FOLLOWUP	↓	↓
6868 & 6869	NWTPH-DRO + RRO	500 mL GL AMBER	—
6870	EPH FOLLOWUP	↓	↓
6871 & 6872	SVOCs (EPA 8270C-LL)	↓	↓
6873 & 6874	DIOXINS/FURANS (EPA 1613B)	1-L GL AMBER	—

CHAIN OF CUSTODY FORM 36573 COC TAPE
SHIPPING CONTAINER

COMMENTS

SW-06

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP0586
DATE 27 APRIL TIME 1510 SAMPLED BY KW
WEATHER CONDITIONS CLOUDY, SLIGHT BREEZE ~58°F

SAMPLE LOCATION SW-06
SAMPLE DEPTH N/A DIRECTLY FROM OUTFALL PIPE ~1" BELOW SURFACE
SURFACE WATER FLOW RATE SLIGHT DISCONTINUOUS TOWARD R. SIDE OF OUTFALL PIPE (FACING PIPE); WHICH IS WHERE SAMPLES WERE COLLECTED
SURFACE WATER TYPE GRAB
SAMPLE CONDITION (i.e. turbidity, odor, oily) CLEAR, VERY LIGHT BRN COLOR

SAMPLE COLLECTION
COLLECTION METHOD PERISTALTIC PUMP W/ CLEAN (NEW) DEDICATED SILICON'S TEFLON-LINED PE TUBING
COLLECTION TIME 1520

Turbidity 7.6 NTU

SAMPLE INFORMATION pH 7.08 COND. 0.254 mS/cm T(C) 11.68°C D.OXYGEN ~~6.9~~ 6.58 mg/L (SW 4/27)

TAG #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
6875 ~~6874~~ KW	TOC (EPA 415.1)	250 mL AMBER GLASS	H_2SO_4
6876 & 6877	TSS (EPA 160.2)	~1-L POLY	—
6878 & 6879	METALS (DISSOLVED*; EPA 200.8/6010B/7470) HARDNESS (SM 2340B)	500 mL POLY	*TO BE FILTERED @ LAB
6880 & 6881	METALS (TOTAL; EPA 200.8/6010B/7470)	1-L POLY	HNO3
6882-6887	NWTPH-GRO	40 mL VIAL	HCl
6888-6890	VPH FOLLOWUP	↓	↓
6891-6894	NWTPH-DRO+RRO	500 mL AMBER GL	—
6895 & 6896	EPH FOLLOWUP	↓	↓
6897-6900	SVOCs (EPA 8270C-LL)	↓	↓
6901-6904	DIOXINS/FURANS (EPA 1613B)	1-L AMBER GL	—

CHAIN OF CUSTODY FORM 73 & 71 COC TAPE
SHIPPING CONTAINER

COMMENTS

SW-07

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. ~~LSP0598~~ LSP0589

DATE 27APRIL06 TIME 1800 SAMPLED BY KW

WEATHER CONDITIONS CLOUDY, MILD BREEZE, ~58°F

SAMPLE LOCATION SW-07

SAMPLE DEPTH 2-3" BELOW WATER SURFACE ~ 2' OUT FROM EDGE OF POND

SURFACE WATER FLOW RATE NA (STAGNANT POND)

SURFACE WATER TYPE GRAB

SAMPLE CONDITION (i.e. turbidity, odor, oily) CLEAR, NO ODOR

SAMPLE COLLECTION

COLLECTION METHOD PERISTALTIC PUMP W/NEW TEFLON-LINED PE & SILICON TUBING

COLLECTION TIME 1810

TURB NTU = 0.95

SAMPLE INFORMATION pH 7.33 COND. 0.220 ms/cm°C T(C) 12.75°C D.OXYGEN 5.15 mg/L

TAG#	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
6905	TOC (EPA 415.1)	250-ML AMBER GL	H_2SO_4
6906	TSS (EPA 160.2)	~1-L POLY	—
6907	METALS (DISSOLVED* EPA 200.8/6010B/7470)	500-ML POLY	*TO BE FILTERED @ LAB
6908	HARDNESS (SM 2340B) METALS (TOTAL* EPA 200.8/6010B/7470)	1-L POLY	HNO_3
6909-6911	NWTPH-GRO	40-ML VIAL	HCl
6912 & 6913	VPH-FOLLOWUP	↓	↓
6914 & 6915	NWTPH-DRO+RRO	500-ML AMBER GL	→
6916	EPH-FOLLOWUP	↓	↓
6917 & 6918	SVOCs (EPA 8270C-LL)	↓	↓

CHAIN OF CUSTODY FORM 71 & 75 COC TAPE

SHIPPING CONTAINER INSULATED COOLER

COMMENTS

SW-09

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP0584
DATE 27 April TIME 1200 SAMPLED BY
WEATHER CONDITIONS OVERCAST W/ SUN BREAKS, ~53°F, SLIGHT BREEZE

SAMPLE LOCATION SW-09
SAMPLE DEPTH 1"-2" BELOW WATER SURFACE
SURFACE WATER FLOW RATE LIGHT ~~TO MOD~~
SURFACE WATER TYPE GRAB
SAMPLE CONDITION (i.e. turbidity, odor, oily) CLEAR, NO ODOR,

SAMPLE COLLECTION
COLLECTION METHOD PERISTALTIC W/ NEW DEDICATED SILICON & TEFLON-LINED PE TUBING
COLLECTION TIME 1215

TURB = 0.8 NTU

SAMPLE INFORMATION pH 7.33 COND 0.352 mS/cm T(C) 12.7°C D.OXYGEN 8.25 mg/L

TAG#	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
6919	TOC (EPA 415.1)	250-ML AMBER GL	H_2SO_4
6920	TSS (EPA 160.2)	~1-L POLY	—
6921	METALS (DISSOLVED*; EPA 200.8/6010B/7470)	500ML POLY	*TO BE FILTERED @ LAB
6922	HARDNESS (SM 2340B) METALS (TOTAL; EPA 200.8/6010B/7470)	1-L POLY	HNO_3
6923-6925	NWTPH-GRO	40ML VIAL	HCl
6926 & 6927	VPH FOLLOWUP	↓	↓
6928 & 6929	NWTPH-DRO + RRD	500ML AMBER GL	—
6930	EPH FOLLOWUP	↓	↓
6931 & 6932	SVOCs (EPA 8270C-LL)	↓	↓

CHAIN OF CUSTODY FORM 75 & 92 COC TAPE
SHIPPING CONTAINER

COMMENTS SLIGHT PLANT BASED SHEEN ON S. SIDE of CREEK. SAMPLE WAS COLLECTED MID-CHANNEL.

SW-1Ø

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP0590
DATE 27 APRIL TIME ~~0910~~ 0915 SAMPLED BY KM
WEATHER CONDITIONS OVERCAST, CALM, 50°F SLIGHT WINDS

SAMPLE LOCATION SW-1Ø 311D CEDARWOOD MANHOLE
SAMPLE DEPTH
SURFACE WATER FLOW RATE VERY SLIGHT
SURFACE WATER TYPE GRAB
SAMPLE CONDITION (i.e. turbidity, odor, oily) NO ODOR, CLEAR

SAMPLE COLLECTION
COLLECTION METHOD PERISTALTIC PUMP W/ CLEAN (NEW) DEDICATED SILICON & TEFLON LINED PE TUBING
COLLECTION TIME 0930

Turbidity = 1.5 NTU

SAMPLE INFORMATION pH 7.09 COND. 0.307 mS/cm T(C) 11.74°C D.OXYGEN 8.20 mg/l

TAG #	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
6933	TOC (EPA 415.1)	250-mL AMBER GL	H_2SO_4
6934	TSS (EPA 160.2)	~1-L POLY	—
6935	METALS (DISSOLVED*; EPA 200.8/6010B/7470)	500-mL POLY	* TO BE FILTERED @ LAB
6936	HARDNESS (SM 2340B) METALS (TOTAL; EPA 200.8/6010B/7470)	1-L POLY	HNO_3
6937-6939	NWTPH - GRO	40-mL VIAL	HCl
6940 & 6941	VPH FOLLOWUP	↓	↓
6942 & 6943	NWTPH - DRO + RRO	500mL AMBER GL	—
6944	EPH FOLLOWUP	↓	↓
6945 & 6946	SVOCs (EPA 8270C-LL)	↓	↓
6947 & 6948	DIOXINS/FURANS (EPA 1613B)	1-L AMBER GL	↓

CHAIN OF CUSTODY FORM 92 & 93 COC TAPE
SHIPPING CONTAINER

COMMENTS

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP
SAMPLE NO. LSP0599
DATE 27 APRIL 06
TIME 1330
SAMPLED BY Km
WEATHER CONDITIONS Overcast, calm, Mid 50's °F

SAMPLE LOCATION SW-11
SAMPLE DEPTH NA
SURFACE WATER FLOW RATE TRICKLE FROM BENEATH CORRUGATED PIPE (RUSTY!)
SURFACE WATER TYPE GRAB
SAMPLE CONDITION (i.e. turbidity, odor, oily) TURBID, RUSTY COLORED SAMPLE, Fe ODOR.

SAMPLE COLLECTION
COLLECTION METHOD COLLECT WATER TRICKLING UNDER PIPE INTO DECON'D STAINLESS STEEL BOWL
COLLECTION TIME 1345

Turbidity: 21.0 NTU

SAMPLE INFORMATION pH 7.10 COND. 0.202 mS/cm T(C) 12.01°C D.OXYGEN 6.99 mg/L

TAL#	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
7097	TOC (EPA 415.1)	250-mL AMBER GL	H_2SO_4
7098	TSS (EPA 160.2)	1-L POLY	——
7099	METALS (DISSOLVED*; EPA 200.8/6010B/7470) HARDNESS (EPA 2340B)	500-mL POLY	*TO BE FILTERED @ LAB
7100	METALS (TOTAL; EPA 200.8/6010B/7470)	1-L POLY	HNO_3
7101-7103	NWTPH-GRO	40mL VIAL	HCl
7104 & 7105	VPH FOLLOWUP	↓	↓
7106 & 7107	NWTPH-DRO + RRO	500-mL AMBER GL	——
7108	EPH FOLLOWUP	↓	↓
7109 & 7110	SVOCs (EPA 8270C-LL)	↓	↓

CHAIN OF CUSTODY FORM 93, 94
COC TAPE
SHIPPING CONTAINER

COMMENTS

12
SW-73
K— CEDARS
1 May 06

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP SAMPLE NO. LSP0601
DATE 1 MAY 06 TIME 1030 SAMPLED BY MH
WEATHER CONDITIONS 55 50°F 45 WINDY, OVERCAST, SPORADIC SPRINKLES

SAMPLE LOCATION SW-73 12 K— 1 May 06
SAMPLE DEPTH NA DIRECT FROM PIPE
SURFACE WATER FLOW RATE >~1 gal/min (1-2 gal/min)
SURFACE WATER TYPE GRAB
SAMPLE CONDITION (i.e. turbidity, odor, oily)

SAMPLE COLLECTION
COLLECTION METHOD DIRECT
COLLECTION TIME 1030 TURB. = 4.9 NTU

SAMPLE INFORMATION pH 7.11 COND 0.078 mS/cm T(C) 10.57°C D.OXYGEN 8.58 mg/L

ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
7125 TOC (415.1)	250 ml AMB GL	H_2SO_4
7126 TSS (160.2)	1-L POLY	—
7127 ~~DISS~~ HTKL [?] METALS (EPA 200.8/6010B/7470)	500 ml POLY	TO BE FILTERED @ LAB
7128 TOTAL METALS " " " HARDNESS (SM2340B)	1-L POLY	HNO_3
7129-7131 NWTPH-GRO	40 ml VIAL	HCl
7132 & 7133 VPH-FOLLOWUP	↓	↓
7134 & 7135 NWTPH-DRO + RRO	500 ml AMB	—
7136 EPH FOLLOWUP	↓	↓
7137 & 7138 SVOCs (EPA 8270C-LL)	↓	↓

Hold analysis pending TPH results

CHAIN OF CUSTODY FORM COC TAPE
SHIPPING CONTAINER

COMMENTS

REFERENCE STN

INTEGRAL CONSULTING INC.
SURFACE WATER SAMPLING FORM

PROJECT LSP — SAMPLE NO. LSP0582
DATE 27APR2006 — TIME 7:15 — SAMPLED BY KM
WEATHER CONDITIONS Overcast / Mist Calm Winds Low 50°F

SAMPLE LOCATION REF STN. CLEARBROOK & MODOC
SAMPLE DEPTH COLLECTED FROM TOP 2" OF WATER SURFACE
SURFACE WATER FLOW RATE SWIFT FLOW
SURFACE WATER TYPE GRAB W/PERISTALTIC
SAMPLE CONDITION (i.e. turbidity, odor, oily) CLEAR, NO ODOR, SLIGHT TAN COLOR.

SAMPLE COLLECTION
COLLECTION METHOD PERISTALTIC PUMP w/ NEW DEDICATED TEFLON-LINED PE & SILICON TUBING
COLLECTION TIME 0750
TURB=3.0 NTU

SAMPLE INFORMATION pH 7.10 COND. 0.099 mS/cm³ T(C) 8.76°C D.OXYGEN 9.99mg/L

TAB#	ANALYSIS	CONTAINERS	SAMPLE PREP/PRESERVATION
6949	TOC (EPA ~~415.2~~ 415.1)	250-mL AMBER GL	H_2SO_4
6950	TSS (EPA 160.2)	1-L POLY	→
6951	METALS (DISSOLVED*; EPA 200.8/6010B/7470)	500-mL POLY	*TO BE FILTERED @LAB
6952	METALS (TOTAL; EPA 200.8/6010B/7470) HARDNESS (SM 2340B)	1-L POLY	HNO_3
6953-6955	NW-TPH-GRO	40-mL VIAL	HCl
6956 & 6957	VPH FOLLOWUP	↓	↓
6958 & 6959	NWTPH-DRO+RRO	500-mL AMBER GL	—
6960	EPH FOLLOWUP	↓	↓
6961 & 6962	SVOCs (EPA 8270C-LL)	↓	↓
6963 & 6964	DIOXINS/FURANS (EPA 1613B)	1-L AMBER GL	↓

CHAIN OF CUSTODY FORM 35 — COC TAPE
SHIPPING CONTAINER

COMMENTS

ATTACHMENT 5

BOREHOLE AND
PIEZOMETER/WELL LOGS

Major Divisions		Symbols		Typical Names
Coarse Grained Soils (More than 1/2 of soil >No. 200 sieve size)	**Gravels** (More than 50% coarse fraction > no. 4 sieve	GW		Well-graded gravels or gravel-sand mixtures, little to no fines
		GP		Poorly-graded gravels or gravel-sand mixtures, little to no fines
		GM		Silty gravels, gravel-sand-silt mixtures
		GC		Clayey gravels or gravel-sand-clay mixtures
	Sands (Less than 50% coars fraction > no. 4 sieve)	SW		Well-graded sands or gravel-sand mixtures, little to no fines
		SP		poorly-graded sands or gravelly sands, little to no fines
		SM		Silty sands, sand-silt mixtures
		SC		Clayey sands, sand-clay mixtures
Fine Grained Soils (More than 1/2 of soil <No. 200 sieve size)	**Silts & Clays** Liquid limit* less than 50%	ML		Inorganic silts and very fine sands, silty or clayey fine sands or clayey silts with slight plasticity
		CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy or silty clays, lean clays
		OL		Organic silts and organic silty clays of low plasticity
	Silts & Clays Liquid limit* greater than 50%	MH		Inorganic silts, micaceous or ditomaceous fine sand or silty soils, elastic silts
		CH		Inorganic clays of high plasticity, fat clays
		OH		Organic clays of medium to high plasticity, organic silty clay, organic silts
Highly Organic Soils		Pt		Peat or other highly organic soils

*Liquid limit represents the moisture contnet (in percent) of a soil at which point the soil no longer behaves like a plastic and starts to behave like a liquid.

Boring Log Symbols

Sample Interval

Groundwater, First Observed

Groundwater, Static

Sample Types

SS	Split Spoon
G	Grab
ST	Shelby Tube
GS	Geoprobe Sampler

Sheen Types

NS	No Sheen Observed
SS	Slight Sheen observed (Spotty coverage of sheen pan, no
MS	Moderate Sheen (Full Coverage)
HS	Heavy Sheen (Full Coverage, Irredescent)

Sample Moisture

Dry	No Moisture, dry to touch
Moist	Damp but no visible moisture
Wet	Visible free water

Sample Plasticity (Fine-Grained Soils)

Non-Plastic - Cannot be rolled at any moisture content

Low - Barely rolled, lump cannot be formed when drier than plastic limit

Medium - Easily rolled, lump crumbles when drier than plastic limit

High - Easily rolled yet takes considerable time to reach the plastic limit, lump can be formed without crumbling when drier than the plastic limi

Partical Size Range (Course-Grained Soils)

Gravel - Fine, Course

Sand - Fine, Medium, Coarse

Integral Consulting, Inc.
2817 NE 22nd Avenue
Portland, Oregon 97212
503-284-5545
503-284-5755 (Fax)

Based on Unified Soil Classification System and ASTM Standard D2487 and D2488

integral consulting inc.

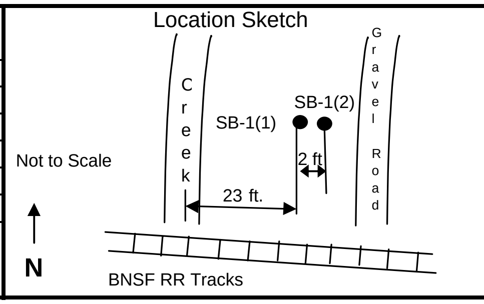
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-1
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 2, 2006

SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0121	1005	1,1,1	70%	5.2/	NS	0-1		ML	Silt w/ sand, black (10 YR 2/1), 20-30% fine sand, 20% roots/organics
				0.8					no odor, wet.
LSP0122	1015	1,1,1	10%	5.8/	NS	1-2	2--		Large root in sampler 1.5 - 3.0 ft.
				4.6					
LSP0124	1035	2,2	90%	9.0/	NS	3-4			
				30.6				▼	
							4--	SM	Silty fine sand, very dark gray (7.5 YR 3/1), 25-35% silt, 5-10% roots/
LSP0125	1045	1,2	40%	8.2/	NS	4-5			organics, no petroleum odor, wet, sulfur odor.
				124					As above w/ color dark gray (7.5 YR 4/1), 15-20% silt, fine to med.
									sand, no petroleum odor, sulfur odor.
LSP0126	1055	2/3	75%	11.8/	NS	5-6	6--		As above w/ 10-15% silt, ~3% roots/organics, no odor, petroleum odor,
				100					slight sulfur odor.
-		-	60%	-	NS	6-7			
-		2/2	30%	-	NS	7-8	8--	SP	Fine to med. Sand, dark gray (5 YR 4/1), ~5% silt, trace roots, wet,
									no odor.
									Boring terminated at 8 ft.
							10--		
									Elevated FID readings possibly due to sulfides or methane in samples.
							12--		Poor sample recovery on some intervals. Moved 2 ft and advanced
									second borehole.
Background PID=3.4 ppm to 7.3 ppm.							14--		

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg California Modified
COORDINATES	Northing: 648247.35 ft
	Easting: 1234334.27 ft
SURFACE ELEVATION	13.12 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



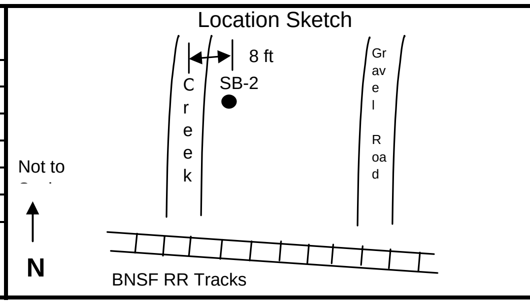
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER: SB-2
PROJECT: Little Squalicum Park RI/FS
LOCATION: Bellingham, Washington
PROJECT NUMBER: C075-02
LOGGED BY: Eron Dodak, R.G.
DATE: February 2, 2006

Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION: USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0132	1450	N/A	N/A	12.7/3.2	NS	0-1		ML	Clayey silt, very dark brown (7.5 YR 2.5/2), ~10% roots, soft, no petroleum odor,
LSP0133 (dup)	1500					0-1			very moist.
									Clayey silt, very dark grayish brown (10 YR 3/2), 5% organics, soft, no
LSP0127	1315	2/3	40%	10.6/1.2	NS	1-2	2--		petroleum odor.
								PT	Peat layer ~2 - 2.2 ft bgs, very dark brown (10 YR 2/2).
LSP0128	1325	1/2	75%	18.6/6.5	NS	2-3		SP	Fine to med. Sand, very dark gray (2.5 Y 3/1), trace silt, 5-10% roots/organics,
									no petroleum odor. 20-25% organic at 3 ft.
LSP0129	1335	1/2	80%	10.3/4	NS	3-4	4--	PT	Silty peat, dark brown (7.5 YR 3/2), no petroleum odor, slight sulfur odor, v. moist.
LSP0130	1340	1/2	100%	14.4/27	NS	4-5		▼	As above, very dark brown (7.5 YR 5/2), some undecomposed wood.
									No recovery 5-6 (sand?)
-	1345	3/3	0%	-	-	5-6	6--		
								GW	Sandy fine to coarse gravel, dark gray (7.5 YR 4/1), 25% fine to coarse sand,
LSP0131	1400	6/17	30%	29.0/7	NS	6-7			wet, no petroleum odor.
							8--		Boring terminated at 7 ft bgs.
									Note: Samples 0-1' and 1-2' collected with hand auger ~3 ft North (parallel to
							10--		creek) of SB-2.
							12--		
Background PID=7.5 ppm									
							14--		

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg California Modified
COORDINATES	Northing: 648251.47 ft
	Easting: 1234319.52 ft
SURFACE ELEVATION	12.53 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



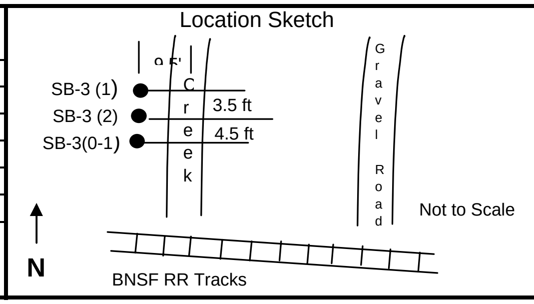
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-3
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 2, 2006

SAMPLE INFORMATION									DESCRIPTION
Sample ID	**Time**	**Blow Counts**	**% Recovery**	**PID/FID**	**Sheen**	**Sample Depth (ft)**	**Depth (ft)**	**STRATA**	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0168	1545	-	-	5.4/0	NS	0-1		ML	Silt, v. dark gray (5 YR 3/1), trace of clay, ~5% roots, no petroleum odor.
LSP0138	1555	2/2	80%	10.8/0.5	NS	1-2			
							2--		
LSP0120	1455	3/5	60%	17.3/4.5	NS	2-3		ML	Clayey silt, v. dark gray (5 YR 3/1), 20-30% clay, ~1-2% roots, moist, no odor.
LSP0134	1503	3/2	40%	14.9/7	NS	3-4			Sandy silt, very dark gray (7.5 YR 3/1), 30% fine sand, slight sulfur odor, v. moist.
							4--		
LSP0136	1515	10/38	100%	20.6/5.7	NS	4-5		▼	
									As above w/ 10-15% fine to coarse gravel.
LSP0137	1525	24/23	40%	20.8/7.	NS	5-6		GW SW	Sandy gravel, dark gray (2.5 Y 4/1), 40% fine to coarse gravel, wet, no petroleum odor, gravely fine to coarse sand, 20-30% fine to coarse gravel (mostly fine), wet, no petroleum odor.
							6--		
									Boring terminated at 6 ft bgs.
0-1 ft sample collected using a hand auger on 2/3/06 at 1545							8--		Advanced second borehole ~2 ft south (parellel to creek) for additional sample volume. 1-2 ft interval sampled from second borehole.
							10--		
PID Background 5.9 ppm for 0-1 sample.									
PID background 8.6 ppm									
							12--		
*background PID=7.5 ppm									
							14--		

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg California Modified
COORDINATES	Northing: 648256.16 ft
	Easting: 1234303.03 ft
SURFACE ELEVATION	12.39 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

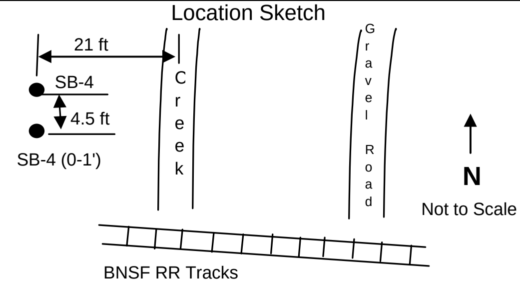
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-4
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 3, 2006

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0169	1515	-	-	5.9/0	NS	0-1		ML	Slightly sandy silt, grayish-brown (10 YR 3/2) ~10% fine sand, ~5% coarse gravel
LSP0170 (dup)	1530					0-1			some roots, moist, no odor.
									Sandy silt, v. dark grayish brown (10 YR 3/2), ~20% fine to med. Sand, ~5%
LSP0139	0830	3/3	100%	4.6/1.6	NS	1-2	2--		roots/organics, moist, no odor.
									Piece of wood ~1" thick at 1.2 ft bgs, sand content ~30% below wood,
LSP0140	0840	4/4	40%	5.3/1.2	NS	2-3			As above w/o sand, some orange moltting, no odor.
								▼	Gravely silt, v. dark gray (10 YR 3/1), 25% gravel, 15% organics, v. moist to wet.
LSP0141	850	3/6	100%	13.2/2.7	NS	3-4	4--	SP	Gravely sand, dark gray (2.5 Y 4/1), 15% F-C gravel, trace wood, wet, no odor.
								GW	Silty sandy gravel, v. dark gray (2.5 Y 3/1), ~15% silt, 30% sand, fine to coarse
LSP0142	0900	6/4	40%	6.3/0.9	NS	4-5			subrounded gravel, wet, indistinct odor.
LSP0143	0910	5/6	80%	12.8/0.	NS	5-6	6--		
									As above w/ ~5% silt, few pieces of wood.
LSP0144	0920	8/27	90%	7.0/0.6	NS	6-7			As above w/ 40% fine to med sand.
							8--		Boring termindated at 7 ft bgs.
									0-1 ft sample collected using a hand auger ~5 ft south of SB-4.
							10--		
							12--		
Background PID=1.5 ppm, FID=0 ppm									
							14--		

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg California Modified
COORDINATES	Northing: 648256.16 ft
	Easting: 1234291.55 ft
SURFACE ELEVATION	14.16 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



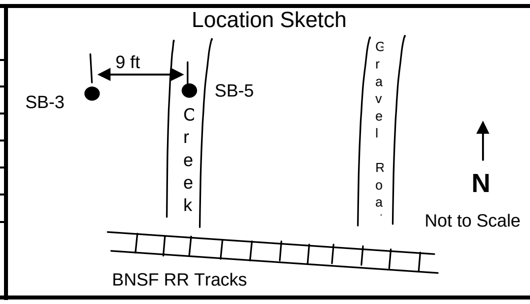
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-5
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 3, 2006

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0145	0940	3/8	40%	13.6/	NS	0-1		GW	Silty sandy gravel, v. dark gray (2.5 Y 3/1), 20% silt, 30% fine to coarse sand,
				3.5					fine to coarse rounded gravel, no odor.
LSP0146	0955	9/16	50%	12.3/	NS	1-2			As above w/15% silt, 25% sand, gravel up to 2" dia.
				0.4			2--		
LSP0147	1005	8/19	70%	6.3/	NS	2-3			As above w/ 10% silt, 30% medium to coarse sand, no odor.
				2.6					
LSP0148	1015	14/21	80%	15.4/	NS	3-4			As above w/ less than 5% silt, 35% med. to coarse sand, no odor.
				3.0			4--		
LSP0149	1025	19/15	90%	10.2/	NS	4-5			
				1.7					
								—	Refusal at 5 ft bgs.
							6--		
							8--		
							10--		
							12--		
Background PID=2.6 ppm, FID=0 ppm									
							14--		

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg California Modified
COORDINATES	Northing: 648254.66 ft
	Easting: 1234309.74 ft
SURFACE ELEVATION	9.49 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-6
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 3, 2006

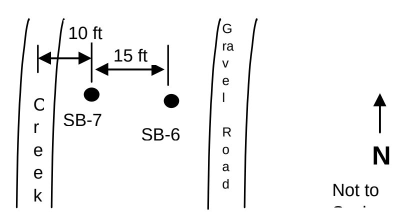
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0150	1200	3/8	100%	10.4/	NS	0-1		SM	Silty fine to medium sand, brown (10YR 4/3), 15-20% silt, 10-15% fine to coarse
				0.5				GW	gravel, trace of roots, moist, no odor.
LSP0151	1210	20/24	50%	3.1/	NS	1-2			Silty sandy gravel, v. dark grayish brown (10YR 3/2), ~20% silt, 35% medium
				0.4			2--		to coarse sand, fine to 2" dia. gravel, moist, no odor (fill).
LSP0152	1225	10/12	45%	4.4/	NS	2-3			
				0.4				▼	
	1235	3/4	0%			3-4		GM	Silty gravel, v. dark gray (10 YR 3/1), 40% silt, fine to coarse gravel, wet,
LSP0153**	1240	3/5	90%	3.8/	NS	4-5	4--		no odor (fill).
				15.7					
LSP0154	1250	1/3	90%	3.9/	NS	5-6		PT	Silty peat, v. dark grayish brown (10 YR 3/2), moist, slight sulfur odor.
				14.5				SM	Organic-rich fine to medium sand, v. dark gray (7.5 YR 3/1), 20-25% organics,
LSP0155	1305	1/2	50%	12.9/	NS	6-7	6--		wet, no odor.
				33.6					
LSP0156	1320	3/4	100%	9.6/	NS	7-8		PT	Silty peat, v. dark gray (7.5 YR 3/2), wet, sulfur odor.
				6.2				SM	Organic-rich fine to med. Sand (as above), 15-20% organics.
									Piece of wood 7.9 - 8.0 ft.
							8--	—	
									Boring termindated at 8 ft bgs.
							10--		
							12--		
							14--		

**5 ppm hit with FID when core was opened
(collected jars for NWTPH-GRO analysis)

Background PID=2.4 ppm, FID=0 ppm

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg California Modified
COORDINATES	Northing: 648420.45 ft
	Easting: 1234351.85 ft
SURFACE ELEVATION	16.93 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

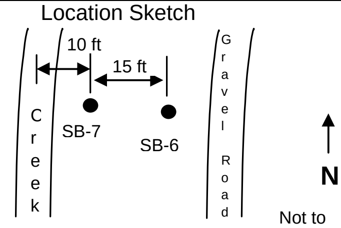
BOREHOLE NUMBER	SB-7
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 3, 2006

Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0157	1345	3/4	100%	10.4/	NS	0-1		ML	Slightly sandy silt, dark brown (7.5 YR 3/3), 10% roots, moist, no odor.
				2.6				GM	Sandy silty gravel, dark brown (7.5 YR 3/2), 20% fine to coarse sand, 30% silt,
LSP0128	1350	2/2	100%	11.2/	NS	1-2			fine to coarse gravel, moist, no odor.
				0.0			2--	PT	Silty peat, very dark brown (10 YR 2/2), no odor, moist.
LSP0159	1355	2/2	100%	14.2/	NS	2-3			-Fine to med. Sand lamination ~ 0.25 inches thick) at 1.6 ft.
				7.2					-Clayey Peat at 2 ft, otherwise as above.
LSP0160	1405	2	100%	7.6/	NS	3-4			Sandy peat zone 3.7-3.8 ft bgs.
				0.0			4--		As above w/ 5% fine sand.
LSP0161	1410	2/2	80%	14.2/	NS	4-5			
				6.5				ML	Sandy silt, very dark gray (7.5 YR 3/1), 25% fine sand, ~5% organics, moist to
									very moist, no odor.
							6--		
									Boring terminated at 5 ft bgs.
							8--		
							10--		
							12--		
							14--		

Background PID=4.0 ppm, FID=0 ppm

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg California Modified
COORDINATES	Northing: 648424.39 ft
	Easting: 1234337.64 ft
SURFACE ELEVATION	14.73 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



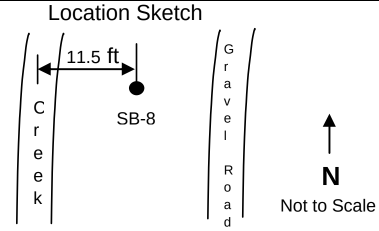
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-8
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 3, 2006

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Shean	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0162	1450	2/2	80%	5.9/	NS	0-1		ML	Gravely sandy silt, v. dark gray (7.5 YR 3/1), 15% fine to coarse gravel, 20% fine
				0.2					sand, very moist, no odor, trace roots.
LSP0163	1505	2/2	70%	5.9/	NS	1-2			As above w/ some orange mottling, 30% sand.
				0.2			2--	GW	Silty sandy gravel, dark gray (7.5 YR 4/1), 15% silt, 35% fine to coarse sand,
LSP0164	1515	2/2	50%	5.9/	NS	2-3			abundant roots, v. moist, no odor. Wood debris 2.5' to 2.7' bgs.
				0.5				SP/SM	Organic rich fine to medium sand, v. dark gray (2.5 Y 3/1), 40% organics, no odor.
LSP0165	1525	3/2	60%	5.9/	NS	3-4			
				5.4			4--	PT	Silty peat, dark brown (7.5 YR 3/2), v. moist, sulfur odor.
LSP0166	1535	2/6	60%	5.9/	NS	4-5			0.1' thick piece of wood at 3.7 ft bgs.
				1.8					0.15' thick piece of wood at 5.0 ft bgs
LSP0167	1545	2/4	100%	5.9/	NS	5-6		▼	Sand layer w/ wood 5.4 - 5.6 ft bgs, v. dark gray (2.5Y 3/1), trace gravel, wet,
				1.5					sulfur odor.
							6--	—	
									Boring terminated at 6 ft bgs.
							8--		
							10--		
							12--		
Background PID=5.9 ppm, FID=0 ppm									
							14--		

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg California Modified
COORDINATES	Northing: 648552.76 ft
	Easting: 1234398.49 ft
SURFACE ELEVATION	15.26 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

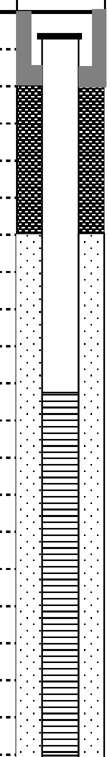
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-9
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 6-8, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (5.1-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (10.1-5.1)
Sump: 1" dia Sch 80 PVC (10.3-10.1)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (3.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (10.3-3.0)

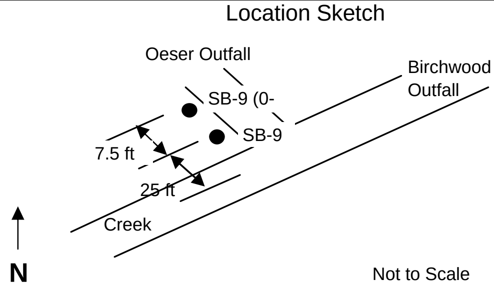
SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION
Sample ID	Time	Blow Counts	PID/FID (ppm)	% Recov.	Sheen	Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0171	1020	3/3/2/3	11.8/3.7	40%	NS	0-2		ML	Silt, dark brown (10 YR 3/3), trace med. Sand, (<2%), some roots, moist to
									very moist, no odor.
							2--		As above with color, v. dark grayish brown (10 YR 3/2).
LSP0172	1025	3/3/6/8	11.4/2.4	75%	NS	2-3			As above with color dark grayish brown (10 YR 4/2), some orange mottling.
LSP0173	1030		7.8/1.5	75%	NS	3-4			As above with color brown (10 YR 4/3), 35% fine to med. sand (sandy silt),
							4--		trace black charcoal, v. moist.
LSP0174	1045	7/5	3.1/0.6	100%	NS	4-5		SM	Silty fine to med. sand, dark grayish brown (10 YR 4/2), 40% silt, v. moist,
									no odor.
LSP0175	1055	5/3	13.8/6.9	75%	NS	5-6		▼	As above with fine gravelly layer (5.5 - 5.7 ft bgs).
							6--		Orange mottling at 6 ft bgs.
LSP0176	1100	2/3	12.7/1.2	100%	MS	6-7			Gravely silty sand at 6.75 ft. bgs, with sheen and strong creosote-like odor,
									approx 20% gravel.
LSP0177	1105	3/4	15.5/8.0	100%	HS	7-8			Silty fine to med. sand/sandy silt, brown (10 YR 4/3), trace gravel, some orange
							8--	SM/ML	mottling, sheen, strong creosote-like odor.
LSP0178	1130	3/4	5.7/9.4	80%	HS	8-9		SM	Silty, v. fine sand, dark gray (Glay 1 4/), 30-35% silt, possible sheen,
									moderately strong creosote-like odor.
LSP0179	1140	14/7	10.1/5.0	90%	HS	9-10			
							10--	CL	Clay, dark gray (Glay 1 4/), moderately stiff, slight creosote-like odor, no sheen.
									Borehole terminated at 10 ft bgs.
							12--		Collected 0-1 ft (& dup) and 1-2 ft samples with hand auger on 2/18/06.
									Hand auger samples: LSP0213 (0-1 ft), LSP0214 (0-1 ft dup), LSP0215 (1-2 ft).
Background PID = 0.5 ppm, FID = 0.0 ppm									
							14--		

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Portable HSA Rig, 2.25" ID x 4.63" OD Augers
SAMPLING EQUIPMENT	2" dia. x 24" lg. SPT
COORDINATES	Northing: 649243.97 ft
	Easting: 1235152.92 ft
CASING ELEVATION	39.47 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

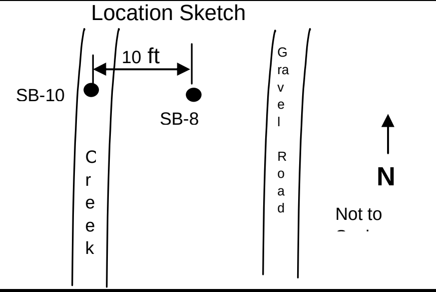
BOREHOLE NUMBER	SB-10
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 6, 2006

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0180	1405	3/2	25%	5.3/	NS	0-1		GW	Sandy fine to coarse gravel, v. dark gray (10 YR 3/1), fine to coarse sand (~40%),
				31.2					large piece of wood debris, no odor.
-	-	3/4	0%	-	-	1-2		SM	Silty fine to medium sand, v. dark gray (2.5 Y 3/1), ~40% silt, few pieces of
							2--		gravel, no odor.
LSP0181	1420	3/4	10%	10.4/	NS	2-3			As above w/ 15-20% coarse gravel, 15% wood fragments, no odor.
				1.3					
LSP0182	1430	5/16	70%	11.3/	NS	3-4			Gravelly fine to coarse sand, v. dark gray (10 YR 3/1), 25% fine gravel, piece of wood
				4.1			4--	SW	from 3.8-3.9 ft bgs, no odor.
LSP0183		21/33	40%	9.0/	NS	4-5		GW	Sandy gravel, v. dark gray (Glay 1 3/), 40% fine to coarse sand, fine to coarse
				2.2					gravel, no odor.
LSP0184	1440	-	30%	8.3/	NS	5-6			
				2.0					As above w/ 25% fine to coarse sand, no odor.
							6--	—	
									Boring terminated at 6 ft bgs.
							8--		
							10--		
							12--		
							14--		

Background PID=0.6 ppm, FID=0 ppm

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg California Modified
COORDINATES	Northing: 648556.97 ft
	Easting: 1234389.24 ft
SURFACE ELEVATION	12.56 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

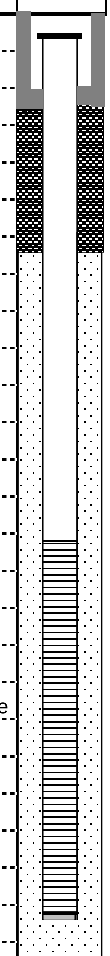
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-11
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 7, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (7.2-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (12.2-7.2)
Sump (end cap): 1" dia Sch 80 PVC (12.20-12.25)
Annular Fill: Surface Seal: Concrete (1.5-0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (3.5-1.5)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (12.8-3.5)

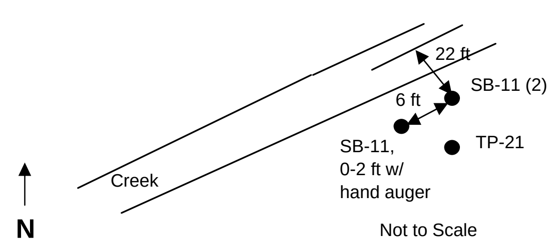
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	PID/FID (ppm)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0186	0815	2/5	5.0/0	40%	NS	0-1		ML	Sandy silt, v. dark grayish brown (10 YR 3/2), 30% fine sand, trace of
LSP0274	1430	(collected w/HA 2-11-06)				0-1			roots, no odor, moist to very moist (fill).
	0830	8/12	3.4/0.6	0%	NS	1-2			As above with color, v. dark gray (10 YR 3/1), 10% organics.
LSP0275	1445	(collected w/HA 2-11-06)				1-2	2--		
									As above with trace fine gravel, v. moist, no odor (fill).
LSP0187	0830	3/14	4.4/0.9	100%	NS	2-3			As above with 20% fine to med. sand, ~2% fine to coarse gravel.
LSP0188	0835	10/12	5.3/0.4	25%	NS	3-4	4--		
									As above with 35% fine sand, no gravel, some orange mottling, brown
LSP0189	0840	4/5	5.2/0.6	50%	NS	4-5			(10 YR 4/3), trace roots, moist.
									Silt, v. dark gray (5 YR 3/1), trace charcoal, some fine orange veining,
LSP0190	0845	5/3	8.5/0.4	50%	NS	5-6	6--		trace roots, moist, no odor.
									Clayey silt, v. dark gray (7.5 YR 3/1), ~40% clay, trace roots, moderately
LSP0191	0850	2/4	11.6/1.8	100%	NS	6-7			stiff, few pieces of gravel, v. moist, no odor (fill).
								▼	
LSP0192	0855	2/3	6.0/0.9	35%	NS	7-8	8--	SM	Silty fine sand, dark gray (10 YR 4/1), 35% silt, wet, no odor (native).
									-8-9 ft sandy clay/clayey fine sand, brown (7.5 YR 4/2), some orange mottling,
LSP0193	0900	2/5	6.2/1.0	90%	NS	8-9			no odor, v. moist to wet.
									-9-10 ft silty clayey fine sand, grayish brown (10 YR 5/2), fine to med. sand, some
LSP0194	0910	4/38	6.5/0.6	50%	NS	9-10	10--		orange mottling, trace roots and fine gravel, wet, no odor.
								SM/SP	Silty fine to med. sand, v. dark gray (10 YR 3/1), 15% silt, ~15% fine to
LSP0195	0930	21/10	6.2/0.4	65%	NS	10-11			2 in. gravel, slight creosote like odor, wet.
									-2 in rock in sampler.
-	-	5/7	-	0%	-	11-12	12--		
								CL	Clay, dark gray (Glay 1 4/), mod. stiff, indistinct odor.
LSP0196	0955	3/5	5.2/0.2	100%	LS	12-13		SM	Silty fine sand, dark gray (Glay 1 4/1), 25% silt, wet, no odor observed.
Background PID = 0.5 ppm, FID = 0.0 ppm.							14--		Boring terminated at 12 ft, sampled to 13 ft bgs.

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg California Modified
COORDINATES	Northing: 649117.85 ft
	Easting: 1235067.96 ft
CASING ELEVATION	35.49 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



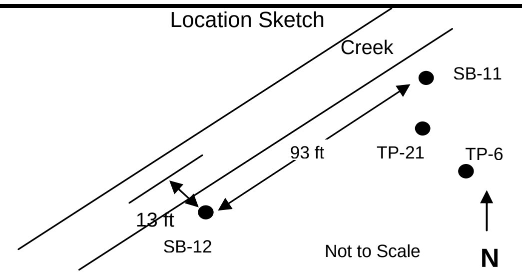
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-12
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 7, 2006

SAMPLE INFORMATION									
Sample ID	**Time**	**Blow Counts**	**% Recovery**	**PID/FID**	**Sheen**	**Sample Depth (ft)**	**Depth (ft)**	**STRATA**	**DESCRIPTION** USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0197	1303	3/5	50%	2.2/	NS	0-1		ML	Sandy silt, v. dark grayish brown (10 YR 3/2), 20% fine sand, 15% fine to 2" dia.
				0.0					gravel, trace roots, moist, no odor.
LSP0198	1310	9/14	60%	1.9/	NS	1-2		GW	Silty fine to 2" dia. gravel, dark grayish brown (10 YR 4/2), 20% silt ~5% fine to
				0.0			2--		coarse sand, moist, no odor.
LSP0199	1315	31/44	15%	2.1/	NS	2-3		ML	Gravelly silt, dark grayish brown (10 YR 4/2), 25% fine sand, trace roots, 20%
				0.0				▼	gravel, moist, no odor.
LSP0200	1320	12/14	75%	1.9/	HS	3-4		GW	Silty sandy gravel, v. dark gray (10 YR 3/1), ~15% silt, ~20% fine to coarse sand,
				0.0			4--		fine to 2" dia. gravel, heavy sheen/NAPL globules, strong cresote-like odor, wet.
LSP0201	1325	7/9	60%	2.2/	HS	4-5			
				8.8					
LSP0202	1355	3/11	25%	2.5/	HS	5-6		GW/GP	Sandy fine gravel, v. dark gray (10 YR 3/1), 35% medium to coarse sand,
				1.9			6--		heavy sheen/NAPL globules, strong cresote-like odor, wet.
LSP0203	1410	60-6"	30%	2.3/	HS	6-7			
				3.5					
-	-	51/6	20%	-	HS	7-8			
-	-	-	0%	-	-	8-8.5	8--		
LSP0204**	1500	-	-	-	-	8		CL	Clay, dark gray (Glay 1 4/), moderately stiff, some fine sandy zones (observed on
									auger teeth).
**Collected clay sample from lead auger							10--		Borehole terminated to 8 ft bgs, sampled to 8.5 ft bgs.
							12--		
Background PID=1.9 ppm, FID=0 ppm									
							14--		

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg California Modified
COORDINATES	Northing: 649074.30 ft
	Easting: 1234993.07 ft
SURFACE ELEVATION	29.44 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

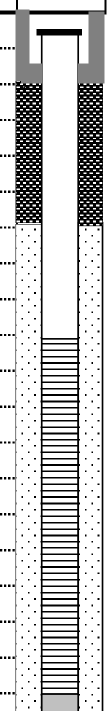
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-13
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 8, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (4.5-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (9.5-4.5)
Sump: 1" dia Sch 80 PVC (9.8-9.5)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (3.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (9.8-3.0)

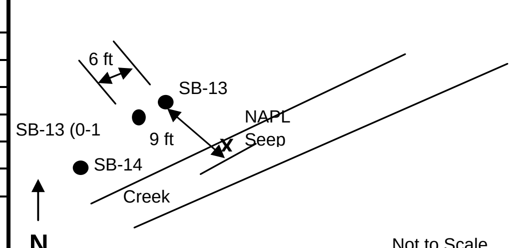
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0203	1015	3/4	0.5/3.0	80%	NS	0-1		ML	Clayey silt, v. dark grayish brown (10 YR 3/2), ~25% clay, trace roots,
LSP0224	0805	(collected w/HA 2-9-06)				0-1			moist, no odor.
LSP0206	1025	2/3	0.9/2.3	40%	NS	1-2			
LSP0225	0820	(collected w/HA 2-9-06)				1-2	2--		
									Fine sandy silt, dark grayish brown (10 YR 4/2), 20% fine sand, no odor,
LSP0207	1050	4/4	0.2/1.9	90%	NS	2-3			moist, trace roots.
									As above with 40% fine to med. sandy, ~20% clay, some orange moltting, v.
LSP0208	1100	9/12	0.4/2.1	40%	NS	3-4	4--		moist, no odor.
-	-	1/5	-	0%	-	4-5			
								S	Silty fine sand, dark gray (2.5 Y 4/1), 20% silt, indistinct odor, wet.
LSP0209	1110	2/2		60%	NS	5-6	6--	ML	Clayey silt, v. dark gray (2.5 Y 3/1), 30% clay, trace wood, indistinct sweet odor.
								SM	Silty fine to med. Sand, very dark grayish brown (2.5 Y 3/2), 35% silt, 10%
LSP0210	1125	5/15	0.5/2.2	60%	NS	6-7			wood debris, wet, indistict slight sweet odor.
								GW	Sandy fine to coarse gravel, v. dark gray (2.5 Y 3/2), 30% fine to coarse sand,
LSP0211	1140	27/50	0.8/1.2	45%	NS	7-8	8--		~10% silt, indistinct slightly sweet odor, wet.
-	-	50-0"	-	0%	-	8-9			As above with fine to 3/4" gravel, indistinct/weak creosote-like odor.
								CL	Clay, dark gray (Glay 1 4/), moderately stiff, weak creosote-like odor,
LSP0212	1240	9/5	0.6/1.7	25%	NS	8.5 -	10--		v. moist (observed on auger teeth).
						9.5			
									Boring terminated at 9.5 ft bgs (refusal).
							12--		
							14--		

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Portable HSA Rig, 2.25" ID x 4.63" OD Augers
SAMPLING EQUIPMENT	2" dia. x 24" lg. SPT
COORDINATES	Northing: 649197.31 ft
	Easting: 1235106.67 ft
CASING ELEVATION	34.95 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

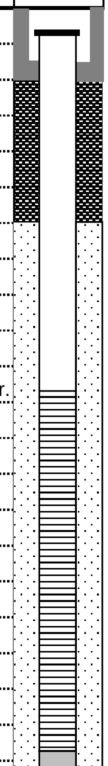
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-14
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 9, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (5.4-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (10.4-5.4)
Sump: 1" dia Sch 80 PVC (10.7-10.4)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (3.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (10.7-3.0)

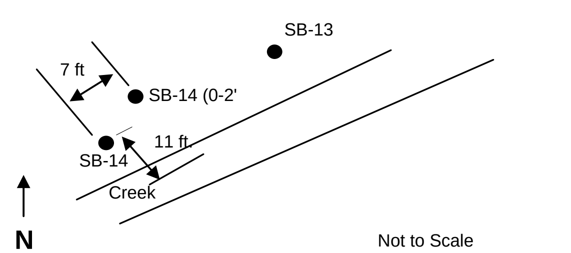
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
-	1503	2/4	0.3/0.0	-	NS	0-1		ML	Clayey silt, v. dark gray (10 YR 3/1), 30-40% clay, trace roots, moist, no odor.
LSP0227	0825	(collected w/HA 2-9-06)				0-1			
LSP0216	1505	2/4	3.5/0.0	80%	NS	1-2		CL	Silty clay, dark gray brown (10 YR 4/2), moderately stiff, some orange
LSP0228	0840	(collected w/HA 2-9-06)				1-2	2--		mottling, moist, no odor.
LSP0217	1515	2/4	4.0/0.2	60%	NS	2-3			As above w/ color very dark gray (10 YR 3/1).
									As above with color brown (10 YR 4/3), increased silt content.
LSP0218	1540	5/5	6.2/0.0	90%	NS	3-4	4--	S	Silty fine sand, dark gray (10 YR 4/1) ~15% silt, no odor, v. moist.
								▼	Silty clay, layer 4-4.3 ft bgs, brown (10 YR 4/3), wet at 4.5 ft bgs.
LSP0219	1540	5/2	4.2/0.1	100%	NS	4-5		CL	Silty clay, v. dark gray (10 YR 3/2), trace of organics, soft, no odor.
								S	Silty sand, dark grayish brown (10 YR 4/2), 20% silt, wet, weak creosote-like odor.
LSP0220	1555	7/12	3.2/0.0	60%	LS	5-6	6--		Organic rich fine to med. sand, 30% organics, strong creosote-like odor.
								GW	Sandy gravel, v. dk gray (10YR 3/1), 25% fine sand, strong creosote-like odor.
LSP0221	1610	10/4	3.3/4.7	75%	HS	6-7		SM / SP	Silty sand layer, very dark gray (10 YR 3/1), slight creosote odor. Wood 6.7-7 ft.
									Gravely fine to med. sand, v. dark gray (Glay 1 3/), 20% fine to 3/4" gravel,
-	-	6/10	-	0%	-	7-8	8--		strong creosote-like odor.
LSP0222	1635	20/12	3.6/3.0	30%	HS	8-9			
LSP0223	1700	22/30	5.2/7.4	60%	LS	9-10	10--	GW	Silty sandy gravel, v. dark gray (7.5 YR 3/1), 25% fine to coarse sand,
									15% silt, wet, moderate creosote-like odor.
LSP0226	0820	20/10	6.7/3.4	50%	NS	10-11			
							12--		Boring terminated at 10.25 ft bgs, sampled to 11 ft bgs.
									No gray clay observed on augers.
Background FID = 0.0 ppm, PID = 3.4 ppm									
							14--		

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Portable HSA Rig, 2.25" ID x 4.63" OD Augers
SAMPLING EQUIPMENT	2" dia. x 24" lg. SPT
COORDINATES	Northing: 649125.08 ft
	Easting: 1235020.36 ft
CASING ELEVATION	32.13 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



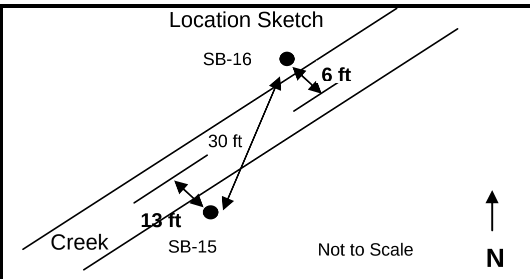
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-15
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 9, 2006

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0229	1150	-	-	0.8/0	NS	0-1		GM	Clayey silty gravel, v. dark grayish brown (10 YR 3/2), fine to coarse gravel,
									~10% clay, ~20% silt, moist, no odor (fill).
LSP0230	1220	-	-	0.6/0	NS	1-2		CL	Clay, dark gray (10 YR 4/1), stiff, moist, no odor.
							2--		
LSP0231	1250	4/8	100%	0.5/0	NS	2-3			
								ML	Grading to clayey silt, dark gray (2.5 Y 4/1), trace organics, ~25% clay, most, no odor.
LSP0232	1300	2/3	100%	0.5/0	NS	3-4		CL	Clay, v. dark greenish gray (Glay 1 3/1), v. stiff, moist, no odor.
								▼	Drillers noted augers dropped at 3.5 ft bgs with no downward pressure.
LSP0233	1315	2/3	100%	1.0/0	NS	4-5	4--		
									As above w/ color dark gray (Glay 1 4/), silt content ~25% from 4-6-4.9 ft bgs, wet.
									Boring terminated at 5 ft bgs.
							6--		
							8--		
							10--		
Note: 0-1 and 1- 2 ft samples collected w/hand auger.							12--		
Background PID=0.5 ppm, FID=0.0 ppm									
							14--		

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Portable HSA Rig, 2.25" ID x 4.63" OD Augers
SAMPLING EQUIPMENT	2" dia. x 24" lg. SPT
COORDINATES	Northing: 648975.97 ft
	Easting: 1234861.57 ft
SURFACE ELEVATION	27.55 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

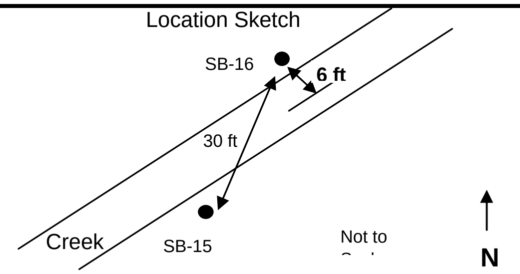
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-16
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 9, 2006

Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION: USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0234	1340	-	-	0.8/	NS	0-1		CL	Silty gravelly clay, v. dark gray (10 YR 3/1), 25% coarse gravel, 20% organics,
				3.2					~20% silt, weak petroleum odor, soft, wet at 0.5 ft bgs (at creek level).
LSP0235	1350	-	-	0.8/	NS	1-2			
				4.3			2--		Clay, dark greenish gray (Glay 1 4/1), v. stiff, indistinct petroleum odor.
LSP0236	1400	-	-	0.8/	NS	2-3			As above w/ no petroleum odor, trace organics.
				0					
							4--		Boring terminated at 3 ft bgs.
							6--		
							8--		
							10--		
							12--		
Background PID= 0.5 ppm, FID=0 ppm									
							14--		

DRILLING CONTRACTOR	NA
DRILLING METHOD	NA
SAMPLING EQUIPMENT	3.0" dia. hand auger
COORDINATES	Northing: 649003.30 ft
	Easting: 1234869.62 ft
SURFACE ELEVATION	25.50 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



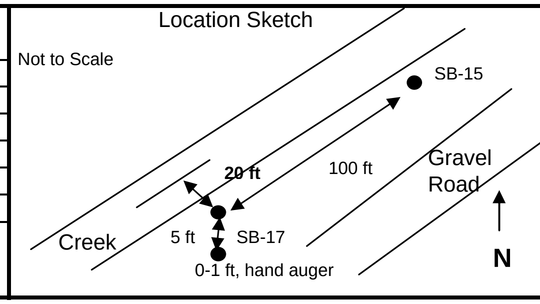
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-17
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 9, 2006

SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0245	0815	-	-	0.5/0	NS	0-1		GW	Sandy silty gravel, v. dark grayish brown (10 YR 3/2), 15% fine to coarse sand,
									35% silt, fine to 2" dia. gravel, trace organics, no odor.
LSP0237	1600	8/10	100%	0.5/0	NS	1-2		SM	Silty fine sand, brown (10 YR 4/3), 15% silt, moist, no odor.
							2--		
LSP0238	1610	5/3	100%	0.4/0	NS	2-2.3		CL	Silty clay, dark gray (2.5 Y 4/1), 15% silt, v. stiff, moist, no odor.
LSP0239	1615	"	"	"	"	2.3-3			
LSP0240	1620	3/4	100%	-	NS	3-4	4--		
LSP0241	1625	4/10	100%	0.5/0	NS	4-4.75			Silty fine sand lamination (0.02' thick), at 4.1 bgs.
LSP0242	1630	"	"	"	"	4.75-5		SM	Silty fine sand, v. dark gray (Glay 1 3/), 35% silt, very moist to wet, no odor.
LSP0243	1640	3/6	100%	0.5/0	NS	5-5.5			Wet at 5 ft bgs.
LSP0244	1645	"	"	"	"	5.5-6		CL	Clay, dark gray (Glay 1 4/), v. stiff, no odor, moist.
							6--		
									Boring terminated at 6 ft bgs.
							8--		
							10--		
0-1 ft sample collected with hand auger on 2-10-06.							12--		
Background PID= 0.5 ppm, FID=0 ppm									
							14--		

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Portable HSA Rig, 2.25" ID x 4.63" OD Augers
SAMPLING EQUIPMENT	2" dia. x 24" lg. SPT
COORDINATES	Northing: 648927.74 ft
	Easting: 1234770.39 ft
SURFACE ELEVATION	26.62 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

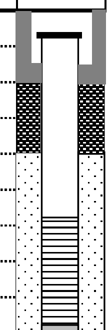
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-18
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 10, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing:1" dia Sch 80 PVC (2.9-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (4.4-2.9)
Sump (end cap): 1" dia Sch 80 PVC (4.5-4.4)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (2-1)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (4.5-2)

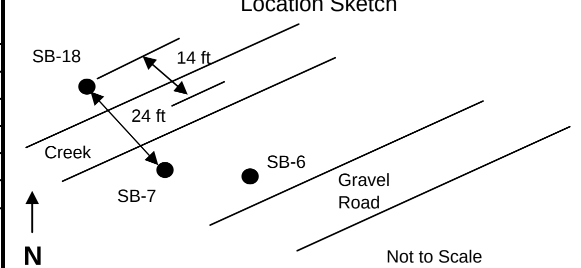
SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0250**	0940	NA	3.6/0	NA	NS	0-1		PT	Silty/clayey peat, v. dark gray (10 YR 3/1), low density, moist, no odor.
LSP0251**	0945	(duplicate)				0-1			
LSP0246	0835	1/1	1/.00	20%	NS	1-2		ML/PT	Organic rich silt, v. dark gray (7.5 YR 3/1), trace fine sand, moist, trace
LSP0252**	1000					1-2	2--		roots, no odor, trace wood debris.
LSP0247	0840	11/22	1.6/0	30%	NS	2-3		PT	Silty peat, v. dark gray (2.5 Y 3/1), ~10% silt, wet, no odor.
									-fine sand (dark gray 2.5 Y 4/1) at bottom of sampler.
LSP0248	0850	16/18	1.7/0	30%	NS	3-4		GW	Silty sandy gravel, dark gray (2.5 Y 4/1), 10% silt, 15-20% fine to coarse
							4--		sand, no odor, wet, fine to 1.5" dia. gravel.
LSP0249	0900	26/32	1.8/0	35%	NS	4-5			Sandy silty gravel, dark grayish brown (2.5 Y 4/2), 15% fine to coarse sand,
									25% silt, wet, no odor, fine to 1.5" dia. gravel.
									Boring terminatd at 4.5 ft bgs (refusal), sampled to 5 ft bgs.
							6--		
							8--		
							10--		
							12--		
**Collected w/hand auger on 2-10-06									
Background PID = 0.6 ppm, FID = 0.0 ppm							14--		

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Portable HSA Rig, 2.25" ID x 4.63" OD Augers
SAMPLING EQUIPMENT	2" dia. x 24" lg. SPT
COORDINATES	Northing: 648439.52 ft
	Easting: 1234318.54 ft
CASING ELEVATION	13.24 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

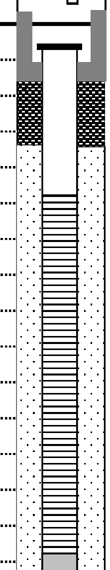
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-19
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 10, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (2.4-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (7.4-2.4)
Sump: 1" dia Sch 80 PVC (7.7-7.4)
Annular Fill: Surface Seal: Concrete (0.7 to -0.1)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (1.7-0.7)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (7.7-0.7)

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0263**	1415	-	6.0/2.1	-	NS	0-1		PT	Silty/clayey peat, v. dark gray (10 YR 3/1), ~15% silt/clay, low density, no
									odor.
-	-	1/1	3.5/1.8	10%	NS	1-2			
LSP0264**	1420	"	"	"	"	1-2	2--	▼	Silty fine to med. sand, v. dark gray (Glay 1 3/), 15-20% silt, trace fiberous
								SM	organic material, wet, mododerate creosote-like odor.
LSP0253	1125	1/1	4.3/1.5	45%	LS	2-3			Silty/clayey peat, v. dark gray (10 YR 3/1), ~15% silt/clay, some fiberous
LSP0254	1130	3/6	3.1/2.9	100%	LS	3-3.6		PT	organic material, wet, strong creosote-like odor.
LSP0255	1135	"	"	"	"	3.6-4		SW	Gravely fine to coarse sand, v. dark gray (10 YR 3/1), 30% fine gravel,
LSP0256	1150	9/12	4.4/1.8	90%	NS	4-5	4--		wet, weak creosote-like odor.
									Fine to coarse sand, v. dark gray (2.5 Y 3/1), mostly med. sand, wet, indistinct
LSP0257	1155	16/42	4.9/2.2	100%	NS	5-5.5			creosote-like odor.
LSP0258	1200	"	"	"	"	5.5-6		GW	Sandy gravel, dark gray (2.5 Y 4/1), 30% F-C sand, 10% silt, F-C gravel,
LSP0259	1240	38/50.5	3.1/2.4	90%	NS	6-6.5	6--		indistinct creosote-like odor.
LSP0260	1245	"	"	"	"	6.5-7		SP	Med. Sand, dark gray (Glay 1 4/), trace coarse sand, wet, indistinct odor.
LSP0261	1300	25/38	1.2/1.6	90%	NS	7-7.6			
LSP0262	1305	"	"	"	"	7.6-8	8--	SM	Silty fine sand, v. dark gray (10 YR 3/1), 30% silt, wet, indistinct creosote-like
									odor.
									Boring terminated at 7 ft bgs (heaving sand), sampled to 8 ft bgs.
							10--		
							12--		
							14--		

Well Diagram

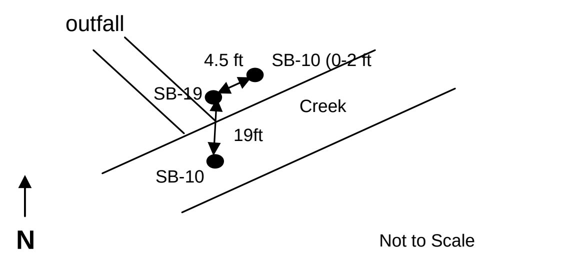


**Collected w/hand auger on 2-10-06

Background PID = 0.9 ppm, FID = 0.2 ppm

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Portable HSA Rig, 2.25" ID x 4.63" OD Augers
SAMPLING EQUIPMENT	2" dia. x 24" lg. SPT
COORDINATES	Northing: 648574.21 ft
	Easting: 1234396.30 ft
CASING ELEVATION	14.38 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

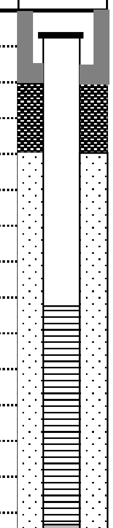
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-20
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 10, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (4.2-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (7.2-4.2)
Sump (end cap): 1" dia Sch 80 PVC (7.3-7.2)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (2.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (7.3-2.0)

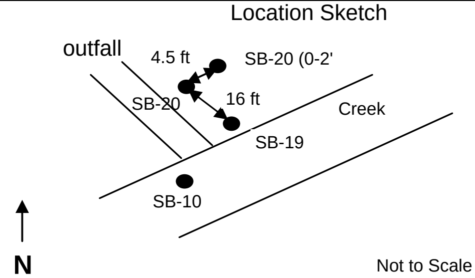
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0271**	1610	-	2.3/0.5	-	NS	0-1		ML	Organic rich clayey silt, v. dark gray (10 YR 3/1), 30% clay, 20% organics,
									v. moist, no odor. 40% organics below 1 ft bgs.
LSP0272**	1625	-	3.2/0	-	NS	1-2		▼	
LSP0273**	1630	(duplicate)				1-2	2--	SM	Silty fine to med. sand, dark gray (7.5 YR 3/1), 20% silt, wet, no odor.
LSP0265	1435	8/5	2.3/0.5	30%	NS	2-3		PT	Clayey peat, v. dark gray (7.5 YR 3/1), v. moist to wet, no odor.
								GW	Sandy gravel, dark gray (7.5 YR 4/1), 40% fine to coarse sand, wet, no odor.
LSP0266	1440	3/2	2.4/0.3	65%	NS	3-4		SM	Clayey fine sand, v. dark gray (7.5 YR 3/1), 40% clay, trace wood and
							4--		gravel, wet, no odor. Clay content inreases with depth.
LSP0267	1455	1/1	-	30%	NS	4-5			As above w/ 20% clay, fine to med. sand.
									As above with 5% wood/organics, indistict "sweet" odor at 5 ft bgs.
LSP0268	1500	2/12	2.2/0.6	80%	NS	5-5.6			
LSP0269	1505					5.6-6	6--	GW	Sandy fine gravel, v. dark gray (10 YR 3/1), 30% F-C sand, 10% silt, wet,
-	-	19/20	-	0%	-	6-7			indistinct odor, ~20% organics, 5.6 - 5.8 bgs.
LSP0270	1530	25/19	1.6/0.4	80%	NS	7-8			Coarse sandy fine gravel, v. dark gray (10 YR 3/1), 30% coarse sand,
							8--		predominately fine gravel, trace coarse gravel, wet, no odor.
									Boring terminated at 7.5 ft bgs (refusal), sampled to 8 ft bgs.
							10--		
							12--		
**Collected w/hand auger on 2-10-06									
							14--		

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Portable HSA Rig, 2.25" ID x 4.63" OD Augers
SAMPLING EQUIPMENT	2" dia. x 24" lg. SPT
COORDINATES	Northing: 648590.03 ft
	Easting: 1234395.47 ft
CASING ELEVATION	15.41 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

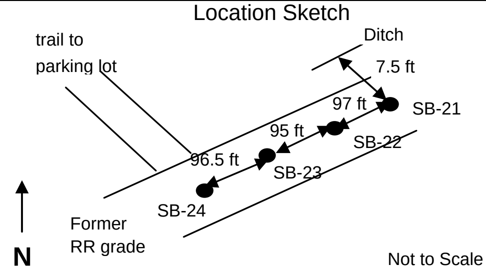
WELL NUMBER	SB-21
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	Feburary 13, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 PVC (21.2-0.3)
Screen: 2" dia Sch 40 PVC, 0.010" slot (31.2-21.2)
Sump: 2" dia Sch 40 PVC (31.5-31.2)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (17.0-2.0)
Annular Fill: Bentonite chips (33-32, 19-17; 2-1)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (31.5-19)

SAMPLE INFORMATION									DESCRIPTION	
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.	Well Diagram
LSP0276	0915	10/12/15	1.5/0.2	75%	NS	1-1.9		GW	Gravel (3/4" minus), gray (7.5 YR 6/1), moist (crushed rock fill).	
								GW	Silty sandy gravel, brown (10 YR 4/2), 35% F-C sand, 15% silt,	
									F-C gravel, moist, no odor (fill).	
LSP0277	0930	6/6/7	3.2/2.0	100%	NS	1.9-3	2--			
								ML	Sandy silt, brown (10 YR 5/3), some orange mottling, 30% fine	
									sand, trace roots, moist, no odor.	
LSP0278	0945	10/12/15	2.2/0	85%	NS	3-4.5		CL	Silty clay, light grayish brown (10 YR 6/2), 25% silt, very stiff,	
							4--		moist, no odor.	
									As above with color grayish brown (10 YR 5/2), 15% silt, slightly moist.	
LSP0279	0955	9/10/13	2.5/0.3	90%	NS	4.5-5				
LSP0280	1000	10/13/15	4.4/1.0	"	NS	5-6		SM	Silty fine sand, v. dark gray (7.5 YR 3/1), 20-35% silt (varies),	
							6--		v. moist to moist, no odor.	
LSP0281	1010	15/20/20	2.5/0	75%	NS	6-7.5		SP	Fine sand, v. dark grayish brown (10 YR 3/2), 5-10% silt, loose,	
									moist to v. moist, no odor.	
LSP0282	1015	12/15/16	3.1/0.4	100%	NS	7.5-9	8--		As above, 5% silt.	
LSP0283	1020	9/12/14	3.2/0	90%	NS	9-10.5				
							10--			
LSP0284	1025	15/20/21	1.9/0	70%	NS	10.5-12			As above with few pieces of gravel at 11.7 bgs (gravel may be	
									sluff).	
							12--			
LSP0285	1030	15/20/21	3.3/0	70%	NS	12-13.5				
									As above with 3-5% fine rounded gravel.	
									As above w/ 10% F-C gravel.	
LSP0286	1035	-	3.1/1.2	70%	NS	13.5-14.6	14--		Sandy F-C gravel, v. dark grayish brown (10 YR 3/2), 40% fine sand,	
								GW	5% silt, moist, no odor.	

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649375.81 ft
	Easting: 1235210.33 ft
CASING ELEVATION	63.90 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

WELL NUMBER	SB-21
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	Feburary 13, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 PVC (21.2-0.3)
Screen: 2" dia Sch 40 PVC, 0.010" slot (31.2-21.2)
Sump: 2" dia Sch 40 PVC (31.5-31.2)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (17.0-2.0)
Annular Fill: Bentonite chips (33-32, 19-17; 2-1)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (31.5-19)

SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION	Well Diagram
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.	
LSP0287	1037	18/18/20	2.4/0	"	NS	14.6-15		SP	Gravely sand, v. dark gray brown (10 YR 3/2), 25-30% F-C gravel,	
LSP0288	1040	18/20/23	2.9/0.9	70%	NS	15-16.5			moist, no odor.	
							16--			
								SW	Gravely F-C sand, v. dark grayish brown (10 YR 3/2), 40% F-C	
LSP0289	1045	15/20/20	2.6/0.2	90%	NS	16.5-18			gravel (mostly fine), subrounded gravel, 5% silt, very moist, no odor.	
							18--			
LSP0290	1050	12/15/19	2.6/0	75%	NS	18-19.5		GW	Sandy F-C gravel, v. dark grayish brown (10 YR 3/2), 40% F-C sand,	
									5% silt, predominately subrounded fine gravel, moist,	
									no odor.	
LSP0291	1105	18/22/25	2.6/0.9	60%	NS	19.5-21	20--			
LSP0292	1110	20/20/23	-	30%	NS	21-22.5			Sandy coarse gravel, brown (10 YR 4/3), 25% m-c sand, 15% silt,	
							22--		some fine gravel, moist, no odor.	
LSP0293	1115	18/20/20	2.7/3.5	60%	NS	22.5-24			As above with predominately fine gravel, some coarse gravel,	
									20% m-c sand.	
							24--			
LSP0294	1120	23/24/25	3.3/0.5	60%	NS	24-25.5			As above with increased coarse gravel content (up to 2" dia.)	
									As above with equal proportions fine and coarse gravel (up to 1.5" dia),	
LSP0295	1125	18/21/24	2.6/1.1	50%	NS	25.5-27	26--		dark yellowish band (10 YR 4/4) at 26.5 ft (0.2' thick).	
									As above with 20% silt, 15% M-C sand, fine to 1.5" dia. gravel (sandy	
LSP0296	1140	22/24/25	3.2/1.2	70%	NS	27-28.5			silty gravel).	
							28--		Silty fine sand, dark grayish brown (10 YR 4/2), 30% silt, very moist,	
LSP0297	1145	13/13/14	2.8/0.4	100%	NS	28.5- 30		SM	to wet, no odor.	

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649375.81 ft
	Easting: 1235210.33 ft
CASING ELEVATION	63.90 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch
(See Page 1)

integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

WELL NUMBER	SB-21
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	Feburary 13, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 PVC (21.2-0.3)
Screen: 2" dia Sch 40 PVC, 0.010" slot (31.2-21.2)
Sump: 2" dia Sch 40 PVC (31.5-31.2)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (17.0-2.0)
Annular Fill: Bentonite chips (33-32, 19-17; 2-1)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (31.5-19)

SAMPLE INFORMATION									DESCRIPTION	
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.	Well Diagram
								SM	As above w/ color v. dark grayish brown (10 YR 3/2), v. moist to wet,	
									no odor, silt content increasing with depth.	
LSP0298	1150	10/11/13	1.6/1.4	100%	NS	30-31	30			
LSP0299	1200	"	2.5/0.6	"	NS	31-31.5		CL	Silty clay, grayish brown (10 YR 5/2), moist, no odor.	
LSP0300	1300	15/18/20	3.9/0.5	100%	NS	31.5-32		SM	Silty fine sand, v. dark grayish brown (10 YR 3/2), 25% silt, wet, no odor	
LSP0301	1305	-	62/1.1	-	NS	32-33	32	CL/SM	Interlayered silty clays and silty sands, grayish brown (10 YR 5/2),	
									v. moist to wet, no odor.	
LSP0302	1330	10/12/15	22.4/0	100%	NS	33-34.5				
							34			
									Borehole terminated at 33 ft bgs, sampled to 34.5 ft bgs.	
							36			
							38			
							40			

Background PID = 0.3 - 0.5 ppm, FID = 0.0 PPM

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649375.81 ft
	Easting: 1235210.33 ft
CASING ELEVATION	63.90 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAD 88

Location Sketch
(See Page 1)

integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

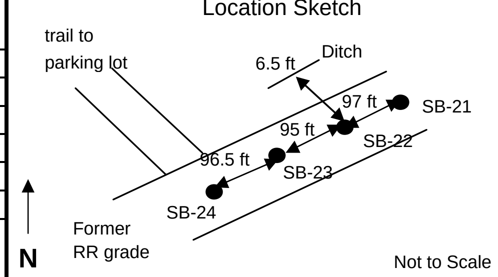
WELL NUMBER	SB-22
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 13-14, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 Stainless Steel (19.9-0.3)
Screen: 2" dia Sch 40 Stainless Steel, 0.010" slot (29.9-19.9)
Sump: 2" dia Sch 40 Stainless Steel (30.1-29.9)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (16.0-2.0)
Annular Fill: Bentonite chips (31-30.5, 18-16, 2-1)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (30.5-18)

SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION	Well Diagram
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.	
LSP0303	1530	10/11/13	2.3/1.0	70%	NS	0 - 1.5		GW	Gravel (3/4" minus), gray (7.5 YR 6/1), moist, no odor (fill).	
								GW	Sandy silty gravel, v. dark gray (10 YR 3/1), 30% silt, 20% F-C sand,	
									moist, no odor (fill).	
LSP0304	1540	8/9/10	3.0/0	60%	NS	1.5 - 2.6	2--			
									-piece of wood at 2' bgs	
LSP0305	1545	"	2.6/NM	"	NS	2.6 - 3		CL	Silty clay, brown (10 YR 4/3), some orange moltting, 30% silt,	
LSP0306	1550	4/5/6	2.0/NM	65%	NS	3-4.5			moderately stiff, moist, no odor (fill).	
							4--		As above w/ 2% black organics (charcoal), 15% fine sand, color	
									dark grayish brown (10 YR 4/2).	
LSP0307	1600	3/5/6	2.7/NM	80%	NS	4.5-4.9		ML	Gravely organic-rich silt, black (10 YR 2/1), 15% F-C gravel, 40%	
LSP0308	1611	"	3.7/NM	"	NS	4.9-6			organics, moist, no odor (fill).	
							6--		Clayey silt, dark grayish brown (10 YR 4/2), 25% clay, 5% F-C	
LSP0309	1615	3/3/4	1.5/NM	50%	NS	6-8			gravel, trace roots, moist, no odor (fill).	
									As above w/ 30% F-C gravel, trace red brick, no odor, moist (fill).	
							8--			
LSP0310	1625	3/4/5	2.5/NM	50%	NS	8-9		GW	Sandy gravel, dark gray (10 YR 4/1), 30% M-C sand, rock fragments	
									up to 1.5" dia., moist, no odor (fill).	
LSP0311	1640	4/5/4	3.3/NM	75%	NS	9-10.1		ML	Sandy silt, dark grayish brown (10 YR 4/2), 15-25% fine sand, 1% gravel,	
							10--		trace roots, moist, no odor.	
LSP0312	1645	"	"	"	NS	10.1-10.5		GW	Sandy silty gravel, v. dk. grayish brown (10 YR 3/2), organic rich, no odor	
LSP0313	1650	4/5/7	1.7/NM	70%	NS	10.5-12		SP	Slightly silty fine sand, brown (10YR 4/3), 10% silt, loose, moist, no odor.	
									loose, moist, no odor.	
							12--		Silt rich zone (30% silt), 0.1' thick at 11' bgs.	
LSP0314	0800	7/12/15	3.5/0	60%	NS	12-13.5				
									As above with few pieces of gravel, silty zone at 13.5 ft bgs.	
LSP0315	0810	15/18/26	2.8/0	45%	NS	13.5-14	14--		Sandy F-C gravel, brown (10 YR 4/3), 30% M-C sand, 15% silt,	
LSP0316	0815	"	4.1/0	"	NS	14-15		GW	subrounded gravel, moist, no odor.	

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649311.11 ft
	Easting: 1235138.47 ft
CASING ELEVATION	60.56 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

WELL NUMBER	SB-22
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 13-14, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 Stainless Steel (19.9-0.3)
Screen: 2" dia Sch 40 Stainless Steel, 0.010" slot (29.9-19.9)
Sump: 2" dia Sch 40 Stainless Steel (30.1-29.9)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (16.0-2.0)
Annular Fill: Bentonite chips (31-30.5, 18-16, 2-1)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (30.5-18)

Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION (USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.)
								GW	As above with incrased silt content (20%) [silty sandy gravel].
LSP0317	0820	18/20/24	4.4/0.7	65%	NS	15-16.5			
							16		
LSP0318	0825	18/19/20	3.5/0	65%	NS	16.5-18			As above with predominately fine gravel, trace of coarse gravel.
							18		As above with predominately coarse gravel up to 2.5" dia. broken
LSP0319	0830	20/20/23	2.8/0.4	55%	NS	18-19.5			gravel that includes quartzite and basalt.
LSP0320	0840	19/23/25	4.2/3.3	60%	NS	19.5-21	20		As above with fine to coarse gravel.
									As above with 15% coarse sand, 15% silt, F-C gravel up to 2" dia.,
LSP0321	0850	19/23/27	3.6/1.0	70%	NS	21-22.5			v. moist, no odor.
							22		
LSP0322	0900	22/25/28	4.0/1.3	55%	NS	22.5-24			As above with 10% coarse sand 5-10% silt, predominately coarse
									gravel (basalt, quartzite, gneiss), gravels were broken.
							24		As above with 15% silt, v. moist, no odor.
LSP0323	0905	25/30/32	3.0/0.1	45%	NS	24-25.5			
								GC	Clayey F-C gravel, brown (10 YR 4/3), 15-20% clay, F to 2" dia. gravel
LSP0324	0910	20/18/15	3.0/1.0	80%	NS	25.5-27	26		(mostly gneiss and basalt), v. moist, no odor.
LSP0325	0915	22/23/25	3/0	70%	HS	27-28.5		▼	As above with heavy sheen and some petroleum NAPL globules,
							28		strong creosote like odor, 20-25% clay, 5% F-C sand, wet.
LSP0326	0930	23/25/27	2.1/1.4	100%	HS	28.5-29.6			As above with mostly fine gravel.

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649311.11 ft
	Easting: 1235138.47 ft
CASING ELEVATION	60.56 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch
(See Page 1)

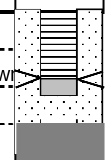
integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

WELL NUMBER	SB-22
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 13-14, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 Stainless Steel (19.9-0.3)
Screen: 2" dia Sch 40 Stainless Steel, 0.010" slot (29.9-19.9)
Sump: 2" dia Sch 40 Stainless Steel (30.1-29.9)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (16.0-2.0)
Annular Fill: Bentonite chips (31-30.5, 18-16, 2-1)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (30.5-18)

SAMPLE INFORMATION									DESCRIPTION	
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.	Well Diagram
								GC	Clayey F-C gravel as above.	
LSP0327	0910	"	3.9/0	"	NS	29.6-30	30--	CL/SM	Interbedded silty sands and silty clays: Silty fine sand, dark graysih brown	
LSP0328	1005	18/25	5.1/0.3	85%	NS	30-31			(10 YR 4/2), 30% silt, weak to no creosote-like odor; Silty clay, grayish	
									brown (10YR 5/2), moist, no odor	
									Borehole terminated at 30 ft bgs, sampled to 31 ft bgs.	
							32--			
							34--			
							36--			
							38--			
							40--			



Background PID = 0.8 -1.6 ppm, FID = 0.0 ppm
NM - FID ran out of hydrogen gas

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649311.11 ft
	Easting: 1235138.47 ft
CASING ELEVATION	60.56 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch
(See Page 1)

integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

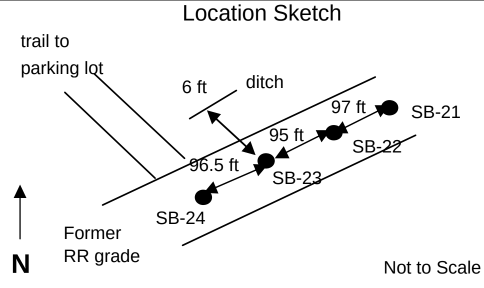
WELL NUMBER	SB-23
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 14-15, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 PVC (0.3 to 20.5)
Screen: 2" dia Sch 40 PVC, 0.010" slot (30.2-20.2)
Sump: 2" dia Sch 40 PVC (30.5-30.2)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (16-2)
Annular Fill: Bentonite chips (31.5-31, 18-16, 2-1)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (31-18)

SAMPLE INFORMATION									DESCRIPTION	
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.	Well Diagram
LSP0329	1305	8/12/15	1.7/0	75%	NS	0-1.5		GW	Gravel (3/4" minus), gray (7.5 YR 5/1), moist, no odor (crushed rock fill).	
								GW	Silty sandy gravel, dark grayish brown (10 YR 4/2), 30% F-C sand,	
									15% silt, moist, no odor (fill).	
LSP0330	1310	5/6/6	2.8/2.8	70%	NS	1.5 - 2.5	2--	CL/SM	Silty clay/silty sand, brown (10 YR 4/3), 25-30% silt, moist, no odor	
LSP0331	1315	"	"	"	NS	2.5-3				
LSP0332	1320	6/6/7	2.1/0	50%	NS	3-4.5		SP	Slightly silty fine sand, brown (10 YR 4/3), 15% silt, moist, no odor.	
							4--		As above w/ 5-10% silt, few pieces of fine gravel.	
									As above w/ color v. dark grayish brown (10 YR 3/2), 10% silt,	
LSP0333	1330	9/10/13	2.4/0.4	90%	NS	4.5-6			~2-5% fine rounded gravel, v. moist.	
							6--		Silty sand zone 5.7 - 6 ft bgs, some roots.	
LSP0334	1335	10/13/15	2.0/0.8	80%	NS	6-7.5			As above, v. moist, no odor, no gravel.	
LSP0335	1340	15/20/20	2.1/0.7	25%	NS	7.5-9	8--	GW	Silty sandy fine gravel, dark grayish brown (10 YR 4/2), 35% F-C	
									sand, 20% silt, v. moist, no odor.	
LSP0336	1350	13/14/16	2.4/1.6	60%	NS	9-10.5			As above w/ 5-10% silt (sandy gravel), wet.	
							10--			
									As above w/ 40% F-C sand, wet.	
LSP0337	1355	16/18/20	2.2/0.4	40%	NS	10.5-12				
									Predominately coarse gravel below 11.5 ft.	
							12--			
LSP0338	1400	18/20/22	1.6/0.7	60%	NS	12-13.5			As above w/ color brown (10 YR 4/3), 30% F-C sand, 15% silt,	
									v. moist to wet, no odor.	
LSP0339	1410	20/23/25	2.9/0.5	65%	NS	13.5-15	14--		As above w/ 5-10% silt, 30% M-C sand, fine to 1.5" dia. gravel, wet,	
									no odor.	

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649243.97 ft
	Easting:1235071.01 ft
CASING ELEVATION	58.19 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

WELL NUMBER	SB-23
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 14-15, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 PVC (0.3 to 20.5)
Screen: 2" dia Sch 40 PVC, 0.010" slot (30.2-20.2)
Sump: 2" dia Sch 40 PVC (30.5-30.2)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (16-2)
Annular Fill: Bentonite chips (31.5-31, 18-16, 2-1)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (31-18)

SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION	Well Diagram
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.	
								GW		
LSP0340	1415	20/21/25	2.2/0.1	60%	NS	15-16.5			As above with color dark grayish brown (10 YR 4/2), gravel (mostly quartzite, basalt, and gneiss), v. moist.	
							16--			
LSP0341	1420	19/23/26	3.3/0.9	30%	NS	16.5-18			As above with large chuck of basalt cut with sampler	
							18--			
LSP0342	1425	18/19/23	2.4/0	100%	NS	18-19.5			35% M-C sand, 10% silt, fine to 2" dia. gravel, wet, no odor.	
LSP0343	1430	18/20/24	2.2/0.4	60%	NS	19.5-21				
							20--			
-	-	20/26/26	-	0%	-	21-22.5			Drillers note hard drilling.	
							22--			
-	-	21/24/27	-	0%	-	22.5-24			Drillers note hard drilling.	
							24--			
LSP0344	1440	25/29/32	1.3/0	35%	NS	24-25.5			Recovery mostly pulverized/broken basalt, moist.	
								GC	Clayey sandy gravel, dark yellow brown (10YR 4/4),15-20% coarse sand, 10% clay, fine to 2" gravel (mostly basalt and quartzite).	
LSP0345	1445	32/35/37	2.0/0	85%	NS	25.5-27	26--			
LSP0346	1450	35/37/40	1.3/0.3	60%	NS	27-28.5			As above w/ 15% clay, 10-15% coarse sand, no odor.	
							28--	▼		
									Sandy silty gravel, dark grayish brown (10 YR 4/2), 15% silt,	
LSP0347	1500	30/27/20	1.3/0	80%	NS	28.5-30.2		GM	15% F-C sand, fine to 2" dia. gravel, wet, no odor.	

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649243.97 ft
	Easting:1235071.01 ft
CASING ELEVATION	58.19 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch
(See Page 1)

integral consulting inc.

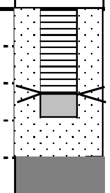
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

WELL NUMBER	SB-23
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 14-15, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 PVC (0.3 to 20.5)
Screen: 2" dia Sch 40 PVC, 0.010" slot (30.2-20.2)
Sump: 2" dia Sch 40 PVC (30.5-30.2)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (16-2)
Annular Fill: Bentonite chips (31.5-31, 18-16, 2-1)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (31-18)

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
							30--		
LSP0348	1505	15/12/15	1.4/0	100%	NS	30.2-31.3		SM	Silty fine sand, brown (10 YR 4/3), 30% silt, moist, no odor.
									abundant clay laminations (~20%).
LSP0349	1530	-	0.7/0	100%		31.3-32.3		CL	Silty clay, dark gy. brown (10 YR 4/2), v. stiff, ~25% silt, moist, no odor
								SM /CL	Interlayered silty fine sand (~30% silt) and silty clay (~30% silt),
LSP0350	1540	-	0.9/0	"	NS	32.3-33.0	32--		grayish brown (10 YR 5/2), moist, no odor.
								ML	Sandy clayey silt, dark gray (Glay 1 4/), 30% clay, 10-20% fine sand,
									moist, no odor. Few fine sand laminations ~0.02' thick.
							34--		
									Borehole drilled to 31.5 ft, sampled to 33 ft.
							36--		
							38--		
							40--		

Well Diagram



Background PID = 0.4 - 0.8 ppm, FID = 0.0 ppm

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649243.97 ft
	Easting:1235071.01 ft
CASING ELEVATION	58.19 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch
(See Page 1)

integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

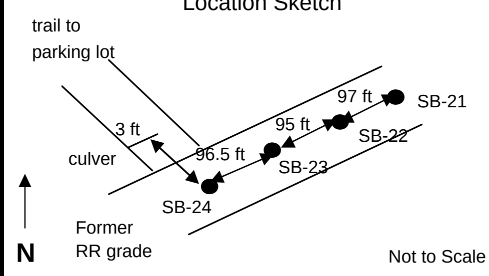
WELL NUMBER	SB-24
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 15, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 PVC (24.7-0.3)
Screen: 2" dia Sch 40 PVC, 0.010" slot (34.7-24.7)
Sump: 2" dia Sch 40 PVC (35-34.7)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (21-1)
Annular Fill: Bentonite chips (36.5-35.5, 23-21)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (35.5-23)

SAMPLE INFORMATION									DESCRIPTION	
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.	Well Diagram
LSP0351	1030	7/8/9	1.4/0	100%	NS	0-0.75		GW	Silty sandy gravel, v. dark grayish brown (10 YR 3/2), 20% silt, 30%	
								ML	F-C sand, moist, no odor (fill).	
LSP0352	1035	"	2.0/0.6	"	NS	0.75-1.5			Clayey silt, dark grayish brown (10 YR 4/2), some orange and	
									gray mottling, 40-50% clay, moist, no odor.	
							2--		Piece of wood 0.1' thick at GW/ML contact.	
							4--			
LSP0353	1040	4/5/6	1.8/0.1	55%	NS	5-6.1			As above w/ color brown (10 YR 4/3), 30% clay, moist, no odor.	
							6--			
LSP0354	1045	"	2.0/0.2	"	NS	6.1-6.5		SM/SP	Slightly silty fine sand, brown (10 YR 4/3), 15% silt, moist, no odor.	
							8--			
							10--			
LSP0355	1050	10/12/15	1.6/0	75%	NS	10-16.5		GW	Silty sandy gravel, dark grayish brown (10 YR 4/2), fine to 1.5" dia.	
									gravel, 30% F-C sand, 20% silt, moist, no odor.	
							12--			
							14--			

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649180.41 ft
	Easting: 1234998.41 ft
CASING ELEVATION	54.94 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



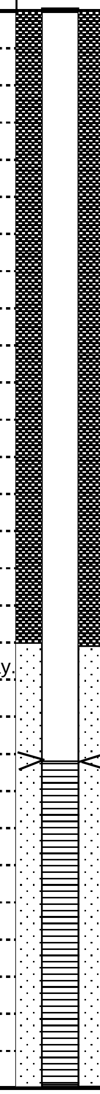
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

WELL NUMBER	SB-24
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 15, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 PVC (24.7-0.3)
Screen: 2" dia Sch 40 PVC, 0.010" slot (34.7-24.7)
Sump: 2" dia Sch 40 PVC (35-34.7)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (21-1)
Annular Fill: Bentonite chips (36.5-35.5, 23-21)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (35.5-23)

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
								GW	
LSP0356	1055	18/20/25	3.1/0	30%	NS	15-16.5			Slightly clayey sand, F-C gravel, brown (7.5 YR 4/2), 10% clay,
							16--		20% M-C sand, v. moist, no odor.
							18--		
							20--		
LSP0357	1105	19/26/30	2.0/0	20%	NS	20.21.5		GC	Sandy clayey gravel, dark grayish brown (10 YR 4/2), 10%
									M-C sand, 15-20% clay, F-1.5" dia. gravel, v. moist, no odor. .
-	-	18/20/26	-	0%	-	21.5-23			
							22--		
LSP0358	1110	19/23/25	1.5/0	25%	NS	23-24.5			As above with color brown (10 YR 4/3), gravel up to 2" dia., 10-15% clay.
							24--		
LSP0359	1115	17/20/23	3.1/0	15%	NS	24.5-26			As above with gravel up to 1.5" dia., v. moist.
							26--		
-	-	12/12/13	-	0%	-	26-27.5			As above with color brown (10 YR 5/3), 15-20% clay, 10% F-C sand,
								▼	F to 2" gravel, wet.
LSP0360	1130	12/14/16	3.0/0	60%	NS	27.5-29	28--		Material appeared to be same as above.

Well Diagram



DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649180.41 ft
	Easting: 1234998.41 ft
CASING ELEVATION	54.94 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch
(See Page 1)

integral consulting inc.

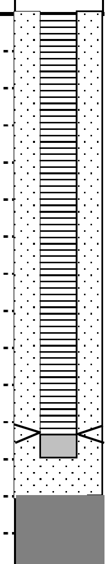
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

WELL NUMBER	SB-24
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 15, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 2" dia Sch 40 PVC (24.7-0.3)
Screen: 2" dia Sch 40 PVC, 0.010" slot (34.7-24.7)
Sump: 2" dia Sch 40 PVC (35-34.7)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (21-1)
Annular Fill: Bentonite chips (36.5-35.5, 23-21)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (35.5-23)

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	PID/FID (PPM)	% Recov.	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0361	1140	13/14/15	3.0/0	25%	NS	29-30.5			
							30--		
LSP0362	1145	10/12/15	2.8/0	35%	NS	30.5-32			
								GW	Clayey sandy fine gravel, brown (10 YR 5/3), 25% M-C sand,
									5-10% clay, wet, no odor.
							32--		
LSP0363	1150	12/13/15	3.2/0	35%	NS	32-33.5			As above with fine to 1" dia. subrounded gravel.
LSP0364	1155	15/16/17	3.0/0	30%	NS	33.5-35	34--	GC	Clayey F-C gravel, grayish brown (10 YR 5/2), 30% clay, no odor, wet.
								CL	Silty clay, gray (10YR 5/1), 25% silt, no odor, wet (description based
									on clay observed on lead auger; contact location based on driller's
LSP0365	1210	15/18/20	2.4/0	20%	NS	35-36.5			observations).
***LSP0366**	1433	-	-	-	-	-			
							36--		Drilled to 35 ft bgs, sampled to 36.5 ft.
***Collected from bottom 2.0 ft of augers**								—	
							38--		
							40--		
Background PID = 0.4 - 0.8 ppm, FID = 0.0 ppm									

Well Diagram



DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	CMF 75 HSA Rig, 4.25" ID x 8" OD augers
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames & Moore
COORDINATES	Northing: 649180.41 ft
	Easting: 1234998.41 ft
CASING ELEVATION	54.94 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch
(See Page 1)

integral consulting inc.

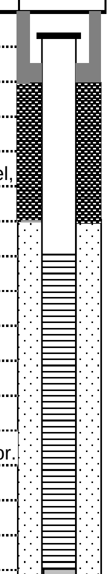
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-25
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 4, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (3.5-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (8-3.5)
Sump: 1" dia Sch 80 PVC (8.1-8)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (3.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (8.1-3)

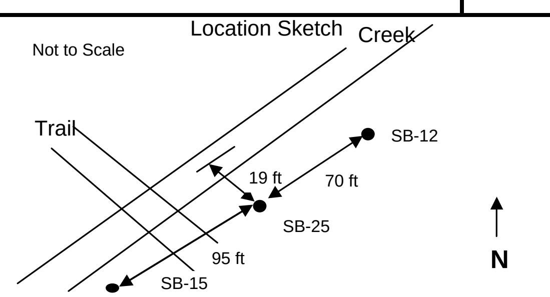
SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION
Sample ID	Time	Blow Counts	% Recov.	PID/FID	Sheen	Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0382	1005	6/5	50%	0/0	NS	0-1		ML	Gravelly sandy silt, v. dark grayish brown (10 YR 3/2), 30% sand fine to 2" dia.
LSP0451	0915	(Hand auger, 06-Apr-06)				0-1			gravel, trace roots, moist, no odor.
LSP0383	1010	9/30	60%	0/0	NS	1-2			As above with 30% gravel.
LSP0452	0920	(Hand auger, 06-Apr-06)				1-2	2--		Thin silty clay layer (~0.05 in thick), at bottom of sampler, dark gray (10 YR 4/1).
LSP0384	1025	25/47	10%	0/0	NS	2-3		GM	Silty fine gravel, dark gray (10 YR 3/1), 40% silt, 10% sand, fine to 0.5" dia. gravel,
									no odor.
LSP0385	1030	21/28	50%	0/0	NS	3-4		GW	Silty sandy gravel, dark gray (10 YR 4/1), 30% fine to med. sand, 15-20% silt,
							4--		fine to 2" dia. gravel, v. moist to wet, no odor.
LSP0386	1035	14/20	75%	0/0	LS	4-5		SM	Silty fine to med. sand, dark grayish brown (2.5 Y 4/2), 10-20% silt, grayish
									layer (same SM) at 3.9 ft bgs with light sheen and moderate creosole-like odor.
LSP0387	1045	5/19	100%	0/3.4	NS	5-6			5- 6 ft as above with color olive brown (2.5 Y 4/3), weak creosote-like odor, wet.
							6--		
LSP0388	1100	7/16	80%	0/0	LS	6-6.6		SP	As above, v. dark gray brown (2.5 Y 3/2), 5% silt, trace of spotty sheen, mod. odor.
LSP0389	1105	"	"	"	"	6.6-7		SM	Silty sand (as above) with indistinct creosote-like odor.
LSP0390	1110	6/6	70%	0/0	NS	7-7.8		SP	Fine to medium sand, dark gray (2.5 Y 4/1), 5-10% silt, indistinct creosote-like
LSP0391	1115	"	"	"	"	7.8-8	8--		odor, wet.
LSP0392	1120	5	100%	0/1.4	NS	8-8.5		CL	Silty clay, dark gray (2.5 Y 4/1), v. stiff, moist, no odor. Fine sandy clay zone
									7.9 - 8.0 ft bgs.
							10--		Drilled to 8 ft bgs, sampled to 8.5 ft bgs.
							12--		
Background PID= 0.0 ppm, FID=0 ppm									
							14--		

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 649018.56 ft
	Easting: 1234946.99 ft
CASING ELEVATION	27.83 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



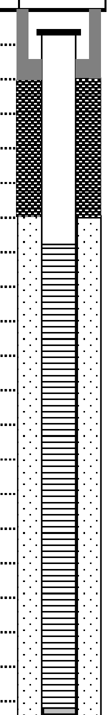
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296   FAX (360) 756-7914

PIEZOMETER NUMBER	SB-26
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 4, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (3.4-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (10.1-3.4)
Sump: 1" dia Sch 80 PVC (10.2-10.1)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (3.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (10.3-3)

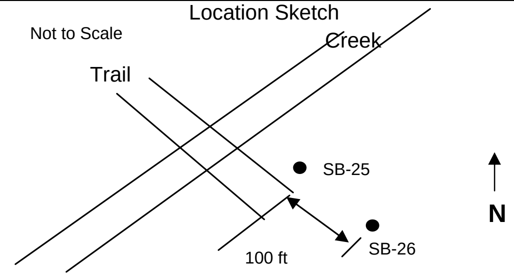
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recov.	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0393	1320	5/8	70%	0/0	NS	0-1		ML	Sandy silty w/ gravel, dark grayish brown (10 YR 4/2), 30% fine to med. sand,
LSP0453	0930	(Hand auger, 06-Apr-06)				0-1			15% fine to 1" dia. gravel, trace roots, no odor.
LSP0394	1325	15/15	60%	0/0	NS	1-2		SW	Gravely medium sand, dark yellow brown (10 YR 3/4), 20-25% fine to 1" dia.
LSP0454	0940	(Hand auger, 06-Apr-06)				1-2			gravel, some coarse sand, no odor, v. moist.
LSP0455	0945	(Hand auger, duplicate)				1-2	2--	SP	Medium sand, v. dark grayish brown (2.5 Y 3/2), trace silt and coarse sand,
LSP0395	1330	9/15	60%	0/0	NS	2-3			v. moist, no odor.
LSP0396	1335	13/17	95%	0/0	NS	3-4		SM	Silty fine to med. sand, brown (10 YR 4/3), 30% silt, no odor, wet at 3.5 ft bgs.
							4--		
LSP0397	1355	15/21	75%	0/0.4	NS	4-5		SP	Medium sand, brown (10 YR 4/3), 5-10% silt, wet, no odor.
LSP0398	1400	11/16	90%	0/0	NS	5-5.6			
LSP0399	1405	"	"		NS	5.6-6	6--	SM	Silty fine sand, brown (10 YR 5/3), 30-40% silt, v. moist to wet, no odor.
LSP0400	1410	11/21	90%	0/0	NS	6-6.6		SP	Medium sand (as above) grading to fine sand at 6.5 ft.
LSP0401	1415	"	"	"	NS	6.6-7			Sandy clay laminations, brown (10 YR 4/3), 6.5-6.7 ft bgs.
LSP0402	1425	15/20	90%	0/0	NS	7-8			As above w/ 10-15% silt.
							8--		As above with color dark grayish brown (10 YR 4/2).
LSP0403	1430	6/14	60%	0/0	NS	8-9			As above with fine to med. sand, 5-10% silt.
LSP0404	1435	13/14	80%	0/0	NS	9-10			As above with increasing fine sand content w/ depth.
							10--		
LSP0405	1440	4/13	70%	0/0	NS	10-10.8		CL	Silty clay, dark gray (Glay 1 4/), 30% silt, moderately stiff, moist, no odor.
LSP0406	1445	"	"	"	NS	10.8-11		SM	Silty fine sand, dark gray (Glay 1 4/1), 20% silt, wet, no odor.
							12--		Drilled to 10.3 ft bgs, sampled to 11.0 ft bgs.
Background PID= 0.0 ppm, FID=0 ppm									
							14--		

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 648928.31 ft
	Easting: 1234984.30 ft
CASING ELEVATION	28.22 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



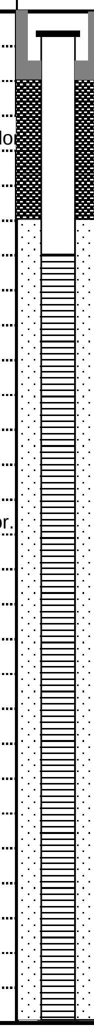
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-27
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 4-5, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (3.5-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (20.6-3.5)
Sump: 1" dia Sch 80 PVC (20.7-20.6)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (3.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (20.6-3)

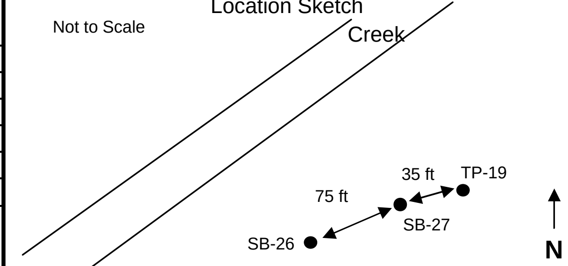
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recov.	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0407	1640	-	90%	0/0	NS	0-1		ML	Gravelly sandy silt, dark grayish brown (10 YR 4/2), trace roots, 25%
LSP0456	1000	(Hand auger, 06-Apr-06)				0-1			fine to 1" dia. gravel, 30% fine to med. sand, v. moist, no odor.
LSP0408	1645	10/18	100%	0/0	NS	1-1.7			As above with increased sand content, gravel to 1.5" dia.
LSP0409	1650	"	"	"	NS	1.7-2	2--	SM	Silty fine to med. sand, brown (10YR 4/3), 30% silt, trace fine gravel, moist, no odo
LSP0457	1010	(Hand auger, 06-Apr-06)				1-2		SP	Fine sand, brown (10 YR 4/3), ~5% silt, v. moist, no odor.
LSP0410	1655	13/19	80%	0/0	NS	2-3			
LSP0411	1700	14/15	90%	0/0	NS	3-3.4		SM	Silty fine sand, dark yellow brown (10 YR 4/4), 30% silt, no odor.
LSP0412	1705	"	"	"	NS	3.4-4		▼	As above with fine to med. sand, dark grayish brown (10 YR 4/2), 15% silt.
LSP0413	0755	10/13	80%	2.3/1.3	NS	4-5	4--	SP	Fine sand, dark grayish brown (10 YR 4/2), 10% silt, wet, no odor.
LSP0414	0800	10/13	90%	1.8/2.1	NS	5-6			As above with w/2 thin orange bands at 5.5' bgs, 10-15% silt.
							6--		
LSP0415	0805	18/23	80%	3.3/0	NS	6-7			As above with color dark yellow brown (10 YR 3/4), 15% silt.
LSP0416	0810	8/12	100%	2.8/0	NS	7-8			As above with color dark gray (Glay 1 4/), silt content decreasing w/depth, no odor.
							8--		
LSP0417	0815	12/15	80%	1.1/0	NS	8-8.5			
LSP0418	0820	"	"	"	NS	8.5-9		SM	Silty fine sand, dark gray (7.5 YR 4/1), 25% silt, wet, no odor.
LSP0419	0835	9/11	40%	0/0	NS	9-10			As above with few silt laminations (~0.01 in thick) at 9.8 ft bgs.
							10--		
LSP0420	0840	7/11	70%	1.0/0	NS	10-11		SP	Fine sand, dark gray (7.5 4/1), 10-15% silt, wet, no odor.
LSP0421	0855	14/17	80%	0.1/0	NS	11-12			As above w/ color dark gray (2.5 Y 4/1), 15% silt, trace of wood debris.
							12--		As above w/ no wood.
LSP0422	0920	9/16	90%	0/0	NS	12-13			
									As above w/ 10-15% silt.
LSP0423	0925	7/17	80%	3.2/1.6	NS	13-14			
							14--		As above with fine to med. sand.
LSP0424	0930	13/18	95%	0/0	NS	14-15			Drillers note heaving sand (~4 ft) in augers.

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 648982.25 ft
	Easting: 1235038.62 ft
CASING ELEVATION	28.91 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



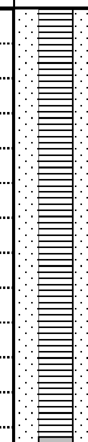
PIEZOMETER NUMBER	SB-27
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 4-5, 2006

integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (3.5-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (20.6-3.5)
Sump: 1" dia Sch 80 PVC (20.7-20.6)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (3.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (20.6-3)

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recov.	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
								SP	As above.
LSP0425	1045	8/15	90%	-	NS	15-16			
							16--		
LSP0426	1100	7/9	100%	0/0	NS	16-17			As above w/ 10% silt.
LSP0427	1105	5/4	100%	0/0	NS	17-18			
							18--		
LSP0428	1110	5/11	100%	1.1/0	NS	18-18.5			
LSP0429	1115	"	"	"	NS	18.5-19			Clay laminations at 18.5-18.6 and 18.75-18.85 ft bgs.
LSP0430	1130	6/7	65%	0.8/0	NS	19-20		SM	Silty fine sand, dark gray (2.5 Y 4/1), 20-25% silt, numerous clay laminations
							20--		less than 0.01' thick, no odor.
LSP0431	1205	6/3	90%	0.3/0.6	NS	20.20.5			As above with no clay laminations.
LSP0432	1210	"	"	"	NS	20.5-21		CL	Silty clay, dark gray (2.5 4/1), v. stiff, moist, no odor.
LSP0433	1225	5/12	60%	1.5/1.8	NS	21-22		SM	Silty fine sand, dark yellow brown (10 YR 4/4), 30% silt, wet, no odor.
							22--		Silt content ~15% at 22 ft bgs.
LSP0434	1235	5/7	75%	1.5/0.1	NS	22-23		SP	Med. sand, brown (10 YR 4/3), 5% silt, loose, wet, no odor.
								—	
									Borehole terminated at 23 ft bgs.
							24--		
							26--		
							28--		

Well Diagram



Background PID= 0.0-0.5 ppm, FID=0 ppm

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 648982.25 ft
	Easting: 1235038.62 ft
CASING ELEVATION	28.91 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch
(See sheet 1)

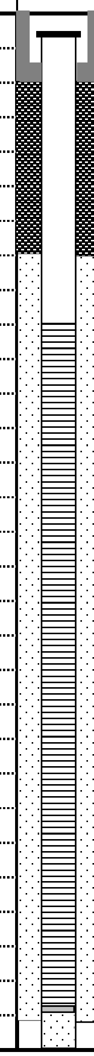
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-28
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 5-6, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (4.5-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (14.4-4.5)
Sump: 1" dia Sch 80 PVC (14.5-14.4)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (3.5-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (14.6-3.5)

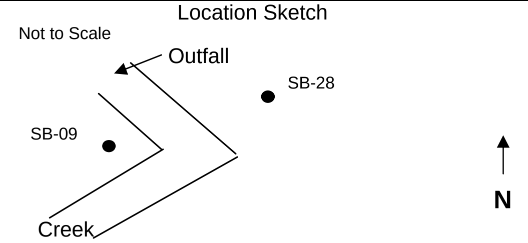
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recov.	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0435	1600	4/5	100%	0/0	NS	0-1		ML	Silt, v. dark grayish brown (10 YR 3/3), trace of sand and roots, no odor, moist.
LSP0436	1605	4/6	70%	0/0	NS	1-2			Grading to clayey silt below 1.5' bgs, brown (7.5 YR 4/2), 30% clay, few pieces
							2--		of gravel, moist, no odor.
LSP0437	1610	5/6	70%	0/0	NS	2-3			As above with 2-5% fine gravel, ~5% fine to coarse sand, trace orange mottling,
									moist, no odor.
LSP0438	1615	3/5	60%	0/0	NS	3-4			As above with 10% fine to med. sand, few roots.
							4--		
LSP0439	1620	3/4	80%	0/0	NS	4-5			As above with color dark brown (7.5 YR 3/2), decreased clay content (~20%),
									moist to v. moist.
LSP0440	1625	4/4	70%	0/1.4	NS	5-6			Clayey sandy silt, dark brown (7.5 YR 3/2), 15-20% fine to med. sand,
							6--		15% clay, few pieces of fine gravel, v. moist, no odor.
LSP0441	1635	2/3	90%	0/0	NS	6-7		▼	Layered silty clay with organics and silty fine to med. and, brown (7.5 YR 4/2),
									some orange mottling, trace coarse sand, wet at 6.5' bgs, no odor (fill).
LSP0442	1640	9/9	50%	2.4/0	NS	7-8		GM	Sandy silty gravel, dark grayish brown (10 YR 4/2), 35% silt, 20% F-M sand,
							8--		fine to 1.5" dia. gravel (subrounded to rounded), wet, no odor.
LSP0443	1650	6/9	25%	0/0	NS	8-9			As above with 20% silt, 15% F-M sand.
LSP0444	1655	3/4	30%	0/0	NS	9-10			As above with 30% silt, 20% fine to med. Sand, gravel up to 2" dia.
							10--		
LSP0445	1700	3/3	50%	0.1/0	NS	10-11			
LSP0446	1710	8/17	100%	0/0	NS	11-12		SW	Gravelly fine to coarse sand, v. dark gray (10 YR 3/1), 25-30%, F-1" dia.
							12--		gravel, 10% organics, 10% silt, wet, indistinct odor.
LSP0447	0800	22/15	10%	-	NS	12-13			
									As above with color v. dark gray (7.5 YR 3/1), no organics.
LSP0448	0805	13/5	10%	1.1/0	NS	13-14			
							14--		
LSP0449	0810	2/3	100%	3/0	NS	14-14.3		CL	Silty clay, dark gray (7.5 YR 4/1), thin fine sand laminations 14.3-14.6' bgs,
LSP0450	0815	"	"	"	NS	14.3-15			mod. stiff, med. plasticity, no odor. Drilled to 14.6 ft, sampled to 15 ft bgs.

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 649279.36 ft
	Easting: 1235211.12 ft
CASING ELEVATION	39.74 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



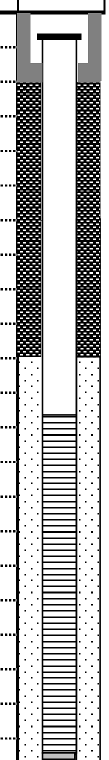
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-29
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 6, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (5.8-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (10.7-5.8)
Sump: 1" dia Sch 80 PVC (10.8-10.7)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (5.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (10.9-5)

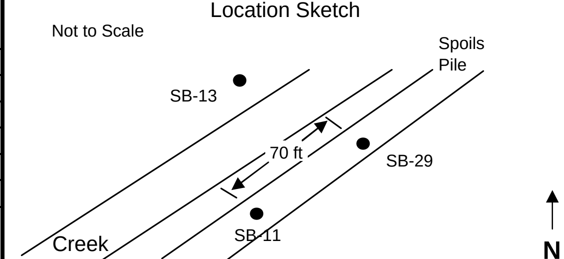
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recov.	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0458	1055	2/2	85%	0/0	NS	0-1		ML	Slightly gravelly silt, v. dark grayish brown (10 YR 3/2), 5% fine gravel,
									trace sand, some roots, moist, no odor.
LSP0459	1100	3/4	65%	0/0	NS	1-2			As above with 10% fine to 1.5" dia. gravel.
							2--		
LSP0460	1105	4/6	70%	0/0	NS	2-2.5			As above with 30% fine to 1" dia. gravel, 25% sand.
LSP0461	1110	4/6	70%	0/0	NS	2.5-3		CL	Silty clay, v. dark grayish brown (10 YR 3/2), some orange mottling, trace
LSP0462	1115	3/5	60%	1.0/0	NS	3-4			black organics, moist, no odor.
							4--		As above with trace of wood.
LSP0463	1120	3/4	50%	0/0	NS	4-5			As above with no wood, dark grayish brown (10 YR 4/2).
									As above with ~20% F-M sand, moist, no odor.
LSP0464	1125	5/7	70%	0.4/0	NS	5-5.5		ML	Sandy silt, dark grayish brown (10 YR 4/2), 25% F-M sand, moist, no odor.
LSP0465	1130	"	"	"	NS	5.5-6		SM	Gravelly silty sand, v. dk. gy. brown (10 YR 3/2), 15% gravel, 35% silt, no odor.
LSP0466	1135	9/7	65%	0/0	NS	6-6.7	6--	GW	Sandy gravel, v. dark grayish brown , 30% F-C sand, wet at 6.5' bgs, no odor.
LSP0467	1140	"	"	"	SH	6.7-7		SM	Silty F-M sand, black (Glay 1 2.5/), 20% silt, moderate petroleum odor, heavy
LSP0468	1145	3/3	90%	0.4/0	SH	7-7.3		ML/	sheen, wet.
LSP0469	1150	"	"	-	NS	7.3-8		SM	Interlayered clayey silt and silty fine sand (mostly silt), v. dark gray brown
LSP0470	1210	6/4	60%	1.2/0	NS	8-8.7	8--		(10 YR 3/2), 40% silt in fine sand, 20% clay in silt, moist, no odor.
LSP0471	1215	"	"	-	SH	8.7-9		SM	Silty F-M sand, black (Glay 1 2.5/), heavy sheen, strong creosote-like odor, wet.
LSP0472	1230	5/10	80%	0/0	SH	9-9.6		CL	Sandy clay, v. dark green gray (Glay 1 3/1), 25% fine sand, mod. heavy sheen,
LSP0473	1235	"	"	2.8/0	SH	9.6-10		SM	strong creosote-like odor.
LSP0474	1240	4/4	70%	7.5/2.8	SH	10-10.6	10--		Silty fine sand, v. dark gray (Glay 1 3/), light sheen, strong creosote-like odor.
LSP0475	1245	"	"	2.4/4.8	NS	10.6-11		CL	Clay: dark gray (Glay 1 4/), v. stiff, medium-high plasticity, strong odor (possibly
									from overlying silty sand), wet.
							12--		
									Borehole terminated at 11 ft bgs.
							14--		

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 649172.54 ft
	Easting: 1235111.51 ft
CASING ELEVATION	35.48 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



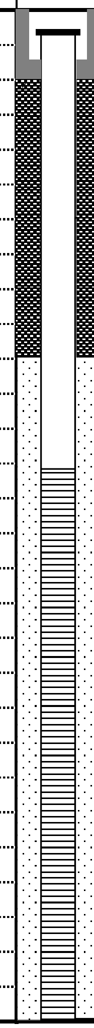
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-30
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 6-7, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (6.6-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (16.5-6.6)
Sump: 1" dia Sch 80 PVC (16.6-16.5)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (5.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (16.6-5)

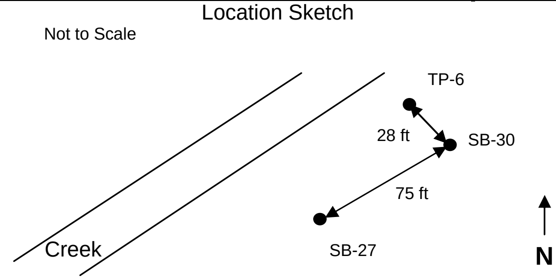
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recov.	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
-	-	3/6	60%	1.8/0	NS	0-1		ML	Gravelly sandy silt, v. dark grayish brown (10 YR 3/2), 25% fine to med.
LSP0492	0830	(Hand auger, 07-Apr-06)				0-1			sand, 10-15% fine to 1" dia. gravel, trace roots, moist, no odor.
LSP0493	0835	(Hand auger dup, 07-Apr-06				0-1			Mostly roots/wood in 1-2' bgs sample.
-	-	18/38	30%	0/0	NS	1-2			
LSP0494	0840	(Hand auger, 07-Apr-06)				1-2	2--	GM	Silty F-C gravel, brown (7.5 YR 4/2), 30% silt, 15% sand, moist, no odor.
LSP0476	1540	8/8	60%	1.2/0	NS	2-2.5		SM	Gravelly silty med. sand, brown (10 YR 4/3), 25% silt, 15% fine gravel, no odor.
LSP0477	1545	"	"	-	NS	2.5-3			Silty fine sand, dark gray brown (10 YR 4/2), 15% silt, wet, no odor.
LSP0478	1550	9/13	75%	2.1/0.1	NS	3-4			Silty rich laminations 3.6 - 3.7 ft.
LSP0479	1555	9/8	80%	4/1.5	NS	4-5	4--		As above with color brown (10 YR 4/3), 20-25% silt contend descreasing w/depth
LSP0480	1600	6/12	75%	1.2/0	NS	5-6			As above with 15% silt, v. moist to wet, no odor.
LSP0481	1605	8/11	70%	0	NS	6-7	6--	SP	Fine sand, dark gray (7.5 YR 4/1), 10% silt, wet, no odor.
LSP0482	1610	6/7	70%	3.3/0	NS	7-8			As above with trace carbonized wood.
LSP0483	1620	8/13	70%	2.4/0	NS	8-8.4	8--		As above with silty clay laminations at 8.1 ft (0.1' thick), and 8.3 ft (0.05' thick),
LSP0484	1625	"	"	3.3/0	NS	8.4-9			dark gray (10 YR 4/1).
LSP0485	1630	8/12	80%	3.9/0	NS	9-10			As above with 15% silt.
									As above with trace wood debris at 9.5', silt rich zone (~25% silt), 9.8 - 9.9' bgs.
LSP0486	1635	9/10	70%	2.1/0	NS	10-11	10--		
LSP0487	1655	8/13	85%		NS	11-12			As above w/color V. dark gray (10YR 3/1).
LSP0488	1715	8/11	75%	2.2/0	NS	12-13	12--		
LSP0489	1725	7/10	90%	1.3/0	NS	13-14			
LSP0490	0800	13/17	85%	0.7/0	NS	14-15	14--		As above with 5-10% silt.

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 649011.36 ft
	Easting: 1235106.93 ft
CASING ELEVATION	30.49 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-30
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 6-7, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (6.6-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (16.5-6.6)
Sump: 1" dia Sch 80 PVC (16.6-16.5)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (5.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (16.6-5)

SAMPLE INFORMATION									DESCRIPTION	
Sample ID	Time	Blow Counts	% Recov.	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.	Well Diagram
								SP		
LSP0491	0810	6/12	45%	1.0/0	NS	15-16				
							16--		As above, no odor.	
LSP0495	0855	2.8/0	100%	-	NS	16-16.4				
LSP0496	0905	2.0/1.9	100%	-	NS	16.4-16.9		CL	Silty clay, dark gray (Glay 1 4/), mod. stiff, med. plasticity, moist, no odor.	
LSP0497	0910	1.9/0	100%	-	NS	16.9-17			Silty fine sand (16.9-17.0 ft bgs), dark gray (Glay 1 4/), 25% silt, wet, no odor.	
									Drilled to 16.8 ft, sampled to 17 ft bgs.	
							18--			
							20--			
							22--			
							24--			
							26--			
							28--			

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 649011.36 ft
	Easting: 1235106.93 ft
CASING ELEVATION	30.49 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch
(See sheet 1)

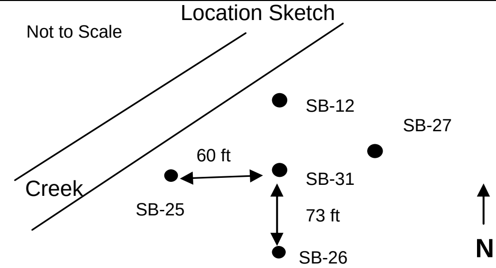
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-31
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 7, 2006

SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0498	1100	(Hand auger, 07-Apr-06)				0-0.9		ML	Clayey silt, v. dark grayish brown (10 YR 3/2), trace sand, 30% clay, wet, no odor.
LSP0499	1105	(Hand auger dup, 07-Apr-06)				0-0.9		GW	Sandy gravel, v. dk. gray brown (10 YR 3/2), 30% F-M sand, 15% silt, moist, no odor.
LSP0500	1135	7/23	100%	1.1/0	NS	0-1		GM	Silty gravel, dark grayish brown (10 YR 4/2), 35% silt, 5% sand, trace of wood,
LSP0501	1145	24/31	70%	0.3/0	NS	1-2			moist, no odor.
LSP0502	1155	19/22	50%	0.3/0	NS	2-3	2--		
LSP0503	1200	19/16	70%	2.1/0	NS	3-3.8			As above with 40% silt, moderate petroleum odor 3-3.8' bgs.
LSP0504	1205	"	"	4.1/3.2	NS	3.8-4		▼	
LSP0505	1210	13/16	100%	3.2/0	NS	4-4.5	4--	SM	Silty fine sand, dark gray brown (2.5 Y 4/2), 15-20% silt, wet, slight petroleum odor.
LSP0506	1215	"	"	0.9/0	NS	4.5-5			As above, olive brown (2.5Y 4/3), 30% silt, laminations of clay 4.25-5' bgs, no odor.
LSP0507	1225	11/14	80%	2.5/0	NS	5-6		SP	Fine sand, dark grayish brown (2.5Y 4/2), 15% silt, some orange bands, wet, no odor.
LSP0508	1230	8/12	65%	0.7/0	NS	6-7	6--		
									As above with no orange bands.
LSP0509	1235	6/14	95%	1.7/0	NS	7-8			As above with color dark gray brown (2.5 Y 4/2).
									As above with strong creosote-like odor, heavy sheen, few drips of brown NAPL
LSP0510	1310	14/16	100%	0.9/0	HS	8-9	8--		observed on bottom of sampler.
LSP0511	1320	7/7	75%	1.9/0	HS	9-9.6			Silty fine sand, v. dark grayish brown (10 YR 3/2), 20-25% silt, strong petroleum odor,
LSP0512	1325	"	"	3.3/0	HS	9.6-10		SM	heavy irridescent sheen, wet.
LSP0513	1330	12/15	70%	1.8/0	HS	10-10.2	10--	SP	Silty clay lamination (0.08 ft thick) at 10.1 ft, v. dark gray (10 YR 3/1).
LSP0514	1335	"	"	0.1/0	NS	10.2-11			Fine sand, v. dark gray (10 YR 3/1), 5-10% silt, no sheen, indistinct odor.
LSP0515	1350	5/5	50%	3.3/0	NS	11-12			
									As above w/ weak odor (sheen observed, but only appears to be present in sluff)
LSP0516	1405	7/10	60%	3.2/0	NS	12-13	12--		As above, no apparent sheen on sample, weak creosote-like odor, 10-15% silt.
LSP0517	1415	4/7	60%	3.1/0	NS	13-14			
LSP0518	1420	11/14	100%	2.1/0	NS?	14-15	14--		As above with moderately strong creosote-like odor.

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 648999.45 ft
	Easting: 1234989.64 ft
SURFACE ELEVATION	28.14 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAD 88

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225

(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-31
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 7, 2006

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
								SP	As above, moderately strong to strong creosote-like odor, 5-10% silt.
LSP0519	1430	3/5	40%	-	N	15-16			silt.
							16--	—	Borehole terminated at 16 ft bgs.
									Heaving sand (~4 ft in augers) at 16 ft bgs.
							18--		
							20--		
							22--		
							24--		
							26--		
							28--		

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 648999.45 ft Easting: 1234989.64 ft
SURFACE ELEVATION	28.14 ft
DATUMS	Horizontal: NAD 83/91 Vertical: NAVD 88

Location Sketch
(See sheet 1)

integral consulting inc.

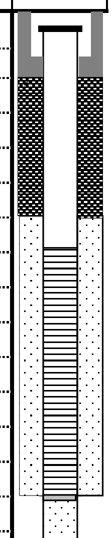
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

PIEZOMETER NUMBER	SB-32
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 8, 2006

WELL CONSTRUCTION DETAILS (depths are ft bgs)
Blank Casing: 1" dia Sch 80 PVC (3.4-0.3)
Screen: 1" dia Sch 80 PVC, 0.010" slot (7-3.4)
Sump: 1" dia Sch 80 PVC (7.1-7)
Annular Fill: Surface Seal: Concrete (1.0-0.0)
Annular Fill: Bentonite grout (NA)
Annular Fill: Filter Pack Seal: Bentonite chips (3.0-1.0)
Annular Fill: Filter Pack: #10/20 Colorado silica sand (7.8-3)

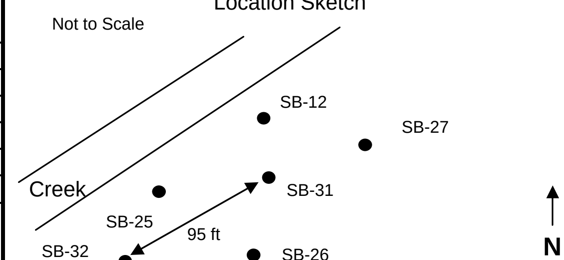
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recov.	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0520	0755	7/8	75%	2.9/0	NS	0-1		ML	Sandy silt, dark grayish brown (10 YR 4/2), 30% F-M sand, v. moist, no odor.
								GW	Sandy fine gravel, brown (10 YR 4/3), 40% M-C sand, 15% silt, trace gravel,
LSP0521	0800	14/15	60%	3.8/0	NS	1-2			v. moist, no odor.
								▼	As above with 30% M-C sand, 5-10% silt.
LSP0522	0810	14/14	60%	4.5/0.9	NS	2-3	2--		
									As above, fine to 3/4" dia. gravel.
LSP0523	0815	8/6	75%	7.1/1.1	NS	3-3.5			
LSP0524	0820	"	"	6.7/0	NS	3.5-4		SM	Silty fine sand, dark grayish brown (10 YR 4/2), 20% silt, wet, no odor.
LSP0525	0830	3/4	60%	5.7/0	NS	4-5	4--		As above with decreased silt content (~15%), 1/2" thick piece of wood at 4.7'
									bgs, trace carbonized wood.
LSP0526	0840	2/7	100%	5.2/0	NS	5-5.7			As above with 15-20% silt, trace gravel.
LSP0527	0845	"	"	5.5/0.2	NS	5.7-6			
LSP0528	0850	5/3	65%	5.5/0	NS	6-6.8	6--	SP	Fine sand, dark gray (7.5 YR 4/1), 10% silt, trace of wood debris, wet, no odor.
LSP0529	0855	"	"	7.2/0	NS	6.8-7		CL	
LSP0530	0900	4	100%	8.4/0	NS	7-7.8			Silty clay, dark gray (Glay 1 4/1), moderately stiff, med. plasticity, no odor.
									As above with fine sandy zone 7.1 - 7.2 ft bgs.
							8--		
									Drilled to 7.0 ft, sampled to 7.8 ft bgs.
							10--		
							12--		
Background PID= 3.0 ppm, FID=0.0 ppm									
							14--		

Well Diagram



DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 648943.02 ft
	Easting: 1234918.35 ft
CASING ELEVATION	26.95 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

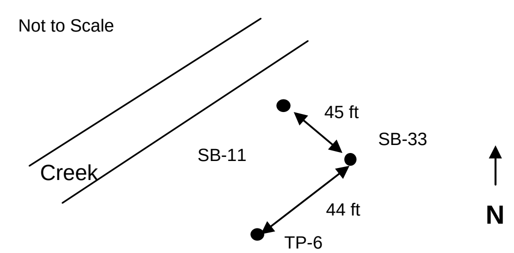
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296   FAX (360) 756-7914

BOREHOLE NUMBER	SB-33
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	April 8, 2006

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
-	-	12/14	65%	0/1.5	-	0-1		GM	Sandy silty gravel, v. dark grayish brown (10 YR 3/3), 30% silt, 20% fine sand,
LSP0531	1015	14/16	70%	0/0	N	1-1.3			fine to 2" dia. gravel, moist, no odor. Silt content 15% below 0.5 ft bgs.
LSP0532	1020	"	"	0.8/0	N	1.3-2		ML	Sandy silt, v. dark grayish brown (10 YR 3/2), 20-30% fine sand, trace of wood,
									some orange banding, slight petroleum odor.
							2--		
LSP0533	1025	10/10	70%	0/0	N	2-3			As above with 30-40% fine sand, dark gray (10YR 4/1), trace of carbonized wood,
									moderately strong creosote-like odor.
LSP0534	1030	3/5	80%	0/7.8	N	3-4			Clayey silt, v. dark gray (10 YR 3/1), 10% wood and carbonized organics,
									trace fine gravel, mod. creosote-like odor, moist.
							4--		
LSP0535	1035	4/24	100%	0/7.3	N	4-4.4			As above w/color v. dark grayish brown (10 YR 3/2), no clay, slight creosote-like odor.
LSP0537	1040	"	"	0/0	N	4.4-4.9		CL	Silty clay, v. dark gray (10 YR 3/1), 2-5% black organics, mod to v. stiiff, slightly plastic
LSP0536	1037	"	"	0/16	N	4.9-5		▼ SM	Gravely silty F-M sand, dark gray (7.5 YR 4/1), 10% gravel, 25% silt, slight
LSP0538	1105	13/14	100%	0/2.3	N	5-5.3			creosote-like odor, wet.
LSP0539	1110	"	"	0/12.4	N	5.3-6	6--	GW	Sandy fine to 1" dia. gravel, dark gray (7.5 YR 4/1), 35% M-C sand, slight
LSP0540	1115	41/20	45%	0/0	N	6-7			creosote-like odor, wet.
LSP0541	1120	18/11	40%	0/0	N	7-8			As above with 40% M-C sand, subrounded gravel, indistinct creosote-like odor.
							8--		
LSP0542	1125	15/10	40%	0/1.8	N	8-9			As above with no odor.
LSP0543	1130	3/7	50%	0/0.5	N	9-9.2		SC	Clayey fine sand (9-9.2' bgs), dark gray (Glay 1 4/), 40% clay, wet, no odor.
LSP0544	1135	"	"	-	N	9.2-10		CL	Silty clay, dark gray (Glay 1 4/), mod. stiff and plastic, no odor.
							10--		
									Borehole drilled to 9 ft, sampled to 10 ft bgs.
							12--		
							14--		

DRILLING CONTRACTOR	Boretec, Inc.
DRILLING METHOD	Track HSA Rig, 3.25" ID x 6.5" OD augers
SAMPLING EQUIPMENT	18" long x 3" dia. California Modified
COORDINATES	Northing: 649079.08 ft
	Easting: 1235090.65 ft
SURFACE ELEVATION	30.94 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225

(360) 756-9296 FAX (360) 756-7914

CORE NUMBER	SB-34
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 11, 2006

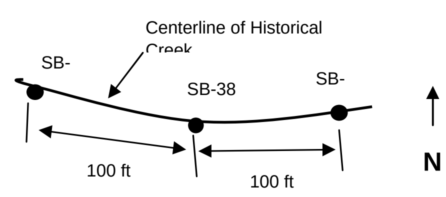
SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION
Sample ID	Time			PID/FID	Sheen	Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0555	0945			3.3/30.3	NS	0-1.1		ML/ CL	Sandy silt/clay, black (7.5YR 2.5/1), ~40% F-M sand, 60% fines, medium plasticity, ~20% rootlets, wet, no odor.
							1--		
									Silty/sandy gravel (50/35/15), dark grayish brown (2.5 Y 4/2), subrounded to subangular gravel up to 2.25" long, no odor (based on sample collected from bottom of boring).
							2--		Refusal at 1.5' bgs.
									No standing water at station.
									Drive length: 1.5'
							3--		Recovered length: 1.1'
							4--		
							5--		
							6--		

Background PID = 0.2 ppm, FID = 0.0 ppm.

CORING METHOD	Portable Vibracore
SAMPLING EQUIPMENT	48" long x 4" dia. CAB Lined Alum. Tubes
COORDINATES	Northing: 648756.84 ft
	Easting: 1234985.76 ft
SURFACE ELEVATION	26.01 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch

Not to Scale



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

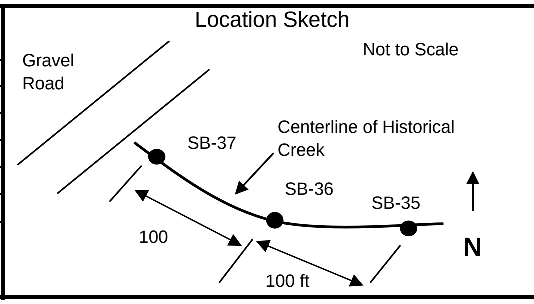
CORE NUMBER	SB-35
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 10, 2006

Sample ID	Time			PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION: USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0545	1400			2.9/0.0	NS	0-1		SM	Silty sand, dark brown (7.5YR 3/2), 80% fine sand, 20% fines, minor clay component,
									low to medium plasticity, few rootlets and plant debris, damp, no odor.
							1--		
LSP0546	1405			6.1/0.0	NS	1-1.8			Intebedded sandy clay (0.1 inches thick) and silty sand to 1.2' to 1.6' bgs.
									trace fines to 1.8'. Sandy clay (7.5 YR 5/1), silty sand brown (2.5 YR 4/2), no odor.
LSP0547	1410			3.9/45	NS	1.8-3.2		ML	Silt w/sand, v. dark gray (2.5Y 3/1), trace fine sand, few rootlets and plant debris,
							2--		medium plasticity, moist, mild H2S odor.
									As above with increasing sand content with depth.
									As above with trace coarse sand and fine gravel.
							3--		
								—	Drive length: 4'
									Recovered length: 3.2'
							4--		No standing water at station.
							5--		
							6--		

Background PID = 0.5 ppm, FID = 0.0 ppm.

CORING METHOD	Portable Vibracore
SAMPLING EQUIPMENT	48" long x 4" dia. CAB Lined Alum. Tubes
COORDINATES	Northing: 648759.18 ft
	Easting: 1234894.85 ft
SURFACE ELEVATION	25.91 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

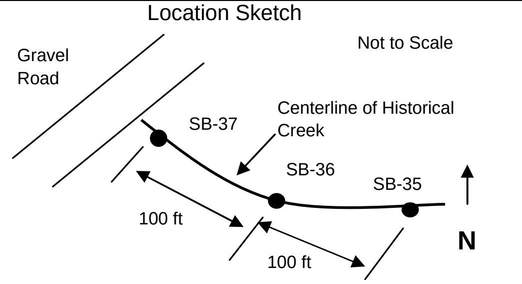
CORE NUMBER	SB-36
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 10, 2006

Sample ID	Time			PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION: USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0548	1530			4.4/23.4	NS	0-0.8		SM	Silty sand, dark grayish brown (10 YR 3/2), ~70% fine sand, ~30% fines, clayey lenses 0-0.3' bgs, trace rootlets, wet, no odor.
LSP0549	1535			5.2/2.2	NS	0.8-1.8	1--	SP	Fine to med. sand, dark gray (Gley 1 4/), trace fines and coarse sand, trace fine gravel, yellowish red mottling (5 YR 5/8) in root burrows, wet, no odor.
LSP0550	1540			3.7/27.2	NS	1.8-2.6	2--		As above with no mottling, laminae of v. fine sand (0.1-0.3' thick) below 2.2' bgs, clay lamination 0.02' thick at SP/OM contact.
LSP0551	1545			2.2/61	NS	2.6-3.5	3--	OM	Silty peat, black (5YR 2.5/1), moderate to low density, wood fragments and rootlets, medium plasticity, moist, no odor.
							4--		Drive length: 4'
									Recovered length: 3.5'
									0.2 ft standing water at station.
							5--		
							6--		

Background PID = 0.5 ppm, FID = 0.0 ppm.

CORING METHOD	Portable Vibracore
SAMPLING EQUIPMENT	48" long x 4" dia. CAB Lined Alum. Tubes
COORDINATES	Northing: 648795.21 ft
	Easting: 1234806.58 ft
SURFACE ELEVATION	23.44 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

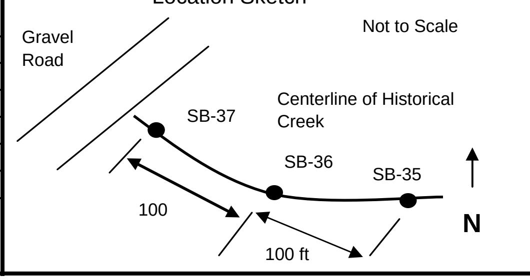
CORE NUMBER	SB-37
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 10, 2006

Sample ID	Time			PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION: USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0552	1630			5.2/0	NS	0-1.2		ML/ CL	Clayey silt, v. dark brown to black (10YR 2/2 - 2/1), trace sand, little plant debris and and rootlets and wood debris, moist to wet, no odor.
							1--		
LSP0553	1635			6.7/2	NS	1.2-2		SW/ SM	V. fine to fine sand with silt, v. dark gray (10YR 3/1), approx. 5-10% fines, trace fine gravel (precipitate?), trace rootlets, mottling to 1.5' bgs, wet, no odor.
							2--		As above with fine to medium, abrupt contact with clay lamination 0.06' thick at 2.5' bgs,
LSP0554	1640			4.9/-	NS	2-3.2			
								PT	Peat layer 2.6-2.9' bgs
							3--	SW	Well graded fine to coarse sand 2.9-3.1' bgs, few fine gravels, moist, mild sulfur odor.
									Refusal at 3.5 ft bgs.
							4--		Drive length: 3.5'
									Recovered length: 3.1'
									No standing water at sampling station, but ground was saturated.
							5--		
							6--		

Background PID = 0.2 ppm, FID = 0.0 ppm.

CORING METHOD	Portable Vibracore
SAMPLING EQUIPMENT	48" long x 4" dia. CAB Lined Alum. Tubes
COORDINATES	Northing: 648831.87 ft
	Easting: 1234716.98 ft
SURFACE ELEVATION	22.32 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

CORE NUMBER	SB-38
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 11, 2006

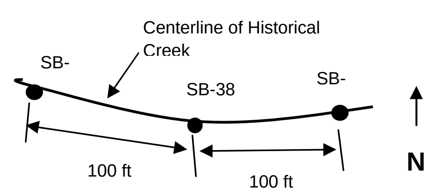
SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time			PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0557	1020			6.0/58.7	N	0-1		CL/ ML	Silty clay, gray (2.5Y 5/1), trace sand, trace gravel (pumace-like precipitate?), weak
LSP0561	1040	Duplicate							sulfur odor, wet.
									0.04' thick of root material at 0.4' bgs, some mottling.
							1--		
LSP0558	1025			6.9/11.3	N	1-1.9			As above with sandy zone 1.2-1.4' bgs (10% sand).
LSP0562	1045	Duplicate				1-1.9			
							2--	SM	
LSP0559	1030			3.2/33.2	N	1.9-2.4			Silty sand, dark gray (Gley N 4/), ~25% silt, dense, trace rootlets, wet, surfur odor.
LSP0560	1035			7.2/25.2	N	2.4-3.2		CL/ ML	Silty clay, dark gray (10 YR 4/1), trace fine sand, high plasticity, few soft wood debris
									and plant deiritus (increases with depth), damp, sulfur odor.
							3--		
									Drive length: 4'
									Recovered length: 3.2'
							4--		
							5--		
							6--		

Background PID = 0.3 ppm, FID = 0.0 ppm.

CORING METHOD	Portable Vibracore
SAMPLING EQUIPMENT	48" long x 4" dia. CAB Lined Alum. Tubes
COORDINATES	Northing: 648712.79 ft
	Easting: 1235076.07 ft
SURFACE ELEVATION	25.40 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch

Not to Scale



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

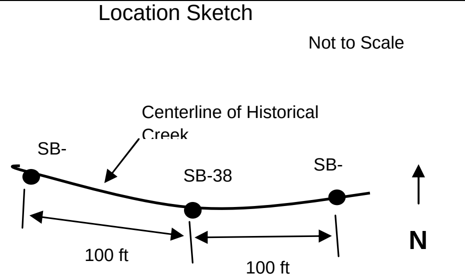
CORE NUMBER	SB-39
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 11, 2006

Sample ID	Time			PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION: USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0563	1300			8.2/13.2	NS	0-0.7		SC	Clayey F-M sand, dk. grayish brown (10YR 4/2), ~20% fines, trace orgaincs, no odor.
								GW	Gravel with F-C sand, black (10YR 2/1), ~25% fines (<5% clay), loose subangular to subrounded gravel up to 0.2' long, no odor, wet.
LSP0564	1305			4.9/2.0	NS	0.7-2	1--	SM	Silty v. fine sand, dark gray (2.5Y 4/1) to v. dk. grayish brown (2.5Y 3/2), 30% fines, interbeds of clayey silt and silty sands, beds 0.25" to 3" thick, trace plant detritus, trace mottling and pumice-like gravel, moist.
							2--		
LSP0565	1310			8.4/8.5	NS	2-3		SC	Clayey fine sand, dark gray (2.5Y 4/1), 25% clayey fines that occur primarily in faint laminae, trace mottling along root burrows at 2.6' bgs, trace pumice-like gravel, wet, sulfur odor.
							3--		
LSP0566	1315			10.2/30.4	NS	3-3.6		CL/ML	Silty clay (organic), black (7.5 YR 2.5/1), little orgaincs (woody detritus, rootlets), high plasticity, damp, sulfur odor.
							4--		Drive length: 4'
									Recovered length: 3.6'
							5--		
							6--		

Background PID = 0.0 ppm, FID = 0.0 ppm.

CORING METHOD	Portable Vibracore
SAMPLING EQUIPMENT	48" long x 4" dia. CAB Lined Alum. Tubes
COORDINATES	Northing: 648782.21 ft
	Easting: 1235145.84 ft
SURFACE ELEVATION	27.08 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



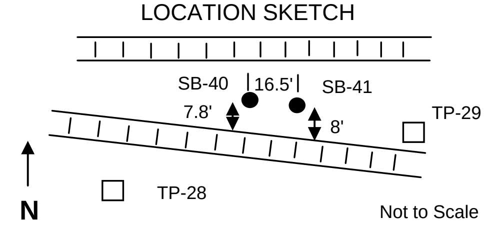
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-40
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C317.0102
LOGGED BY	Eron Dodak, R.G.
DATE	October 9, 2006

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0607	0923	20/20	100	0.5	NS	0-1		GW	Sandy silty gravel, v. drk grey (10YR 3/1), trace carbonized organics, 30% silt,
									30% F-C sand, F-3/4" dia. gravel, moist, no odor.
LSP0608	0926	14/13	30	0.0	NS	1-2			as above with color v. dk. grayish brown (10YR 3/2), decresed gravel content
LSP0609	0934	7/8	75	1.2	NS	2-3	2--	ML	Gravely clayey silt, dk. grayish brown (10YR 4/2), 25% F-1.5" dia. gravel, moist,
									no odor.
LSP0610	0942	9/9	75	0.0	NS	3-4			
LSP0611	0947	4/6/5	70	0.1	NS	4-4.5	4--		as above with color grayish brown (10YR 5/2), 35% F sand, trace gravel, some
									some orange mottling.
LSP0612	0952	14/19/50-3"	70	0.3	NS	5.5-7			
							6--		Gravely sandy silt, grayish brown (10YR 5/2), 10% gravel, 20% F sand, moist
									to v. moist, no odor (fill).
		9/9/19	10	0.3	NS	7-8.5			as above, v. moist
							8--		as above, wet
LSP0613	1014	10/8/2	40	0.0	NS	8.5-10			
LSP0614	1018	2/4/5	45	0.3	NS	10-11.5	10--		Slightly clayey silt, dark grayish brown (10YR 4/2), trace fine gravel, soft, wet,
									no odor (fill).
LSP0615	1031	7/8/8	60	0.8	NS	11.5-13			
							12--		as above, with color brown (10YR 4/3), trace sand and gravel.
LSP0616	1038	5/7/50-5"	70	0.0	NS	13-14.5			
									Sandy silt, dark gray (2.5YR 4/1), 40% F-sand, wet, indistinct odor.
							14--		Wood in sampler 14.1-14.5' bgs (native?).

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	Hollow-Stem Auger
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames and Moore
COORDINATES	Northings: 649453.024
	Eastings: 1235072.685
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/91

LOCATION SKETCH



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-40
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C317.0102
LOGGED BY	Eron Dodak, R.G.
DATE	October 9, 2006

Sample ID	Time	Blow Counts	% Recovery	PID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION: USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0617	1048	50-5"	90	0.6	NS	14.5-16		ML	as above
									Clayey silt, gray (2.5YR4/1) moderatly stiff, wood 14.7-15.0' bgs, indistinct
							16--		petroleum-like odor, v. moist.
LSP0618	1101	30/50-6"	90	0.5	NS	16-17		CL	Silty clay, olive brown (2.5Y 4/3), very stiff, moist, no odor.
									silty F-M sand: drk grayish brown (2.5Y4/2), 20-25%
LSP0619	1103	"	"	"	"	17-17.5		SW	Gravelly F-M sand, v. dk. brown (2.5Y 3/2) no odor.
LSP0620	1114	20/25/30	80	0.0	NS	17.5-19	18--	SM	Silty F-M sand, dk. grayish brown (2.5Y 4/2), 20-25% silt, trace gravel, moist,
									no odor.
LSP0621	1118	50-6"	60	0.0	NS	19-20.5			
							20--	SW	Silty gravely F-C sand, dk. grayish brown (2.5Y 4/2), 30% F-1" dia. rounded to
LSP0622	1130	50-6"	55	0.4	NS	20.5-22			subrounded gravel, 10% silt, wet, no odor.
							22--		
LSP0623	1134	50-6"	40	0.0	NS	22-23.5			
-	-	50-6"	35	-	-	23.5-25	24--		
									as above with 35-40% gravel up to 1.5" dia., 15% silt.
LSP0624	1148	32/50-6"	60	0.6	NS	25-26.5		GW	Silty sandy F-1" dia. gravel, olive brown (5Y 4/3),30% F-C sand, 10% silt,
							26--		subrounded to rounded gravel, wet, no odor.
-	-	36/40/50-4"	60	2.2	NS	26.5-28			
							28--		
-	-	38/50-6"	20	2.9	NS	28-29.5			as above with color dk. grayish brown (2.5Y 4/2), 15-25% silt, gravel up to 2" dia.

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	Hollow-Stem Auger
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames and Moore
COORDINATES	Northings: 649453.024
	Eastings: 1235072.685
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/91

See sheet 1

integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-40
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C317.0102
LOGGED BY	Eron Dodak, R.G.
DATE	October 9, 2006

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
								GW	as above
LSP0625	1211	50-5"	25	3.7	NS	29.5-31		GM	Sandy silty gravel, dk. grayish brown (2.5Y 4/2), 20% F-C sand, 25% silt, F-2"
							30--		dia. subrounded gravel, moist, no odor.
-	-	50-3"	5	4.0	NS	31-32.5			
							32--		
LSP0626	1219	50-5"	20	2.4	NS	32.5-34			
									as above with 15% silt, predominately M-C sand (GM/GW)
							34--		
LSP0627	1241	50-2"	25	0.0	NS	34-35.5		GC	as above with 30% clay/silt, 15% M-C sand, trace wood, moist, no odor.
-	-	50-6"	10	-	NS	35.5-37		GM	Sandy silty gravel, dk. grayish brown (2.5Y 4/2), 20% F-C sand, 25% silt, F-2"
							36--		dia. subrounded gravel, moist, no odor.
								▼	
-	-	38/45/50-5"	25	0.7	NS	37-38.5			recovery mostly fine to 2.5" dia. gravel (quartzite, basalt), wet.
							38--		
LSP0628	1302	37/30/30	90	1.2	NS	38.5-39.5			
LSP0629	1304	"	"	"	"	39.5-40		CL	Silty clay, dk. grayish brown (2.5Y 4/2), v. stiff, moist, no odor. Fine sand
							40--		lamination at bottom of sampler.
									Borehole terminated at 40 ft bgs.
							42--		Note: Refusal at SB-40(1) at 7' bgs. Likely hit a large rock in the fill. Moved 2.9'
									to the west and advanced the borehole to depth.
Background PID=0.0 ppm									

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	Hollow-Stem Auger
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames and Moore
COORDINATES	Northings: 649453.024
	Eastings: 1235072.685
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/91

See sheet 1

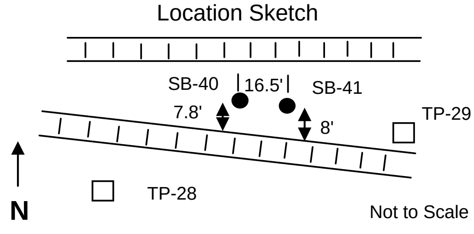
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-41
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C317.0102
LOGGED BY	Eron Dodak, R.G.
DATE	October 9, 2006

SAMPLE INFORMATION							Depth (ft)	STRATA	DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID/FID	Sheen	Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
									See log for adjacent borehole SB-40
							2--		
							4--		
							6--		
							8--		
							10--		
LSP0630	1420	5/3/3	85	0.0	NS	11-12.5		SM	Silty fine sand, dk. grayish brown (10YR 4/2), 30-35% silt, micaceous, moist,
									no odor.
							12--		
LSP0631	1424	5/3/3	65	0.0	NS	12.5-14			
							14--		
LSP0632	1431	3/5/3	85	0.5	NS	14-15.2		SM/ML	as above with 50% silt (SM/ML), v. moist at 13.5' bgs.

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	Hollow-Stem Auger
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames and Moore
COORDINATES	Northings: 649459.104
	Eastings: 1235072.855
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/91

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER SB-41
PROJECT W. Illinois Street Extension
LOCATION Bellingham, Washington
PROJECT NUMBER C317.0102
LOGGED BY Eron Dodak, R.G.
DATE October 9, 2006

Sample ID	Time	Blow Counts	% Recovery	PID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION: USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
								SM/ML	as above with trace orange mottling.
LSP0633	1432	"	"	"	"	15.2-15.5		ML	Clayey silt (15.2-15.5' bgs), brown (10YR 4/3), mod. to v. stiff, moist, no odor.
LSP0634	1443	5/27/28	90	0.4	NS	15.5-16.5	16--		Sandy silt (at 15.5' bgs), dk. gray brown (10YR 4/2), 30% F sand, wet, no odor.
LSP0635	1445	"	"	"	"	16.5-17		SM	Gravelly silty sand, v. dk. gray brown (10YR 4/2).
							18--		
LSP0636	1451	28/34/50	75	1.4	NS	19.5-21		SW	Silty gravelly F-C sand, v. dk. brown (2.5Y 4/2), 10% silt, 35% F-0.75" dia.
							20--		subrounded to rounded gravel, wet, no odor.
							22--		
							24--		
LSP0637	1458	32/46/50	70	0.7	NS	24.5-26		GW	Silty sandy F-2" dia. gravel, olive brown (2.5Y 4/3), 10% silt, 30% F-C
									sand (predominately M-C sand).
							26--		
							28--		

DRILLING CONTRACTOR Cascade Drilling
DRILLING METHOD Hollow-Stem Auger
SAMPLING EQUIPMENT 3" dia. x 18" lg Dames and Moore
COORDINATES Northings: 649459.104
Eastings: 1235072.855
SURFACE ELEVATION
DATUM Horizontal: NAD 83/91

See sheet 1

integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-41
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C317.0102
LOGGED BY	Eron Dodak, R.G.
DATE	October 9, 2006

Sample ID	Time	Blow Counts	% Recovery	PID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION: USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0638	1513	50-6"	50	0.0	NS	29.5-31	30--	GM/GC	Silty/clayey gravel, olive brown (2.5Y 4/3) 20-30% silty/clay, 25% F-C sand, v. moist, F-2" dia. subrounded gravel, no odor.
							32--		
							34--		
LSP0639	1517	50-6"	50	2.4	NS	34.5-36		GM	as above with 15% silt/clay, 25% M-C sand, F-2" dia. subangular to subrounded gravel, no odor.
							36--	▼?	
							38--		
LSP0640	1525	45/50-6"	35	1.9	NS	38.5-39.5		SM	Silty F-M sand, dk. grayish brown (2.5Y 4/2), 30% silt, wet, no odor.
LSP0641	1529	20/30/45		3.1	NS	39.5-41	40--		as above with decreasing silt content (15-25%).
LSP0642	1535	18/38/38	100	2.6	NS	41-42.5	42--		as above with color dk. grayish brown (10YR 4/2), 20-25% silt, thin (0.01' thick) silt laminations.
LSP0643	1553	17/40/41	100	1.2	NS	42.5-44		SP	F-M sand, dk. grayish brown (10YR 4/2), 5-10% silt, some orange banding, wet, no odor.
Background PID=0.0 ppm							44--		Boring terminated at 44' bgs

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	Hollow-Stem Auger
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames and Moore
COORDINATES	Northings: 649459.104
	Eastings: 1235072.855
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/91

See sheet 1

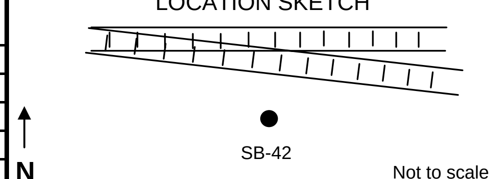
integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-42
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C414.0101
LOGGED BY	Mark Herrenkohl, LG, LEG
DATE	January 29, 2007

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
									0-1 ft composed of railroad ballast material. Background PID = 0.0
								GW	(Fill)
LSP0674	1043	8/7/8	33	0.0	NS	1-2.5			Sandy gravel with silt, brown (10YR 2/2), trace carbonized organics and wood,
							2--		<10% silt, 20-25% F-C sand, F-2" dia. gravel, damp to moist, no odor.
LSP0679	1046	6/5/3	47	0.0	NS	2.5-4			as above with color greenish brown (2.5Y 3/3).
									Gravelly sandy clayey silt (Fill), dk greenish brown (2.5Y 7/1), 20% F-C sand,
							4--	ML	10-15% F gravel, damp, no odor.
LSP0675	1053	4/1/3	53	0.0	NS	4-5.5			
								ML/	as above with C sand and F gravel increasing with depth, damp to moist.
							6--	GW	becoming mostly gravel with depth.
							8--		
							10--		
LSP0676	1057	3/3/3	0	-	NS	9-10.5			No recovery, 2.5" gravel in shoe, bottom of shoe was moist.
							12--		
							14--		

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	Hollow-Stem Auger
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames and Moore
COORDINATES	Northing: 649428.524
	Easting: 1235088.480
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/86

LOCATION SKETCH



Oeser/Birchwood outfall ~20 ft south of SB-42

integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225

(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-42
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C414.0101
LOGGED BY	Mark Herrenkohl, LG, LEG
DATE	January 29, 2007

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0677	1105	5/5/5	33	0.0	NS	14-15.5		GW	Sandy gravel with fines, orange-brown (10YR 4/3), 10% fines, 30% M-C sand,
									F-1" gravels, moist to wet, no odor. (Fill)
							16--		
							18--		
								▼	
LSP0678	1109	3/13/14	87	0.0	NS	19-20.5			
								SW/	Silty gravelly sand (Fill?), brown (10YR 5/3), 10-15% silt, 30-35% F gravel,
							20--	SM	wet (groundwater?), moderate petroleum odor detected in auger cuttings,
									no odor in sample.
							22--		
							24--		
								GW	Sandy gravel with trace of fines, brown (10YR 4/3), 10% fines,
LSP0680	1112	8/13/14	33	0.0	NS	24-25.5			35-40% M-C sand, F-1" gravel, wet, no odor (Native).
							26--		
LSP0681	1205	31/33/33	66	0.0	NS	26.5-28			as above with color olive brown (2.5Y 5/3), gravel up to 2" dia.
							28--		

DRILLING CONTRACTOR	Cascade Drilling
DRILLING METHOD	Hollow-Stem Auger
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames and Moore
COORDINATES	Northing: 649428.524
	Easting: 1235088.480
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/86

See sheet 1

integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

BOREHOLE NUMBER	SB-42
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C414.0101
LOGGED BY	Mark Herrenkohl, LG, LEG
DATE	January 29, 2007

SAMPLE INFORMATION									DESCRIPTION
Sample ID	Time	Blow Counts	% Recovery	PID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
								GW	Sandy gravel with trace of fines, olive brown (2.5Y 5/3), 10% fines,
LSP0682	1210	13/23/24	53	0.0	NS	29-30.5	30--		35-40% M-C sand, F-2" gravel, wet, no odor (Native).
LSP0683	1215	13/23/25	67	0.0	NS	31.5-33	32--		as above with 2-3"gravels, dk olive brown (2.5Y 4/2), not as wet.
							34--		
LSP0684	1218	12/15/16	60	0.0	NS	34-35.5			as above with gravels more angular, brown (10YR 5/4).
							36--		
LSP0685	1240	26/5/6	33	0.0	**S**	36.5-38		CL	Silty clay, dk grayish brown (G2 4/5B to 10YR 4/4), stiff, damp, trace sheen,
									moderate to strong creosote odor, (Native).
									(Note: the sheen and odor was associated with soil at top of clay and sluff
							38--		from material above. No odor registered with PID.)
									Borehole terminated at 38.5 ft bgs.
							40--		
							42--		
Background PID=0.0 ppm									

DRILLING CONTRACTOR	Cascade Drilling	See sheet 1
DRILLING METHOD	Hollow-Stem Auger	
SAMPLING EQUIPMENT	3" dia. x 18" lg Dames and Moore	
COORDINATES	Northing: 649428.524	
	Easting: 1235088.480	
SURFACE ELEVATION		
DATUM	Horizontal: NAD 83/86	

ATTACHMENT 6

TEST PIT LOGS

Major Divisions			Symbols		Typical Names
Coarse Grained Soils (More than 1/2 of soil >No. 200 sieve size)	**Gravels** (More than 50% coarse fraction > no. 4 sieve		GW		Well-graded gravels or gravel-sand mixtures, little to no fines
			GP		Poorly-graded gravels or gravel-sand mixtures, little to no fines
			GM		Silty gravels, gravel-sand-silt mixtures
			GC		Clayey gravels or gravel-sand-clay mixtures
	Sands (Less than 50% coars fraction > no. 4 sieve)		SW		Well-graded sands or gravel-sand mixtures, little to no fines
			SP		poorly-graded sands or gravelly sands, little to no fines
			SM		Silty sands, sand-silt mixtures
			SC		Clayey sands, sand-clay mixtures
Fine Grained Soils (More than 1/2 of soil <No. 200 sieve size)	**Silts & Clays** Liquid limit* less than 50%		ML		Inorganic silts and very fine sands, silty or clayey fine sands or clayey silts with slight plasticity
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy or silty clays, lean clays
			OL		Organic silts and organic silty clays of low plasticity
	Silts & Clays Liquid limit* greater than 50%		MH		Inorganic silts, micaceous or ditomaceous fine sand or silty soils, elastic silts
			CH		Inorganic clays of high plasticity, fat clays
			OH		Organic clays of medium to high plasticity, organic silty clay, organic silts
Highly Organic Soils			Pt		Peat or other highly organic soils

*Liquid limit represents the moisture contnet (in percent) of a soil at which point the soil no longer behaves like a plastic and starts to behave like a liquid.

Boring Log Symbols

Sample Interval
Groundwater, First Observed
Groundwater, Static

Sample Types

SS	Split Spoon
G	Grab
ST	Shelby Tube
GS	Geoprobe Sampler

Sheen Types

NS	No Sheen Observed
SS	Slight Sheen observed (Spotty coverage of sheen pan, no
MS	Moderate Sheen (Full Coverage)
HS	Heavy Sheen (Full Coverage, Irredescent)

Sample Moisture

Dry	No Moisture, dry to touch
Moist	Damp but no visible moisture
Wet	Visible free water

Sample Plasticity (Fine-Grained Soils)

Non-Plastic - Cannot be rolled at any moisture content
Low - Barely rolled, lump cannot be formed when drier than plastic limit
Medium - Easily rolled, lump crumbles when drier than plastic limit
High - Easily rolled yet takes considerable time to reach the plastic limit, lump can be formed without crumbling when drier than the plastic limit

Partical Size Range (Course-Grained Soils)

Gravel - Fine, Course
Sand - Fine, Medium, Coarse

Integral Consulting, Inc.
2817 NE 22nd Avenue
Portland, Oregon 97212
503-284-5545
503-284-5755 (Fax)

Based on Unified Soil Classification System and ASTM Standard D2487 and D2488

integral consulting inc.

integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-1
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	M. Herrenkohl, P.E.G.
DATE	November 9, 2005

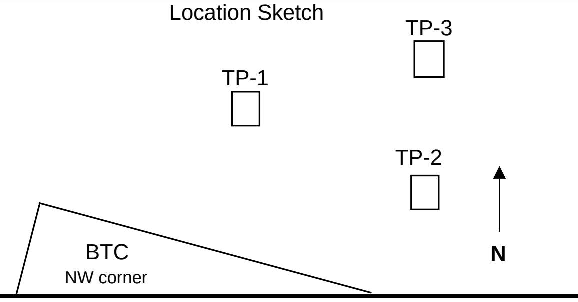
SAMPLE INFORMATION								DESCRIPTION
Sample ID	Sample Time	FID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0059	1435	1.4	NS		0-1		GM/SM	Sandy gravel w/fines, light brown, some earthworms observed (fill).
LSP0060*	1440				0-1			
LSP0061	1450	3.3	NS		1-2		Debris	Black layer, burnt garbage ash, metal debris, bones (fill).
						2--		
LSP0062	1455	2.3	LS		2-3		Debris	Orange (rusted) with white (ash) layer, garbage odor (fill).
							Debris	Black layer simlar to above with metal parts, bottles, and glass (fill).
LSP0063	1447	2.8	LS		3-4		Debris	Orange layer, clays/sand/gravel matrix, similar to above with less debris (fill).
						4--		
LSP0064	1445	9.5	NS		4-5		GM	Silty sandy fine to coarse gravel w/clay, gray (10 YR 6/1 - 5/1), 65-70% gravel.
*Duplicate							—	Bottom of test pit at 5' bgs.

ADDITIONAL NOTES / SKETCHES

Samples collected from west and south side walls.
Materials encountered from 1' to 4' bgs appear to be municipal landfill materials in a soil matrix with a "garbage odor".
Landfill materials decreasefrom 3-4' bgs, and are absent below 4' bgs.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon/Shovel/Bowl
COORDINATES	Northing: 649016.90 ft
	Easting: 1235609.38 ft
SURFACE ELEVATION	38.24 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-2
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	M. Herrenkohl, P.E.G.
DATE	November 10, 2005

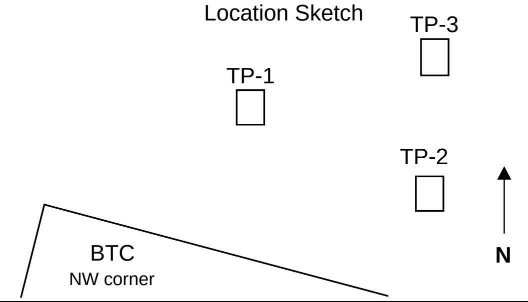
SAMPLE INFORMATION								DESCRIPTION
Sample ID	Sample Time	FID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0065	0830	**	NS		0-1		GM	Sand/gravel/clay/silt matrix, reddish dark brown (5YR 3/2) , no odor (fill).
LSP0066*	0840				0-1			
LSP0067	0850	**	NS		1-1.6		Debris	Black ash/burned materials mixed into similar matrix observed above.
LSP0071	1000	**	NS		1.6-2.9	2--	Debris	Rust zone with metal debris in a silty sand matrix, some white material of unkown
								source and large piece of concrete.
LSP0070	0950	**	NS		2.9 - 3.7			
							GM	Clayey sandy gravel w/silt, dark brown (7.5 YR 3/2) (fill).
LSP0069	0940	**	LS		3.7- 4.2	4--	Debri	As above, mixed with black ashy material (fill).
LSP0068	0855	**	NS		4.2- 5.3		G	
								Gravel w/fines, tan to light brown (10 YR 5/2 - 5/3) (Fill?)
*Duplicate							—	
**Problems calibrating PID/FID								Bottom of test pit at 5.3 ft bgs.

ADDITIONAL NOTES / SKETCHES

Large 1 ft x 1 ft concrete "block" observed at approximately 2 - 2.5 ft bgs.
Chrome stripping from car was observed at approximatley 2 ft bgs.
No municipal waste was observed in the test pit.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon/Shovel/Bowl
COORDINATES	Northing: 648930.22 ft
	Easting: 1235708.04 ft
SURFACE ELEVATION	40.61 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-3
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	M. Herrenkohl, P.E.G.
DATE	November 10, 2005

SAMPLE INFORMATION								DESCRIPTION
Sample ID	Sample Time	FID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0075	1300	**	NS		0-1		CL	Silty clay with gravel and sand to gravely silty clay with sand, dark brown,
								(7.5 YR 3/4), (fill).
LSP0074	1250	**	NS		1-2			Sand and gravel content increasing with depth.
						2--		
LSP0073	1240	**	NS		2-3		GM	Clayey silty sandy gravel, dark brown (7.5 YR 3/2), fines decreasing with depth.
							GM/GP	Grading to sandy gravel w/ silt, grayish brown (10YR 5/2), 80% gravel, 20% sand,
LSP0072	1230	**	NS		>3			>5% fines (Native?).
								Bottom of test pit at 3 ft bgs.
						4--		
**Problems calibrating PID/FID								
No obvious odors								

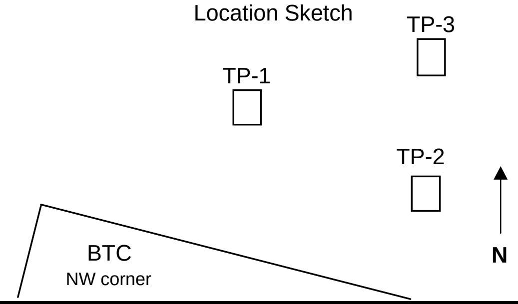
ADDITIONAL NOTES / SKETCHES

Scrap metal (rusted bucket) observed at ~1 ft bgs.

Note: This station was moved 54 ft 060° (magnetic north) from its surveyed location. N 48.7672°, W 122.51147°.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon/Shovel/Bowl
COORDINATES	Northing: 649053.78 ft
	Easting: 1235712.67 ft
SURFACE ELEVATION	38.42 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-4
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	M. Herrenkohl, P.E.G.
DATE	November 9, 2005

Sample ID	Sample Time	FID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0055	1115	3.4**	NS		0-1		GM	Silty Sandy Gravel w/clay: Brown (7.5YR 4/2), 15-20% fines, 25% sand,
								60-70% gravel, mottled brown, yellow, and gray, moist. Organic-rich zone
LSP0056	1125	14**	NS		1-2			0.25 to 0.5 ft bgs.
						2--	CL/GM	-zones of mottled clay and silty sandy gravel 1.5 to 2.0 ft bgs. Clay and
LSP0057	1135	4.2**	NS		2-3			large gravel/cobbles increase w/depth.
							SM/SP	Silty sand to Sand w/silt: mottled yellow/red/brown (generally 5YR 4/6),
LSP0058	1145	1.7**	NS		3			damp to moist, moisture content increasing with depth, no odor.
						4--		
								Test pit sampled and logged to 3 ft bgs and excavated to 8 ft bgs. No clay
								layers encountered from 3-8 ft bgs; scattered gravels observed at 8 ft bgs.

**Readings may not be accurate due to malfunctioning FID / PID meter.

ADDITIONAL NOTES / SKETCHES

No obvious fill materials observed

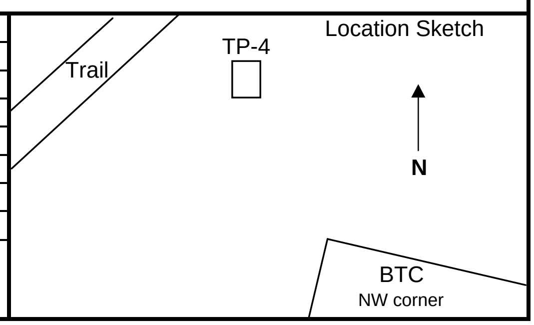
Samples collected from northeast corner of the excavation.

Heterogeneity observed in test pit from side wall to side wall

Clay material in upper 2 ft varies in thickness by location within the test pit

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 649316.98 ft
	Easting: 1235338.57 ft
SURFACE ELEVATION	40.57 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-5
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	M. Herrenkohl, P.E.G.
DATE	November 9, 2005

SAMPLE INFORMATION								DESCRIPTION
Sample ID	**Sample Time**	**PID (ppm)**	**Sheen**		**Sample Depth (ft)**	**Depth (ft)**	**STRATA**	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0050	0910	1.7	NS		0-1		GM	Silty sandy gravel, dark brown (7.5YR 3/3), 15% fines, 50-60% F-C gravel,
								25-35% F-Msand, vegetative cover, damp to moist.
LSP0052	0915	3.2	NS		1-2			As above w/color (7.5YR 4/2).
						2--		Increasing clay content.
LSP0053	0920	5.1	NS		2-3		SM/SP	Silty sand/silty gravel, gray (7.5 YR 4/1) compressed layer.
							SM /SP	Silty F-M sand to F-M sand w/silt, mottled yellow brown (10 YR 5/6).
LSP0054	0925	4	NS		3			
						4--		
								Gray clay (mottled) observed in test pit spoils at 6.5 ft bgs.
								Bottom of test pit at 6.5 ft bgs.

ADDITIONAL NOTES / SKETCHES

Scattered worms and natural wood debris observed.

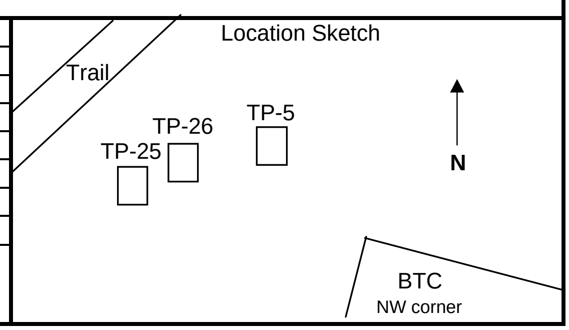
A few cobble size rocks in the upper 2 ft bgs (primary).

No sign of sheen or odor (earthy only).

Samples collected from the north and west excavation side walls.

No obvious fill materials observed.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 649122.32 ft
	Easting: 1235209.15 ft
SURFACE ELEVATION	33.40 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225

(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-6
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	M. Herrenkohl, P.E.G.
DATE	November 8, 2005

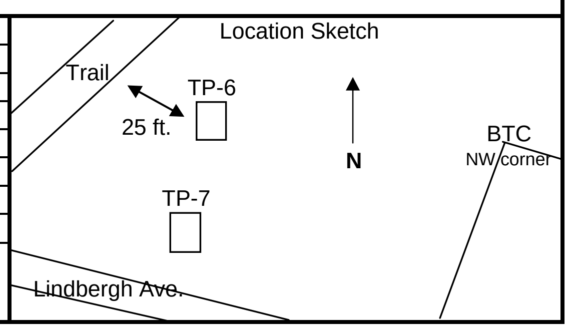
Sample ID	Sample Time	PID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP044	1510	4**	MS		0-1		GW	Vegetation overlying gravel "matrix" with cresoted wood debris, sheen,
								strong odor (fill).
LSP0045	1515	-	HS		1-2		SM	Sand with gravel and fines, dark brown (2.5Y5/1), some NAPL, heavy sheen,
						2--		damp to moist, strong creosote-like odor.
LSP0046	1610	1**	HS		2-3			As above with color brown (7.5YR 4/3), wet at 2.8 ft bgs.
							OH	Grading to orgainc clay with silt, mottled red/gray (10YR 4/2 to 7.5YR 4/3),
LSP0047	1630	1**	HS		3-4			medium plasticity, wet (native?).
						4--		
LSP0048	1640	0**	NS		>4			Gray silty clay observed at 4 ft bgs.
								Bottom of test pit at 4 ft bgs.

**Possible malfunctioning PID/FID meter.

ADDITIONAL NOTES / SKETCHES

Samples collected from the west and east excavation side walls.
Water seeping into excavation at 2.8 ft bgs.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon/Shovel/Bowl
COORDINATES	Northing: 649033.38 ft
	Easting: 1235087.80 ft
SURFACE ELEVATION	30.16 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

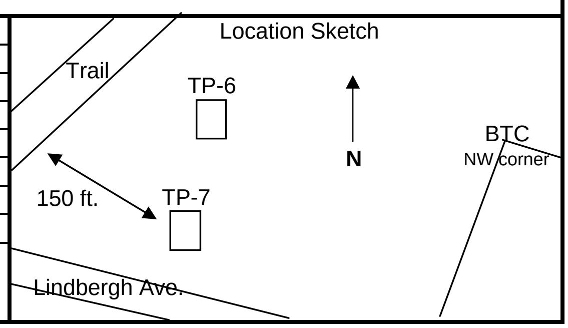
TEST PIT NUMBER	TP-7
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	M. Herrenkohl, P.E.G.
DATE	November 8, 2005

Sample ID	Sample Time	PID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION — USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0040	1015	0	NS		0-1		SP/SM	Sand w/ silt/silty sand, 5YR 4/3, zones of fine grained material, some earthworms
								observed, moist, earthy odor (native?).
LSP0041	1020	0	NS		1-2			
						2--		
LSP0042	1025	0	NS		2-3		SP	F-M sand w/ gravel & silt, 7.5YR 4/4, scattered gravel, some lenses of silty sand.
							▼	Saturated at 3' bgs, increased gravel content, decreased fines content.
LSP0043	1030	0	NS		3			
						4--		Bottom of test pit at 3' bgs.

ADDITIONAL NOTES / SKETCHES

Samples collected from the south and east excavation side walls.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 648836.71 ft
	Easting: 1235050.25 ft
SURFACE ELEVATION	28.71 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-8
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	M. Herrenkohl, P.E.G.
DATE	November 8, 2005

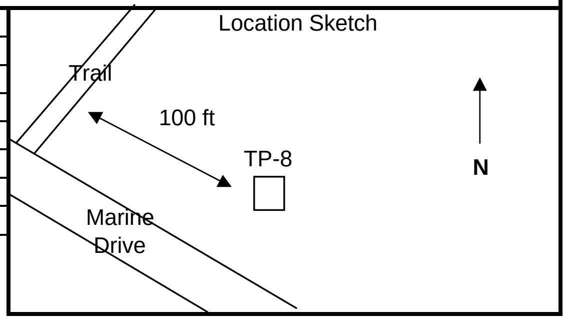
SAMPLE INFORMATION								DESCRIPTION
Sample ID	Sample Time	PID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0037	0830	2	NS		0-1.4		GM	Silty sandy gravel, brown (7.5 YR 4/3), 50% F-M gravel, 30% F-M sand, 20% fines
								(mostly silt), trace of clay, slight plasticity, poorly sorted,
LSP0038	0835	2	NS		1.4 - 3			some earthworms observed, moist (fill).
							SM	Silty F-M sand, dark brown to brown (7.5 YR 3.2 to 7.5 YR 4.3), no plasticity,
						2--		80% F-M sand, >20% fines (silty), scattered gravels, moist to wet (native).
							▼	Color change at bottom of test pit (7.5 YR 6.1 - 6.2).
LSP0039	0840	3	NS		3			
						4--		Bottom of test pit at 3 ft bgs.

ADDITIONAL NOTES / SKETCHES

Water seeping into excavation at 3 ft bgs.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 648819.66 ft
	Easting: 1234837.58 ft
SURFACE ELEVATION	26.95 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-9
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	November 7, 2005

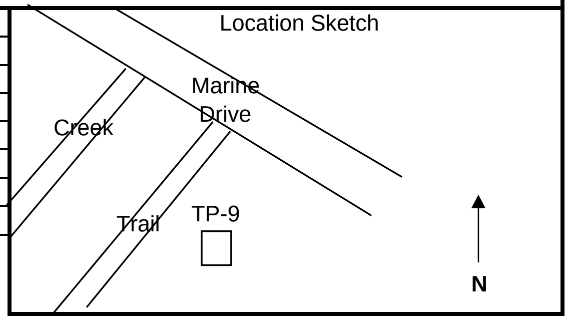
SAMPLE INFORMATION						Depth (ft)	STRATA	DESCRIPTION
Sample ID	**Sample Time**	**PID (ppm)**	**Sheen**		**Sample Depth (ft)**			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0031	1600	2	NS		0-1		SM/ML	Sand with silt and gravel/silt with sand and gravel, dark brown (7.5 YR 3/2), 20%
LSP0032	1605	2	LS		1-2			F-C subrounded to rounded gravel, 40% silt, 40% fine sand, trace glass
								and some concrete, moist, no odor (fill).
						2--		
LSP0033	1610	<1	NS		2-3		GW/SW	Gravel w/ sand/sand w/ gravel, dark brown (7.5 YR 3/2), 45% F-C subrounded to
-	-	-	LS		3			rounded gravel, 45% F-C sand, 10% silt, moist, no odor (fill to ~2.8 ft bgs).
LSP0034	1615	1	NS		3-4			
						4--	SP	Fine sand, v. dark brown (7.5 YR 2.5/2), 5-10% silt, wet, no odor.
LSP0036	1620	1	NS		4			
								Bottom of test pit at 4 ft bgs.

ADDITIONAL NOTES / SKETCHES

Water seeping into excavation at 4 ft bgs.
Samples collected from north and south excavation side walls.
Concrete encountered at 2.8 ft bgs.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 648641.99 ft
	Easting: 1234552.91 ft
SURFACE ELEVATION	24.54 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225

(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-10
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	November 7, 2005

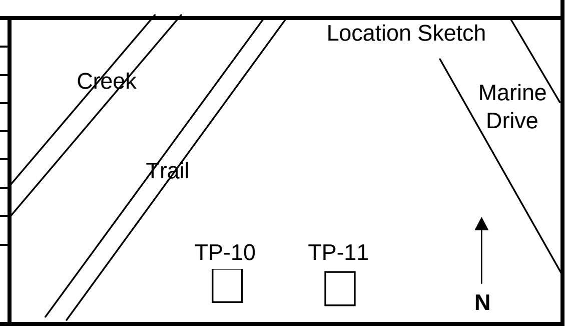
SAMPLE INFORMATION								
Sample ID	**Sample Time**	**PID (ppm)**	**Sheen**		**Sample Depth (ft)**	**Depth (ft)**	**STRATA**	**DESCRIPTION** USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0028	1300	0	LS		0-1		GM	Gravel with silt and sand, brown (7.5 YR 4/2), 25% fine sand, 20% silt, mostly
							▼	subrounded to rounded fine gravel, weak odor (fill).
LSP0029	1305	0	LS		1-2			As above w/color v. dark gray (7.5 YR 3/1), 35% sand, 10% silt (fill)
						2--		
LSP0030	1310	<1	NS		2-3		SP	Fine sand, v. dark gray (10 YR 3/1), 5-10% silt, some orange banding,
								moist to wet, no odor.
LSP0035	1315	0	NS		3-4		SM	Sand with silt, v. dark grayish brown (10 YR 3/2), 20-25% silt, fine sand, slightly
								micaceous, v. moist to wet, no odor.
						4--		
								Bottom of test pit at 4 ft bgs.

ADDITIONAL NOTES / SKETCHES

Sample was not collected at the bottom of excavation due to 2-3 inches of standing water. Unable to remove water with the backhoe bucket.
Water seeping into excavation at 1 ft bgs.
Steel pipe observed at 1.5 ft bgs, piece of milled wood observed at 2 ft bgs.
Piece of treated wood debris with odor observed at 0.7 ft bgs.
Samples collected from west, east, and south excavation side walls.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 648455.94 ft
	Easting: 1234485.41 ft
SURFACE ELEVATION	19.18 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

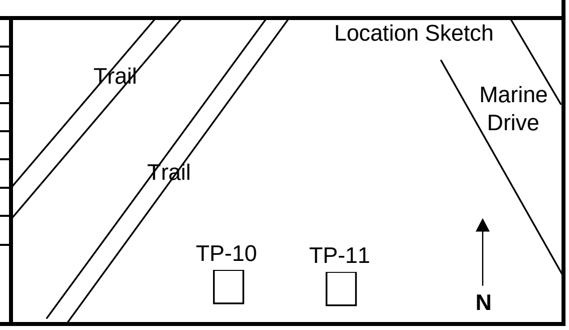
TEST PIT NUMBER	TP-11
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	November 7, 2005

SAMPLE INFORMATION								
Sample ID	**Sample Time**	**PID (ppm)**	**Sheen**		**Sample Depth (ft)**	**Depth (ft)**	**STRATA**	**DESCRIPTION** USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0023	1115	<1	NS		0-1		ML	Silt with sand, v. dark gray (7.5 YR 3/1) 20-25% fine sand, 5-10% fine to coarse
LSP0027	1140	0	NS		1.4-2			gravel, 5-10% roots, moist, no odor.
LSP0024	1125	<1	NS		1-2		SM	Fine sand w/ silt, black (7.5 YR 2.5/1), micaceous, 15-20% silt, moist, no odor to
						2--		slight sulfur odor. A small pocket of strong brown (7.5YR 5/6) gravel w/sand was
LSP0026	1130	1	NS		2-3		▼	observed from 1.4-2 ft bgs near the SE corner of the test pit (sample collected).
								As above with color dark brown (7.5 YR 3/2).
LSP0025	1135	0	NS		3			
						4--		Bottom of test pit at 3 ft bgs.

ADDITIONAL NOTES / SKETCHES

Water seeping into excavation at 2.6 ft bgs.
Samples collected from north, south, and east excavation side walls.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 648454.98 ft
	Easting: 1234581.92 ft
SURFACE ELEVATION	20.66 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

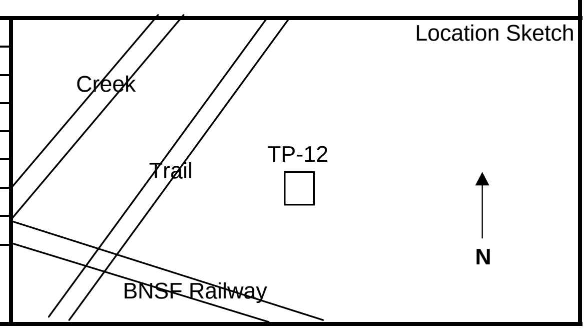
TEST PIT NUMBER	TP-12
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	November 7, 2005

SAMPLE INFORMATION								DESCRIPTION
Sample ID	Sample Time	PID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0019	0920	0.7	No		0-1		ML	Silt with sand, dark brown (7.5 YR 3/2) 15% F-M sand, 5% F-C gravel, 5-10% roots, moist, no odor.
LSP00020	0925	1	No		1-2		GM	Gravel w/silt & sand, dk. brn. (10 YR 3/2), 20-25% silt, 15% F-M sand, no odor.
							GW	Fine to coarse gravel with sand, brown (7.5 YR 4/2), 20-25% M-C sand,
LSP0021	0930	1.2	No		2-3	2--	▼	mostly fine subrounded to rounded gravel, v. moist to wet, no odor.
LSP0022	0935	1.8	No		3			Bottom of test pit at 3 ft bgs.
						4--		

ADDITIONAL NOTES / SKETCHES

Water seeping into excavation at 2.3 ft bgs.
Samples collected from north, south, and east excavation side walls.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 648299.38 ft Easting: 1234434.29 ft
SURFACE ELEVATION	16.35 ft
DATUMS	Horizontal: NAD 83/91 Vertical: NAVD 88



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-13
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	November 16, 2005

SAMPLE INFORMATION								**DESCRIPTION**
Sample ID	**Sample Time**	**PID/FID (ppm)**	**Sheen**		**Sample Depth (ft)**	**Depth (ft)**	**STRATA**	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0083	0820	1.7/0	NS		0-1		GM	Silty gravel w/ sand, v. dark brown (10YR 2/2), 60% F-C subangular gravel,
								20% F-C sand, 20% fines, gravel up to 2" dia., trace roots/rootlets, no odor.
LSP0084	0825	0.7/0	NS		1-5.5		SP/SM	Sand with silt, yellowish brown (10YR 5/4), F-C sand (trace C, 20% M, 80% F),
						2--		10% silt, gravelly to 2.8 ft, trace to no gravel below 2.8 ft, some orange mottling,
								trace of clasts of medium placticity material, no odor.
						4--	▼	Wet at 3.8 ft bgs.
								Bottom of test pit at 5.5 ft bgs.

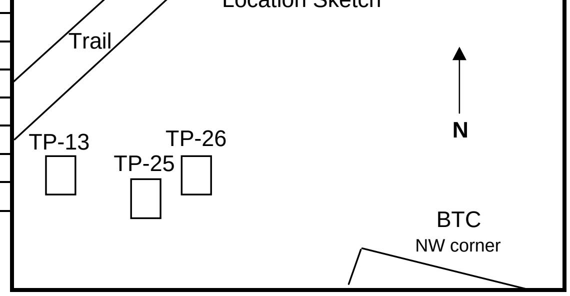
ADDITIONAL NOTES / SKETCHES

Samples collected from southeast excavation side wall.
The 0-1 ft sample was collected directly from excavation side wall.
The 1-5.5 ft composite sample was collected from the excavator bucket.

Background PID = 0.2 ppm, FID=0.0 ppm

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 649118.15 ft
	Easting: 1235099.31 ft
SURFACE ELEVATION	31.78 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-14
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	November 16, 2005

Sample ID	Sample Time	PID/FID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	DESCRIPTION: USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0085	0925	1.0/0	NS		0-0.5		GM	Silty gravel with sand, some roots, rootlets, and worms, no odor.
							SW/SP	F-C sand, dark yellowish brown (10YR 4/4), trace gravel,
LSP0086	0930	1.4/0	NS		0.5-4.2			sand (10% C, 70% M, 20% F).
							SP/SM	Sand w/ silt, light olive brown (2.5Y5/3), trace roots, orange motting throughout,
						2--		no odor.
							▼	
						4--		
							—	Bottom of test pit at 4.2 ft bgs.

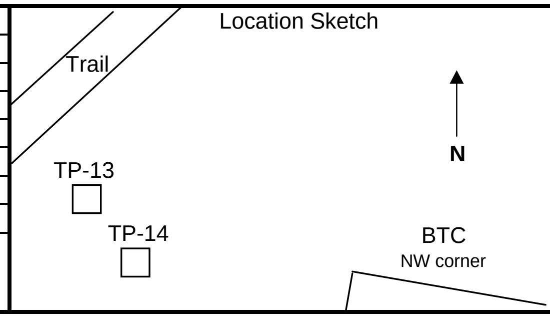
ADDITIONAL NOTES / SKETCHES

The 0-0.5 ft sample was collected directly from excavation side wall.
The 0.5-4.2 ft composite sample was collected from the excavator bucket.

Background PID = 0.4 ppm, FID=0.0 ppm

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 649095.94 ft
	Easting: 1235115.79
SURFACE ELEVATION	9
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-15
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	November 16, 2005

SAMPLE INFORMATION								DESCRIPTION
Sample ID	**Sample Time**	**PID/FID (ppm)**	**Sheen**		**Sample Depth (ft)**	**Depth (ft)**	**STRATA**	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0078	1110	1.6/0	LS		0-1		SC	Clayey sand with gravel, v. dark brown (10YR 2/2), 20% gravel, 60% sand,
								20% fines (med. plasticity), faint odor in gravel lenses, some organics, moist.
LSP0079	1105	2.0/0	NS		1-2		SW/SM	Sand with silt, v. dark brown, 10% gravel, 75% fine to coarse sand, 10-15% silt,
						2--		angular to subrounded gravel up to 3" dia., moist, no odor.
LSP0080	1100	1.7/0	NS		2-3		ML/CL	Sandy silt/clay, 10% gravel, 20% F sand, 70% fines, med plasticity, subrounded
								gravels up to 1" dia., some black organic lenses 3-4" thick, moist, no odor.
LSP0081	1120	2.2/0	LS		3-4		SM	Silty sand with gravel, v. dark gray (10YR 3/1), 30% F-C gravel, 50% F-C sand,
								20% fines, subangular to subrounded gravels up to 4" dia., mild "sweet odor".
						4--		
								Bottom of test pit at 4 ft bgs.

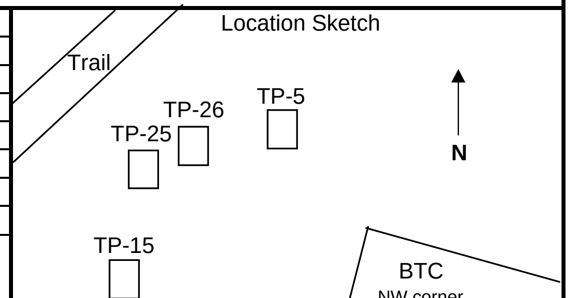
ADDITIONAL NOTES / SKETCHES

Cobbles up to 10 in. long removed from test pit.
The 0-1 ft, 1-2 ft, 2-3 ft samples collected directly from west excavation side wall.
The 3-4 ft sample collected and described from excavator bucket.

Background PID = 0.4-0.3 ppm.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 649050.98 ft
	Easting: 1235148.03 ft
SURFACE ELEVATION	31.20 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225

(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-16
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	November 16, 2005

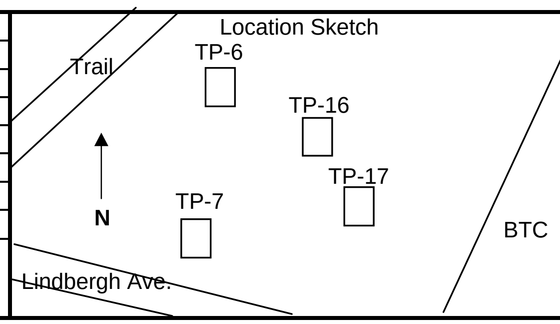
SAMPLE INFORMATION								
Sample ID	**Sample Time**	**PID/FID (ppm)**	**Sheen**		**Sample Depth (ft)**	**Depth (ft)**	**STRATA**	**DESCRIPTION** USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0088	1345	1.4/0	NS		0-2		SP/SM	Sand with silt, brown (10YR 4/3), poorly graded, 10% gravel, 80% sand, 10% silt,
								some roots (mostly in top 0.5 ft bgs), moist.
								Subrounded cobbles up to 4" dia. near GP/GM contact.
						2--		Gravel with silt, v. dk brn (10YR 2/2), poorly graded, 5-10% silt, 20% F sand, no
LSP0087	1355	1.6/0	NS		2-4		GP/GM	odor. Discontinuous dense black organic layer at 2 ft bgs, no odor.
							SM/ML	Silty fine sand, brown (10YR 4/3), trace gravel, 25% silt, 75% sand, some clayey
							▼	lenses, mottling (estimated 10%), no odor.
						4--		
								Bottom of excavation at 4 ft bgs.

ADDITIONAL NOTES / SKETCHES

The 0-2 ft sample was collected directly from the northwest excavation side wall.
The 2-4 ft sample was collected from the excavator bucket.
Water seeping into excavation at 3.5 ft bgs.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 648944.72 ft
	Easting: 1235185.97 ft
SURFACE ELEVATION	29.00 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-17
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	November 16, 2005

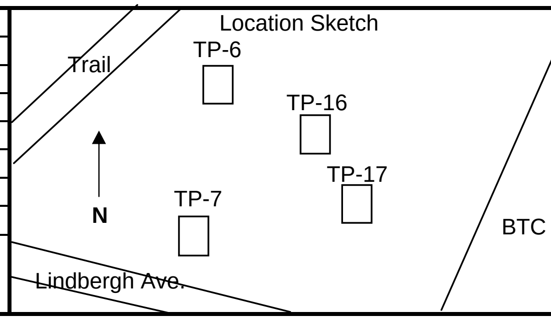
SAMPLE INFORMATION								DESCRIPTION
Sample ID	Sample Time	PID/FID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0089	1510	1.1/0	NS		0-1		ML	Sandy silt, brown (10YR4/3), trace gravel, 35% fine sand, 65% silt, sulfur odor,
								damp, soft.
LSP0090	1515	2.4/0	NS		1-2		SM	Silty sand, dark grayish brown (10 YR 4/2), 80% sand (v. fine to fine), 20% silt,
						2--	▼	soft, damp.
LSP0091	1520	2.2/0	NS		2-3			As above with 70% sand, 30% silt, trace coarse sand, some rootlets, no odor.
LSP0092	1525	2/0	NS		3-4		ML/SM	Silt with sand (dark gray, 10YR 4/1) and silt (v. dark gray, 10YR 3/1),
						4--		heterogeneous mixture, v. fine to fine sand, mottled, no odor.
							—	
								Botom of test pit at 4 ft bgs.

ADDITIONAL NOTES / SKETCHES

The 0-1 and 1-2 ft samples were collected directly from the north excavation side wall.
The 2-3 and 3-4 ft samples were collected from the excavator bucket.
Water seeping into excavation at 2 ft bgs.
Background PID = 0.4 ppm.
Gray clay present at 4 ft based on excavation spoils.
Water seeping into excavation rapidly at 2 ft bgs.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 648860.83 ft
	Easting: 1235211.84 ft
SURFACE ELEVATION	27.73 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-18
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	November 17, 2005

SAMPLE INFORMATION						Depth (ft)	STRATA	DESCRIPTION
Sample ID	**Sample Time**	**PID/FID (ppm)**	**Sheen**		**Sample Depth (ft)**			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0093	0815	0.2/0	NS		0-1		GW/GM	Gravel with silt and sand, v. dark grayish brown (10YR 3/2), 60% gravel ~2" dia.,
								25% F-C sand, 10% silt, some roots and earthworms observed, moist, no odor
LSP0094	0820	0/0.7	NS		1-2.5			As above but hard to v. hard, trace roots, yellowish brown (10YR 5/4).
						2--		As above with color grayish brown (10YR 5/2), 70% F-C gravel with cobbles,
								20% F-C sand, 10% silt, some rust colored mottling.
LSP0095	0825	0.1/0	NS		2.5-3.5		SW/SM	Sand with silt, v. dark grayish brown (2.5Y 3/2), well graded sand (F-C), 10% silt
								loose, moist, no odor.
								Bottom of test pit at 3.5 ft bgs.
						4--		

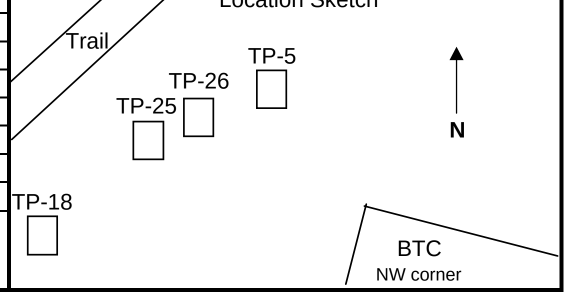
ADDITIONAL NOTES / SKETCHES

All samples collected from northeast corner and east excavation side wall.

Background PID and FID = 0.0 ppm.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 648782.44 ft
	Easting: 1235141.76 ft
SURFACE ELEVATION	27.08 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-19
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	November 17, 2005

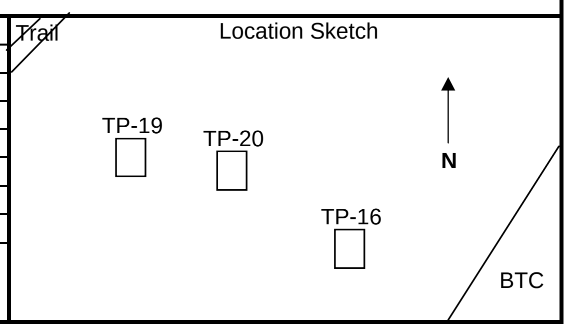
SAMPLE INFORMATION								DESCRIPTION
Sample ID	Sample Time	PID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0096	1000	0.3	NS		0-1		GW/GM	Gravel with silt and sand, v. dark brown (10YR 2/2), 50% gravel, 40% sand,
								10% fines, some roots, one earthworm observed, damp, no odor.
LSP0097	1005	0.2	NS		1-2		GW	As above with color dark yellow brown (10 YR 5/4), 70% gravel, 20% sand,
						2--		5-10% silt, firm to hard, damp, no odor
LSP0098	1010	0.4	NS		2-3		SP	Sand poorly graded, light olive brn (2.5Y 5/3), F-M sand, hard, damp, no odor.
								As above with color yellowish brown (10YR 4/6), 10% silt,
							—	trace black organic lenses and clay lenses.
								Bottom of test pit at 3 ft bgs.
						4--		

ADDITIONAL NOTES / SKETCHES

Background PID = 0.0 ppm. FID meter malfunctioning.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 648992.97 ft
	Easting: 1235072.11 ft
SURFACE ELEVATION	29.97 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-20
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	November 17, 2005

SAMPLE INFORMATION						Depth (ft)	STRATA	DESCRIPTION
Sample ID	Sample Time	PID/FID	Sheen		Sample Depth (ft)			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0099	1130	0.4/0	NS		0-2		GW/GM	Gravel with silt and sand, v. dark grayish brown (10YR 3/2), 50% F-C gravel,
								40% VF-M sand with trace coarse, 10% silt, no odor. Loose/loamy with organic
LSP0101	1235	-	NS		1.3-2			detritus (20%) from surface to 0.5' bgs.
							PT	Humic peat: black (2.5Y 2.5/1), thickness varies around test pit, hard, moist.
LSP0100	1130	0.5/0	NS		2-4	2--	GM	Silty gravel with sand, dark yellowish brown (10YR 4/6), 60% subrounded to
								subangular F-C gravel (up to 2" dia.), 25% VF-M sand, 15% silt, firm, no odor.
						4--	▼	
								Bottom of test pit at 4 ft bgs.

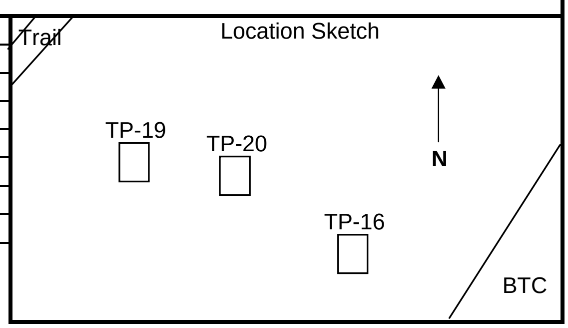
ADDITIONAL NOTES / SKETCHES

Water seeping into excavation at 4 ft bgs.
Samples collected from northwest corner of excavation side wall.

Background PID = 0.0 ppm.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 648982.56 ft Easting: 1235130.08
SURFACE ELEVATION	30.87 ft
DATUMS	Horizontal: NAD 83/91 Vertical: NAVD 88

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-21
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	November 17, 2005

SAMPLE INFORMATION / **DESCRIPTION**

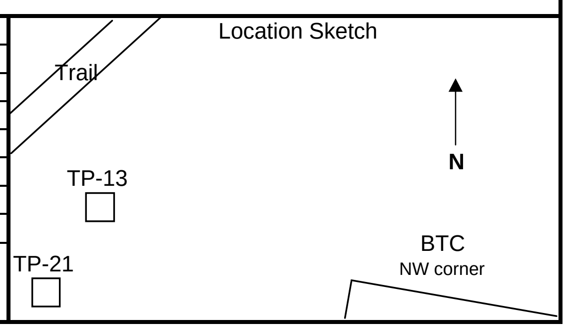
Sample ID	Sample Time	PID/FID (ppm)	Sheen		Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0102	1310	0.1/0	NS		0-2		GW/GM	Gravel w/ silt & sand, dk yellowish brown (10YR 3/4), 70% F-C gravel (up to 3.4"
								dia.), 20% F-C sand, 10% silt, some roots & earthworms observed, moist, no odor.
							ML	Sandy silt with gravel, dark grayish brown (10YR 4/2), 10% gravel, 40% VF-F sand,
						2--		50% silt, trace rootlets, alternating clay/silt and gravel mixtures, trace black orgainc
LSP0103	1315	0.3/0	NS		2-4			lenses, moist, no odor.
LSP0104*	1320				2-4			
							CL	Clay, v. dark gray (10YR 3/1), trace reddish motting and dark organic lenses, firm to
						4--		hard, few organics, moist, no odor.
								Bottom of test pit at 4 ft bgs.

*Duplicate

ADDITIONAL NOTES / SKETCHES

All samples collected from east excavation side wall.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Backhoe - John Deere 310
SAMPLING EQUIPMENT	Stainless Steel Spoon and Bowl
COORDINATES	Northing: 649085.54 ft
	Easting: 1235062.19 ft
SURFACE ELEVATION	30.80 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-22
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	January 31, 2006

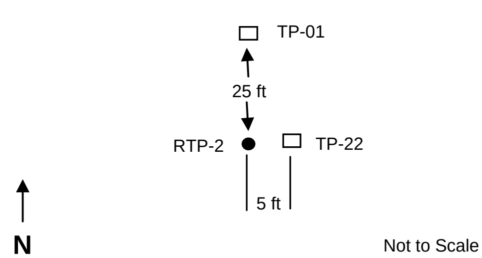
SAMPLE INFORMATION					Depth (ft)	STRATA	DESCRIPTION
Sample ID	Time	PID/FID	Sheen	Sample Depth			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0105	0950	5.8/0	NS	0-0.5		GW	Sandy gravel w/ silt, dark brown (7.5 YR 3/2), fine to 3" dia. gravel
(1015 for VOC sample)						SM/ ML	(40%), sand (30%), silt (30%), no garbage, moist, no odor (fill).
LSP0106	0940	6.0/0	NS	0.5-1.7			Silty sand/sandy silt w/gravel, v. dark gray (7.5 YR 3/1), 15% bottles/metal,
LSP0107	0930	10.2/0	NS	1.7-2.2	2--	GW ▼	10% charcoal, 30% silt, 30% sand, 15% gravel, moist, no odor (fill).
(1040 for VOC sample)							Gravel w/ sand, reddish brown (5 YR 4/4), 15% bottles/glass, 30% sand,
							55% gravel, moist to wet, no odor (fill).
					4--		
						—	Bottom of test pit at 4.5' bgs. Sampled to 2.2' bgs.

ADDITIONAL NOTES / SKETCHES

Water seeping into excavation at 2.2 ft bgs.
Glass pieces, intact bottles, metal debris encountered from 0.5' to 4.5' bgs (bottom of test pit).
A total of 31 intact bottles were removed from test pit (13 were collected for identification).

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Track Hoe
SAMPLING EQUIPMENT	SS Spoons/bowls
COORDINATES	Northing: 648990.85 ft
	Easting: 1235612.97 ft
SURFACE ELEVATION	38.70 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



TEST PIT NUMBER	TP-23
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	January 31, 2006

integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

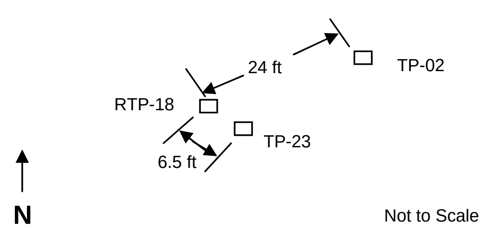
SAMPLE INFORMATION							DESCRIPTION
Sample ID	Time	PID/FID	Sheen	Sample Depth	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0108	1210	2.6	NS	0-2.0		ML	Sandy Silt w/ gravel, brown (10 YR 4/2), ~15% sand, 25% fine to 8" dia.
							gravel, ~60% silt, moist, no odor, no garbage observed (fill).
					2--		Sandy silt w/ gravel, very dark gray brown (10 YR 3/2), ~15% debris (glass,
LSP0104	1155	2.4	NS	2.0-3.5			bottles, metal), ~25% sand, ~25% fine to 3" gravel, ~35% silt, moist, no odor (fill).
							Mixture of gravel w/ sand, silt, and debris, reddish brown (5 YR 4/4), orange stained,
LSP0110	1145	3	NS	3.5 - 4.0	4--	GW	~30% debris (glass, metal), v. moist, no odor (fill).
LSP0111	1140	3.2	NS	4.0		ML	Organic-rich silt w/ gravel, black (5 YR 2.5/1), slight sulfur odor, moist (native).
LSP0112	1310	6.0	NS	4.5-5.0		SW ▼	Sand w/ gravel, dark gray (7.5 YR 4/1), 15-25% F-C gravel, trace silt, v. moist to
							wet, no odor (native).
							Bottom of test pit at 5.2 ft bgs.

ADDITIONAL NOTES / SKETCHES

Metal and glass debris observed from 2.5 ft to 4 ft bgs.
Water seeping into excavation at 5.2 ft bgs.
A total of 16 intact bottles were removed from test pit (13 were collected for identification).
No diesel odor observed (diesel odor was observed in RTP-18).

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Track Hoe
SAMPLING EQUIPMENT	SS Spoons/bowls
COORDINATES	Northing: 648928.50 ft
	Easting: 1235685.09 ft
SURFACE ELEVATION	40.59 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.

1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225

(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-24
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	January 31, 2006

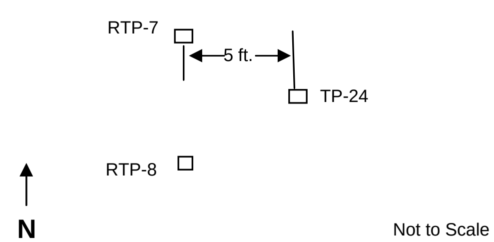
SAMPLE INFORMATION							
Sample ID	Time	PID/FID	Sheen	Sample Depth	Depth (ft)	STRATA	DESCRIPTION USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0113	1410	4.8/0	NS	0-1.5		ML	Silt with gravel, dark brown (7.5 YR 3/2), ~15% fine to corase gravel, ~5-10% sand, trace roots, moist, no odor (fill?). No debris/garbage encountered.
LSP0114	1415	5.8/0	NS	1.5	2--	GW	Gravel w/ sand, gray (10 YR 5/1), 35% sand, 5-10% silt, fine to 4" dia gravel, wet, no odor (native). No debris/garbage encountered.
							Bottom of test pit at 3.2 ft bgs.
					4--		

ADDITIONAL NOTES / SKETCHES

Standing water in test pit at 1.5 ft bgs.
Excavated to 3.2 ft bgs; could not excavate deeper due to sluffing gravel.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Track Hoe
SAMPLING EQUIPMENT	SS Spoons/bowls
COORDINATES	Northing: 649061.59 ft Easting: 1235609.45 ft
SURFACE ELEVATION	38.00 ft
DATUMS	Horizontal: NAD 83/91 Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-25
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 1, 2006

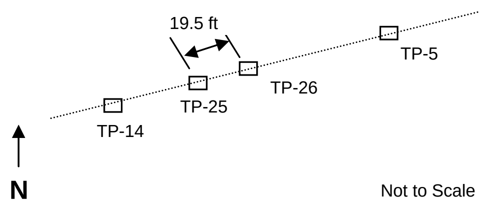
SAMPLE INFORMATION					Depth (ft)	STRATA	DESCRIPTION
Sample ID	Time	PID/FID	Sheen	Sample Depth			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0115	840	7.7/	NS	0-0.6		ML	Sandy silt, v. dark brown (10 YR 2/2), 30% fine to med. sand, abundant
		1.8				SP	roots, v. moist, no odor.
LSP0116	835	7.0/	NS	0.6-2.0			Fine to med. Sand, dark yellowish-brown (10 YR 4/4), trace (~5%) silt, moist
		1.9			2--		no odor.
LSP0117	825	8.1/	NS	2.0-3.0		▼	
		7.8					Wet at 2.5 ft bgs.
LSP0118	820	8.4/	NS	3.0-4.0			
		1.8					
					4--	—	Bottom of test pit at 4.0 ft bgs.

ADDITIONAL NOTES / SKETCHES

Water seeping into excavation at 2.5 ft bgs (standing water at 2.5 ft bgs).
After collecting the 2-3' and 3-4' bgs samples, the excavation was backfilled to ~2' bgs to safely collect the 0 - 0.6' and 0.6 - 2.0' bgs samples.
VOC sample was not collected from the 2-3' bgs interval due to standing water in the excavation.

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Track Hoe
SAMPLING EQUIPMENT	SS Spoons/bowls
COORDINATES	Northing: 649108.43 ft
	Easting: 1235153.96 ft
SURFACE ELEVATION	32.57 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-26
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C317.0102
LOGGED BY	Eron Dodak, R.G.
DATE	October 12, 2006

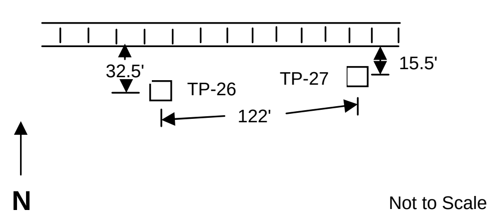
Sample ID	PID (ppm)	Sheen	Sample Time	Sample Depth	Depth (ft)	STRATA	DESCRIPTION: USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0649	3.7	NS	1555	0-1		ML	Gravelly silt, dk brown (7.5YR 3/2), 20-25% F-2" dia. gravel, trace bituminous
							coal, 10%, M-C sand, some roots, one RR spike, moist, no odor (fill).
LSP0650	7.2	NS	1600	1-2			
						ML	Slightly clayey silt, grayish brown (10YR 5/2) some orange mottling,
LSP0651	8.6	NS	1605	2-3	2--		moderately stiff, few roots, moist, no odor (native).
LSP0652	7.9	NS	1610	3-4			as above with no roots.
					4--		Test pit terminated at 4 ft bgs
Background PID=0.0ppm							No evidence of contamination observed

ADDITIONAL NOTES / SKETCHES

0-3' samples collected from test pit sidewalls
3-4' sample collected from track hoe bucket

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Track Hoe
SAMPLING EQUIPMENT	Stainless steel bowl, spoon
COORDINATES	Northings:649449.122
	Eastings: 1234694.701
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/91

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-27
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C317.0102
LOGGED BY	Eron Dodak, R.G.
DATE	October 12, 2006

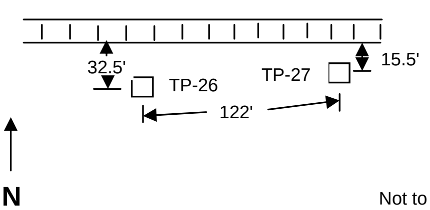
SAMPLE INFORMATION							DESCRIPTION
Sample ID	PID (ppm)	Sheen	Sample Time	Sample Depth	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0653	5.1	NS	1445	0-1		GM/ML	Silty gravel/gravely silt, dk grayish brown (10YR 4/2), 45% silt, 45% F-2" dia.
							gravel, 10% M-C sand, few pieces of wood, trace charcoal, moist, no odor (fill).
LSP0654	3.3	NS	1450	1-2		ML	Slighlty clayey silt, brown (10YR 5/3) some orange mottling, trace black organics,
					2--		slightly moist, no odor (native).
LSP0655	1.4	NS	1455	2-3			
LSP0656	4.7	NS	1500	3-4			as above with no black organics.
					4--		Test pit terminated at 4 ft bgs
Background PID=0.0ppm							No evidence of contamination observed

ADDITIONAL NOTES / SKETCHES

0-3' samples collected from test pit sidewalls
3-4' sample collected from track hoe bucket

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Track Hoe
SAMPLING EQUIPMENT	Stainless steel bowl, spoon
COORDINATES	Northings: 649464.725
	Eastings: 1234815.659
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/91

Location Sketch



Not to Scale

integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-28
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C317.0102
LOGGED BY	Eron Dodak, R.G.
DATE	October 12, 2006

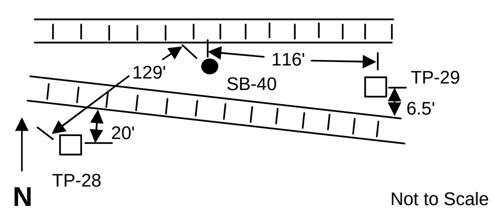
SAMPLE INFORMATION							DESCRIPTION
Sample ID	PID (ppm)	Sheen	Sample Time	Sample Depth	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0657	1.5	NS	1335	0-1		ML	Gravelly silt, dk grayish brown (10YR 4/2), 30% F-3" dia gravel, 10% M-C sand,
							5-10% bituminus coal 0.9-1.2' bgs, moist, no odor (fill).
LSP0658	5.6	NS	1340	1-2			
					2--	ML	Slightly clayey silt, brown (10YR 5/3), trace roots and organics, some orange
LSP0659	9.4	NS	1345	2-3			mottling, moderately stiff, moist, no odor (native).
LSP0660	8.4	NS	1350	3-4			as above, with color brown (10YR 4/3), no roots or organics.
					4--	—	Test pit terminated at 4 ft bgs
Background PID=0.0ppm							No evidence of contamination observed

ADDITIONAL NOTES / SKETCHES

0-3' samples collected from test pit sidewalls
3-4' sample collected from track hoe bucket

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Track Hoe
SAMPLING EQUIPMENT	Stainless steel bowl, spoon
COORDINATES	Northings: 649443.763
	Eastings: 1234939.841
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/91

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-29
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C317.0102
LOGGED BY	Eron Dodak, R.G.
DATE	October 12, 2006

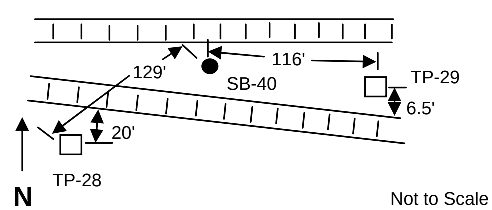
SAMPLE INFORMATION					Depth (ft)	STRATA	DESCRIPTION
Sample ID	PID (ppm)	Sheen	Sample Time	Sample Depth			USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0661	2.4	NS	1125	0-1		ML	Gravelly silt, brown (7.5YR 4/2), 30-35% F-4" dia. gravel, trace orange mottling,
							piece of bituminous coal at 1' bgs, moist, no odor (fill).
LSP0662	2.5	NS	1130	1-2			
					2--		
LSP0663	3.4	NS	1135	2-3		ML	Slightly clayey silt, grayish brown (10YR 5/2), v. stiff, slightly moist, no
							odor (native).
LSP0664	2.8	NS	1140	3-4			as above with color brown (10YR 4/3), trace orange mottling.
					4--		
						—	Test pit terminated at 4 ft bgs
Background PID=0.0ppm							No evidence of contamination observed

ADDITIONAL NOTES / SKETCHES

0-3' samples collected from test pit sidewalls
3-4' sample collected from track hoe bucket

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Track Hoe
SAMPLING EQUIPMENT	Stainless steel bowl, spoon
COORDINATES	Northings: 649462.989
	Eastings: 1235173.455
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/91

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-30
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C317.0102
LOGGED BY	Eron Dodak, R.G.
DATE	October 12, 2006

SAMPLE INFORMATION							DESCRIPTION
Sample ID	**PID (ppm)**	**Sheen**	**Sample Time**	**Sample Depth**	**Depth (ft)**	**STRATA**	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0665	1.9	NS	1000	0-1		ML	Silty gravel, v. dk grayish brown (10YR 3/2), 30% silt, 10% F-C sand, F-1.5" dia.
LSP0673 (Dup)	"	"	1005	"			gravel, trace roots/cattails, indistinct odor, moist (fill).
LSP0666	3.2	NS	1010	1-2		ML	Slightly clayey silt, brown (10YR 5/3), some orange mottling, trace roots and
					2--		carbonized organics, trace F-3" dia. gravel, slightly moist, no odor (native).
LSP0667	3.6	NS	1015	2-3			
LSP0668	4.7	NS	1020	3-4			as above with no gravel or roots
					4--	—	Test pit terminated at 4 ft bgs

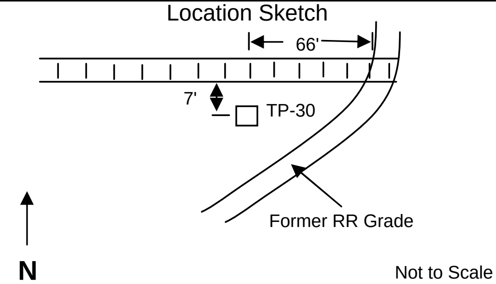
Background PID=0.3ppm

ADDITIONAL NOTES / SKETCHES

0-3' samples collected from test pit sidewalls
3-4' sample collected from track hoe bucket

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Track Hoe
SAMPLING EQUIPMENT	Stainless steel bowl, spoon
COORDINATES	Northings: 649455.066
	Eastings: 1235257.714
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/91

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

TEST PIT NUMBER	TP-31
PROJECT	W. Illinois Street Extension
LOCATION	Bellingham, Washington
PROJECT NUMBER	C317.0102
LOGGED BY	Eron Dodak, R.G.
DATE	October 12, 2006

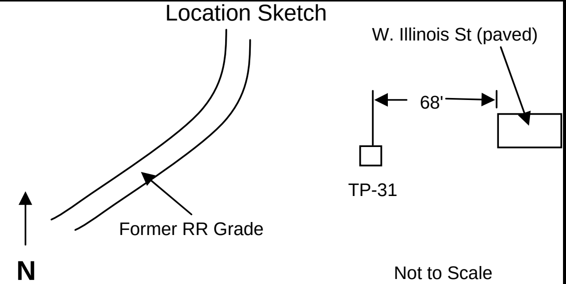
SAMPLE INFORMATION							DESCRIPTION
Sample ID	PID (ppm)	Sheen	Sample Time	Sample Depth	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0669	0.4	NS	0835	0-1		ML	Slightly gravelly silt, dk grayish brown (10YR 4/2), 15% F-2" dia. gravel, trace
							debris (plastic, rags), trace charcoal, some roots, moist, no odor (fill).
LSP0670	0.8	NS	0840	1-2			worms observed from 1-2' bgs.
					2--	ML	Slightly clayey silt, grayish brown (10YR 4/2) some orange mottling, trace roots,
LSP0671	1.0	NS	0845	2-3			slighlty moist, no odor (native).
LSP0672	0.7	NS	0850	3-4			as above w/color brown (10YR 4/3), trace carbonized and non-carbonized organics
					4--	—	Test pit terminated at 4 ft bgs
Background PID=0.0 ppm							No evidence of contamination observed

ADDITIONAL NOTES / SKETCHES

0-3' samples collected from test pit sidewalls
3-4' sample collected from track hoe bucket

EXCAVATING CONTRACTOR	Wilder Construction
EXCAVATION METHOD	Track Hoe
SAMPLING EQUIPMENT	Stainless steel bowl, spoon
COORDINATES	Northings: 649445.565
	Eastings: 1235414.311
SURFACE ELEVATION	
DATUM	Horizontal: NAD 83/91

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

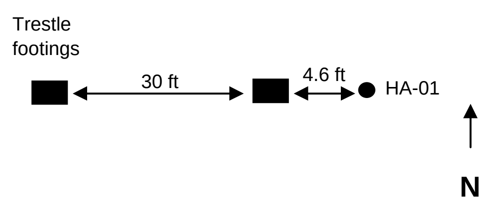
HAND AUGER NO.	HA-01
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 12, 2006

SAMPLE INFORMATION							DESCRIPTION
Sample ID	Time	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0569	0845	0/0	NS	0-1		GM	Silty gravel with sand, (50/30/20), black (10 YR 2/1), gravel up to 3" long,
							rounded to subrounded, fine to coarse sand, med to low plasticity,
							trace roots and organic detritus, worms, trace glass debris, moist, no odor.
					1--		
LSP0570	0850	0/0	NS	1-2			
							As above, some black streaks in clumps of fine-grained material, trace shell
							debris
					2--		
							Boring terminated at 2 ft bgs.
					3--		
					4--		
					5--		
					6--		
Background PID = 0.0 ppm, FID = 0.0 ppm.							

SAMPLING EQUIPMENT	3.25" dia. SS hand auger
COORDINATES	Northing: 648110.84 ft
	Eastings: 1234474.56 ft
SURFACE ELEVATION	15.38 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch

Not to Scale



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

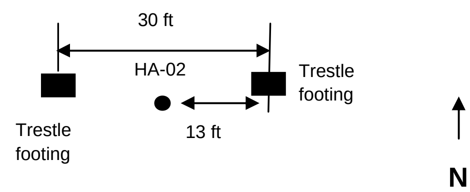
HAND AUGER NO.	HA-02
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 12, 2006

SAMPLE INFORMATION							DESCRIPTION
Sample ID	Time	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0571	0930	0/0	NS	0-1		CL	Sandy clay with gravel (30/30/40), v. dark gray (10 YR 3/1), about 25% woody debris, subangular gravel up to 3" dia., fine to coarse sand, moist to wet.
					1--	PT	Silty peat, black (10 YR 2/1), mostly woody detritus, trace sand and fine gravel,
LSP0572	0935	0/2.4	NS	1-2			20-30% silt, wet, no odor.
					2--		Boring terminated at 2 ft bgs.
					3--		
					4--		
					5--		
					6--		
Background PID = 0.0 ppm, FID = 0.0 ppm.							

SAMPLING EQUIPMENT	3.25" dia. SS hand auger
COORDINATES	Northing: 648169.29 ft
	Eastings: 1234375.86 ft
SURFACE ELEVATION	12.27 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch

Not to Scale



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

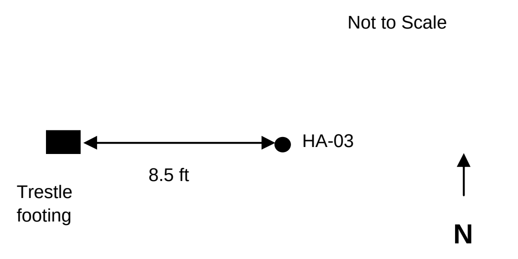
HAND AUGER NO.	HA-03
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 12, 2006

SAMPLE INFORMATION							DESCRIPTION
Sample ID	Time	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0573	1050	0/0	NS	0-1		SP/ SC	Sand with clay and gravel (35/55/10), v. dark grayish brown, gravel up to 2" dia., subangular to subrounded, fine sand, clay occurs as lenses or beds, trace plant detritus, trace mottling in clay clumps, moist, no odor.
					1--		
LSP0574	1055	0/0	NS	1-2		SP	Sand with gravel (35/60/5), 2" dia., fine to med. sand, otherwise as above.
					2--		
							Boring terminated at 2 ft. bgs.
					3--		
					4--		
					5--		
					6--		

Background PID = 0.0 ppm, FID = 0.0 ppm.

SAMPLING EQUIPMENT	3.25" dia. SS hand auger
COORDINATES	Northing: 648253.39 ft
	Eastings: 1234242.75 ft
SURFACE ELEVATION	15.53 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

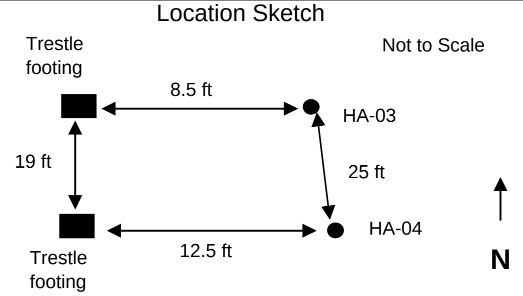
HAND AUGER NO.	HA-04
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 12, 2006

SAMPLE INFORMATION							DESCRIPTION
Sample ID	Time	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0575	1110	0/0	NS	0-1		SP	Fine sand (10/90/<5), v. dk grayish brown (10YR 3/2), trace fines, subangular gravel up to 2.5" dia., trace rootlets, moist, no odor.
					1--		
LSP0576	1115	0/0	NS	1-2		SP/ SM	Sand with silt (10/80/10), color as above, similar to above, slightly siltier, silt occurs in lenses and in matrix, gravel up to about 0.5" dia., no odor, moist.
					2--		
							Boring terminated at 2 ft bgs.
					3--		
					4--		
					5--		
					6--		

Background PID = 0.0 ppm, FID = 0.0 ppm.

SAMPLING EQUIPMENT	3.25" dia. SS hand auger
COORDINATES	Northing: 648231.38 ft
	Eastings: 1234234.49 ft
SURFACE ELEVATION	13.80 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

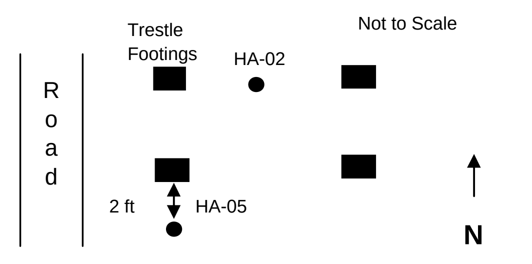
HAND AUGER NO.	HA-05
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 12, 2006

SAMPLE INFORMATION							DESCRIPTION
Sample ID	Time	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0577	1015	0/0	NS	0-1		CL/ML	Silty clay with sand, 20% v. fine to fine sand, black (10 YR 2/1), trace fine subangular gravel, trace glass shards, 15% organics (roots, rootlets), medium to high plasticity, moist, no odor.
					1--		
LSP0578	1020	0/0	NS	1-2			As above with increased fine sand content, trace fine sand lenses (gray), 20% rootlets and woody debris, moist to wet, no odor.
					2--	—	Boring terminated at 2 ft bgs.
					3--		
					4--		
					5--		
					6--		

Background PID = 0.0 ppm, FID = 0.0 ppm.

SAMPLING EQUIPMENT	3.25" dia. SS hand auger
COORDINATES	Northing: 648159.70 ft
	Eastings: 1234349.45 ft
SURFACE ELEVATION	11.69 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

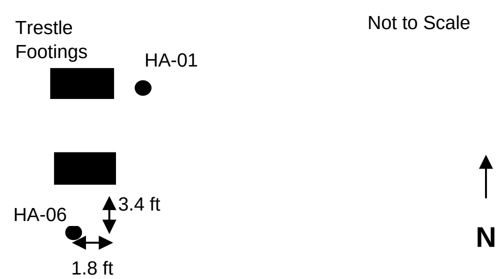
HAND AUGER NO.	HA-06
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Susan Fitzgerald, P.G.
DATE	April 12, 2006

SAMPLE INFORMATION							DESCRIPTION
Sample ID	Time	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0579	0900	0/0	NS	0-1		GC	Clayey gravel with sand (50/25/25), black (10YR 2/1), subangular to subrounded gravel
							up to 1.5" dia., fine to coarse sand, ~10% rootlets, several earthworms, moist to wet,
LSP0581	0905	-	-	0-1 (dup)			no odor.
					1--		
LSP0580	0910	0/2.4	NS	1-2			As above with increased sand content (50/20/30), increased wood debris content,
							trace glass shards.
					2--		
							Boring terminated at 2 ft bgs.
					3--		
					4--		
					5--		
					6--		

Background PID = 0.0 ppm, FID = 0.0 ppm.

SAMPLING EQUIPMENT	3.25" dia. SS hand auger
COORDINATES	Northing: 648093.36 ft
	Eastings: 1234457.60 ft
SURFACE ELEVATION	13.33 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

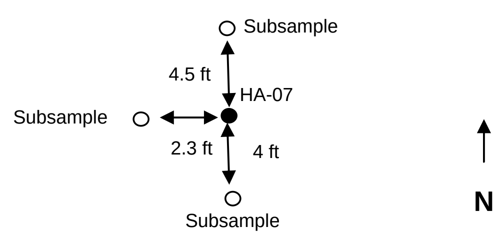
HAND AUGER NO.	HA-07
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	November 4, 2005

SAMPLE INFORMATION							DESCRIPTION
Sample ID	**Time**	**PID/FID**	**Sheen**	**Sample Depth (ft)**	**Depth (ft)**	**STRATA**	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0015	1445	0.9	NS	0-1		ML	Clayey silt, dark gray (7.5 YR 4/1), 15-20% clay, 5-10% fine to med. sand,
							~5% roots, moist, no odor.
					1--		Silt with sand, brown (7.5 YR 4/2), 20-25% fine to med. sand, 5-10% clay, v.
LSP0016	1500	2.0	NS	1-2			moist, indistinct to no odor.
							Water in borings at 1.5 to 2 ft bgs.
					2--	—	Boring terminated at 2 ft bgs.
					3--		
					4--		
					5--		
					6--		

SAMPLING EQUIPMENT	3.25" dia. SS hand auger
COORDINATES	Northing: 649325.59 ft
	Eastings: 1235251.68 ft
SURFACE ELEVATION	35.44 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAVD 88

Location Sketch

Not to Scale



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

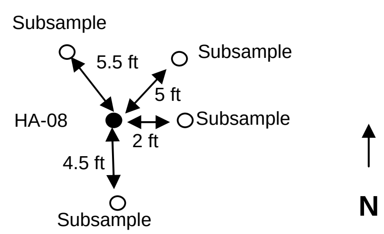
HAND AUGER NO.	HA-08
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	November 4, 2005

SAMPLE INFORMATION							DESCRIPTION
Sample ID	Time	PID/FID	Sheen	Sample Depth (ft)	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0017	1550	1.4	NS	0-1		ML	Sandy silt, dark grayish brown (10 YR 4/2), 20-25% fine to med. sand,
							10-15% clay, 3-5% roots, moist, no odor.
LSP0018	1600	1.3	NS	1-2	1--		
							Well graded sand w/ silt and gravel, dark grayish brown (10 YR 4/2), 25-30%
						SW	fine to coarse subrounded gravel, 10-15% silt, wet, no odor.
							Standing water in borings at about 1 ft logs.
					2--	—	
							Boring terminated at 2 ft. bgs.
					3--		
					4--		
					5--		
					6--		

SAMPLING EQUIPMENT	3.25" dia. SS hand auger
COORDINATES	Northing: 649359.48 ft
	Eastings: 1235277.73 ft
SURFACE ELEVATION	36.60 ft
DATUMS	Horizontal: NAD 83/91
	Vertical: NAD 88

Location Sketch

Not to Scale



integral consulting inc.
1201 Cornwall Avenue, Suite 208
Bellingham, WA 98225
(360) 756-9296 FAX (360) 756-7914

HAND AUGER NO.	HA-09 (corner of wetland)
PROJECT	Little Squalicum Park RI/FS
LOCATION	Bellingham, Washington
PROJECT NUMBER	C075-02
LOGGED BY	Eron Dodak, R.G.
DATE	February 1, 2006

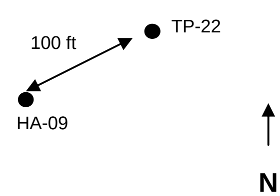
SAMPLE INFORMATION							DESCRIPTION
Sample ID	Time	PID/FID	Sheen	Depth	Depth (ft)	STRATA	USCS group name, color, grain size range, minor constituents, plasticity, odor, sheen, moisture content, texture, weathering, cementation, geologic interpretation, etc.
LSP0119	1645	3.2/102	NS	0-2.5		ML	Clayey silt v. dark brown (10 YR 2/2), 20% roots/wood, soft, wet, sulfur odor.
							Clayey silt, v. dark grayish brown (10 YR 3/2), ~ 5% roots/some organics,
					1--		orange mottling, slightly stiff, v. moist, slight sulfur odor.
							Silty fine sand/sandy silt, v. dark gray (10 YR 3/1), no odor, moist.
					2--		
						—	
					3--		Refusal at 2.5 ft bgs.
							Pushed to 2.5 ft in each of 3 cores.
							Recovery 1.1 to 1.3 ft per core.
					4--		Sample is a composite of all three cores.
							Cores collected in a 6 ft area.
					5--		
					6--		

**Elevated FID reading likely due to methane or sulfate in sediments.
Background PID=1.3 ppm.

SAMPLING EQUIPMENT	2" Push Core
COORDINATES	Station HA-9 was not surveyed.

Location Sketch

Not to Scale



ATTACHMENT 7

PHOTO LOGS

Photo 1. Groundwater purging through a flow-through cell using a peristaltic pump. Piezometer SB-28 is shown in the photo.

Photo 2. Groundwater purging using a new, disposable Teflon® bailer. Monitoring well MW-6D is shown in the photo.

Photo 3. Surface water sample collection using a peristaltic pump. The reference surface water station is shown in the photo.

Photo 4. Vibracore sample collection in the historical creek channel. Station SB-38 is shown in the photo.

Photo 5. Soil sample collection using a stainless steel hand auger. Station HA-8 is shown in the photo.

Photo 6. Small track excavator used to excavate test pits. Reconnaissance test pit RTP-13 is shown in the photo.

Photo 7. Standard rubber tire hollow-stem auger drill rig used to install monitoring wells. Monitoring well SB-24 is shown in the photo.

Photo 8. Track-mounted hollow-stem auger dill rig used to advance soil borings and install piezometers. Soil boring station SB-5 is shown in the photo.

Photo 9. Acker® portable hollow-stem auger drill rig used to advance soil borings and install piezometers. Station SB-14 is shown in the photo.

Photo 10. PVC surge block used to develop piezometers that produced little water.

Photo 11. Centrifugal pump used to develop monitoring wells.

Photo 12. Bottles and metal debris recovered from test pit TP-22.

Photo 13. Soil sample collection from 1.7 to 2.2 ft below ground surface at test pit TP-22.

Photo 14. Historical landfill debris underlain by a black organic-rich silt (native) observed at test pit TP-23.

ATTACHMENT 8

FIELD CHANGE REQUEST FORMS

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park Project No.: C075.0206
Client: City of Bellingham Request No.: FCR-1

To: Mark Herrenkohl Date: 03-Nov-05

Field Change Request Title: Surface Water Sampling – Equipment Rinsate Blank

Description:
Project SAP dated 30-Sep-05 indicates that equipment rinsate blanks will be collected once per sampling method (p. 4-22). Equipment rinsate blank is not necessary for surface water sampling.

Reason for Change:
Surface water samples are collected from each station using new disposable teflon-lined LDPE tubing and silicone tubing or the sample bottles are filled directly from a stream of water (e.g. outfall pipe).

Recommended Disposition:
Do not collect equipment rinsate blank for surface water sampling.

Eron Dodak [signature] 03-Nov-05
Field Operations Lead (or designee) Signature Date

Disposition:

Project Manager Signature Date

Approval:
MARK J. HERRENKOHL [signature] 11/3/05
Project Manager Signature Date

Distribution:
City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead
QA Officer
Project File
Other: Mary O'Herron, Ecology

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park　　Project No.: C075.0206
Client: City of Bellingham　　Request No.: FCR- 2

To: Mark Herrenkohl　　Date: 03-Nov-05

Field Change Request Title: Groundwater Sampling - Equipment Rinsate Blank

Description:
Project SAP ~~dra~~ [03-Nov-05] dated 30-Sep-05 indicates that equipment rinsate blanks will be collected once per sampling method (P. 4-21). An equipment rinsate blank is not necessary for groundwater sampling.

Reason for Change:
Groundwater samples are collected from each well using new disposable teflon-lined LDPE ~~tubing~~ [03-Nov-05] and Silicone tubing and/or a new disposable teflon bailer.

Recommended Disposition:
Do not collect an equipment rinsate blank for groundwater sampling.

Evan Dodak　　[signature]　　03-Nov-05
Field Operations Lead (or designee)　　Signature　　Date

Disposition:

Project Manager　　Signature　　Date

Approval:
[signature]　　MARK J. HERRENKOHL　　11/3/05
Project Manager　　Signature　　Date

Distribution:
City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead
QA Officer
Project File
Other: Mary O'Herron, Ecology

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park RI/FS   Project No.: C0750206
Client: City of Bellingham, Parks Dept.   Request No.: FCR-3

To: Project File   Date: 11/3/05

Field Change Request Title: Groundwater Monitoring Well MWLSC01

Description:
No groundwater samples were collected from MWLSC01.

Reason for Change:
The well contains sand/gravel (foundation) material and submersible sampling pump. It appears well has been altered/destroyed by nearby construction activities

Recommended Disposition:
Recommend decommissioning well. This recommendation will be made to the City of Bellingham.

Marty Herrendahl   [signature]   11/3/05
Field Operations Lead (or designee)   Signature   Date

Disposition:

Project Manager   Signature   Date

Approval:
[signature]   11/3/05
Project Manager   Signature   Date

Distribution:
City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead
QA Officer
Project File
Other:

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: LSP RI/FS Project No.: C0750206
Client: City of Bellingham Request No.: FCR- 4

To: Project Files Date: 11/7/05

Field Change Request Title: Surface Sediment Samples – Mouth of Creek (LSC-10, -11, -12)

Description:

Surface sediment collection at stations LSC-10, LSC-11, LSC-12 located at the end of culvert, mouth of LSC.

Reason for Change:

No fine-grained sediment was observed at these locations. The mouth of the creek and beach are exposed to wind and waves of Bellingham Bay. Fines are washed away.

Recommended Disposition:

Do not collect samples from these locations. Email to Ecology 11/7/05 requesting change. Agreed on 11/7/05.

Field Operations Lead (or designee) Signature Date

Disposition:

Project Manager Signature Date

Approval:

Mark J. Herrenkohl [signature] 11/7/05

Project Manager Signature Date

Distribution:

City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead
QA Officer
Project File
Other:

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park　　Project No.: C075

Client: City of Bellingham　　Request No.: FCR- 05

To: Mark Herrenkohl, Proj. Mgr　　Date: 11 Nov 05

Field Change Request Title: TOC Rinsate Blank for Test Pit Sampling

Description:

TOC rinsate volume not collected

Reason for Change:

Inadvertant omission.

Recommended Disposition:

Susan FitzGerald　　[signature]　　11 November 05

Field Operations Lead (or designee)　　Signature　　Date

Disposition:

TOC is not a chemical of concern.

Mark J. Herrenkohl

Project Manager　　Signature　　Date

Approval:

[signature]　　11/11/05

Project Manager　　Signature　　Date

Distribution:

City of Bellingham Project Manager

Integral Project Manager

Field Operations Lead

QA Officer

Project File

Other:

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park   Project No.: C075.0206/0211
Client: City of Bellingham   Request No.: FCR- 6

To: Mark Herrenkohl   Date: 14-Feb-06

Field Change Request Title: Containment of Visually Contaminated IDW

Description:
Encountered visually contaminated soil/sediment in several boreholes (sheen, NAPL globules, creosote-like odor). Drum up all visually contaminated materials.

Reason for Change:
To avoid leaving visually contaminated materials at sample stations.

Recommended Disposition:
Drum all visually contaminated soil/sediment cuttings and decontamination water used to clean augers/sampling equipment that are visually contaminated

Eron Dodak   [signature]   14-Feb-06
Field Operations Lead (or designee)   Signature   Date

Disposition:
Agree w/ above - discussed on phone 2/14/06

Project Manager   Signature   Date

Approval:
Mark Herrenkohl   [signature]   2/22/06
Project Manager   Signature   Date

Distribution:
City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead
QA Officer
Project File
Other:

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park Project No.: C075.0206/0211
Client: City of Bellingham Request No.: FCR- 7

To: Mark Herrenkohl Date: 14-Feb-06

Field Change Request Title: Decontamination when encountering NAPL.

Description:
Removed methanol (methyl alcohol) from decontamination procedure when encountered petroleum NAPL

Reason for Change:
Field crew concerned about the health hazards of methanol. Methanol is only used to displace water prior to hexane whipe.

Recommended Disposition:
New decon procedure: (1) Liquinox wash (2) tap water rinse (3) Distilled water rinse (4) dry equipment w/ paper towels (5) hexane whipe (6) Final distilled water rinse.

Eron Dodak [signature] 14-Feb-06
Field Operations Lead (or designee) Signature Date

Disposition:
Agree w/ above. Discussed on phone 2/14/06

Project Manager Signature Date

Approval:
MARK HERRENKOHL [signature] 2/22/06
Project Manager Signature Date

Distribution:
City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead
QA Officer
Project File
Other:

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park — Project No.: C075.0211
Client: City of Bellingham — Request No.: FCR-8

To: Mark Herrenkohl — Date: 14-Feb-06

Field Change Request Title: Sample collection intervals on SB-24

Description:
Reduce number of samples collected from SB-24 below 20 ft bgs.

Reason for Change:
Field observations from SB-21, 22, 23 indicated no contamination above the water table. Reducing the number of samples collected above the water table will significantly speed up the drilling process.

Recommended Disposition:
Collect soil samples every 5 ft (18" samples) to 15 ft bgs and continuously below 20 ft bgs.

Erin Dodak — [signature] — 14-Feb-06
Field Operations Lead (or designee) — Signature — Date

Disposition:
Agree w/ above. Discussed on phone 2/14/06

Project Manager — Signature — Date

Approval:
MARK HERRENKOHL — [signature] — 2/22/06
Project Manager — Signature — Date

Distribution:
City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead
QA Officer
Project File
Other:

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park
Project No.: C075-0206/0211
Client: City of Bellingham
Request No.: FCR- 9

To: Mark Henneman
Date: 17-Feb-06

Field Change Request Title: Piezometer and Monitoring Well Development

Description:
Many of the 1"Ø piezometers and 2"Ø monitoring wells installed produce very little water that is very turbid.

Reason for Change:
Unable to pump 50 casing volumes or reduce turbidity to 50 NTUs in a reasonable amount of time.

Recommended Disposition:
Surge w/ pump or PVC surge block, pump dry, allow to recover and repeat the procedure for approximately 4 hrs.

Brian Dodak | [signature] | 17-Feb-06
Field Operations Lead (or designee) | Signature | Date

Disposition:
Agree w/ above. Discussed on phone 2/17/06

Project Manager | Signature | Date

Approval:
Mark Henneman | [signature] | 2/22/06
Project Manager | Signature | Date

Distribution:
City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead
QA Officer
Project File
Other:

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park
Project No.: C075.02 11
Client: City of Bellingham
Request No.: FCR- 10

To: Mark Herrenkohl
Date: 20-Feb-06

Field Change Request Title: Water Quality Parameters on SB-9

Description:
A moderately heavy petroleum sheen was observed on purge water from SB-9. Do not collect field water quality parameters during purging activities.

Reason for Change:
The petroleum sheen may damage the Horiba U-22 water quality meter probes (replacement cost $3000-5000).

Recommended Disposition:
Do not collect water quality parameters on purge water from SB-9. Include visual description of groundwater (turbidity, color, sheen, odor) on field sampling sheet.

Field Operations Lead (or designee)	Signature	Date
Erin Dodd	[signature]	20-Feb-06

Disposition:
Agree w/above. Discussed on phone 2/20/06

Project Manager	Signature	Date

Approval:

Project Manager	Signature	Date
MARK HERRENKOHL	[signature]	2/22/06

Distribution:
City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead
QA Officer
Project File
Other:

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park
Client: City of Bellingham

Project No.: C075.0211
Request No.: FCR-11

To: Mark Herrenkohl Date:

Field Change Request Title: Soil Sample analyses from SB-26, 27, 30, -32.

Description:
Did not analyze Surface Soil Samples collected from SB-26, -27, -30, -32

Reason for Change:
These Stations are located 100 ft or more from the creek in areas where sufficient surface soil data already exist

Recommended Disposition:
Archive Surface Soil Samples from SB-26, -27, -30, and -32. Discussed with M. Herrenkohl on or about April 9, 2006.

Eron Dodak [signature] May 11 / 2006

Field Operations Lead (or designee) Signature **Date**

Disposition:

Project Manager Signature Date

Approval:

MARK HERRENKOHL [signature] 5/11/06

Project Manager Signature Date

Distribution:

City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead

QA Officer
Project File
Other:

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park
Client: City of Bellingham

Project No.: C075.0211
Request No.: FCR- 12

To: Mark Herrenkohl
Date: May 11, 2006

Field Change Request Title: Groundwater sample collection at SB-26, -27, -28, -30.

Description:
Did not collect dioxin/furan groundwater samples from stations SB-26, -27, -28, and -30.

Reason for Change:
No visual evidence of contamination at these stations.

Recommended Disposition:
Do not collect dioxin/furan groundwater samples from these stations. Discussed with M. Herrenkohl on or about April 30, 2006.

Eron Dodak — [signature] — May 11, 2006
Field Operations Lead (or designee) — **Signature** — **Date**

Disposition:
Discussed w/ Mary O'Herron of Ecology. Decided to collect and analyze dioxins for SB-25, 29, 32

Project Manager — Signature — Date

Approval:
MARK HERRENKOHL — [signature] — 5/11/06
Project Manager — Signature — Date

Distribution:
City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead
QA Officer
Project File
Other:

FIELD CHANGE REQUEST (FCR) FORM (TYPICAL)

Project Name: Little Squalicum Park **Project No.:** C075.0211
Client: City of Bellingham **Request No.:** FCR-13

To: Mark Herrenkohl **Date:** May 11, 2006

Field Change Request Title: Water Quality Parameters on SB-29

Description:
A petroleum sheen was observed on purge water from SB-29. Do not ~~include~~ *longer* collect water quality parameters during purging activities.

Reason for Change:
The petroleum sheen may damage the water quality meter probes.

Recommended Disposition:
Did not collect water quality parameters on purge water from SB-29.

Evan Dobrick | [signature] | May 11, 2006
Field Operations Lead (or designee) | Signature | **Date**

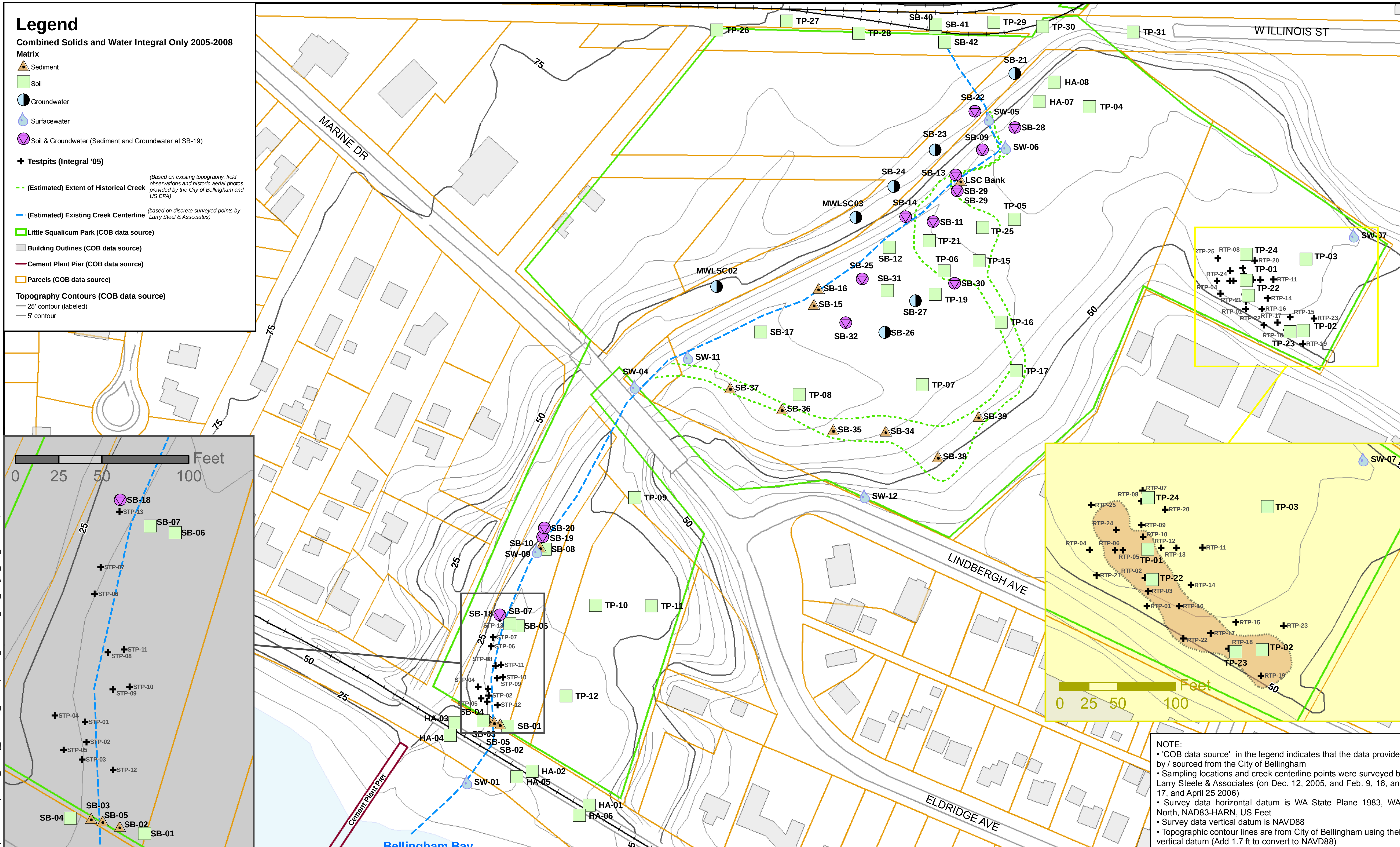
Disposition:

Project Manager | Signature | Date

Approval:

MARK HERRENKOHL | [signature] | 5/11/06
Project Manager | Signature | Date

Distribution:
City of Bellingham Project Manager
Integral Project Manager
Field Operations Lead
QA Officer
Project File
Other:



Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_integral_locs_2008.mxd) TWC -- 6/24/2008 -- 10:11:07 AM

Feet
0 50 100 200

DRAFT

Figure B-1
Sampling Locations
Little Squalicum Park RI, Bellingham, WA

APPENDIX C

DATA VALIDATION REPORT (CD)

EcoChem, INC.
Environmental Data Quality

DATA QUALITY EVALUATION

LITTLE SQUALICUM PARK
BELLINGHAM, WASHINGTON

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

GROUND WATER SAMPLES

Prepared for:

Integral Consulting
1201 Cornwall Avenue, Suite 208
Bellingham, Washington 98225

Prepared by:

EcoChem, Inc.
710 Second Avenue, Suite 660
Seattle, Washington 98104

EcoChem Project: C22112

August 11, 2006

Approved for Release:

____

Eric Strout
Project Manager/Technical Director
EcoChem, Inc.

DATA QUALITY EVALUATION

BASIS OF DATA EVALUATION

The data were validated using guidance and quality control (QC) criteria documented in the analytical methods; *Little Squalicum Park Remedial Investigation/Feasibility Study, Bellingham, WA, Quality Assurance Project Plan* (QAPP) (Integral 2005), and *National Functional Guidelines for Organic and/or Inorganic Data Review* (USEPA 1999 & 2002). Additional guidance for validation of dioxin/furan data is documented in *EPA Region 10 SOP for the Validation of Polychlorinated Dibenzodioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) Data* (EPA 1996).

Samples were analyzed for the following parameters:

Test	Method
Semivolatile Organic Compounds (SVOC)	SW 8270D
Gasoline Range Organics (GRO)	NWTPH-Gx and WA VPH
Diesel Range Organics (DRO) and Motor Oil	NWTPH-Dx and WA EPH
Dioxin/Furan Compounds	E1613B
Metals	SW 6010B/E200.8
Mercury	SW7470A
Total Organic Carbon (TOC)	E415.1
Total Suspended Solids (TSS)	E160.2
Hardness	SW6010/SM2340B

EcoChem's goal in assigning data assessment qualifiers is to assist in proper data interpretation. If values are assigned a J or UJ, data may be used for site evaluation and risk assessment purposes, but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet the data quality objectives as stated in the above-referenced documents and methods.

Data qualifier definitions, reason codes, and validation criteria are included as **Appendix A**. Data validation reports, which discuss individual findings for each quality control element by sample delivery group (SDG), are provided in **Appendix B**. Data validation worksheets and communication records are organized by SDG and will be kept on file at EcoChem.

PROCESS FOR DATA VALIDATION

With the exception of the conventional and physical parameters analyses, the first data package generated for the aqueous matrix for each chemical analysis type received Level 4 (full) validation. The following quality control elements, as appropriate for each method, were evaluated:

- Package completeness
- Sample chain-of-custody and sample preservation
- Analytical holding times

- Blank contamination
- Precision (replicate analyses)
- Accuracy (compound recovery)
- Chromatogram review
- Detection limits
- Instrument performance (initial calibration, continuing calibration, tuning, sensitivity and degradation)
- Compound identification
- Transcription and calculation checks

No significant data quality issues were identified therefore; all remaining data were evaluated based on the review of standard analytical quality control elements, using data summaries generated from the analytical database.

EcoChem validation process provides a dual-tier system of primary and secondary reviewers to ensure technical correctness and QC of the validation process; and all data validation is documented using standardized and controlled validation worksheets and spreadsheets. These worksheets are completed for each SDG, documenting all deficiencies, outliers and subsequent qualifiers.

After qualifiers are entered into the EcoChem database, a second party verifies 100% of the qualifier entry. Algorithms are then used within the database to apply the final interpretive qualifiers to the field samples. The interpretive qualifiers merge quantitative laboratory flags with the validation qualifiers. The qualified data is then exported to the project database (Integral).

SUMMARY OF DATA VALIDATION: SEMIVOLATILE ORGANIC COMPOUNDS

A total of 27 ground water samples were analyzed for semivolatile organic compounds (SVOC) for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed the SVOC analyses.

The SVOC data for the ground water samples were generally acceptable. A total of four (4) data points (0.19% of all ground water SVOC results) were of unacceptable quality and were rejected. Twenty (20) data points were estimated because control limits were exceeded in one or more laboratory QC samples or procedures. Qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were greater than 99% complete for the ground water SVOC analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial calibration analyses met all acceptance criteria.

The continuing calibration percent difference (%D) values were reviewed to evaluate instrument stability. When %D outliers were present, the potential bias was determined. If the %D outlier indicated a low bias, associated positive results and detection limits were estimated (J or UJ). If the %D outlier indicated a high bias, only associated positive results were estimated (J). A total of 15 detection limits were estimated (UJ). Overall, 0.73% of the ground water SVOC results were estimated based on calibration outliers.

Method Blank Analyses

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times (5x) the concentration detected in the blank for most compounds and ten times (10x) for phthalates. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Various target analytes were detected in the method blanks. A total of 20 results (0.97% of all ground water SVOC results) were qualified as not detected (U) based on method blank contamination. The qualifiers were issued to bis(2-ethylhexyl)phthalate (one result) and di-n-butyl phthalate (19 results).

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. The surrogate recoveries reported by the laboratory typically met the criteria for acceptable performance; however, a surrogate recovery outlier was present in one sample. As there was only one percent recovery (%R) value outlier per fraction (acid or base-neutral), the associated field data were not impacted, and no further action was taken.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. All of the recoveries reported by the laboratory for MS/MSD analyses met the criteria for acceptable performance.

Laboratory Control Sample Recoveries

Laboratory control sample/laboratory control sample duplicate (LCS/LCSD) analyses were performed at the proper frequency. Several of the recoveries reported by the laboratory did not meet the criteria for acceptable performance. Twenty (20) ground water SVOC results (0.97% overall) were estimated (J or UJ) because the control limits for LCS/LCSD recovery were not met. Four (4) results (0.19% overall) were rejected (R). Results were rejected when the %R value was less than 10%, indicating an extremely low bias.

Precision

MS/MSD and LCS/LCSD analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values for the MS/MSD and LCS/LCSD analyses met the criteria for acceptable performance.

Field Quality Control Samples

Field QC samples collected for the ground water sampling event included field replicate samples.

Field Replicate Samples

All of the RPD values for field replicate analyses met the criteria for acceptable precision.

SUMMARY OF DATA VALIDATION: GASOLINE RANGE ORGANICS (GRO)

A total of 28 ground water samples were analyzed for GRO for the Little Squalicum Park RI/FS event. The samples were analyzed using Method NWTPH-Gx and one sample (LSP0596) was also analyzed using the WA VPH method. Analytical Resources, Inc (ARI), Seattle, Washington completed the GRO analyses.

The GRO data for the ground water samples were acceptable. No data were qualified for any reason. The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the ground water GRO analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial and continuing calibrations met all acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. The surrogate recoveries reported by the laboratory typically met the criteria for acceptable performance; however, surrogate recovery outliers were present in several samples. As the outliers indicated a potential high bias and GRO was not detected in the associated samples, no action was taken.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. All of the recoveries reported by the laboratory for MS/MSD analyses met the criteria for acceptable performance.

Laboratory Control Sample Recoveries

Laboratory control sample (LCS) analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Precision

MS/MSD and LCS/LCSD analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values for the MS/MSD analyses met the criteria for acceptable performance.

Field Quality Control Samples

Field QC samples collected for the ground water sampling event included field replicate samples.

Field Replicate Samples

One of the RPD values for field replicate analyses did not meet the criteria for acceptable precision. The field replicate precision outliers are discussed in greater detail in the data validation reports. No data were qualified based on field precision; however, users of the data should consider the potential impact of precision outliers on the reported results.

SUMMARY OF DATA VALIDATION: DIESEL RANGE ORGANICS (DRO)

A total of 27 ground water samples were analyzed for DRO (including motor oil) for the Little Squalicum Park RI/FS event. The samples were analyzed using Method NWTPH-Dx and three samples (LSP0591, LSP0592, and LSP0596) were also analyzed using the WA EPH method. Analytical Resources, Inc (ARI), Seattle, Washington completed the DRO analyses.

The DRO data for the ground water samples were generally acceptable. No data were rejected for any reason. A total of 6 data points (7.1% of all ground water DRO results) were estimated because control limits were exceeded in one or more laboratory quality control (QC) samples or procedures. These qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the ground water DRO analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial and continuing calibration analyses met acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. The surrogate recoveries reported by the laboratory typically met the criteria for acceptable performance; however, surrogate recovery outliers were present in several samples. As the outliers indicated a potential high bias and DRO was not detected in the associated samples, no action was taken.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. All of the recoveries reported by the laboratory for MS/MSD analyses met the criteria for acceptable performance.

Laboratory Control Sample Recoveries

Laboratory control sample (LCS) analyses met the criteria for frequency of analysis. Several of the recoveries reported by the laboratory for the LCS analyses did not meet the criteria for acceptable performance. Six (6) reporting limits (7.1% overall) were estimated (UJ) because the control limits for LCS recovery were not met.

Precision

MS/MSD and LCS/LCSD analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values for the MS/MSD analyses met the criteria for acceptable performance.

Field Quality Control Samples

Field QC samples collected for the ground water sampling event included field replicate samples.

Field Replicate Samples

All of the RPD values for field replicate analyses were acceptable.

SUMMARY OF DATA VALIDATION: DIOXIN/FURAN COMPOUNDS

Sixteen (16) ground water samples were analyzed for dioxin and furan compounds for the Little Squalicum Park RI/FS event. Severn Trent Laboratories, Sacramento, California completed the analyses.

The dioxin/furan data for the ground water samples were generally acceptable. No data were rejected for any reason. All of the data were estimated based on holding time outliers. These qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the ground water dioxin/furan analyses.

Holding Times and Sample Preservation

The QAPP-required holding time criterion is seven days from the date sampling to date of extraction. The holding time criterion for extracts is 40 days from extraction to analysis. All samples were extracted beyond the 7 day extraction criterion, ranging from 14 days to 21 days after the date of sampling. All of the ground water dioxin/furan results were estimated (J/UJ).

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial and continuing calibration analyses met all acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

Labeled Compound Recoveries

Labeled compounds were added to all field and QC samples. The labeled compound recoveries reported by the laboratory met the criteria for acceptable performance.

Matrix Spike Recoveries

Matrix and duplicate matrix spike (MS/MSD) analyses were not performed. Accuracy was assessed using the labeled compound and ongoing precision and recovery (OPR) analyses.

Ongoing Precision and Recovery Sample Recoveries

OPR analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Precision

Laboratory duplicate OPR analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values met the criteria for acceptable performance.

Compound Identification and Quantitation

A laboratory "E" flag indicates that the reported result is greater than the upper calibration range established by the initial calibration. If no dilution analysis was performed, the "E" flagged data were estimated (J). One (1) data point was estimated based on calibration range exceedance.

Field Quality Control Samples

Field Replicate Samples

All the RPD values for field replicate analyses met the criteria for acceptable precision.

SUMMARY OF DATA VALIDATION: METALS (INCLUDING MERCURY)

A total of 20 ground water samples were analyzed for total and dissolved metals for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed all analyses. The following analytical methods were used:

Parameter	Method
ICP Metals	SW6010B
ICP-MS Metals	E200.8
Mercury	SW7470A

The metals data for the ground water samples were acceptable. No data were qualified for any reason. The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the ground water metals analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. The calibrations met all acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of analytical bias (matrix spike [MS], laboratory control sample [LCS], contract required detection limit [CRDL] standard recovery values, interference check samples [ICS], and serial dilution percent difference [%D] values).

Matrix Spike Recoveries

MS analyses met the criteria for frequency of analysis. All of the recoveries reported by the laboratory met the criteria for acceptable performance.

Laboratory Control Sample Recoveries

LCS analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Contract Required Detection Limit Standard Analyses

CRDL standards were analyzed at the beginning of each analytical sequence. All recoveries were acceptable.

Interference Check Samples

ICP interference check samples were analyzed at the beginning of each analytical sequence. All ICP interference check sample results were within the acceptance criteria.

Serial Dilution Analyses

Serial dilution analyses were not performed. Any significant physical or chemical interferences due to sample matrix could not be determined.

Precision

Laboratory duplicate analyses were evaluated for laboratory precision. All relative percent difference (RPD) values were acceptable.

Field Quality Control Samples

Field QC samples collected for the ground waters sampling event included field replicate samples.

Field Replicate Samples

Two of the RPD values in the field replicate analyses did not meet the criteria for acceptable precision. The field replicate precision outliers are discussed in greater detail in the data validation reports. No data were qualified based on field precision; however, users of the data should consider the potential impact of precision outliers on the reported results.

SUMMARY OF DATA VALIDATION: CONVENTIONAL PARAMETERS

A total of 36 ground water samples were analyzed for the following parameters for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington, completed all analyses. The following analytical methods were used:

Parameter	Method Number
Total Organic Carbon (TOC)	E415.1
Total Suspended Solids (TSS)	E160.2
Hardness	SW6010/SM2340B

Overall, the conventional parameters data for the ground water samples were acceptable. No data were qualified for any reason. The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the ground water conventional parameters analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for the TOC analyses and met the criteria for frequency of analysis. The initial calibrations met the linearity (percent relative standard deviation or correlation coefficient) control limits.

Method Blank Analyses

Two types of laboratory blanks were evaluated for possible contamination effects. These blanks were: initial and continuing calibration blanks (ICB and CCB) and method blanks (MB). The required frequency of one at the beginning and one every ten samples for calibration blank analysis was met. The laboratory analyzed one MB for every 20 samples digested or one per batch, for each digestion procedure, as required. No target analytes were detected in the blanks.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of analytical bias (matrix spike [MS] and laboratory control sample [LCS] recoveries) and precision (sample or matrix spike duplicate [MSD] analyses).

Matrix Spike Recoveries

MS analyses were completed for the TOC analyses and met the criteria for frequency of analysis. All recovery values met the acceptance criteria.

Laboratory Control Sample Recoveries

An LCS was analyzed for the TOC analyses. All LCS recovery values were acceptable.

Precision

Laboratory duplicate analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values met the criteria for acceptable performance.

Field Quality Control Samples

Field QC samples collected for the Phase 2 RI/FS included field replicate samples.

Field Replicate Samples

All of the RPD values in the field replicate analyses met the criteria for acceptable precision.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Conventional Parameter Analyses
Matrix: Groundwater

This report documents the review of analytical data from the analyses of groundwater samples and the associated laboratory and field quality control (QC) samples. Analytical Resources, Inc., Seattle, Washington, analyzed the samples.

SDG	Number of Samples	Validation Level
IS32	4 Groundwater	3
JC38	14 Groundwater	3
JH84	8 Groundwater	2

The analytical tests that were performed are summarized below:

Parameter	Method
Total Suspended Solids (TSS)	160.2
Total Organic Carbon (TOC)	EPA 415.1
Hardness (H)	SW6010/SM2340B

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II TECHNICAL DATA VALIDATION

The QC requirements for review are listed below.

1 Technical Holding Times and Sample Preservation
Initial Calibration (ICAL)
Calibration Verification (CVER)
CRDL Standard
Laboratory Blanks
Field Blanks
Laboratory Control Samples
Matrix Spike Samples
Laboratory Duplicates
ICP Interference Check Samples
ICP Serial Dilution
ICPMS Internal Standards
1 Field Duplicates
1 Reporting Limits (MDL and MRL)

---

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Technical Holding Times and Sample Preservation

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received many of the sample coolers with temperatures below the advisory control limits, with a low of -2.0ºC. It was determined that these outliers did not impact data quality and no action was taken.

Field Duplicates

Replicate sample pairs were listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 35% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and replicate must be less than two times the RL. No data were qualified based on field replicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG IS32: One set of field duplicates was submitted with this SDG: LSP0010 & LSP0012. All field duplicate criteria were met.

SDG JC38: One pair of samples, LSP0375 & LSP0376, was submitted as field replicates. All results met the acceptance criteria.

SDG JH84: One pair of samples, LSP0591 & LSP0592, was submitted as field replicates. All results met the acceptance criteria.

Reporting Limits (Method Detection Limit and Method Reporting Limit)

The QAPP specifies a method reporting limit (MRL) of 0.01% for total organic carbon (TOC), but the laboratory MRL is listed as 0.02%.

III. OVERALL ASSESSMENT

As determined by this evaluation, the laboratory followed the specified analytical methods. The laboratory RPD and RSD values indicated acceptable precision. Accuracy was also acceptable, as demonstrated by the matrix spike, laboratory control sample and standard reference material percent recovery.

All data, as reported, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Dioxin/Furan Compounds
Matrix: Groundwater

This report documents the review of analytical data from the analyses of groundwater samples and the associated laboratory quality control (QC) samples. Severn Trent Laboratories, Inc., of Sacramento, California analyzed the samples.

SDG	Number of Samples	Validation Level
IS32	4 Groundwater	3
JC38	9 Groundwater	3
JH83	3 Groundwater	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables, with the exceptions noted below. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

SDG IS32: The majority of the closing calibration standards from the DB-5 column were not included in the data packages. A closing calibration is not required by EPA Method 1613 version B. As nearly all of the submitted calibration standards were acceptable no action was taken.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

2	Holding Times and Sample Receipt	1	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
1	GC/MS Instrument Performance Check		Ongoing Precision and Recovery (OPR)
	Initial Calibration (ICAL)	1	Field Duplicates
	Continuing Calibration (CCAL)		Laboratory Duplicates
	Laboratory Blanks	2	Compound Identification/Reported Results
	Field Blanks		Reporting Limits (MDL and MRL)
	Labeled Compounds		Calculation Verification (full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion is seven days from the date sampling to date of extraction. The holding time criterion for extracts is 40 days from extraction to analysis. The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. All holding times and all sample receipt temperatures were acceptable with the following exceptions:

SDG IS32: All samples were extracted 12 days beyond the 7 day holding time criterion. Positive results and reporting limits were estimated (J/UJ-1).

SDG JC38: All samples were extracted 7 or more days beyond the 7 day holding time criterion. All positive results and reporting limits were estimated (J/UJ-1).

The sample cooler was received by the laboratory with a temperature at 1.0°C. It was determined that the temperature outlier did not impact data quality and no qualifiers were required.

SDG JH83: All samples were extracted 14 days beyond the 7 day holding time criterion. All positive results and reporting limits were estimated (J/UJ-1).

GC/MS Instrument Performance Check

SDG IS32 and JC38: The analytical method specifies that the GC/MS instrument performance check (tune) be analyzed at the start and end of each 12 hour analytical shift. The tunes were not analyzed at this frequency, and instead were analyzed at the start and end of each analytical sequence, more than 24 hours apart. Continuing calibration (CCAL) standards were analyzed at the proper frequency of one at the start of each 12 hour analytical shift and as all CCAL and tunes were acceptable no qualifiers were assigned. In addition, the absolute retention time of 13C-1,2,3,4-TCDD was less than the method specified criterion of 25 minutes. The retention times and separation of all target analytes and retention time markers were reviewed and it was determined that there was no impact on the data.

Matrix Spikes/Matrix Spike Duplicates

No matrix spike/matrix spike duplicate (MS/MSD) sets were analyzed. Accuracy and precision were assessed using labeled compound recoveries and the ongoing precision and recovery sample.

Field Duplicates

Duplicate sample pairs are listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL. No data were qualified based on field duplicate outliers; however, data users should take field precision into account when interpreting sample data.

SDG IS32: Samples LSP0010 and LSP0012 were identified as field duplicates. OCDD was detected in LSP0012 at an estimated concentration below the reporting limit, and was not detected in LSP0010. The difference value was acceptable.

SDG JC38: One set of field duplicates, Samples LSP00375 and LSP0376, were submitted. All values met the acceptance criteria described above.

Compound Identification

SDG JC38: The reported result for OCDD in Sample LSP0373 exceeded the linear range of the calibration and no dilution analysis was performed. This result was qualified as estimated (J-20).

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy and was acceptable, as demonstrated by the labeled compound and OPR percent recovery values. Precision was acceptable, as demonstrated by the field duplicate RPD values.

Data were estimated due to extractions occurring past the specified holding times and for a value greater than the linear range of the calibration.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Diesel and Residual Range Organics
Matrix: Groundwater

This report documents the review of analytical data from the analyses of groundwater samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	Number of Samples	Method	Validation Level
IS32	4 Groundwater	NWTPH-Dx	3
JC38	15 Groundwater	NWTPH-Dx	3
JH83	8 Groundwater	NWTPH-Dx	2
JJ25	3 Groundwater	WA EPH	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1 Holding Times and Sample Receipt
GC/MS Instrument Performance Check
Initial Calibration (ICAL)
Continuing Calibration (CCAL)
Blanks (Method)
Blanks (Field)
1 Surrogate Compounds
Matrix Spike/Matrix Spike Duplicates (MS/MSD)
2 Laboratory Control Samples (LCS/LCSD)
1 Field Replicates
Internal Standards
Target Analyte List
Reporting Limits (MDL and MRL)
Compound Identification (Full validation only)
Calculation Verification (Full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for preserved water samples is 14 days from date of sampling to date of extraction. The QAPP-required holding time criterion for extracts is 40 days from extraction to analysis. All holding time criteria were met.

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received the majority of the sample coolers with temperatures below the advisory control limits, with a low of -2.0ºC. It was determined that these outliers did not impact data quality and no action was taken.

Surrogates

SDG JH83: The percent recovery (%R) values for the surrogate o-terphenyl were greater than the upper control limit for Samples LSP0597, LSP0598, and Sample LSP0598 MSD. No action was taken, there were no positive results or the outliers occurred in QC samples.

SDG JJ25: The %R value for the surrogate 1-chlorooctadecane was greater than the upper control limit for Sample LSP0592. No action was taken, there was no positive result. The %R value for the surrogate o-terphenyl was greater than the upper control limit for the laboratory control spike sample. No action was taken for a QC sample.

Laboratory Control Sample

SDG JJ25: The %R values for C8-C10 aliphatics and C10-C12 aliphatics were less than the lower control limit in the laboratory control sample/laboratory control sample duplicate (LCS/LCSD). The reporting limits were estimated (UJ-10) in the associated samples.

Field Duplicates

Replicate sample pairs were listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and replicate must be less than two times the RL. No data were qualified based on field replicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG IS32: One pair of samples, LSP0010 & LSP0012, was submitted as field duplicates. Results for DRO and RRO met the acceptance criteria. Field precision was judged acceptable.

SDG JC38: One pair of samples, LSP0375 & LSP0376, was submitted as field replicates. The RPD values for DRO and RRO met the acceptance criteria above.

SDG JH83: One pair of samples, LSP0591 & LSP0592, was submitted as field replicates. The RPD values for DRO and RRO met the acceptance criteria above.

SDG JJ25: One pair of samples, LSP0591 & LSP0592, was submitted as field replicates. The RPD values for AREPH met the acceptance criteria above. The ALEPH compounds were not detected in either sample

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, matrix spike/matrix spike duplicate (MS/MSD), and LCS %R values. Precision was also acceptable as demonstrated by the field duplicate and MS/MSD RPD values.

Data were estimated due to LCS/LCSD %R outliers.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Gasoline Range Organics
Matrix: Groundwater

This report documents the review of analytical data from the analyses of groundwater samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	Number of Samples	Method	Validation Level
IS32	5 Groundwater	NWTPH-Gx	3
JC38	14 Groundwater	NWTPH-Gx	3
JH83	9 Groundwater	NWTPH-Gx	2
JH83	1 Groundwater	WA VPH	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1	Holding Times and Sample Receipt		Laboratory Control Samples (LCS/LCSD)
	GC/MS Instrument Performance Check	1	Field Replicates
	Initial Calibration (ICAL)		Internal Standards
	Continuing Calibration (CCAL)		Target Analyte List
	Blanks (Method)	1	Reporting Limits (MDL and MRL)
	Blanks (Field)		Compound Identification (Full validation only)
1	Surrogate Compounds		Calculation Verification (Full validation only)
	Matrix Spike/Matrix Spike Duplicates (MS/MSD)		

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for preserved water samples is 14 days from date of sampling to date of analysis. All samples were analyzed within the holding time criterion.

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received the majority of the sample coolers with temperatures below the advisory control limits, with a low of -2.0ºC. It was determined that these outliers did not impact data quality and no action was taken.

Surrogates

SDG JH83: The percent recovery (%R) values for the surrogate bromobenzene were greater than the upper control limit for Samples LSP0592, LSP0594, and LSP0595. The %R value for the surrogate trifluorotoluene was greater than the upper control limit for Sample LSP0593. No action was taken, there were no positive results.

Field Replicates

Replicate sample pairs were listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and replicate must be less than two times the RL. No data were qualified based on field replicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG IS32: One pair of samples, LSP0010 & LSP0012, was submitted as field duplicates. Results for GRO met the acceptance criteria. Field precision was judged acceptable.

SDG JC38: One pair of samples, LSP0375 & LSP0376, was submitted as field replicates. The RPD value for GRO met the acceptance criteria above.

SDG JH83: One pair of samples, LSP0591 & LSP0592, was submitted as field replicates. The RPD value for GRO was greater than control limits.

Reporting Limits (Method Detection Limits and Method Reporting Limits)

SDG JH83: Reporting limits for VPH analytes were greater than limits listed in the QAPP. No action was taken other than noting this discrepancy.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, matrix spike/matrix spike duplicate (MS/MSD), and laboratory control sample/laboratory control sample duplicate %R values. Precision was also acceptable as demonstrated by the field duplicate and MS/MSD RPD values.

Field duplicate precision outliers were noted.

All data, as reported, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Total and Dissolved Metals
Matrix: Groundwater

This report documents the review of analytical data from the analysis of groundwater samples and the associated laboratory and field quality control (QC) samples. Analytical Resources, Inc., Seattle, Washington, analyzed the samples.

SDG	Number of Samples	Validation Level
IS32	4 Groundwater	3
JC38	10 Groundwater	3
JH84	16 Groundwater	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements for review are listed below.

1	Technical Holding Times and Sample Preservation		Laboratory Duplicates
	Initial Calibration (ICAL)		ICP Interference Check Samples
	Calibration Verification (CVER)	1	ICP Serial Dilution
	CRDL Standard		ICPMS Internal Standards
	Laboratory Blanks	1	Field Duplicates
	Field Blanks		Reporting Limits (MDL and MRL)
	Laboratory Control Samples		Calculation Verification (Full validation only)
	Matrix Spike Samples		

---

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Technical Holding Times and Sample Preservation

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The majority of the coolers were received at the laboratory at temperatures outside of these limits, with temperatures ranging from 0.4° to 5.2°C. The temperature outliers were judged to have no significant impact on the reported results; no further action was taken.

Field Duplicates

The relative percent difference (RPD) control limit is 35% for sample results greater than five times the reporting limit (RL). For results less than five times the RL, the difference must be less than twice the RL. Although qualification of data is not required for field duplicate outliers, data users should take field precision into account when interpreting the sample results.

SDG IS32: One set of field duplicates was submitted with this SDG: LSP0010 & LSP0012. All field duplicate criteria were met.

SDG JC38: One set of field duplicates was submitted with this SDG: LSP0375 & LSP0376. The RPD for dissolved chromium exceeded criteria. All other field duplicate criteria were met.

SDG JH84: One set of field duplicates was submitted with this SDG: LSP0591 & LSP0592. The RPD for total nickel exceeded criteria. All other field duplicate criteria were met.

ICP Serial Dilution

An ICP serial dilution sample was not analyzed. Any significant physical or chemical interferences due to sample matrix could not be determined.

III. OVERALL ASSESSMENT

As determined by this evaluation, the laboratory followed the specified analytical methods. The laboratory and field duplicate RPD values indicated acceptable precision, except as noted above. Accuracy was also acceptable, as demonstrated by the matrix spike and laboratory control samples percent recovery values.

No data were qualified for any reason. Field duplicate outliers were noted but not qualified.

All data, as reported, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Semivolatile Organic Compounds
Matrix: Groundwater

This report documents the review of analytical data from the analyses of groundwater samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	Number of Samples	Validation Level
IS32	4 Groundwater	3
JC38	15 Groundwater	3
JH83	8 Groundwater	3

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1	Holding Times and Sample Receipt	2	Laboratory Control Samples (LCS/LCSD)
	GC/MS Instrument Performance Check	1	Field Duplicates
1	Initial Calibration (ICAL)		Internal Standards
2	Continuing Calibration (CCAL)		Target Analyte List
2	Laboratory Blanks	1	Reporting Limits (MDL and MRL)
1	Surrogate Compounds	2	Compound Identification and Quantitation
	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)	1	Calculation Verification (Full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for aqueous samples is 7 days from the date of sampling to date of extraction. The holding time criterion for extracts is 40 days from extraction to analysis. All samples were extracted and analyzed within the holding time criteria.

Several of the sample coolers were received with temperatures less than the lower acceptance limit of 2°C, ranging from -2.0ºC to 1.6ºC. The low temperatures did not impact data quality and no qualifiers were required.

Initial Calibration

All relative response factor (RRF) values were greater than the 0.05 minimum control limit. All percent relative standard deviation (%RSD) values were within the 30% control limit for all initial calibrations (ICAL), with the exceptions noted below. Since the affected compounds were not detected in the associated samples, no action was taken.

SDG JC38: The %RSD value for 2,4-dinitrophenol (48.9%) was greater than the 30% control limit in the ICAL analyzed 3/3/06 on instrument NT4.

Continuing Calibration

All relative response factor (RRF) values were greater than the 0.05 minimum control limit. All percent difference (%D) values were within the ±25% control limit for all continuing calibrations (CCAL), with the exceptions noted below. If the %D outlier indicates a low bias, positive results and reporting limits in samples associated with %D outliers were estimated (J/UJ-5B). If the %D outlier indicates a potential high bias, only positive results were estimated (J-5B).

SDG IS32:

- CCAL 11/16/05: 2,3,5,6-tetrachlorophenol (high bias)

SDG JC38:

- CCAL 3/6/06: hexachlorocyclopentadiene (low bias). The only associated sample was a secondary dilution of LSP0372. This compound was not reported from this dilution; no qualifiers were necessary.

SDG JH83:

- CCAL 5/4/06: 2,4-dinitrophenol (low bias) and hexachlorocyclopentadiene (low bias).
- CCAL 5/5/06: 2,4-dinitrophenol (low bias). The only associated analyses were secondary dilutions of three samples. This compound was not reported from these dilutions; no qualifiers were necessary.

Laboratory Blanks

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times the concentration reported in the blank (ten times for common laboratory contaminants). If a contaminant is reported in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U-7). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Method blanks were analyzed at the appropriate frequency. For the analytical batches noted below, one or more target analytes were reported in the method blank. A summary of contaminant levels, associated samples, and action levels is provided in the data validation worksheets.

Various target analytes were detected in the method blanks; however, only the following analytes were qualified as not detected in one or more samples in the associated laboratory data sets:

SDG IS32: Di-n-butyl phthalate (four results); bis(2-ethylhexyl)phthalate (one result).

SDG JC38: Di-n-butyl phthalate (15 results).

Surrogate Compounds

SDG JH83: The percent recovery (%R) value for d4-2-chlorophenol was less than the lower control limit in Sample LSP0592 (46%) due to the dilution factor (15x) used for this sample. No action is necessary unless there are two or more surrogate outliers. No qualifiers were required.

Laboratory Control Sample

SDG JH83: The %R value for benzoic acid was less than the lower control limit and less than 10% in the laboratory control sample (LCS) prepared on 5/3/06. Positive results for benzoic acid were estimated (J-10) and reporting limits were rejected (R-10) in all associated samples. The %R values for hexachloro-cyclopentadiene and 2,4-dinitrophenol were less than the lower control limits. These compounds were not detected in the associated samples; the reporting limits were estimated (UJ-10).

Field Duplicates

Duplicate sample pairs were listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL. No data were qualified based on field duplicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG IS32: Samples LSP0010 and LSP0012 were identified as field duplicates. All RPD and absolute difference values were within control limits. Field precision was acceptable.

SDG JC38: Samples LSP0375 and LSP0376 were identified as field duplicates. All RPD and absolute difference values were within control limits. Field precision was acceptable.

SDG JH83: Samples LSP0591 and LSP0592 were identified as field duplicates. The RPD and absolute difference values met the above criteria. Field precision was acceptable.

Reporting Limits (Method Detection Limit and Method Reporting Limit)

In an attempt to meet the screening benchmark detection limits specified in the QAPP, the laboratory reported several compounds down to the MDL value, and flagged the detection limit as an estimate (UJ). Several of these reporting limits were still greater than the benchmark detection limits. No action was taken.

Several samples were diluted due to the concentrations of one or more target compounds present in the samples. Reporting limits were elevated accordingly.

Compound Identification and Quantitation

SDG JC38: The reported results for several target analytes exceeded the initial calibration linear range in Samples LSP0369, LSP0372, LSP0373, LSP0374, LSP0375, and LSP0376. The sample extracts were diluted and reanalyzed. Both sets of results were reported. The original results for those analytes that exceeded the linear range were qualified do-not-report (DNR-20). The dilution results should be used instead. The reporting limits and reported results for all analytes except those which exceeded the calibration linear range were qualified do-not-report (DNR-11) in the dilution analyses.

SDG JH83: The reported results for several target analytes exceeded the initial calibration linear range in Samples LSP0591, LSP0592, and LSP0596. The sample extracts were diluted and reanalyzed. Both sets of results were reported. The original results for those analytes that exceeded the linear range were qualified as do-not-report (DNR-20). Results were reported from the diluted analyses instead. The results and reporting limits for all other analytes were qualified as do-not-report (DNR-11) in the diluted analyses.

Calculation Verification

Calculation verifications were not performed.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, MS/MSD, and LCS %R values, with exceptions noted above. Precision was also acceptable as demonstrated by the field duplicate and MS/MSD RPD values.

Data were qualified as estimated based on calibration %D and LCS %R outliers. Data were also qualified as not detected based on contamination in the associated method blanks.

Data were rejected due to LCS %R values less than 10%, and re-analysis data were qualified do-not-report in order to report only one result per analyte per sample. Data that have been rejected are not useable for any purpose.

All other data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Total Metals
Matrix: Sediment

This report documents the review of analytical data from the analysis of sediment samples and the associated laboratory and field quality control (QC) samples. Analytical Resources, Inc., Seattle, Washington, analyzed the samples.

SDG	Number of Samples	Validation Level
JA16	4 Sediment	3
JA18	3 Sediment	3
JB14	1 Sediment	3
JB17	3 Sediment	3
JB19	2 Sediment	3
JC30	2 Sediment	3
JE31	2 Sediment	3
JG15	13 Sediment	2
JH04	2 Sediment	2
JI44	1 Sediment	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements for review are listed below.

2 Technical Holding Times and Sample Preservation
Initial Calibration (ICAL)
Calibration Verification (CVER)
1 CRDL Standard
1 Laboratory Blanks
1 Field Blanks
Laboratory Control Samples
2 Matrix Spike Samples
2 Laboratory Duplicates
1 ICP Interference Check Samples
1 ICP Serial Dilution
ICPMS Internal Standards
1 Field Duplicates
2 Reporting Limits (MDL and MRL)
Calculation Verification (Full validation only)

1 Quality control results are discussed below, but no data were qualified.
2 Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.

Technical Holding Times and Sample Preservation

For metals analyses the QAPP-required holding time criterion for sediment samples is 6 months from date of sampling to date of extraction. For frozen sediments, the holding time criterion is 2 years from date of sampling to date of extraction. For mercury, the QAPP-required holding time criterion for any sediment sample is 28 days from date of sampling to date of extraction.

SDG JI44: Sample LSP0560 was analyzed for mercury 29 days after collection, the positive result was estimated (J-1).

All SDGs: The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received the majority of the sample coolers with temperatures below the advisory control limits, with a low of -2.8ºC. It was determined that these outliers did not impact data quality and no action was taken.

CRDL Standard

Contract required detection limit (CRDL) standards were analyzed at the beginning of each analytical sequence. For recoveries greater than upper control limit of 130%, positive results less than two times the CRDL were estimated (J-14) to indicate a potential high bias. For recoveries less than the lower control limit of 70%, positive results less than twice the CRDL and reporting limits were estimated (J/UJ-14) to indicate a potential low bias. The following outliers were noted:

SDG JB17: zinc (159%) – no qualifiers assigned (all positive results greater than 2x CRDL)

Laboratory Blanks

Various analytes were detected in the method and instrument blanks at levels greater than the method detection limits (MDL). To evaluate the effect on the sample data, action levels of five times the blank concentrations were established. Positive results less than the action levels in the associated samples were qualified as not detected (U-7) at the reported concentration. No action was taken for non-detects.

SDGs JA16 and JA18: Zinc was detected in the method blank. Associated results were greater than the action level; therefore no qualification of data was necessary.

SDG JC30: Copper was detected in several calibration blanks. Associated results were greater than the action level; therefore no qualification of data was necessary.

SDG JG15: Zinc was detected in the method blanks. Associated results were greater than the action level; therefore no qualification of data was necessary.

Matrix Spike Samples

A matrix spike sample (MS) was analyzed at the proper frequency of one per 20 samples or one per batch; whichever was more frequent. The percent recovery (%R) values were within the control limits of 75%-125%, with the exceptions noted below. For %R values greater than 125%, the associated positive results were estimated (J) to indicate a possible high bias. No action was taken for non-detects. For %R values less than 75%, the associated positive results and reporting limits were qualified as estimated (J/UJ-8) to indicate a possible low bias.

SDG JB17: LSP0224 – nickel (67.8%) – low bias

SDG JE31: LSP0187 – mercury (68.7%) – low bias

Laboratory Duplicate Samples

A laboratory duplicate sample was analyzed at the proper frequency of one per 20 samples or one per batch; whichever was more frequent. The relative percent difference (RPD) values were less than the control limit of 20%, with the exceptions noted below. For RPD values greater than 20%, the associated results were estimated (J/UJ-9).

SDG JA16: LSP0138 – copper and lead

SDG JB17: LSP0224 – lead and nickel

SDG JC30: LSP0124 – chromium, copper, lead, nickel, and zinc

SDG JE31: LSP0187 – copper, lead, mercury and nickel

Field Duplicates

The RPD control limit is 50% for sample results greater than five times the reporting limit (RL). For results less than five times the RL, the difference must be less than twice the RL. Although qualification of data is not required for field duplicate outliers, data users should take field precision into account when interpreting the sample results.

SDG JA18: One pair of samples, LSP0132 & LSP0133, was submitted as field replicates. All results met the acceptance criteria, except lead.

ICP Interference Check Samples

The concentration of the interfering elements iron and aluminum were greater than the level in the interference check samples (ICSA/ICSAB) in several samples. The ICSA results were carefully evaluated to determine if there was a potential high or low bias caused by aluminum or iron interference. The ICSA values for arsenic, chromium, copper, and lead were often greater than ± MDL. In these cases , an action level of two times the absolute value of the ICSA result was established. All sample results for these analytes were greater than the action levels; therefore qualification of data was necessary.

ICP Serial Dilution

An ICP serial dilution sample was not analyzed. Any significant physical or chemical interference due to sample matrix could not be determined.

Reporting Limits

SDGs JA16, JA18, JC30, and JE31: The reporting limits (RL) for several compounds were slightly greater than the QAPP method reporting limits (MRL). No action was taken other than to note this discrepancy. Several samples were diluted due to matrix interference. Reporting limits were elevated accordingly.

SDG JE31: Due to interference, the arsenic RL (7-20 mg/kg) was greater than the RL of 0.2 mg/kg specified in the QAPP. The sample results were greater than the laboratory MRL in three of eight samples. Where arsenic was not detected, the reporting limit was estimated (UJ-14).

III. OVERALL ASSESSMENT

As determined by this evaluation, the laboratory followed the specified analytical methods. The laboratory and field duplicate RPD values indicated acceptable precision, except as noted above. Accuracy was also acceptable, as demonstrated by the matrix spike and laboratory control samples %R values, except as noted above.

Data were qualified based on matrix spike %R and laboratory duplicate RPD outliers, and exceeded holding times. Data were also estimated due to potential interference.

All data, as qualified, are acceptable for use.

EcoChem, INC.
Environmental Data Quality

DATA QUALITY EVALUATION

LITTLE SQUALICUM PARK
BELLINGHAM, WASHINGTON

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

SEDIMENT SAMPLES

Prepared for:

Integral Consulting
1201 Cornwall Avenue, Suite 208
Bellingham, Washington 98225

Prepared by:

EcoChem, Inc.
710 Second Avenue, Suite 660
Seattle, Washington 98104

EcoChem Project: C22112

August 11, 2006

Approved for Release:

Eric Strout
Project Manager/Technical Director
EcoChem, Inc.

DATA QUALITY EVALUATION

BASIS OF DATA EVALUATION

The data were validated using guidance and quality control (QC) criteria documented in the analytical methods; *Little Squalicum Park Remedial Investigation/Feasibility Study, Bellingham, WA, Quality Assurance Project Plan* (QAPP) (Integral 2005), and *National Functional Guidelines for Organic and/or Inorganic Data Review* (USEPA 1999 & 2002). Additional guidance for validation of the dioxin/furan data is documented in *EPA Region 10 SOP for the Validation of Polychlorinated Dibenzodioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) Data* (EPA 1996).

Samples were analyzed for the following parameters:

Test	Method
Semivolatile Organic Compounds (SVOC)	PSDDA SW 8270D
Diesel Range Organics (DRO) and Motor Oil	NWTPH-Dx and WA EPH
Dioxin/Furan Compounds	E1613B
Metals	SW 6010B
Mercury	SW7471A
Total Organic Carbon (TOC)	Plumb, 1981

EcoChem's goal in assigning data assessment qualifiers is to assist in proper data interpretation. If values are assigned a J or UJ, data may be used for site evaluation and risk assessment purposes, but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet the data quality objectives as stated in the above-referenced documents and methods.

Data qualifier definitions, reason codes, and validation criteria are included as **Appendix A**. Data validation reports, which discuss individual findings for each quality control element [by sample delivery group (SDG)], are provided in **Appendix B**. Data validation worksheets and communication records are organized by SDG and will be kept on file at EcoChem.

PROCESS FOR DATA VALIDATION

With the exception of conventional and physical parameters, the first data package generated for the solids matrix for each chemical analysis type received Level 4 (full) validation. The following quality control elements, as appropriate for each method, were evaluated:

- Package completeness
- Sample chain-of-custody and sample preservation
- Analytical holding times
- Blank contamination
- Precision (replicate analyses)

- Accuracy (compound recovery)
- Chromatogram review
- Detection limits
- Instrument performance (initial calibration, continuing calibration, tuning, sensitivity and degradation)
- Compound identification
- Transcription and calculation checks

No significant data quality issues were identified therefore, all remaining data were evaluated based on the review of standard analytical quality control elements, using the summary forms and electronic data summaries generated from the analytical database.

EcoChem validation process provides a dual-tier system of primary and secondary reviewers to ensure technical correctness and QC of the validation process; and all data validation is documented using standardized and controlled validation worksheets and spreadsheets. These worksheets are completed for each SDG, documenting all deficiencies, outliers and subsequent qualifiers.

After qualifiers are entered into the EcoChem database, a second party verifies 100% of the qualifier entry. Algorithms are then used within the database to apply the final interpretive qualifiers to the field samples. The interpretive qualifiers merge quantitative laboratory flags with the validation qualifiers. The qualified data is then exported to the project database (Integral).

SUMMARY OF DATA VALIDATION: SEMIVOLATILE ORGANIC COMPOUNDS

A total of 17 sediment samples were analyzed for semivolatile organic compounds (SVOC) for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed the SVOC analyses.

The SVOC data for the sediment samples were generally acceptable. A total of 5 data points (0.38% of all sediment SVOC results) were of unacceptable quality and were rejected. One hundred (100) data points were estimated because control limits were exceeded in one or more laboratory QC samples or procedures. Qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were greater than 99% complete for the sediment SVOC analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of -2.8ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. Several initial calibration percent relative standard deviation (%RSD) values were greater than the upper control limit. The affected compounds were not detected in the associated samples; no action was necessary.

The continuing calibration percent difference (%D) values were reviewed to evaluate instrument stability. When %D outliers were present, the potential bias was determined. If the %D outlier indicated a low bias, associated positive results and detection limits were estimated (J or UJ). If the %D outlier indicated a high bias, only associated positive results were estimated (J). A total of 6 detection limits were estimated (J/UJ). Overall, 0.46% of the sediment SVOC results were estimated based on calibration outliers.

Method Blank Analyses

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times (5x) the concentration detected in the blank for most compounds and ten times (10x) for phthalates. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Various target analytes were detected in the method blanks. A total of 13 results (1.0% of all sediment SVOC results) were qualified as not detected (U) based on method blank contamination. The qualifiers were issued to bis(2-ethylhexyl)phthalate (seven results), di-n-butyl phthalate (three results), phenol (two results) and benzoic acid (one result).

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. Several of the surrogate recoveries reported by the laboratory did not meet the criteria for acceptable performance. As there was only one recovery outlier per fraction (acid or base/neutral) in each sample, no action was necessary.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. Several of the recoveries reported by the laboratory for MS/MSD analyses did not meet the criteria for acceptable performance. Two (2) sediment SVOC results (0.15% overall) were estimated (J) because the control limits for MS/MSD recovery were not met.

Laboratory Control Sample Recoveries

Laboratory control sample (LCS) analyses were performed at the proper frequency. Several of the recoveries reported by the laboratory did not meet the criteria for acceptable performance. Sixty (60) sediment SVOC results (4.6% overall) were estimated (J or UJ) because the control limits for LCS/LCSD recovery were not met. Five (5) results (0.38% overall) were rejected (R). Results were rejected when the %R value was less than 10%, indicating an extremely low bias.

GCMS Internal Standards

The areas of the internal standards were outside the control limits in several samples. If the internal standard area was greater than the upper control limit, no action was taken unless there were positive results associated with the internal standard. For internal standard areas less than the lower control limits, all target analytes associated with the internal standard were estimated (J or UJ) with potential low bias. Eighteen (18) SVOC results (1.4% of all sediment SVOC results) were estimated (J) based on internal standard area outliers.

Precision

MS/MSD analyses were evaluated for laboratory precision. Several of the relative percent difference (RPD) values for the MS/MSD analyses did not meet the criteria for acceptable performance. For MS/MSD precision outliers, qualifiers were issued only to the parent sample. Fifteen (15) data points were estimated (J or UJ). Overall, 1.1% of the sediment SVOC results were estimated based on precision outliers.

Field Quality Control Samples

Field QC samples collected for the sediment sampling event included field replicate samples.

Field Replicate Samples

All of the RPD values for field replicate analyses met the criteria for acceptable precision.

SUMMARY OF DATA VALIDATION: DIESEL RANGE ORGANICS (DRO)

A total of 37 sediment samples were analyzed for DRO (including motor oil) for the Little Squalicum Park RI/FS event. The samples were analyzed using Method NWTPH-Dx and two samples (LSP0546 and LSP0561) were also analyzed using the WA EPH method. Analytical Resources, Inc (ARI), Seattle, Washington completed the DRO analyses.

The DRO data for the sediment samples were acceptable. No data were rejected for any reason. Seven (7) data points were estimated because control limits were exceeded in one or more laboratory QC samples or procedures. Qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the sediment DRO analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.8ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial and continuing calibration analyses met acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. The surrogate recoveries reported by the laboratory typically met the criteria for acceptable performance; however, surrogate recovery outliers were present in several samples. As the outliers were due to a required dilution, no action was taken.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. Several of the recoveries reported by the laboratory for MS/MSD analyses did not meet the criteria for acceptable performance. The associated sediment DRO results were not affected by the MS/MSD outliers, and no action was taken.

Laboratory Control Sample Recoveries

Laboratory control sample (LCS) analyses met the criteria for frequency of analysis. Several of the recoveries reported by the laboratory for the LCS analyses did not meet the criteria for acceptable performance. Seven (7) sediment DRO results (7.6% overall) were estimated (J or UJ) because the control limits for LCS recovery were not met.

Precision

MS/MSD and LCS/LCSD analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values for the MS/MSD analyses met the criteria for acceptable performance.

Field Quality Control Samples

Field QC samples collected for the sediment sampling event included field replicate samples.

Field Replicate Samples

All of the RPD values for field replicate analyses were acceptable.

SUMMARY OF DATA VALIDATION: DIOXIN/FURAN COMPOUNDS

Eight (8) sediment samples were analyzed for dioxin and furan compounds for the Little Squalicum Park RI/FS event. Severn Trent Laboratories, Sacramento, California completed the analyses.

The dioxin/furan data for the sediment samples were generally acceptable. No data were rejected for any reason. Twenty (20) data points (10% of all sediment dioxin/furan results) were estimated (J or UJ). These qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the sediment dioxin/furan analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. Several of the sample coolers were received with temperatures less than the lower acceptance limit of 2°C, ranging from -2.8° to 1.6°C. The low temperatures did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial and continuing calibration analyses met all acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

Labeled Compound Recoveries

Labeled compounds were added to all field and QC samples. The recovery values of several labeled compounds were outside the specified control limits. Six (6) data points (3.0% of the sediment dioxin/furan results) were estimated based on labeled compound recovery outliers.

Matrix Spike Recoveries

Matrix and duplicate matrix spike (MS/MSD) analyses were not performed. Accuracy was assessed using the labeled compound and ongoing precision and recovery (OPR) analyses.

Ongoing Precision and Recovery Sample Recoveries

OPR analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Precision

Laboratory duplicate OPR analyses and duplicate sample analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values met the criteria for acceptable performance.

Compound Identification and Quantitation

A laboratory "E" flag indicates that the reported result is greater than the upper calibration range established by the initial calibration. If no dilution analysis was performed, the "E" flagged data were estimated (J). Seventeen (17) data points (8.5% of all sediment dioxin/furan data points) were estimated based on calibration range exceedance.

Field Quality Control Samples

Field Replicate Samples

No samples identified as field replicates were analyzed.

SUMMARY OF DATA VALIDATION: METALS (INCLUDING MERCURY)

A total of 33 sediment samples were analyzed for total metals for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed all analyses. The following analytical methods were used:

Parameter	Method
ICP Metals	SW6010B
Mercury	SW7471A

The metals data for the sediment samples were acceptable. No data were rejected for any reason. Thirty-five (35) data points (12% of all sediment metals results) were estimated (J or UJ). These qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the quality control (QC) procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the sediment metals analyses.

Holding Times and Sample Preservation

For metals analyses the QAPP-required holding time criterion for sediment samples is 6 months from date of sampling to date of extraction. For frozen sediments, the holding time criterion is 2 years from date of sampling to date of extraction. For mercury, the QAPP-required holding time criterion for any sediment sample is 28 days from date of sampling to date of extraction. The mercury result in Sample LSP0560 was analyzed 29 days after collection, the positive result was estimated (J-1).

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.8ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. The calibrations met all acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times (5x) the concentration detected in the blank. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Several target analytes were detected in the method blanks. All of the results in the associated samples were greater than the 5x action limit; no data were qualified.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of analytical bias (matrix spike [MS], laboratory control sample [LCS], contract required detection limit [CRDL] standard recovery values, interference check samples [ICS], and serial dilution percent difference [%D] values).

Matrix Spike Recoveries

MS analyses met the criteria for frequency of analysis. Several of the recoveries reported by the laboratory did not meet the criteria for acceptable performance, with all outliers indicating a potential low bias. A total of five metals results (1.8% overall) were estimated (J or UJ) during the quality assurance review because the control limits for MS recovery were not met.

Laboratory Control Sample Recoveries

LCS analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Contract Required Detection Limit Standard Analyses

CRDL standards were analyzed at the beginning of each analytical sequence. One recovery was greater than the upper control limit. All associated sample results were positive and were at concentrations greater than two times the CRDL value. No data were qualified.

Interference Check Samples

ICP interference check samples were analyzed at the beginning of each analytical sequence. All ICP interference check sample results were within the acceptance criteria.

Serial Dilution Analyses

Serial dilution analyses were not performed. Any significant physical or chemical interferences due to sample matrix could not be determined.

Precision

Laboratory duplicate analyses were evaluated for laboratory precision. Thirteen (13) of the relative percent difference (RPD) values were outside the acceptance limits. Thirty-two (32) results (11.3% of all sediment metals results) were estimated (J or UJ) based on laboratory precision outliers.

Field Quality Control Samples

Field QC samples collected for the sediments sampling event included field replicate samples.

Field Replicate Samples

One of the RPD values in the field replicate analyses did not meet the criteria for acceptable precision. The field replicate precision outliers are discussed in greater detail in the data validation reports. No data were qualified based on field precision; however, users of the data should consider the potential impact of precision outliers on the reported results.

SUMMARY OF DATA VALIDATION: CONVENTIONAL PARAMETERS

A total of 25 sediment samples were analyzed for the following parameters for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington, completed all analyses. The following analytical methods were used:

Parameter	Method Number
Total Organic Carbon (TOC)	Plumb, 1981

Overall, the conventional parameters data for the sediment samples were acceptable. No data were qualified for any reason. The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the quality control (QC) procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the sediment conventional parameters analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.8ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for the TOC analyses and met the criteria for frequency of analysis. The initial calibrations met the linearity (percent relative standard deviation or correlation coefficient) control limits.

Method Blank Analyses

Two types of laboratory blanks were evaluated for possible contamination effects. These blanks were: initial and continuing calibration blanks (ICB and CCB) and method blanks (MB). The required frequency of one at the beginning and one every ten samples for calibration blank analysis was met. The laboratory analyzed one MB for every 20 samples digested or one per batch, for each digestion procedure, as required. No target analytes were detected in the blanks.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of analytical bias (matrix spike [MS] and laboratory control sample [LCS] recoveries) and precision (sample or matrix spike duplicate [MSD] analyses).

Matrix Spike Recoveries

MS analyses were completed for the TOC analyses and met the criteria for frequency of analysis. All recovery values met the acceptance criteria.

Laboratory Control Sample Recoveries

An LCS was analyzed for the TOC analyses. All LCS recovery values were acceptable.

Precision

Laboratory duplicate analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values met the criteria for acceptable performance.

Field Quality Control Samples

Field QC samples collected for the Phase 2 RI/FS included field replicate samples.

Field Replicate Samples

All of the RPD values in the field replicate analyses met the criteria for acceptable precision.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Conventional Parameter Analyses
Matrix: Sediment

This report documents the review of analytical data from the analysis of sediment samples and the associated laboratory and field quality control (QC) samples. Analytical Resources, Inc., Seattle, Washington, analyzed the samples.

SDG	Number of Samples	Validation Level
JA16	4 Sediment	3
JA18	3 Sediment	3
JB17	3 Sediment	3
JB19	2 Sediment	3
JG15	13 Sediment	3

The analytical tests that were performed are summarized below:

Parameter	Method
Total Organic Carbon (TOC)	Plumb, 1981

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II TECHNICAL DATA VALIDATION

The QC requirements for review are listed below.

1	Technical Holding Times and Sample Preservation		Laboratory Duplicates
	Initial Calibration (ICAL)		ICP Interference Check Samples
	Calibration Verification (CVER)		ICP Serial Dilution
	CRDL Standard		ICPMS Internal Standards
	Laboratory Blanks	1	Field Duplicates
	Field Blanks	1	Reporting Limits (MDL and MRL)
	Laboratory Control Samples		
1	Matrix Spike Samples		

[1] Quality control results are discussed below, but no data were qualified.
[2] Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.

Technical Holding Times and Sample Preservation

For TOC analyses the QAPP-required holding time criterion for sediment samples is 14 days from date of sampling to date of extraction. For frozen sediments, the holding time criterion is 6 months from date of sampling to date of extraction. All samples were extracted within the holding time limits.

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received the majority of the sample coolers with temperatures below the advisory control limits, with a low of -2.8ºC. It was determined that these outliers did not impact data quality and no action was taken.

Matrix Spike Samples

A matrix spike sample (MS) was analyzed at the proper frequency of one per 20 samples or one per batch; whichever was more frequent. The percent recovery (%R) values were within the control limits of 75%-125%.

SDGs JA16, JB17, and JB19: A batch MS was analyzed for these SDGs, %R values were acceptable.

Field Duplicates

Replicate sample pairs were listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and replicate must be less than two times the RL. No data were qualified based on field replicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG JA18: One pair of samples, LSP0132 & LSP0133, was submitted as field replicates. All results met the acceptance criteria.

Reporting Limits (Method Detection Limit and Method Reporting Limit)

The QAPP specifies a method reporting limit (MRL) of 0.01% for total organic carbon (TOC), but the laboratory MRL is listed as 0.02%.

III. OVERALL ASSESSMENT

As determined by this evaluation, the laboratory followed the specified analytical methods. The laboratory RPD and RSD values indicated acceptable precision. Accuracy was also acceptable, as demonstrated by the MS, laboratory control sample and standard reference material %R.

All data, as reported, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Dioxin/Furan Compounds
Matrix: Sediment

This report documents the review of analytical data from the analyses of sediment samples and the associated laboratory quality control (QC) samples. Severn Trent Laboratories, Inc., of Sacramento, California analyzed the samples.

SDG	Number of Samples	Validation Level
JH01	4 Sediment	3
JK00	4 Sediment	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables, with the exceptions noted below. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1	Holding Times and Sample Receipt		Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
1	GC/MS Instrument Performance Check		Ongoing Precision and Recovery (OPR)
	Initial Calibration (ICAL)		Field Duplicates
	Continuing Calibration (CCAL)		Laboratory Duplicates
	Laboratory Blanks	2	Compound Identification/Reported Results
	Field Blanks		Reporting Limits (MDL and MRL)
2	Labeled Compounds		Calculation Verification (full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for sediment samples is 14 days from date of sampling to date of extraction. The holding time criterion for frozen sediment is one year from date of sampling to date of extraction. The QAPP-required holding time criterion for extracts is 40 days from extraction to analysis. All extracts were analyzed within the holding time criterion.

Several of the sample coolers were received with temperatures less than the lower acceptance limit of 2^{o}C, ranging from -2.8º to 1.6ºC. The low temperatures did not impact data quality and no qualifiers were required.

GC/MS Instrument Performance Check

SDG JH01: The analytical method specifies that the GC/MS instrument performance check (tune) be analyzed at the start and end of each 12 hour analytical shift. The tunes were not analyzed at this frequency, and instead were analyzed at the start and end of each analytical sequence, more than 24 hours apart. Continuing calibration (CCAL) standards were analyzed at the proper frequency of one at the start of each 12 hour analytical shift and as all CCAL and tunes were acceptable no qualifiers were assigned. In addition, the absolute retention time of 13C-1,2,3,4-TCDD was less than the method specified criterion of 25 minutes. The retention times and separation of all target analytes and retention time markers were reviews and it was determined that there was no impact on the data.

Labeled Compounds

SDG JH01: The percent recovery (%R) value for $^{13}C_{12}$-OCDD exceeded the upper control limit in Sample LSP0127. The ion abundance rations for $^{13}C_{12}$-OCDD did not meet the acceptance criteria in Samples LSP0133 and LSP0264. The laboratory used the theoretical ion abundance ration for calculating the %R of $^{13}C_{12}$-OCDD and the concentrations of the associated native analytes. The concentrations of OCDD and OCDF were estimated (J-13) in these samples.

Matrix Spikes/Matrix Spike Duplicates

Matrix spike/matrix spike duplicate (MS/MSD) analyses were not performed. Accuracy and precision were assessed using labeled compound recoveries and the ongoing precision and recovery (OPR) sample.

Laboratory Duplicates

Duplicate sample pairs are listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL.

SDG JH01: Laboratory duplicate analysis was performed on Sample LSP0127. All RPD values were within the acceptance limits.

Compound Identification/Reported Results

All results for 2,3,7,8-TCDF were confirmed on a DB-225 column as required by the method. Although the 2,3,7,8-TCDF results from both columns were reported in the raw data, only the results from the DB-225 column were reported in the EDD. No action was necessary.

The laboratory used an "E" flag to indicate when reported results (usually OCDD or OCDF) were at concentrations greater than the linear range of the instrument calibration. These samples were usually not reanalyzed at dilutions. Since results greater than the linear range could have a potential low bias, all "E" flagged results were estimated (J-20), as noted below.

SDG JH01: The reported results for one or more analytes exceeded the linear range of the calibration in three samples. These results were qualified as estimated (J-20).

SDG JK00: The reported results for one or more analytes exceeded the linear range of the calibration in four samples. These results were qualified as estimated (J-20).

Reporting Limits (Method Detection Limit and Method Reporting Limit)

SDG JH01: Samples LSP0133 and LSP0254 were analyzed at dilution, 10X and 20X respectively. Reporting limits were adjusted accordingly.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy and was acceptable, as demonstrated by the labeled compound and OPR percent recovery values. Precision was acceptable, as demonstrated by the field duplicate RPD values.

Data were estimated due to labeled compound outliers and results exceeding the linear range of the calibration.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Diesel and Residual Range Hydrocarbons
Matrix: Sediment

This report documents the review of analytical data from the analyses of sediment samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	Number of Samples	Method	Validation Level
JA16	4 Sediment	NWTPH-Dx	3
JA18	4 Sediment	NWTPH-Dx	3
JB13	1 Sediment	NWTPH-Dx	3
JB14	1 Sediment	NWTPH-Dx	3
JB17	3 Sediment	NWTPH-Dx	3
JB18	2 Sediment	NWTPH-Dx	3
JB19	2 Sediment	NWTPH-Dx	3
JC08	2 Sediment	NWTPH-Dx	2
JG15	13 Sediment	NWTPH-Dx	2
JH04	3 Sediment	NWTPH-Dx	2
JJ35	2 Sediment	WA EPH	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1	Holding Times and Sample Receipt	2	Laboratory Control Samples (LCS/LCSD)
	GC/MS Instrument Performance Check	1	Field Duplicates
	Initial Calibration (ICAL)		Internal Standards
	Continuing Calibration (CCAL)		Target Analyte List
	Blanks (Method)		Reporting Limits (MDL and MRL)
	Blanks (Field)	1	Compound Identification (Full validation only)
1	Surrogate Compounds		Calculation Verification (Full validation only)
1	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)		

[1] *Quality control results are discussed below, but no data were qualified.*
[2] *Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.*

Holding Times and Sample Receipt

The QAPP-required holding time criterion for sediment samples is 14 days from date of sampling to date of extraction. The holding time criterion for frozen sediment is one year from date of sampling to date of extraction. The QAPP-required holding time criterion for extracts is 40 days from extraction to analysis. All extracts were analyzed within the holding time criterion.

Several of the sample coolers were received with temperatures less than the lower acceptance limit of 2°C, ranging from -2.8° to 1.6°C. The low temperatures did not impact data quality and no qualifiers were required.

Surrogates

SDG JB18: The percent recovery (%R) values for o-terphenyl were less than the lower control limit in Samples LSP0253 and LSP0254, due to required dilution factor (20x). No qualifiers were applied.

Matrix Spike/Matrix Spike Duplicates

SDG JA18: The matrix spike/matrix spike duplicate (MS/MSD) analyses were performed on Sample LSP0275, from SDG JB51. Recoveries were not reported due to a concentration of diesel in the parent sample which exceeded the spiked concentration by a factor of five. No qualifiers were applied.

SDG JJ35: The MS/MSD analyses were performed on Sample LSP0468. The MS %R values for C10-C12 aliphatics, C12-C16 aliphatics and C16-C21 aliphatics were less than lower control limits; no action was taken for these aliphatic groups as the MSD and laboratory control sample (LCS) recoveries were within control limits. As the parent sample (LSP0468) is a soil sample and not a sediment sample, the issued qualifiers are discussed in the soil report.

Laboratory Control Sample (and Laboratory Control Sample Duplicate)

All %R values were within the specified control limits and all relative percent difference (RPD) values were less than the control limit of 50% in the LCS/LCSD analyses, with the exceptions noted below.

SDGs JB17 & JB18: The %R value for diesel was less than the lower control limit in the LCS from 2/14/2006. Positive results and reporting limits in the associated samples were estimated (J/UJ-10) with potential low bias.

SDG JJ35: The LCS %R value for C8-C10 aliphatics was less than lower control limits, the reporting limit was estimated (UJ-10) for all samples in the batch.

Field Duplicates

Replicate sample pairs were listed below. The following acceptance criteria were applied: the RPD control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and replicate must be less than two times the RL. No data were qualified based on field replicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG JA18: One pair of samples, LSP0132 & LSP0133, was submitted as field replicates. All results met the RPD control limit.

Compound Identification

All samples in these SDGs were sulfuric acid/silica gel "cleaned" prior to analysis to reduce the effects of biogenic interference in the samples. Biogenic interference can elevate the motor oil chromatographic response, making the sample results to be biased high. No further action was necessary.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, MS/MSD, and LCS/LCSD %R values, with the above exceptions. Precision was also acceptable as demonstrated by the field duplicate, MS/MSD, and LCS/LCSD RPD values, with the above exceptions.

Data were estimated because of LCS recovery outliers.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Semivolatile Organic Compounds
Matrix: Sediment

This report documents the review of analytical data from the analyses of sediment samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	Number of Samples	Validation Level
JA18	3 Sediment	3
JC08	5 Sediment	2
JH03	9 Sediment	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1	Holding Times and Sample Receipt	2	Laboratory Control Samples (LCS/LCSD)
	GC/MS Instrument Performance Check	1	Field Duplicates
1	Initial Calibration (ICAL)	2	Internal Standards
2	Continuing Calibration (CCAL)		Target Analyte List
2	Laboratory Blanks	1	Reporting Limits (MDL and MRL)
	Field Blanks	2	Compound Identification and Quantitation
1	Surrogate Compounds		Calculation Verification (Full validation only)
2	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)		

[1] Quality control results are discussed below, but no data were qualified.
[2] Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.

Holding Times and Sample Receipt

The QAPP-required holding time criterion for sediment samples is 14 days from date of sampling to date of extraction. The holding time criterion for frozen sediment is one year from date of sampling to date of extraction. The QAPP-required holding time criterion for extracts is 40 days from extraction to analysis. All extracts were analyzed within the holding time criterion.

Several of the sample coolers were received with temperatures less than the lower acceptance limit of 2^{o}C, ranging from -2.8º to 1.6ºC. The low temperatures did not impact data quality and no qualifiers were required.

Initial Calibration

Calibrations are not assessed during a Level 2 review. All relative response factor (RRF) values were greater than the 0.05 minimum control limit. All percent relative standard deviation (%RSD) values were within the 30% control limit for all initial calibrations (ICAL), with the exceptions noted below. Since the affected compounds were not detected in the associated samples, no action was taken.

SDG JA18: The %RSD value for 2,4-dinitrophenol (39%) was greater than the 30% control limit in the ICAL analyzed 2/15/06 on instrument NT4. The %RSD value for 2,4-dinitrophenol (48.9%) was greater than the 30% control limit in the ICAL analyzed 3/3/06 on instrument NT4.

Continuing Calibration

Calibrations are not assessed during a Level 2 review. All RRF values were greater than the 0.05 minimum control limit. All percent difference (%D) values were within the ±25% control limit for all continuing calibrations (CCAL), with the exceptions noted below. If the %D outlier indicates a low bias, positive results and reporting limits in samples associated with %D outliers were estimated (J/UJ-5B). If the %D outlier indicates a potential high bias, only positive results were estimated (J-5B).

SDG JA18:

- CCAL 2/24/06: 4-nitrophenol and 4-nitroaniline (high bias), and benzidine (low bias)
- CCAL 2/27/06: 2,4-dinitrophenol and benzidine (low bias)
- CCAL 2/28/06: 4-nitrophenol, 4-nitroaniline, and 3,3'-dichlorobenzidine (high bias); 2,4-dinitrophenol and benzidine (low bias)

Laboratory Blanks

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times the concentration reported in the blank (ten times for common laboratory contaminants). If a contaminant is reported in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U-7). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Method blanks were analyzed at the appropriate frequency. For the analytical batches noted below, one or more target analytes were reported in the method blank. A summary of contaminant levels, associated samples, and action levels is provided in the data validation worksheets.

Various target analytes were detected in the method blanks; however, the compounds were not detected in the associated samples. No action was necessary.

SDG JA18: Di-n-butyl phthalate (3 results).

SDG JC08: Bis(2-ethylhexyl)phthalate (seven results).

SDG JH03: Benzoic acid (one result); phenol (two results).

Surrogates

The percent recovery (%R) values for the surrogates were within the specified control limits of with the exceptions noted below. Qualifiers were only assigned when more than one %R value per fraction (acid or base-neutral) is outside the control limits. If the outliers indicated a potential high bias, only the associated positive results were estimated (J-13). If the outliers indicated a potential low bias, positive results and reporting limits were estimated (J/UJ-13).

SDG JA18: terphenyl-d14 (high bias) in Samples LSP0127, LSP0132, LSP0133, and LSP0127 MS/MSD. The recoveries were acceptable in the dilution analyses.

SDG JC08: terphenyl-d14 (high bias) in the laboratory control sample (LCS) analysis. No action.

SDG JH03: 2,4,6-tribromophenol (high bias) in Sample LSP0546. 2,4,6-tribromophenol (low bias) in Samples LSP0486 and LSP0474.

Matrix Spike/Matrix Spike Duplicate

SDG JA18: Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed on Sample LSP0127. The spiking compound pentachlorophenol was not recovered in the MS/MSD, and the pyrene recovery values were significantly greater than the upper control limit. The native pentachlorophenol concentration was greater than five times the spiking amount. No action was taken. The native pyrene concentration was less than five times the spiking amount. The pyrene result in the parent sample was estimated (J-8).

SDG JC08: MS/MSD analyses were performed on Sample LSP0264. The %R value for pyrene was much greater than the control limit in the MS and not recovered in the MSD. Pyrene was estimated (J-8) in the parent sample. The %R value for phenol was slightly greater than the control limit in the MSD; no action was taken as MS and LCS recoveries were acceptable.

The RPD values were greater than the control limit for anthracene, chrysene, pyrene, benzo(a)anthracene, fluoranthene, benzo(a)pyrene, benzo(k)fluoranthene, carbazole, fluorene, dibenzofuran, naphthalene, 4-methylphenol, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and phenanthrene. Results for these compounds were estimated (J/UJ-9) in the parent sample.

SDG JH03: MS/MSD analyses were performed on Sample LSP0546. The %R values for pentachlorophenol were less than the control limit, no action was taken because the concentration in the parent sample was much greater than the amount spiked. This MS/MSD was re-analyzed and the MSD %R value for pentachlorophenol were greater than the control limit, no action was taken as the MS and LCS recoveries were acceptable.

Laboratory Control Sample

SDG JC08: The %R value for aniline was less than 10%. Reporting limits were rejected (R-10) in all associated samples. The pyridine, 4-chloroaniline, and 3,3'-dichlorobenzidine %R values were less than lower control limits. These analytes were not detected in the associated samples, the reporting limits were estimated (UJ-10) in all samples.

SDG JH03: The benzoic acid, aniline, pyridine, 4-chloroaniline, and 3,3′-dichlorobenzidine %R values were less than lower control limits. The positive results and reporting limits were estimated (J/UJ-10) in all associated samples. The aniline, pyridine, and 3,3′-dichlorobenzidine %R values were less than lower control limits in the LCS associated with the re-extraction and re-analysis. No action was taken, the results from the initial LCS were used.

Field Duplicates

Duplicate sample pairs were listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL. No data were qualified based on field duplicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG JA18: Samples LSP0132 and LSP0133 were identified as field duplicates. All RPD and absolute difference values were within control limits, with the following exception: the RPD value for di-n-butyl phthalate (87.4%) was greater than the 50% control limit.

Internal Standards

SDG JA18: The %R values for the internal standard perylene-d12 were less than the lower control limits in Samples LSP0127, LSP0132, and LSP0133. All three samples were reanalyzed at dilutions, with similar internal standard results. The analytes quantitated using perylene-d12 were estimated (J-19).

Compound Identification and Quantitation

SDGs JA18, JC08, and JH03: The reported results for multiple analytes exceeded the initial calibration linear range in a number samples. The sample extract was diluted and reanalyzed and/or re-extracted and reanalyzed. Up to three sets of results were reported. The results for those analytes that exceeded the linear range were qualified do-not-report (DNR-20). The dilution or re-extraction results should be used instead. The reporting limits and reported results for all analytes except those which exceeded the calibration range were qualified do-not-report (DNR-11) in the dilution analyses.

Reporting Limits (Method Detection Limit and Method Reporting Limit)

In an attempt to meet the screening benchmark detection limits specified in the QAPP, the laboratory reported several compounds down to the MDL value, and flagged the detection limit as an estimate (UJ). Several of these reporting limits were still greater than the benchmark detection limits. No action was taken.

Several samples were diluted due to the concentrations of one or more target compounds present in the samples. Reporting limits were elevated accordingly.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, MS/MSD, and LCS %R values, with the noted exceptions. Precision was also acceptable as demonstrated by the MS/MSD RPD values, with the noted exceptions.

Data were estimated because of calibration %D outliers, MS/MSD and LCS %R outliers, MS/MSD RPD outliers, and internal standard recovery outliers. Data were also qualified as not detected based on contamination in the associated method blanks. Field duplicate precision outliers were noted.

Data were rejected due to very low LCS recovery. When multiple results were reported due to dilution or re-extraction analyses, data were qualified do-not-report (DNR) to designate which results should not be used so there is only one result per analyte per sample.

Data that have been rejected or flagged as do-not report are not useable for any purpose. All other data, as qualified, are acceptable for use.

EcoChem, INC.
Environmental Data Quality

DATA QUALITY EVALUATION

LITTLE SQUALICUM PARK
BELLINGHAM, WASHINGTON

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

SURFACE WATER SAMPLES

Prepared for:

Integral Consulting
1201 Cornwall Avenue, Suite 208
Bellingham, Washington 98225

Prepared by:

EcoChem, Inc.
710 Second Avenue, Suite 660
Seattle, Washington 98104

EcoChem Project: C22112

August 11, 2006

Approved for Release:

Eric Strout
Project Manager/Technical Director
EcoChem, Inc.

DATA QUALITY EVALUATION

BASIS OF DATA EVALUATION

The data were validated using guidance and quality control (QC) criteria documented in the analytical methods; *Little Squalicum Park Remedial Investigation/Feasibility Study, Bellingham, WA, Quality Assurance Project Plan* (QAPP) (Integral 2005), and *National Functional Guidelines for Organic and/or Inorganic Data Review* (USEPA 1999 & 2002). Additional guidance for validation of dioxin/furan data is documented in *EPA Region 10 SOP for the Validation of Polychlorinated Dibenzodioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) Data* (EPA 1996).

Samples were analyzed for the following parameters:

Test	Method
Semivolatile Organic Compounds (SVOC)	SW 8270D
Gasoline Range Organics (GRO)	NWTPH-Gx
Diesel Range Organics (DRO) and Motor Oil	NWTPH-Dx
Dioxin/Furan Compounds	E1613B
Metals	SW 6010B/E200.8
Mercury	SW7470A
Total Organic Carbon (TOC)	E415.1
Total Suspended Solids (TSS)	E160.2
Hardness	SW6010/SM2340B

EcoChem's goal in assigning data assessment qualifiers is to assist in proper data interpretation. If values are assigned a J or UJ, data may be used for site evaluation and risk assessment purposes, but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet the data quality objectives as stated in the above-referenced documents and methods.

Data qualifier definitions, reason codes, and validation criteria are included as **Appendix A**. Data validation reports, which discuss individual findings for each quality control element by sample delivery group (SDG), are provided in **Appendix B**. Data validation worksheets and communication records are organized by SDG and will be kept on file at EcoChem.

PROCESS FOR DATA VALIDATION

With the exception of the conventional and physical parameters analyses, the first data package generated for the aqueous matrix for each chemical analysis type received Level 4 (full) validation. The following quality control elements, as appropriate for each method, were evaluated:

- Package completeness
- Sample chain-of-custody and sample preservation
- Analytical holding times

- Blank contamination
- Precision (replicate analyses)
- Accuracy (compound recovery)
- Chromatogram review
- Detection limits
- Instrument performance (initial calibration, continuing calibration, tuning, sensitivity and degradation)
- Compound identification
- Transcription and calculation checks

No significant data quality issues were identified therefore; all remaining data were evaluated based on the review of standard analytical quality control elements, using data summaries generated from the analytical database.

EcoChem validation process provides a dual-tier system of primary and secondary reviewers to ensure technical correctness and QC of the validation process; and all data validation is documented using standardized and controlled validation worksheets and spreadsheets. These worksheets are completed for each SDG, documenting all deficiencies, outliers and subsequent qualifiers.

After qualifiers are entered into the EcoChem database, a second party verifies 100% of the qualifier entry. Algorithms are then used within the database to apply the final interpretive qualifiers to the field samples. The interpretive qualifiers merge quantitative laboratory flags with the validation qualifiers. The qualified data is then exported to the project database (Integral).

SUMMARY OF DATA VALIDATION: SEMIVOLATILE ORGANIC COMPOUNDS

A total of 19 surface water samples were analyzed for semivolatile organic compounds (SVOC) for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed the SVOC analyses.

The SVOC data for the surface water samples were generally acceptable. A total of 11 data points (0.76% of all surface water SVOC results) were of unacceptable quality and were rejected. Thirty-two (32) data points were estimated because control limits were exceeded in one or more laboratory quality control (QC) samples or procedures. Qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were greater than 99% complete for the surface water SVOC analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of 1.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial calibration analyses met all acceptance criteria.

The continuing calibration percent difference (%D) values were reviewed to evaluate instrument stability. When %D outliers were present, the potential bias was determined. If the %D outlier indicated a low bias, associated positive results and detection limits were estimated (J or UJ). If the %D outlier indicated a high bias, only associated positive results were estimated (J). One positive result and a total of 30 detection limits were estimated (J/UJ). Overall, 2.1% of the surface water SVOC results were estimated based on calibration outliers.

Method Blank Analyses

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times (5x) the concentration detected in the blank for most compounds and ten times (10x) for phthalates. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Various target analytes were detected in the method blanks. A total of 23 results (1.6% of all surface water SVOC results) were qualified as not detected (U) based on method blank contamination. The qualifiers were issued to bis(2-ethylhexyl)phthalate (eight results) and di-n-butyl phthalate (15 results).

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. The surrogate recoveries reported by the laboratory met the criteria for acceptable performance.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. One compound (benzidine) was not recovered in one MS/MSD set. The benzidine reporting limit was rejected (R) in the parent sample. All other recoveries reported by the laboratory for MS/MSD analyses met the criteria for acceptable performance. No other data were qualified.

Laboratory Control Sample Recoveries

Laboratory control sample/laboratory control sample duplicate (LCS/LCSD) analyses were performed at the proper frequency. Several of the recoveries reported by the laboratory did not meet the criteria for acceptable performance. Three (3) surface water SVOC results (0.21% overall) were estimated (UJ) because the control limits for LCS/LCSD recovery were not met. Four (4) results (0.19% overall) were rejected (R). Results were rejected when the %R value was less than 10%, indicating an extremely low bias.

Precision

MS/MSD and LCS/LCSD analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values for the MS/MSD and LCS/LCSD analyses met the criteria for acceptable performance.

Field Quality Control Samples

Field QC samples collected for the surface water sampling event included field replicate samples.

Field Replicate Samples

All of the RPD values for field replicate analyses met the criteria for acceptable precision.

SUMMARY OF DATA VALIDATION: GASOLINE RANGE ORGANICS (GRO)

A total of 23 surface water samples were analyzed for GRO for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed the GRO analyses.

The GRO data for the surface water samples were acceptable. No data were qualified for any reason. The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the surface water GRO analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial and continuing calibrations met all acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. The surrogate recoveries reported by the laboratory typically met the criteria for acceptable performance; however, surrogate recovery outliers were present in several samples. As the outliers indicated a potential high bias and GRO was not detected in the associated samples, no action was taken.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. All of the recoveries reported by the laboratory for MS/MSD analyses met the criteria for acceptable performance.

Laboratory Control Sample Recoveries

Laboratory control sample (LCS) analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Precision

MS/MSD and LCS/LCSD analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values for the MS/MSD analyses met the criteria for acceptable performance.

Field Quality Control Samples

Field QC samples collected for the surface water sampling event included field replicate samples.

Field Replicate Samples

All of the RPD values for field replicate analyses met the criteria for acceptable precision.

SUMMARY OF DATA VALIDATION: DIESEL RANGE ORGANICS (DRO)

A total of 20 surface water samples were analyzed for DRO (including motor oil) for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed the DRO analyses.

The DRO data for the surface water samples were acceptable. No data were qualified for any reason. The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the surface water DRO analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial and continuing calibration analyses met acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. The surrogate recoveries reported by the laboratory typically met the criteria for acceptable performance; however, surrogate recovery outliers were present in several samples. As the outliers indicated a potential high bias and DRO was not detected in the associated samples, no action was taken.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. All of the recoveries reported by the laboratory for MS/MSD analyses met the criteria for acceptable performance.

Laboratory Control Sample Recoveries

Laboratory control sample (LCS) analyses met the criteria for frequency of analysis. All of the recoveries reported by the laboratory for the LCS analyses met the criteria for acceptable performance.

Precision

MS/MSD and LCS/LCSD analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values for the MS/MSD analyses met the criteria for acceptable performance.

Field Quality Control Samples

Field QC samples collected for the surface water sampling event included field replicate samples.

Field Replicate Samples

All of the RPD values for field replicate analyses were acceptable.

SUMMARY OF DATA VALIDATION: DIOXIN/FURAN COMPOUNDS

Seven (7) surface water samples were analyzed for dioxin and furan compounds for the Little Squalicum Park RI/FS event. Severn Trent Laboratories, Sacramento, California completed the analyses.

The dioxin/furan data for the surface water samples were generally acceptable. No data were rejected for any reason. All of the data were estimated based on holding time outliers. These qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the surface water dioxin/furan analyses.

Holding Times and Sample Preservation

The QAPP-required holding time criterion is 7 days from the date sampling to date of extraction. The holding time criterion for extracts is 40 days from extraction to analysis. All samples were extracted beyond the 7 day extraction criterion, ranging from 13 days to 19 days after the date of sampling. All of the surface water dioxin/furan results were estimated (J/UJ).

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial and continuing calibration analyses met all acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

Labeled Compound Recoveries

Labeled compounds were added to all field and QC samples. The labeled compound recoveries reported by the laboratory met the criteria for acceptable performance.

Matrix Spike Recoveries

Matrix and duplicate matrix spike (MS/MSD) analyses were not performed. Accuracy was assessed using the labeled compound and ongoing precision and recovery (OPR) analyses.

Ongoing Precision and Recovery Sample Recoveries

OPR analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Precision

Laboratory duplicate OPR analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values met the criteria for acceptable performance.

Field Quality Control Samples

Field Replicate Samples

One of the RPD values in the field replicate analyses did not meet the criteria for acceptable precision. The field replicate precision outliers are discussed in greater detail in the data validation reports. No data were qualified based on field precision; however, users of the data should consider the potential impact of precision outliers on the reported results.

SUMMARY OF DATA VALIDATION: METALS (INCLUDING MERCURY)

A total of 31 surface water samples were analyzed for total and dissolved metals for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed all analyses. The following analytical methods were used:

Parameter	Method
ICP Metals	SW6010B
ICP-MS Metals	E200.8
Mercury	SW7470A

The metals data for the surface water samples were acceptable. No data were estimated or rejected for any reason. Several data points were qualified as not detected based on blank contamination. The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the surface water metals analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. The calibrations met all acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times (5x) the concentration detected in the blank. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Total chromium was detected in one of the method blanks. A total of nine total chromium results (2.0% of all surface water metals results) were qualified as not detected (U) based on method blank contamination.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of analytical bias (matrix spike [MS], laboratory control sample [LCS], contract required detection limit [CRDL] standard recovery values, interference check samples [ICS], and serial dilution percent difference [%D] values).

Matrix Spike Recoveries

MS analyses met the criteria for frequency of analysis. All of the recoveries reported by the laboratory met the criteria for acceptable performance.

Laboratory Control Sample Recoveries

LCS analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Contract Required Detection Limit Standard Analyses

CRDL standards were analyzed at the beginning of each analytical sequence. All recoveries were acceptable.

Interference Check Samples

ICP interference check samples were analyzed at the beginning of each analytical sequence. All ICP interference check sample results were within the acceptance criteria.

Serial Dilution Analyses

Serial dilution analyses were not performed. Any significant physical or chemical interferences due to sample matrix could not be determined.

Precision

Laboratory duplicate analyses were evaluated for laboratory precision. All relative percent difference (RPD) values were acceptable.

Field Quality Control Samples

Field QC samples collected for the surface waters sampling event included field replicate samples.

Field Replicate Samples

One of the RPD values in the field replicate analyses did not meet the criteria for acceptable precision. The field replicate precision outliers are discussed in greater detail in the data validation reports. No data were qualified based on field precision; however, users of the data should consider the potential impact of precision outliers on the reported results.

SUMMARY OF DATA VALIDATION: CONVENTIONAL PARAMETERS

A total of 20 surface water samples were analyzed for the following parameters for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington, completed all analyses. The following analytical methods were used:

Parameter	Method Number
Total Organic Carbon (TOC)	E415.1
Total Suspended Solids (TSS)	E160.2
Hardness	SW6010/SM2340B

Overall, the conventional parameters data for the surface water samples were acceptable. No data were qualified for any reason. The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the surface water conventional parameters analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for the TOC analyses and met the criteria for frequency of analysis. The initial calibrations met the linearity (percent relative standard deviation or correlation coefficient) control limits.

Method Blank Analyses

Two types of laboratory blanks were evaluated for possible contamination effects. These blanks were: initial and continuing calibration blanks (ICB and CCB) and method blanks (MB). The required frequency of one at the beginning and one every ten samples for calibration blank analysis was met. The laboratory analyzed one MB for every 20 samples digested or one per batch, for each digestion procedure, as required. No target analytes were detected in the blanks.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of analytical bias (matrix spike [MS] and laboratory control sample [LCS] recoveries) and precision (sample or matrix spike duplicate [MSD] analyses).

Matrix Spike Recoveries

MS analyses were completed for the TOC analyses and met the criteria for frequency of analysis. All recovery values met the acceptance criteria.

Laboratory Control Sample Recoveries

An LCS was analyzed for the TOC analyses. All LCS recovery values were acceptable.

Precision

Laboratory duplicate analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values met the criteria for acceptable performance.

Field Quality Control Samples

Field QC samples collected for the Phase 2 RI/FS included field replicate samples.

Field Replicate Samples

All of the RPD values in the field replicate analyses met the criteria for acceptable precision.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Conventional Parameter Analyses
Matrix: Surface Water

This report documents the review of analytical data from the analyses of surface water samples and the associated laboratory and field quality control (QC) samples. Analytical Resources, Inc., Seattle, Washington, analyzed the samples.

SDG	Number of Samples	Validation Level
IS16	9 Surface Water	3
JH47	10 Surface Water	2
JH85	1 Surface Water	2

The analytical tests that were performed are summarized below:

Parameter	Method
Total Suspended Solids (TSS)	160.2
Total Organic Carbon (TOC)	EPA 415.1
Hardness (H)	SW6010/SM2340B

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements for review are listed below.

1	Technical Holding Times and Sample Preservation		Laboratory Duplicates
	Initial Calibration (ICAL)		ICP Interference Check Samples
	Calibration Verification (CVER)		ICP Serial Dilution
	CRDL Standard		ICPMS Internal Standards
	Laboratory Blanks	1	Field Replicates
	Field Blanks	1	Reporting Limits (MDL and MRL)
	Laboratory Control Samples		
	Matrix Spike Samples		

---

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Technical Holding Times and Sample Preservation

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received many of the sample coolers with temperatures below the advisory control limits, with a low of -2.0ºC. It was determined that these outliers did not impact data quality and no action was taken.

Field Duplicates

Replicate sample pairs were listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 35% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and replicate must be less than two times the RL. No data were qualified based on field replicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG IS16: One set of field duplicates was submitted with this SDG: LSP0004 & LSP0005. All field duplicate criteria were met.

SDG JH47: One pair of samples, LSP0587 & LSP0588, was submitted as field replicates. All results met the acceptance criteria.

Reporting Limits (Method Detection Limit and Method Reporting Limit)

The QAPP specifies a method reporting limit (MRL) of 0.01% for total organic carbon (TOC), but the laboratory MRL is listed as 0.02%.

III. OVERALL ASSESSMENT

As determined by this evaluation, the laboratory followed the specified analytical methods. The laboratory RPD and relative standard deviation values indicated acceptable precision. Accuracy was also acceptable, as demonstrated by the matrix spike, laboratory control sample and standard reference material percent recovery.

All data, as reported, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Dioxin/Furan Compounds
Matrix: Surface Water

This report documents the review of analytical data from the analyses of surface water samples and the associated laboratory quality control (QC) samples. Severn Trent Laboratories, Inc., of Sacramento, California analyzed the samples.

SDG	Number of Samples	Validation Level
IS16	5 Surface Water	4
JH48	2 Surface Water	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables, with the exceptions noted below. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

SDG IS16: The majority of the closing calibration standards from the DB-5 column were not included in the data packages. A closing calibration is not required by EPA Method 1613 version B. As nearly all of the submitted calibration standards were acceptable no action was taken.

II TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

2	Holding Times and Sample Receipt		Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
	GC/MS Instrument Performance Check		Ongoing Precision and Recovery (OPR)
	Initial Calibration (ICAL)	1	Field Duplicates
	Continuing Calibration (CCAL)		Laboratory Duplicates
	Laboratory Blanks		Compound Identification/Reported Results
	Field Blanks		Reporting Limits (MDL and MRL)
	Labeled Compounds		Calculation Verification (full validation only)

[1] Quality control results are discussed below, but no data were qualified.
[2] Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.

Holding Times and Sample Receipt

The QAPP-required holding time criterion is 7 days from the date sampling to date of extraction. The holding time criterion for extracts is 40 days from extraction to analysis. The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. All holding times and all sample receipt temperatures were acceptable with the following exceptions:

SDG IS16: Samples LSP0004, LSP0005, LSP0006, LSP0008, and LSP0009 were extracted 13 or

14 days after the date of collection. Positive results and reporting limits were estimated (J/UJ-1).

SDG JH48: Samples LSP0587 and LSP0588 were extracted 19 days after collection. Positive results and reporting limits were estimated (J/UJ-1).

Field Duplicates

Duplicate sample pairs are listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL. No data were qualified based on field duplicate outliers; however, data users should take field precision into account when interpreting sample data.

SDG JH48: One set of field duplicates, Samples LSP0587 and LSP0588, were submitted. All values met the acceptance criteria described above except Total HxCDD.

SDG IS16: Samples LSP0004 and LSP0005 were identified as field duplicates. The field duplicate criteria discussed above were met for these samples. Field precision was acceptable.

Laboratory Duplicates

Duplicate sample pairs are listed below. The following acceptance criteria were applied: the RPD control limit is 50% for results greater than five times the RL. For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL.

SDG IS16: Duplicate analysis was performed on Sample LSP0006. All reported values met the acceptance criteria as described above.

Calculation Verification

SDG IS16: A full validation (Level IV) was performed this SDG. No anomalies were identified.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy and was acceptable, as demonstrated by the labeled compound and ongoing precision recovery (OPR) percent recovery values. Precision was acceptable, as demonstrated by the field duplicate RPD values.

Data were estimated due to extractions occurring past the specified holding times. Field duplicate precision outliers were noted.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Diesel and Residual Range Organics
Matrix: Surface Water

This report documents the review of analytical data from the analyses of surface water samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	Number of Samples	Validation Level
IS16	9 Surface Water	4
JH48	10 Surface Water	2
JH82	1 Surface Water	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1 Holding Times and Sample Receipt
GC/MS Instrument Performance Check
Initial Calibration (ICAL)
Continuing Calibration (CCAL)
Blanks (Method)
Blanks (Field)
1 Surrogate Compounds
Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
Laboratory Control Samples (LCS/LCSD)
1 Field Duplicates
Internal Standards
Target Analyte List
Reporting Limits (MDL and MRL)
Compound Identification (Full validation only)
1 Calculation Verification (Full validation only)

---

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for preserved water samples is 14 days from date of sampling to date of extraction. The QAPP-required holding time criterion for extracts is 40 days from extraction to analysis. All holding time criteria were met.

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received the majority of the sample coolers with temperatures below the advisory control limits, with a low of -2.0ºC. It was determined that these outliers did not impact data quality and no action was taken.

Surrogates

SDG JH48: The percent recovery (%R) values for the surrogate o-terphenyl were greater than the upper control limit for Samples LSP0582, LSP0584, LSP0587, LSP0586 MS, and the method blank. No action was taken, as the outliers indicated a possible high bias and there were no positive results in the field samples, and no action is taken for surrogate outliers in QC samples.

Field Duplicates

Duplicate sample pairs are listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL. No data were qualified based on field duplicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG IS16: One pair of samples, LSP0004 & LSP0005, was submitted as field duplicates. There were no positive results for any target analytes in either of these samples. Field precision was acceptable.

SDG JH48: Samples LSP0587 and LSP0588 were identified as field duplicates. There were no positive results for any target analytes in either of these samples. Field precision was acceptable.

Calculation Verification

SDG IS16: Calculation verifications were performed on this SDG. No calculation errors were found.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, matrix spike/matrix spike duplicate (MS/MSD), and laboratory control sample %R values. Precision was also acceptable as demonstrated by the field duplicate and MS/MSD RPD values.

All data, as reported, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Gasoline Range Organics
Matrix: Surface Water

This report documents the review of analytical data from the analyses of surface water samples and the associated laboratory and field quality control (QC) samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	Number of Samples	Validation Level
IS16	11 Surface Water	4
JH48	11 Surface Water	2
JH82	1 Surface Water	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1 Holding Times and Sample Receipt
GC/MS Instrument Performance Check
Initial Calibration (ICAL)
Continuing Calibration (CCAL)
Blanks (Method)
1 Blanks (Field)
1 Surrogate Compounds
Matrix Spike/Matrix Spike Duplicates (MS/MSD)
Laboratory Control Samples (LCS/LCSD)
1 Field Replicates
Internal Standards
Target Analyte List
Reporting Limits (MDL and MRL)
Compound Identification (Full validation only)
1 Calculation Verification (Full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for preserved water samples is 14 days from date of sampling to date of analysis. All samples were analyzed within the holding time criterion.

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received the majority of the sample coolers with temperatures below the advisory control limits, with a low of -2.0ºC. It was determined that these outliers did not impact data quality and no action was taken.

Surrogates

SDG JH48: The percent recovery (%R) values for the surrogates bromobenzene and trifluorotoluene were greater than the upper control limits for Samples LSP0582, LSP0587, LSP0588, and LSP0589. The %R values for trifluorotoluene were greater than the upper control limit for Samples LSP0583, LSP0584, LSP0585, LSP0589, LSP0599, the laboratory control spike sample, and the matrix spike duplicate using LSP0586. The %R value for bromobenzene was greater than the upper control limit for the matrix spike using LSP0586. No action was taken for high bias outliers as the target analyte was not detected in any sample.

SDG JH82: The %R values for the surrogate trifluorotoluene were greater than the upper control limit for the laboratory control spike and method blank samples. No action was taken for surrogate outliers in QC samples.

Field Duplicates

Duplicate sample pairs were listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL. No data were qualified based on field duplicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG IS16: One pair of samples, LSP0004 & LSP0005, was submitted as field duplicates. There were no positive results for any target analytes in either of these samples. Field precision was acceptable.

SDG JH48: Samples LSP0587 and LSP0588 were identified as field duplicates. There were no positive results for any target analytes in either of these samples. Field precision was acceptable.

Calculation Verification

SDG IS16: Calculation verifications were performed on this SDG. No calculation errors were found.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, matrix spike/matrix spike duplicate (MS/MSD), and laboratory control sample/laboratory control sample duplicate %R values. Precision was also acceptable as demonstrated by the field duplicate and MS/MSD RPD values.

All data, as reported, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Total and Dissolved Metals
Matrix: Surface Water

This report documents the review of analytical data from the analysis of surface water samples and the associated laboratory and field quality control (QC) samples. Analytical Resources, Inc., Seattle, Washington, analyzed the samples.

SDG	Number of Samples	Validation Level
IS16	9 Surface Water	4
JH47	20 Surface Water	2
JH85	2 Surface Water	2

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The QC requirements for review are listed below.

1	Technical Holding Times and Sample Preservation		Laboratory Duplicates
	Initial Calibration (ICAL)		ICP Interference Check Samples
	Calibration Verification (CVER)	1	ICP Serial Dilution
	CRDL Standard		ICPMS Internal Standards
2	Laboratory Blanks	1	Field Replicates
	Field Blanks		Reporting Limits (MDL and MRL)
	Laboratory Control Samples	1	Calculation Verification (Full validation only)
	Matrix Spike Samples		

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Technical Holding Times and Sample Preservation

The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received many of the sample coolers with temperatures below the advisory control limits, with a low of -2.0ºC. It was determined that these outliers did not impact data quality and no action was taken.

Laboratory Blanks

SDG JH47: Total Chromium was detected in the method blank at a level greater than the reporting limit (RL). To evaluate the effect on the sample data, an action level of five times the blank concentration was established. Nine associated results were qualified as not detected (U-7).

Field Duplicates

The relative percent difference (RPD) control limit is 35% for sample results greater than five times the reporting limit (RL). For results less than five times the RL, the difference must be less than twice the RL. Although qualification of data is not required for field duplicate outliers, data users should take field precision into account when interpreting the sample results.

SDG IS16: One set of field duplicates was submitted with this SDG: LSP0004 & LSP0005. These samples were analyzed for total and dissolved metals. All field duplicate criteria were met.

SDG JH47: One set of field duplicates was submitted with this SDG: LSP0587 & LSP0588. These samples were analyzed for total and dissolved metals. All field duplicate criteria were met, except for dissolved zinc.

ICP Serial Dilution

An ICP serial dilution sample was not analyzed. Any significant physical or chemical interferences due to sample matrix could not be determined.

Calculation Verification

SDG IS16: Several results were verified by recalculation from the raw data. No calculation or transcription errors were found.

III. OVERALL ASSESSMENT

As determined by this evaluation, the laboratory followed the specified analytical methods. The laboratory and field duplicate RPD values indicated acceptable precision, except as noted above. Accuracy was also acceptable, as demonstrated by the matrix spike and laboratory control samples percent recovery values.

Field duplicate outliers were noted but not qualified. No data were qualified for any reason.

All data, as reported, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Semivolatile Organic Compounds
Matrix: Surface Water

This report documents the review of analytical data from the analyses of surface water samples and the associated laboratory and field quality control samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	Number of Samples	Validation Level
IS16	9 Surface Water	4
JH48	10 Surface Water	3

I. DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II. TECHNICAL DATA VALIDATION

The quality control (QC) requirements that were reviewed are listed below.

1	Holding Times and Sample Receipt	2	Laboratory Control Samples (LCS/LCSD)
	GC/MS Instrument Performance Check	1	Field Duplicates
	Initial Calibration (ICAL)		Internal Standards
2	Continuing Calibration (CCAL)		Target Analyte List
2	Laboratory Blanks	1	Reporting Limits (MDL and MRL)
	Surrogate Compounds	2	Compound Identification and Quantitation
2	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)	1	Calculation Verification (Full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for aqueous samples is 7 days from the date of sampling to date of extraction. The holding time criterion for extracts is 40 days from extraction to analysis. All samples were extracted and analyzed within the holding time criteria.

Several of the sample coolers were received with temperatures less than the lower acceptance limit of 2^{o}C, ranging from 1.0º to 1.2ºC. The low temperatures did not impact data quality and no qualifiers were required.

Continuing Calibration

All relative response factor (RRF) values were greater than the 0.05 minimum control limit. All percent difference (%D) values were within the ±25% control limit for all continuing calibrations

(CCAL), with the exceptions noted below. If the %D outlier indicates a low bias, positive results and reporting limits in samples associated with %D outliers were estimated (J/UJ-5B). If the %D outlier indicates a potential high bias, only positive results were estimated (J-5B).

SDG IS16:

- CCAL 11/16/05: 4-nitrophenol (high bias)
- CCAL 11/16/05: 2,3,5,6-tetrachlorophenol (high bias)
- CCAL 11/17/05: 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, benzidine (all low bias)

SDG JH48:

- CCAL 5/2/06: 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, and benzidine (all low bias).
- CCAL 5/3/06: benzoic acid, 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol (all low bias).

Laboratory Blanks

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times the concentration reported in the blank (ten times for common laboratory contaminants). If a contaminant is reported in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U-7). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Method blanks were analyzed at the appropriate frequency. For the analytical batches noted below, one or more target analytes were reported in the method blank. A summary of contaminant levels, associated samples, and action levels is provided in the data validation worksheets.

Various target analytes were detected in the method blanks; however, only the following analytes were qualified as not detected in one or more samples in the associated laboratory data sets:

SDG IS16: Di-n-butyl phthalate (nine results), bis(2-ethylhexyl)phthalate (eight results)

SDG JH48: Di-n-butyl phthalate (six results).

Matrix Spike/Matrix Spike Duplicate

SDG JH48: Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed using Sample LSP0586. The spiking compound benzidine was not recovered in the MS/MSD. The benzidine reporting limit was rejected (R-8) in the parent sample.

Laboratory Control Sample

SDG JH48: The percent recovery (%R) value for benzoic acid was less than the lower control limit and less than 10% in the laboratory control sample (LCS) prepared on 5/2/06. The benzoic acid reporting limits were rejected (R-10) in all associated samples. The 2,4-dinitrophenol %R value was also less than the lower control limit. The 2,4-dinitrophenol detection limits were estimated (UJ-10) in the associated samples.

Field Duplicates

Duplicate sample pairs were listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL. No data were qualified based on field duplicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG IS16: Samples LSP0004 and LSP0005 were identified as field duplicates. All RPD and absolute difference values were within control limits. Field precision was acceptable.

SDG JH48: Samples LSP0587 and LSP0588 were identified as field duplicates. There were no positive results for any target analytes in either of these samples. Field precision was acceptable.

Reporting Limits (Method Detection Limit and Method Reporting Limit)

In an attempt to meet the screening benchmark detection limits specified in the QAPP, the laboratory reported several compounds down to the MDL value, and flagged the detection limit as an estimate (UJ). Several of these reporting limits were still greater than the benchmark detection limits. No action was taken.

Several samples were diluted due to the concentrations of one or more target compounds present in the samples. Reporting limits were elevated accordingly.

Compound Identification and Quantitation

SDG IS16: The reported results for pentachlorophenol exceeded the initial calibration linear range in Samples LSP0004 and LSP0005. The sample extracts were diluted (5x) and reanalyzed. Both sets of results were reported. The pentachlorophenol results from the original analyses were qualified do-not-report (DNR-20). The reporting limits and reported results for all analytes except pentachlorophenol were qualified do-not-report (DNR-11) in the dilution analyses. Only pentachlorophenol results should be reported from the dilution analyses.

Calculation Verification

SDG IS16: Calculation verifications were performed on this SDG. No calculation errors were found.

III. OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, MS/MSD, and LCS %R values, with exceptions noted above. Precision was also acceptable as demonstrated by the field duplicate and MS/MSD RPD values.

Data were qualified as estimated because of calibration outliers. Data were also qualified as not detected based on contamination in the associated method blanks.

Data were rejected based on LCS and MS/MSD %R values less than 10%. For samples with multiple reported results, data were qualified do-not-report (DNR) to designate which results should not be used. Data that have been rejected or flagged DNR are not useable for any purpose.

All other data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Conventional Parameter Analyses
Matrix: Soil
Analytical Resources, Inc. — Seattle

This report documents the review of analytical data from the analysis of soil samples and the associated laboratory and field quality control samples. Analytical Resources, Inc., Seattle, Washington, analyzed the samples.

SDG	Number of Samples	Validation Level
IS33	2 Soil Samples	3
IS77	7 Soil Samples	3
IT12	16 Soil Samples	3
JA16	6 Soil Samples	3
JA17	4 Soil Samples	3
JA18	4 Soil Samples	3
JB13	3 Soil Samples	3
JB14	1 Soil Sample	3
JB15	2 Soil Samples	3
JB17	3 Soil Samples	3
JB18	3 Soil Samples	3
JB19	3 Soil Samples	3
JB51	2 Soil Samples	3
JF81	6 Soil Samples	2
JG15	2 Soil Samples	2
JG37	13 Soil Samples	2
JH02	8 Soil Samples	2
JH03	8 Soil Samples	2
JH04	5 Soil Samples	2
JH15	1 Soil Sample	2

The analytical tests that were performed are summarized below:

Parameter	Method
Total Organic Carbon (TOC)	Plumb, 1981

I DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II TECHNICAL DATA VALIDATION

The quality control (QC) requirements for review are listed below.

- 1 Technical Holding Times and Sample Preservation
- Initial Calibration (ICAL)
- Calibration Verification (CVER)
- CRDL Standard
- Laboratory Blanks
- Field Blanks
- Laboratory Control Samples
- 1 Matrix Spike Samples
- 1 Laboratory Duplicates
- ICP Interference Check Samples
- ICP Serial Dilution
- ICPMS Internal Standards
- 1 Field Replicates
- 1 Reporting Limits (MDL and MRL)

---

[1] Quality control results are discussed below, but no data were qualified.
[2] Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.

Technical Holding Times and Sample Preservation

For TOC analyses the QAPP-required holding time criterion for soil samples is 14 days from date of sampling to date of extraction. For frozen soils, the holding time criterion is 6 months from date of sampling to date of extraction. All samples were extracted within the holding time limits.

All SDGs: The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received the majority of the sample coolers with temperatures below the advisory control limits, with a low of -2.8ºC. It was determined that these outliers did not impact data quality and no action was taken.

Laboratory Duplicates

Laboratory triplicates were analyzed at the proper frequency of one per 20 samples or one per batch; whichever was more frequent. The relative standard deviation (RSD) values were within the control limit of 35% for sample results greater than five times the reporting limit (for results less than five times the reporting limit, the absolute difference was less than twice the reporting limit) with the exceptions noted below. For RSD values exceeding the control limits, associated positive results and non-detects were qualified as estimated (J/UJ).

SDG JA15: Laboratory duplicate samples were not analyzed for this SDG, precision was not measured.

Matrix Spike Samples

A matrix spike sample (MS) was analyzed at the proper frequency of one per twenty samples or one per batch; whichever was more frequent. The percent recovery (%R) values were within the control limits of 75%-125%.

SDGs JA16, JA17, JA18, JB17, JB18, and JB19: Batch MS analyses were analyzed for these SDGs, %R values were acceptable.

Field Replicates

The RPD control limit is 50% for sample results greater than five times the reporting limit (RL). For results less than five times the RL, the difference must be less than twice the RL. Although qualification of data is not required for field duplicate outliers, data users should take field precision into account when interpreting the sample results.

SDG IT12: Two sets of field duplicates were submitted with this SDG: LSP0059 & LSP0060 and LSP0065 & LSP0066. All field duplicate criteria were met.

SDG JA16: One pair of samples, LSP0169 & LSP0170, was submitted as field replicates. All results met the acceptance criteria.

SDG JA18: One pair of samples, LSP0132 & LSP0133, was submitted as field replicates. All results met the acceptance criteria.

SDG JB13: One pair of samples, LSP0213 & LSP0214, was submitted as field replicates. All results met the acceptance criteria.

SDG JB19: One pair of samples, LSP0272 & LSP0273, was submitted as field replicates. All results met the acceptance criteria.

Reporting Limits (Method Detection Limit and Method Reporting Limit)

All SDGs: The QAPP specifies a method reporting limit (MRL) of 0.01% for total organic carbon (TOC), but the laboratory MRL is listed as 0.02%.

III OVERALL ASSESSMENT

As determined by this evaluation, the laboratory followed the specified analytical methods. The laboratory RPD and RSD values indicated acceptable precision. Accuracy was also acceptable, as demonstrated by the matrix spike, laboratory control sample and standard reference material percent recovery (%R).

All data, as reported, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Dioxin/Furan Compounds
Matrix: Soil
Severn Trent Laboratories—Sacramento

This report documents the review of analytical data from the analyses of soil samples and the associated laboratory quality control samples. Samples were analyzed by Severn Trent Laboratories, Inc., of Sacramento, California.

SDG	No. Samples	Validation Level
IT99	2 Soil Samples	4
JH01	2 Soil Samples	3
JK00	5 Soil Samples	2

I DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables, with the exceptions noted below. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

SDG IT66: The majority of the closing calibration standards from the DB-5 column were not included in the data packages. A closing calibration is not required by EPA Method 1613 version B. As nearly all of the submitted calibration standards were acceptable no action was taken.

II TECHNICAL DATA VALIDATION

The quality control (QC) requirements that were reviewed are listed below.

1	Holding Times and Sample Receipt	1	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
1	GC/MS Instrument Performance Check		Ongoing Precision and Recovery (OPR)
	Initial Calibration (ICAL)	1	Field Duplicates
	Continuing Calibration (CCAL)	1	Laboratory Duplicates
	Laboratory Blanks	2	Compound Identification/Reported Results
	Field Blanks		Reporting Limits (MDL and MRL)
2	Labeled Compounds	1	Calculation Verification (full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for soil samples is 14 days from date of sampling to date of extraction. The holding time criterion for frozen soil is one year from date of sampling to date of extraction. The QAPP-required holding time criterion for extracts is 40 days from extraction to analysis. All extracts were analyzed within the holding time criterion.

Several of the sample coolers were received with temperatures less than the lower acceptance limit of 2°C, ranging from -2.8ºC to 1.8ºC. The low temperatures did not impact data quality and no qualifiers were required.

GC/MS Instrument Performance Check

SDG JH01: The analytical method specifies that the GC/MS instrument performance check (tune) be analyzed at the start and end of each 12 hour analytical shift. The tunes were not analyzed at this frequency, and instead were analyzed at the start and end of each analytical sequence, more than 24 hours apart. Continuing calibration (CCAL) standards were analyzed at the proper frequency of one at the start of each 12 hour analytical shift and as all CCAL and tunes were acceptable no qualifiers were assigned. In addition, the absolute retention time of ^{13}C-1,2,3,4-TCDD was less than the method specified criterion of 25 minutes. The retentions times and separation of all target analytes and retention time markers were reviews and it was determined that there was no impact on the data.

Labeled Compounds

SDG IT99: The percent recovery (%R) values for cleanup standard, ^{37}C-2,3,7,8-TCDD, were less than the lower control limit in Samples LSP0088 and LSP0090 and positive results for the associated congeners were estimated (J-13).

The %R value for ^{13}C-1,2,3,6,7,8-HxCDD in Sample LSP0090 was less than the lower control limit. A positive result for the associated unlabeled congener was estimated (J-13) in this sample.

SDG JH01: The ion abundance rations for ^{13}C-OCDD did not meet the acceptance criteria in Sample LSP0271. The laboratory used the theoretical ion abundance ration for calculating the %R of ^{13}C-OCDD and the concentrations of the associated native analytes. The concentrations of OCDD and OCDF were estimated (J-13) in this sample.

Matrix Spikes/Matrix Spike Duplicates (MS/MSD)

All SDG: MS/MSD analyses were not performed. Accuracy and precision were assessed using labeled compound recoveries and the ongoing precision and recovery sample.

Laboratory Duplicates

Duplicate sample pairs are listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL.

SDG IT99: Duplicate analysis was performed on Sample LSP0088. The RPD values for 2,3,7,8-TCDD, 1,2,3,4,6,7,8-HpCDD, and OCDD exceeded the acceptance criteria and results for these congeners were estimated (J-9).

SDG JH01: Laboratory duplicate analysis was performed on Sample LSP0127 and all RPD values were within the acceptance limits.

Field Duplicates

No samples identified as field duplicates were submitted.

Compound Identification/Reported Results

All results for 2,3,7,8-TCDF were confirmed on a DB-225 column as required by the method. Although the 2,3,7,8-TCDF results from both columns were reported in the raw data, only the results from the DB-225 column were reported in the EDD. No action was necessary.

The laboratory used an "E" flag to indicate when reported results (usually OCDD or OCDF) were at concentrations greater than the linear range of the instrument calibration. These samples were usually not reanalyzed at dilutions. Since results greater than the linear range could have a potential low bias, all "E" flagged results were estimated (J-20), as noted below.

All SDG: The reported results for one or more analytes exceeded the linear range of the calibration in all samples. These results were qualified as estimated (J-20).

Reporting Limits (MDL and MRL)

SDG JH01: Samples LSP0133 and LSP0254 were analyzed at dilution, 10X and 20X respectively. Reporting limits were adjusted accordingly.

Calculation Verification

SDG IT99: A full validation (Level IV) was performed this SDG. No anomalies were identified.

III OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy and was acceptable, as demonstrated by the labeled compound and OPR percent recovery values, with the exception noted above. Precision was acceptable, as demonstrated by the laboratory duplicate RPD values.

Data were estimated due to laboratory duplicate precision outliers, labeled compound outliers, results exceeding the linear range of the calibration, and due to labeled compound ion abundance ratio outliers.

All data, as qualified, are acceptable for use.

DATA QUALITY EVALUATION

LITTLE SQUALICUM PARK
BELLINGHAM, WA

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

SOIL SAMPLES

Prepared for:

Integral Consulting
1201 Cornwall Avenue, Suite 208
Bellingham, Washington 98225

Prepared by:

EcoChem, Inc.
710 Second Avenue, Suite 660
Seattle, Washington 98104

EcoChem Project: C22112

August 14, 2006

Approved for Release:

____

Eric Strout
Project Manager/Technical Director
EcoChem, Inc.

DATA QUALITY EVALUATION

BASIS OF DATA EVALUATION

The data were validated using guidance and quality control (QC) criteria documented in the analytical methods; *Little Squalicum Park Remedial Investigation/Feasibility Study, Bellingham, WA, Quality Assurance Project Plan* (QAPP) (Integral 2005), and *National Functional Guidelines for Organic and/or Inorganic Data Review* (USEPA 1999 & 2002). Additional guidance for validation of the dioxin/furan data is documented in *EPA Region 10 SOP for the Validation of Polychlorinated Dibenzodioxin (PCDD) and Polychlorinated Dibenzofuran (PCDF) Data* (EPA 1996).

Samples were analyzed for the following parameters:

Test	Method
Semivolatile Organic Compounds (SVOC)	PSDDA SW 8270D
Pesticides	SW8081
PCB Aroclors	SW8082
Gasoline Range Organics (GRO)	NWTPH-Gx
Diesel Range Organics (DRO) and Motor Oil	NWTPH-Dx and WA EPH
Dioxin/Furan Compounds	E1613B
Metals	SW6010B
Mercury	SW7471A
Total Organic Carbon (TOC)	Plumb, 1981

EcoChem's goal in assigning data assessment qualifiers is to assist in proper data interpretation. If values are assigned a J or UJ, data may be used for site evaluation and risk assessment purposes, but reasons for data qualification should be taken into consideration when interpreting sample concentrations. If values are assigned an R, the data are to be rejected and should not be used for any site evaluation purposes. If values have no data qualifier assigned, then the data meet the data quality objectives as stated in the above-referenced documents and methods.

Data qualifier definitions, reason codes, and validation criteria are included as **Appendix A**. Data validation reports, which discuss individual findings for each quality control element by sample delivery group (SDG)], are provided in **Appendix B**. Data validation worksheets and communication records are organized by SDG and will be kept on file at EcoChem.

PROCESS FOR DATA VALIDATION

With the exception of the pesticides, PCB Aroclors, and TOC analyses, the first data package generated for the solids matrix for each chemical analysis type received Level 4 (full) validation. The following quality control elements, as appropriate for each method, were evaluated:

- Package completeness
- Sample chain-of-custody and sample preservation
- Analytical holding times

- Blank contamination
- Precision (replicate analyses)
- Accuracy (compound recovery)
- Chromatogram review
- Detection limits
- Instrument performance (initial calibration, continuing calibration, tuning, sensitivity and degradation)
- Compound identification
- Transcription and calculation checks

No significant data quality issues were identified therefore; all remaining data were evaluated based on the review of standard analytical quality control elements, using the summary forms and electronic data summaries generated from the analytical database.

EcoChem validation process provides a dual-tier system of primary and secondary reviewers to ensure technical correctness and QC of the validation process; and all data validation is documented using standardized and controlled validation worksheets and spreadsheets. These worksheets are completed for each SDG, documenting all deficiencies, outliers and subsequent qualifiers.

After qualifiers are entered into the EcoChem database, a second party verifies 100% of the qualifier entry. Algorithms are then used within the database to apply the final interpretive qualifiers to the field samples. The interpretive qualifiers merge quantitative laboratory flags with the validation qualifiers. The qualified data is then exported to the project database (Integral).

SUMMARY OF DATA VALIDATION: SEMIVOLATILE ORGANIC COMPOUNDS

A total of 43 soil samples were analyzed for semivolatile organic compounds (SVOC) for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed the SVOC analyses.

The SVOC data for the soil samples were generally acceptable. A total of 31 data points (0.94% of all soil SVOC results) were of unacceptable quality and were rejected. A total of 108 data points were estimated because control limits were exceeded in one or more laboratory QC samples or procedures. Qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were greater than 99% complete for the soil SVOC analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of -2.8ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. Several initial calibration percent relative standard deviation (%RSD) values were greater than the upper control limit. The affected compounds were not detected in the associated samples; no action was necessary.

The continuing calibration percent difference (%D) values were reviewed to evaluate instrument stability. When %D outliers were present, the potential bias was determined. If the %D outlier indicated a low bias, associated positive results and detection limits were estimated (J or UJ). If the %D outlier indicated a high bias, only associated positive results were estimated (J). A total of 17 detection limits were estimated (J/UJ). Overall, 0.51% of the soil SVOC results were estimated based on calibration outliers.

Method Blank Analyses

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times (5x) the concentration detected in the blank for most compounds and ten times (10x) for phthalates. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Various target analytes were detected in the method blanks. A total of 13 results (0.39 of all soil SVOC results) were qualified as not detected (U) based on method blank contamination. The qualifiers were issued to bis(2-ethylhexyl)phthalate (four results), di-n-butyl phthalate (two results), phenol (five results) and benzoic acid (two results).

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. Several of the surrogate recoveries reported by the laboratory did not meet the criteria for acceptable performance. As there was only one recovery outlier per fraction (acid or base/neutral) in each sample, no action was necessary.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. Several of the recoveries reported by the laboratory for MS/MSD analyses did not meet the criteria for acceptable performance. Five (5) soil SVOC results (0.15% overall) were estimated (J or UJ) because the control limits for MS/MSD recovery were not met. Eight (8) results (0.24% overall) were rejected (R). Results were rejected when the %R value was less than 10%, indicating an extremely low bias.

Laboratory Control Sample Recoveries

Laboratory control sample (LCS) analyses were performed at the proper frequency. Several of the recoveries reported by the laboratory did not meet the criteria for acceptable performance. Seventy-nine (79) soil SVOC results (2.4% overall) were estimated (J or UJ) because the control limits for LCS/LCSD recovery were not met. A total of 26 results (0.78% overall) were rejected (R). Results were rejected when the %R value was less than 10%, indicating an extremely low bias.

GCMS Internal Standards

The areas of the internal standards were outside the control limits in several samples. In each case, the samples were reanalyzed as dilutions and the internal standards were acceptable. The compounds associated with the internal standard outliers were reported from the dilution analyses, so no action was necessary.

Precision

MS/MSD analyses were evaluated for laboratory precision. Several of the relative percent difference (RPD) values for the MS/MSD analyses did not meet the criteria for acceptable performance. For MS/MSD precision outliers, qualifiers were issued only to the parent sample. Thirteen (13) data points were estimated (J or UJ). Overall, 0.39 of the soil SVOC results were estimated based on precision outliers.

Field Quality Control Samples

Field QC samples collected for the soil sampling event included field replicate samples.

Field Replicate Samples

Two of the RPD values in the field replicate analyses did not meet the criteria for acceptable precision. The field replicate precision outliers are discussed in greater detail in the data validation reports. No data were qualified based on field precision; however, users of the data should consider the potential impact of precision outliers on the reported results.

SUMMARY OF DATA VALIDATION: PESTICIDE COMPOUNDS

A total of 13 soil samples were analyzed for pesticides for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed the pesticides analyses.

The pesticide data for the soil samples were generally acceptable. No data were rejected. A single data point was estimated because control limits were exceeded in one or more laboratory quality control (QC) samples or procedures. These qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the soil pesticide analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of 1.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Calibrations

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All calibrations met all acceptance criteria.

Endrin/DDT Breakdown

Performance evaluation mixtures (PEM) were analyzed at the proper frequency to measure percent breakdown of 4,4'-DDT and endrin. All breakdown values were acceptable.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blank.

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. The surrogate recoveries reported by the laboratory typically met the criteria for acceptable performance; however, surrogate recovery outliers were present in several samples. Since only one surrogate outlier was present, or since the outliers were due to required dilution factors, the data were not affected and no action was taken.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. All of the recoveries reported by the laboratory for MS/MSD analyses met the criteria for acceptable performance.

Laboratory Control Sample Recoveries

Laboratory control sample (LCS) analyses met the criteria for frequency of analysis. All of the recoveries reported by the laboratory for LCS analyses met the criteria for acceptable performance.

Precision

MS/MSD analyses were evaluated for laboratory precision. The relative percent difference (RPD) values were within the acceptance limits in the MS/MSD analyses.

Compound Identification

The results from the two analytical columns were compared for agreement. In cases where the RPD value between the two columns was greater than 40% the reported result was "P" flagged by the laboratory. As the elevated RPD value may indicate the presence of an interferent that may result in a high bias, the associated results were estimated (J). One data point was estimated (J). This was the only detected pesticide result.

Field Quality Control Samples

No samples identified as field replicates were submitted.

SUMMARY OF DATA VALIDATION: POLYCHLORINATED BIPHENYL (PCB) COMPOUNDS

A total of 15 soil samples were analyzed for PCB-Aroclors for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed the pesticides analyses.

The PCB data for the soil samples were acceptable. No data were qualified for any reason. The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the soil PCB analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of 1.0ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Calibrations

Initial and continuing calibrations were completed for all reported analytes at the proper frequency. All initial calibrations met all acceptance criteria.

One percent difference value was outside the control limit in one continuing calibration. As the percent difference value was acceptable on the other column, no action was taken.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in any method blank.

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. The surrogate recoveries reported by the laboratory met the criteria for acceptable performance.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. All of the recoveries reported by the laboratory met the criteria for acceptable performance.

Laboratory Control Sample Recoveries

Laboratory control sample (LCS) analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Precision

MS/MSD and LCS/LCSD analyses were evaluated for laboratory precision. The relative percent difference (RPD) values reported by the laboratory met the criteria for acceptable performance.

Compound Identification

PCB Aroclors were not detected in any sample.

Field Quality Control Samples

No samples identified as field replicates were submitted.

SUMMARY OF DATA VALIDATION: GASOLINE RANGE ORGANICS (GRO)

A total of 21 soil samples were analyzed for GRO for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed the GRO analyses.

The GRO data for the soil samples were generally acceptable. No data were rejected for any reason. Two (2) data points were estimated because control limits were exceeded in one or more laboratory QC samples or procedures. Qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the soil GRO analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.8ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial and continuing calibrations met all acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. The surrogate recoveries reported by the laboratory met the criteria for acceptable performance.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. . Several of the recoveries reported by the laboratory for the MS/MSD analyses did not meet the criteria for acceptable performance. One (1) soil GRO results was estimated (UJ) because the control limits for MS/MSD recovery were not met.

Laboratory Control Sample Recoveries

Laboratory control sample (LCS) analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Precision

MS/MSD and LCS/LCSD analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values for the MS/MSD analyses met the criteria for acceptable performance.

Compound Identification and Quantitation

The chromatographic pattern for Sample LSP0045 did not match that of the gasoline range organics standard used for calibration. The GRO result in this sample was flagged by the laboratory and qualified as estimated (J).

Field Quality Control Samples

Field QC samples collected for the soil sampling event included field replicate samples.

Field Replicate Samples

All of the RPD values for field replicate analyses met the criteria for acceptable precision.

SUMMARY OF DATA VALIDATION: DIESEL RANGE ORGANICS (DRO)

A total of 142 soil samples were analyzed for DRO (including motor oil) for the Little Squalicum Park RI/FS event. Most of the samples were analyzed using Method NWTPH-Dx; several samples (LSP0044, LSP0045, LSP0051, LSP0177, LSP0275, and LSP0468) were also analyzed using the WA EPH method. Analytical Resources, Inc (ARI), Seattle, Washington completed the DRO analyses.

The DRO data for the soil samples were acceptable. A total of four (4) data points (1.2% of all soil DRO results) were of unacceptable quality and were rejected. Seventeen (17) data points were estimated because control limits were exceeded in one or more laboratory QC samples or procedures. Qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during the analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were greater than 98% complete for the soil DRO analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.8ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial and continuing calibration analyses met acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

Surrogate Compound Recoveries

Surrogate compounds were added to all samples. The surrogate recoveries reported by the laboratory typically met the criteria for acceptable performance; however, surrogate recovery outliers were present in several samples. As the outliers were due to a required dilution, no action was taken.

Matrix Spike Recoveries

Matrix spike/matrix spike duplicate (MS/MSD) analyses were performed at the proper frequency. Several of the recoveries reported by the laboratory for MS/MSD analyses did not meet the criteria for acceptable performance. One (1) soil DRO result was estimated (UJ) because the control limits for LCS recovery were not met. A total of four (4) results (1.2% overall) were rejected (R). Results were rejected when the %R value was less than 10%, indicating an extremely low bias.

Laboratory Control Sample Recoveries

Laboratory control sample (LCS) analyses met the criteria for frequency of analysis. Several of the recoveries reported by the laboratory for the LCS analyses did not meet the criteria for acceptable performance. Thirteen (13) soil DRO results (3.9% overall) were estimated (J or UJ) because the control limits for LCS recovery were not met.

Precision

MS/MSD analyses were evaluated for laboratory precision. Several of the relative percent difference (RPD) values for the MS/MSD analyses did not meet the criteria for acceptable performance. For MS/MSD precision outliers, qualifiers were issued only to the parent sample. Four (4) data points were estimated (J or UJ). Overall, 1.2% of the soil DRO results were estimated based on precision outliers.

Field Quality Control Samples

Field QC samples collected for the soil sampling event included field replicate samples.

Field Replicate Samples

One of the RPD values in the field replicate analyses did not meet the criteria for acceptable precision. The field replicate precision outliers are discussed in greater detail in the data validation reports. No data were qualified based on field precision; however, users of the data should consider the potential impact of precision outliers on the reported results.

SUMMARY OF DATA VALIDATION: DIOXIN/FURAN COMPOUNDS

Nine (9) soil samples were analyzed for dioxin and furan compounds for the Little Squalicum Park RI/FS event. Severn Trent Laboratories, Sacramento, California completed the analyses.

The dioxin/furan data for the soil samples were generally acceptable. No data were rejected for any reason. Twenty (20) data points (10% of all soil dioxin/furan results) were estimated (J or UJ). These qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the soil dioxin/furan analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. Several of the sample coolers were received with temperatures less than the lower acceptance limit of 2^{o}C, ranging from -2.8ºC to 1.6ºC. The low temperatures did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. All initial and continuing calibration analyses met all acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. No target analytes were detected in the method blanks.

Accuracy

Labeled Compound Recoveries

Labeled compounds were added to all field and QC samples. The recovery values of several labeled compounds were outside the specified control limits. Seven (7) data points (3.1% of the soil dioxin/furan results) were estimated based on labeled compound recovery outliers.

Matrix Spike Recoveries

Matrix and duplicate matrix spike (MS/MSD) analyses were not performed. Accuracy was assessed using the labeled compound and ongoing precision and recovery (OPR) analyses.

Ongoing Precision and Recovery Sample Recoveries

OPR analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Precision

Laboratory duplicate OPR analyses and duplicate sample analyses were evaluated for laboratory precision. Several of the relative percent difference (RPD) values for the duplicate analyses did not meet the criteria for acceptable performance. Six (6) data points were estimated (J or UJ). Overall, 2.7% of the soil dioxin/furan results were estimated based on precision outliers.

Compound Identification and Quantitation

A laboratory "E" flag indicates that the reported result is greater than the upper calibration range established by the initial calibration. If no dilution analysis was performed, the "E" flagged data were estimated (J). Fifteen (15) data points (6.7% of all soil dioxin/furan data points) were estimated based on calibration range exceedance.

Field Quality Control Samples

Field Replicate Samples

No samples identified as field replicates were analyzed.

SUMMARY OF DATA VALIDATION: METALS (INCLUDING MERCURY)

A total of 109 soil samples were analyzed for total metals for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington completed all analyses. The following analytical methods were used:

Parameter	Method
ICP Metals	SW6010B
Mercury	SW7471A

The metals data for the soil samples were acceptable. No data were rejected for any reason. A total of 95 data points (10% of all soil metals results) were estimated (J or UJ). These qualified data points may have a larger associated bias or may be less precise than unqualified data, but are usable for the intended purpose.

The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the soil metals analyses.

Holding Times and Sample Preservation

For metals analyses the QAPP-required holding time criterion for soil samples is 6 months from date of sampling to date of extraction. For frozen soils, the holding time criterion is 2 years from date of sampling to date of extraction. For mercury, the QAPP-required holding time criterion for any soil sample is 28 days from date of sampling to date of extraction. Mercury in five samples were analyzed up to 78 days after collection, the reporting limits were estimated (UJ).

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.8ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for all target analytes and met the criteria for frequency of analysis. The calibrations met all acceptance criteria.

Method Blank Analyses

Method blanks were analyzed at the appropriate frequency. To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times (5x) the concentration detected in the blank. If a contaminant is detected in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Several target analytes were detected in the method blanks. All of the results in the associated samples were greater than the 5x action limit; no data were qualified.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of analytical bias (matrix spike [MS], laboratory control sample [LCS], contract required detection limit [CRDL] standard recovery values, interference check samples [ICS], and serial dilution percent difference [%D] values).

Matrix Spike Recoveries

Matrix spike (MS) analyses met the criteria for frequency of analysis. Several of the recoveries reported by the laboratory did not meet the criteria for acceptable performance, with all outliers indicating a potential low bias. A total of 38 metals results (4.1% overall) were estimated (J or UJ) during the quality assurance review because the control limits for MS recovery were not met.

Laboratory Control Sample Recoveries

LCS analyses met the criteria for frequency of analysis. The recoveries reported by the laboratory met the criteria for acceptable performance.

Contract Required Detection Limit Standard Analyses

CRDL standards were analyzed at the beginning of each analytical sequence. One recovery was greater than the upper control limit. All associated sample results were positive and were at concentrations greater than two times the CRDL value. No data were qualified.

Interference Check Samples

ICP interference check samples were analyzed at the beginning of each analytical sequence. All ICP interference check sample results were within the acceptance criteria.

Serial Dilution Analyses

Serial dilution analyses were not performed. Any significant physical or chemical interferences due to sample matrix could not be determined.

Precision

Laboratory duplicate analyses were evaluated for laboratory precision. Thirteen (13) of the relative percent difference (RPD) values were outside the acceptance limits. A total of 49 results (5.3% of all soil metals results) were estimated (J or UJ) based on laboratory precision outliers.

Field Quality Control Samples

Field QC samples collected for the soils sampling event included field replicate samples.

Field Replicate Samples

Five of the RPD values in the field replicate analyses did not meet the criteria for acceptable precision. The field replicate precision outliers are discussed in greater detail in the data validation reports. No data were qualified based on field precision; however, users of the data should consider the potential impact of precision outliers on the reported results.

SUMMARY OF DATA VALIDATION: CONVENTIONAL PARAMETERS

A total of 97 soil samples were analyzed for the following parameters for the Little Squalicum Park RI/FS event. Analytical Resources, Inc (ARI), Seattle, Washington, completed all analyses. The following analytical methods were used:

Parameter	Method Number
Total Organic Carbon (TOC)	Plumb, 1981

Overall, the conventional parameters data for the soil samples were acceptable. No data were qualified for any reason. The laboratory data were evaluated in terms of completeness, holding times, instrument performance, bias, and precision. The results of the QC procedures used during sample analyses are discussed below.

Completeness of Data Set

Completeness is defined as the total number of usable results (results that were not rejected during data validation) divided by the total results reported by the laboratory. The results reported by the laboratory were 100% complete for the soil conventional parameters analyses.

Holding Times and Sample Preservation

The initial sample preservation requirement (cooler temperature of 4°C ±2°) was not met for all samples. The majority of the sample coolers were received at the laboratory with temperatures less than the advisory lower control limit of 2°C, with a low of –2.8ºC. These temperature outliers did not impact data quality and no action was taken.

Instrument Performance

Initial and continuing calibrations were completed for the TOC analyses and met the criteria for frequency of analysis. The initial calibrations met the linearity (percent relative standard deviation or correlation coefficient) control limits.

Method Blank Analyses

Two types of laboratory blanks were evaluated for possible contamination effects. These blanks were: initial and continuing calibration blanks (ICB and CCB) and method blanks (MB). The required frequency of one at the beginning and one every ten samples for calibration blank analysis was met. The laboratory analyzed one MB for every 20 samples digested or one per batch, for each digestion procedure, as required. No target analytes were detected in the blanks.

Accuracy

The accuracy of the analytical results is evaluated in the following sections in terms of analytical bias (matrix spike [MS] and laboratory control sample [LCS] recoveries) and precision (sample or matrix spike duplicate [MSD] analyses).

Matrix Spike Recoveries

MS analyses were completed for the TOC analyses and met the criteria for frequency of analysis. All recovery values met the acceptance criteria.

Laboratory Control Sample Recoveries

An LCS was analyzed for the TOC analyses. All LCS recovery values were acceptable.

Precision

Laboratory duplicate analyses were evaluated for laboratory precision. All of the relative percent difference (RPD) values met the criteria for acceptable performance.

Field Quality Control Samples

Field QC samples collected for the RI/FS included field replicate samples.

Field Replicate Samples

All of the RPD values in the field replicate analyses met the criteria for acceptable precision.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Diesel and Residual Range Hydrocarbons
Matrix: Soil
Analytical Resources, Inc. — Seattle

This report documents the review of analytical data from the analyses of soil samples and the associated laboratory and field quality control samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	No. Samples	Method	Validation Level
IS33	2 Soil Samples	NWTPH-Dx	3
IS77	9 Soil Samples	NWTPH-Dx	3
IT12	17 Soil Samples	NWTPH-Dx	4
IT93	9 Soil Samples	NWTPH-Dx	3
IU29	4 Soil Samples	NWTPH-Dx	3
JA15	10 Soil Samples	NWTPH-Dx	3
JA16	7 Soil Samples	NWTPH-Dx	3
JA17	4 Soil Samples	NWTPH-Dx	3
JA18	4 Soil Samples	NWTPH-Dx	3
JB13	4 Soil Samples	NWTPH-Dx	3
JB14	3 Soil Samples	NWTPH-Dx	3
JB15	4 Soil Samples	NWTPH-Dx	3
JB16	2 Soil Samples	NWTPH-Dx	3
JB17	3 Soil Samples	NWTPH-Dx	3
JB18	3 Soil Samples	NWTPH-Dx	3
JB19	3 Soil Samples	NWTPH-Dx	3
JB51	2 Soil Samples	NWTPH-Dx	3
JB63	1 Soil Sample	NWTPH-Dx	3
JC08	1 Soil Sample	NWTPH-Dx	2
JC45	1 Soil Sample	NWTPH-Dx	2
JF81	6 Soil Samples	NWTPH-Dx	2
JG15	2 Soil Samples	NWTPH-Dx	2
JG37	13 Soil Samples	NWTPH-Dx	2
JH02	10 Soil Samples	NWTPH-Dx	2
JH03	7 Soil Samples	NWTPH-Dx	2
JH04	5 Soil Samples	NWTPH-Dx	2
IS76	3 Soil Samples	WA EPH	3
JC45	1 Soil Sample	WA EPH	2
JJ35	2 Soil Samples	WA EPH	2

I DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1	Holding Times and Sample Receipt	2	Laboratory Control Samples (LCS/LCSD)
	GC/MS Instrument Performance Check	1	Field Replicates
	Initial Calibration (ICAL)		Internal Standards
	Continuing Calibration (CCAL)		Target Analyte List
	Blanks (Method)		Reporting Limits (MDL and MRL)
	Blanks (Field)	1	Compound Identification (Full validation only)
2	Surrogate Compounds	1	Calculation Verification (Full validation only)
2	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)		

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for soil samples is 14 days from date of sampling to date of extraction. The QAPP-required holding time criterion for extracts is 40 days from extraction to analysis. All extracts were analyzed within the holding time criterion.

All SDGs: The laboratory received the majority of the sample coolers with temperatures below the advisory control limits, with a low of -2.8ºC. It was determined that these outliers did not impact data quality and no action was taken.

Surrogates

SDG JB13: The percent recovery (%R) value for o-terphenyl was less than the lower control limit in Sample LSP0177, due to required dilution factor (20X). No qualifiers were applied.

SDG JB18: The %R values for o-terphenyl were less than the lower control limit in Samples LSP0253 and LSP0254, due to required dilution factor (20X). No qualifiers were applied.

SDG JB51: The %R value for o-terphenyl was less than the lower control limit in Sample LSP0275, due to required dilution factor (10X). No qualifiers were applied.

SDG JB63: The %R value for o-terphenyl was less than the lower control limit in Sample LSP0325, due to the required dilution factor (10X). No qualifiers were applied.

SDG JH02: Due to interference, the surrogate o-terphenyl was not recovered in Sample LSP0176. The sample was reanalyzed at a 1:10 dilution factor, and the surrogate recovery was acceptable. The original results were qualified as do-not-report (DNR), and should not be used. The DRO results from the dilution analysis of Sample LSP0176 should be reported.

SDG JH03: The surrogate o-terphenyl was diluted out in Samples LSP0468 (10x) and LSP0474 (10x). No action was taken on this basis.

Matrix Spike/Matrix Spike Duplicates

SDG IS76: The %R for diesel range organics (DRO) in the matrix spike for Sample LSP0044 (51.4%) was within control limits, but the %R for the matrix spike duplicate (800%) was greater than the upper control limit. Since the MS result was within control, no action was taken. Also, the DRO relative percent difference (RPD) value (143%) was greater than the control limit of 50%. The DRO result in the parent sample was estimated (J-9).

SDGs JA18 and JB51: The MS/MSD analyses were performed on Sample LSP0275, from SDG JB51. Recoveries were not reported due to a concentration of diesel in the parent sample which exceeded the spiked concentration by a factor of five. No qualifiers were applied.

SDGs JB15 and JB16: The MS/MSD analyses were performed on Sample LSP0198, from SDG JB15. The %R values for were less than the lower control limit. The sample was re-extracted and re-analyzed and the %R values were within control limits, no qualifiers were applied. The initial results for this sample were qualified do not report (DNR-11) in favor of the re-analysis results.

SDG JC45: The MS/MSD analyses were performed on Sample LSP0275. The C8-C10 aliphatics and C10-C12 aliphatics were not recovered in the MS or MSD. Reporting limits were rejected (R-8) in the parent sample. The %R values for C12-C16 aliphatics and C16-C21 aliphatics were less than lower control limits. No action was taken for C12-C16 aliphatics as the MSD and LCS recoveries were within control limits. No action was taken for the C16-C21 aliphatics as the spike amount was much less than the parent concentration.

SDG JJ35: The MS/MSD analyses were performed on Sample LSP0468. The MS %R values for C10-C12 aliphatics, C12-C16 aliphatics and C16-C21 aliphatics were less than lower control limits; no action was taken for these aliphatic groups as the MSD and LCS recoveries were within control limits. The MS %R value for C8-C10 aliphatics was less than lower control limits, the reporting limit was estimated (UJ-8).

Laboratory Control Sample (and Laboratory Control Sample Duplicate)

All %R values were within the specified control limits and all RPD values were less than the control limit of 50% in the LCS/LCSD analyses, with the exceptions noted below.

SDGs JB15, JB16, JB17, & JB18: The %R value for diesel was less than the lower control limit in the LCS from 2/14/2006. Positive results and reporting limits in the associated samples were estimated (J/UJ-10) with potential low bias.

SDG JJ35: The laboratory control sample (LCS) %R value for C8-C10 aliphatics was less than lower control limits, the reporting limit was estimated (UJ-10) for all samples in the batch.

Field Duplicates

Duplicate sample pairs are listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit

(RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL. No data were qualified based on field duplicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG IT12: One pair of samples, LSP0059 & LSP0060, was submitted as field duplicates. Results for DRO and RRO met the acceptance criteria. Field precision was judged acceptable.

SDG IU29: One pair of samples, LSP0103 & LSP0104, was submitted as field duplicates. Results for DRO and RRO met the acceptance criteria. Field precision was judged acceptable.

SDG JA16: One pair of samples, LSP0169 & LSP0170, was submitted as field replicates. The RPD values for DRO and RRO met the acceptance criteria above.

SDG JA18: One pair of samples, LSP0132 & LSP0133, was submitted as field replicates. All results met the RPD control limit.

SDG JB19: One pair of samples, LSP0272 & LSP0273, was submitted as field replicates. The RPD between results for DRO (at 83%) exceeded the control limit, while the RPD for RRO met the acceptance criteria.

Compound Identification

All samples in these SDGs were sulfuric acid/silica gel "cleaned" prior to analysis to reduce the effects of biogenic interference in the samples. Biogenic interference can elevate the motor oil chromatographic response, making the sample results to be biased high. No further action was necessary.

Calculation Verification

SDG IT12: Calculation verifications were performed on this SDG. No calculation errors were found.

III OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, MS/MSD, and LCS %R values, with the above exceptions. Precision was also acceptable as demonstrated by the MS/MSD RPD values, with the above exceptions.

Data were estimated due to MS/MSD and LCS recovery outliers. Data were rejected based on no recovery in the MS analysis. Data were also flagged as DNR to indicate which result (of multiple results) should not be used.

Data that were rejected or flagged DNR should not be used for any purpose. All other data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Gasoline Range Hydrocarbons by Method NWTPH-Gx
Matrix: Soil
Analytical Resources, Inc. — Seattle

This report documents the review of analytical data from the analyses of soil samples and the associated laboratory and field quality control samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	No. Samples	Validation Level
IS77	5 Soil Samples	3
IT12	14 Soil Samples	4
JA15	1 Soil Sample	3
JA16	1 Soil Sample	3

I DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II TECHNICAL DATA VALIDATION

The QC requirements that were reviewed are listed below.

1 Holding Times and Sample Receipt
GC/MS Instrument Performance Check
Initial Calibration (ICAL)
Continuing Calibration (CCAL)
Blanks (Method)
Blanks (Field)
Surrogate Compounds
2 Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
Laboratory Control Samples (LCS/LCSD)
1 Field Replicates
Internal Standards
Target Analyte List
Reporting Limits (MDL and MRL)
2 Compound Identification (Full validation only)
Calculation Verification (Full validation only)

---

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for soil samples is 14 days from date of sampling to date of extraction. The QAPP-required holding time criterion for extracts is 40 days from extraction to analysis. All extracts were analyzed within the holding time limits.

All SDGs: The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received the majority of the sample coolers with temperatures below the advisory control limits, with a low of -2.8ºC. It was determined that these outliers did not impact data quality and no action was taken.

Matrix Spike/Matrix Spike Duplicates

SDGs JA15 and JA16: The MS/MSD analyses were performed on Sample LSP0107. The gasoline percent recovery (%R) values were below the control limit of 50% for both the MS and the MSD. Gasoline was not detected in the parent sample, so the gasoline reporting limit was qualified as estimated (UJ-8) for potential low bias.

Field Duplicates

Duplicate sample pairs were listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL. No data were qualified based on field duplicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG IT12: One pair of samples, LSP0059 & LSP0060, was submitted as field duplicates. Results for GRO met the acceptance criteria. Field precision was judged acceptable.

Compound Identification and Quantitation

SDG IS77: The chromatographic pattern for Sample LSP0045 did not match that of the gasoline range organics standard used for calibration. The GRO result in this sample was flagged by the laboratory and qualified as estimated (J-2).

Calculation Verification

SDG IT12: Calculation verifications were performed on this SDG. No calculation errors were found.

III OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, MS/MSD, and LCS %R values, with the above exceptions. Precision was also acceptable as demonstrated by the MS/MSD RPD values.

Data were estimated because of an MS/MSD %R outlier and chromatographic pattern mismatches.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Metals
Matrix: Soil
Analytical Resources, Inc. — Seattle

This report documents the review of analytical data from the analysis of soil samples and the associated laboratory and field quality control samples. Analytical Resources, Inc., Seattle, Washington, analyzed the samples.

SDG	No. Samples	Validation Level
IS33	2 Soil Samples	3
IS77	7 Soil Samples	3
IT12	17 Soil Samples	4
IU81	3 Soil Samples	3
JA15	10 Soil Samples	3
JA16	5 Soil Samples	3
JA17	4 Soil Samples	3
JA18	4 Soil Samples	3
JB13	3 Soil Samples	3
JB14	3 Soil Samples	3
JB15	2 Soil Samples	3
JB17	3 Soil Samples	3
JB18	3 Soil Samples	3
JB19	3 Soil Samples	3
JB51	2 Soil Samples	3
JC30	1 Soil Sample	3
JE31	6 Soil Samples	3
JF81	6 Soil Samples	2
JG15	2 Soil Samples	2
JG37	13 Soil Samples	2
JH02	1 Soil Sample	2
JH03	3 Soil Samples	2
JH71	4 Soil Samples (Zinc only)	2
JJ36	2 Soil Samples (Zinc only)	2

I DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II TECHNICAL DATA VALIDATION

The quality control (QC) requirements for review are listed below.

2	Technical Holding Times and Sample Preservation	2	Laboratory Duplicates
	Initial Calibration (ICAL)	1	ICP Interference Check Samples
	Calibration Verification (CVER)	1	ICP Serial Dilution
	CRDL Standard		ICPMS Internal Standards
1	Laboratory Blanks	1	Field Duplicates
	Field Blanks	2	Reporting Limits (MDL and MRL)
	Laboratory Control Samples	1	Calculation Verification (Full validation only)
2	Matrix Spike Samples		

[1] Quality control results are discussed below, but no data were qualified.
[2] Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.

Technical Holding Times and Sample Preservation

For metals analyses the QAPP-required holding time criterion for soil samples is 6 months from date of sampling to date of extraction. For frozen soils, the holding time criterion is 2 years from date of sampling to date of extraction. For mercury, the QAPP-required holding time criterion for any soil sample is 28 days from date of sampling to date of extraction.

SDG JB13: The mercury analysis of Samples LSP0213, LSP0214, and LSP0215 was performed beyond the recommended twenty-eight day holding time. Results were estimated (UJ-1).

SDG JH02: Sample LSP0177 was analyzed for mercury 78 days after collection, the reporting limit was estimated (UJ-1).

SDG JH03: Sample LSP0325 was analyzed for mercury 70 days after collection, the reporting limit was estimated (UJ-1).

All SDGs: The validation guidance documents state that the cooler temperatures should be within an advisory temperature range of 2° to 6°C. The laboratory received the majority of the sample coolers with temperatures below the advisory control limits, with a low of -2.8ºC. It was determined that these outliers did not impact data quality and no action was taken.

CRDL Standard

Contract required detection limit (CRDL) standards were analyzed at the beginning of each analytical sequence. For recoveries greater than upper control limit of 130%, positive results less than two times the CRDL were estimated (J-14) to indicate a potential high bias. For recoveries less than the lower control limit of 70%, positive results less than twice the CRDL and reporting limits were estimated (J/UJ-14) to indicate a potential low bias. The following outliers were noted:

SDG JB15 & JB17: zinc (159%) – no qualifiers assigned (all positive results greater than twice the CRDL)

Laboratory Blanks

Various analytes were detected in the method and instrument blanks at levels greater than the method detection limits (MDL). To evaluate the effect on the sample data, action levels of five times the blank concentrations were established. Positive results less than the action levels in the associated samples were qualified as not detected (U-7) at the reported concentration. No action was taken for non-detects.

SDGs IU81, JA15, JA16, JA17, and JA18: Zinc was detected in the method blanks. Associated results were greater than the action level; therefore no qualification of data was necessary.

SDG JC30: Copper was detected in several calibration blanks. Associated results were greater than the action level; therefore no qualification of data was necessary.

SDGs JG15, JH02, JJ36: Zinc was detected in the method blanks. Associated results were greater than the action level; therefore no qualification of data was necessary.

Matrix Spike Samples

A matrix spike sample (MS) was analyzed at the proper frequency of one per twenty samples or one per batch; whichever was more frequent. The percent recovery (%R) values were within the control limits of 75%-125%, with the exceptions noted below. For %R values greater than 125%, the associated positive results were estimated (J) to indicate a possible high bias. No action was taken for non-detects. For %R values less than 75%, the associated positive results non-detects were qualified as estimated (J/UJ) to indicate a possible low bias.

SDG JA15: LSP0105 – chromium – high bias

SDG JA17: LSP0157 – nickel – low bias

SDGs JB15 & JB17: LSP0224 – nickel – low bias

SDG JG37: LSP0569 – zinc – low bias

SDG JE31: LSP0187 – mercury – low bias

Laboratory Duplicate Samples

A laboratory duplicate sample was analyzed at the proper frequency of one per twenty samples or one per batch; whichever was more frequent. The relative percent difference (RPD) values were less than the control limit of 20%, with the exceptions noted below. For RPD values greater than 20%, the associated results were estimated (J/UJ-9).

SDG JA16: LSP0138 – copper and lead

SDG JB15 & JB17: LSP0224 – lead and nickel

SDG JC30: LSP0124 – chromium, copper, lead, nickel, and zinc

SDG JE31: LSP0187 – copper, lead, mercury and nickel

Field Duplicates

The RPD control limit is 35% for sample results greater than five times the reporting limit (RL). For results less than five times the RL, the difference must be less than twice the RL. Although qualification of data is not required for field duplicate outliers, data users should take field precision into account when interpreting the sample results.

SDG IT12: Two sets of field duplicates were submitted with this SDG: LSP0059 & LSP0060 and LSP0065 & LSP0066. For Samples LSP0059 & LSP0060, the concentration of mercury was less than five times the RL, while the difference was greater than twice the RL. In addition, the RPD value for chromium (43.6%) was greater than the control limit of 35%.

For Samples LSP0065 & LSP0066, the RPD value for lead (44%) was greater than the control limit.

SDG JA16: One pair of samples, LSP0169 & LSP0170, was submitted as field replicates. All results met the acceptance criteria, except lead.

SDG JA18: One pair of samples, LSP0132 & LSP0133, was submitted as field replicates. All results met the acceptance criteria, except lead.

SDG JB13: One pair of samples, LSP0213 & LSP0214, was submitted as field replicates. All results met the acceptance criteria.

SDG JB19: One pair of samples, LSP0272 & LSP0273, was submitted as field replicates. All results met the acceptance criteria.

ICP Interference Check Samples

The concentration of the interfering elements iron and aluminum were greater than the level in the interference check samples (ICSA/ICSAB) in several samples. The ICSA results were carefully evaluated to determine if there was a potential high or low bias caused by aluminum or iron interference. The ICSA values for arsenic, chromium, copper, and lead were often greater than ± MDL. In these cases , an action level of two times the absolute value of the ICSA result was established. All sample results for these analytes were greater than the action levels; therefore qualification of data was necessary.

ICP Serial Dilution

An ICP serial dilution samples were not analyzed. Any significant physical or chemical interference due to sample matrix could not be determined.

Reporting Limits

SDGs JA15, JA16, JA18, JB51, JC30, and JE31: The reporting limits (RL) for several compounds were slightly greater than the QAPP method reporting limits (MRL). No action was taken other than to note this discrepancy. Several samples were diluted due to matrix interference. Reporting limits were elevated accordingly.

SDG JB13: Due to interference, the arsenic RL (5 mg/kg) was greater than the RL of 0.2 mg/kg specified in the QAPP. The sample results were greater than the laboratory MRL with the exception of Sample LSP0215. Arsenic was not detected in this sample. No action was taken other than to note this discrepancy.

SDG JE31: Due to interference, the arsenic reporting limit (7-20 mg/kg) was greater than the RL of 0.2 mg/kg specified in the QAPP. The sample results were greater than the laboratory MRL in three of six samples. Where arsenic was not detected, the reporting limit was estimated (UJ-14).

Calculation Verification

SDG IT12: Several results were verified by recalculation from the raw data. No calculation or transcription errors were found.

III OVERALL ASSESSMENT

As determined by this evaluation, the laboratory followed the specified analytical methods. The laboratory and field duplicate RPD values indicated acceptable precision, except as noted above. Accuracy was also acceptable, as demonstrated by the matrix spike and laboratory control samples %R values, except as noted above.

Data were qualified based on matrix spike %R and laboratory duplicate RPD outliers, and exceeded holding times. Data were also estimated due to potential interference.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
PCB – Aroclors
Matrix: Soil
Analytical Resources, Inc. — Seattle

This report documents the review of analytical data from the analyses of soil samples and the associated laboratory and field quality control samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	No. Samples	Validation Level
IV40	2 Soil Samples	3
JG37	13 Soil Samples	2

I DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II TECHNICAL DATA VALIDATION

The quality control (QC) requirements that were reviewed are listed below.

1 Holding Times and Sample Receipt
Initial Calibration (ICAL)
1 Continuing Calibration (CCAL)
Laboratory Blanks
Field Blanks
Surrogate Compounds
Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
Laboratory Control Samples (LCS)
Field Duplicates
Internal Standards
Target Analyte List
Reporting Limits (MDL and MRL)
Compound Identification and Quantitation

---

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for soil samples is 14 days from date of sampling to date of extraction. The holding time criterion for frozen soil is one year from date of sampling to date of extraction. The QAPP-required holding time criterion for extracts is 40 days from extraction to analysis. All extracts were analyzed within the holding time criterion.

Several of the sample coolers were received with temperatures less than the lower acceptance limit of 2°C, ranging from 1.0ºC to 2.8ºC. The low temperatures did not impact data quality and no qualifiers were required.

Continuing Calibration (CCAL)

SDG JG37: The percent difference (%D) value for Aroclor 1260 on the primary column was outside of the ±25% control limit, at 40.6%, in the closing CCAL. No action was taken since the %D value for Aroclor 1260 was within control limits on the second column.

III OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, MS/MSD, and LCS/LCSD %R values. Precision was also acceptable as demonstrated by the MS/MSD and LCS/LCSD RPD values.

No data were qualified for any reason.

All data, as reported, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Pesticides
Matrix: Soil
Analytical Resources, Inc. — Seattle

This report documents the review of analytical data from the analyses of soil samples and the associated laboratory and field quality control samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	No. Samples	Validation Level
JG37	13 Soil Samples	2

I DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II TECHNICAL DATA VALIDATION

The quality control (QC) requirements that were reviewed are listed below.

1	Holding Times and Sample Receipt		Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
	Initial Calibration (ICAL)		Laboratory Control Samples (LCS)
	Continuing Calibration (CCAL)		Field Duplicates
	DDT/Endrin Breakdown	1	Internal Standards
	Laboratory Blanks		Target Analyte List
	Field Blanks		Reporting Limits (MDL and MRL)
1	Surrogate Compounds	2	Compound Identification

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for soil samples is 14 days from date of sampling to date of extraction. The holding time criterion for frozen soil is one year from date of sampling to date of extraction. The QAPP-required holding time criterion for extracts is 40 days from extraction to analysis. All extracts were analyzed within the holding time criterion.

Several of the sample coolers were received with temperatures less than the lower acceptance limit of 2°C, ranging from 1.0ºC to 1.5ºC. The low temperatures did not impact data quality and no qualifiers were required.

Surrogates

SDG JG37: The percent recovery (%R) values for decachlorobiphenyl were greater than the upper control limit in Samples LSP0569 (189%), LSP0570 (141%), LSP0571 (174%), LSP0579 (136%), and LSP0581 (137%). No action was taken since the %R values for tetrachloro-m-xylene were within control limits in these samples.

Internal Standards

SDG JG37: Retention time shifts for both internal standards and on both the primary and secondary columns occurred for the entire analytical sequence. No results were qualified as the areas for the internal standards were within control limits.

Compound Identification

SDG JG37: The percent difference (%D) value between the primary and secondary columns for 4,4′-DDT in Sample LSP0569 exceeded 40%. The 4,4′-DDT result in this sample was qualified as estimated (J-3).

III OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, MS/MSD, and LCS/LCSD %R values, with the exceptions noted above. Precision was also acceptable as demonstrated by the MS/MSD and LCS/LCSD RPD values.

Data were qualified as estimated due to a confirmation outlier.

All data, as qualified, are acceptable for use.

DATA VALIDATION REPORT
Little Squalicum Park RI/FS
Semivolatile Organic Compounds
Matrix: Soil
Analytical Resources, Inc. — Seattle

This report documents the review of analytical data from the analyses of soil samples and the associated laboratory and field quality control samples. Samples were analyzed by Analytical Resources, Inc., Seattle, Washington.

SDG	No. Samples	Validation Level
IS76	3 Soil Samples	3
IS77	3 Soil Samples	3
IT93	3 Soil Samples	4
JA15	2 Soil Samples	3
JB13	1 Soil Sample	3
JB63	1 Soil Sample	3
JC08	5 Soil Samples	2
JC45	2 Soil Samples	2
JD79	1 Soil Sample	2
JE09	2 Soil Samples	2
JH02	8 Soil Samples	2
JH03	7 Soil Samples	2
JH04	5 Soil Samples	2

I DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables, with the exception noted below. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative.

II TECHNICAL DATA VALIDATION

The quality control (QC) requirements that were reviewed are listed below.

1	Holding Times and Sample Receipt
	GC/MS Instrument Performance Check
	Initial Calibration (ICAL)
2	Continuing Calibration (CCAL)
2	Laboratory Blanks
	Field Blanks
1	Surrogate Compounds
2	Matrix Spikes/Matrix Spike Duplicates (MS/MSD)
	Laboratory Control Samples (LCS/LCSD)
1	Field Duplicates
1	Internal Standards
1	Target Analyte List
	Reporting Limits (MDL and MRL)
1	Compound Identification and Quantitation
1	Calculation Verification (Full validation only)

[1] ***Quality control results are discussed below, but no data were qualified.***
[2] ***Quality control outliers that impact the reported data were noted. Data qualifiers were issued as discussed below.***

Holding Times and Sample Receipt

The QAPP-required holding time criterion for sediment samples is 14 days from date of sampling to date of extraction. The holding time criterion for frozen sediment is one year from date of sampling to date of extraction. The QAPP-required holding time criterion for extracts is 40 days from extraction to analysis. All extracts were analyzed within the holding time criterion.

Several of the sample coolers were received with temperatures less than the lower acceptance limit of 2^oC, ranging from -2.8ºC to 1.8ºC. The low temperatures did not impact data quality and no qualifiers were required.

Initial Calibration

All relative response factor (RRF) values were greater than the 0.05 minimum control limit. All percent relative standard deviation (%RSD) values were within the 30% control limit for all initial calibrations (ICAL), with the exceptions noted below. Since the affected compounds were not detected in the associated samples, no action was taken.

SDGs JA15, JB13 and JB63: 2,4-dinitrophenol (39%) in the ICAL analyzed 2/15/06 on instrument NT4.

SDG JB63: 2,4-dinitrophenol (48.9%) in the ICAL analyzed 3/3/06 on instrument NT4.

Continuing Calibration

All relative response factor (RRF) values were greater than the 0.05 minimum control limit. All percent difference (%D) values were within the ±25% control limit for all continuing calibrations (CCAL), with the exceptions noted below. When the %D outlier indicates a potential high bias, and there were no positive results for these compounds, no qualifiers were required.

SDG IS76:

- CCAL 11/16/05: 4-nitrophenol (high bias)
- CCAL 11/16/05: 2,3,5,6-tetrachlorophenol (high bias)

SDG IS77:

- CCAL 11/22/05: 2,4-dinitrophenol (low bias), bis(2-ethylhexyl)phthalate (high bias), and benzidine (low bias)
- CCAL 11/25/05: 2,4-dinitrophenol (low bias) and benzidine (low bias)

SDG IT93:

- CCAL 12/1/05: benzidine (low bias)
- CCAL 12/5/05: 2,4-dinitrophenol (low bias) and benzidine (low bias)

SDG JA15:

- CCAL 2/24/06: 4-nitrophenol and 4-nitroaniline (high bias), and benzidine (low bias)
- CCAL 2/27/06: 2,4-dinitrophenol and benzidine (low bias)

SDGs JB13 & JB63:

- CCAL 2/28/06: 2,4-dinitrophenol and benzidine (low bias); 4-nitrophenol, 4-nitroaniline, and 3,3′-dichlorobenzidine (all high bias)

Laboratory Blanks

To assess the impact of each blank contaminant on the reported sample results, an action level is established at five times the concentration reported in the blank (ten times for common laboratory contaminants). If a contaminant is reported in an associated field sample and the concentration is less than the action level, the result is qualified as not detected (U-7). If the result is also less than the reporting limit, then the result is elevated to the reporting limit. No action is taken if the sample result is greater than the action level, or for non-detected results.

Method blanks were analyzed at the appropriate frequency. For the analytical batches noted below, one or more target analytes were reported in the method blank. A summary of contaminant levels, associated samples, and action levels is provided in the data validation worksheets.

Various target analytes were detected in the method blanks; however, only the following analytes were qualified as not detected in one or more samples in the associated laboratory data sets:

SDG IT93: Di-n-butyl phthalate (one result).

SDG JC08: Bis(2-ethylhexyl)phthalate (three results).

SDG JE09: Di-n-butyl phthalate (one result); bis(2-ethylhexyl)phthalate (one result).

SDG JH02: Benzoic acid (one result); phenol (two results).

SDG JH03: Phenol (one result).

SDG JH04: Benzoic acid (one result); phenol (two results).

Surrogates

The percent recovery (%R) values for the surrogates were within the specified control limits with the exceptions noted below. Qualifiers were only assigned when more than one %R value per fraction (acid or base-neutral) is outside the control limits. If the outliers indicated a potential high bias, only the associated positive results were estimated (J-13). If the outliers indicated a potential low bias, positive results and reporting limits were estimated (J/UJ-13). No action was taken if the outliers were due to a dilution.

SDG IS76: All surrogates diluted out in Samples LSP0051 DL (50x) and LSP0045 DL (100x).

SDG IS77: All surrogates diluted out in Samples LSP0046 DL (100x) and LSP0047 DL (50x).

SDG IT93: All surrogates diluted out in Samples LSP0088 and LSP0090 (300x and 100x).

SDG JA15: terphenyl-d14 (high bias) in Samples LSP0110.

SDG JB13: All surrogates diluted out in Samples LSP0177 DL (50x) and LSP0177 DL2 (200x).

SDG JB63: All surrogates diluted out in Sample LSP0325 DL (25x).

SDG JC08: terphenyl-d14 (high bias) in the LCS. No action was taken for a QC sample.

SDG JE09: 2,4,6-tribromophenol (high bias) in Sample LSP0221.

SDG JH03: 2,4,6-tribromophenol (low bias) in Samples LSP0468 and LSP0474.

Matrix Spike/Matrix Spike Duplicate

SDG IS76: MS/MSD analyses were performed on Sample LSP0044. The spiking compound, pyrene, was not recovered in the MS and the %R value for the MSD (154%) exceeded the upper control limit of 150%. The pyrene result in the parent sample was qualified as estimated (J-8).

SDG IS77: MS/MSD analyses were performed on Sample LSP0048. The spiking compound, pyrene, was not recovered in the MS/MSD. The pyrene result in the parent sample was qualified as estimated (J-8) since the native concentration of pyrene in the parent sample was less than five times the spiking amount. Acenaphthene was not recovered in the MS/MSD. No action was taken as the native concentration in the parent sample was greater than five times the spiking amount.

SDG JA15: MS/MSD analyses were performed on Sample LSP0108. Seven spiking compounds were not recovered in the MS/MSD analyses. The compounds were not detected in the parent sample; reporting limits were rejected (R-8). Hexachlorocyclopentadiene was recovered at less than 10% in the MSD (and low in the MS). The reporting limit for this compound was also rejected (R-8).

The 2,4-dinitrophenol %R value was less than the lower control limit in the MSD analysis. The 2,4-dinitrophenol reporting limit was estimated (UJ-8) in the parent sample. The pentachlorophenol and benzo(b)fluoranthene %R values were greater than the upper control limit in the MS analysis. The reported results for these compounds were estimated (J-8) due to the potential high bias.

The relative percent difference (RPD) values were greater than the 50% control limit for pyridine, hexachlorocyclopentadiene, 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, and pentachlorophenol. The results for these compounds were estimated (J/UJ-9) unless the results were already rejected based on low recovery values.

SDG JB13: MS/MSD analyses were performed on Sample LSP0127 (from SDG JA18). The spiking compound pentachlorophenol was not recovered in the MS/MSD, and the pyrene recovery values were significantly greater than the upper control limit. No action was taken as the parent sample was not from this SDG.

SDG JC08: MS/MSD analyses were performed on sediment Sample LSP0264. Qualifiers based on the following outliers are discussed in the sediment report.

The %R value for pyrene was much greater than the control limit in the MS and not recovered in the MSD. The %R value for phenol was slightly greater than the control limit in the MSD. The

RPD values were greater than the control limit for anthracene, chrysene, fluorene, pyrene, fluoranthene, carbazole, benzo(a)anthracene, benzo(a)pyrene, dibenzofuran, naphthalene, benzo(k)fluoranthene, 4-methylphenol, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and phenanthrene.

SDG JC45: MS/MSD analyses were performed on Sample LSP0274. The %R values for pyrene were greater than the control limit, no action was taken because the concentration in the parent sample was much greater than the amount spiked. The %R value for 1,2,4-trichlorobenzene was less than the lower control limit in the MSD, no action was taken as the MS and LCS recoveries were acceptable.

The RPD values were greater than the control limit for benzo(g,h,i)perylene and benzo(k)fluoranthene. Results for these compounds were estimated (J-9) in the parent sample.

SDG JD79: MS/MSD analyses were performed on Sample LSP0191. The RPD values were greater than the control limit for anthracene, chrysene, benzo(a)anthracene, pyrene, fluoranthene, and phenanthrene. Results for these compounds were estimated (J-9) in the parent sample.

SDG JE09: MS/MSD analyses were performed on Sample LSP0221. The %R values for acenaphthene and pyrene were less than the control limit, no action was taken because the concentration in the parent sample was much greater than the amount spiked.

SDG JH02: MS/MSD analyses were performed on Sample LSP0179. The %R values for acenaphthene and pyrene were less than the control limit, no action was taken because the concentration in the parent sample was much greater than the amount spiked.

SDG JH03: MS/MSD analyses were performed on Sample LSP0546. The %R values for pentachlorophenol were less than the control limit, no action was taken because the concentration in the parent sample was much greater than the amount spiked. This MS/MSD was re-analyzed and the MSD %R value for pentachlorophenol were greater than the control limit, no action was taken as the MS and LCS recoveries were acceptable.

Laboratory Control Sample

SDG JA15: The %R value for aniline was less than the lower control limit and less than 10%. Two other compounds (4-chloroaniline and 3,3′-dichlorobenzidine) were not recovered. These analytes were not detected in the associated samples. The reporting limits were rejected (R-10) in all samples.

SDG JB63: The %R values for 3,3′-dichlorobenzidine and aniline were less than the lower control limit and less than 10% in the LCS prepared on 2/20/06. The reporting limits were rejected (R-10) for these analytes. The %R value for 4-chloroaniline was less than the lower control limit in the same LCS. The 4-chloroaniline reporting limit was estimated (UJ-10) in the associated sample.

SDG JC08: The %R value for aniline was less than 10%. Reporting limits were rejected (R-10) in all associated samples. The pyridine, 4-chloroaniline, and 3,3′-dichlorobenzidine %R values were less than lower control limits. These analytes were not detected in the associated samples, the reporting limits were estimated (UJ-10) in all samples.

SDG JC45: The %R values for n-nitrosodimethylamine, 4-chloroaniline, and pyridine were less than lower control limits. These analytes were not detected in the associated samples, the reporting limits were estimated (UJ-10) in all samples.

SDG JD79: The %R value for aniline was less than 10%. Reporting limits were rejected (R-10) in all associated samples. The 4-chloroaniline and 3,3′-dichlorobenzidine %R values were less than lower control limits. These analytes were not detected in the associated samples, the reporting limits were estimated (UJ-10) in all samples.

SDG JE09: The %R values for n-nitrosodimethylamine and pyridine were less than lower control limits. These analytes were not detected in the associated samples, the reporting limits were estimated (UJ-10) in all samples. The 4-chloroaniline and 3,3′-dichlorobenzidine %R values were less than 10%. These analytes were not detected in the associated samples, the reporting limits were rejected (R-10) in all samples.

SDG JH02: The %R value for aniline was less than lower control limits. This analyte was not detected in the associated samples, the reporting limits were estimated (UJ-10) in all samples. The %R values for 4-chloroaniline and 3,3′-dichlorobenzidine were less than lower control limits. These analytes were not detected in the associated samples, the reporting limits were estimated (UJ-10) in all samples.

SDG JH03: The benzoic acid, aniline, pyridine, 4-chloroaniline, and 3,3′-dichlorobenzidine %R values were less than lower control limits. The positive results and reporting limits were estimated (J/UJ-10) in all associated samples. The %R values for aniline, pyridine, and 3,3′-dichlorobenzidine were less than lower control limits in the laboratory control sample (LCS) associated with the re-extraction and re-analysis. No action was taken, the results from the initial LCS were used.

Internal Standards

SDG IS77: The %R values for chrysene-d12 and di-n-octylphthalate-d4 were greater than the upper control limits in Sample LSP0046. No action was taken as the analytes quantitated using these internal standards were not reported from the original analyses, but from the dilution analyses.

SDG IT93: The %R values for internal standard perylene-d12 were less than the lower control limits in Samples LSP0088 and LSP0090. Both samples were reanalyzed at dilutions. The analytes quantitated using perylene-d12 were not reported from the original analyses but from the dilution analyses.

SDG JA15: The %R value for the internal standard perylene-d12 was less than the lower control limit in Sample LSP0110. No action was taken as the analytes quantitated using perylene-d12 were not reported from the original analysis, but from the dilution analysis.

Field Duplicates

Duplicate sample pairs were listed below. The following acceptance criteria were applied: the relative percent difference (RPD) control limit is 50% for results greater than five times the reporting limit (RL). For results less than five times the RL, the absolute difference between the sample and duplicate must be less than two times the RL. No data were qualified based on field duplicate precision outliers. Users of the data should consider the impact of field precision outliers on the reported results.

SDG JC08: Samples LSP0213 & LSP0214 and LSP0250 & LSP0251 were identified as field duplicates. In the pair LSP0250 & LSP0251 fluoranthene and pyrene did not meet control criteria. All other RPD and absolute difference values were within control limits. Field precision was acceptable.

Compound Identification and Quantitation

All SDGs: The reported results for multiple analytes exceeded the initial calibration linear range in a number samples. The sample extracts were diluted and reanalyzed and/or re-extracted and reanalyzed. Up to three sets of results were reported. The results for those analytes that exceeded the linear range were qualified do-not-report (DNR-20). The dilution or re-extraction results should be used instead. The reporting limits and reported results for all analytes except those which exceeded the calibration range were qualified do-not-report (DNR-11) in the dilution analyses.

Reporting Limits (Method Detection Limit and Method Reporting Limit)

All SDGs: The method detection limits (MDL) for several compounds were greater than the QAPP MDL. No action was taken since the QAPP method reporting limits (MRL) were met.

Several samples were diluted due to matrix interference. Reporting limits were elevated accordingly.

Calculation Verification

SDG IT93: Calculation verifications were performed on this SDG. No calculation errors were found.

III OVERALL ASSESSMENT

As was determined by this evaluation, the laboratory followed the specified analytical method. Accuracy was acceptable, as demonstrated by the surrogate, MS/MSD, and LCS/LCSD %R values, with the noted exceptions. Precision was also acceptable as demonstrated by the field duplicate, MS/MSD, and LCS/LCSD RPD values.

Data were qualified as estimated based on calibration %D outliers, LCS/LCSD recovery outliers, and MS/MSD recovery and precision outliers. Data were also qualified as not detected based on contamination in the associated method blanks.

Data were rejected LCS and MS/MSD %R values being less than 10%. Data were qualified do-not-report because of results exceeded the initial calibration linear range, and re-analysis data were qualified do-not-report in order to report only one result per analyte per sample.

All other data, as qualified, are acceptable for use.

APPENDIX D

PROJECT ACCESS DATABASE (Upon Request)

BIOLOGICAL TESTING RESULTS

LIST OF TABLES

Table D-1. 10-day Amphipod Sediment Toxicity Test Results

	Hyalella azteca	
Sample	Mean Survival (%)	Mean Dry Weight per Organism (mg)
Lab Control	88	0.1
SD9 (Reference)	91	0.24
SD1	88	0.18
SD2	90	0.13
SD3	93	0.15
SD4	78	0.18
SD5	81	0.14
SD6	93	0.2
SD7	83	0.2
SD8	93	0.16
SD10	93	0.15

Table D-2. 28-day Oligochaete Sediment Bioaccumulation Test Results

	Lumbriculus varietagus			
Sample	Replicate	Tissue Weight (g)	Mean Tissue Weight (g)	Sediment TOC (%)
Lab Control	A	9.84	8.89	unknown
	B	9.79		
	C	9.75		
	D	7.99		
	E	7.1		
SD2	A	3.36	3.69	1.3
	B	3.69		
	C	5.24		
	D	3.3		
	E	2.85		
SD5	A	3	2.89	1.8
	B	2.47		
	C	3.08		
	D	4.64		
	E	1.24		
SD6	A	7.98	11.21	11
	B	6.19		
	C	10.26		
	D	14.24		
	E	17.36		

Table D-3. Sediment Oligochaete Tissue Concentrations

		Lumbriculus variegatus			**Sediment**		
	Location Study	SD2 & SD5 RI	SD6 RI	Laboratory Control RI	SD2 RI	SD5 RI	SD6 RI
Dioxins							
1,2,3,4,7,8-HxCDD	ng/Kg	**7.394**	NA	0.203 U	3.81	4.95	**16.7**
1,2,3,6,7,8-HxCDD	ng/Kg	**119.97**	NA	0.14 U	**223**	**30**	**79.6**
1,2,3,4,6,7,8-HpCDD	ng/Kg	**1883.7 J**	NA	1.907 UJ	**10100**	**978**	**25100**
1,2,3,4,6,7,8-HpCDF	ng/Kg	**292.16**	NA	0.193 U	**1950**	**163**	**421**
1,2,3,4,7,8,9-HpCDF	ng/Kg	**15.07**	NA	0.275 UJ	**68.3**	**10.7**	**31.6**
OCDD	ng/Kg	**16282.4**	NA	20.121 UJ	**126000**	**60200**	**304000**
OCDF	ng/Kg	**856.7**	NA	0.801 UJ	**11500**	**1210**	**39400**
Total TCDD	ng/Kg	**11.2**	NA	0.128 U	**3.4**	0.345	**2.23**
Total TCDF	ng/Kg	**30.1**	NA	0.182 U	**23**	**0.558**	**1.74**
Total PeCDD	ng/Kg	**6.8**	NA	0.197 U	**5.6**	**1.25**	**9.85**
Total PeCDF	ng/Kg	**231.3**	NA	0.166 U	**337**	**31.9**	**90.9**
Total HxCDD	ng/Kg	**346.8**	NA	0.14 U	**820**	**130**	**381**
Total HxCDF	ng/Kg	**982.5**	NA	0.141 U	**1800**	**175**	**473**
Total HpCDD	ng/Kg	**3346.2**	NA	**1.36**	**18500**	**1780**	**43500**
Total HpCDF	ng/Kg	**307.2**	NA	**1.27**	**1950**	**174**	**453**
TEQ (ND=0.5 DL)	ng/Kg	**36.36**	NA	NA	**320.96**	**81.25**	**624.13**
SVOCs							
2,4,6-Trichlorophenol	mg/kg	NA	**0.74 J**	0.13 U	0.013	0.013	0.031
2-Methylphenol	mg/kg	NA	**1 J**	0.13 U	0.013	0.013	0.031
3&4-Methylphenol	mg/kg	NA	**3.3 J**	**0.27 J**	0.013	**0.012**	**0.1**
Anthracene	mg/kg	NA	**0.37**	0.027 U	**2.2**	**0.061**	**0.56**
Benzo(a)anthracene	mg/kg	NA	**0.17 J**	0.027 U	**3.7**	**0.12**	**1.7**
Benzo(a)pyrene	mg/kg	NA	**0.4**	0.027 U	**2.4**	**0.34**	**1.4**
Benzo(b)fluoranthene	mg/kg	NA	**0.28 J**	0.027 U	**0.82**	**0.15**	**0.7**
Benzo(j)fluoranthene	mg/kg	NA	**0.28 J**	0.27 U			
Benzo(k)fluoranthene	mg/kg	NA	**0.28 J**	0.027 U	**0.82**	**0.15**	**0.7**
Benzoic acid	mg/kg	NA	**5.3 J**	0.27 U	0.026	0.026	0.061
Benzyl alcohol	mg/kg	NA	**13 J**	**1.5 J**	0.013	0.013	0.031
Chrysene	mg/kg	NA	**0.46 J**	0.027 U	**8.3**	**0.23**	**2.2**
Fluoranthene	mg/kg	NA	**1.3**	0.027 U	**0.47**	**0.1**	**3.2**
Naphthalene	mg/kg	NA	**0.11**	0.027 U	**0.024**	**0.0058**	**0.025**
Pentachlorophenol	mg/kg	NA	**2.1 J**	0.13 UJ	**0.033**	**0.056**	**0.46**
Phenanthrene	mg/kg	NA	**0.48**	0.027 U	**0.61**	**0.041**	**0.41**
Phenol	mg/kg	NA	**0.34 J**	0.13 U	0.013	0.013	0.031
Pyrene	mg/kg	NA	**0.43 J**	0.027 U	**0.66**	**0.096**	**2.9**
Tetrachlorophenols	mg/kg	NA	**4 J**	0.13 U	**0.0054**	0.013	**0.079**

Notes: NA = not applicable
Bold font indicates detected concentrations

Table D-4. Berry Tissue Concentrations

	Sample Location	99070520 Berry 1	99070521 Berry 1	99070522 Berry 2	99070523 Berry 2	99070524 Berry 3	99070525 Berry 3	99070524 Berry 4 (Reference)	99070525 Berry 4 (Reference)
	Treatment	Washed	Unwashed	Washed	Unwashed	Washed	Unwashed	Washed	Unwashed
	Study	RI	RI	RI	RI	RI	RI	RI	RI
	Date	8/20/1999	8/20/1999	8/20/1999	8/20/1999	8/20/1999	8/20/1999	8/20/1999	8/20/1999
Dioxins									
1,2,3,4,6,7,8-HpCDD	ng/Kg	1.50 U	3.19 U	1.59 U	**2.7**	2.21 U	**1.07**	0.92 U	0.92 U
OCDD	ng/Kg	**14.47**	**30.42**	**17.84**	**31.07**	**22.02**	**9.45**	10.89 U	**17.72**
OCDF	ng/Kg	1.36 U	**2.72**	1.46 U	**2.91**	1.04 U	2.52 U	0.91 U	0.87 U
Total HpCDD	ng/Kg	1.50 U	0.60 U	1.59 U	**5.04**	1.20 U	**1.07**	0.92 U	0.92 U
TEQ (ND=0.5 DL)	ng/Kg	**0.001**	**0.003**	**0.002**	**0.3**	**0.002**	**0.012**	NA	**0.002**
VOCs									
p-Isopropyltoluene	mg/kg	**0.003**	**0.0067**	**0.013**	**0.015 J**	**0.012 J**	**0.018**	**0.027 J**	**0.013**
Styrene	mg/kg	0.003 U	**0.00034 J**	**0.00018 J**	**0.00022 J**	**0.0013**	**0.0022**	**0.0045**	**0.00061**
SVOCs									
1,2,3-Trichlorobenzene	mg/kg	0.003 U	0.00036 U	0.00036 U	0.00032 UJ	0.00032 UJ	0.00034 U	**0.00033**	0.00035 U
2-Methylnaphthalene	mg/kg	0.0013 U	0.0019 U	**0.0017**	**0.002**	**0.0017**	**0.0011 J**	0.0013 U	0.0013 U
Benzoic acid	mg/kg	0.013 U	**0.032**	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U	0.013 U
Benzyl alcohol	mg/kg	**0.056**	**0.06**	0.0065 U	**0.04**	**0.063**	**0.063**	0.0063 U	0.0065 U
Fluoranthene	mg/kg	**0.0047**	**0.0058**	0.0013 U	0.0027 U	**0.0012 J**	0.0013 U	**0.0041**	0.0013 U
Fluorene	mg/kg	**0.0032**	**0.0033**	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U
Naphthalene	mg/kg	**0.0003**	**0.00036**	0.00036 U	0.00032 UJ	0.00032 UJ	0.00034 U	0.00033 U	0.00035 U
Phenanthrene	mg/kg	**0.015**	**0.016**	**0.0087**	**0.0072**	**0.0053**	**0.0053**	**0.0086**	**0.011**
Phenol	mg/kg	0.0066 U	**0.004 J**	0.0065 U	0.0065 U	0.0065 U	**0.009**	0.0063 U	0.0065 U
Pyrene	mg/kg	0.0013 U	**0.0037**	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U	0.0013 U

Notes: NA = not applicable
Bold font indicates detected concentrations

Table D-5. Ecology Sediment Toxicity Test Results

	10-day Amphipod (*Hyalella azteca*)			**20-day Midge (*Chironomus tentans*)**						**Microtox**	
Site	Mean % Survival	Mean RPD % Survival	Compared to Control p-values [a] Survival	Mean % Survival	Mean RPD % Survival	Mean Weight per Org (mg)	T/C Mean Weight per Org (mg)	Control p-values [a] Survival	Control p-values [a] Growth	Light Reading $I_{(15)}/I_{(0)}$	Mean Change $T_{(15)}/C_{(15)}$
Control	88	NA	NA	96	NA	1.044	NA	NA	NA	0.89/0.93 [b]	NA
LSC-01	80	10	0.091	86	11	1.564	1.5	0.052	---	0.90	1.01
LSC-02	79	11	0.208	60	46	1.824	1.7	0.001	---	0.93	1.03
LCS-03	0	200	<0.001	0	200	NA	NA	<0.001	<0.001	1.08	0.42
LSC-04	70	23	0.029	80	18	2.005	1.9	0.100	---	0.97	1.03
LCS-05	84	5	0.327	84	13	1.927	1.8	0.210	---	0.95	0.78
LSC-06	67	27	0.015	82	16	2.113	2.0	0.093	---	0.99	0.78

Notes: [a] One-tailed t-test. Survival data arcsine square-root transformation prior to t-test.

[b] Microtox test were run in two batches. Test samples LSC01, LSC-02 and LSC-03 were run with a control in the first batch and test samples LSC-04, LSC-05, and LSC-06 were run with a control in the second batch. Only control batch results are presented.

NA-Not Available or Not Applicable

--- Site response greater than control sediment response.

$I_{(0)}$ is the light reading after the initial five minute incubation period

$I_{(15)}$ is the light reading fifteen minutes after $I_{(0)}$

$C_{(t)}$ and $T_{(t)}$ are the changes in light readings from the intial reading in each sample container for the control and test sites. $I_{(t)}/I_{(0)}$

T = test sample

C = Control sample

RPD = relative percent difference

RPD = ((T-C)/((T+C)/2))*100

APPENDIX E

ARCHAEOLOGICAL REPORT
(CD)

AN ARCHAEOLOGICAL SURVEY AND EVALUATION OF A PORTION OF LITTLE SQUALICUM PARK, BELLINGHAM, WASHINGTON

by

GARY C. WESSEN, Ph.D.

Prepared for

Integral Consulting, Inc.
1201 Cornwall Avenue, No. 208
Bellingham, Washington 98225

By

Wessen & Associates, Inc.
15028 24th Avenue SW
Burien, Washington 98166

December 2005

MANAGEMENT SUMMARY

Archaeological site survey activities on the 'floor' of the Little Squalicum Creek ravine in Little Squalicum Park indicate that it is a highly disturbed area. Historic gravel mining and other industrial activities have removed much of the Holocene soil and altered the original form and character of the ravine. As such, much of this area has no possibility of containing potentially significant archaeological resources. Within this disturbed landscape, however, we conducted a limited investigation of a previously reported - - yet unrecorded - - shell midden site. This site area was identified and its boundaries were determined without actually sampling the shell midden deposits. It has since been formally recorded as 45WH740. Since the site itself was not a focus of study, we know relatively little about it. While we are confident that prehistoric archaeological materials are present in the 45WH740 site area, important questions remain about their condition and significance. In particular, it is unclear whether intact cultural deposits are actually present and whether this site area is actually the location where the represented prehistoric cultural activities occurred. Data generated by this effort are not sufficient to address these questions and their resolution will require direct study of the deposits in the 45WH740 site area. As such, we believe that no ground-disturbing activities should be conducted in the immediate vicinity of 45WH740 until its significance is better understood. Ground-disturbing activities elsewhere on the 'floor' of the Little Squalicum Creek ravine are not an archaeological concern.

The cover picture is an aerial photograph of Little Squalicum Park and its vicinity in Bellingham. The study area is the floor of the wooded ravine located in the left middle distance of this view. Compare this image to Figure 5 in the report.

ACKNOWLEDGEMENTS

This study of the Little Squalicum Park Project Area has benefited from the interest and support of a number of people. Mark Herrenkohl of Integral Consulting, Inc. was the coordinator between Integral Consulting and Wessen & Associates, Inc. and has provided much helpful information about the project area. Mark also provided much appreciated practical assistance during the field work. Tim Wahl of the City of Bellingham's Parks and Recreation Department has a wealth of information about the land use history of the Little Squalicum Park area and its vicinity, and he has been quite generous in sharing such information with us. This project has been in progress for sometime and, during this period, we have maintained a dialogue with Isaac Blum, then Nicole Baker, and most recently with Lena Tso of the Lummi Nation's Tribal Historic Preservation Office. Stephenie Kramer of the Washington State Department of Archaeology and Historic Preservation also provided helpful background information during our effort.

Some of the maps used in this report were prepared by Integral Consulting, Inc. Gloria Gould-Wessen of Wessen & Associates, Inc. prepared additional graphics and edited text for this report.

TABLE OF CONTENTS

1 INTRODUCTION

In 2003, Integral Consulting, Inc. invited Wessen & Associates, Inc. to join its team engaged in studies to support an environmental assessment of the City of Bellingham's Little Squalicum Park. In particular, Integral Consulting wanted to be certain that its activities did not adversely impact any potentially significant archaeological resources that might be present within the park. To this end, Wessen & Associates, Inc. undertook a survey of the proposed project area and coordinated with Integral Consulting in order to ensure that a previously unrecorded prehistoric archaeological site - - 45WH740 - - was not disturbed. The fieldwork activities were conducted by Gary Wessen, Ph.D. on the 3, 4, and 5 November 2005.

This report describes the background, goals, methods, fieldwork, findings, conclusions, and recommendations of our study of a portion of Little Squalicum Park. Field notes and photographs taken during the study are on file with Wessen & Associates, Inc.

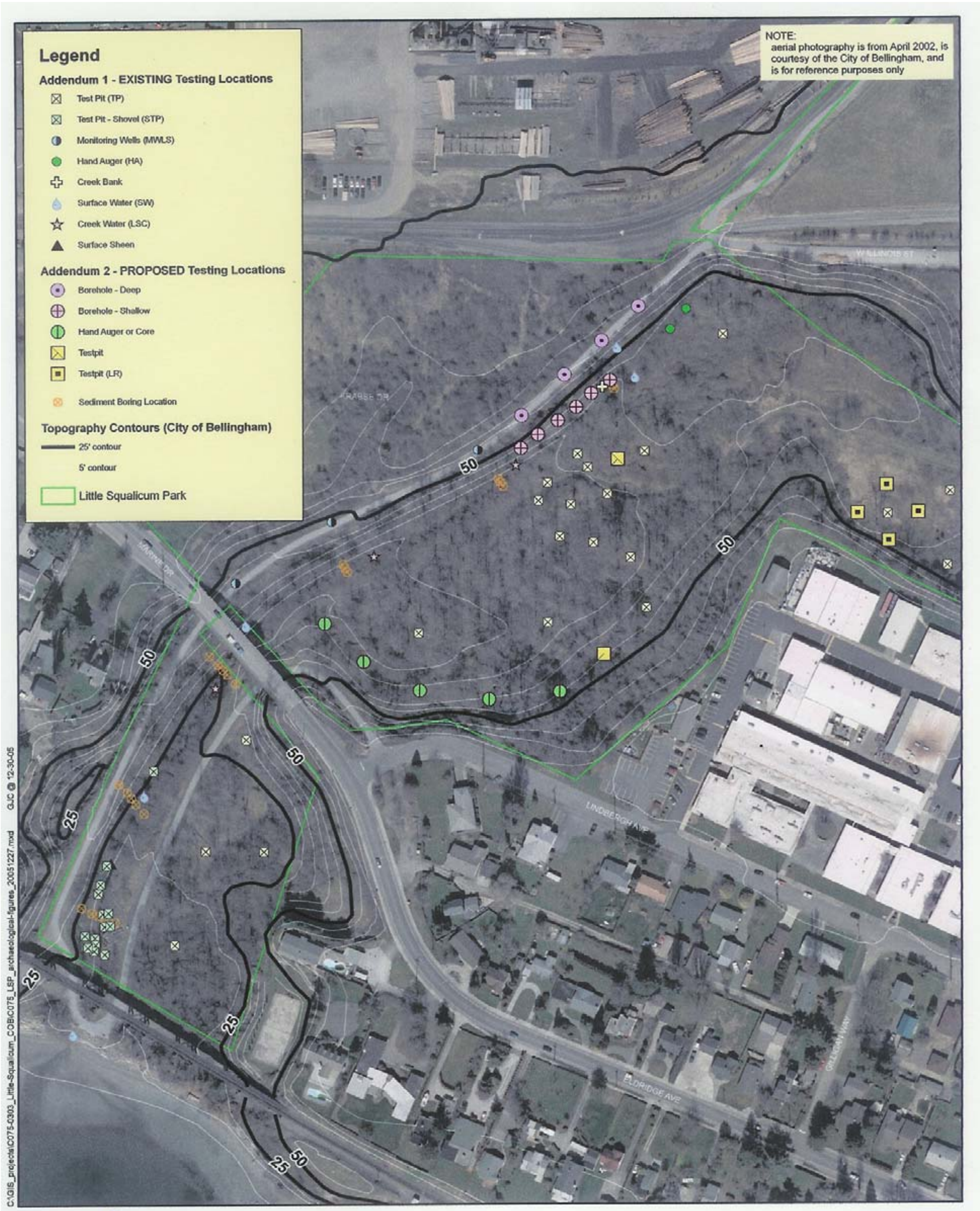
2 BACKGROUND

Appropriate areas of background consideration for this presentation include the basic character of the Little Squalicum Park Project Area and its environmental, cultural, and archaeological settings.

2.1 The Project Area

The Little Squalicum Park Project Area is essentially the 'floor' of the present Little Squalicum Creek ravine in Little Squalicum Park. This area is located along the marine shoreline of Bellingham Bay, in the northwestern portion of Bellingham, Washington (see Figure 1). Specifically, it is located in the northern half of Section 43, Township 38 North, Range 2 East. The ravine's 'floor' is an approximately 1,200 by 250 foot area trending first slightly to the east of north, and then more directly to the northeast (see Figure 2). As such, it covers an area of approximately 6.8 acres. The point where the ravine turns to the northeast is marked by a prominent bridge that conveys Marine Drive - - a two-lane paved road - - across the ravine. The area to the south of the Marine Drive Bridge (i.e., down ravine, toward Bellingham Bay) contains an open flat surface covered by grass and bordered by relatively young second growth trees (see Figure 3). The Little Squalicum Creek channel is located along the western margin of this open area and an artificial berm - - associated with an old railroad grade - - parallels the creek close to the western wall of the ravine. This old railroad grade extended to a large pier on the Bellingham Bay shoreline near the lower end of the ravine. The pier is still there, as is the grade, although the tracks have since been removed and a foot path now runs along it. An active railroad trestle crosses the ravine close to the marine shoreline and at least some of the area around the mouth of Little Squalicum Creek appears to have been filled. The area to the northeast of the Marine Drive Bridge (i.e., up ravine, and away from Bellingham Bay) is undeveloped except for an unpaved road bed and the above-noted old railroad grade. The rest of the area is mantled by a relatively young second growth forest (see Figure 4). The Little Squalicum Creek channel is located close to the western wall of the ravine and much of the rest of the ravine floor is marked by depressions and other surface irregularities that are probably related to historic gravel mining (see Section 2.3.2).

Figure 1 The Location of the Little Squalicum Park Project Area, Bellingham, Washington.



integral consulting inc.

Figure 2
Site Features and Investigation Locations
Little Squalicum Park, Bellingham, WA

Figure 3 The lower ravine portion of the Little Squalicum Park Project Area, Bellingham, Washington. The 45WH740 site area is located in the right middle distance. View is to the south.

Figure 4 The upper ravine portion of the Little Squalicum Park Project Area, Bellingham, Washington. View is to the south.

Ground-disturbing activities currently proposed in the Little Squalicum Park Project Area are associated with Integral Consulting's sampling to assess the possible presence and extent of contaminated soils and sediments within the park's boundaries. Various types of sampling will occur and the total number required will be determined during the sampling process. Most samples will be obtained from approximately 2 by 4 foot test holes dug to a depth of approximately 6 feet. Between 20 and 30 such holes will be dug. Approximately 30 borings will also be drilled in the area. The latter are approximately 1 foot in diameter and will be dug to a depth of at least 10 feet. Finally, an unknown number of "surface" sediment samples will be collected. The latter will penetrate into the ground to a depth of less than 6 inches.

2.2 Environmental Setting

As noted, the Little Squalicum Park Project Area is essentially the 'floor' of the present the Little Squalicum Creek ravine. Starting at the modern beach, it rises to an elevation of approximately 35 feet above sea level at its upper end. The ravine has been cut into an extensive glacial plain that is present across much of the northwestern part of Bellingham. The plain's surface - - in the vicinity of the ravine - - is approximately 65 feet above sea level. Thus, the ravine's walls are almost 50 feet high near the beach and closer to 30 feet high near the upper end of the project area. At this time, the 'floor' of the ravine is more than 300 feet wide over most of this area. It is clear, however, that this width reflects the extensive mid 20th century gravel mining that occurred here (see Section 2.3.2). Details of the ravine's width prior to the mining have not been established, but early historic maps suggest that it could have been as much as 100 feet narrower.

The principal fresh water resource in this area is Little Squalicum Creek. This creek has been extensively altered during the historic period, but only some of the details of this alteration are well understood. While the lower portion of this creek still flows year round, much of the natural flow of Little Squalicum Creek was diverted into the nearby Squalicum Creek watershed in the early 20th century. Prior to this diversion, the headwaters of Little Squalicum Creek drained somewhat higher ground to the east of Lost Lake, approximately 2 miles north of the project area. It is also clear that at least some of the present lower Little Squalicum Creek channel is an artificial feature that was created during the gravel mining era. The creek is clearly in an artificial channel in the northern part of the project area. Whether the channel to the south of the Marine Drive Bridge is a natural feature is uncertain.

The entire Little Squalicum Park Project Area is described by Goldin (1992: Map 38) as being mantled by an Urban Land-Whatcom-Labounty Complex soil. This large scale soil mapping unit is an intricate mosaic of urban land, Labounty, and Whatcom series soils with small 'pockets' of still other soil types. Both the Labounty and Whatcom series soils consist of an upper zone of silt loam over a much thicker zone of sand, gravel, and cobbles. It is associated with the glacial plain above the project area and is marked by soils that have developed from a mixture of loess, volcanic ash, and glaciomarine drift deposits. As such, this may not be a useful description of the soils in the bottom of the ravine. Here, the original Holocene soil probably consisted of a mixture of the latter sediments re-worked by a combination of alluvial and colluvial processes. Goldin (ibid) reports that the floodplain of the nearby Squalicum Creek ravine is mantled by a Bellingham silty clay loam soil and the original Holocene soil in the Little Squalicum Creek ravine may have been similar. Unfortunately, our knowledge of the original soils here is limited due to a variety of historic activities - - including both the gravel mining and localized filling.

Much of the Little Squalicum Park Project Area is covered by a relatively young second growth forest with a brushy understory. The most abundant trees in the area are red alder (*Alnus rubra*) and big leaf maple (*Acer macrophyllum*). Much smaller numbers of hemlock (*Tsuga heterophylla*) and western red cedar (*Thuja plicata*) are also present. None of these trees appear to be more than 30 to 40 years old and many are probably much younger. There are no old growth trees, nor old growth tree stumps, anywhere in the vicinity. The understory in much of the project area is heavily dominated by Himalayan blackberry (*Rubus discolor*), a non-native invasive plant. Elsewhere, sword fern (*Polystichum munitum*) is a common understory plant. We have not determined when the original forest vegetation was removed from the project area, but it probably happened in the late 19th or early 20th centuries. Thus, the native vegetation of this area may have been absent for more than a century.

No wildlife observations were made during the fieldwork, but it is assumed that the area hosts, or formerly hosted, most animals common to nearshore lowland areas in Whatcom County.

2.3 Cultural Setting

The cultural setting of the Little Squalicum Park Project Area includes both the Native American and Euro-American use of the vicinity. The following sections briefly consider each.

2.3.1 Native American Setting

The late prehistoric and early historic Native American occupants of southwestern Whatcom County were members of a broad grouping of peoples referred to as the Coast Salish. Coast Salish peoples are widespread in Western Washington and southwestern British Columbia and are divisible into a number of smaller regional groups. The people of the Whatcom, northwestern Skagit, and San Juan County areas are considered to be members of the Central Coast Salish (Suttles 1990). They are distinguished from their neighbors by the language they speak: Lkungen, as opposed to the Lushootseed spoken by other local Salish groups further to the south. They also differ in their pursuit of a distinctive subsistence and settlement system which traditionally placed a heavy emphasis upon exploiting the marine resources, particularly the reef-netting of sockeye salmon, within their traditional territory.

The Central Coast Salish people have often been divided into a number of tribal groups, but it is worthwhile to note that such tribal groups may be historic phenomena and the term "tribe" may not be directly applicable to the pre-contact inhabitants of the area. Most types of economic, political and social affiliation appear to have focused on local lineal groups (i.e., families). Family control of resource collection localities and ownership of the rights to ceremonial properties such as dances, songs, titles, and masks was the rule. The historic tribal groups most frequently mentioned in northwestern Whatcom County include the Lummi and the Nooksack Indians.

There appears to be very little ethno-historical information about the Little Squalicum Park Project Area and its general vicinity. We know that the Lummi People held much of the land to the west and that the Nooksack lands were mostly to the north and east. There is no clear agreement regarding the boundary between these two territories. Indeed, there is even some reason to believe that such boundaries have probably changed over time (Allen 1976). In this regard, it is interesting to note that Wayne Suttles has offered differing views of whose traditional territory the Little Squalicum Creek ravine is. In 1951(34) he described the entire shoreline of Bellingham Bay as Lummi territory and reported that the Lummi had a settlement at the mouth of Squalicum Creek, 0.6 mile to the south. In 1990 (454), however, Suttles described the mouth of Whatcom Creek as the boundary between Lummi and Nooksack territories. In this later account, he places Lummi territory to the north of the creek and assigns the creek itself and the shoreline to the south to Nooksack territory. Allan Richardson (1974, 1989) offered support for the latter view, reporting a Nooksack settlement at the mouth of Whatcom Creek. Alternatively, Hale et al. (2005:15) cite a report of a Lummi Indian having been buried in this area. The present study has little to add to this issue beyond the observation that - - even given the latter data - - Little Squalicum Creek still lays within the area attributed to the Lummi.

2.3.2 Euro-American Setting

The earliest known Euro-American activities in the general vicinity of the Little Squalicum Park Project Area are associated with Bellingham Bay (Carhart 1926, Edson 1968). The first European to enter the area was probably Francisco Eliza, who briefly visited Bellingham Bay in 1791. The following year Joseph Whidbey, who served under George Vancouver, surveyed the bay and it was subsequently given the name "Bellingham Bay" on the latter's chart. The name was apparently given in honor of Sir William Bellingham, an associate of Vancouver's. The first settler on Bellingham Bay was William Prattle, who arrived in 1852. Additional settlers became established in the next few years and four separate platted communities - - Whatcom, Sehome, Bellingham, and Fairhaven - - were present along the eastern shore of the bay by the 1880s (Scott and Turbeville III 1983). The four communities ultimately merged to become the modern City of Bellingham.

The Little Squalicum Park Project Area was a part of Edward Eldridge's original 320 acre Donation Land Claim in 1853, and it has remained in the hands of the Eldridge Family for most of the historic period (Wahl 2005). We don't know when the old growth trees were removed from the property, but it is clear that the vicinity of the park has been a focus of industrial activities for a long time. The railroad line across entrance to the ravine was developed in the late 1880s and quickly became a part of the Great Northern Railroad Company's system (Scott and Turbeville III 1983). Tidelands and uplands near the project area were deeded to the Olympic Cement Company by Hugh Eldridge in 1911. The former was responsible for the large pier on Bellingham Bay and the old railroad grade that extends down the west side of the ravine to it. Cement operations were conducted in the area until 1987. Of more direct relevance to the project area, Hugh Eldridge granted the Marietta Township rights to the gravel within the ravine in 1932. Very extensive sand and gravel mining operations were conducted here until the late 1960s (see Figure 5). While the specific details of the mining operation's impacts have not been documented by this study, their general character is clear. Beyond the mining itself, the Remedial Investigation Work Plans(Integral 2005) for the environmental assessment study, of which the present effort is a part, states: "*The entire ravine was altered substantially from natural conditions with rerouting of the original creek bed and significant changes to the soils and lithology (e.g., backfilling of gravel pit and wash pond excavations, temporary road maintenance, rail bed and track placement).*"

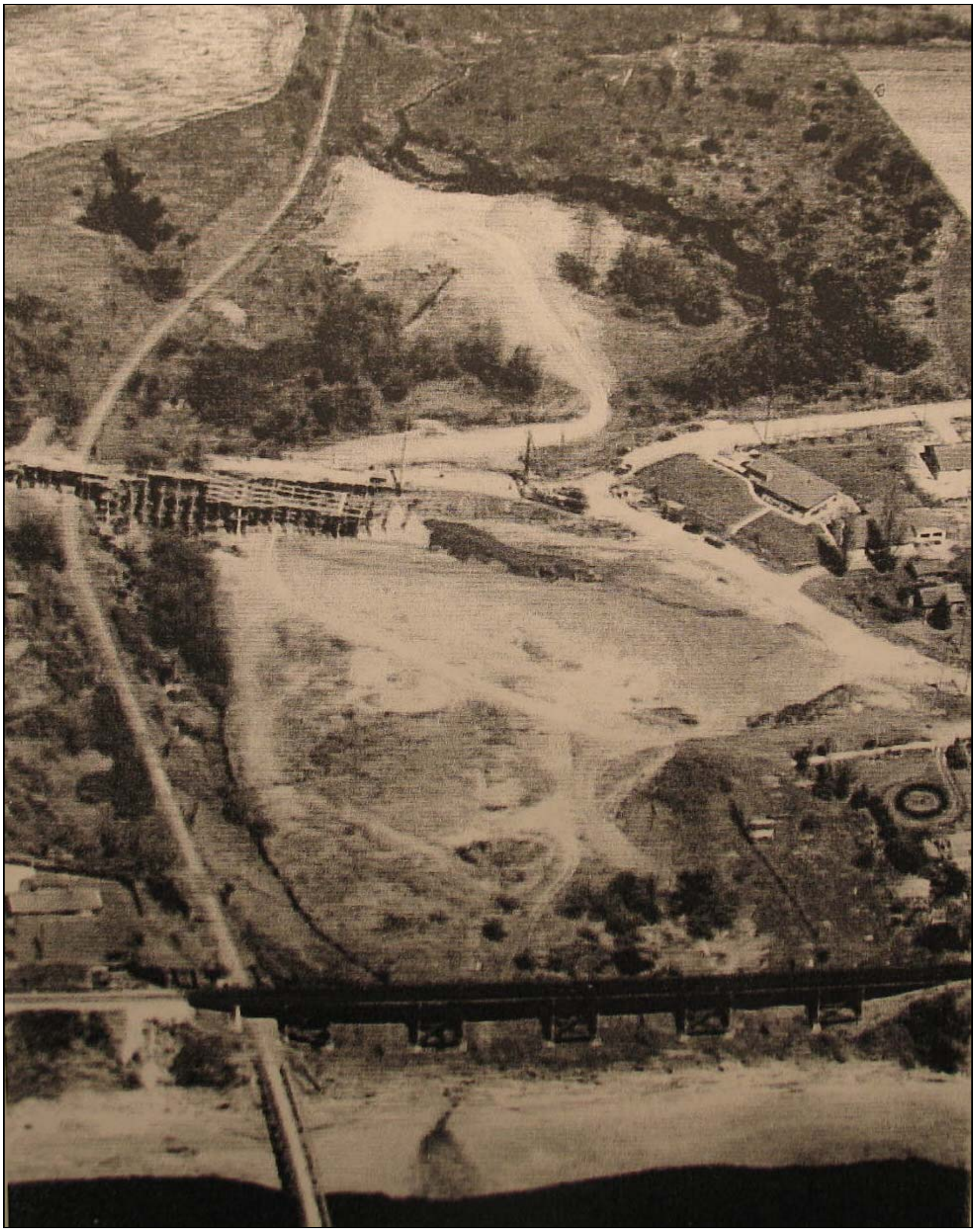


Figure 5 An aerial view of mining operations in the Little Squalicum Creek ravine in 1954. Note the lower Little Squalicum Creek channel and the old railroad grade running down the ravine.

Following the closure of the mine, the lower ravine was used to store logs by the Mount Baker Plywood Company and some localized filling of the area may have occurred at that time. Log storage was probably terminated in the early 1970s. The Little Squalicum Creek ravine was acquired by Whatcom County Parks in 1976 and subsequently leased to the City of Bellingham.

2.4 Archaeological Setting

The history of archaeological research in this region begins shortly before the beginning of the 20^{th} century, but the vast majority of such activities have occurred during the last 50 years. The earliest efforts were associated with the American Museum of Natural History's Jessup North Pacific Expedition, and these resulted in what are essentially reconnaissance reports of prehistoric cultural resources by Harlan Smith and Gerald Fowkes (1901), and Smith (1907). Smith and Fowkes noted the presence of shell midden sites on the northern part of Bellingham Bay, but they provided very little information about them. Writing shortly later, Albert Reagan (1917) also identified several midden sites on the northern part of Bellingham Bay, but he also offered few details about any of these places. After Smith, Fowkes, and Reagan, there were virtually no further archaeological studies in western Whatcom County until the early 1970s. At that time, Garland Grabert and his students at Western Washington University initiated a wide-ranging survey and excavation studies in this area. Grabert was active for more than 20 years and, directly or indirectly, had a role in the recording of more than 100 sites in Whatcom County. Grabert's replacement at Western Washington University, Sarah Campbell, remains active in the archaeology of this region today. Most of the recorded archaeological sites in western Whatcom County are shell middens associated with the modern marine shoreline. These sites probably represent late prehistoric to early historic settlements. Present in lesser numbers are grave sites, petroglyph (rock art) sites, and lithic sites. Only a small percentage of Whatcom County's sites have been dated with radiometric techniques and most of the latter are from a few hundred to a few thousand years old. Nevertheless, assessments of site age based upon stylistic comparisons, suggest that some Whatcom County sites are probably much older.

Against this backdrop, there has been only very limited prior archaeological study either within, or in the immediate of, the Little Squalicum Park Project Area. To some degree, it is likely that this condition reflects the history of gravel mining here. There are no previously recorded sites in the project area, but - - as noted earlier - - a shell midden was reported to be present close to the Bellingham Bay shoreline. The report of a shell midden deposit comes from Washington State Department of Ecology staff who visited the park in 2003. The individuals reporting the midden were not archaeologists and no further action was taken at that time. More recently, archaeological studies focused upon proposed trail alignments, have located a prehistoric archaeological site along the western rim of the Little Squalicum Creek Ravine. Cultural materials from this site (45WH726) were first observed by Hale et al. in 2004. Additional studies have shown that ca. 900 year old features are present (Shong and Stevenson 2005). Thus, one confirmed prehistoric archaeological site is known to be located just outside of the present study area and a second is reported to be present within it (see Figure 6).

Figure 6
Reported Archaeological Resources
Little Squalicium Park, Bellingham, WA

3 RESEARCH DESIGN

The activities described in this report represent a limited program of site survey designed to determine whether potentially significant archaeological resources are present within the Little Squalicum Park Project Area. The research design of the study included both a clear statement of goals and an identified set of appropriate methods.

3.1 Research Goals

The goals of this effort were to identify any potentially significant archaeological resources which might be present in the project area, to document them, and to offer recommendations to protect them during the environmental investigation of the site. A particular focus of the effort was the shell midden deposit reported to be present on the west side of the Little Squalicum Creek channel, near the Bellingham Bay shoreline. As such, clarifying the boundaries of this site area was a principal project goal. We also sought evidence of other prehistoric occupation and/or earlier historical activities known to have occurred here. To this end, the investigation reviewed the entire project area and considered some adjoining areas. The effort was descriptive and documentary in nature. As such, the articulation of study findings within any particular proposed regional cultural framework was not a high priority. Similarly, the study results cannot be considered to be a test of any particular model of prehistoric settlement and subsistence patterns or other cultural process dynamics.

3.2 Research Methods

The work plan for this study relied upon standardized archaeological techniques. The effort consisted of background research and field activities including both a thorough ground surface inspection and a limited program of subsurface testing.

Background research for the study included the review of relevant documents on file with the Office of Archaeology and Historic Preservation, materials provided by the City of Bellingham's Parks and Recreation Department and Integral Consulting, and additional materials in the author's possession.

The surface survey was designed to employ both judgmental and transect interval techniques, and we were confident that all portions of the project area - - and some adjacent areas near it - - would be addressed. Coverage would approximate that obtained by a transect interval in the range of 18 to 30 feet. Considering the developed second-growth forest community mantling most of the area, ground surface visibility was expected to range from fair to poor.

Following the surface inspection, subsurface testing would occur. Small subsurface test pits were used to assess the possible presence of cultural deposits and to determine the boundaries of such deposits after they have been found. Testing was conducted by probing selected locations with small (i.e., 12 to 15 inch diameter) shovel test pits. All test locations would be investigated until either obviously intact cultural deposits, bedrock, intact glacial sediments, or the maximum depth of the proposed impact was encountered. (As the deliberate disturbing of a cultural deposit requires a permit under Washington State Law [RCW - 25.48], digging must stop if intact cultural materials are encountered.) Recovered subsurface test sediments would be screened through 1/4 inch hardware mesh in order to facilitate the recognition of any cultural materials which might be present. The represented depositional structure at each test exposure were recorded, but no samples of any kind were collected. Indeed, the Health & Safety Plan under which the work was conducted specifically stipulates that no sediments or other materials be removed by the archaeologists. All test pits were back-filled immediately after examination.

3.3 Practical Expectations

The background review and prior experience in other portions of the northern Puget Sound basin suggested that the potential for archaeological materials in the Little Squalicum Park Project Area was probably not great. This view was based heavily in our appreciation of the probable condition of the project area. While it is clear that there was a substantial Native American presence in the general vicinity - - and at least a few sites are already reported to be present - - it seems unlikely that a large prehistoric population was present. Moreover, much of the evidence for what was present would have been extensively disturbed and/or destroyed by the large-scale historic gravel mining operation here. As such, we did not expect the Little Squalicum Park Project Area to be rich in archaeological resources and felt that any materials we did encounter were likely to be in relatively poor condition.

4 FIELDWORK AND FIELD FINDINGS

Fieldwork activities conducted at the Little Squalicum Park Project Area were conducted on the 3rd through the 5th of November 2005 by Gary Wessen. Weather during this period was cool and wet. My initial action was to meet with Mark Herrenkohl of Integral Consulting at the job site. Mark gave me an overview of the project area and proposed activities, and clarified health and safety procedures. While my efforts addressed the reported shell midden area first, and then broaden their focus to investigate other areas, this presentation will consider the broader area first.

4.1 The Survey

The initial fieldwork activity was the ground surface inspection. The first consideration was how much of Little Squalicum Park should be addressed by our survey. While we had been directed to confine our effort to the 'floor' of the ravine, we also knew that much of this area had been extensively disturbed during the gravel mining period. In particular, we knew that the ravine had been significantly widened during the mining and that much of its eastern half had probably been created at that time. We had reason to suspect that the western flank of the ravine (i.e., the area to the west of the old railroad grade) might be in relatively better condition, but had also been advised that no ground-disturbing actions were planned in this latter area. As such, Mark Herrenkohl of Integral Consulting requested that we concentrate our effort in the vicinity of the existing Little Squalicum Creek channel (see Figure 7).

My first action was a pedestrian inspection of the vicinity of the existing Little Squalicum Creek channel from the marine shoreline of Bellingham Bay northward to a point where it is undeniably running in an artificial channel. I walked up the channel itself, investigating both banks as I went. The area around the Bellingham Bay shoreline is extensively disturbed. The mouth of the creek in particular appears to have been partially filled. I did note the presence of an alignment of older creosote-treated log pilings under the existing railroad trestle across the ravine's mouth and suspect that these represent an older railroad trestle here. Numerous examples of relatively recent debris were observed on exposed surfaces, but no older historic artifacts were encountered. Moving slightly further upstream, the creek occupies a down-cut channel and the reported shell midden area was readily apparent. While much of this site area was covered with a layer of blown leaves and twigs, intermittent exposures of marine shell and fire-cracked rocks were visible in the bank face along the west side of the creek and in the creek bed itself (see Section 4.2). Survey further up the channel to the vicinity of the Marine Drive Bridge revealed additional evidence of considerable disturbance. Relatively recent and older 20th century debris was noted, partially buried in alluvium, in several places. A location with sediments that presented a petroleum sheen was noted. Finally, the vicinity of the old railroad grade - - along the west side of the creek channel - - also contains other small built infrastructure.

Conditions in the ravine above the Marine Drive Bridge are somewhat different. Here, the old railroad grade has climbed the ravine wall and the creek channel runs close to the toe of the latter. The channel itself is less deeply down-cut, and several ravine wall cut-bank exposures are available here. The latter suggest that the top of the gravels was at least 6 to 8 feet above the top of current ground surface here. Further away from the creek channel, the ravine's 'floor' is marked by a road bed and several large old pit features that are undoubtedly left from the mining era. Relatively recent and older 20th century debris is also common in this area. In some

Figure 7
(Estimated) Archaeological Survey Coverage
Little Squalicium Park, Bellingham, WA

contrast to the latter, however, this upper area also contains building refuse. Pieces of asphalt pavement were noted near the Marine Drive Bridge and pieces of brick and/or paving stone are present in the creek channel in the upper ravine.

Of particular significance, I found no potentially significant archaeological materials anywhere in this area other than at the reported shell midden site. Rather, I found an extensively disturbed landscape. While recent and older 20th century debris is relatively common, no unequivocally 19th century or older objects were encountered at any location other than the shell midden site.

Initial observations of existing ravine wall cut-bank exposures and aerial photos of the gravel mine from the 1960s supported the conclusion that much of the current ravine 'floor' represents mine-related activities rather than any pre-mining landforms. In an effort to explore this view, I began to walk approximately 30 foot transects in which I probed the ground with a solid 0.5 inch diameter aluminum dowel every approximately 30 feet. This effort determined that a very compact high density gravel deposit is present at a depth of 2 to 4 inches, or less, over most of this area. The shallow deposit overlying the very compact gravel is a gravely sandy loam. This basic two-unit structure accounts for most of the area on both sides of the creek channel, above the Marine Drive Bridge, and most of the area to east of the creek channel, below the Marine Drive Bridge. Relatively deep fine-grained sediments were only encountered in the area between the creek channel and old railroad grade and close to the beach. Elsewhere, a very compact high density gravel deposit is present close to the ground surface. While no screening was conducted at this time, it was clear that the gravely sandy loam which overlies the gravel sometimes contains recent historic debris.

4.2 The 45WH740 Site Area

The shell midden deposit in the lower Little Squalicum Creek ravine, first reported by Washington State Department of Ecology staff in 2003, has been assigned the Smithsonian Number: 45WH740. The Archaeological Site Inventory Form for 45WH740 is provided as an appendix to this report.

The shell deposits exposed in the cut-bank along the west side of the Little Squalicum Creek channel were first pointed by Mark Herrenkohl of Integral Consulting. At first glance, the site appears as approximately 14 meters (46 feet) of one or two shell deposits intermittently exposed in an eroding bank. Our first action in the apparent site area was to clear its surface. By prior arrangement, we had much of the blackberry that dominated the site area cut down. Using a rake as the principal tool, I then cleared the ground surface to the west of the creek. The size of the resulting clearing was determined by the surface distribution of marine shell. The result was the identification of an approximately 16 by 7 meter (52 by 23 foot) area marked by shell debris that is roughly coincident with the shell layers exposed in the cut-bank (see Figure 8). The eastern and western margins of this area were essentially the cut-bank along the west side of the Little Squalicum Creek channel and the western toe of the old railroad grade.

The entire exposed surface was carefully examined. No samples were collected, nor was a detailed map prepared, but a number of observations were made about the exposed materials. The most abundant material exposed on the surface appears to be fragments of marine shell. Shell density varies considerably, but few areas are really bare. There were no apparent or suggested features. Shell fragmentation also varies, but very few intact valves are present. An estimated 80 to 90 percent of the marine shell here appears to represent either of two bivalves:

the native littleneck clam (*Protothaca staminea*) and the butter clam (*Saxidomus giganteus*). Other shellfish represented on the surface in small numbers include: horse clams (*Tresus* sp.), basket cockles (*Clinocardium nuttalli*), Manila clams (*Venerupis japonica*), and Japanese oysters (*Crassostrea gigas*). Note that the last two are introduced shellfish species that were not present in this region prior to the early 20th century. Also present were a few dozen dogwhinkles (*Thais lamellosa*) and a few pieces of barnacle (*Balanus* spp.) shell. No bone of any kind was observed. Also present within the approximately 16 by 7 meter area were approximately 15 pieces of fire-cracked rock, one good dacite primary flake, three other possible pieces of chipped stone debitage, eight glass beer bottles, a condom, small radio vacuum tube, a fragment of metal conduit and junction box, a partially buried plastic bucket, and numerous small fragments of plastic sheet and/or foil.

Figure 8 The 45WH740 site area after raking of the surface litter, Little Squalicum Park, Bellingham. View is to the south.

After examining this surface, I turned my attention to the creek channel itself. I located a few additional examples of fire-cracked rocks in the channel and then scrapped the bank face - - on both sides of the channel - - over the distance where shell was exposed. The first result of the bank scraping was to confirm my earlier impression that shell is only present on the west side of the creek. Closer examination of the profile on this western side indicated that three distinct deposits are present, and that the upper two of these both contain marine shell. After examining the creek bank exposures we drew a 'typical' profile section. The location of this profile section is indicated in Figure 9. This profile is shown in Figures 9 and 10, and described in Table 1.

Figure 9 Typical stratigraphic profile of the creek bank exposure in the 45WH740 site area, Little Squalicum Park, Bellingham, Washington. Note trowel for scale.

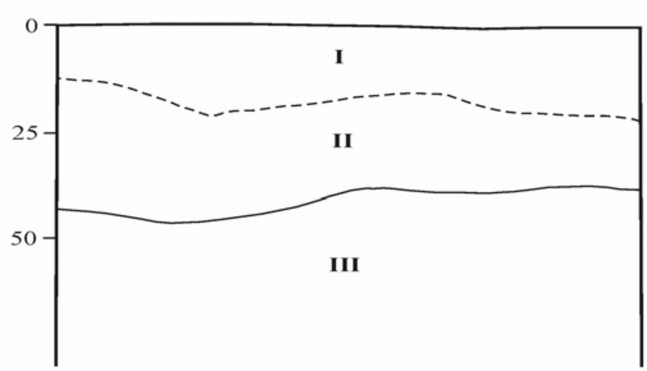


Figure 10 Stratigraphic profile drawing of the shell exposure in the cut-bank face, 45WH740, Little Squalicum Park, Bellingham, Washington.

TABLE 1	A STRATIGRAPHIC PROFILE DESCRIPTION FOR A PORTION OF 45WH740, LITTLE SQUALICUM CREEK, BELLINGHAM, WASHINGTON.
STRATUM	**DESCRIPTION**
	Organic litter
I	Very dark grayish brown (10YR3/2); gravelly sandy loam with roots and a low to moderate density of variably fragmented marine shell, a low density of recent and older 20th century refuse, chipped stone debitage, fire-cracked rocks and charcoal; no apparent structure; slightly-sticky; slightly-plastic; strong smear (wet); diffuse smooth boundary.
II	Very dark gray (2.5Y3/0); gravelly fine sand with few roots, approximately 15% subrounded to subangular small cobbles, a low to moderate density of variably fragmented marine shell, and a very low density of mammal bone, fire-cracked rocks and charcoal; sticky; plastic; very strong smear (wet); clear wavy boundary.
III	Dark grayish brown (10YR4/2) to brown (10YR5/3); sandy gravel with few roots, approximately 15% to 20% subrounded to subangular small cobbles; compact, possible very weakly-developed bedding; non-sticky; non-plastic; very weak smear (moist).

The uppermost portion of the profile is a thin layer of organic litter or duff. This is the material that I raked off at the beginning of my effort. It has no mineral fraction and lacks any kind of archaeological material; it was not given a stratum designation. Stratum I is approximately 10 to 25 centimeters (4 to 10 inches) of a very dark grayish brown gravelly sandy loam. It is the deposit that my raking exposed over the entire surface of the site area. As just described, it contains a mix of both recent historic and prehistoric cultural materials. It is also worth noting that - - apart from the shell and prehistoric cultural materials - - Stratum I in the 45WH740 site area appears to be very much like the shallow deposit of gravelly sandy loam that overlies the compact gravel in much of Little Squalicum Park. Stratum II is approximately 10 to 30 centimeters (4 to 12 inches) of very dark gray gravelly fine sand. It is superficially similar to Stratum I, yet it appears to differ in several important aspects. Most immediately apparent, I saw no examples of recent historic materials associated with Stratum II. Also of significance, while the shellfish content of Stratum II is similar, several differences were noted. Stratum II is also dominated by native little neck and butter clams, but it both lacks the introduced historic shellfish (e.g., Manila clams and Japanese oysters) and includes local species such as blue mussels (*Mytilus edulis*) that do not appear to be represented in Stratum I. Finally, Stratum II was also observed to contain at least a small quantity of burnt mammal bone. The lowermost deposit in the profile (Stratum III) is a compact sandy gravel. It appears to be completely free of any type of cultural material. Stratum III is at least 50 centimeters (20 inches) thick and I suspect that it is dramatically thicker than this.

While I am not certain of the significance of all of the represented strata, some comments are useful here and further discussion of this matter will be presented below in Section 5. Beginning with what is relatively clear, I am confident that Stratum III is a glacial deposit. I believe that it probably underlies most of the area and was the focus of the earlier gravel mining operation here. Given this, the focus of interest becomes the significance of Strata I and II. Do either, or both, of these strata represent potentially intact prehistoric cultural deposits? On the basis of the observations made thus far, I was fairly confident that Stratum I was not. Stratum I appears to be either a disturbed deposit, a very recent alluvium, or some combination of both. Stratum II appears to be the only serious candidate to be a potentially intact prehistoric cultural deposit.

After the ground surface inspection, I then dug a series of shovel test pits in order to determine the site's boundaries. A total of 12 shovel test pits were dug (see Figure 9). I started by digging a test pit just beyond the edge of the surface distribution of shell. If no cultural materials potentially attributable to the midden were encountered, the location was considered to be outside of the site's boundary. If cultural materials were encountered, a another pit was dug approximately 10 to 15 feet further away and the process was repeated. Attention was focused on the northern and southern margins of the site area as the eastern and western margins appeared to be relatively well defined. In fact, some test pits were dug on the eastern side of Little Squalicum Creek, but no effort was made to investigate the area on the west side of the old railroad berm.

The shovel testing showed a number of basic characteristics of the distribution of cultural deposits in the 45WH740 site area. For the most part, the distribution of potentially intact cultural deposits appears to closely parallel the scatter of shell materials exposed on its surface. The cultural deposits are only present on the west side of the creek. None of the five shovel test pits dug to the east of Little Squalicum Creek revealed either shell or other indications of the presence of a shell midden deposit. The testing along the site's southern boundary that a previously unknown deposit is present here. An approximately 10 to 15 foot wide zone - - located just to the south of the surface scatter of shell - - is marked by as much as 40 centimeters (16 inches) of what appears to be the Stratum I deposit, except that this matrix lacks shell and simultaneously contains an unusually high density of fire-cracked rocks. Small quantities of recent historic materials were encountered within this matrix to depths of approximately 30 centimeters.

The shovel testing also revealed a curious aspect of the site's landform expression. Most of the surface on the east side of Little Squalicum Creek is approximately 1.5 feet higher than in the site area. As noted earlier, probing on the east side of Little Squalicum Creek found that this area is marked by a shallow gravely sandy loam overlying a very compact gravel that is considered to be a glacial deposit. When the elevations on both sides of the creek are compared, it thus appears that the Stratum II shell deposit lays approximately 30 centimeters (12 inches) below the top of the Stratum III gravel immediately across the creek. This difference in elevation is surprising and its significance is not immediately apparent.

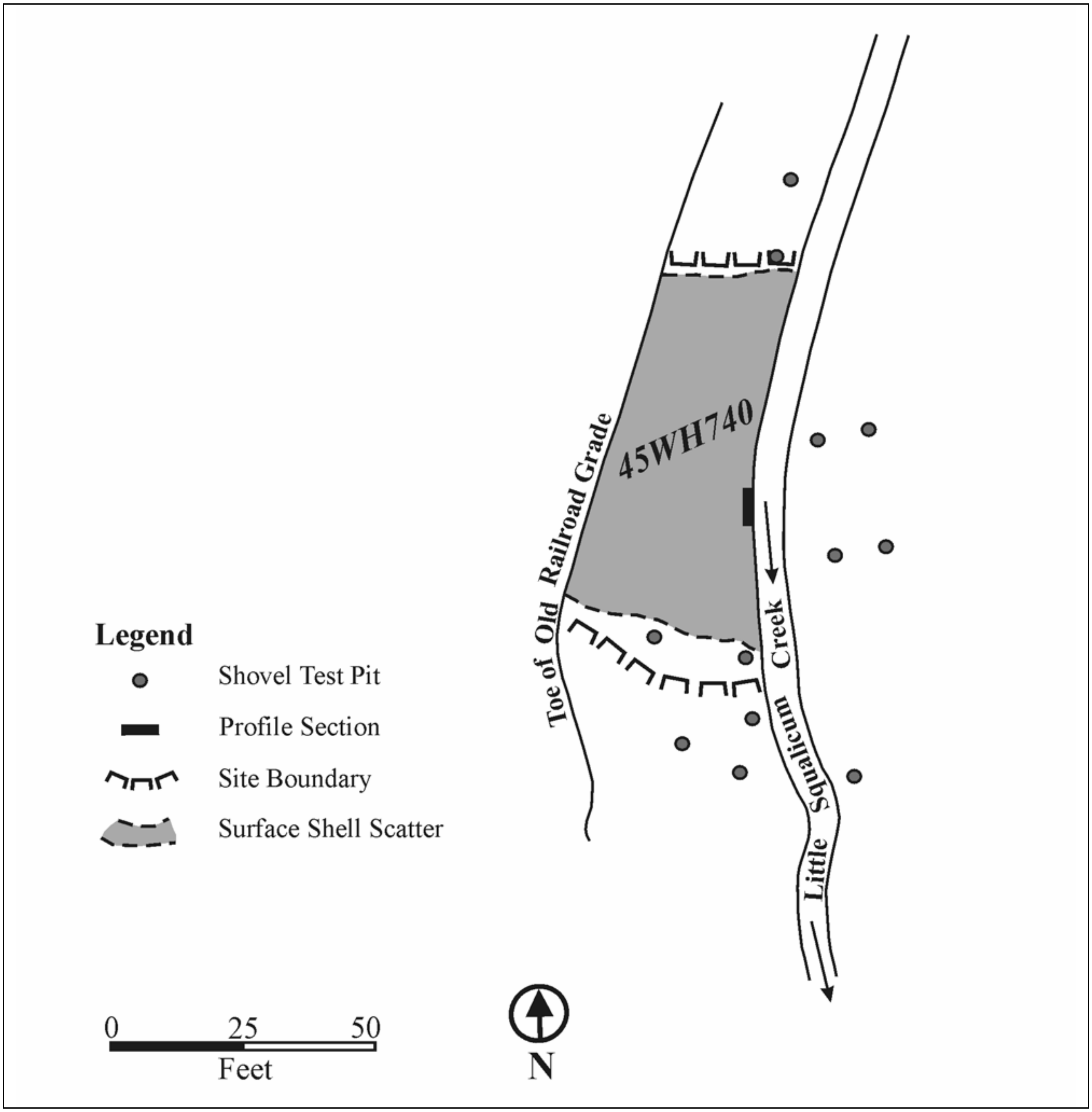


Figure 9 The 45WH740 site area and the locations of shovel test pits used to determine it, Little Squalicum Park, Bellingham, Washington.

5 DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This survey and assessment of the Little Squalicum Park Project Area has found that this is an extensively disturbed landscape. Much of the disturbance can be attributed to a gravel mining operation that was present here during the mid 20th century, but other impacts both prior to and after the gravel mining are also apparent. Unfortunately, our knowledge of the details of these impacts, and the conditions that existed here before they occurred, is limited. Within this area, only a single archaeological resource - - an area with shell midden deposits designated 45WH740 - - has been identified. This site is located on a narrow surface that may be somewhat less disturbed than much of the rest of the area (see below). The rest of the project area appears to represent relatively recent post-industrial surfaces that were probably below and/or outside of the original natural grade in the ravine. We believe that the remaining deposits in these latter areas have virtually no prospect to contain potentially significant archaeological resources.

Much of our work in the project area has focused upon the vicinity of the 45WH740 site area and it is therefore appropriate that we offer some discussion of this site. In this regard, however, it is important to note that we were asked to establish the boundaries of this site area, not to evaluate it. As such, we have made no effort to sample or probe deposits within the site's boundaries and therefore know relatively little about it. We have learned some things about the 45WH740 site area, but readily acknowledge that important questions about the significance of this site remain unresolved.

We are confident that prehistoric archaeological materials representing a shell midden deposit are present in the 45WH740 site area. Judging from the apparent quantities and densities of materials, we would guess that the represented settlement was probably not large. The available data suggests some type of small seasonal camp rather than a village area. Since no radiocarbon dates were obtained, nor were chronologically-sensitive objects encountered, we have no direct basis to suggest the site's age. We would add, however, the condition of the observed shellfish remains is relatively good and this suggests that the site is not very ancient. If we had to guess, we would suggest that the represented settlement is unlikely to be more than a few thousand years old and might be considerably more recent than this. Areas where important questions remain include: Is the site intact (i.e., potentially eligible for listing with the National Register of Historic Places) and What did the site area look like prior to historic disturbance?

We have very little direct information about the site's condition. In addressing the matter, we can ask the question: Are any of the strata exposed in the creek bank profile likely to be intact prehistoric cultural deposits? While we cannot definitively answer this question, we believe that there is only one serious candidate: Stratum II. It is very clear that Stratum I is disturbed. Relatively recent historic objects were found within it at depths up to approximately 30 centimeters (12 inches). We suspect that at least some of this deposit represents relatively recent alluvium and it is also possible that at least some fill sediments are present. We have observed some unequivocal prehistoric materials (e.g., the single dacite primary flake) associated with Stratum I, but suspect that this is more evidence of disturbance. It is relatively easy to imagine a scenario wherein historic disturbance damaged an underlying prehistoric cultural deposit and re-worked some prehistoric materials into the upper sediments. Note that such an interpretation implies at least some disturbance to Stratum II. In fact, extensive disturbance to Stratum II could have occurred during the historic period and it is possible little - - or even none - - of Stratum II is intact.

Directly related to the issue of the site's condition is the matter of its setting. As already noted, however, this issue is particularly problematic in light of our uncertainties about the pre-disturbance landscape here. One very important aspect of the pre-disturbance landscape is the location of the Little Squalicum Creek channel. Is the current location of the Little Squalicum Creek channel (in the vicinity of 45WH740) its original, pre-disturbance, location, or was it moved to here during the gravel mining operation? We simply do not have sufficient information to answer this question and - - in attempting to frame it - - the above-noted observation about elevations is perplexing. We have observed that, immediately to the east of the site area (i.e., across the current Little Squalicum Creek channel), the top of the Stratum III gravel is approximately 30 centimeters (12 inches) higher than the Stratum II shell deposit at 45WH740. Recall that we believe: (a) that the Stratum III gravel is a glacial deposit and (b) that the top of Stratum III reflects the extent of historic mining rather than the natural top of this deposit. Thus, if the Stratum II shell deposit at 45WH740 represents an intact late prehistoric cultural deposit, the current location of the Little Squalicum Creek channel is its original, pre-disturbance, location and the above-noted assumptions about the Stratum III gravel are all correct, then we must explain why the relatively recent shell midden deposit is lower than the much older gravel deposits adjacent to it. We cannot offer an explanation at this time and acknowledge that this could be an argument that the 45WH740 site area is not actually the location of the represented settlement. In fact, at this time we are not strongly committed to the interpretation that the 45WH740 site area is the location of the represented settlement. Unfortunately, arguing that the actual settlement location was somewhere else nearby has its own problems. The site appears to have relatively coherent boundaries. If it represents re-deposited materials, why are they present only in this area? Further, while shell fragmentation varies in both Stratum I and II, relatively large fragments of shell are present in both strata. While disturbance mechanism can vary widely, most effects that re-work and/or re-deposit shell tend to break them up and relatively large fragments are unusual.

In sum, while prehistoric archaeological materials representing a shell midden deposit are clearly present in the 45WH740 site area, important questions about its significance remain unresolved and are not resolvable with the current data. Resolution of these questions will require further study. A test excavation within the 45WH740 site area will be particularly important in this regard. We also think that exploration of the area immediately to the west of the old railroad grade is also desirable. If intact prehistoric cultural deposits are present, it is possible that they extend under the old grade and might be present in somewhat better condition further to the west.

Having recognized that prehistoric archaeological materials - - and possibly intact prehistoric cultural deposits - - are present, how does this finding impact the ongoing assessment of the possible presence and extent of contaminated sediments? We think that it has relatively little impact. The 45WH740 site area is relatively small and we recommend that the present environmental assessment avoid it. Similarly, we recommend that any future plans for Little Squalicum Park avoid disturbance to this area. Thus protected, additional study is not needed at this time. If, however, future plans call for impacts to the site area - - or to the area immediately to the west of the old railroad grade - - further study of this site is needed. Beyond the 45WH740 site area and the area immediately to the west of the old railroad grade, we do not have archaeological resource management concerns. The rest of the ravine floor is extensively disturbed and we believe that the remaining deposits in these latter areas have virtually no prospect to contain potentially significant archaeological resources.

6 REFERENCES CITED

Allen, Edwin J., Jr.
1976 Intergroup Ties and Exogamy Among the Northern Coast Salish. *Northwest Anthropological Research Notes* 10(2):161-172.

Carhart, Edith Beebe (editor)
1926 A *History of Bellingham, Washington*. The Argonaut Press. Bellingham.

Edson, Lelah Jackson
1968 *The Fourth Corner – Highlights from the Early Northwest*. Whatcom County Museum of History and Art. Bellingham.

Goldin, Alan
1992 *Soil Survey of Whatcom County Area, Washington*. U.S.D.A. Soil Conservation Service in Cooperation with Washington State Department of Natural Resources and the Washington State University Agricultural Research Center. Washington D.C.

Hale, James W., Alfred Reid, and Kati Claborn, Stacie Nored, and James Hilligass
2004 Cultural Resource Investigations for the Little Squalicum Park and the Coast Millennium Trail Squalicum Connector Segment A Development at Bellingham, Whatcom County, Washington. A report prepared for the Bellingham Parks and Recreation Department by Alfred Reid Archaeological Consulting. Bellingham.

Hale, James W., James Hillegas, Kati Claborn, Stacie Nored, and Alfred Reid
2005 Report of Cultural Resources Assessment of Whatcom Creek Trail Repair and Accessibility Improvements, Bellingham, Whatcom County, Washington. A report prepared for Bellingham Parks and Recreation by Alfred Reid Archaeological Consulting. Bellingham.

Integral
2005 Final Works Plan. Little Squalicum Park Remedial Investigation/Feasibility Study, Bellingham, Washington. A report prepared for Bellingham Parks and Recreation by Integral Consulting. Bellingham.

Koert, Dorothy and Galen Biery
1982 *Looking Back*. Lynden Tribune. Lynden.

Muenscher, W.C.
1941 *The Flora of Whatcom County*. Published by the author. Ithaca.

Reagan, Albert B.
1917 Archaeological Notes on Western Washington and Adjacent British Columbia. *Proceeding of the California Academy of Science, Fourth Series*, VII(1):1-31.

Richardson, Allan
1974 *Traditional Fisheries and Traditional Villages, Camps, and Fishing Sites of the Nooksack Indians*. Nooksack Tribal Center. Deming.

Scott, James W. and Daniel E. Turbeville III
1983 *Whatcom County in Maps 1832-1937*. Center for Pacific Northwest Studies, Western Washington University. Bellingham.

Shong, Michael V. and Alexander E. Stevenson
2005 Report of Cultural Resources Monitoring at the Coast Millennium Trail Squalicum Connector Segment A and Archaeological Testing at Site 45WH726, Whatcom County, Washington. A report prepared for Bellingham Parks and Recreation by Northwest Archaeological Associates, Inc. Seattle.

Smith, Harlan I.
1907 Archaeology of the Gulf of Georgia and Puget Sound. American Museum of Natural History *Memoir* 4, Part 6. New York.

Smith, Harlan I. and Gerald Fowkes
1901 Cairns of British Columbia and Washington. American Museum of Natural History *Memoir* 4, Part 2. New York.

Stern, Bernhard J.
1934 *The Lummi Indians of Northwest Washington*. Columbia University Press, New York.

Suttles, Wayne P.
1951 *Economic Life of the Coast Salish of Haro and Rosario Straits*. Unpublished Ph.D. Dissertation, Department of Anthropology, University of Washington. Seattle.
1990 Central Coast Salish. In: Northwest Coast, edited by Wayne Suttles. *Handbook of North American Indians*, Vol. 7. Smithsonian Institute, Washington D.C.

Wahl, Tim
2005 A Land-Use History of the Eldridge Industrial Sites Focusing on Lots 7 & 8, added to Little Squalicum Park. Unpublished report prepared by the City of Bellingham's Parks and Recreation Department. Bellingham.

APPENDIX

AN ARCHAEOLOGICAL SITE INVENTORY FORM FOR 45WH740

WASHINGTON ARCHAEOLOGICAL SITE INVENTORY FORM

County: Whatcom **Site:** 45WH740
Date: December 2005 **Compiler:** Gary Wessen

SITE DESIGNATION

Site Name: **Computer Number:**

SITE LOCATION

UTM **Zone** 10 **Easting** 535559 **Northing** 5401254
Legal Description **T** 38 N **R** 2 E **Section** 43 **1/4** SW **1/4, 1/4** ___ **1/4, 1/4, 1/4** ___
USGS Map **Quad Name:** Ferndale, WA **Series:** 7.5 min **Date:**
Elevation (ft): ca. 15 **Slope:** 0 **Aspect:** south **Drainage:** Little Squalicum Creek
River Mile: 0.1

Location Description:
The site is located on the west side of modern floodplain of Little Squalicum Creek, in Little Squalicum Park, on the north side of the City of Bellingham. The vicinity of the site is a dissected canyon close to the shoreline of Bellingham Bay. This area was formerly a gravel mine and it has been extensively disturbed prior to development of the park. In this regard, at least some of the surfaces in the vicinity of the site are not natural and details of the pre-disturbance landscape are not well understood. The site area itself is an undeveloped area in the park dominated by a thick stand of blackberry and relatively young second-growth trees. Little Squalicum Creek passes along the eastern margin of the site area, but whether this creek is actually flowing in its pre-disturbance channel is unknown.

Approach (to relocate):
From the Lakeway Drive exit on U.S. Route 5, proceed west on Lakeway Drive to the junction with Holly Street. Proceed northwest on Holly Street through downtown Bellingham. At the junction with Broadway, Holly becomes Elderidge Avenue. Continue northwest on Eldridge until the latter becomes Marine Drive. Cross the Marine Drive Bridge across the Little Squalicum Creek canyon. Park in the Little Squalicum Park parking area, on the north side of Marine Drive, on the west side of the Little Squalicum Creek canyon. Follow the foot path to the floodplain of Little Squalicum Creek and then walk southwest toward Bellingham Bay. The site area is located on the west side of Little Squalicum Creek, just upstream of the large railroad trestle bear Bellingham Bay.

SITE DESCRIPTION

Narrative Description:
The site consists of an area of shell midden deposits and some associated deposits that are rich in fire-cracked rocks, but lack shell. The midden contains a relatively low density of variably fragmented shell dominated by *Protothaca staminea* and *Saxidomus giganteus*. Observations of the midden is are complicated by the fact that the prehistoric deposit is mantled by a scatter of marine shell and recent historic debris that are not a part of the site. The recent shell material is also dominated by *Protothaca Staminea*, but also contains small quantities of *Crassostrea gigas* and *Venerupis japonica* (neither of which are native shellfish). The uppermost deposit here appears to be disturbed, but a lower stratum of prehistoric shell midden deposits appears to be in relatively good shape. The latter appears to be massive and lacks any indication of internal structure or cultural features.

Site Type: prehistoric shell midden

Dimensions **Method of Horizontal Measurement:** surface inspection and limited shovel testing; actual measurements were made with an EDM.
Length (m): approx. 19 **Direction:** NE-SW
Width (m): approx. 7 **Direction:** SE-NW
Method of Vertical Measurement: examination of exposed profile in creek bank
Depth (cm): approx. 20
Vegetation **On Site:** *Rubus discolor* and *Corylus cornuta*
Local: same as above plus *Alnus rubra* and grasses
Regional: *Tsuga heterophylla* Zone (Franklin and Dyrness 1972)
Landforms **On Site:** alluvial floodplain **Local:** alluvial floodplain
Water Resources **Type:** creek **Distance:** adjacent to site **Permanence:** year round

CULTURAL MATERIALS AND FEATURES

Narrative Description:
Cultural materials observed here include chipped stone debitage, seven varieties of marine shell, mammal bone, fire-cracked rocks, and charcoal. Recent historic debris (including shell debris) are not considered to be a part of this site.

No materials collected.

SITE AGE

Component: none assigned **Dates:** none **Dating Method:**
Phase: none assigned **Basis for Phase Designation:** none

Judging from the condition of the observed shell, I believe that this is relatively recent late prehistoric site. I would guess that it is less than 1,500 years old.

SITE RECORDERS

Observed by:
Address:
Recorded by: Gary Wessen
Date Recorded: November 4, 2005 **Affiliation:** Wessen & Associates, Inc.
Revisited by:
Affiliation:

SITE HISTORY

Previous Work:
No previous work.

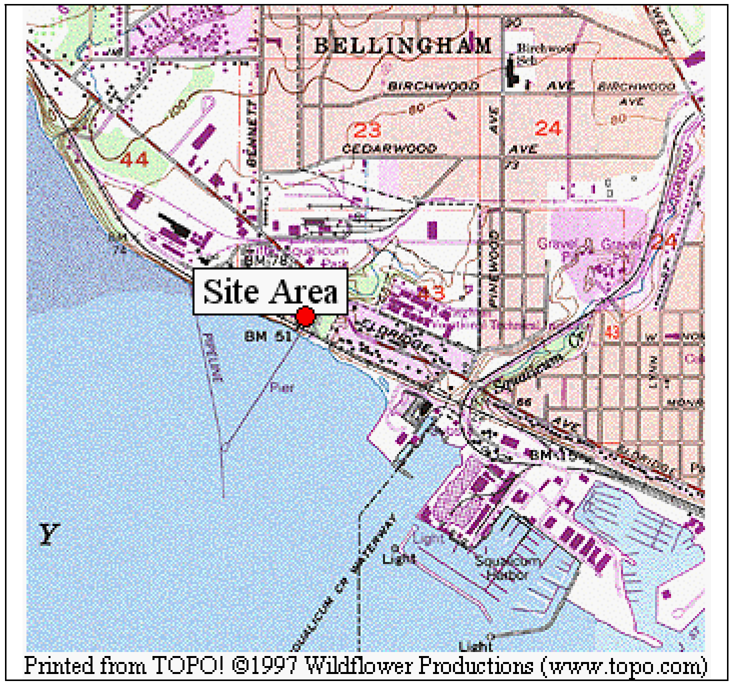
SITE OWNERSHIP

Owner: Bellingham Parks & Recreation Department
Address: 3424 Meridan
Bellingham, WA 98225

Tax Lot No.:

USGS MAP

Quad Name: Sumas, Wash.
Series: 7.5 minute series
Date: 1952
Section: 11



SKETCH MAP

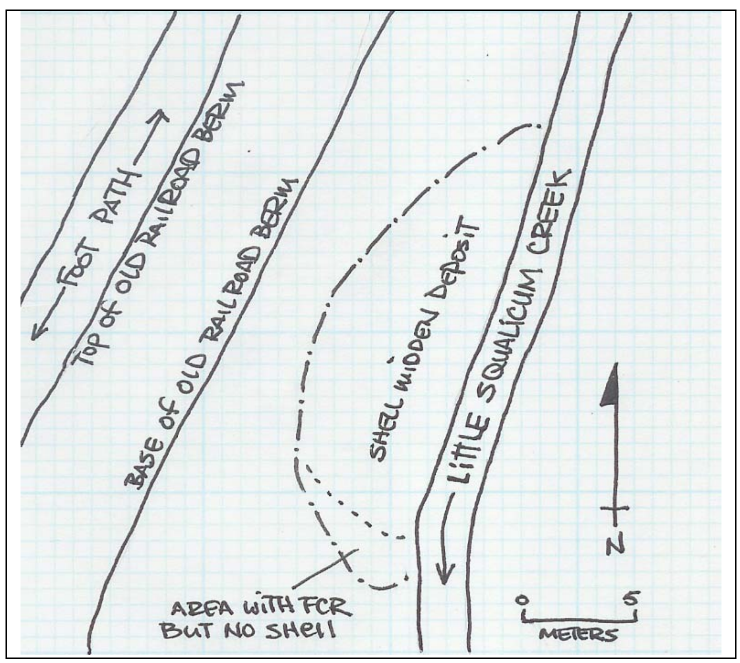
Legend

Known Boundary: .-.-.-.-.-.-.-.

Possible Boundary:

Scale:

North Arrow:



WASHINGTON ARCHAEOLOGICAL SITE INVENTORY FORM
Fauna Page

45WH740

SHELLFISH

Protothaca staminea	- Major Species -
Saxidomus giganteus	- Major Species -
Mytilus edulis	- Minor Species -
Mytilus californianus	- not observed -
Clinocardium nuttalli	- Minor Species -
Tresus spp.	- Minor Species -
Macoma nasuta	- not observed -
Macoma irus	- not observed -
Ostrea lurida	- not observed -
Hinnites multirugosa	- not observed -
Thais lamellosa	- Minor Species -
Thais caniculata	- not observed -
Thais lima	- not observed -
Fusitriton oregonensis	- not observed -
Littorina sitkana	- not observed -
Acmaea pelta	- not observed -
Acmaea t.scutum	- not observed -
Searlesia dira	- not observed -
Natica clausa	- not observed -
Cryptochiton stelleri	- not observed -
Katharina tunicata	- not observed -
Cancer productus	- not observed -
Balanus spp.	- Minor Species -
Strongylocentrotus spp.	- not observed -

VERTEBRATES

Odocoileus hemionus	- not observed -
Cervus canadianus	- not observed -
Moderate-sized unidentified mammal	- not observed -
Small unidentified mammal	- not observed -
Unidentified terrestrial mammal	- Present -
Callorhinus ursinus	- not observed -
Eumetopias jubata	- not observed -
Phocaenidae	- not observed -
Cetacea	- not observed -
Unidentified marine mammal	- not observed -
Large unidentified bird	- not observed -
Moderate-sized unidentified bird	- not observed -
Oncorhynchus spp.	- not observed -
Squalus acanthias	- not observed -
Clupea spp.	- not observed -
Pleuronectiformes	- not observed -
Unidentified fish	- not observed -

Table F-1. Preliminary Indicator Hazardous Substances for Soil Site Wide

Analyte	No. of Samples Analyzed (a)	No. of Data Points (b)	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If not Detected, Does Max. DL Exceed SL?	Comment (info. on chemical uses from HSDB
Herbicides, mg/kg																									
2,4,5-T	1	1	0	0	1.8E-02	1.8E-02	--	--	--	--	8.0E+02	2.3E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4,5-TP (Silvex)	1	1	0	0	1.8E-02	1.8E-02	--	--	--	--	6.4E+02	2.8E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4-D	1	1	0	0	7.2E-02	7.2E-02	--	--	--	--	8.0E+02	9.0E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4-DB	1	1	0	0	3.6E-01	3.6E-01	--	--	--	--	6.4E+02	5.6E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Dalapon	1	1	0	0	1.3E+00	1.3E+00	--	--	--	--	2.4E+03	5.4E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Dicamba	1	1	0	0	3.6E-02	3.6E-02	--	--	--	--	2.4E+03	1.5E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Dichloroprop	1	1	0	0	7.2E-02	7.2E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dinoseb	1	1	0	0	3.6E-02	3.6E-02	--	--	--	--	8.0E+01	4.5E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
MCPA	1	1	0	0	3.6E+01	3.6E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Metals, mg/kg																									
Aluminum	27	27	27	100	NA	NA	1.1E+04	3.0E+04	B-BB3	99070535	7.6E+04	0.0E+00	0	--	3.9E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Antimony	27	27	10	37	6.6E-01	4.1E+00	4.8E-01	3.6E+01	MWLSC01	99070511	3.0E-01	1.4E+01	17	100	1.2E+02	10	100	100	Y	Y	N	Not above background		--	
Arsenic	140	140	72	51	8.0E-01	4.0E+01	3.0E+00	2.4E+02	SB-40	LSP0609	6.7E-01	6.0E+01	68	100	3.5E+02	72	100	100	Y	Y	Y			--	
Barium	27	27	27	100	NA	NA	6.9E+01	5.1E+02	MWLSC01	99070511	8.2E+01	0.0E+00	0	--	6.2E+00	25	93	93	Y	Y	N	Not above background		--	
Beryllium	27	27	2	7	4.0E-01	8.0E+00	4.3E-01	4.6E-01	B-AA2	99070532	3.0E+00	2.7E+00	21	84	1.5E-01	0	0	78	Y	--	--	Doesn't exceed SL		--	
Cadmium	135	135	87	64	4.0E-02	2.0E-01	1.5E-01	1.0E+01	TP-23	LSP0110	4.0E-01	5.0E-01	0	0	2.5E+01	58	67	43	Y	Y	N	Not above background		--	
Calcium	32	32	32	100	NA	NA	3.8E+03	5.2E+04	RES-43	99224021	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Chromium	140	140	140	100	NA	NA	2.2E+01	1.6E+02	TP-24; SB-01	LSP0114; LSP0121	2.0E+00	0.0E+00	0	--	7.8E+01	140	100	100	Y	Y	N	Not above background in soil		--	
Cobalt	27	27	27	100	NA	NA	9.1E+00	2.4E+01	B-AA4	99070588	9.0E+02	0.0E+00	0	--	2.7E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Copper	134	134	134	100	NA	NA	1.5E+01	4.1E+02	TP-23	LSP0110	3.0E+03	0.0E+00	0	--	1.4E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Iron	27	27	27	100	NA	NA	2.0E+04	4.1E+04	B-AA4	99070588	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Lead	135	135	134	99	3.0E-01	3.0E-01	2.0E+00	4.0E+03	TP-22	LSP0107	2.5E+02	1.2E-03	0	0	1.6E+01	7	5	5	Y	Y	Y			--	
Magnesium	32	32	32	100	NA	NA	5.7E+03	1.4E+04	B-AA4	99070588	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Manganese	27	27	27	100	NA	NA	2.2E+02	1.4E+03	SP05	99070654	1.1E+04	0.0E+00	0	--	1.3E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Mercury	135	135	84	62	2.0E-03	1.8E-01	4.0E-02	1.6E+00	TP-23	LSP0110	2.4E+01	7.5E-03	0	0	6.8E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Nickel	133	133	133	100	NA	NA	2.2E+01	1.2E+02	TP-23	LSP0110	7.0E+00	0.0E+00	0	--	1.7E+01	133	100	100	Y	Y	N	Not above background in soil		--	
Potassium	27	27	27	100	NA	NA	7.9E+02	3.5E+03	B-BB5	99070595	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Selenium	27	27	3	11	2.5E+00	5.7E+00	8.0E-01	3.4E+00	B-AA2	99070532	3.0E-01	1.9E+01	24	100	1.1E+01	3	100	100	Y	Y	N	Not above background		--	
Silver	135	135	7	5	3.0E-02	6.1E-01	3.1E-01	1.4E+00	TP-01	LSP0061	2.0E+00	3.1E-01	0	0	7.0E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Sodium	27	27	2	7	9.9E+01	7.2E+03	1.1E+02	1.1E+02	B-AA2; B-AA4	99070532; 99070533	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Thallium	27	27	7	26	4.4E-02	2.5E-01	8.1E-02	4.7E-01	B-BB3	99070535	5.6E+00	4.5E-02	0	0	8.4E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Vanadium	27	27	27	100	NA	NA	3.5E+01	8.3E+01	B-AA4	99070588	3.0E-02	0.0E+00	0	--	2.8E+03	27	100	100	Y	Y	N	Not above background		--	
Zinc	142	142	142	100	NA	NA	3.4E+01	3.1E+03	TP-23	LSP0110	6.2E+02	0.0E+00	0	--	4.9E+00	7	5	5	Y	Y	Y			--	
VOCs, mg/kg																									
Acetone	1	1	1	100	NA	NA	8.9E-01	8.9E-01	TP-06	LSP0045	8.0E-01	0.0E+00	0	--	1.1E+00	1	100	100	Y	Y	N	Common lab contaminant Barely exceeds SL Not associated with historical practices		--	
Acrolein	1	1	0	0	4.3E-04	4.3E-04	--	--	--	--	1.6E+03	2.7E-07	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Benzene	31	31	0	0	1.0E-05	5.0E-01	--	--	--	--	2.0E-03	2.5E+02	30	97	0.0E+00	0	--	97	--	--	--	Not detected		Y	Most soil DLs exceed SL. Most groundwater and surface water DLs are below SL but it wasn't detected in groundwater or surface water. Based on solubility, benzene is expected to be seen in water. Not analyzed in sediment.
Bromobenzene	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	2.8E+01	1.8E-06	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bromochloromethane	1	1	0	0	8.0E-05	8.0E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Bromodichloromethane	1	1	0	0	6.0E-05	6.0E-05	--	--	--	--	3.0E-02	2.0E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bromoethane	1	1	0	0	7.0E-05	7.0E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Bromoform	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	4.0E-02	1.3E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bromomethane	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	1.0E-02	4.0E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Butanone	1	1	0	0	4.9E-04	4.9E-04	--	--	--	--	4.8E+04	1.0E-08	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
n-Butylbenzene	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	2.4E+02	2.1E-07	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
sec-Butylbenzene	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
tert-Butylbenzene	1	1	0	0	6.0E-05	6.0E-05	--	--	--	--	3.9E+02	1.5E-07	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Carbon Disulfide	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	2.0E+00	2.0E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Carbon Tetrachloride	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	3.0E-03	1.7E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Chlorobenzene	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	7.0E-02	7.1E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Chloroethane	1	1	0	0	6.0E-05	6.0E-05	--	--	--	--	3.5E+02	1.7E-07	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Chloroethylvinylether	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Chloroform	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	3.0E-02	1.3E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Chloromethane	1	1	0	0	3.0E-05	3.0E-05	--	--	--	--	7.7E+01	3.9E-07	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Chlorotoluene	1	1	0	0	8.0E-05	8.0E-05	--	--	--	--	1.6E+03	5.0E-08	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Chlorotoluene	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibromochloromethane	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	2.0E-02	2.5E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2-Dibromo-3-chloropropane	1	1	0	0	1.1E-04	1.1E-04	--	--	--	--	7.1E-01	1.5E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2-Dibromoethane	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	1.2E-02	4.2E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Dibromomethane	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	6.7E+01	6.0E-07	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
trans-1,4-Dichloro-2-butene	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1,1-Dichloroethane	1	1	0	0	3.0E-05	3.0E-05	--	--	--	--	1.0E+00	3.0E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2-Dichloroethane	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	1.0E-03	4.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1-Dichloroethene	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	3.0E-03	1.3E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
cis-1,2-Dichloroethene	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	2.0E-02	2.5E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
trans-1,2-Dichloroethene	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	3.0E-02	1.3E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2-Dichloropropane	1	1	0	0	3.0E-05	3.0E-05	--	--	--	--	1.0E-03	3.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,3-Dichloropropane	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	1.1E+02	3.8E-07	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,2-Dichloropropane	1	1	0	0	3.0E-05	3.0E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1,1-Dichloropropene	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
cis-1,3-Dichloropropene	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
trans-1,3-Dichloropropene	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	2.0E-04	2.0E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Ethylbenzene	31	31	1	3	5.0E-01	5.0E-01	2.1E-01	2.1E-01	TP-06	LSP0045	7.0E-01	7.1E-01	0	0	3.0E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Fluorotrichloromethane	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	2.4E+04	2.1E-09	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Hexanone	1	1	0	0	4.4E-04	4.4E-04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Iodomethane	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Isopropylbenzene	1	1	0	0	3.0E-05	3.0E-05	--	--	--	--	8.0E+03	3.8E-09	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
p-Isopropyltoluene	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Methyl tert-butyl Ether	30	30	0	0	5.0E-01	5.0E-01	--	--	--	--	5.6E+02	8.9E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Methyl-2-pentanone	1	1	0	0	2.9E-04	2.9E-04	--	--	--	--	6.4E+03	4.5E-08	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Methylene Chloride	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	1.0E-03	5.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Propenenitrile	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	1.9E+00	2.1E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
n-Propylbenzene	1	1	0	0	3.0E-05	3.0E-05	--	--	--	--	2.4E+02	1.3E-07	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Styrene	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	2.0E-01	2.5E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1,1,2-Tetrachloroethane	1	1	0	0	6.0E-05	6.0E-05	--	--	--	--	3.8E+01	1.6E-06	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1,2,2-Tetrachloroethane	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	2.0E-04	2.0E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Tetrachloroethene	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	3.0E-03	1.7E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Toluene	31	31	1	3	5.0E-01	5.0E-01	8.8E-02	8.8E-02	TP-06	LSP0045	6.0E-01	8.3E-01	0	0	1.5E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,1,2-Trichloro-1,2,2-trifluoroethane	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	2.4E+06	1.7E-11	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1,1-Trichloroethane	1	1	0	0	3.0E-05	3.0E-05	--	--	--	--	1.0E-01	3.0E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1,2-Trichloroethane	1	1	0	0	5.0E-05	5.0E-05	--	--	--	--	9.0E-04	5.6E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Trichloroethene	1	1	0	0	6.0E-05	6.0E-05	--	--	--	--	2.5E+00	2.4E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2,3-Trichloropropane	1	1	0	0	6.0E-05	6.0E-05	--	--	--	--	1.4E-01	4.3E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	

Table F-1. Preliminary Indicator Hazardous Substances for Soil Site Wide

Analyte	No. of Samples Analyzed (a)	No. of Data Points (b)	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If not Detected, Does Max. DL Exceed SL?	Comment (info. on chemical uses from HSDB)
1,2,4-Trimethylbenzene	1	1	1	100	NA	NA	5.1E-01	5.1E-01	TP-06	LSP0045	4.0E+03	0.0E+00	0	--	1.3E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,3,5-Trimethylbenzene	1	1	1	100	NA	NA	1.8E-01	1.8E-01	TP-06	LSP0045	4.0E+03	0.0E+00	0	0	4.5E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
Vinyl Acetate	1	1	0	0	3.0E-05	3.0E-05	--	--	--	--	8.0E+00	3.8E-06	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Vinyl Chloride	1	1	0	0	4.0E-05	4.0E-05	--	--	--	--	7.0E-04	5.7E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
m&p-Xylene	31	31	2	6	5.0E-01	5.0E-01	1.8E-01	6.3E-01	MWLSC02	99070547	6.0E-01	8.3E-01	0	0	1.1E+00	1	50	3	Y	Y	Y			--	
o-Xylene	31	31	1	3	5.0E-01	5.0E-01	1.5E-01	1.5E-01	TP-06	LSP0045	1.0E+01	5.0E-02	0	0	1.5E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
SVOCs, mg/kg																			--	--	--	Not detected		N	
Aniline	32	32	0	0	1.9E-02	3.8E-01	--	--	--	--	1.8E+02	2.1E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,4-Benzenediamine	5	5	0	0	9.6E-02	2.2E+00	--	--	--	--	1.5E+04	1.5E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Benzidine	45	45	0	0	4.7E-01	1.1E+01	--	--	--	--	4.3E-03	2.6E+03	45	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Formerly used in manufacture of azo dyes, as reagent for
Benzoic Acid	86	86	14	16	1.9E-02	2.0E+00	2.1E-02	2.9E+00	LSC-S2	3394048	2.0E+01	1.0E-01	0	0	1.5E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Benzyl Alcohol	86	86	6	7	9.5E-03	9.5E-01	6.8E-03	1.1E+00	SP03	99070652	2.4E+04	4.0E-05	0	0	4.6E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
Bis(2-chloroethoxy) Methane	86	86	0	0	9.5E-03	2.8E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Bis-(2-chloroethyl) Ether	86	86	0	0	9.5E-03	2.7E-01	--	--	--	--	2.0E-05	1.4E+04	86	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Can be formed during water chlorination; formerly used in textile industry and as solvent in resins
Bis(2-chloroisopropyl)ether	44	44	0	0	9.5E-03	1.9E-01	--	--	--	--	3.2E+03	6.0E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bis(2-chloro-1-methylethyl) Ether	42	42	0	0	1.2E-02	2.7E-01	--	--	--	--	1.4E+01	1.9E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bis(2-ethylhexyl)phthalate	86	86	26	30	1.1E-02	9.5E-01	1.4E-02	6.2E+00	LSC-S2	3394048	7.1E+01	1.3E-02	0	0	8.7E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
4-Bromophenyl-phenylether	86	86	0	0	9.5E-03	2.9E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Butylbenzylphthalate	86	86	14	16	9.5E-03	3.8E-01	1.6E-03	6.7E-01	LSC-S1	3394047	8.1E+02	4.7E-04	0	0	8.2E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
Caffeine	2	2	0	0	2.2E-02	1.2E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Carbazole	47	47	34	72	2.0E-02	1.9E-01	1.1E-02	3.3E+01	TP-06	LSP0045	3.0E-02	6.4E+00	5	38	1.1E+03	30	88	74	Y	Y	Y			--	
4-Chloroaniline	82	82	0	0	9.5E-03	2.2E+00	--	--	--	--	3.0E-02	7.3E+01	45	55	0.0E+00	0	--	55	--	--	--	Not detected		Y	Used in synthesis of dyes, pharmaceuticals, and agricultural chemicals; degradation product of certain pesticides, a hospital disinfectant, and contact lens disinfectant
4-Chloro-3-methylphenol	86	86	0	0	9.5E-03	2.2E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
2-Chloronaphthalene	86	86	0	0	3.8E-03	2.1E-01	--	--	--	--	4.9E+03	4.3E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Chlorophenol	86	86	0	0	9.5E-03	2.0E-01	--	--	--	--	2.0E-01	1.0E+00	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Chlorophenyl-phenylether	86	86	0	0	9.5E-03	2.7E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
3B-Coprostanol	2	2	0	0	2.2E-01	1.2E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Creosote	6	6	5	83	7.0E+00	7.0E+00	5.2E+01	9.5E+03	SB-12	LSP0201	--	--	--	--	--	--	--	--	Y	--	--	No SL	PAHs evaluated instead	--	
7H-Dibenzo(c,g)carbazole	38	38	4	11	1.9E-03	3.0E-02	5.0E-02	3.1E-01	SP03	99070652	--	--	--	--	--	--	--	--	Y	--	--	No SL	Evaluation of other PAHs should be sufficiently protective.	--	
Dibenzofuran	86	86	39	45	9.5E-03	3.5E-01	1.4E-03	1.2E+02	TP-06	LSP0045	1.6E+02	2.2E-03	0	0	7.5E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,2-Dichlorobenzene	86	86	0	0	4.0E-05	2.3E-01	--	--	--	--	9.0E-01	2.6E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,3-Dichlorobenzene	86	86	0	0	5.0E-05	2.0E-01	--	--	--	--	5.3E+02	3.8E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,4-Dichlorobenzene	86	86	0	0	6.0E-05	2.1E-01	--	--	--	--	1.0E-01	2.1E+00	19	22	0.0E+00	0	--	22	--	--	--	Not detected		Y	Used as insecticide, space deodorant, and chemical intermediate
3,3'-Dichlorobenzidine	79	79	0	0	9.5E-03	2.0E+00	--	--	--	--	3.0E-04	6.7E+03	79	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Intermediate in manufacture of dyes and pigments
2,4-Dichlorophenol	86	86	0	0	8.0E-03	1.0E+00	--	--	--	--	5.0E-02	2.0E+01	24	28	0.0E+00	0	--	28	--	--	--	Not detected		Y	Manufacturing intermediate; can form in waste streams containing both phenol and chlorine; may be contaminant of 2,4-D
Diethylphthalate	86	86	1	1	9.5E-03	2.4E-01	1.2E-02	1.2E-02	TP-23	LSP0110	6.4E+04	3.8E-06	0	0	1.9E-07	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,4-Dimethylphenol	86	86	2	2	9.5E-03	3.0E-01	4.4E-02	7.7E-02	LSC-S1	3394047	4.0E-01	7.5E-01	0	0	1.9E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Dimethylphthalate	86	86	19	22	9.5E-03	3.0E-01	3.2E-03	3.1E+00	LSC-S1	3394047	8.0E+04	3.7E-06	0	0	3.9E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
di-n-Butylphthalate	86	86	10	12	9.5E-03	6.7E-01	1.0E-02	4.6E-01	SB-09	LSP0177	2.7E+02	2.5E-03	0	0	1.7E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
4,6-Dinitro-2-methylphenol	82	82	1	1	9.5E-03	2.5E+00	1.3E-02	1.3E-02	B-AA2	99070532	6.1E+00	4.1E-01	0	0	2.1E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,4-Dinitrophenol	86	86	0	0	9.5E-03	4.7E+00	--	--	--	--	1.0E-02	4.7E+02	76	88	0.0E+00	0	--	88	--	--	--	Not detected		Y	Manufacturing intermediate
2,4-Dinitrotoluene	86	86	4	5	9.5E-03	2.0E+00	3.6E-02	4.2E+00	TP-06	LSP0045	4.0E-05	5.0E+04	82	100	1.1E+05	4	100	100	Y	Y	Y			--	
2,6-Dinitrotoluene	86	86	1	1	9.5E-03	2.2E+00	2.2E-02	2.2E-02	B-BB5	99070536	3.0E-05	7.3E+04	85	100	7.3E+02	1	100	100	Y	Y	Y			--	
di-n-Octylphthalate	86	86	0	0	9.5E-03	9.5E-01	--	--	--	--	1.6E+03	6.0E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2-Diphenylhydrazine	47	47	0	0	1.9E-02	4.5E-01	--	--	--	--	1.3E+00	3.5E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Hexachlorobenzene	86	86	2	2	9.5E-03	2.3E-01	1.2E-02	1.4E-02	LSC-S2	3394048	1.0E-01	2.3E+00	20	24	1.4E-01	0	0	23	Y	--	--	Doesn't exceed SL		--	
Hexachlorobutadiene	86	86	0	0	2.0E-05	3.8E-01	--	--	--	--	1.0E-01	3.8E+00	19	22	0.0E+00	0	--	22	--	--	--	Not detected		Y	Used as solvent for elastomers, heat transfer liquid, transformer and hydraulic fluid; released during refuse combustion; found in fly ash
Hexachlorocyclopentadiene	85	85	0	0	9.5E-03	2.0E+00	--	--	--	--	2.0E+01	1.0E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Hexachloroethane	86	86	0	0	9.5E-03	2.2E-01	--	--	--	--	2.0E-02	1.1E+01	36	42	0.0E+00	0	--	42	--	--	--	Not detected		Y	Produced and used in many products; formed during incineration of chlorinated wastes
Isophorone	86	86	0	0	9.5E-03	2.5E-01	--	--	--	--	3.0E-02	8.3E+00	35	41	0.0E+00	0	--	41	--	--	--	Not detected		Y	Solvent for inks, lacquers, and adhesives; chemical intermediate
1-Methylnaphthalene	47	47	26	55	2.0E-02	4.1E-01	1.9E-02	1.6E+02	TP-06	LSP0045	4.0E+00	1.0E-01	0	0	4.0E+01	11	42	23	Y	Y	Y			--	
2-Methylphenol	86	86	2	2	9.5E-03	5.4E-01	4.8E-02	6.5E-02	LSC-S2	3394048	8.0E-01	6.8E-01	0	0	8.1E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
3&4-Methylphenol	39	39	1	3	9.5E-03	1.8E-01	1.1E-01	1.1E-01	SP03	99070652	4.0E+03	4.5E-05	0	0	2.8E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
4-Methylphenol	47	47	2	4	1.9E-02	2.0E-01	9.2E-02	1.1E-01	LSC-S2	3394048	4.0E+02	5.0E-04	0	0	2.9E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
2-Nitroaniline	86	86	0	0	9.5E-03	4.0E+00	--	--	--	--	1.8E+02	2.2E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
3-Nitroaniline	85	85	0	0	9.5E-03	1.7E+00	--	--	--	--	1.8E+01	9.3E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Nitroaniline	85	85	0	0	9.5E-03	2.2E+00	--	--	--	--	3.0E-02	7.3E+01	40	47	0.0E+00	0	--	47	--	--	--	Not detected		Y	Chemical intermediate; emitted in stack effluents from hazardous waste incineration
Nitrobenzene	86	86	0	0	9.5E-03	2.4E-01	--	--	--	--	7.0E-03	3.4E+01	86	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Used in manufacture of chemicals, soaps, shoe polishes; used as solvent
2-Nitrophenol	86	86	0	0	8.4E-03	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
4-Nitrophenol	86	86	0	0	9.5E-03	2.2E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1-Nitropyrene	3	3	0	0	2.3E-03	2.5E-03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
n-Nitrosodimethylamine	42	42	0	0	4.6E-02	2.0E+00	--	--	--	--	2.0E-02	1.0E+02	42	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Found in cigarette smoke; emitted during plastic manufacturing; used in production of rocket fuels; additive for lubicants
N-nitrosodiphenylamine	83	83	1	1	9.5E-03	2.5E+00	2.4E-02	2.4E-02	LSC-S2	3394048	6.0E-02	4.2E+01	24	29	4.0E-01	0	0	29	Y	--	--	Doesn't exceed SL		--	
n-Nitroso-di-n-propylamine	86	86	0	0	8.0E-03	1.7E+00	--	--	--	--	2.0E-06	8.5E+05	86	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Found in cigarette smoke; contaminant in herbicides
Pentachlorophenol	86	86	41	48	9.5E-03	1.0E+00	5.6E-03	7.1E+00	TP-16	LSP0088	1.0E-03	1.0E+03	45	100	7.1E+03	41	100	100	Y	Y	Y			--	
Phenol	86	86	5	6	9.5E-03	2.7E-01	4.1E-03	4.3E-01	LSC-S2	3394048	5.0E+00	5.4E-02	0	0	8.6E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Pyridine	41	41	0	0	4.1E-02	2.2E+00	--	--	--	--	8.0E+01	2.8E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Retene	47	47	8	17	2.0E-02	2.2E+00	1.3E-02	3.7E-01	SB-18	LSP0250	--	--	--	--	--	--	--	--	Y	--	--	No SL	Evaluation of other PAHs should be sufficiently protective.	--	
2,3,4,5-Tetrachlorophenol	40	40	0	0	9.6E-02	2.2E+00	--	--	--	--	2.4E+03	9.2E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,3,4,6-Tetrachlorophenol	40	40	1	3	9.6E-02	2.2E+00	8.7E-02	8.7E-02	TP-23	LSP0108	2.4E+03	9.2E-04	0	0	3.6E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,3,5,6-Tetrachlorophenol	40	40	0	0	9.6E-02	2.2E+00	--	--	--	--	2.4E+03	9.2E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Tetrachlorophenols	39	39	6	15	9.5E-03	1.5E-01	2.3E-02	2.0E-01	SP03	99070652	2.4E+03	6.3E-05	0	0	8.3E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,2,3-Trichlorobenzene	2	2	0	0	6.0E-05	4.1E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1,2,4-Trichlorobenzene	86	86	1	1	5.0E-05	2.0E-01	3.8E-03	3.8E-03	B-BB5	99070536	3.0E-01	6.7E-01	0	0	1.3E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,4,5-Trichlorophenol	86	86	1	1	5.7E-03	1.5E+00	7.9E-03	7.9E-03	LSC-S1	3394047	1.4E+01	1.1E-01	0	0	5.6E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,4,6-Trichlorophenol	86	86	1	1	8.4E-03	1.0E+00	3.2E-02	3.2E-02	LSC-S1	3394047	8.0E-03	1.3E+02	85	100	4.0E+00	1	100	100	Y	Y	Y			--	
PAHs, mg/kg																									
Acenaphthene	86	86	35	41	1.9E-03	2.1E-01	6.7E-03	3.2E+02	TP-06	LSP0045	2.9E+01	7.2E-03	0	0	1.1E+01	10	29	12	Y	Y	Y			--	
Acenaphthylene	86	86	40	47	1.9E-03	1.9E-01	2.0E-03	7.2E+00	SB-11	LSP0275	2.9E+01	6.6E-03	0	0	2.5E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Anthracene	86	86	52	60	1.9E-03	1.9E-01	2.2E-03	1.2E+02	TP-06	LSP0045	5.9E+02	3.2E-04	0	0	2.0E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Fluorene	86	86	43	50	1.9E-03	1.9E-01	1.8E-03	2.4E+02	TP-06	LSP0045	2.8E+01	6.8E-03	0	0	8.6E+00	8	19	9	Y	Y	Y			--	
Naphthalene	86	86	50	58	1.9E-03	2.4E-01	2.0E-03	5.2E+02	TP-06	LSP0045	4.0E+00	6.0E-02	0	0	1.3E+02	12	24	14	Y	Y	Y			--	
Phenanthrene	86	86	60	70	1.9E-03	1.9E-01	2.9E-03	7.2E+02	TP-06	LSP0045	5.9E+02	3.2E-04	0	0	1.2E+00	1	2	1	Y	Y	Y			--	
2-Methylnaphthalene	86	86	44	51	1.9E-03	3.7E-01	4.3E-03	2.8E+02	TP-06	LSP0045	4.0E+00	9.3E-02	0	0	7.0E+01	12	27	14	Y	Y	Y			--	
Benzo(a)anthracene	86	86	51	59	1.9E-03	1.9E-01	3.3E-03	1.1E+02	SB-11	LSP0275	8.0E-02	2.4E+00	5	14	1.4E+03	41	80	53	Y	Y	N	purposes only. BaPE used for screening.		--	
Benzo(a)pyrene	86	86	55	64	1.9E-03	3.8E-01	2.6E-03	3.4E+02	SB-11	LSP0275	1.4E-01	2.7E+00	4	13	2.4E+03	39	71	50	Y	Y	N	Provided for informational purposes only.		--	

Table F-1. Preliminary Indicator Hazardous Substances for Soil Site Wide

Analyte	No. of Samples Analyzed (a)	No. of Data Points (b)	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If not Detected, Does Max. DL Exceed SL?	Comment (info. on chemical uses from HSDB
Benzo(b)fluoranthene	86	86	57	66	1.9E-03	1.9E-01	3.0E-03	3.3E+02	SB-11	LSP0275	1.4E-01	1.4E+00	2	7	2.4E+03	39	68	48	Y	Y	N	Provided for informational purposes only.		--	
Benzo(j)fluoranthene	39	39	13	33	1.9E-02	2.6E-02	3.4E-03	1.1E+01	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
Benzo(k)fluoranthene	86	86	53	62	1.9E-03	1.9E-01	3.4E-03	2.3E+02	SB-11	LSP0275	1.4E-01	1.4E+00	2	6	1.6E+03	38	72	47	Y	Y	N	Provided for informational purposes only.		--	
Chrysene	86	86	58	67	1.9E-03	1.9E-01	2.3E-03	3.6E+02	SB-11	LSP0275	1.4E-01	1.4E+00	2	7	2.6E+03	40	69	49	Y	Y	N	Provided for informational purposes only.		--	
Dibenzo(a,h)anthracene	86	86	38	44	1.9E-03	3.8E-01	2.3E-02	1.0E+02	SB-11	LSP0275	8.0E-02	4.8E+00	5	10	1.3E+03	34	89	45	Y	Y	N	Provided for informational purposes only.		--	
Fluoranthene	86	86	62	72	1.9E-03	1.6E-01	3.7E-03	4.2E+02	TP-06	LSP0045	2.1E+02	7.4E-04	0	0	2.0E+00	1	2	1	Y	Y	Y			--	
Indeno(1,2,3-cd)pyrene	86	86	55	64	1.9E-03	3.8E-01	4.0E-03	2.3E+02	SB-11	LSP0275	1.4E-01	2.7E+00	2	6	1.6E+03	40	73	49	Y	Y	N	Provided for informational purposes only.		--	
Pyrene	86	86	59	69	1.9E-03	1.9E-01	1.8E-03	3.0E+02	TP-06	LSP0045	2.1E+02	9.1E-04	0	0	1.4E+00	1	2	1	Y	Y	Y			--	
Benzo(g,h,i)perylene	86	86	54	63	1.9E-03	1.9E-01	4.8E-03	2.3E+02	SB-11	LSP0275	2.1E+02	9.1E-04	0	0	1.1E+00	1	2	1	Y	Y	Y			--	
Dibenzo(a,h)acridine	37	37	0	0	1.9E-03	3.7E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzo(a,j)acridine	37	37	1	3	1.9E-03	3.7E-02	3.6E-02	3.6E-02	SP05	99070654	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
Dibenzo(a,e)pyrene	39	39	7	18	1.9E-03	2.6E-03	6.4E-02	2.6E+00	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
Dibenzo(a,h)pyrene	39	39	7	18	1.9E-03	2.6E-03	7.3E-03	1.4E+00	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
Dibenzo(a,i)pyrene	39	39	7	18	1.9E-03	2.6E-03	2.9E-02	4.7E-01	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
Dibenzo(a,l)pyrene	38	38	4	11	1.9E-03	3.7E-02	3.9E-03	1.0E-01	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
7,12-Dimethylbenz(a)anthracene	77	77	5	6	1.9E-03	8.8E-01	1.6E-02	3.4E+00	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
BaPE (ND = 1/2 DL)	86	86	62	72	1.9E-03	3.8E-01	1.6E-03	4.4E+02	SB-11	LSP0275	1.4E-01	2.7E+00	2	8	3.2E+03	43	69	52	Y	Y	Y			--	
Pesticides, mg/kg																									
Aldrin	12	12	0	0	4.3E-05	4.4E-05	--	--	--	--	2.0E-02	2.2E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
alpha-BHC	12	12	0	0	5.0E-05	5.1E-05	--	--	--	--	3.0E-05	1.7E+00	12	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Insecticide component
beta-BHC	12	12	0	0	8.9E-05	9.1E-05	--	--	--	--	1.0E-04	9.1E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
gamma-BHC (Lindane)	12	12	0	0	8.8E-05	9.0E-05	--	--	--	--	5.0E-04	1.8E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
delta-BHC	12	12	0	0	2.1E-05	2.1E-05	--	--	--	--	1.0E-04	2.1E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
alpha-Chlordane	12	12	0	0	5.7E-05	5.8E-05	--	--	--	--	5.0E-01	1.2E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
gamma-Chlordane	12	12	0	0	1.2E-04	1.2E-04	--	--	--	--	5.0E-01	2.4E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4,4'-DDD	12	12	0	0	9.3E-05	9.5E-05	--	--	--	--	8.0E-01	1.2E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4,4'-DDE	12	12	0	0	1.2E-04	1.2E-04	--	--	--	--	2.9E+00	4.1E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4,4'-DDT	12	12	1	8	2.0E-04	2.0E-04	3.2E-03	3.2E-03	HA-01	LSP0569	2.0E+00	1.0E-04	0	0	1.6E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Dieldrin	12	12	0	0	8.3E-05	8.5E-05	--	--	--	--	2.0E-04	4.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Endosulfan I	12	12	0	0	6.2E-05	6.3E-05	--	--	--	--	9.0E-01	7.0E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Endosulfan II	12	12	0	0	1.2E-04	1.2E-04	--	--	--	--	9.0E-01	1.3E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Endosulfan Sulfate	12	12	0	0	1.5E-04	1.5E-04	--	--	--	--	9.0E-01	1.7E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Endrin	12	12	0	0	8.0E-05	8.2E-05	--	--	--	--	5.0E-02	1.6E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Endrin Aldehyde	12	12	0	0	1.8E-04	1.8E-04	--	--	--	--	5.0E-02	3.6E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Endrin Ketone	12	12	0	0	1.8E-04	1.9E-04	--	--	--	--	5.0E-02	3.8E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Heptachlor	12	12	0	0	7.2E-05	7.3E-05	--	--	--	--	2.2E-01	3.3E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Heptachlor Epoxide	12	12	0	0	5.3E-05	5.4E-05	--	--	--	--	1.1E-01	4.9E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Methoxychlor	12	12	0	0	1.1E-03	1.1E-03	--	--	--	--	8.0E+00	1.4E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Toxaphene	12	12	0	0	4.7E-02	1.0E-01	--	--	--	--	9.1E-01	1.1E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Aroclors, mg/kg																									
Aroclor 1016	14	14	0	0	1.9E-03	3.3E-02	--	--	--	--	5.6E+00	5.9E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Aroclor 1221	14	14	0	0	1.9E-03	3.3E-02	--	--	--	--	1.6E+00	2.1E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Aroclor 1232	14	14	0	0	1.9E-03	3.3E-02	--	--	--	--	1.6E+00	2.1E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Aroclor 1242	14	14	0	0	1.9E-03	3.3E-02	--	--	--	--	1.6E+00	2.1E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Aroclor 1248	14	14	0	0	1.9E-03	3.3E-02	--	--	--	--	1.6E+00	2.1E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Aroclor 1254	14	14	0	0	1.9E-03	3.3E-02	--	--	--	--	1.6E+00	2.1E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Aroclor 1260	14	14	0	0	1.9E-03	3.3E-02	--	--	--	--	1.6E+00	2.1E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Petroleum, mg/kg																									
Gasoline Range Hydrocarbons	19	19	3	16	4.0E-03	1.1E-02	1.1E+02	1.6E+03	TP-06	LSP0045	3.0E+01	3.7E-04	0	0	5.3E+01	3	100	16	Y	Y	Y			--	
Diesel Range Hydrocarbons	142	142	94	66	4.0E-01	2.6E+00	6.5E+00	8.4E+03	TP-06	LSP0045	2.0E+03	1.3E-03	0	0	4.2E+00	4	4	3	Y	Y	Y			--	
Motor Oil	140	140	101	72	1.1E+01	2.5E+02	1.2E+01	2.9E+03	SB-11	LSP0275	2.0E+03	1.3E-01	0	0	1.5E+00	2	2	1	Y	Y	Y			--	
TPH	67	67	66	99	2.0E+00	2.0E+00	2.2E+01	2.1E+03	SP-FS50	SP-FS50	2.0E+03	1.0E-03	0	0	1.1E+00	3	5	4	Y	Y	Y			--	
C5-C6 Aliphatics	30	30	0	0	5.0E+00	5.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C6-C8 Aliphatics	30	30	0	0	5.0E+00	5.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C8-C10 Aliphatics	34	34	0	0	2.4E+00	1.4E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C10-C12 Aliphatics	43	43	1	2	2.4E+00	1.4E+01	9.4E+00	9.4E+00	SB-09	LSP0177	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C12-C16 Aliphatics	44	44	9	20	5.2E+00	6.8E+00	2.6E+00	3.0E+02	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C16-C18 Aliphatics	39	39	4	10	5.2E+00	6.8E+00	7.1E+00	2.5E+02	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C16-C21 Aliphatics	5	5	5	100	NA	NA	1.5E+01	2.0E+02	TP-06	LSP0045	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C18-C21 Aliphatics	39	39	5	13	5.2E+00	6.8E+00	6.7E+00	2.2E+02	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C21-C28 Aliphatics	39	39	7	18	5.2E+00	6.8E+00	1.0E+01	2.4E+02	SP07	99070656	--	--	--	--	--	--	--	--	Y	--	--	No SL	Aliphatic and aromatic ranges were provided for informational purposes only. Screening was performed on GRO, DRO, MO, and TPH. Aliphatic and aromatic ranges will be useful in calculating site-specific cleanup levels.	--	
C21-C34 Aliphatics	5	5	5	100	NA	NA	1.4E+01	1.7E+02	SB-11	LSP0275	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C28-C36 Aliphatics	39	39	7	18	5.2E+00	6.8E+00	6.5E+00	2.1E+02	SP07	99070656	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C8-C10 Aromatics	35	35	2	6	2.4E+00	6.6E+01	4.9E+00	3.0E+01	TP-06	LSP0045	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C10-C12 Aromatics	43	43	3	7	2.4E+00	6.4E+00	1.3E+01	8.0E+02	TP-06	LSP0045	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C12-C13 Aromatics	30	30	1	3	5.0E+00	5.0E+00	7.4E+01	7.4E+01	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C12-C16 Aromatics	43	43	5	12	2.4E+00	6.8E+00	6.5E+00	2.0E+03	TP-06	LSP0045	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C16-C18 Aromatics	39	39	1	3	5.2E+00	6.8E+00	5.1E+02	5.1E+02	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C16-C21 Aromatics	5	5	5	100	NA	NA	2.9E+01	5.1E+03	TP-06	LSP0045	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C18-C21 Aromatics	39	39	4	10	5.2E+00	6.8E+00	9.6E+00	2.5E+03	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C21-C28 Aromatics	39	39	6	15	5.2E+00	6.8E+00	7.9E+00	7.0E+02	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C21-C34 Aromatics	5	5	5	100	NA	NA	2.0E+02	4.9E+03	SB-11	LSP0275	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C28-C36 Aromatics	39	39	8	21	5.2E+00	6.8E+00	5.9E+00	4.5E+02	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Dioxins_Furans, mg/kg																									
2,3,7,8-TCDD	41	41	8	20	1.5E-07	4.3E-05	6.7E-07	3.6E-05	TP-16	LSP0088	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total TCDD	41	41	23	56	1.5E-07	4.3E-05	5.5E-06	2.1E-04	SB-18	LSP0250	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8-PeCDD	41	41	16	39	3.5E-07	5.4E-06	1.0E-06	1.4E-04	SP07	99070656	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total PeCDD	41	41	23	56	3.5E-07	1.5E-05	3.6E-06	5.3E-04	SB-18	LSP0250	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,7,8-HxCDD	41	41	20	49	3.4E-07	5.0E-05	1.4E-06	4.2E-04	SP07	99070656	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,6,7,8-HxCDD	41	41	27	66	4.5E-07	2.7E-05	7.3E-07	2.9E-03	SP07	99070656	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8,9-HxCDD	41	41	24	59	2.7E-07	3.0E-05	2.4E-06	7.5E-04	SP07	99070656	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HxCDD	41	41	30	73	4.5E-07	2.4E-06	2.4E-06	1.3E-02	SP07	99070656	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,6,7,8-HpCDD	41	41	32	78	6.1E-07	2.3E-05	4.3E-06	7.8E-02	SP07	99070656	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HpCDD	41	41	34	83	6.1E-07	9.6E-07	4.3E-06	1.7E-01	TP-16	LSP0088	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
OCDD	41	41	32	78	4.1E-06	7.1E-05	1.2E-04	7.9E-01	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
2,3,7,8-TCDF	41	41	21	51	2.5E-07	1.3E-04	2.7E-07	3.8E-05	SB-20	LSP0271	--	--	--	--	--	--	--	--	Y	--	--	No SL	Individual congeners were provided for informational purposes only. Screening was performed on TEQs calculated using 2005 TEFs.	--	
Total TCDF	41	41	20	49	2.4E-07	1.3E-04	1.2E-06	1.4E-04	SB-18	LSP0250	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8-PeCDF	41	41	7	17	2.2E-07	5.4E-05	1.3E-06	1.8E-04	SB-20	LSP0271	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
2,3,4,7,8-PeCDF	41	41	13	32	2.3E-07	2.4E-06	9.3E-07	2.1E-04	SB-20	LSP0271	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total PeCDF	41	41	25	61	2.3E-07	5.4E-05	4.5E-06	3.0E-03	SP07	99070656	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,7,8-HxCDF	41	41	9	22	4.5E-07	3.1E-03	1.6E-05	1.4E-03	SB-20	LSP0271	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,6,7,8-HxCDF	41	41	6	15	2.0E-07	7.3E-05	7.9E-06	3.0E-04	SB-20	LSP0271	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8,9-HxCDF	41	41	5	12	2.9E-07	1.2E-04	5.3E-06	3.6E-05	SB-20	LSP0271	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
2,3,4,6,7,8-HxCDF	41	41	10	24	2.3E-07	8.5E-05	5.2E-06	2.2E-04	SB-20	LSP0271	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HxCDF	41	41	30	73	3.4E-07	1.4E-05	4.8E-06	1.6E-02	SB-20	LSP0271	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	

Table F-1. Preliminary Indicator Hazardous Substances for Soil Site Wide

Analyte	No. of Samples Analyzed (a)	No. of Data Points (b)	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If not Detected, Does Max. DL Exceed SL?	Comment (info. on chemical uses from HSDB
1,2,3,4,6,7,8-HpCDF	41	41	30	73	5.6E-07	5.5E-06	1.2E-05	1.7E-02	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,7,8,9-HpCDF	41	41	15	37	7.9E-07	1.5E-04	2.4E-05	6.3E-04	SB-20	LSP0271	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HpCDF	41	41	30	73	5.6E-07	5.5E-06	1.2E-05	6.9E-02	TP-16	LSP0088	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
OCDF	41	41	33	80	6.4E-07	6.4E-06	6.9E-06	1.5E-01	SP02	99070651	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
																						purposes only.			
TEQDF 0.5M98	41	41	34	83	4.1E-06	1.9E-05	9.0E-07	1.7E-03	SP07	99070656	6.7E-06	2.8E+00	6	86	2.6E+02	24	71	73	Y	Y	N	TEQs using 2005 TEFs were		--	
TEQDF 0.5M05	41	41	34	83	4.1E-06	1.9E-05	8.5E-07	1.9E-03	SP07	99070656	6.7E-06	2.8E+00	6	86	2.8E+02	24	71	73	Y	Y	Y			--	

Notes: (a) Field duplicate and replicate samples are excluded from counts. Their results have been avearged with corresponding normal sample results.
(b) Number of Data Points might be different from the Number of Samples Analyzed for metals if they were analyzed by more than one method.
BaPE = Benzo(a)pyrene toxicity equivalents
DL = Detection limit
DRO = Diesel range organics
GRO = Gasoline range organics
HSDB = Hazardous substance databank
IHS = Indicator hazardous substance
MO = Motor oil
NA = Not applicable
SL = Screening level
TEF = Toxicity equivalency factor
TEQ = 2,3,7,8-TCDD toxicity equivalents
TPH = Total petroleum hydrocarbons
-- = Not available

Table F-2. Preliminary Indicator Hazardous Substances for Sediment Site Wide

Analyte	No. of Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If Not Detected, Does Max. DL Exceed SL?	Comment (information on chemical uses from HSDB)
Metals, mg/kg																									
Aluminum	18	18	18	100	NA	NA	8.0E+03	1.6E+04	SD11	99070530	7.6E+04	0.0E+00	0	--	2.0E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Antimony	18	18	6	33	5.9E-01	1.4E+01	4.0E+00	8.3E+00	OS06	95352505	3.0E-01	4.7E+01	12	100	2.8E+01	6	100	100	Y	Y	N	Not above background		--	
Arsenic	48	48	36	75	9.0E-01	2.0E+01	2.2E+00	3.1E+01	OS06	95352505	6.7E-01	3.0E+01	12	100	4.6E+01	36	100	100	Y	Y	Y			--	
Barium	18	18	18	100	NA	NA	3.4E+01	1.6E+02	SD06	99070525	8.2E+01	0.0E+00	0	--	2.0E+00	9	50	50	Y	Y	N	Not above background		--	
Beryllium	18	18	7	39	4.6E-01	6.0E+00	2.0E-01	2.7E-01	OS05; OS06	95352504; 95352505	3.0E+00	2.0E+00	1	9	9.0E-02	0	0	6	Y	--	--	Doesn't exceed SL		--	
Cadmium	45	56	42	75	5.0E-02	4.5E+00	2.1E-01	2.5E+00	SB-37	LSP0552	4.0E-01	1.1E+01	2	14	6.3E+00	28	67	54	Y	Y	N	Not above background		--	
Calcium	18	18	18	100	NA	NA	4.0E+03	3.3E+04	OS06	95352505	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Chromium	45	45	45	100	NA	NA	1.4E+01	2.5E+02	OS01	95352500	2.0E+00	0.0E+00	0	--	1.2E+02	45	100	100	Y	Y	Y			--	
Cobalt	18	18	18	100	NA	NA	5.3E+00	1.2E+02	OS07	95352506	9.0E+02	0.0E+00	0	--	1.3E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Copper	47	58	58	100	NA	NA	4.4E+00	3.3E+02	SB-19	LSP0263	3.0E+03	0.0E+00	0	--	1.1E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Iron	18	18	18	100	NA	NA	1.3E+04	2.5E+04	OS05	95352504	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Lead	47	58	57	98	2.0E-01	2.0E-01	3.0E+00	3.3E+02	SB-02	LSP0132	2.5E+02	8.0E-04	0	0	1.3E+00	3	5	5	Y	Y	Y			--	
Magnesium	18	18	18	100	NA	NA	4.1E+03	7.7E+03	SD11	99070530	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Manganese	18	18	18	100	NA	NA	2.4E+02	9.3E+02	SD10	99070529	1.1E+04	0.0E+00	0	--	8.5E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Mercury	48	59	33	56	3.0E-03	3.5E-01	4.0E-03	4.0E-01	SB-37	LSP0552	2.4E+01	1.5E-02	0	0	1.7E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Nickel	45	56	56	100	NA	NA	3.2E+00	1.4E+02	OS01	95352500	7.0E+00	0.0E+00	0	--	2.0E+01	50	89	89	Y	Y	N	Not above background in sediment		--	
Potassium	18	18	18	100	NA	NA	4.9E+02	1.7E+03	SD11	99070530	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Selenium	18	18	0	0	2.0E-01	1.4E+01	--	--	--	--	3.0E-01	4.7E+01	11	61	0.0E+00	0	--	61	--	--	--	Not detected		Y	Not above background
Silver	45	45	1	2	5.0E-02	2.3E+00	3.0E+01	3.0E+01	SD04	99070523	2.0E+00	1.2E+00	1	2	1.5E+01	1	100	4	Y	Y	Y			--	
Sodium	18	18	7	39	1.2E+02	4.8E+03	1.6E+02	4.8E+02	OS01	95352500	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Thallium	18	18	0	0	2.5E-01	4.5E+00	--	--	--	--	5.6E+00	8.0E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Vanadium	18	18	18	100	NA	NA	2.9E+01	6.1E+01	SD11	99070530	3.0E-02	0.0E+00	0	--	2.0E+03	18	100	100	Y	Y	N	Not above background		--	
Zinc	48	59	59	100	NA	NA	2.1E+01	4.5E+02	SD06	99070525	6.2E+02	0.0E+00	0	--	7.2E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
SVOCs, mg/kg																									
Aniline	25	25	1	4	2.0E-02	2.3E-01	1.2E-01	1.2E-01	SB-02	LSP0127	1.8E+02	1.3E-03	0	0	6.7E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,4-Benzenediamine	1	1	0	0	2.3E+00	2.3E+00	--	--	--	--	1.5E+04	1.5E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Benzidine	24	24	0	0	3.4E-01	1.1E+01	--	--	--	--	4.3E-03	2.6E+03	24	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Formerly used in manufacture of azo dyes, as reagent for detection of blood, and as rubber compounding agent
Benzoic Acid	41	41	18	44	2.2E-02	2.0E+00	8.1E-02	8.2E+00	LSC-05	3394044	2.0E+01	1.0E-01	0	0	4.1E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Benzyl Alcohol	41	41	10	24	1.1E-02	3.4E-01	2.6E-02	1.3E+01	SD06	99070525	2.4E+04	1.4E-05	0	0	5.4E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
Bis(2-chloroethoxy) Methane	41	41	0	0	1.0E-02	2.8E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Bis-(2-chloroethyl) Ether	41	41	0	0	1.0E-02	2.7E-01	--	--	--	--	2.0E-05	1.4E+04	41	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Can be formed during water chlorination; formerly used in textile industry and as solvent in resins
Bis(2-chloroisopropyl)ether	18	18	0	0	1.1E-02	2.3E-01	--	--	--	--	3.2E+03	7.1E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bis(2-chloro-1-methylethyl) Ether	23	23	0	0	1.2E-02	4.1E-01	--	--	--	--	1.4E+01	2.9E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bis(2-ethylhexyl)phthalate	41	41	20	49	2.2E-02	9.7E-01	5.3E-02	1.7E+00	OS04	95352503	7.1E+01	1.4E-02	0	0	2.4E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
4-Bromophenyl-phenylether	41	41	0	0	1.0E-02	2.9E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--			--	
Butylbenzylphthalate	41	41	21	51	1.1E-02	2.3E-01	2.2E-03	1.0E+00	SB-34	LSP0555	8.1E+02	2.8E-04	0	0	1.2E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Caffeine	6	6	0	0	2.0E-02	2.0E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Carbazole	31	31	22	71	2.2E-02	3.9E-01	1.1E-02	4.8E+00	LSC-03	3394042	3.0E-02	1.3E+01	7	78	1.6E+02	21	95	90	Y	Y	Y			--	
4-Chloroaniline	41	41	0	0	1.1E-02	2.3E+00	--	--	--	--	3.0E-02	7.7E+01	27	66	0.0E+00	0	--	66	--	--	--	Not detected		Y	Used in synthesis of dyes, pharmaceuticals, and agricultural chemicals; degradation product of certain pesticides, a hospital disinfectant, and contact lens disinfectant
4-Chloro-3-methylphenol	41	41	0	0	9.9E-03	8.3E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
2-Chloronaphthalene	41	41	0	0	4.3E-03	2.3E-01	--	--	--	--	4.9E+03	4.6E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Chlorophenol	41	41	0	0	1.0E-02	2.3E-01	--	--	--	--	2.0E-01	1.1E+00	4	10	0.0E+00	0	--	10	--	--	--	Not detected		Y	Can be formed during water chlorination
4-Chlorophenyl-phenylether	41	41	0	0	1.0E-02	2.7E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
3B-Coprostanol	6	6	2	33	2.4E-01	2.0E+00	6.4E-01	2.8E+00	LSC-03	3394042	--	--	--	--	--	--	--	--	Y	--	--	No SL	Fecal indicator chemical	--	
Creosote	2	2	2	100	NA	NA	5.2E+03	1.1E+04	SB-19	LSP0254	--	--	--	--	--	--	--	--	Y	--	--	No SL	PAHs evaluated instead	--	
7H-Dibenzo(c,g)carbazole	11	11	1	9	2.2E-03	1.0E-02	1.3E-02	1.3E-02	SD02	99070521	--	--	--	--	--	--	--	--	Y	--	--	No SL	Evaluation of other PAHs should be sufficiently protective.	--	
Dibenzofuran	41	41	25	61	1.1E-02	1.9E-01	1.6E-03	3.3E+01	LSC Bank	LSP0051	1.6E+02	1.2E-03	0	0	2.1E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,2-Dichlorobenzene	41	41	0	0	1.0E-02	2.6E-01	--	--	--	--	9.0E-01	2.9E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,3-Dichlorobenzene	41	41	0	0	1.0E-02	2.3E-01	--	--	--	--	5.3E+02	4.3E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,4-Dichlorobenzene	41	41	0	0	1.0E-02	2.3E-01	--	--	--	--	1.0E-01	2.3E+00	15	37	0.0E+00	0	--	37	--	--	--	Not detected		Y	Used as insecticide, space deodorant, and chemical intermediate
3,3'-Dichlorobenzidine	35	35	0	0	1.1E-02	1.1E+00	--	--	--	--	3.0E-04	3.7E+03	35	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Intermediate in manufacture of dyes and pigments
2,4-Dichlorophenol	41	41	0	0	8.1E-03	1.0E+00	--	--	--	--	5.0E-02	2.0E+01	12	29	0.0E+00	0	--	29	--	--	--	Not detected		Y	Manufacturing intermediate; can form in waste streams containing both phenol and chlorine; may be contaminant of 2,4-D
Diethylphthalate	41	41	1	2	1.0E-02	2.4E-01	8.3E-03	8.3E-03	SD09	99070528	6.4E+04	3.8E-06	0	0	1.3E-07	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,4-Dimethylphenol	41	41	9	22	1.1E-02	2.3E-01	1.2E-02	2.2E-01	OS04	95352503	4.0E-01	5.6E-01	0	0	5.5E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Dimethylphthalate	41	41	27	66	2.5E-02	2.1E-01	2.0E-03	2.7E+00	SB-19	LSP0263	8.0E+04	2.6E-06	0	0	3.4E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
di-n-Butylphthalate	41	41	8	20	1.0E-02	2.3E-01	4.8E-02	7.1E-01	SB-34	LSP0555	2.7E+02	8.4E-04	0	0	2.6E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
4,6-Dinitro-2-methylphenol	41	41	0	0	1.1E-02	2.5E+00	--	--	--	--	6.1E+00	4.1E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4-Dinitrophenol	41	41	0	0	1.1E-02	9.0E+00	--	--	--	--	1.0E-02	9.0E+02	41	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Manufacturing intermediate
2,4-Dinitrotoluene	41	41	0	0	1.0E-02	1.0E+00	--	--	--	--	4.0E-05	2.5E+04	41	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Selected as preliminary IHS in soil
2,6-Dinitrotoluene	41	41	0	0	1.1E-02	2.3E+00	--	--	--	--	3.0E-05	7.7E+04	41	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Selected as preliminary IHS in soil
di-n-Octylphthalate	41	41	1	2	1.0E-02	2.3E-01	1.2E-02	1.2E-02	SB-10	LSP0181	1.6E+03	1.4E-04	0	0	7.5E-06	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,2-Diphenylhydrazine	30	30	0	0	2.0E-02	4.6E-01	--	--	--	--	1.3E+00	3.5E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Hexachlorobenzene	41	41	1	2	1.0E-02	2.4E-01	7.6E-02	7.6E-02	LSC-06	3394045	1.0E-01	2.4E+00	15	38	7.6E-01	0	0	37	Y	--	--	Doesn't exceed SL		--	
Hexachlorobutadiene	40	40	0	0	1.1E-02	2.3E-01	--	--	--	--	1.0E-01	2.3E+00	15	38	0.0E+00	0	--	38	--	--	--	Not detected		Y	Used as solvent for elastomers, heat transfer liquid, transformer and hydraulic fluid; released during refuse combustion; found in fly ash
Hexachlorocyclopentadiene	40	40	0	0	1.1E-02	1.1E+00	--	--	--	--	2.0E+01	5.7E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Hexachloroethane	41	41	1	2	1.1E-02	2.3E-01	7.3E-03	7.3E-03	LSC-06	3394045	2.0E-02	1.1E+01	28	70	3.7E-01	0	0	68	Y	--	--	Doesn't exceed SL		--	
Isophorone	41	41	0	0	1.0E-02	2.5E-01	--	--	--	--	3.0E-02	8.3E+00	24	59	0.0E+00	0	--	59	--	--	--	Not detected		Y	Solvent for inks, lacquers, and adhesives; chemical intermediate
1-Methylnaphthalene	23	23	12	52	2.0E-02	2.0E-01	2.5E-02	1.1E+01	LSC Bank	LSP0051	4.0E+00	5.0E-02	0	0	2.8E+00	2	17	9	Y	Y	Y			--	
2-Methylphenol	41	41	9	22	1.1E-02	2.3E-01	6.4E-03	1.0E+00	SD06	99070525	8.0E-01	2.8E-01	0	0	1.3E+00	1	11	2	Y	Y	Y			--	
3&4-Methylphenol	11	11	6	55	1.1E-02	5.0E-02	3.0E-03	1.7E+00	SD06	99070525	4.0E+03	1.3E-05	0	0	4.3E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
4-Methylphenol	30	30	14	47	2.0E-02	2.0E-01	2.4E-02	1.0E+00	SB-37	LSP0552	4.0E+02	5.0E-04	0	0	2.5E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
2-Nitroaniline	41	41	0	0	1.1E-02	1.2E+00	--	--	--	--	1.8E+02	6.6E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
3-Nitroaniline	41	41	0	0	1.1E-02	1.2E+00	--	--	--	--	1.8E+01	6.6E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Nitroaniline	41	41	0	0	1.1E-02	2.3E+00	--	--	--	--	3.0E-02	7.7E+01	29	71	0.0E+00	0	--	71	--	--	--	Not detected		Y	Chemical intermediate; emitted in stack effluents from hazardous waste incineration
Nitrobenzene	41	41	0	0	1.0E-02	2.4E-01	--	--	--	--	7.0E-03	3.4E+01	41	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Used in manufacture of chemicals, soaps, shoe polishes; used as solvent
2-Nitrophenol	41	41	0	0	8.6E-03	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
4-Nitrophenol	41	41	0	0	1.1E-02	2.3E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1-Nitropyrene	1	1	0	0	1.2E-02	1.2E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	

Table F-2. Preliminary Indicator Hazardous Substances for Sediment Site Wide

Analyte	No. of Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If Not Detected, Does Max. DL Exceed SL?	Comment (information on chemical uses from HSDB)
n-Nitrosodimethylamine	30	30	0	0	4.7E-02	1.1E+00	--	--	--	--	2.0E-02	5.5E+01	30	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Found in cigarette smoke; emitted during plastic manufacturing; used in production of rocket fuels; additive for lubicants
N-nitrosodiphenylamine	41	41	2	5	1.0E-02	2.8E+00	1.7E-01	2.0E-01	OS03	95352502	6.0E-02	4.7E+01	17	44	3.3E+00	2	100	46	Y	Y	Y			--	
n-Nitroso-di-n-propylamine	41	41	0	0	1.0E-02	1.0E+00	--	--	--	--	2.0E-06	5.0E+05	41	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Found in cigarette smoke; contaminant in herbicides
Pentachlorophenol	41	41	36	88	5.0E-02	9.3E-01	3.7E-03	7.9E+00	SB-36	LSP0548	1.0E-03	9.3E+02	5	100	7.9E+03	36	100	100	Y	Y	Y			--	
Phenol	41	41	17	41	1.1E-02	2.8E-01	1.6E-02	2.1E+00	LSC-05	3394044	5.0E+00	5.6E-02	0	0	4.2E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Pyridine	30	30	0	0	4.2E-02	2.3E+00	--	--	--	--	8.0E+01	2.9E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Retene	23	23	7	30	2.4E-02	2.3E+00	5.6E-02	1.8E+01	SB-19	LSP0253	--	--	--	--	--	--	--	--	Y	--	--	No SL	Evaluation of other PAHs should be sufficiently protective	--	
2,3,4,5-Tetrachlorophenol	17	17	2	12	9.9E-02	2.3E+00	1.1E-01	1.1E-01	SB-02; SB-02	SP0127; LSP0132	2.4E+03	9.6E-04	0	0	4.6E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,3,4,6-Tetrachlorophenol	17	17	2	12	9.9E-02	2.3E+00	1.5E-01	1.8E-01	SB-02	LSP0132	2.4E+03	9.6E-04	0	0	7.3E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,3,5,6-Tetrachlorophenol	17	17	2	12	9.9E-02	2.3E+00	2.0E-01	2.3E-01	SB-02	LSP0132	2.4E+03	9.6E-04	0	0	9.4E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
Tetrachlorophenols	11	11	7	64	1.1E-02	5.0E-02	4.6E-03	2.0E+00	SD06	99070525	2.4E+03	2.1E-05	0	0	8.5E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,2,3-Trichlorobenzene	1	1	0	0	4.6E-01	4.6E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1,2,4-Trichlorobenzene	41	41	0	0	1.0E-02	2.3E-01	--	--	--	--	3.0E-01	7.5E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4,5-Trichlorophenol	41	41	0	0	5.8E-03	1.0E+00	--	--	--	--	1.4E+01	7.1E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4,6-Trichlorophenol	41	41	1	2	8.6E-03	1.0E+00	7.4E-01	7.4E-01	SD06	99070525	8.0E-03	1.3E+02	40	100	9.3E+01	1	100	100	Y	Y	Y			--	
PAHs, mg/kg																									
Acenaphthene	41	41	29	71	2.2E-03	1.9E-01	3.5E-03	1.3E+02	LSC Bank	LSP0051	2.9E+01	6.4E-03	0	0	4.5E+00	1	3	2	Y	Y	Y			--	
Acenaphthylene	41	41	29	71	2.2E-03	2.1E-01	4.4E-03	1.8E+00	SB-38	LSP0561	2.9E+01	7.2E-03	0	0	6.2E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Anthracene	41	41	36	88	2.2E-03	1.9E-01	1.2E-02	8.8E+01	LSC Bank	LSP0051	5.9E+02	3.1E-04	0	0	1.5E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Fluorene	41	41	31	76	2.2E-03	1.9E-01	6.3E-03	1.0E+02	LSC Bank	LSP0051	2.8E+01	6.6E-03	0	0	3.6E+00	1	3	2	Y	Y	Y			--	
Naphthalene	41	41	30	73	2.2E-03	1.9E-01	3.5E-03	4.3E+00	LSC Bank	LSP0051	4.0E+00	4.6E-02	0	0	1.1E+00	1	3	2	Y	Y	Y			--	
Phenanthrene	41	41	40	98	1.9E-01	1.9E-01	2.4E-03	3.2E+02	LSC Bank	LSP0051	5.9E+02	3.1E-04	0	0	5.4E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
2-Methylnaphthalene	41	41	26	63	2.2E-03	1.9E-01	2.1E-03	8.7E+00	LSC Bank	LSP0051	4.0E+00	4.8E-02	0	0	2.2E+00	1	4	2	Y	Y	Y			--	
Benzo(a)anthracene	41	41	37	90	1.0E-02	1.9E-01	3.0E-03	7.4E+01	LSC Bank	LSP0051	8.0E-02	2.3E+00	3	75	9.3E+02	32	86	85	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Benzo(a)pyrene	41	41	38	93	1.0E-02	1.9E-01	4.1E-03	6.3E+01	SB-38	LSP0561	1.4E-01	1.3E+00	1	33	4.5E+02	32	84	80	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Benzo(b)fluoranthene	41	41	38	93	1.0E-02	2.0E-01	4.4E-03	6.6E+01	SB-38	LSP0561	1.4E-01	1.4E+00	2	67	4.7E+02	31	82	80	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Benzo(j)fluoranthene	11	11	10	91	1.0E-01	1.0E-01	4.4E-03	1.1E+00	SD10	99070529	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Benzo(k)fluoranthene	41	41	38	93	1.0E-02	2.0E-01	4.4E-03	3.1E+01	LSC Bank	LSP0051	1.4E-01	1.4E+00	2	67	2.2E+02	32	84	83	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Chrysene	41	41	38	93	1.0E-02	1.9E-01	9.8E-03	9.5E+01	LSC Bank	LSP0051	1.4E-01	1.3E+00	1	33	6.8E+02	34	89	85	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Dibenzo(a,h)anthracene	41	41	31	76	2.2E-03	2.0E-01	8.7E-03	8.3E+00	SB-38	LSP0561	8.0E-02	2.5E+00	5	50	1.0E+02	25	81	73	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Fluoranthene	41	41	40	98	1.9E-01	1.9E-01	1.4E-02	3.4E+02	LSC Bank	LSP0051	2.1E+02	8.8E-04	0	0	1.6E+00	1	3	2	Y	Y	Y			--	
Indeno(1,2,3-cd)pyrene	41	41	37	90	2.4E-03	2.0E-01	2.2E-03	4.5E+01	SB-38	LSP0561	1.4E-01	1.4E+00	2	50	3.2E+02	31	84	80	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Pyrene	41	41	40	98	1.9E-01	1.9E-01	1.1E-02	2.2E+02	LSC Bank	LSP0051	2.1E+02	8.8E-04	0	0	1.0E+00	1	3	2	Y	Y	Y			--	
Benzo(g,h,i)perylene	41	41	37	90	2.4E-03	2.0E-01	3.0E-03	1.3E+01	SB-38	LSP0561	2.1E+02	9.3E-04	0	0	6.2E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Dibenzo(a,h)acridine	11	11	0	0	2.2E-03	1.4E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzo(a,j)acridine	11	11	0	0	2.2E-03	1.0E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzo(a,e)pyrene	11	11	5	45	2.2E-03	1.0E-02	2.0E-02	1.6E-01	SD02	99070521	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
Dibenzo(a,h)pyrene	11	11	5	45	2.2E-03	2.1E-01	1.1E-02	8.0E-02	SD08	99070527	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
Dibenzo(a,i)pyrene	11	11	4	36	2.2E-03	3.9E-02	5.9E-03	1.0E-01	SD06	99070525	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
Dibenzo(a,l)pyrene	11	11	2	18	2.2E-03	3.4E-02	9.6E-03	1.5E-02	SD08	99070527	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
7,12-Dimethylbenz(a)anthracene	28	28	1	4	2.2E-03	1.0E+00	1.4E-01	1.4E-01	SD10	99070529	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
BaPE (ND = 1/2 DL)	41	41	38	93	1.0E-02	2.0E-01	5.7E-03	7.9E+01	SB-38	LSP0561	1.4E-01	1.4E+00	2	67	5.7E+02	33	87	85	Y	Y	Y			--	
Petroleum, mg/kg																									
Diesel Range Hydrocarbons	33	33	27	82	5.0E-01	7.0E-01	9.7E+00	3.7E+03	LSC Bank	LSP0051	2.0E+03	3.5E-04	0	0	1.9E+00	2	7	6	Y	Y	Y			--	
Motor Oil	32	32	27	84	1.2E+01	1.7E+01	1.3E+01	2.7E+03	SB-35	LSP0546	2.0E+03	8.5E-03	0	0	1.4E+00	1	4	3	Y	Y	Y			--	
C8-C10 Aliphatics	3	3	0	0	2.9E+00	1.4E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C10-C12 Aliphatics	14	14	0	0	2.9E+00	2.9E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C12-C16 Aliphatics	14	14	5	36	5.9E+00	2.9E+01	7.2E+00	6.9E+01	LSC Bank	LSP0051	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C16-C18 Aliphatics	11	11	3	27	6.1E+00	2.9E+01	6.1E+00	3.6E+01	SD06	99070525	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C16-C21 Aliphatics	3	3	3	100	NA	NA	1.0E+02	1.2E+02	LSC Bank; SB-35	SP0051; LSP0546	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C18-C21 Aliphatics	11	11	5	45	6.1E+00	2.9E+01	7.7E+00	7.6E+01	SD06	99070525	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C21-C28 Aliphatics	11	11	10	91	6.1E+00	6.1E+00	2.3E+01	4.7E+02	SD06	99070525	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C21-C34 Aliphatics	3	3	3	100	NA	NA	5.3E+01	3.8E+02	SB-35	LSP0546	--	--	--	--	--	--	--	--	Y	--	--	No SL	Aliphatic and aromatic ranges were provided for informational purposes only. Screening was performed on GRO, DRO, MO, and TPH. Aliphatic and aromatic ranges will be useful in calculating site-specific cleanup levels.	--	
C28-C36 Aliphatics	11	11	9	82	6.1E+00	2.9E+01	2.5E+01	3.9E+02	SD06	99070525	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C8-C10 Aromatics	3	3	1	33	2.9E+00	4.0E+00	1.6E+01	1.6E+01	LSC Bank	LSP0051	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C10-C12 Aromatics	14	14	1	7	2.9E+00	2.9E+01	1.6E+01	1.6E+01	LSC Bank	LSP0051	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C12-C16 Aromatics	14	14	1	7	2.9E+00	2.9E+01	5.2E+02	5.2E+02	LSC Bank	LSP0051	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C16-C18 Aromatics	11	11	0	0	5.9E+00	2.9E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C16-C21 Aromatics	3	3	3	100	NA	NA	2.3E+01	3.2E+03	LSC Bank	LSP0051	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C18-C21 Aromatics	11	11	5	45	6.1E+00	2.9E+01	9.0E+00	1.1E+02	SD06	99070525	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C21-C28 Aromatics	11	11	9	82	6.1E+00	2.9E+01	7.8E+00	1.2E+02	SD06	99070525	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C21-C34 Aromatics	3	3	3	100	NA	NA	2.0E+02	1.8E+03	LSC Bank	LSP0051	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C28-C36 Aromatics	11	11	10	91	6.1E+00	6.1E+00	2.2E+01	1.7E+02	SD06	99070525	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Dioxins_Furans, mg/kg																									
2,3,7,8-TCDD	19	19	7	37	2.9E-07	2.4E-06	3.2E-06	8.9E-06	SB-36	LSP0548	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total TCDD	19	19	15	79	2.9E-07	4.9E-06	1.6E-06	1.1E-03	SB-37	LSP0552	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8-PeCDD	19	19	13	68	5.7E-07	8.2E-06	2.3E-06	1.2E-04	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total PeCDD	19	19	16	84	5.7E-07	3.2E-05	1.3E-06	1.6E-03	SB-37	LSP0552	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,7,8-HxCDD	19	19	13	68	1.1E-06	3.2E-05	4.3E-06	4.0E-04	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,6,7,8-HxCDD	19	19	19	100	NA	NA	1.4E-05	8.4E-03	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8,9-HxCDD	19	19	19	100	NA	NA	3.6E-06	1.1E-03	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HxCDD	19	19	19	100	NA	NA	4.1E-05	2.4E-02	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,6,7,8-HpCDD	19	19	19	100	NA	NA	1.6E-04	2.2E-01	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HpCDD	19	19	19	100	NA	NA	2.9E-04	3.8E-01	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
OCDD	19	19	19	100	NA	NA	1.4E-03	1.2E+00	SB-36	LSP0548	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
2,3,7,8-TCDF	19	19	13	68	3.3E-07	9.6E-07	1.4E-06	3.0E-04	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL	Individual congeners were provided for	--	

Table F-2. Preliminary Indicator Hazardous Substances for Sediment Site Wide

Analyte	No. of Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If Not Detected, Does Max. DL Exceed SL?	Comment (information on chemical uses from HSDB)
Total TCDF	19	19	16	84	4.0E-07	9.6E-07	5.6E-07	4.6E-04	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL	informational purposes only. Screening was	--	
1,2,3,7,8-PeCDF	19	19	9	47	2.9E-07	2.7E-05	1.6E-06	1.2E-03	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL	performed on TEQs calculated using 2005 TEFs.	--	
2,3,4,7,8-PeCDF	19	19	13	68	5.0E-07	2.6E-05	1.7E-06	1.6E-03	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total PeCDF	19	19	19	100	NA	NA	8.8E-06	1.1E-02	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,7,8-HxCDF	19	19	8	42	8.3E-06	1.5E-03	1.4E-04	9.9E-03	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,6,7,8-HxCDF	19	19	13	68	1.4E-06	3.9E-05	3.5E-06	1.9E-03	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8,9-HxCDF	19	19	8	42	1.4E-06	1.8E-04	2.8E-06	3.2E-04	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
2,3,4,6,7,8-HxCDF	19	19	8	42	1.7E-06	6.2E-05	1.5E-05	1.1E-03	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HxCDF	19	19	19	100	NA	NA	4.2E-05	1.0E-01	SB-02	LSP0132	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,6,7,8-HpCDF	19	19	19	100	NA	NA	3.6E-05	5.4E-02	SB-36	LSP0548	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,7,8,9-HpCDF	19	19	16	84	2.7E-06	3.0E-04	4.2E-06	4.3E-03	SB-36	LSP0548	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HpCDF	19	19	19	100	NA	NA	3.6E-05	3.6E-01	SB-36	LSP0548	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
OCDF	19	19	19	100	NA	NA	8.6E-05	2.4E-01	SB-35	LSP0546	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
TEQDF 0.5M98	19	19	19	100	NA	NA	7.4E-06	6.1E-03	SB-02	LSP0132	6.7E-06	0.0E+00	0	--	9.1E+02	19	100	100	Y	Y	N	Provided for informational purposes only. TEQs using 2005 TEFs were used.		--	
TEQDF 0.5M05	19	19	19	100	NA	NA	7.6E-06	5.9E-03	SB-02	LSP0132	6.7E-06	0.0E+00	0	--	8.9E+02	19	100	100	Y	Y	Y			--	

Notes: [a]Field duplicate and replicate samples are excluded from counts. Their results have been avearged with corresponding normal sample results.
[b]Number of Data Points might be different from the Number of Samples Analyzed for metals if they were analyzed by more than one method.
BaPE = Benzo(a)pyrene toxicity equivalents
DL = Detection limit
DRO = Diesel range organics
GRO = Gasoline range organics
HSDB = Hazardous substance databank
IHS = Indicator hazardous substance
MO = Motor oil
NA = Not applicable
SL = Screening level
TEF = Toxicity equivalency factor
TEQ = Toxicity equivalents
TPH = Total petroleum hydrocarbons
-- = Not available

Table F-3. Preliminary Indicator Hazardous Substances for Groundwater Site Wide

Analyte	No. Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppb	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If Not Detected, Does Max. DL Exceed SL?	Comment (information on chemical uses from HSDB)
Metals, ug/L																									
Aluminum	6	6	2	33	2.0E+01	2.0E+01	3.3E+01	6.8E+01	MWLSC03	99384363	5.0E+01	4.0E-01	0	0	1.4E+00	1	50	17	Y	Y	N	Not above background		--	
Aluminum dissolved	6	6	0	0	2.0E+01	2.0E+01	--	--	--	--	5.0E+01	4.0E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Antimony	6	6	0	0	5.0E-01	4.5E+01	--	--	--	--	5.6E+00	8.0E+00	3	50	0.0E+00	0	--	50	--	--	--	Not detected		Y	Not above background
Antimony dissolved	6	6	0	0	5.0E-01	4.5E+01	--	--	--	--	5.6E+00	8.0E+00	3	50	0.0E+00	0	--	50	--	--	--	Not detected		Y	Not above background
Arsenic	23	23	18	78	2.0E-01	1.0E+00	2.0E-01	2.6E+01	SB-23	LSP0378	1.8E-02	5.6E+01	5	100	1.4E+03	18	100	100	Y	Y	Y			--	
Arsenic dissolved	23	23	15	65	2.0E-01	1.0E+00	2.0E-01	1.4E+01	SB-25	LSP0591	1.8E-02	5.6E+01	8	100	7.8E+02	15	100	100	Y	Y	N	Dissolved concentrations not evaluated		--	
Barium	6	6	6	100	NA	NA	2.0E+01	8.7E+01	MWLSC01	99384358	2.0E+03	0.0E+00	0	--	4.3E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Barium dissolved	6	6	6	100	NA	NA	1.9E+01	8.9E+01	MWLSC01	99384359	2.0E+03	0.0E+00	0	--	4.5E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Beryllium	6	6	0	0	1.0E+00	1.0E+00	--	--	--	--	4.0E+00	2.5E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Beryllium dissolved	6	6	0	0	1.0E+00	1.0E+00	--	--	--	--	4.0E+00	2.5E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Cadmium dissolved	23	23	2	9	2.0E-02	2.0E+00	6.0E-02	4.7E-01	MWLSC03	99504023	5.0E+00	4.0E-01	0	0	9.4E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Cadmium	23	23	4	17	2.0E-02	2.0E+00	2.0E-01	1.0E+00	SB-23	LSP0378	5.0E+00	4.0E-01	0	0	2.0E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Calcium	23	23	23	100	NA	NA	1.4E+04	6.2E+04	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Calcium dissolved	23	23	23	100	NA	NA	1.4E+04	6.1E+04	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Chromium	23	23	15	65	2.0E-01	5.0E+00	5.0E-01	1.2E+02	SB-23	LSP0378	4.8E+01	1.0E-01	0	0	2.5E+00	1	7	4	Y	Y	N	Not above background in groundwater		--	
Chromium dissolved	23	23	12	52	2.0E-01	5.0E+00	5.0E-01	3.5E+00	SB-11	LSP0375	4.8E+01	1.0E-01	0	0	7.3E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Cobalt	6	6	0	0	5.0E+00	5.0E+00	--	--	--	--	7.3E+02	6.8E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Cobalt dissolved	6	6	0	0	5.0E+00	5.0E+00	--	--	--	--	7.3E+02	6.8E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Copper dissolved	23	23	15	65	1.0E-01	4.0E+00	6.0E-01	4.7E+00	SB-24	LSP0377	5.9E+02	6.8E-03	0	0	8.0E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Copper	23	23	16	70	1.0E-01	4.0E+00	5.0E-01	2.0E+02	SB-23	LSP0378	5.9E+02	6.8E-03	0	0	3.5E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Iron	6	6	5	83	1.0E+01	1.0E+01	1.2E+01	8.9E+01	MWLSC03	99384363	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Iron dissolved	6	6	1	17	1.0E+01	1.0E+01	5.1E+01	5.1E+01	MWLSC01	99504039	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Lead	23	23	6	26	1.2E-01	1.0E+00	3.0E+00	2.5E+01	SB-23	LSP0378	1.5E+01	6.7E-02	0	0	1.7E+00	1	17	4	Y	Y	Y			--	
Lead dissolved	23	23	0	0	1.0E-01	1.0E+00	--	--	--	--	1.5E+01	6.7E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Magnesium	23	23	23	100	NA	NA	5.8E+03	4.0E+04	SB-23	LSP0378	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Magnesium dissolved	23	23	23	100	NA	NA	5.8E+03	2.3E+04	MWLSC02	99384351	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Manganese	6	6	6	100	NA	NA	1.0E+00	4.2E+02	MWLSC01	99504038	5.0E+01	0.0E+00	0	--	8.4E+00	3	50	50	Y	Y	N	Not above background		--	
Manganese dissolved	6	6	6	100	NA	NA	1.0E+00	4.0E+02	WLSC01; MWLSC01	99384359; 99504039	5.0E+01	0.0E+00	0	--	8.0E+00	3	50	50	Y	Y	N	Not above background		--	
Mercury dissolved	23	23	0	0	4.0E-03	2.0E-01	--	--	--	--	2.0E+00	1.0E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Mercury	23	23	1	4	4.0E-03	2.0E-01	2.4E-01	2.4E-01	SB-23	LSP0378	2.0E+00	1.0E-01	0	0	1.2E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Nickel	23	23	17	74	1.0E+01	1.0E+01	1.0E+00	2.2E+02	SB-23	LSP0378	1.0E+02	1.0E-01	0	0	2.2E+00	1	6	4	Y	Y	N	Not above background in groundwater		--	
Nickel dissolved	23	23	17	74	1.0E+01	1.0E+01	1.1E+00	1.7E+01	SB-32	LSP0598	1.0E+02	1.0E-01	0	0	1.7E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Potassium	6	6	6	100	NA	NA	2.3E+03	3.1E+03	MWLSC03	99384363	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Potassium dissolved	6	6	6	100	NA	NA	1.8E+03	3.3E+03	MWLSC03	99384364	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Selenium dissolved	6	6	0	0	1.0E+00	1.5E+00	--	--	--	--	5.0E+01	3.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Selenium	6	6	0	0	1.0E+00	1.5E+00	--	--	--	--	5.0E+01	3.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Silver	23	23	1	4	1.0E-02	4.0E+00	3.0E-01	3.0E-01	SB-23	LSP0378	8.0E+01	5.0E-02	0	0	3.8E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Silver dissolved	23	23	0	0	1.0E-02	4.0E+00	--	--	--	--	8.0E+01	5.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Sodium	6	6	6	100	NA	NA	1.1E+04	1.5E+04	MWLSC01	99504038	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicit	--	
Sodium dissolved	6	6	6	100	NA	NA	1.1E+04	1.6E+04	MWLSC02	99384351	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicit	--	
Thallium	6	6	0	0	5.0E-01	2.0E+00	--	--	--	--	2.4E-01	8.3E+00	6	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Not above background
Thallium dissolved	6	6	0	0	5.0E-01	2.0E+00	--	--	--	--	2.4E-01	8.3E+00	6	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Not above background
Vanadium dissolved	6	6	0	0	3.0E+00	3.0E+00	--	--	--	--	1.1E+02	2.7E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Vanadium	6	6	0	0	3.0E+00	3.0E+00	--	--	--	--	1.1E+02	2.7E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Zinc dissolved	23	23	2	9	2.0E+00	4.0E+00	6.0E+00	7.7E+00	MWLSC02	99504041	4.8E+03	8.3E-04	0	0	1.6E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Zinc	23	23	12	52	2.0E+00	4.4E+00	4.9E+00	3.0E+02	SB-23	LSP0378	4.8E+03	9.2E-04	0	0	6.3E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
VOCs, ug/L																									
Acetone	4	4	2	50	2.0E+00	4.0E+00	1.8E+01	2.0E+01	MWLSC03	94075	8.0E+02	5.0E-03	0	0	2.6E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Benzene	10	10	0	0	2.0E-02	1.0E+02	--	--	--	--	2.2E+00	4.5E+01	1	10	0.0E+00	0	--	10	--	--	--	Not detected		Y	Most soil DLs exceed SL. Most groundwater and surface water DLs are below SL but it wasn't detected in groundwater or surface water. Based on solubility, benzene is expected to be seen in water. Not analyzed in sediment.
Bromobenzene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	2.0E+01	4.9E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bromochloromethane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Bromodichloromethane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	5.5E-01	1.8E+00	9	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Formed during water chlorination
Bromoform	9	9	0	0	1.0E+00	5.0E+00	--	--	--	--	4.3E+00	1.2E+00	3	33	0.0E+00	0	--	33	--	--	--	Not detected		Y	Formed during seawater chlorination; used in organic synthesis; solvent; medicinal uses
Bromomethane	9	9	0	0	2.0E+00	2.0E+00	--	--	--	--	1.1E+01	1.8E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Butanone	9	9	0	0	2.0E+00	4.0E+00	--	--	--	--	7.0E+03	5.7E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
n-Butylbenzene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	2.4E+02	4.1E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
sec-Butylbenzene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
tert-Butylbenzene	9	9	0	0	1.0E+00	2.0E+00	--	--	--	--	2.4E+02	8.2E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Carbon Disulfide	9	9	0	0	2.0E+00	2.0E+00	--	--	--	--	8.0E+02	2.5E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Carbon Tetrachloride	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	2.3E-01	4.3E+00	9	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Solvent for asphalt, chlorinated rubber, and others; cleaning agent for machinery; used in synthesis of nylon-7
Chlorobenzene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	1.0E+02	1.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Chloroethane	9	9	0	0	1.0E+00	2.0E+00	--	--	--	--	4.6E+00	4.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Chloroform	9	9	4	44	2.0E-02	1.0E+00	2.0E-02	5.0E-02	MWLSC02	99504040	5.7E+00	1.8E-01	0	0	8.8E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Chloromethane	9	9	0	0	1.0E+00	2.0E+00	--	--	--	--	3.4E+00	5.9E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Chlorotoluene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	1.6E+02	6.3E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Chlorotoluene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibromochloromethane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	4.0E-01	2.5E+00	9	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Formed during water chlorination; chemical intermediat
1,2-Dibromo-3-chloropropane	9	9	0	0	5.0E-02	2.0E+00	--	--	--	--	2.0E-01	1.0E+01	4	44	0.0E+00	0	--	44	--	--	--	Not detected		Y	Chemical intermediate; soil fumigant and nematocide
1,2-Dibromoethane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	5.6E-03	1.8E+02	9	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Gasoline additive; used in manufactur of dyes pharmaceuticals, polymers; solvent
Dibromomethane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	6.1E+01	1.6E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Dichlorodifluoromethane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	1.6E+03	6.3E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1-Dichloroethane	9	9	0	0	2.0E-02	1.0E+00	--	--	--	--	8.0E+02	1.3E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2-Dichloroethane	9	9	0	0	2.0E-02	1.0E+00	--	--	--	--	3.8E-01	2.6E+00	3	33	0.0E+00	0	--	33	--	--	--	Not detected		Y	Gasoline additive; used in manufactur of soaps; solver
1,1-Dichloroethene	9	9	0	0	2.0E-02	1.0E+00	--	--	--	--	7.3E-01	1.4E+00	4	44	0.0E+00	0	--	44	--	--	--	Not detected		Y	May be formed in groundwater containing chlorinatec solvents; degreasing agent; used in manufacturing
cis-1,2-Dichloroethene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	7.0E+01	1.4E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
trans-1,2-Dichloroethene	9	9	0	0	1.0E+00	2.0E+00	--	--	--	--	1.0E+02	2.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2-Dichloropropane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	5.0E-01	2.0E+00	9	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Solvent
1,3-Dichloropropane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	1.2E+02	8.2E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,2-Dichloropropane	9	9	0	0	1.0E+00	2.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1,1-Dichloropropene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
cis-1,3-Dichloropropene	9	9	0	0	1.1E+00	1.1E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
trans-1,3-Dichloropropene	9	9	0	0	9.4E-01	9.4E-01	--	--	--	--	2.4E+02	3.9E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Ethylbenzene	10	10	0	0	5.0E-02	1.0E+02	--	--	--	--	5.3E+02	1.9E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Fluorotrichloromethane	9	9	0	0	1.0E+00	5.0E+00	--	--	--	--	2.4E+03	2.1E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Hexanone	9	9	0	0	2.0E+00	1.0E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Isopropylbenzene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	6.6E+02	1.5E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
p-Isopropyltoluene	9	9	0	0	1.0E+00	2.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Methyl tert-butyl Ether	10	10	0	0	1.0E+00	1.0E+02	--	--	--	--	2.4E+01	4.2E+00	1	10	0.0E+00	0	--	10	--	--	--	Not detected		Y	Gasoline additive
4-Methyl-2-pentanone	9	9	0	0	2.0E+00	1.0E+01	--	--	--	--	2.0E+03	5.0E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Methylene Chloride	9	9	0	0	1.0E+00	5.0E+00	--	--	--	--	4.6E+00	1.1E+00	3	33	0.0E+00	0	--	33	--	--	--	Not detected		Y	Formed during water chlorination
Pentachloroethane	9	9	0	0	1.0E+00	2.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
n-Propylbenzene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	2.4E+02	4.1E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	

Table F-3. Preliminary Indicator Hazardous Substances for Groundwater Site Wide

Analyte	No. Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppb	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If Not Detected, Does Max. DL Exceed SL?	Comment (information on chemical uses from HSDB)
Styrene	9	9	0	0	1.0E+00	2.0E+00	--	--	--	--	1.5E+00	1.3E+00	4	44	0.0E+00	0	--	44	--	--	--	Not detected		Y	Found in cigarette smoke; used in manufacture of plastics and resins; chemical intermediate
1,1,1,2-Tetrachloroethane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	1.7E+00	5.9E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1,2,2-Tetrachloroethane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	1.7E-01	5.9E+00	9	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Solvent; chemical intermediate
Tetrachloroethene	9	9	0	0	2.0E-02	1.0E+00	--	--	--	--	6.9E-01	1.4E+00	3	33	0.0E+00	0	--	33	--	--	--	Not detected		Y	Dry cleaning agent; degreasing agent; chemical intermediate may be formed during water chlorination
Toluene	10	10	0	0	1.0E+00	1.0E+02	--	--	--	--	6.4E+02	1.6E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1,2-Trichloro-1,2,2-trifluoroethane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	2.4E+05	4.2E-06	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1,1-Trichloroethane	9	9	0	0	1.0E+00	2.0E+00	--	--	--	--	2.0E+02	1.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1,2-Trichloroethane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	5.9E-01	1.7E+00	9	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Chemical intermediate; may be released from landfills
Trichloroethene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	1.1E+00	9.1E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2,3-Trichloropropane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	6.3E-03	1.6E+02	9	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Solvent; chemical intermediate; impurity in soil fumigants and nematicides
1,2,4-Trimethylbenzene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	4.0E+02	2.5E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,3,5-Trimethylbenzene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	1.2E+01	8.1E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Vinyl Chloride	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	2.5E-02	4.0E+01	9	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Used in manufacture of polyvinyl chloride; degradation product of chlorinated solvents
m&p-Xylene	10	10	0	0	4.0E-02	2.0E+02	--	--	--	--	1.6E+03	1.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
o-Xylene	10	10	0	0	2.0E-02	1.0E+02	--	--	--	--	1.6E+04	6.3E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
SVOCs, ug/L																									
Aniline	22	22	0	0	6.0E-01	6.0E-01	--	--	--	--	7.7E+00	7.8E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Benzidine	22	22	0	0	4.2E+00	4.2E+00	--	--	--	--	8.6E-05	4.9E+04	22	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Formerly used in manufacture of azo dyes, as reagent for detection of blood, and as rubber compounding agent
Benzoic Acid	29	29	7	24	4.7E-02	4.7E+00	6.4E-02	1.2E+02	SB-20	LSP0369	6.4E+04	7.3E-05	0	0	1.9E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Benzyl Alcohol	33	33	5	15	2.4E-02	5.1E-01	1.0E+00	9.8E+00	WP1	99070515	2.4E+03	2.1E-04	0	0	4.1E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Bis(2-chloroethoxy) Methane	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Bis-(2-chloroethyl) Ether	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	3.0E-02	9.0E+01	23	70	0.0E+00	0	--	70	--	--	--	Not detected		Y	Can be formed during water chlorination; formerly used in textile industry and as solvent in resins
Bis(2-chloroisopropyl)ether	11	11	0	0	2.4E-02	2.7E+00	--	--	--	--	3.2E+02	8.4E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bis(2-chloro-1-methylethyl) Ether	22	22	0	0	4.4E-01	4.4E-01	--	--	--	--	2.7E-01	1.6E+00	22	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Used in textile industry; solvent for resin
Bis(2-ethylhexyl)phthalate	33	33	6	18	1.9E-01	3.8E+01	1.8E+00	3.2E+01	SB-23	LSP0378	1.2E+00	3.2E+01	2	7	2.7E+01	6	100	24	Y	Y	Y			--	
4-Bromophenyl-phenylether	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Butylbenzylphthalate	33	33	0	0	8.3E-03	2.7E+00	--	--	--	--	1.3E+03	2.1E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Carbazole	31	31	6	19	2.4E-02	2.9E-01	5.5E+00	4.3E+01	SB-29	LSP0596	4.4E+00	6.6E-02	0	0	9.8E+00	6	100	19	Y	Y	Y			--	
4-Chloroaniline	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	3.2E+01	8.4E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Chloro-3-methylphenol	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
2-Chloronaphthalene	33	33	0	0	9.4E-03	1.1E+00	--	--	--	--	4.9E+02	2.3E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Chlorophenol	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	4.0E+01	6.8E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Chlorophenyl-phenylether	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
7H-Dibenzo(c,g)carbazole	11	11	0	0	4.7E-03	5.4E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzofuran	33	33	10	30	2.4E-02	3.5E-01	5.2E-02	4.9E+02	WP1	99070515	3.2E+01	1.1E-02	0	0	1.5E+01	2	20	6	Y	Y	Y			--	
1,2-Dichlorobenzene	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	4.2E+02	6.4E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,3-Dichlorobenzene	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	1.8E+02	1.5E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,4-Dichlorobenzene	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	1.8E+01	1.5E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
3,3'-Dichlorobenzidine	33	33	1	3	2.4E-02	9.0E-01	1.1E+01	1.1E+01	WP1	99070515	2.1E-02	4.3E+01	32	100	5.2E+02	1	100	100	Y	Y	Y			--	
2,4-Dichlorophenol	33	33	1	3	2.4E-02	2.7E+00	1.6E+00	1.6E+00	SB-25	LSP0591	2.4E+01	1.1E-01	0	0	6.7E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Diethylphthalate	33	33	2	6	2.4E-02	2.7E+00	2.9E-01	3.4E+00	SB-27	LSP0594	1.3E+04	2.1E-04	0	0	2.6E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,4-Dimethylphenol	33	33	3	9	2.4E-02	2.7E+00	4.9E-02	1.1E+00	SB-29	LSP0596	1.6E+02	1.7E-02	0	0	6.9E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Dimethylphthalate	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	1.6E+04	1.7E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
di-n-Butylphthalate	33	33	0	0	4.1E-02	3.5E+00	--	--	--	--	2.0E+03	1.8E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4,6-Dinitro-2-methylphenol	33	33	0	0	2.4E-02	1.0E+01	--	--	--	--	3.7E+00	2.7E+00	22	67	0.0E+00	0	--	67	--	--	--	Not detected		Y	Insecticide and herbicide
2,4-Dinitrophenol	33	33	0	0	2.4E-02	1.0E+01	--	--	--	--	3.2E+01	3.1E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4-Dinitrotoluene	33	33	1	3	2.4E-02	3.1E-01	2.5E+01	2.5E+01	WP1	99070515	1.1E-01	2.8E+00	22	69	2.3E+02	1	100	70	Y	Y	Y			--	
2,6-Dinitrotoluene	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	1.6E+01	1.7E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
di-n-Octylphthalate	33	33	2	6	1.1E-02	2.7E+00	1.1E-01	2.7E-01	MWLSC01	99384358	3.2E+02	8.4E-03	0	0	8.4E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,2-Diphenylhydrazine	22	22	0	0	4.0E-01	4.0E-01	--	--	--	--	3.6E-02	1.1E+01	22	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Chemical intermediate
Hexachlorobenzene	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	2.8E-04	9.6E+03	33	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Used in wood preservative industry; used in manufacture of a variety of products
Hexachlorobutadiene	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	4.4E-01	6.1E+00	23	70	0.0E+00	0	--	70	--	--	--	Not detected		Y	Used as solvent for elastomers, heat transfer liquid transformer and hydraulic fluid; released during refuse combustion; found in fly ash
Hexachlorocyclopentadiene	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	4.0E+01	6.8E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Hexachloroethane	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	1.4E+00	1.9E+00	1	3	0.0E+00	0	--	3	--	--	--	Not detected		Y	Produced and used in many products; formed during incineration of chlorinated wastes
Isophorone	33	33	1	3	2.4E-02	2.7E+00	6.7E-03	6.7E-03	MWLSC01	99384358	3.5E+01	7.7E-02	0	0	1.9E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
1-Methylnaphthalene	22	22	6	27	5.0E-01	5.0E-01	2.9E+01	2.3E+02	SB-29	LSP0596	1.6E+02	3.1E-03	0	0	1.4E+00	1	17	5	Y	Y	Y			--	
2-Methylphenol	33	33	2	6	2.4E-02	2.7E+00	2.4E-01	2.1E+00	SB-32	LSP0598	1.8E+03	1.5E-03	0	0	1.2E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
3&4-Methylphenol	11	11	2	18	2.4E-02	2.7E+00	5.2E-02	5.5E-02	MWLSC02	94080	1.8E+03	1.5E-03	0	0	3.0E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
4-Methylphenol	22	22	2	9	1.3E-01	1.3E-01	7.0E-01	1.8E+00	SB-20	LSP0369	1.8E+02	7.1E-04	0	0	9.9E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
2-Nitroaniline	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	1.1E+02	2.5E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
3-Nitroaniline	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	3.2E+00	8.4E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Nitroaniline	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	3.2E+00	8.4E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Nitrobenzene	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	4.0E+00	6.8E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Nitrophenol	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
4-Nitrophenol	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1-Nitropyrene	11	11	0	0	4.7E-03	5.4E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
n-Nitrosodimethylamine	22	22	0	0	1.3E+00	1.3E+00	--	--	--	--	6.9E-04	1.9E+03	22	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Found in cigarette smoke; emitted during plastic manufacturing; used in production of rocket fuels; additive fo lubicants
N-nitrosodiphenylamine	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	3.3E+00	8.2E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
n-Nitroso-di-n-propylamine	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	5.0E-03	5.4E+02	33	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Found in cigarette smoke; contaminant in herbicide
Pentachlorophenol	33	33	11	33	2.4E-02	2.7E+00	2.5E-02	4.6E+02	SB-25	LSP0591	2.7E-01	1.0E+01	19	86	1.7E+03	6	55	76	Y	Y	Y			--	
Phenol	33	33	6	18	2.4E-02	1.5E-01	1.1E-01	2.1E+00	SB-20	LSP0369	4.8E+03	3.1E-05	0	0	4.4E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
Pyridine	22	22	0	0	5.0E+00	5.0E+00	--	--	--	--	8.0E+00	6.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,3,4,5-Tetrachlorophenol	22	22	1	5	2.5E+00	5.0E+00	1.4E+01	1.4E+01	SB-25	LSP0591	4.8E+02	1.0E-02	0	0	2.9E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,3,4,6-Tetrachlorophenol	22	22	2	9	1.7E+00	5.0E+00	6.4E+00	3.9E+01	SB-25	LSP0591	4.8E+02	1.0E-02	0	0	8.1E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,3,5,6-Tetrachlorophenol	22	22	2	9	1.2E+00	5.0E+00	2.6E+00	3.8E+01	SB-25	LSP0591	4.8E+02	1.0E-02	0	0	7.9E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Tetrachlorophenols	11	11	1	9	6.6E-03	2.7E+00	4.0E-02	4.0E-02	MWLSC03	99384363	4.8E+02	5.6E-03	0	0	8.3E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,2,3-Trichlorobenzene	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1,2,4-Trichlorobenzene	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	3.5E+01	7.7E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4,5-Trichlorophenol	33	33	1	3	2.4E-02	2.7E+00	2.4E+00	2.4E+00	SB-25	LSP0591	8.0E+02	3.4E-03	0	0	2.9E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,4,6-Trichlorophenol	33	33	0	0	2.4E-02	2.7E+00	--	--	--	--	1.4E+00	1.9E+00	1	3	0.0E+00	0	--	3	--	--	--	Not detected		Y	May be formed during water chlorination; potentia degradation product of pentachlorophenol
PAHs, ug/L																									
Acenaphthene	33	33	15	45	4.7E-03	4.7E-01	4.8E-03	9.3E+02	WP1	99070515	6.4E+02	7.3E-04	0	0	1.5E+00	1	7	3	Y	Y	Y			--	
Acenaphthylene	33	33	8	24	4.7E-03	5.4E-01	9.2E-03	5.8E+00	SB-29	LSP0596	6.4E+02	8.4E-04	0	0	9.1E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Anthracene	33	33	18	55	3.0E-01	3.0E-01	8.7E-03	4.3E+02	WP1	99070515	4.8E+03	6.3E-05	0	0	9.0E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Fluorene	33	33	10	30	4.7E-03	4.3E-01	1.5E-01	9.4E+02	WP1	99070515	6.4E+02	6.7E-04	0	0	1.5E+00	1	10	3	Y	Y	Y			--	
Naphthalene	33	33	18	55	4.7E-03	4.6E-01	1.2E-02	2.8E+03	SB-29	LSP0596	1.6E+02	2.9E-03	0	0	1.8E+01	2	11	6	Y	Y	Y			--	
Phenanthrene	33	33	18	55	3.7E-01	3.7E-01	5.3E-03	1.7E+03	WP1	99070515	4.8E+03	7.7E-05	0	0	3.5E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
2-Methylnaphthalene	33	33	15	45	4.7E-03	4.3E-01	7.1E-03	4.0E+02	SB-29	LSP0596	1.6E+02	2.7E-03	0	0	2.5E+00	2	13	6	Y	Y	Y			--	

Table F-3. Preliminary Indicator Hazardous Substances for Groundwater Site Wide

Analyte	No. Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppb	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If Not Detected, Does Max. DL Exceed SL?	Comment (information on chemical uses from HSDB)
Benzo(a)anthracene	33	33	9	27	4.7E-03	3.3E-01	1.1E-02	3.8E+02	WP1	99070515	3.8E-03	8.7E+01	24	100	1.0E+05	9	100	100	Y	Y	N	Provided for informational purposes only BaPE used for screening.		--	
Benzo(a)pyrene	33	33	6	18	4.7E-03	3.0E-01	1.2E+00	1.5E+02	WP1	99070515	3.8E-03	7.9E+01	27	100	3.9E+04	6	100	100	Y	Y	N	Provided for informational purposes only BaPE used for screening.		--	
Benzo(b)fluoranthene	27	27	6	22	4.8E-03	2.5E-01	6.1E-01	1.0E+02	WP1	99070515	3.8E-03	6.6E+01	21	100	2.6E+04	6	100	100	Y	Y	N	Provided for informational purposes only BaPE used for screening.		--	
Benzo(j)fluoranthene	5	5	2	40	4.8E-02	4.9E-02	6.1E-01	1.0E+02	WP1	99070515	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
Benzo(k)fluoranthene	27	27	6	22	4.8E-03	7.2E-01	6.1E-01	1.0E+02	WP1	99070515	3.8E-03	1.9E+02	21	100	2.6E+04	6	100	100	Y	Y	N	Provided for informational purposes only BaPE used for screening.		--	
Chrysene	33	33	8	24	4.7E-03	4.0E-01	6.8E-03	3.0E+02	WP1	99070515	3.8E-03	1.1E+02	25	100	7.9E+04	8	100	100	Y	Y	N	Provided for informational purposes only BaPE used for screening.		--	
Dibenzo(a,h)anthracene	33	33	5	15	4.7E-03	2.2E-01	1.1E-01	1.2E+01	WP1	99070515	3.8E-03	5.8E+01	28	100	3.2E+03	5	100	100	Y	Y	N	Provided for informational purposes only BaPE used for screening.		--	
Fluoranthene	33	33	10	30	4.7E-03	3.4E-01	5.0E-02	1.4E+03	WP1	99070515	6.4E+02	5.3E-04	0	0	2.2E+00	1	10	3	Y	Y	Y			--	
Indeno(1,2,3-cd)pyrene	33	33	6	18	4.7E-03	2.6E-01	5.0E-01	3.7E+01	WP1	99070515	3.8E-03	6.8E+01	27	100	9.7E+03	6	100	100	Y	Y	N	Provided for informational purposes only BaPE used for screening.		--	
Pyrene	33	33	13	39	4.7E-03	3.4E-01	4.8E-03	1.1E+03	WP1	99070515	4.8E+02	7.1E-04	0	0	2.3E+00	1	8	3	Y	Y	Y			--	
Benzofluoranthenes	6	6	0	0	4.7E-03	4.9E-03	--	--	--	--	1.2E-02	4.1E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Benzo(g,h,i)perylene	33	33	5	15	4.7E-03	2.7E-01	5.0E-01	2.8E+01	WP1	99070515	6.4E+02	4.2E-04	0	0	4.4E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Dibenzo(a,h)acridine	11	11	0	0	4.7E-03	5.4E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzo(a,j)acridine	11	11	1	9	4.7E-03	5.5E-03	2.6E+00	2.6E+00	WP1	99070515	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
Dibenzo(a,e)pyrene	11	11	2	18	4.7E-03	4.9E-03	1.5E-01	3.4E+00	WP1	99070515	--	--	--	--	--	--	--	--	Y	--	--	No SL	Typically associated with combustion sources rather than wood treating.	--	
Dibenzo(a,h)pyrene	11	11	0	0	4.7E-03	5.4E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzo(a,i)pyrene	11	11	0	0	4.7E-03	5.4E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzo(a,l)pyrene	11	11	0	0	4.7E-03	5.4E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
7,12-Dimethylbenz(a)anthracene	33	33	0	0	4.7E-03	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
BaPE (ND = 1/2 DL)	33	33	9	27	4.7E-03	7.2E-01	4.1E-03	2.2E+02	WP1	99070515	3.8E-03	1.9E+02	24	100	5.7E+04	9	100	100	Y	Y	Y			--	
Petroleum, ug/L																									
Gasoline Range Hydrocarbons	23	23	6	26	7.0E+01	5.8E+02	3.3E+02	4.4E+03	SB-29	LSP0596	8.0E+02	7.3E-01	0	0	5.5E+00	3	50	13	Y	Y	Y			--	
Diesel Range Hydrocarbons	24	24	7	29	2.0E+01	2.0E+01	4.0E+02	5.3E+04	WP1	99070515	5.0E+02	4.0E-02	0	0	1.1E+02	6	86	25	Y	Y	Y			--	
Motor Oil	24	24	2	8	5.0E+02	1.0E+03	2.4E+03	9.2E+03	WP1	99070515	5.0E+02	2.0E+00	1	5	1.8E+01	2	100	13	Y	Y	Y			--	
C5-C6 Aliphatics	10	10	0	0	1.5E+01	1.0E+03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C6-C8 Aliphatics	10	10	1	10	1.0E+01	1.0E+03	1.7E+01	1.7E+01	MWLSC03	94075	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C8-C10 Aliphatics	11	11	0	0	3.0E+01	5.2E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C10-C12 Aliphatics	11	11	0	0	4.2E+01	5.2E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C12-C16 Aliphatics	11	11	0	0	4.2E+01	5.2E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C16-C21 Aliphatics	11	11	0	0	4.2E+01	6.4E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C21-C34 Aliphatics	11	11	2	18	4.2E+01	1.4E+02	6.1E+01	3.5E+02	MWLSC03	99504022	--	--	--	--	--	--	--	--	Y	--	--	No SL	Aliphatic and aromatic ranges were provided for informational purposes only. Screening was performed on GRO, DRO, MO, and TPH. Aliphatic and aromatic ranges will be useful in calculating site-specific cleanup levels.	--	
C8-C10 Aromatics	11	11	2	18	2.5E+01	2.5E+01	4.8E+01	1.6E+02	SB-29	LSP0596	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C10-C12 Aromatics	11	11	1	9	4.2E+01	5.0E+01	3.8E+03	3.8E+03	SB-29	LSP0596	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C12-C13 Aromatics	1	1	1	100	NA	NA	1.8E+03	1.8E+03	SB-29	LSP0596	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C12-C16 Aromatics	11	11	2	18	4.7E+01	5.0E+01	1.2E+02	1.5E+03	SB-29	LSP0596	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C16-C21 Aromatics	11	11	2	18	4.7E+01	5.0E+01	1.4E+02	6.7E+02	SB-29	LSP0596	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C21-C34 Aromatics	11	11	1	9	4.2E+01	5.0E+01	6.3E+01	6.3E+01	SB-29	LSP0596	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Dioxins_Furans, ug/L																									
2,3,7,8-TCDD	21	21	0	0	1.6E-06	7.4E-06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Total TCDD	21	21	0	0	1.6E-06	7.4E-06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1,2,3,7,8-PeCDD	21	21	0	0	1.7E-06	1.5E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Total PeCDD	15	15	0	0	4.1E-06	1.9E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1,2,3,4,7,8-HxCDD	21	21	1	5	9.1E-07	1.2E-05	2.8E-05	2.8E-05	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,6,7,8-HxCDD	21	21	2	10	7.8E-07	2.4E-05	7.0E-05	2.4E-04	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8,9-HxCDD	21	21	2	10	7.7E-07	9.4E-06	4.0E-05	1.2E-04	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HxCDD	15	15	2	13	4.6E-06	2.5E-05	2.8E-04	8.9E-04	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,6,7,8-HpCDD	21	21	6	29	2.1E-06	2.1E-05	3.8E-05	7.8E-03	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HpCDD	15	15	6	40	2.6E-06	2.1E-05	3.8E-05	1.4E-02	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
OCDD	21	21	16	76	4.0E-06	4.2E-05	8.5E-06	8.3E-02	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
2,3,7,8-TCDF	21	21	0	0	9.8E-07	6.2E-06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Total TCDF	21	21	1	5	9.8E-07	6.2E-06	5.6E-06	5.6E-06	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL	Individual congeners were provided for informational purposes only. Screening was performed on TEQs calculated using 2005 TEFs.	--	
1,2,3,7,8-PeCDF	21	21	0	0	9.0E-07	7.9E-06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
2,3,4,7,8-PeCDF	21	21	0	0	8.1E-07	8.1E-06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Total PeCDF	15	15	1	7	2.3E-06	8.4E-06	3.3E-05	3.3E-05	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,7,8-HxCDF	21	21	2	10	9.4E-07	7.3E-06	2.7E-05	9.1E-05	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,6,7,8-HxCDF	21	21	1	5	8.4E-07	1.0E-05	3.6E-05	3.6E-05	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8,9-HxCDF	21	21	0	0	1.4E-06	6.9E-06	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
2,3,4,6,7,8-HxCDF	21	21	0	0	9.5E-07	1.5E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Total HxCDF	15	15	4	27	2.0E-06	7.3E-06	3.5E-05	1.1E-03	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,6,7,8-HpCDF	21	21	4	19	1.3E-06	2.1E-05	7.9E-05	1.6E-03	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,7,8,9-HpCDF	21	21	1	5	2.2E-06	2.1E-05	1.2E-04	1.2E-04	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HpCDF	15	15	5	33	2.4E-06	2.2E-05	6.8E-05	8.0E-03	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
OCDF	21	21	6	29	2.4E-06	4.6E-05	1.3E-05	1.1E-02	SB-22	LSP0373	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
TEQDF 0.5M98	21	21	16	76	4.0E-06	4.2E-05	2.9E-06	1.7E-04	SB-22	LSP0373	5.0E-09	8.3E+03	5	100	3.3E+04	16	100	100	Y	Y	N	Provided for informational purposes only TEQs using 2005 TEFs were used.		--	
TEQDF 0.5M05	21	21	16	76	4.0E-06	4.2E-05	2.7E-06	1.9E-04	SB-22	LSP0373	5.0E-09	8.3E+03	5	100	3.7E+04	16	100	100	Y	Y	Y			--	

Notes: [a]Field duplicate and replicate samples are excluded from counts. Their results have been averaged with corresponding normal sample results.
[b]Number of Data Points might be different from the Number of Samples Analyzed for metals if they were analyzed by more than one method.
BaPE = Benzo(a)pyrene toxicity equivalents
DL = Detection limit
DRO = Diesel range organics
GRO = Gasoline range organics
HSDB = Hazardous substance databank
IHS = Indicator hazardous substance
MO = Motor oil
NA = Not applicable
SL = Screening level
TEF = Toxicity equivalency factor
TEQ = Toxicity equivalents
TPH = Total petroleum hydrocarbons
-- = Not available

Table F-4. Preliminary Indicator Hazardous Substances for Surface Water Site Wide

Analyte	No. of Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppb	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If Not Detected, Does Max. DL Exceed SL?	Comment (information on chemical uses from HSDB)
Metals, ug/L																									
Aluminum	20	20	14	70	4.9E+00	2.0E+01	1.2E+01	1.6E+03	SW-08	99504856	5.0E+01	4.0E-01	0	0	3.2E+01	8	57	40	Y	Y	N	Not above background		--	
Aluminum dissolved	12	12	7	58	2.0E+01	2.0E+01	2.2E+01	1.3E+02	SW-06	99504861	5.0E+01	4.0E-01	0	0	2.5E+00	3	43	25	Y	Y	N	Not above background		--	
Antimony dissolved	12	12	5	42	5.0E-01	4.0E+01	5.6E-01	1.0E+00	SW-01	99504001	5.6E+00	7.1E+00	3	43	1.8E-01	0	0	25	Y	--	--	Doesn't exceed SL		--	
Antimony	20	20	9	45	5.0E-01	4.0E+01	5.3E-01	1.3E+00	SW-06	99314155	5.6E+00	7.1E+00	4	36	2.3E-01	0	0	20	Y	--	--	Doesn't exceed SL		--	
Arsenic	36	36	32	89	1.0E+00	1.5E+00	2.0E-01	3.2E+00	SW-11	LSP0599	1.8E-02	8.3E+01	4	100	1.8E+02	32	100	100	Y	Y	Y			--	
Arsenic dissolved	28	28	25	89	1.0E+00	1.0E+00	2.0E-01	1.7E+00	SW-11	LSP0599	1.8E-02	5.6E+01	3	100	9.4E+01	25	100	100	Y	Y	N	Dissolved concentrations not evaluated		--	
Barium	20	20	20	100	NA	NA	1.1E+01	1.1E+02	SW-08	99504856	2.0E+03	0.0E+00	0	--	5.6E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Barium dissolved	12	12	12	100	NA	NA	1.1E+01	3.3E+01	SW-06	99504861	2.0E+03	0.0E+00	0	--	1.7E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Beryllium dissolved	12	12	0	0	5.0E-01	1.0E+00	--	--	--	--	4.0E+00	2.5E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Beryllium	20	20	0	0	4.0E-02	1.0E+00	--	--	--	--	4.0E+00	2.5E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Cadmium dissolved	28	28	4	14	2.0E-02	2.0E+00	4.2E-02	1.3E-01	SW-06	99504861	5.0E+00	4.0E-01	0	0	2.6E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Cadmium	36	36	4	11	2.0E-02	2.0E+00	1.0E-01	2.1E-01	SW-08	99504856	5.0E+00	4.0E-01	0	0	4.2E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Calcium	36	36	36	100	NA	NA	5.7E+03	6.0E+04	SW-04	LSP0585	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Calcium dissolved	28	28	28	100	NA	NA	5.4E+03	5.7E+04	SW-04	LSP0585	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Chromium	36	36	7	19	2.0E-01	5.1E+00	6.0E-01	5.3E+00	SW-04	LSP0003	4.8E+01	1.1E-01	0	0	1.1E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Chromium dissolved	28	28	6	21	2.0E-01	5.0E+00	6.0E-01	1.4E+00	SW-11	LSP0599	4.8E+01	1.0E-01	0	0	2.9E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Cobalt dissolved	12	12	0	0	5.0E+00	1.0E+01	--	--	--	--	7.3E+02	1.4E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Cobalt	20	20	7	35	5.0E+00	1.0E+01	8.1E-02	2.8E-01	SW-06	99314155	7.3E+02	1.4E-02	0	0	3.8E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
Copper	36	36	31	86	3.0E+00	4.1E+00	7.4E-01	3.5E+01	SW-12	LSP0601	5.9E+02	6.9E-03	0	0	5.9E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Copper dissolved	28	28	20	71	3.0E+00	4.0E+00	1.3E+00	2.9E+01	SW-12	LSP0601	5.9E+02	6.8E-03	0	0	4.9E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Iron	20	20	16	80	1.0E+01	1.0E+01	4.8E+01	1.5E+03	SW-08	99504856	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Iron dissolved	12	12	9	75	1.0E+01	1.0E+01	2.7E+01	1.6E+02	SW-06	99504861	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Lead	36	36	21	58	1.0E-01	2.5E+00	1.3E-01	1.3E+01	SW-04	LSP0003	1.5E+01	1.7E-01	0	0	8.7E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Lead dissolved	28	28	6	21	1.0E-01	5.0E-01	2.6E-01	1.0E+00	SW-11	LSP0599	1.5E+01	3.3E-02	0	0	6.7E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Magnesium dissolved	28	28	28	100	NA	NA	1.5E+03	2.7E+04	OS03	95372613	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Magnesium	36	36	36	100	NA	NA	1.6E+03	2.6E+04	OS03	95372612	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Manganese dissolved	12	12	12	100	NA	NA	2.0E+00	7.2E+01	OS03	95372613	5.0E+01	0.0E+00	0	--	1.4E+00	4	33	33	Y	Y	N	Not above background		--	
Manganese	20	20	18	90	1.0E-01	1.0E+00	1.0E+00	1.8E+02	OS07	95352507	5.0E+01	2.0E-02	0	0	3.5E+00	11	61	55	Y	Y	N	Not above background		--	
Mercury	29	29	0	0	4.0E-03	2.0E-01	--	--	--	--	2.0E+00	1.0E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Mercury dissolved	28	28	0	0	4.0E-03	2.0E-01	--	--	--	--	2.0E+00	1.0E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Nickel	36	36	23	64	1.0E+01	1.0E+01	9.5E-01	1.6E+01	SW-11	LSP0599	1.0E+02	1.0E-01	0	0	1.6E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Nickel dissolved	28	28	16	57	1.0E+01	1.0E+01	7.5E-01	1.4E+01	SW-11	LSP0599	1.0E+02	1.0E-01	0	0	1.4E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
Potassium dissolved	12	12	12	100	NA	NA	1.7E+03	4.8E+03	SW-05	99504859	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Potassium	20	20	20	100	NA	NA	1.1E+03	4.8E+03	SW-05	99504858	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Selenium	20	20	4	20	1.0E+00	2.0E+00	1.0E+00	1.3E+00	SW-06	99314155	5.0E+01	4.0E-02	0	0	2.6E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Selenium dissolved	12	12	0	0	1.0E+00	2.0E+00	--	--	--	--	5.0E+01	4.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Silver	36	36	0	0	1.0E-02	4.1E+00	--	--	--	--	8.0E+01	5.1E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Silver dissolved	28	28	0	0	1.0E-02	4.0E+00	--	--	--	--	8.0E+01	5.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Sodium	20	20	20	100	NA	NA	6.1E+03	1.9E+04	OS03; SW-09	5372612; 99504002	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Sodium dissolved	12	12	12	100	NA	NA	5.5E+03	1.9E+04	OS03	95372613	--	--	--	--	--	--	--	--	Y	--	--	No SL	Essential nutrient not associated with toxicity	--	
Thallium dissolved	12	12	0	0	5.0E-01	1.0E+00	--	--	--	--	2.4E-01	4.2E+00	12	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Not above background
Thallium	20	20	0	0	5.0E-01	2.5E+00	--	--	--	--	2.4E-01	1.0E+01	20	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Not above background
Vanadium	20	20	9	45	3.0E+00	3.1E+00	3.6E-01	5.6E+00	SW-08	99504856	1.1E+02	2.8E-02	0	0	5.1E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Vanadium dissolved	12	12	0	0	3.0E+00	3.0E+00	--	--	--	--	1.1E+02	2.7E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Zinc	36	36	32	89	2.0E+00	4.0E+00	3.6E+00	1.0E+02	SW-12	LSP0601	4.8E+03	8.3E-04	0	0	2.1E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Zinc dissolved	28	28	19	68	2.0E+00	4.0E+00	7.0E+00	8.6E+01	SW-12	LSP0601	4.8E+03	8.3E-04	0	0	1.8E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
VOCs, ug/L																									
Acetone	3	3	0	0	4.0E+00	4.0E+00	--	--	--	--	8.0E+02	5.0E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Benzene	19	19	1	5	2.0E-02	1.0E+00	1.5E-01	1.5E-01	SW-05	99504858	2.2E+00	4.5E-01	0	0	6.8E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Bromobenzene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	2.0E+01	4.9E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bromochloromethane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Bromodichloromethane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	5.5E-01	1.8E+00	9	56	0.0E+00	0	--	56	--	--	--	Not detected		Y	Formed during water chlorination
Bromoform	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	4.3E+00	2.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bromomethane	16	16	0	0	4.0E-01	2.0E+00	--	--	--	--	1.1E+01	1.8E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Butanone	9	9	0	0	2.0E+00	4.0E+00	--	--	--	--	7.0E+03	5.7E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
n-Butylbenzene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	2.4E+02	4.1E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
sec-Butylbenzene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
tert-Butylbenzene	16	16	0	0	4.0E-01	2.0E+00	--	--	--	--	2.4E+02	8.2E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Carbon Disulfide	9	9	0	0	2.0E+00	2.0E+00	--	--	--	--	8.0E+02	2.5E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Carbon Tetrachloride	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	2.3E-01	4.3E+00	16	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Solvent for asphalt, chlorinated rubber, and others; cleaning agent for machinery; used in synthesis of nylon-7
Chlorobenzene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	1.0E+02	1.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Chloroethane	16	16	0	0	4.0E-01	2.0E+00	--	--	--	--	4.6E+00	4.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Chloroform	16	16	7	44	2.0E-02	4.0E-01	1.5E-02	4.2E-01	SW-06	99504860	5.7E+00	7.0E-02	0	0	7.4E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
Chloromethane	16	16	0	0	4.0E-01	2.0E+00	--	--	--	--	3.4E+00	5.9E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Chlorotoluene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	1.6E+02	6.3E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Chlorotoluene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibromochloromethane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	4.0E-01	2.5E+00	9	56	0.0E+00	0	--	56	--	--	--	Not detected		Y	Formed during water chlorination; chemical intermediate
1,2-Dibromo-3-chloropropane	16	16	0	0	5.0E-02	4.0E-01	--	--	--	--	2.0E-01	2.0E+00	7	44	0.0E+00	0	--	44	--	--	--	Not detected		Y	Chemical intermediate; soil fumigant and nematocide
1,2-Dibromoethane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	5.6E-03	1.8E+02	16	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Gasoline additive; used in manufactur of dyes, pharmaceuticals, polymers; solvent
Dibromomethane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	6.1E+01	1.6E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Dichlorodifluoromethane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	1.6E+03	6.3E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1-Dichloroethane	16	16	0	0	2.0E-02	1.0E+00	--	--	--	--	8.0E+02	1.3E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2-Dichloroethane	16	16	0	0	2.0E-02	4.0E-01	--	--	--	--	3.8E-01	1.1E+00	7	44	0.0E+00	0	--	44	--	--	--	Not detected		Y	Gasoline additive; used in manufactur of soaps; solvent
1,1-Dichloroethene	16	16	0	0	2.0E-02	1.0E+00	--	--	--	--	7.3E-01	1.4E+00	5	31	0.0E+00	0	--	31	--	--	--	Not detected		Y	May be formed in groundwater containing chlorinated solvents; degreasing agent; used in manufacturing
cis-1,2-Dichloroethene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	7.0E+01	1.4E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
trans-1,2-Dichloroethene	16	16	0	0	4.0E-01	2.0E+00	--	--	--	--	1.0E+02	2.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2-Dichloropropane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	5.0E-01	2.0E+00	9	56	0.0E+00	0	--	56	--	--	--	Not detected		Y	Solvent
1,3-Dichloropropane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	1.2E+02	8.2E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,2-Dichloropropane	9	9	0	0	1.0E+00	2.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1,1-Dichloropropene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
cis-1,3-Dichloropropene	16	16	0	0	4.0E-01	1.1E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
trans-1,3-Dichloropropene	16	16	0	0	4.0E-01	9.4E-01	--	--	--	--	2.4E+02	3.9E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Ethylbenzene	19	19	0	0	4.0E-01	1.0E+00	--	--	--	--	5.3E+02	1.9E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Fluorotrichloromethane	16	16	0	0	4.0E-01	5.0E+00	--	--	--	--	2.4E+03	2.1E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Hexanone	9	9	0	0	2.0E+00	1.0E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Isopropylbenzene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	6.6E+02	1.5E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
p-Isopropyltoluene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Methyl tert-butyl Ether	16	16	7	44	5.0E+00	5.0E+00	2.4E+00	3.4E+00	SW-04; SW-05	9314153; 99314154	2.4E+01	2.1E-01	0	0	1.4E-01	0	0	0	Y	--	--	Doesn't exceed SL		--	
4-Methyl-2-pentanone	9	9	0	0	2.0E+00	4.0E+00	--	--	--	--	2.0E+03	2.0E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	

Table F-4. Preliminary Indicator Hazardous Substances for Surface Water Site Wide

Analyte	No. of Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppb	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If Not Detected, Does Max. DL Exceed SL?	Comment (information on chemical uses from HSDB)
Methylene Chloride	16	16	0	0	4.0E-01	2.0E+00	--	--	--	--	4.6E+00	4.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Pentachloroethane	9	9	0	0	1.0E+00	2.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
n-Propylbenzene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	2.4E+02	4.1E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Styrene	16	16	0	0	4.0E-01	2.0E+00	--	--	--	--	1.5E+00	1.3E+00	3	19	0.0E+00	0	--	19	--	--	--	Not detected		Y	Found in cigarette smoke; used in manufacture of plastics and resins; chemical intermediate
1,1,1,2-Tetrachloroethane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	1.7E+00	5.9E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1,2,2-Tetrachloroethane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	1.7E-01	5.9E+00	16	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Solvent; chemical intermediate
Tetrachloroethene	16	16	0	0	2.0E-02	2.0E+00	--	--	--	--	6.9E-01	2.9E+00	1	6	0.0E+00	0	--	6	--	--	--	Not detected		Y	Dry cleaning agent; degreasing agent; chemical intermediate; may be formed during water chlorination
Toluene	19	19	2	11	4.0E-01	1.0E+00	5.1E-02	8.0E-02	SW-06	99314155	6.4E+02	1.6E-03	0	0	1.3E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,1,2-Trichloro-1,2,2-trifluoroethane	9	9	0	0	1.0E+00	1.0E+00	--	--	--	--	2.4E+05	4.2E-06	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1,1-Trichloroethane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	2.0E+02	5.0E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,1,2-Trichloroethane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	5.9E-01	1.7E+00	9	56	0.0E+00	0	--	56	--	--	--	Not detected		Y	Chemical intermediate; may be released from landfills
Trichloroethene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	1.1E+00	9.1E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2,3-Trichloropropane	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	6.3E-03	1.6E+02	16	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Solvent; chemical intermediate; impurity in soil fumigants and nematicides
1,2,4-Trimethylbenzene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	4.0E+02	2.5E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,3,5-Trimethylbenzene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	1.2E+01	8.1E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Vinyl Chloride	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	2.5E-02	4.0E+01	16	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Used in manufacture of polyvinyl chloride; degradation product of chlorinated solvents
m&p-Xylene	19	19	1	5	4.0E-02	1.0E+00	1.2E-01	1.2E-01	SW-05	99504858	1.6E+03	6.3E-04	0	0	7.5E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
o-Xylene	19	19	8	42	2.0E-02	1.0E+00	8.8E-02	7.8E-01	SW-05	99314154	1.6E+04	6.3E-05	0	0	4.9E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
SVOCs, ug/L																									
Aniline	22	22	0	0	4.2E-01	6.0E-01	--	--	--	--	7.7E+00	7.8E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Benzidine	18	18	0	0	8.4E-01	4.2E+00	--	--	--	--	8.6E-05	4.9E+04	18	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Formerly used in manufacture of azo dyes, as reagent for detection of blood, and as rubber compounding agent
Benzoic Acid	32	32	1	3	4.7E-02	1.0E+01	7.7E-02	7.7E-02	SW-04	99314153	6.4E+04	1.6E-04	0	0	1.2E-06	0	0	0	Y	--	--	Doesn't exceed SL		--	
Benzyl Alcohol	40	40	3	8	2.4E-02	5.1E-01	7.4E-03	1.1E-01	SW-08	99504856	2.4E+03	2.1E-04	0	0	4.6E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
Bis(2-chloroethoxy) Methane	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Bis-(2-chloroethyl) Ether	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	3.0E-02	1.7E+01	26	65	0.0E+00	0	--	65	--	--	--	Not detected		Y	Can be formed during water chlorination; formerly used in textile industry and as solvent in resins
Bis(2-chloroisopropyl)ether	25	25	0	0	2.4E-02	5.0E-01	--	--	--	--	3.2E+02	1.6E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Bis(2-chloro-1-methylethyl) Ether	15	15	0	0	4.4E-01	4.4E-01	--	--	--	--	2.7E-01	1.6E+00	15	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Used in textile industry; solvent for resins
Bis(2-ethylhexyl)phthalate	40	40	1	3	5.2E-02	1.8E+00	1.2E+00	1.2E+00	343	97040343	1.2E+00	1.5E+00	3	8	1.0E+00	0	0	8	Y	--	--	Doesn't exceed SL		--	
4-Bromophenyl-phenylether	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Butylbenzylphthalate	40	40	0	0	2.4E-02	2.0E+00	--	--	--	--	1.3E+03	1.5E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Carbazole	31	31	2	6	4.7E-02	5.0E-01	3.6E-02	7.5E-02	SW-05	99504858	4.4E+00	1.1E-01	0	0	1.7E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
4-Chloroaniline	40	40	1	3	2.4E-02	1.1E+00	4.2E-02	4.2E-02	SW-08	99504856	3.2E+01	3.4E-02	0	0	1.3E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
4-Chloro-3-methylphenol	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
2-Chloronaphthalene	39	39	0	0	9.4E-03	5.0E-01	--	--	--	--	4.9E+02	1.0E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Chlorophenol	40	40	0	0	4.2E-03	5.0E-01	--	--	--	--	4.0E+01	1.3E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Chlorophenyl-phenylether	40	40	0	0	2.4E-02	5.2E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
7H-Dibenzo(c,g)carbazole	18	18	0	0	4.7E-03	1.0E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzofuran	40	40	6	15	2.4E-02	5.0E-01	3.8E-03	7.4E-02	SW-05	99504858	3.2E+01	1.6E-02	0	0	2.3E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,2-Dichlorobenzene	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	4.2E+02	1.2E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,3-Dichlorobenzene	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	1.8E+02	2.7E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,4-Dichlorobenzene	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	1.8E+01	2.8E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
3,3'-Dichlorobenzidine	40	40	0	0	2.4E-02	2.0E+00	--	--	--	--	2.1E-02	9.5E+01	40	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Intermediate in manufacture of dyes and pigments
2,4-Dichlorophenol	40	40	1	3	2.4E-02	5.0E-01	7.7E-03	7.7E-03	SW-05	99314154	2.4E+01	2.1E-02	0	0	3.2E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
Diethylphthalate	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	1.3E+04	3.8E-05	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4-Dimethylphenol	40	40	1	3	2.4E-02	5.0E-01	1.5E-01	1.5E-01	SW-05	99314154	1.6E+02	3.1E-03	0	0	9.4E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
Dimethylphthalate	40	40	1	3	6.1E-03	5.0E-01	1.3E+00	1.3E+00	SW-04	LSP0003	1.6E+04	3.1E-05	0	0	8.1E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
di-n-Butylphthalate	40	40	2	5	3.6E-02	1.6E+00	4.0E-01	5.0E-01	SW-04	99314153	2.0E+03	8.0E-04	0	0	2.5E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
4,6-Dinitro-2-methylphenol	40	40	0	0	2.4E-02	1.0E+01	--	--	--	--	3.7E+00	2.7E+00	19	48	0.0E+00	0	--	48	--	--	--	Not detected		Y	Insecticide and herbicide
2,4-Dinitrophenol	40	40	0	0	2.4E-02	1.8E+01	--	--	--	--	3.2E+01	5.6E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4-Dinitrotoluene	40	40	0	0	2.4E-02	2.0E+00	--	--	--	--	1.1E-01	1.8E+01	23	58	0.0E+00	0	--	58	--	--	--	Not detected		Y	Selected as preliminary IHS in soil
2,6-Dinitrotoluene	40	40	0	0	2.4E-02	2.0E+00	--	--	--	--	1.6E+01	1.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
di-n-Octylphthalate	40	40	0	0	9.9E-03	2.0E+00	--	--	--	--	3.2E+02	6.3E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1,2-Diphenylhydrazine	19	19	0	0	4.0E-01	4.5E-01	--	--	--	--	3.6E-02	1.3E+01	19	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Chemical intermediate
Hexachlorobenzene	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	2.8E-04	1.8E+03	40	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Used in wood preservative industry; used in manufacture of a variety of products
Hexachlorobutadiene	40	40	0	0	2.4E-02	5.4E-01	--	--	--	--	4.4E-01	1.2E+00	20	50	0.0E+00	0	--	50	--	--	--	Not detected		Y	Used as solvent for elastomers, heat transfer liquid, transformer and hydraulic fluid; released during refuse combustion; found in fly ash
Hexachlorocyclopentadiene	39	39	0	0	2.4E-02	2.2E+00	--	--	--	--	4.0E+01	5.5E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Hexachloroethane	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	1.4E+00	3.6E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Isophorone	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	3.5E+01	1.4E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
1-Methylnaphthalene	15	15	0	0	5.0E-01	5.0E-01	--	--	--	--	1.6E+02	3.1E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Methylphenol	40	40	1	3	2.4E-02	5.0E-01	3.0E-01	3.0E-01	SW-05	99314154	1.8E+03	2.7E-04	0	0	1.6E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
3&4-Methylphenol	18	18	2	11	2.4E-02	4.8E-01	8.7E-03	1.6E-02	SW-05	99314154	1.8E+03	2.6E-04	0	0	8.8E-06	0	0	0	Y	--	--	Doesn't exceed SL		--	
4-Methylphenol	22	22	1	5	1.3E-01	5.0E-01	6.5E+00	6.5E+00	OS07	95352507	1.8E+02	2.7E-03	0	0	3.6E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
2-Nitroaniline	40	40	0	0	2.4E-02	8.3E-01	--	--	--	--	1.1E+02	7.6E-03	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
3-Nitroaniline	40	40	0	0	2.4E-02	2.0E+00	--	--	--	--	3.2E+00	6.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
4-Nitroaniline	40	40	0	0	2.4E-02	2.0E+00	--	--	--	--	3.2E+00	6.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Nitrobenzene	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	4.0E+00	1.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2-Nitrophenol	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
4-Nitrophenol	40	40	0	0	2.4E-02	2.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
1-Nitropyrene	10	10	0	0	4.7E-03	5.3E-03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
n-Nitrosodimethylamine	19	19	0	0	8.4E-01	1.3E+00	--	--	--	--	6.9E-04	1.9E+03	19	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Found in cigarette smoke; emitted during plastic manufacturing; used in production of rocket fuels; additive for lubicants
N-nitrosodiphenylamine	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	3.3E+00	1.5E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
n-Nitroso-di-n-propylamine	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	5.0E-03	1.0E+02	40	100	0.0E+00	0	--	100	--	--	--	Not detected		Y	Found in cigarette smoke; contaminant in herbicides
Pentachlorophenol	40	40	16	40	2.4E-02	2.2E+00	2.7E-02	1.4E+02	SW-05	LSP0004	2.7E-01	8.1E+00	18	75	5.2E+02	10	63	70	Y	Y	Y			--	
Phenol	40	40	4	10	2.4E-02	5.0E-01	5.8E-02	2.6E+00	OS07	95352507	4.8E+03	1.0E-04	0	0	5.4E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
Pyridine	19	19	0	0	4.2E-01	5.0E+00	--	--	--	--	8.0E+00	6.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,3,4,5-Tetrachlorophenol	15	15	0	0	2.5E+00	5.0E+00	--	--	--	--	4.8E+02	1.0E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,3,4,6-Tetrachlorophenol	15	15	1	7	1.7E+00	5.0E+00	7.7E+00	7.7E+00	SW-05	LSP0004	4.8E+02	1.0E-02	0	0	1.6E-02	0	0	0	Y	--	--	Doesn't exceed SL		--	
2,3,5,6-Tetrachlorophenol	15	15	1	7	1.2E+00	5.0E+00	1.0E+00	1.0E+00	SW-05	LSP0004	4.8E+02	1.0E-02	0	0	2.1E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Tetrachlorophenols	15	15	6	40	9.4E-03	4.8E-01	8.3E-03	1.0E+00	SW-05	99504858	4.8E+02	1.0E-03	0	0	2.1E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
1,2,3-Trichlorobenzene	16	16	0	0	4.0E-01	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	

Table F-4. Preliminary Indicator Hazardous Substances for Surface Water Site Wide

Analyte	No. of Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppb	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If Not Detected, Does Max. DL Exceed SL?	Comment (information on chemical uses from HSDB)
1,2,4-Trichlorobenzene	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	3.5E+01	1.4E-02	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4,5-Trichlorophenol	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	8.0E+02	6.3E-04	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
2,4,6-Trichlorophenol	40	40	0	0	2.4E-02	5.0E-01	--	--	--	--	1.4E+00	3.6E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
PAHs, ug/L																									
Acenaphthene	40	40	13	33	4.7E-03	4.7E-01	1.8E-02	1.2E-01	SW-05	99504858	6.4E+02	7.3E-04	0	0	1.9E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
Acenaphthylene	40	40	5	13	4.7E-03	4.5E-01	5.8E-03	5.0E-02	SW-05	99504858	6.4E+02	7.0E-04	0	0	7.8E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
Anthracene	40	40	20	50	4.9E-03	4.2E-01	6.6E-03	9.0E-01	OS01	95372614	4.8E+03	8.8E-05	0	0	1.9E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
Fluorene	40	40	8	20	4.7E-03	4.5E-01	4.8E-03	1.9E-01	SW-05	99504858	6.4E+02	7.0E-04	0	0	3.0E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
Naphthalene	40	40	9	23	4.7E-03	4.6E-01	6.3E-03	1.8E-01	SW-05	99504858	1.6E+02	2.9E-03	0	0	1.1E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Phenanthrene	40	40	18	45	4.9E-03	4.5E-01	9.9E-03	1.9E-01	SW-05	99504858	4.8E+03	9.4E-05	0	0	4.0E-05	0	0	0	Y	--	--	Doesn't exceed SL		--	
2-Methylnaphthalene	40	40	5	13	4.7E-03	4.8E-01	5.1E-03	2.6E-01	SW-05	99504858	1.6E+02	3.0E-03	0	0	1.6E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Benzo(a)anthracene	40	40	5	13	4.7E-03	4.5E-01	1.5E-02	5.8E-02	SW-05	99504858	3.8E-03	1.2E+02	35	100	1.5E+01	5	100	100	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Benzo(a)pyrene	40	40	12	30	4.7E-03	4.5E-01	5.3E-03	2.0E-01	SW-08	99504856	3.8E-03	1.2E+02	28	100	5.3E+01	12	100	100	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Benzo(b)fluoranthene	31	31	4	13	4.8E-03	4.5E-01	7.2E-03	8.0E-01	SW-05	LSP0004	3.8E-03	1.2E+02	27	100	2.1E+02	4	100	100	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Benzo(j)fluoranthene	9	9	0	0	4.8E-03	1.0E-01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Benzo(k)fluoranthene	31	31	2	6	4.8E-03	7.2E-01	4.0E-02	6.0E-01	SW-05	LSP0004	3.8E-03	1.9E+02	29	100	1.6E+02	2	100	100	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Chrysene	40	40	12	30	4.7E-03	4.5E-01	5.3E-03	1.7E+00	OS01	95372614	3.8E-03	1.2E+02	28	100	4.5E+02	12	100	100	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Dibenzo(a,h)anthracene	40	40	1	3	4.7E-03	4.5E-01	2.3E-02	2.3E-02	SW-08	99504856	3.8E-03	1.2E+02	39	100	6.1E+00	1	100	100	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Fluoranthene	40	40	22	55	4.7E-03	4.5E-01	3.8E-03	1.4E+00	SW-05	LSP0004	6.4E+02	7.0E-04	0	0	2.1E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Indeno(1,2,3-cd)pyrene	40	40	7	18	4.7E-03	4.5E-01	7.3E-03	3.0E-01	SW-05	LSP0004	3.8E-03	1.2E+02	33	100	7.9E+01	7	100	100	Y	Y	N	Provided for informational purposes only. BaPE used for screening.		--	
Pyrene	40	40	20	50	4.7E-03	4.5E-01	4.5E-03	7.5E-01	SW-05	LSP0004	4.8E+02	9.4E-04	0	0	1.6E-03	0	0	0	Y	--	--	Doesn't exceed SL		--	
Benzofluoranthenes	9	9	3	33	4.7E-03	5.3E-03	2.4E-02	2.1E-01	SW-08	99504856	1.2E-02	4.4E-01	0	0	1.8E+01	3	100	33	Y	Y	Y			--	
Benzo(g,h,i)perylene	40	40	5	13	4.7E-03	4.5E-01	2.0E-02	3.5E-01	SW-08	99504856	6.4E+02	7.0E-04	0	0	5.5E-04	0	0	0	Y	--	--	Doesn't exceed SL		--	
Dibenzo(a,h)acridine	18	18	0	0	4.7E-03	1.0E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzo(a,j)acridine	18	18	0	0	4.7E-03	1.0E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzo(a,e)pyrene	18	18	0	0	4.7E-03	1.0E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzo(a,h)pyrene	18	18	0	0	4.7E-03	1.0E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzo(a,i)pyrene	18	18	0	0	4.7E-03	1.0E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
Dibenzo(a,l)pyrene	18	18	0	0	4.7E-03	1.0E-02	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
7,12-Dimethylbenz(a)anthracene	33	33	0	0	4.7E-03	1.0E+00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
BaPE (ND = 1/2 DL)	40	40	14	35	4.7E-03	7.2E-01	3.6E-03	3.6E-01	SW-05	LSP0004	3.8E-03	1.9E+02	26	100	9.4E+01	13	93	98	Y	Y	Y			--	
Petroleum, ug/L																									
Gasoline Range Hydrocarbons	19	19	0	0	7.0E+01	1.0E+02	--	--	--	--	8.0E+02	1.3E-01	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Diesel Range Hydrocarbons	19	19	0	0	2.0E+01	5.0E+02	--	--	--	--	5.0E+02	1.0E+00	0	0	0.0E+00	0	--	0	--	--	--	Not detected		N	
Motor Oil	16	16	1	6	5.0E+02	5.0E+02	7.0E+02	7.0E+02	SW-04	LSP0003	5.0E+02	1.0E+00	0	0	1.4E+00	1	100	6	Y	Y	Y			--	
C5-C6 Aliphatics	16	16	0	0	1.5E+01	1.5E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C6-C8 Aliphatics	16	16	0	0	1.0E+01	1.0E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C8-C10 Aliphatics	16	16	0	0	3.0E+01	3.0E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C10-C12 Aliphatics	17	17	0	0	2.4E+01	5.0E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C12-C16 Aliphatics	17	17	0	0	2.4E+01	5.0E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected	Aliphatic and aromatic ranges were provided for informational purposes only. Screening was performed on GRO, DRO, MO, and TPH. Aliphatic and aromatic ranges will be useful in calculating site-specific cleanup levels.	--	
C16-C21 Aliphatics	17	17	0	0	4.7E+01	5.0E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C21-C34 Aliphatics	17	17	5	29	4.7E+01	1.2E+02	5.8E+01	1.1E+02	SW-02	99504004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C8-C10 Aromatics	16	16	1	6	2.5E+01	2.5E+01	7.9E+00	7.9E+00	SW-03	99314152	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C10-C12 Aromatics	17	17	1	6	4.7E+01	5.0E+01	3.8E+01	3.8E+01	SEEP-1	99244027	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C12-C16 Aromatics	17	17	0	0	2.4E+01	5.0E+01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
C16-C21 Aromatics	17	17	1	6	4.7E+01	5.0E+01	5.8E+01	5.8E+01	SW-05	99504858	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
C21-C34 Aromatics	17	17	1	6	4.7E+01	5.0E+01	5.2E+01	5.2E+01	SW-08	99504856	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Dioxins_Furans, ug/L																									
2,3,7,8-TCDD	21	21	1	5	2.7E-06	1.9E-05	7.4E-06	7.4E-06	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total TCDD	21	21	2	10	2.7E-06	1.9E-05	9.3E-06	9.3E-06	SW-05	99314154	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8-PeCDD	21	21	1	5	4.3E-06	2.2E-05	5.9E-05	5.9E-05	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total PeCDD	13	13	1	8	4.9E-06	1.8E-05	1.3E-04	1.3E-04	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,7,8-HxCDD	21	21	1	5	2.8E-06	1.9E-05	1.7E-04	1.7E-04	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,6,7,8-HxCDD	21	21	6	29	3.8E-06	1.5E-05	2.6E-05	6.8E-04	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8,9-HxCDD	21	21	2	10	4.4E-06	4.4E-05	5.4E-05	3.4E-04	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HxCDD	13	13	7	54	3.8E-06	1.1E-05	1.5E-05	3.2E-03	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,6,7,8-HpCDD	21	21	13	62	3.6E-06	1.7E-05	1.9E-05	2.3E-02	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HpCDD	13	13	10	77	3.6E-06	1.4E-05	3.5E-05	4.0E-02	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
OCDD	21	21	17	81	1.3E-05	6.4E-05	7.8E-05	2.5E-01	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
2,3,7,8-TCDF	21	21	1	5	1.8E-06	1.8E-05	6.1E-06	6.1E-06	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL	Individual congeners were provided for informational purposes only. Screening was performed on TEQs calculated using 2005 TEFs.	--	
Total TCDF	21	21	1	5	2.2E-06	1.8E-05	5.0E-05	5.0E-05	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8-PeCDF	21	21	1	5	2.9E-06	3.5E-05	3.0E-05	3.0E-05	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
2,3,4,7,8-PeCDF	21	21	1	5	2.9E-06	3.5E-05	2.9E-05	2.9E-05	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total PeCDF	13	13	3	23	3.6E-06	1.1E-05	7.0E-05	3.4E-04	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,7,8-HxCDF	21	21	1	5	2.4E-06	1.8E-04	1.4E-04	1.4E-04	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,6,7,8-HxCDF	21	21	1	5	1.8E-06	8.0E-05	1.0E-04	1.0E-04	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,7,8,9-HxCDF	21	21	0	0	2.2E-06	1.3E-04	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Not detected		--	
2,3,4,6,7,8-HxCDF	21	21	1	5	2.1E-06	9.3E-05	5.4E-05	5.4E-05	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HxCDF	13	13	5	38	1.8E-06	2.9E-05	6.9E-05	4.0E-03	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,6,7,8-HpCDF	21	21	8	38	2.5E-06	5.8E-05	1.9E-05	4.2E-03	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
1,2,3,4,7,8,9-HpCDF	21	21	1	5	3.5E-06	4.0E-05	3.4E-04	3.4E-04	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
Total HpCDF	13	13	7	54	2.5E-06	1.6E-05	2.8E-04	2.0E-02	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
OCDF	21	21	13	62	3.5E-06	3.1E-05	2.6E-05	3.1E-02	SW-05	LSP0004	--	--	--	--	--	--	--	--	Y	--	--	No SL		--	
TEQDF 0.5M98	21	21	17	81	1.8E-05	6.4E-05	7.9E-06	5.3E-04	SW-05	LSP0004	5.0E-09	1.3E+04	4	100	1.1E+05	17	100	100	Y	Y	N	Provided for informational purposes only. TEQs using 2005 TEFs were used.		--	
TEQDF 0.5M05	21	21	17	81	1.8E-05	6.4E-05	7.4E-06	5.8E-04	SW-05	LSP0004	5.0E-09	1.3E+04	4	100	1.2E+05	17	100	100	Y	Y	Y			--	

Notes: [a]Field duplicate and replicate samples are excluded from counts. Their results have been avearged with corresponding normal sample results.
[b]No. of Data Points might be different from the No. of Samples Analyzed for metals if they were analyzed by more than one method.
BaPE = Benzo(a)pyrene toxicity equivalents
DL = Detection limit
DRO = Diesel range organics

Table F-4. Preliminary Indicator Hazardous Substances for Surface Water Site Wide

Analyte	No. of Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppb	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	Ever Detected?	Max. Detect Exceeds SL?	Preliminary IHS?	Reason for Exclusion	Comment	If Not Detected, Does Max. DL Exceed SL?	Comment (information on chemical uses from HSDB)

GRO = Gasoline range organics
HSDB = Hazardous substance databank
IHS = Indicator hazardous substance
MO = Motor oil
NA = Not applicable
SL = Screening level
TEF = Toxicity equivalency factor
TEQ = Toxicity equivalents
TPH = Total petroleum hydrocarbons
-- = Not available

Table F-5. Final Indicator Hazardous Substances for Surface Soil and Spoil Piles by Site Area

Analyte	No. of Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	95UCL[c]	Min. of 95UCL and Max. Value	Freq. of Detect > 5%?	95UCL[d] > SL?	Max. Detect > 2xSL?	> 10% Values[e] Exceed SL?	Final IHS?	Reason for Exclusion
Beach (DAF=1)																										
Petroleum, mg/kg																										
TPH	1	1	0	0	2.00E+00	2.00E+00	--	--	--	--	2.00E+03	1.00E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
General Site (DAF=1)																										
Metals, mg/kg																										
Arsenic	12	12	4	33	9.00E-01	1.40E+01	3.02E+00	6.00E+00	TP-10	LSP0028	6.70E-01	2.09E+01	8	100	8.96E+00	4	100	100	8.00E+00	6.00E+00	Y	Y	Y	Y	Y	
Lead	9	9	9	100	NA	NA	6.00E+00	9.40E+01	SP07	99070656	2.50E+02	0.00E+00	0	--	3.76E-01	0	0	0	NC	9.40E+01	Y	N	N	N	N	Complies with three part statistical rule
Zinc	9	9	9	100	NA	NA	4.80E+01	4.00E+02	SP07	99070656	6.20E+02	0.00E+00	0	--	6.45E-01	0	0	0	NC	4.00E+02	Y	N	N	N	N	Complies with three part statistical rule
VOCs, mg/kg																										
m&p-Xylene	1	1	0	0	5.00E-01	5.00E-01	--	--	--	--	1.00E+01	8.33E-01	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
SVOCs, mg/kg																										
Carbazole	3	3	0	0	1.36E-01	1.56E-01	--	--	--	--	3.00E-02	5.20E+00	3	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,4-Dinitrotoluene	4	4	0	0	1.60E-02	3.12E-01	--	--	--	--	4.00E-05	7.80E+03	4	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,6-Dinitrotoluene	4	4	0	0	1.60E-02	7.81E-01	--	--	--	--	3.00E-05	2.60E+04	4	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
1-Methylnaphthalene	3	3	0	0	1.36E-01	1.56E-01	--	--	--	--	4.00E+00	3.90E-02	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Pentachlorophenol	4	4	1	25	6.78E-01	7.81E-01	2.20E+00	2.20E+00	SP07	99070656	1.00E-03	7.81E+02	3	100	2.20E+03	1	100	100	NC	2.20E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	4	4	0	0	1.60E-02	7.81E-01	--	--	--	--	8.00E-03	9.76E+01	4	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	4	4	1	25	1.36E-01	1.56E-01	2.50E-02	2.50E-02	SP07	99070656	2.90E+01	5.38E-03	0	0	8.62E-04	0	0	0	NC	2.50E-02	Y	N	N	N	N	Complies with three part statistical rule
Fluorene	4	4	1	25	1.36E-01	1.56E-01	1.70E-01	1.70E-01	SP07	99070656	2.80E+01	5.57E-03	0	0	6.07E-03	0	0	0	NC	1.70E-01	Y	N	N	N	N	Complies with three part statistical rule
Naphthalene	4	4	2	50	1.43E-01	1.56E-01	5.46E-02	8.80E-02	SP07	99070656	4.00E+00	3.90E-02	0	0	2.20E-02	0	0	0	NC	8.80E-02	Y	N	N	N	N	Complies with three part statistical rule
Phenanthrene	4	4	2	50	1.43E-01	1.56E-01	6.60E-02	5.50E-01	SP07	99070656	5.90E+02	2.64E-04	0	0	9.32E-04	0	0	0	NC	5.50E-01	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	4	4	1	25	1.36E-01	1.56E-01	5.80E-02	5.80E-02	SP07	99070656	4.00E+00	3.90E-02	0	0	1.45E-02	0	0	0	NC	5.80E-02	Y	N	N	N	N	Complies with three part statistical rule
Fluoranthene	4	4	3	75	1.56E-01	1.56E-01	3.68E-02	6.60E-01	SP07	99070656	2.10E+02	7.43E-04	0	0	3.14E-03	0	0	0	NC	6.60E-01	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	4	4	2	50	1.43E-01	1.56E-01	6.46E-02	4.60E-01	SP07	99070656	2.10E+02	7.43E-04	0	0	2.19E-03	0	0	0	NC	4.60E-01	Y	N	N	N	N	Complies with three part statistical rule
Benzo(g,h,i)perylene	4	4	3	75	1.56E-01	1.56E-01	1.43E-01	2.50E+00	SP07	99070656	2.10E+02	7.43E-04	0	0	1.19E-02	0	0	0	NC	2.50E+00	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	4	4	3	75	3.12E-01	3.12E-01	1.43E-01	3.41E+00	SP07	99070656	1.40E-01	2.23E+00	1	100	2.43E+01	3	100	100	NC	3.41E+00	Y	Y	Y	Y	Y	
Petroleum, mg/kg																										
Gasoline Range Hydrocarbons	1	1	0	0	6.00E-03	6.00E-03	--	--	--	--	3.00E+01	2.00E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Diesel Range Hydrocarbons	9	9	3	33	5.00E-01	2.20E+00	6.50E+00	1.40E+01	TP-11	LSP0023	2.00E+03	1.10E-03	0	0	7.00E-03	0	0	0	NC	1.40E+01	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	9	9	8	89	1.20E+01	1.20E+01	1.50E+01	5.90E+01	TP-11	LSP0023	2.00E+03	6.00E-03	0	0	2.95E-02	0	0	0	NC	5.90E+01	Y	N	N	N	N	Complies with three part statistical rule
TPH	1	1	1	100	NA	NA	6.66E+02	6.66E+02	SP-FS28	SP-FS28	2.00E+03	0.00E+00	0	--	3.33E-01	0	0	0	NC	6.66E+02	Y	N	N	N	N	Complies with three part statistical rule
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	4	4	4	100	NA	NA	2.55E-06	1.88E-03	SP07	99070656	6.70E-06	0.00E+00	0	--	2.80E+02	1	25	25	NC	1.88E-03	Y	Y	Y	Y	Y	
Historical creek (DAF=1)																										
Metals, mg/kg																										
Arsenic	4	4	2	50	9.00E-01	1.00E+00	7.00E+00	8.00E+00	SB-29	LSP0458	6.70E-01	1.49E+00	2	100	1.19E+01	2	100	100	NC	8.00E+00	Y	Y	Y	Y	Y	
Lead	4	4	4	100	NA	NA	1.80E+01	4.20E+01	TP-25	LSP0115	2.50E+02	0.00E+00	0	--	1.68E-01	0	0	0	NC	4.20E+01	Y	N	N	N	N	Complies with three part statistical rule
Zinc	4	4	4	100	NA	NA	5.90E+01	1.12E+02	SB-11	LSP0274	6.20E+02	0.00E+00	0	--	1.80E-01	0	0	0	NC	1.12E+02	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, mg/kg																										
Carbazole	4	4	4	100	NA	NA	3.70E-02	8.40E-01	TP-16	LSP0088	3.00E-02	0.00E+00	0	--	2.80E+01	4	100	100	NC	8.40E-01	Y	Y	Y	Y	Y	
2,4-Dinitrotoluene	4	4	0	0	3.00E-01	2.00E+00	--	--	--	--	4.00E-05	5.00E+04	4	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,6-Dinitrotoluene	4	4	0	0	3.00E-01	2.00E+00	--	--	--	--	3.00E-05	6.67E+04	4	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
1-Methylnaphthalene	4	4	0	0	5.90E-02	4.10E-01	--	--	--	--	4.00E+00	1.03E-01	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Pentachlorophenol	4	4	3	75	1.40E-01	1.40E-01	2.40E-01	7.10E+00	TP-16	LSP0088	1.00E-03	1.40E+02	1	100	7.10E+03	3	100	100	NC	7.10E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	4	4	0	0	2.60E-02	1.80E-01	--	--	--	--	8.00E-03	2.25E+01	4	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	4	4	1	25	3.10E-02	2.10E-01	1.60E-01	1.60E-01	TP-16	LSP0088	2.90E+01	7.24E-03	0	0	5.52E-03	0	0	0	NC	1.60E-01	Y	N	N	N	N	Complies with three part statistical rule
Fluorene	4	4	3	75	3.40E-02	3.40E-02	2.40E-01	7.80E-01	TP-16	LSP0088	2.80E+01	1.21E-03	0	0	2.79E-02	0	0	0	NC	7.80E-01	Y	N	N	N	N	Complies with three part statistical rule
Naphthalene	4	4	3	75	2.40E-01	2.40E-01	8.50E-02	2.30E-01	SB-11	LSP0274	4.00E+00	6.00E-02	0	0	5.75E-02	0	0	0	NC	2.30E-01	Y	N	N	N	N	Complies with three part statistical rule
Phenanthrene	4	4	4	100	NA	NA	8.60E-02	4.00E+00	TP-16	LSP0088	5.90E+02	0.00E+00	0	--	6.78E-03	0	0	0	NC	4.00E+00	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	4	4	1	25	5.40E-02	3.70E-01	1.20E-01	1.20E-01	SB-11	LSP0274	4.00E+00	9.25E-02	0	0	3.00E-02	0	0	0	NC	1.20E-01	Y	N	N	N	N	Complies with three part statistical rule
Fluoranthene	4	4	4	100	NA	NA	2.40E-01	4.90E+01	TP-16	LSP0088	2.10E+02	0.00E+00	0	--	2.33E-01	0	0	0	NC	4.90E+01	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	4	4	4	100	NA	NA	4.60E-01	1.30E+02	TP-16	LSP0088	2.10E+02	0.00E+00	0	--	6.19E-01	0	0	0	NC	1.30E+02	Y	N	N	N	N	Complies with three part statistical rule
Benzo(g,h,i)perylene	4	4	4	100	NA	NA	1.60E+00	8.70E+01	SB-11	LSP0274	2.10E+02	0.00E+00	0	--	4.14E-01	0	0	0	NC	8.70E+01	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	4	4	4	100	NA	NA	3.87E+00	1.44E+02	SB-11	LSP0274	1.40E-01	0.00E+00	0	--	1.03E+03	4	100	100	NC	1.44E+02	Y	Y	Y	Y	Y	
Petroleum, mg/kg																										
Gasoline Range Hydrocarbons	1	1	0	0	6.00E-03	6.00E-03	--	--	--	--	3.00E+01	2.00E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Diesel Range Hydrocarbons	8	8	7	88	6.00E-01	6.00E-01	9.80E+00	4.90E+02	TP-16	LSP0088	2.00E+03	3.00E-04	0	0	2.45E-01	0	0	0	NC	4.90E+02	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	7	7	7	100	NA	NA	2.70E+01	2.40E+03	SB-11	LSP0274	2.00E+03	0.00E+00	0	--	1.20E+00	1	14	14	NC	2.40E+03	Y	Y	N	Y	Y	
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	1	1	1	100	NA	NA	1.33E-03	1.33E-03	TP-16	LSP0088	6.70E-06	0.00E+00	0	--	1.99E+02	1	100	100	NC	1.33E-03	Y	Y	Y	Y	Y	
Illinois Street (DAF=20)																										
Metals, mg/kg																										
Arsenic	7	7	6	86	9.00E-01	9.00E-01	1.15E+01	1.30E+02	SB-40	LSP0607	6.70E-01	1.34E+00	1	100	1.94E+02	6	100	100	NC	1.30E+02	Y	Y	Y	Y	Y	
Cadmium	7	7	7	100	NA	NA	4.00E-01	3.60E+00	TP-31	LSP0669	8.00E+00	0.00E+00	0	--	9.00E+00	6	86	86	NC	3.60E+00	Y	N	Y	Y	Y	
Lead	7	7	7	100	NA	NA	7.00E+00	1.69E+02	TP-31	LSP0669	2.50E+02	0.00E+00	0	--	6.76E-01	0	0	0	NC	1.69E+02	Y	N	N	N	N	Complies with three part statistical rule
Zinc	7	7	7	100	NA	NA	1.06E+02	1.16E+03	SB-40	LSP0607	1.20E+04	0.00E+00	0	--	1.87E+00	1	14	14	NC	1.16E+03	Y	N	N	Y	Y	
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	7	7	6	86	5.00E-01	5.00E-01	1.28E+01	1.40E+02	SB-40	LSP0607	2.00E+03	2.50E-04	0	0	7.00E-02	0	0	0	NC	1.40E+02	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	7	7	6	86	1.20E+01	1.20E+01	2.60E+01	1.60E+02	TP-31	LSP0669	2.00E+03	6.00E-03	0	0	8.00E-02	0	0	0	NC	1.60E+02	Y	N	N	N	N	Complies with three part statistical rule
Landfill																										
Metals, mg/kg																										
Arsenic	6	6	2	33	9.00E-01	1.00E+01	6.00E+00	1.00E+01	TP-23	LSP0108	6.70E-01	1.49E+01	4	100	1.49E+01	2	100	100	NC	1.00E+01	Y	Y	Y	Y	Y	
Cadmium	6	6	4	67	5.00E-02	1.00E-01	6.00E-01	1.20E+00	TP-23	LSP0108	4.00E-01	2.50E-01	0	0	3.00E+00	4	100	67	NC	1.20E+00	Y	Y	Y	Y	Y	
Lead	6	6	6	100	NA	NA	1.90E+01	2.85E+02	TP-23	LSP0108	2.50E+02	0.00E+00	0	--	1.14E+00	1	17	17	NC	2.85E+02	Y	Y	N	Y	Y	
Zinc	6	6	6	100	NA	NA	8.07E+01	5.05E+02	TP-23	LSP0108	6.20E+02	0.00E+00	0	--	8.15E-01	0	0	0	NC	5.05E+02	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, mg/kg																										
Carbazole	1	1	0	0	2.00E-02	2.00E-02	--	--	--	--	3.00E-02	6.67E-01	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
2,4-Dinitrotoluene	1	1	0	0	1.00E-02	1.00E-02	--	--	--	--	4.00E-05	2.50E+02	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,6-Dinitrotoluene	1	1	0	0	1.20E-02	1.20E-02	--	--	--	--	3.00E-05	4.00E+02	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
1-Methylnaphthalene	1	1	0	0	2.00E-02	2.00E-02	--	--	--	--	4.00E+00	5.00E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Pentachlorophenol	1	1	1	100	NA	NA	3.50E-01	3.50E-01	TP-23	LSP0108	1.00E-03	0.00E+00	0	--	3.50E+02	1	100	100	NC	3.50E-01	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	1	1	0	0	8.60E-03	8.60E-03	--	--	--	--	8.00E-03	1.08E+00	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	1	1	0	0	1.00E-02	1.00E-02	--	--	--	--	2.90E+01	3.45E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%

Table F-5. Final Indicator Hazardous Substances for Surface Soil and Spoil Piles by Site Area

Analyte	No. of Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	95UCL[c]	Min. of 95UCL and Max. Value	Freq. of Detect > 5%?	95UCL[d] > SL?	Max. Detect > 2xSL?	> 10% Values[e] Exceed SL?	Final IHS?	Reason for Exclusion
Fluorene	1	1	0	0	1.10E-02	1.10E-02	--	--	--	--	2.80E+01	3.93E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Naphthalene	1	1	0	0	1.10E-02	1.10E-02	--	--	--	--	4.00E+00	2.75E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Phenanthrene	1	1	1	100	NA	NA	1.30E-01	1.30E-01	TP-23	LSP0108	5.90E+02	0.00E+00	0	--	2.20E-04	0	0	0	NC	1.30E-01	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	1	1	0	0	1.80E-02	1.80E-02	--	--	--	--	4.00E+00	4.50E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Fluoranthene	1	1	1	100	NA	NA	1.70E-01	1.70E-01	TP-23	LSP0108	2.10E+02	0.00E+00	0	--	8.10E-04	0	0	0	NC	1.70E-01	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	1	1	1	100	NA	NA	1.70E-01	1.70E-01	TP-23	LSP0108	2.10E+02	0.00E+00	0	--	8.10E-04	0	0	0	NC	1.70E-01	Y	N	N	N	N	Complies with three part statistical rule
Benzo(g,h,i)perylene	1	1	1	100	NA	NA	1.80E-02	1.80E-02	TP-23	LSP0108	2.10E+02	0.00E+00	0	--	8.57E-05	0	0	0	NC	1.80E-02	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	1	1	1	100	NA	NA	9.81E-02	9.81E-02	TP-23	LSP0108	1.40E-01	0.00E+00	0	--	7.01E-01	0	0	0	NC	9.81E-02	Y	N	N	N	N	Complies with three part statistical rule
Petroleum, mg/kg																										
Gasoline Range Hydrocarbons	3	3	0	0	5.00E-03	7.00E-03	--	--	--	--	3.00E+01	2.33E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Diesel Range Hydrocarbons	6	6	3	50	5.00E-01	6.00E-01	7.15E+00	3.40E+01	TP-23	LSP0108	2.00E+03	3.00E-04	0	0	1.70E-02	0	0	0	NC	3.40E+01	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	6	6	6	100	NA	NA	2.10E+01	2.10E+02	TP-23	LSP0108	2.00E+03	0.00E+00	0	--	1.05E-01	0	0	0	NC	2.10E+02	Y	N	N	N	N	Complies with three part statistical rule
Lower creek (DAF=1)																										
Metals, mg/kg																										
Arsenic	7	7	5	71	9.00E-01	1.00E+00	6.00E+00	2.00E+01	SB-18	LSP0250	6.70E-01	1.49E+00	2	100	2.99E+01	5	100	100	NC	2.00E+01	Y	Y	Y	Y	Y	
Lead	7	7	7	100	NA	NA	8.00E+00	1.15E+02	SB-18	LSP0250	2.50E+02	0.00E+00	0	--	4.60E-01	0	0	0	NC	1.15E+02	Y	N	N	N	N	Complies with three part statistical rule
Zinc	7	7	7	100	NA	NA	4.95E+01	2.97E+02	SB-18	LSP0250	6.20E+02	0.00E+00	0	--	4.79E-01	0	0	0	NC	2.97E+02	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, mg/kg																										
Carbazole	3	3	1	33	2.20E-02	2.90E-02	4.46E-01	4.46E-01	LSC-S1	3394047	3.00E-02	9.67E-01	0	0	1.49E+01	1	100	33	NC	4.46E-01	Y	Y	Y	Y	Y	
2,4-Dinitrotoluene	3	3	0	0	2.20E-02	3.90E-01	--	--	--	--	4.00E-05	9.75E+03	3	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,6-Dinitrotoluene	3	3	0	0	4.40E-02	3.90E-01	--	--	--	--	3.00E-05	1.30E+04	3	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
1-Methylnaphthalene	3	3	1	33	5.90E-02	7.80E-02	1.29E-01	1.29E-01	LSC-S1	3394047	4.00E+00	1.95E-02	0	0	3.23E-02	0	0	0	NC	1.29E-01	Y	N	N	N	N	Complies with three part statistical rule
Pentachlorophenol	3	3	3	100	NA	NA	4.00E-01	5.96E+00	LSC-S1	3394047	1.00E-03	0.00E+00	0	--	5.96E+03	3	100	100	NC	5.96E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	3	3	1	33	2.60E-02	3.40E-02	3.20E-02	3.20E-02	LSC-S1	3394047	8.00E-03	4.25E+00	2	100	4.00E+00	1	100	100	NC	3.20E-02	Y	Y	Y	Y	Y	
PAHs, mg/kg																										
Acenaphthene	3	3	1	33	3.10E-02	4.10E-02	8.30E-02	8.30E-02	LSC-S1	3394047	2.90E+01	1.41E-03	0	0	2.86E-03	0	0	0	NC	8.30E-02	Y	N	N	N	N	Complies with three part statistical rule
Fluorene	3	3	1	33	3.40E-02	4.60E-02	1.53E-01	1.53E-01	LSC-S1	3394047	2.80E+01	1.64E-03	0	0	5.46E-03	0	0	0	NC	1.53E-01	Y	N	N	N	N	Complies with three part statistical rule
Naphthalene	3	3	1	33	3.50E-02	4.60E-02	2.47E-01	2.47E-01	LSC-S1	3394047	4.00E+00	1.15E-02	0	0	6.18E-02	0	0	0	NC	2.47E-01	Y	N	N	N	N	Complies with three part statistical rule
Phenanthrene	3	3	3	100	NA	NA	1.40E-01	1.05E+00	LSC-S1	3394047	5.90E+02	0.00E+00	0	--	1.78E-03	0	0	0	NC	1.05E+00	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	3	3	1	33	5.40E-02	7.20E-02	2.48E-01	2.48E-01	LSC-S1	3394047	4.00E+00	1.80E-02	0	0	6.20E-02	0	0	0	NC	2.48E-01	Y	N	N	N	N	Complies with three part statistical rule
Fluoranthene	3	3	3	100	NA	NA	1.50E-01	2.20E+00	LSC-S1	3394047	2.10E+02	0.00E+00	0	--	1.05E-02	0	0	0	NC	2.20E+00	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	3	3	3	100	NA	NA	1.90E-01	1.79E+00	LSC-S1	3394047	2.10E+02	0.00E+00	0	--	8.52E-03	0	0	0	NC	1.79E+00	Y	N	N	N	N	Complies with three part statistical rule
Benzo(g,h,i)perylene	3	3	3	100	NA	NA	1.90E-01	1.08E+00	LSC-S1	3394047	2.10E+02	0.00E+00	0	--	5.14E-03	0	0	0	NC	1.08E+00	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	3	3	3	100	NA	NA	6.29E-01	3.71E+00	LSC-S1	3394047	1.40E-01	0.00E+00	0	--	2.65E+01	3	100	100	NC	3.71E+00	Y	Y	Y	Y	Y	
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	7	7	5	71	5.00E-01	5.00E-01	7.50E+00	9.05E+01	SB-18	LSP0250	2.00E+03	2.50E-04	0	0	4.53E-02	0	0	0	NC	9.05E+01	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	7	7	7	100	NA	NA	1.20E+01	2.30E+02	SB-20	LSP0271	2.00E+03	0.00E+00	0	--	1.15E-01	0	0	0	NC	2.30E+02	Y	N	N	N	N	Complies with three part statistical rule
TPH	5	5	5	100	NA	NA	4.18E+02	2.11E+03	SP-FS50	SP-FS50	2.00E+03	0.00E+00	0	--	1.05E+00	2	40	40	NC	2.11E+03	Y	Y	N	Y	Y	
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	2	2	2	100	NA	NA	1.13E-03	1.58E-03	SB-20	LSP0271	6.70E-06	0.00E+00	0	--	2.36E+02	2	100	100	NC	1.58E-03	Y	Y	Y	Y	Y	
Railroad (DAF=1)																										
Metals, mg/kg																										
Arsenic	6	6	6	100	NA	NA	7.00E+00	1.00E+01	HA-02; HA-05; HA-0	0571; LSP0577; LSP0	6.70E-01	0.00E+00	0	--	1.49E+01	6	100	100	NC	1.00E+01	Y	Y	Y	Y	Y	
Lead	6	6	6	100	NA	NA	1.50E+01	3.27E+02	HA-02	LSP0571	2.50E+02	0.00E+00	0	--	1.31E+00	1	17	17	NC	3.27E+02	Y	Y	N	Y	Y	
Zinc	6	6	6	100	NA	NA	8.22E+01	2.78E+02	HA-02	LSP0571	6.20E+02	0.00E+00	0	--	4.48E-01	0	0	0	NC	2.78E+02	Y	N	N	N	N	Complies with three part statistical rule
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	6	6	6	100	NA	NA	1.25E+01	2.10E+02	HA-02	LSP0571	2.00E+03	0.00E+00	0	--	1.05E-01	0	0	0	NC	2.10E+02	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	6	6	6	100	NA	NA	4.50E+01	2.90E+02	HA-04	LSP0575	2.00E+03	0.00E+00	0	--	1.45E-01	0	0	0	NC	2.90E+02	Y	N	N	N	N	Complies with three part statistical rule
South Slope (DAF=20)																										
Metals, mg/kg																										
Arsenic	7	7	7	100	NA	NA	4.65E+00	1.39E+01	RES-43	99224021	6.70E-01	0.00E+00	0	--	2.07E+01	7	100	100	NC	1.39E+01	Y	Y	Y	Y	Y	
Lead	5	5	5	100	NA	NA	2.20E+01	5.10E+01	B-BB3	99070535	2.50E+02	0.00E+00	0	--	2.04E-01	0	0	0	NC	5.10E+01	Y	N	N	N	N	Complies with three part statistical rule
Zinc	5	5	5	100	NA	NA	9.50E+01	1.70E+02	B-BB3	99070535	1.20E+04	0.00E+00	0	--	2.74E-01	0	0	0	NC	1.70E+02	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, mg/kg																										
Carbazole	2	2	0	0	1.32E-01	1.91E-01	--	--	--	--	6.00E-01	6.37E+00	2	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,4-Dinitrotoluene	7	7	2	29	1.10E-02	3.81E-01	3.60E-02	4.50E-02	B-BB3	99070535	8.00E-04	9.53E+03	5	100	1.13E+03	2	100	100	NC	4.50E-02	Y	Y	Y	Y	Y	
2,6-Dinitrotoluene	7	7	1	14	1.10E-02	9.53E-01	2.20E-02	2.20E-02	B-BB5	99070536	7.00E-04	3.18E+04	6	100	7.33E+02	1	100	100	NC	2.20E-02	Y	Y	Y	Y	Y	
1-Methylnaphthalene	2	2	1	50	1.91E-01	1.91E-01	9.17E-02	9.17E-02	RES-43	99224021	8.40E+01	4.78E-02	0	0	2.29E-02	0	0	0	NC	9.17E-02	Y	N	N	N	N	Complies with three part statistical rule
Pentachlorophenol	7	7	3	43	1.10E-02	9.53E-01	8.50E-03	1.50E-02	B-AA2	99070532	3.00E-02	9.53E+02	4	100	1.50E+01	3	100	100	NC	1.50E-02	Y	N	Y	Y	Y	
2,4,6-Trichlorophenol	7	7	0	0	1.10E-02	9.53E-01	--	--	--	--	2.00E-01	1.19E+02	7	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	7	7	0	0	2.30E-03	1.91E-01	--	--	--	--	5.70E+02	6.59E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Fluorene	7	7	0	0	2.30E-03	1.91E-01	--	--	--	--	5.60E+02	6.82E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Naphthalene	7	7	6	86	1.91E-01	1.91E-01	5.90E-03	1.02E-01	RES-43	99224021	8.40E+01	4.78E-02	0	0	2.55E-02	0	0	0	NC	1.02E-01	Y	N	N	N	N	Complies with three part statistical rule
Phenanthrene	7	7	4	57	2.30E-03	1.91E-01	9.70E-03	7.27E-02	RES-43	99224021	1.20E+04	3.24E-04	0	0	1.23E-04	0	0	0	NC	7.27E-02	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	7	7	6	86	1.91E-01	1.91E-01	4.30E-03	1.41E-01	RES-43	99224021	8.40E+01	4.78E-02	0	0	3.53E-02	0	0	0	NC	1.41E-01	Y	N	N	N	N	Complies with three part statistical rule
Fluoranthene	7	7	7	100	NA	NA	9.70E-03	6.38E-02	RES-46	99224022	3.20E+03	0.00E+00	0	--	3.04E-04	0	0	0	NC	6.38E-02	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	7	7	4	57	2.30E-03	1.91E-01	1.10E-02	4.44E-02	RES-43	99224021	2.40E+03	9.10E-04	0	0	2.11E-04	0	0	0	NC	4.44E-02	Y	N	N	N	N	Complies with three part statistical rule
Benzo(g,h,i)perylene	7	7	1	14	2.30E-03	1.91E-01	1.56E-01	1.56E-01	RES-43	99224021	3.20E+03	9.10E-04	0	0	7.43E-04	0	0	0	NC	1.56E-01	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	7	7	5	71	2.50E-03	3.81E-01	1.89E-03	1.94E-01	RES-43	99224021	1.40E-01	2.72E+00	1	50	1.39E+00	1	20	29	NC	1.94E-01	Y	Y	N	Y	Y	
Petroleum, mg/kg																										
TPH	20	20	20	100	NA	NA	5.00E+01	4.75E+02	SS-FS05	SS-FS05	2.00E+03	0.00E+00	0	--	2.38E-01	0	0	0	1.58E+02	1.58E+02	Y	N	N	N	N	Complies with three part statistical rule
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	7	7	7	100	NA	NA	4.69E-06	7.81E-05	RES-43	99224021	6.70E-06	0.00E+00	0	--	1.17E+01	5	71	71	NC	7.81E-05	Y	Y	Y	Y	Y	
Upper creek (DAF=1)																										
Metals, mg/kg																										
Arsenic	20	20	8	40	1.00E+00	2.00E+01	6.00E+00	1.50E+02	MWLSC01	99070511	6.70E-01	2.99E+01	12	100	2.24E+02	8	100	100	8.30E+01	8.30E+01	Y	Y	Y	Y	Y	
Lead	20	20	20	100	NA	NA	3.80E+00	1.70E+02	MWLSC01	99070511	2.50E+02	0.00E+00	0	--	6.80E-01	0	0	0	5.66E+01	5.66E+01	Y	N	N	N	N	Complies with three part statistical rule
Zinc	20	20	20	100	NA	NA	5.40E+01	6.10E+02	MWLSC01	99070511	6.20E+02	0.00E+00	0	--	9.84E-01	0	0	0	2.57E+02	2.57E+02	Y	N	N	N	N	Complies with three part statistical rule
VOCs, mg/kg																										
m&p-Xylene	6	6	0	0	5.00E-01	5.00E-01	--	--	--	--	1.00E+01	8.33E-01	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
SVOCs, mg/kg																										
Carbazole	3	3	3	100	NA	NA	1.66E-01	4.80E-01	SB-11	LSP0274	3.00E-02	0.00E+00	0	--	1.60E+01	3	100	100	NC	4.80E-01	Y	Y	Y	Y	Y	
2,4-Dinitrotoluene	13	13	1	8	9.80E-03	4.90E-01	4.20E-02	4.20E-02	MWLSC02	99070512	4.00E-05	1.23E+04	12	100	1.05E+03	1	100	100	4.73E-01	4.20E-02	Y	Y	Y	Y	Y	
2,6-Dinitrotoluene	13	13	0	0	9.80E-03	4.90E-01	--	--	--	--	3.00E-05	1.63E+04	13	100	0.00E+00	0	--	100	5.41E-01	5.41E-01	N	Y	--	Y	N	FOD less than 5%
1-Methylnaphthalene	3	3	1	33	5.90E-02	9.90E-02	5.30E-02	5.30E-02	LSC-S2	3394048	4.00E+00	2.48E-02	0	0	1.33E-02	0	0	0	NC	5.30E-02	Y	N	N	N	N	Complies with three part statistical rule

Table F-5. Final Indicator Hazardous Substances for Surface Soil and Spoil Piles by Site Area

Analyte	No. of Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	95UCL[c]	Min. of 95UCL and Max. Value	Freq. of Detect > 5%?	95UCL[d] > SL?	Max. Detect > 2xSL?	> 10% Values[e] Exceed SL?	Final IHS?	Reason for Exclusion
Pentachlorophenol	13	13	11	85	1.10E-02	1.50E-01	5.60E-03	1.80E+00	SP03	99070652	1.00E-03	1.50E+02	2	100	1.80E+03	11	100	100	2.50E+01	1.80E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	13	13	0	0	9.80E-03	2.34E-01	--	--	--	--	8.00E-03	2.93E+01	13	100	0.00E+00	0	--	100	3.00E-01	3.00E-01	N	Y	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	13	13	6	46	2.00E-03	5.10E-02	6.70E-03	7.20E+01	SP02	99070651	2.90E+01	1.76E-03	0	0	2.48E+00	1	17	8	NC	7.20E+01	Y	Y	Y	N	Y	
Fluorene	13	13	9	69	2.10E-03	2.20E-03	1.20E-02	5.70E+01	SP02	99070651	2.80E+01	7.86E-05	0	0	2.04E+00	1	11	8	NC	5.70E+01	Y	Y	Y	N	Y	
Naphthalene	13	13	11	85	2.20E-03	3.70E-02	5.90E-03	5.50E+00	SP02	99070651	4.00E+00	9.25E-03	0	0	1.38E+00	1	9	8	NC	5.50E+00	Y	Y	N	N	Y	
Phenanthrene	13	13	12	92	2.20E-03	2.20E-03	6.50E-03	2.00E+02	SP02	99070651	5.90E+02	3.73E-06	0	0	3.39E-01	0	0	0	NC	2.00E+02	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	13	13	11	85	2.20E-03	5.40E-02	4.30E-03	1.10E+01	SP02	99070651	4.00E+00	1.35E-02	0	0	2.75E+00	1	9	8	NC	1.10E+01	Y	Y	Y	N	Y	
Fluoranthene	13	13	12	92	2.20E-03	2.20E-03	1.10E-02	1.50E+02	SP02	99070651	2.10E+02	1.05E-05	0	0	7.14E-01	0	0	0	NC	1.50E+02	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	13	13	12	92	2.20E-03	2.20E-03	9.70E-03	1.70E+02	SP02	99070651	2.10E+02	1.05E-05	0	0	8.10E-01	0	0	0	NC	1.70E+02	Y	N	N	N	N	Complies with three part statistical rule
Benzo(g,h,i)perylene	13	13	11	85	2.10E-03	2.20E-03	9.50E-03	8.70E+01	SB-11	LSP0274	2.10E+02	1.05E-05	0	0	4.14E-01	0	0	0	NC	8.70E+01	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	13	13	12	92	2.20E-03	2.20E-03	1.40E-02	1.44E+02	SB-11	LSP0274	1.40E-01	1.57E-02	0	0	1.03E+03	9	75	69	6.21E+05	1.44E+02	Y	Y	Y	Y	Y	
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	10	10	9	90	6.00E-01	6.00E-01	1.15E+01	4.60E+02	SB-11	LSP0274	2.00E+03	3.00E-04	0	0	2.30E-01	0	0	0	NC	4.60E+02	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	10	10	9	90	1.50E+01	1.50E+01	3.00E+01	2.40E+03	SB-11	LSP0274	2.00E+03	7.50E-03	0	0	1.20E+00	1	11	10	NC	2.40E+03	Y	Y	N	N	Y	
TPH	38	38	38	100	NA	NA	2.20E+01	2.08E+03	SP-FS10	SP-FS10	2.00E+03	0.00E+00	0	--	1.04E+00	1	3	3	1.06E+03	1.06E+03	Y	N	N	N	N	Complies with three part statistical rule
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	11	11	11	100	NA	NA	1.49E-06	1.37E-03	SP02	99070651	6.70E-06	0.00E+00	0	--	2.05E+02	10	91	91	NC	1.37E-03	Y	Y	Y	Y	Y	
Wetlands (DAF=1)																										
Metals, mg/kg																										
Arsenic	2	2	2	100	NA	NA	1.00E+01	4.70E+01	HA-08	LSP0017	6.70E-01	0.00E+00	0	--	7.01E+01	2	100	100	NC	4.70E+01	Y	Y	Y	Y	Y	
Lead	2	2	2	100	NA	NA	3.25E+01	1.00E+02	HA-08	LSP0017	2.50E+02	0.00E+00	0	--	4.00E-01	0	0	0	NC	1.00E+02	Y	N	N	N	N	Complies with three part statistical rule
Zinc	2	2	2	100	NA	NA	9.79E+01	2.57E+02	HA-08	LSP0017	6.20E+02	0.00E+00	0	--	4.15E-01	0	0	0	NC	2.57E+02	Y	N	N	N	N	Complies with three part statistical rule
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	2	2	0	0	5.00E-01	7.00E-01	--	--	--	--	2.00E+03	3.50E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Motor Oil	2	2	2	100	NA	NA	1.80E+01	2.30E+01	HA-08	LSP0017	2.00E+03	0.00E+00	0	--	1.15E-02	0	0	0	NC	2.30E+01	Y	N	N	N	N	Complies with three part statistical rule
TPH	2	2	2	100	NA	NA	6.10E+01	7.95E+01	SP-FS21	SP-FS21	2.00E+03	0.00E+00	0	--	3.98E-02	0	0	0	NC	7.95E+01	Y	N	N	N	N	Complies with three part statistical rule

Notes: [a]Field duplicate and replicate samples are excluded from counts. Their results have been avearged with corresponding normal sample results.
[b]No. of Data Points might be different from the No. of Samples Analyzed for metals if they were analyzed by more than one method.
[c]95UCLs were calculated for data sets of at least 11 samples.
[d]Defaults to the Max. detected value when the 95UCL is larger than the Max. detected value.
[e]Refers to all values including both detected values and detection limits.
DL = Detection limit
DRO = Diesel range organics
FOD = Freq. of detection
GRO = Gasoline range organics
HSDB = Hazardous substance databank
IHS = Indicator hazardous substance
MO = Motor oil
NA = Not applicable
NC = Not calculated
SL = Screening level
TEQ = 2,3,7,8-TCDD toxicity equivalents
TPH = Total petroleum hydrocarbons
95UCL = Upper 95 percent confidence limit on the mean
-- = Not available

Table F-6. Final Indicator Hazardous Substances for Subsurface Soil by Site Area

Analyte	No. of Samples Analyzeda	No. of Data Pointsb	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	95UCL[c]	Min. of 95UCL and Max. Value	Freq. of Detect > 5%?	95UCL[d] > SL?	Max. Detect > 2xSL?	> 10% Values[e] Exceed SL?	Final IHS?	Reason for Exclusion
General Site (DAF=1)																										
Metals, mg/kg																										
Arsenic	1	1	0	0	8.00E-01	8.00E-01	--	--	--	--	6.70E-01	1.19E+00	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
Lead	1	1	1	100	NA	NA	8.00E+00	8.00E+00	TP-10	LSP0029	2.50E+02	0.00E+00	0	--	3.20E-02	0	0	0	NC	8.00E+00	Y	N	N	N	N	Complies with three part statistical rule
Zinc	1	1	1	100	NA	NA	5.97E+01	5.97E+01	TP-10	LSP0029	6.20E+02	0.00E+00	0	--	9.63E-02	0	0	0	NC	5.97E+01	Y	N	N	N	N	Complies with three part statistical rule
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	2	2	1	50	4.00E-01	4.00E-01	8.00E+00	8.00E+00	TP-10	LSP0029	2.00E+03	2.00E-04	0	0	4.00E-03	0	0	0	NC	8.00E+00	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	2	2	1	50	1.10E+01	1.10E+01	3.60E+01	3.60E+01	TP-10	LSP0029	2.00E+03	5.50E-03	0	0	1.80E-02	0	0	0	NC	3.60E+01	Y	N	N	N	N	Complies with three part statistical rule
Historical creek (DAF=1)																										
Metals, mg/kg																										
Arsenic	9	9	6	67	8.00E-01	1.00E+01	6.00E+00	1.00E+01	SB-11	LSP0190	6.70E-01	1.49E+01	3	100	1.49E+01	6	100	100	NC	1.00E+01	Y	Y	Y	Y	Y	
Lead	9	9	9	100	NA	NA	2.00E+00	4.35E+01	SB-11	LSP0187	2.50E+02	0.00E+00	0	--	1.74E-01	0	0	0	NC	4.35E+01	Y	N	N	N	N	Complies with three part statistical rule
Zinc	12	12	12	100	NA	NA	3.42E+01	2.06E+02	SB-29	LSP0462	6.20E+02	0.00E+00	0	--	3.32E-01	0	0	0	NC	2.06E+02	Y	N	N	N	N	Complies with three part statistical rule
VOCs, mg/kg																										
m&p-Xylene	1	1	1	100	NA	NA	1.80E-01	1.80E-01	TP-06	LSP0045	1.00E+01	0.00E+00	0	--	3.00E-01	0	0	0	NC	1.80E-01	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, mg/kg																										
Carbazole	10	10	9	90	2.20E-02	2.20E-02	1.10E-02	3.30E+01	TP-06	LSP0045	3.00E-02	7.33E-01	0	0	1.10E+03	8	89	80	NC	3.30E+01	Y	Y	Y	Y	Y	
2,4-Dinitrotoluene	10	10	1	10	9.90E-03	1.00E+00	4.20E+00	4.20E+00	TP-06	LSP0045	4.00E-05	2.50E+04	9	100	1.05E+05	1	100	100	NC	4.20E+00	Y	Y	Y	Y	Y	
2,6-Dinitrotoluene	10	10	0	0	1.20E-02	2.20E+00	--	--	--	--	3.00E-05	7.33E+04	10	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
1-Methylnaphthalene	10	10	6	60	2.00E-02	2.00E-01	1.80E-01	1.60E+02	TP-06	LSP0045	4.00E+00	5.00E-02	0	0	4.00E+01	4	67	40	NC	1.60E+02	Y	Y	Y	Y	Y	
Pentachlorophenol	10	10	6	60	4.50E-02	1.00E+00	1.80E-01	3.50E+00	TP-06	LSP0045	1.00E-03	1.00E+03	4	100	3.50E+03	6	100	100	NC	3.50E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	10	10	0	0	8.40E-03	1.00E+00	--	--	--	--	8.00E-03	1.25E+02	10	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	10	10	7	70	1.00E-02	1.30E-01	1.80E-01	3.20E+02	TP-06	LSP0045	2.90E+01	4.48E-03	0	0	1.10E+01	3	43	30	NC	3.20E+02	Y	Y	Y	Y	Y	
Fluorene	10	10	8	80	1.10E-02	3.40E-02	7.40E-01	2.40E+02	TP-06	LSP0045	2.80E+01	1.21E-03	0	0	8.57E+00	3	38	30	NC	2.40E+02	Y	Y	Y	Y	Y	
Naphthalene	10	10	8	80	3.50E-02	1.30E-01	2.00E-02	5.20E+02	TP-06	LSP0045	4.00E+00	3.25E-02	0	0	1.30E+02	4	50	40	NC	5.20E+02	Y	Y	Y	Y	Y	
Phenanthrene	10	10	10	100	NA	NA	3.20E-02	7.20E+02	TP-06	LSP0045	5.90E+02	0.00E+00	0	--	1.22E+00	1	10	10	NC	7.20E+02	Y	Y	N	N	Y	
2-Methylnaphthalene	10	10	7	70	1.80E-02	1.20E-01	4.00E-02	2.80E+02	TP-06	LSP0045	4.00E+00	3.00E-02	0	0	7.00E+01	4	57	40	NC	2.80E+02	Y	Y	Y	Y	Y	
Fluoranthene	10	10	10	100	NA	NA	9.20E-02	4.20E+02	TP-06	LSP0045	2.10E+02	0.00E+00	0	--	2.00E+00	1	10	10	NC	4.20E+02	Y	Y	N	N	Y	
Pyrene	10	10	10	100	NA	NA	1.20E-01	3.00E+02	TP-06	LSP0045	2.10E+02	0.00E+00	0	--	1.43E+00	1	10	10	NC	3.00E+02	Y	Y	N	N	Y	
Benzo(g,h,i)perylene	10	10	10	100	NA	NA	3.60E-02	2.30E+02	SB-11	LSP0275	2.10E+02	0.00E+00	0	--	1.10E+00	1	10	10	NC	2.30E+02	Y	Y	N	N	Y	
BaPE (ND = 1/2 DL)	10	10	10	100	NA	NA	4.55E-01	4.44E+02	SB-11	LSP0275	1.40E-01	0.00E+00	0	--	3.17E+03	10	100	100	NC	4.44E+02	Y	Y	Y	Y	Y	
Petroleum, mg/kg																										
Gasoline Range Hydrocarbons	3	3	3	100	NA	NA	1.10E+02	1.60E+03	TP-06	LSP0045	3.00E+01	0.00E+00	0	--	5.33E+01	3	100	100	NC	1.60E+03	Y	Y	Y	Y	Y	
Diesel Range Hydrocarbons	19	19	17	89	5.00E-01	5.00E-01	6.60E+00	8.40E+03	TP-06	LSP0045	2.00E+03	2.50E-04	0	0	4.20E+00	2	12	11	5.37E+04	8.40E+03	Y	Y	Y	Y	Y	
Motor Oil	18	18	15	83	1.20E+01	1.60E+01	2.20E+01	2.90E+03	SB-11	LSP0275	2.00E+03	8.00E-03	0	0	1.45E+00	1	7	6	1.09E+03	1.09E+03	Y	N	N	N	N	Complies with three part statistical rule
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	2	2	2	100	NA	NA	1.04E-04	3.59E-04	TP-17	LSP0090	6.70E-06	0.00E+00	0	--	5.36E+01	2	100	100	NC	3.59E-04	Y	Y	Y	Y	Y	
Illinois Street (DAF=20)																										
Metals, mg/kg																										
Arsenic	5	5	3	60	1.00E+00	1.00E+01	1.30E+01	2.35E+02	SB-40	LSP0609	6.70E-01	1.49E+01	2	100	3.51E+02	3	100	100	NC	2.35E+02	Y	Y	Y	Y	Y	
Cadmium	5	5	4	80	4.00E-02	4.00E-02	3.00E-01	1.50E+00	SB-40	LSP0608	8.00E+00	1.00E-01	0	0	3.75E+00	3	75	60	NC	1.50E+00	Y	N	Y	Y	Y	
Lead	5	5	4	80	3.00E-01	3.00E-01	6.00E+00	5.38E+02	SB-40	LSP0609	2.50E+02	1.20E-03	0	0	2.15E+00	1	25	20	NC	5.38E+02	Y	Y	Y	Y	Y	
Zinc	5	5	5	100	NA	NA	7.25E+01	1.37E+03	SB-40	LSP0609	1.20E+04	0.00E+00	0	--	2.21E+00	2	40	40	NC	1.37E+03	Y	N	Y	Y	Y	
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	7	7	2	29	4.00E-01	5.00E-01	5.20E+01	1.50E+02	SB-40	LSP0608	2.00E+03	2.50E-04	0	0	7.50E-02	0	0	0	NC	1.50E+02	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	7	7	2	29	1.10E+01	1.30E+01	1.30E+02	1.80E+02	SB-40	LSP0608	2.00E+03	6.50E-03	0	0	9.00E-02	0	0	0	NC	1.80E+02	Y	N	N	N	N	Complies with three part statistical rule
Landfill (DAF=1)																										
Metals, mg/kg																										
Arsenic	17	17	7	41	8.00E-01	4.00E+01	6.00E+00	1.30E+01	TP-22	LSP0106	6.70E-01	5.97E+01	10	100	1.94E+01	7	100	100	1.21E+01	1.21E+01	Y	Y	Y	Y	Y	
Cadmium	17	17	13	76	4.00E-02	6.00E-02	4.00E-01	1.00E+01	TP-23	LSP0110	4.00E-01	1.50E-01	0	0	2.50E+01	10	77	59	NC	1.00E+01	Y	Y	Y	Y	Y	
Lead	17	17	17	100	NA	NA	3.00E+00	3.97E+03	TP-22	LSP0107	2.50E+02	0.00E+00	0	--	1.59E+01	4	24	24	6.73E+03	3.97E+03	Y	Y	Y	Y	Y	
Zinc	17	17	17	100	NA	NA	4.46E+01	3.06E+03	TP-23	LSP0110	6.20E+02	0.00E+00	0	--	4.94E+00	4	24	24	1.47E+03	1.47E+03	Y	Y	Y	Y	Y	
SVOCs, mg/kg																										
Carbazole	1	1	0	0	2.00E-02	2.00E-02	--	--	--	--	3.00E-02	6.67E-01	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
2,4-Dinitrotoluene	1	1	0	0	1.00E-02	1.00E-02	--	--	--	--	4.00E-05	2.50E+02	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,6-Dinitrotoluene	1	1	0	0	1.20E-02	1.20E-02	--	--	--	--	3.00E-05	4.00E+02	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
1-Methylnaphthalene	1	1	0	0	2.00E-02	2.00E-02	--	--	--	--	4.00E+00	5.00E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Pentachlorophenol	1	1	0	0	4.60E-02	4.60E-02	--	--	--	--	1.00E-03	4.60E+01	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,4,6-Trichlorophenol	1	1	0	0	8.60E-03	8.60E-03	--	--	--	--	8.00E-03	1.08E+00	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	1	1	0	0	1.00E-02	1.00E-02	--	--	--	--	2.90E+01	3.45E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Fluorene	1	1	0	0	1.10E-02	1.10E-02	--	--	--	--	2.80E+01	3.93E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Naphthalene	1	1	0	0	1.20E-02	1.20E-02	--	--	--	--	4.00E+00	3.00E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Phenanthrene	1	1	1	100	NA	NA	1.40E-02	1.40E-02	TP-23	LSP0110	5.90E+02	0.00E+00	0	--	2.37E-05	0	0	0	NC	1.40E-02	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	1	1	0	0	1.80E-02	1.80E-02	--	--	--	--	4.00E+00	4.50E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Fluoranthene	1	1	1	100	NA	NA	3.20E-02	3.20E-02	TP-23	LSP0110	2.10E+02	0.00E+00	0	--	1.52E-04	0	0	0	NC	3.20E-02	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	1	1	1	100	NA	NA	5.00E-02	5.00E-02	TP-23	LSP0110	2.10E+02	0.00E+00	0	--	2.38E-04	0	0	0	NC	5.00E-02	Y	N	N	N	N	Complies with three part statistical rule
Benzo(g,h,i)perylene	1	1	1	100	NA	NA	2.50E-02	2.50E-02	TP-23	LSP0110	2.10E+02	0.00E+00	0	--	1.19E-04	0	0	0	NC	2.50E-02	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	1	1	1	100	NA	NA	4.36E-02	4.36E-02	TP-23	LSP0110	1.40E-01	0.00E+00	0	--	3.12E-01	0	0	0	NC	4.36E-02	Y	N	N	N	N	Complies with three part statistical rule
Petroleum, mg/kg																										
Gasoline Range Hydrocarbons	10	10	0	0	4.00E-03	1.00E-02	--	--	--	--	3.00E+01	3.33E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Diesel Range Hydrocarbons	16	16	7	44	4.00E-01	6.00E-01	1.30E+01	5.20E+01	TP-23	LSP0110	2.00E+03	3.00E-04	0	0	2.60E-02	0	0	0	4.85E+01	4.85E+01	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	16	16	8	50	1.10E+01	1.50E+01	2.60E+01	2.30E+02	TP-23	LSP0110	2.00E+03	7.50E-03	0	0	1.15E-01	0	0	0	1.09E+02	1.09E+02	Y	N	N	N	N	Complies with three part statistical rule
Lower creek (DAF=1)																										
Metals, mg/kg																										
Arsenic	9	9	3	33	9.00E-01	2.00E+01	7.00E+00	8.00E+00	SB-20	LSP0272	6.70E-01	2.99E+01	6	100	1.19E+01	3	100	100	NC	8.00E+00	Y	Y	Y	Y	Y	
Lead	9	9	9	100	NA	NA	7.00E+00	5.20E+01	SB-01	LSP0122	2.50E+02	0.00E+00	0	--	2.08E-01	0	0	0	NC	5.20E+01	Y	N	N	N	N	Complies with three part statistical rule
Zinc	9	9	9	100	NA	NA	5.50E+01	1.84E+02	SB-18	LSP0252	6.20E+02	0.00E+00	0	--	2.97E-01	0	0	0	NC	1.84E+02	Y	N	N	N	N	Complies with three part statistical rule
Petroleum, mg/kg																										
Gasoline Range Hydrocarbons	1	1	0	0	1.10E-02	1.10E-02	--	--	--	--	3.00E+01	3.67E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Diesel Range Hydrocarbons	9	9	5	56	4.00E-01	2.60E+00	8.40E+00	6.40E+01	SB-18	LSP0252	2.00E+03	1.30E-03	0	0	3.20E-02	0	0	0	NC	6.40E+01	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	9	9	6	67	1.10E+01	6.30E+01	2.00E+01	1.60E+02	SB-18	LSP0252	2.00E+03	3.15E-02	0	0	8.00E-02	0	0	0	NC	1.60E+02	Y	N	N	N	N	Complies with three part statistical rule
Railroad (DAF=1)																										
Metals, mg/kg																										
Arsenic	6	6	3	50	1.00E+01	2.00E+01	6.00E+00	9.00E+00	HA-01	LSP0570	6.70E-01	2.99E+01	3	100	1.34E+01	3	100	100	NC	9.00E+00	Y	Y	Y	Y	Y	
Lead	6	6	6	100	NA	NA	1.10E+01	1.17E+02	HA-02	LSP0572	2.50E+02	0.00E+00	0	--	4.68E-01	0	0	0	NC	1.17E+02	Y	N	N	N	N	Complies with three part statistical rule
Zinc	6	6	6	100	NA	NA	6.10E+01	1.47E+02	HA-02	LSP0572	6.20E+02	0.00E+00	0	--	2.37E-01	0	0	0	NC	1.47E+02	Y	N	N	N	N	Complies with three part statistical rule
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	6	6	3	50	5.00E-01	1.00E+00	1.20E+01	4.00E+01	HA-04	LSP0576	2.00E+03	5.00E-04	0	0	2.00E-02	0	0	0	NC	4.00E+01	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	6	6	6	100	NA	NA	1.40E+01	1.60E+02	HA-04	LSP0576	2.00E+03	0.00E+00	0	--	8.00E-02	0	0	0	NC	1.60E+02	Y	N	N	N	N	Complies with three part statistical rule
South Slope (DAF=20)																										
Metals, mg/kg																										

Table F-6. Final Indicator Hazardous Substances for Subsurface Soil by Site Area

Analyte	No. of Samples Analyzed[a]	No. of Data Points[b]	No. of Samples Detected	Percent Detected Data Points	Min. Detection Limit	Max. Detection Limit	Min. Detected Value	Max. Detected Value	Location of Max. Detected Value	Sample ID of Max. Detected Value	Human Health Screening Level, ppm	Ratio of Max. DL to SL	No. of DL Exceedances	Freq. of DL Exceedance	Ratio of Max. Detect to SL	No. of Detected Exceedances	Freq. of Detected Exceedance	Total Freq. of Exceedance Detected & DL	95UCL[c]	Min. of 95UCL and Max. Value	Freq. of Detect > 5%?	95UCL[d] > SL?	Max. Detect > 2xSL?	> 10% Values[e] Exceed SL?	Final IHS?	Reason for Exclusion
Arsenic	8	8	2	25	6.90E+00	9.80E+00	5.00E+00	6.70E+00	B-AA4	99070588	6.70E-01	1.46E+01	6	100	1.00E+01	2	100	100	NC	6.70E+00	Y	Y	Y	Y	Y	
Lead	8	8	8	100	NA	NA	3.20E+00	8.30E+00	B-AA4	99070588	2.50E+02	0.00E+00	0	--	3.32E-02	0	0	0	NC	8.30E+00	Y	N	N	N	N	Complies with three part statistical rule
Zinc	8	8	8	100	NA	NA	4.40E+01	9.90E+01	B-AA4	99070588	1.20E+04	0.00E+00	0	--	1.60E-01	0	0	0	NC	9.90E+01	Y	N	N	N	N	Complies with three part statistical rule
VOCs, mg/kg																										
m&p-Xylene	10	10	0	0	5.00E-01	5.00E-01	--	--	--	--	2.10E+02	8.33E-01	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
SVOCs, mg/kg																										
2,4-Dinitrotoluene	10	10	0	0	1.00E-02	1.30E-02	--	--	--	--	8.00E-04	3.25E+02	10	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,6-Dinitrotoluene	10	10	0	0	1.00E-02	1.30E-02	--	--	--	--	7.00E-04	4.33E+02	10	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
Pentachlorophenol	10	10	0	0	1.00E-02	1.30E-02	--	--	--	--	3.00E-02	1.30E+01	10	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,4,6-Trichlorophenol	10	10	0	0	1.00E-02	1.30E-02	--	--	--	--	2.00E-01	1.63E+00	10	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	10	10	0	0	2.10E-03	2.50E-03	--	--	--	--	5.70E+02	8.62E-05	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Fluorene	10	10	0	0	2.10E-03	2.50E-03	--	--	--	--	5.60E+02	8.93E-05	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Naphthalene	10	10	1	10	2.10E-03	2.50E-03	2.00E-03	2.00E-03	B-BB5	99070597	8.40E+01	6.25E-04	0	0	5.00E-04	0	0	0	NC	2.00E-03	Y	N	N	N	N	Complies with three part statistical rule
Phenanthrene	10	10	1	10	2.10E-03	2.50E-03	6.60E-03	6.60E-03	B-AA6	99070592	1.20E+04	4.24E-06	0	0	1.12E-05	0	0	0	NC	6.60E-03	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	10	10	0	0	2.10E-03	2.50E-03	--	--	--	--	8.40E+01	6.25E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Fluoranthene	10	10	1	10	2.10E-03	2.50E-03	5.10E-03	5.10E-03	B-AA6	99070592	3.20E+03	1.19E-05	0	0	2.43E-05	0	0	0	NC	5.10E-03	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	10	10	1	10	2.10E-03	2.50E-03	4.10E-03	4.10E-03	B-AA6	99070592	2.40E+03	1.19E-05	0	0	1.95E-05	0	0	0	NC	4.10E-03	Y	N	N	N	N	Complies with three part statistical rule
Benzo(g,h,i)perylene	10	10	0	0	2.10E-03	2.50E-03	--	--	--	--	3.20E+03	1.19E-05	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
BaPE (ND = 1/2 DL)	10	10	1	10	2.10E-03	2.50E-03	1.60E-03	1.60E-03	B-AA6	99070592	1.40E-01	1.79E-02	0	0	1.14E-02	0	0	0	NC	1.60E-03	Y	N	N	N	N	Complies with three part statistical rule
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	8	8	2	25	4.11E-06	1.86E-05	2.24E-06	5.61E-06	B-AA2	99070587	6.70E-06	2.78E+00	5	83	8.37E-01	0	0	63	NC	5.61E-06	Y	N	N	Y	Y	
Upper creek (DAF=1)																										
Metals, mg/kg																										
Arsenic	22	22	12	55	9.00E-01	2.00E+01	6.00E+00	1.00E+01	SB-11	LSP0190	6.70E-01	2.99E+01	10	100	1.49E+01	12	100	100	1.11E+01	1.00E+01	Y	Y	Y	Y	Y	
Lead	22	22	22	100	NA	NA	2.70E+00	4.35E+01	SB-11	LSP0187	2.50E+02	0.00E+00	0	--	1.74E-01	0	0	0	2.16E+01	2.16E+01	Y	N	N	N	N	Complies with three part statistical rule
Zinc	29	29	29	100	NA	NA	3.75E+01	2.06E+02	SB-29	LSP0462	6.20E+02	0.00E+00	0	--	3.32E-01	0	0	0	1.29E+02	1.29E+02	Y	N	N	N	N	Complies with three part statistical rule
VOCs, mg/kg																										
m&p-Xylene	13	13	1	8	5.00E-01	5.00E-01	6.30E-01	6.30E-01	MWLSC02	99070547	1.00E+01	8.33E-01	0	0	1.05E+00	1	100	8	NC	6.30E-01	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, mg/kg																										
Carbazole	26	26	22	85	2.00E-02	2.20E-02	1.10E-02	1.00E+01	SB-09	LSP0178	3.00E-02	7.33E-01	0	0	3.33E+02	18	82	69	NC	1.00E+01	Y	Y	Y	Y	Y	
2,4-Dinitrotoluene	39	39	0	0	9.50E-03	1.70E+00	--	--	--	--	4.00E-05	4.25E+04	39	100	0.00E+00	0	--	100	9.35E-01	9.35E-01	N	Y	--	Y	N	FOD less than 5%
2,6-Dinitrotoluene	39	39	0	0	9.50E-03	1.70E+00	--	--	--	--	3.00E-05	5.67E+04	39	100	0.00E+00	0	--	100	9.00E-01	9.00E-01	N	Y	--	Y	N	FOD less than 5%
1-Methylnaphthalene	26	26	19	73	2.00E-02	2.00E-01	1.90E-02	7.90E+01	SB-31	LSP0510	4.00E+00	5.00E-02	0	0	1.98E+01	8	42	31	NC	7.90E+01	Y	Y	Y	Y	Y	
Pentachlorophenol	39	39	17	44	9.50E-03	1.00E+00	9.30E-03	6.40E+00	SB-09	LSP0178	1.00E-03	1.00E+03	22	100	6.40E+03	17	100	100	3.22E+00	3.22E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	39	39	0	0	8.60E-03	1.00E+00	--	--	--	--	8.00E-03	1.25E+02	39	100	0.00E+00	0	--	100	3.13E-01	3.13E-01	N	Y	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	39	39	22	56	1.90E-03	3.10E-02	1.10E-02	1.60E+02	SB-31	LSP0510	2.90E+01	1.07E-03	0	0	5.52E+00	7	32	18	NC	1.60E+02	Y	Y	Y	Y	Y	
Fluorene	39	39	25	64	1.90E-03	3.40E-02	1.80E-03	1.10E+02	SB-31	LSP0510	2.80E+01	1.21E-03	0	0	3.93E+00	5	20	13	NC	1.10E+02	Y	Y	Y	Y	Y	
Naphthalene	39	39	23	59	1.90E-03	3.50E-02	1.70E-02	1.60E+02	SB-31	LSP0510	4.00E+00	8.75E-03	0	0	4.00E+01	8	35	21	NC	1.60E+02	Y	Y	Y	Y	Y	
Phenanthrene	39	39	28	72	1.90E-03	1.00E-02	2.90E-03	4.40E+02	SB-31	LSP0510	5.90E+02	1.69E-05	0	0	7.46E-01	0	0	0	NC	4.40E+02	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	39	39	21	54	1.90E-03	5.40E-02	4.30E-03	1.20E+02	SB-31	LSP0510	4.00E+00	1.35E-02	0	0	3.00E+01	8	38	21	NC	1.20E+02	Y	Y	Y	Y	Y	
Fluoranthene	39	39	26	67	1.90E-03	2.00E-02	3.70E-03	2.00E+02	SB-31	LSP0510	2.10E+02	9.52E-05	0	0	9.52E-01	0	0	0	NC	2.00E+02	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	39	39	27	69	1.90E-03	2.00E-02	1.80E-03	1.40E+02	SB-31	LSP0510	2.10E+02	9.52E-05	0	0	6.67E-01	0	0	0	NC	1.40E+02	Y	N	N	N	N	Complies with three part statistical rule
Benzo(g,h,i)perylene	39	39	26	67	1.90E-03	2.00E-02	4.80E-03	2.30E+02	SB-11	LSP0275	2.10E+02	9.52E-05	0	0	1.10E+00	1	4	3	NC	2.30E+02	Y	Y	N	N	Y	
BaPE (ND = 1/2 DL)	39	39	28	72	1.90E-03	2.00E-02	3.42E-03	4.44E+02	SB-11	LSP0275	1.40E-01	1.43E-01	0	0	3.17E+03	19	68	49	1.06E+02	1.06E+02	Y	Y	Y	Y	Y	
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	38	38	30	79	5.00E-01	6.00E-01	7.00E+00	5.20E+03	SB-31	LSP0510	2.00E+03	3.00E-04	0	0	2.60E+00	2	7	5	2.22E+03	2.22E+03	Y	Y	Y	N	Y	
Motor Oil	38	38	22	58	1.20E+01	2.50E+02	1.30E+01	2.90E+03	SB-11	LSP0275	2.00E+03	1.25E-01	0	0	1.45E+00	1	5	3	9.40E+02	9.40E+02	Y	N	N	N	N	Complies with three part statistical rule
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	7	7	6	86	1.39E-05	1.39E-05	8.50E-07	4.04E-04	SB-31	LSP0510	6.70E-06	2.07E+00	1	100	6.03E+01	4	67	71	2.35E-02	4.04E-04	Y	Y	Y	Y	Y	
Wetlands (DAF=1)																										
Metals, mg/kg																										
Arsenic	2	2	2	100	NA	NA	7.00E+00	9.00E+00	HA-08	LSP0018	6.70E-01	0.00E+00	0	--	1.34E+01	2	100	100	NC	9.00E+00	Y	Y	Y	Y	Y	
Lead	2	2	2	100	NA	NA	9.00E+00	1.00E+01	HA-07	LSP0016	2.50E+02	0.00E+00	0	--	4.00E-02	0	0	0	NC	1.00E+01	Y	N	N	N	N	Complies with three part statistical rule
Zinc	2	2	2	100	NA	NA	5.89E+01	6.55E+01	HA-07	LSP0016	6.20E+02	0.00E+00	0	--	1.06E-01	0	0	0	NC	6.55E+01	Y	N	N	N	N	Complies with three part statistical rule

Notes: [a]Field duplicate and replicate samples are excluded from counts. Their results have been avearged with corresponding normal sample results.
[b]Number of Data Points might be different from the Number of Samples Analyzed for metals if they were analyzed by more than one method.
[c]95UCLs were calculated for data sets of at least 11 samples.
[d]Defaults to the maximum detected value when the 95UCL is larger than the maximum detected value.
[e]Refers to all values including both detected values and detection limits.
DL = Detection limit
DRO = Diesel range organics
FOD = Frequency of detection
GRO = Gasoline range organics
HSDB = Hazardous substance databank
IHS = Indicator hazardous substance
MO = Motor oil
NA = Not applicable
NC = Not calculated
SL = Screening level
TEQ = 2,3,7,8-TCDD toxicity equivalents
TPH = Total petroleum hydrocarbons
95UCL = Upper 95 percent confidence limit on the mean
-- = Not available

Table F-7. Final Indicator Hazardous Substances for Surface Sediment by Site Area

Analyte	Number Samples Analyzed[a]	Number Data Points[b]	Number Samples Detected	Percent Detected Data Points	Minimum Detection Limit	Maximum Detection Limit	Minimum Detected Value	Maximum Detected Value	Location of Maximum Detected Value	Sample ID of Maximum Detected Value	Human Health Screening Level, ppm	Ratio of Maximum DL to SL	Number of DL Exceedances	Frequency of DL Exceedance	Ratio of Maximum Detect to SL	Number of Detected Exceedances	Frequency of Detected Exceedance	Total Frequency of Exceedance Detected & DL	95UCL[c]	Minimum of 95UCL and Maximum Value	Frequency of Detect > 5%?	95UCL[d] > SL?	Maximum Detect > 2xSL?	> 10% Values[e] Exceed SL?	Final IHS?	Reason for Exclusion
Beach																										
Metals, mg/kg																										
Arsenic	1	1	1	100	NA	NA	4.14E+00	4.14E+00	OS01	95352500	6.70E-01	0.00E+00	0	--	6.18E+00	1	100	100	NC	4.14E+00	Y	Y	Y	Y	Y	
Chromium	1	1	1	100	NA	NA	2.49E+02	2.49E+02	OS01	95352500	2.00E+00	0.00E+00	0	--	1.25E+02	1	100	100	NC	2.49E+02	Y	Y	Y	Y	Y	
Lead	1	1	1	100	NA	NA	9.84E+00	9.84E+00	OS01	95352500	2.50E+02	0.00E+00	0	--	3.94E-02	0	0	0	NC	9.84E+00	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, mg/kg																										
Carbazole	1	1	0	0	1.70E-01	1.70E-01	--	--	--	--	3.00E-02	5.67E+00	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2-Methylphenol	1	1	0	0	1.70E-01	1.70E-01	--	--	--	--	8.00E-01	2.13E-01	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
N-nitrosodiphenylamine	1	1	0	0	1.70E-01	1.70E-01	--	--	--	--	6.00E-02	2.83E+00	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
Pentachlorophenol	1	1	1	100	NA	NA	3.91E-02	3.91E-02	OS01	95352500	1.00E-03	0.00E+00	0	--	3.91E+01	1	100	100	NC	3.91E-02	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	1	1	0	0	1.70E-01	1.70E-01	--	--	--	--	8.00E-03	2.13E+01	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	1	1	0	0	1.70E-01	1.70E-01	--	--	--	--	2.90E+01	5.86E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Fluorene	1	1	0	0	1.70E-01	1.70E-01	--	--	--	--	2.80E+01	6.07E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Naphthalene	1	1	1	100	NA	NA	1.86E-02	1.86E-02	OS01	95352500	4.00E+00	0.00E+00	0	--	4.65E-03	0	0	0	NC	1.86E-02	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	1	1	1	100	NA	NA	2.50E-02	2.50E-02	OS01	95352500	4.00E+00	0.00E+00	0	--	6.25E-03	0	0	0	NC	2.50E-02	Y	N	N	N	N	Complies with three part statistical rule
Fluoranthene	1	1	1	100	NA	NA	4.12E-02	4.12E-02	OS01	95352500	2.10E+02	0.00E+00	0	--	1.96E-04	0	0	0	NC	4.12E-02	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	1	1	1	100	NA	NA	5.04E-02	5.04E-02	OS01	95352500	2.10E+02	0.00E+00	0	--	2.40E-04	0	0	0	NC	5.04E-02	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	1	1	1	100	NA	NA	9.55E-02	9.55E-02	OS01	95352500	1.40E-01	0.00E+00	0	--	6.82E-01	0	0	0	NC	9.55E-02	Y	N	N	N	N	Complies with three part statistical rule
Historical creek																										
Metals, mg/kg																										
Arsenic	6	6	4	67	1.00E+01	1.00E+01	7.00E+00	1.20E+01	SB-35	LSP0545	6.70E-01	1.49E+01	2	100	1.79E+01	4	100	100	NC	1.20E+01	Y	Y	Y	Y	Y	
Chromium	6	6	6	100	NA	NA	3.27E+01	8.60E+01	SB-37	LSP0552	2.00E+00	0.00E+00	0	--	4.30E+01	6	100	100	NC	8.60E+01	Y	Y	Y	Y	Y	
Lead	6	6	6	100	NA	NA	3.00E+01	3.19E+02	SB-37	LSP0552	2.50E+02	0.00E+00	0	--	1.28E+00	2	33	33	NC	3.19E+02	Y	Y	N	Y	Y	
SVOCs, mg/kg																										
Carbazole	6	6	3	50	1.20E-01	1.20E-01	1.80E-01	2.60E-01	SB-38	LSP0561	3.00E-02	4.00E+00	3	100	8.67E+00	3	100	100	NC	2.60E-01	Y	Y	Y	Y	Y	
1-Methylnaphthalene	6	6	0	0	1.20E-01	2.00E-01	--	--	--	--	4.00E+00	5.00E-02	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
2-Methylphenol	6	6	0	0	1.20E-01	2.00E-01	--	--	--	--	8.00E-01	2.50E-01	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
N-nitrosodiphenylamine	6	6	0	0	1.20E-01	2.00E-01	--	--	--	--	6.00E-02	3.33E+00	6	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
Pentachlorophenol	6	6	4	67	2.80E-01	2.80E-01	1.30E+00	7.90E+00	SB-36	LSP0548	1.00E-03	2.80E+02	2	100	7.90E+03	4	100	100	NC	7.90E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	6	6	0	0	5.20E-02	1.00E+00	--	--	--	--	8.00E-03	1.25E+02	6	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	6	6	2	33	1.20E-01	1.70E-01	8.70E-02	1.40E-01	SB-38	LSP0561	2.90E+01	5.86E-03	0	0	4.83E-03	0	0	0	NC	1.40E-01	Y	N	N	N	N	Complies with three part statistical rule
Fluorene	6	6	2	33	1.20E-01	1.70E-01	1.50E-01	3.00E-01	SB-38	LSP0561	2.80E+01	6.07E-03	0	0	1.07E-02	0	0	0	NC	3.00E-01	Y	N	N	N	N	Complies with three part statistical rule
Naphthalene	6	6	1	17	1.20E-01	1.70E-01	1.70E-01	1.70E-01	SB-38	LSP0561	4.00E+00	4.25E-02	0	0	4.25E-02	0	0	0	NC	1.70E-01	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	6	6	0	0	1.10E-01	1.90E-01	--	--	--	--	4.00E+00	4.75E-02	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Fluoranthene	6	6	6	100	NA	NA	4.50E-01	1.70E+01	SB-38	LSP0561	2.10E+02	0.00E+00	0	--	8.10E-02	0	0	0	NC	1.70E+01	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	6	6	6	100	NA	NA	2.80E-01	1.30E+01	SB-38	LSP0561	2.10E+02	0.00E+00	0	--	6.19E-02	0	0	0	NC	1.30E+01	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	6	6	6	100	NA	NA	2.82E-01	7.94E+01	SB-38	LSP0561	1.40E-01	0.00E+00	0	--	5.67E+02	6	100	100	NC	7.94E+01	Y	Y	Y	Y	Y	
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	6	6	6	100	NA	NA	1.20E+02	1.10E+03	SB-36	LSP0548	2.00E+03	0.00E+00	0	--	5.50E-01	0	0	0	NC	1.10E+03	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	6	6	6	100	NA	NA	2.80E+02	1.65E+03	SB-38	LSP0557	2.00E+03	0.00E+00	0	--	8.25E-01	0	0	0	NC	1.65E+03	Y	N	N	N	N	Complies with three part statistical rule
Dioxins_Furans, mg/kg																			NC	0.00E+00						
TEQDF 0.5M05	3	3	3	100	NA	NA	6.86E-04	3.29E-03	SB-36	LSP0548	6.70E-06	0.00E+00	0	--	4.91E+02	3	100	100	NC	3.29E-03	Y	Y	Y	Y	Y	
Lower creek																										
Metals, mg/kg																										
Arsenic	9	9	8	89	9.00E-01	9.00E-01	3.10E+00	1.80E+01	SD03	99070522	6.70E-01	1.34E+00	1	100	2.69E+01	8	100	100	NC	1.80E+01	Y	Y	Y	Y	Y	
Chromium	9	9	9	100	NA	NA	1.40E+01	1.51E+02	OS02	95352501	2.00E+00	0.00E+00	0	--	7.55E+01	9	100	100	NC	1.51E+02	Y	Y	Y	Y	Y	
Lead	9	13	13	100	NA	NA	4.30E+00	3.35E+02	SB-02	LSP0132	2.50E+02	0.00E+00	0	--	1.34E+00	1	8	8	NC	3.35E+02	Y	Y	N	N	Y	
SVOCs, mg/kg																										
Carbazole	6	6	6	100	NA	NA	4.20E-02	4.78E+00	LSC-03	3394042	3.00E-02	0.00E+00	0	--	1.59E+02	6	100	100	NC	4.78E+00	Y	Y	Y	Y	Y	
1-Methylnaphthalene	5	5	4	80	7.30E-02	7.30E-02	3.45E-02	1.02E+01	LSC-03	3394042	4.00E+00	1.83E-02	0	0	2.55E+00	1	25	20	NC	1.02E+01	Y	Y	Y	Y	Y	
2-Methylphenol	10	10	3	30	1.10E-02	2.25E-01	6.40E-03	2.35E-02	SB-02	LSP0132	8.00E-01	2.81E-01	0	0	2.94E-02	0	0	0	NC	2.35E-02	Y	N	N	N	N	Complies with three part statistical rule
N-nitrosodiphenylamine	10	10	1	10	1.10E-02	2.25E-01	1.73E-01	1.73E-01	LSC-02	3394041	6.00E-02	3.75E+00	1	11	2.88E+00	1	100	20	NC	1.73E-01	Y	Y	Y	Y	Y	
Pentachlorophenol	10	10	10	100	NA	NA	3.70E-03	4.50E+00	SB-02	LSP0132	1.00E-03	0.00E+00	0	--	4.50E+03	10	100	100	NC	4.50E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	10	10	0	0	8.70E-03	2.25E-01	--	--	--	--	8.00E-03	2.81E+01	10	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	10	10	8	80	2.20E-03	3.80E-02	3.50E-03	1.20E+01	LSC-03	3394042	2.90E+01	1.31E-03	0	0	4.14E-01	0	0	0	NC	1.20E+01	Y	N	N	N	N	Complies with three part statistical rule
Fluorene	10	10	9	90	2.20E-03	2.20E-03	6.30E-03	1.70E+01	LSC-03	3394042	2.80E+01	7.86E-05	0	0	6.07E-01	0	0	0	NC	1.70E+01	Y	N	N	N	N	Complies with three part statistical rule
Naphthalene	10	10	9	90	2.20E-03	2.20E-03	3.50E-03	3.82E+00	LSC-03	3394042	4.00E+00	5.50E-04	0	0	9.55E-01	0	0	0	NC	3.82E+00	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	10	10	8	80	2.20E-03	6.70E-02	2.10E-03	2.61E+00	LSC-03	3394042	4.00E+00	1.68E-02	0	0	6.53E-01	0	0	0	NC	2.61E+00	Y	N	N	N	N	Complies with three part statistical rule
Fluoranthene	10	10	10	100	NA	NA	2.20E-02	8.63E+01	LSC-03	3394042	2.10E+02	0.00E+00	0	--	4.11E-01	0	0	0	NC	8.63E+01	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	10	10	10	100	NA	NA	1.50E-02	7.80E+01	LSC-03	3394042	2.10E+02	0.00E+00	0	--	3.71E-01	0	0	0	NC	7.80E+01	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	10	10	10	100	NA	NA	5.71E-03	2.89E+01	LSC-03	3394042	1.40E-01	0.00E+00	0	--	2.07E+02	7	70	70	NC	2.89E+01	Y	Y	Y	Y	Y	
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	4	4	3	75	5.00E-01	5.00E-01	4.40E+01	1.70E+02	SB-02	LSP0132	2.00E+03	2.50E-04	0	0	8.50E-02	0	0	0	NC	1.70E+02	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	4	4	4	100	NA	NA	1.30E+01	4.90E+02	SB-19	LSP0263	2.00E+03	0.00E+00	0	--	2.45E-01	0	0	0	NC	4.90E+02	Y	N	N	N	N	Complies with three part statistical rule
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	5	5	5	100	NA	NA	1.17E-05	5.94E-03	SB-02	LSP0132	6.70E-06	0.00E+00	0	--	8.86E+02	5	100	100	NC	5.94E-03	Y	Y	Y	Y	Y	
Upper creek																										
Metals, mg/kg																										
Arsenic	12	12	12	100	NA	NA	2.20E+00	3.09E+01	OS06	95352505	6.70E-01	0.00E+00	0	--	4.61E+01	12	100	100	1.18E+01	1.18E+01	Y	Y	Y	Y	Y	
Chromium	12	12	12	100	NA	NA	1.50E+01	1.48E+02	OS03	95352502	2.00E+00	0.00E+00	0	--	7.40E+01	12	100	100	9.14E+01	9.14E+01	Y	Y	Y	Y	Y	
Lead	12	18	18	100	NA	NA	8.00E+00	7.00E+01	SD06	99070525	2.50E+02	0.00E+00	0	--	2.80E-01	0	0	0	3.41E+01	3.41E+01	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, mg/kg																										
Carbazole	8	8	7	88	6.20E-02	6.20E-02	9.73E-02	2.80E+00	LSC Bank	LSP0051	3.00E-02	2.07E+00	1	100	9.33E+01	7	100	100	NC	2.80E+00	Y	Y	Y	Y	Y	
1-Methylnaphthalene	3	3	3	100	NA	NA	1.22E-01	1.10E+01	LSC Bank	LSP0051	4.00E+00	0.00E+00	0	--	2.75E+00	1	33	33	NC	1.10E+01	Y	Y	Y	Y	Y	
2-Methylphenol	13	13	4	31	1.10E-02	2.07E-01	1.60E-02	1.00E+00	SD06	99070525	8.00E-01	2.59E-01	0	0	1.25E+00	1	25	8	NC	1.00E+00	Y	Y	N	N	Y	
N-nitrosodiphenylamine	13	13	1	8	1.00E-02	2.26E-01	1.95E-01	1.95E-01	OS03	95352502	6.00E-02	3.77E+00	4	33	3.25E+00	1	100	38	NC	1.95E-01	Y	Y	Y	Y	Y	
Pentachlorophenol	13	13	13	100	NA	NA	1.50E-02	4.27E+00	LSC-06	3394045	1.00E-03	0.00E+00	0	--	4.27E+03	13	100	100	2.08E+00	2.08E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	13	13	1	8	1.10E-02	2.26E-01	7.40E-01	7.40E-01	SD06	99070525	8.00E-03	2.83E+01	12	100	9.25E+01	1	100	100	6.56E-01	6.56E-01	Y	Y	Y	Y	Y	
PAHs, mg/kg																										
Acenaphthene	13	13	12	92	1.70E-01	1.70E-01	5.40E-03	1.30E+02	LSC Bank	LSP0051	2.90E+01	5.86E-03	0	0	4.48E+00	1	8	8	NC	1.30E+02	Y	Y	Y	N	Y	
Fluorene	13	13	12	92	1.70E-01	1.70E-01	1.40E-02	1.00E+02	LSC Bank	LSP0051	2.80E+01	6.07E-03	0	0	3.57E+00	1	8	8	NC	1.00E+02	Y	Y	Y	N	Y	
Naphthalene	13	13	13	100	NA	NA	5.80E-03	4.30E+00	LSC Bank	LSP0051	4.00E+00	0.00E+00	0	--	1.08E+00	1	8	8	NC	4.30E+00	Y	Y	N	N	Y	
2-Methylnaphthalene	13	13	13	100	NA	NA	2.40E-03	8.70E+00	LSC Bank	LSP0051	4.00E+00	0.00E+00	0	--	2.18E+00	1	8	8	NC	8.70E+00	Y	Y	Y	N	Y	
Fluoranthene	13	13	13	100	NA	NA	7.00E-02	3.40E+02	LSC Bank	LSP0051	2.10E+02	0.00E+00	0	--	1.62E+00	1	8	8	NC	3.40E+02	Y	Y	N	N	Y	
Pyrene	13	13	13	100	NA	NA	9.60E-02	2.20E+02	LSC Bank	LSP0051	2.10E+02	0.00E+00	0	--	1.05E+00	1	8	8	NC	2.20E+02	Y	Y	N	N	Y	
BaPE (ND = 1/2 DL)	13	13	13	100	NA	NA	8.69E-02	5.27E+01	LSC Bank	LSP0051	1.40E-01	0.00E+00	0	--	3.77E+02	12	92	92	7.10E+01	5.27E+01	Y	Y	Y	Y	Y	
Petroleum, mg/kg																			NC	0.00E+00						
Diesel Range Hydrocarbons	3	3	3	100	NA	NA	9.70E+00	3.70E+03	LSC Bank	LSP0051	2.00E+03	0.00E+00	0	--	1.85E+00	1	33	33	NC	3.70E+03	Y	Y	N	Y	Y	
Motor Oil	2	2	2	100	NA	NA	4.40E+01	6.60E+01	SB-16	LSP0234	2.00E+03	0.00E+00	0	--	3.30E-02	0	0	0	NC	6.60E+01	Y	N	N	N	N	Complies with three part statistical rule
Dioxins_Furans, mg/kg																										

Table F-7. Final Indicator Hazardous Substances for Surface Sediment by Site Area

Analyte	Number Samples Analyzed[a]	Number Data Points[b]	Number Samples Detected	Percent Detected Data Points	Minimum Detection Limit	Maximum Detection Limit	Minimum Detected Value	Maximum Detected Value	Location of Maximum Detected Value	Sample ID of Maximum Detected Value	Human Health Screening Level, ppm	Ratio of Maximum DL to SL	Number of DL Exceedances	Frequency of DL Exceedance	Ratio of Maximum Detect to SL	Number of Detected Exceedances	Frequency of Detected Exceedance	Total Frequency of Exceedance Detected & DL	95UCL[c]	Minimum of 95UCL and Maximum Value	Frequency of Detect > 5%?	95UCL[d] > SL?	Maximum Detect > 2xSL?	> 10% Values[e] Exceed SL?	Final IHS?	Reason for Exclusion
TEQDF 0.5M05	6	6	6	100	NA	NA	1.26E-05	7.31E-04	SD10	99070529	6.70E-06	0.00E+00	0	--	1.09E+02	6	100	100	NC	7.31E-04	Y	Y	Y	Y	Y	
Wetlands																										
Metals, mg/kg																										
Arsenic	2	2	1	50	4.50E+00	4.50E+00	2.34E+00	2.34E+00	OS07	95352506	6.70E-01	6.72E+00	1	100	3.49E+00	1	100	100	NC	2.34E+00	Y	Y	Y	Y	Y	
Chromium	2	2	2	100	NA	NA	4.65E+01	2.17E+02	OS07	95352506	2.00E+00	0.00E+00	0	--	1.09E+02	2	100	100	NC	2.17E+02	Y	Y	Y	Y	Y	
Lead	2	3	3	100	NA	NA	6.56E+00	1.85E+01	SD11	99070530	2.50E+02	0.00E+00	0	--	7.40E-02	0	0	0	NC	1.85E+01	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, mg/kg																			NC	0.00E+00						
Carbazole	2	2	0	0	1.85E-01	3.93E-01	--	--	--	--	3.00E-02	1.31E+01	2	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
1-Methylnaphthalene	1	1	1	100	NA	NA	2.50E-02	2.50E-02	LSC-05	3394044	4.00E+00	0.00E+00	0	--	6.25E-03	0	0	0	NC	2.50E-02	Y	N	N	N	N	Complies with three part statistical rule
2-Methylphenol	3	3	1	33	5.00E-02	1.85E-01	1.98E-01	1.98E-01	LSC-05	3394044	8.00E-01	2.31E-01	0	0	2.48E-01	0	0	0	NC	1.98E-01	Y	N	N	N	N	Complies with three part statistical rule
N-nitrosodiphenylamine	3	3	0	0	5.00E-02	1.85E-01	--	--	--	--	6.00E-02	3.08E+00	2	67	0.00E+00	0	--	67	NC	--	N	--	--	Y	N	FOD less than 5%
Pentachlorophenol	3	3	1	33	5.00E-02	9.26E-01	1.27E+00	1.27E+00	LSC-05	3394044	1.00E-03	9.26E+02	2	100	1.27E+03	1	100	100	NC	1.27E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	3	3	0	0	5.00E-02	3.93E-01	--	--	--	--	8.00E-03	4.91E+01	3	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	3	3	1	33	1.00E-02	1.85E-01	1.50E-02	1.50E-02	LSC-05	3394044	2.90E+01	6.38E-03	0	0	5.17E-04	0	0	0	NC	1.50E-02	Y	N	N	N	N	Complies with three part statistical rule
Fluorene	3	3	2	67	1.85E-01	1.85E-01	1.10E-02	6.00E-02	LSC-05	3394044	2.80E+01	6.61E-03	0	0	2.14E-03	0	0	0	NC	6.00E-02	Y	N	N	N	N	Complies with three part statistical rule
Naphthalene	3	3	1	33	1.00E-02	1.85E-01	7.60E-02	7.60E-02	LSC-05	3394044	4.00E+00	4.63E-02	0	0	1.90E-02	0	0	0	NC	7.60E-02	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	3	3	1	33	1.00E-02	1.85E-01	5.00E-02	5.00E-02	LSC-05	3394044	4.00E+00	4.63E-02	0	0	1.25E-02	0	0	0	NC	5.00E-02	Y	N	N	N	N	Complies with three part statistical rule
Fluoranthene	3	3	2	67	1.85E-01	1.85E-01	1.35E-02	3.00E-01	LSC-05	3394044	2.10E+02	8.81E-04	0	0	1.43E-03	0	0	0	NC	3.00E-01	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	3	3	2	67	1.85E-01	1.85E-01	1.10E-02	2.94E-01	LSC-05	3394044	2.10E+02	8.81E-04	0	0	1.40E-03	0	0	0	NC	2.94E-01	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	3	3	0	0	1.00E-02	1.96E-01	--	--	--	--	1.40E-01	1.40E+00	2	67	0.00E+00	0	--	67	NC	--	N	--	--	Y	N	FOD less than 5%
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	1	1	1	100	NA	NA	7.56E-06	7.56E-06	SD11	99070530	6.70E-06	0.00E+00	0	--	1.13E+00	1	100	100	NC	7.56E-06	Y	Y	N	Y	Y	

Notes: [a]Field duplicate and replicate samples are excluded from counts. Their results have been avearged with corresponding normal sample results.
[b]Number of Data Points might be different from the Number of Samples Analyzed for metals if they were analyzed by more than one method.
[c]95UCLs were calculated for data sets of at least 11 samples.
[d]Defaults to the maximum detected value when the 95UCL is larger than the maximum detected value.
[e]Refers to all values including both detected values and detection limits.
DL = Detection limit
DRO = Diesel range organics
FOD = Frequency of detection
GRO = Gasoline range organics
HSDB = Hazardous substance databank
IHS = Indicator hazardous substance
MO = Motor oil
NA = Not applicable
NC = Not calculated
SL = Screening level
TEQ = 2,3,7,8-TCDD toxicity equivalents
TPH = Total petroleum hydrocarbons
95UCL = Upper 95 percent confidence limit on the mean
-- = Not available

Table F-8. Final Indicator Hazardous Substances for Subsurface Sediment by Site Area

Analyte	Number Samples Analyzed[a]	Number Data Points[b]	Number Samples Detected	Percent Detected Data Points	Minimum Detection Limit	Maximum Detection Limit	Minimum Detected Value	Maximum Detected Value	Location of Maximum Detected Value	Sample ID of Maximum Detected Value	Human Health Screening Level, ppm	Ratio of Maximum DL to SL	Number of DL Exceedances	Frequency of DL Exceedance	Ratio of Maximum Detect to SL	Number of Detected Exceedances	Frequency of Detected Exceedance	Total Frequency of Exceedance Detected & DL	95UCL[c]	Minimum of 95UCL and Maximum Value	Frequency of Detect > 5%?	95UCL[d] > SL?	Maximum Detect > 2xSL?	> 10% Values[e] Exceed	Final IHS?	Reason for Exclusion
Historical creek																										
Metals, mg/kg																										
Arsenic	8	8	5	63	9.00E-01	1.00E+01	8.00E+00	1.10E+01	SB-35	LSP0547	6.70E-01	1.49E+01	3	100	1.64E+01	5	100	100	NC	1.10E+01	Y	Y	Y	Y	Y	
Chromium	5	5	5	100	NA	NA	3.03E+01	4.48E+01	SB-38	LSP0558	2.00E+00	0.00E+00	0	--	2.24E+01	5	100	100	NC	4.48E+01	Y	Y	Y	Y	Y	
Lead	7	7	7	100	NA	NA	5.00E+00	6.00E+01	SB-35	LSP0546	2.50E+02	0.00E+00	0	--	2.40E-01	0	0	0	NC	6.00E+01	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, mg/kg																										
Carbazole	3	3	1	33	2.20E-02	2.20E-02	3.20E-01	3.20E-01	SB-35	LSP0546	3.00E-02	7.33E-01	0	0	1.07E+01	1	100	33	NC	3.20E-01	Y	Y	Y	Y	Y	
1-Methylnaphthalene	3	3	0	0	5.90E-02	1.00E-01	--	--	--	--	4.00E+00	2.50E-02	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
2-Methylphenol	3	3	0	0	2.00E-02	1.00E-01	--	--	--	--	8.00E-01	1.25E-01	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
N-nitrosodiphenylamine	3	3	0	0	2.60E-02	1.00E-01	--	--	--	--	6.00E-02	1.67E+00	1	33	0.00E+00	0	--	33	NC	--	N	--	--	Y	N	FOD less than 5%
Pentachlorophenol	3	3	2	67	1.40E-01	1.40E-01	1.50E-01	7.30E+00	SB-35	LSP0546	1.00E-03	1.40E+02	1	100	7.30E+03	2	100	100	NC	7.30E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	3	3	0	0	2.60E-02	4.40E-02	--	--	--	--	8.00E-03	5.50E+00	3	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	3	3	1	33	3.10E-02	3.10E-02	7.00E-02	7.00E-02	SB-35	LSP0546	2.90E+01	1.07E-03	0	0	2.41E-03	0	0	0	NC	7.00E-02	Y	N	N	N	N	Complies with three part statistical rule
Fluorene	3	3	1	33	3.40E-02	3.40E-02	1.60E-01	1.60E-01	SB-35	LSP0546	2.80E+01	1.21E-03	0	0	5.71E-03	0	0	0	NC	1.60E-01	Y	N	N	N	N	Complies with three part statistical rule
Naphthalene	3	3	1	33	3.50E-02	3.50E-02	9.70E-02	9.70E-02	SB-35	LSP0546	4.00E+00	8.75E-03	0	0	2.43E-02	0	0	0	NC	9.70E-02	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	3	3	0	0	5.40E-02	1.00E-01	--	--	--	--	4.00E+00	2.50E-02	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Fluoranthene	3	3	3	100	NA	NA	8.50E-02	1.40E+00	SB-35	LSP0546	2.10E+02	0.00E+00	0	--	6.67E-03	0	0	0	NC	1.40E+00	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	3	3	3	100	NA	NA	5.00E-02	8.40E-01	SB-35	LSP0546	2.10E+02	0.00E+00	0	--	4.00E-03	0	0	0	NC	8.40E-01	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	3	3	3	100	NA	NA	2.30E-01	1.29E+01	SB-35	LSP0546	1.40E-01	0.00E+00	0	--	9.21E+01	3	100	100	NC	1.29E+01	Y	Y	Y	Y	Y	
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	8	8	7	88	5.00E-01	5.00E-01	2.70E+01	9.10E+02	SB-35	LSP0546	2.00E+03	2.50E-04	0	0	4.55E-01	0	0	0	NC	9.10E+02	Y	N	N	N	N	Complies with three part statistical rule
Motor Oil	8	8	7	88	1.30E+01	1.30E+01	8.30E+01	2.70E+03	SB-35	LSP0546	2.00E+03	6.50E-03	0	0	1.35E+00	1	14	13	NC	2.70E+03	Y	Y	N	Y	Y	
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	1	1	1	100	NA	NA	2.45E-03	2.45E-03	SB-35	LSP0546	6.70E-06	0.00E+00	0	--	3.66E+02	1	100	100	NC	2.45E-03	Y	Y	Y	Y	Y	
Lower creek																										
Metals, mg/kg																										
Arsenic	8	8	5	63	1.00E+00	1.00E+00	6.00E+00	1.15E+01	SB-10	LSP0182	6.70E-01	1.49E+00	3	100	1.72E+01	5	100	100	NC	1.15E+01	Y	Y	Y	Y	Y	
Chromium	8	8	8	100	NA	NA	1.96E+01	4.19E+01	SB-19	LSP0264	2.00E+00	0.00E+00	0	--	2.10E+01	8	100	100	NC	4.19E+01	Y	Y	Y	Y	Y	
Lead	8	8	7	88	2.00E-01	2.00E-01	3.00E+00	1.28E+02	SB-19	LSP0264	2.50E+02	8.00E-04	0	0	5.12E-01	0	0	0	NC	1.28E+02	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, mg/kg																										
Carbazole	5	5	5	100	NA	NA	1.10E-02	6.60E-01	SB-19	LSP0254	3.00E-02	0.00E+00	0	--	2.20E+01	4	80	80	NC	6.60E-01	Y	Y	Y	Y	Y	
1-Methylnaphthalene	5	5	4	80	2.00E-02	2.00E-02	2.80E-02	3.80E-01	SB-19	LSP0253	4.00E+00	5.00E-03	0	0	9.50E-02	0	0	0	NC	3.80E-01	Y	N	N	N	N	Complies with three part statistical rule
2-Methylphenol	5	5	1	20	2.00E-02	1.10E-01	1.10E-02	1.10E-02	SB-02	LSP0127	8.00E-01	1.38E-01	0	0	1.38E-02	0	0	0	NC	1.10E-02	Y	N	N	N	N	Complies with three part statistical rule
N-nitrosodiphenylamine	5	5	0	0	2.00E-02	2.80E+00	--	--	--	--	6.00E-02	4.67E+01	2	40	0.00E+00	0	--	40	NC	--	N	--	--	Y	N	FOD less than 5%
Pentachlorophenol	5	5	5	100	NA	NA	5.40E-02	3.20E+00	SB-02	LSP0127	1.00E-03	0.00E+00	0	--	3.20E+03	5	100	100	NC	3.20E+00	Y	Y	Y	Y	Y	
2,4,6-Trichlorophenol	5	5	0	0	8.60E-03	5.00E-02	--	--	--	--	8.00E-03	6.25E+00	5	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, mg/kg																										
Acenaphthene	5	5	5	100	NA	NA	2.00E-02	5.40E+00	SB-19	LSP0254	2.90E+01	0.00E+00	0	--	1.86E-01	0	0	0	NC	5.40E+00	Y	N	N	N	N	Complies with three part statistical rule
Fluorene	5	5	5	100	NA	NA	2.40E-02	9.20E+00	SB-19	LSP0254	2.80E+01	0.00E+00	0	--	3.29E-01	0	0	0	NC	9.20E+00	Y	N	N	N	N	Complies with three part statistical rule
Naphthalene	5	5	4	80	1.20E-02	1.20E-02	6.20E-02	2.60E-01	SB-19	LSP0254	4.00E+00	3.00E-03	0	0	6.50E-02	0	0	0	NC	2.60E-01	Y	N	N	N	N	Complies with three part statistical rule
2-Methylnaphthalene	5	5	3	60	1.80E-02	6.80E-02	5.00E-02	1.70E-01	SB-19	LSP0254	4.00E+00	1.70E-02	0	0	4.25E-02	0	0	0	NC	1.70E-01	Y	N	N	N	N	Complies with three part statistical rule
Fluoranthene	5	5	5	100	NA	NA	7.40E-01	1.40E+02	SB-19	LSP0254	2.10E+02	0.00E+00	0	--	6.67E-01	0	0	0	NC	1.40E+02	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	5	5	5	100	NA	NA	5.60E-01	1.20E+02	SB-19	LSP0254	2.10E+02	0.00E+00	0	--	5.71E-01	0	0	0	NC	1.20E+02	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	5	5	5	100	NA	NA	1.81E-01	2.18E+01	SB-19	LSP0254	1.40E-01	0.00E+00	0	--	1.56E+02	5	100	100	NC	2.18E+01	Y	Y	Y	Y	Y	
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	11	11	8	73	5.00E-01	7.00E-01	1.00E+01	2.30E+03	SB-19	LSP0254	2.00E+03	3.50E-04	0	0	1.15E+00	1	13	9	5.70E+06	2.30E+03	Y	Y	N	N	Y	
Motor Oil	11	11	8	73	1.20E+01	1.70E+01	2.10E+01	7.40E+02	SB-19	LSP0264	2.00E+03	8.50E-03	0	0	3.70E-01	0	0	0	2.39E+03	7.40E+02	Y	N	N	N	N	Complies with three part statistical rule
Dioxins_Furans, mg/kg																										
TEQDF 0.5M05	3	3	3	100	NA	NA	1.10E-03	4.70E-03	SB-02	LSP0127	6.70E-06	0.00E+00	0	--	7.02E+02	3	100	100	NC	4.70E-03	Y	Y	Y	Y	Y	
Upper creek																										
Metals, mg/kg																										
Arsenic	2	2	0	0	1.00E+01	2.00E+01	--	--	--	--	6.70E-01	2.99E+01	2	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
Chromium	2	2	2	100	NA	NA	5.30E+01	6.30E+01	SB-15	LSP0230	2.00E+00	0.00E+00	0	--	3.15E+01	2	100	100	NC	6.30E+01	Y	Y	Y	Y	Y	
Lead	2	2	2	100	NA	NA	8.00E+00	8.00E+00	SB-15; SB-15	LSP0230; LSP0231	2.50E+02	0.00E+00	0	--	3.20E-02	0	0	0	NC	8.00E+00	Y	N	N	N	N	Complies with three part statistical rule
Petroleum, mg/kg																										
Diesel Range Hydrocarbons	1	1	0	0	5.00E-01	5.00E-01	--	--	--	--	2.00E+03	2.50E-04	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Motor Oil	1	1	0	0	1.30E+01	1.30E+01	--	--	--	--	2.00E+03	6.50E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%

Notes: [a]Field duplicate and replicate samples are excluded from counts. Their results have been avearged with corresponding normal sample results.
[b]Number of Data Points might be different from the Number of Samples Analyzed for metals if they were analyzed by more than one method.
[c]95UCLs were calculated for data sets of at least 11 samples.
[d]Defaults to the maximum detected value when the 95UCL is larger than the maximum detected value.
[e]Refers to all values including both detected values and detection limits.
DL = Detection limit
DRO = Diesel range organics
FOD = Frequency of detection
GRO = Gasoline range organics
HSDB = Hazardous substance databank
IHS = Indicator hazardous substance
MO = Motor oil
NA = Not applicable
NC = Not calculated
SL = Screening level
TEQ = 2,3,7,8-TCDD toxicity equivalents
TPH = Total petroleum hydrocarbons
95UCL = Upper 95 percent confidence limit on the mean
-- = Not available

Table F-9. Final Indicator Hazardous Substances for Groundwater by Site Area

Analyte	Number Samples Analyzed[a]	Number Data Points[b]	Number Samples Detected	Percent Detected Data Points	Minimum Detection Limit	Maximum Detection Limit	Minimum Detected Value	Maximum Detected Value	Location of Maximum Detected Value	Sample ID of Maximum Detected Value	Human Health Screening Level, ppb	Ratio of Maximum DL to SL	Number of DL Exceedances	Frequency of DL Exceedance	Ratio of Maximum Detect to SL	Number of Detected Exceedances	Frequency of Detected Exceedance	Total Frequency of Exceedance Detected & DL	95UCL[c]	Minimum of 95UCL and Maximum Value	Frequency of Detect > 5%?	95UCL[d] > SL?	Maximum Detect > 2xSL?	> 10% Values[e] Exceed SL?	Final IHS?	Reason for Exclusion
Historical creek																										
Metals, ug/L																										
Arsenic	2	2	2	100	NA	NA	1.55E+00	3.40E+00	SB-29	LSP0596	1.80E-02	0.00E+00	0	--	1.89E+02	2	100	100	NC	3.40E+00	Y	Y	Y	Y	Y	
Lead	2	2	0	0	4.00E-01	4.00E-01	--	--	--	--	1.50E+01	2.67E-02	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
SVOCs, ug/L																										
Bis(2-ethylhexyl)phthalate	2	2	0	0	2.50E-01	2.50E-01	--	--	--	--	1.20E+00	2.08E-01	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Carbazole	2	2	2	100	NA	NA	5.50E+00	4.30E+01	SB-29	LSP0596	4.40E+00	0.00E+00	0	--	9.77E+00	2	100	100	NC	4.30E+01	Y	Y	Y	Y	Y	
Dibenzofuran	2	2	2	100	NA	NA	2.45E+01	7.10E+01	SB-29	LSP0596	3.20E+01	0.00E+00	0	--	2.22E+00	1	50	50	NC	7.10E+01	Y	Y	Y	Y	Y	
3,3'-Dichlorobenzidine	2	2	0	0	9.00E-01	9.00E-01	--	--	--	--	2.10E-02	4.29E+01	2	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,4-Dinitrotoluene	2	2	0	0	3.10E-01	3.10E-01	--	--	--	--	1.10E-01	2.82E+00	2	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
1-Methylnaphthalene	2	2	2	100	NA	NA	2.85E+01	2.30E+02	SB-29	LSP0596	1.60E+02	0.00E+00	0	--	1.44E+00	1	50	50	NC	2.30E+02	Y	Y	N	Y	Y	
Pentachlorophenol	2	2	1	50	9.10E-01	9.10E-01	1.60E+01	1.60E+01	SB-29	LSP0596	2.70E-01	3.37E+00	1	100	5.93E+01	1	100	100	NC	1.60E+01	Y	Y	Y	Y	Y	
PAHs, ug/L																										
Acenaphthene	2	2	2	100	NA	NA	1.00E+02	2.70E+02	SB-29	LSP0596	6.40E+02	0.00E+00	0	--	4.22E-01	0	0	0	NC	2.70E+02	Y	N	N	N	N	Complies with three part statistical rule
Fluorene	2	2	2	100	NA	NA	4.05E+01	1.00E+02	SB-29	LSP0596	6.40E+02	0.00E+00	0	--	1.56E-01	0	0	0	NC	1.00E+02	Y	N	N	N	N	Complies with three part statistical rule
Naphthalene	2	2	2	100	NA	NA	5.65E+01	2.80E+03	SB-29	LSP0596	1.60E+02	0.00E+00	0	--	1.75E+01	1	50	50	NC	2.80E+03	Y	Y	Y	Y	Y	
2-Methylnaphthalene	2	2	2	100	NA	NA	1.70E+01	4.00E+02	SB-29	LSP0596	1.60E+02	0.00E+00	0	--	2.50E+00	1	50	50	NC	4.00E+02	Y	Y	Y	Y	Y	
Fluoranthene	2	2	2	100	NA	NA	4.85E+00	3.60E+01	SB-29	LSP0596	6.40E+02	0.00E+00	0	--	5.63E-02	0	0	0	NC	3.60E+01	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	2	2	2	100	NA	NA	3.40E+00	2.80E+01	SB-29	LSP0596	4.80E+02	0.00E+00	0	--	5.83E-02	0	0	0	NC	2.80E+01	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	2	2	1	50	7.20E-01	7.20E-01	3.67E+00	3.67E+00	SB-29	LSP0596	3.80E-03	1.89E+02	1	100	9.67E+02	1	100	100	NC	3.67E+00	Y	Y	Y	Y	Y	
Petroleum, ug/L																										
Gasoline Range Hydrocarbons	2	2	2	100	NA	NA	3.25E+02	4.40E+03	SB-29	LSP0596	8.00E+02	0.00E+00	0	--	5.50E+00	1	50	50	NC	4.40E+03	Y	Y	Y	Y	Y	
Diesel Range Hydrocarbons	2	2	2	100	NA	NA	3.95E+02	2.40E+03	SB-29	LSP0596	5.00E+02	0.00E+00	0	--	4.80E+00	1	50	50	NC	2.40E+03	Y	Y	Y	Y	Y	
Motor Oil	2	2	0	0	5.00E+02	5.00E+02	--	--	--	--	5.00E+02	1.00E+00	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Dioxins_Furans, ug/L																										
TEQDF 0.5M05	2	2	2	100	NA	NA	6.81E-06	8.91E-06	SB-29	LSP0596	5.00E-09	0.00E+00	0	--	1.78E+03	2	100	100	NC	8.91E-06	Y	Y	Y	Y	Y	
Lower creek																										
SVOCs, ug/L																										
Bis(2-ethylhexyl)phthalate	3	3	1	33	2.50E-01	2.50E-01	1.80E+00	1.80E+00	SB-18	LSP0367	1.20E+00	2.08E-01	0	0	1.50E+00	1	100	33	NC	1.80E+00	Y	Y	N	Y	Y	
Carbazole	3	3	0	0	2.90E-01	2.90E-01	--	--	--	--	4.40E+00	6.59E-02	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Dibenzofuran	3	3	1	33	3.50E-01	3.50E-01	6.00E-01	6.00E-01	SB-19	LSP0368	3.20E+01	1.09E-02	0	0	1.88E-02	0	0	0	NC	6.00E-01	Y	N	N	N	N	Complies with three part statistical rule
3,3'-Dichlorobenzidine	3	3	0	0	9.00E-01	9.00E-01	--	--	--	--	2.10E-02	4.29E+01	3	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
2,4-Dinitrotoluene	3	3	0	0	3.10E-01	3.10E-01	--	--	--	--	1.10E-01	2.82E+00	3	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
1-Methylnaphthalene	3	3	0	0	5.00E-01	5.00E-01	--	--	--	--	1.60E+02	3.13E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Pentachlorophenol	3	3	0	0	9.10E-01	9.10E-01	--	--	--	--	2.70E-01	3.37E+00	3	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, ug/L																										
Acenaphthene	3	3	1	33	4.70E-01	4.70E-01	2.80E+00	2.80E+00	SB-19	LSP0368	6.40E+02	7.34E-04	0	0	4.38E-03	0	0	0	NC	2.80E+00	Y	N	N	N	N	Complies with three part statistical rule
Fluorene	3	3	1	33	4.30E-01	4.30E-01	2.60E+00	2.60E+00	SB-19	LSP0368	6.40E+02	6.72E-04	0	0	4.06E-03	0	0	0	NC	2.60E+00	Y	N	N	N	N	Complies with three part statistical rule
Naphthalene	3	3	0	0	4.60E-01	4.60E-01	--	--	--	--	1.60E+02	2.88E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
2-Methylnaphthalene	3	3	0	0	4.30E-01	4.30E-01	--	--	--	--	1.60E+02	2.69E-03	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Fluoranthene	3	3	1	33	3.40E-01	3.40E-01	3.70E+00	3.70E+00	SB-19	LSP0368	6.40E+02	5.31E-04	0	0	5.78E-03	0	0	0	NC	3.70E+00	Y	N	N	N	N	Complies with three part statistical rule
Pyrene	3	3	1	33	3.40E-01	3.40E-01	3.00E+00	3.00E+00	SB-19	LSP0368	4.80E+02	7.08E-04	0	0	6.25E-03	0	0	0	NC	3.00E+00	Y	N	N	N	N	Complies with three part statistical rule
BaPE (ND = 1/2 DL)	3	3	1	33	7.20E-01	7.20E-01	2.79E-01	2.79E-01	SB-19	LSP0368	3.80E-03	1.89E+02	2	100	7.33E+01	1	100	100	NC	2.79E-01	Y	Y	Y	Y	Y	
Petroleum, ug/L																										
Gasoline Range Hydrocarbons	3	3	0	0	7.00E+01	7.00E+01	--	--	--	--	8.00E+02	8.75E-02	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Diesel Range Hydrocarbons	3	3	0	0	2.00E+01	2.00E+01	--	--	--	--	5.00E+02	4.00E-02	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Motor Oil	3	3	0	0	5.00E+02	5.00E+02	--	--	--	--	5.00E+02	1.00E+00	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Upper creek																										
Metals, ug/L																										
Arsenic	23	23	18	78	2.00E-01	1.00E+00	2.00E-01	2.59E+01	SB-23	LSP0378	1.80E-02	5.56E+01	5	100	1.44E+03	18	100	100	9.80E+00	9.80E+00	Y	Y	Y	Y	Y	
Lead	23	23	6	26	1.20E-01	1.00E+00	3.00E+00	2.50E+01	SB-23	LSP0378	1.50E+01	6.67E-02	0	0	1.67E+00	1	17	4	1.34E+01	1.34E+01	Y	N	N	N	N	Complies with three part statistical rule
SVOCs, ug/L																										
Bis(2-ethylhexyl)phthalate	30	30	5	17	1.90E-01	3.80E+01	2.10E+00	3.20E+01	SB-23	LSP0378	1.20E+00	3.17E+01	2	8	2.67E+01	5	100	23	1.94E+01	1.94E+01	Y	Y	Y	Y	Y	
Carbazole	28	28	6	21	2.40E-02	2.90E-01	5.50E+00	4.30E+01	SB-29	LSP0596	4.40E+00	6.59E-02	0	0	9.77E+00	6	100	21	NC	4.30E+01	Y	Y	Y	Y	Y	
Dibenzofuran	30	30	9	30	2.40E-02	3.50E-01	5.20E-02	4.90E+02	WP1	99070515	3.20E+01	1.09E-02	0	0	1.53E+01	2	22	7	1.85E+02	1.85E+02	Y	Y	Y	N	Y	
3,3'-Dichlorobenzidine	30	30	1	3	2.40E-02	9.00E-01	1.10E+01	1.10E+01	WP1	99070515	2.10E-02	4.29E+01	29	100	5.24E+02	1	100	100	4.48E+00	4.48E+00	N	Y	Y	Y	N	FOD less than 5%
2,4-Dinitrotoluene	30	30	1	3	2.40E-02	3.10E-01	2.50E+01	2.50E+01	WP1	99070515	1.10E-01	2.82E+00	19	66	2.27E+02	1	100	67	9.26E+00	9.26E+00	N	Y	Y	Y	N	FOD less than 5%
1-Methylnaphthalene	19	19	6	32	5.00E-01	5.00E-01	2.85E+01	2.30E+02	SB-29	LSP0596	1.60E+02	3.13E-03	0	0	1.44E+00	1	17	5	NC	2.30E+02	Y	Y	N	N	Y	
Pentachlorophenol	30	30	11	37	2.40E-02	2.70E+00	2.50E-02	4.60E+02	SB-25	LSP0591	2.70E-01	1.00E+01	16	84	1.70E+03	6	55	73	1.74E+02	1.74E+02	Y	Y	Y	Y	Y	
PAHs, ug/L																										
Acenaphthene	30	30	14	47	4.70E-03	4.70E-01	4.80E-03	9.30E+02	WP1	99070515	6.40E+02	7.34E-04	0	0	1.45E+00	1	7	3	NC	9.30E+02	Y	Y	N	N	Y	
Fluorene	30	30	9	30	4.70E-03	4.30E-01	1.50E-01	9.40E+02	WP1	99070515	6.40E+02	6.72E-04	0	0	1.47E+00	1	11	3	NC	9.40E+02	Y	Y	N	N	Y	
Naphthalene	30	30	18	60	4.70E-03	4.60E-01	1.20E-02	2.80E+03	SB-29	LSP0596	1.60E+02	2.88E-03	0	0	1.75E+01	2	11	7	NC	2.80E+03	Y	Y	Y	N	Y	
2-Methylnaphthalene	30	30	15	50	4.70E-03	4.30E-01	7.10E-03	4.00E+02	SB-29	LSP0596	1.60E+02	2.69E-03	0	0	2.50E+00	2	13	7	NC	4.00E+02	Y	Y	Y	N	Y	
Fluoranthene	30	30	9	30	4.70E-03	3.40E-01	5.00E-02	1.40E+03	WP1	99070515	6.40E+02	5.31E-04	0	0	2.19E+00	1	11	3	NC	1.40E+03	Y	Y	Y	N	Y	
Pyrene	30	30	12	40	4.70E-03	3.40E-01	4.80E-03	1.10E+03	WP1	99070515	4.80E+02	7.08E-04	0	0	2.29E+00	1	8	3	NC	1.10E+03	Y	Y	Y	N	Y	
BaPE (ND = 1/2 DL)	30	30	8	27	4.70E-03	7.20E-01	4.11E-03	2.16E+02	WP1	99070515	3.80E-03	1.89E+02	22	100	5.68E+04	8	100	100	7.94E+01	7.94E+01	Y	Y	Y	Y	Y	
Petroleum, ug/L																										
Gasoline Range Hydrocarbons	20	20	6	30	7.00E+01	5.80E+02	3.25E+02	4.40E+03	SB-29	LSP0596	8.00E+02	7.25E-01	0	0	5.50E+00	3	50	15	3.50E+03	3.50E+03	Y	Y	Y	Y	Y	
Diesel Range Hydrocarbons	21	21	7	33	2.00E+01	2.00E+01	3.95E+02	5.30E+04	WP1	99070515	5.00E+02	4.00E-02	0	0	1.06E+02	6	86	29	2.79E+04	2.79E+04	Y	Y	Y	Y	Y	
Motor Oil	21	21	2	10	5.00E+02	1.00E+03	2.40E+03	9.20E+03	WP1	99070515	5.00E+02	2.00E+00	1	5	1.84E+01	2	100	14	2.85E+03	2.85E+03	Y	Y	Y	Y	Y	
Dioxins_Furans, ug/L																										
TEQDF 0.5M05	21	21	16	76	4.02E-06	4.16E-05	2.71E-06	1.85E-04	SB-22	LSP0373	5.00E-09	8.32E+03	5	100	3.70E+04	16	100	100	3.52E-05	3.52E-05	Y	Y	Y	Y	Y	

Notes: [a]Field duplicate and replicate samples are excluded from counts. Their results have been averaged with corresponding normal sample results.
[b]Number of Data Points might be different from the Number of Samples Analyzed for metals if they were analyzed by more than one method.
[c]95UCLs were calculated for data sets of at least 11 samples.
[d]Defaults to the maximum detected value when the 95UCL is larger than the maximum detected value.
[e]Refers to all values including both detected values and detection limits.
DL = Detection limit
DRO = Diesel range organics
FOD = Frequency of detection
GRO = Gasoline range organics
HSDB = Hazardous substance databank
IHS = Indicator hazardous substance
MO = Motor oil
NA = Not applicable
NC = Not calculated
SL = Screening level
TEQ = 2,3,7,8-TCDD toxicity equivalents
TPH = Total petroleum hydrocarbons
95UCL = Upper 95 percent confidence limit on the mean
-- = Not available

Table F-10. Final Indicator Hazardous Substances for Surface Water by Site Area

Analyte	Number Samples Analyzed[a]	Number Data Points[b]	Number Samples Detected	Percent Detected Data Points	Minimum Detection Limit	Maximum Detection Limit	Minimum Detected Value	Maximum Detected Value	Location of Maximum Detected Value	Sample ID of Maximum Detected Value	Human Health Screening Level, ppb	Ratio of Maximum DL to SL	Number of DL Exceedances	Frequency of DL Exceedance	Ratio of Maximum Detect to SL	Number of Detected Exceedances	Frequency of Detected Exceedance	Total Frequency of Exceedance Detected & DL	95UCL[c]	Minimum of 95UCL and Maximum Value	Frequency of Detect > 5%?	95UCL[d] > SL?	Maximum Detect > 2xSL?	> 10% Values[e] Exceed SL?	Final IHS?	Reason for Exclusion
Beach																										
Metals, ug/L																										
Arsenic	1	1	0	0	1.00E+00	1.00E+00	--	--	--	--	1.80E-02	5.56E+01	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
SVOCs, ug/L																										
Pentachlorophenol	1	1	0	0	2.20E+00	2.20E+00	--	--	--	--	2.70E-01	8.15E+00	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, ug/L																										
BaPE (ND = 1/2 DL)	1	1	1	100	NA	NA	2.30E-01	2.30E-01	OS01	95372614	3.80E-03	0.00E+00	0	--	6.04E+01	1	100	100	NC	2.30E-01	Y	Y	Y	Y	Y	
Historical creek																										
Metals, ug/L																										
Arsenic	2	2	2	100	NA	NA	7.00E-01	3.20E+00	SW-11	LSP0599	1.80E-02	0.00E+00	0	--	1.78E+02	2	100	100	NC	3.20E+00	Y	Y	Y	Y	Y	
SVOCs, ug/L																										
Pentachlorophenol	1	1	0	0	9.10E-01	9.10E-01	--	--	--	--	2.70E-01	3.37E+00	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
PAHs, ug/L																										
BaPE (ND = 1/2 DL)	1	1	0	0	7.20E-01	7.20E-01	--	--	--	--	3.80E-03	1.89E+02	1	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
Petroleum, ug/L																										
Motor Oil	2	2	0	0	5.00E+02	5.00E+02	--	--	--	--	5.00E+02	1.00E+00	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Lower creek																										
Metals, ug/L																										
Arsenic	8	8	7	88	1.00E+00	1.00E+00	2.10E-01	1.50E+00	SW-09	LSP0002	1.80E-02	5.56E+01	1	100	8.33E+01	7	100	100	NC	1.50E+00	Y	Y	Y	Y	Y	
SVOCs, ug/L																										
Pentachlorophenol	8	8	4	50	2.40E-02	2.20E+00	5.50E-02	1.50E+01	SW-09	LSP0002	2.70E-01	8.15E+00	3	75	5.56E+01	3	75	75	NC	1.50E+01	Y	Y	Y	Y	Y	
PAHs, ug/L																										
Benzofluoranthenes	2	2	1	50	4.70E-03	4.70E-03	2.40E-02	2.40E-02	SW-01	99504000	1.20E-02	3.92E-01	0	0	2.00E+00	1	100	50	NC	2.40E-02	Y	Y	N	Y	Y	
BaPE (ND = 1/2 DL)	8	8	2	25	4.70E-03	7.20E-01	1.72E-02	3.93E-02	SW-01	99314150	3.80E-03	1.89E+02	6	100	1.03E+01	2	100	100	NC	3.93E-02	Y	Y	Y	Y	Y	
Petroleum, ug/L																										
Motor Oil	4	4	0	0	5.00E+02	5.00E+02	--	--	--	--	5.00E+02	1.00E+00	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Dioxins_Furans, ug/L																										
TEQDF 0.5M05	3	3	2	67	1.83E-05	1.83E-05	1.60E-05	5.10E-05	SW-01	99504000	5.00E-09	3.66E+03	1	100	1.02E+04	2	100	100	NC	5.10E-05	Y	Y	Y	Y	Y	
Upper creek																										
Metals, ug/L																										
Arsenic	22	22	21	95	1.00E+00	1.00E+00	2.50E-01	3.20E+00	SW-11	LSP0599	1.80E-02	5.56E+01	1	100	1.78E+02	21	100	100	1.30E+00	1.30E+00	Y	Y	Y	Y	Y	
SVOCs, ug/L																										
Pentachlorophenol	26	26	11	42	2.40E-02	2.20E+00	2.70E-02	1.40E+02	SW-05	LSP0004	2.70E-01	8.15E+00	11	73	5.19E+02	7	64	69	1.11E+02	1.11E+02	Y	Y	Y	Y	Y	
PAHs, ug/L																										
Benzofluoranthenes	6	6	2	33	4.70E-03	5.30E-03	1.70E-01	2.10E-01	SW-08	99504856	1.20E-02	4.42E-01	0	0	1.75E+01	2	100	33	NC	2.10E-01	Y	Y	Y	Y	Y	
BaPE (ND = 1/2 DL)	26	26	11	42	4.70E-03	7.20E-01	3.63E-03	3.56E-01	SW-05	LSP0004	3.80E-03	1.89E+02	15	100	9.36E+01	10	91	96	9.49E-01	3.56E-01	Y	Y	Y	Y	Y	
Petroleum, ug/L																										
Motor Oil	10	10	1	10	5.00E+02	5.00E+02	7.00E+02	7.00E+02	SW-04	LSP0003	5.00E+02	1.00E+00	0	0	1.40E+00	1	100	10	NC	7.00E+02	Y	Y	N	N	Y	
Dioxins_Furans, ug/L																										
TEQDF 0.5M05	16	16	14	88	1.91E-05	3.49E-05	7.36E-06	5.77E-04	SW-05	LSP0004	5.00E-09	6.98E+03	2	100	1.15E+05	14	100	100	5.39E-04	5.39E-04	Y	Y	Y	Y	Y	
Wetlands																										
Metals, ug/L																										
Arsenic	5	5	4	80	1.50E+00	1.50E+00	2.00E-01	3.60E-01	SW-07	99314157	1.80E-02	8.33E+01	1	100	2.00E+01	4	100	100	NC	3.60E-01	Y	Y	Y	Y	Y	
SVOCs, ug/L																										
Pentachlorophenol	5	5	1	20	2.50E-02	2.10E+00	6.50E-02	6.50E-02	SW-07	99504862	2.70E-01	7.78E+00	3	75	2.41E-01	0	0	60	NC	6.50E-02	Y	N	N	Y	Y	
PAHs, ug/L																										
Benzofluoranthenes	1	1	0	0	4.70E-03	4.70E-03	--	--	--	--	1.20E-02	3.92E-01	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
BaPE (ND = 1/2 DL)	5	5	0	0	4.70E-03	7.20E-01	--	--	--	--	3.80E-03	1.89E+02	5	100	0.00E+00	0	--	100	NC	--	N	--	--	Y	N	FOD less than 5%
Petroleum, ug/L																										
Motor Oil	2	2	0	0	5.00E+02	5.00E+02	--	--	--	--	5.00E+02	1.00E+00	0	0	0.00E+00	0	--	0	NC	--	N	--	--	N	N	FOD less than 5%
Dioxins_Furans, ug/L																										
TEQDF 0.5M05	2	2	1	50	6.37E-05	6.37E-05	1.90E-05	1.90E-05	SW-07	99504862	5.00E-09	1.27E+04	1	100	3.80E+03	1	100	100	NC	1.90E-05	Y	Y	Y	Y	Y	

Notes: [a]Field duplicate and replicate samples are excluded from counts. Their results have been avearged with corresponding normal sample results.
[b]Number of Data Points might be different from the Number of Samples Analyzed for metals if they were analyzed by more than one method.
[c]95UCLs were calculated for data sets of at least 11 samples.
[d]Defaults to the maximum detected value when the 95UCL is larger than the maximum detected value.
[e]Refers to all values including both detected values and detection limits.
DL = Detection limit
DRO = Diesel range organics
FOD = Frequency of detection
GRO = Gasoline range organics
HSDB = Hazardous substance databank
IHS = Indicator hazardous substance
MO = Motor oil
NA = Not applicable
NC = Not calculated
SL = Screening level
TEQ = 2,3,7,8-TCDD toxicity equivalents
TPH = Total petroleum hydrocarbons
95UCL = Upper 95 percent confidence limit on the mean
-- = Not available

Table F-11. Calculation of Berry Screening Levels

Analyte	CPF (risk per mg/kg-day)	RfD (mg/kg-day)	Cancer SL (mg/kg)	Noncancer SL (mg/kg)	Source for Toxicity Data
Benzyl alcohol		3.E-01		1.43E+03	HEAST
Bis(2-ethylhexyl)phthalate	1.4E-02		3.40E-01		IRIS
Fluoranthene		4.E-02		1.90E+02	IRIS
p-Isopropyltoluene		NA			
2-Methylnaphthalene		2.E-02		9.52E+01	Naphthalene as surrogate
Naphthalene		2.E-02		9.52E+01	IRIS
Phenanthrene		NA			
Phenol		3.E-01		1.43E+03	IRIS
Styrene		2.E-01		9.52E+02	IRIS
TEQDF 0M05	1.5E+05		3.17E-08		HEAST

Equations

Noncancer effects	SL = RfD x HQ / (BCR x UCF)
Cancer effects	SL = Risk / (CPF x BCR x UCF)

Parameter Definitions

Abbrev.	Parameter	Value	Units
BCR	Berry consumption rate	0.21	g/kg-day
CPF	Carcinogenic potency factor	Chem. Spec.	risk/(mg/kg-day)
HQ	Acceptable hazard quotient	1	unitless
RfD	Reference dose	Chem. Spec.	mg/kg-day
Risk	Acceptable risk level	1.E-06	unitless
UCF	Unit conversion factor	1.E-03	kg/g

Notes: HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
NA = Not available
SL = Screening level

Table F-12. Human Health Screening of Detected Blackberry Results

Site Area	Location	Sample ID	Analyte	VALUE conv	Units conv	detect flag	Matrix	Maximum Detected	SL
South Slope	Berry2	99080033	2-Methylnaphthalene	2.00E-03	mg/kg	Y	Berry Unwashed		
Historical creek	Berry3	99080026	2-Methylnaphthalene	1.10E-03	mg/kg	Y	Berry Unwashed		
South Slope	Berry2	99080032	2-Methylnaphthalene	1.70E-03	mg/kg	Y	Berry Washed		
Historical creek	Berry3	99080027	2-Methylnaphthalene	1.70E-03	mg/kg	Y	Berry Washed	2.00E-03	9.52E+01
South Slope	Berry2	99080033	Benzyl Alcohol	4.00E-02	mg/kg	Y	Berry Unwashed		
Historical creek	Berry3	99080026	Benzyl Alcohol	6.30E-02	mg/kg	Y	Berry Unwashed		
Historical creek	Berry3	99080027	Benzyl Alcohol	6.30E-02	mg/kg	Y	Berry Washed	6.30E-02	1.43E+03
Historical creek	Berry3	99080026	Bis(2-ethylhexyl)phthalate	1.40E-02	mg/kg	Y	Berry Unwashed	1.40E-02	3.40E-01
Historical creek	Berry3	99080027	Fluoranthene	1.20E-03	mg/kg	Y	Berry Washed	1.20E-03	1.90E+02
South Slope	Berry2	99080033	Naphthalene	1.00E-03	mg/kg	Y	Berry Unwashed		
Historical creek	Berry3	99080026	Naphthalene	7.60E-04	mg/kg	Y	Berry Unwashed		
South Slope	Berry2	99080032	Naphthalene	7.80E-04	mg/kg	Y	Berry Washed		
Historical creek	Berry3	99080027	Naphthalene	9.10E-04	mg/kg	Y	Berry Washed	1.00E-03	9.52E+01
Historical creek	Berry3	99080026	Phenanthrene	5.30E-03	mg/kg	Y	Berry Unwashed		
South Slope	Berry2	99080033	Phenanthrene	7.20E-03	mg/kg	Y	Berry Unwashed		
South Slope	Berry2	99080032	Phenanthrene	8.70E-03	mg/kg	Y	Berry Washed		
Historical creek	Berry3	99080027	Phenanthrene	5.30E-03	mg/kg	Y	Berry Washed	8.70E-03	NA
Historical creek	Berry3	99080026	Phenol	9.00E-03	mg/kg	Y	Berry Unwashed	9.00E-03	1.43E+03
South Slope	Berry2	99080033	p-Isopropyltoluene	1.50E-02	mg/kg	Y	Berry Unwashed		
Historical creek	Berry3	99080026	p-Isopropyltoluene	1.80E-02	mg/kg	Y	Berry Unwashed		
Historical creek	Berry3	99080027	p-Isopropyltoluene	1.20E-02	mg/kg	Y	Berry Washed		
South Slope	Berry2	99080032	p-Isopropyltoluene	1.30E-02	mg/kg	Y	Berry Washed	1.80E-02	NA
South Slope	Berry2	99080033	Styrene	2.20E-04	mg/kg	Y	Berry Unwashed		
Historical creek	Berry3	99080026	Styrene	2.20E-03	mg/kg	Y	Berry Unwashed		
South Slope	Berry2	99080032	Styrene	1.80E-04	mg/kg	Y	Berry Washed		
Historical creek	Berry3	99080027	Styrene	1.30E-03	mg/kg	Y	Berry Washed	2.20E-03	9.52E+02
Historical creek	Berry3	99080026	TEQDF 0.5M05	4.81E-07	mg/kg	Y	Berry Unwashed		
South Slope	Berry2	99080033	TEQDF 0.5M05	4.67E-07	mg/kg	Y	Berry Unwashed		
Historical creek	Berry3	99080027	TEQDF 0.5M05	2.81E-06	mg/kg	Y	Berry Washed		
South Slope	Berry2	99080032	TEQDF 0.5M05	2.95E-06	mg/kg	Y	Berry Washed	2.95E-06	3.17E-08
Historical creek	Berry3	99080026	TEQDF 0.5M98	5.02E-07	mg/kg	Y	Berry Unwashed		
South Slope	Berry2	99080033	TEQDF 0.5M98	4.81E-07	mg/kg	Y	Berry Unwashed		
South Slope	Berry2	99080032	TEQDF 0.5M98	3.08E-06	mg/kg	Y	Berry Washed		
Historical creek	Berry3	99080027	TEQDF 0.5M98	2.92E-06	mg/kg	Y	Berry Washed		

APPENDIX G

SELECTION OF THE APPROACH FOR THE TERRESTRIAL ECOLOGICAL EVALUATION

MTCA regulations outline a series of criteria for determining whether a site is excluded from the TEE process, is subject to a simplified TEE, or subject to a site-specific TEE. The discussion below evaluates these possibilities and provides the justification for a site-specific approach.

G.1 Evaluation of Exclusion Criteria

An ecological evaluation is not required if a site meets any one of five exclusionary criteria defined by WAC 173-340-7491. A summary of each of the exclusionary criteria and an evaluation of their applicability to the LSP site is provided below. None of the site conditions qualify for an exclusion from the TEE. Consequently, the site was further evaluated to determine whether it qualified for a simplified TEE.

Evaluation of Exclusionary Criteria for Terrestrial Ecological Evaluation.

Criteria	Evaluation
1. Contaminated soil is located below the point of compliance (the biologically active zone, to a depth of 6 feet or a site-specific alternative depth appropriate to the site approved by the agency).	*The area of contamination does not qualify for an exclusion based on this criterion.*
2. All contaminated soil is or will be covered by buildings, pavement, or other physical barriers that will prevent plant or wildlife exposure.	*The plans for the site do not qualify for an exclusion based on this criterion.*
3. There is less than 1.5 acres of contiguous undeveloped land on or within 500 ft of any area of contamination.	*The size of the site does not qualify for an exclusion based on this criterion.*

Evaluation of Exclusionary Criteria for Terrestrial Ecological Evaluation (continued).

Criteria	Evaluation
4. There is less than ¼ acre of contiguous undeveloped land on or within 500 ft for sites contaminated with any of the following: PCBs, chlorinated dioxins/furans, DDx, aldrin, chlordane, dieldrin, endosulfan, endrin, heptachlor or its epoxide, benzene, hexachlorobenzene, toxaphene, pentachlorophenol (PCP), and/or pentachlorobenzene.	*The amount of contiguous undeveloped land in the vicinity of the site does not qualify for an exclusion based on this criterion.*
5. Concentrations of hazardous substances do not exceed natural background levels from areas similar to the site that have not been influenced by site activities or other localized anthropogenic activities.	*The site does not qualify for an exclusion based on this criterion because:* *a. Existing data indicate TPH and dioxins/furans are present* *b. Ecology does not recognize natural background levels of these organic chemicals.* *c. It is unlikely these organic chemicals will be remediated to concentrations below non-detection levels, on which basis the site will not meet this criterion in the future, either.*

G.2 Applicability of Simplified Evaluation

The simplified TEE is intended for sites that do not have a substantial potential for posing a threat of significant adverse effects to terrestrial ecological receptors and may therefore be removed from further ecological consideration during the remedial investigation and cleanup process. The simplified TEE is structured with an intent to protect terrestrial wildlife at industrial or commercial sites (WAC 173-340-792(1) (b)).

A simplified ecological evaluation may be conducted in the absence of six limiting conditions or criteria. A summary of each of the criteria for a simplified TEE and an evaluation of their applicability to the LSP site is provided below. Where any one of these conditions is present, a simplified TEE is not appropriate and a site-specific TEE is required. LSP does not qualify for a simplified TEE because it is located in a natural area (Criterion 1) and it is larger than 10 acres (Criterion 5). In addition, use of the site by sensitive species (Criterion 3) cannot be ruled out based on current information.

Evaluation of Criteria for Conducting a Simplified Terrestrial Ecological Evaluation.

Criteria	Evaluation
1. The site is located on or directly adjacent to an area where management or land use plans will maintain or restore native or semi-native vegetation [-7491(2) (a) (i)].	Little Squalicum Park is a City Park with native vegetation and wildlife habitat.
2. The site is used by a threatened or endangered species [-7491(2) (a) (ii)]. For animals, "used" means that individuals of a species have been observed to live, feed or breed at the site. For plants, "used" means that a plant species grows at the site or has been found growing at the site.	The 2002 RI/FS for the site indicates that two federally listed species, the bald eagle (*Haliaetus leucocephalus*) and the bull trout (*Salvelinus confluentus*) may be present in the site vicinity. The bald eagle occupies forested areas with large-diameter trees along major water bodies, where it feeds on fish, waterfowl, and carrion. The bald eagle prefers areas with limited human activity, so the site, as a public park, is probably not preferred habitat. It is possible that bald eagles could use the trees along the shoreline as perches while they look for food in Bellingham Bay; however, this use would not fit the definition of site "use." The bull trout occupies pools of large cold rivers in the northwest, and is most common in high mountainous areas; such habitat is not present at the site.

Evaluation of Criteria for Conducting a Simplified Terrestrial Ecological Evaluation (continued).

Criteria	Evaluation
3. Is the site used by a wildlife species classified by the Washington State Department of Fish and Wildlife as a “priority species” or “species of concern” under Title 77 RCW [-7491(2)(a)(ii)]?	The 2002 RI/FS for the Oeser site indicates five “species of concern” as indicated by the U.S. Fish and Wildlife Service: Pacific lamprey (*Entosphenus tridentata*), river lamprey (*Lampetera ayresi*), long-eared myotis (the bat *Myotis evotis*), long-legged myotis (the bat *M. volans*), and peregrine falcon (*Falco peregrinus*). No lampreys have been recovered at the site during sampling by the Washington Department of Fish and Wildlife. Neither species of bat nor the peregrine falcon were observed during site visits for the RI/FS, but their potential presence cannot be ruled out.
4. Is the site used by a plant species classified by the Washington State Department of Natural Resources Natural Heritage Program as “endangered,” “threatened,” or “sensitive” under Title 79 RCW [-7491(2)(a)(ii)]?	No additional species identified as state endangered, threatened, or sensitive were acknowledged in the RI/FS.
5. Is the area of contamination located on a property that contains at least 10 acres of native vegetation within 500 feet of the area of contamination [-7491(2)(a)(iii)]?	The site is larger than 10 acres, most of which is covered in native vegetation.
6. Has the department determined that the site may present a risk to significant wildlife populations [-7491(2)(a)(iv)]?	Ecology has not determined that the site may present a significant risk to wildlife populations.

G.3 Summary

The LSP site is located in a natural setting and does not qualify for an exclusion from a TEE. The simplified TEE is not appropriate for the LSP site because of its natural setting, status as a City Park, and size (>10 acres). Consequently, the site-specific evaluation was adopted for the TEE of the LSP site.

TABLES

LIST OF TABLES

Table G-1. Comparison of Maximum Concentrations of LSP Site Soil Samples to EICs for Soils and Sediments.

										Screening Against Soil EICs					Screening Against Sediment EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
Aluminum	28	100	--	--	11000	30000	B-BB3	99070535	South Slope	50	0.0	--	600.0	0	--	--	--	--	--
Antimony	29	34	0.66	4.1	0.48	36	MWLSC01	99070511	Upper creek	5	0.8	0.0	7.2	0	0.4	10.3	1.0	90.0	1
Arsenic	160	58	0.8	9.8	10	9.09	RES-B-07	99234025	Background	7	1.4	0.1	1.3	0.268817204	20	0.5	0.2	0.5	0.838709677
Barium	28	100	--	--	100	90	B-BB5	99070593	South Slope	102	0.0	--	0.9	0.964285714	--	--	--	--	--
Beryllium	29	14	0.4	8	0.36	0.46	B-AA2	99070532	South Slope	10	0.8	0.9	0.0	0	--	--	--	--	--
Cadmium	135	62	0.04	0.2	0.15	8	TP-22	LSP0107	Landfill	4	0.1	0.0	2.0	0.011904762	0.6	0.3	0.0	13.3	0.392857143
Calcium	54	100	--	--	12000	9570	RES-B-07	99234025	Background	--	--	--	--	--	--	--	--	--	--
Chromium	159	100	--	--	155	98.2	RES-B-05	99234018	Background	42	0.0	--	2.3	0.364779874	95	0.0	--	1.0	0.006289308
Cobalt	29	100	--	--	10	9.8	B-BB5	99070595	South Slope	20	0.0	--	0.5	0.24137931	--	--	--	--	--
Copper	134	100	--	--	104	97.5	SB-18	LSP0252	Lower creek	100	0.0	--	1.0	1	80	0.0	--	1.2	0.059701493
Iron	29	100	--	--	20000	41000	B-AA4	99070588	South Slope	--	--	--	--	--	--	--	--	--	--
Lead	135	100	--	--	10	97	SB-20	LSP0271	Lower creek	50	0.0	--	1.9	0.2	335	0.0	--	0.3	0.362962963
Magnesium	54	100	--	--	10700	9700	MWLSC01	99070541	Upper creek	--	--	--	--	--	--	--	--	--	--
Manganese	29	100	--	--	1000	960	B-AA4	99070533	South Slope	1100	0.0	--	0.9	0.931034483	--	--	--	--	--
Mercury	135	64	0.002	0.18	0.0385	1.62	TP-23	LSP0110	Landfill	0.03	6.0	0.4	54.0	1	0.5	0.4	0.0	3.2	0.022988506
Nickel	133	100	--	--	106	94	B-AA4	99070588	South Slope	30	0.0	--	3.1	0.804511278	60	0.0	--	1.6	0.060150376
Potassium	28	100	--	--	1100	990	SP03; SP06	99070652; 99070655	Upper creek; Upper creek	--	--	--	--	--	--	--	--	--	--
Selenium	29	14	0.42	5.7	0.45	3.4	B-AA2	99070532	South Slope	0.3	19.0	1.0	11.3	1	--	--	--	--	--
Silver	135	5	0.04	0.61	0.31	1.4	TP-01	LSP0061	Landfill	2	0.3	0.0	0.7	0	2	0.3	0.0	0.7	0
Sodium	29	14	110	99	110	340	MW-06D	95372607	Background	--	--	--	--	--	--	--	--	--	--
Thallium	29	24	0.044	0.26	0.081	0.47	B-BB3	99070535	South Slope	1	0.3	0.0	0.5	0	--	--	--	--	--
Vanadium	28	100	--	--	35	83	B-AA4	99070588	South Slope	2	0.0	--	41.5	1	--	--	--	--	--
Zinc	145	100	--	--	100	99	B-AA4	99070588	South Slope	86	0.0	--	1.2	0.124137931	140	0.0	--	0.7	0.779310345
Acetone	3	67	0.0541	0.0541	0.89	1.78	MW-06D	95372607	Background	--	--	--	--	--	--	--	--	--	--
Acrolein	1	0	0.00043	0.00043	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	33	0	0.00001	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromobenzene	3	0	0.00005	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromochloromethane	3	0	0.00008	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromodichloromethane	3	0	0.00006	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromoethane	1	0	0.00007	0.00007	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromoform	3	0	0.00005	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bromomethane	3	0	0.00004	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Butanone	3	0	0.00049	0.0356	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Butylbenzene	3	0	0.00005	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
sec-Butylbenzene	3	0	0.00004	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
tert-Butylbenzene	3	0	0.00006	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Disulfide	3	0	0.00004	0.0071	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Tetrachloride	3	0	0.00005	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorobenzene	3	0	0.00005	0.0018	--	--	--	--	--	40	0.0	0.0	0.0	--	--	--	--	--	--
1-Chlorobutane	2	0	0.0014	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroethane	3	0	0.00006	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chloroethylvinylether	1	0	0.00005	0.00005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform	3	0	0.00004	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloromethane	3	0	0.00003	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	3	0	0.00008	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Chlorotoluene	3	0	0.00005	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibromochloromethane	3	0	0.00005	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	3	0	0.00011	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromoethane	3	0	0.00005	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibromomethane	3	0	0.00004	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichloro-2-butene	2	0	0.0029	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
trans-1,4-Dichloro-2-butene	1	0	0.00005	0.00005	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichlorodifluoromethane	2	0	0.0014	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethane	3	0	0.00003	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethane	3	0	0.00004	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloroethene	3	0	0.00004	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	3	0	0.00005	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethene (ND = 0)	3	0	0.00005	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloroethene (ND = 1/2 DL)	3	0	0.00005	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
trans-1,2-Dichloroethene	3	0	0.00004	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichloropropane	3	0	0.00003	0.0018	--	--	--	--	--	700	0.0	0.0	0.0	--	--	--	--	--	--
1,3-Dichloropropane	3	0	0.00004	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,2-Dichloropropane	3	0	0.00003	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1-Dichloropropene	3	0	0.00004	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	3	0	0.00004	0.0019	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table G-1. Comparison of Maximum Concentrations of LSP Site Soil Samples to EICs for Soils and Sediments.

										Screening Against Soil EICs					Screening Against Sediment EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
1,3-Dichloropropene (ND = 1/2 DL)	3	0	0.00004	0.0019	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichloropropene (ND = 0)	3	0	0.00004	0.0019	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	3	0	0.00004	0.0017	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethyl Ether	2	0	0.0014	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethyl Methacrylate	2	0	0.0029	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	33	3	0.0014	0.5	0.21	0.21	TP-06	LSP0045	Historical creek	--	--	--	--	--	--	--	--	--	--
Fluorotrichloromethane	3	0	0.00005	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Hexanone	3	0	0.00044	0.0356	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Iodomethane	3	0	0.00004	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Isopropylbenzene	3	0	0.00003	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
p-Isopropyltoluene	3	0	0.00005	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methacrylonitrile	2	0	0.0029	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl acrylate	2	0	0.0014	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl Methacrylate	2	0	0.0029	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methyl tert-butyl Ether	32	0	0.0014	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Methyl-2-pentanone	3	0	0.00029	0.0178	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methylene Chloride	3	0	0.00005	0.0089	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Nitropropane	2	0	0.0029	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachloroethane	2	0	0.0014	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Propenenitrile	3	0	0.00004	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Propylbenzene	3	0	0.00003	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Styrene	3	0	0.00005	0.0018	--	--	--	--	--	300	0.0	0.0	0.0	--	--	--	--	--	--
1,1,1,2-Tetrachloroethane	3	0	0.00006	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	3	0	0.00004	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	3	0	0.00005	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes (ND = 0)	33	6	0.0029	0.5	0.33	0.63	MWLSC02	99070547	Upper creek	--	--	--	--	--	--	--	--	--	--
Toluene	33	3	0.0014	0.5	0.088	0.088	TP-06	LSP0045	Historical creek	200	0.0	0.0	0.0	0	--	--	--	--	--
Total Xylenes (ND = 1/2 DL)	33	6	0.0029	0.5	0.33	0.88	MWLSC02	99070547	Upper creek	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	1	0	0.00004	0.00004	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	3	0	0.00003	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	3	0	0.00005	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	3	0	0.00006	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichloropropane	3	0	0.00006	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	3	33	0.0029	0.0036	0.51	0.51	TP-06	LSP0045	Historical creek	--	--	--	--	--	--	--	--	--	--
1,3,5-Trimethylbenzene	3	33	0.0029	0.0036	0.18	0.18	TP-06	LSP0045	Historical creek	--	--	--	--	--	--	--	--	--	--
Vinyl Acetate	1	0	0.00003	0.00003	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl Chloride	3	0	0.00004	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
m&p-Xylene	33	6	0.0029	0.5	0.18	0.63	MWLSC02	99070547	Upper creek	--	--	--	--	--	--	--	--	--	--
o-Xylene	33	3	0.0014	0.5	0.15	0.15	TP-06	LSP0045	Historical creek	--	--	--	--	--	--	--	--	--	--
Total Xylenes	2	0	0.0029	0.0036	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Allyl Chloride	2	0	0.0014	0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aniline	59	0	0.019	0.381	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Benzenediamine	5	0	0.096	2.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzidine	73	0	0.344	8.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Acenaphthene	114	33	0.0019	0.21	0.0067	9.9	SB-31	LSP0512	Upper creek	20	0.0	0.0	0.5	0.394736842	1.06	0.2	0.0	9.3	0.578947368
Acenaphthylene	114	40	0.0019	0.2	0.002	7.2	SB-11; SB-11	LSP0275; LSP0275	Historical creek; Upper creek	--	--	--	--	--	0.47	0.4	0.0	15.3	0.5
Bis(2-chloroethoxy) Methane	114	0	0.0095	0.28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis-(2-chloroethyl) Ether	114	0	0.0095	0.27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-chloroisopropyl)ether	66	0	0.0095	0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-chloro-1-methylethyl) Ether	48	0	0.012	0.27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Anthracene	114	52	0.0019	0.2	0.0022	78	SP02	99070651	Upper creek	--	--	--	--	--	1.2	0.2	0.0	65.0	0.525423729
4-Bromophenyl-phenylether	114	0	0.0095	0.29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluorene	114	41	0.0019	0.2	0.0018	9.4	SB-29; SB-29	LSP0468; LSP0468	Historical creek; Upper creek	30	0.0	0.0	0.3	0.29787234	1	0.2	0.0	9.4	0.489361702
Caffeine	2	0	0.022	0.117	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbazole	75	53	0.02	0.2	0.011	9.3	SB-31	LSP0510	Upper creek	--	--	--	--	--	--	--	--	--	--
4-Chloroaniline	110	0	0.0095	2.2	--	--	--	--	--	20	0.1	0.0	0.0	--	--	--	--	--	--
4-Chloro-3-methylphenol	114	0	0.0095	2.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chloronaphthalene	114	0	0.0038	0.21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chlorophenol	114	0	0.0095	0.2	--	--	--	--	--	7	0.0	0.0	0.0	--	--	--	--	--	--
4-Chlorophenyl-phenylether	114	0	0.0095	0.27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3B-Coprostanol	2	0	0.221	1.17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Creosote	6	83	7	7	2900	9500	SB-12	LSP0201	Upper creek	--	--	--	--	--	--	--	--	--	--
7H-Dibenzo(c,g)carbazole	38	11	0.0019	0.03	0.05	0.31	SP03	99070652	Upper creek	--	--	--	--	--	--	--	--	--	--
Naphthalene	114	58	0.0019	0.24	0.002	80	TP-06	LSP0046	Historical creek	--	--	--	--	--	0.5	0.5	0.0	160.0	0.318181818

Table G-1. Comparison of Maximum Concentrations of LSP Site Soil Samples to EICs for Soils and Sediments.

										Screening Against Soil EICs					Screening Against Sediment EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
1,3-Dichlorobenzene	114	0	0.00005	0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3,3'-Dichlorobenzidine	107	0	0.0095	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,4-Dichlorophenol	114	0	0.008	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	114	75	0.0019	0.191	0.0029	94	SB-09	LSP0179	Upper creek	--	--	--	--	--	6.1	0.0	0.0	15.4	0.070588235
2-Methylnaphthalene	114	42	0.0019	0.37	0.0043	9.2	TP-06	LSP0047	Historical creek	--	--	--	--	--	0.47	0.8	0.0	19.6	0.333333333
4,6-Dinitro-2-methylphenol	110	1	0.0095	2.5	0.013	0.013	B-AA2	99070532	South Slope	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	114	0	0.0095	8.01	--	--	--	--	--	20	0.4	0.1	0.0	--	--	--	--	--	--
2,4-Dinitrotoluene	114	4	0.0095	2	0.036	4.2	TP-06	LSP0045	Historical creek	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	114	1	0.0095	2.2	0.022	0.022	B-BB5	99070536	South Slope	--	--	--	--	--	--	--	--	--	--
di-n-Octylphthalate	114	0	0.0095	0.953	--	--	--	--	--	--	--	--	--	--	0.026	36.7	0.6	0.0	--
1,2-Diphenylhydrazine	75	0	0.019	0.45	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorocyclopentadiene	109	0	0.0095	2	--	--	--	--	--	10	0.2	0.0	0.0	--	--	--	--	--	--
Hexachloroethane	114	0	0.0014	0.22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Isophorone	114	0	0.0095	0.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1-Methylnaphthalene	73	38	0.02	0.41	0.019	79	SB-31	LSP0510	Upper creek	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	114	51	0.0019	0.278	0.0033	9.2	SB-09	LSP0179	Upper creek	--	--	--	--	--	4.26	0.1	0.0	2.2	0.137931034
3&4-Methylphenol	39	3	0.0095	0.18	0.11	0.11	SP03	99070652	Upper creek	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	75	3	0.019	0.2	0.092	0.114	LSC-S2	3394048	Upper creek	--	--	--	--	--	0.67	0.3	0.0	0.2	0
2-Nitroaniline	114	0	0.0095	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3-Nitroaniline	113	0	0.0095	1.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Nitroaniline	113	0	0.0095	2.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrobenzene	114	0	0.0095	0.24	--	--	--	--	--	40	0.0	0.0	0.0	--	--	--	--	--	--
2-Nitrophenol	114	0	0.0084	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Nitrophenol	114	0	0.0095	2.2	--	--	--	--	--	7	0.3	0.0	0.0	--	--	--	--	--	--
1-Nitropyrene	3	0	0.0023	0.0025	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Nitrosodimethylamine	50	0	0.046	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Nitroso-di-n-propylamine	114	0	0.008	1.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	114	56	0.0019	0.381	0.0026	75	TP-06	LSP0045	Historical creek	12	0.0	0.0	6.3	0.421875	3.3	0.1	0.0	22.7	0.21875
Chrysene	114	67	0.0019	0.2	0.0023	8.8	SB-09	LSP0179	Upper creek	--	--	--	--	--	5.94	0.0	0.0	1.5	0.039473684
Pyridine	49	0	0.041	2.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Retene	73	16	0.02	2.2	0.013	0.37	SB-18	LSP0250	Lower creek	--	--	--	--	--	--	--	--	--	--
2,3,4,5-Tetrachlorophenol	46	0	0.096	2.2	--	--	--	--	--	20	0.1	0.0	0.0	--	--	--	--	--	--
2,3,4,6-Tetrachlorophenol	46	2	0.096	2.2	0.087	0.087	TP-23	LSP0108	Landfill	--	--	--	--	--	--	--	--	--	--
2,3,5,6-Tetrachlorophenol	46	0	0.096	2.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachlorophenols	39	15	0.0095	0.15	0.023	0.2	SP03	99070652	Upper creek	--	--	--	--	--	--	--	--	--	--
Tetrahydrofuran	2	0	0.0145	0.0178	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene	4	0	0.00006	0.41	--	--	--	--	--	20	0.0	0.0	0.0	--	--	--	--	--	--
2,4,5-Trichlorophenol	114	1	0.0057	1.5	0.0079	0.0079	LSC-S1	3394047	Lower creek	4	0.4	0.0	0.0	0	--	--	--	--	--
2,4,6-Trichlorophenol	114	1	0.0084	1	0.032	0.032	LSC-S1	3394047	Lower creek	10	0.1	0.0	0.0	0	--	--	--	--	--
Dibenzo(a,h)anthracene	114	39	0.0019	0.381	0.023	9.9	TP-06	LSP0045	Historical creek	--	--	--	--	--	0.8	0.5	0.0	12.4	0.422222222
2,4-Dimethylphenol	111	2	0.0095	0.3	0.044	0.077	LSC-S1	3394047	Lower creek	--	--	--	--	--	0.029	10.3	0.4	2.7	1
2-Methylphenol	114	2	0.0095	0.54	0.048	0.065	LSC-S2	3394048	Upper creek	--	--	--	--	--	0.063	8.6	0.4	1.0	0.5
Phenol	114	4	0.0095	0.27	0.0041	0.429	LSC-S2	3394048	Upper creek	70	0.0	0.0	0.0	0	0.42	0.6	0.0	1.0	0.2
Pentachlorophenol	114	39	0.0095	1	0.0056	7.1	TP-16	LSP0088	Historical creek	3	0.3	0.0	2.4	0.133333333	0.36	2.8	0.4	19.7	0.6
Bis(2-ethylhexyl)phthalate	114	25	0.011	2.76	0.014	6.18	LSC-S2	3394048	Upper creek	--	--	--	--	--	0.23	12.0	0.3	26.9	0.413793103
Butylbenzylphthalate	114	12	0.0095	0.381	0.0016	0.666	LSC-S1	3394047	Lower creek	--	--	--	--	--	0.26	1.5	0.3	2.6	0.142857143
Dimethylphthalate	114	17	0.0095	0.297	0.0032	3.13	LSC-S1	3394047	Lower creek	200	0.0	0.0	0.0	0.052631579	0.046	6.5	0.5	68.0	0.631578947
Benzoic Acid	114	26	0.019	2	0.021	2.92	LSC-S2	3394048	Upper creek	--	--	--	--	--	0.65	3.1	0.3	4.5	0.666666667
Benzo(b)fluoranthene	114	63	0.0019	0.2	0.003	9.5	SB-29; SB-29	LSP0474; LSP0474	Historical creek; Upper creek	--	--	--	--	--	--	--	--	--	--
Benzo(j)fluoranthene	39	33	0.019	0.026	0.0034	2.2	SP01	99070650	Upper creek	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	114	56	0.0019	0.2	0.0034	9.9	SB-31	LSP0510	Upper creek	--	--	--	--	--	--	--	--	--	--
Benzyl Alcohol	114	6	0.0095	0.953	0.0068	1.1	SP03	99070652	Upper creek	--	--	--	--	--	0.057	16.7	0.4	19.3	0.571428571
Dibenzofuran	114	39	0.0095	0.35	0.0014	9.9	SP02	99070651	Upper creek	--	--	--	--	--	0.4	0.9	0.0	24.8	0.477272727
Fluoranthene	114	77	0.0019	0.2	0.0037	9.4	SB-22	LSP0326	Upper creek	--	--	--	--	--	11	0.0	0.0	0.9	0.306818182
Indeno(1,2,3-cd)pyrene	114	60	0.0019	0.381	0.004	94	SB-11; SB-11	LSP0274; LSP0274	Historical creek; Upper creek	--	--	--	--	--	4.12	0.1	0.0	22.8	0.132352941
Pyrene	114	71	0.0019	0.2	0.0018	95	SB-29; SB-29	LSP0468; LSP0468	Historical creek; Upper creek	--	--	--	--	--	8.8	0.0	0.0	10.8	0.037037037
Benzo(g,h,i)perylene	114	59	0.0019	0.2	0.0048	87	SB-11; SB-11	LSP0274; LSP0274	Historical creek; Upper creek	--	--	--	--	--	4.02	0.0	0.0	21.6	0.089552239
Dibenzo(a,h)acridine	37	0	0.0019	0.037	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,j)acridine	37	3	0.0019	0.037	0.036	0.036	SP05	99070654	Upper creek	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,e)pyrene	39	18	0.0019	0.0026	0.064	2.6	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,h)pyrene	39	18	0.0019	0.0026	0.0073	1.4	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,i)pyrene	39	18	0.0019	0.0026	0.029	0.47	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--

Table G-1. Comparison of Maximum Concentrations of LSP Site Soil Samples to EICs for Soils and Sediments.

										Screening Against Soil EICs					Screening Against Sediment EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
Dibenzo(a,l)pyrene	38	11	0.0019	0.037	0.0039	0.1	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--
7,12-Dimethylbenz(a)anthracene	83	6	0.0019	0.88	0.016	3.4	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--
LPAH (ND = 1/2 DL)	114	81	0.0019	0.191	0.0089	8.574	SP01	99070650	Upper creek	--	--	--	--	--	6.6	0.0	0.0	1.3	0.076086957
Total Benzofluoranthenes (ND = 0)	114	64	0.019	0.2	0.003	91	TP-17	LSP0090	Historical creek	--	--	--	--	--	11	0.0	0.0	8.3	0.479452055
Total Benzofluoranthenes (ND = 1/2 DL)	114	64	0.019	0.2	0.0057	91	TP-17	LSP0090	Historical creek	--	--	--	--	--	11	0.0	0.0	8.3	0.479452055
HPAH (ND = 1/2 DL)	114	79	0.019	0.312	0.02935	9.333	LSC-S2	3394048	Upper creek	--	--	--	--	--	31	0.0	0.0	0.3	0.277777778
TPAHs (ND = 1/2 DL)	114	84	0.019	0.312	0.0319	99.92	SB-09	LSP0176	Upper creek	--	--	--	--	--	--	--	--	--	--
Aldrin	12	0	0.000043	0.000044	--	--	--	--	--	0.1	0.0	0.0	0.0	--	--	--	--	--	--
alpha-BHC	12	0	0.00005	0.000051	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
beta-BHC	12	0	0.000089	0.000091	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
gamma-BHC (Lindane)	12	0	0.000088	0.00009	--	--	--	--	--	6	0.0	0.0	0.0	--	--	--	--	--	--
delta-BHC	12	0	0.000021	0.000021	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
alpha-Chlordane	12	0	0.000057	0.000058	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
gamma-Chlordane	12	0	0.00012	0.00012	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlordane (ND = 0)	12	0	0.00012	0.00012	--	--	--	--	--	1	0.0	0.0	0.0	--	--	--	--	--	--
Chlordane (ND = 1/2 DL)	12	0	0.00012	0.00012	--	--	--	--	--	1	0.0	0.0	0.0	--	--	--	--	--	--
4,4'-DDD	12	0	0.000093	0.000095	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDE	12	0	0.00012	0.00012	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDT	12	8	0.0002	0.0002	0.0032	0.0032	HA-01	LSP0569	Railroad	--	--	--	--	--	--	--	--	--	--
Dieldrin	12	0	0.000083	0.000085	--	--	--	--	--	0.07	0.0	0.0	0.0	--	--	--	--	--	--
Endosulfan I	12	0	0.000062	0.000063	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Endosulfan II	12	0	0.00012	0.00012	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Endosulfan Sulfate	12	0	0.00015	0.00015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Endrin	12	0	0.00008	0.000082	--	--	--	--	--	0.2	0.0	0.0	0.0	--	--	--	--	--	--
Endrin Aldehyde	12	0	0.00018	0.00018	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Endrin Ketone	12	0	0.00018	0.00019	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor	12	0	0.000072	0.000073	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor Epoxide	12	0	0.000053	0.000054	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methoxychlor	12	0	0.0011	0.0011	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toxaphene	12	0	0.047	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Heptachlor (ND = 0)	12	0	0.000072	0.000073	--	--	--	--	--	0.4	0.0	0.0	0.0	--	--	--	--	--	--
Total Heptachlor (ND = 1/2 DL)	12	0	0.000072	0.000073	--	--	--	--	--	0.4	0.0	0.0	0.0	--	--	--	--	--	--
Total DDX (ND = 0)	12	8	0.0002	0.0002	0.0032	0.0032	HA-01	LSP0569	Railroad	0.75	0.0	0.0	0.0	0	--	--	--	--	--
Total DDX (ND = 1/2 DL)	12	8	0.0002	0.0002	0.0033065	0.0033065	HA-01	LSP0569	Railroad	0.75	0.0	0.0	0.0	0	--	--	--	--	--
Endosulfan (ND = 0)	12	0	0.00015	0.00015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Endosulfan (ND = 1/2 DL)	12	0	0.00015	0.00015	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1016	14	0	0.0019	0.033	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1221	14	0	0.0019	0.033	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1232	14	0	0.0019	0.033	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1242	14	0	0.0019	0.033	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1248	14	0	0.0019	0.033	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1254	14	0	0.0019	0.033	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1260	14	0	0.0019	0.033	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Aroclors (ND = 0)	14	0	0.0019	0.033	--	--	--	--	--	0.65	0.1	0.0	0.0	--	0.06	0.6	0.0	0.0	--
Total Aroclors (ND = 1/2 DL)	14	0	0.0019	0.033	--	--	--	--	--	0.65	0.1	0.0	0.0	--	0.06	0.6	0.0	0.0	--
Gasoline Range Hydrocarbons	19	16	0.004	0.011	110	170	TP-06	LSP0046	Historical creek	100	0.0	0.0	1.7	1	--	--	--	--	--
Diesel Range Hydrocarbons	138	70	0.4	2.6	100	96	HA-04	LSP0575	Railroad	200	0.0	0.0	0.5	0.635416667	--	--	--	--	--
Motor Oil	136	76	11	78	100	90	TP-22	LSP0107	Landfill	--	--	--	--	--	--	--	--	--	--
TPH	67	99	2	2	103	99	SS-FS20	SS-FS20	South Slope	--	--	--	--	--	--	--	--	--	--
C5-C6 Aliphatics	30	0	5	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
C6-C8 Aliphatics	30	0	5	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
C8-C10 Aliphatics	35	0	14	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
C10-C12 Aliphatics	44	2	14	6.4	9.4	9.4	SB-09	LSP0177	Upper creek	--	--	--	--	--	--	--	--	--	--
C12-C16 Aliphatics	46	24	5.2	6.8	11	8.7	MWLSC02	99070512	Upper creek	--	--	--	--	--	--	--	--	--	--
C16-C18 Aliphatics	39	10	5.2	6.8	250	9	SP07	99070656	General Site	--	--	--	--	--	--	--	--	--	--
C16-C21 Aliphatics	7	100	--	--	15	87	SB-11; SB-11	LSP0275; LSP0275	Historical creek; Upper creek	--	--	--	--	--	--	--	--	--	--
C18-C21 Aliphatics	39	13	5.2	6.8	15	6.7	SP06	99070655	Upper creek	--	--	--	--	--	--	--	--	--	--
C21-C28 Aliphatics	39	18	5.2	6.8	10	94	SP01	99070650	Upper creek	--	--	--	--	--	--	--	--	--	--
C21-C34 Aliphatics	7	100	--	--	130	19	TP-06	LSP0044	Historical creek	--	--	--	--	--	--	--	--	--	--
C28-C36 Aliphatics	39	18	5.2	6.8	140	8.2	MWLSC01	99070511	Upper creek	--	--	--	--	--	--	--	--	--	--
C8-C10 Aromatics	37	5	2.4	66	30	4.9	TP-06	LSP0044	Historical creek	--	--	--	--	--	--	--	--	--	--
C10-C12 Aromatics	44	7	2.4	6.4	13	90	SB-09	LSP0177	Upper creek	--	--	--	--	--	--	--	--	--	--
C12-C13 Aromatics	30	3	5	5	74	74	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--

Table G-1. Comparison of Maximum Concentrations of LSP Site Soil Samples to EICs for Soils and Sediments.

										Screening Against Soil EICs					Screening Against Sediment EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
C12-C16 Aromatics	44	14	2.4	6.8	2000	81	SB-29; SB-29	LSP0468; LSP0468	Historical creek; Upper creek	--	--	--	--	--	--	--	--	--	--
C16-C18 Aromatics	39	3	5.2	6.8	510	510	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--
C16-C21 Aromatics	7	100	--	--	29	900	SB-29; SB-29	LSP0468; LSP0468	Historical creek; Upper creek	--	--	--	--	--	--	--	--	--	--
C18-C21 Aromatics	39	10	5.2	6.8	20	9.6	SP03	99070652	Upper creek	--	--	--	--	--	--	--	--	--	--
C21-C28 Aromatics	39	15	5.2	6.8	11	700	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--
C21-C34 Aromatics	7	100	--	--	200	4900	SB-11; SB-11	LSP0275; LSP0275	Historical creek; Upper creek	--	--	--	--	--	--	--	--	--	--
C28-C36 Aromatics	39	21	5.2	6.8	22	81	SP07	99070656	General Site	--	--	--	--	--	--	--	--	--	--
2,3,7,8-TCDD	62	15	0.000000151	0.000043	0.000000669	0.000036	TP-16	LSP0088	Historical creek	--	--	--	--	--	--	--	--	--	--
Total TCDD	62	68	0.000000151	0.000043	0.000002227	0.00021	SB-18	LSP0250	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8-PeCDD	62	29	0.000000242	0.00000538	0.00000102	0.000135	SP07	99070656	General Site	--	--	--	--	--	--	--	--	--	--
Total PeCDD	62	66	0.000000354	0.000015	0.000001696	0.00053	SB-18	LSP0250	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-HxCDD	62	52	0.000000239	0.0000497	0.000000475	0.000423	SP07	99070656	General Site	--	--	--	--	--	--	--	--	--	--
1,2,3,6,7,8-HxCDD	62	73	0.000000168	0.000027	0.000000569	0.00292	SP07	99070656	General Site	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8,9-HxCDD	62	60	0.000000191	0.0000297	0.000001269	0.000745	SP07	99070656	General Site	--	--	--	--	--	--	--	--	--	--
Total HxCDD	62	82	0.000000446	0.0000024	0.0000024	0.0132	SP07	99070656	General Site	--	--	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-HpCDD	62	85	0.000000609	0.0000234	0.00000426	0.078	SP07	99070656	General Site	--	--	--	--	--	--	--	--	--	--
Total HpCDD	62	89	0.000000609	0.000000956	0.00000426	0.17	TP-16	LSP0088	Historical creek	--	--	--	--	--	--	--	--	--	--
OCDD	62	84	0.00000411	0.0000712	0.000082307	0.79	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--
2,3,7,8-TCDF	62	53	0.000000248	0.00013	0.000000268	0.000038	SB-20	LSP0271	Lower creek	--	--	--	--	--	--	--	--	--	--
Total TCDF	62	56	0.000000237	0.00013	0.000000918	0.00014	SB-18	LSP0250	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8-PeCDF	62	15	0.000000135	0.000054	0.0000013	0.00018	SB-20	LSP0271	Lower creek	--	--	--	--	--	--	--	--	--	--
2,3,4,7,8-PeCDF	62	27	0.000000139	0.000003843	0.000000932	0.00021	SB-20	LSP0271	Lower creek	--	--	--	--	--	--	--	--	--	--
Total PeCDF	62	71	0.000000228	0.000054	0.000001524	0.00304	SP07	99070656	General Site	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-HxCDF	62	21	0.000000454	0.00314	0.000003881	0.0014	SB-20	LSP0271	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,6,7,8-HxCDF	62	13	0.000000189	0.0000725	0.000002108	0.0003	SB-20	LSP0271	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8,9-HxCDF	62	15	0.000000291	0.000115	0.000000415	0.000036	SB-20	LSP0271	Lower creek	--	--	--	--	--	--	--	--	--	--
2,3,4,6,7,8-HxCDF	62	16	0.000000218	0.0000848	0.0000052	0.00022	SB-20	LSP0271	Lower creek	--	--	--	--	--	--	--	--	--	--
Total HxCDF	62	79	0.000000247	0.0000141	0.000001914	0.016	SB-20	LSP0271	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-HpCDF	62	79	0.000000559	0.000012424	0.000001577	0.0174	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8,9-HpCDF	62	27	0.000000252	0.00015	0.000002172	0.00063	SB-20	LSP0271	Lower creek	--	--	--	--	--	--	--	--	--	--
Total HpCDF	62	79	0.000000336	0.00000547	0.000001577	0.069	TP-16	LSP0088	Historical creek	--	--	--	--	--	--	--	--	--	--
OCDF	62	82	0.00000064	0.000053698	0.000002437	0.147	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--
TEQDF B1	62	89	0.00000411	0.0000186	1.05174E-06	0.0008058	SB-20	LSP0271	Lower creek	0.000002	9.3	1.0	402.9	0.854545455	--	--	--	--	--
TEQDF F1	62	89	0.00000411	0.0000186	6.46545E-07	0.00085612	SP07	99070656	General Site	0.000002	9.3	1.0	428.1	0.781818182	--	--	--	--	--
TEQDF 0.5M98	62	89	0.00000411	0.0000186	7.24827E-07	0.001719635	SP07	99070656	General Site	0.000002	9.3	1.0	859.8	0.836363636	--	--	--	--	--
TEQDF 0.5M05	62	89	0.00000411	0.0000186	7.01962E-07	0.001876575	SP07	99070656	General Site	0.000002	9.3	1.0	938.3	0.836363636	--	--	--	--	--
Total PCDD (ND = 0)	62	89	0.00000411	0.0000186	0.00000426	0.9326668	SP07	99070656	General Site	--	--	--	--	--	--	--	--	--	--
Total PCDD (ND = 1/2 DL)	62	89	0.00000411	0.0000186	0.000030586	0.9326668	SP07	99070656	General Site	--	--	--	--	--	--	--	--	--	--
Total PCDF (ND = 1/2 DL)	62	87	0.00000069	0.00000637	0.000006764	0.1648013	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--
Total PCDF (ND = 0)	62	87	0.00000069	0.00000637	0.000005989	0.1647363	SP02	99070651	Upper creek	--	--	--	--	--	--	--	--	--	--
Liquid Limit	7	100	--	--	23.7	63.2	TP-06	LSP0048	Historical creek	--	--	--	--	--	--	--	--	--	--
Moisture Content	15	100	--	--	10	9	SC-18	SC-18-01101993-0-0.5	--	--	--	--	--	--	--	--	--	--	--
Percent Moisture	25	100	--	--	14	9.9	TP-02	LSP0068	Landfill	--	--	--	--	--	--	--	--	--	--
Plastic Limit	7	100	--	--	15	64.3	SB-22	LSP0328	Upper creek	--	--	--	--	--	--	--	--	--	--
Plasticity Index	7	100	--	--	11.6	6.3	SB-09	LSP0173	Upper creek	--	--	--	--	--	--	--	--	--	--
Specific Gravity	15	100	--	--	2.47	2.77	SB-32	LSP0530	Upper creek	--	--	--	--	--	--	--	--	--	--
Total Organic Carbon	18	100	--	--	1300	79000	SP03	99070652	Upper creek	--	--	--	--	--	--	--	--	--	--
Total Organic Carbon	98	100	--	--	0.085	9.37	SB-25	LSP0451	Upper creek	--	--	--	--	--	--	--	--	--	--
Total Solids	145	100	--	--	20.8	99.8	MWLSC04	99070514	Upper creek	--	--	--	--	--	--	--	--	--	--

Notes: -- = No data

Table G-2. Comparison of Maximum Concentrations of LSP Site Sediment Samples to EICs for Sediments and Soils.

										Screening Against Sediment EICs					Screening Against Soil EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
Aluminum	18	100	--	--	10500	9700	SD03	99070522	Lower creek	--	--	--	--	--	50	0.0	--	194.0	0.222222222
Antimony	18	33	0.59	4.2	4	8.3	OS06	95352505	Upper creek	0.4	10.5	1.0	20.8	1	5	0.8	0.0	1.7	0.5
Arsenic	48	75	0.9	4.5	10	9.5	SB-38	LSP0559	Historical creek	20	0.2	0.1	0.5	0.527777778	7	0.6	0.0	1.4	0.138888889
Barium	18	100	--	--	100	96.9	OS04	95352503	Upper creek	--	--	--	--	--	102	0.0	--	1.0	0.888888889
Beryllium	18	39	0.46	6	0.2	0.27	OS05; OS06	95352504; 95352505	Upper creek; Upper creek	--	--	--	--	--	10	0.6	0.8	0.0	0
Cadmium	56	75	0.05	4.5	0.21	2.5	SB-37	LSP0552	Historical creek	0.6	7.5	0.1	4.2	0.380952381	4	1.1	0.1	0.6	0
Calcium	18	100	--	--	12100	9100	SD11	99070530	Wetlands	--	--	--	--	--	--	--	--	--	--
Chromium	45	100	--	--	103	86	SB-37	LSP0552	Historical creek	95	0.0	--	0.9	0	42	0.0	--	2.0	0.288888889
Cobalt	18	100	--	--	10.6	9.8	SD10	99070529	Upper creek	--	--	--	--	--	20	0.0	--	0.5	0.666666667
Copper	58	100	--	--	104	91.3	OS03	95352502	Upper creek	80	0.0	--	1.1	0.051724138	100	0.0	--	0.9	1
Iron	18	100	--	--	13000	24700	OS05	95352504	Upper creek	--	--	--	--	--	--	--	--	--	--
Lead	58	98	0.2	0.2	11.2	92	SB-36	LSP0548	Historical creek	335	0.0	0.0	0.3	0.456140351	50	0.0	0.0	1.8	0.315789474
Magnesium	18	100	--	--	4100	7650	SD11	99070530	Wetlands	--	--	--	--	--	--	--	--	--	--
Manganese	18	100	--	--	235	930	SD10	99070529	Upper creek	--	--	--	--	--	1100	0.0	--	0.8	1
Mercury	59	56	0.003	0.35	0.004	0.4	SB-37	LSP0552	Historical creek	0.5	0.7	0.0	0.8	0	0.03	11.7	0.4	13.3	0.909090909
Nickel	56	100	--	--	106	95.4	OS03	95352502	Upper creek	60	0.0	--	1.6	0.142857143	30	0.0	--	3.2	0.660714286
Potassium	18	100	--	--	1300	990	SD02	99070521	Lower creek	--	--	--	--	--	--	--	--	--	--
Selenium	18	0	0.2	8.9	--	--	--	--	--	--	--	--	--	--	0.3	29.7	0.6	0.0	--
Silver	45	2	0.05	2.3	30	30	SD04	99070523	Lower creek	2	1.2	0.0	15.0	1	2	1.2	0.0	15.0	1
Sodium	18	39	120	4800	162	483	OS01	95352500	Beach	--	--	--	--	--	--	--	--	--	--
Thallium	18	0	0.25	4.5	--	--	--	--	--	--	--	--	--	--	1	4.5	0.6	0.0	--
Vanadium	18	100	--	--	29	60.5	SD11	99070530	Wetlands	--	--	--	--	--	2	0.0	--	30.3	1
Zinc	59	100	--	--	100	98	SB-15	LSP0230	Upper creek	140	0.0	--	0.7	0.762711864	86	0.0	--	1.1	0.101694915
Aniline	25	4	0.02	0.226	0.12	0.12	SB-02	LSP0127	Lower creek	--	--	--	--	--	--	--	--	--	--
1,4-Benzenediamine	1	0	2.3	2.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzidine	24	0	0.339	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Acenaphthene	41	71	0.0022	0.185	0.0035	5.4	SB-19	LSP0254	Lower creek	1.06	0.2	0.0	5.1	0.137931034	20	0.0	0.0	0.3	0.068965517
Acenaphthylene	41	71	0.0022	0.21	0.0044	1.8	SB-38	LSP0561	Historical creek	0.47	0.4	0.0	3.8	0.137931034	--	--	--	--	--
Bis(2-chloroethoxy) Methane	41	0	0.01	0.28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis-(2-chloroethyl) Ether	41	0	0.01	0.27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-chloroisopropyl)ether	18	0	0.011	0.226	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bis(2-chloro-1-methylethyl) Ether	23	0	0.012	0.41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Anthracene	41	88	0.0022	0.185	0.012	9	SB-19	LSP0253	Lower creek	1.2	0.2	0.0	7.5	0.444444444	--	--	--	--	--
4-Bromophenyl-phenylether	41	0	0.01	0.29	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluorene	41	76	0.0022	0.185	0.0063	9.2	SB-19	LSP0254	Lower creek	1	0.2	0.0	9.2	0.129032258	30	0.0	0.0	0.3	0.032258065
Caffeine	6	0	0.02	0.196	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbazole	31	71	0.022	0.393	0.011	4.78	LSC-03	3394042	Lower creek	--	--	--	--	--	--	--	--	--	--
4-Chloroaniline	41	0	0.011	2.3	--	--	--	--	--	--	--	--	--	--	20	0.1	0.0	0.0	--
4-Chloro-3-methylphenol	41	0	0.0099	0.83	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chloronaphthalene	41	0	0.0043	0.226	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Chlorophenol	41	0	0.01	0.226	--	--	--	--	--	--	--	--	--	--	7	0.0	0.0	0.0	--
4-Chlorophenyl-phenylether	41	0	0.01	0.27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3B-Coprostanol	6	33	0.236	1.96	0.638	2.8	LSC-03	3394042	Lower creek	--	--	--	--	--	--	--	--	--	--
Creosote	2	100	--	--	11000	5200	SB-19	LSP0253	Lower creek	--	--	--	--	--	--	--	--	--	--
7H-Dibenzo(c,g)carbazole	11	9	0.0022	0.01	0.013	0.013	SD02	99070521	Lower creek	--	--	--	--	--	--	--	--	--	--
Naphthalene	41	73	0.0022	0.185	0.0035	4.3	LSC Bank	LSP0051	Upper creek	0.5	0.4	0.0	8.6	0.066666667	--	--	--	--	--
1,2-Dichlorobenzene *	23	0	0.112936345	6.666666667	--	--	--	--	--	2.3	2.9	0.2	0.0	--	--	--	--	--	--
1,3-Dichlorobenzene	41	0	0.01	0.226	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene *	23	0	0.102669405	6.666666667	--	--	--	--	--	3.1	2.2	0.1	0.0	--	20	0.3	0.1	0.0	--
3,3'-Dichlorobenzidine	35	0	0.011	1.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,4-Dichlorophenol	41	0	0.0081	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diethylphthalate *	23	4	0.102669405	6.666666667	0.638461538	0.638461538	SD09	99070528	Upper creek	61	0.1	0.0	0.0	0	100	0.1	0.2	0.0	0
Phenanthrene	41	98	0.185	0.185	0.0024	7.8	SB-19	LSP0254	Lower creek	6.1	0.0	0.0	1.3	0.05	--	--	--	--	--
2-Methylnaphthalene	41	63	0.0022	0.19	0.0021	8.7	LSC Bank	LSP0051	Upper creek	0.47	0.4	0.0	18.5	0.076923077	--	--	--	--	--
di-n-Butylphthalate *	23	30	0.281818182	6.666666667	0.87456847	4.857142857	SB-35	LSP0545	Historical creek	220	0.0	0.1	0.0	0.285714286	200	0.0	0.1	0.0	0.285714286
4,6-Dinitro-2-methylphenol	41	0	0.011	2.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	41	0	0.011	9.03	--	--	--	--	--	--	--	--	--	--	20	0.5	0.2	0.0	--
2,4-Dinitrotoluene	41	0	0.01	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,6-Dinitrotoluene	41	0	0.011	2.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
di-n-Octylphthalate	41	2	0.01	0.23	0.012	0.012	SB-10	LSP0181	Lower creek	0.026	8.8	0.6	0.5	0	--	--	--	--	--
1,2-Diphenylhydrazine	30	0	0.02	0.46	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobenzene *	23	0	0.102669405	6.666666667	--	--	--	--	--	0.38	17.5	0.9	0.0	--	17	0.4	0.2	0.0	--
Hexachlorobutadiene *	23	0	0.205338809	6.666666667	--	--	--	--	--	3.9	1.7	0.1	0.0	--	--	--	--	--	--
Hexachlorocyclopentadiene	40	0	0.011	1.13	--	--	--	--	--	--	--	--	--	--	10	0.1	0.0	0.0	--
Hexachloroethane	41	2	0.011	0.226	0.0073	0.0073	LSC-06	3394045	Upper creek	--	--	--	--	--	--	--	--	--	--
Isophorone	41	0	0.01	0.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1-Methylnaphthalene	23	52	0.02	0.2	0.025	11	LSC Bank	LSP0051	Upper creek	--	--	--	--	--	--	--	--	--	--
Benzo(a)anthracene	41	90	0.01	0.185	0.003	8.8	OS05	95352504	Upper creek	4.26	0.0	0.0	2.1	0.108108108	--	--	--	--	--
3&4-Methylphenol	11	55	0.011	0.05	0.003	1.7	SD06	99070525	Upper creek	--	--	--	--	--	--	--	--	--	--

Table G-2. Comparison of Maximum Concentrations of LSP Site Sediment Samples to EICs for Sediments and Soils.

										Screening Against Sediment EICs					Screening Against Soil EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
Benzo(a)pyrene	41	93	0.01	0.185	0.0041	9.4	SB-35	LSP0546	Historical creek	3.3	0.1	0.0	2.8	0.184210526	12	0.0	0.0	0.8	0.447368421
2-Nitroaniline	41	0	0.011	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3-Nitroaniline	41	0	0.011	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Nitroaniline	41	0	0.011	2.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrobenzene	41	0	0.01	0.24	--	--	--	--	--	--	--	--	--	--	40	0.0	0.0	0.0	--
2-Nitrophenol	41	0	0.0086	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Nitrophenol	41	0	0.011	2.3	--	--	--	--	--	--	--	--	--	--	7	0.3	0.0	0.0	--
1-Nitropyrene	1	0	0.012	0.012	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Nitrosodimethylamine	30	0	0.047	1.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
N-nitrosodiphenylamine *	23	0	0.205338809	6.666666667	--	--	--	--	--	11	0.6	0.2	0.0	--	20	0.3	0.1	0.0	--
n-Nitroso-di-n-propylamine	41	0	0.01	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chrysene	41	93	0.01	0.185	0.0098	95	LSC Bank	LSP0051	Upper creek	5.94	0.0	0.0	16.0	0.184210526	--	--	--	--	--
Dibenzo(a,h)anthracene	41	76	0.0022	0.196	0.0087	8.3	SB-38	LSP0561	Historical creek	0.8	0.2	0.0	10.4	0.290322581	--	--	--	--	--
Pyridine	30	0	0.042	2.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Retene	23	30	0.024	2.3	0.056	18	SB-19	LSP0253	Lower creek	--	--	--	--	--	--	--	--	--	--
2,3,4,5-Tetrachlorophenol	17	12	0.099	2.3	0.11	0.11	SB-02; SB-02	LSP0127; LSP0132	Lower creek; Lower creek	--	--	--	--	--	20	0.1	0.0	0.0	0
2,3,4,6-Tetrachlorophenol	17	12	0.099	2.3	0.15	0.175	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
2,3,5,6-Tetrachlorophenol	17	12	0.099	2.3	0.2	0.225	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
Tetrachlorophenols	11	64	0.011	0.05	0.0046	2.0395	SD06	99070525	Upper creek	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene	1	0	0.46	0.46	--	--	--	--	--	--	--	--	--	--	20	0.0	0.0	0.0	--
1,2,4-Trichlorobenzene *	23	0	0.205338809	6.666666667	--	--	--	--	--	0.81	8.2	0.6	0.0	--	20	0.3	0.1	0.0	--
2,4,5-Trichlorophenol	41	0	0.0058	1	--	--	--	--	--	--	--	--	--	--	4	0.3	0.0	0.0	--
2,4,6-Trichlorophenol	41	2	0.0086	1	0.74	0.74	SD06	99070525	Upper creek	--	--	--	--	--	10	0.1	0.0	0.1	0
Fluoranthene	41	98	0.185	0.185	0.0135	86.3	LSC-03	3394042	Lower creek	11	0.0	0.0	7.8	0.275	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	41	90	0.0024	0.196	0.0022	9.6	SB-39	LSP0563	Historical creek	4.12	0.0	0.0	2.3	0.081081081	--	--	--	--	--
Pyrene	41	98	0.185	0.185	0.011	8.88	OS05	95352504	Upper creek	8.8	0.0	0.0	1.0	0.025	--	--	--	--	--
Benzo(g,h,i)perylene	41	90	0.0024	0.196	0.003	9.4	SB-36	LSP0548	Historical creek	4.02	0.0	0.0	2.3	0.135135135	--	--	--	--	--
LPAH (ND = 1/2 DL)	41	98	0.185	0.185	0.009	8.647	SB-35	LSP0546	Historical creek	6.6	0.0	0.0	1.3	0.075	--	--	--	--	--
Total Benzofluoranthenes (ND = 0)	41	93	0.1	0.196	0.0132	96	SB-38	LSP0561	Historical creek	11	0.0	0.0	8.7	0.578947368	--	--	--	--	--
Total Benzofluoranthenes (ND = 1/2 DL)	41	93	0.1	0.196	0.0132	96	SB-38	LSP0561	Historical creek	11	0.0	0.0	8.7	0.578947368	--	--	--	--	--
2,4-Dimethylphenol	41	22	0.011	0.225	0.012	0.22	OS04	95352503	Upper creek	0.029	7.8	0.5	7.6	0.444444444	--	--	--	--	--
2-Methylphenol	41	22	0.011	0.225	0.0064	1	SD06	99070525	Upper creek	0.063	3.6	0.5	15.9	0.333333333	--	--	--	--	--
Benzo(b)fluoranthene	41	93	0.01	0.196	0.0044	9.1	OS04	95352503	Upper creek	--	--	--	--	--	--	--	--	--	--
Benzo(j)fluoranthene	11	91	0.1	0.1	0.0044	1.1	SD10	99070529	Upper creek	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	41	93	0.01	0.196	0.0044	6.7	SB-19	LSP0253	Lower creek	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	30	47	0.02	0.2	0.024	1	SB-37	LSP0552	Historical creek	0.67	0.3	0.0	1.5	0.071428571	--	--	--	--	--
Phenol	41	41	0.011	0.28	0.016	2.11	LSC-05	3394044	Wetlands	0.42	0.7	0.0	5.0	0.117647059	70	0.0	0.0	0.0	0
Pentachlorophenol	41	88	0.05	0.926	0.0037	7.9	SB-36	LSP0548	Historical creek	0.36	2.6	0.2	21.9	0.75	3	0.3	0.0	2.6	0.194444444
Bis(2-ethylhexyl)phthalate	41	49	0.022	0.972	0.053	1.68	OS04	95352503	Upper creek	0.23	4.2	0.5	7.3	0.5	--	--	--	--	--
Butylbenzylphthalate	41	51	0.011	0.225	0.0022	1	SB-34	LSP0555	Historical creek	0.26	0.9	0.0	3.8	0.238095238	--	--	--	--	--
Dimethylphthalate	41	66	0.025	0.21	0.002	2.7	SB-19	LSP0263	Lower creek	0.046	4.6	0.8	58.7	0.777777778	200	0.0	0.0	0.0	0
Dibenzo(a,h)acridine	11	0	0.0022	0.014	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,j)acridine	11	0	0.0022	0.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,e)pyrene	11	45	0.0022	0.01	0.02	0.16	SD02	99070521	Lower creek	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,h)pyrene	11	45	0.0022	0.21	0.011	0.08	SD08	99070527	Upper creek	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,i)pyrene	11	36	0.0022	0.039	0.0059	0.1	SD06	99070525	Upper creek	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,l)pyrene	11	18	0.0022	0.034	0.0096	0.015	SD08	99070527	Upper creek	--	--	--	--	--	--	--	--	--	--
7,12-Dimethylbenz(a)anthracene	28	4	0.0022	1	0.14	0.14	SD10	99070529	Upper creek	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	41	44	0.022	2	0.081	8.24	LSC-05	3394044	Wetlands	0.65	3.1	0.4	12.7	0.555555556	--	--	--	--	--
Benzyl Alcohol	41	24	0.011	0.34	0.026	6.29	LSC-05	3394044	Wetlands	0.057	6.0	0.5	110.4	0.9	--	--	--	--	--
Dibenzofuran	41	61	0.011	0.185	0.0016	33	LSC Bank	LSP0051	Upper creek	0.4	0.5	0.0	82.5	0.12	--	--	--	--	--
HPAH (ND = 1/2 DL)	41	98	0.185	0.185	0.0734	9.44305	SD06	99070525	Upper creek	31	0.0	0.0	0.3	0.4	--	--	--	--	--
TPAHs (ND = 1/2 DL)	41	98	0.185	0.185	0.0824	96.692	OS05	95352504	Upper creek	--	--	--	--	--	--	--	--	--	--
TEQDF B1	19	100	--	--	5.32786E-06	0.004439	SB-02	LSP0132	Lower creek	--	--	--	--	--	0.000002	0.0	--	2219.5	1
Motor Oil	32	84	12	17	1000	990	SB-34	LSP0555	Historical creek	--	--	--	--	--	--	--	--	--	--
C8-C10 Aliphatics	3	0	14	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
C10-C12 Aliphatics	14	0	14	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
C12-C16 Aliphatics	14	36	29	6.6	10	8.9	SB-38	LSP0561	Historical creek	--	--	--	--	--	--	--	--	--	--
C16-C18 Aliphatics	11	27	29	6.6	12	6.1	SD10	99070529	Upper creek	--	--	--	--	--	--	--	--	--	--
C16-C21 Aliphatics	3	100	--	--	100	120	LSC Bank; SB-35	LSP0051; LSP0546	Historical creek; Upper creek	--	--	--	--	--	--	--	--	--	--
C18-C21 Aliphatics	11	45	29	6.5	13	76	SD06	99070525	Upper creek	--	--	--	--	--	--	--	--	--	--
C21-C28 Aliphatics	11	91	6.1	6.1	100	64	SD02	99070521	Lower creek	--	--	--	--	--	--	--	--	--	--
C21-C34 Aliphatics	3	100	--	--	130	53	LSC Bank	LSP0051	Upper creek	--	--	--	--	--	--	--	--	--	--
C28-C36 Aliphatics	11	82	29	6.1	25	91	SD05	99070524	Upper creek	--	--	--	--	--	--	--	--	--	--
C8-C10 Aromatics	3	33	2.9	4	16	16	LSC Bank	LSP0051	Upper creek	--	--	--	--	--	--	--	--	--	--
C10-C12 Aromatics	14	7	16	7	16	16	LSC Bank	LSP0051	Upper creek	--	--	--	--	--	--	--	--	--	--
C12-C16 Aromatics	14	7	16	7	520	520	LSC Bank	LSP0051	Upper creek	--	--	--	--	--	--	--	--	--	--
C16-C18 Aromatics	11	0	16	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Table G-2. Comparison of Maximum Concentrations of LSP Site Sediment Samples to EICs for Sediments and Soils.

										Screening Against Sediment EICs					Screening Against Soil EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
C16-C21 Aromatics	3	100	--	--	23	90	SB-38	LSP0561	Historical creek	--	--	--	--	--	--	--	--	--	--
C18-C21 Aromatics	11	45	29	6.5	110	9	SD08	99070527	Upper creek	--	--	--	--	--	--	--	--	--	--
C21-C28 Aromatics	11	82	29	6.1	11	8.1	SD03	99070522	Lower creek	--	--	--	--	--	--	--	--	--	--
C21-C34 Aromatics	3	100	--	--	1800	460	SB-38	LSP0561	Historical creek	--	--	--	--	--	--	--	--	--	--
C28-C36 Aromatics	11	91	6.1	6.1	155	50	SD02	99070521	Lower creek	--	--	--	--	--	--	--	--	--	--
2,3,7,8-TCDD	19	37	0.00000029	0.00000242	0.0000032	0.0000089	SB-36	LSP0548	Historical creek	--	--	--	--	--	--	--	--	--	--
Total TCDD	19	79	0.00000029	0.0000049	0.00000162	0.0011	SB-37	LSP0552	Historical creek	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8-PeCDD	19	68	0.000000568	0.0000082	0.00000231	0.00012	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
Total PeCDD	19	84	0.000000568	0.000032	0.00000125	0.0016	SB-37	LSP0552	Historical creek	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-HxCDD	19	68	0.00000107	0.000032	0.00000434	0.0004	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,6,7,8-HxCDD	19	100	--	--	0.000014	0.0084	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8,9-HxCDD	19	100	--	--	0.0000036	0.0011	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
Total HxCDD	19	100	--	--	0.000040995	0.024	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-HpCDD	19	100	--	--	0.0001617	0.22	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
Total HpCDD	19	100	--	--	0.000286	0.38	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
OCDD	19	100	--	--	0.0013845	1.2	SB-36	LSP0548	Historical creek	--	--	--	--	--	--	--	--	--	--
2,3,7,8-TCDF	19	68	0.000000329	0.00000096	0.00000137	0.0003	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
Total TCDF	19	84	0.000000395	0.00000096	0.000000558	0.00046	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8-PeCDF	19	47	0.000000287	0.0000269	0.00000159	0.0012	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
2,3,4,7,8-PeCDF	19	68	0.000000501	0.0000262	0.00000168	0.0016	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
Total PeCDF	19	100	--	--	0.00000881	0.011	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-HxCDF	19	42	0.0000083	0.00154	0.00014	0.0099	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,6,7,8-HxCDF	19	68	0.00000142	0.0000391	0.00000351	0.0019	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8,9-HxCDF	19	42	0.0000014	0.00018	0.00000281	0.00032	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
2,3,4,6,7,8-HxCDF	19	42	0.00000166	0.0000621	0.000015	0.0011	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
Total HxCDF	19	100	--	--	0.0000416	0.1	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-HpCDF	19	100	--	--	0.0000358	0.054	SB-36	LSP0548	Historical creek	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8,9-HpCDF	19	84	0.00000267	0.000297	0.00000423	0.0043	SB-36	LSP0548	Historical creek	--	--	--	--	--	--	--	--	--	--
Total HpCDF	19	100	--	--	0.0000358	0.36	SB-36	LSP0548	Historical creek	--	--	--	--	--	--	--	--	--	--
OCDF	19	100	--	--	0.0000861	0.24	SB-35	LSP0546	Historical creek	--	--	--	--	--	--	--	--	--	--
TEQDF F1	19	100	--	--	4.34971E-06	0.003375	SB-02	LSP0132	Lower creek	--	--	--	--	--	0.000002	0.0	--	1687.5	1
TEQDF 0.5M98	19	100	--	--	7.38741E-06	0.006065	SB-02	LSP0132	Lower creek	--	--	--	--	--	0.000002	0.0	--	3032.5	1
TEQDF 0.5M05	19	100	--	--	7.56393E-06	0.005936	SB-02	LSP0132	Lower creek	--	--	--	--	--	0.000002	0.0	--	2968.0	1
Diesel Range Hydrocarbons	33	82	0.5	0.7	10	950	SB-38	LSP0557	Historical creek	--	--	--	--	--	200	0.0	0.0	4.8	0.555555556
Total PCDD (ND = 0)	19	100	--	--	0.001718795	1.48335	SB-36	LSP0548	Historical creek	--	--	--	--	--	--	--	--	--	--
Total PCDD (ND = 1/2 DL)	19	100	--	--	0.00171999	1.48335	SB-36	LSP0548	Historical creek	--	--	--	--	--	--	--	--	--	--
Total PCDF (ND = 1/2 DL)	19	100	--	--	0.00017279	0.571552	SB-36	LSP0548	Historical creek	--	--	--	--	--	--	--	--	--	--
Total PCDF (ND = 0)	19	100	--	--	0.00017231	0.571552	SB-36	LSP0548	Historical creek	--	--	--	--	--	--	--	--	--	--
Liquid Limit	4	100	--	--	140	68.9	SB-02	LSP0132	Lower creek	--	--	--	--	--	--	--	--	--	--
Percent Moisture	14	93	0.1	0.1	160.6	99.5	SB-38	LSP0557	Historical creek	--	--	--	--	--	--	--	--	--	--
Plastic Limit	4	100	--	--	19.8	86	SB-38	LSP0560	Historical creek	--	--	--	--	--	--	--	--	--	--
Plasticity Index	4	100	--	--	14.65	54	SB-38	LSP0560	Historical creek	--	--	--	--	--	--	--	--	--	--
Specific Gravity	6	100	--	--	2.13	2.6	SB-38	LSP0559	Historical creek	--	--	--	--	--	--	--	--	--	--
Total Organic Carbon	11	100	--	--	110000	7500	SD03	99070522	Lower creek	--	--	--	--	--	--	--	--	--	--
Total Organic Carbon	22	100	--	--	0.326	9.74	SB-02	LSP0127	Lower creek	--	--	--	--	--	--	--	--	--	--
Total Solids	36	100	--	--	19	87.5	SD10	99070529	Upper creek	--	--	--	--	--	--	--	--	--	--

Notes: -- = No data

Table G-3. Comparison of Maximum Concentrations of LSP Site Water Samples to EICs for Surface Water.

										Screening Against Sediment EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
Barium	29	100	--	--	10.5	35.3	SW-05	99504858	Upper creek	4	0.0	--	8.8	0
Barium dissolved	3	100	--	--	20.7	22	OS03	95372613	Upper creek	4	0.0	--	5.5	0
Copper dissolved	23	96	3	3	1.3	9.3	SW-04	LSP0003	Upper creek	9	0.3	0.0	1.0	0.045454545
Copper	49	76	3	4.1	0.74	9.55	SW-01	LSP0001	Lower creek	9	0.5	0.0	1.1	0.027027027
Lead	49	57	0.1	2.48	0.13	8	SW-09	LSP0002	Lower creek	2.5	1.0	0.0	3.2	0.178571429
Magnesium	49	100	--	--	10200	9710	SW-07	LSP0007	Wetlands	647	0.0	--	15.0	0.326530612
Magnesium dissolved	23	100	--	--	10000	9470	SW-07	LSP0589	Wetlands	647	0.0	--	14.6	0.173913043
Anthracene	43	47	0.0049	0.42	0.0066	0.9	OS01	95372614	Beach	0.73	0.6	0.0	1.2	0.05
Benzo(a)anthracene	43	12	0.0047	0.45	0.015	0.058	SW-05	99504858	Upper creek	0.027	16.7	0.6	2.1	0.4
Benzo(a)pyrene	43	28	0.0047	0.45	0.0053	0.2	SW-08	99504856	Upper creek	0.014	32.1	0.7	14.3	0.833333333
Pyrene	43	47	0.0047	0.45	0.0045	0.75	SW-05	LSP0004	Upper creek	0.3	1.5	0.9	2.5	0.05
2,3,4,6-Tetrachlorophenol	18	6	1.7	5	7.7	7.7	SW-05	LSP0004	Upper creek	1.2	4.2	1.0	6.4	1
2,3,7,8-TCDD	22	5	0.0000027	0.000019	0.0000074	0.0000074	SW-05	LSP0004	Upper creek	0.000000003	6333.3	1.0	2466.7	1
TEQDF B1	22	77	0.0000183	0.0000637	1.051E-05	0.00027732	SW-05	LSP0004	Upper creek	0.000000003	21233.3	1.0	92440.0	1
TEQDF F1	22	77	0.0000183	0.0000637	8.3911E-06	0.00030195	SW-05	LSP0004	Upper creek	0.000000003	21233.3	1.0	100649.2	1
TEQDF 0.5M98	22	77	0.0000183	0.0000637	7.8537E-06	0.0005281	SW-05	LSP0004	Upper creek	0.000000003	21233.3	1.0	176033.3	1
TEQDF 0.5M05	22	77	0.0000183	0.0000637	7.3647E-06	0.00057681	SW-05	LSP0004	Upper creek	0.000000003	21233.3	1.0	192270.0	1
Alkalinity	16	100	--	--	117000	99000	SW-01	99504000	Lower creek	20000	0.0	--	5.0	0.5625
Aluminum	29	72	20	9.14	12	61	OS02	95372616	Lower creek	87	0.1	0.3	0.7	0
Antimony	29	48	0.5	40	0.53	1.3	SW-06	99314155	Upper creek	30	1.3	0.3	0.0	0
Arsenic	49	92	1	1.5	0.2	3.2	SW-11; SW-11	LSP0599; LSP0599	Historical creek; Upper creek	190	0.0	0.0	0.0	0.066666667
Arsenic dissolved	23	87	1	1	0.2	1.7	SW-11; SW-11	LSP0599; LSP0599	Historical creek; Upper creek	190	0.0	0.0	0.0	0
Cadmium	49	16	0.02	2	0.042	0.21	SW-08	99504856	Upper creek	0.25	8.0	0.1	0.8	0
Chromium dissolved	23	35	0.2	5	0.6	2.7	SW Reference	LSP0582	Background	42	0.1	0.2	0.1	0
Chromium	49	18	0.2	5.1	0.6	5.3	SW-04	LSP0003	Upper creek	42	0.1	0.6	0.1	0.111111111
Cobalt	29	24	10	5.1	0.081	0.28	SW-06	99314155	Upper creek	23	0.2	0.8	0.0	0
Iron	29	79	10	10	103	82	SW-07	99504862	Wetlands	1000	0.0	0.0	0.1	1
Iron dissolved	3	67	10	10	37.3	61.1	OS02	95372617	Lower creek	1000	0.0	0.0	0.1	1
Lead dissolved	23	9	0.4	0.5	1	1	SW-11; SW-11	LSP0599; LSP0599	Historical creek; Upper creek	2.5	0.2	0.0	0.4	0
Manganese dissolved	3	100	--	--	49	71.8	OS03	95372613	Upper creek	120	0.0	--	0.6	1
Manganese	29	93	0.1	1	1	83	SW-05	99504858	Upper creek	120	0.0	0.0	0.7	0.925925926
Nickel dissolved	23	87	10	10	0.75	3.85	SW-06	LSP0586	Upper creek	52	0.2	0.0	0.1	0
Nickel	49	55	10	10	0.95	4.85	SW-05	LSP0004	Upper creek	52	0.2	0.0	0.1	0
Selenium	29	14	1	2	1	1.3	SW-06	99314155	Upper creek	5	0.4	0.0	0.3	0
Vanadium	29	31	3	3.1	0.36	5.6	SW-08	99504856	Upper creek	20	0.2	1.0	0.3	0.222222222
Zinc	49	84	2	4	10	98	SW-04	LSP0003	Upper creek	120	0.0	1.0	0.8	0.87804878
Zinc dissolved	23	74	2	4	10	9	SW-07	LSP0007	Wetlands	120	0.0	1.0	0.1	0.882352941
Benzene	19	5	0.02	1	0.15	0.15	SW-05	99504858	Upper creek	130	0.0	0.0	0.0	0
Chloroform	16	44	0.02	0.4	0.015	0.42	SW-06	99504860	Upper creek	28	0.0	0.0	0.0	0
Methyl tert-butyl Ether	16	44	5	5	2.4	3.4	SW-04; SW-05	99314153; 99314154	Upper creek; Upper creek	11070	0.0	1.0	0.0	1
Total Xylenes (ND = 1/2 DL)	19	42	0.04	1	0.208	1.18	SW-05	99314154	Upper creek	13	0.1	0.0	0.1	0
Total Xylenes (ND = 0)	19	42	0.04	1	0.208	0.78	SW-05	99314154	Upper creek	13	0.1	0.0	0.1	0
Toluene	19	11	0.4	1	0.051	0.08	SW-06	99314155	Upper creek	9.8	0.1	0.0	0.0	0
m&p-Xylene	19	5	0.04	1	0.12	0.12	SW-05	99504858	Upper creek	1.8	0.6	0.0	0.1	0
Benzoic Acid	33	3	0.047	4.5	0.077	0.077	SW-04	99314153	Upper creek	42	0.1	0.0	0.0	0
Benzyl Alcohol	43	7	0.024	0.51	0.0074	0.11	SW-08	99504856	Upper creek	8.6	0.1	0.0	0.0	0
Bis(2-ethylhexyl)phthalate	43	2	0.052	1.8	1.2	1.2	343	97040343	Upper creek	3	0.6	0.0	0.4	0
4-Chloroaniline	43	2	0.024	1.1	0.042	0.042	SW-08	99504856	Upper creek	232	0.0	0.0	0.0	0
Dibenzofuran	43	14	0.024	0.5	0.0038	0.074	SW-05	99504858	Upper creek	3.7	0.1	0.0	0.0	0
2,4-Dichlorophenol	43	2	0.024	0.5	0.0077	0.0077	SW-05	99314154	Upper creek	11	0.0	0.0	0.0	0
2,4-Dimethylphenol	43	2	0.024	0.5	0.15	0.15	SW-05	99314154	Upper creek	100	0.0	0.0	0.0	0
Dimethylphthalate	43	2	0.0061	0.5	1.3	1.3	SW-04	LSP0003	Upper creek	1.65	0.3	0.0	0.8	0
di-n-Butylphthalate	43	5	0.036	1.6	0.4	0.5	SW-04	99314153	Upper creek	35	0.0	0.0	0.0	0
2-Methylphenol	43	2	0.024	0.5	0.3	0.3	SW-05	99314154	Upper creek	13	0.0	0.0	0.0	0
3&4-Methylphenol	18	11	0.024	0.48	0.0087	0.016	SW-05	99314154	Upper creek	62	0.0	0.0	0.0	0
4-Methylphenol	25	4	0.13	0.5	6.5	6.5	OS07	95352507	Wetlands	25	0.0	0.0	0.3	1
Pentachlorophenol	43	37	0.024	2.2	0.027	8.5	SW-02	99504004	Upper creek	15	0.1	0.1	0.6	0.25
Phenol	43	9	0.024	0.5	0.058	2.6	OS07	95352507	Wetlands	110	0.0	0.0	0.0	0.25
Acenaphthene	43	30	0.0047	0.47	0.018	0.12	SW-05	99504858	Upper creek	23	0.0	0.0	0.0	0
Acenaphthylene	43	12	0.0047	0.45	0.0058	0.05	SW-05	99504858	Upper creek	4840	0.0	0.0	0.0	0
Fluorene	43	19	0.0047	0.45	0.0048	0.19	SW-05	99504858	Upper creek	3.9	0.1	0.0	0.0	0
Naphthalene	43	21	0.0047	0.46	0.0063	0.18	SW-05	99504858	Upper creek	12	0.0	0.0	0.0	0
Phenanthrene	43	42	0.0049	0.45	0.0099	0.19	SW-05	99504858	Upper creek	3.6	0.1	0.0	0.1	0
2-Methylnaphthalene	43	12	0.0047	0.48	0.0051	0.26	SW-05	99504858	Upper creek	130	0.0	0.0	0.0	0
Benzo(b)fluoranthene	34	12	0.0048	0.45	0.0072	0.8	SW-05	LSP0004	Upper creek	9.07	0.0	0.0	0.1	0

Table G-3. Comparison of Maximum Concentrations of LSP Site Water Samples to EICs for Surface Water.

										Screening Against Sediment EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
Chrysene	43	28	0.0047	0.45	0.0053	1.7	OS01	95372614	Beach	7	0.1	0.0	0.2	0
Dibenzo(a,h)anthracene	43	2	0.0047	0.45	0.023	0.023	SW-08	99504856	Upper creek	4	0.1	0.0	0.0	0
Fluoranthene	43	51	0.0047	0.45	0.0038	1.35	SW-05	LSP0004	Upper creek	1.9	0.2	0.0	0.7	0
Indeno(1,2,3-cd)pyrene	43	16	0.0047	0.45	0.0073	0.3	SW-05	LSP0004	Upper creek	4.31	0.1	0.0	0.1	0
Benzo(g,h,i)perylene	43	12	0.0047	0.45	0.02	0.35	SW-08	99504856	Upper creek	7.64	0.1	0.0	0.0	0
Chloride	16	100	--	--	11000	9660	SW-08	99504856	Upper creek	230000	0.0	--	0.0	0.5625
Aluminum dissolved	3	0	20	20	--	--	--	--	--	87	0.2	0.0	0.0	--
Antimony dissolved	3	0	40	40	--	--	--	--	--	30	1.3	1.0	0.0	--
Beryllium	29	0	0.04	1	--	--	--	--	--	0.66	1.5	0.6	0.0	--
Beryllium dissolved	3	0	0.5	0.5	--	--	--	--	--	0.66	0.8	0.0	0.0	--
Cadmium dissolved	23	0	0.02	2	--	--	--	--	--	0.25	8.0	0.1	0.0	--
Cobalt dissolved	3	0	10	10	--	--	--	--	--	23	0.4	0.0	0.0	--
Mercury	42	0	0.004	0.2	--	--	--	--	--	0.012	16.7	0.5	0.0	--
Mercury dissolved	23	0	0.004	0.2	--	--	--	--	--	0.012	16.7	0.1	0.0	--
Selenium dissolved	3	0	2	2	--	--	--	--	--	5	0.4	0.0	0.0	--
Silver dissolved	23	0	0.01	3	--	--	--	--	--	0.36	8.3	0.1	0.0	--
Silver	49	0	0.01	4.1	--	--	--	--	--	0.36	11.4	0.4	0.0	--
Thallium dissolved	3	0	1	1	--	--	--	--	--	12	0.1	0.0	0.0	--
Thallium	29	0	0.5	2.5	--	--	--	--	--	12	0.2	0.0	0.0	--
Vanadium dissolved	3	0	3	3	--	--	--	--	--	20	0.2	1.0	0.0	--
Acetone	3	0	4	4	--	--	--	--	--	1500	0.0	1.0	0.0	--
Bromodichloromethane	16	0	0.4	1	--	--	--	--	--	4320	0.0	0.0	0.0	--
Bromoform	16	0	0.4	1	--	--	--	--	--	320	0.0	0.0	0.0	--
Bromomethane	16	0	0.4	2	--	--	--	--	--	16	0.1	0.6	0.0	--
2-Butanone	9	0	2	4	--	--	--	--	--	14000	0.0	1.0	0.0	--
n-Butylbenzene	16	0	0.4	1	--	--	--	--	--	71	0.0	0.0	0.0	--
sec-Butylbenzene	16	0	0.4	1	--	--	--	--	--	82	0.0	0.0	0.0	--
tert-Butylbenzene	16	0	0.4	2	--	--	--	--	--	48	0.0	0.0	0.0	--
Carbon Disulfide	9	0	2	2	--	--	--	--	--	0.92	2.2	1.0	0.0	--
Carbon Tetrachloride	16	0	0.4	1	--	--	--	--	--	9.8	0.1	0.0	0.0	--
Chlorobenzene	16	0	0.4	1	--	--	--	--	--	64	0.0	0.0	0.0	--
Chloromethane	16	0	0.4	2	--	--	--	--	--	55000	0.0	0.0	0.0	--
Dibromochloromethane	16	0	0.4	1	--	--	--	--	--	9.7	0.1	0.0	0.0	--
Dichlorodifluoromethane	16	0	0.4	1	--	--	--	--	--	1960	0.0	0.0	0.0	--
1,1-Dichloroethane	16	0	0.02	1	--	--	--	--	--	47	0.0	0.0	0.0	--
1,2-Dichloroethane	16	0	0.02	0.4	--	--	--	--	--	910	0.0	0.0	0.0	--
1,1-Dichloroethene	16	0	0.02	1	--	--	--	--	--	25	0.0	0.0	0.0	--
1,2-Dichloroethene (ND = 1/2 DL)	16	0	0.4	2	--	--	--	--	--	590	0.0	0.0	0.0	--
trans-1,2-Dichloroethene	16	0	0.4	2	--	--	--	--	--	970	0.0	0.0	0.0	--
1,2-Dichloroethene (ND = 0)	16	0	0.4	2	--	--	--	--	--	590	0.0	0.0	0.0	--
1,2-Dichloropropane	16	0	0.4	1	--	--	--	--	--	360	0.0	0.0	0.0	--
1,3-Dichloropropene (ND = 1/2 DL)	16	0	0.4	1.1	--	--	--	--	--	0.055	20.0	1.0	0.0	--
1,3-Dichloropropene (ND = 0)	16	0	0.4	1.1	--	--	--	--	--	0.055	20.0	1.0	0.0	--
Ethylbenzene	19	0	0.4	1	--	--	--	--	--	7.3	0.1	0.0	0.0	--
Fluorotrichloromethane	16	0	0.4	5	--	--	--	--	--	1740	0.0	0.1	0.0	--
2-Hexanone	9	0	10	2	--	--	--	--	--	99	0.0	0.0	0.0	--
Isopropylbenzene	16	0	0.4	1	--	--	--	--	--	255	0.0	0.0	0.0	--
p-Isopropyltoluene	16	0	0.4	1	--	--	--	--	--	85	0.0	0.0	0.0	--
4-Methyl-2-pentanone	9	0	2	4	--	--	--	--	--	170	0.0	1.0	0.0	--
Methylene Chloride	16	0	0.4	2	--	--	--	--	--	2200	0.0	0.0	0.0	--
Pentachloroethane	9	0	1	2	--	--	--	--	--	56.4	0.0	0.0	0.0	--
n-Propylbenzene	16	0	0.4	1	--	--	--	--	--	128	0.0	0.0	0.0	--
Styrene	16	0	0.4	2	--	--	--	--	--	32	0.1	0.0	0.0	--
1,1,2,2-Tetrachloroethane	16	0	0.4	1	--	--	--	--	--	610	0.0	0.0	0.0	--
Tetrachloroethene	16	0	0.02	2	--	--	--	--	--	98	0.0	0.0	0.0	--
1,1,2-Trichloro-1,2,2-trifluoroethane	9	0	1	1	--	--	--	--	--	413	0.0	0.0	0.0	--
1,1,1-Trichloroethane	16	0	0.4	1	--	--	--	--	--	11	0.1	0.0	0.0	--
1,1,2-Trichloroethane	16	0	0.4	1	--	--	--	--	--	1200	0.0	0.0	0.0	--
Trichloroethene	16	0	0.4	1	--	--	--	--	--	47	0.0	0.0	0.0	--
1,2,4-Trimethylbenzene	16	0	0.4	1	--	--	--	--	--	77	0.0	0.0	0.0	--
1,3,5-Trimethylbenzene	16	0	0.4	1	--	--	--	--	--	71	0.0	0.0	0.0	--
Vinyl Chloride	16	0	0.4	1	--	--	--	--	--	930	0.0	0.0	0.0	--
Aniline	25	0	0.42	0.6	--	--	--	--	--	4.1	0.1	0.0	0.0	--
Benzidine	21	0	0.84	4.2	--	--	--	--	--	3.9	1.1	0.8	0.0	--
Bis-(2-chloroethyl) Ether	43	0	0.024	0.5	--	--	--	--	--	12000	0.0	0.0	0.0	--
4-Bromophenyl-phenylether	43	0	0.024	0.5	--	--	--	--	--	1.5	0.3	0.0	0.0	--

Table G-3. Comparison of Maximum Concentrations of LSP Site Water Samples to EICs for Surface Water.

										Screening Against Sediment EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
Butylbenzylphthalate	43	0	0.024	2	--	--	--	--	--	19	0.1	0.1	0.0	--
4-Chloro-3-methylphenol	43	0	0.024	0.5	--	--	--	--	--	0.3	1.7	0.2	0.0	--
2-Chloronaphthalene	42	0	0.0094	0.5	--	--	--	--	--	0.396	1.3	0.6	0.0	--
2-Chlorophenol	43	0	0.0042	0.5	--	--	--	--	--	24	0.0	0.0	0.0	--
1,2-Dichlorobenzene	43	0	0.024	0.5	--	--	--	--	--	14	0.0	0.0	0.0	--
1,3-Dichlorobenzene	43	0	0.024	0.5	--	--	--	--	--	71	0.0	0.0	0.0	--
1,4-Dichlorobenzene	43	0	0.024	0.5	--	--	--	--	--	15	0.0	0.0	0.0	--
3,3'-Dichlorobenzidine	43	0	0.024	2	--	--	--	--	--	4.5	0.4	0.0	0.0	--
Diethylphthalate	43	0	0.024	0.5	--	--	--	--	--	210	0.0	0.0	0.0	--
4,6-Dinitro-2-methylphenol	43	0	0.024	4.5	--	--	--	--	--	23	0.2	0.1	0.0	--
2,4-Dinitrophenol	43	0	0.024	2	--	--	--	--	--	19	0.1	0.1	0.0	--
2,4-Dinitrotoluene	43	0	0.024	2	--	--	--	--	--	44	0.0	0.0	0.0	--
2,6-Dinitrotoluene	43	0	0.024	2	--	--	--	--	--	81	0.0	0.0	0.0	--
di-n-Octylphthalate	43	0	0.0099	2	--	--	--	--	--	22	0.1	0.0	0.0	--
1,2-Diphenylhydrazine	22	0	0.4	0.45	--	--	--	--	--	23	0.0	0.0	0.0	--
Hexachlorobenzene	43	0	0.024	0.5	--	--	--	--	--	0.0003	1666.7	1.0	0.0	--
Hexachlorobutadiene	43	0	0.024	0.54	--	--	--	--	--	0.053	10.2	0.6	0.0	--
Hexachlorocyclopentadiene	42	0	0.024	2.2	--	--	--	--	--	0.07	31.4	0.6	0.0	--
Hexachloroethane	43	0	0.024	0.5	--	--	--	--	--	12	0.0	0.0	0.0	--
Isophorone	43	0	0.024	0.5	--	--	--	--	--	920	0.0	0.0	0.0	--
1-Methylnaphthalene	18	0	0.5	0.5	--	--	--	--	--	2.1	0.2	0.0	0.0	--
Nitrobenzene	43	0	0.024	0.5	--	--	--	--	--	220	0.0	0.0	0.0	--
2-Nitrophenol	43	0	0.024	0.5	--	--	--	--	--	1920	0.0	0.0	0.0	--
4-Nitrophenol	43	0	0.024	2	--	--	--	--	--	300	0.0	0.0	0.0	--
n-Nitrosodimethylamine	22	0	0.84	1.3	--	--	--	--	--	94000	0.0	0.0	0.0	--
N-nitrosodiphenylamine	43	0	0.024	0.5	--	--	--	--	--	210	0.0	0.0	0.0	--
n-Nitroso-di-n-propylamine	43	0	0.024	0.5	--	--	--	--	--	20	0.0	0.0	0.0	--
Pyridine	22	0	0.42	5	--	--	--	--	--	2380	0.0	0.8	0.0	--
1,2,4-Trichlorobenzene	43	0	0.024	0.5	--	--	--	--	--	110	0.0	0.0	0.0	--
2,4,5-Trichlorophenol	43	0	0.024	0.5	--	--	--	--	--	64	0.0	0.0	0.0	--
2,4,6-Trichlorophenol	43	0	0.024	0.5	--	--	--	--	--	4.9	0.1	0.0	0.0	--
7,12-Dimethylbenz(a)anthracene	36	0	0.0047	1	--	--	--	--	--	0.548	1.8	0.2	0.0	--
Calcium dissolved	23	100	--	--	10400	7790	SW Reference	LSP0582	Background	--	--	--	--	--
Calcium	49	100	--	--	10100	7800	SW Reference	LSP0582	Background	--	--	--	--	--
Potassium	29	100	--	--	1100	4770	SW-05	99504859	Upper creek	--	--	--	--	--
Potassium dissolved	3	100	--	--	1700	2570	OS01	95372615	Beach	--	--	--	--	--
Sodium	29	100	--	--	10900	8270	SW-01	99504000	Lower creek	--	--	--	--	--
Sodium dissolved	3	100	--	--	17800	18900	OS03	95372613	Upper creek	--	--	--	--	--
o-Xylene	19	42	0.02	1	0.088	0.78	SW-05	99314154	Upper creek	--	--	--	--	--
Carbazole	34	6	0.047	0.5	0.036	0.075	SW-05	99504858	Upper creek	--	--	--	--	--
2,3,5,6-Tetrachlorophenol	18	6	1.2	5	1	1	SW-05	LSP0004	Upper creek	--	--	--	--	--
Tetrachlorophenols	15	40	0.0094	0.48	0.0083	1	SW-05	99504858	Upper creek	--	--	--	--	--
Benzo(k)fluoranthene	34	6	0.0048	0.72	0.04	0.6	SW-05	LSP0004	Upper creek	--	--	--	--	--
Benzofluoranthenes	9	33	0.0047	0.0053	0.024	0.21	SW-08	99504856	Upper creek	--	--	--	--	--
LPAH (ND = 1/2 DL)	43	51	0.0049	0.47	0.02445	1.85	OS01	95372614	Beach	--	--	--	--	--
Total Benzofluoranthenes (ND = 0)	34	12	0.0048	0.72	0.0072	1.4	SW-05	LSP0004	Upper creek	--	--	--	--	--
Total Benzofluoranthenes (ND = 1/2 DL)	34	12	0.0048	0.72	0.0265	1.4	SW-05	LSP0004	Upper creek	--	--	--	--	--
HPAH (ND = 1/2 DL)	43	53	0.0047	0.72	0.0379	5.16	SW-05	LSP0004	Upper creek	--	--	--	--	--
TPAHs (ND = 1/2 DL)	43	60	0.48	0.72	0.0732	6.605	SW-05	LSP0004	Upper creek	--	--	--	--	--
Motor Oil	20	5	500	500	700	700	SW-04	LSP0003	Upper creek	--	--	--	--	--
C21-C34 Aliphatics	17	29	120	50	110	87	SW-06	99504860	Upper creek	--	--	--	--	--
C8-C10 Aromatics	16	6	25	25	7.9	7.9	SW-03	99314152	Upper creek	--	--	--	--	--
C10-C12 Aromatics	17	6	47	50	38	38	SEEP-1	99244027	Upper creek	--	--	--	--	--
C16-C21 Aromatics	17	6	47	50	58	58	SW-05	99504858	Upper creek	--	--	--	--	--
C21-C34 Aromatics	17	6	47	50	52	52	SW-08	99504856	Upper creek	--	--	--	--	--
Total TCDD	22	9	0.0000027	0.000019	0.00000925	0.00000933	SW-05	99314154	Upper creek	--	--	--	--	--
1,2,3,7,8-PeCDD	22	5	0.0000043	0.0000224	0.0000585	0.0000585	SW-05	LSP0004	Upper creek	--	--	--	--	--
Total PeCDD	14	7	0.0000049	0.0000177	0.00013	0.00013	SW-05	LSP0004	Upper creek	--	--	--	--	--
1,2,3,4,7,8-HxCDD	22	5	0.0000028	0.0000192	0.00017	0.00017	SW-05	LSP0004	Upper creek	--	--	--	--	--
1,2,3,6,7,8-HxCDD	22	27	0.0000038	0.0000146	0.000026	0.00068	SW-05	LSP0004	Upper creek	--	--	--	--	--
1,2,3,7,8,9-HxCDD	22	9	0.00000436	0.0000441	0.0000539	0.000335	SW-05	LSP0004	Upper creek	--	--	--	--	--
Total HxCDD	14	50	0.0000038	0.000011	0.0000154	0.00315	SW-05	LSP0004	Upper creek	--	--	--	--	--
1,2,3,4,6,7,8-HpCDD	22	59	0.00000355	0.0000174	0.0000189	0.0225	SW-05	LSP0004	Upper creek	--	--	--	--	--
Total HpCDD	14	71	0.00000355	0.000014	0.0000345	0.0395	SW-05	LSP0004	Upper creek	--	--	--	--	--
OCDD	22	77	0.0000126	0.0000637	0.000078	0.245	SW-05	LSP0004	Upper creek	--	--	--	--	--
2,3,7,8-TCDF	22	5	0.0000018	0.000018	0.00000605	0.00000605	SW-05	LSP0004	Upper creek	--	--	--	--	--

Table G-3. Comparison of Maximum Concentrations of LSP Site Water Samples to EICs for Surface Water.

										Screening Against Sediment EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
Total TCDF	22	5	0.0000022	0.000018	0.0000495	0.0000495	SW-05	LSP0004	Upper creek	--	--	--	--	--
1,2,3,7,8-PeCDF	22	5	0.0000029	0.0000345	0.0000295	0.0000295	SW-05	LSP0004	Upper creek	--	--	--	--	--
2,3,4,7,8-PeCDF	22	5	0.0000029	0.0000348	0.000029	0.000029	SW-05	LSP0004	Upper creek	--	--	--	--	--
Total PeCDF	14	21	0.0000036	0.000011	0.0000697	0.00034	SW-05	LSP0004	Upper creek	--	--	--	--	--
1,2,3,4,7,8-HxCDF	22	5	0.00000239	0.00018	0.00014	0.00014	SW-05	LSP0004	Upper creek	--	--	--	--	--
1,2,3,6,7,8-HxCDF	22	5	0.00000179	0.0000797	0.0000995	0.0000995	SW-05	LSP0004	Upper creek	--	--	--	--	--
2,3,4,6,7,8-HxCDF	22	5	0.00000209	0.0000932	0.000054	0.000054	SW-05	LSP0004	Upper creek	--	--	--	--	--
Total HxCDF	14	36	0.00000179	0.000029	0.0000688	0.00395	SW-05	LSP0004	Upper creek	--	--	--	--	--
1,2,3,4,6,7,8-HpCDF	22	36	0.00000247	0.0000576	0.0000188	0.00415	SW-05	LSP0004	Upper creek	--	--	--	--	--
1,2,3,4,7,8,9-HpCDF	22	5	0.00000348	0.0000396	0.00034	0.00034	SW-05	LSP0004	Upper creek	--	--	--	--	--
Total HpCDF	14	50	0.00000247	0.000016	0.000279	0.02	SW-05	LSP0004	Upper creek	--	--	--	--	--
OCDF	22	59	0.00000346	0.000031	0.0000255	0.0305	SW-05	LSP0004	Upper creek	--	--	--	--	--
Total PCDD (ND = 0)	22	77	0.0000183	0.0000637	0.000078	0.28778925	SW-05	LSP0004	Upper creek	--	--	--	--	--
Total PCDD (ND = 1/2 DL)	22	77	0.0000183	0.0000637	0.00010115	0.28778925	SW-05	LSP0004	Upper creek	--	--	--	--	--
Total PCDF (ND = 1/2 DL)	22	59	0.00000425	0.000031	3.3225E-05	0.0548395	SW-05	LSP0004	Upper creek	--	--	--	--	--
Total PCDF (ND = 0)	22	59	0.00000425	0.000031	0.0000255	0.0548395	SW-05	LSP0004	Upper creek	--	--	--	--	--
Bromide	16	13	200	200	204	209	SW-02	99314151	Upper creek	--	--	--	--	--
Chemical Oxygen Demand	17	47	5000	5000	11000	9000	SW-06	99314155	Upper creek	--	--	--	--	--
Fluoride	16	100	--	--	46	99	SW-06; SW-01	99314155; 99504000	Lower creek; Upper creek	--	--	--	--	--
Hardness dissolved	20	100	--	--	130000	81000	SW-11; SW-11	LSP0599; LSP0599	Historical creek; Upper creek	--	--	--	--	--
Hardness	36	100	--	--	117000	97800	SW-04	99504006	Upper creek	--	--	--	--	--
Nitrate+Nitrite	16	100	--	--	1030	964	SW-04	99504006	Upper creek	--	--	--	--	--
Sulfate	16	100	--	--	11200	33700	SW-01	99504000	Lower creek	--	--	--	--	--
Total Dissolved Solids	16	100	--	--	120000	227000	SW-02	99314151	Upper creek	--	--	--	--	--
Total Organic Carbon	36	100	--	--	10000	9990	SW-06	LSP0006	Upper creek	--	--	--	--	--
Total Suspended Solids	36	67	1100	2500	1100	8230	SW-04	99504006	Upper creek	--	--	--	--	--
Bromobenzene	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
Bromochloromethane	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
Chloroethane	16	0	0.4	2	--	--	--	--	--	--	--	--	--	--
2-Chlorotoluene	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
4-Chlorotoluene	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	16	0	0.05	0.4	--	--	--	--	--	--	--	--	--	--
1,2-Dibromoethane	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
Dibromomethane	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
cis-1,2-Dichloroethene	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
1,3-Dichloropropane	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
2,2-Dichloropropane	9	0	1	2	--	--	--	--	--	--	--	--	--	--
1,1-Dichloropropene	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	16	0	0.4	1.1	--	--	--	--	--	--	--	--	--	--
trans-1,3-Dichloropropene	16	0	0.4	0.94	--	--	--	--	--	--	--	--	--	--
1,1,1,2-Tetrachloroethane	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichloropropane	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
Bis(2-chloroethoxy) Methane	43	0	0.024	0.5	--	--	--	--	--	--	--	--	--	--
Bis(2-chloroisopropyl)ether	25	0	0.024	0.5	--	--	--	--	--	--	--	--	--	--
Bis(2-chloro-1-methylethyl) Ether	18	0	0.44	0.44	--	--	--	--	--	--	--	--	--	--
4-Chlorophenyl-phenylether	43	0	0.024	0.52	--	--	--	--	--	--	--	--	--	--
7H-Dibenzo(c,g)carbazole	18	0	0.0047	0.01	--	--	--	--	--	--	--	--	--	--
2-Nitroaniline	43	0	0.024	0.83	--	--	--	--	--	--	--	--	--	--
3-Nitroaniline	43	0	0.024	2	--	--	--	--	--	--	--	--	--	--
4-Nitroaniline	43	0	0.024	2	--	--	--	--	--	--	--	--	--	--
1-Nitropyrene	10	0	0.0047	0.0053	--	--	--	--	--	--	--	--	--	--
2,3,4,5-Tetrachlorophenol	18	0	2.5	5	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene	16	0	0.4	1	--	--	--	--	--	--	--	--	--	--
Benzo(j)fluoranthene	9	0	0.0048	0.1	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,h)acridine	18	0	0.0047	0.01	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,j)acridine	18	0	0.0047	0.01	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,e)pyrene	18	0	0.0047	0.01	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,h)pyrene	18	0	0.0047	0.01	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,i)pyrene	18	0	0.0047	0.01	--	--	--	--	--	--	--	--	--	--
Dibenzo(a,l)pyrene	18	0	0.0047	0.01	--	--	--	--	--	--	--	--	--	--
Gasoline Range Hydrocarbons	23	0	100	70	--	--	--	--	--	--	--	--	--	--
Diesel Range Hydrocarbons	23	0	20	500	--	--	--	--	--	--	--	--	--	--
C5-C6 Aliphatics	16	0	15	15	--	--	--	--	--	--	--	--	--	--
C6-C8 Aliphatics	16	0	10	10	--	--	--	--	--	--	--	--	--	--
C8-C10 Aliphatics	16	0	30	30	--	--	--	--	--	--	--	--	--	--

Table G-3. Comparison of Maximum Concentrations of LSP Site Water Samples to EICs for Surface Water.

										Screening Against Sediment EICs				
Analyte	n	Percent Detected	Min. DL	Max. DL	Min. Det. Value	Max. Det. Value	Location of Max. Det. Value	Max. Detected Sample ID	Area	EIC	Ratio of Maximum DL to EIC	Frequency of DL Exceedance	Max. Det. Value/EIC	Frequency of Detected Exceedance
C10-C12 Aliphatics	17	0	24	50	--	--	--	--	--	--	--	--	--	--
C12-C16 Aliphatics	17	0	24	50	--	--	--	--	--	--	--	--	--	--
C16-C21 Aliphatics	17	0	47	50	--	--	--	--	--	--	--	--	--	--
C12-C16 Aromatics	17	0	24	50	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8,9-HxCDF	22	0	0.0000022	0.000126	--	--	--	--	--	--	--	--	--	--
Biochemical Oxygen Demand	7	0	2400	2400	--	--	--	--	--	--	--	--	--	--

Notes: -- = No data

Table G-4. Soil Exposure Point Concentrations (mg/kg) and Hazard Quotients (dimensionless) by Area

		Statistics				Soil EICs and HQs						
Area	Analyte	n	Mean	SD	EPC[a]	Plant	PlantHQ	Invert.	Invert.HQ	Wildlife	Wildlife HQ	Potential COPEC[b]
South Slope	Aluminum	5	2.5E+04	3.0E+03	2.8E+04	50	5.6E+02					*
	Antimony	5	1.6	8.4E-02	1.7	5	3.4E-01					--
	Arsenic	7	8.2	3.1	1.0E+01	10	1.0	60	1.7E-01	7	1.5	*
	Cadmium	5	9.5E-01	1.0E-01	1.1	4	2.6E-01	20	5.3E-02	14	7.5E-02	--
	Chromium	7	4.7E+01	7.6	5.2E+01	42	1.2	42	1.2	67	7.8E-01	*
	Copper	5	3.1E+01	7.7	3.9E+01	100	3.9E-01	50	7.7E-01	217	1.8E-01	--
	Lead	5	3.2E+01	1.2E+01	4.3E+01	50	8.7E-01	500	8.7E-02	118	3.7E-01	--
	Mercury	5	1.1E-01	5.2E-02	1.5E-01	0.3	5.0E-01	0.1	1.5	5.5	2.7E-02	*
	Nickel	5	4.3E+01	4.0E+00	4.7E+01	30	1.6	20	2.3	980	4.8E-02	*
	Selenium	5	2.3	9.3E-01	3.2	1	3.2	70	4.5E-02	0.3	1.1E+01	*
	Vanadium	5	7.1E+01	6.9	7.7E+01	2	3.9E+01					*
	Zinc	5	1.3E+02	3.4E+01	1.6E+02	86	1.9	200	8.1E-01	360	4.5E-01	*
	Acenaphthene	7	2.4E-02	4.0E-02	9.6E-02	20	4.8E-03					--
	Acenaphthylene	7	2.4E-02	4.0E-02	9.6E-02							--
	Anthracene	7	2.4E-02	4.0E-02	9.6E-02							--
	Fluorene	7	2.4E-02	4.0E-02	9.6E-02			30	3.2E-03			--
	Naphthalene	7	3.3E-02	4.5E-02	1.0E-01							--
	Phenanthrene	7	2.9E-02	3.8E-02	9.6E-02							--
	2-Methylnaphthalene	7	3.8E-02	5.7E-02	1.4E-01							--
	Benz[a]anthracene	7	2.6E-02	3.9E-02	9.6E-02							--
	Benzo[a]pyrene	7	4.8E-02	7.9E-02	1.9E-01					12	1.6E-02	--
	Chrysene	7	2.7E-02	3.6E-02	9.6E-02							--
	Dibenz[ah]anthracene	7	4.7E-02	8.0E-02	1.9E-01							--
	2,4-Dimethylphenol	7	2.7E-02	3.8E-02	9.6E-02							--
	2-Methylphenol	7	2.7E-02	3.8E-02	9.6E-02							--
	Phenol	7	2.7E-02	3.8E-02	9.6E-02	70	1.4E-03	30	3.2E-03			--
	Pentachlorophenol	7	1.2E-01	2.0E-01	4.8E-01	3	1.6E-01	6	7.9E-02	4.5	1.1E-01	--
	Bis[2-ethylhexyl]phthalate	7	1.8E-01	1.7E-01	3.1E-01							--
	Butylbenzylphthalate	7	5.7E-02	7.5E-02	1.9E-01							--
	Dimethylphthalate	7	7.7E-02	4.0E-02	1.1E-01			200	5.3E-04			--
	BenzoicAcid	7	2.1E-01	3.9E-01	1.1							--
	BenzylAlcohol	7	1.2E-01	2.0E-01	4.8E-01							--
	Dibenzofuran	7	2.3E-02	3.4E-02	9.6E-02							--
Upper Creek	Aluminum	11	1.8E+04	4.1E+03	2.0E+04	50	4.0E+02					*
	Antimony	11	4.9	1.0E+01	1.1E+01	5	2.3					*
	Arsenic	25	1.1E+01	2.9E+01	2.1E+01	10	2.1	60	3.5E-01	7	3.0	*
	Cadmium	24	5.1E-01	4.6E-01	1.5	4	3.8E-01	20	7.5E-02	14	1.1E-01	--
	Chromium	25	3.9E+01	1.0E+01	4.3E+01	42	1.0	42	1.0	67	6.4E-01	*
	Copper	24	4.1E+01	2.1E+01	4.9E+01	100	4.9E-01	50	9.9E-01	217	2.3E-01	--
	Lead	24	3.5E+01	4.2E+01	5.4E+01	50	1.1	500	1.1E-01	118	4.6E-01	*
	Mercury	24	1.0E-01	7.9E-02	3.3E-01	0.3	1.1	0.1	3.3	5.5	6.0E-02	*
	Nickel	23	3.8E+01	8.0	4.1E+01	30	1.4	20	2.1	980	4.2E-02	*
	Selenium	11	1.8	5.9E-01	2.1	1	2.1	70	3.0E-02	0.3	6.9	*
	Vanadium	11	5.8E+01	1.1E+01	6.4E+01	2	3.2E+01					*
	Zinc	24	1.4E+02	1.4E+02	1.8E+02	86	2.1	200	8.8E-01	360	4.9E-01	*
	Acenaphthene	15	4.9	1.9E+01	7.2E+01	20	3.6					*
	Acenaphthylene	15	4.5E-01	7.8E-01	3.0							--
	Anthracene	15	7.0	2.0E+01	7.8E+01							--
	Fluorene	15	4.0	1.5E+01	5.7E+01			30	1.9			*
	Naphthalene	15	4.5E-01	1.4	4.1							--
	Phenanthrene	15	1.4E+01	5.2E+01	2.0E+02							--
	2-Methylnaphthalene	15	8.0E-01	2.8	7.0							--
	Benz[a]anthracene	15	6.2	1.4E+01	5.1E+01							--
	Benzo[a]pyrene	15	1.1E+01	2.9E+01	1.1E+02					12	9.2	*
	Chrysene	15	1.8E+01	3.5E+01	1.2E+02							--
	Dibenz[ah]anthracene	15	3.0	1.0E+01	3.9E+01							--
	2,4-Dimethylphenol	15	3.0E-02	3.5E-02	8.6E-02							--
	2-Methylphenol	15	4.3E-02	7.0E-02	1.5E-01							--
	Phenol	15	7.3E-02	1.3E-01	3.8E-01	70	5.5E-03	30	1.3E-02			--
	Pentachlorophenol	15	6.6E-01	7.1E-01	2.2	3	7.3E-01	6	3.7E-01	4.5	4.9E-01	--
	Bis[2-ethylhexyl]phthalate	15	5.6E-01	1.6	6.2							--
	Butylbenzylphthalate	15	6.3E-02	1.1E-01	3.1E-01							--
	Dimethylphthalate	15	8.0E-02	7.5E-02	1.9E-01			200	9.7E-04			--
	BenzoicAcid	15	2.9E-01	7.4E-01	1.8							--
	BenzylAlcohol	15	1.5E-01	3.0E-01	1.1							--
	Dibenzofuran	15	7.0E-01	2.5	5.0							--
Lower Creek	Arsenic	11	5.8	6.3	2.0E+01	10	2.0	60	3.3E-01	7	2.9	*
	Cadmium	11	3.9E-01	4.0E-01	1.4	4	3.5E-01	20	7.0E-02	14	1.0E-01	--
	Chromium	11	4.4E+01	3.7E+01	6.0E+01	42	1.4	42	1.4	67	8.9E-01	*
	Copper	11	6.4E+01	7.7E+01	1.2E+02	100	1.2	50	2.4	217	5.5E-01	*
	Lead	11	4.0E+01	3.7E+01	9.2E+01	50	1.8	500	1.8E-01	118	7.8E-01	*
	Mercury	11	6.2E-02	9.0E-02	3.0E-01	0.3	1.0	0.1	3.0	5.5	5.5E-02	*
	Nickel	11	4.0E+01	2.2E+01	5.0E+01	30	1.7	20	2.5	980	5.1E-02	*
	Zinc	11	1.0E+02	7.3E+01	1.4E+02	86	1.7	200	7.1E-01	360	4.0E-01	*
	Acenaphthene	3	4.0E-02	3.8E-02	8.3E-02	20	4.2E-03					--
	Acenaphthylene	3	2.6E-01	3.7E-01	6.9E-01							--

Table G-4. Soil Exposure Point Concentrations (mg/kg) and Hazard Quotients (dimensionless) by Area

		Statistics				Soil EICs and HQs						
Area	Analyte	n	Mean	SD	EPC[a]	Plant	PlantHQ	Invert.	Invert.HQ	Wildlife	Wildlife HQ	Potential COPEC[b]
	Anthracene	3	9.5E-01	1.2	2.3							--
	Fluorene	3	6.4E-02	7.7E-02	1.5E-01			30	5.1E-03			--
	Naphthalene	3	9.6E-02	1.3E-01	2.5E-01							--
	Phenanthrene	3	4.6E-01	5.1E-01	1.1							--
	2-Methylnaphthalene	3	1.0E-01	1.3E-01	2.5E-01							--
	Benz[a]anthracene	3	6.5E-01	6.0E-01	1.3							--
	Benzo[a]pyrene	3	1.3	1.3	2.7					12	2.3E-01	--
	Chrysene	3	2.8	2.3	5.5							--
	Dibenz[ah]anthracene	3	2.4E-01	1.7E-01	3.9E-01							--
	2,4-Dimethylphenol	3	3.3E-02	3.8E-02	7.7E-02							--
	2-Methylphenol	3	2.4E-02	2.1E-02	4.8E-02							--
	Phenol	3	9.7E-02	1.0E-01	2.2E-01	70	3.1E-03	30	7.2E-03			--
	Pentachlorophenol	3	2.3	3.2	6.0	3	2.0	6	9.9E-01	4.5	1.3	*
	Bis[2-ethylhexyl]phthalate	3	4.8E-01	6.7E-01	1.3							--
	Butylbenzylphthalate	3	3.0E-01	3.2E-01	6.7E-01							--
	Dimethylphthalate	3	1.8	1.2	3.1			200	1.6E-02			--
	BenzoicAcid	3	1.1	1.5	2.8							--
	BenzylAlcohol	3	1.6E-01	2.4E-01	4.4E-01							--
	Dibenzofuran	3	7.8E-02	8.5E-02	1.8E-01							--
Historical Creek	Arsenic	12	5.9	4.0	7.5	10	7.5E-01	60	1.2E-01	7	1.1	*
	Cadmium	11	8.3E-01	7.3E-01	2.5	4	6.3E-01	20	1.3E-01	14	1.8E-01	--
	Chromium	12	4.3E+01	1.6E+01	4.9E+01	42	1.2	42	1.2	67	7.3E-01	*
	Copper	11	6.2E+01	3.7E+01	7.7E+01	100	7.7E-01	50	1.5	217	3.6E-01	*
	Lead	11	1.1E+02	1.1E+02	2.3E+02	50	4.6	500	4.6E-01	118	2.0	*
	Mercury	11	1.6E-01	1.2E-01	2.1E-01	0.3	7.1E-01	0.1	2.1	5.5	3.9E-02	*
	Nickel	11	4.1E+01	1.3E+01	4.6E+01	30	1.5	20	2.3	980	4.7E-02	*
	Silver	6	3.7E-02	7.5E-03	4.3E-02	2	2.1E-02					--
	Zinc	11	1.6E+02	9.3E+01	2.0E+02	86	2.3	200	9.8E-01	360	5.4E-01	*
	Acenaphthene	11	7.9E-02	4.4E-02	9.7E-02	20	4.9E-03					--
	Acenaphthylene	11	9.5E-01	1.1	3.0							--
	Anthracene	11	4.3	5.4	1.4E+01							--
	Fluorene	11	1.9E-01	2.2E-01	4.3E-01			30	1.4E-02			--
	Naphthalene	11	1.0E-01	5.4E-02	1.2E-01							--
	Phenanthrene	11	7.5E-01	1.2E+00	1.8							--
	2-Methylnaphthalene	11	7.9E-02	4.3E-02	1.0E-01							--
	Benz[a]anthracene	11	7.2	1.2E+01	3.4E+01							--
	Benzo[a]pyrene	11	2.5E+01	3.8E+01	1.1E+02					12	9.2	*
	Chrysene	11	3.6E+01	5.7E+01	1.6E+02							--
	Dibenz[ah]anthracene	11	5.7	1.1E+01	3.9E+01							--
	Fluoranthene	6	3.3	6.7	1.7E+01							--
	Indeno[1,2,3-cd]pyrene	6	1.2E+01	1.7E+01	4.5E+01							--
	Pyrene	6	2.5	5.2	1.3E+01							--
	Benzo[ghi]perylene	6	5.1	5.5	9.7							--
	LPAHs	6	3.7	4.0	7.0							--
	Benzo[bk]fluoranthene	6	1.9E+01	3.8E+01	9.6E+01							--
	2,4-Dimethylphenol	11	6.0E-02	2.7E-02	7.1E-02							--
	2-Methylphenol	11	6.1E-02	2.6E-02	7.2E-02							--
	4-Methylphenol	6	2.3E-01	3.8E-01	1.0							--
	Phenol	11	6.1E-02	2.7E-02	7.2E-02	70	1.0E-03	30	2.4E-03			--
	Pentachlorophenol	11	2.2	2.8	7.9	3	2.6	6	1.3	4.5	1.8	*
	Bis[2-ethylhexyl]phthalate	11	2.1E-01	2.1E-01	5.7E-01							--
	Butylbenzylphthalate	11	2.6E-01	3.2E-01	9.0E-01							--
	Dimethylphthalate	11	7.6E-02	3.7E-02	9.1E-02			200	4.5E-04			--
	BenzoicAcid	11	1.1	1.0	2.1							--
	BenzylAlcohol	11	1.2E-01	1.0E-01	2.0E-01							--
	Dibenzofuran	11	7.2E-02	4.0E-02	9.2E-02							--
	TEQDFB1	3	7.7E-04	5.6E-04	1.4E-03					0.000002	6.9E+02	*
	TEQDFF1	3	7.7E-04	5.6E-04	1.4E-03					0.000002	6.8E+02	*
	TEQDF0_5M05	3	1.8E-03	1.3E-03	3.3E-03					0.000002	1.6E+03	*
	DieselRangeOrganics	6	5.1E+02	4.1E+02	8.5E+02			200	4.2	6000	1.4E-01	*
Landfill	Arsenic	7	3.6	3.6	6.3	10	6.3E-01	60	1.0E-01	7	9.0E-01	--
	Cadmium	6	5.4E-01	4.4E-01	9.0E-01	4	2.3E-01	20	4.5E-02	14	6.4E-02	--
	Chromium	7	3.7E+01	5.2	4.1E+01	42	9.7E-01	42	9.7E-01	67	6.1E-01	--
	Copper	6	5.6E+01	3.0E+01	8.1E+01	100	8.1E-01	50	1.6	217	3.7E-01	*
	Lead	6	1.2E+02	9.2E+01	2.0E+02	50	3.9	500	3.9E-01	118	1.7	*
	Mercury	6	1.3E-01	9.5E-02	2.1E-01	0.3	6.9E-01	0.1	2.1	5.5	3.8E-02	*
	Nickel	6	3.9E+01	4.9	4.3E+01	30	1.4	20	2.1	980	4.3E-02	*
	Zinc	6	1.9E+02	1.6E+02	4.5E+02	86	5.2	200	2.2	360	1.2	*
	Acenaphthene	2	3.7E-02	4.5E-02	6.8E-02	20	3.4E-03					--
	Acenaphthylene	2	4.7E-02	3.0E-02	6.8E-02							--
	Anthracene	2	4.5E-02	3.3E-02	6.8E-02							--
	Fluorene	2	3.7E-02	4.4E-02	6.8E-02			30	2.3E-03			--
	Naphthalene	2	3.0E-02	3.5E-02	5.5E-02							--
	Phenanthrene	2	9.8E-02	4.5E-02	1.3E-01							--
	2-Methylnaphthalene	2	3.9E-02	4.2E-02	6.8E-02							--
	Benz[a]anthracene	2	7.0E-02	2.8E-03	7.2E-02							--

Table G-4. Soil Exposure Point Concentrations (mg/kg) and Hazard Quotients (dimensionless) by Area

		Statistics				Soil EICs and HQs						
Area	Analyte	n	Mean	SD	EPC[a]	Plant	PlantHQ	Invert.	Invert.HQ	Wildlife	Wildlife HQ	Potential COPEC[b]
	Benzo[a]pyrene	2	1.0E-01	4.4E-02	1.4E-01					12	1.1E-02	--
	Chrysene	2	8.9E-02	3.0E-02	1.1E-01							--
	Dibenz[ah]anthracene	2	7.3E-02	8.9E-02	1.4E-01							--
	2,4-Dimethylphenol	2	3.9E-02	4.1E-02	6.8E-02							--
	2-Methylphenol	2	3.9E-02	4.1E-02	6.8E-02							--
	Phenol	2	3.7E-02	4.4E-02	6.8E-02	70	9.7E-04	30	2.3E-03			--
	Pentachlorophenol	2	3.4E-01	7.8E-03	3.5E-01	3	1.2E-01	6	5.8E-02	4.5	7.8E-02	--
	Bis[2-ethylhexyl]phthalate	2	4.7E-01	1.9E-01	6.1E-01							--
	Butylbenzylphthalate	2	7.3E-02	8.9E-02	1.4E-01							--
	Dimethylphthalate	2	3.9E-02	4.1E-02	6.8E-02			200	3.4E-04			--
	BenzoicAcid	2	4.9E-01	5.6E-01	8.8E-01							--
	BenzylAlcohol	2	5.5E-02	6.7E-02	1.0E-01							--
	Dibenzofuran	2	3.8E-02	4.2E-02	6.8E-02							--
Wetland	Arsenic	2	2.9E+01	2.6E+01	4.7E+01	10	4.7	60	7.8E-01	7	6.7	*
	Cadmium	2	7.8E-01	1.8E-01	9.0E-01	4	2.3E-01			14	6.4E-02	--
	Chromium	2	5.0E+01	3.1	5.3E+01	42	1.3	36	1.5	67	7.8E-01	*
	Copper	2	5.6E+01	1.3E+01	6.5E+01	100	6.5E-01	36	1.8	217	3.0E-01	*
	Lead	2	6.6E+01	4.8E+01	1.0E+02	50	2.0	100	1.0	118	8.5E-01	*
	Mercury	2	7.8E-02	1.1E-02	8.5E-02	0.3	2.8E-01	100	8.5E-04	5.5	1.5E-02	--
	Nickel	2	5.1E+01	1.1E+00	5.2E+01	30	1.7	100	5.2E-01	980	5.3E-02	*
	Zinc	2	1.8E+02	1.1E+02	2.6E+02	86	3.0			360	7.1E-01	*
Railroad	Arsenic	6	8.7	1.5	1.0E+01	10	1.0	60	1.7E-01	7	1.4	*
	Cadmium	6	4.0E-01	3.3E-01	6.7E-01	4	1.7E-01			14	4.8E-02	--
	Chromium	6	3.8E+01	1.2E+01	4.7E+01	42	1.1	36	1.3	67	7.1E-01	*
	Copper	6	5.8E+01	2.3E+01	7.6E+01	100	7.6E-01	36	2.1	217	3.5E-01	*
	Lead	6	1.4E+02	1.1E+02	2.3E+02	50	4.6	100	2.3	118	2.0	*
	Mercury	6	1.1E-01	8.6E-02	1.8E-01	0.3	6.2E-01	100	1.8E-03	5.5	3.4E-02	--
	Nickel	6	3.7E+01	8.0E+00	4.4E+01	30	1.5	100	4.4E-01	980	4.4E-02	*
	Zinc	6	1.6E+02	7.3E+01	2.2E+02	86	2.6			360	6.1E-01	*
Background	2,4-Dimethylphenol	17	7.9E-02	7.2E-03	8.2E-02							--
	2-Methylnaphthalene	20	8.0E-02	7.0E-03	8.3E-02							--
	2-Methylphenol	20	8.0E-02	7.0E-03	8.3E-02							--
	Acenaphthene	20	8.0E-02	7.0E-03	8.3E-02	20	4.1E-03					--
	Acenaphthylene	20	8.0E-02	7.0E-03	8.3E-02							--
	Anthracene	20	7.8E-02	9.5E-03	8.2E-02							--
	Arsenic	20	5.3	1.6	6.0	10	6.0E-01	60	9.9E-02	7	8.5E-01	--
	Benz[a]anthracene	20	9.8E-02	6.7E-02	1.1E-01							--
	Benzo[a]pyrene	20	1.7E-01	6.8E-02	1.9E-01					12	1.6E-02	--
	BenzoicAcid	20	9.5E-01	4.3E-01	1.1							--
	BenzylAlcohol	20	4.0E-01	3.5E-02	4.1E-01							--
	Bis[2-ethylhexyl]phthalate	20	4.5E-01	2.2E-01	5.0E-01							--
	Butylbenzylphthalate	20	1.6E-01	1.4E-02	1.7E-01							--
	Chromium	20	4.2E+01	1.5E+01	4.7E+01	42	1.1	42	1.1	67	7.0E-01	*
	Chrysene	20	1.5E-01	1.3E-01	1.9E-01							--
	Dibenz[ah]anthracene	20	1.7E-01	3.7E-02	1.8E-01							--
	Dibenzofuran	20	8.0E-02	7.1E-03	8.3E-02							--
	Dimethylphthalate	20	8.0E-02	7.0E-03	8.3E-02			200	4.1E-04			--
	Fluorene	20	8.0E-02	7.0E-03	8.3E-02			30	2.8E-03			--
	Naphthalene	20	1.0E-01	3.8E-02	1.1E-01							--
	Pentachlorophenol	20	4.0E-01	3.5E-02	4.1E-01	3	1.4E-01	6	6.9E-02	4.5	9.2E-02	--
	Phenanthrene	20	1.7E-01	1.3E-01	2.4E-01							--
	Phenol	20	8.0E-02	7.0E-03	8.3E-02	70	1.2E-03	30	2.8E-03			--

[a] EPCs were maximum values, Student's t-test UCL95s, or UCL95s calculated by Land's method, depending on the data distribution and UCL values.

[b] Metals eliminated by background evaluation were still included in screening for information purposes

Table G-5. Water Exposure Point Concentrations (ug/L) and Hazard Quotients (dimensionless) of CoPECs by Area

Area	Analyte	n	Mean	SD	EPC[a]	EIC		HQ	Potential CoPEC[b]
		Statistics							
Upper Creek	Aluminum	12	2.2E+02	4.5E+02	1.6E+03	87	c	1.9E+01	*
	Aluminum dissolved	7	5.6E+01	5.0E+01	9.3E+01	87	c	1.1	*
	Barium	12	3.0E+01	2.7E+01	4.2E+01	4	d	1.1E+01	*
	Barium dissolved	7	24.5	6.0	2.9E+01	4	d	7.2	*
	Copper	22	6.4	7.7	1.0E+01	9	d	1.1	*
	Copper dissolved	17	5.1	6.4	6.9	9	d	7.6E-01	--
	Iron	12	3.0E+02	4.1E+02	1.5E+03	1000	e	1.5	*
	Lead	22	2.0	3.6	5.4	2.5	e	2.2	*
	Magnesium	22	1.1E+04	6.8E+03	1.4E+04	647	f	2.1E+01	*
	Magnesium dissolved	17	1.0E+04	7.2E+03	1.3E+04	647	f	2.1E+01	*
	Manganese	12	6.1E+01	4.2E+01	8.3E+01	120	d	6.9E-01	--
	Anthracene	26	7.4E-02	6.6E-02	1.5E-01	0.73	d	2.1E-01	--
	Benz[a]anthracene	26	7.2E-02	8.1E-02	2.3E-01	0.027	d	8.3	*
	Benzo[a]pyrene	26	8.1E-02	7.8E-02	2.3E-01	0.014	d	1.6E+01	*
	Pyrene	26	1.3E-01	1.5E-01	3.4E-01	0.3	e	1.1	*
	Pentachlorophenol	26	7.7	27	7.0E+01	15	c	4.7	*
	2,3,4,6-Tetrachlorophenol	9	2.2	2.2	4.6	1.2	e	3.8	*
	2,3,7,8-TCDD	16	4.2E-06	2.6E-06	5.8E-06	0.000000003	e	1.9E+03	*
	TEQDF (Fish)	16	4.0E-05	7.1E-05	5.9E-05	0.000000003	e	2.0E+04	*
	Alkalinity	11	1.1E+05	3.3E+04	1.5E+05	20000	c	7.5	*
Lower Creek	Aluminum	4	7.3E+01	1.0E+02	1.9E+02	87	c	2.2	*
	Aluminum dissolved	3	1.7E+01	1.2E+01	3.1E+01	87	c	3.6E-01	--
	Barium	4	2.1E+01	6.4	2.9E+01	4	d	7.1	*
	Barium dissolved	3	2.0E+01	6.0	2.6E+01	4	d	6.5	*
	Copper	8	4.8	3.6	1.0E+01	9	d	1.1	*
	Copper dissolved	7	3.0	1.7	4.3	9	d	4.7E-01	--
	Iron	4	1.5E+02	1.4E+02	3.0E+02	1000	e	3.0E-01	--
	Lead	8	2.0	3.1	4.1	2.5	e	1.6	*

Table G-5. Water Exposure Point Concentrations (ug/L) and Hazard Quotients (dimensionless) of CoPECs by Area

		Statistics							
Area	Analyte	n	Mean	SD	EPC[a]	EIC		HQ	Potential CoPEC[b]
	Magnesium	8	1.2E+04	6.9E+03	1.7E+04	647	f	2.6E+01	*
	Magnesium dissolved	7	1.2E+04	7.5E+03	1.7E+04	647	f	2.7E+01	*
	Manganese	4	3.1E+01	2.6E+01	6.3E+01	120	d	5.2E-01	--
	Anthracene	8	8.8E-02	6.7E-02	1.5E-01	0.73	d	2.1E-01	--
	Benz[a]anthracene	8	1.1E-01	8.9E-02	1.7E-01	0.027	d	6.4	*
	Benzo[a]pyrene	8	1.1E-01	8.0E-02	2.2E-01	0.014	d	1.6E+01	*
	Pyrene	8	1.4E-01	6.8E-02	1.8E-01	0.3	e	6.1E-01	--
	Pentachlorophenol	8	5.5	7.1	1.0E+01	15	c	6.8E-01	--
	2,3,4,6-Tetrachlorophenol	4	1.7	9.5E-01	2.5	1.2	e	2.1	*
	2,3,7,8-TCDD	3	3.3E-06	1.6E-06	4.9E-06	0.000000003	e	1.6E+03	*
	TEQDF (Fish)	3	1.9E-05	1.1E-05	3.2E-05	0.000000003	e	1.1E+04	*
	Alkalinity	3	1.1E+05	1.4E+04	6.0E-06	20000	c	3.0E-10	--
Historical Creek	Copper	2	2.0E+01	2.0E+01	3.5E+01	9	d	3.8	*
	Copper dissolved	2	1.6E+01	1.8E+01	2.9E+01	9	d	3.2	*
	Lead	2	2.0	1.4	3.0	2.5	e	1.2	*
	Magnesium	2	4.3E+03	3.8E+03	6.9E+03	647	f	1.1E+01	*
	Magnesium dissolved	2	4.2E+03	3.7E+03	6.8E+03	647	f	1.1E+01	*
	Anthracene	1	1.5E-01	NA	1.5E-01	0.73	d	2.1E-01	--
	Benz[a]anthracene	1	1.7E-01	NA	1.7E-01	0.027	d	6.1	*
	Benzo[a]pyrene	1	1.5E-01	NA	1.5E-01	0.014	d	1.1E+01	*
	Pyrene	1	1.7E-01	NA	1.7E-01	0.3	e	5.7E-01	--
	Pentachlorophenol	1	4.6E-01	NA	4.6E-01	15	c	3.0E-02	--
	2,3,4,6-Tetrachlorophenol	1	8.5E-01	NA	8.5E-01	1.2	e	7.1E-01	--
Wetland	Aluminum	3	2.9E+01	1.3E+01	4.1E+01	87	c	4.7E-01	--
	Aluminum dissolved	1	2.2E+01	NA	2.2E+01	87	c	2.5E-01	--
	Barium	3	1.3E+01	3.8	1.7E+01	4	d	4.3	*
	Barium dissolved	1	10.5	NA	10.5	4	d	2.6	*
	Copper	5	1.6	6.0E-01	2.2	9	d	2.5E-01	--

Table G-5. Water Exposure Point Concentrations (ug/L) and Hazard Quotients (dimensionless) of CoPECs by Area

Area	Analyte	Statistics n	Mean	SD	EPC[a]	EIC		HQ	Potential CoPEC[b]
	Copper dissolved	3	1.9	5.1E-01	2.3	9	d	2.6E-01	--
	Iron	3	3.1E+02	4.1E+02	7.8E+02	1000	e	7.8E-01	--
	Lead	5	2.3E-01	1.5E-01	4.9E-01	2.5	e	2.0E-01	--
	Magnesium	5	1.0E+04	1.0E+03	1.1E+04	647	f	1.7E+01	*
	Magnesium dissolved	3	9.1E+03	3.1E+02	9.5E+03	647	f	1.5E+01	*
	Manganese	3	6.9E+01	9.3E+01	1.8E+02	120	d	1.5	*
	Anthracene	5	1.0E-01	9.4E-02	1.9E-01	0.73	d	2.6E-01	--
	Benz[a]anthracene	5	1.1E-01	9.9E-02	2.0E-01	0.027	d	7.5	*
	Benzo[a]pyrene	5	1.0E-01	9.5E-02	1.9E-01	0.014	d	1.4E+01	*
	Pyrene	5	1.1E-01	9.5E-02	2.1E-01	0.3	e	6.9E-01	--
	Pentachlorophenol	5	0.4	0.4	0.8	15	c	0.1	--
	2,3,4,6-Tetrachlorophenol	2	1.7	1.2	2.5	1.2	e	2.1	*
	2,3,7,8-TCDD	2	3.9E-06	2.3E-06	5.5E-06	0.000000003	e	1.8E+03	*
	TEQDF (Fish)	2	2.7E-05	7.4E-06	3.2E-05	0.000000003	e	1.1E+04	*
	Alkalinity	2	7.3E+04	8.4E+03	7.9E+04	20000	c	4.0	*
Beach	Aluminum	1	4.3E+01	NA	4.3E+01	87	c	4.9E-01	--
	Aluminum dissolved	1	1.0E+01	NA	1.0E+01	87	c	1.1E-01	--
	Barium	1	2.1E+01	NA	2.1E+01	4	d	5.4	*
	Barium dissolved	1	2.1E+01	NA	2.1E+01	4	d	5.2	*
	Copper	1	3.6	NA	3.6	9	d	4.0E-01	--
	Copper dissolved	1	3.8	NA	3.8	9	d	4.2E-01	--
	Iron	1	2.2E+02	NA	2.2E+02	1000	e	2.2E-01	--
	Lead	1	7.0E-01	NA	7.0E-01	2.5	e	2.8E-01	--
	Magnesium	1	2.0E+04	NA	2.0E+04	647	f	3.2E+01	*
	Magnesium dissolved	1	2.1E+04	NA	2.1E+04	647	f	3.3E+01	*
	Manganese	1	6.2E+01	NA	6.2E+01	120	d	5.2E-01	--
	Anthracene	1	9.0E-01	NA	9.0E-01	0.73	d	1.2	*
	Benz[a]anthracene	1	2.2E-01	NA	2.2E-01	0.027	d	8.0	*

Table G-5. Water Exposure Point Concentrations (ug/L) and Hazard Quotients (dimensionless) of CoPECs by Area

Area	Analyte	Statistics: n	Mean	SD	EPC[a]	EIC		HQ	Potential CoPEC[b]
	Benzo[a]pyrene	1	1.2E-01	NA	1.2E-01	0.014	d	8.6	*
	Pyrene	1	7.0E-02	NA	7.0E-02	0.3	e	2.3E-01	--
	Pentachlorophenol	1	1.1	NA	1.1	15	c	7.3E-02	--
Background	Copper	2	1.5	4.9E-01	1.8	9	d	2.0E-01	--
	Copper dissolved	2	2.1	8.5E-01	2.7	9	d	3.0E-01	--
	Lead	2	0.2	0	0.2	2.5	e	8.0E-02	--
	Magnesium	2	3.47E+03	6.7E+02	3940.0	647	f	6.1	*
	Magnesium dissolved	2	3.41E+03	6.2E+02	3840.0	647	f	5.9	*
	Anthracene	2	0.2	0	0.2	0.73	d	2.1E-01	--
	Benz[a]anthracene	2	0.2	0	0.2	0.027	d	6.1	*
	Benzo[a]pyrene	2	1.5E-01	0	1.5E-01	0.014	d	1.1E+01	*
	Pyrene	2	1.7E-01	0	1.7E-01	0.3	e	0.6	--
	Pentachlorophenol	2	4.6E-01	0	4.6E-01	15	c	0.0	--
	2,3,4,6-Tetrachlorophenol	2	1.7	1.2	2.5	1.2	e	2.1	*
	2,3,7,8-TCDD	1	3.5E-06	NA	3.5E-06	0.000000003	e	1.2E+03	*
	TEQDF (Fish)	1	1.0E-05	NA	1.0E-05	0.000000003	e	3.3E+03	*

Notes: [a] EPCs were maximum values, Student's t-test UCL95s, or UCL95s calculated by Land's method, depending on the data distribution and UCL values.
[b] Metals eliminated by background evaluation were still included in screening for information purposes
[c] EIC is USEPA WQC continuous exposure value.
[d] EIC is Tier II SCV.
[e] EIC is USEPA Region 5 ESL.
[f] EIC is USEPA Region 6 FWSB.

Table G-6. Sediment Exposure Point Concentrations (mg/kg) and Hazard Quotients (dimensionless) by Area

		Statistics				EICs		HQs			
Area	Analyte	n	mean	SD	EPC[a]	SQS	CSL	SQS	CSL	Source	Potential COPEC[b]
Upper Creek	Aluminum	10	1.2E+04	1.7E+03	1.3E+04	--	--	--	--	--	
	Antimony	10	3.0	2.6	8.3	0.4	0.6	21	14	c	*
	Arsenic	12	6.9	8.0	1.2E+01	20	51	0.6	0.2	c	
	Cadmium	18	5.3E-01	3.8E-01	6.9E-01	0.6	1	1.1	0.7	c	*
	Chromium	12	5.2E+01	4.3E+01	9.0E+01	95	100	1.0	0.9	c	
	Copper	18	3.2E+01	2.8E+01	5.2E+01	80	830	0.6	0.1	c	
	Lead	18	2.4E+01	1.8E+01	3.4E+01	335	430	0.1	0.1	c	
	Mercury	18	5.2E-02	5.5E-02	2.0E-01	0.5	0.75	0.4	0.3	c	
	Nickel	18	3.0E+01	2.4E+01	5.6E+01	60	70	0.9	0.8	c	
	Silver	12	2.4E-01	1.9E-01	6.0E-01	2	2.5	0.3	0.2	c	
	Vanadium	10	4.4E+01	7.0	4.8E+01	--	--	--	--	--	
	Zinc	18	1.9E+02	9.8E+01	2.4E+02	140	160	1.7	1.5	c	*
	2,4-Dimethylphenol	13	5.6E-02	7.0E-02	2.2E-01	0.029	0.029	7.6	7.6	d	*
	2-Methylphenol	13	1.2E-01	2.7E-01	8.2E-01	0.063	0.063	13	13	d	*
	4-Methylphenol	7	1.6E-01	1.7E-01	5.0E-01	0.67	0.67	0.8	0.8	d	
	Phenol	13	1.5E-01	1.7E-01	5.1E-01	0.42	1.2	1.2	0.4	d	*
	Pentachlorophenol	13	1.5	1.2	2.1	0.36	0.69	5.8	3.0	d	*
	Bis[2-ethylhexyl]phthalate	13	4.3E-01	5.5E-01	1.7	0.23	0.32	7.3	5.3	c	*
	Butylbenzylphthalate	13	1.0E-01	1.5E-01	5.1E-01	0.26	0.37	2.0	1.4	c	*
	Dimethylphthalate	13	3.2E-01	6.4E-01	2.0	0.046	0.44	42	4.4	c	*
	TEQDFB1	6	1.0E-04	1.4E-04	3.7E-04	--	--	--	--	--	
	TEQDFF1	6	1.0E-04	1.5E-04	3.9E-04	--	--	--	--	--	
	TEQDF0_5M05	6	2.3E-04	2.8E-04	4.6E-04	--	--	--	--	--	
	BenzoicAcid	13	8.5E-01	1.4	5.3	0.65	0.65	8.2	8.2	d	*
	BenzylAlcohol	13	1.1	3.6	1.3E+01	0.057	0.073	228.1	178.1	d	*
	Dibenzofuran	13	2.7	9.1	3.3E+01	0.4	0.44	82.5	75.0	c	*
	Acenaphthene	13	1.0E+01	3.6E+01	1.3E+02	1.06	1.32	122.6	98.5	c	*
	Acenaphthylene	13	1.4E-01	1.2E-01	2.0E-01	0.47	0.64	0.4	0.3	c	
	Anthracene	13	8.2	2.4E+01	8.8E+01	1.2	1.58	73.3	55.7	c	*
	Fluorene	13	7.9	2.8E+01	1.0E+02	1	3	100.0	33.3	c	*
	Naphthalene	13	4.6E-01	1.2	4.3	0.5	1.31	8.6	3.3	c	*
	Phenanthrene	13	2.5E+01	8.9E+01	2.8E+02	6.1	7.6	46.0	36.9	c	*
	2-Methylnaphthalene	13	7.9E-01	2.4	8.7	0.47	0.56	18.5	15.5	c	*
	Benz[a]anthracene	13	7.4	2.0E+01	7.4E+01	4.26	5.8	17.4	12.8	c	*
	Benzo[a]pyrene	13	5.2	9.7	3.6E+01	3.3	4.81	10.9	7.5	c	*
	Chrysene	13	1.3E+01	2.6E+01	9.5E+01	5.94	6.4	16.0	14.8	c	*
	Dibenz[ah]anthracene	13	6.9E-01	1.3	4.7	0.8	0.84	5.9	5.6	c	*
	Fluoranthene	13	2.7E+01	9.4E+01	3.4E+02	11	15	31	23	c	*
	Indeno[1,2,3-cd]pyrene	13	2.1	3.1	1.1E+01	4.12	5.3	2.7	2.1	c	*
	Pyrene	13	1.9E+01	6.1E+01	2.2E+02	8.8	16	25	14	c	*
	Benzo[ghi]perylene	13	1.9	2.8	1.0E+01	4.02	5.2	2.5	1.9	c	*
	Total LPAH	13	5.3E+01	1.8E+02	6.5E+02	6.6	9.2	99	71	c	*
	Total Benzofluoranthenes[ND=1/2DL]	13	9.6	1.8E+01	6.8E+01	11	14	6.2	4.9	c	*
	DieselRangeOrganics	3	1.2E+03	2.1E+03	3.7E+03	--	--	--	--	--	
Lower Creek	Aluminum	5	1.1E+04	2.2E+03	1.3E+04	--	--	--	--	--	
	Antimony	5	2.7	1.5	4.1	0.4	0.6	10.2	6.8	c	*
	Arsenic	9	7.1	5.5	1.1E+01	20	51	0.5	0.2	c	
	Cadmium	13	5.2E-01	3.3E-01	6.8E-01	0.6	1	1.1	0.7	c	*
	Chromium	9	4.7E+01	4.1E+01	8.5E+01	95	100	0.9	0.8	c	
	Copper	13	7.6E+01	8.9E+01	2.4E+02	80	830	3.0	0.3	c	*
	Lead	13	6.1E+01	8.8E+01	2.2E+02	335	430	0.7	0.5	c	
	Mercury	13	5.7E-02	6.2E-02	1.9E-01	0.5	0.75	0.4	0.3	c	
	Nickel	13	2.8E+01	2.4E+01	6.5E+01	60	70	1.1	0.9	c	*
	Silver	9	3.5	1.0E+01	3.0E+01	2	2.5	15.0	12.0	c	*
	Vanadium	5	3.7E+01	7.1	4.4E+01	--	--	--	--	--	
	Zinc	13	1.5E+02	9.7E+01	2.0E+02	140	160	1.4	1.2	c	*
	2,4-Dimethylphenol	10	2.3E-02	3.3E-02	5.2E-02	0.029	--	1.8	1.8	d	*
	2-Methylphenol	10	2.0E-02	3.3E-02	4.5E-02	0.063	--	0.7	0.7	d	
	4-Methylphenol	6	9.5E-02	9.7E-02	1.7E-01	0.67	--	0.3	0.3	d	
	Phenol	10	4.4E-02	5.3E-02	1.7E-01	0.42	--	0.4	0.1	d	
	Pentachlorophenol	10	1.4	1.7	4.5	0.36	--	12.5	6.5	d	*
	Bis[2-ethylhexyl]phthalate	10	3.3E-01	3.2E-01	1.1	0.23	0.32	4.6	3.3	c	*
	Butylbenzylphthalate	10	6.8E-02	7.8E-02	1.8E-01	0.26	0.37	0.7	0.5	c	
	Dimethylphthalate	10	6.8E-01	9.2E-01	2.7	0.046	0.44	58.7	6.1	c	*
	TEQDFB1	5	9.3E-04	2.0E-03	4.4E-03	--	--	--	--	--	
	TEQDFF1	5	7.1E-04	1.5E-03	3.4E-03	--	--	--	--	--	

Table G-6. Sediment Exposure Point Concentrations (mg/kg) and Hazard Quotients (dimensionless) by Area

		Statistics				EICs		HQs			
Area	Analyte	n	mean	SD	EPC[a]	SQS	CSL	SQS	CSL	Source	Potential COPEC[b]
	TEQDF0_5M05	5	1.3E-03	2.6E-03	5.9E-03	--	--	--	--	--	
	BenzoicAcid	10	4.2E-01	4.6E-01	6.8E-01	0.65	1.0528	1.1	1.1	d	*
	BenzylAlcohol	10	5.1E-02	5.4E-02	1.5E-01	0.057	2.6842	2.7	2.1	d	*
	Dibenzofuran	10	6.9E-02	1.1E-01	3.7E-01	0.4	0.44	0.9	0.8	c	
	Acenaphthene	10	1.3	3.8	1.2E+01	1.06	1.32	11.3	9.1	c	*
	Acenaphthylene	10	8.8E-02	1.3E-01	4.3E-01	0.47	0.64	0.9	0.7	c	
	Anthracene	10	4.4	1.1E+01	3.7E+01	1.2	1.58	30.7	23.3	c	*
	Fluorene	10	1.8	5.3	1.7E+01	1	3	17.0	5.7	c	*
	Naphthalene	10	4.4E-01	1.2	3.8	0.5	1.31	7.6	2.9	c	*
	Phenanthrene	10	3.6	1.0E+01	3.3E+01	6.1	7.6	5.4	4.3	c	*
	2-Methylnaphthalene	10	3.0E-01	8.1E-01	2.6	0.47	0.56	5.6	4.7	c	*
	Benz[a]anthracene	10	3.9	9.3	3.0E+01	4.26	5.8	7.1	5.2	c	*
	Benzo[a]pyrene	10	3.1	6.3	2.1E+01	3.3	4.81	6.3	4.3	c	*
	Chrysene	10	8.0	1.7E+01	5.6E+01	5.94	6.4	9.3	8.7	c	*
	Dibenz[ah]anthracene	10	2.9E-01	4.7E-01	1.6	0.8	0.84	2.0	1.9	c	*
	Fluoranthene	10	9.4	2.7E+01	8.6E+01	11	15	7.8	5.8	c	*
	Indeno[1,2,3-cd]pyrene	10	1.5	3.0	1.0E+01	4.12	5.3	2.4	1.9	c	*
	Pyrene	10	8.5	2.4E+01	7.8E+01	8.8	16	8.9	4.9	c	*
	Benzo[ghi]perylene	10	1.1	2.0	6.8	4.02	5.2	1.7	1.3	c	*
	Total LPAH	10	1.2E+01	3.3E+01	1.1E+02	6.6	9.2	15.9	11.4	c	*
	Total Benzofluoranthenes[ND=1/2DL]	10	5.5	1.1E+01	3.5E+01	11	14	3.2	2.5	c	*
	Diesel Range Organics	4	8.1E+01	7.5E+01	1.7E+02	--	--	--	--	--	
Historical Creek	Arsenic	12	5.9	4.0	7.5	20	51	0.4	0.1	c	
	Cadmium	11	8.3E-01	7.3E-01	2.5	0.6	1	4.2	2.5	c	*
	Chromium	12	4.3E+01	1.6E+01	4.9E+01	95	100	0.5	0.5	c	
	Copper	11	6.2E+01	3.7E+01	7.7E+01	80	830	1.0	0.1	c	
	Lead	11	1.1E+02	1.1E+02	2.3E+02	335	430	0.7	0.5	c	
	Mercury	11	1.6E-01	1.2E-01	2.1E-01	0.5	0.75	0.4	0.3	c	
	Nickel	11	4.1E+01	1.3E+01	4.6E+01	60	70	0.8	0.7	c	
	Silver	6	3.7E-02	7.5E-03	4.3E-02	2	2.5	0.021	0.017	c	
	Zinc	11	1.6E+02	9.3E+01	2.0E+02	140	160	1.4	1.2	c	*
	2,4-Dimethylphenol	11	6.0E-02	2.7E-02	7.1E-02	0.029	0.029	2.5	2.5	d	*
	2-Methylphenol	11	6.1E-02	2.6E-02	7.2E-02	0.063	0.063	1.1	1.1	d	*
	4-Methylphenol	6	2.3E-01	3.8E-01	1.0	0.67	0.67	1.5	1.5	d	*
	Phenol	11	6.1E-02	2.7E-02	7.2E-02	0.42	1.2	0.2	0.1	d	
	Pentachlorophenol	11	2.2	2.8	7.9	0.36	0.69	21.9	11.4	d	*
	Bis[2-ethylhexyl]phthalate	11	2.1E-01	2.1E-01	5.7E-01	0.23	0.32	2.5	1.8	c	*
	Butylbenzylphthalate	11	2.6E-01	3.2E-01	9.0E-01	0.26	0.37	3.5	2.4	c	*
	Dimethylphthalate	11	7.6E-02	3.7E-02	9.1E-02	0.046	0.44	2.0	0.2	c	*
	TEQDFB1	3	7.7E-04	5.6E-04	1.4E-03	--	--	--	--	--	
	TEQDFF1	3	7.7E-04	5.6E-04	1.4E-03	--	--	--	--	--	
	TEQDF0_5M05	3	1.8E-03	1.3E-03	3.3E-03	--	--	--	--	--	
	BenzoicAcid	11	1.1	1.0E+00	2.1E+00	0.65	0.65	3.2	3.2	d	*
	BenzylAlcohol	11	1.2E-01	1.0E-01	2.0E-01	0.057	0.073	3.5	2.7	d	*
	Dibenzofuran	11	7.2E-02	4.0E-02	9.2E-02	0.4	0.44	0.2	0.2	c	
	Acenaphthene	11	7.9E-02	4.4E-02	9.7E-02	1.06	1.32	0.1	0.1	c	
	Acenaphthylene	11	9.5E-01	1.1	3.0	0.47	0.64	6.4	4.7	c	*
	Anthracene	11	4.3	5.4	1.4E+01	1.2	1.58	11.7	8.9	c	*
	Fluorene	11	1.9E-01	2.2E-01	4.3E-01	1	3	0.4	0.1	c	
	Naphthalene	11	1.0E-01	5.4E-02	1.2E-01	0.5	1.31	0.2	0.1	c	
	Phenanthrene	11	7.5E-01	1.2	1.8	6.1	7.6	0.3	0.2	c	
	2-Methylnaphthalene	11	7.9E-02	4.3E-02	1.0E-01	0.47	0.56	0.2	0.2	c	
	Benz[a]anthracene	11	7.2	1.2E+01	3.4E+01	4.26	5.8	8.0	5.9	c	*
	Benzo[a]pyrene	11	2.5E+01	3.8E+01	1.1E+02	3.3	4.81	33.3	22.9	c	*
	Chrysene	11	3.6E+01	5.7E+01	1.6E+02	5.94	6.4	26.9	25.0	c	*
	Dibenz[ah]anthracene	11	5.7	1.1E+01	3.9E+01	0.8	0.84	48.8	46.4	c	*
	Fluoranthene	6	3.3	6.7	1.7E+01	11	15	1.5	1.1	c	*
	Indeno[1,2,3-cd]pyrene	6	1.2E+01	1.7E+01	4.5E+01	4.12	5.3	10.9	8.5	c	*
	Pyrene	6	2.5	5.2	1.3E+01	8.8	16	1.5	0.8	c	*
	Benzo[ghi]perylene	6	5.1	5.5	9.7	4.02	5.2	2.4	1.9	c	*
	Total LPAH	6	3.7	4.0	7.0	6.6	9.2	1.1	0.8	c	*
	Total Benzofluoranthenes[ND=1/2DL]	6	1.9E+01	3.8E+01	9.6E+01	11	14	8.7	6.9	c	*
	Diesel Range Organics	6	5.1E+02	4.1E+02	8.5E+02	--	--	--	--	--	
Wetland	Aluminum	2	1.3E+04	3.4E+03	1.6E+04	--	--	--	--	--	
	Antimony	2	4.5	3.5	7.0	0.4	0.6	17.5	11.7	c	*
	Arsenic	2	2.3	6.4E-02	2.3	20	51	0.1	0.0	c	

Table G-6. Sediment Exposure Point Concentrations (mg/kg) and Hazard Quotients (dimensionless) by Area

		Statistics				EICs		HQs			
Area	Analyte	n	mean	SD	EPC[a]	SQS	CSL	SQS	CSL	Source	Potential COPEC[b]
	Cadmium	3	1.1	1.0	2.3	0.6	1	3.8	2.3	c	*
	Chromium	2	1.3E+02	1.2E+02	2.2E+02	95	100	2.3	2.2	c	*
	Copper	3	4.9E+01	3.0E+01	8.4E+01	80	830	1.0	0.1	c	*
	Lead	3	1.4E+01	6.5	1.9E+01	335	430	0.1	0.0	c	
	Mercury	3	7.9E-02	8.6E-02	1.8E-01	0.5	0.75	0.4	0.2	c	
	Nickel	3	5.7E+01	4.5E+01	1.1E+02	60	70	1.8	1.5	c	*
	Silver	2	6.5E-01	7.1E-01	1.2	2	2.5	0.6	0.5	c	
	Vanadium	2	5.3E+01	1.0E+01	6.1E+01	--	--	--	--	--	
	Zinc	3	9.4E+01	2.8E+01	1.3E+02	140	160	0.9	0.8	c	
	2,4-Dimethylphenol	3	8.4E-02	5.5E-02	1.3E-01	0.029	0.029	4.6	4.6	d	*
	2-Methylphenol	3	1.1E-01	8.7E-02	2.0E-01	0.063	0.063	3.1	3.1	d	*
	4-Methylphenol	2	3.0E-01	3.6E-01	5.5E-01	0.67	0.67	0.8	0.8	d	
	Phenol	3	7.4E-01	1.2	2.1	0.42	1.2	5.0	1.8	d	*
	Pentachlorophenol	3	5.9E-01	6.3E-01	1.3	0.36	0.69	3.5	1.8	d	*
	Bis[2-ethylhexyl]phthalate	3	2.1E-01	2.4E-01	4.9E-01	0.23	0.32	2.1	1.5	c	*
	Butylbenzylphthalate	3	7.2E-02	4.1E-02	9.8E-02	0.26	0.37	0.4	0.3	c	
	Dimethylphthalate	3	7.1E-02	4.2E-02	9.8E-02	0.046	0.44	2.1	0.2	c	*
	TEQDFB1	1	5.3E-06	NA	5.3E-06	--	--	--	--	--	
	TEQDFF1	1	4.3E-06	NA	4.3E-06	--	--	--	--	--	
	TEQDF0_5M05	1	7.6E-06	NA	7.6E-06	--	--	--	--	--	
	BenzoicAcid	3	3.1	4.5	8.2	0.65	0.65	12.7	12.7	d	*
	BenzylAlcohol	3	2.1	3.6	6.3	0.057	0.073	110.4	86.2	d	*
	Dibenzofuran	3	5.6E-02	3.4E-02	9.3E-02	0.4	0.44	0.2	0.2	c	
	Acenaphthene	3	3.8E-02	4.8E-02	9.3E-02	1.06	1.32	0.1	0.1	c	
	Acenaphthylene	3	4.9E-02	4.4E-02	9.3E-02	0.47	0.64	0.2	0.1	c	
	Anthracene	3	6.0E-02	4.8E-02	9.3E-02	1.2	1.58	0.1	0.1	c	
	Fluorene	3	5.5E-02	4.1E-02	9.3E-02	1	3	0.1	0.0	c	
	Naphthalene	3	5.8E-02	4.6E-02	9.3E-02	0.5	1.31	0.2	0.1	c	
	Phenanthrene	3	1.1E-01	1.1E-01	2.3E-01	6.1	7.6	0.0	0.0	c	
	2-Methylnaphthalene	3	4.9E-02	4.4E-02	9.3E-02	0.47	0.56	0.2	0.2	c	
	Benz[a]anthracene	3	4.9E-02	4.4E-02	9.3E-02	4.26	5.8	0.0	0.0	c	
	Benzo[a]pyrene	3	4.9E-02	4.4E-02	9.3E-02	3.3	4.81	0.0	0.0	c	
	Chrysene	3	4.9E-02	4.4E-02	9.3E-02	5.94	6.4	0.0	0.0	c	
	Dibenz[ah]anthracene	3	6.5E-02	5.2E-02	9.8E-02	0.8	0.84	0.1	0.1	c	
	Fluoranthene	3	1.4E-01	1.5E-01	3.0E-01	11	15	0.0	0.0	c	
	Indeno[1,2,3-cd]pyrene	3	6.5E-02	5.2E-02	9.8E-02	4.12	5.3	0.0	0.0	c	
	Pyrene	3	1.3E-01	1.5E-01	2.9E-01	8.8	16	0.0	0.0	c	
	Benzo[ghi]perylene	3	6.5E-02	5.2E-02	9.8E-02	4.02	5.2	0.0	0.0	c	
	Total LPAH	3	2.3E-01	2.8E-01	5.6E-01	6.6	9.2	0.1	0.1	c	
	Total Benzofluoranthenes[ND=1/2DL]	3	8.0E-02	2.6E-02	9.8E-02	11	14	0.0	0.0	c	
Beach	Aluminum	1	1.1E+04	NA	1.1E+04	--	--	--	--	--	
	Antimony	1	5.2	NA	5.2	0.4	0.6	1.3E+01	8.7	c	*
	Arsenic	1	4.1	NA	4.1	20	51	2.1E-01	8.1E-02	c	
	Cadmium	1	1.0E-01	NA	1.0E-01	0.6	1	1.7E-01	1.0E-01	c	
	Chromium	1	2.5E+02	NA	2.5E+02	95	100	2.6	2.5	c	*
	Copper	1	2.5E+01	NA	2.5E+01	80	830	3.2E-01	3.1E-02	c	
	Lead	1	9.8	NA	9.8	335	430	2.9E-02	2.3E-02	c	
	Mercury	1	3.5E-02	NA	3.5E-02	0.5	0.75	6.9E-02	4.6E-02	c	
	Nickel	1	1.4E+02	NA	1.4E+02	60	70	2.3	2.0	c	*
	Silver	1	1.5E-01	NA	1.5E-01	2	2.5	7.5E-02	6.0E-02	c	
	Vanadium	1	4.0E+01	NA	4.0E+01	--	--	--	--	--	
	Zinc	1	8.3E+01	NA	8.3E+01	140	160	5.9E-01	5.2E-01	c	
	2,4-Dimethylphenol	1	8.5E-02	NA	8.5E-02	0.029	0.029	2.9	2.9	d	*
	2-Methylphenol	1	8.5E-02	NA	8.5E-02	0.063	0.063	1.3	1.3	d	*
	4-Methylphenol	1	2.1E-01	NA	2.1E-01	0.67	0.67	3.1E-01	3.1E-01	d	
	Phenol	1	7.8E-02	NA	7.8E-02	0.42	1.2	1.9E-01	6.5E-02	d	
	Pentachlorophenol	1	3.9E-02	NA	3.9E-02	0.36	0.69	1.1E-01	5.7E-02	d	
	Bis[2-ethylhexyl]phthalate	1	8.5E-02	NA	8.5E-02	0.23	0.32	3.7E-01	2.7E-01	c	
	Butylbenzylphthalate	1	8.5E-02	NA	8.5E-02	0.26	0.37	3.3E-01	2.3E-01	c	
	Dimethylphthalate	1	8.5E-02	NA	8.5E-02	0.046	0.44	1.8	1.9E-01	c	*
	BenzoicAcid	1	8.5E-01	NA	8.5E-01	0.65	0.65	1.3	1.3	d	*
	BenzylAlcohol	1	8.5E-02	NA	8.5E-02	0.057	0.073	1.5	1.2	d	*
	Dibenzofuran	1	1.3E-02	NA	1.3E-02	0.4	0.44	3.3E-02	3.0E-02	c	
	Acenaphthene	1	8.5E-02	NA	8.5E-02	1.06	1.32	8.0E-02	6.4E-02	c	
	Acenaphthylene	1	1.3E-02	NA	1.3E-02	0.47	0.64	2.8E-02	2.1E-02	c	
	Anthracene	1	3.0E-02	NA	3.0E-02	1.2	1.58	2.5E-02	1.9E-02	c	

Table G-6. Sediment Exposure Point Concentrations (mg/kg) and Hazard Quotients (dimensionless) by Area

		Statistics				EICs		HQs			
Area	Analyte	n	mean	SD	EPC[a]	SQS	CSL	SQS	CSL	Source	Potential COPEC[b]
	Fluorene	1	8.5E-02	NA	8.5E-02	1	3	8.5E-02	2.8E-02	c	
	Naphthalene	1	1.9E-02	NA	1.9E-02	0.5	1.31	3.7E-02	1.4E-02	c	
	Phenanthrene	1	2.2E-02	NA	2.2E-02	6.1	7.6	3.7E-03	2.9E-03	c	
	2-Methylnaphthalene	1	2.5E-02	NA	2.5E-02	0.47	0.56	5.3E-02	4.5E-02	c	
	Benz[a]anthracene	1	8.5E-02	NA	8.5E-02	4.26	5.8	2.0E-02	1.5E-02	c	
	Benzo[a]pyrene	1	6.2E-02	NA	6.2E-02	3.3	4.81	1.9E-02	1.3E-02	c	
	Chrysene	1	6.8E-02	NA	6.8E-02	5.94	6.4	1.1E-02	1.1E-02	c	
	Dibenz[ah]anthracene	1	8.5E-02	NA	8.5E-02	0.8	0.84	1.1E-01	1.0E-01	c	
	Fluoranthene	1	4.1E-02	NA	4.1E-02	11	15	3.7E-03	2.7E-03	c	
	Indeno[1,2,3-cd]pyrene	1	5.2E-02	NA	5.2E-02	4.12	5.3	1.3E-02	9.7E-03	c	
	Pyrene	1	5.0E-02	NA	5.0E-02	8.8	16	5.7E-03	3.2E-03	c	
	Benzo[ghi]perylene	1	4.9E-02	NA	4.9E-02	4.02	5.2	1.2E-02	9.3E-03	c	
	LPAH [ND = 1/2 DL]	1	2.8E-01	NA	2.8E-01	6.6	9.2	4.2E-02	3.0E-02	c	
	Total Benzofluoranthenes [ND = 1/2 DL]	1	1.1E-01	NA	1.1E-01	11	14	9.9E-03	7.8E-03	c	

Notes: [a] EPCs were maximum values, Student's t-test UCL95s, or UCL95s calculated by Land's method, depending on the data distribution and UCL values.
[b] Metals eliminated by background evaluation were still included in screening for information purposes
[c] EIC are WSDOE Freshwater SQS and CSL.
[d] EICs are WSDOE Marine SQS and CSL.

APPENDIX H

FIGURES FROM OESER RI (E&E 2002)

LIST OF FIGURES

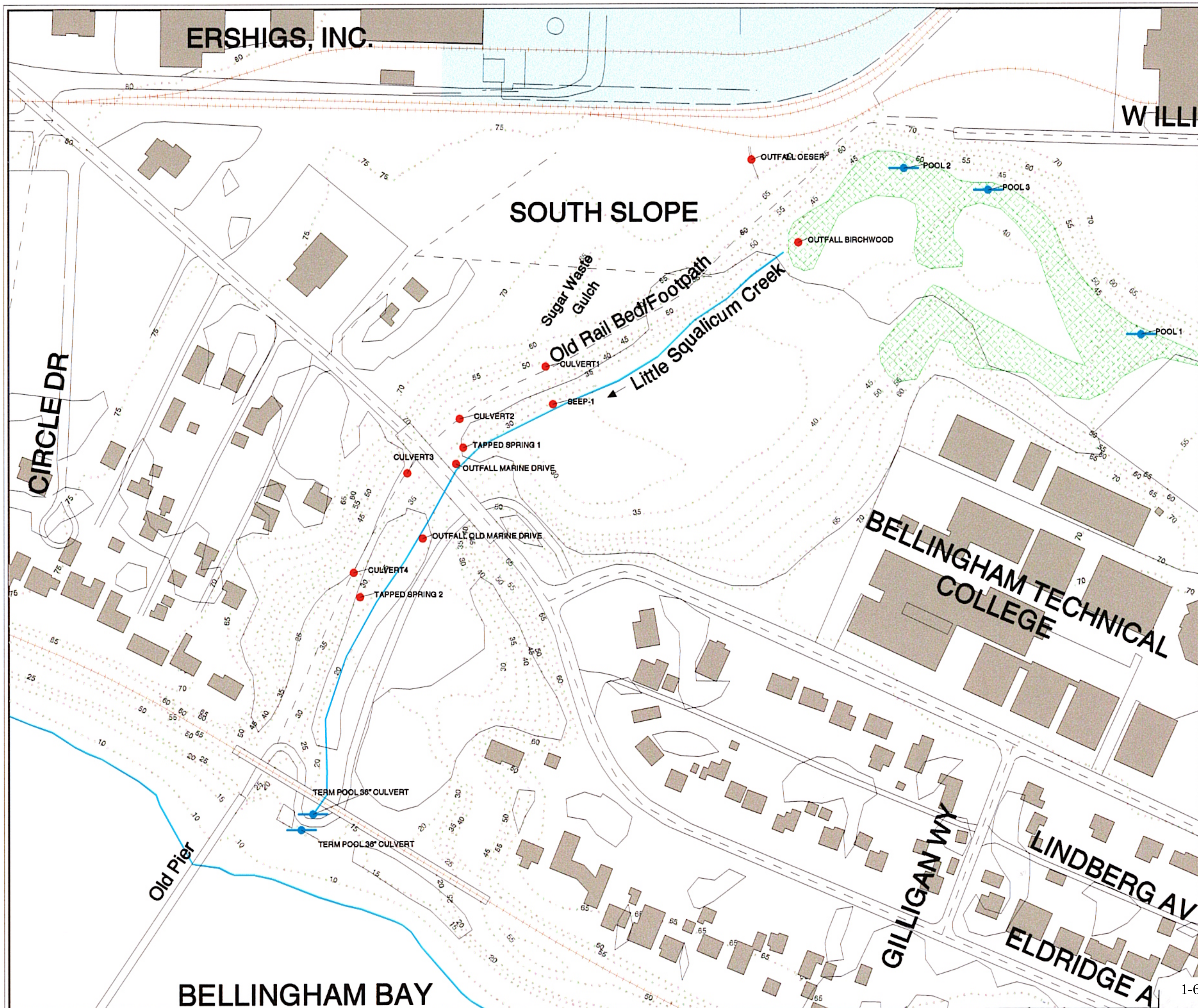


Figure 1-8

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Remedial Investigation

South Slope and Little Squalicum Creek

Legend

- The Oeser Company Facility
- Wetlands
- Building/Residential Structure
- Shoreline and Waterways
- Railroad Line
- Contour Interval
- Flow Direction

N W E S

0 100 200 300 400 500

Feet

MAP SOURCE

City of Bellingham - Department of Public Works
Topographic Data Date: 1988

ecology and environment, inc.
International Specialists in the Environment
Seattle, Washington

/data1/oeser/rifs/fig1-8.aml

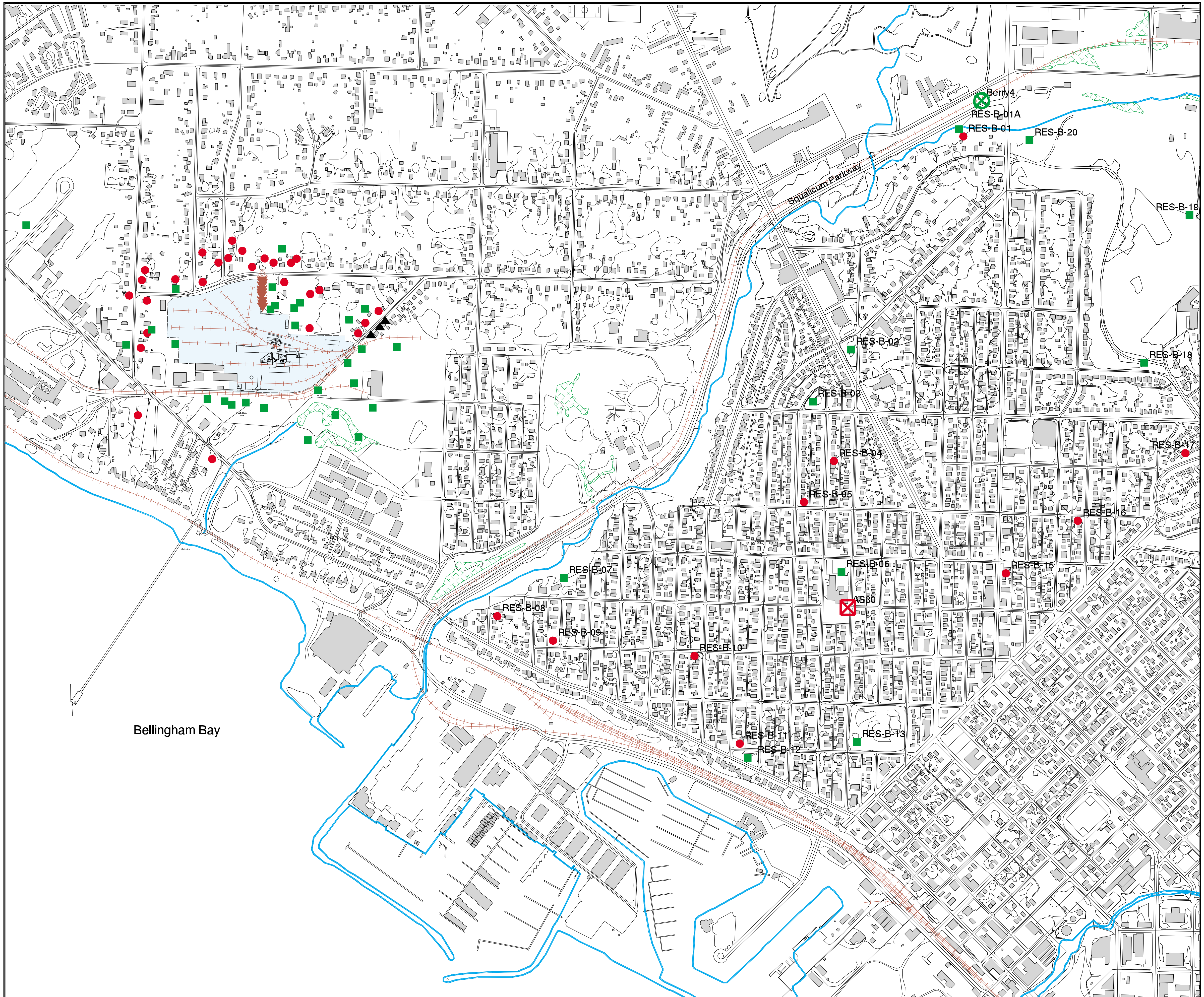


Figure 2-4

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Remedial Investigation

Off-Facility Residential

and Background Surface

Soil Sampling Locations

May 24 - June 3, 1999

Legend

- The Oeser Company Facility
- Wetlands
- Composite Residential Home Sample Location
- Discrete Open Area Sample Location
- Composite Road Border Sample Location
- Composite (A+B+C) Old Drainage Path Sample Location
- Background Blackberry Sample Collection Location
- Background Air Sample Collection Location

N
W E
S

0 500 1000 1500

Feet

MAP SOURCE

City of Bellingham - Department of Public Works
Topographic Data Date: 1988

ecology and environment, inc.
International Specialists in the Environment
Seattle, Washington

/data1/oeser/rifs/off-fac-res-bkg-surf.aml

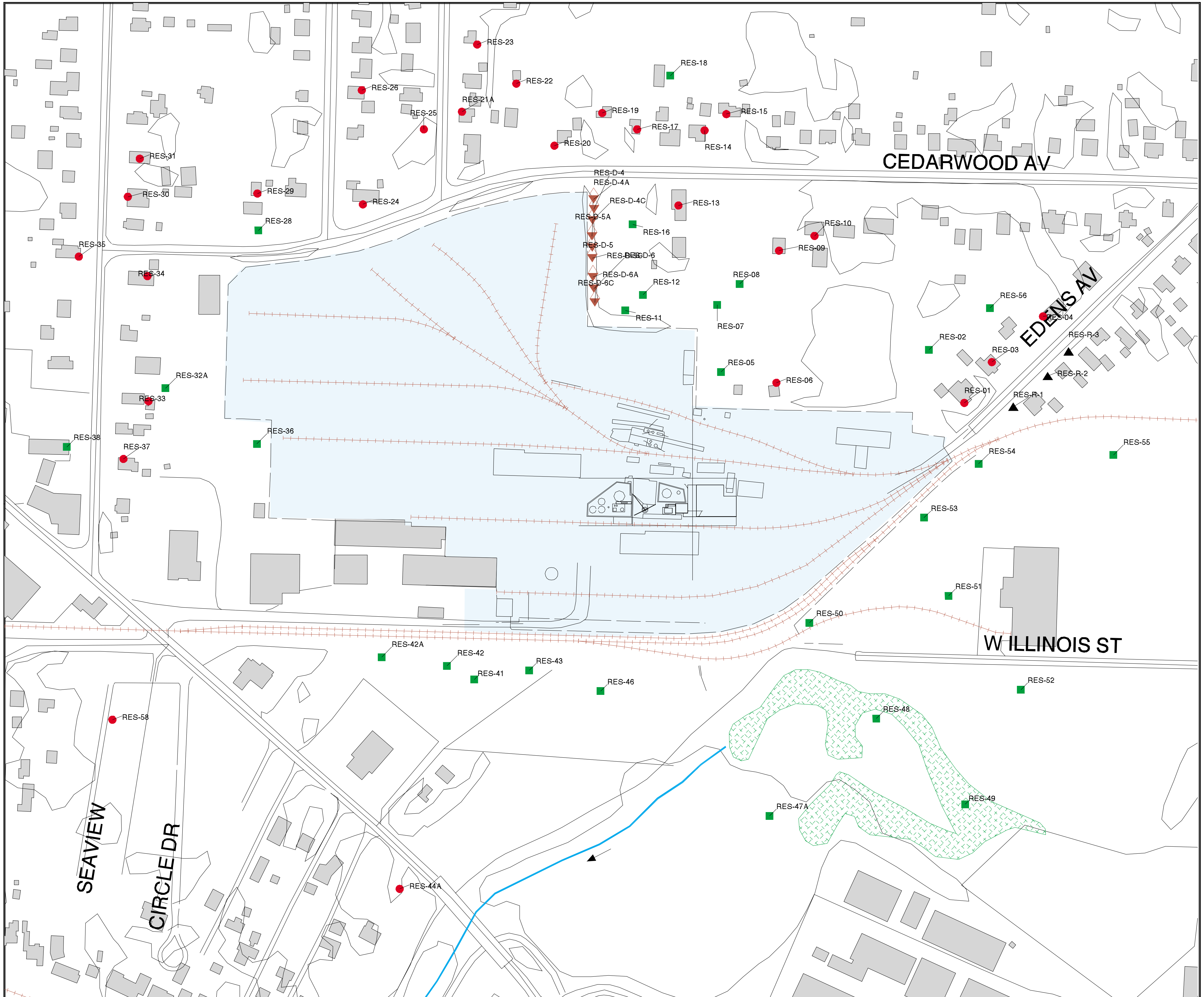


Figure 2-5

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Remedial Investigation

Off-Facility Residential Surface Soil Sampling Locations
May 24 - June 3, 1999

Legend

- The Oeser Company Facility
- Wetlands
- Composite Residential Home Sample Location
- Discrete Open Area Sample Location
- Composite Road Border Sample Location
- Composite (A+B+C) Old Drainage Path Sample Location
- Flow Direction

N W E S

0 150 300 450 600

Feet

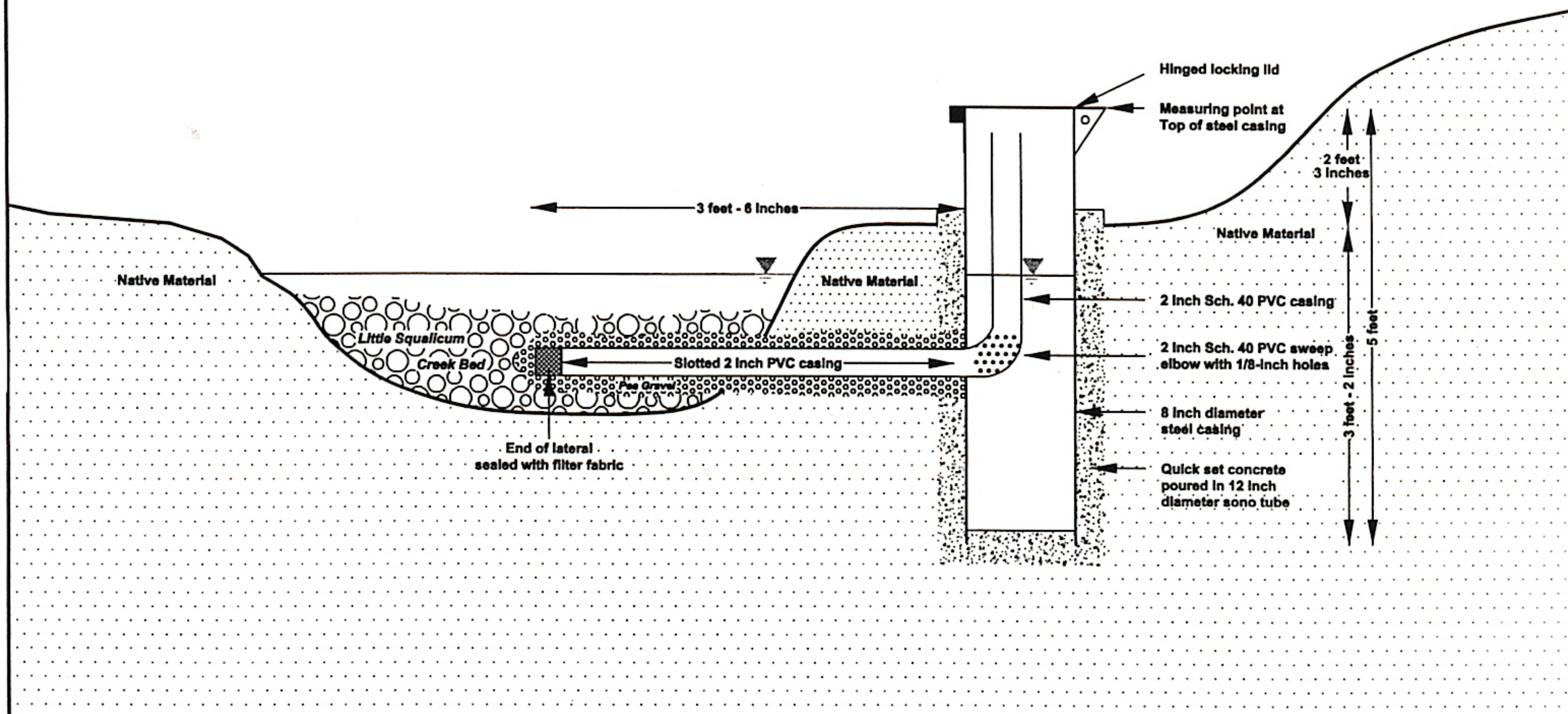
MAP SOURCE

City of Bellingham - Department of Public Works
Topographic Data Date: 1988

Oeser Company Site Map
Larry Steele & Associates
Survey Date: 12/3/1997

ecology and environment, inc.
International Specialists in the Environment
Seattle, Washington

/data1/oeser/rifs/fig2-5.aml



KEY

PVC = Polyvinyl Chloride

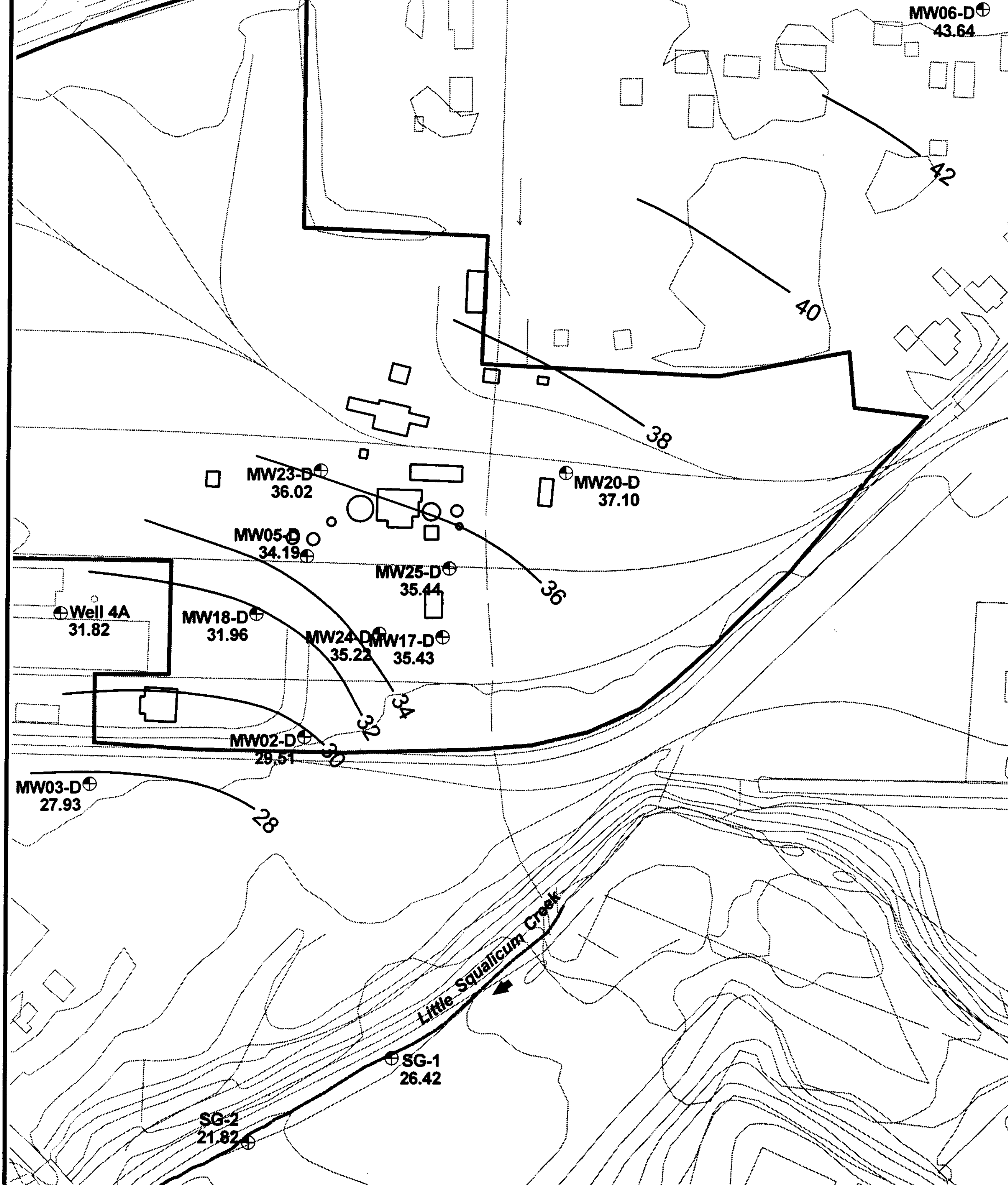
Not to Scale

Figure 2-10
Stilling Well Schematic

The Oeser Company
Remedial Investigation

JE9803, LSC-SW-schem.DWG, 6/2000

Pacific Groundwater Group



KEY:

27.93 — Monitoring Well Location and Groundwater Elevation (Elevations in feet above the North American Vertical Datum of 1988)

Flow Direction

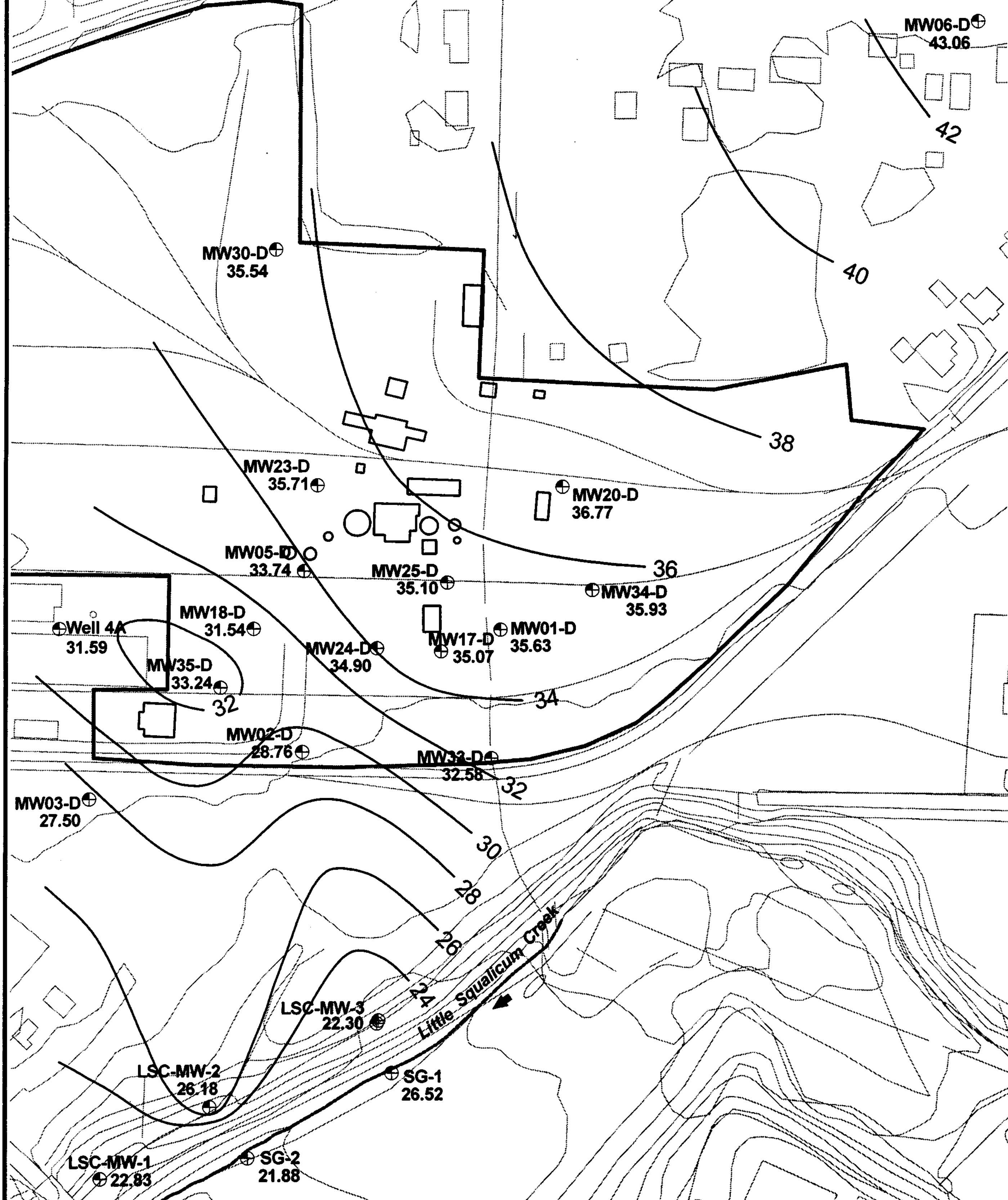
N

100 0 100 Feet

Figure 3-26
Deep Groundwater Elevation
June 1999

The Oeser Company
Remedial Investigation

Pacific Groundwater Group



KEY:

27.93 — Monitoring Well Location and Groundwater Elevation (Elevations in feet above the North American Vertical Datum of 1988)

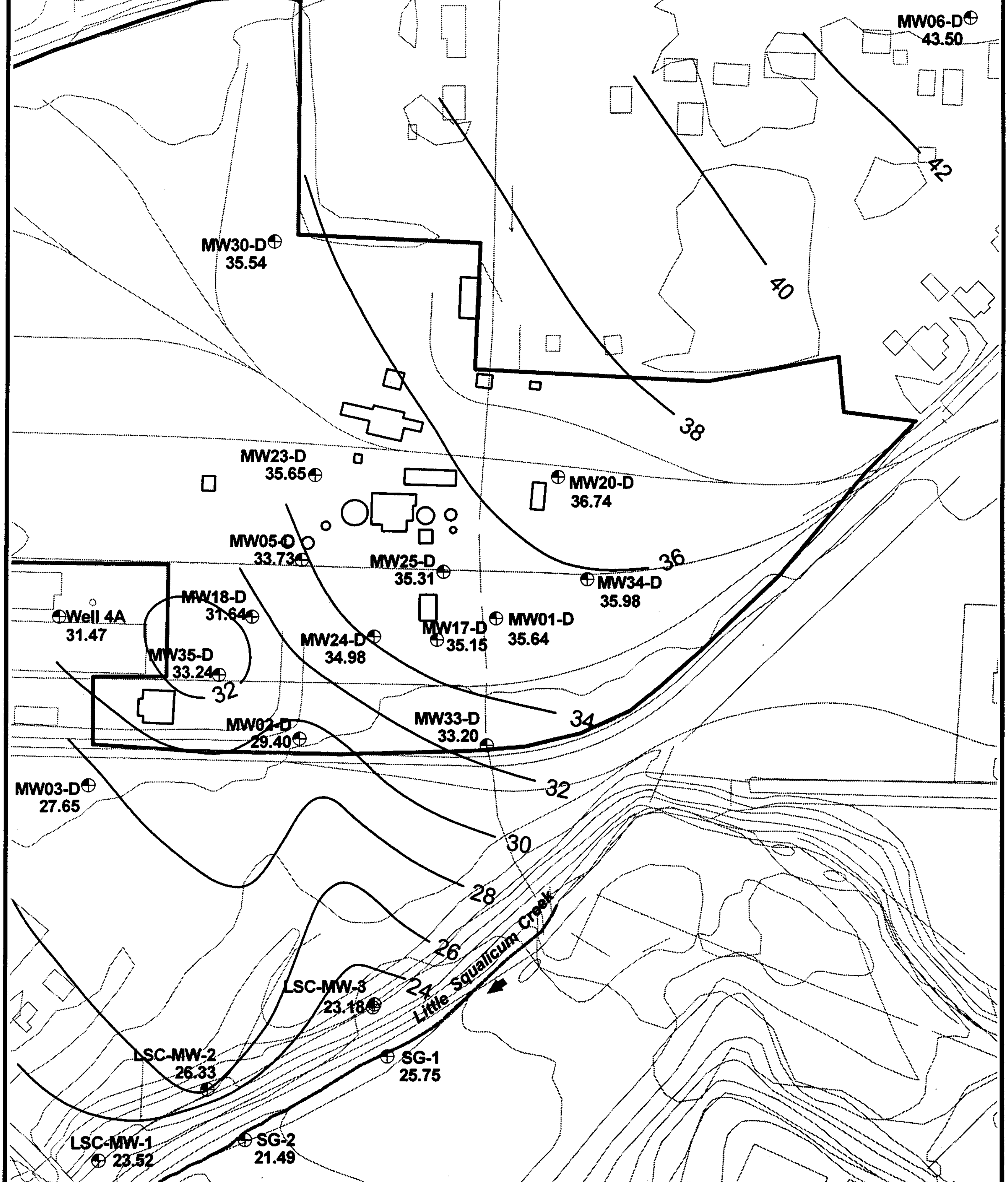
Flow Direction

N

100 0 100 Feet

Figure 3-27
Deep Groundwater Elevation
September 1999

The Oeser Company
Remedial Investigation



KEY:

27.93 — Monitoring Well Location and Groundwater Elevation (Elevations in feet above the North American Vertical Datum of 1988)

Flow Direction

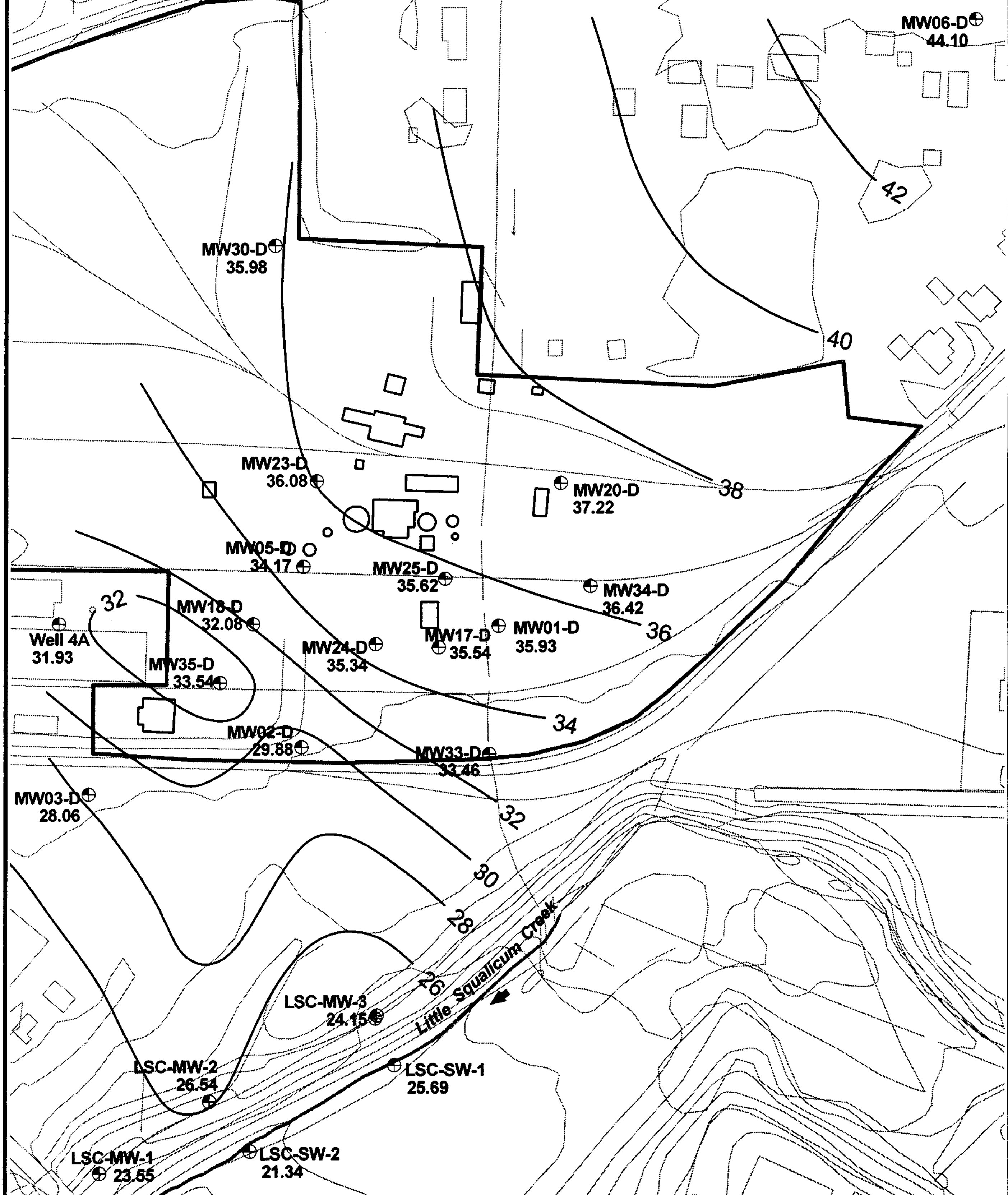
N

100 0 100 Feet

Figure 3-28
Deep Groundwater Elevation
December 1999

The Oeser Company
Remedial Investigation

Pacific Groundwater Group



KEY:

27.93 — Monitoring Well Location and Groundwater Elevation (Elevations in feet above the North American Vertical Datum of 1988)

Flow Direction

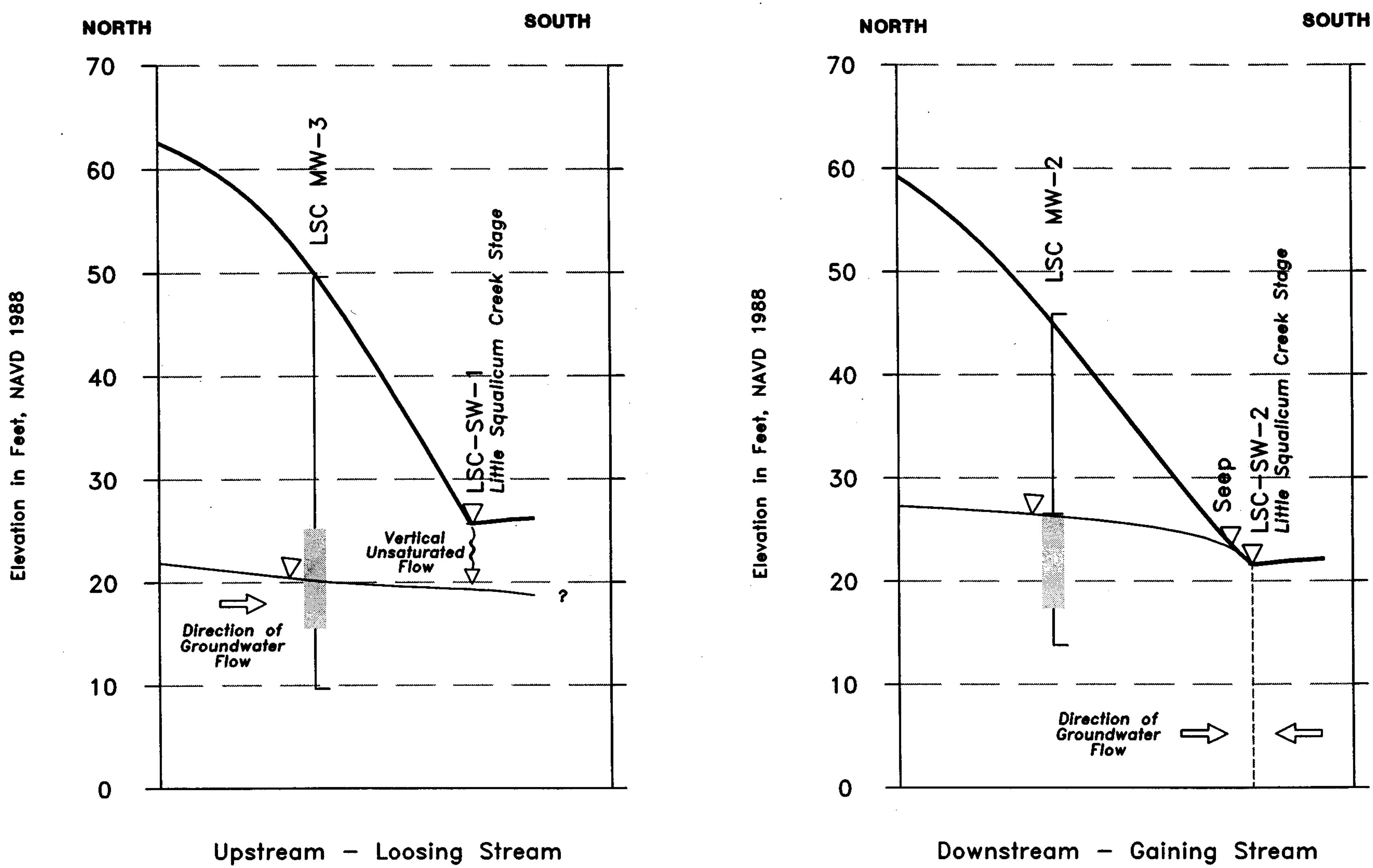
N

100 0 100 Feet

Figure 3-29
Deep Groundwater Elevation
February 2000

The Oeser Company
Remedial Investigation

Pacific Groundwater Group



KEY

Deep Groundwater Table

Water level on 2/27/00

Screened Interval

Vertical Scale in Feet

0 15 30

0 75 150

Figure 3-30
Groundwater-Surface Water Interaction

The Oeser Company
Remedial Investigation

Pacific Groundwater

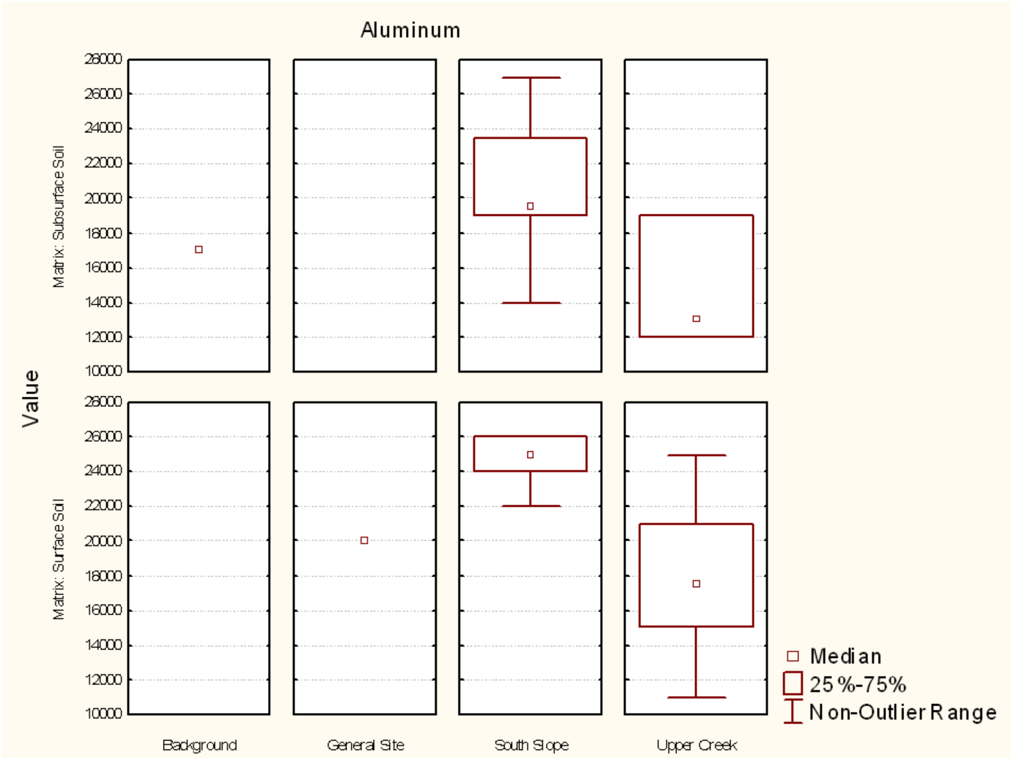


Figure I-1. Box-and-whisker plots for aluminum in soil (mg/kg)

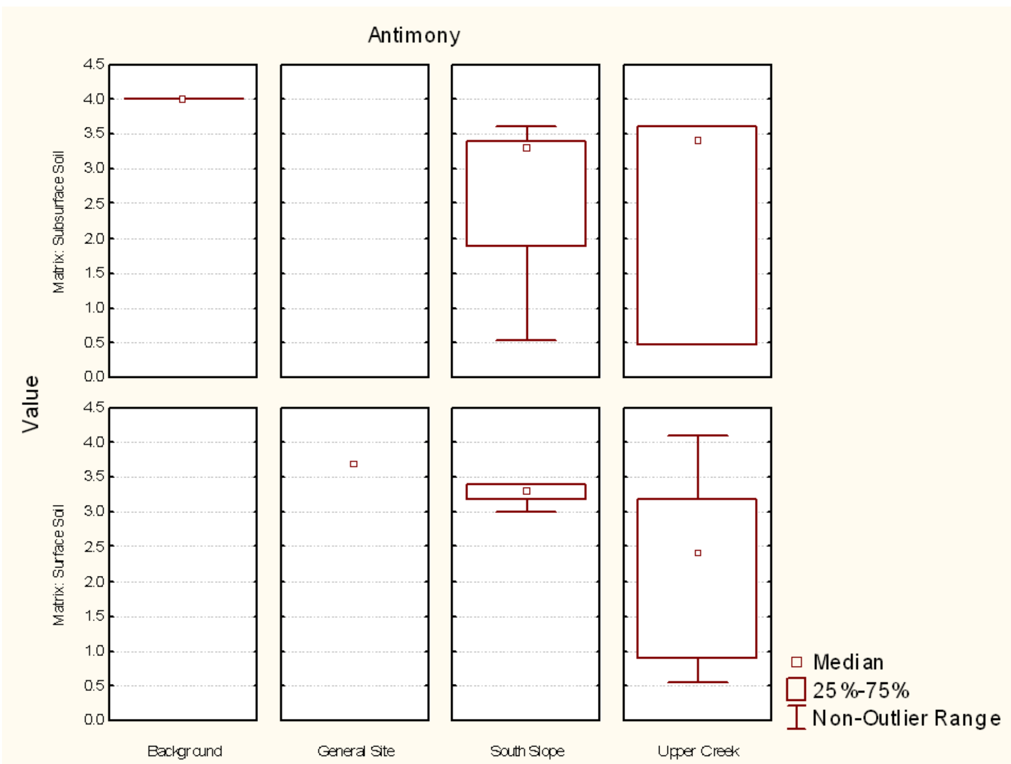


Figure I-2. Box-and-whisker plots for antimony in soil (mg/kg)

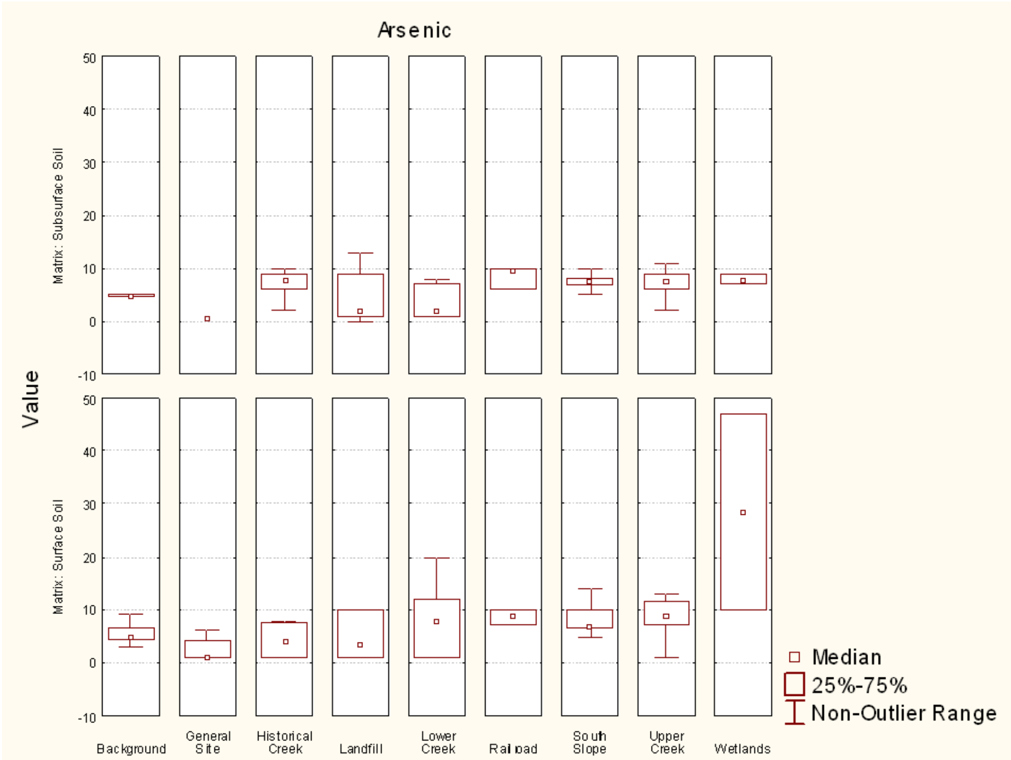


Figure I-3. Box-and-whisker plots for arsenic in soil (mg/kg)

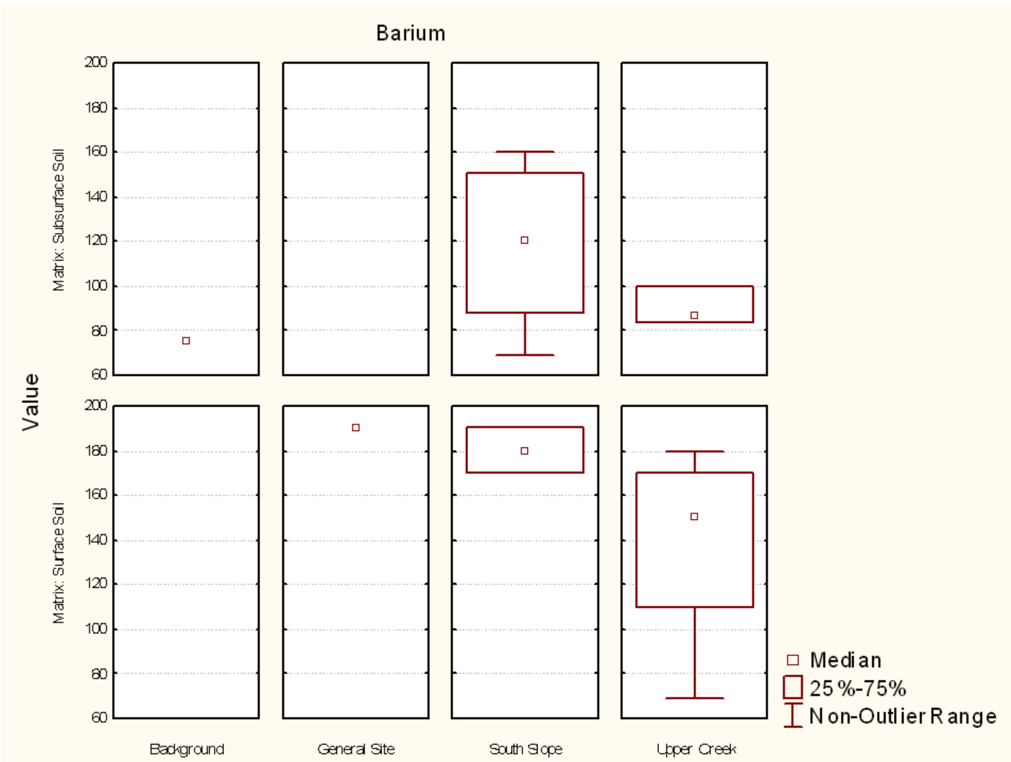


Figure I-4. Box-and-whisker plots for barium in soil (mg/kg)

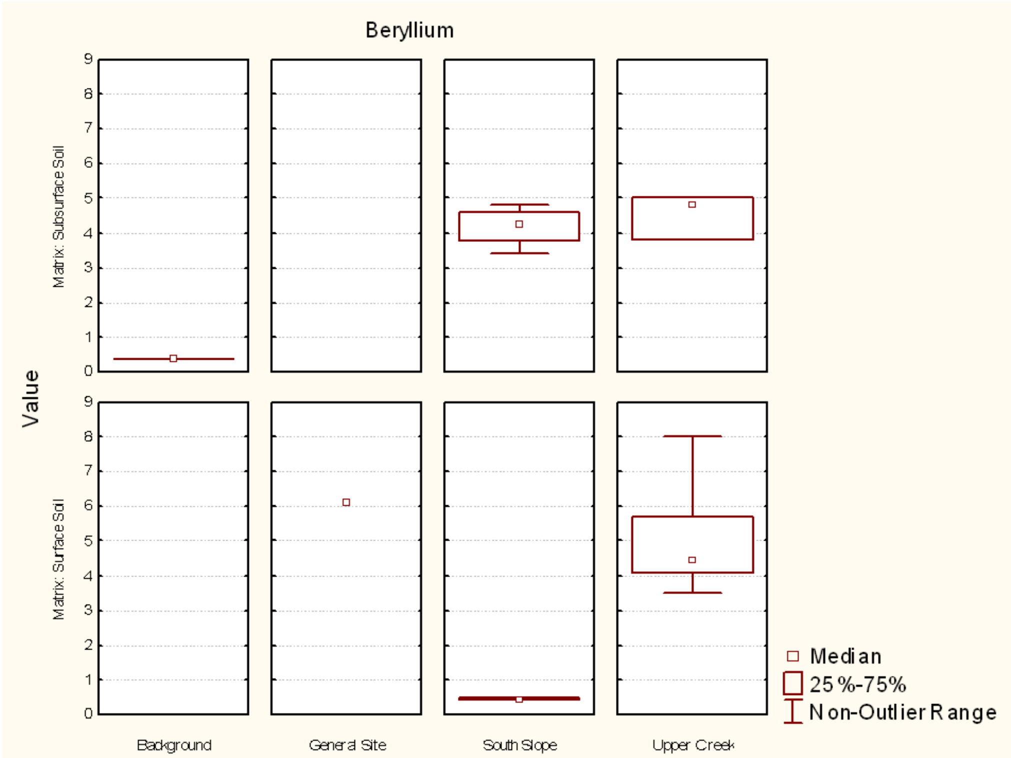


Figure I-5. Box-and-whisker plots for beryllium in soil (mg/kg)

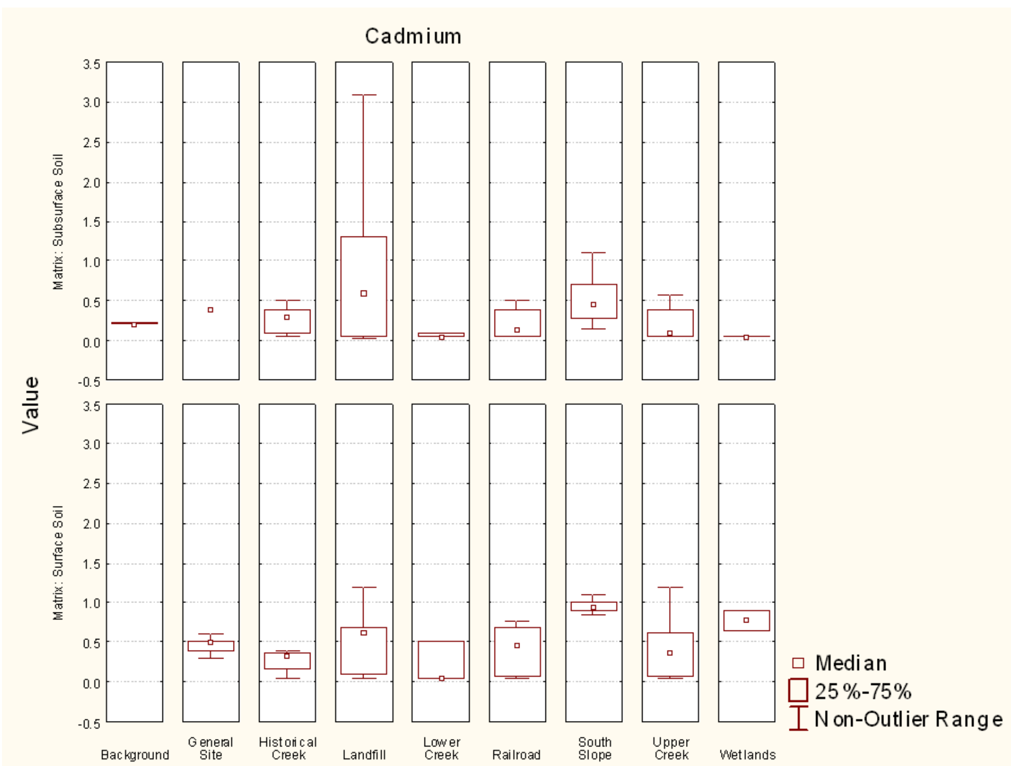


Figure I-6. Box-and-whisker plots for cadmium in soil (mg/kg)

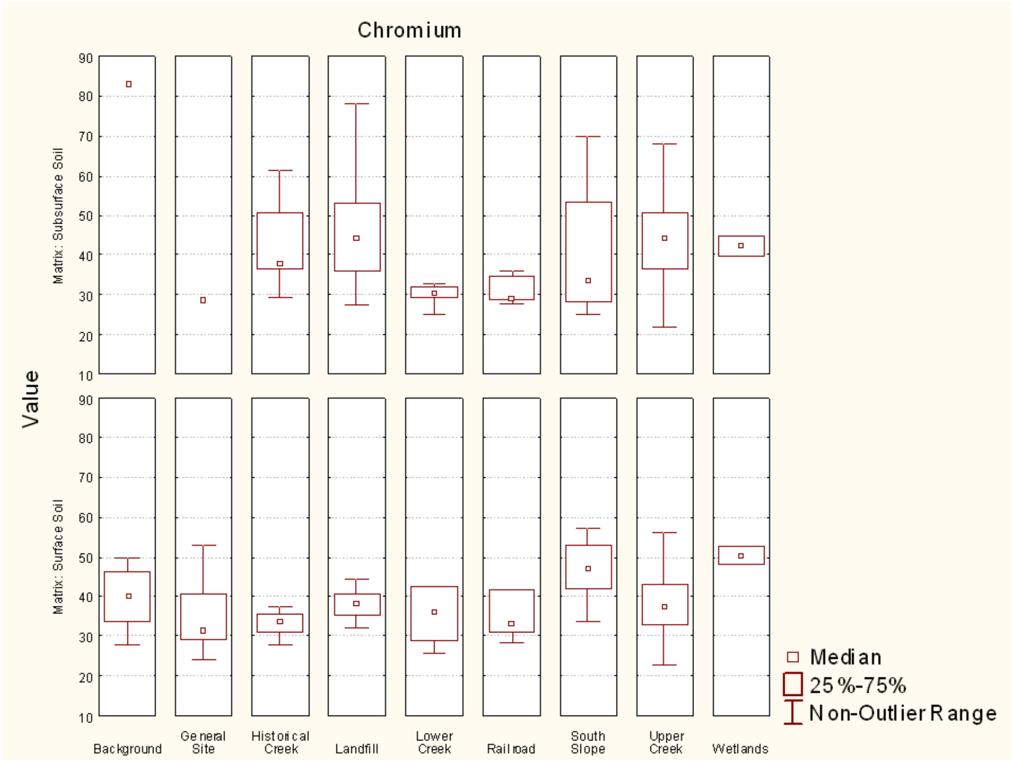


Figure I-7. Box-and-whisker plots for chromium in soil (mg/kg)

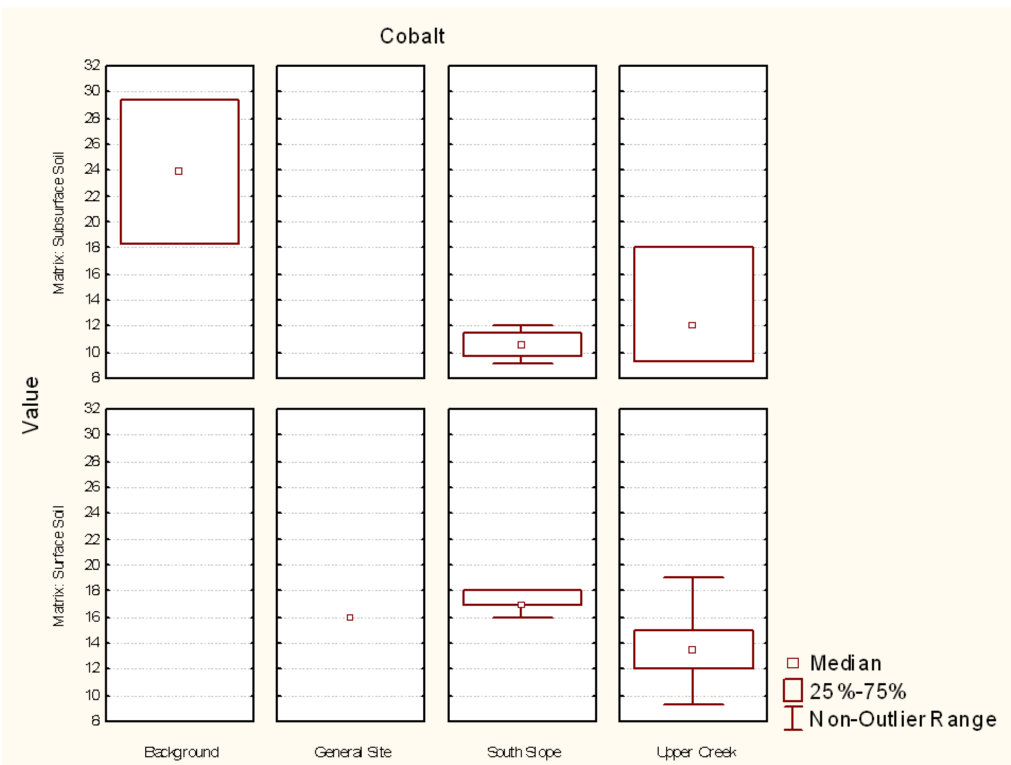


Figure I-8. Box-and-whisker plots for cobalt in soil (mg/kg)

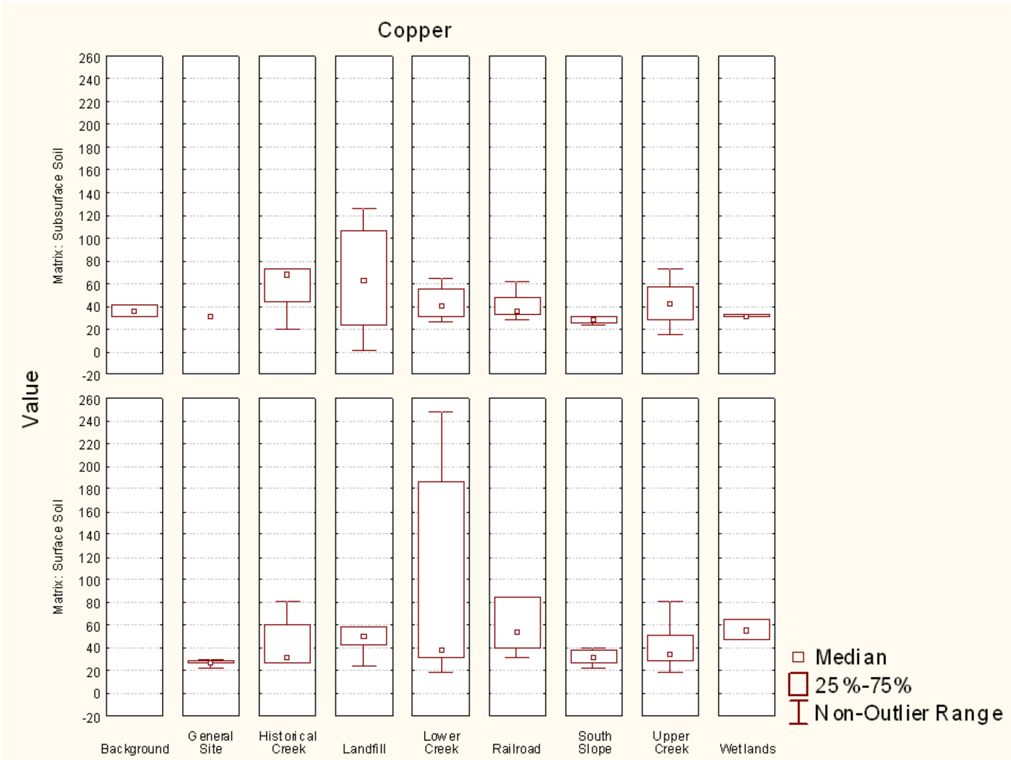


Figure I-9. Box-and-whisker plots for copper in soil (mg/kg)

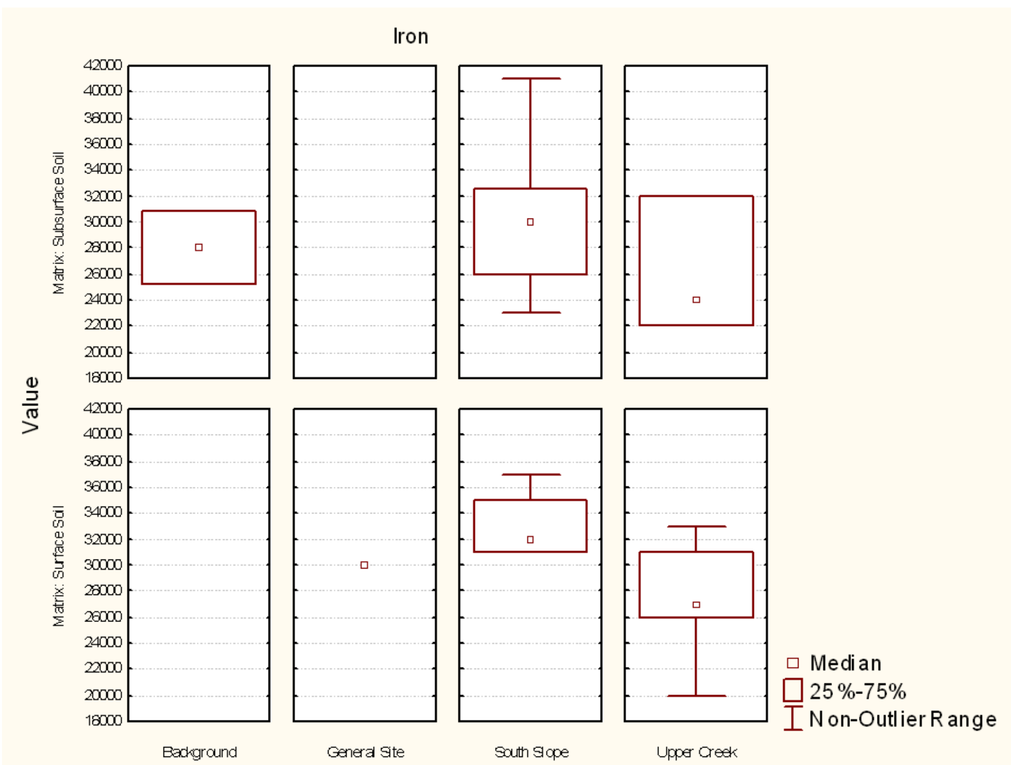


Figure I-10. Box-and-whisker plots for iron in soil (mg/kg)

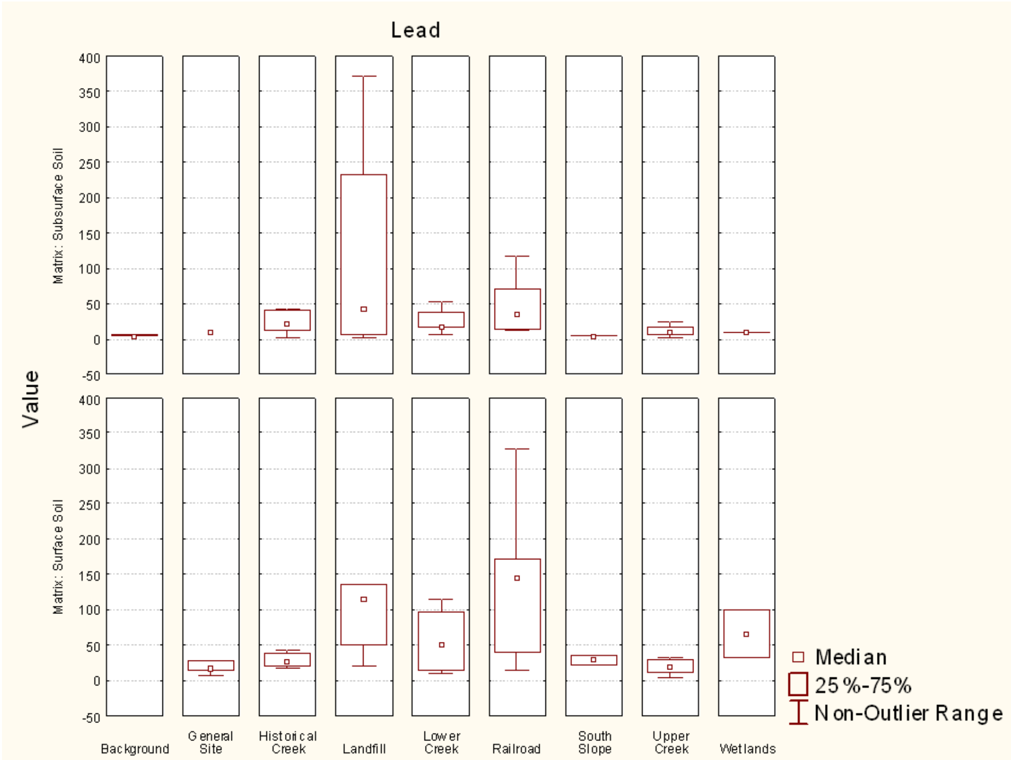


Figure I-11. Box-and-whisker plots for lead in soil (mg/kg)

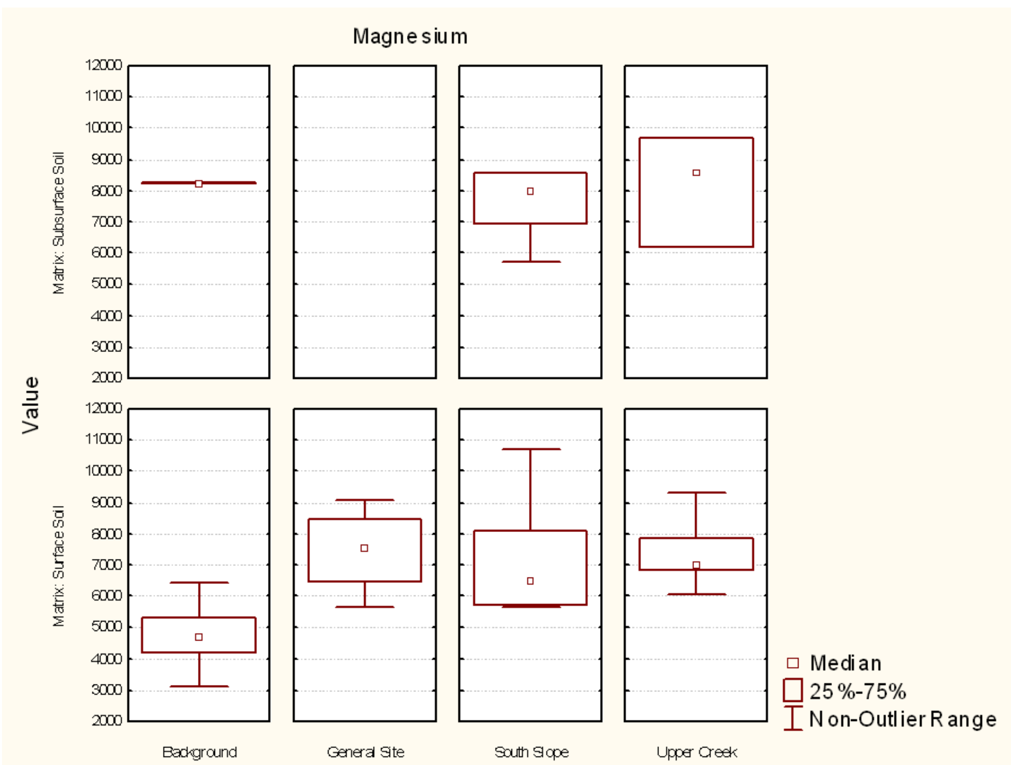


Figure I-12. Box-and-whisker plots for magnesium in soil (mg/kg)

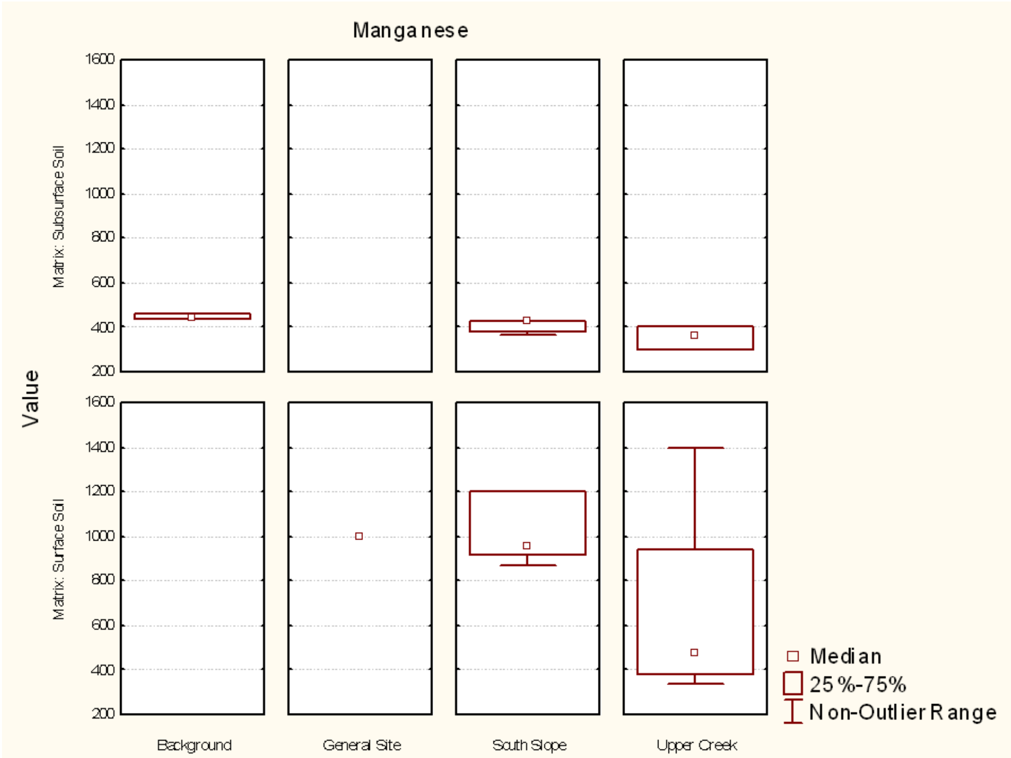


Figure I-13. Box-and-whisker plots for manganese in soil (mg/kg)

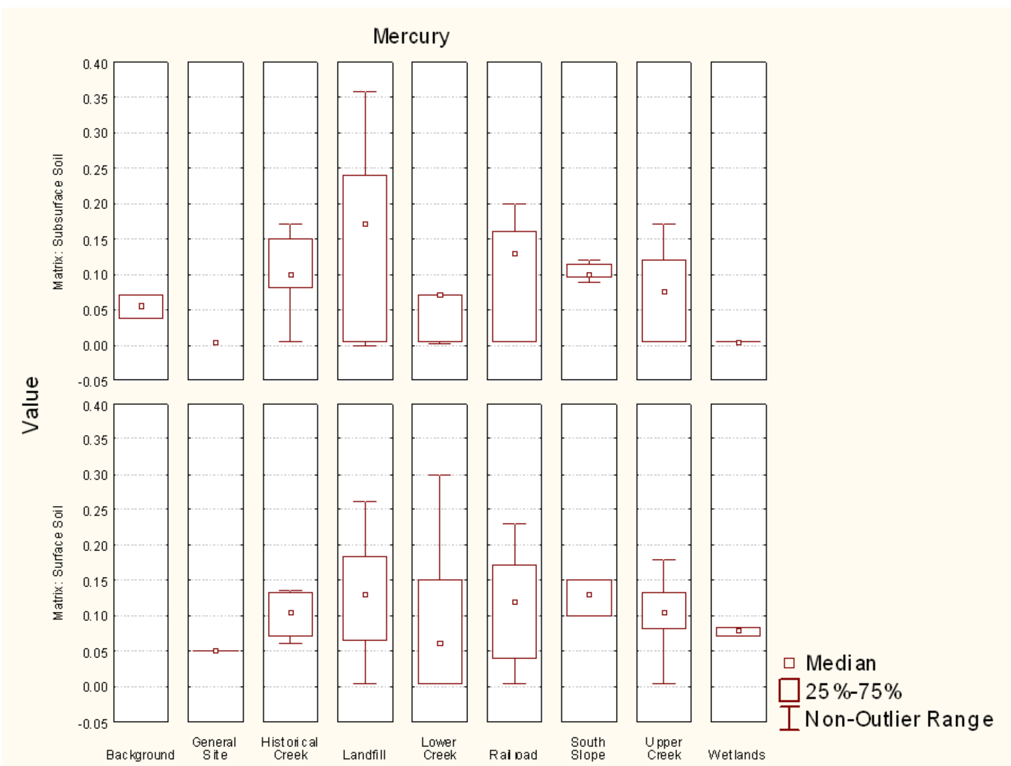


Figure I-14. Box-and-whisker plots for mercury in soil (mg/kg)

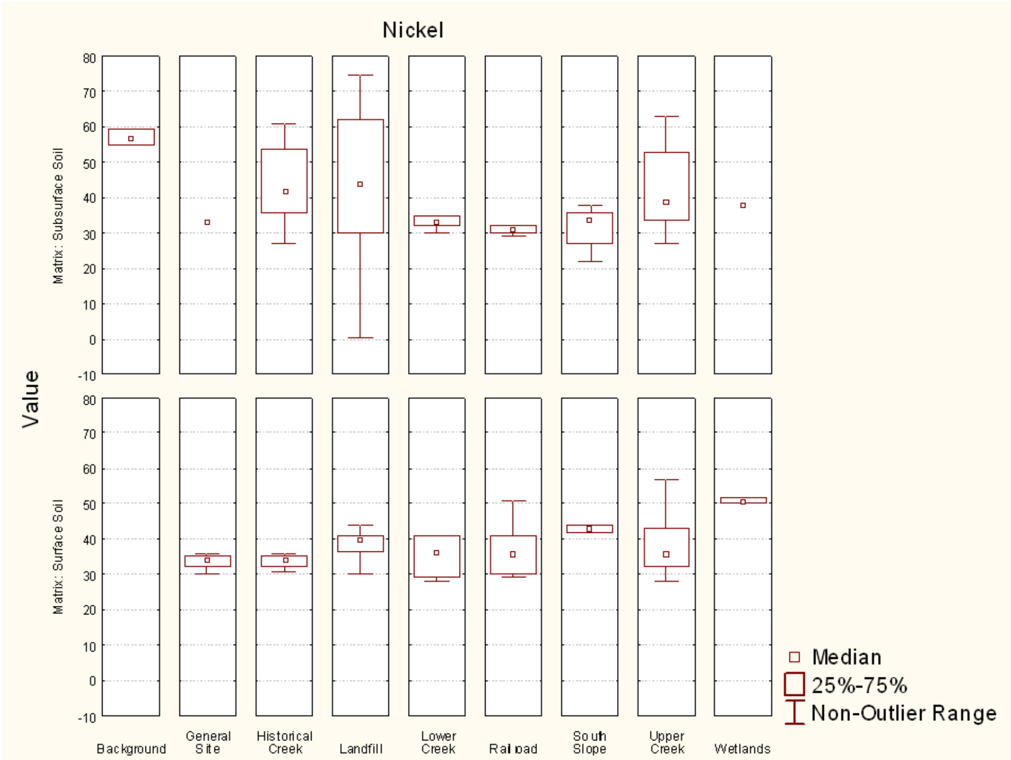


Figure I-15. Box-and-whisker plots for nickel in soil (mg/kg)

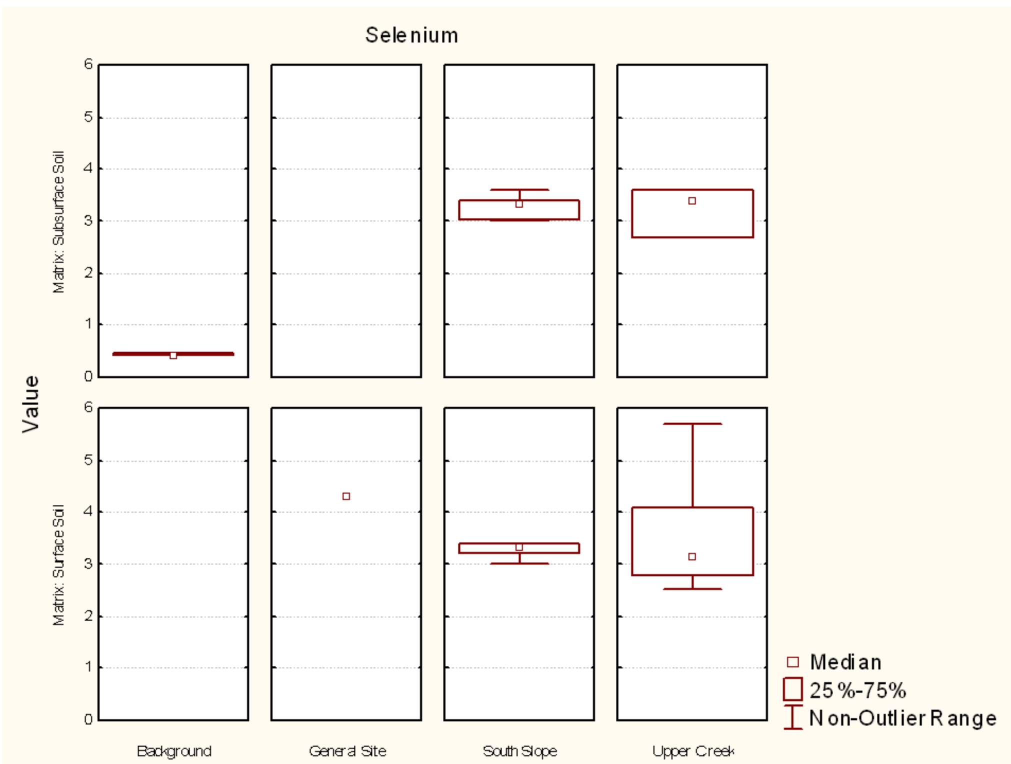


Figure I-16. Box-and-whisker plots for selenium in soil (mg/kg)

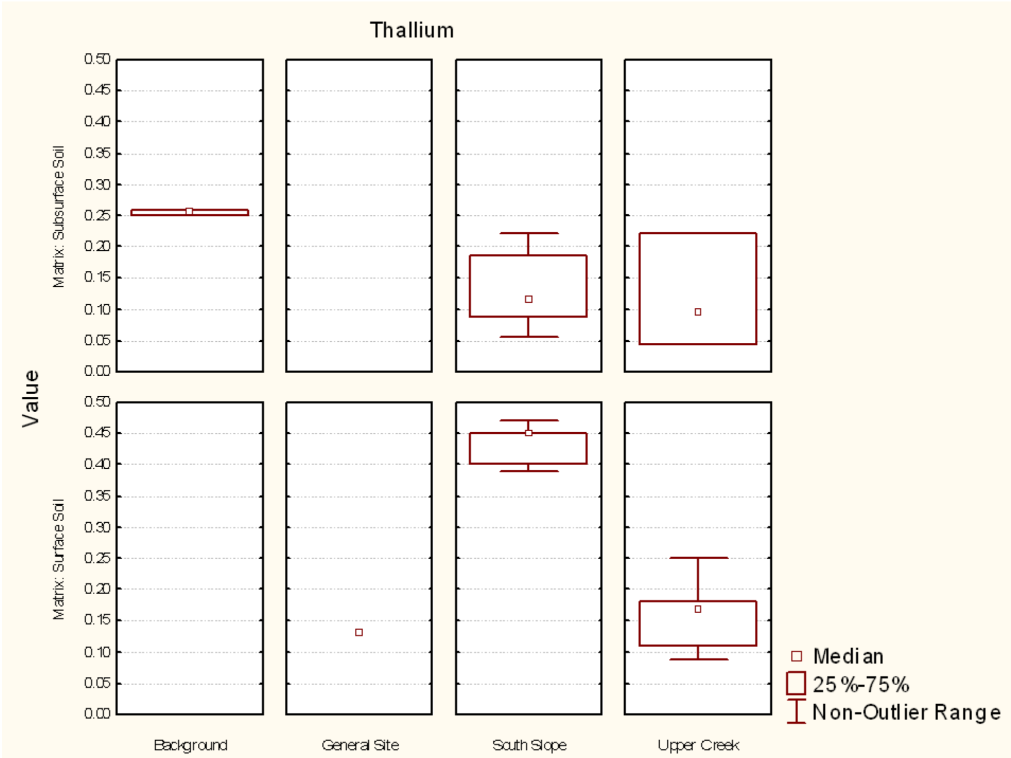


Figure I-17. Box-and-whisker plots for thallium in soil (mg/kg)

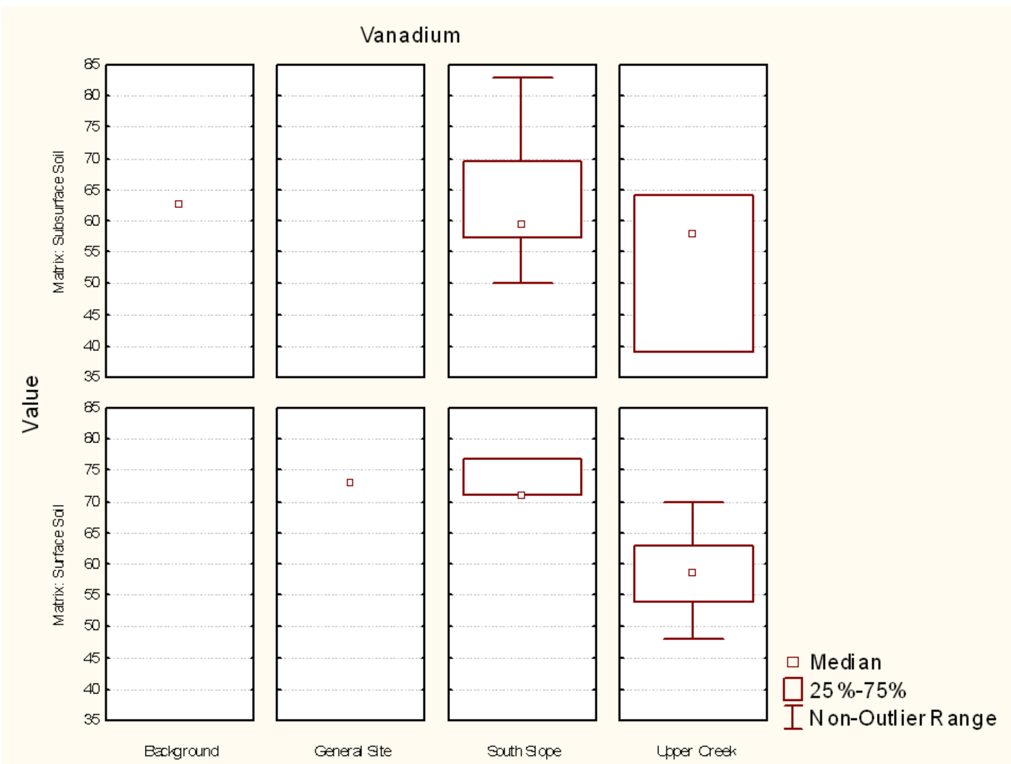


Figure I-18. Box-and-whisker plots for vanadium in soil (mg/kg)

Figure I-19. Box-and-whisker plots for zinc in soil (mg/kg)

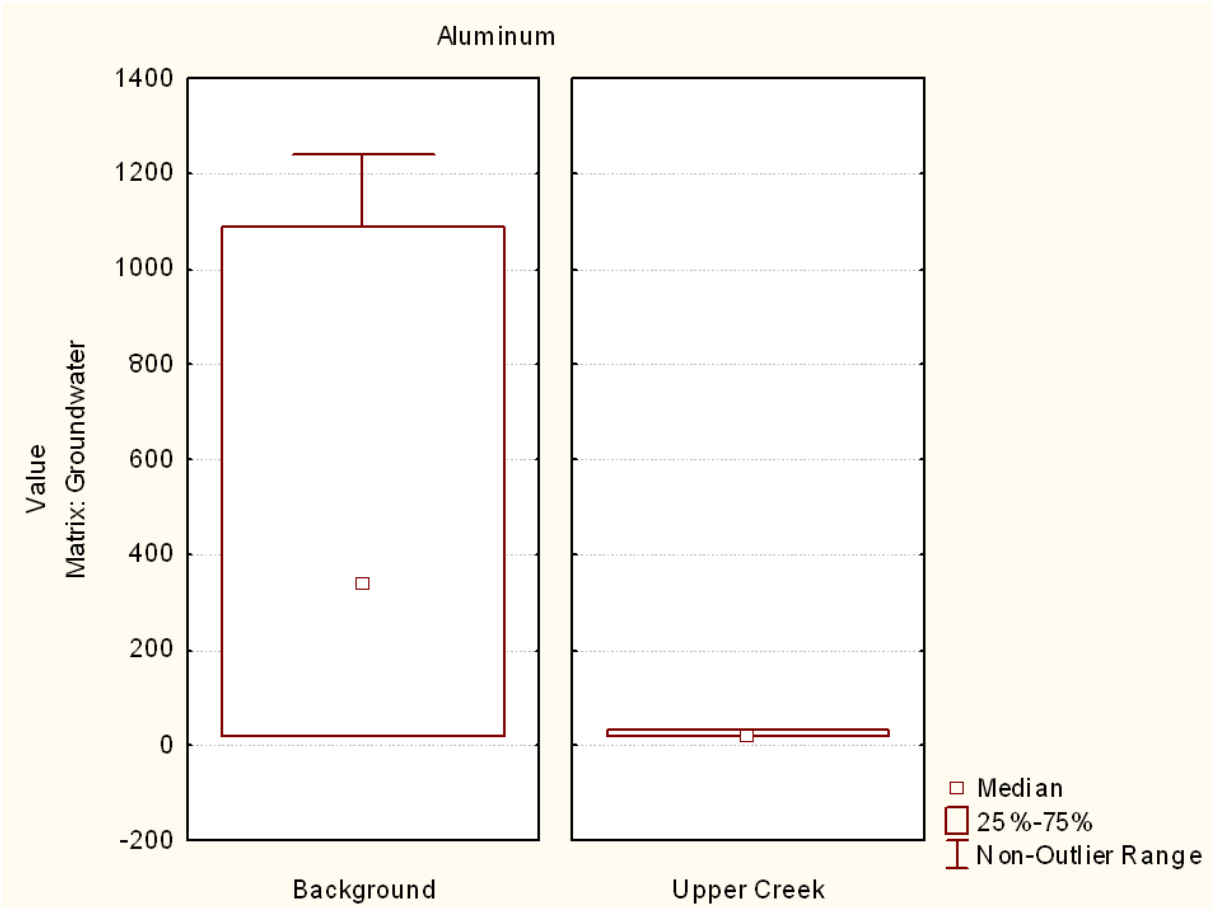


Figure I-20. Box-and-whisker plots for aluminum in groundwater (µg/L)

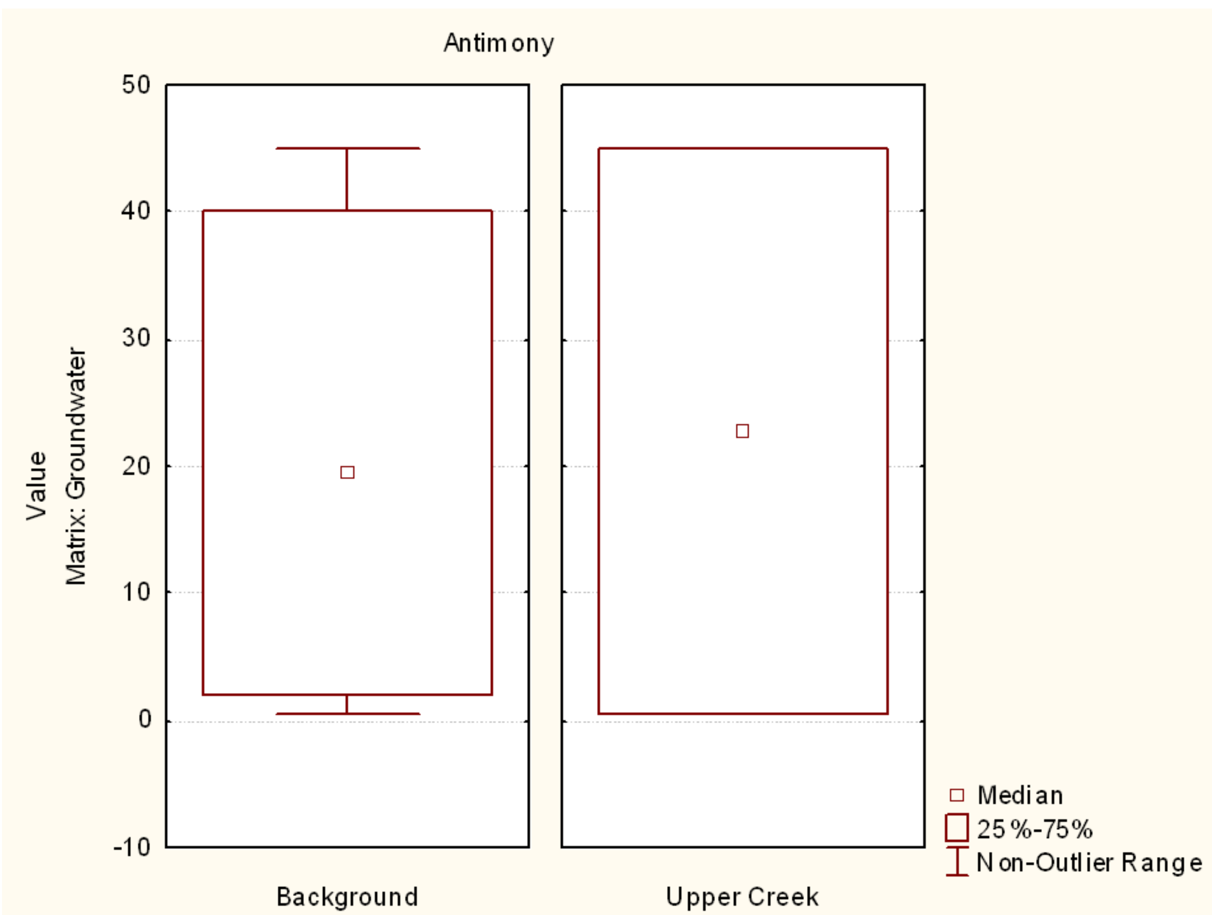


Figure I-21. Box-and-whisker plots for antimony in groundwater (µg/L)

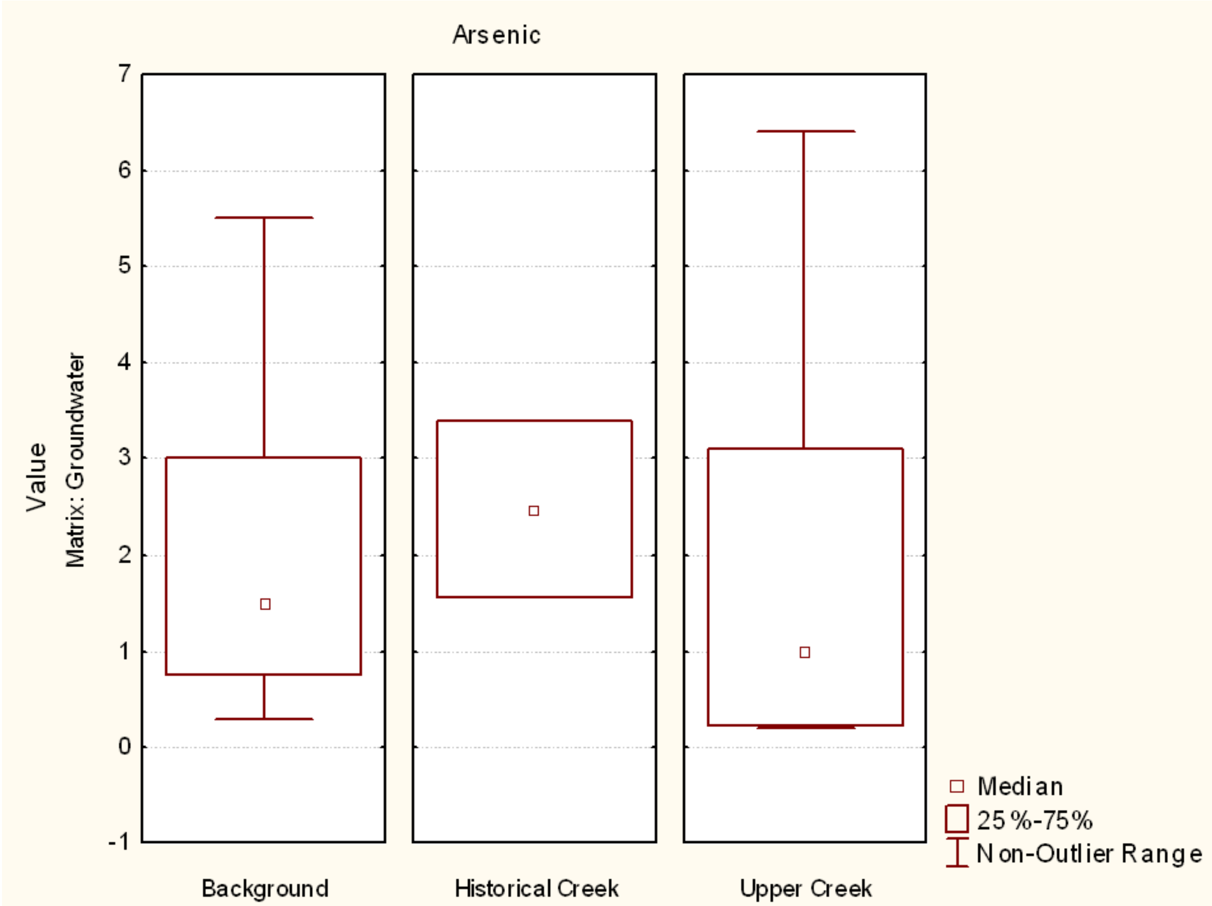


Figure I-22. Box-and-whisker plots for arsenic in groundwater (µg/L)

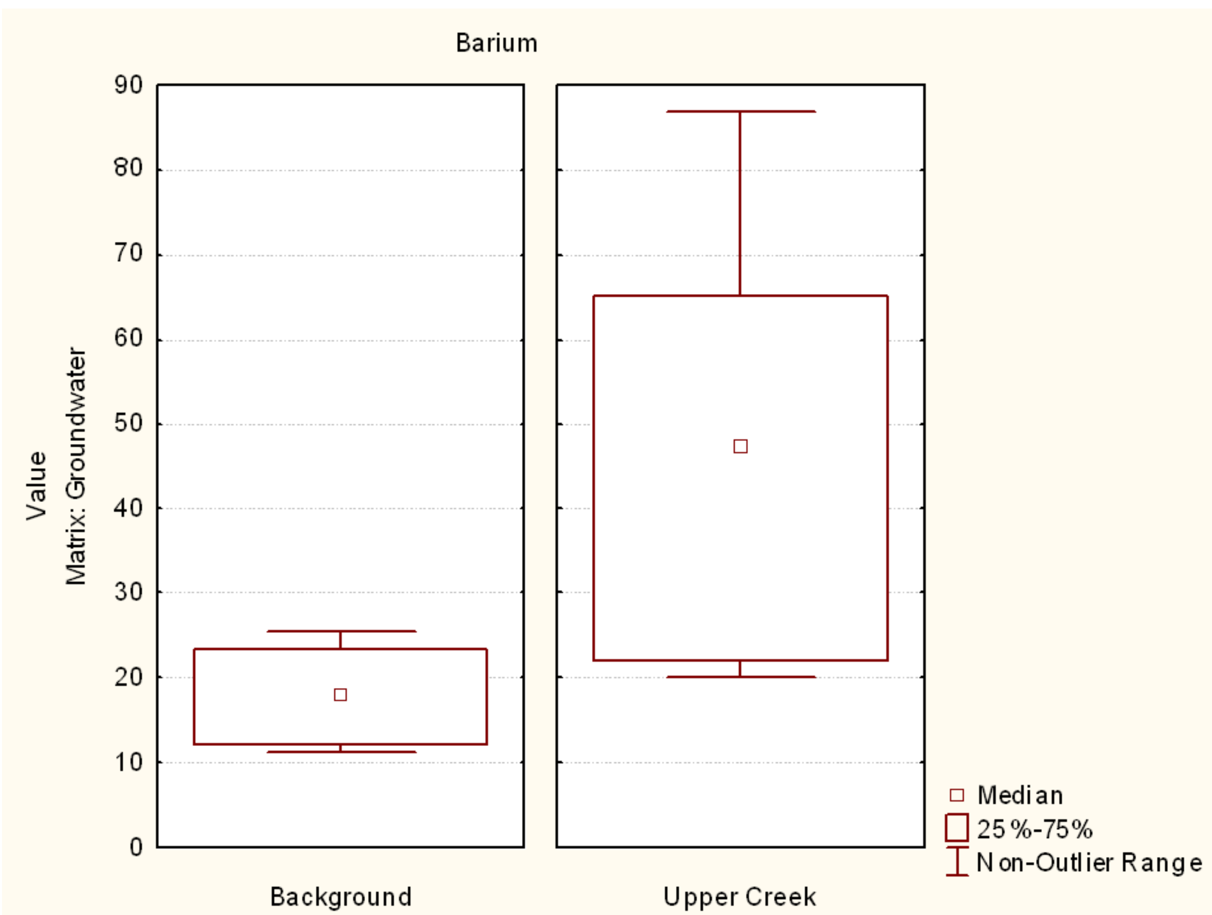


Figure I-23. Box-and-whisker plots for barium in groundwater (µg/L)

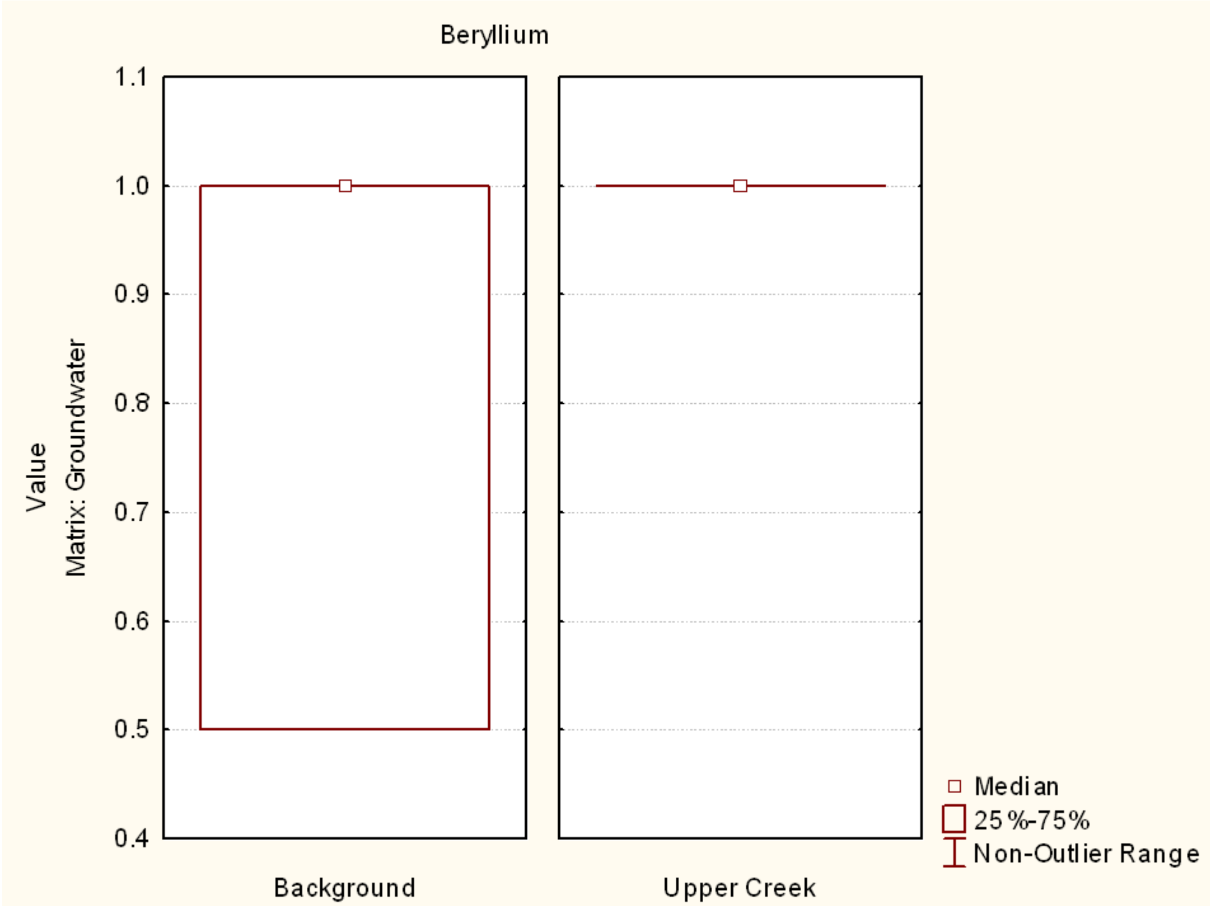


Figure I-24. Box-and-whisker plots for beryllium in groundwater (µg/L)

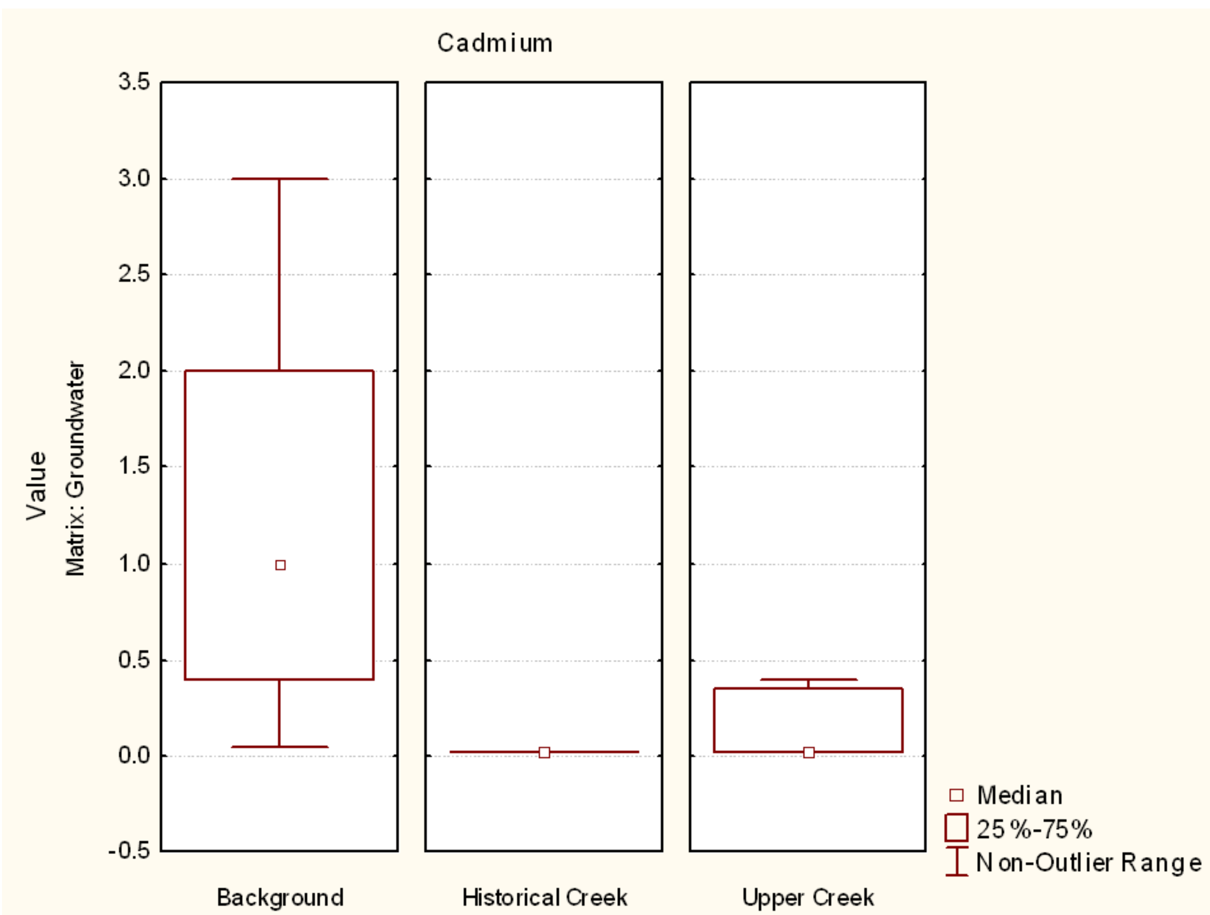


Figure I-25. Box-and-whisker plots for cadmium in groundwater (µg/L)

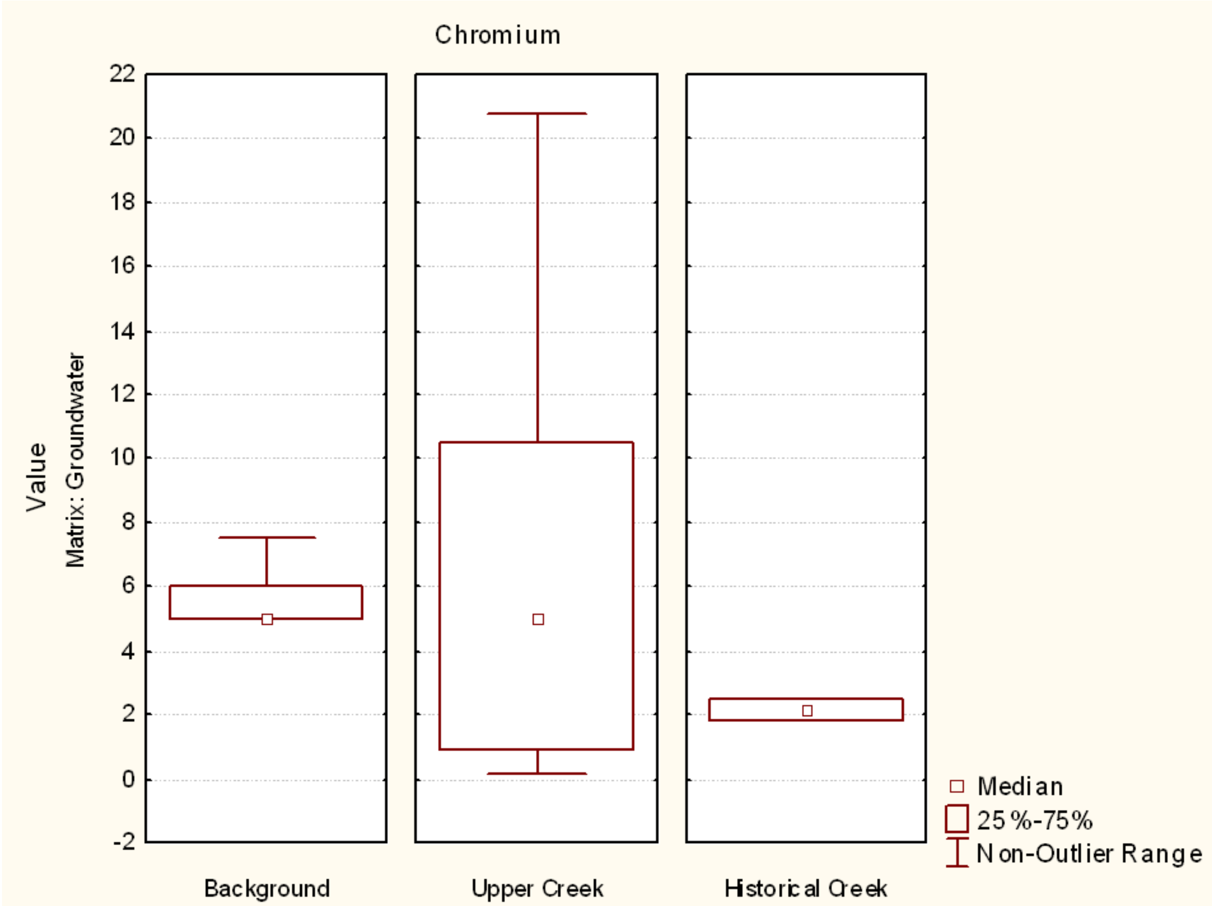


Figure I-26. Box-and-whisker plots for chromium in groundwater (µg/L)

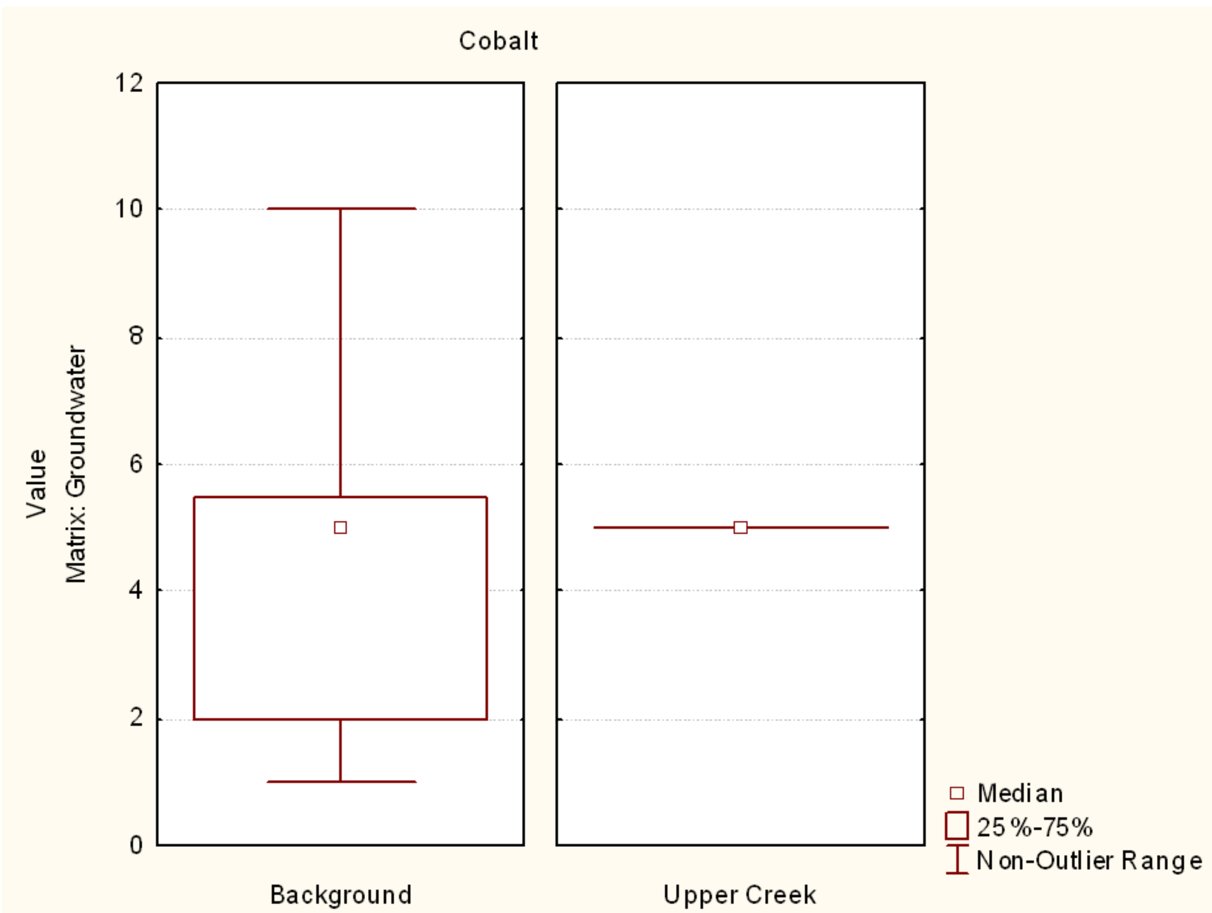


Figure I-27. Box-and-whisker plots for cobalt in groundwater (µg/L)

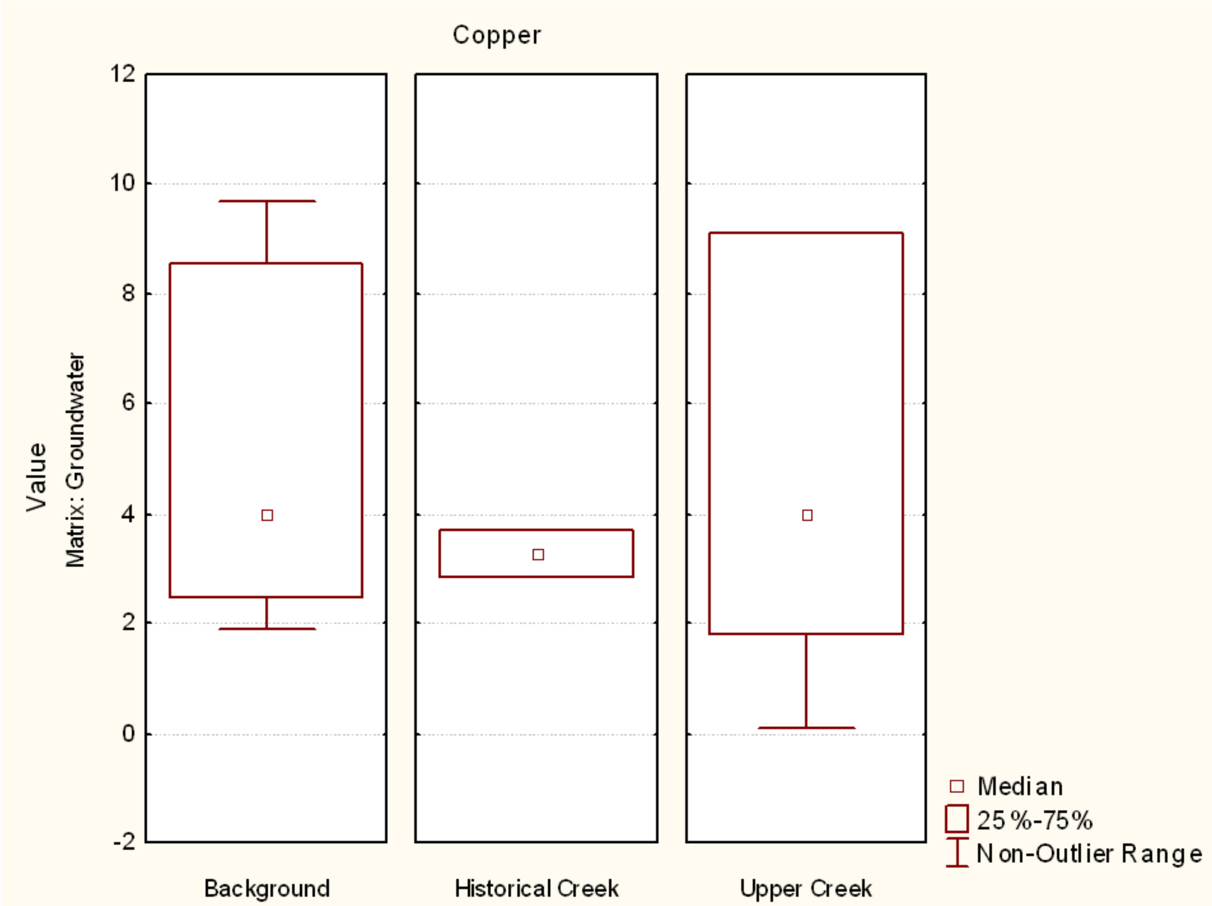


Figure I-28. Box-and-whisker plots for copper in groundwater (µg/L)

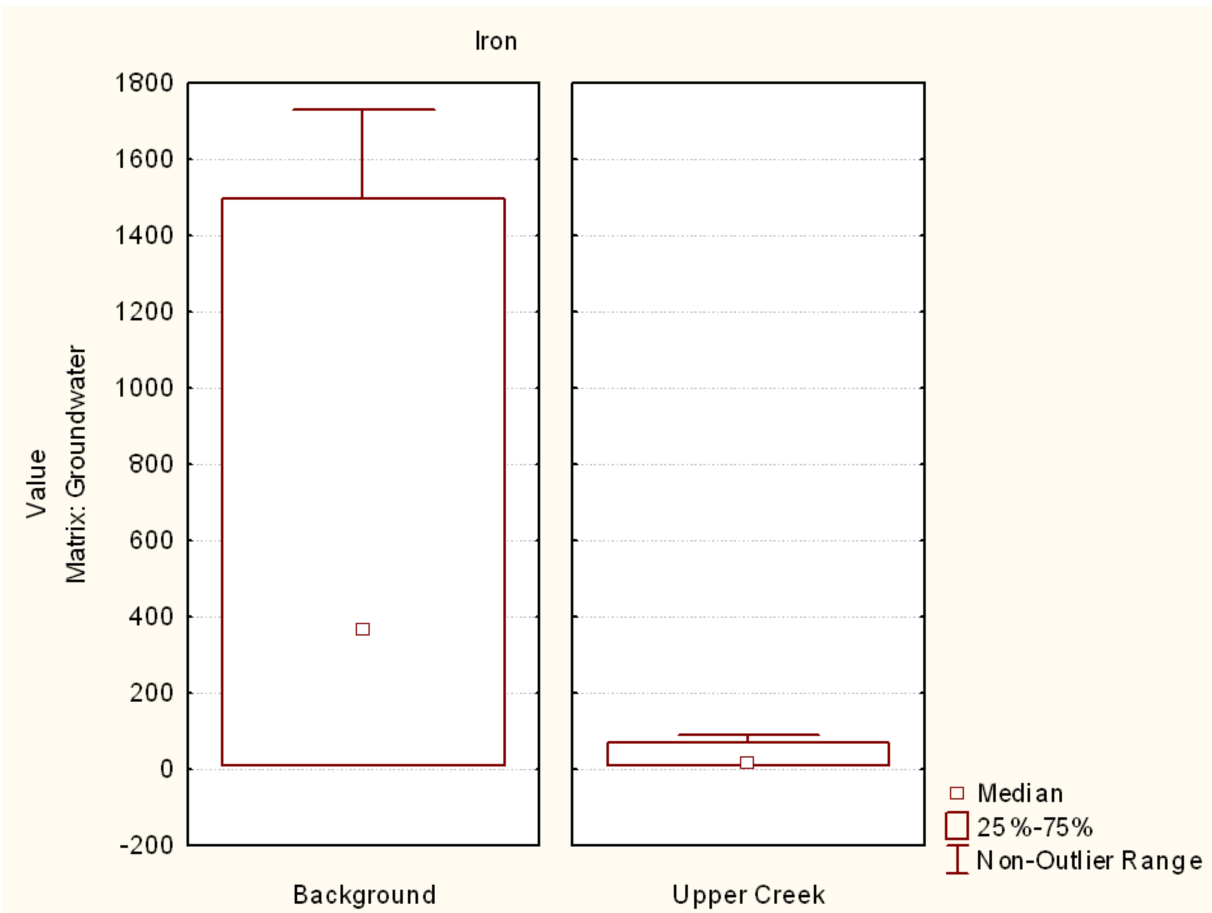


Figure I-29. Box-and-whisker plots for iron in groundwater (µg/L)

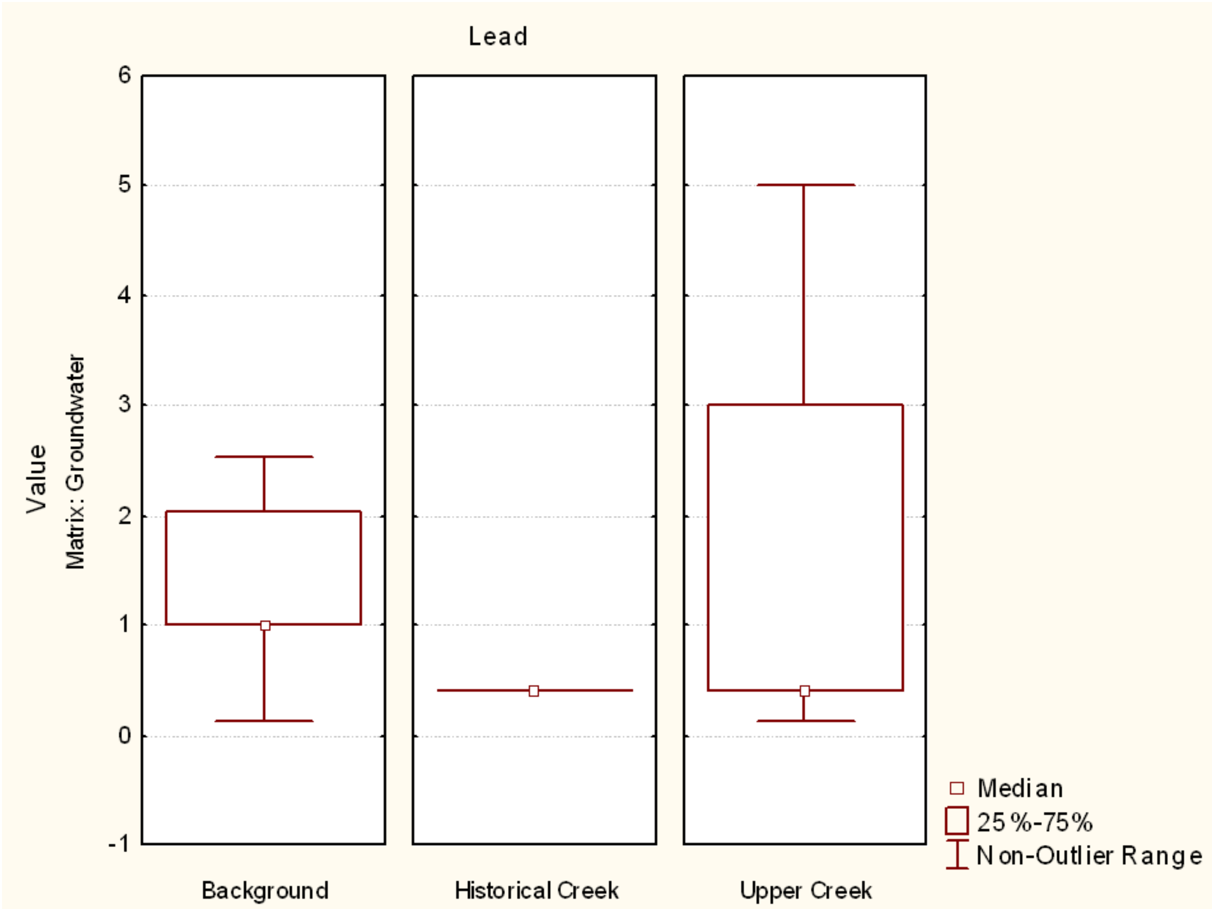


Figure I-30. Box-and-whisker plots for lead in groundwater (μg/L)

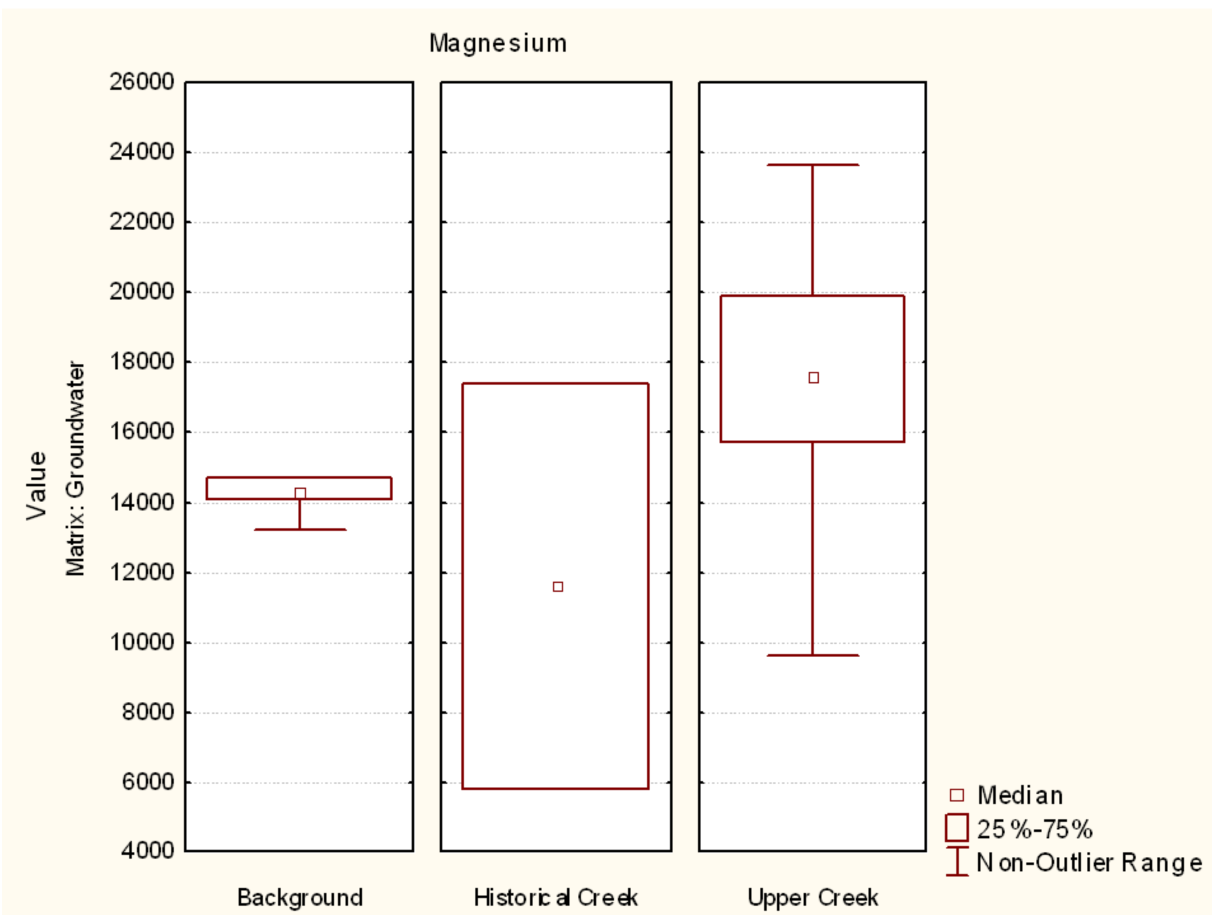


Figure I-31. Box-and-whisker plots for magnesium in groundwater (μg/L)

Figure I-32. Box-and-whisker plots for manganese in groundwater (µg/L)

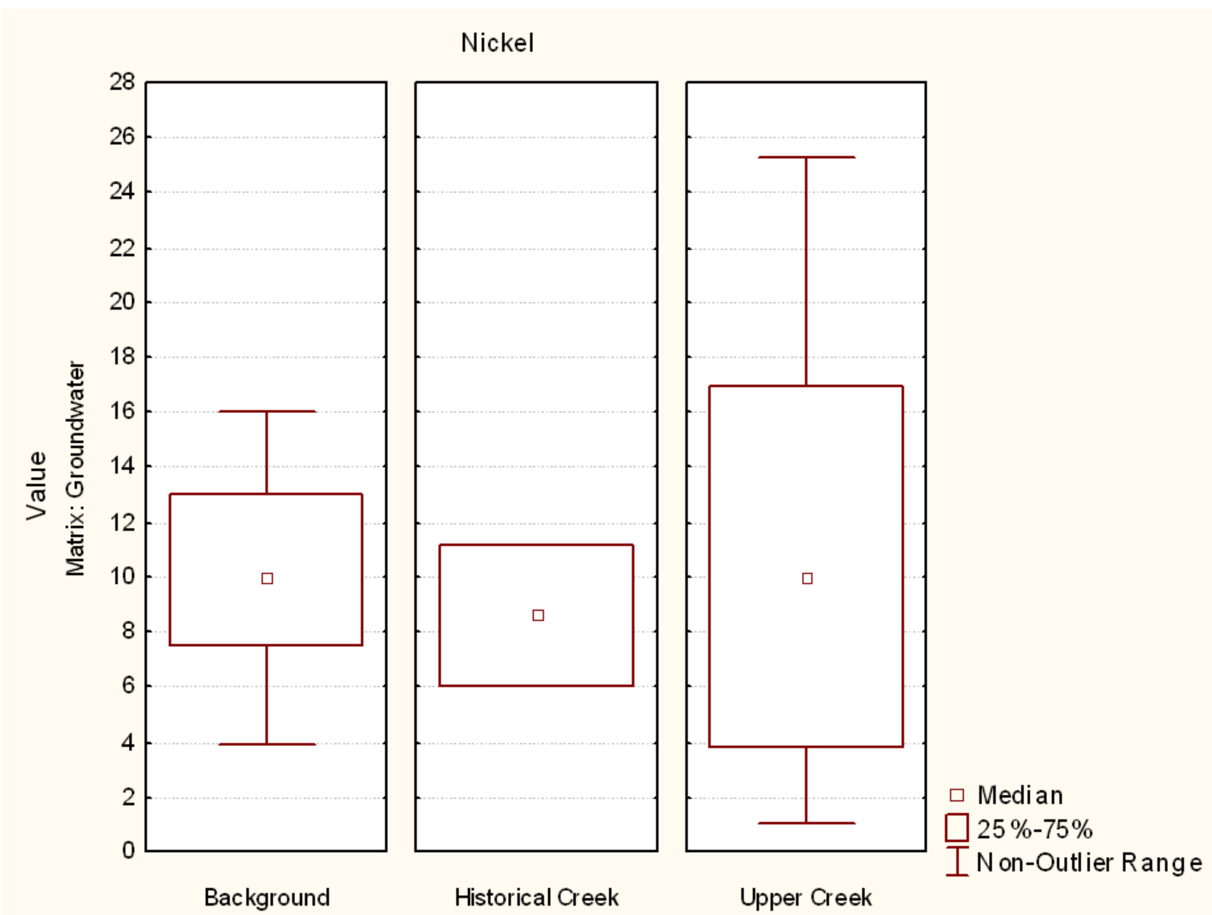


Figure I-33. Box-and-whisker plots for nickel in groundwater (µg/L)

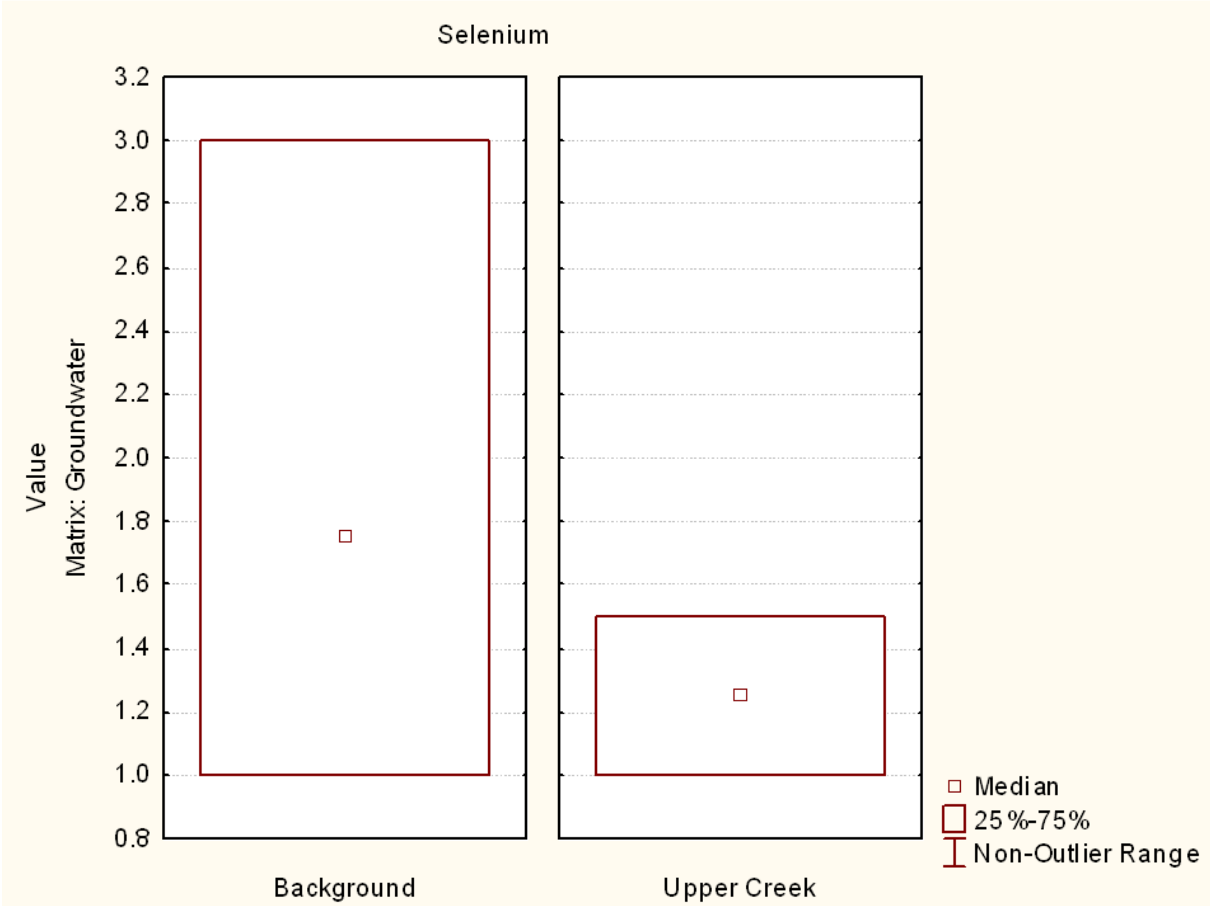


Figure I-34. Box-and-whisker plots for selenium in groundwater (µg/L)

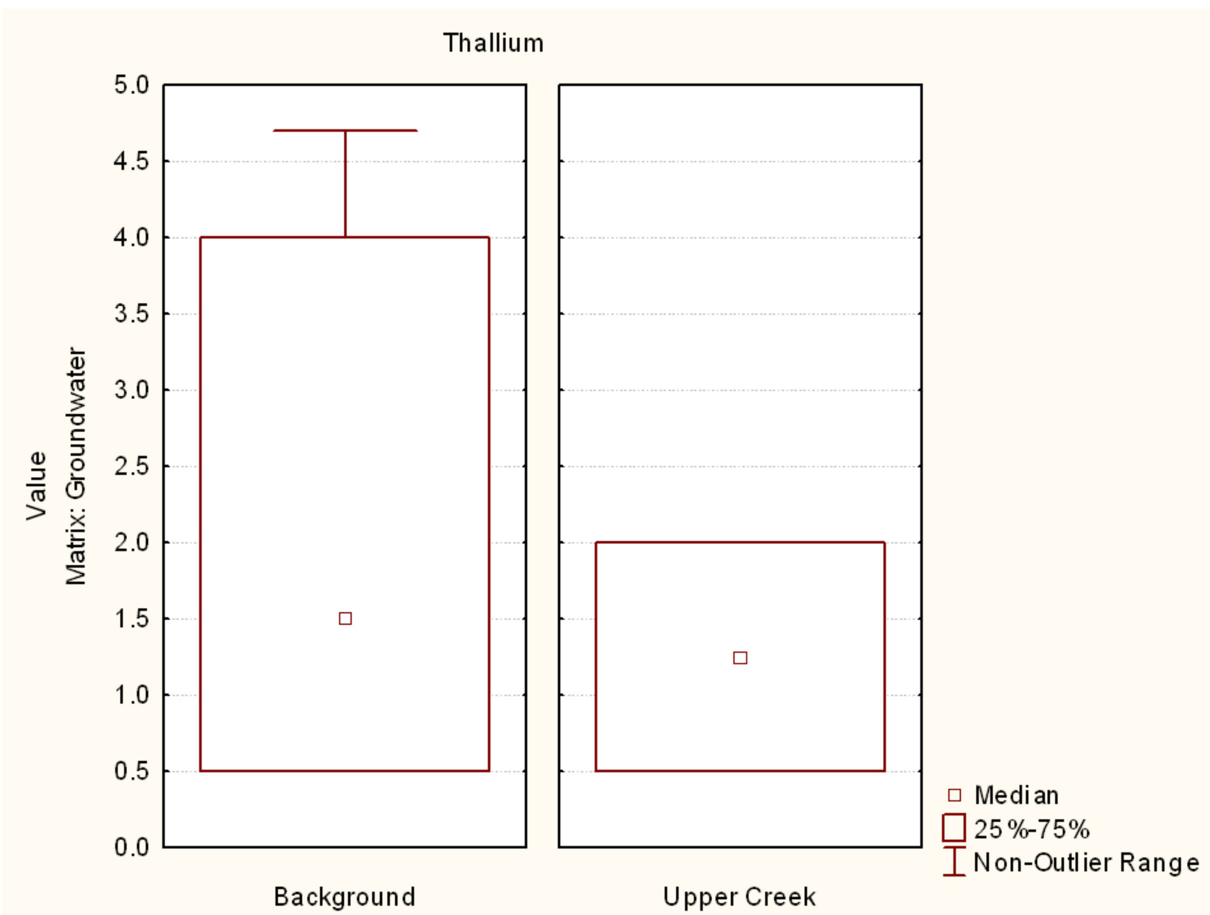


Figure I-35. Box-and-whisker plots for thallium in groundwater (µg/L)

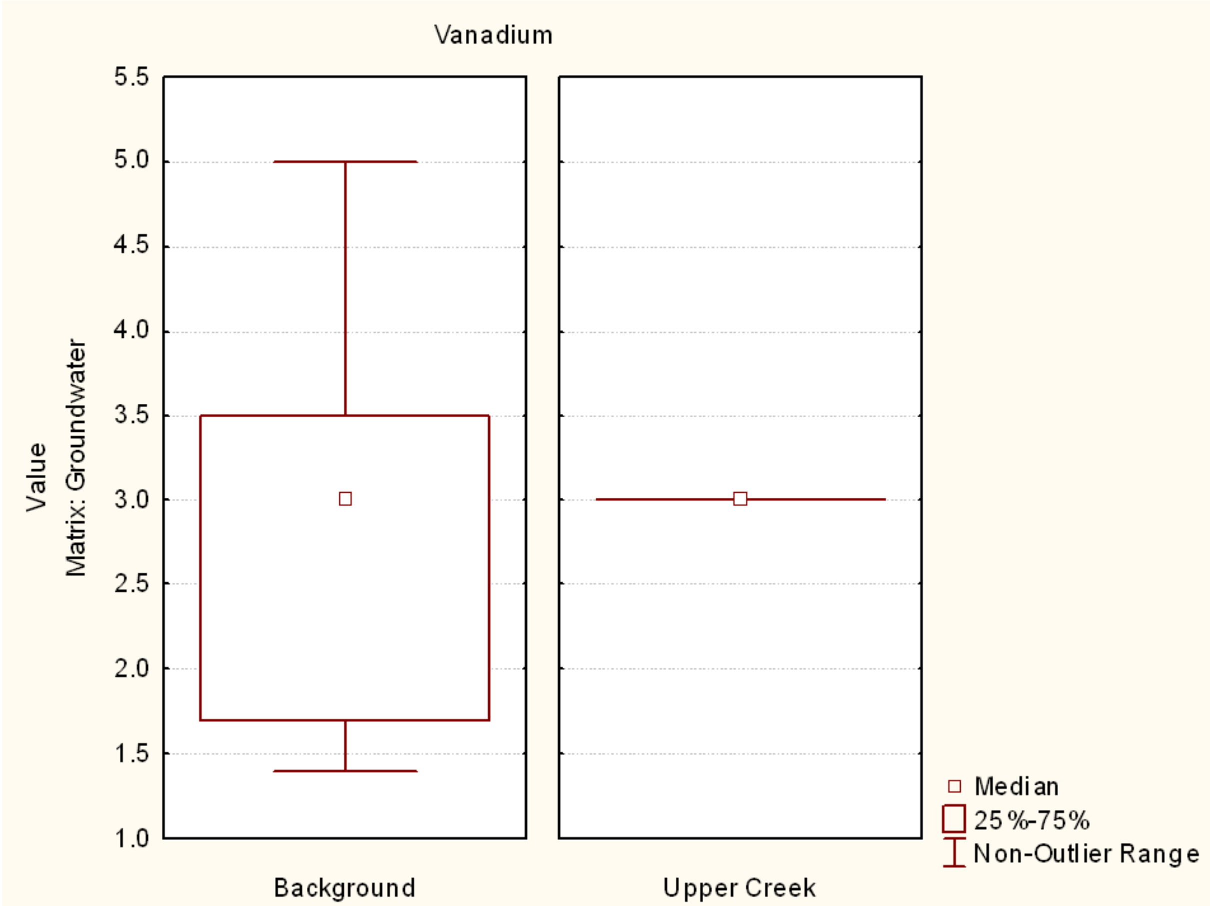


Figure I-36. Box-and-whisker plots for vanadium in groundwater (µg/L)

Figure I-37. Box-and-whisker plots for zinc in groundwater (µg/L)

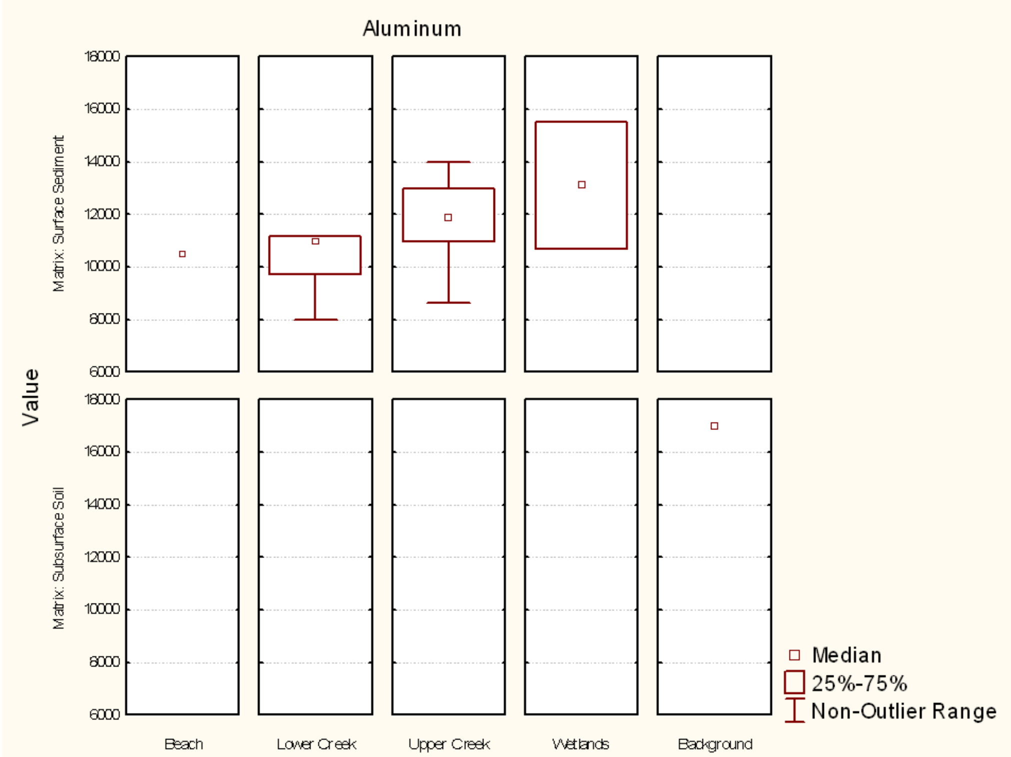


Figure I-38. Box-and-whisker plots for aluminum in sediments (mg/kg)

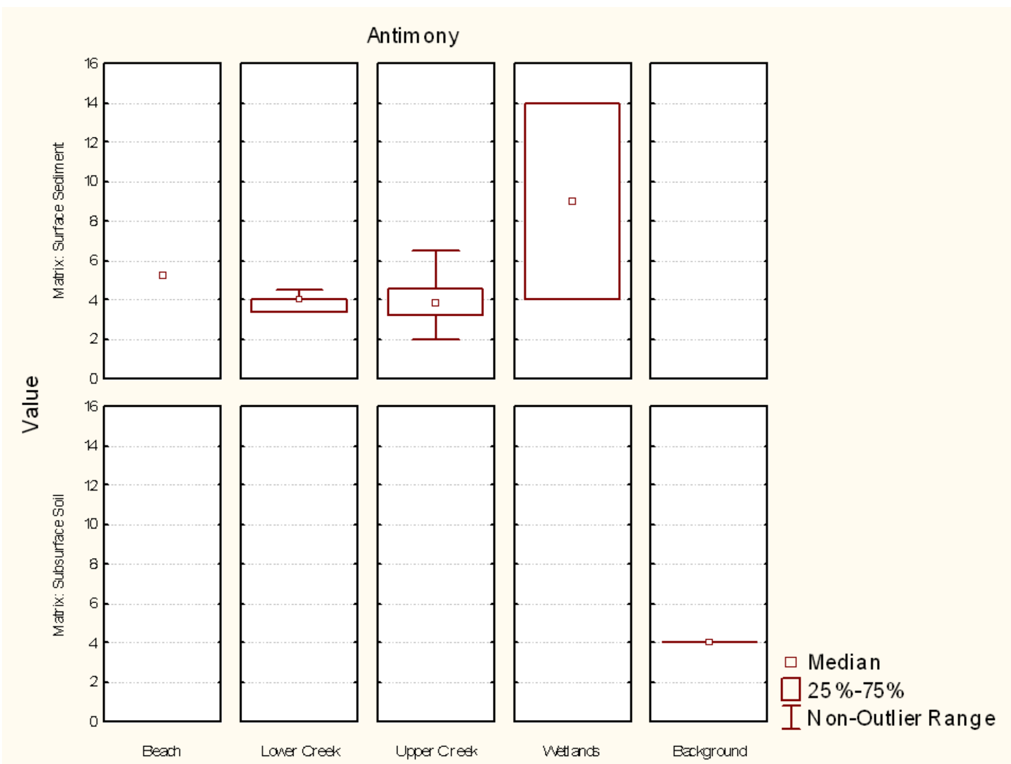


Figure I-39. Box-and-whisker plots for antimony in sediments (mg/kg)

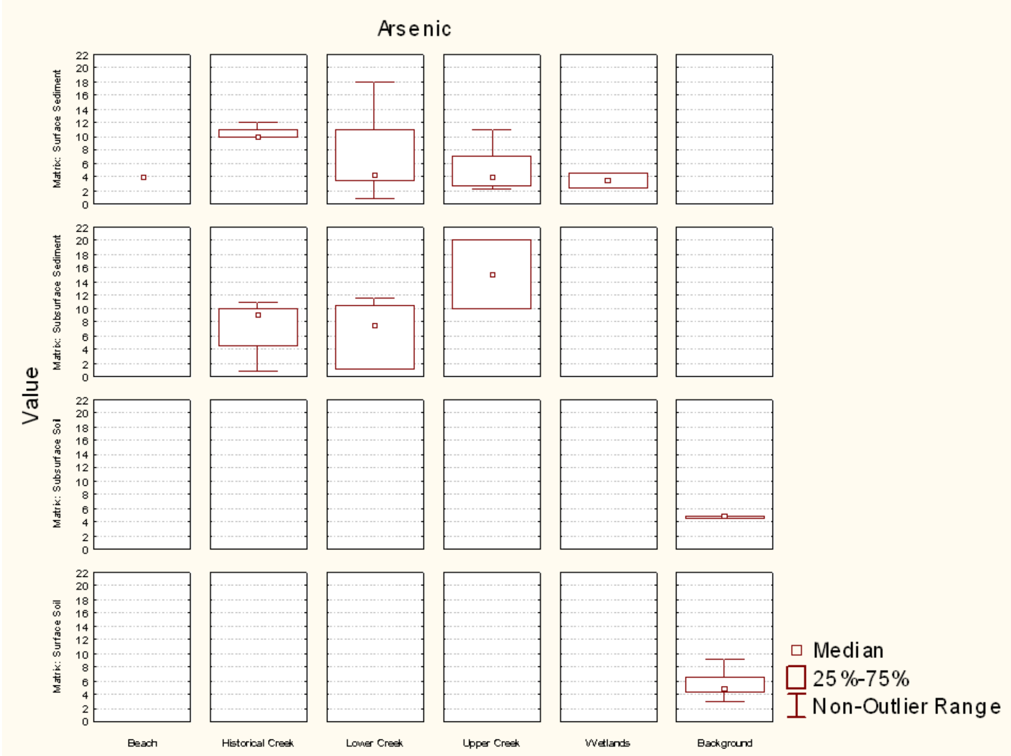


Figure I-40. Box-and-whisker plots for arsenic in sediments (mg/kg)

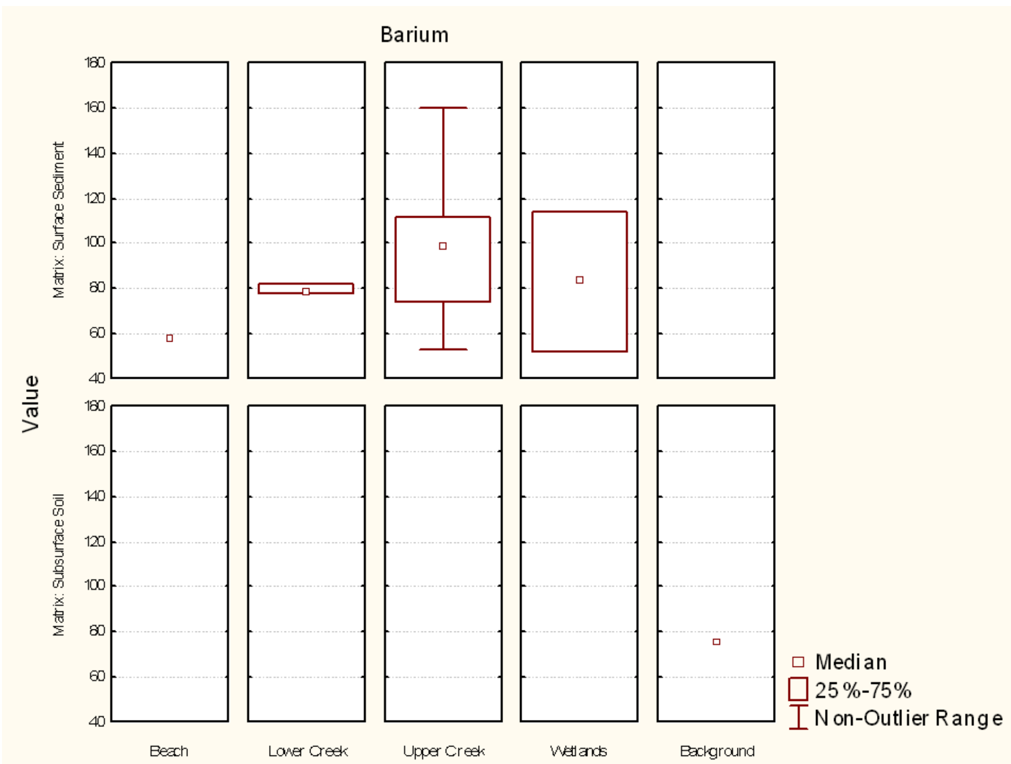


Figure I-41. Box-and-whisker plots for barium in sediments (mg/kg)

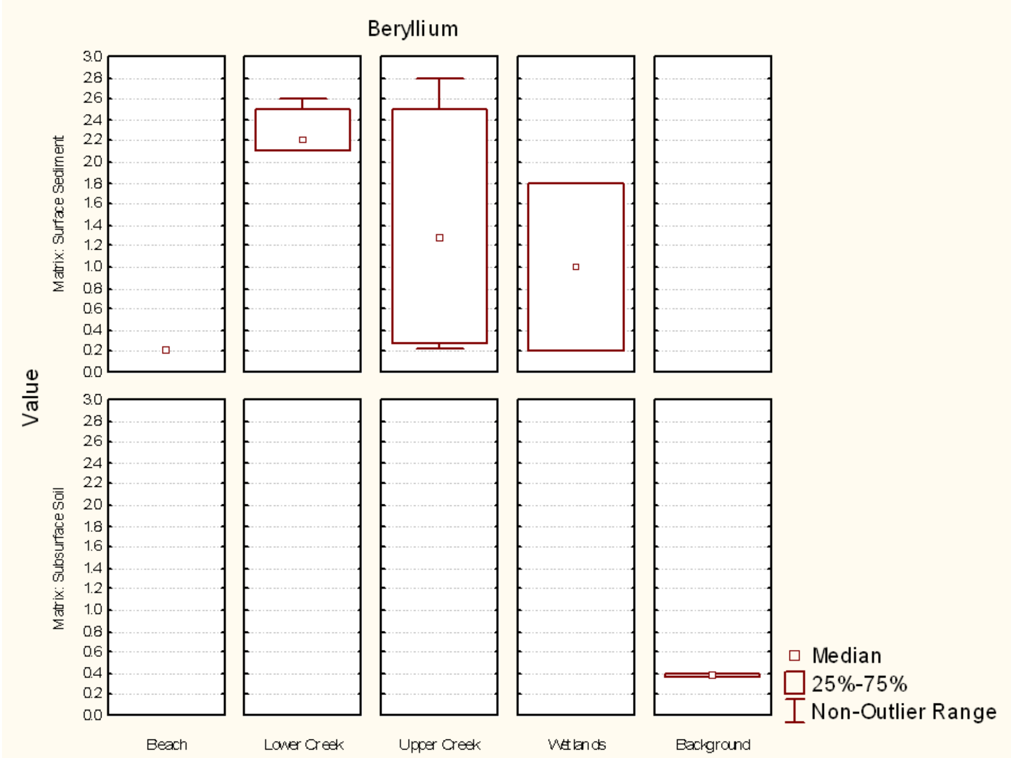


Figure I-42. Box-and-whisker plots for beryllium in sediments (mg/kg)

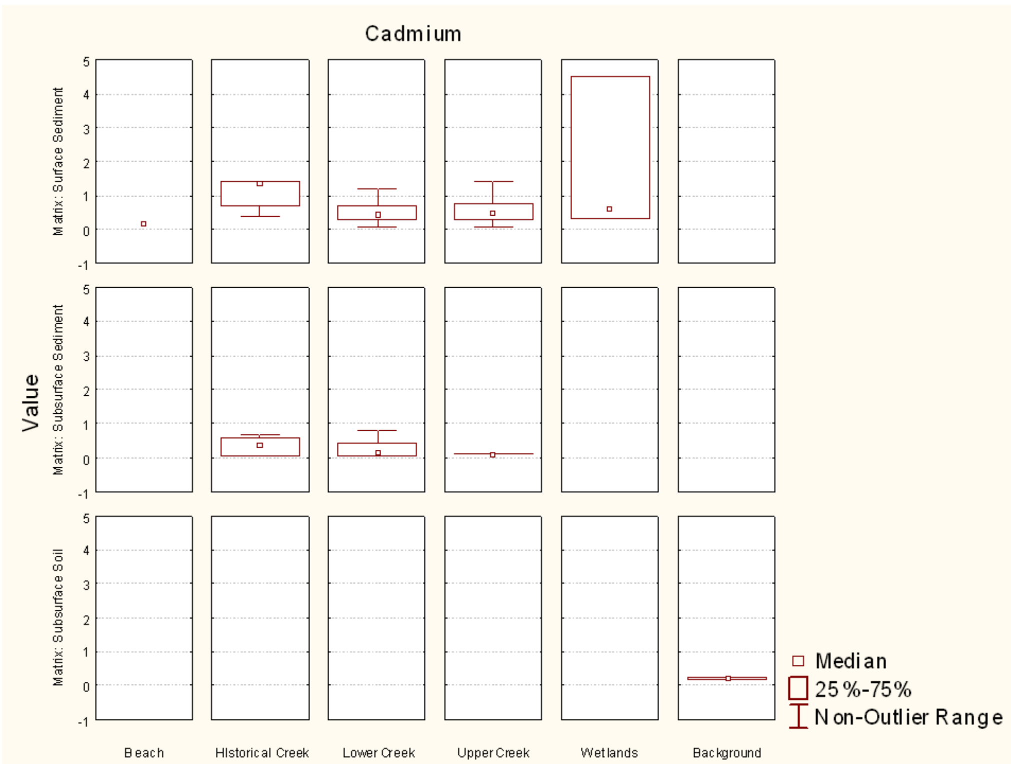


Figure I-43. Box-and-whisker plots for cadmium in sediments (mg/kg)

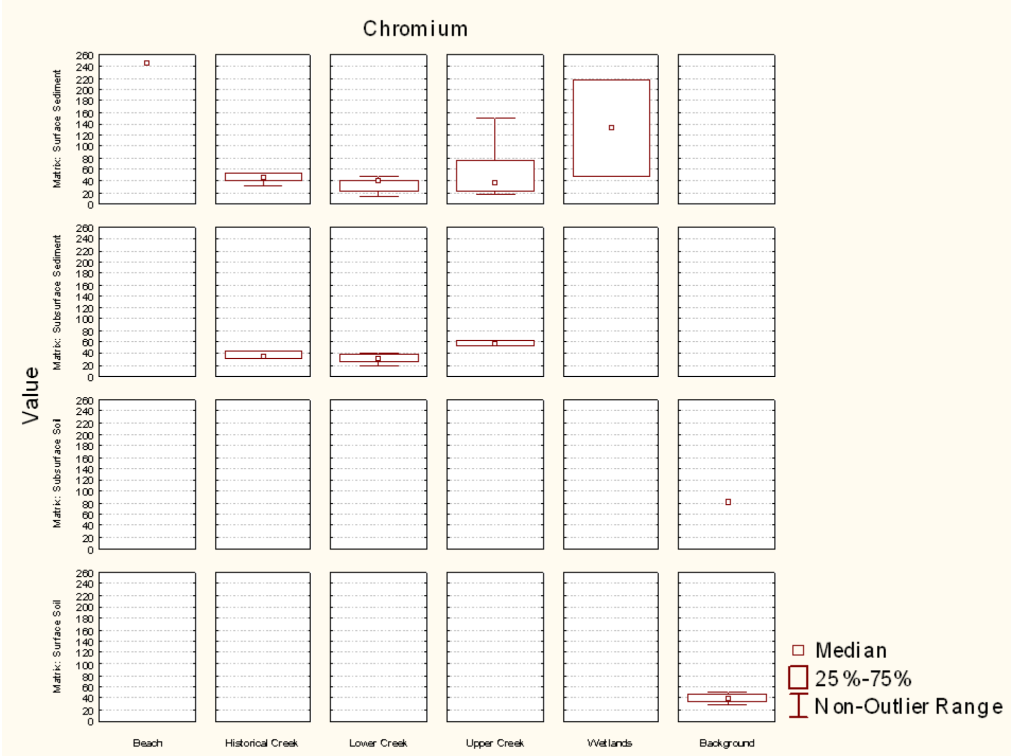


Figure I-44. Box-and-whisker plots for chromium in sediments (mg/kg)

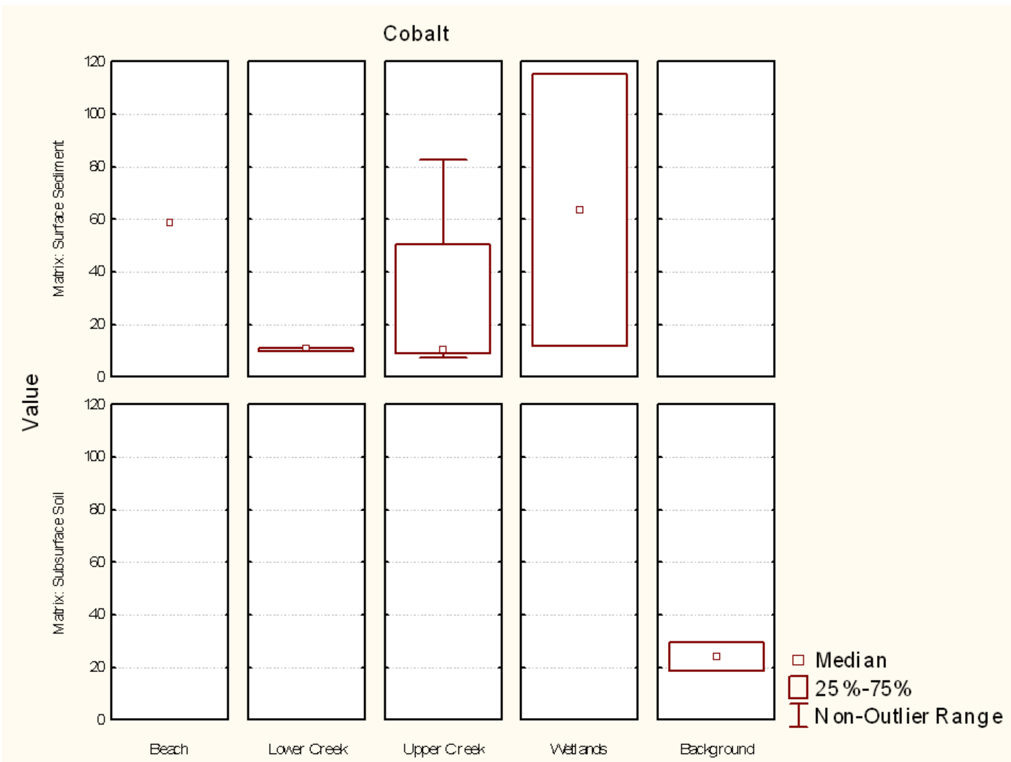


Figure I-45. Box-and-whisker plots for cobalt in sediments (mg/kg)

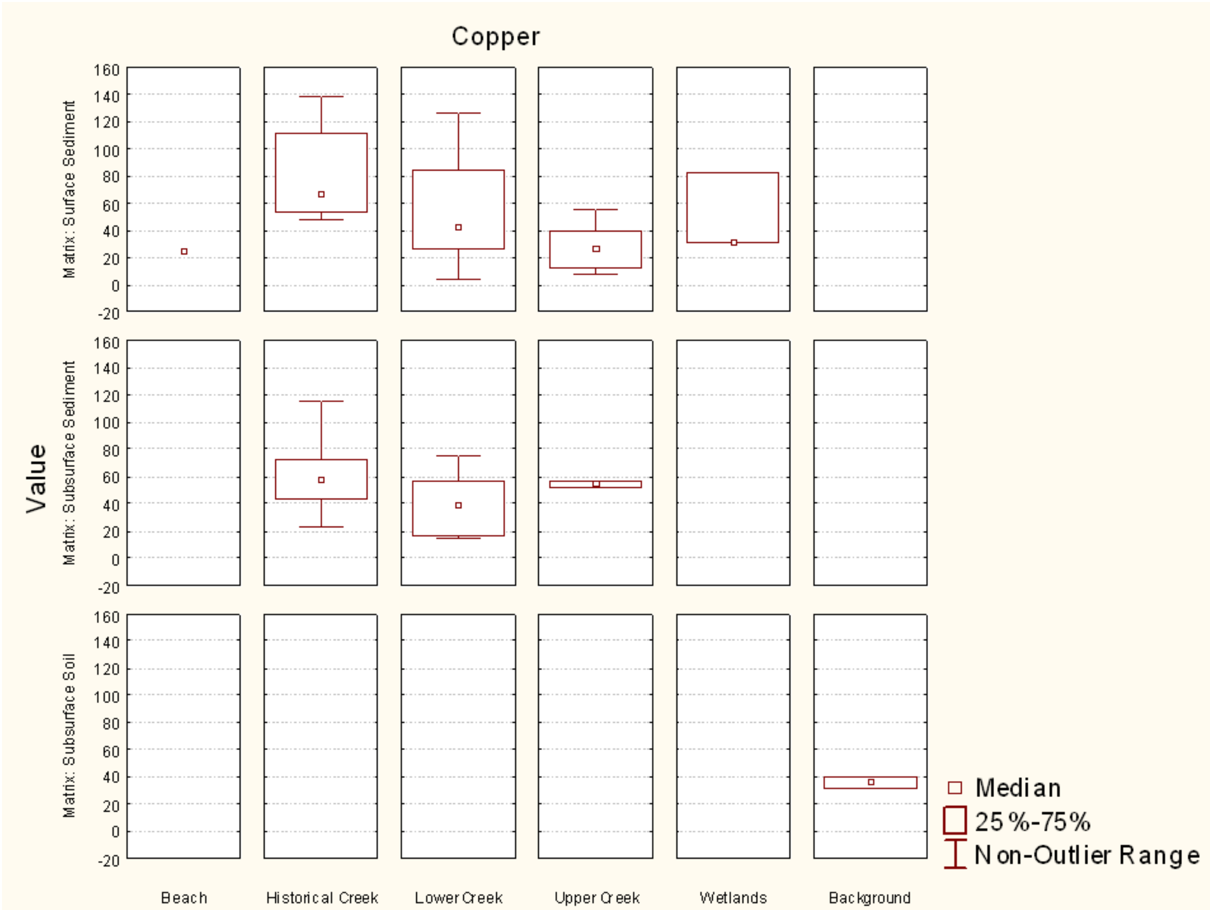


Figure I-46. Box-and-whisker plots for copper in sediments (mg/kg)

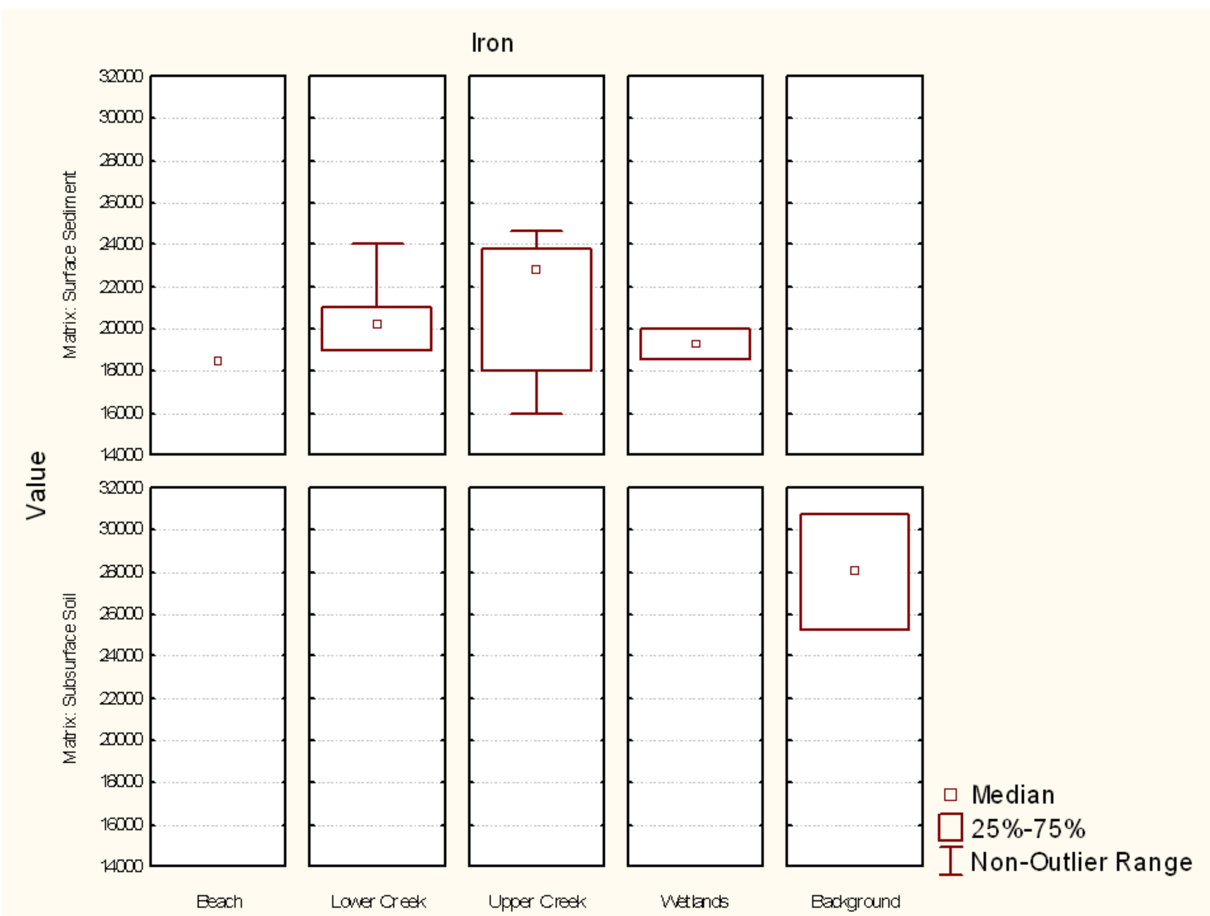


Figure I-47. Box-and-whisker plots for iron in sediments (mg/kg)

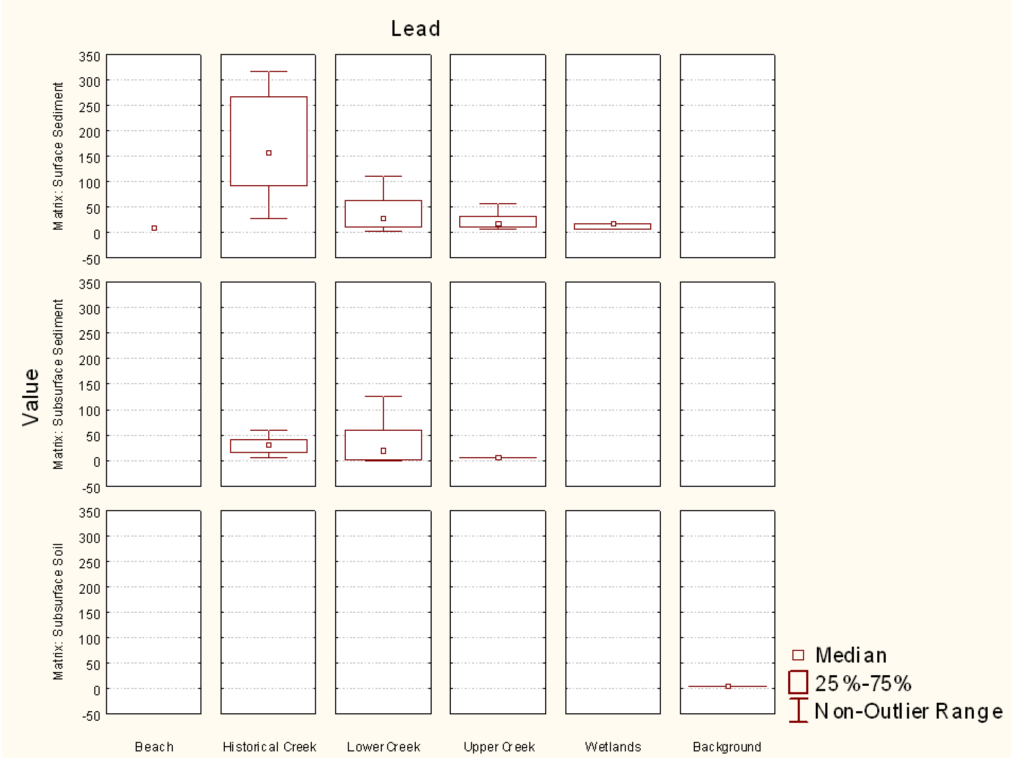


Figure I-48. Box-and-whisker plots for lead in sediments (mg/kg)

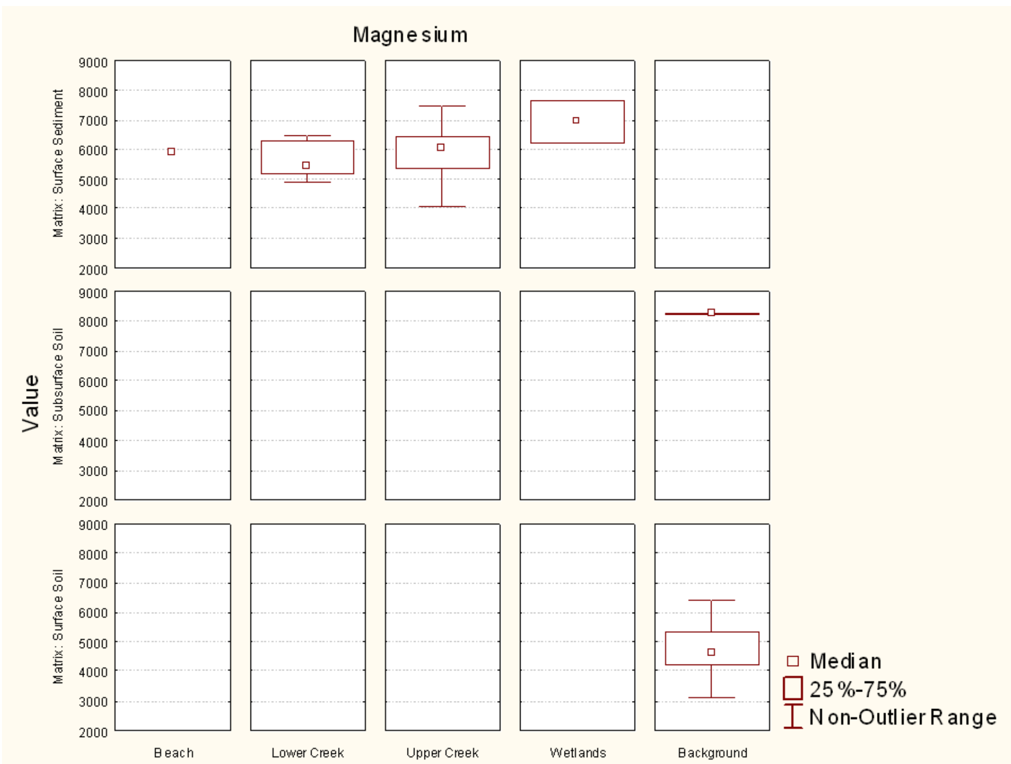


Figure I-49. Box-and-whisker plots for magnesium in sediments (mg/kg)

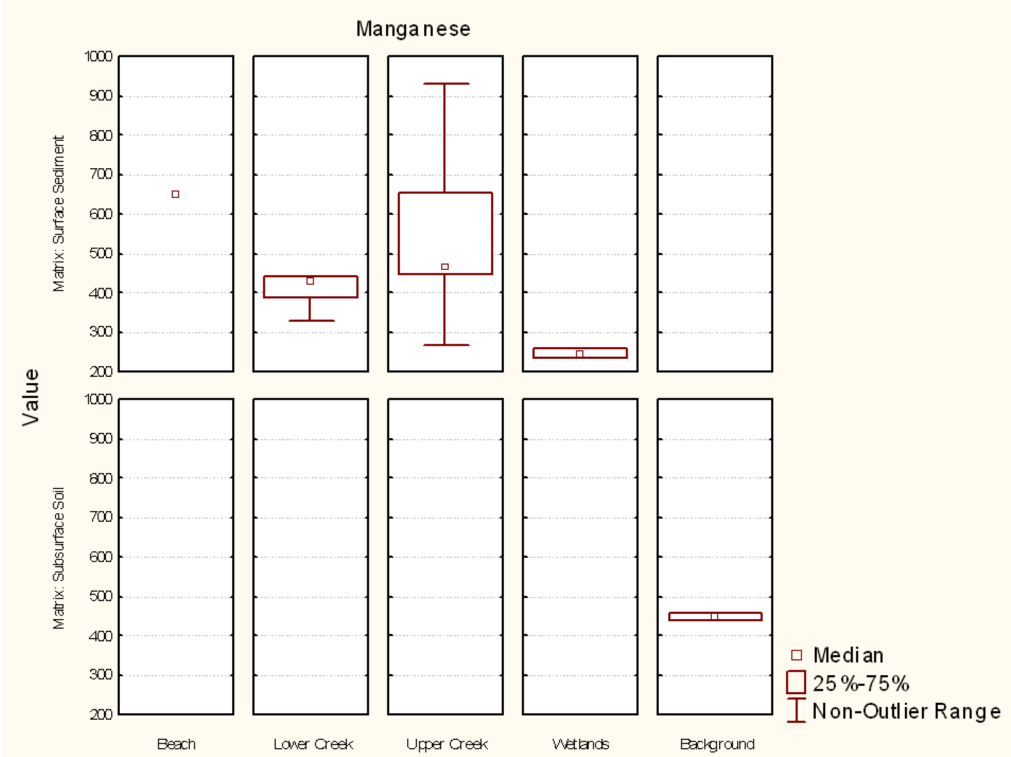


Figure I-50. Box-and-whisker plots for manganese in sediments (mg/kg)

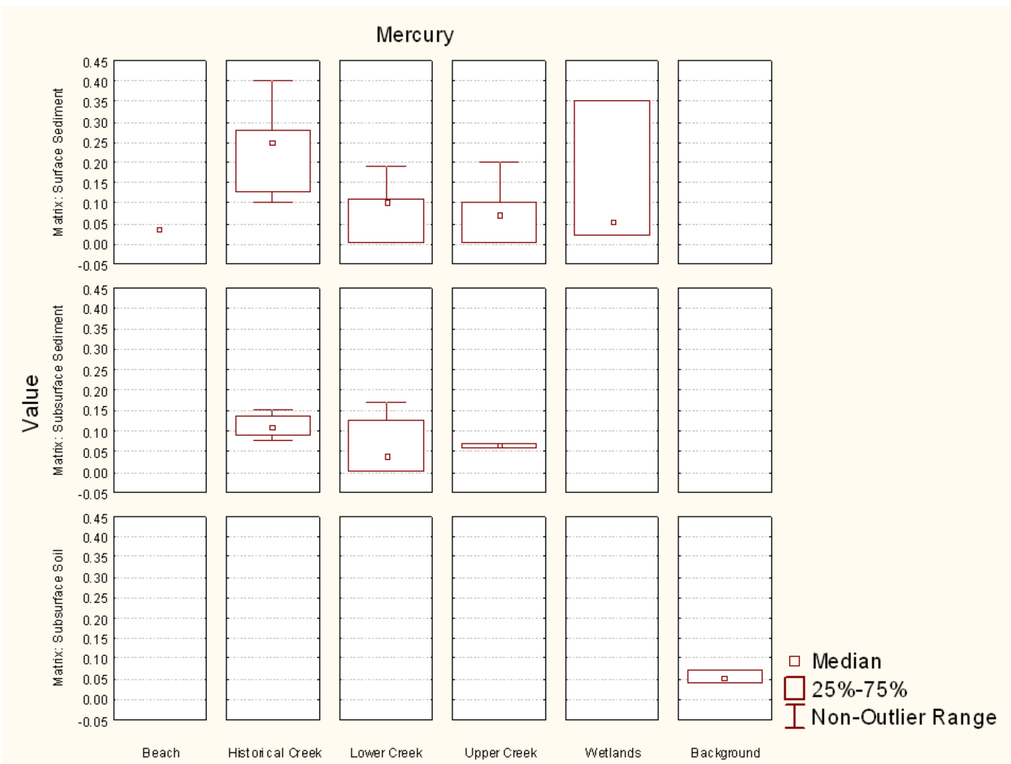


Figure I-51. Box-and-whisker plots for mercury in sediments (mg/kg)

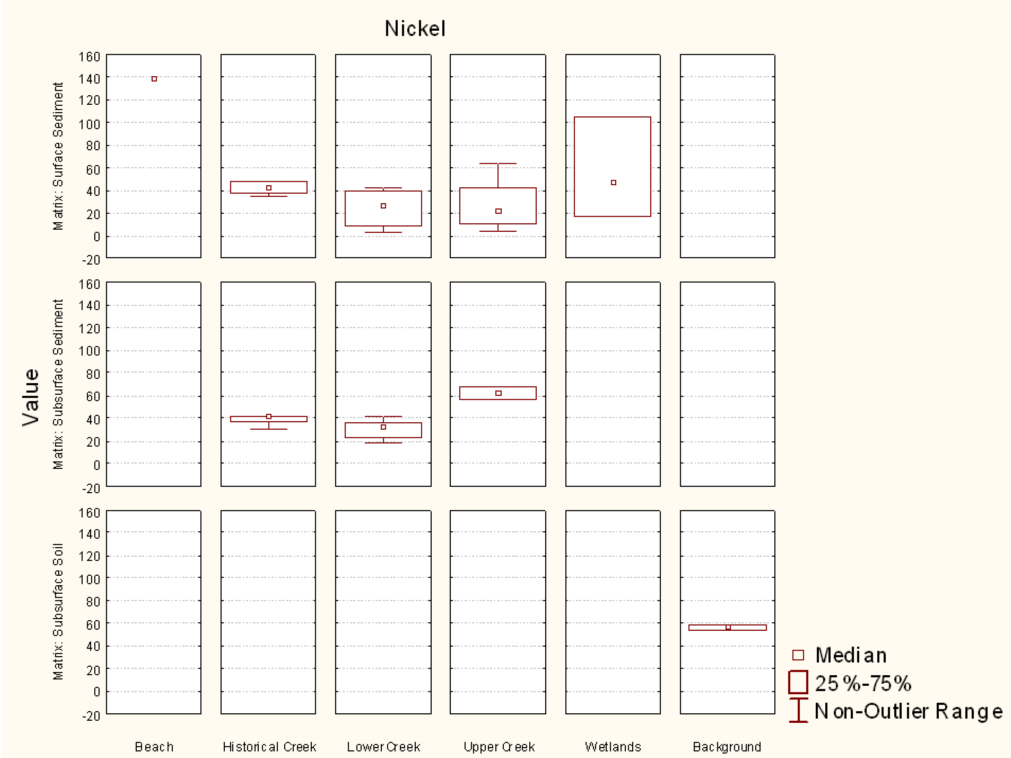


Figure I-52. Box-and-whisker plots for nickel in sediments (mg/kg)

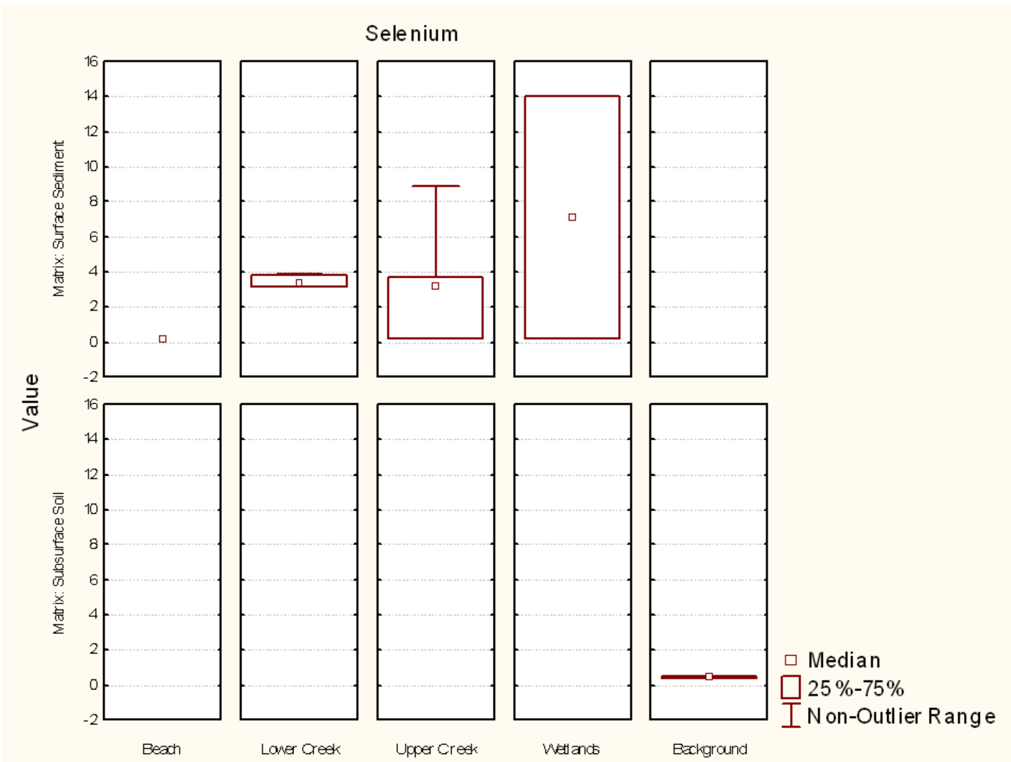


Figure I-53. Box-and-whisker plots for selenium in sediments (mg/kg)

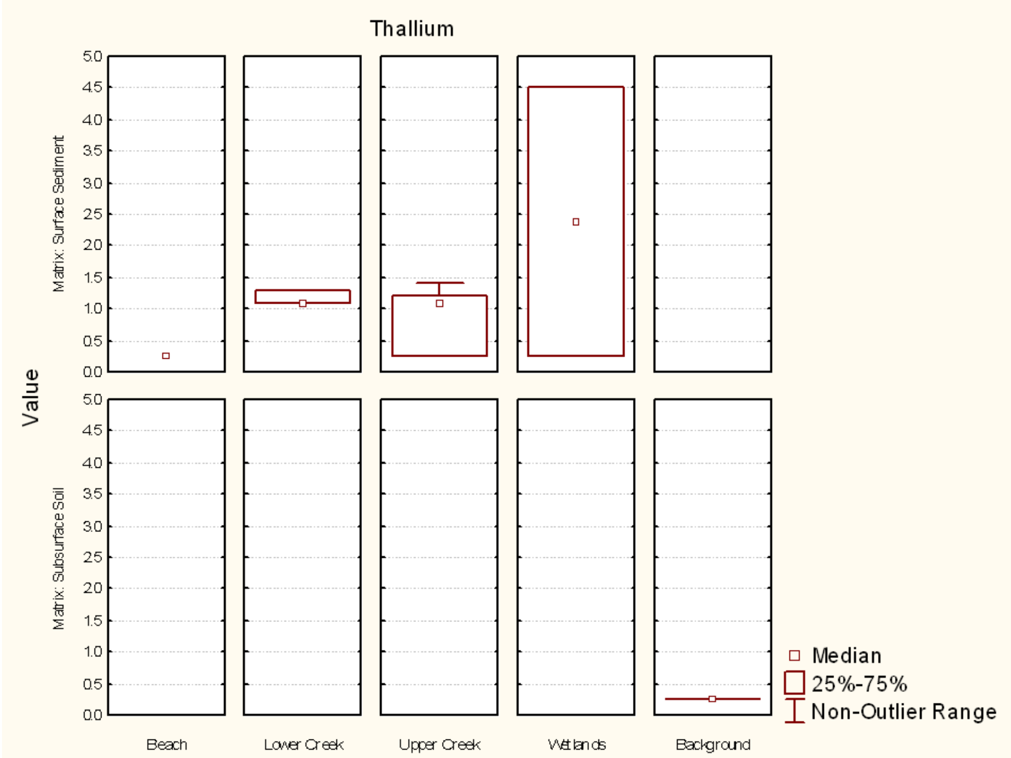


Figure I-54. Box-and-whisker plots for thallium in sediments (mg/kg)

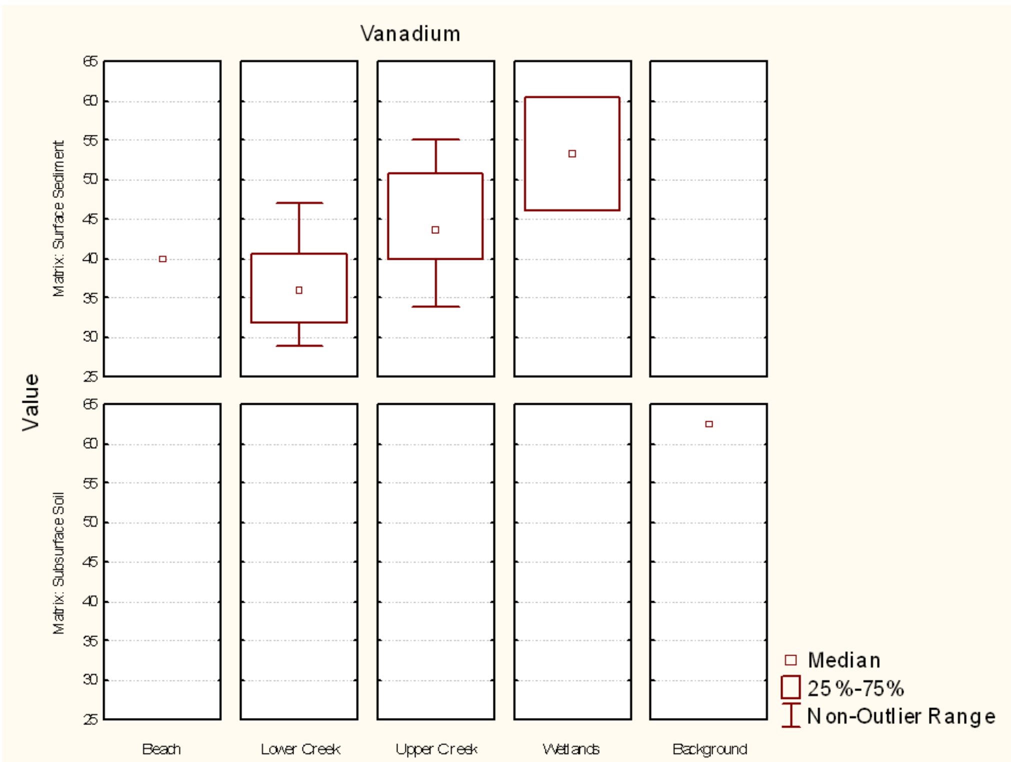


Figure I-55. Box-and-whisker plots for vanadium in sediments (mg/kg)

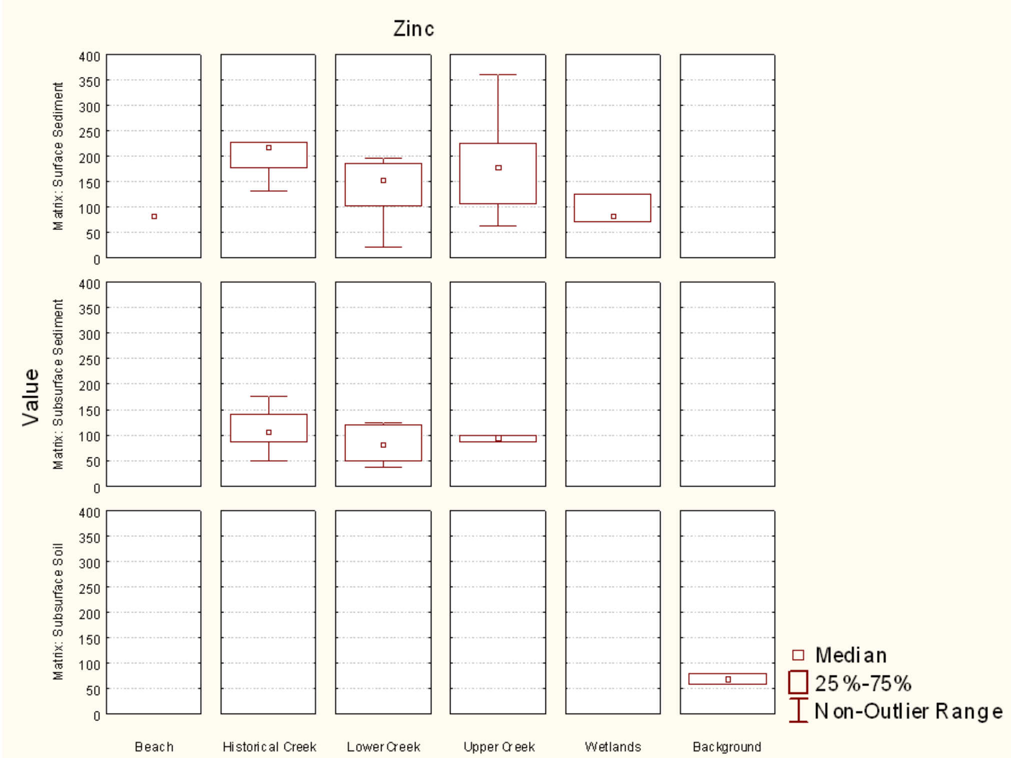


Figure I-56. Box-and-whisker plots for zinc in sediments (mg/kg)

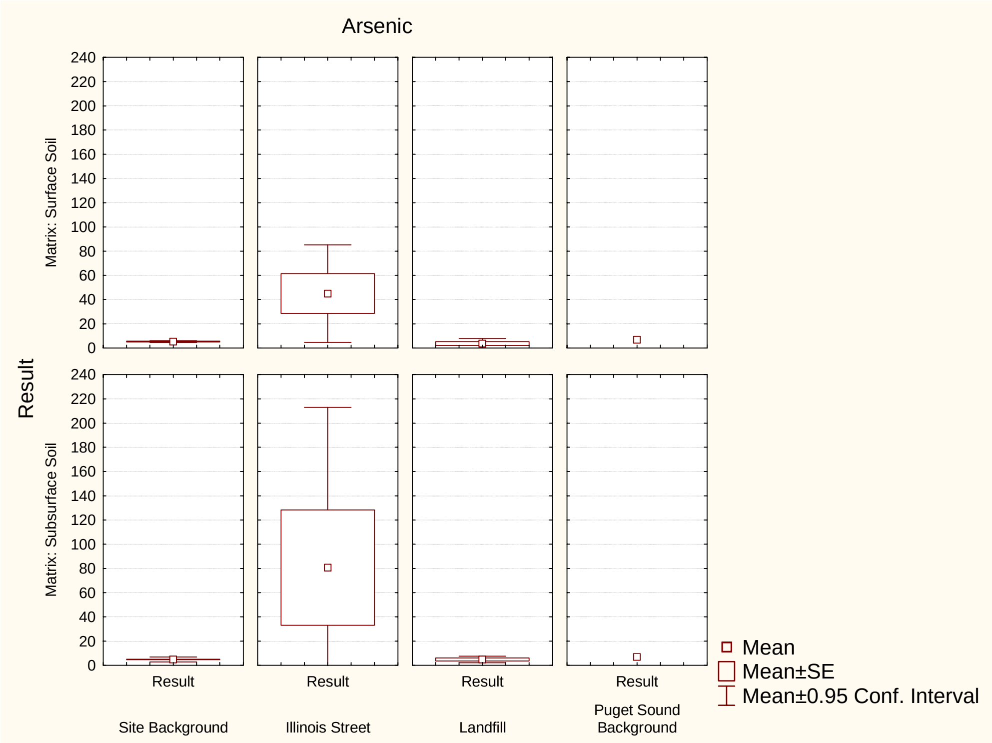


Figure I-57. Arsenic concentrations in Illinois Street and Landfill soil compared with site background and Puget Sound natural background

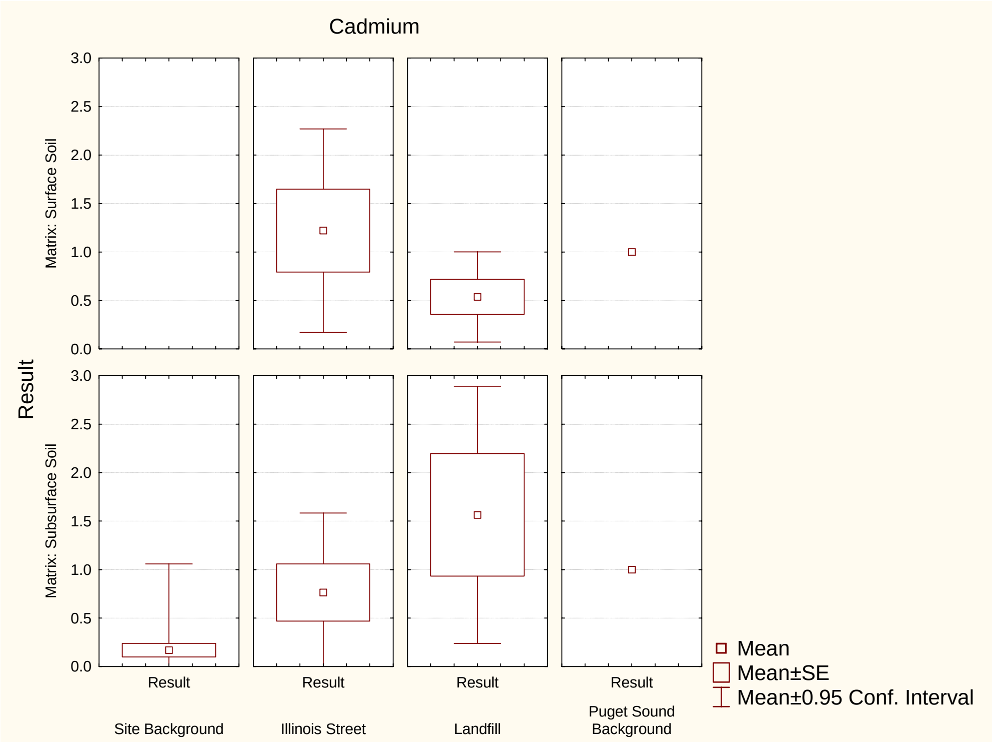


Figure I-58. Cadmium concentrations in Illinois Street and Landfill soil compared with site background and Puget Sound natural background

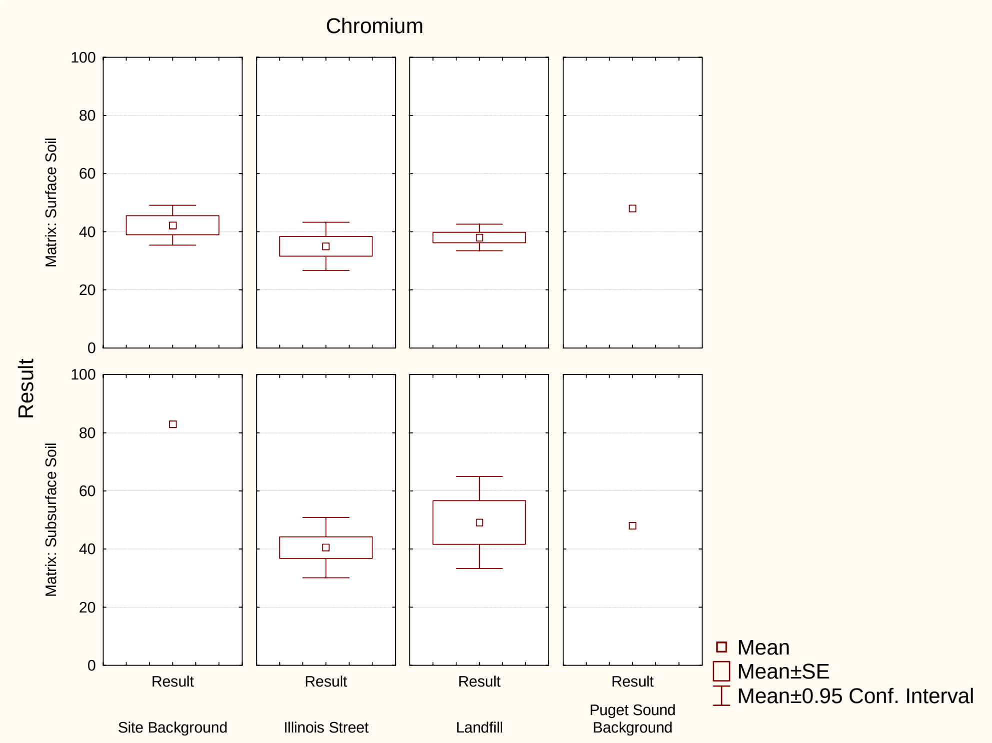


Figure I-59. Chromium concentrations in Illinois Street and Landfill soil compared with site background and Puget Sound natural background

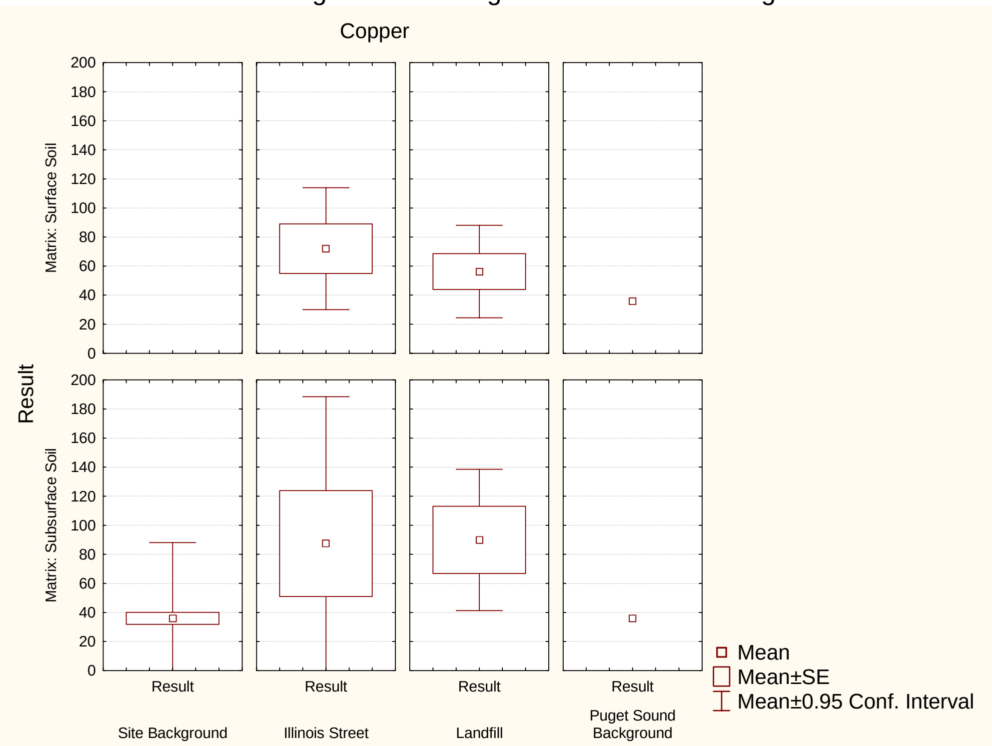


Figure I-60. Copper concentrations in Illinois Street and Landfill soil compared with site background and Puget Sound natural background

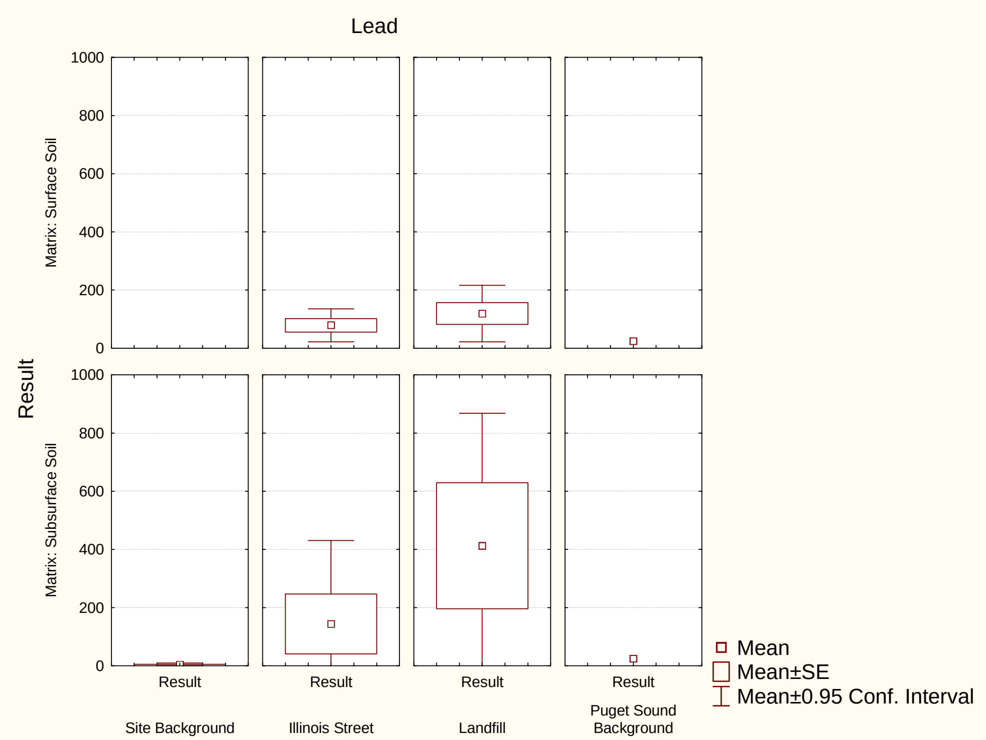


Figure I-61. Lead concentrations in Illinois Street and Landfill soil compared with site background and Puget Sound natural background

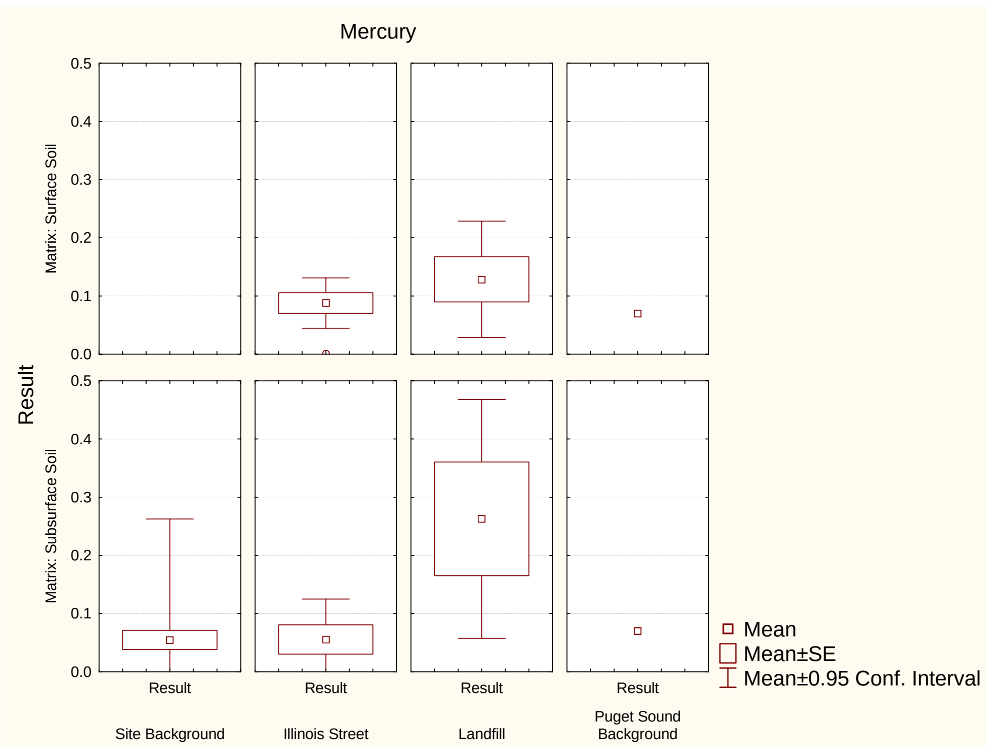


Figure I-62. Mercury concentrations in Illinois Street and Landfill soil compared with site background and Puget Sound natural background

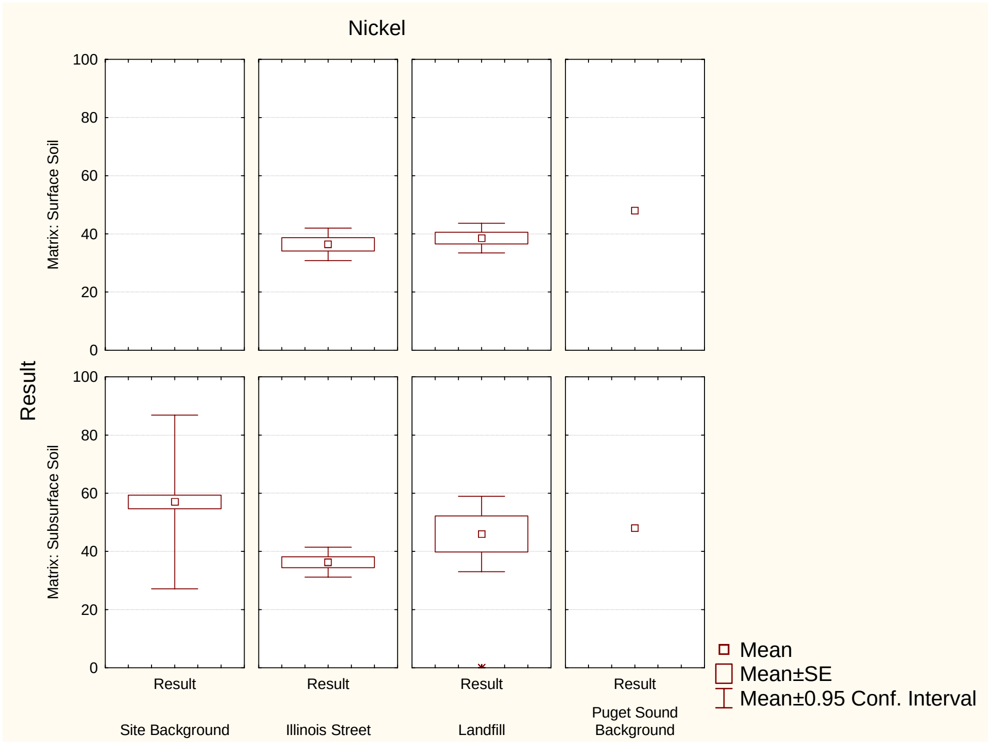


Figure I-63. Nickel concentrations in Illinois Street and Landfill soil compared with site background and Puget Sound natural background

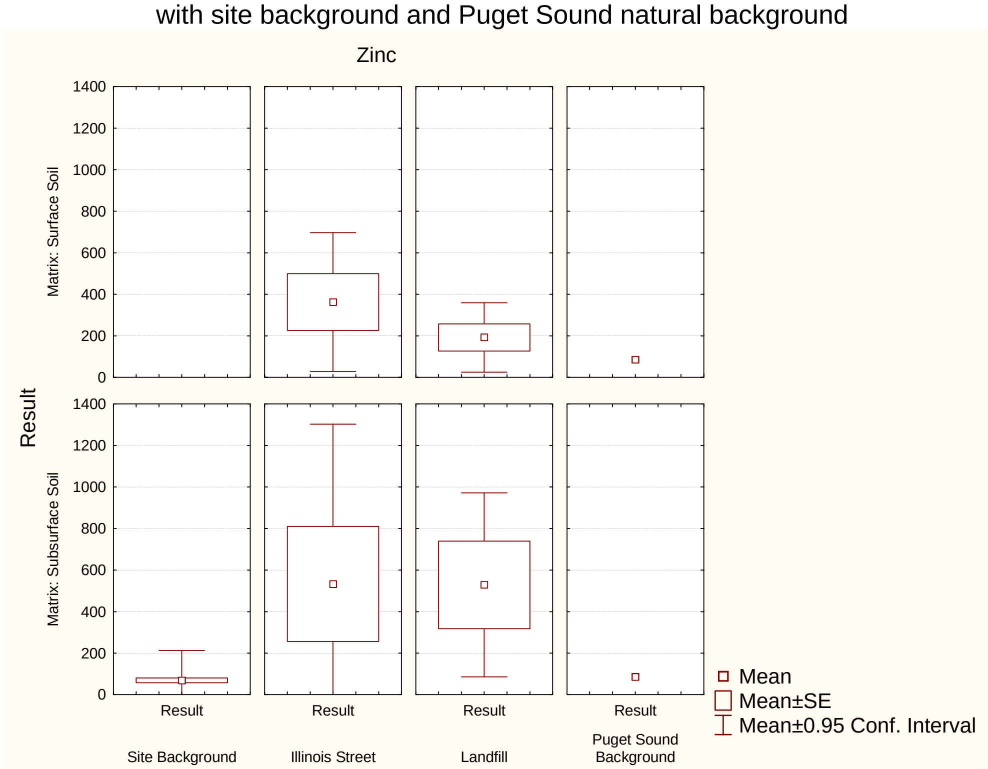


Figure I-64. Zinc concentrations in Illinois Street and Landfill soil compared with site background and Puget Sound natural background

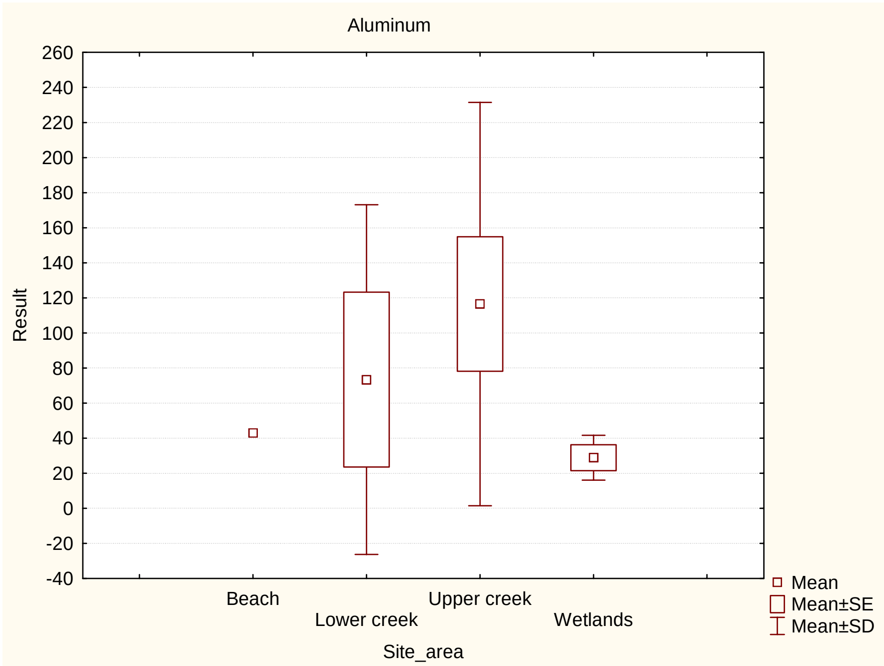


Figure I-65. Aluminum concentrations in surface water

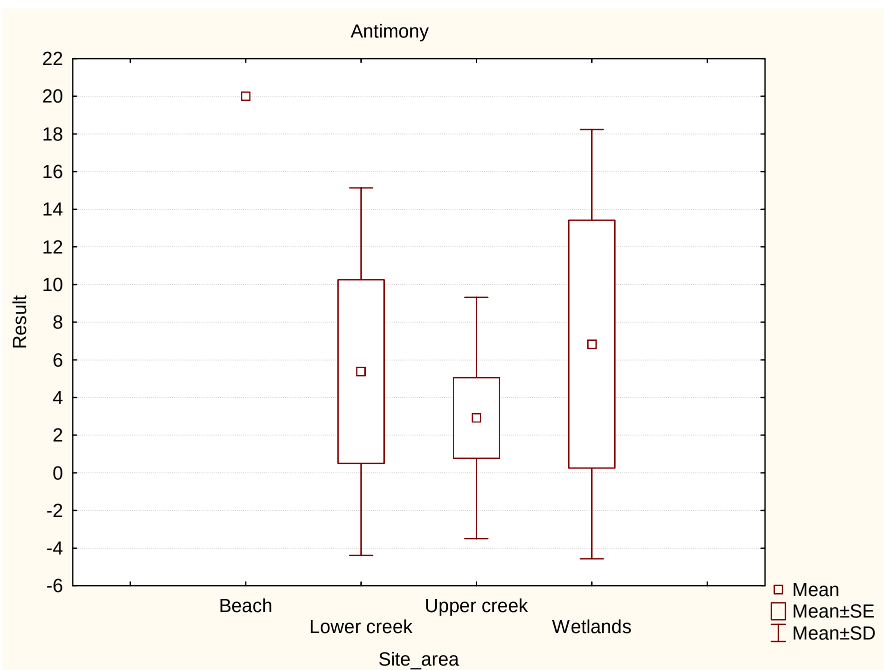


Figure I-66. Antimony concentrations in surface water

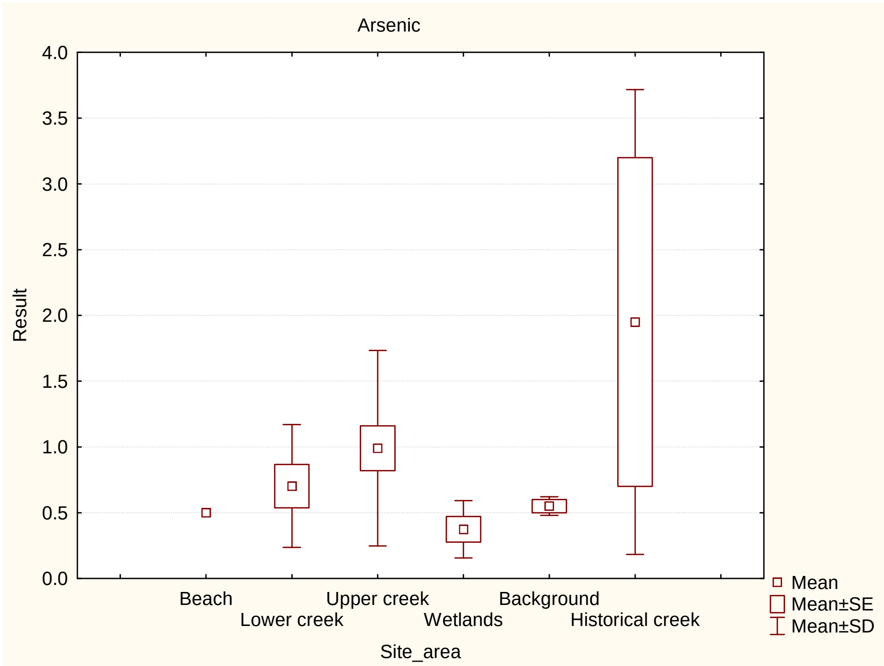


Figure I-67. Arsenic concentrations in surface water

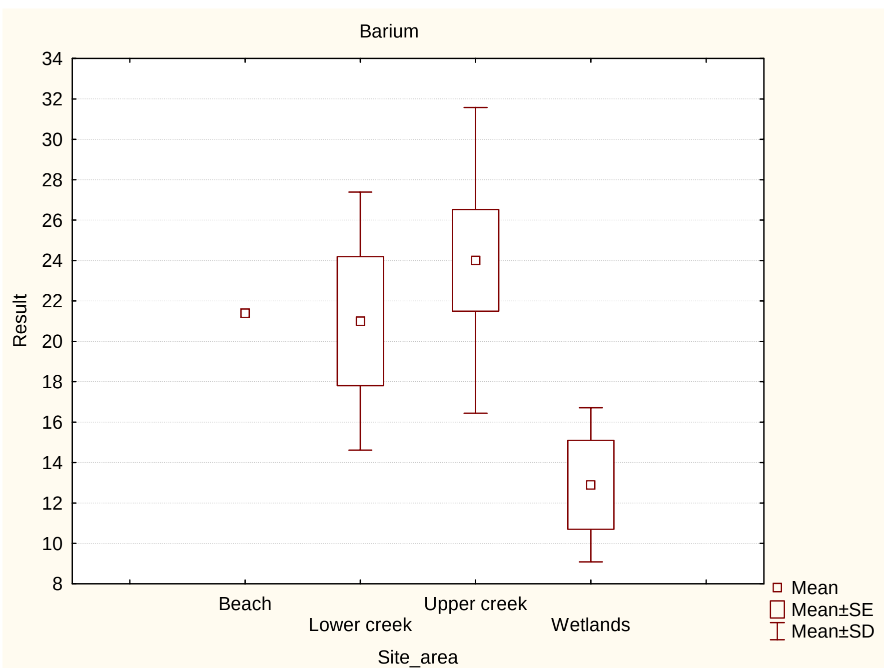


Figure I-68. Barium concentrations in surface water

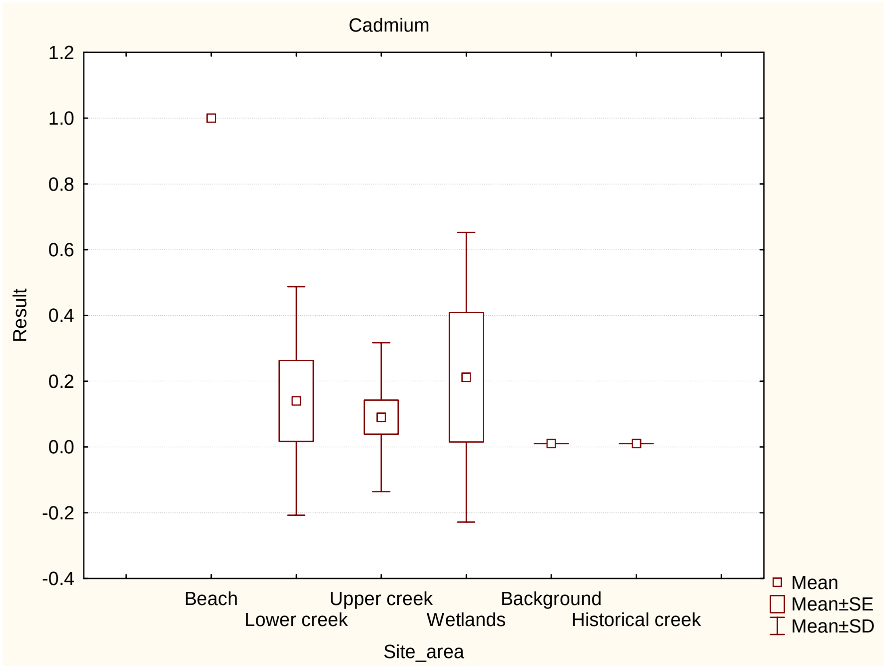


Figure I-69. Cadmium concentrations in surface water

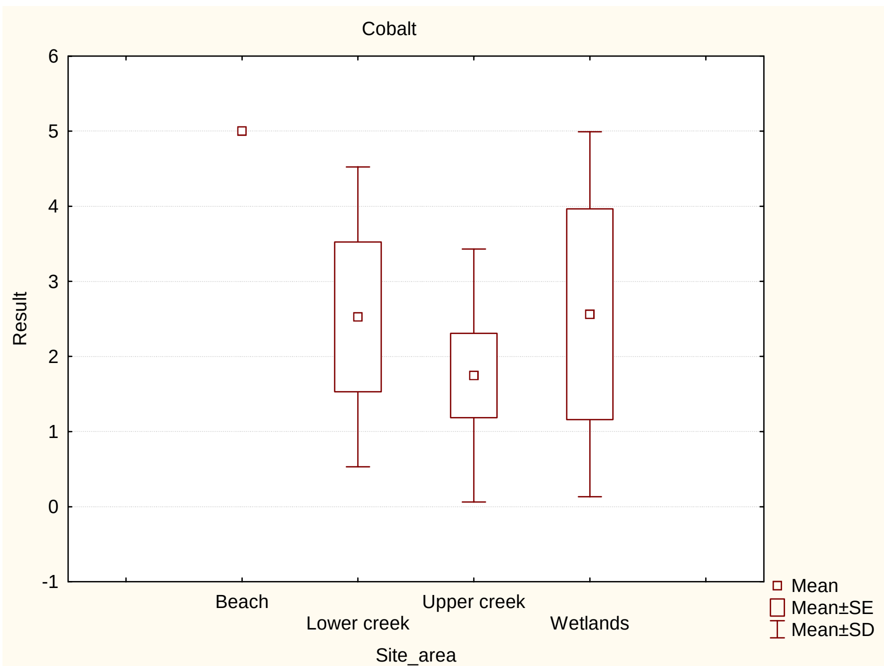


Figure I-70. Cobalt concentrations in surface water

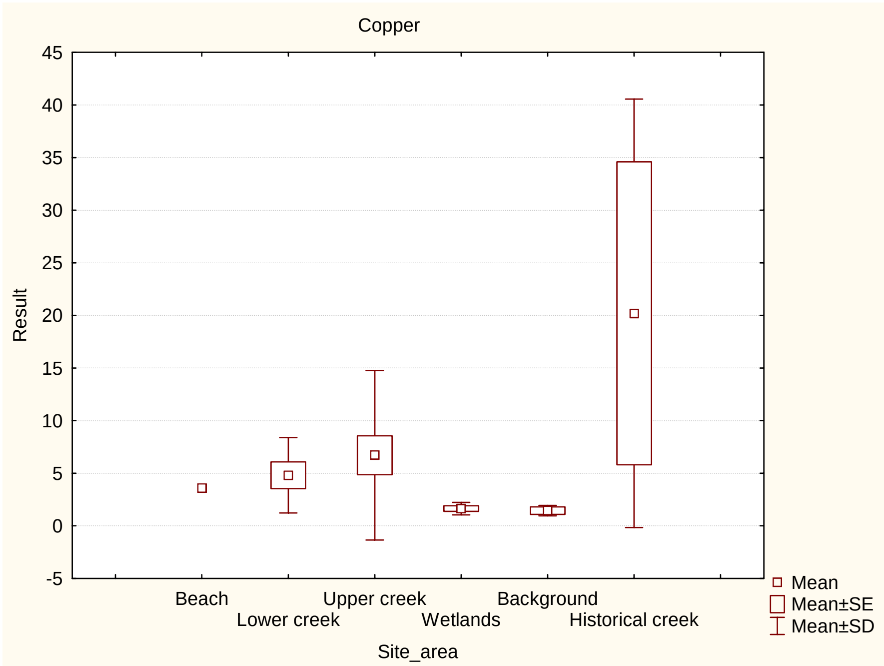


Figure I-71. Copper concentrations in surface water

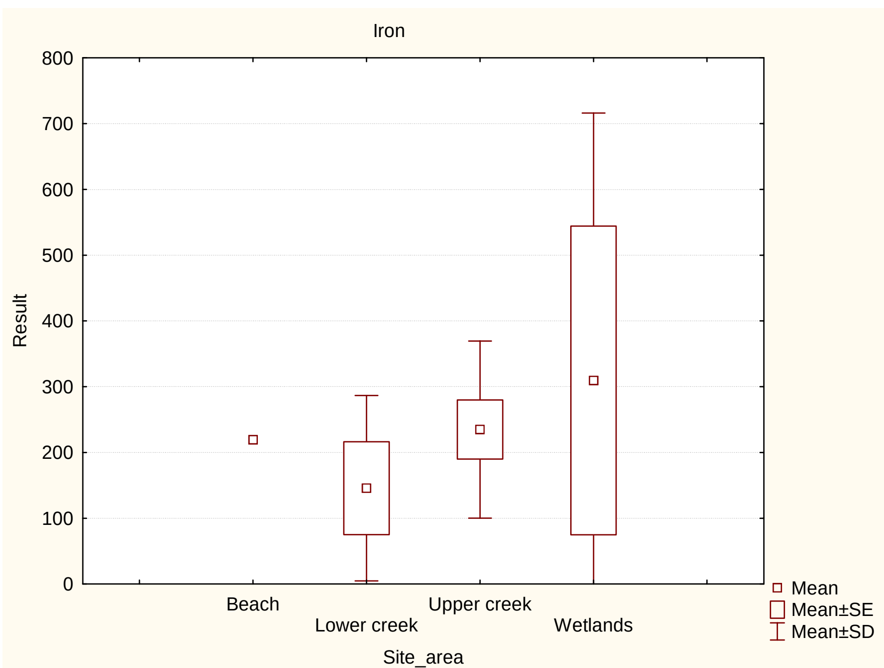


Figure I-72. Iron concentrations in surface water

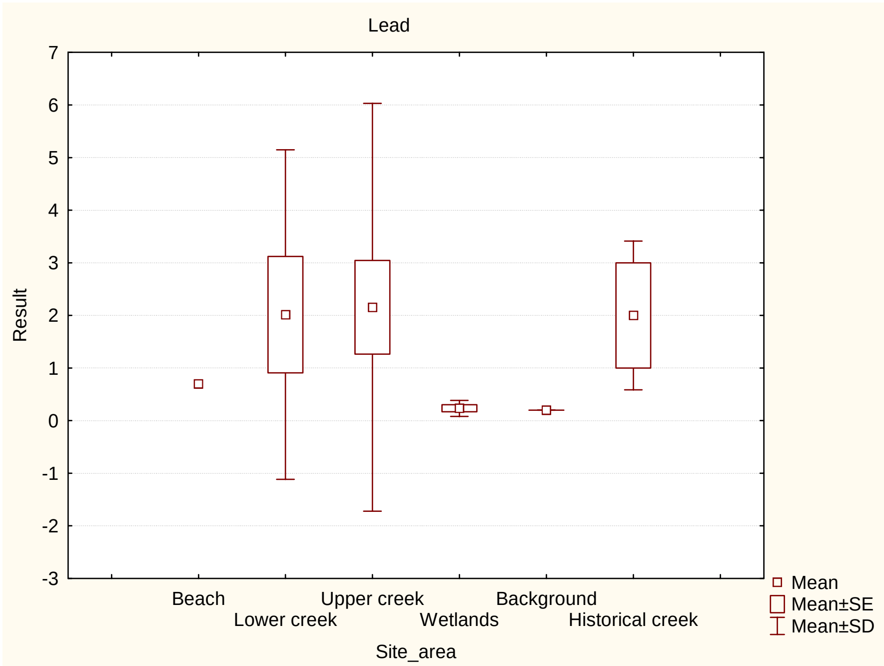


Figure I-73. Lead concentrations in surface water

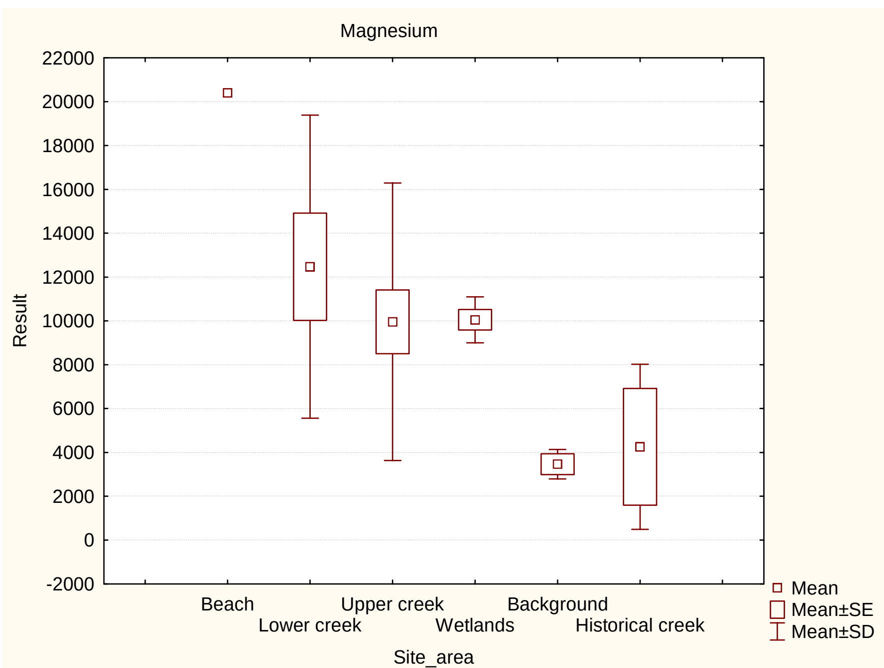


Figure I-74. Magnesium concentrations in surface water

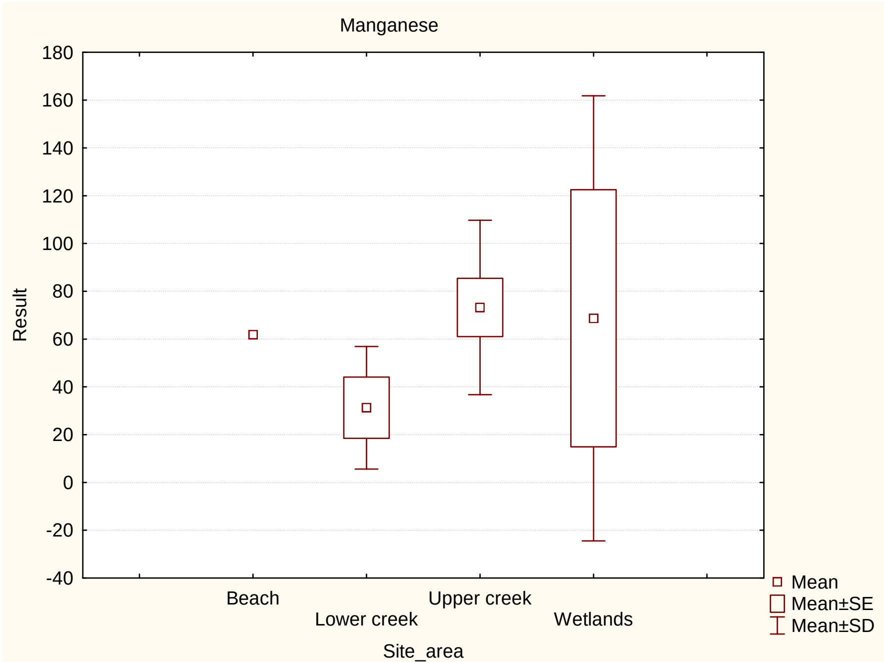


Figure I-75. Manganese concentrations in surface water

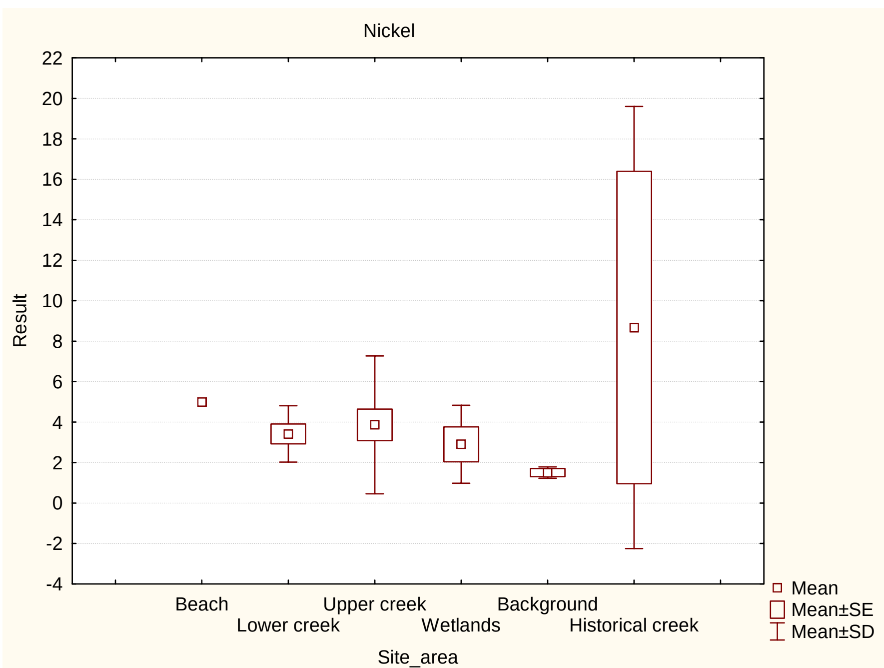


Figure I-76. Nickel concentrations in surface water

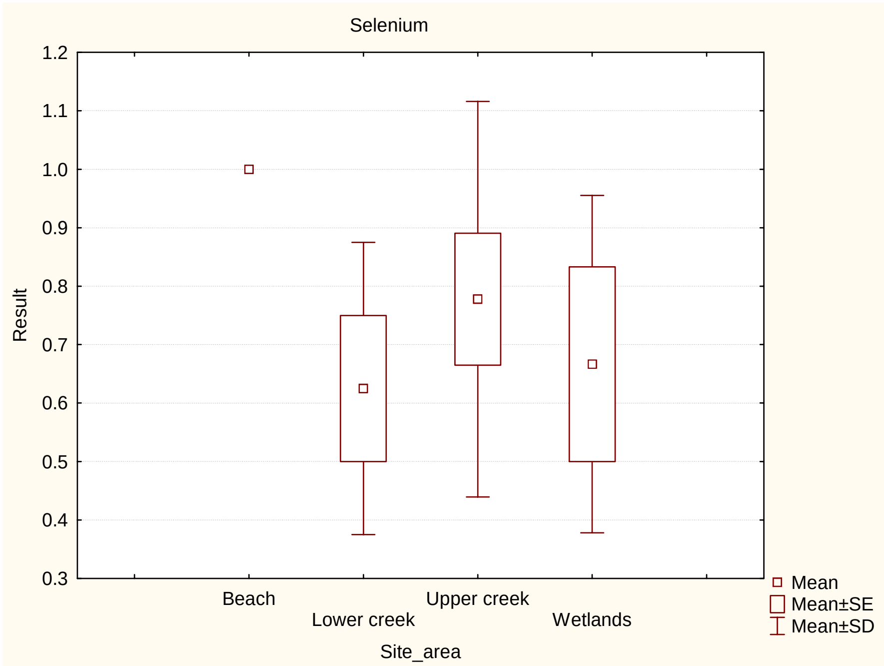


Figure I-77. Selenium concentrations in surface water

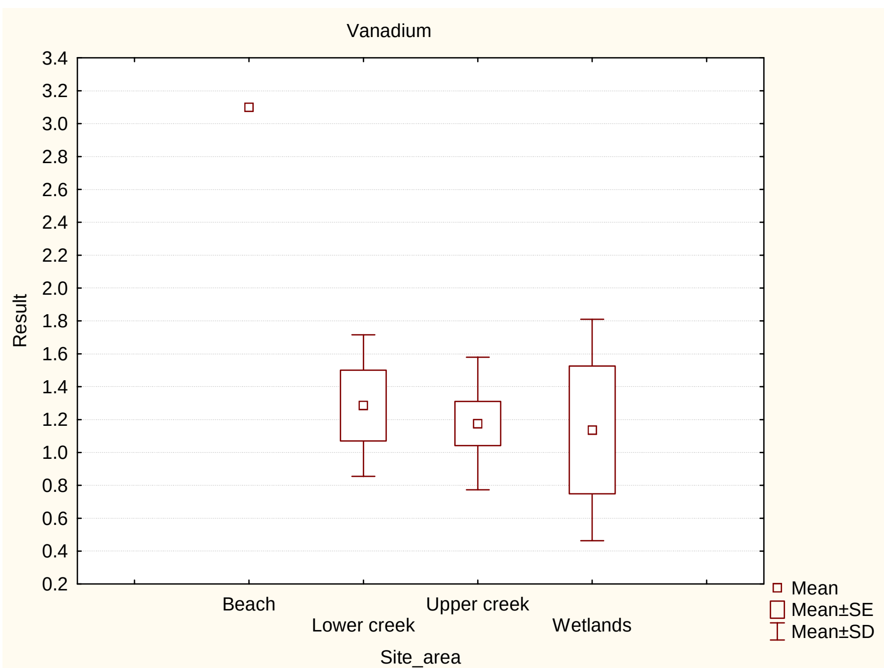


Figure I-78. Vanadium concentrations in surface water

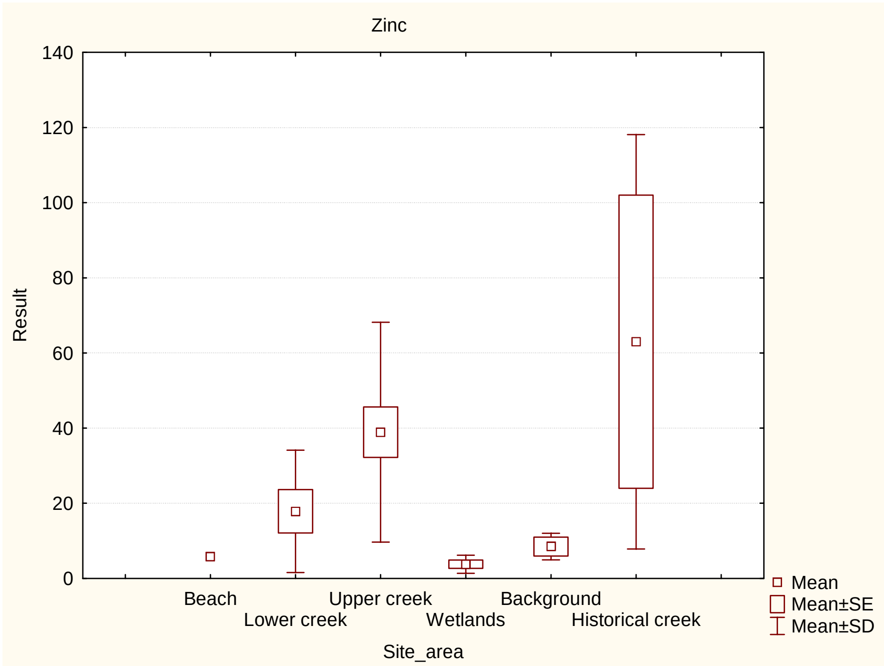


Figure I-79. Zinc concentrations in surface water

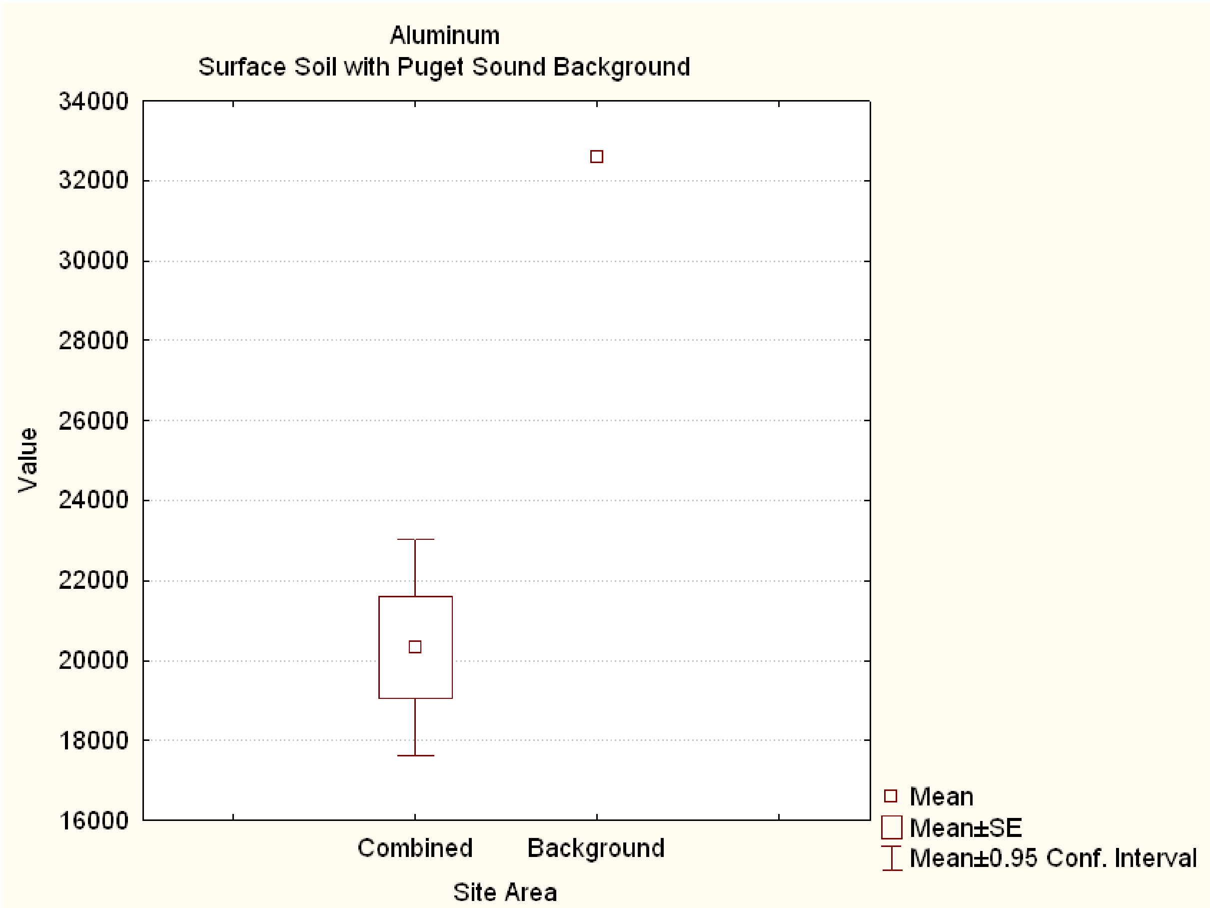


Figure I-80. Aluminum concentrations in site surface soil compared to Puget Sound natural background

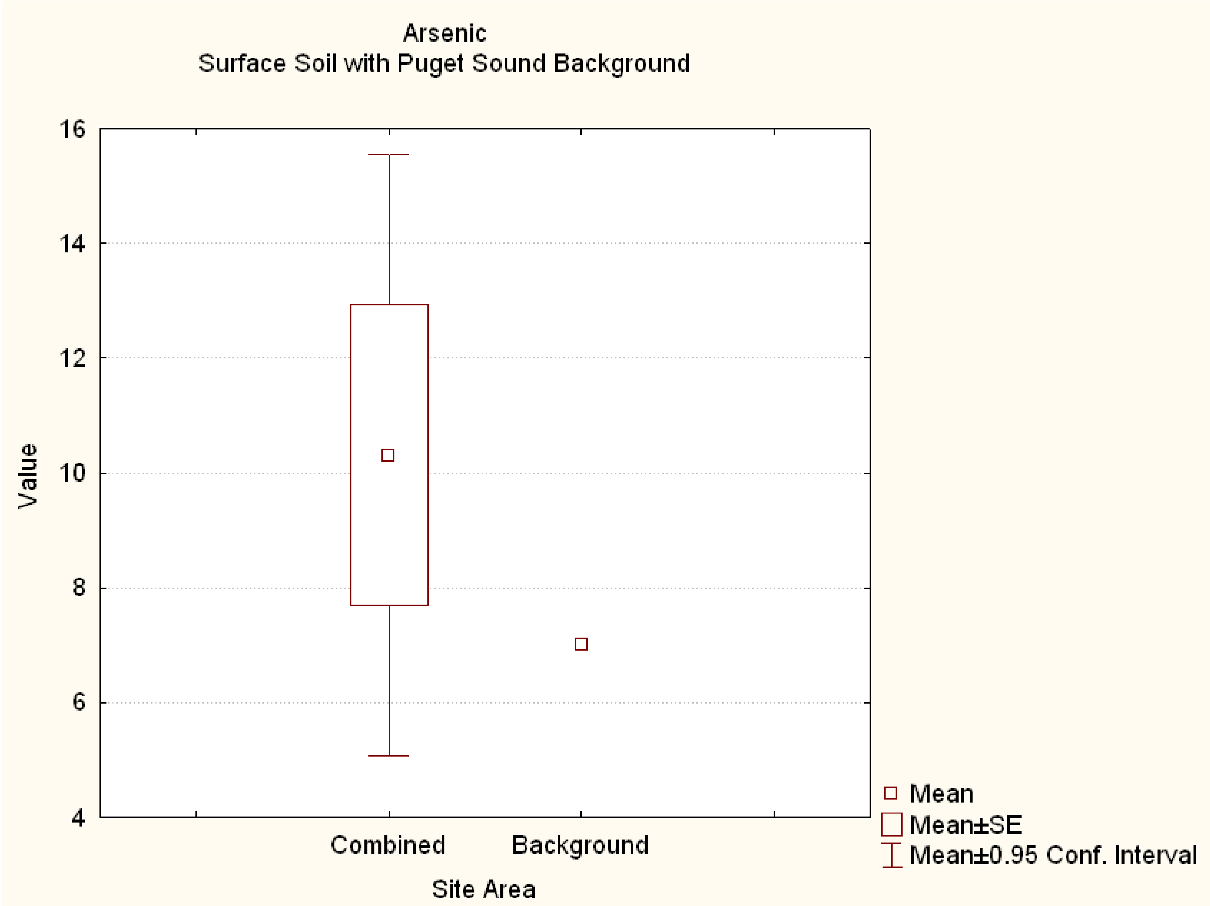


Figure I-81. Arsenic concentrations in site surface soil compared to Puget Sound natural background

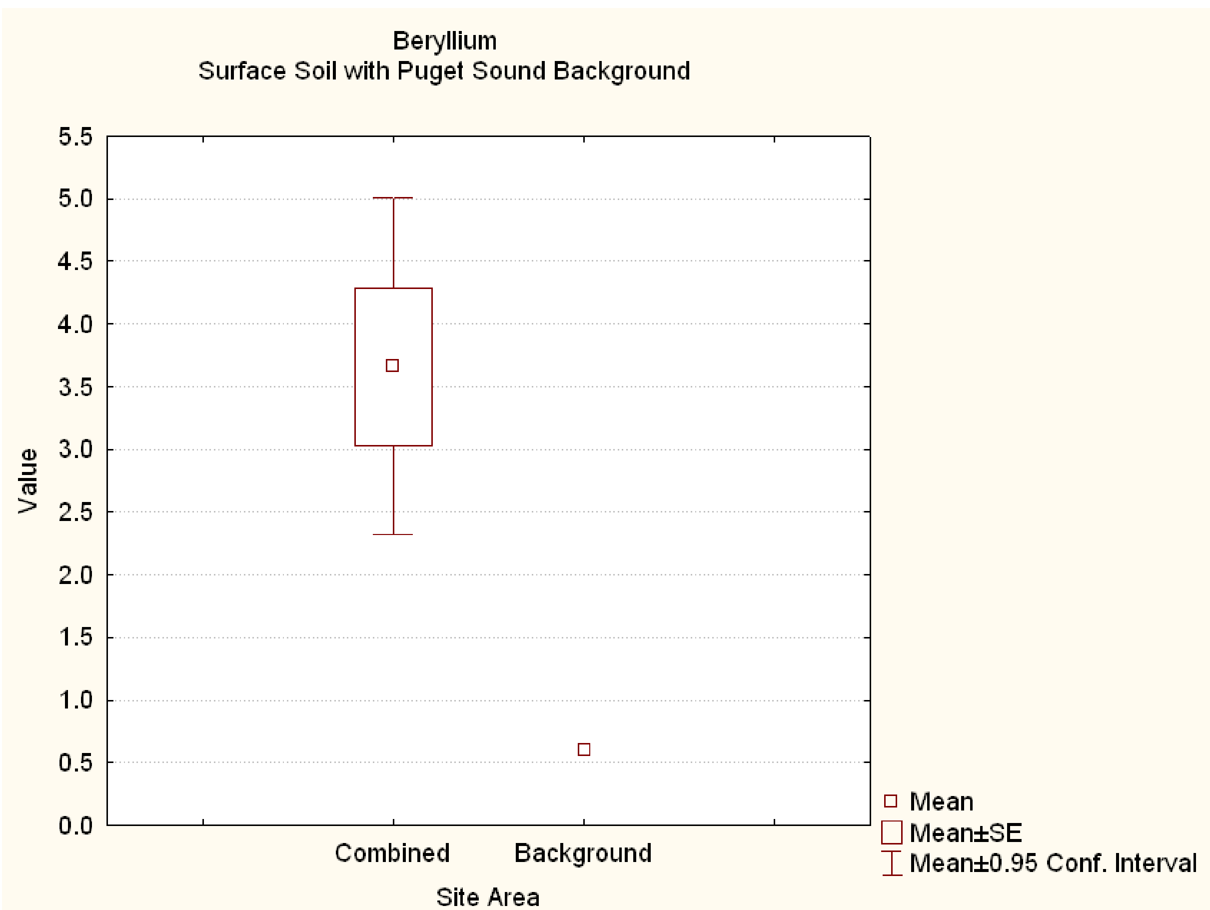


Figure I-82. Beryllium concentrations in site surface soil compared to Puget Sound natural background

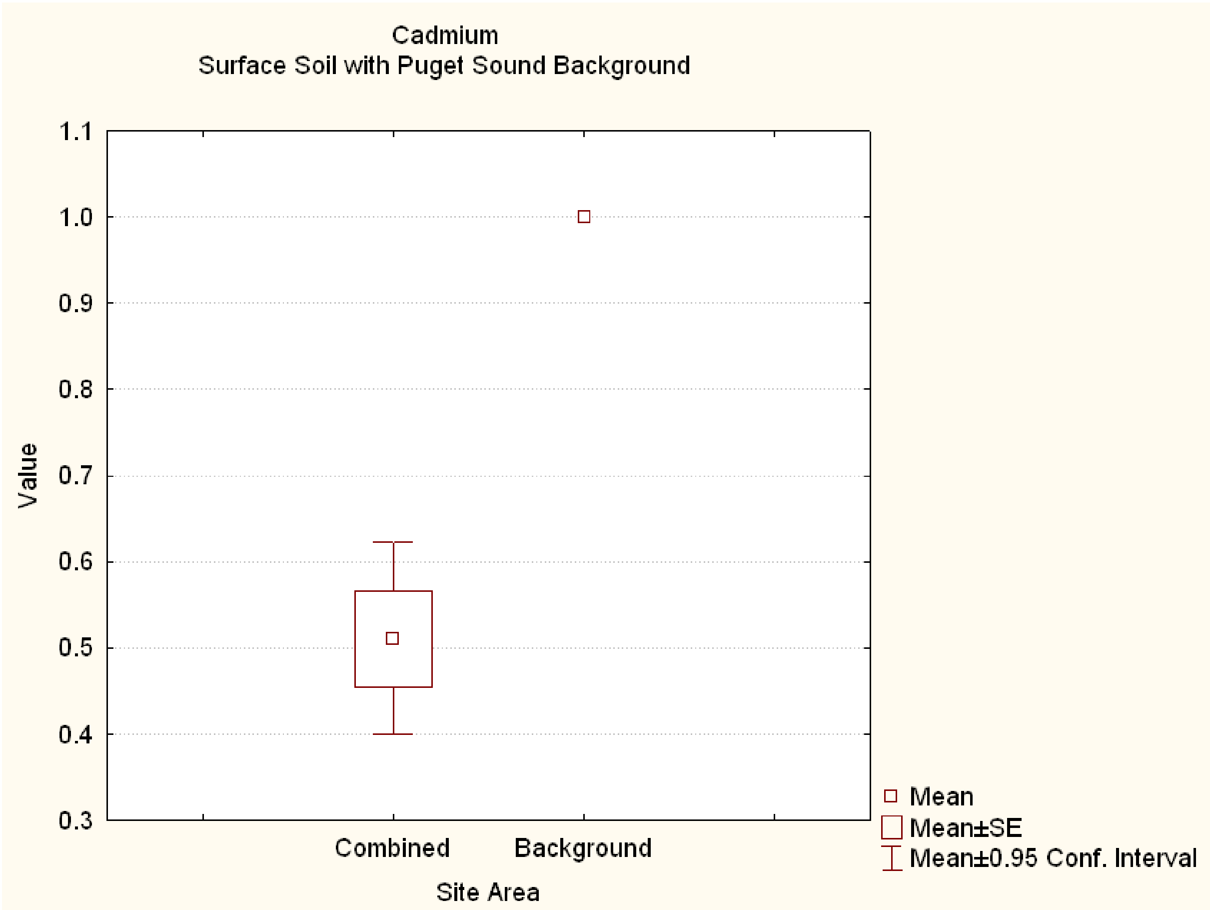


Figure I-83. Cadmium concentrations in site surface soil compared to Puget Sound natural background

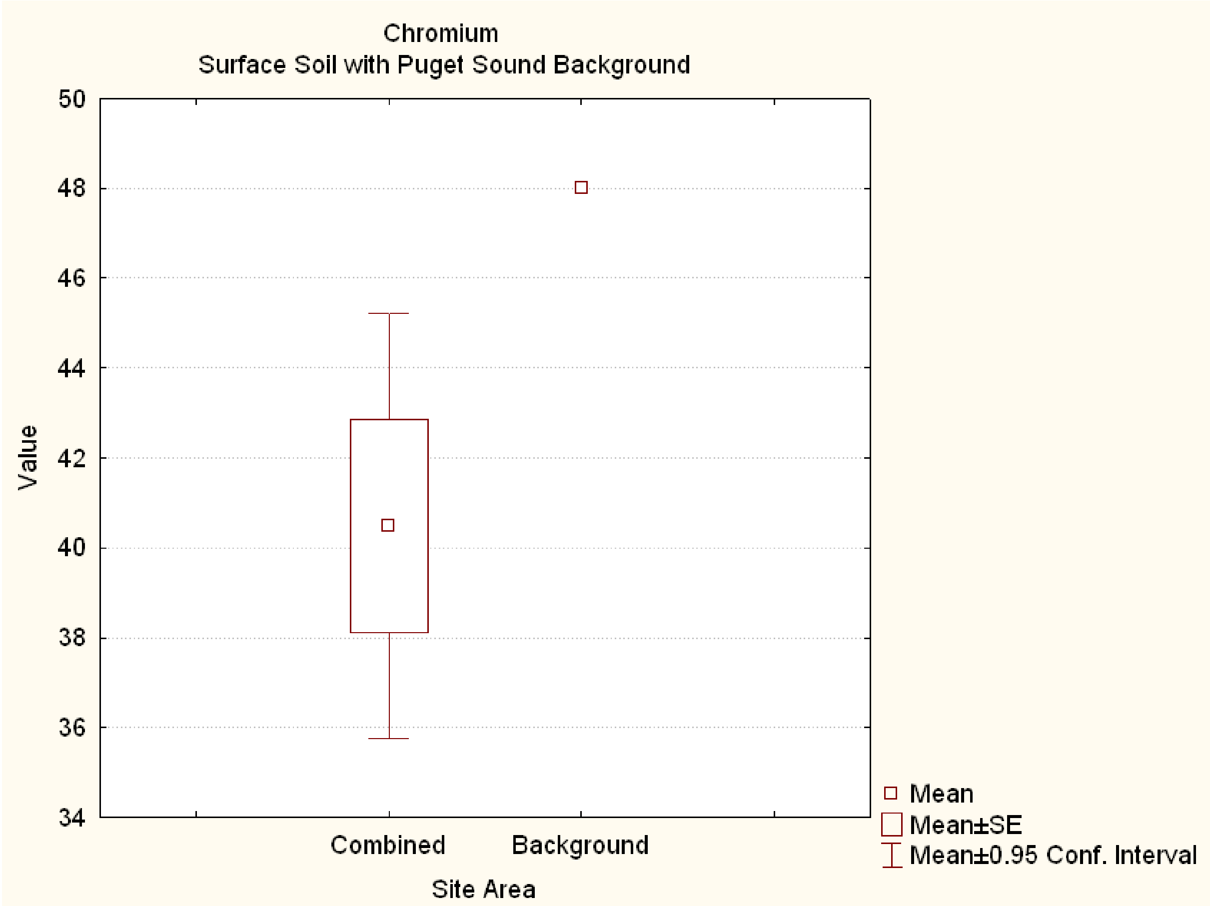


Figure I-84. Chromium concentrations in site surface soil compared to Puget Sound natural background

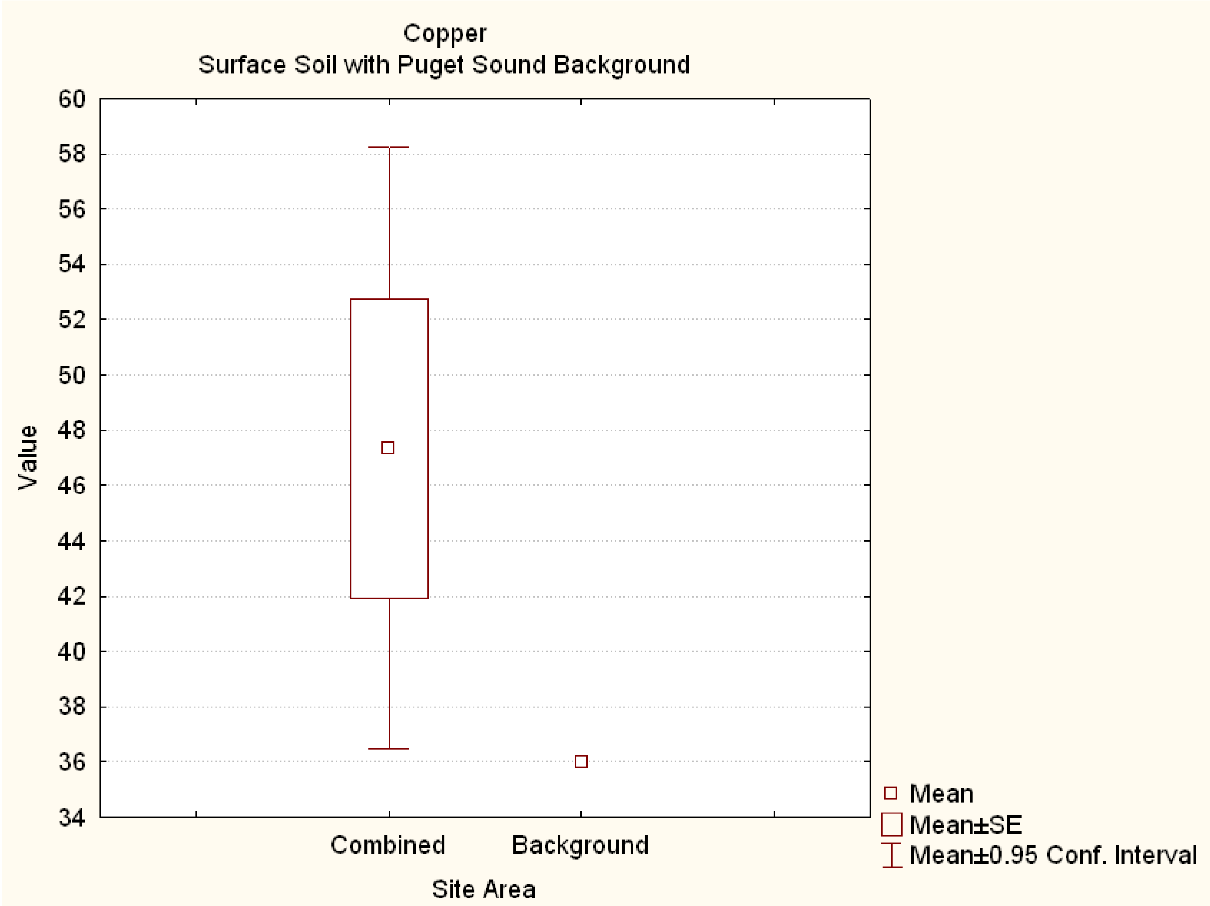


Figure I-85. Copper concentrations in site surface soil compared to Puget Sound natural background

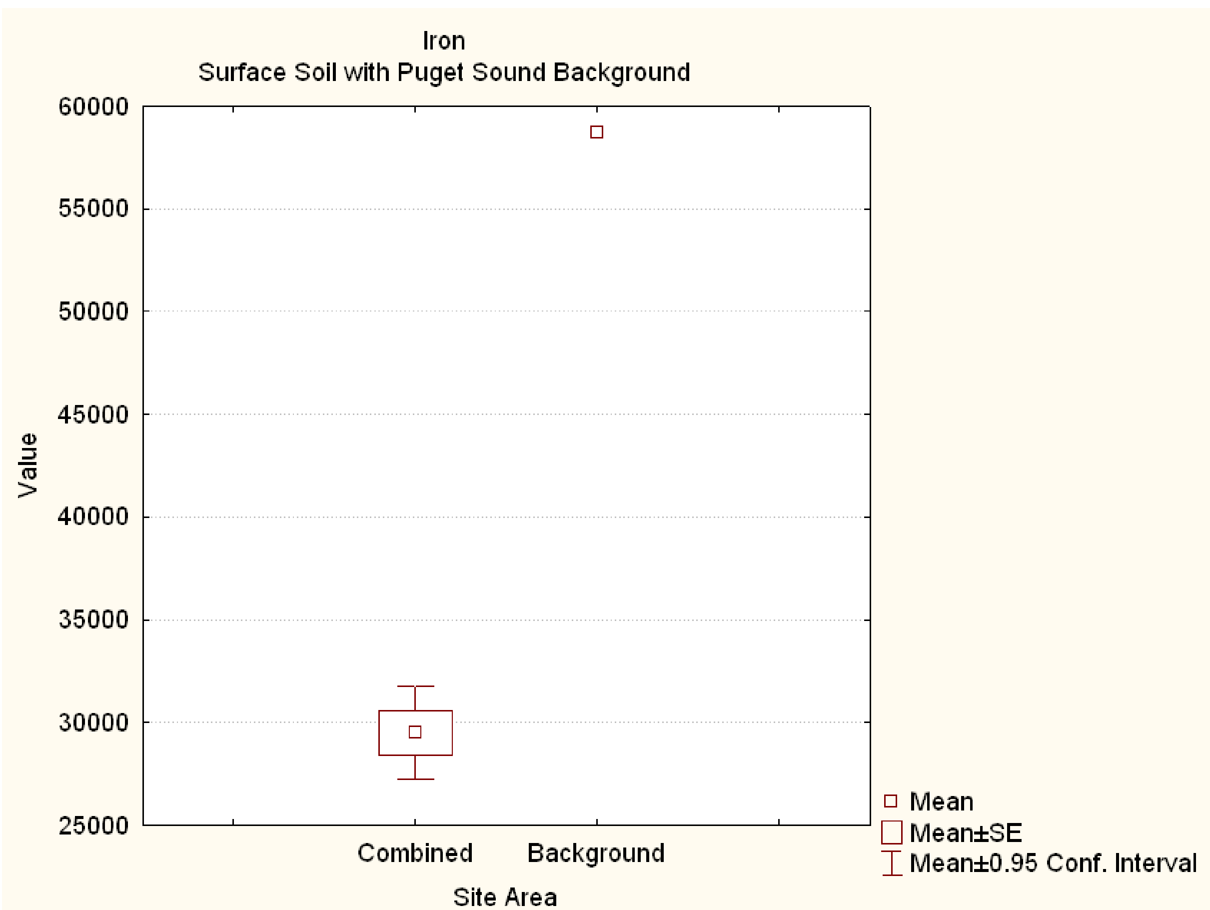


Figure I-86. Iron concentrations in site surface soil compared to Puget Sound natural background

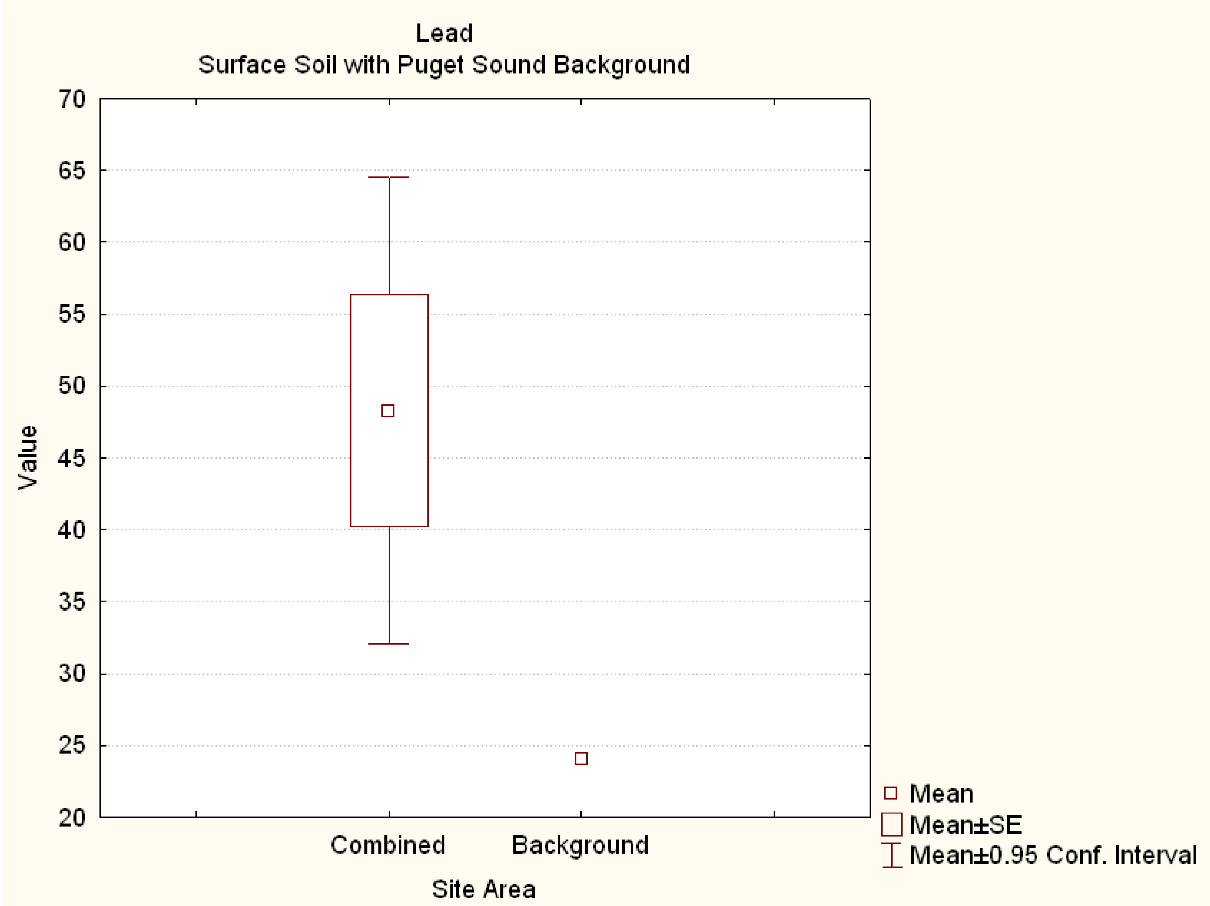


Figure I-87. Lead concentrations in site surface soil compared to Puget Sound natural background

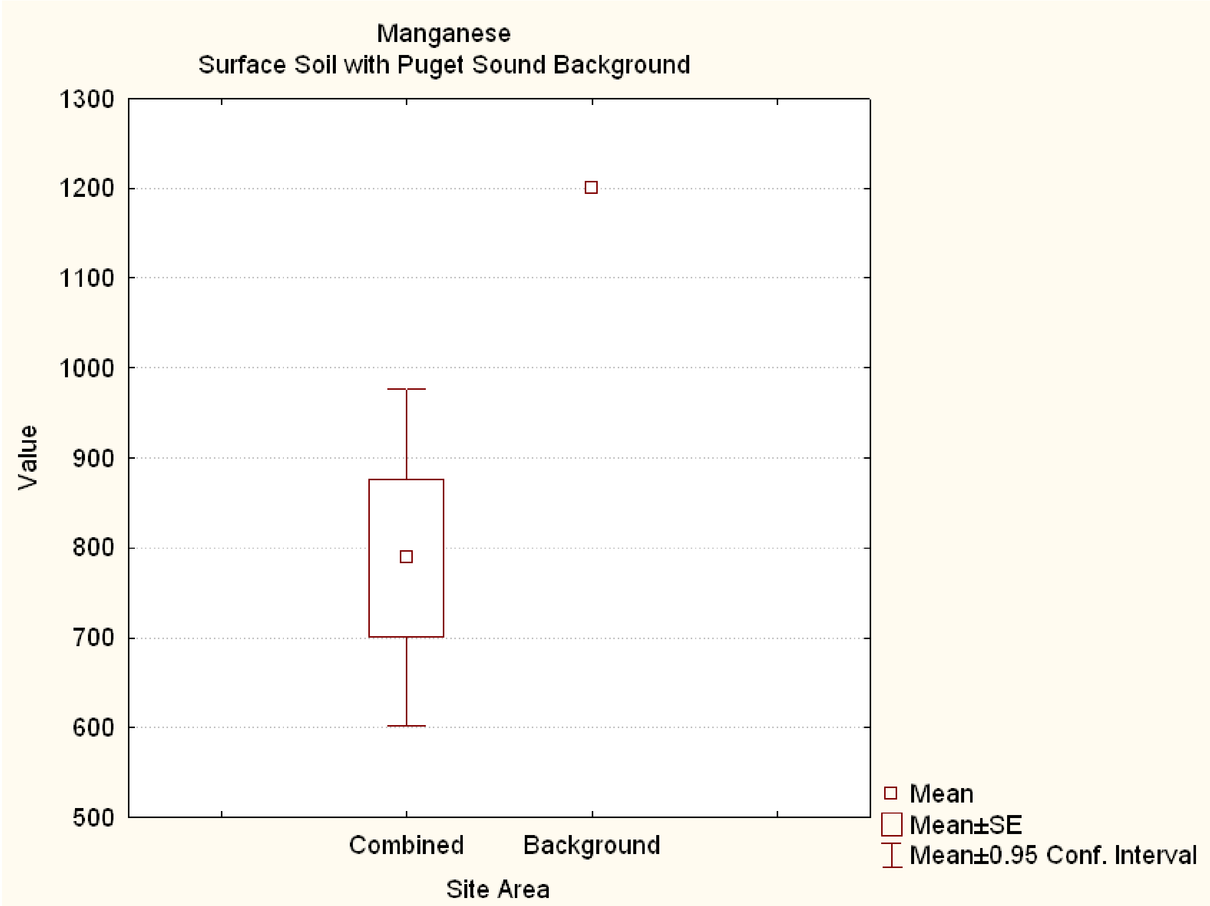


Figure I-88. Manganese concentrations in site surface soil compared to Puget Sound natural background

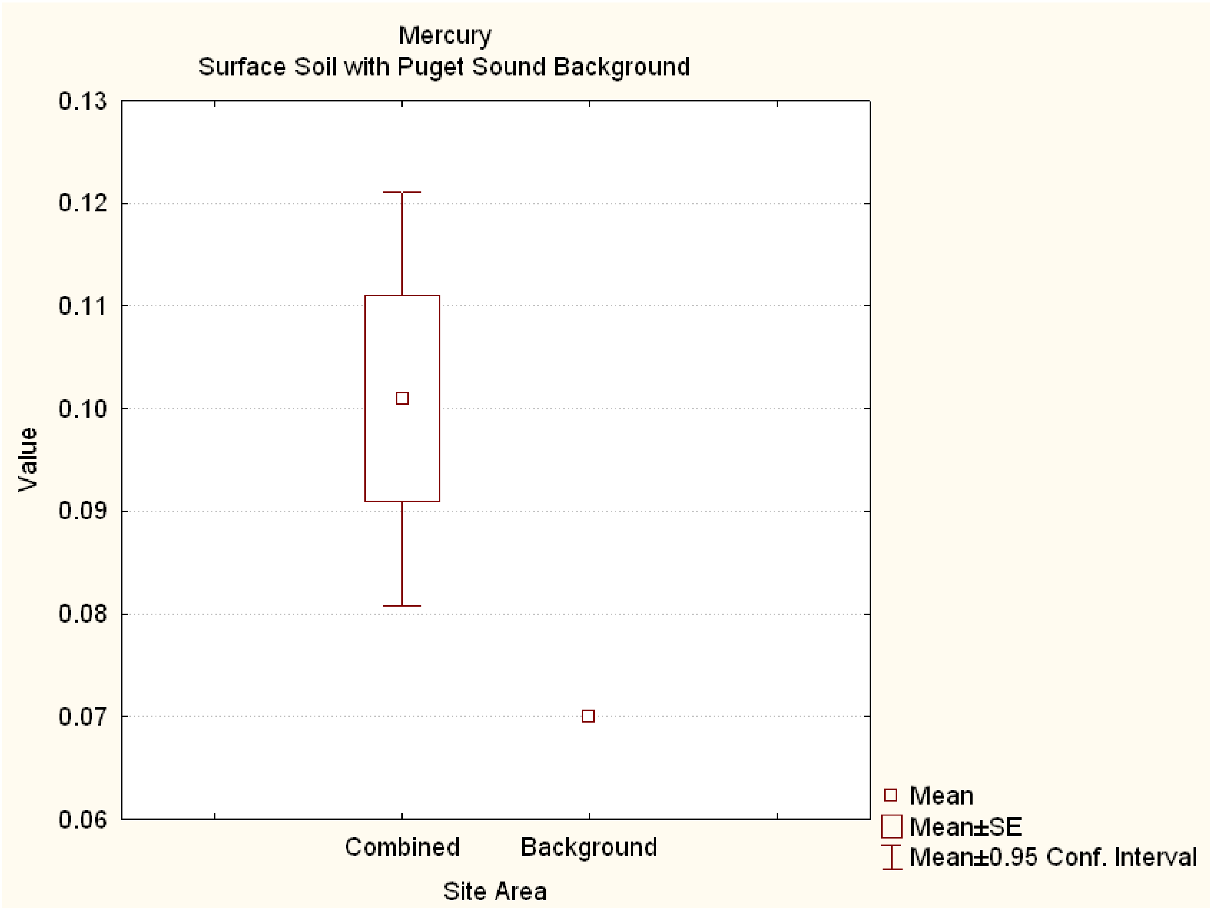


Figure I-89. Mercury concentrations in site surface soil compared to Puget Sound natural background

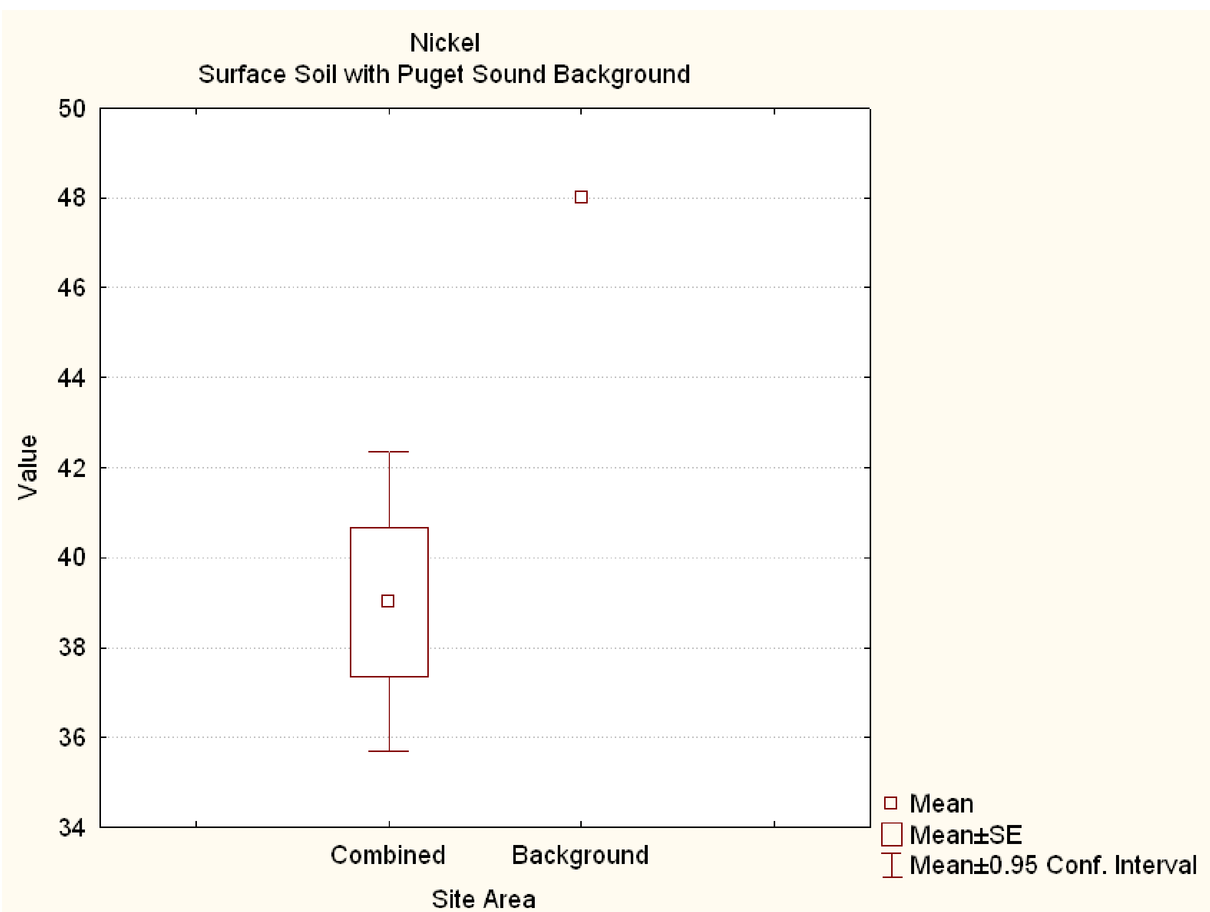


Figure I-90. Nickel concentrations in site surface soil compared to Puget Sound natural background

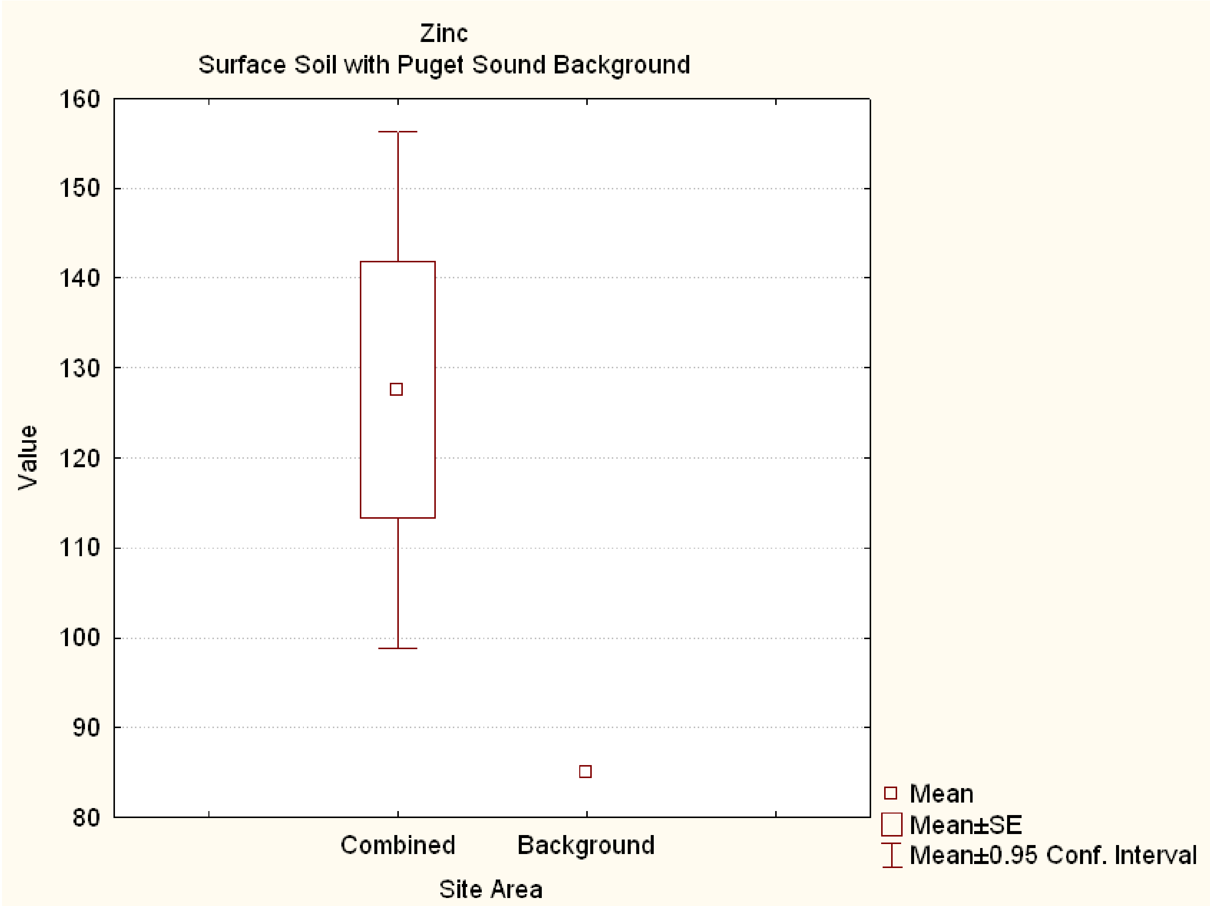


Figure I-91. Zinc concentrations in site surface soil compared to Puget Sound natural background

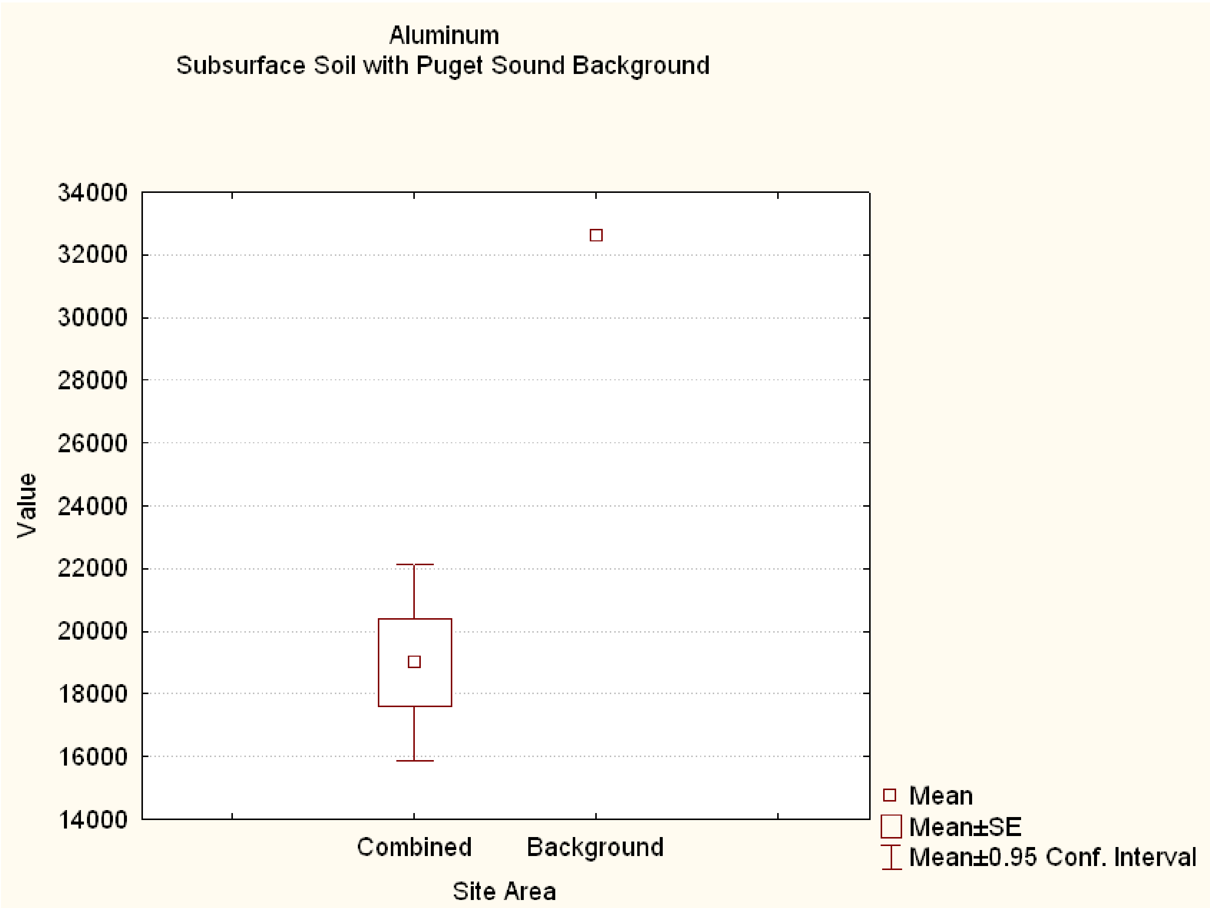


Figure I-92. Aluminum concentrations in site subsurface soils compared to Puget Sound natural background

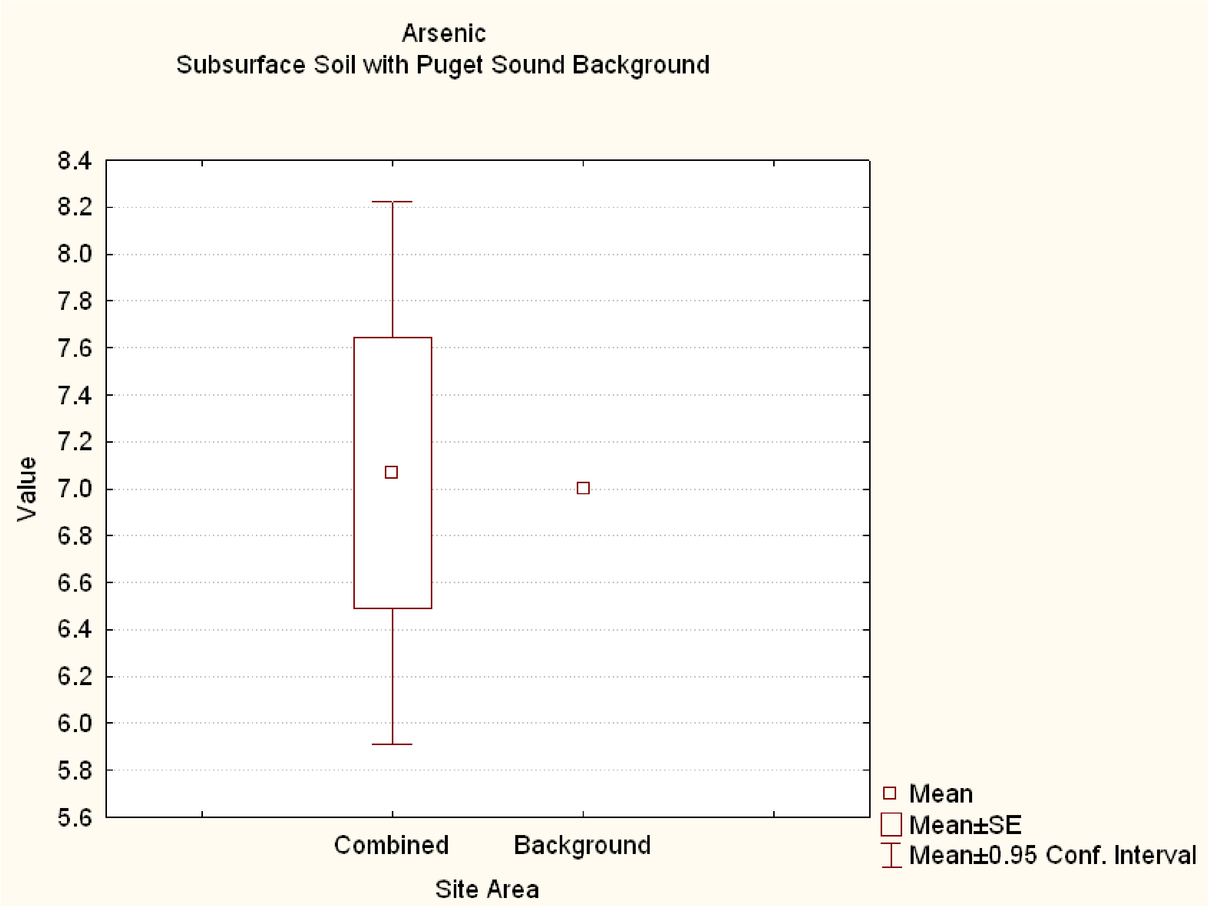


Figure I-93. Arsenic concentrations in site subsurface soils compared to Puget Sound natural background

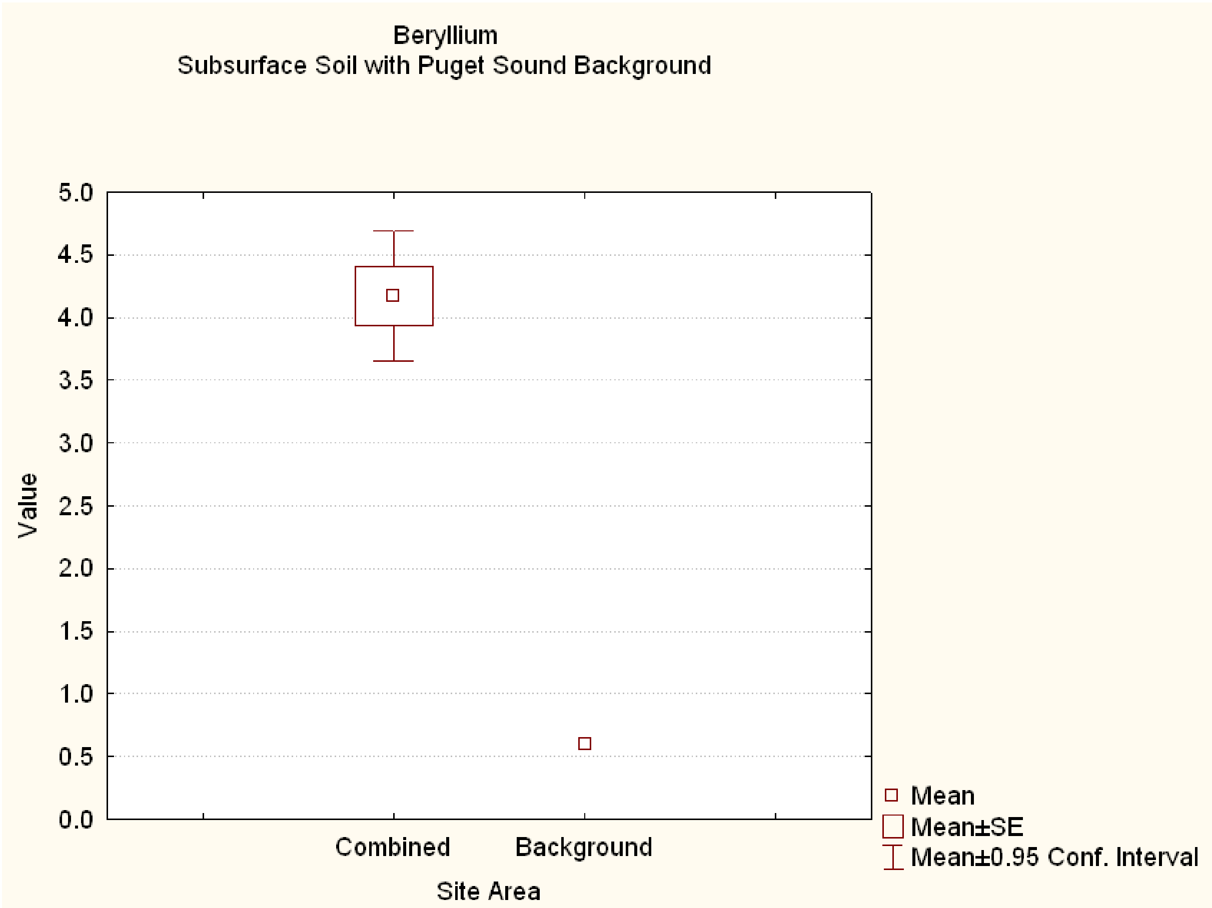


Figure I-94. Beryllium concentrations in site subsurface soils compared to Puget Sound natural background

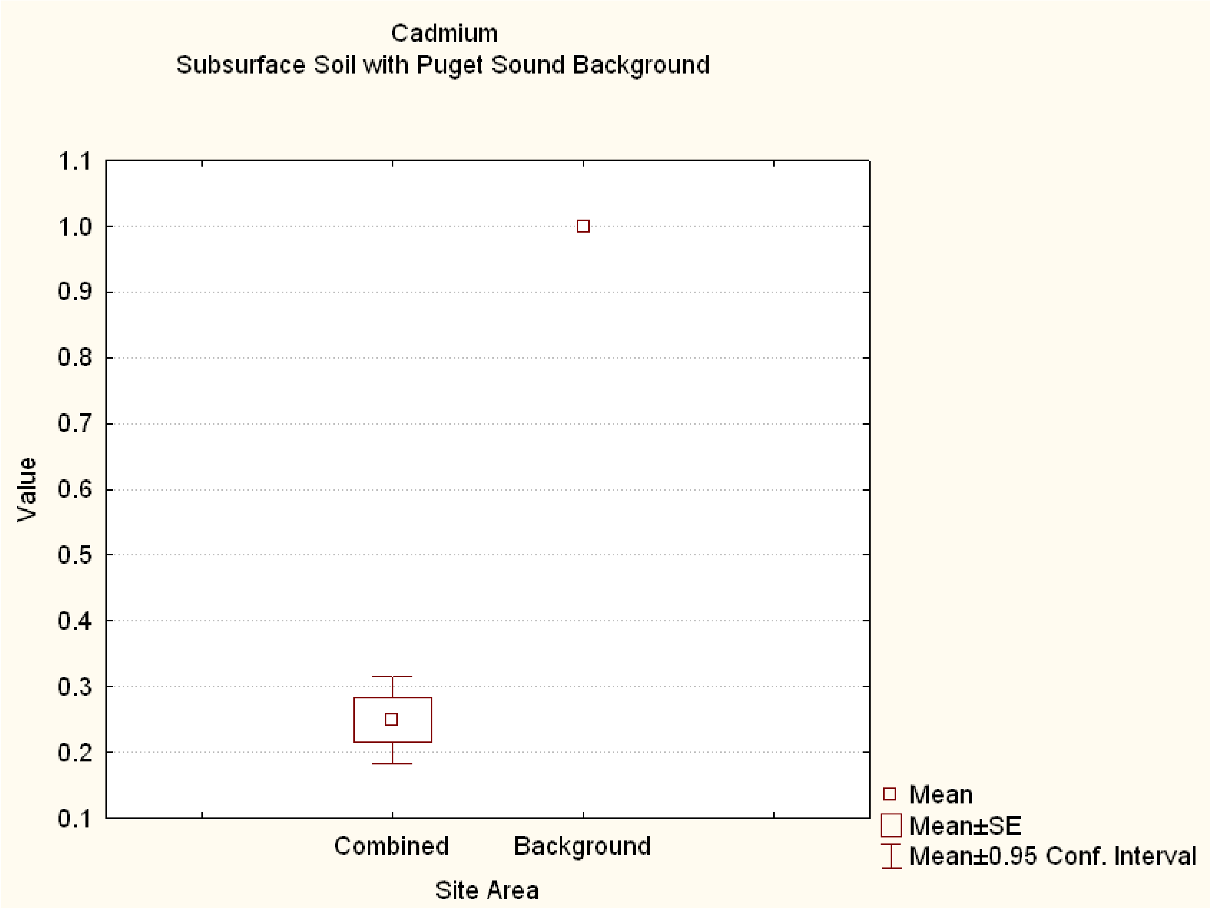


Figure I-95. Cadmium concentrations in site subsurface soils compared to Puget Sound natural background

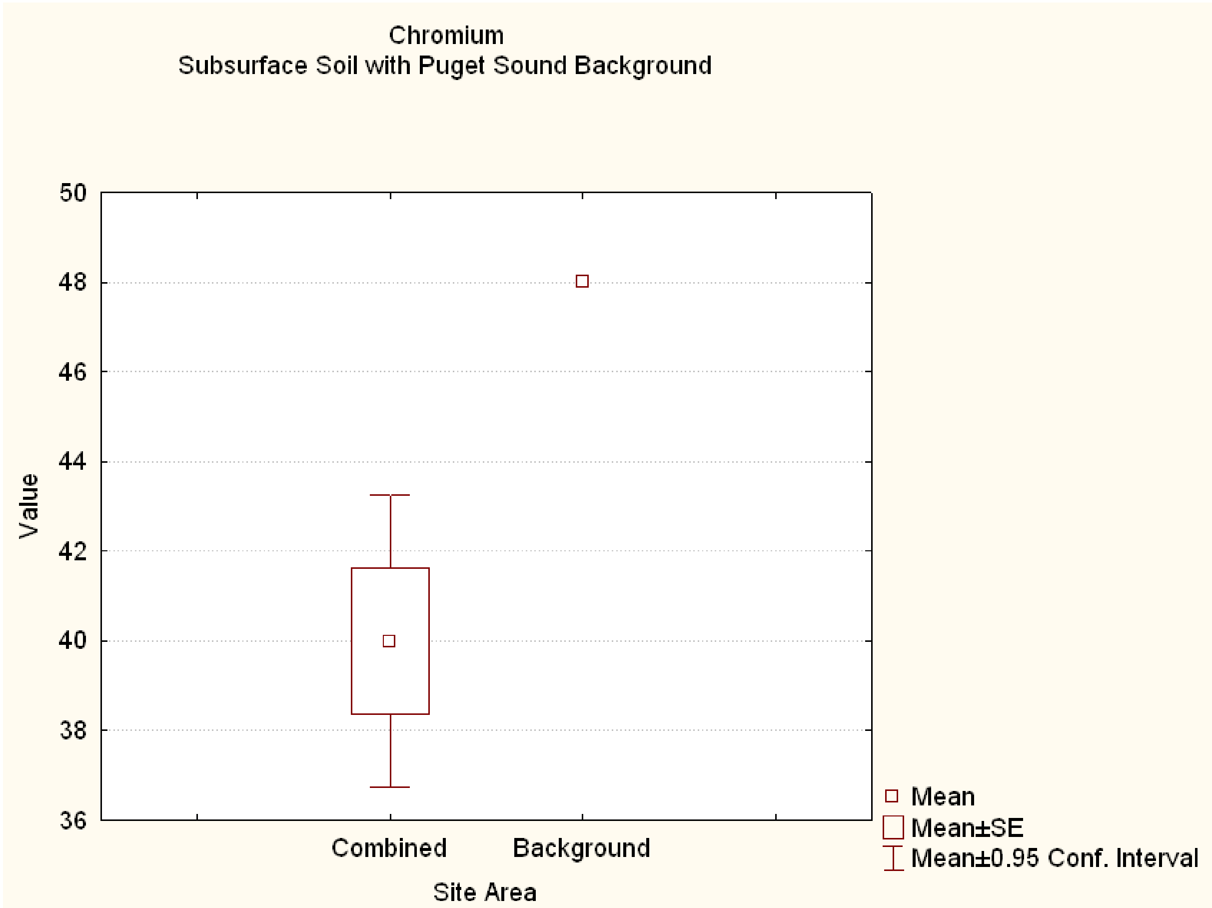


Figure I-96. Chromium concentrations in site subsurface soils compared to Puget Sound natural background

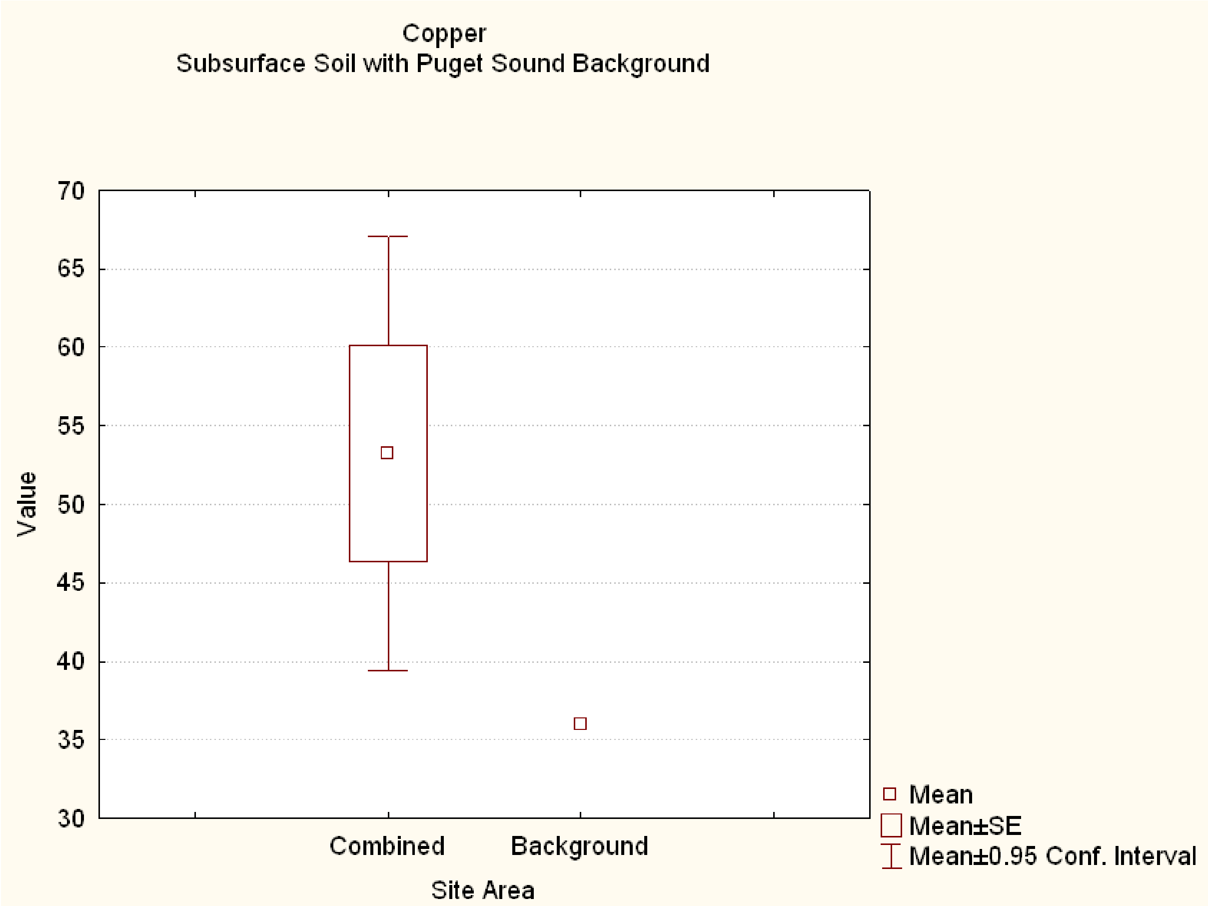


Figure I-97. Copper concentrations in site subsurface soils compared to Puget Sound natural background

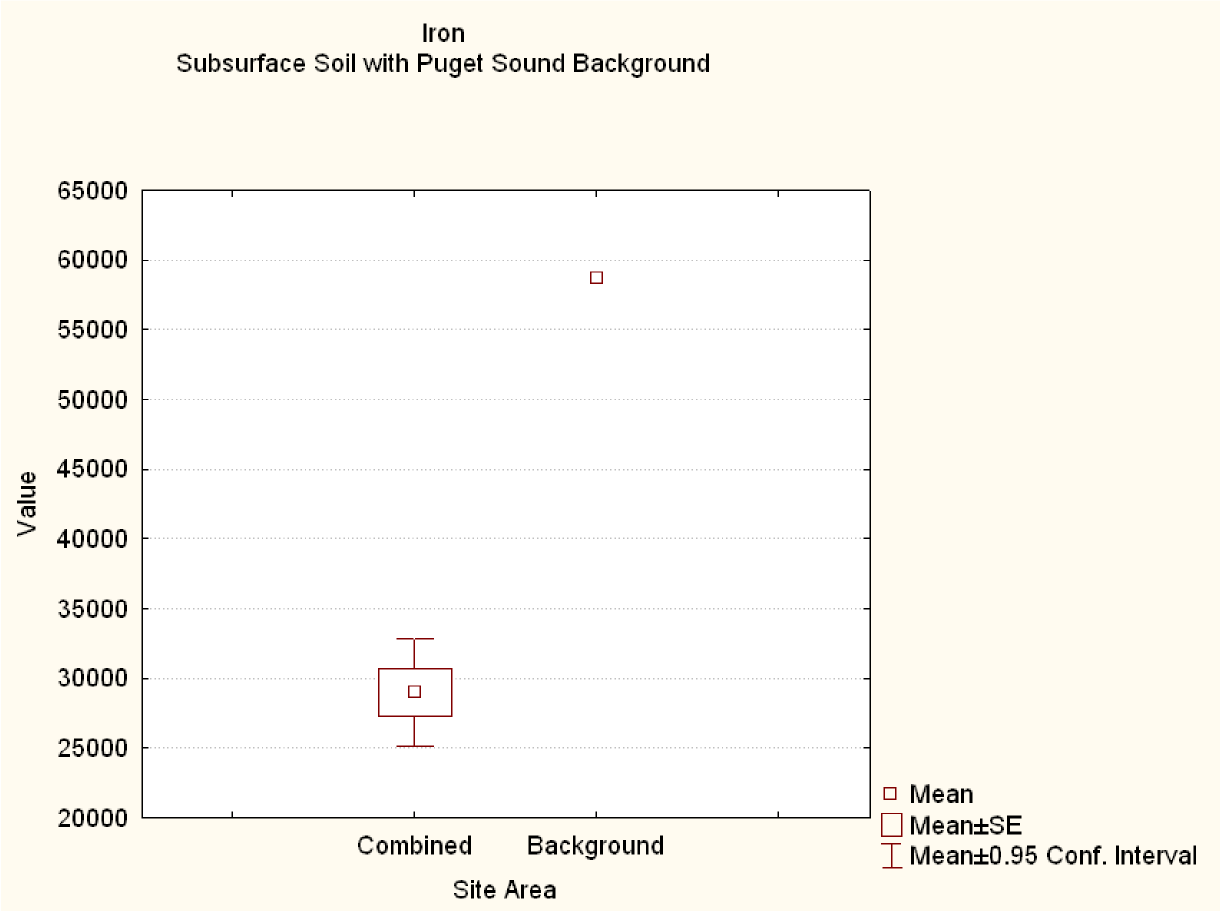


Figure I-98. Iron concentrations in site subsurface soils compared to Puget Sound natural background

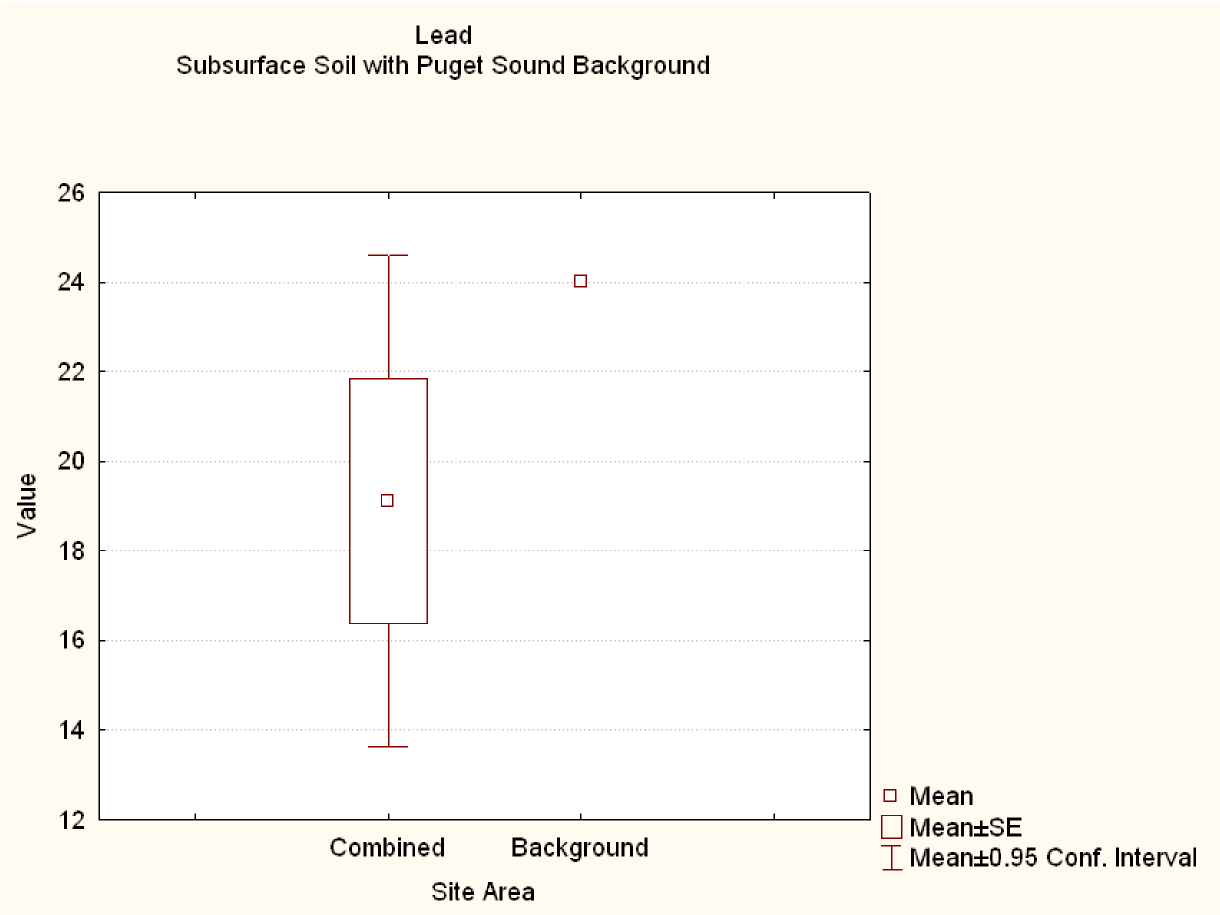


Figure I-99. Lead concentrations in site subsurface soils compared to Puget Sound natural background

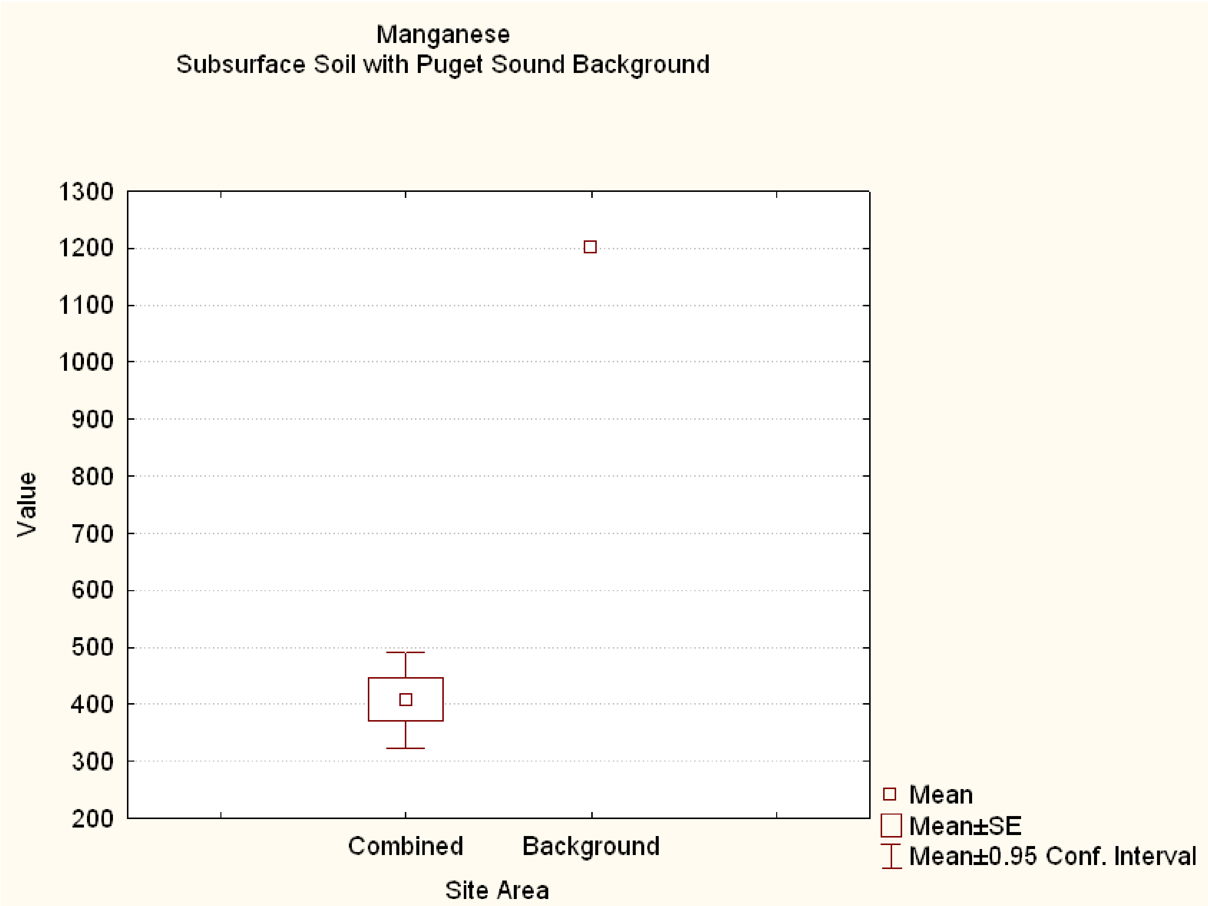


Figure I-100. Manganese concentrations in site subsurface soils compared to Puget Sound natural background

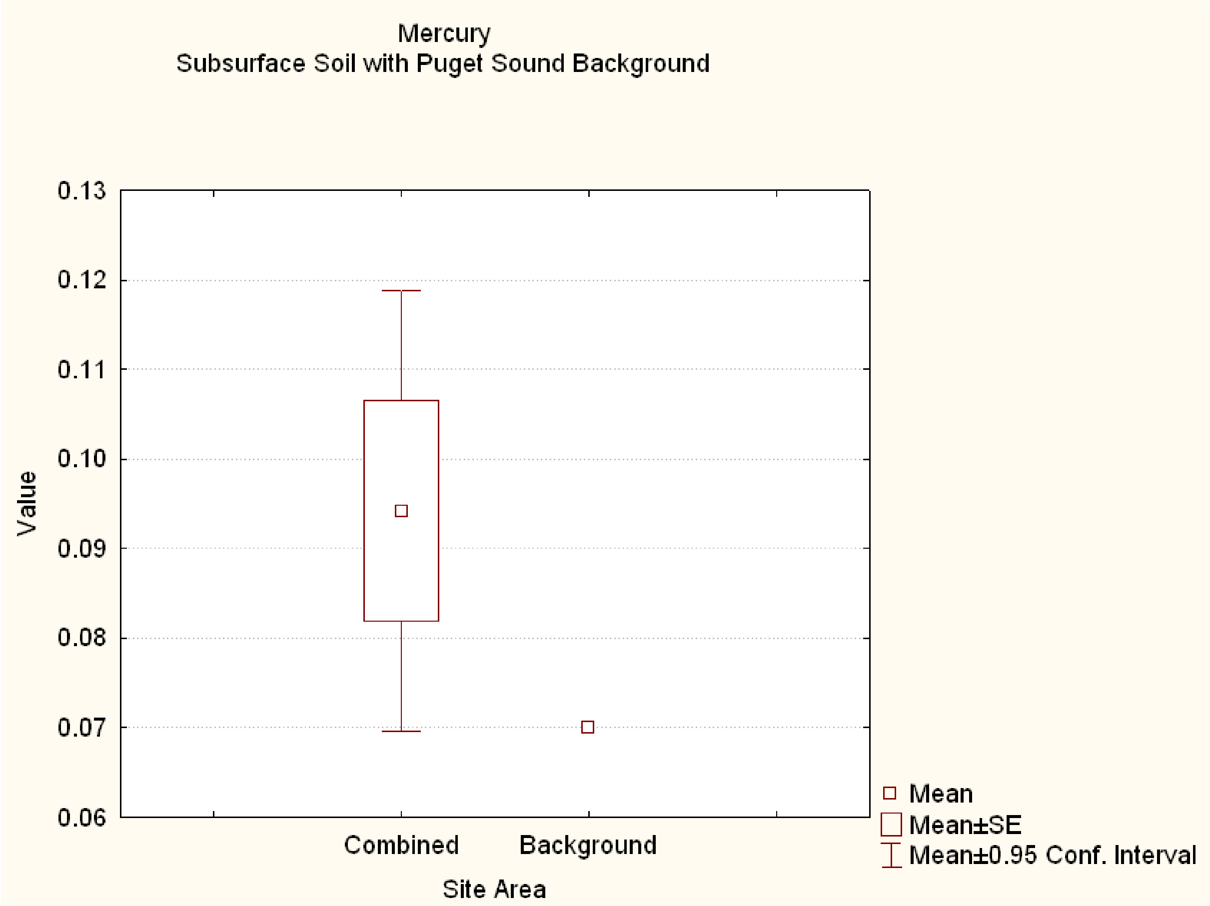


Figure I-101. Mercury concentrations in site subsurface soils compared to Puget Sound natural background

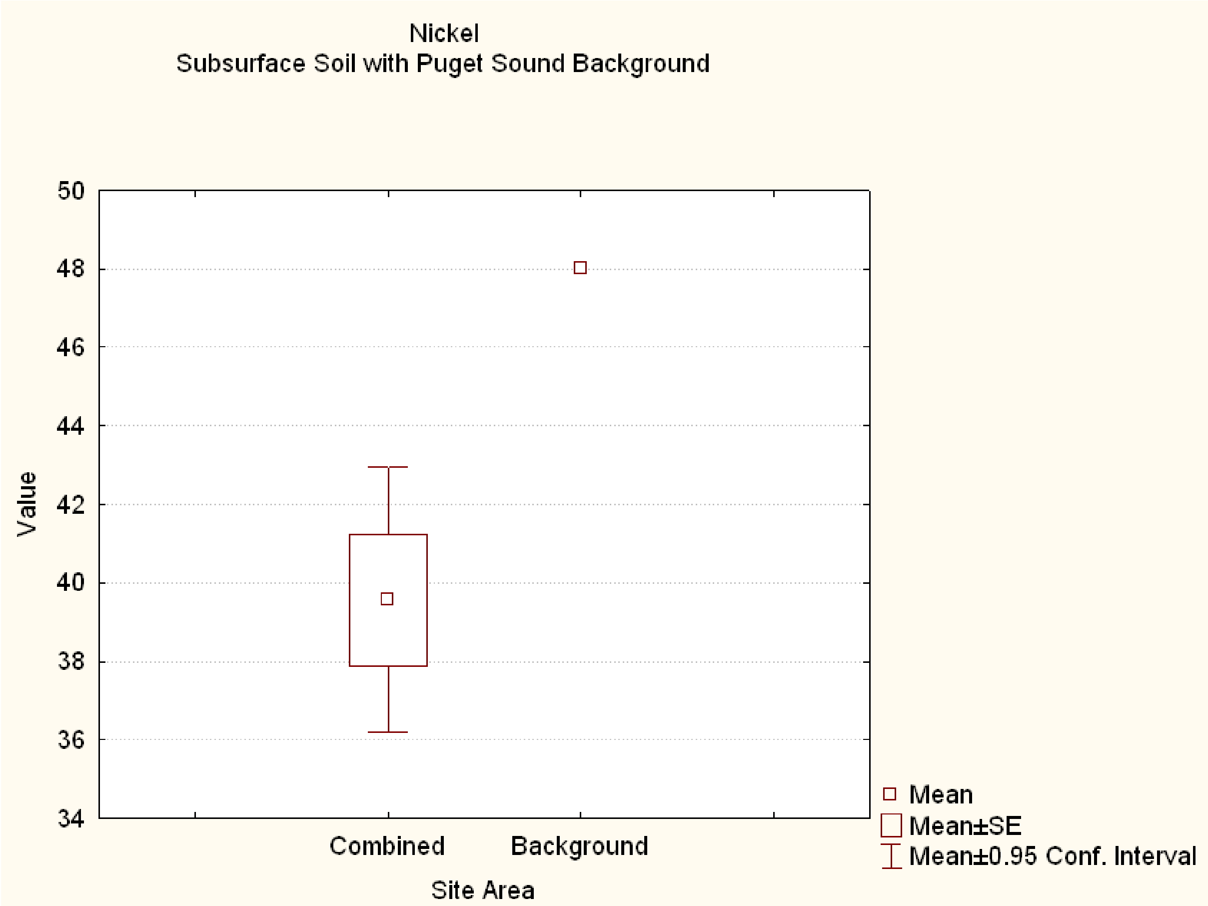


Figure I-102. Nickel concentrations in site subsurface soils compared to Puget Sound natural background

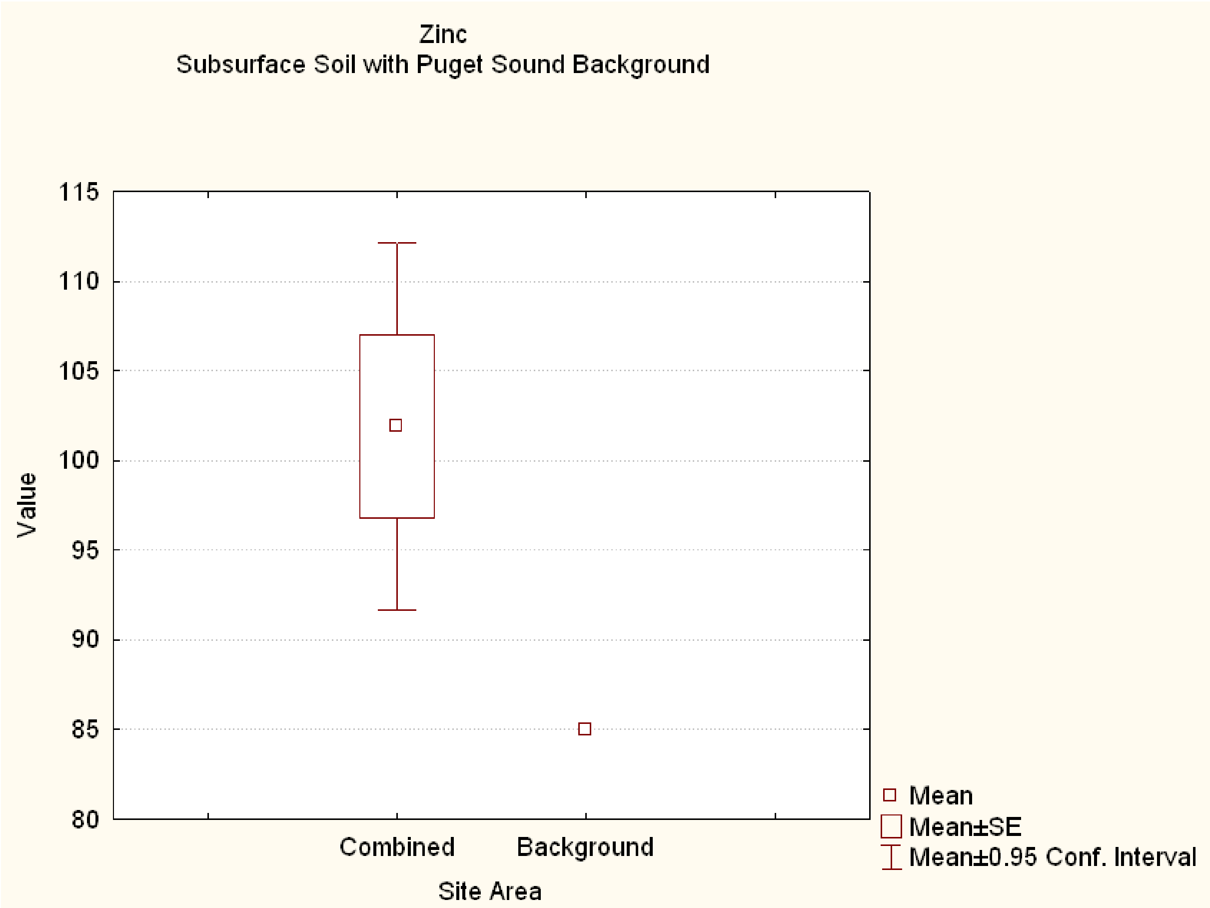


Figure I-103. Zinc concentrations in site subsurface soils compared to Puget Sound natural background

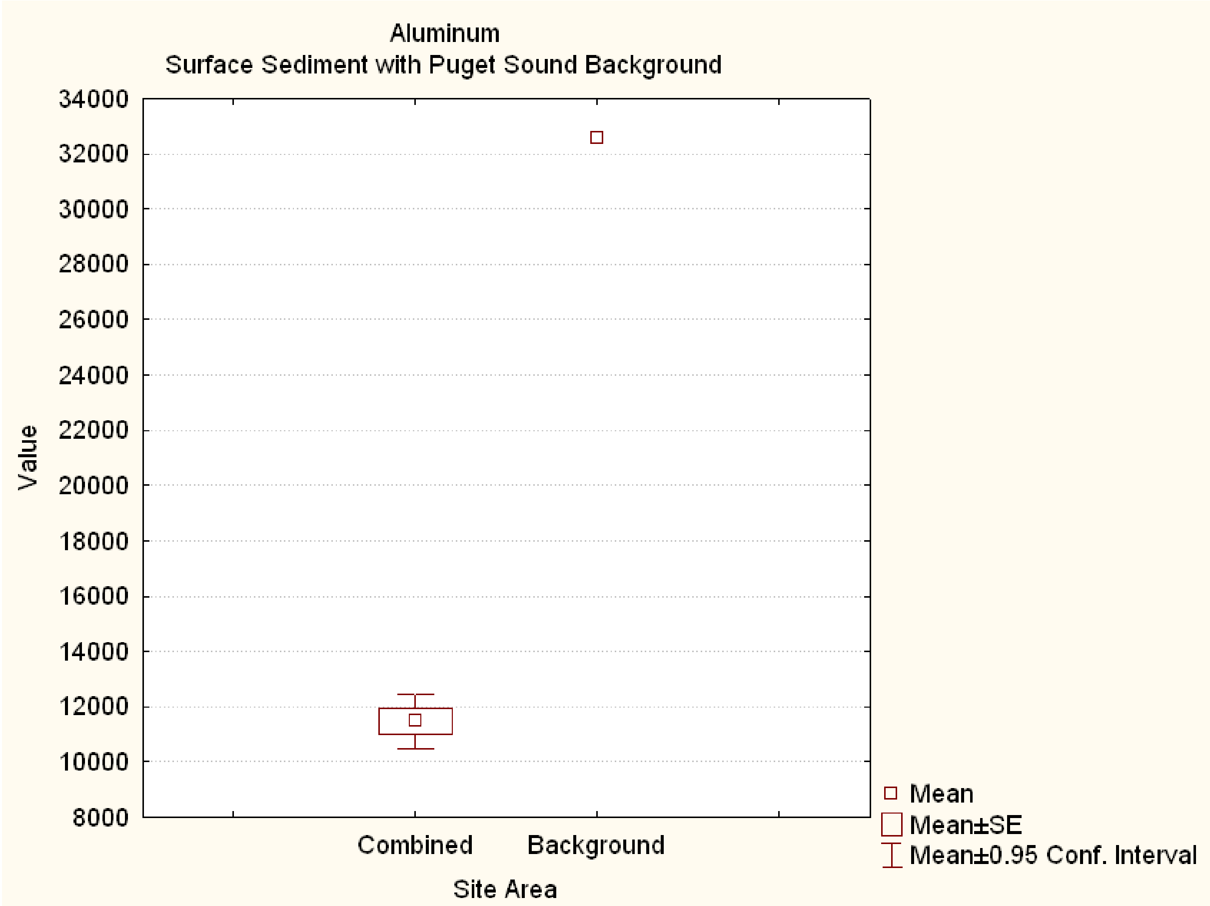


Figure I-104. Aluminum concentrations in site surface sediments compared to Puget Sound natural background

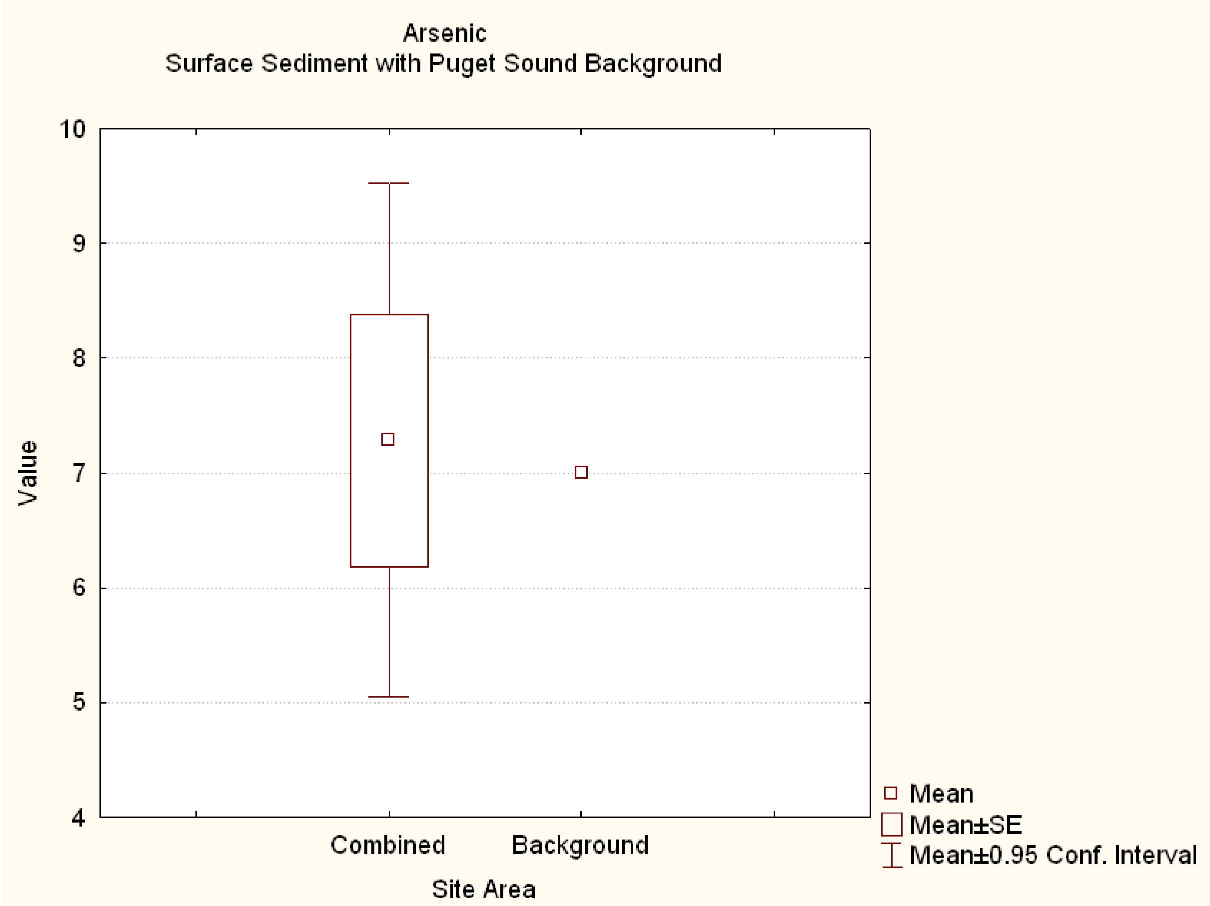


Figure I-105. Arsenic concentrations in site surface sediments compared to Puget Sound natural background

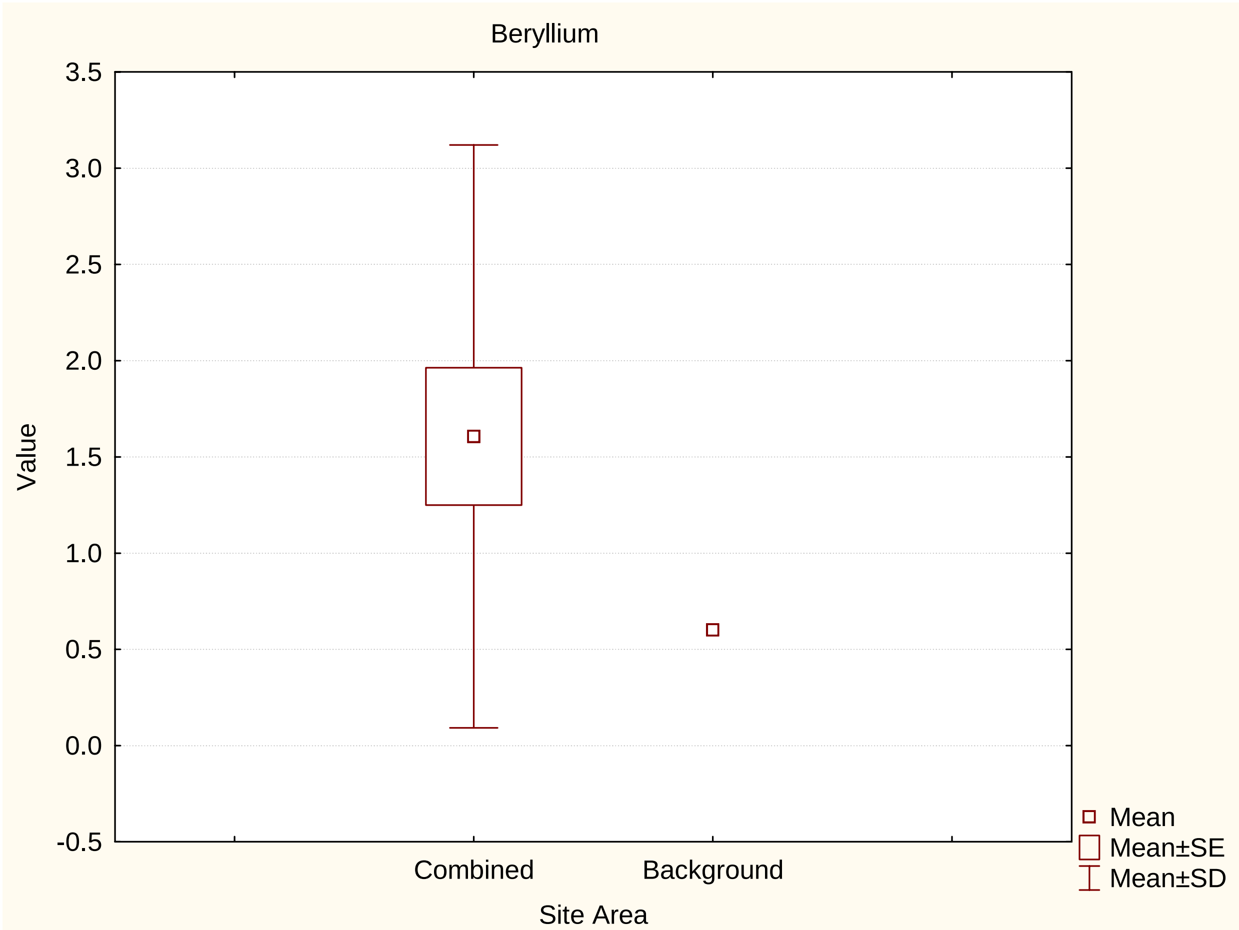


Figure I-106. Arsenic concentrations in site surface sediments compared to Puget Sound natural background

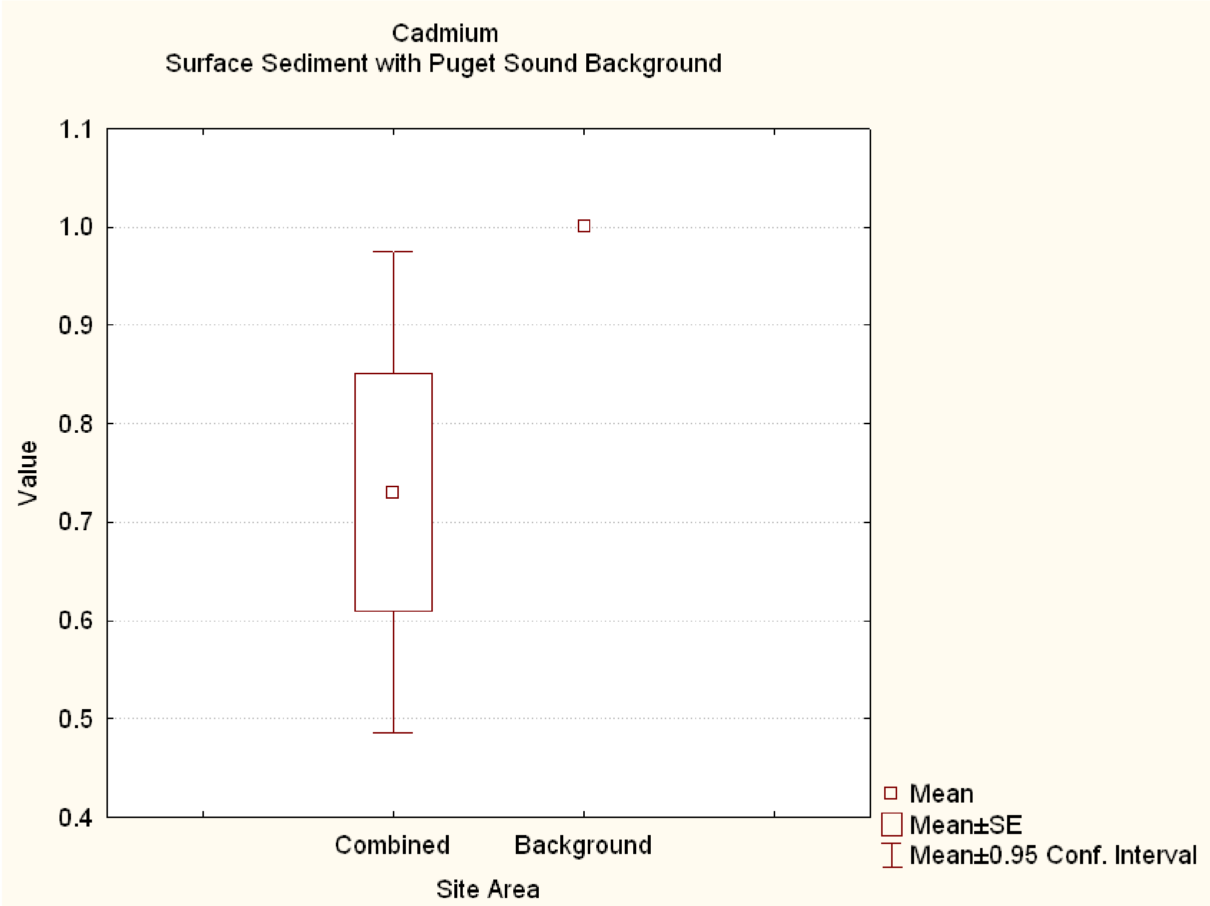


Figure I-107. Cadmium concentrations in site surface sediments compared to Puget Sound natural background

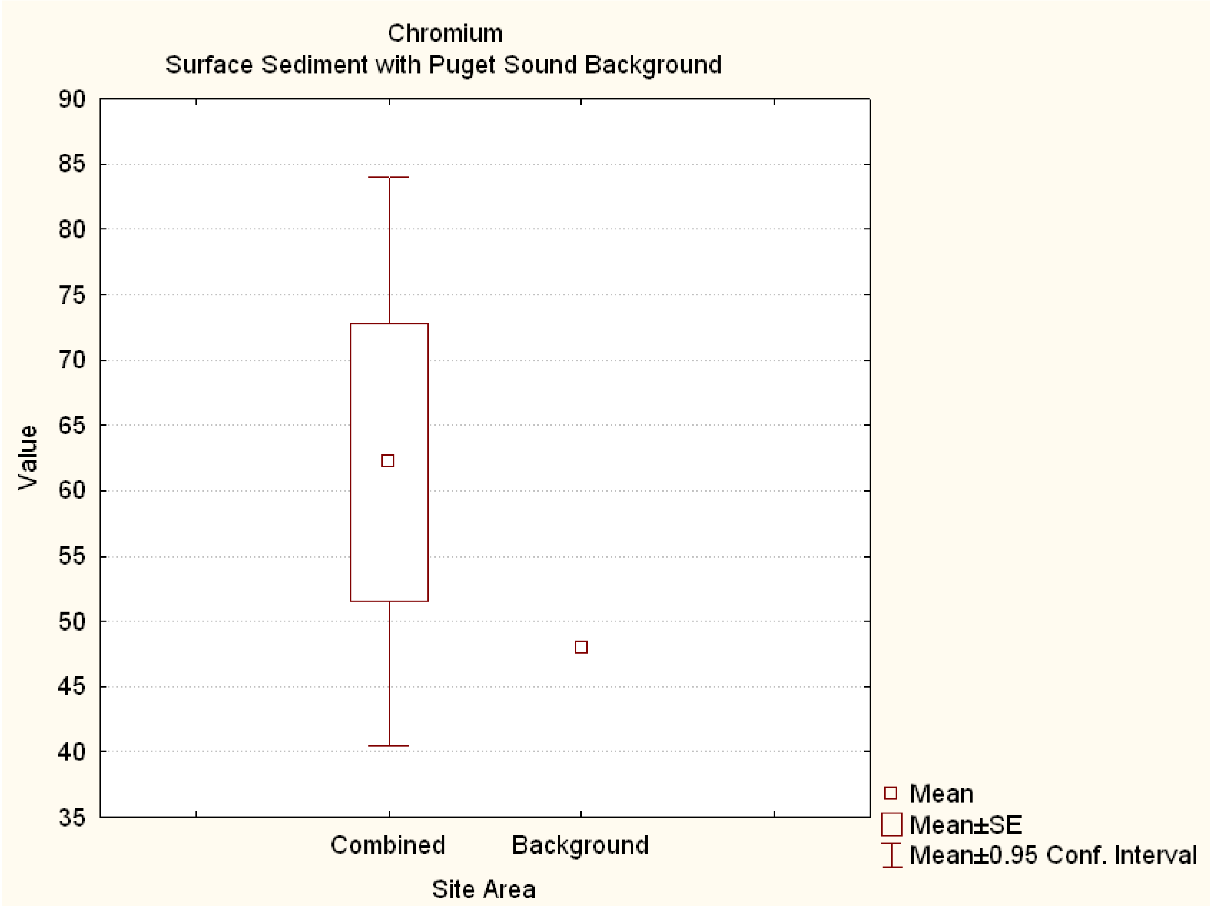


Figure I-108. Chromium concentrations in site surface sediments compared to Puget Sound natural background

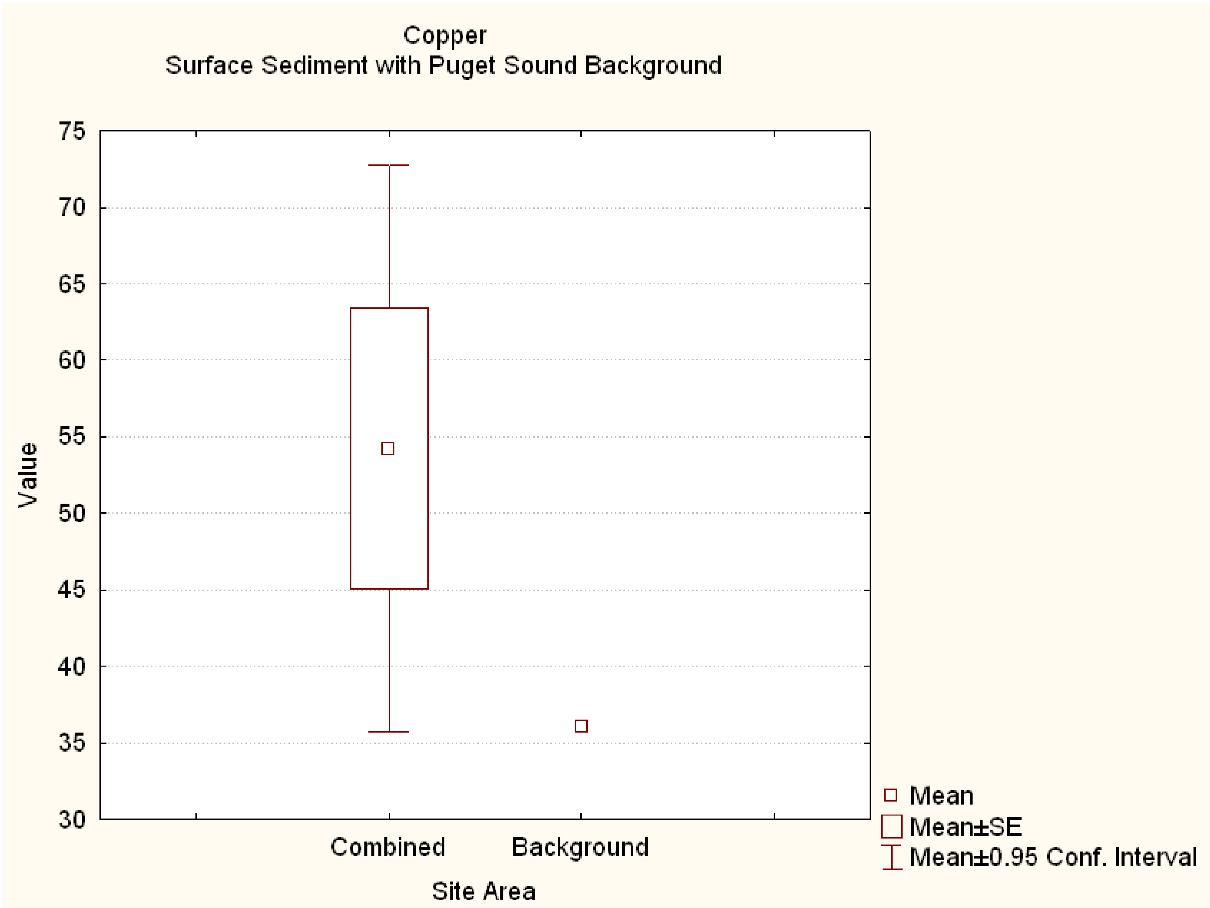


Figure I-109. Copper concentrations in site surface sediments compared to Puget Sound natural background

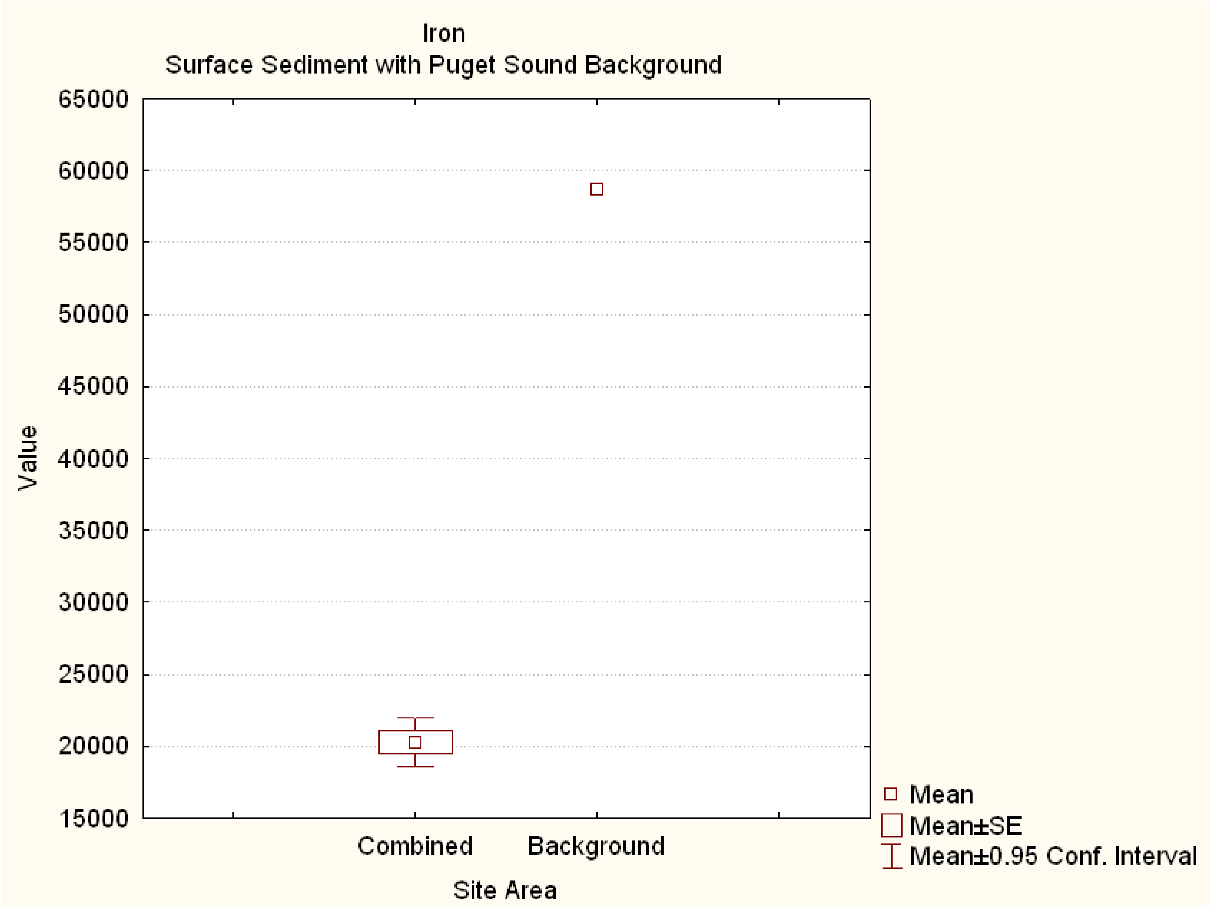


Figure I-110. Iron concentrations in site surface sediments compared to Puget Sound natural background

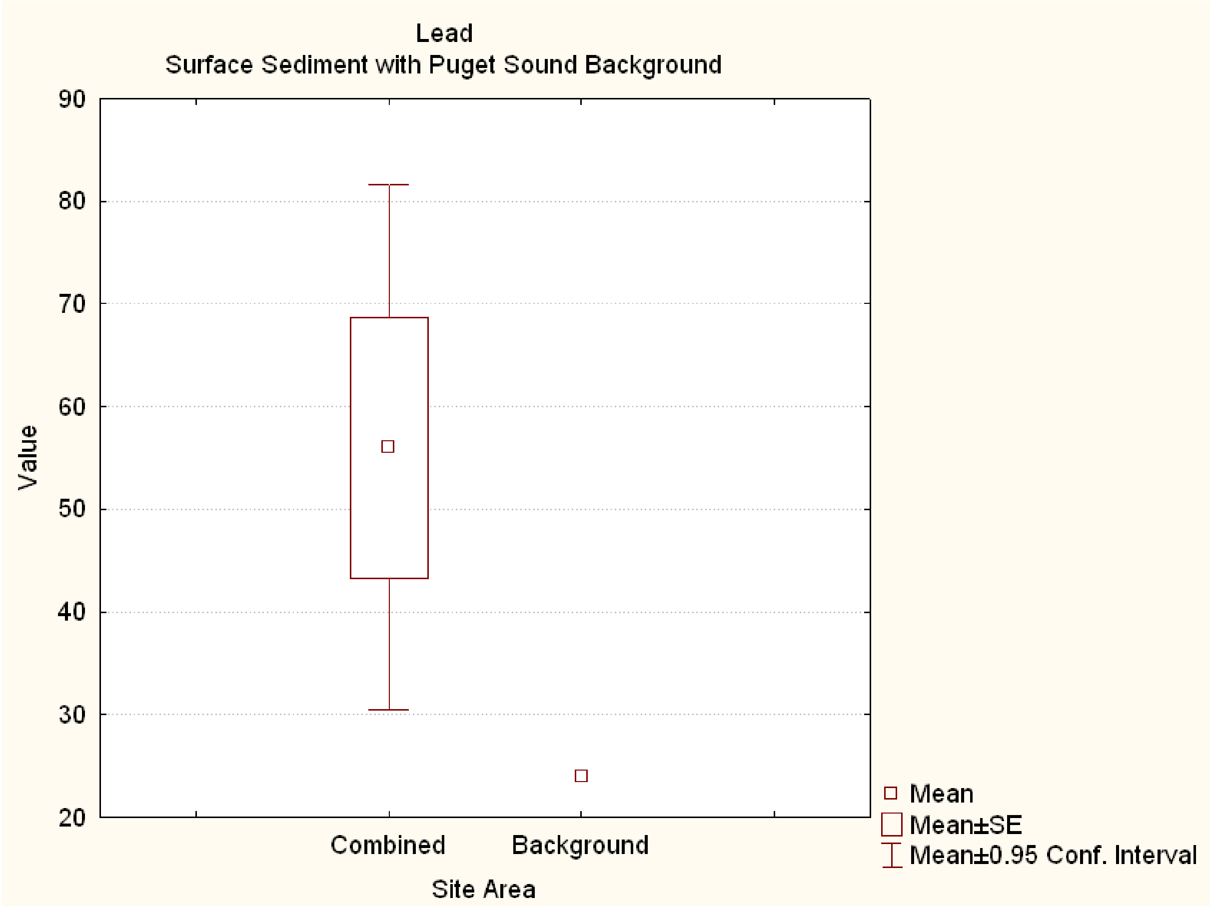


Figure I-111. Lead concentrations in site surface sediments compared to Puget Sound natural background

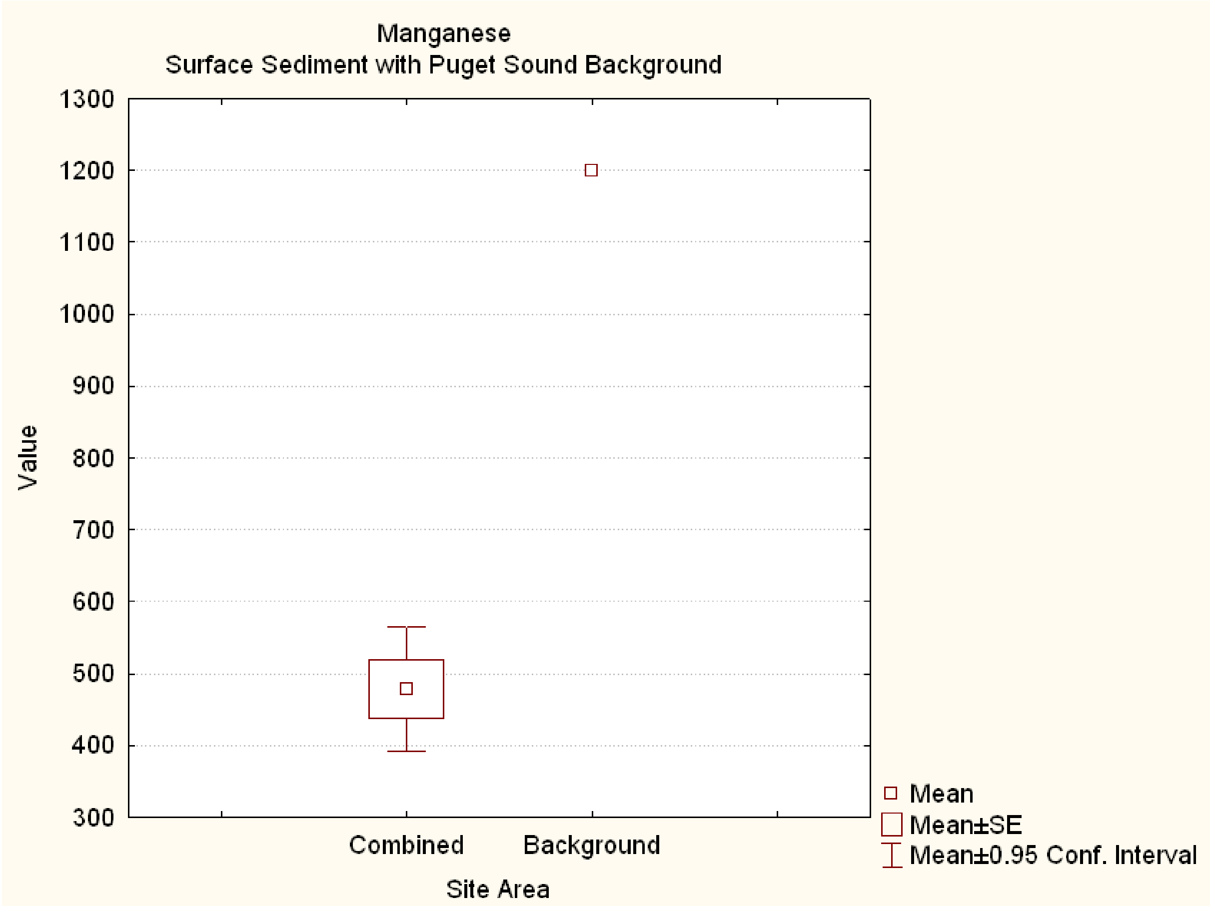


Figure I-112. Manganese concentrations in site surface sediments compared to Puget Sound natural background

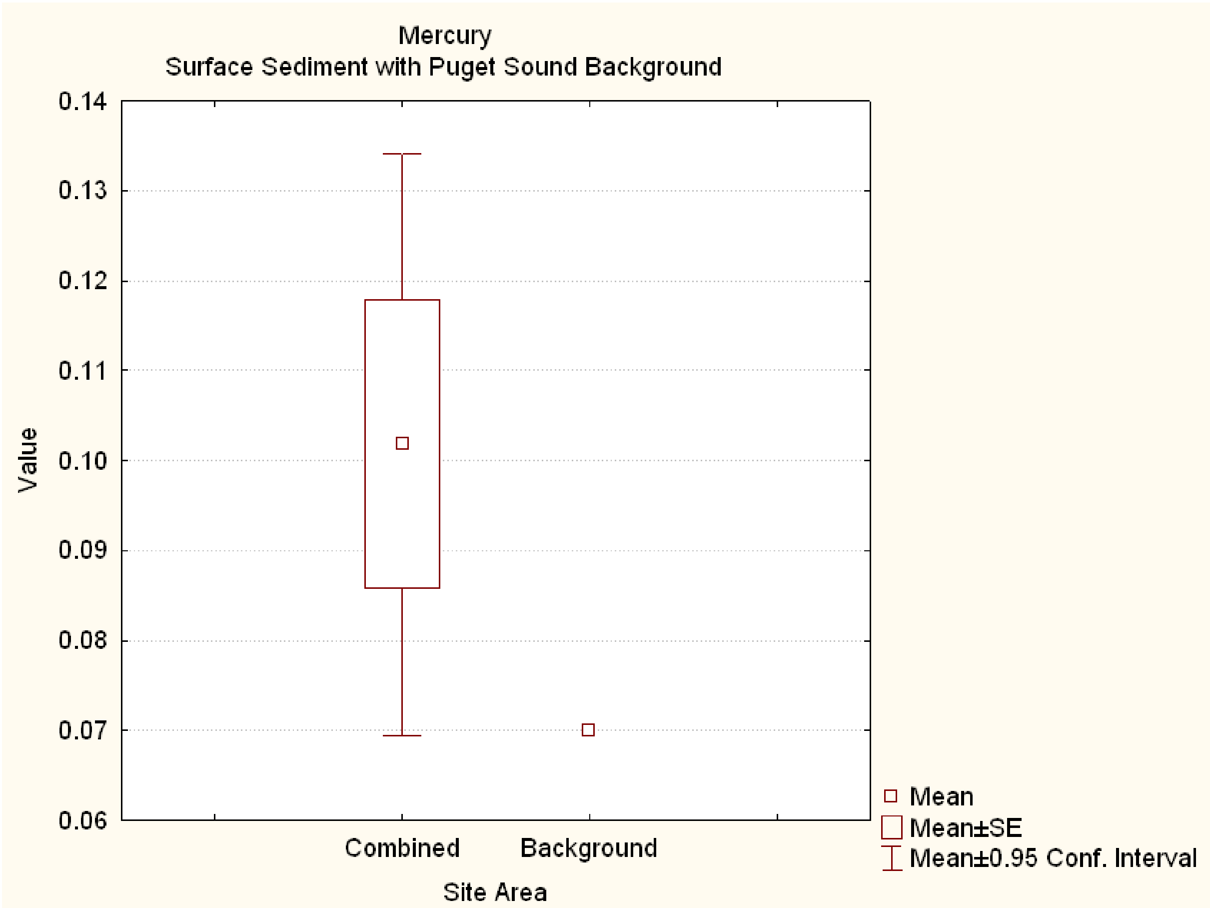


Figure I-113. Mercury concentrations in site surface sediments compared to Puget Sound natural background

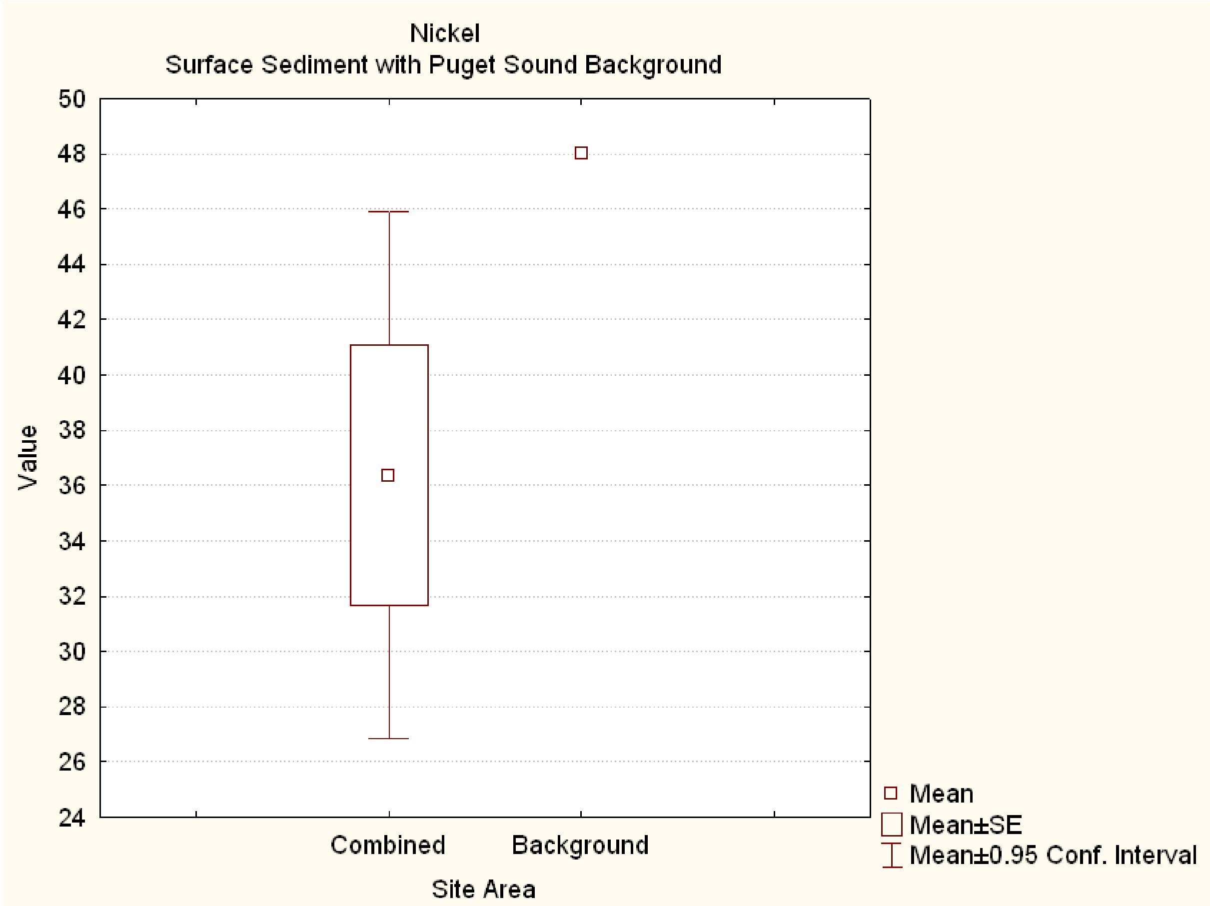


Figure I-114. Nickel concentrations in site surface sediments compared to Puget Sound natural background

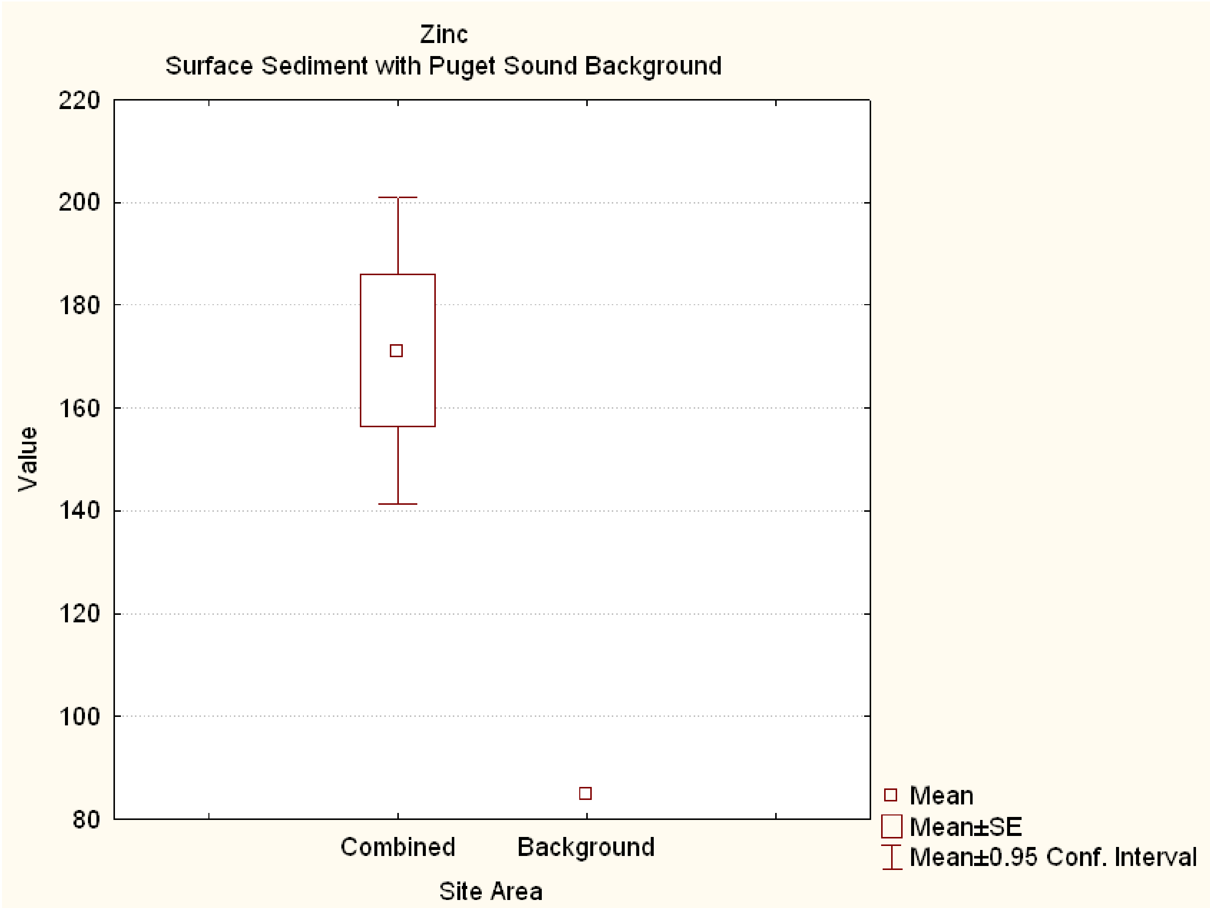


Figure I-115. Zinc concentrations in site surface sediments compared to Puget Sound natural background

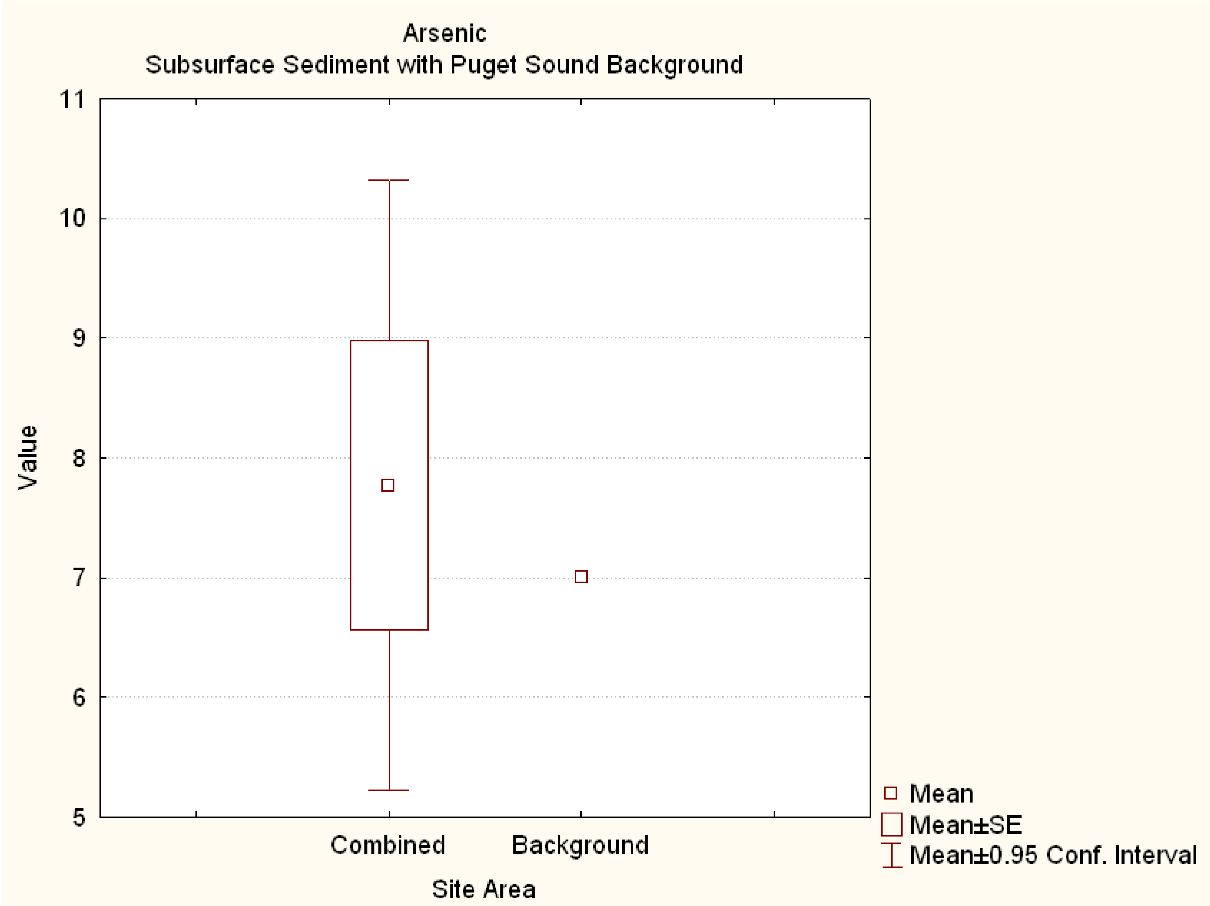


Figure I-116. Arsenic concentrations in site subsurface sediments compared to Puget Sound natural background

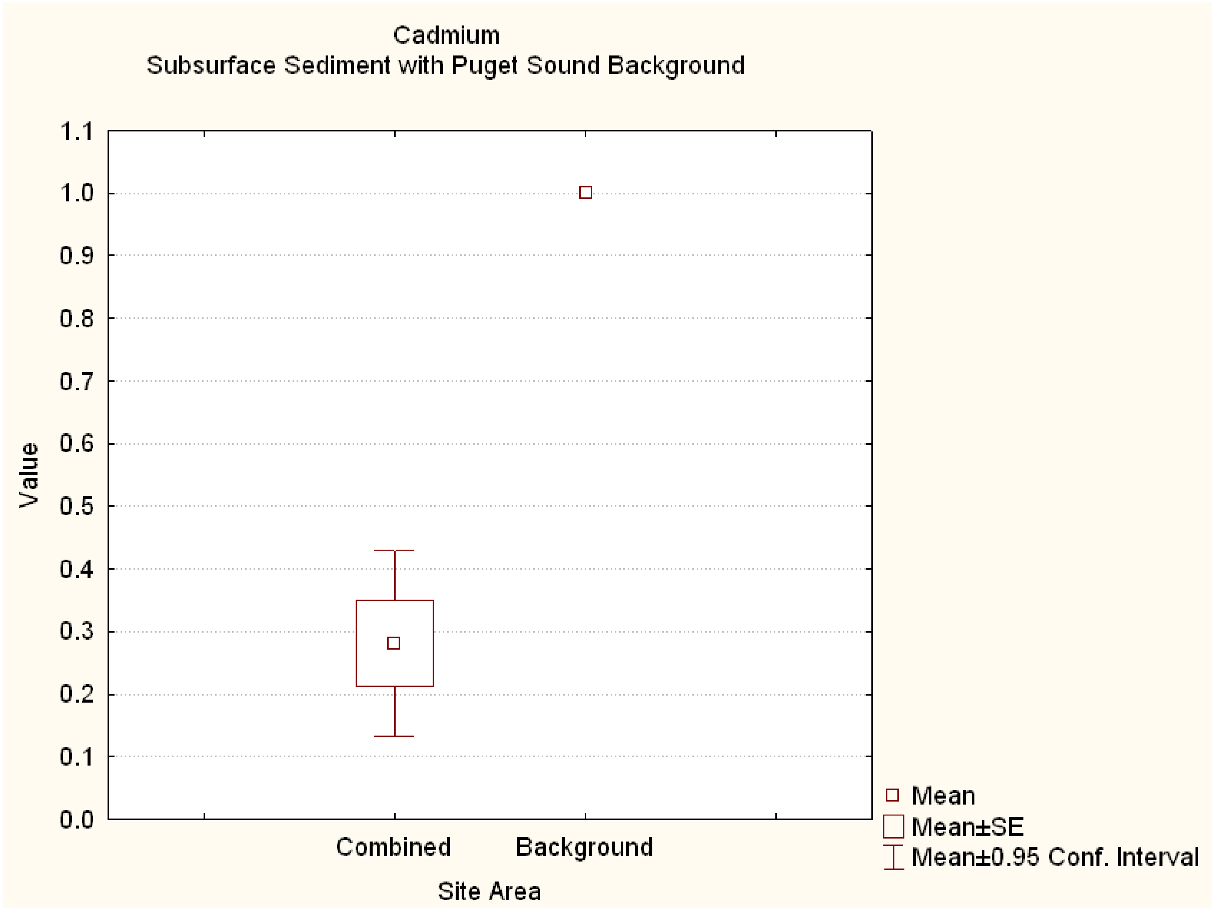


Figure I-117. Cadmium concentrations in site subsurface sediments compared to Puget Sound natural background

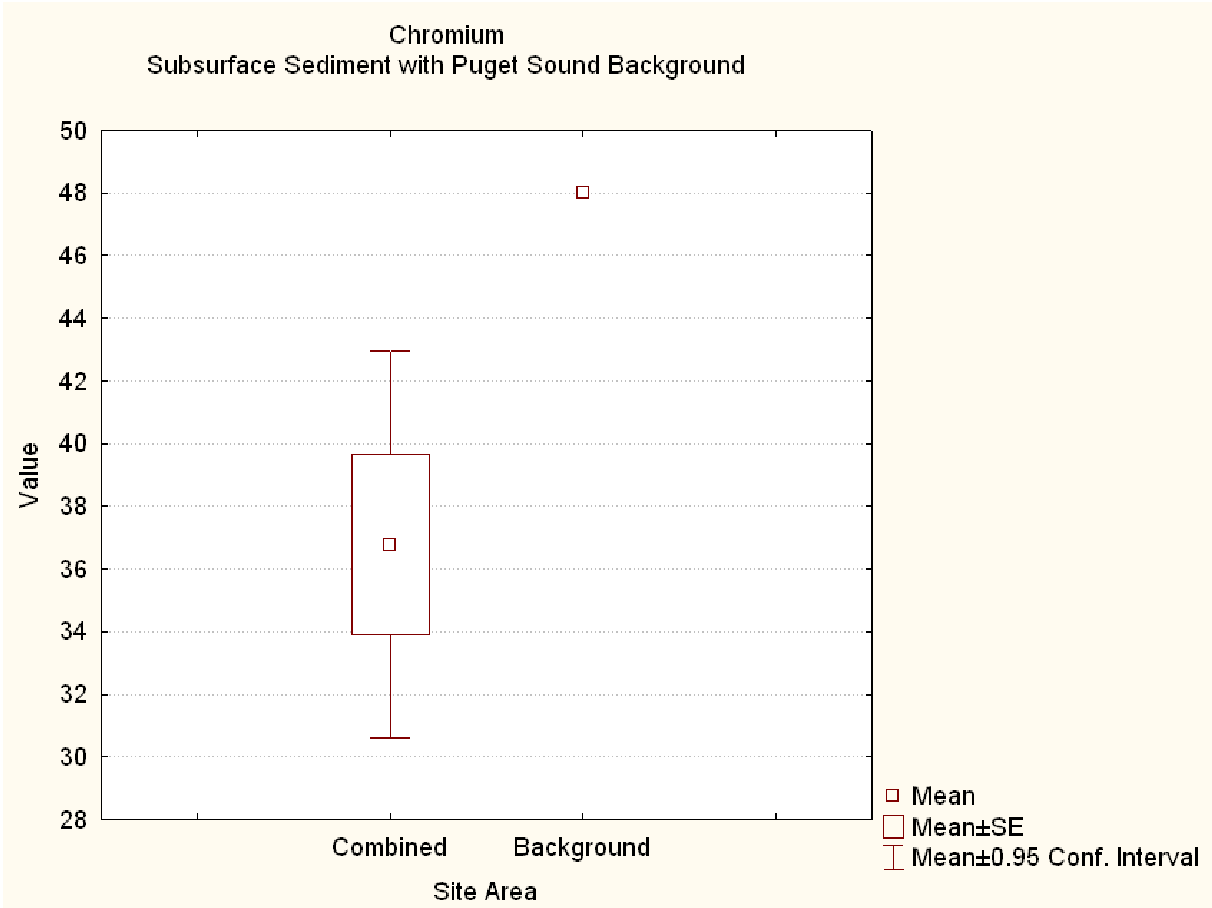


Figure I-118. Chromium concentrations in site subsurface sediments compared to Puget Sound natural background

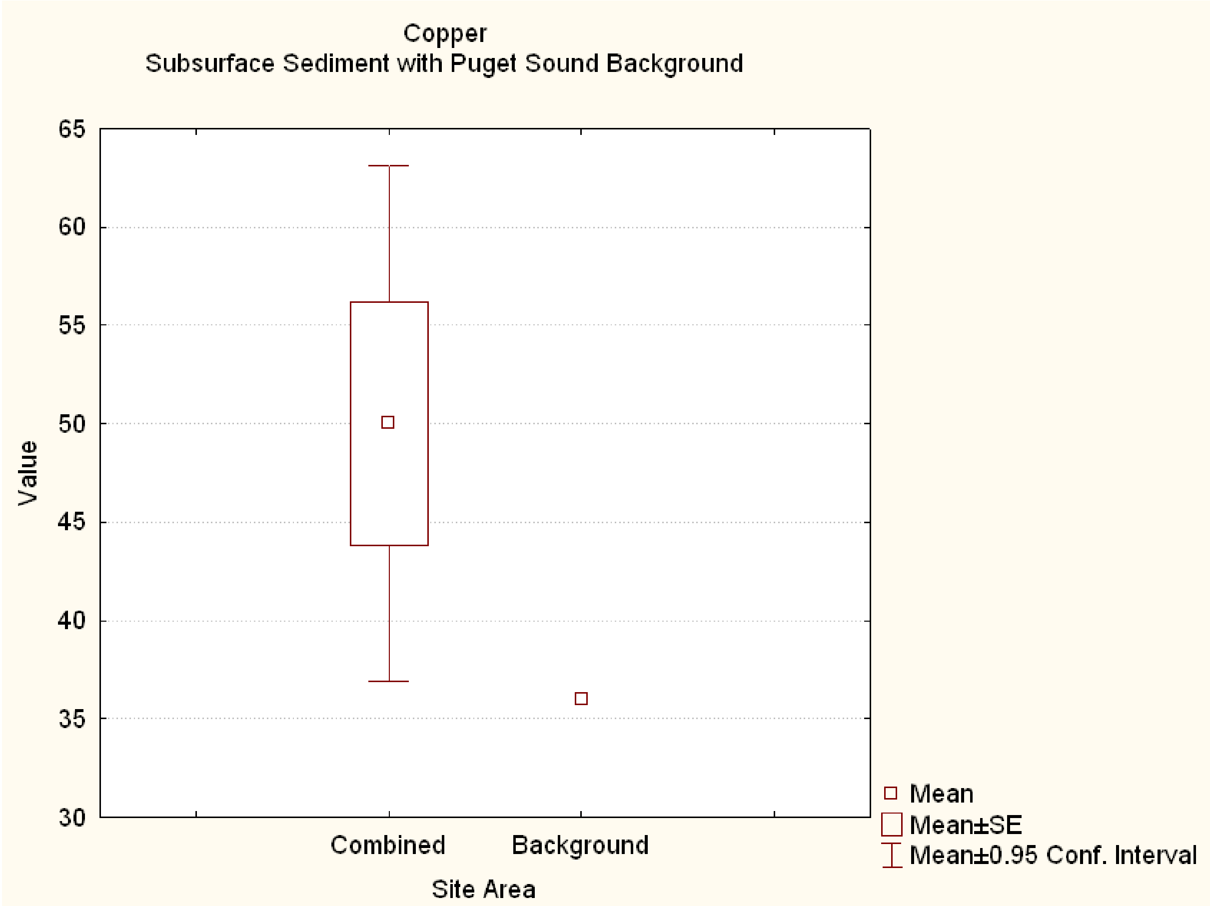


Figure I-119. Copper concentrations in site subsurface sediments compared to Puget Sound natural background

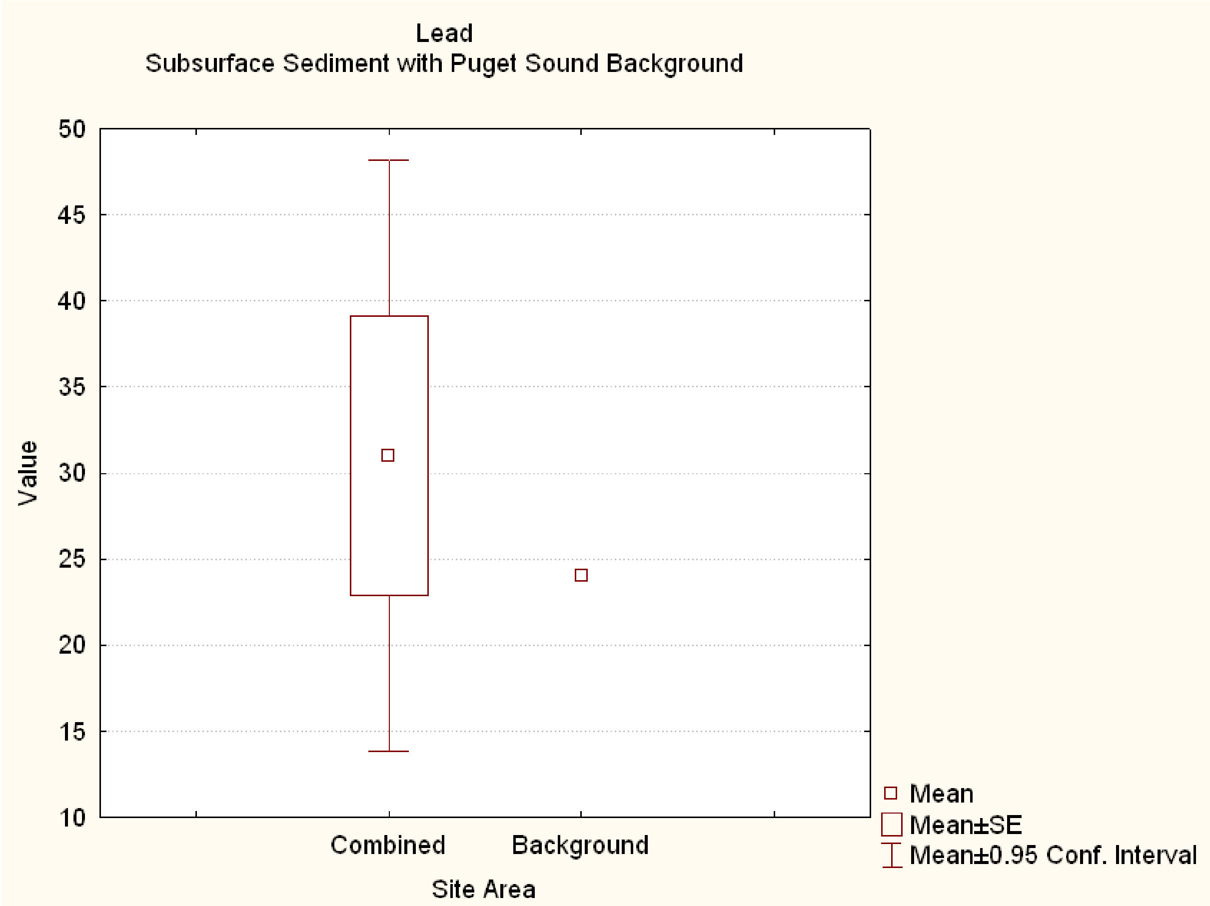


Figure I-120. Lead concentrations in site subsurface sediments compared to Puget Sound natural background

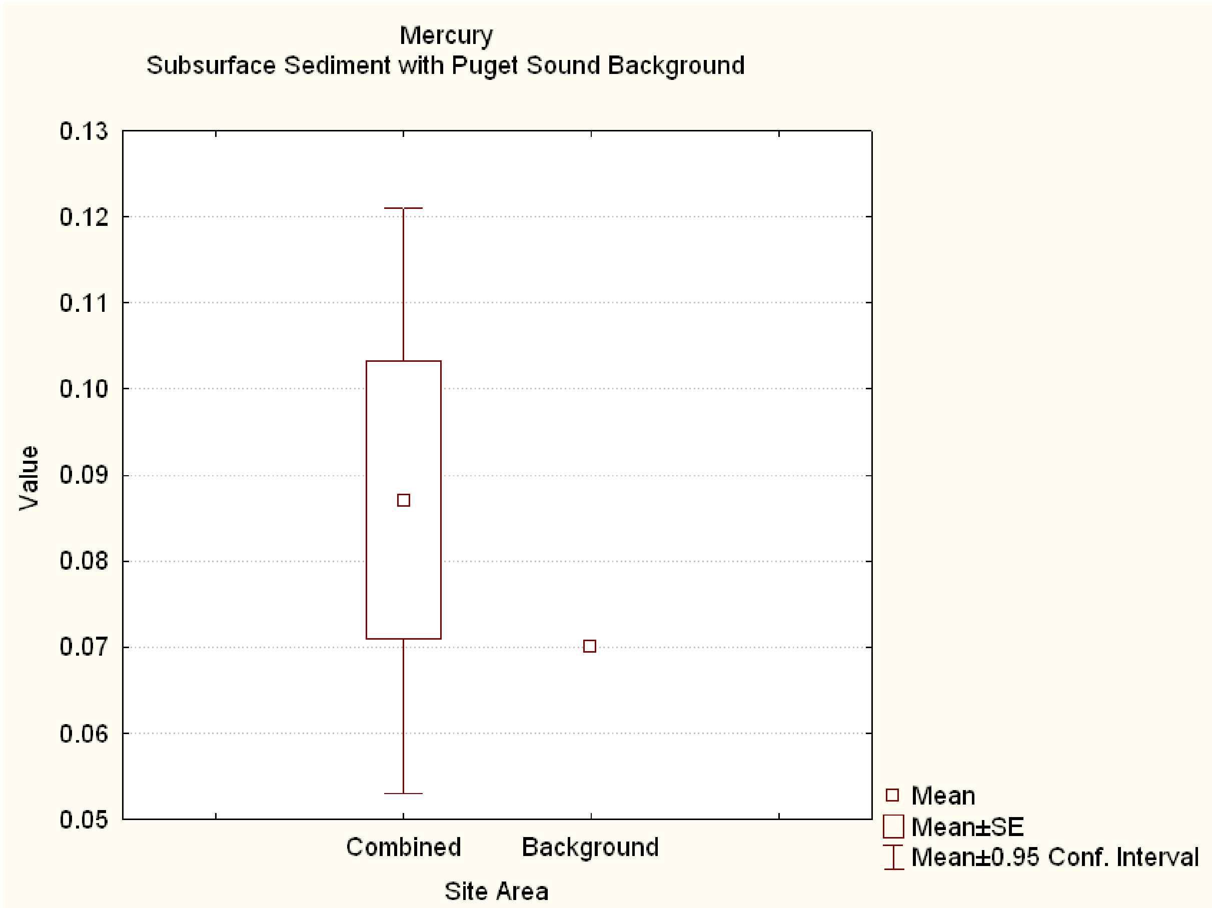


Figure I-121. Mercury concentrations in site subsurface sediments compared to Puget Sound natural background

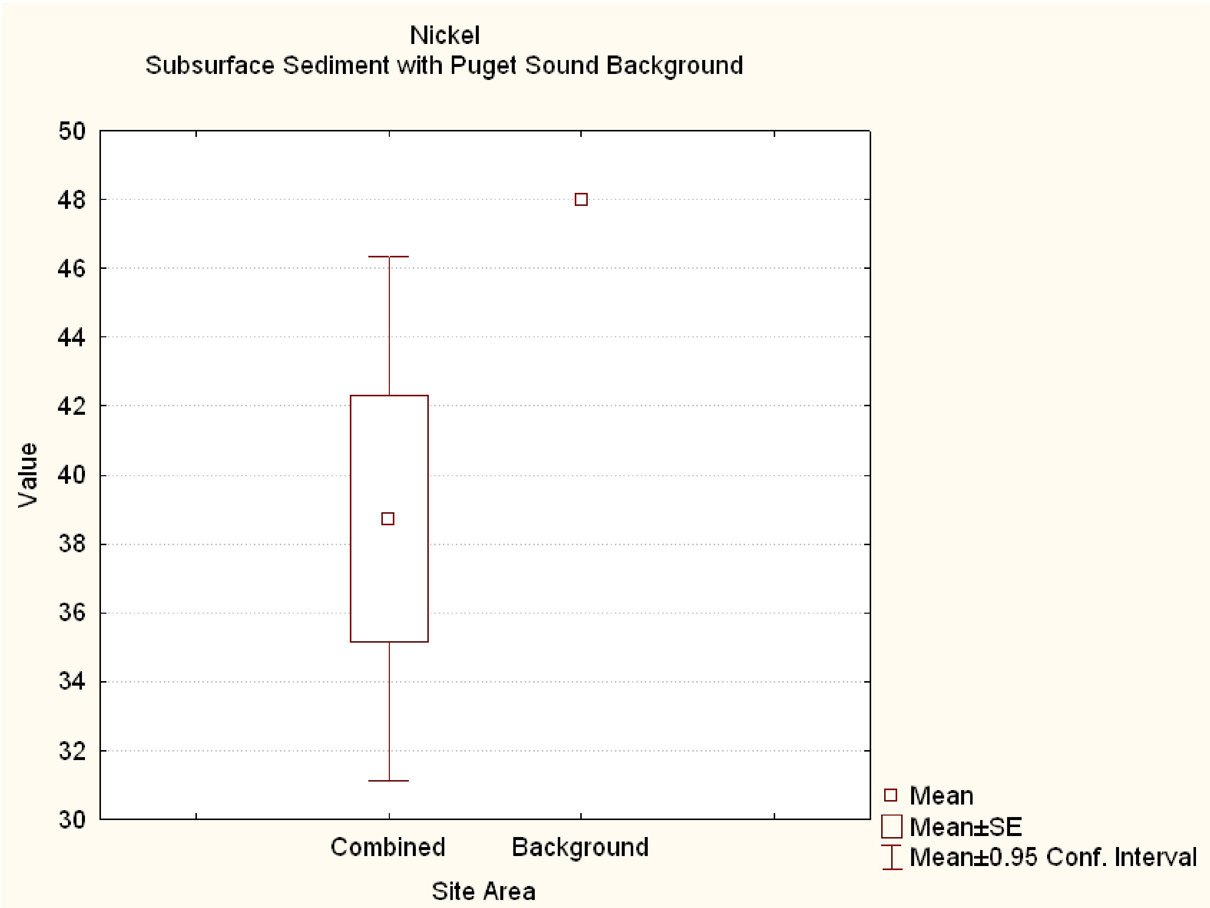


Figure I-122. Nickel concentrations in site subsurface sediments compared to Puget Sound natural background

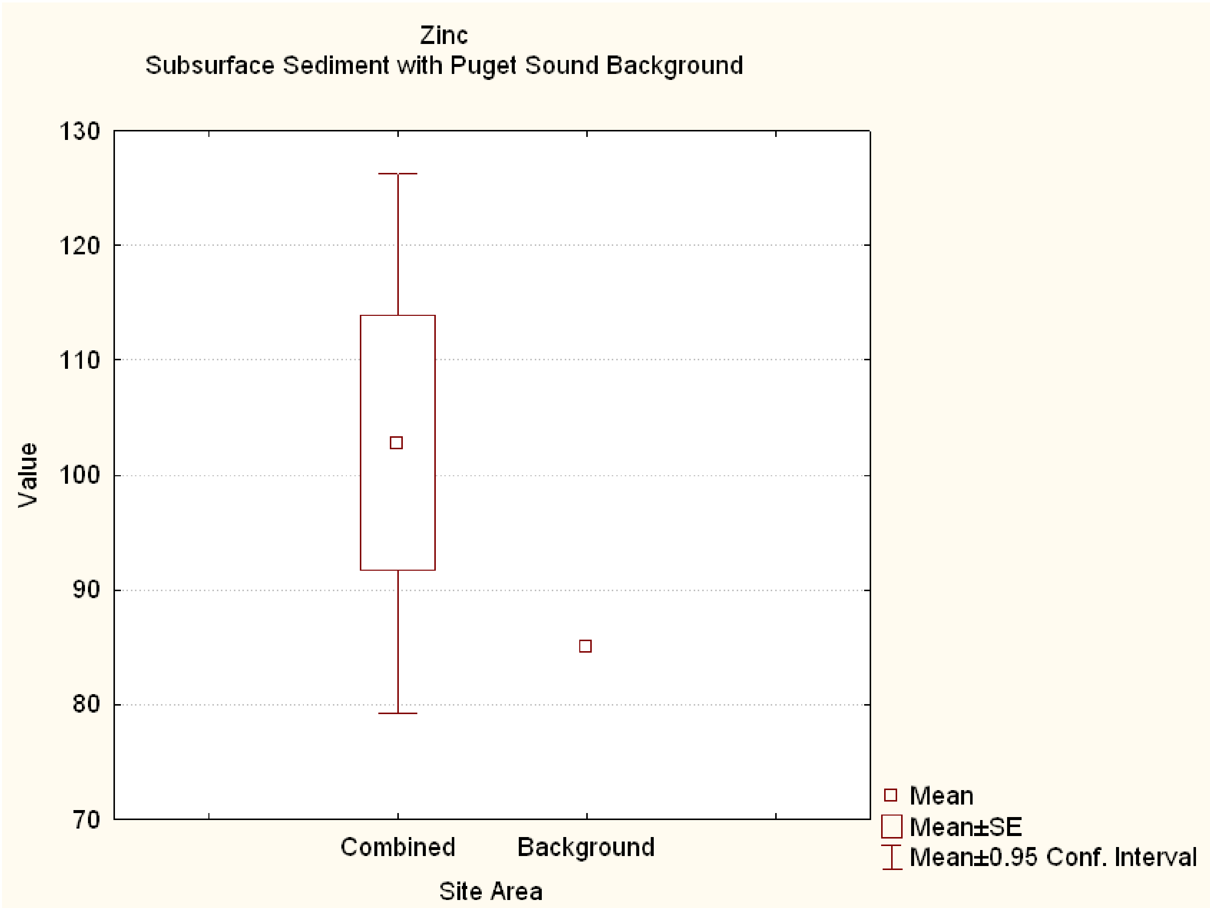


Figure I-123. Zinc concentrations in site subsurface sediments compared to Puget Sound natural background

Table I-1. Sample Sizes for Metals Analyses

Analyte	CAS	Units	Back-ground	Beach	General Site	Historical Creek	Illinois Street	Landfill	Lower Creek (a)	Railroad	South Slope	Upper Creek (a)	Wetlands (a)
Groundwater													
Aluminum	7429-90-5	ug/L	10	--	--	--	--	--	--	--	--	6	--
Aluminum dissolved	7429-90-5	ug/L	10	--	--	--	--	--	--	--	--	6	--
Antimony	7440-36-0	ug/L	10	--	--	--	--	--	--	--	--	6	--
Antimony dissolved	7440-36-0	ug/L	10	--	--	--	--	--	--	--	--	6	--
Arsenic	7440-38-2	ug/L	13	--	--	2	--	--	--	--	--	23	--
Arsenic dissolved	7440-38-2	ug/L	13	--	--	2	--	--	--	--	--	23	--
Barium	7440-39-3	ug/L	10	--	--	--	--	--	--	--	--	6	--
Barium dissolved	7440-39-3	ug/L	10	--	--	--	--	--	--	--	--	6	--
Beryllium	7440-41-7	ug/L	10	--	--	--	--	--	--	--	--	6	--
Beryllium dissolved	7440-41-7	ug/L	10	--	--	--	--	--	--	--	--	6	--
Cadmium	7440-43-9	ug/L	12	--	--	2	--	--	--	--	--	23	--
Cadmium dissolved	7440-43-9	ug/L	12	--	--	2	--	--	--	--	--	23	--
Calcium	7440-70-2	ug/L	13	--	--	2	--	--	--	--	--	23	--
Calcium dissolved	7440-70-2	ug/L	13	--	--	2	--	--	--	--	--	23	--
Chromium	7440-47-3	ug/L	13	--	--	2	--	--	--	--	--	23	--
Chromium dissolved	7440-47-3	ug/L	13	--	--	2	--	--	--	--	--	23	--
Cobalt	7440-48-4	ug/L	10	--	--	--	--	--	--	--	--	6	--
Cobalt dissolved	7440-48-4	ug/L	10	--	--	--	--	--	--	--	--	6	--
Copper	7440-50-8	ug/L	12	--	--	2	--	--	--	--	--	23	--
Copper dissolved	7440-50-8	ug/L	12	--	--	2	--	--	--	--	--	23	--
Iron	7439-89-6	ug/L	10	--	--	--	--	--	--	--	--	6	--
Iron dissolved	7439-89-6	ug/L	10	--	--	--	--	--	--	--	--	6	--
Lead	7439-92-1	ug/L	12	--	--	2	--	--	--	--	--	23	--
Lead dissolved	7439-92-1	ug/L	12	--	--	2	--	--	--	--	--	23	--
Magnesium	7439-95-4	ug/L	13	--	--	2	--	--	--	--	--	23	--
Magnesium dissolved	7439-95-4	ug/L	13	--	--	2	--	--	--	--	--	23	--
Manganese	7439-96-5	ug/L	10	--	--	--	--	--	--	--	--	6	--
Manganese dissolved	7439-96-5	ug/L	10	--	--	--	--	--	--	--	--	6	--
Mercury	7439-97-6	ug/L	12	--	--	2	--	--	--	--	--	23	--
Mercury dissolved	7439-97-6	ug/L	11	--	--	2	--	--	--	--	--	23	--
Nickel	7440-02-0	ug/L	12	--	--	2	--	--	--	--	--	23	--
Nickel dissolved	7440-02-0	ug/L	12	--	--	2	--	--	--	--	--	23	--
Potassium	7440-09-7	ug/L	10	--	--	--	--	--	--	--	--	6	--

Table I-1. Sample Sizes for Metals Analyses

Analyte	CAS	Units	Back-ground	Beach	General Site	Historical Creek	Illinois Street	Landfill	Lower Creek (a)	Railroad	South Slope	Upper Creek (a)	Wetlands (a)
Potassium dissolved	7440-09-7	ug/L	10	--	--	--	--	--	--	--	--	6	--
Selenium	7782-49-2	ug/L	10	--	--	--	--	--	--	--	--	6	--
Selenium dissolved	7782-49-2	ug/L	10	--	--	--	--	--	--	--	--	6	--
Silver	7440-22-4	ug/L	12	--	--	2	--	--	--	--	--	23	--
Silver dissolved	7440-22-4	ug/L	12	--	--	2	--	--	--	--	--	23	--
Sodium	7440-23-5	ug/L	10	--	--	--	--	--	--	--	--	6	--
Sodium dissolved	7440-23-5	ug/L	10	--	--	--	--	--	--	--	--	6	--
Thallium	7440-28-0	ug/L	10	--	--	--	--	--	--	--	--	6	--
Thallium dissolved	7440-28-0	ug/L	10	--	--	--	--	--	--	--	--	6	--
Vanadium	7440-62-2	ug/L	10	--	--	--	--	--	--	--	--	6	--
Vanadium dissolved	7440-62-2	ug/L	10	--	--	--	--	--	--	--	--	6	--
Zinc	7440-66-6	ug/L	12	--	--	2	--	--	--	--	--	23	--
Zinc dissolved	7440-66-6	ug/L	12	--	--	2	--	--	--	--	--	23	--
Subsurface Sediment													
Arsenic	7440-38-2	mg/kg	--	--	--	8	--	--	8	--	--	2	--
Cadmium	7440-43-9	mg/kg	--	--	--	5	--	--	8	--	--	2	--
Chromium	7440-47-3	mg/kg	--	--	--	5	--	--	8	--	--	2	--
Copper	7440-50-8	mg/kg	--	--	--	7	--	--	8	--	--	2	--
Lead	7439-92-1	mg/kg	--	--	--	7	--	--	8	--	--	2	--
Mercury	7439-97-6	mg/kg	--	--	--	8	--	--	8	--	--	2	--
Nickel	7440-02-0	mg/kg	--	--	--	5	--	--	8	--	--	2	--
Silver	7440-22-4	mg/kg	--	--	--	5	--	--	8	--	--	2	--
Zinc	7440-66-6	mg/kg	--	--	--	8	--	--	8	--	--	2	--
Subsurface Soil													
Aluminum	7429-90-5	mg/kg	1	--	--	--	--	--	--	--	8	3	--
Antimony	7440-36-0	mg/kg	2	--	--	--	--	--	--	--	8	3	--
Arsenic	7440-38-2	mg/kg	2	--	1	9	5	17	9	6	8	22	2
Barium	7440-39-3	mg/kg	1	--	--	--	--	--	--	--	8	3	--
Beryllium	7440-41-7	mg/kg	2	--	--	--	--	--	--	--	8	3	--
Cadmium	7440-43-9	mg/kg	2	--	1	9	5	17	9	6	8	22	2
Calcium	7440-70-2	mg/kg	2	--	--	--	--	--	--	--	8	3	--
Chromium	7440-47-3	mg/kg	1	--	1	9	5	17	9	6	8	22	2
Cobalt	7440-48-4	mg/kg	2	--	--	--	--	--	--	--	8	3	--
Copper	7440-50-8	mg/kg	2	--	1	9	5	17	9	6	8	21	2

Table I-1. Sample Sizes for Metals Analyses

Analyte	CAS	Units	Back-ground	Beach	General Site	Historical Creek	Illinois Street	Landfill	Lower Creek (a)	Railroad	South Slope	Upper Creek (a)	Wetlands (a)
Iron	7439-89-6	mg/kg	2	--	--	--	--	--	--	--	8	3	--
Lead	7439-92-1	mg/kg	2	--	1	9	5	17	9	6	8	22	2
Magnesium	7439-95-4	mg/kg	2	--	--	--	--	--	--	--	8	3	--
Manganese	7439-96-5	mg/kg	2	--	--	--	--	--	--	--	8	3	--
Mercury	7439-97-6	mg/kg	2	--	1	9	5	17	9	6	8	22	2
Nickel	7440-02-0	mg/kg	2	--	1	9	5	17	9	6	8	21	2
Potassium	7440-09-7	mg/kg	1	--	--	--	--	--	--	--	8	3	--
Selenium	7782-49-2	mg/kg	2	--	--	--	--	--	--	--	8	3	--
Silver	7440-22-4	mg/kg	2	--	1	9	5	17	9	6	8	22	2
Sodium	7440-23-5	mg/kg	2	--	--	--	--	--	--	--	8	3	--
Thallium	7440-28-0	mg/kg	2	--	--	--	--	--	--	--	8	3	--
Vanadium	7440-62-2	mg/kg	1	--	--	--	--	--	--	--	8	3	--
Zinc	7440-66-6	mg/kg	2	--	1	12	5	17	9	6	8	29	2
Surface sediment													
Aluminum	7429-90-5	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Antimony	7440-36-0	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Arsenic	7440-38-2	mg/kg	--	1	--	6	--	--	9	--	--	12	2
Barium	7440-39-3	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Beryllium	7440-41-7	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Cadmium	7440-43-9	mg/kg	--	1	--	6	--	--	13(9)	--	--	18(12)	3(2)
Calcium	7440-70-2	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Chromium	7440-47-3	mg/kg	--	1	--	6	--	--	9	--	--	12	2
Cobalt	7440-48-4	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Copper	7440-50-8	mg/kg	--	1	--	6	--	--	13(9)	--	--	18(12)	3(2)
Iron	7439-89-6	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Lead	7439-92-1	mg/kg	--	1	--	6	--	--	13(9)	--	--	18(12)	3(2)
Magnesium	7439-95-4	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Manganese	7439-96-5	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Mercury	7439-97-6	mg/kg	--	1	--	6	--	--	13(9)	--	--	18(12)	3(2)
Nickel	7440-02-0	mg/kg	--	1	--	6	--	--	13(9)	--	--	18(12)	3(2)
Potassium	7440-09-7	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Selenium	7782-49-2	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Silver	7440-22-4	mg/kg	--	1	--	6	--	--	9	--	--	12	2
Sodium	7440-23-5	mg/kg	--	1	--	--	--	--	5	--	--	10	2

Table I-1. Sample Sizes for Metals Analyses

Analyte	CAS	Units	Back-ground	Beach	General Site	Historical Creek	Illinois Street	Landfill	Lower Creek (a)	Railroad	South Slope	Upper Creek (a)	Wetlands (a)
Thallium	7440-28-0	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Vanadium	7440-62-2	mg/kg	--	1	--	--	--	--	5	--	--	10	2
Zinc	7440-66-6	mg/kg	--	1	--	6	--	--	13(9)	--	--	18(12)	3(2)
Surface Soil and Spoil Pile													
Aluminum	7429-90-5	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Antimony	7440-36-0	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Arsenic	7440-38-2	mg/kg	20	--	12	4	7	6	7	6	7	20	2
Barium	7440-39-3	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Beryllium	7440-41-7	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Cadmium	7440-43-9	mg/kg	--	--	9	4	7	6	7	6	5	20	2
Calcium	7440-70-2	mg/kg	20	--	4	--	--	--	--	--	7	10	--
Chromium	7440-47-3	mg/kg	20	--	12	4	7	6	7	6	7	20	2
Cobalt	7440-48-4	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Copper	7440-50-8	mg/kg	--	--	9	4	7	6	7	6	5	20	2
Iron	7439-89-6	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Lead	7439-92-1	mg/kg	--	--	9	4	7	6	7	6	5	20	2
Magnesium	7439-95-4	mg/kg	20	--	4	--	--	--	--	--	7	10	--
Manganese	7439-96-5	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Mercury	7439-97-6	mg/kg	--	--	9	4	7	6	7	6	5	20	2
Nickel	7440-02-0	mg/kg	--	--	9	4	7	6	7	6	5	19	2
Potassium	7440-09-7	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Selenium	7782-49-2	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Silver	7440-22-4	mg/kg	--	--	9	4	7	6	7	6	5	20	2
Sodium	7440-23-5	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Thallium	7440-28-0	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Vanadium	7440-62-2	mg/kg	--	--	1	--	--	--	--	--	5	10	--
Zinc	7440-66-6	mg/kg	--	--	9	4	7	6	7	6	5	20	2
Surface water													
Aluminum	7429-90-5	ug/L	--	1	--	--	--	--	4	--	--	12	3
Aluminum dissolved	7429-90-5	ug/L	--	1	--	--	--	--	3	--	--	7	1
Antimony	7440-36-0	ug/L	--	1	--	--	--	--	4	--	--	12	3
Antimony dissolved	7440-36-0	ug/L	--	1	--	--	--	--	3	--	--	7	1
Arsenic	7440-38-2	ug/L	2	1	--	2	--	--	8	--	--	22	5
Arsenic dissolved	7440-38-2	ug/L	2	1	--	2	--	--	7	--	--	17	3

Table I-1. Sample Sizes for Metals Analyses

Analyte	CAS	Units	Back-ground	Beach	General Site	Historical Creek	Illinois Street	Landfill	Lower Creek (a)	Railroad	South Slope	Upper Creek (a)	Wetlands (a)
Barium	7440-39-3	ug/L	--	1	--	--	--	--	4	--	--	12	3
Barium dissolved	7440-39-3	ug/L	--	1	--	--	--	--	3	--	--	7	1
Beryllium	7440-41-7	ug/L	--	1	--	--	--	--	4	--	--	12	3
Beryllium dissolved	7440-41-7	ug/L	--	1	--	--	--	--	3	--	--	7	1
Cadmium	7440-43-9	ug/L	2	1	--	2	--	--	8	--	--	22	5
Cadmium dissolved	7440-43-9	ug/L	2	1	--	2	--	--	7	--	--	17	3
Calcium	7440-70-2	ug/L	2	1	--	2	--	--	8	--	--	22	5
Calcium dissolved	7440-70-2	ug/L	2	1	--	2	--	--	7	--	--	17	3
Chromium	7440-47-3	ug/L	2	1	--	2	--	--	8	--	--	22	5
Chromium dissolved	7440-47-3	ug/L	2	1	--	2	--	--	7	--	--	17	3
Cobalt	7440-48-4	ug/L	--	1	--	--	--	--	4	--	--	12	3
Cobalt dissolved	7440-48-4	ug/L	--	1	--	--	--	--	3	--	--	7	1
Copper	7440-50-8	ug/L	2	1	--	2	--	--	8	--	--	22	5
Copper dissolved	7440-50-8	ug/L	2	1	--	2	--	--	7	--	--	17	3
Iron	7439-89-6	ug/L	--	1	--	--	--	--	4	--	--	12	3
Iron dissolved	7439-89-6	ug/L	--	1	--	--	--	--	3	--	--	7	1
Lead	7439-92-1	ug/L	2	1	--	2	--	--	8	--	--	22	5
Lead dissolved	7439-92-1	ug/L	2	1	--	2	--	--	7	--	--	17	3
Magnesium	7439-95-4	ug/L	2	1	--	2	--	--	8	--	--	22	5
Magnesium dissolved	7439-95-4	ug/L	2	1	--	2	--	--	7	--	--	17	3
Manganese	7439-96-5	ug/L	--	1	--	--	--	--	4	--	--	12	3
Manganese dissolved	7439-96-5	ug/L	--	1	--	--	--	--	3	--	--	7	1
Mercury	7439-97-6	ug/L	2	1	--	2	--	--	7	--	--	17	4
Mercury dissolved	7439-97-6	ug/L	2	1	--	2	--	--	7	--	--	17	3
Nickel	7440-02-0	ug/L	2	1	--	2	--	--	8	--	--	22	5
Nickel dissolved	7440-02-0	ug/L	2	1	--	2	--	--	7	--	--	17	3
Potassium	7440-09-7	ug/L	--	1	--	--	--	--	4	--	--	12	3
Potassium dissolved	7440-09-7	ug/L	--	1	--	--	--	--	3	--	--	7	1
Selenium	7782-49-2	ug/L	--	1	--	--	--	--	4	--	--	12	3
Selenium dissolved	7782-49-2	ug/L	--	1	--	--	--	--	3	--	--	7	1
Silver	7440-22-4	ug/L	2	1	--	2	--	--	8	--	--	22	5
Silver dissolved	7440-22-4	ug/L	2	1	--	2	--	--	7	--	--	17	3
Sodium	7440-23-5	ug/L	--	1	--	--	--	--	4	--	--	12	3
Sodium dissolved	7440-23-5	ug/L	--	1	--	--	--	--	3	--	--	7	1

Table I-1. Sample Sizes for Metals Analyses

Analyte	CAS	Units	Back-ground	Beach	General Site	Historical Creek	Illinois Street	Landfill	Lower Creek (a)	Railroad	South Slope	Upper Creek (a)	Wetlands (a)
Thallium	7440-28-0	ug/L	--	1	--	--	--	--	4	--	--	12	3
Thallium dissolved	7440-28-0	ug/L	--	1	--	--	--	--	3	--	--	7	1
Vanadium	7440-62-2	ug/L	--	1	--	--	--	--	4	--	--	12	3
Vanadium dissolved	7440-62-2	ug/L	--	1	--	--	--	--	3	--	--	7	1
Zinc	7440-66-6	ug/L	2	1	--	2	--	--	8	--	--	22	5
Zinc dissolved	7440-66-6	ug/L	2	1	--	2	--	--	7	--	--	17	3

Notes: [a]The number of data points is different from the number of samples analyzed for some sediment data sets because metals were analyzed by more than one method. The values shown are the number of data points followed by the number of samples in parentheses.

-- Not analyzed

Field duplicate and replicate samples are excluded from the sample counts.

Table I-2. Kruskal-Wallis statistical analyses for surface soil

Beryllium

	Upper creek R:10.700	South Slope R:3.0000	General Site R:14.000
Upper creek		0.009447	1.000000
South Slope	0.009447		0.104794
General Site	1.000000	0.104794	

Multiple Comparisons p values (2-tailed);
Independent (grouping) variable: Site_Area
Kruskal-Wallis test: H (2, N= 16) =10.14265 p =.0063

Cobalt

	Upper creek R:6.1000	South Slope R:12.900	General Site R:10.500
Upper creek		0.027347	1.000000
South Slope	0.027347		1.000000
General Site	1.000000	1.000000	

Multiple Comparisons p values (2-tailed);
Independent (grouping) variable: Site_Area
Kruskal-Wallis test: H (2, N= 16) =7.071429 p =.0291

Magnesium

	Upper creek R:31.200	South Slope R:29.571	General Site R:31.000	Background R:10.900
Upper creek		1.000000	1.000000	0.000073
South Slope	1.000000		1.000000	0.002318
General Site	1.000000	1.000000		0.013128
Background	0.000073	0.002318	0.013128	

Multiple Comparisons p values (2-tailed);
Independent (grouping) variable: Site_Area
Kruskal-Wallis test: H (3, N= 41) =27.85348 p =.0000

Thallium

	Upper creek R:6.1500	South Slope R:14.000	General Site R:4.5000
Upper creek		0.007829	1.000000
South Slope	0.007829		0.205574
General Site	1.000000	0.205574	

Multiple Comparisons p values (2-tailed);
Independent (grouping) variable: Site_Area
Kruskal-Wallis test: H (2, N= 16) =9.991392 p =.0068

Vanadium

	Upper creek R:5.9500	South Slope R:12.500	General Site R:14.000
Upper creek		0.036034	0.320787
South Slope	0.036034		1.000000
General Site	0.320787	1.000000	

Multiple Comparisons p values (2-tailed);
Independent (grouping) variable: Site_Area
Kruskal-Wallis test: H (2, N= 16) =7.766987 p =.0206

Table I-3. Kruskal-Wallis statistical analyses for surface soil in the Ilinois Street Extension and Landfill

Arsenic Surface

	Site Background R:15.350	Illinois Street R:27.214	Landfill R:12.083	Puget Sound Background R:25.000
Site Background		0.040013	1.000000	1.000000
Illinois Street	0.040013		0.037875	1.000000
Landfill	1.000000	0.037875		1.000000
Puget Sound Background	1.000000	1.000000	1.000000	

Table I-4. Kruskal-Wallis statistical analyses for subsurface soil

Lead

	Wetlands R:31.250	Upper creek R:32.295	South Slope R:13.375	Railroad R:54.833	Lower creek R:48.500	Landfill R:51.316	Historical creek R:44.167	General Site R:27.000	Background R:18.000
Wetlands		1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
Upper creek	1.000000		1.000000	1.000000	1.000000	0.264994	1.000000	1.000000	1.000000
South Slope	1.000000	1.000000		0.025378	0.051222	0.002559	0.186011	1.000000	1.000000
Railroad	1.000000	1.000000	0.025378		1.000000	1.000000	1.000000	1.000000	1.000000
Lower creek	1.000000	1.000000	0.051222	1.000000		1.000000	1.000000	1.000000	1.000000
Landfill	1.000000	0.264994	0.002559	1.000000	1.000000		1.000000	1.000000	1.000000
Historical creek	1.000000	1.000000	0.186011	1.000000	1.000000	1.000000		1.000000	1.000000
General Site	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000		1.000000
Background	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	

Multiple Comparisons p values (2-tailed);
Independent (grouping) variable: Site_Area
Kruskal-Wallis test: H (8, N= 78) =24.95715 p =.00

Zinc

	Wetlands R:18.000	Upper creek R:46.793	South Slope R:18.938	Railroad R:40.500	Lower creek R:36.444	Landfill R:57.263	Historical creek R:54.042	General Site R:16.000	Background R:24.000
Wetlands		1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
Upper creek	1.000000		0.227798	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
South Slope	1.000000	0.227798		1.000000	1.000000	0.013378	0.093905	1.000000	1.000000
Railroad	1.000000	1.000000	1.000000		1.000000	1.000000	1.000000	1.000000	1.000000
Lower creek	1.000000	1.000000	1.000000	1.000000		1.000000	1.000000	1.000000	1.000000
Landfill	1.000000	1.000000	0.013378	1.000000	1.000000		1.000000	1.000000	1.000000
Historical creek	1.000000	1.000000	0.093905	1.000000	1.000000	1.000000		1.000000	1.000000
General Site	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000		1.000000
Background	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	

Multiple Comparisons p values (2-tailed);
Independent (grouping) variable: Site_Area
Kruskal-Wallis test: H (8, N= 88) =20.38991 p =.0090

Table I-5. Kruskal-Wallis statistical analyses for surface water

Zinc

	Beach R:10.000	Lower creek R:16.563	Upper creek R:23.579	Wetlands R:5.9000	Background R:13.500	Historical creek R:28.000
Beach		1.000000	1.000000	1.000000	1.000000	1.000000
Lower creek	1.000000		1.000000	1.000000	1.000000	1.000000
Upper creek	1.000000	1.000000		0.017344	1.000000	1.000000
Wetlands	1.000000	1.000000	0.017344		1.000000	0.220133
Background	1.000000	1.000000	1.000000	1.000000		1.000000
Historical creek	1.000000	1.000000	1.000000	0.220133	1.000000	

Table I-6. Kruskal-Wallis statistical analyses for surface sediment

Arsenic

	Background R:24.825	Beach R:17.000	Historical creek R:42.667	Lower creek R:25.556	Upper creek R:20.917	Wetlands R:12.250
Background		1.000000	0.128296	1.000000	1.000000	1.000000
Beach	1.000000		1.000000	1.000000	1.000000	1.000000
Historical creek	0.128296	1.000000		0.389056	0.042666	0.159048
Lower creek	1.000000	1.000000	0.389056		1.000000	1.000000
Upper creek	1.000000	1.000000	0.042666	1.000000		1.000000
Wetlands	1.000000	1.000000	0.159048	1.000000	1.000000	

Multiple Comparisons p values (2-tailed);
Independent (grouping) variable: Site_Area
Kruskal-Wallis test: H (5, N= 50) =11.55185 p =.0415

Copper

	Beach R:13.000	Historical creek R:32.167	Lower creek R:23.385	Upper creek R:15.500	Wetlands R:24.000
Beach		1.000000	1.000000	1.000000	1.000000
Historical creek	1.000000		1.000000	0.031633	1.000000
Lower creek	1.000000	1.000000		0.705526	1.000000
Upper creek	1.000000	0.031633	0.705526		1.000000
Wetlands	1.000000	1.000000	1.000000	1.000000	

Multiple Comparisons p values (2-tailed);
Independent (grouping) variable: Site_Area
Kruskal-Wallis test: H (4, N= 41) =10.15830 p =.0378

Lead

	Beach R:10.000	Historical creek R:35.667	Lower creek R:21.846	Upper creek R:17.500	Wetlands R:12.667
Beach		0.472923	1.000000	1.000000	1.000000
Historical creek	0.472923		0.194084	0.012952	0.066217
Lower creek	1.000000	0.194084		1.000000	1.000000
Upper creek	1.000000	0.012952	1.000000		1.000000
Wetlands	1.000000	0.066217	1.000000	1.000000	

Multiple Comparisons p values (2-tailed);
Independent (grouping) variable: Site_Area
Kruskal-Wallis test: H (4, N= 41) =12.89514 p =.0118

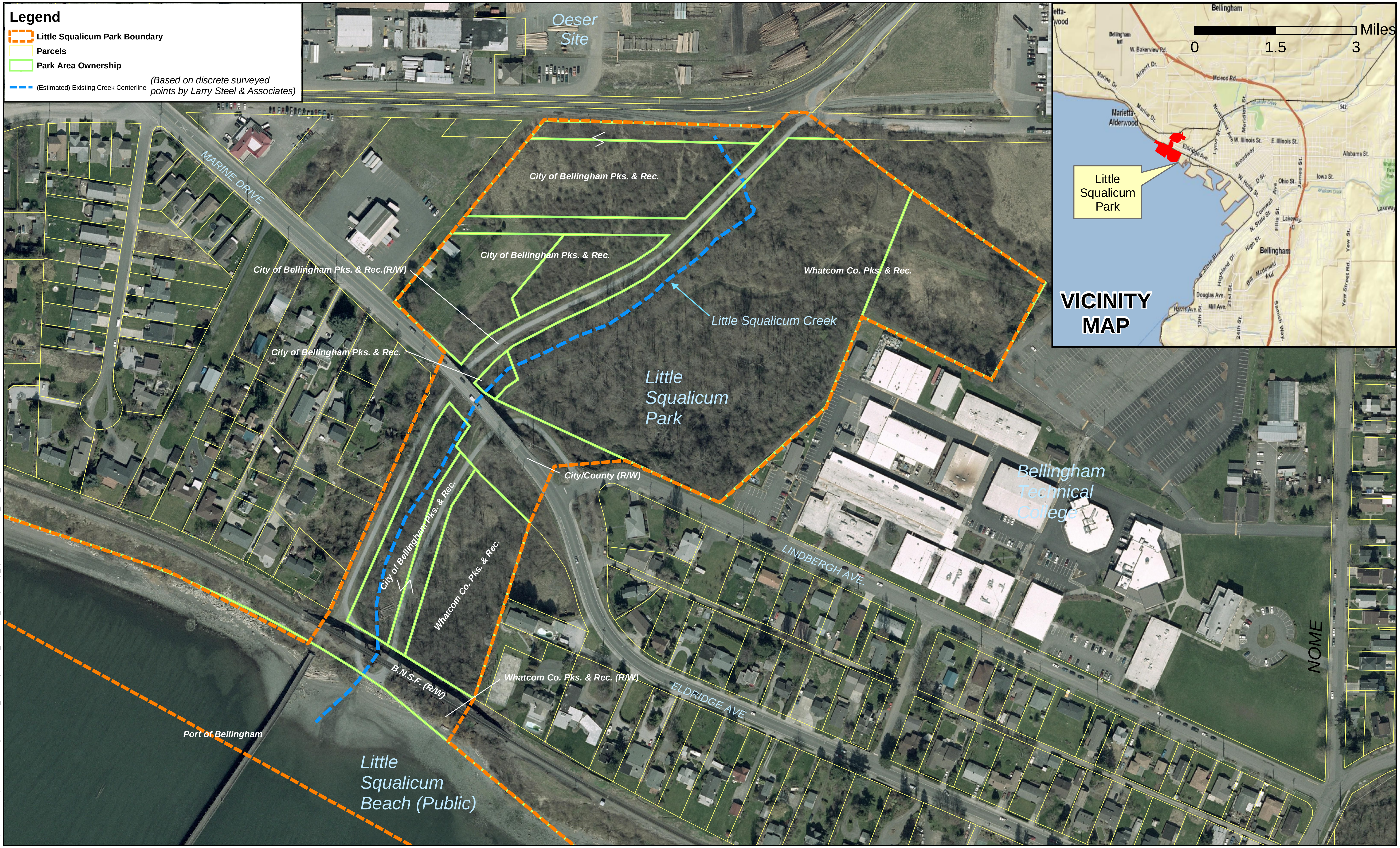
Mercury

	Beach R:14.000	Historical creek R:34.667	Lower creek R:19.115	Upper creek R:17.833	Wetlands R:23.167
Beach		1.000000	1.000000	1.000000	1.000000
Historical creek	1.000000		0.085301	0.028738	1.000000
Lower creek	1.000000	0.085301		1.000000	1.000000
Upper creek	1.000000	0.028738	1.000000		1.000000
Wetlands	1.000000	1.000000	1.000000	1.000000	

Multiple Comparisons p values (2-tailed);
Independent (grouping) variable: Site_Area
Kruskal-Wallis test: H (4, N= 41) =9.867411 p =.0427

FIGURES

LIST OF FIGURES



Map Document: (\\192.168.1.11\gis\ml\C075_Little-Squalicum_COBLSP_vicinity-map_updated-title-block_draft_20061019.mxd) TWC -- 10/13/2007 -- 12:13:48 PM

integral consulting inc.

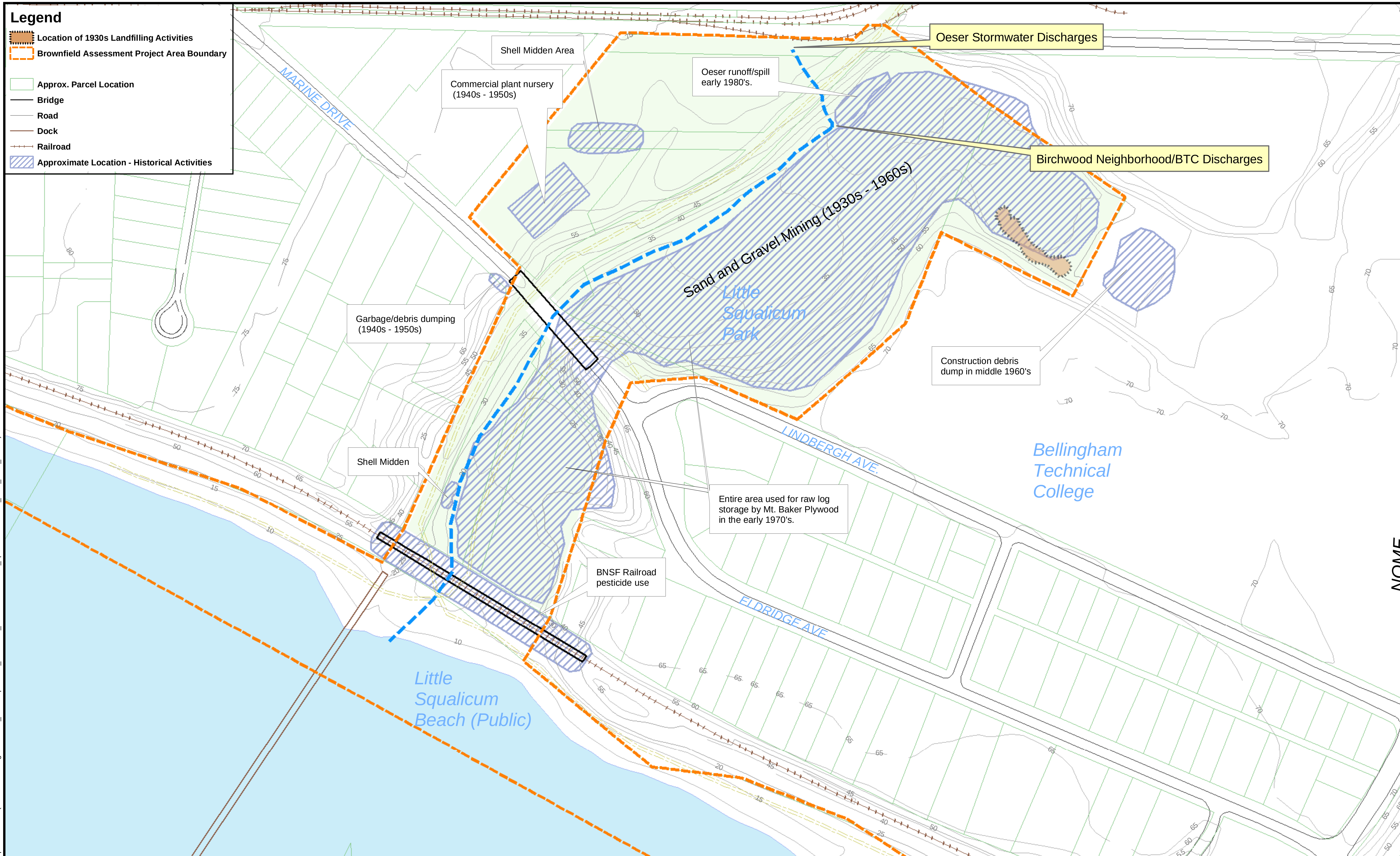
N

Feet
0 100 200 400

Feature Sources:
Topological features: City of Bellingham web site, source:1998 drawings.
Park area, Brownfield area, Area Trails: Transferred from copy - Site Location Map
2002 Aerial Image: City of Bellingham and ADI.

DRAFT

Figure 1-1
Park Area Ownership and Vicinity Map
Little Squalicum Park RI, Bellingham, WA



Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\LSP_Historical-Activities_updated-title-block_draft_2007_tc.mxd) TWC -- 10/15/2007 -- 11:48:15 AM

integral consulting inc.

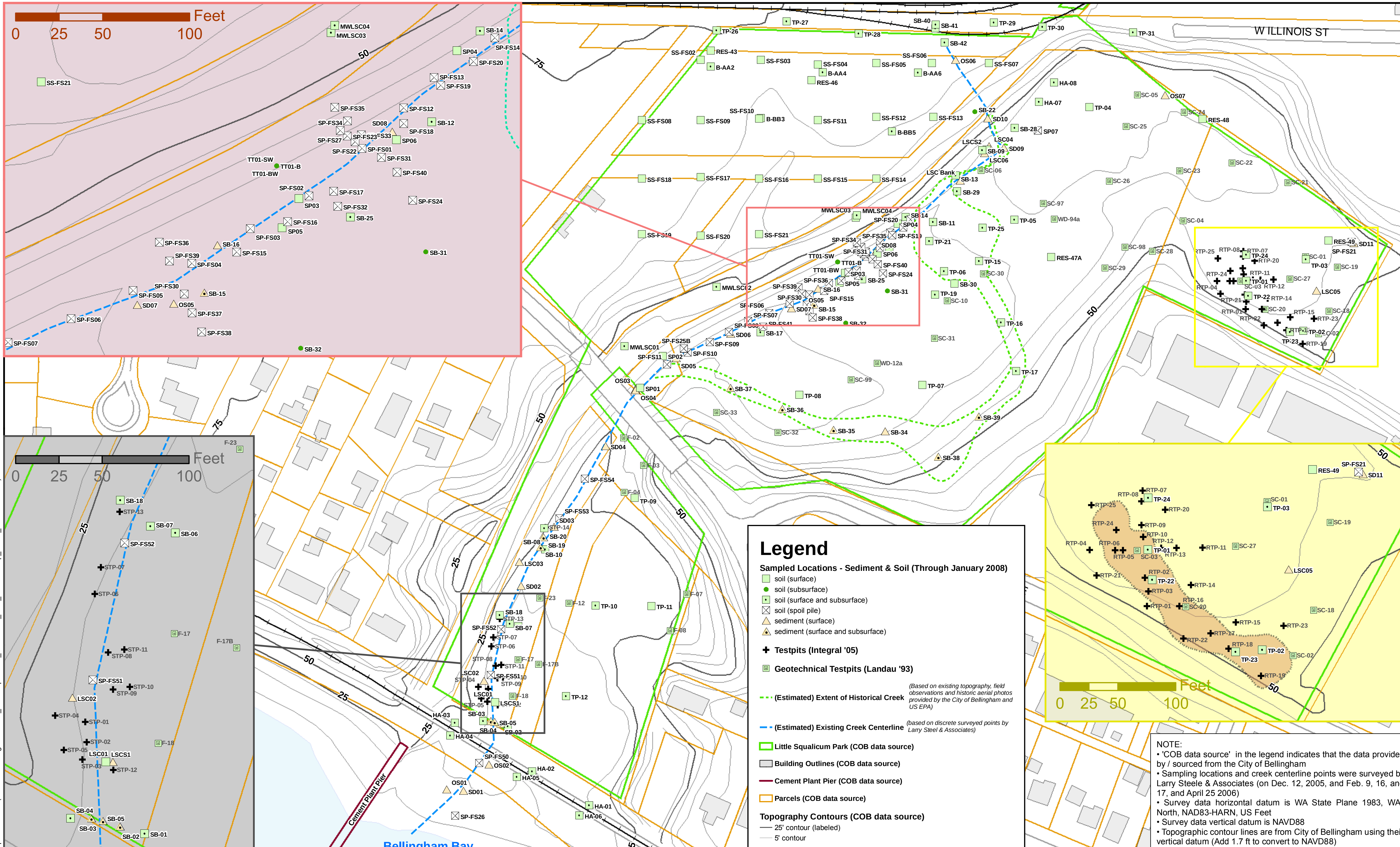
N

0 100 200 400 Feet

Feature Sources:
Topological features: City of Bellingham web site, source:1998 drawings.
Park area, Brownfield area, Area Trails: Transferred from copy - Site Location Map Appendix B Map of Brownfield Assessment Area.

DRAFT

Figure 2-1
Historical Activities
Little Squalicum Park RI, Bellingham, WA



Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_location-map_insets_20060825.mxd) TWC -- 10/23/2007 -- 2:47:24 PM

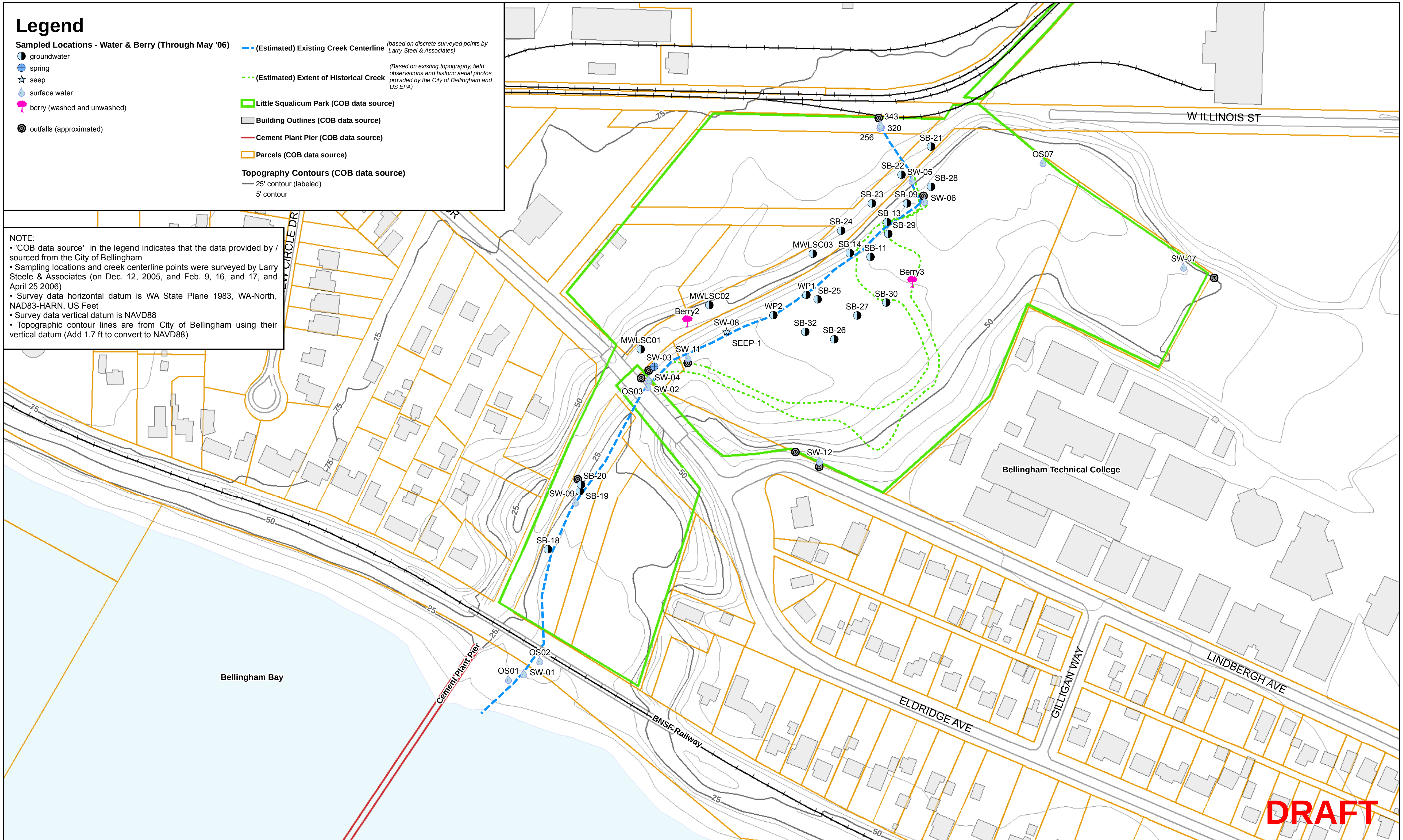
integral consulting inc.

N

Feet
0 50 100 200

DRAFT

Figure 2-2
Sediment and Soil Sampling Locations
Little Squalicum Park RI, Bellingham, WA



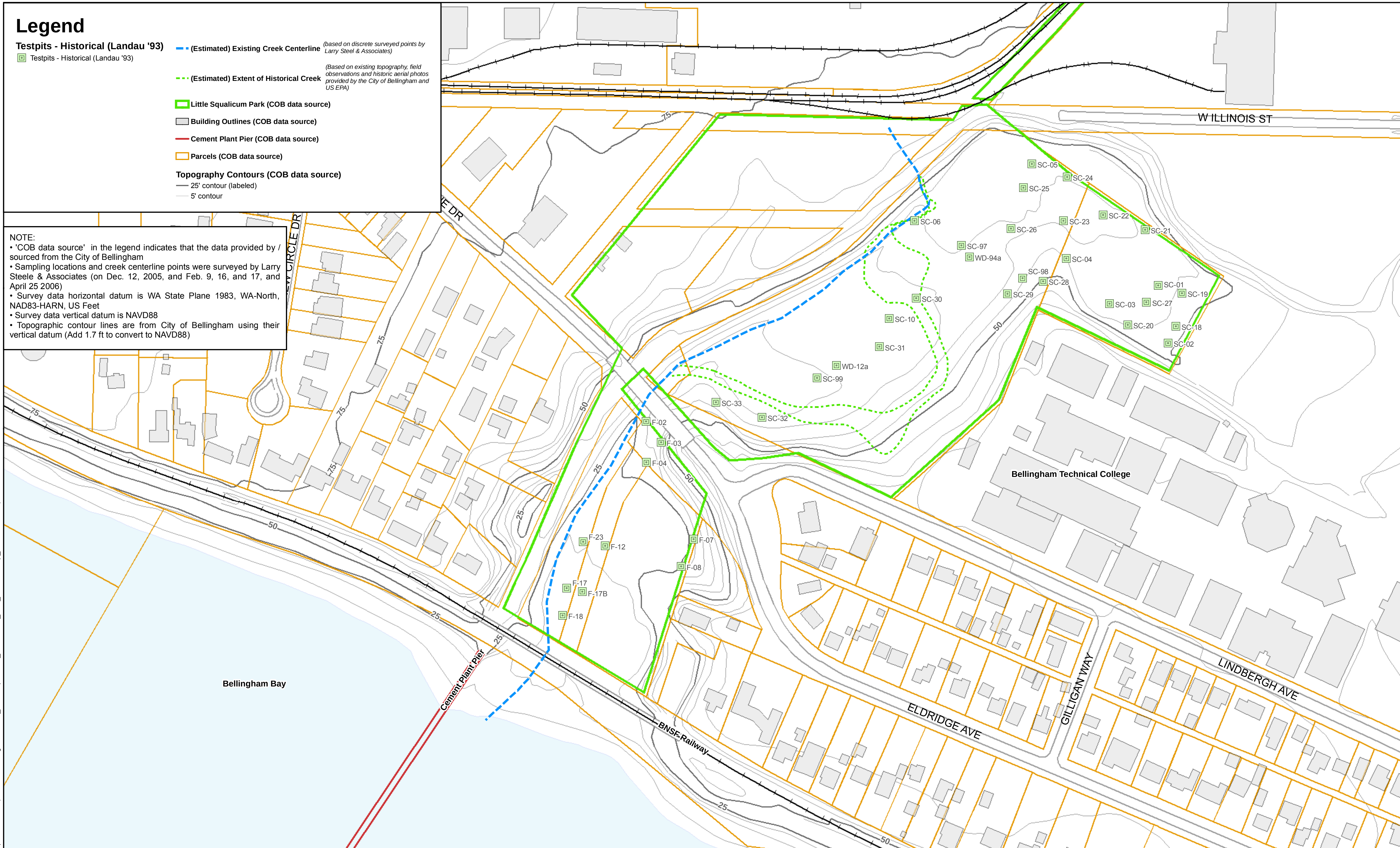
Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_location-map_20060815.mxd) TWC -- 10/23/2007 -- 3:52:09 PM

integral consulting inc.

N

0 100 200 400 Feet

Figure 2-3
Water and Berry Sampling Locations
Little Squalicum Park RI, Bellingham, WA

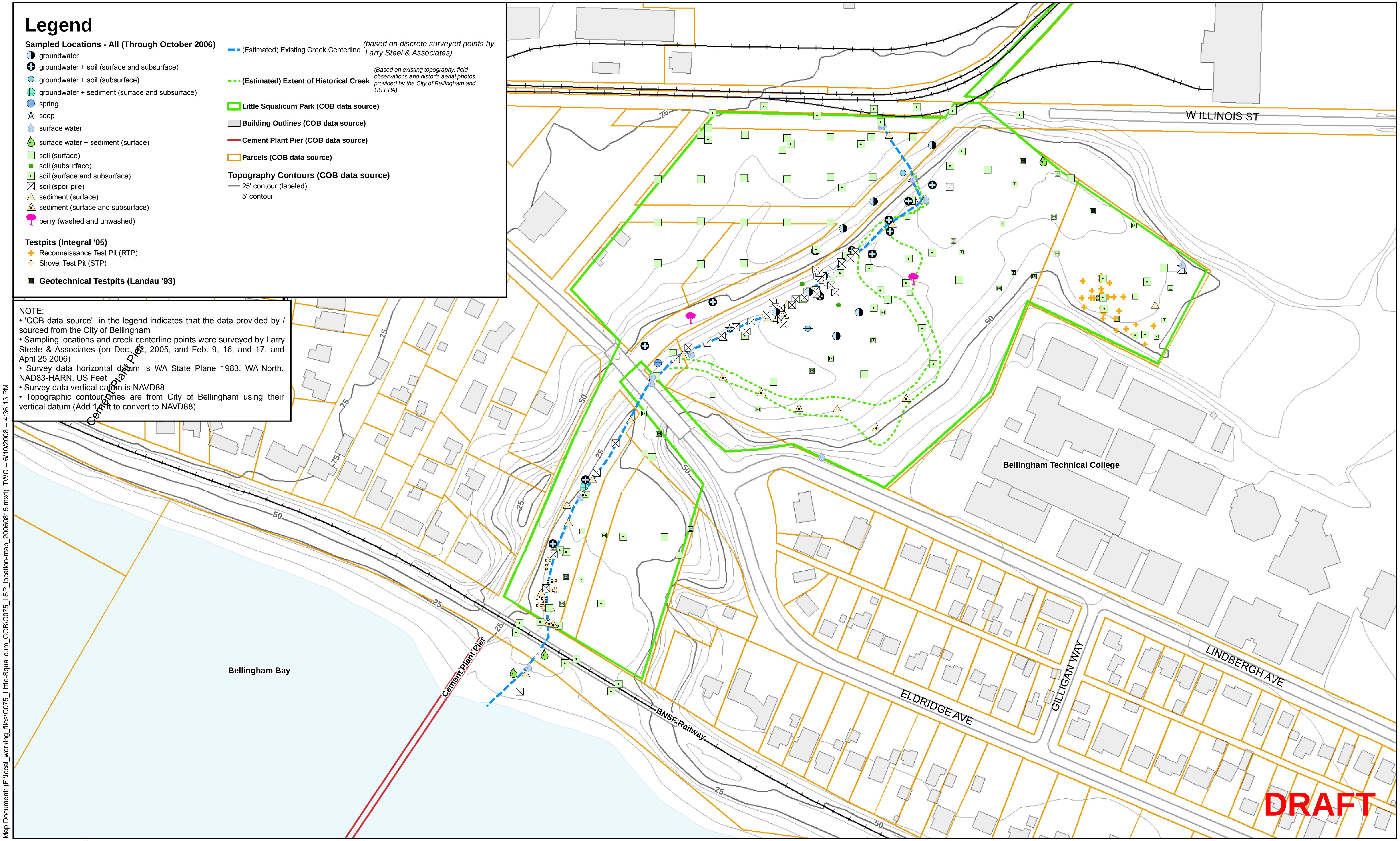


0 100 200 400 Feet

DRAFT

Figure 2-4
Historical Geotechnical Sampling Locations
Little Squalicum Park RI, Bellingham, WA

Map Document: (\\192.168.1.11\gis\m\C075_Little-Squalicum_COB\C075_LSP_location-map_20060815.mxd) TWC -- 10/15/2007 -- 5:38:04 PM



integral consulting inc.

N

0 50 100 200 300 Feet

Figure 3-1
Sampling Locations
Little Squalicum Park RI, Bellingham, WA

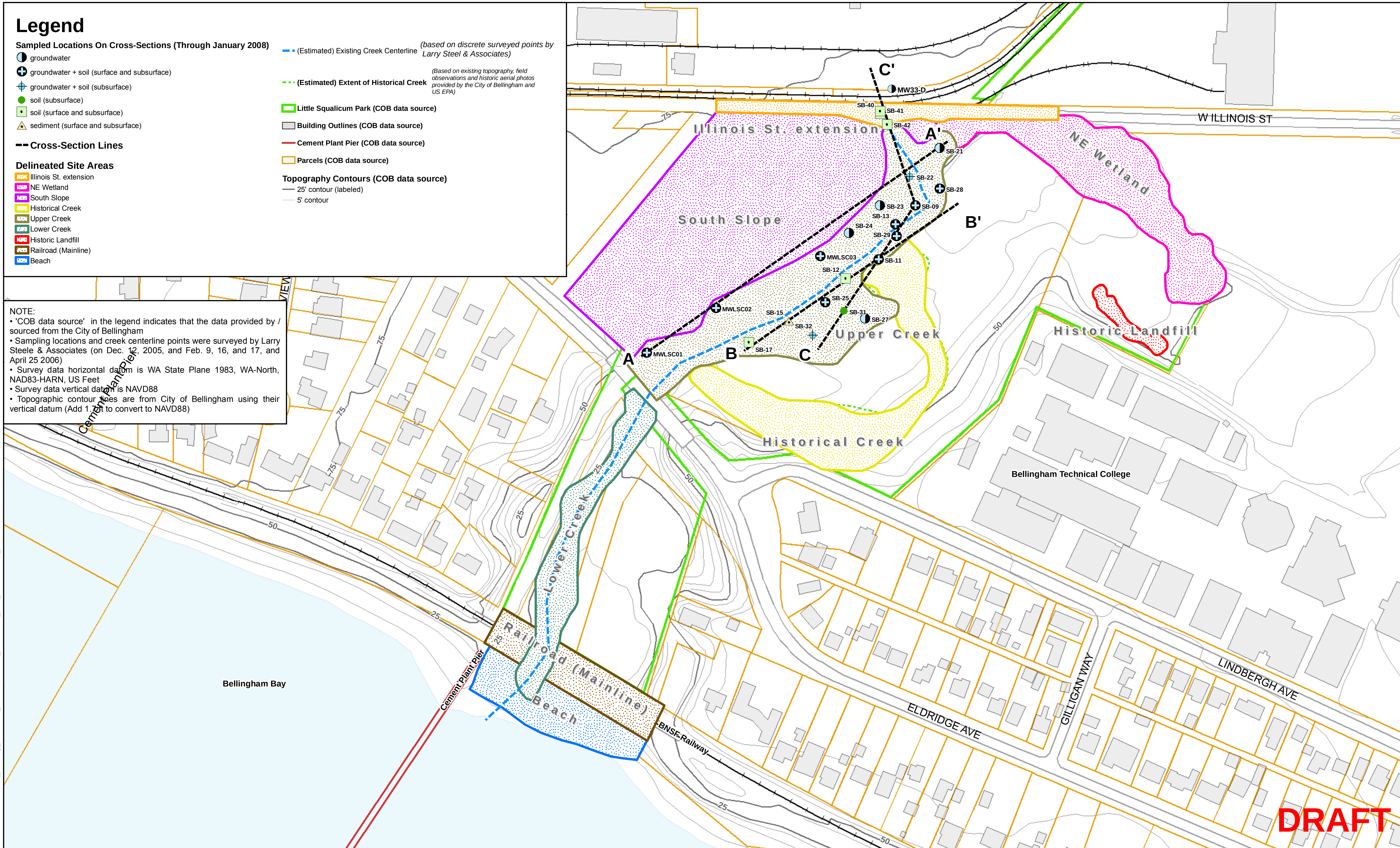
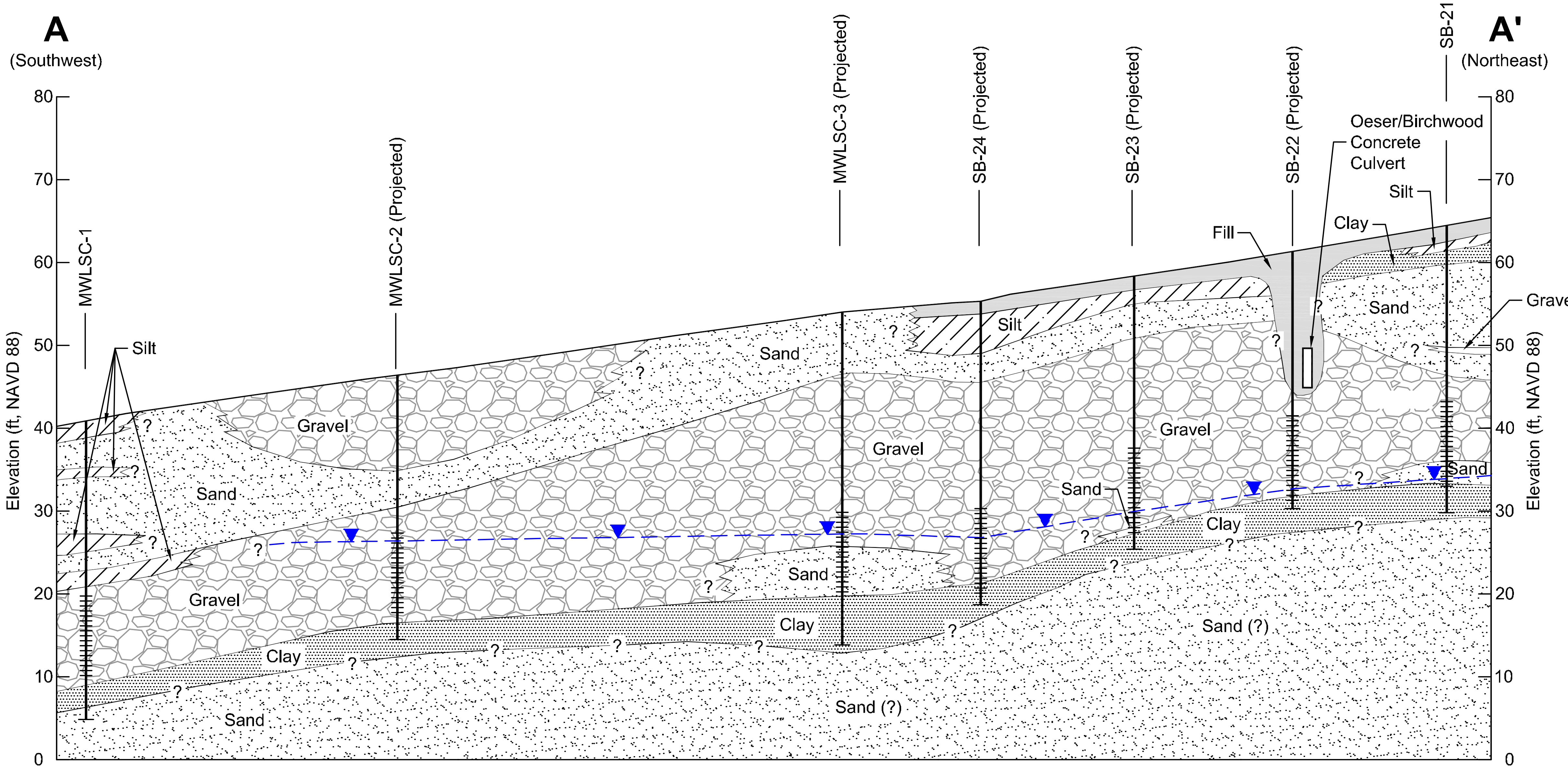


Figure 4-1
Delineated Site Areas and Cross-Section Location Lines
Little Squalicum Park RI, Bellingham, WA

Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_location-map_20060815.mxd) TWC -- 6/10/2008 -- 4:36:13 PM

integral consulting inc.



Legend

?	Inferred soil or geologic contact (queried where uncertain)
Dashed blue line with ▼	Inferred Groundwater Elevation (5/1/06) (ft, NAVD 88)
Pattern	Clay with Silt and Sand
Pattern	Silt with Clay and Sand
Pattern	Sand with Silt
Pattern	Gravel with Clay, Silt, and Sand
Pattern	Fill
Symbol	Boring
Symbol	Well or Piezometer Screen Interval

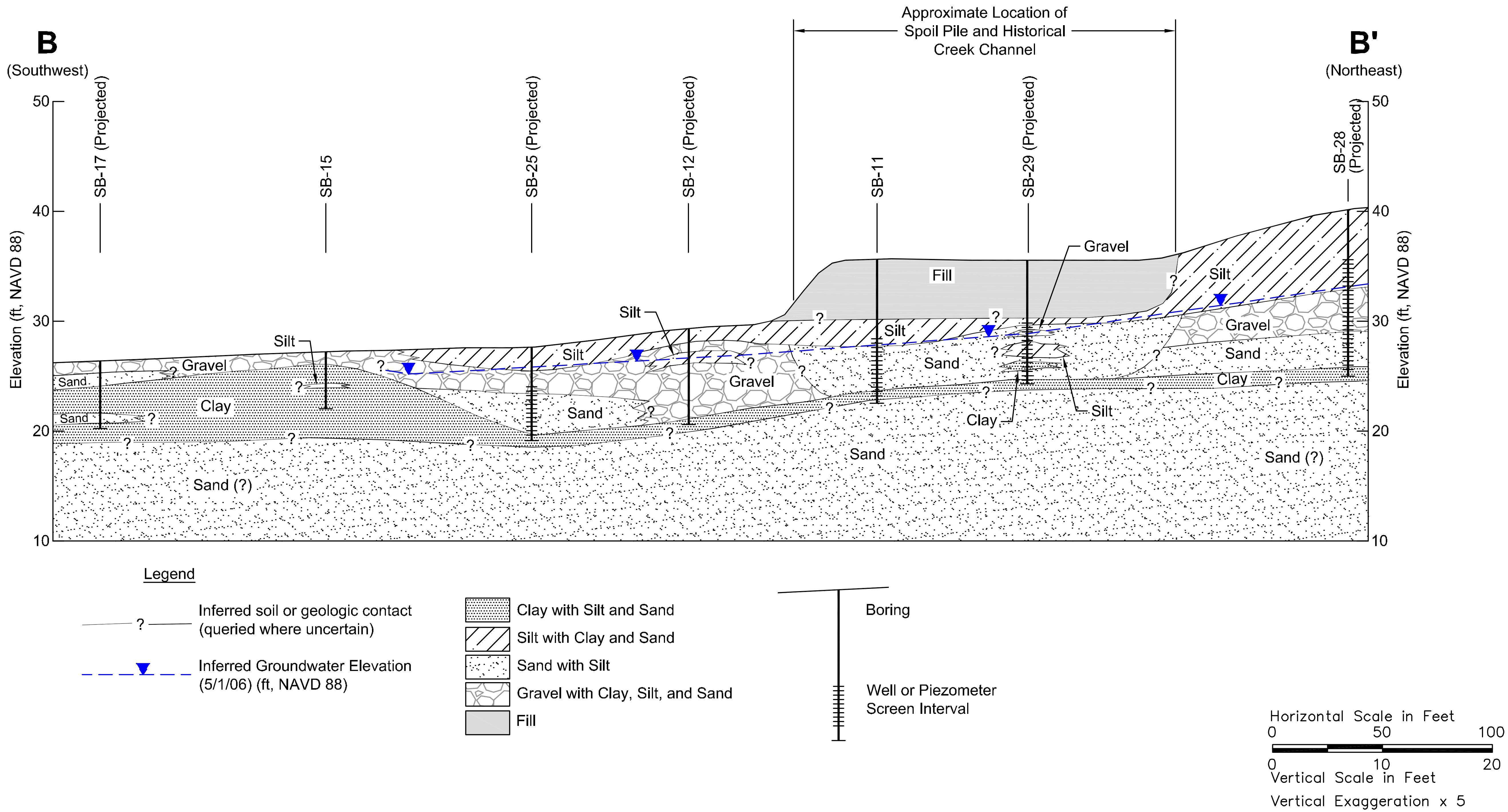
Horizontal Scale in Feet
0 75 150

0 15 30
Vertical Scale in Feet

Vertical Exaggeration x 5

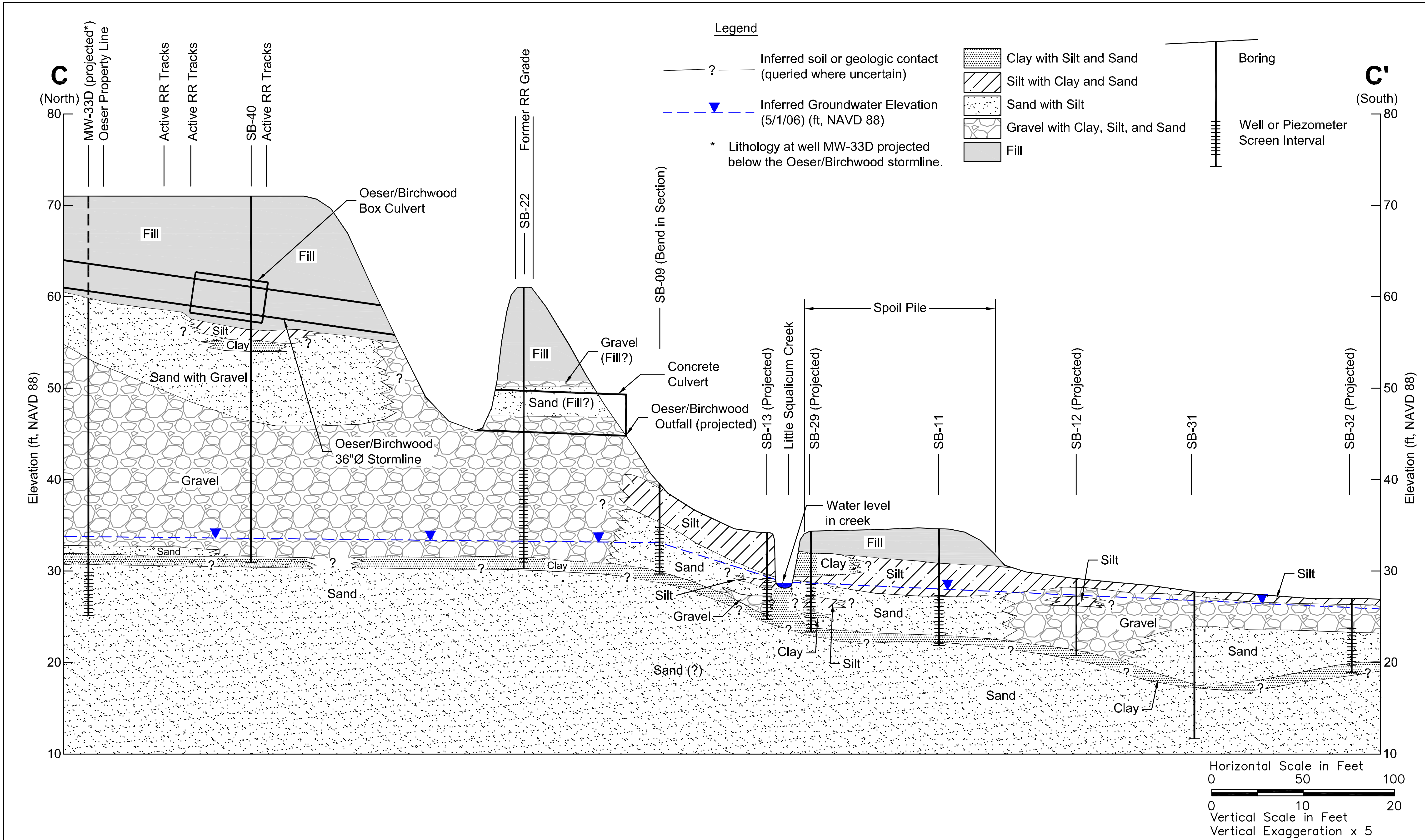
integral consulting inc.

Figure 4-2
Geologic Cross Section A-A'



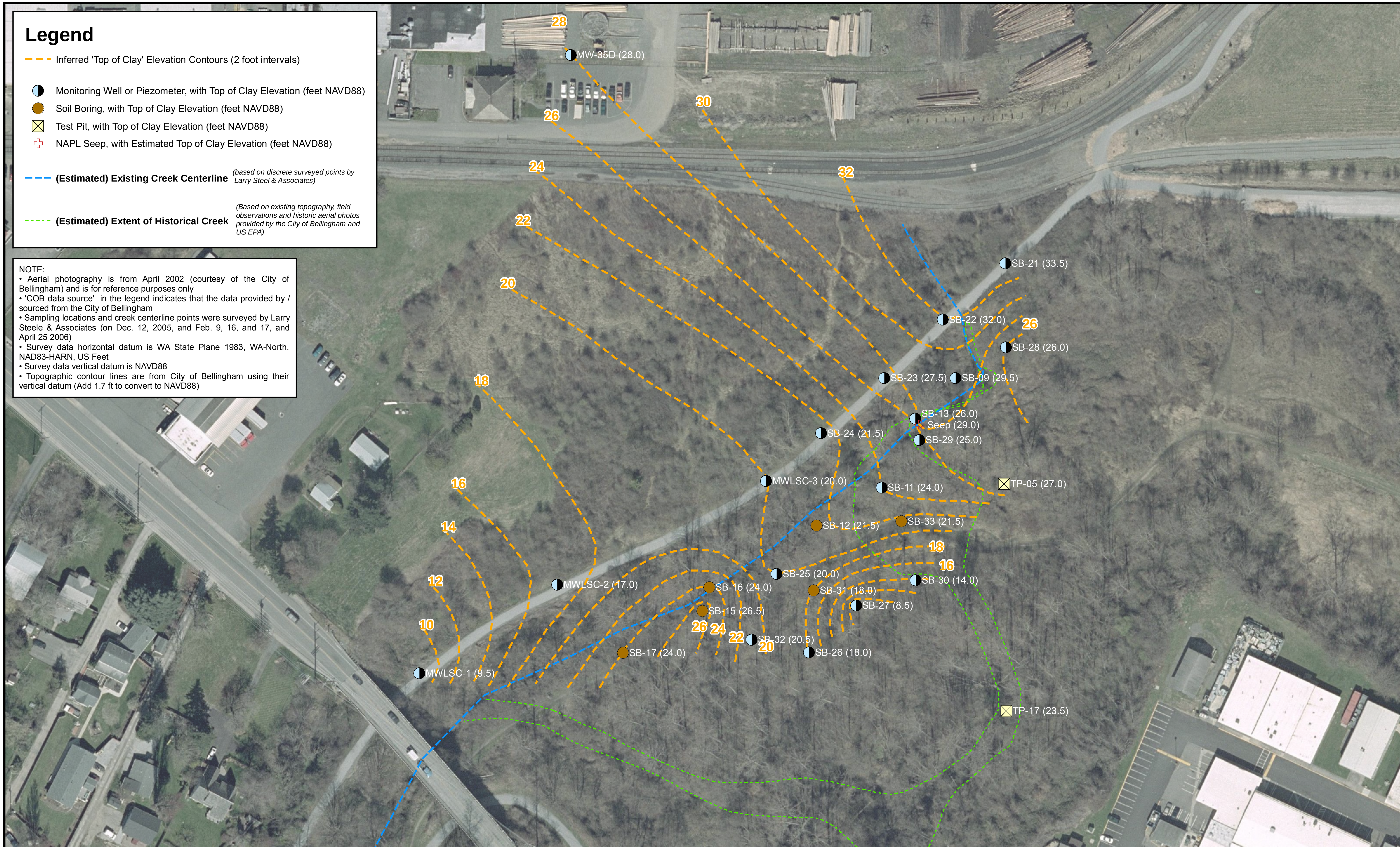
integral consulting inc.

Figure 4-3
Geologic Cross Section B-B'



integral consulting inc.

Figure 4-4
Geologic Cross Section C-C'



Map Document: (\\192.168.1.11\gis\ms\C075_Little-Squalicum_COB\C075_LSP_locations-map_with-Osler_20060302.mxd) TWC -- 10/16/2007 -- 2:46:03 PM

integral consulting inc.

N

0 150 300 600 Feet

DRAFT

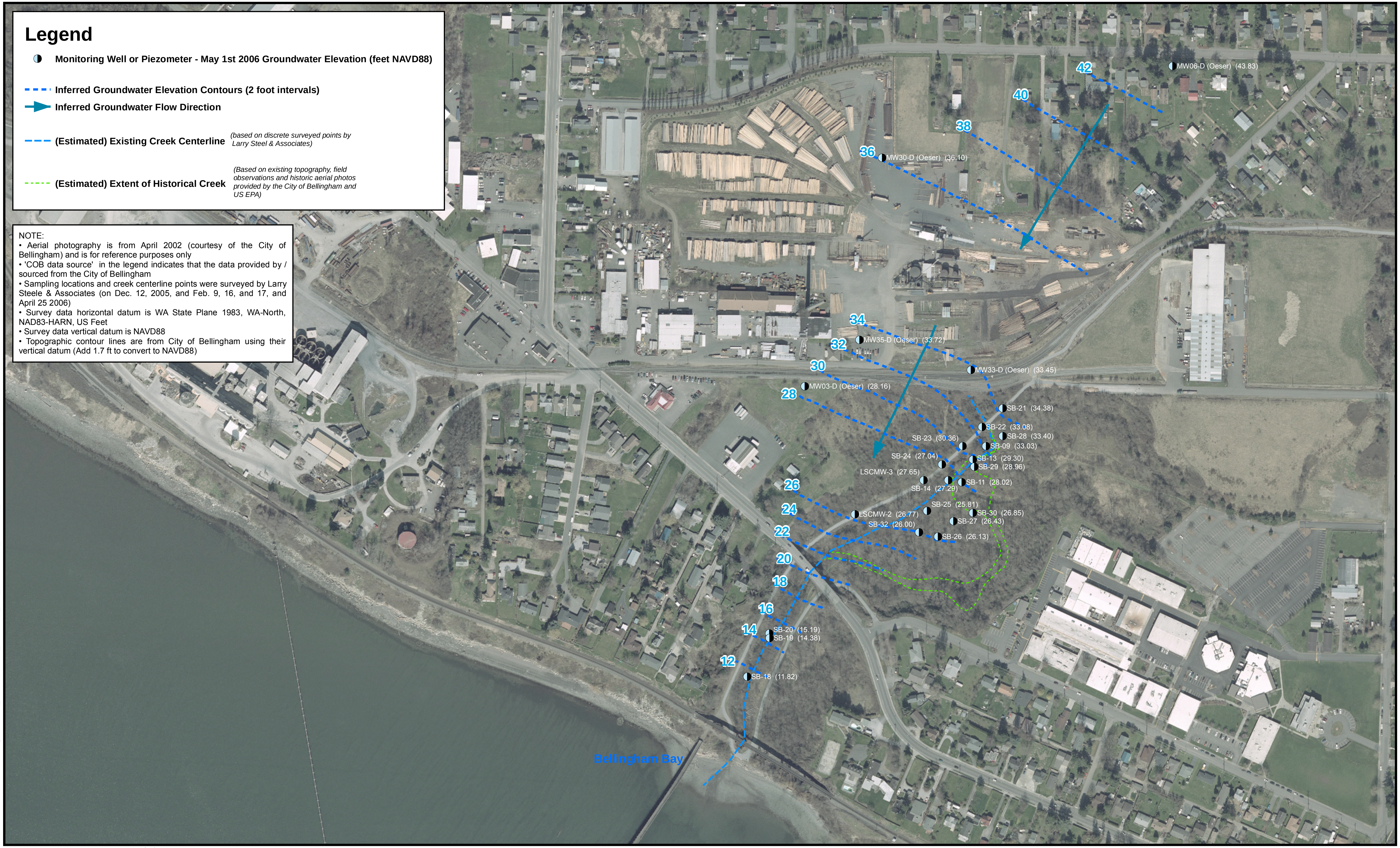
Figure 4-5

Top of Clay Map (Native)

Little Squalicum Park RI, Bellingham, WA

Figure 4-6
Groundwater Surface Map, February 2006
Little Squalicum Park RI, Bellingham, WA

Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_locations-map_with-Osler_20060302.mxd) TWC -- 10/16/2007 -- 2:46:03 PM



Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_locations-map_with-Osler_20060302.mxd) TWC -- 10/16/2007 -- 2:46:03 PM

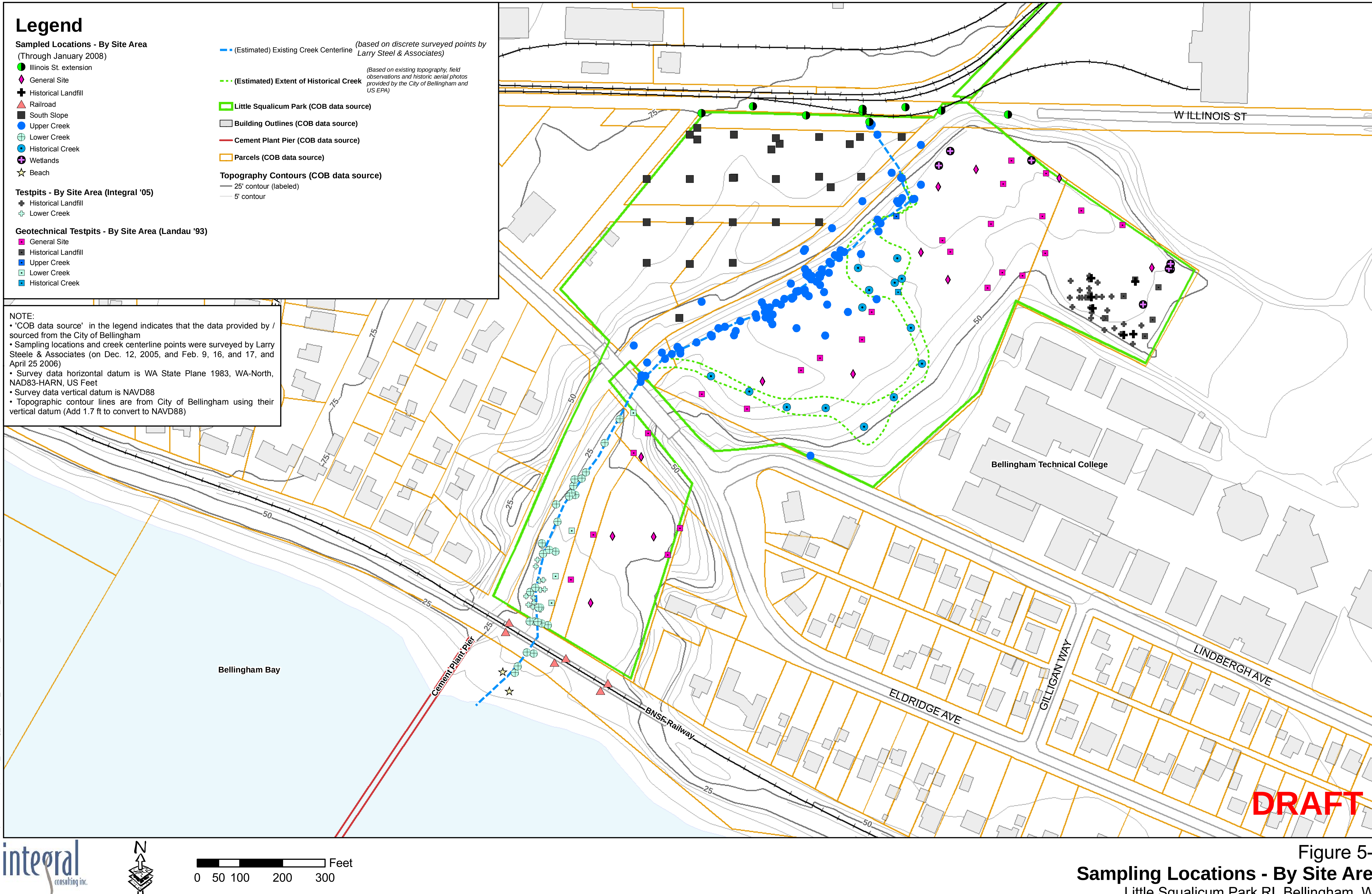
integral consulting inc.

N

0 150 300 600 Feet

DRAFT

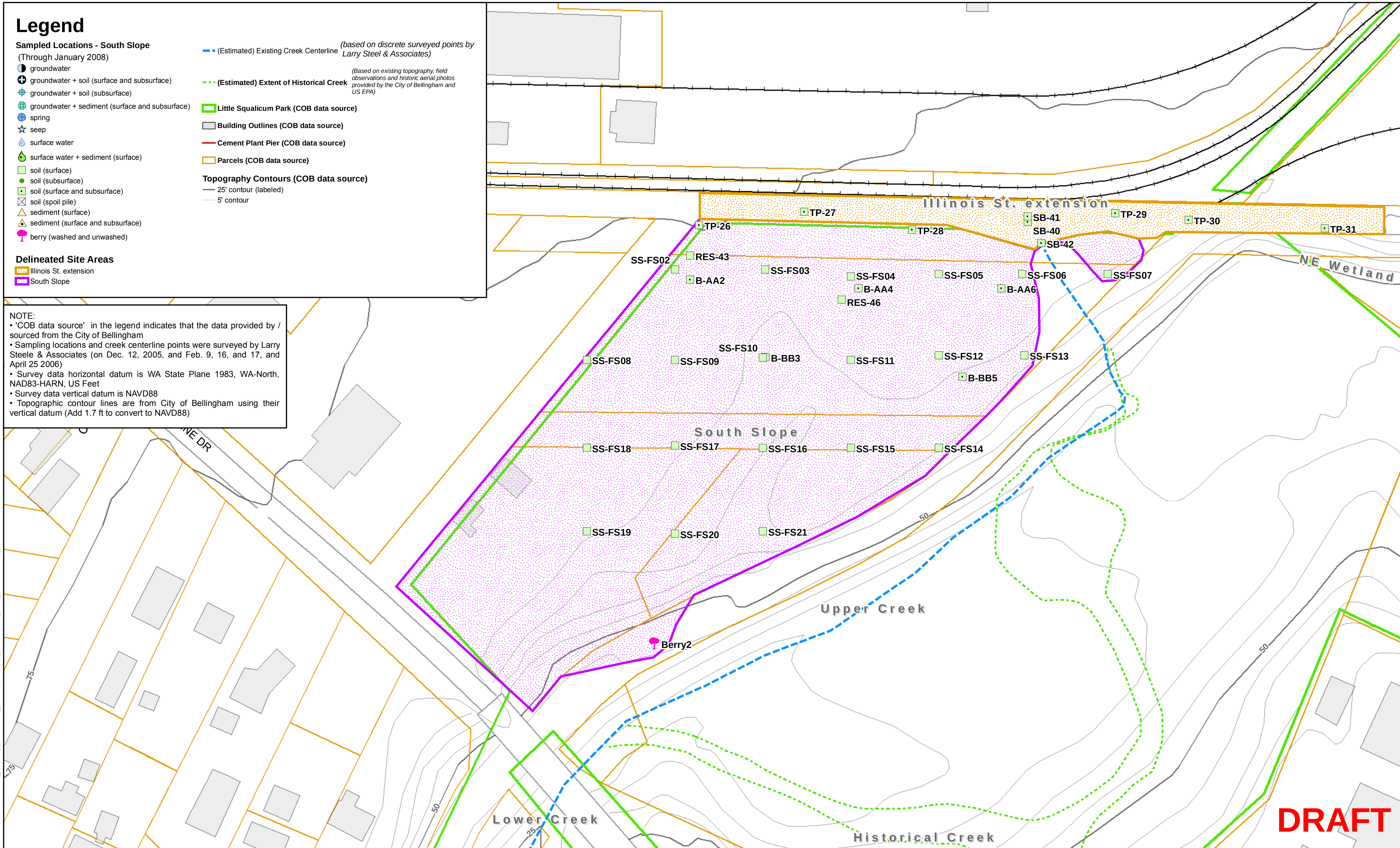
Figure 4-7
Groundwater Surface Map, May 2006
Little Squalicum Park RI, Bellingham, WA



Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_location-map_20060815.mxd) TWC -- 6/10/2008 -- 4:36:13 PM

integral consulting inc.

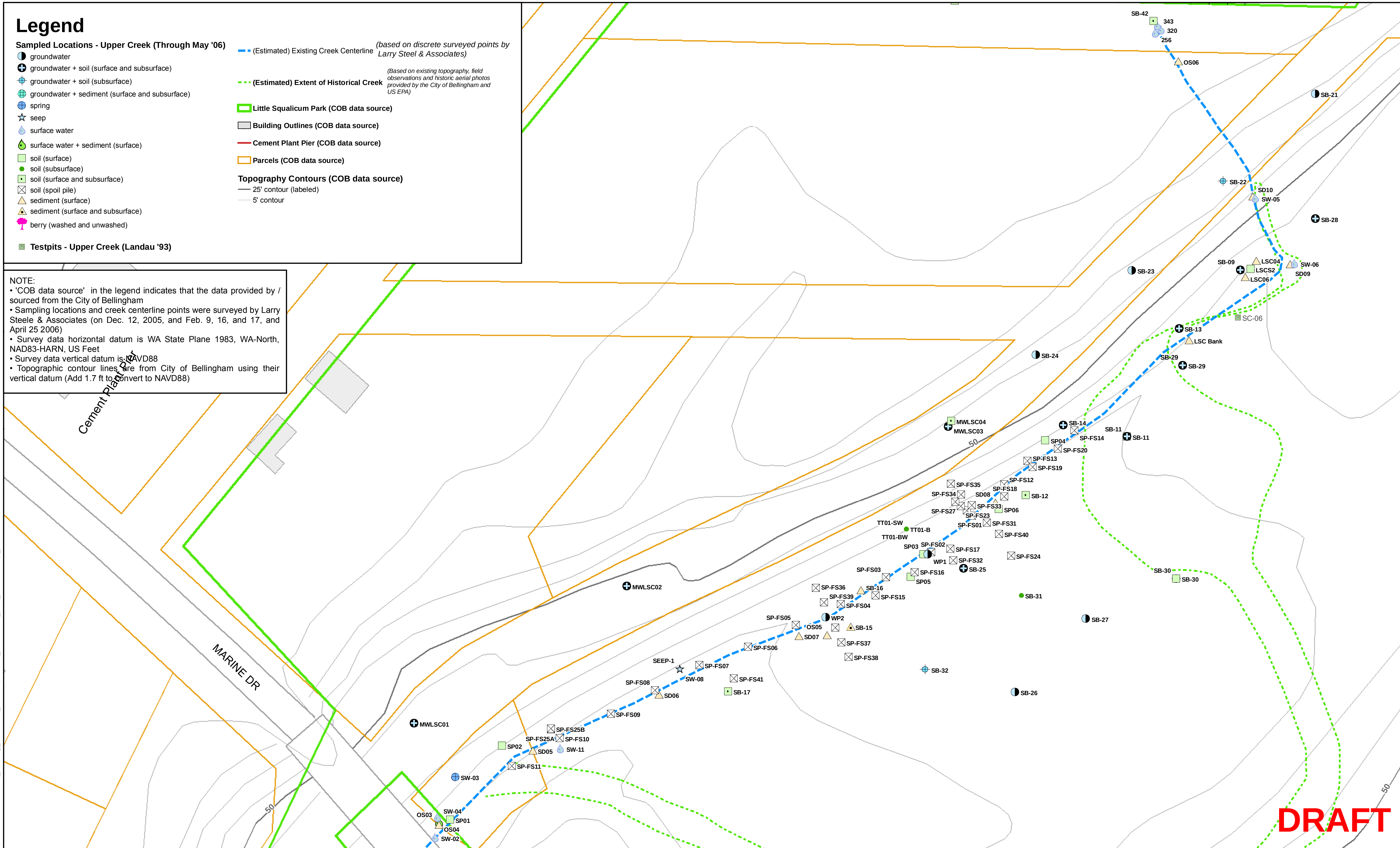
Figure 5-1
Sampling Locations - By Site Area
Little Squalicum Park RI, Bellingham, WA



Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_location-map_20060815.mxd) TWC -- 6/10/2008 -- 4:36:13 PM

integral consulting inc.

Figure 5-2
South Slope and Illinois St. Extension Sampling Locations
Little Squalicum Park RI, Bellingham, WA



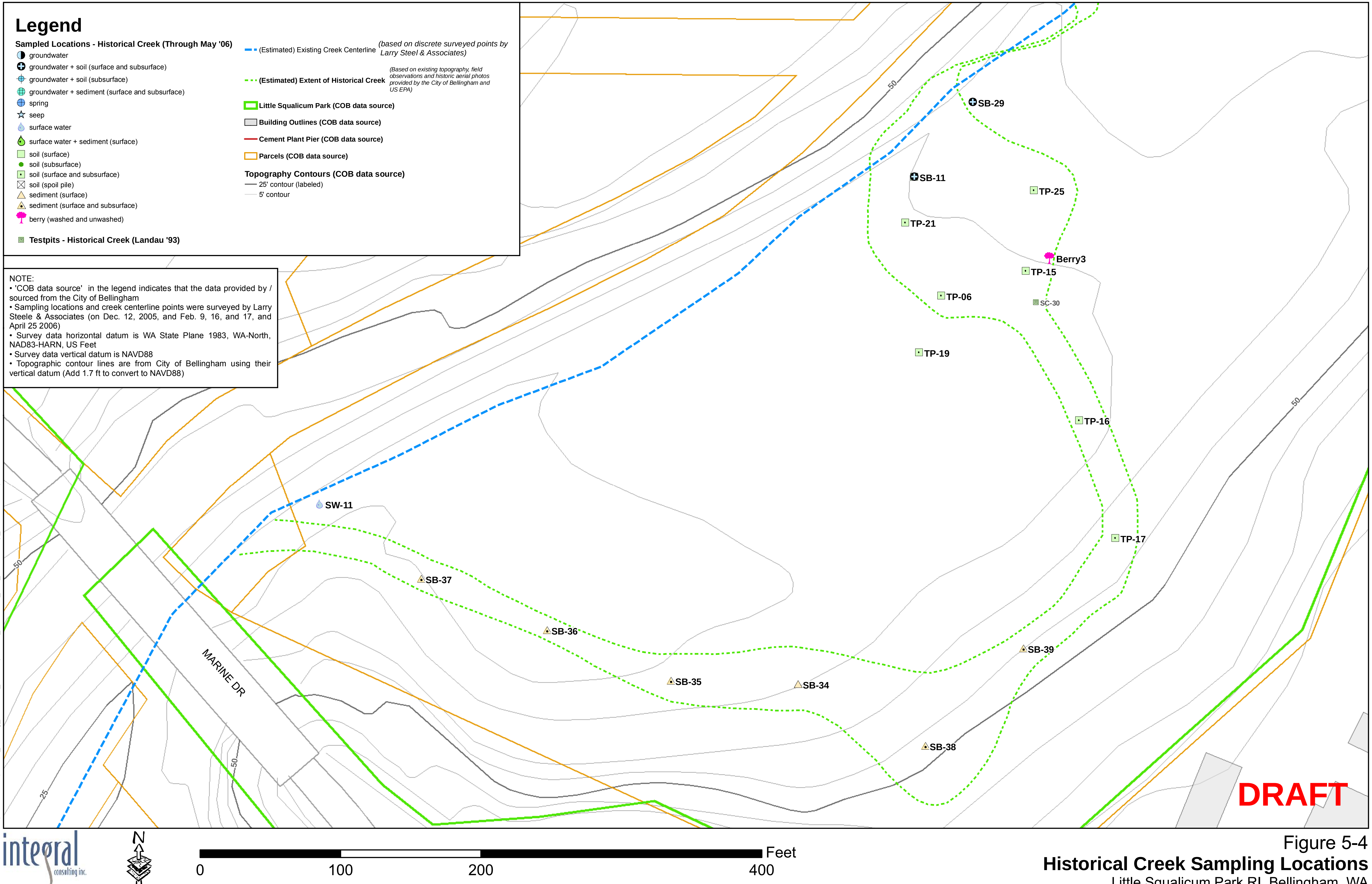
Feet

0 25 50 100

Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_location-map_20060815.mxd) TWC -- 6/10/2008 -- 4:36:13 PM

integral consulting inc.

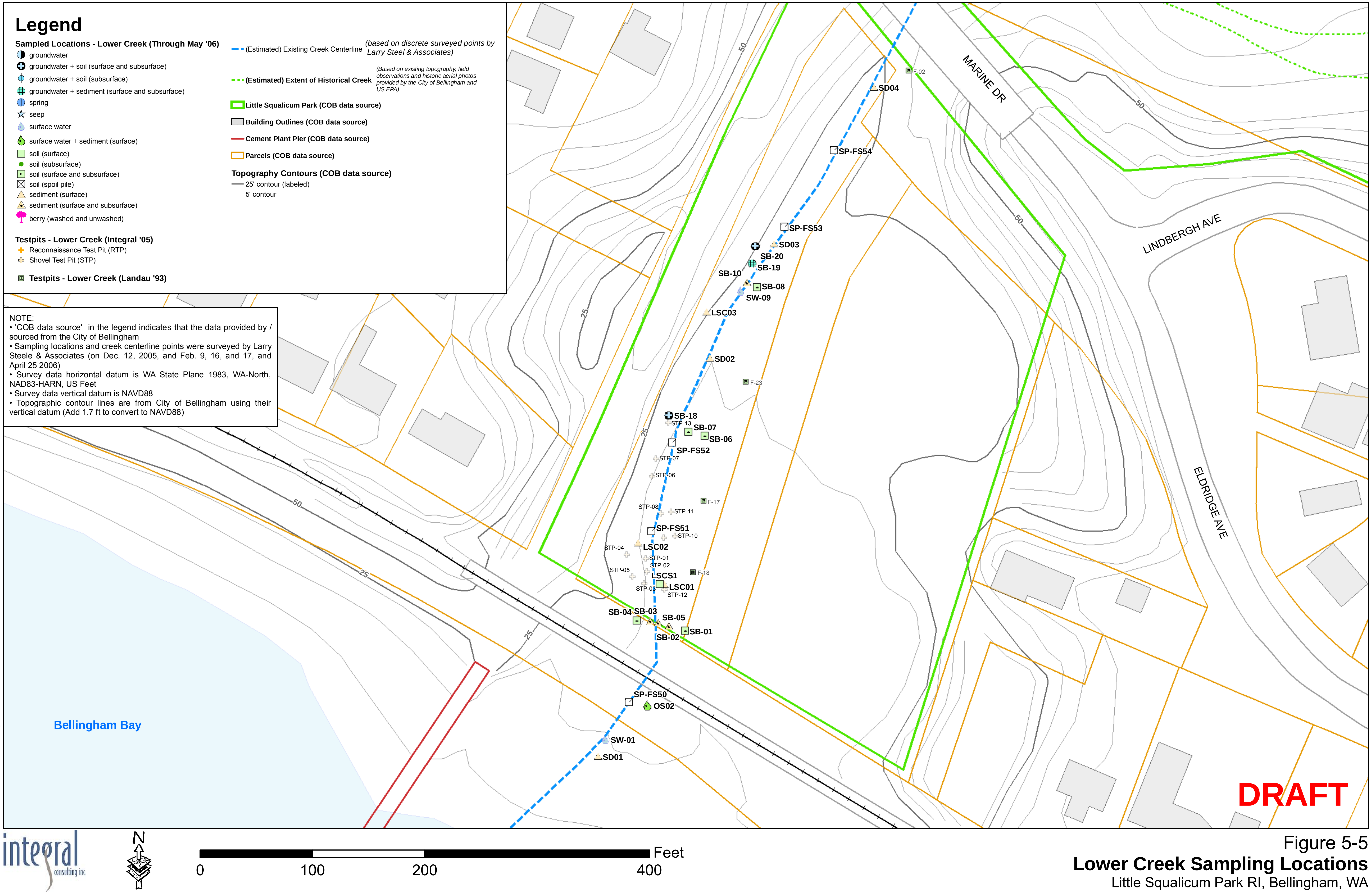
Figure 5-3
Upper Creek Sampling Locations
Little Squalicum Park RI, Bellingham, WA



Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_location-map_20060815.mxd) TWC -- 10/29/2007 -- 2:12:39 PM

integral consulting inc.

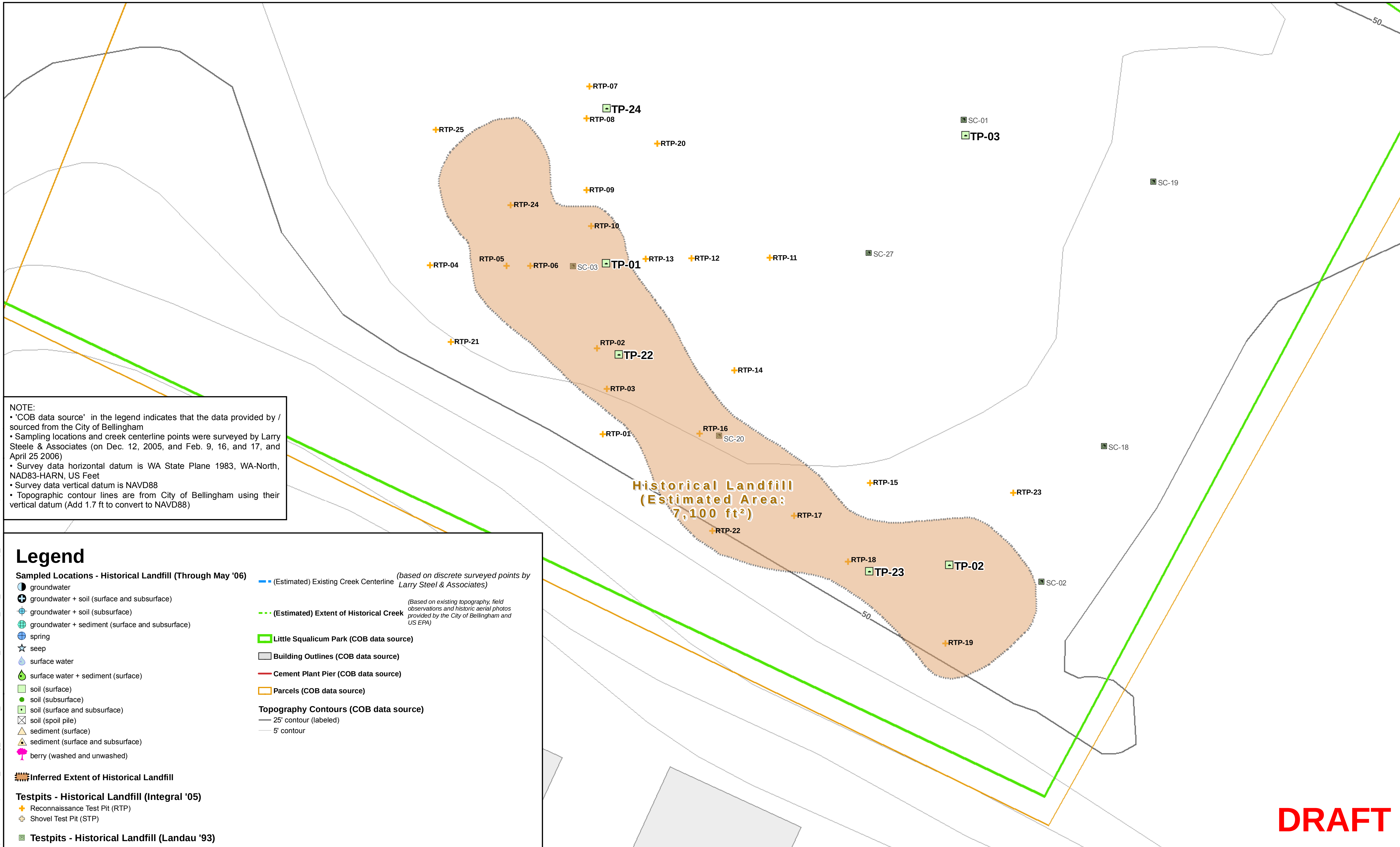
Figure 5-4
Historical Creek Sampling Locations
Little Squalicum Park RI, Bellingham, WA



integral consulting inc.

Figure 5-5
Lower Creek Sampling Locations
Little Squalicum Park RI, Bellingham, WA

Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_location-map_20060815.mxd) TWC -- 10/29/2007 -- 2:12:39 PM



NOTE:
- 'COB data source' in the legend indicates that the data provided by / sourced from the City of Bellingham
- Sampling locations and creek centerline points were surveyed by Larry Steele & Associates (on Dec. 12, 2005, and Feb. 9, 16, and 17, and April 25 2006)
- Survey data horizontal datum is WA State Plane 1983, WA-North, NAD83-HARN, US Feet
- Survey data vertical datum is NAVD88
- Topographic contour lines are from City of Bellingham using their vertical datum (Add 1.7 ft to convert to NAVD88)

Legend

Sampled Locations - Historical Landfill (Through May '06)
- groundwater
- groundwater + soil (surface and subsurface)
- groundwater + soil (subsurface)
- groundwater + sediment (surface and subsurface)
- spring
- seep
- surface water
- surface water + sediment (surface)
- soil (surface)
- soil (subsurface)
- soil (surface and subsurface)
- soil (spoil pile)
- sediment (surface)
- sediment (surface and subsurface)
- berry (washed and unwashed)

Inferred Extent of Historical Landfill

Testpits - Historical Landfill (Integral '05)
- Reconnaissance Test Pit (RTP)
- Shovel Test Pit (STP)

Testpits - Historical Landfill (Landau '93)

(Estimated) Existing Creek Centerline *(based on discrete surveyed points by Larry Steel & Associates)*

(Estimated) Extent of Historical Creek *(Based on existing topography, field observations and historic aerial photos provided by the City of Bellingham and US EPA)*

Little Squalicum Park (COB data source)

Building Outlines (COB data source)

Cement Plant Pier (COB data source)

Parcels (COB data source)

Topography Contours (COB data source)
- 25' contour (labeled)
- 5' contour

Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_location-map_20060815.mxd) TWC -- 10/29/2007 -- 2:12:39 PM

integral consulting inc.

Figure 5-6
Historical Landfill Sampling Locations
Little Squalicum Park RI, Bellingham, WA

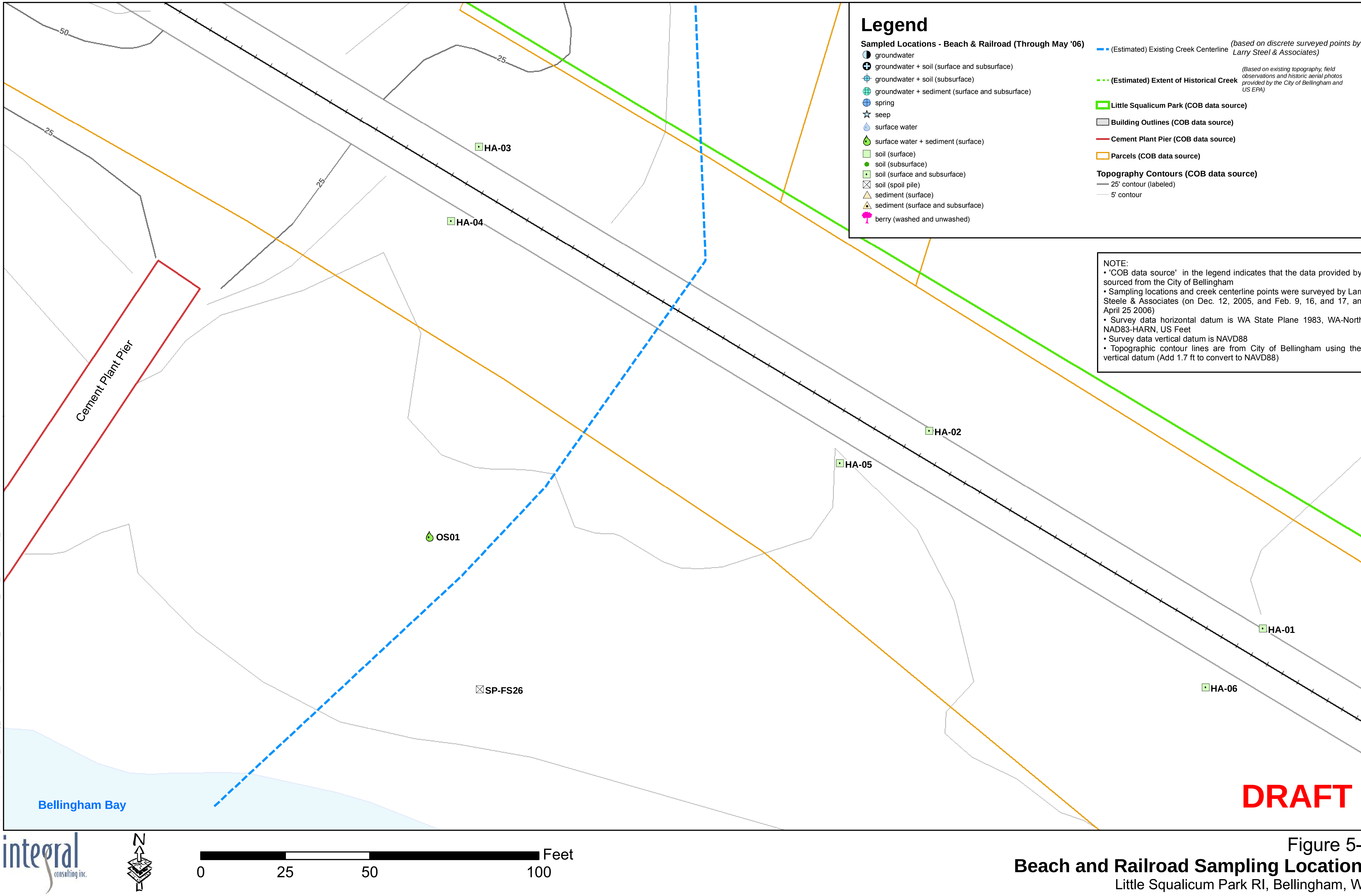
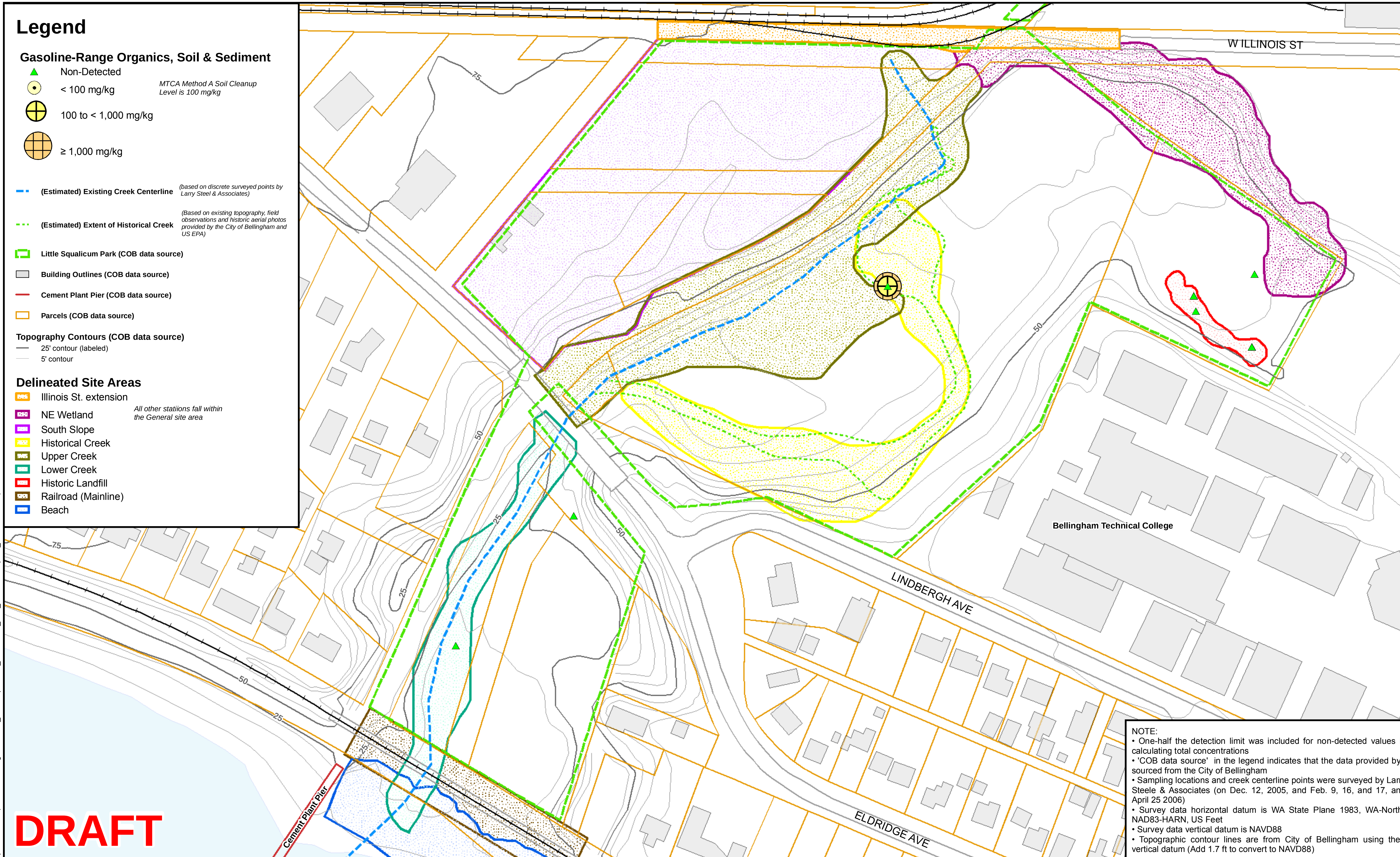


Figure 5-7
Beach and Railroad Sampling Locations
Little Squalicum Park RI, Bellingham, WA



Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_data-bubble-plots_20070412.mxd) TWC -- 10/17/2007 -- 9:52:33 AM

integral consulting inc.

N

Feet
0 75 150 300

Figure 5-8
Soil and Sediment - Gasoline-Range Organic (GRO) Hydrocarbons by NWTPH-G (All Depths)
Little Squalicum Park RI, Bellingham, WA

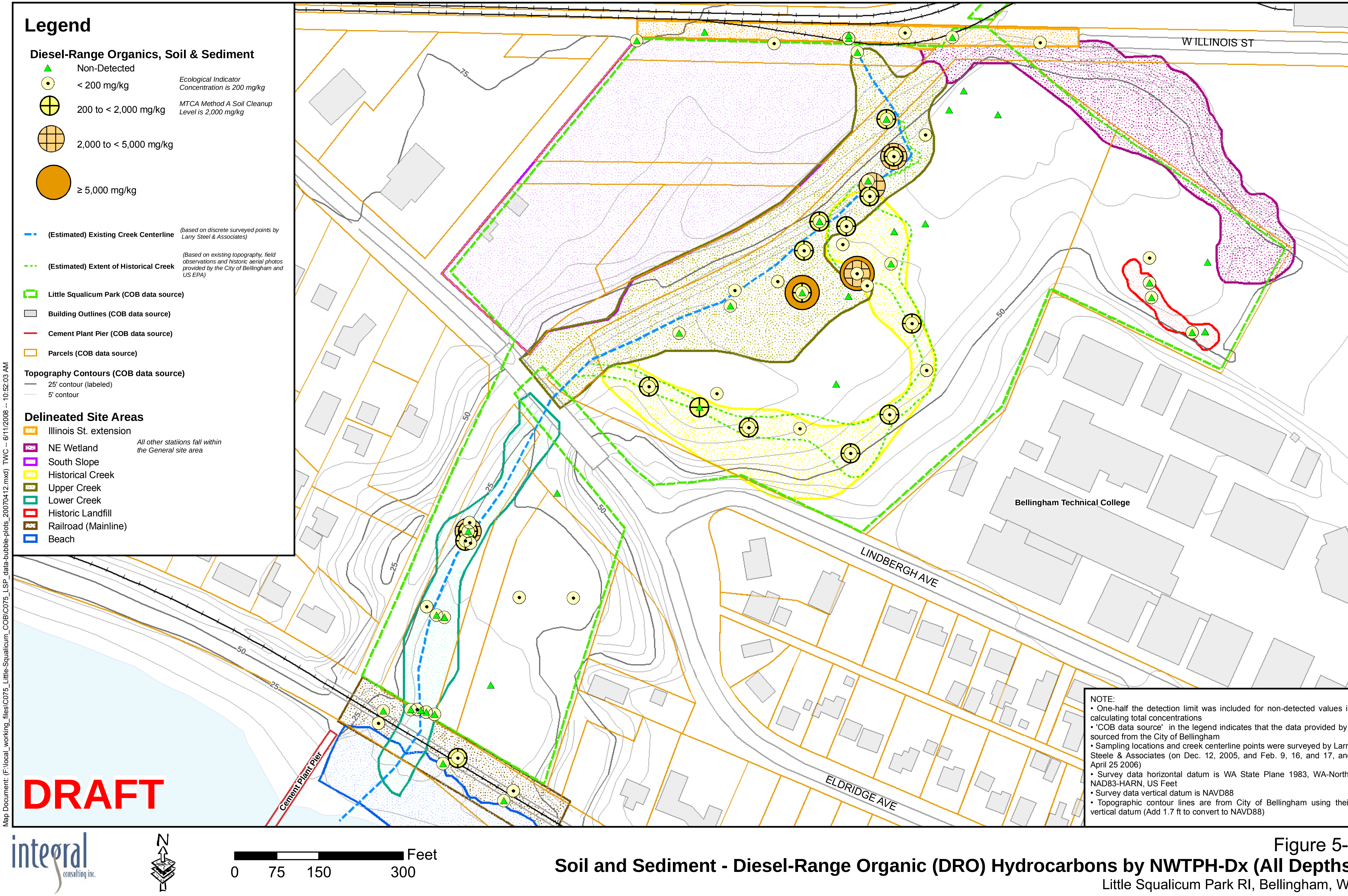
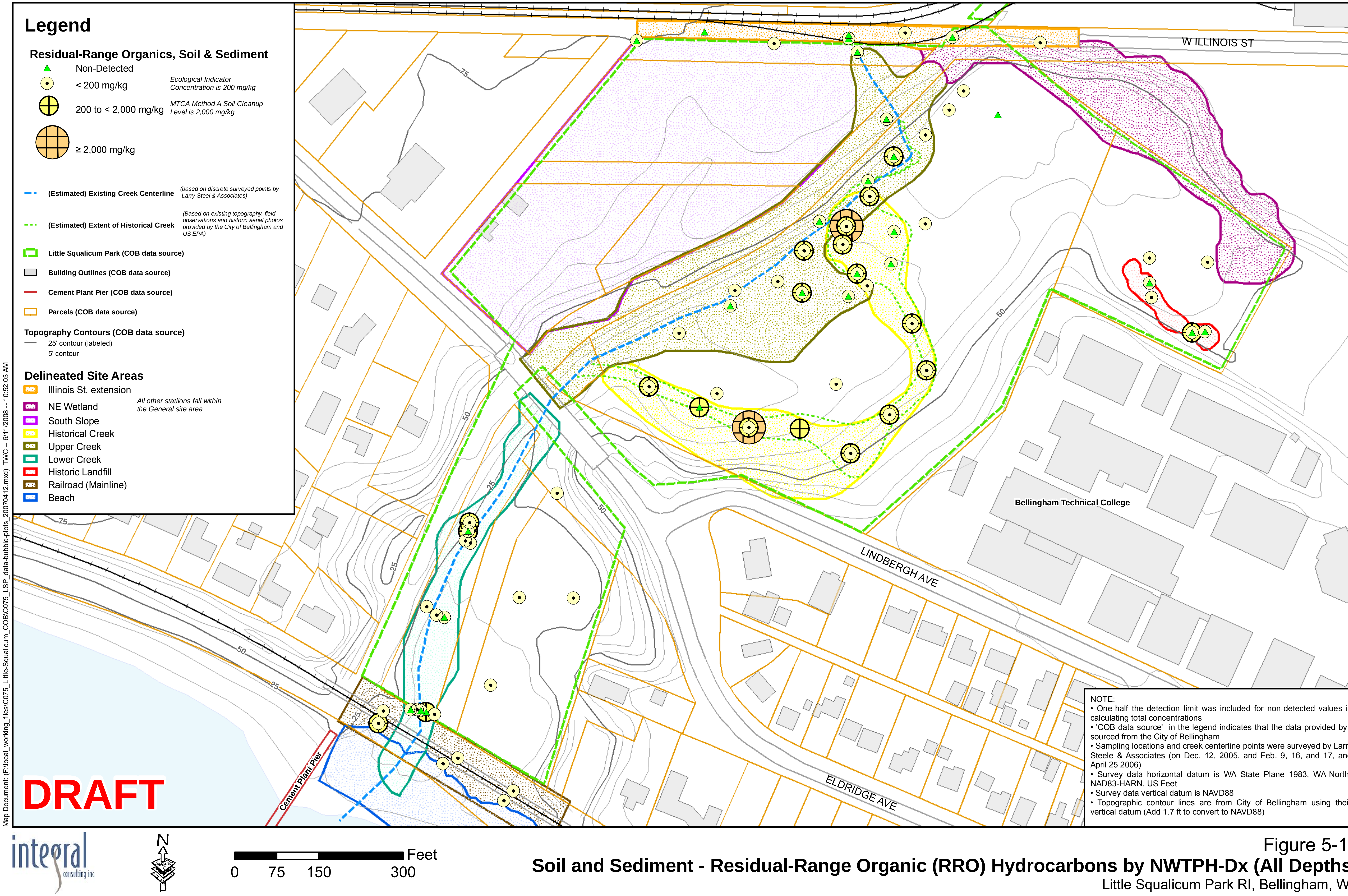


Figure 5-9
Soil and Sediment - Diesel-Range Organic (DRO) Hydrocarbons by NWTPH-Dx (All Depths)
Little Squalicum Park RI, Bellingham, WA

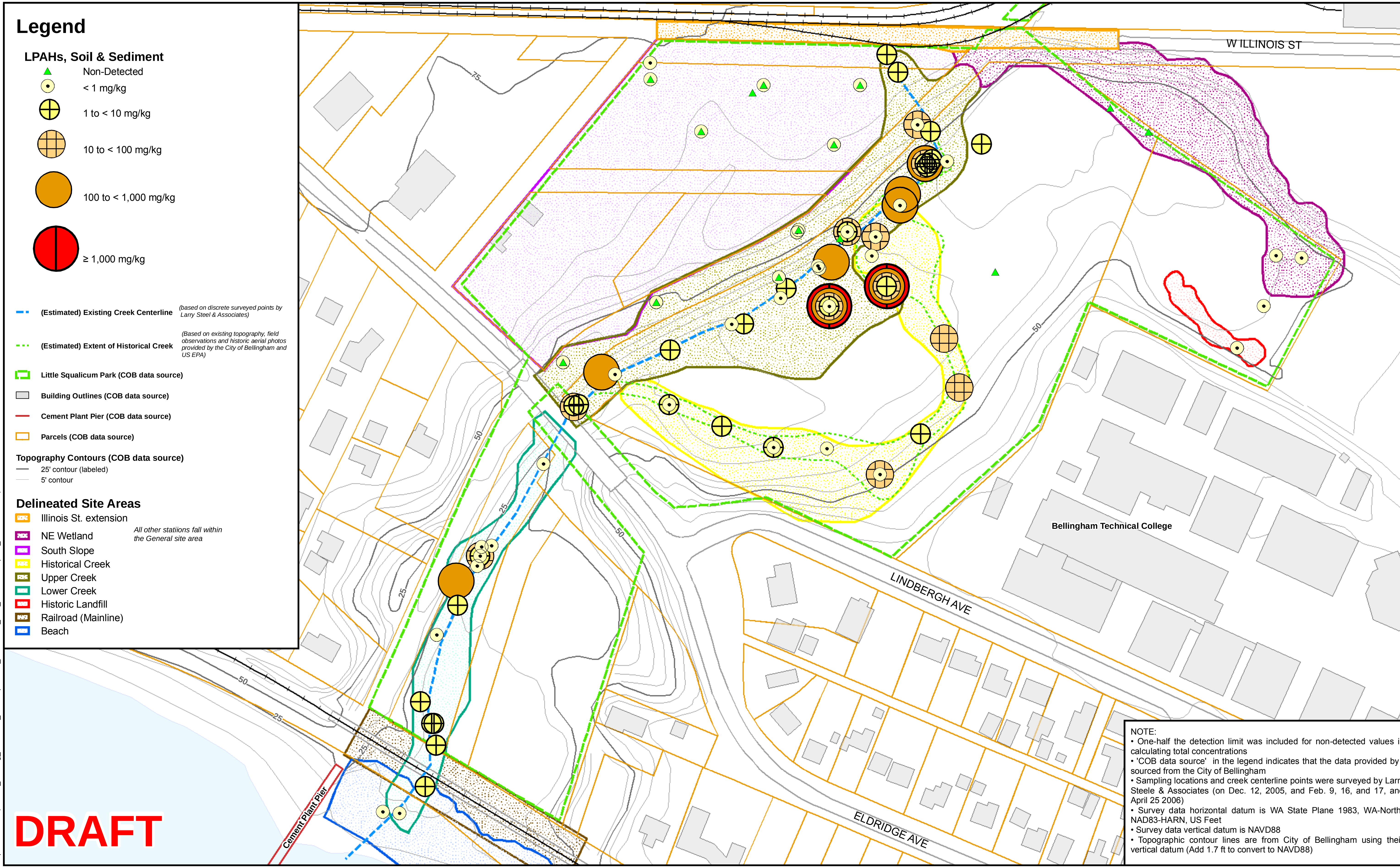


integral consulting inc.

Figure 5-10

Soil and Sediment - Residual-Range Organic (RRO) Hydrocarbons by NWTPH-Dx (All Depths)

Little Squalicum Park RI, Bellingham, WA



Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_data-bubble-plots_20070412.mxd) TWC -- 6/11/2008 -- 10:52:03 AM

integral consulting inc.

N

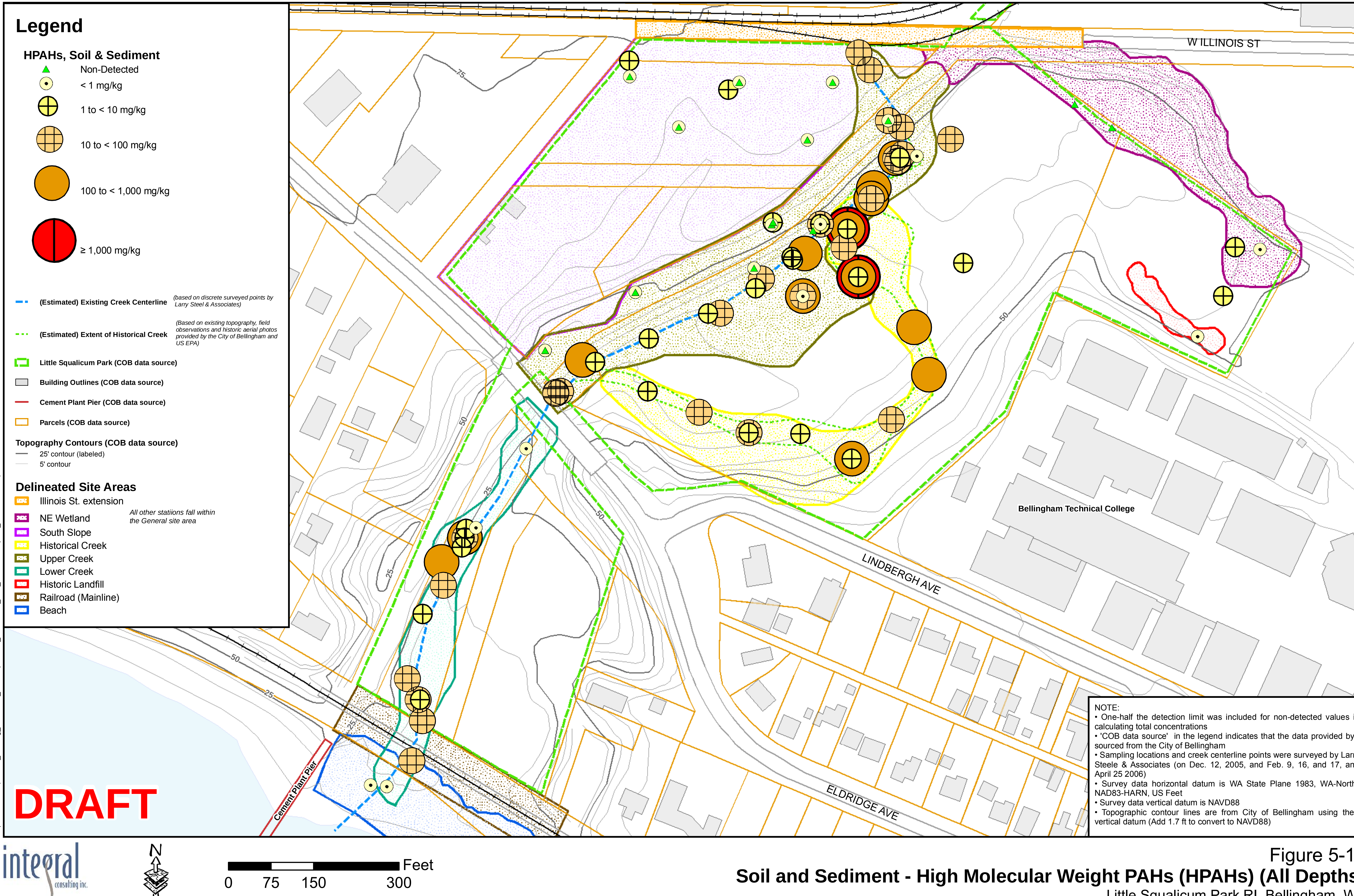
Feet 0 75 150 300

Figure 5-11

Soil and Sediment - Low Molecular Weight PAHs (LPAHs) (All Depths)

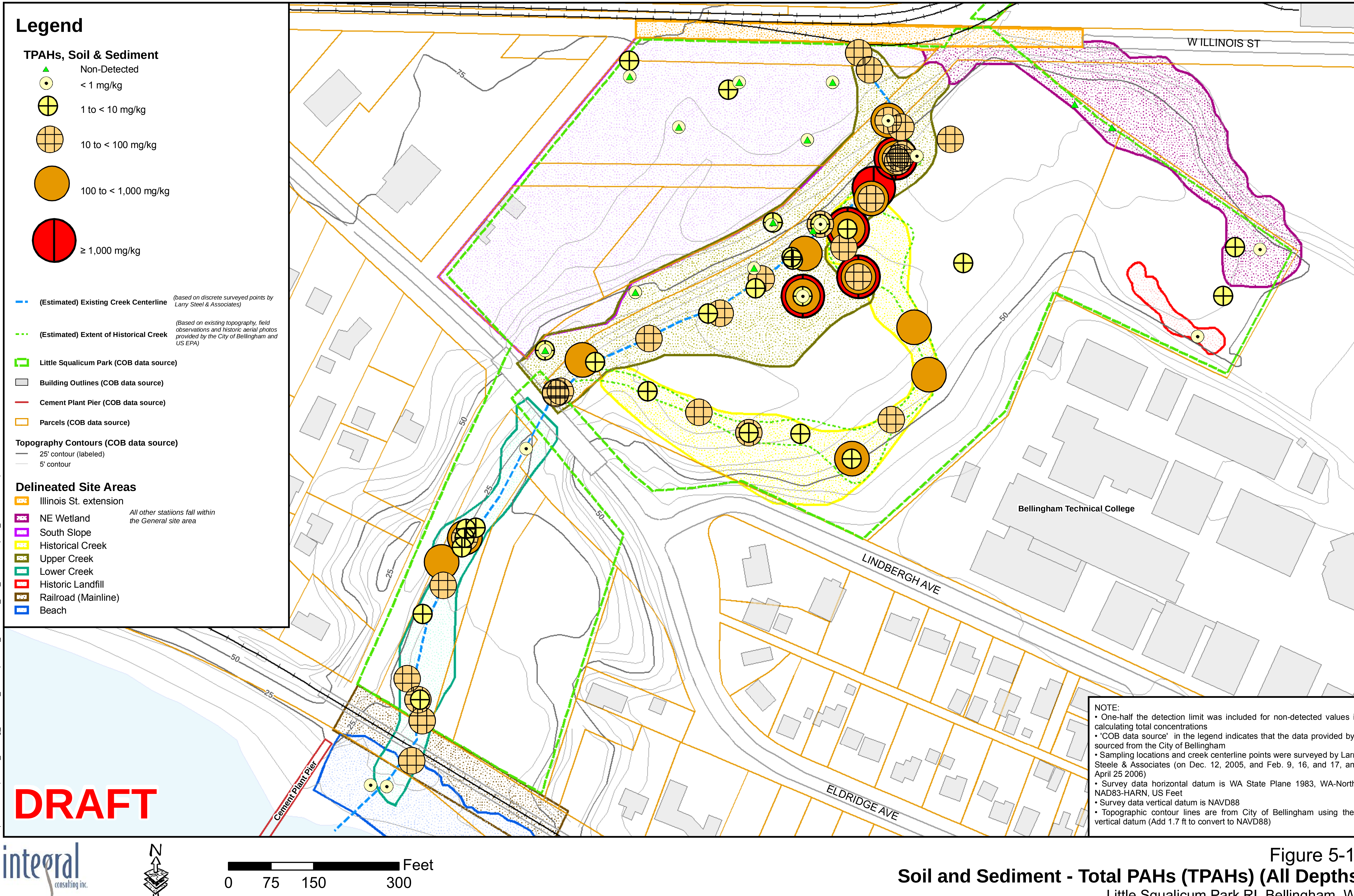
Little Squalicum Park RI, Bellingham, WA

Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_data-bubble-plots_20070412.mxd) TWC -- 6/11/2008 -- 10:52:03 AM



integral consulting inc.

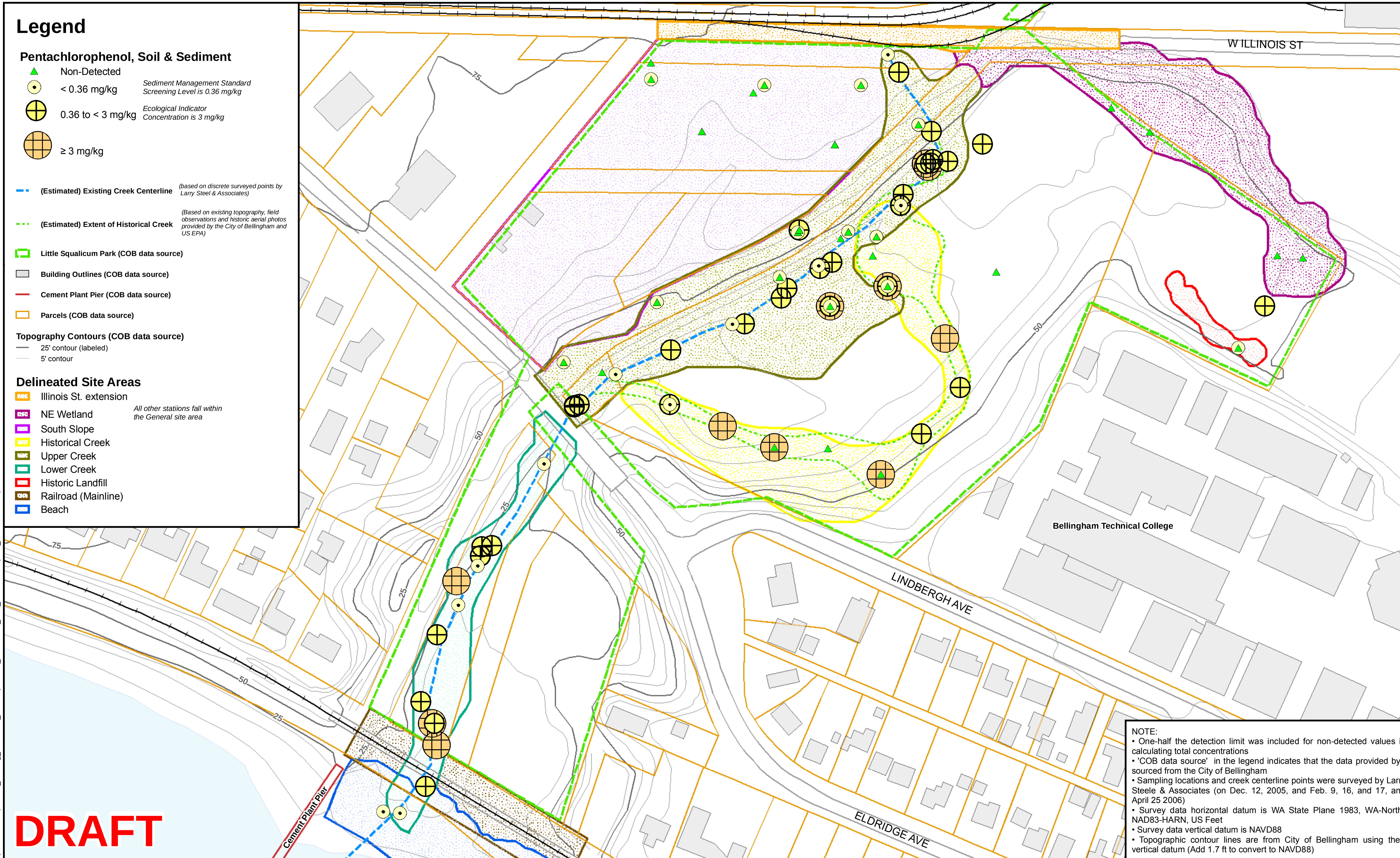
Figure 5-12
Soil and Sediment - High Molecular Weight PAHs (HPAHs) (All Depths)
Little Squalicum Park RI, Bellingham, WA



Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_data-bubble-plots_20070412.mxd) TWC – 6/11/2008 -- 10:52:03 AM

integral consulting inc.

Figure 5-13
Soil and Sediment - Total PAHs (TPAHs) (All Depths)
Little Squalicum Park RI, Bellingham, WA



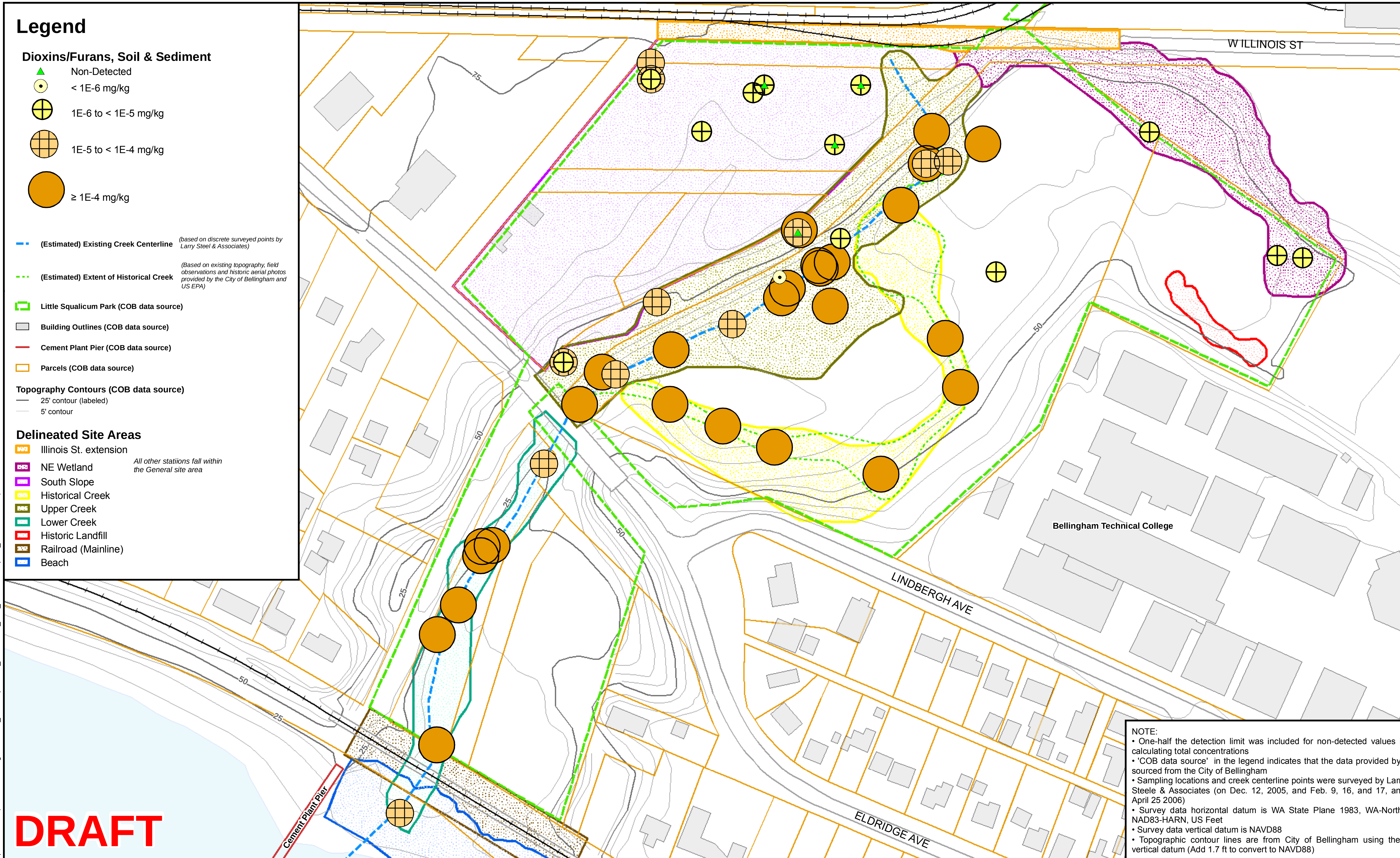
Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_data-bubble-plots_20070412.mxd) TWC -- 6/11/2008 -- 10:52:03 AM

integral consulting inc.

N

Feet
0 75 150 300

Figure 5-14
Soil and Sediment - Pentachlorophenol (PCP) (All Depths)
Little Squalicum Park RI, Bellingham, WA



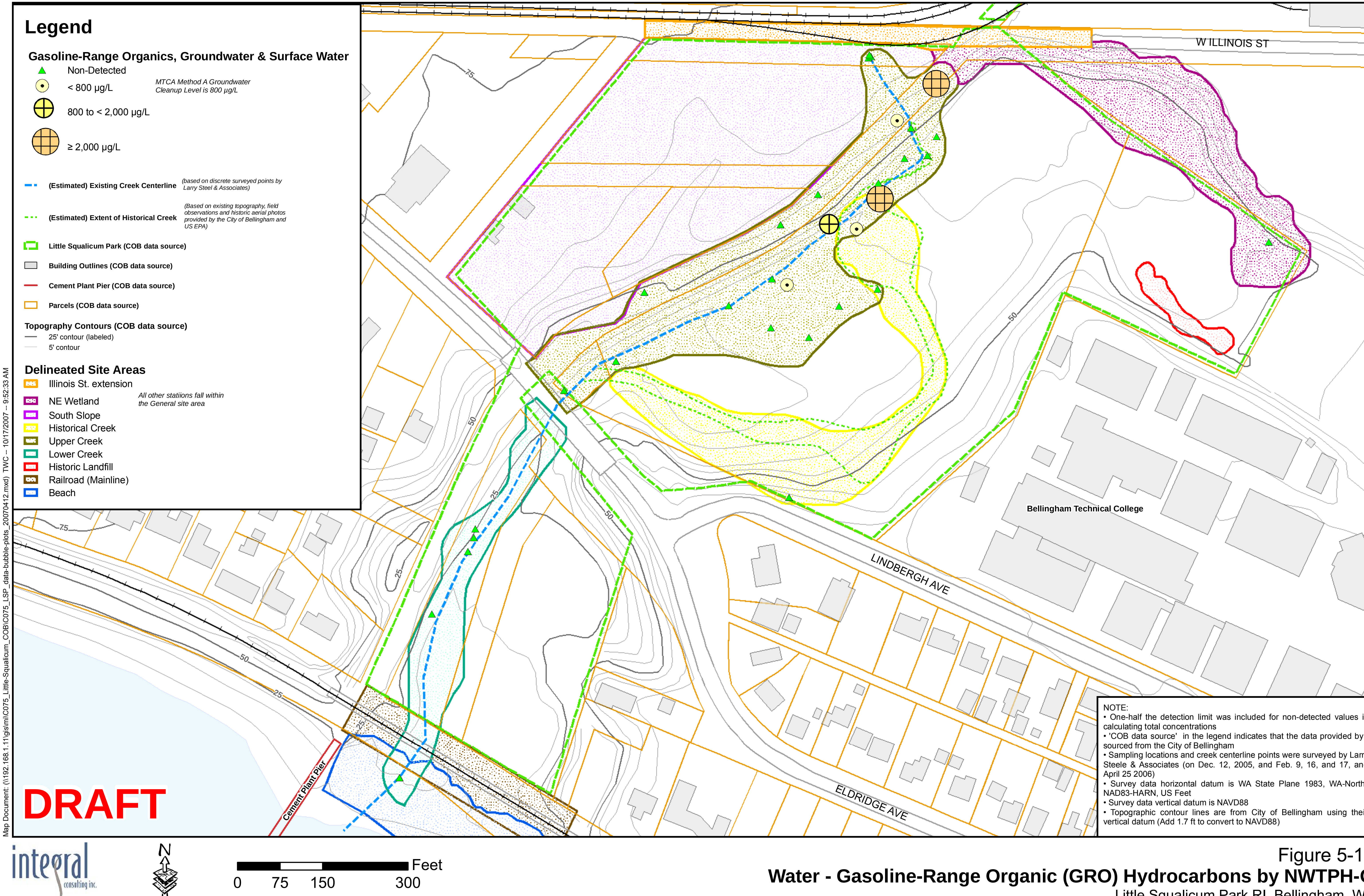
Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_data-bubble-plots_20070412.mxd) TWC -- 10/17/2007 -- 9:52:33 AM

integral consulting inc.

N

0 75 150 300 Feet

Figure 5-15
Soil and Sediment - Dioxins/Furans (TEQ) (All Depths)
Little Squalicum Park RI, Bellingham, WA

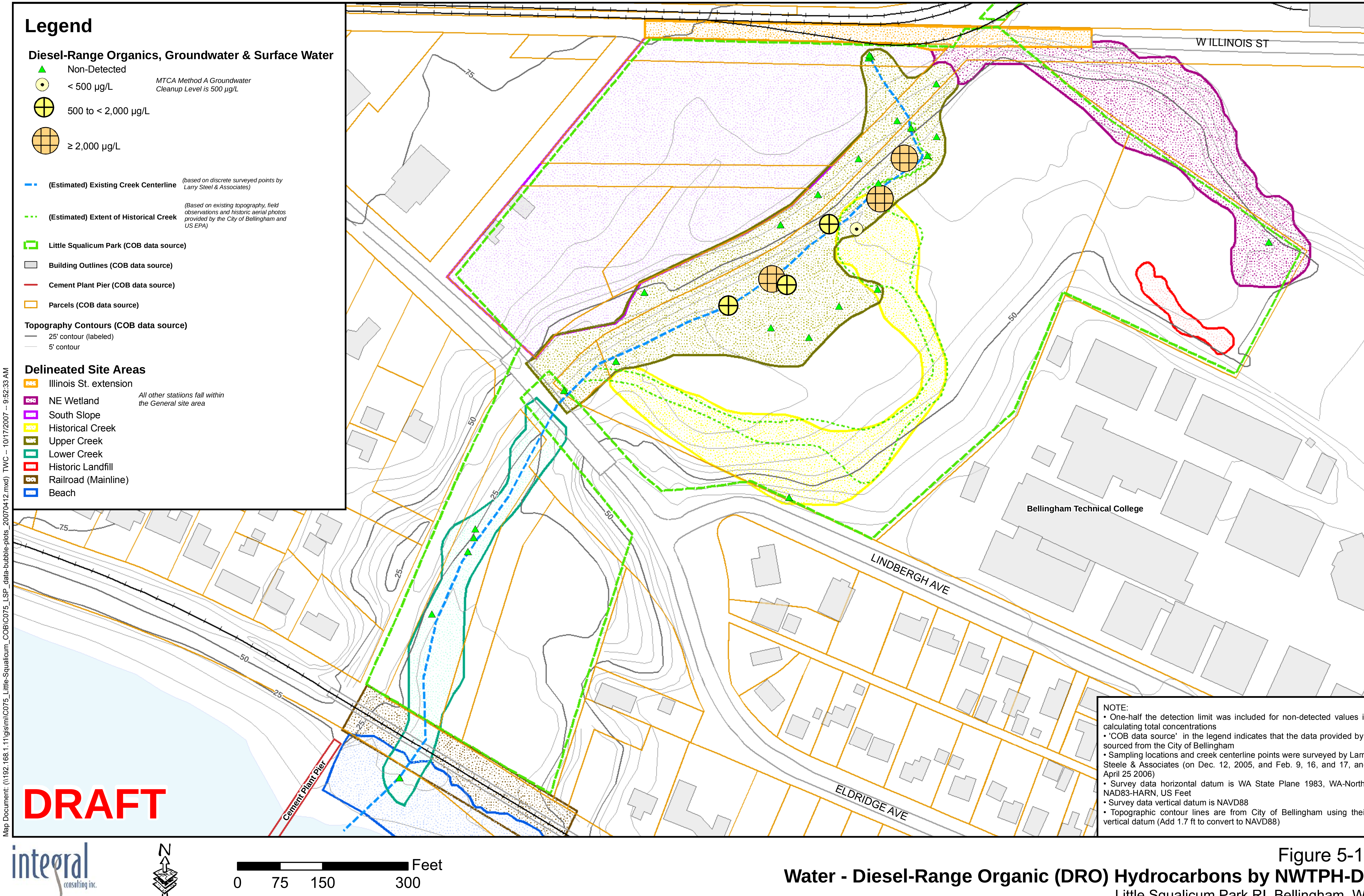


integral consulting inc.

Figure 5-16

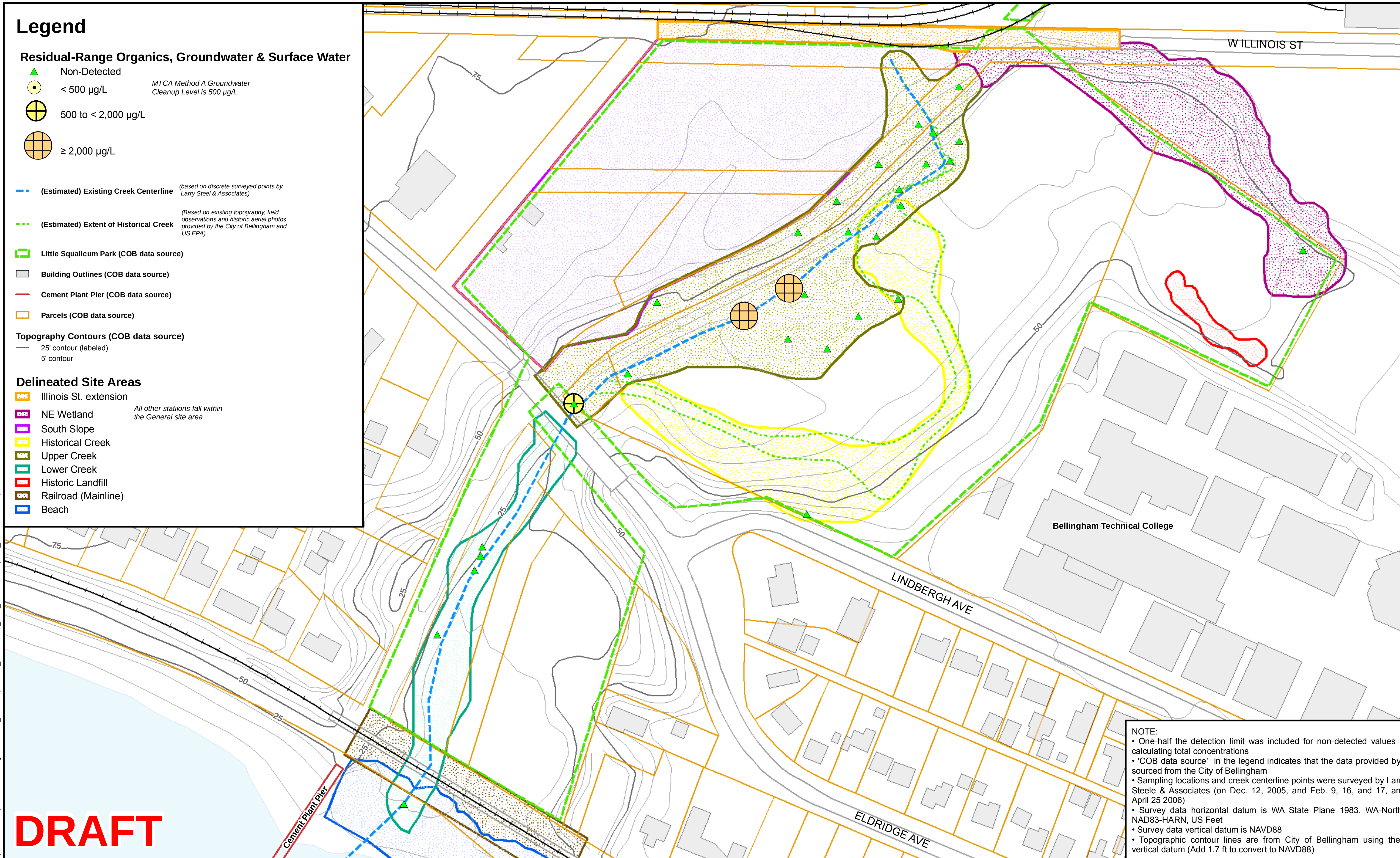
Water - Gasoline-Range Organic (GRO) Hydrocarbons by NWTPH-G

Little Squalicum Park RI, Bellingham, WA



integral consulting inc.

Figure 5-17
Water - Diesel-Range Organic (DRO) Hydrocarbons by NWTPH-Dx
Little Squalicum Park RI, Bellingham, WA

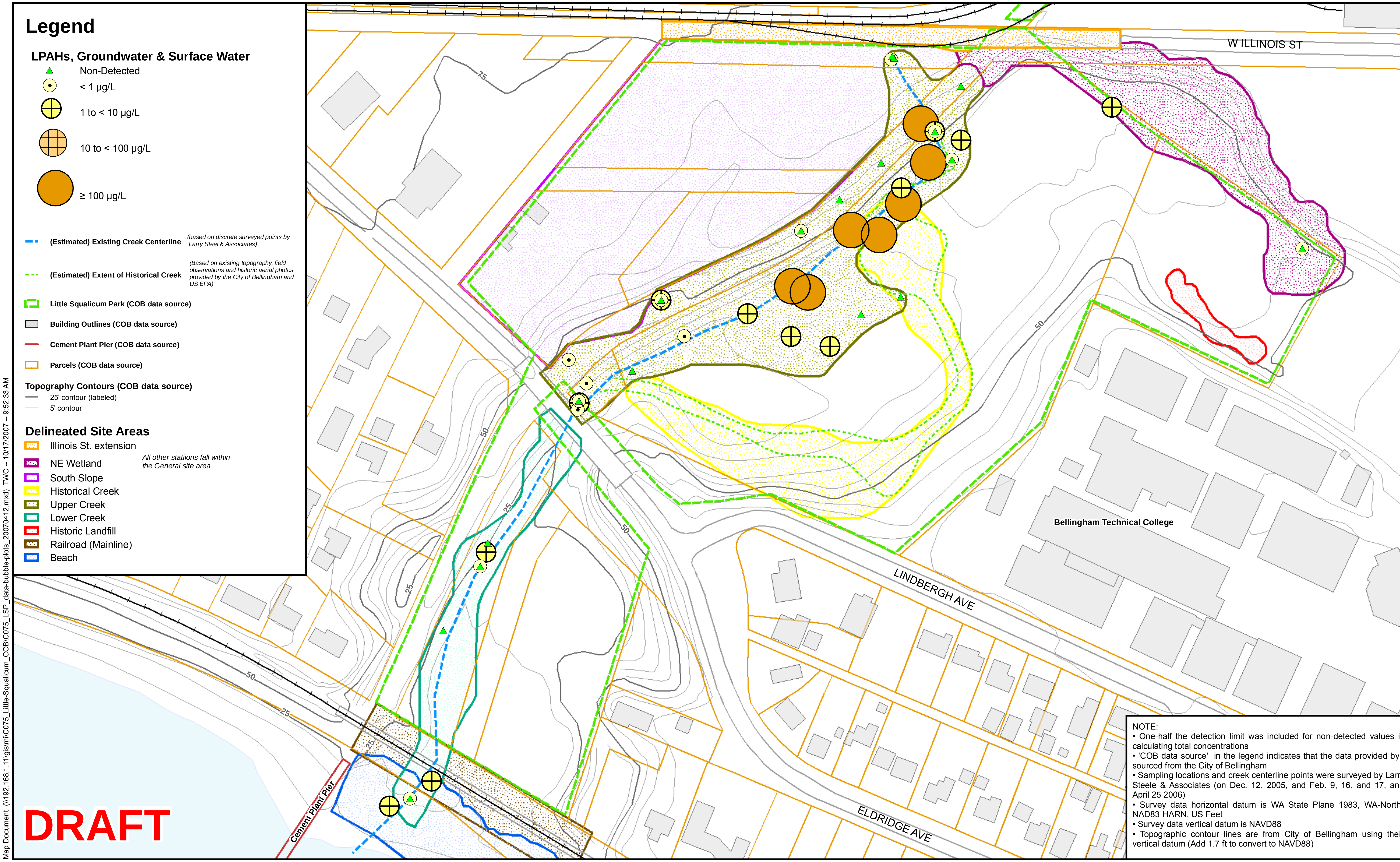


integral consulting inc.

N

Feet
0 75 150 300

Figure 5-18
Water - Residual-Range Organic (RRO) Hydrocarbons by NWTPH-Dx
Little Squalicum Park RI, Bellingham, WA

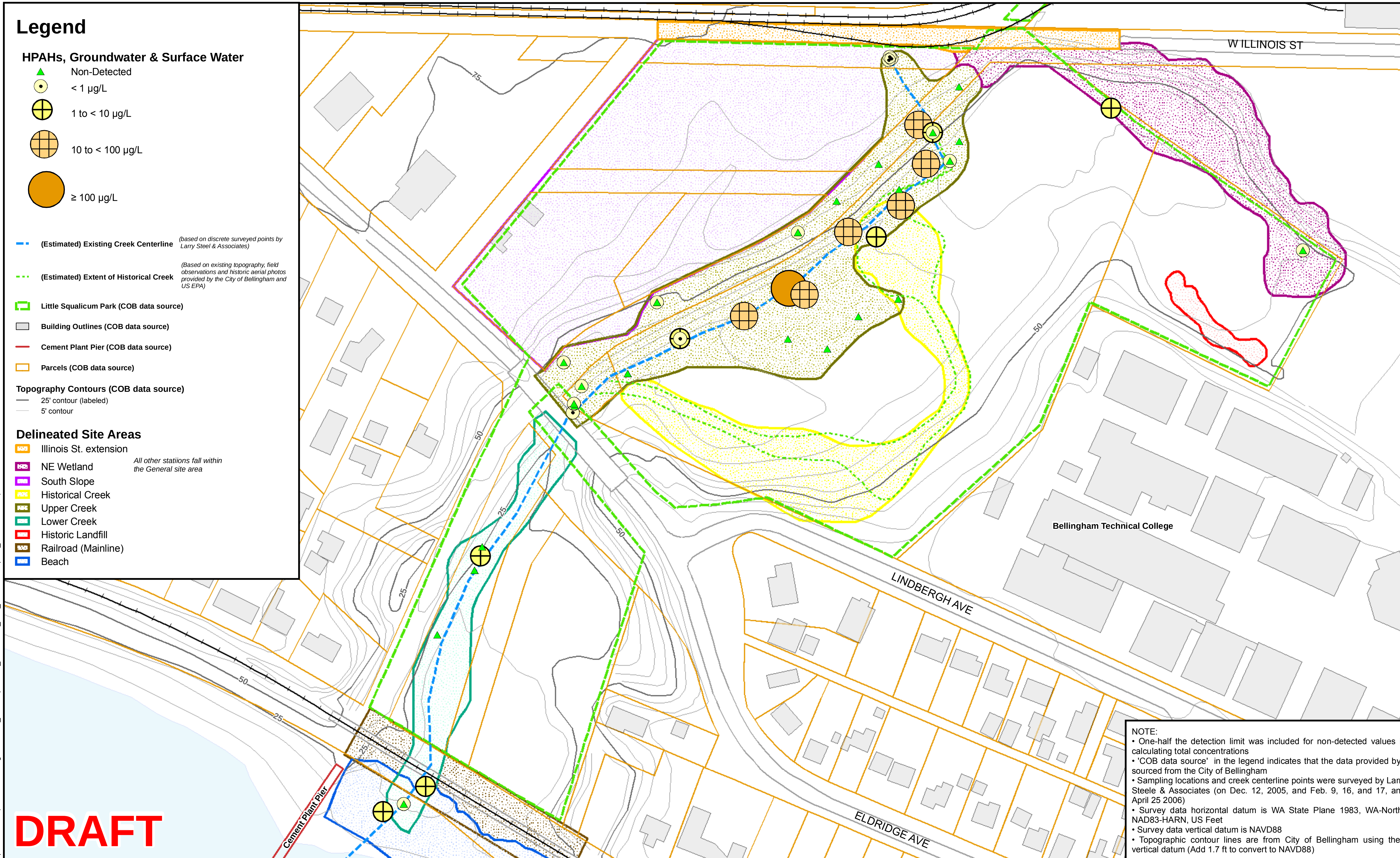


integral consulting inc.

N

Feet
0 75 150 300

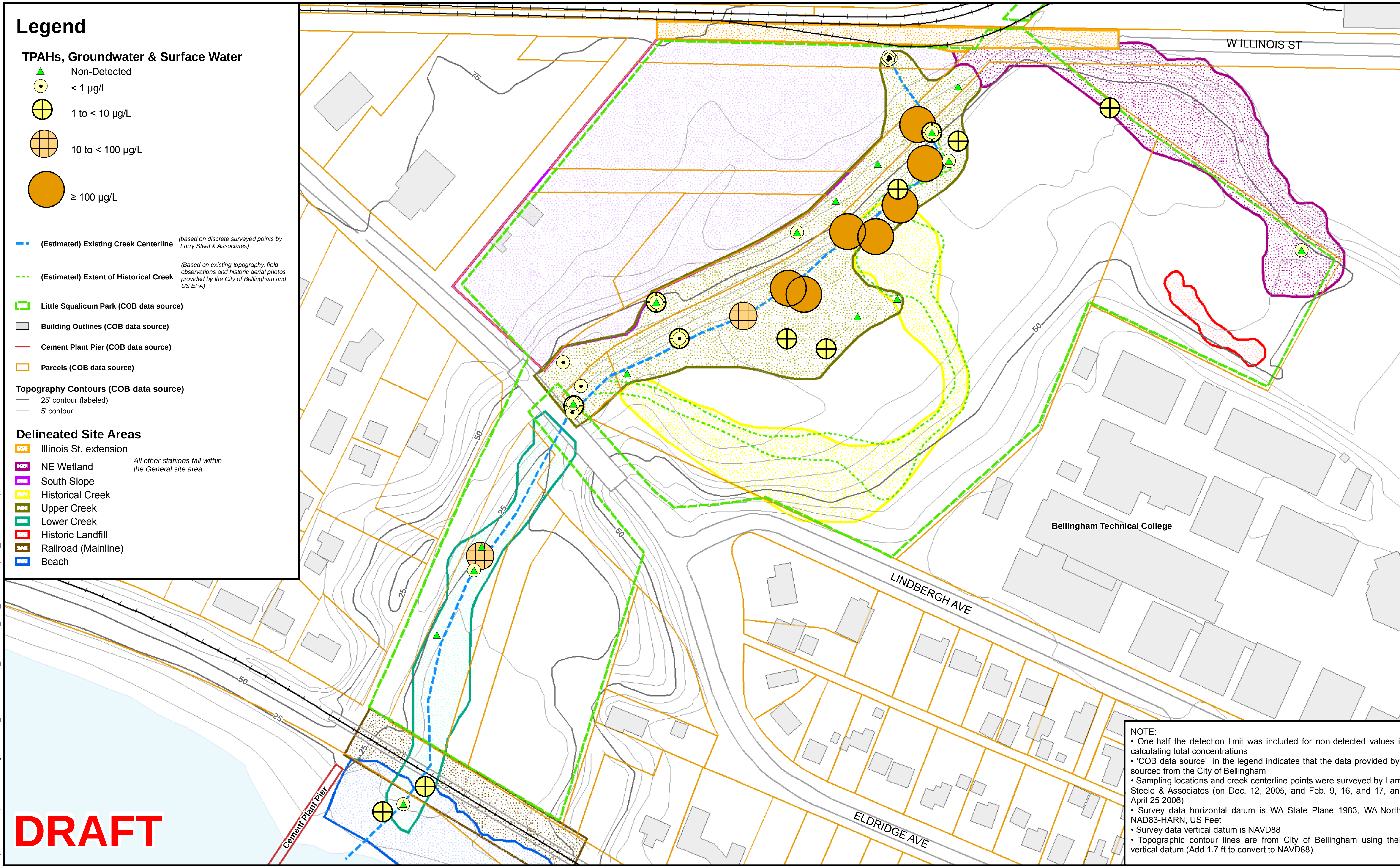
Figure 5-19
Water - Low Molecular Weight PAHs (LPAHs)
Little Squalicum Park RI, Bellingham, WA



Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_data-bubble-plots_20070412.mxd) TWC -- 10/17/2007 -- 9:52:33 AM

integral consulting inc.

Figure 5-20
Water - High Molecular Weight PAHs (HPAHs)
Little Squalicum Park RI, Bellingham, WA



Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_data-bubble-plots_20070412.mxd) TWC -- 10/17/2007 -- 9:52:33 AM

integral consulting inc.

Figure 5-21
Water - Total PAHs (TPAHs) (All Depths)
Little Squalicum Park RI, Bellingham, WA

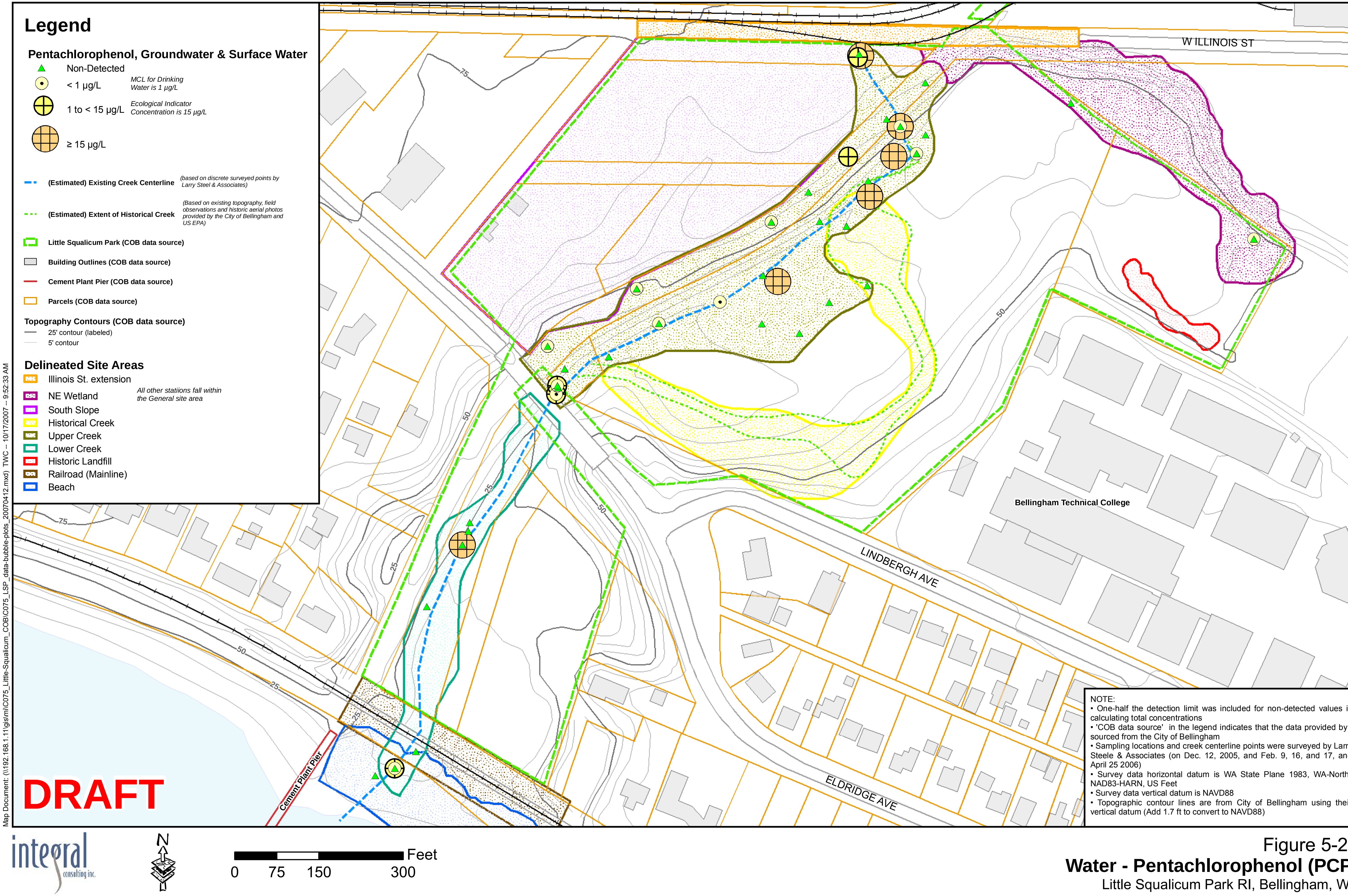
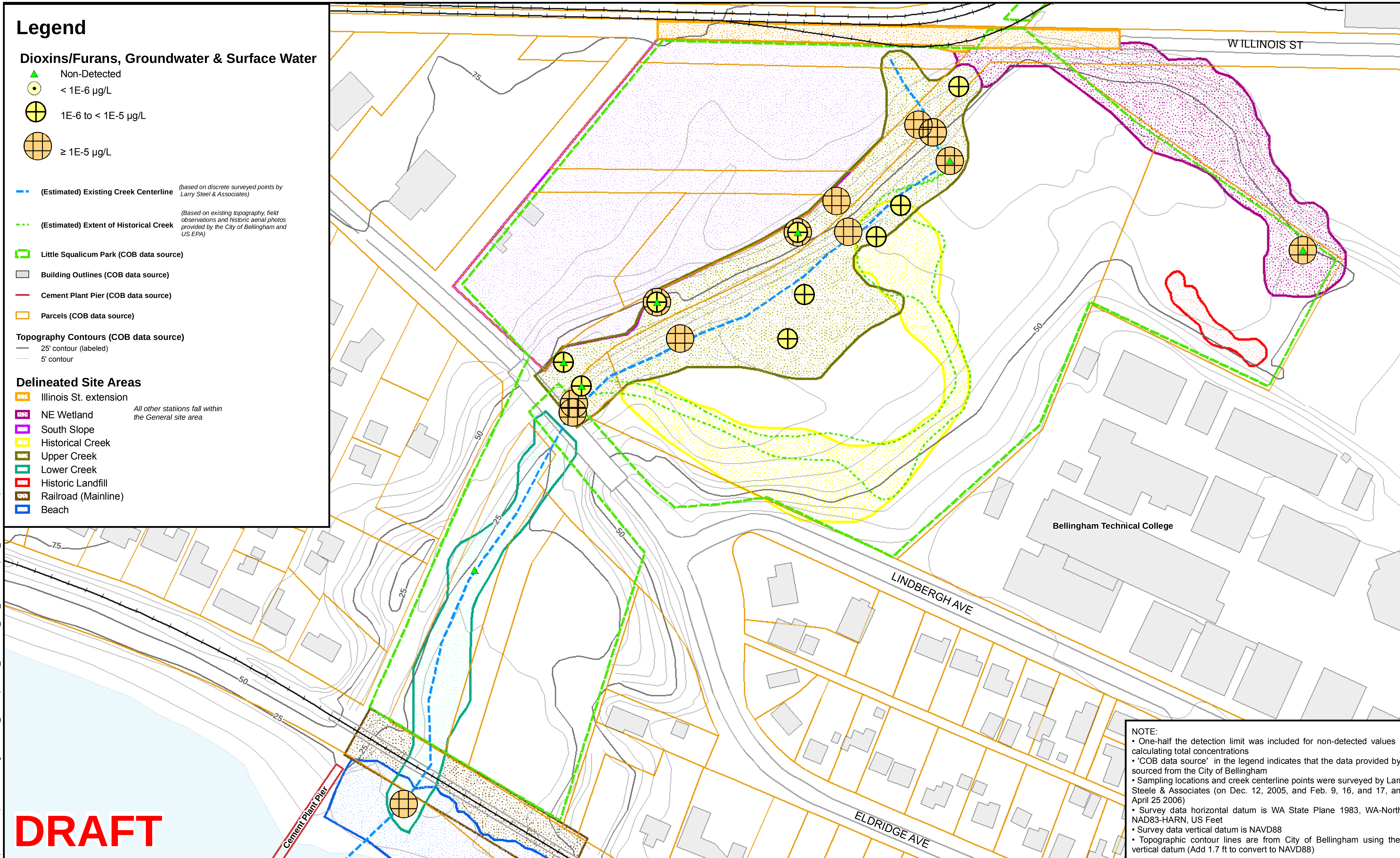


Figure 5-22
Water - Pentachlorophenol (PCP)
Little Squalicum Park RI, Bellingham, WA



Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_data-bubble-plots_20070412.mxd) TWC -- 10/17/2007 -- 9:52:33 AM

integral consulting inc.

N

Feet: 0 75 150 300

Figure 5-23
Water - Dioxins/Furans (TEQ)
Little Squalicum Park RI, Bellingham, WA

TP-01

Depth (ft)		Lead Concentration	
0	1	121.5	mg/kg
1	2	1270	mg/kg
2	3	107	mg/kg
3	4	18	mg/kg
4	5	3	mg/kg

TP-02

Depth (ft)		Lead Concentration	
0	1	106.5	mg/kg
1	1.6	74	mg/kg
1.6	2.9	15	mg/kg
2.9	3.7	233	mg/kg
3.7	4.2	43	mg/kg
4.2	5.3	7	mg/kg

TP-03

Depth (ft)		Lead Concentration	
0	1	19	mg/kg
1	2	23	mg/kg

TP-22

Depth (ft)		Lead Concentration	
0	0.5	134.5	mg/kg
0.5	1.7	222	mg/kg
1.7	2.2	3970	mg/kg
1.7	2.2	660	ug/l

TP-23

Depth (ft)		Lead Concentration	
0	2	285	mg/kg
2	3.5	371	mg/kg
3.5	4	1290	mg/kg
3.5	4	280	ug/L
4	4.5	32	mg/kg
4.5	5	5	mg/kg

TP-24

Depth (ft)		Lead Concentration	
0	1.5	50	mg/kg
1.5	1.5	160	mg/kg

SB-40

Depth (ft)		As Concentration	
0	1	130	mg/kg
0	1	6	ug/L
1	2	150	mg/kg
1	2	12	ug/L
2	3	235	mg/kg
3	4	13	mg/kg

TP-26

Depth (ft)		As Concentration	
0	1	27	mg/kg
1	2	10 U	mg/kg

TP-27

Depth (ft)		As Concentration	
0	1	0.9 U	mg/kg

TP-28

Depth (ft)		As Concentration	
0	1	40	mg/kg
0	1	2 U	ug/L

TP-29

Depth (ft)		As Concentration	
0	1	36	mg/kg

TP-30

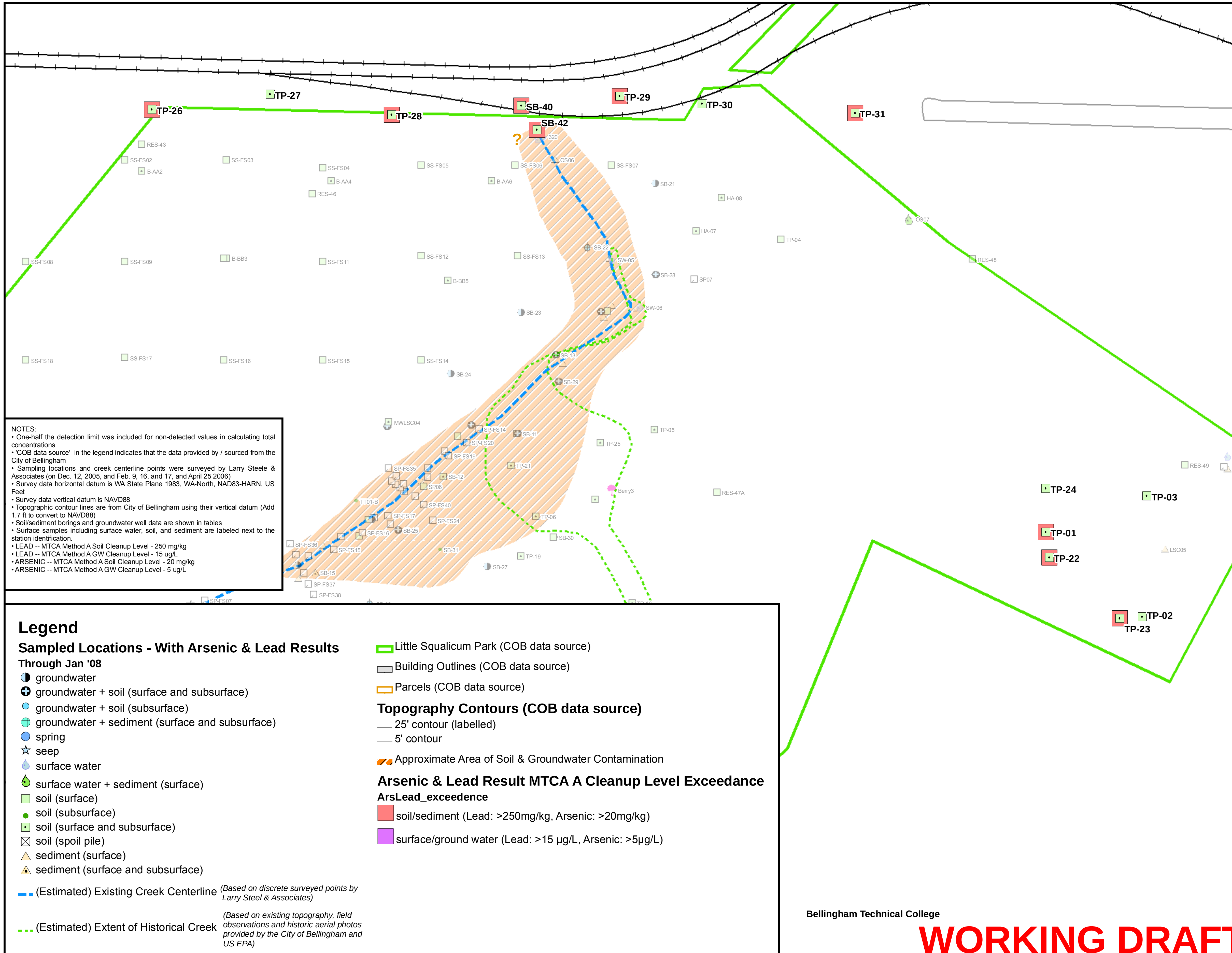
Depth (ft)		As Concentration	
0	1	11.5	mg/kg
1	2	1 U	mg/kg

TP-31

Depth (ft)		As Concentration	
0	1	70	mg/kg
0	1	25	ug/L

SB-42

Depth (ft)		As Concentration	
1	2.5	36.5	mg/kg
2	5.4	30	mg/kg



NOTES:
- One-half the detection limit was included for non-detected values in calculating total concentrations
- 'COB data source' in the legend indicates that the data provided by / sourced from the City of Bellingham
- Sampling locations and creek centerline points were surveyed by Larry Steele & Associates (on Dec. 12, 2005, and Feb. 9, 16, and 17, and April 25 2006)
- Survey data horizontal datum is WA State Plane 1983, WA-North, NAD83-HARN, US Feet
- Survey data vertical datum is NAVD88
- Topographic contour lines are from City of Bellingham using their vertical datum (Add 1.7 ft to convert to NAVD88)
- Soil/sediment borings and groundwater well data are shown in tables
- Surface samples including surface water, soil, and sediment are labeled next to the station identification.
- LEAD -- MTCA Method A Soil Cleanup Level - 250 mg/kg
- LEAD -- MTCA Method A GW Cleanup Level - 15 ug/L
- ARSENIC -- MTCA Method A Soil Cleanup Level - 20 mg/kg
- ARSENIC -- MTCA Method A GW Cleanup Level - 5 ug/L

Legend

Sampled Locations - With Arsenic & Lead Results

Through Jan '08

- groundwater
- groundwater + soil (surface and subsurface)
- groundwater + soil (subsurface)
- groundwater + sediment (surface and subsurface)
- spring
- seep
- surface water
- surface water + sediment (surface)
- soil (surface)
- soil (subsurface)
- soil (surface and subsurface)
- soil (spoil pile)
- sediment (surface)
- sediment (surface and subsurface)
- (Estimated) Existing Creek Centerline *(Based on discrete surveyed points by Larry Steel & Associates)*
- (Estimated) Extent of Historical Creek *(Based on existing topography, field observations and historic aerial photos provided by the City of Bellingham and US EPA)*

- Little Squalicum Park (COB data source)
- Building Outlines (COB data source)
- Parcels (COB data source)

Topography Contours (COB data source)

- 25' contour (labelled)
- 5' contour
- Approximate Area of Soil & Groundwater Contamination

Arsenic & Lead Result MTCA A Cleanup Level Exceedance

ArsLead_exceedence

- soil/sediment (Lead: >250mg/kg, Arsenic: >20mg/kg)
- surface/ground water (Lead: >15 μg/L, Arsenic: >5μg/L)

WORKING DRAFT

integral consulting inc.

N

0 50 100 200 Feet

Figure 5-24

Arsenic (Illinois Street Extenstion Area) and Lead (Landfill Area) Results

Little Squalicum Park RI, Bellingham, WA

Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_Arsenic_Lead_table_figure.mxd) TWC -- 6/10/2008 -- 11:19:43 AM

MWLSC02

Depth (ft)		Concentration	
GW		20 UJ	ug/l
GW		20 UJ	ug/l

MWLSC03

Depth (ft)		Concentration	
GW		20 UJ	ug/l
GW		20 UJ	ug/l

SB-09

Depth (ft)		Concentration	
0	1	53.5	mg/kg
1	2	7	mg/kg
5	6	9.2	mg/kg
6	7	470	mg/kg
7	8	1,200	mg/kg
8	9	3,200	mg/kg
9	10	1,100	mg/kg
GW		2,500	ug/l

SB-11

Depth (ft)		Concentration	
0	1	460	mg/kg
1	2	710	mg/kg
2	3	50	mg/kg
4	5	38	mg/kg
6	7	11	mg/kg
GW		395	ug/l

SB-12

Depth (ft)		Concentration	
0	1	60	mg/kg
1	2	64	mg/kg
4	5	1,900 J	mg/kg

SB-13

Depth (ft)		Concentration	
0	1	12 J	mg/kg
1	2	0.5 UJ	mg/kg
6	7	0.6 UJ	mg/kg
GW		20 U	ug/l

SB-14

Depth (ft)		Concentration	
0	1	0.6 UJ	mg/kg
1	2	0.5 UJ	mg/kg
4	5	7.3	mg/kg
5	6	13	mg/kg
6	7	590 J	mg/kg
8	9	200	mg/kg
9	10	41	mg/kg
10	11	41	mg/kg
GW		1,200	ug/l

SB-15

Depth (ft)		Concentration	
0	1	9.7 J	mg/kg
1	2	0.5 UJ	mg/kg

SB-16

Depth (ft)		Concentration	
0	1	17 J	mg/kg

SB-17

Depth (ft)		Concentration	
0	1	26 J	mg/kg
1	2	0.5 UJ	mg/kg

SB-21

Depth (ft)		Concentration	
GW		20 U	ug/l

SB-22

Depth (ft)		Concentration	
25.5	27	0.5 U	mg/kg
27	28.5	590	mg/kg
28.5	29.6	100	mg/kg
29.6	30	0.5 U	mg/kg
30	31	0.5 U	mg/kg
GW		20 U	ug/l

SB-23

Depth (ft)		Concentration	
GW		20 U	ug/l

SB-24

Depth (ft)		Concentration	
GW		20 U	ug/l

SB-25

Depth (ft)		Concentration	
0	1	14	mg/kg
1	2	19	mg/kg
GW		550	ug/l

SB-26

Depth (ft)		Concentration	
GW		20 U	ug/l

SB-42

Depth (ft)		Concentration	
34	35.5	2 U	mg/kg
36.5	38	92	mg/kg

SB-27

Depth (ft)		Concentration	
GW		20 U	ug/l

SB-28

Depth (ft)		Concentration	
0	1	30	mg/kg
1	2	9	mg/kg
GW		20 U	ug/l

SB-29

Depth (ft)		Concentration	
0	1	38	mg/kg
1	2	20	mg/kg
5	5.5	31	mg/kg
7	7.3	1,300	mg/kg
10	10.6	1,300	mg/kg
GW		2,400	ug/l

SB-30

Depth (ft)		Concentration	
0	1	11.5	mg/kg
GW		20 U	ug/l

SB-31

Depth (ft)		Concentration	
7	8	0.5 U	mg/kg
8	9	5,200	mg/kg
9	9.6	1,600	mg/kg
9.6	10	360	mg/kg
10.2	11	7.4	mg/kg

SB-32

Depth (ft)		Concentration	
GW		20 U	ug/l

SB-34

Depth (ft)		Concentration	
0	1.1	180	mg/kg

SB-35

Depth (ft)		Concentration	
0	1	120	mg/kg
1	1.8	910	mg/kg
1.8	3.2	67	mg/kg

SB-36

Depth (ft)		Concentration	
0	0.8	1,100	mg/kg
0.8	1.8	0.5 U	mg/kg

SB-37

Depth (ft)		Concentration	
0	1.2	320	mg/kg
1.2	2	140	mg/kg
2	3.1	27	mg/kg

SB-38

Depth (ft)		Concentration	
0	1	950	mg/kg
1	1.9	71	mg/kg
1.9	2.4	52	mg/kg

SB-39

Depth (ft)	Concentration		
0	0.7	390	mg/kg
0.7	2	130	mg/kg

TP-06

Depth (ft)		Concentration	
0	1	180 J	mg/kg
1	2	8,400 J	mg/kg
2	3	2,800	mg/kg
3	4	46	mg/kg
4	4	35	mg/kg

TP-15

Depth (ft)		Concentration	
0	1	10	mg/kg
3	4	0.5 U	mg/kg

TP-16

Depth (ft)		Concentration	
0	2	490	mg/kg
2	4	36	mg/kg

TP-17

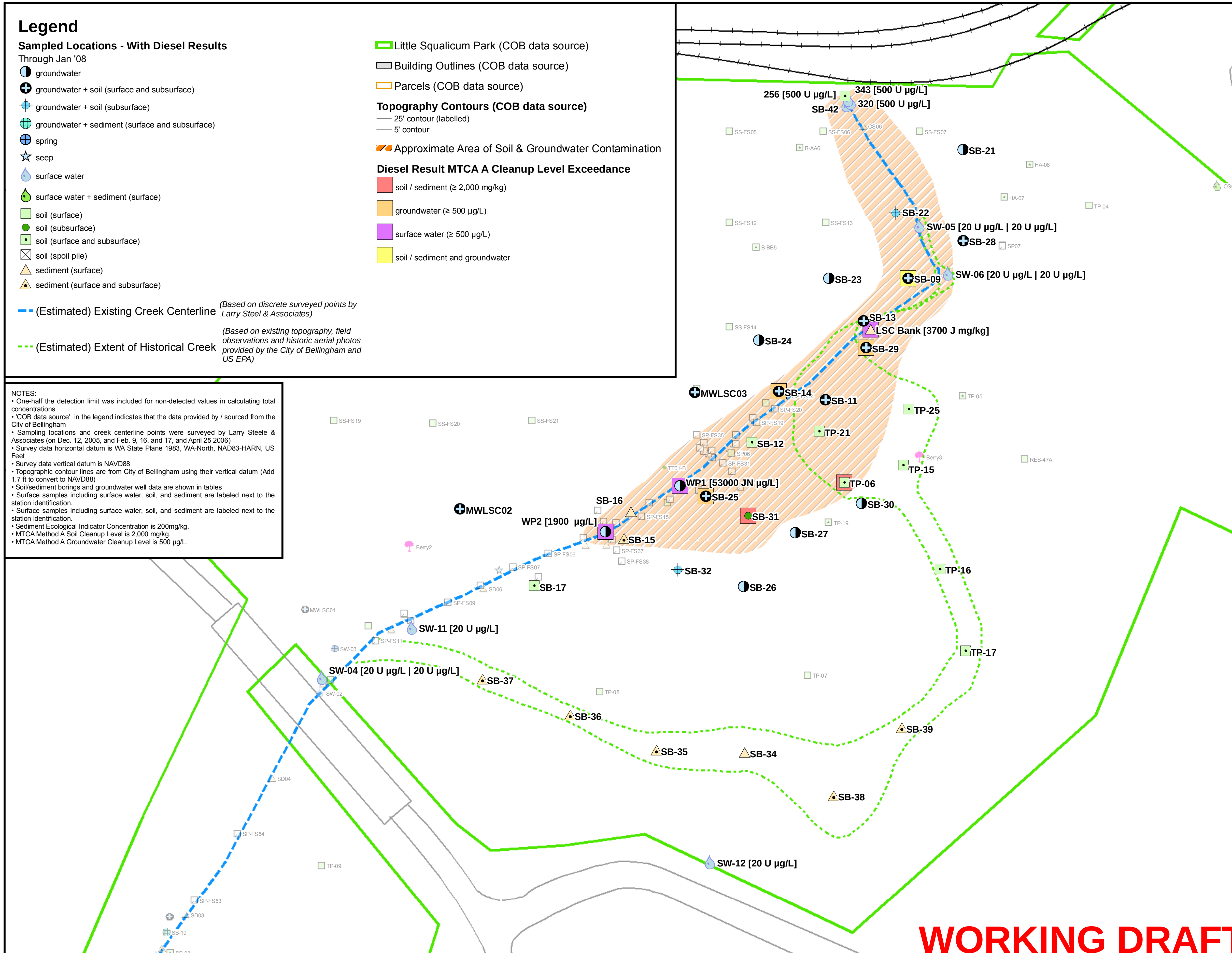
Depth (ft)		Concentration	
0	1	36	mg/kg
1	2	190	mg/kg
2	3	19	mg/kg
3	4	13	mg/kg

TP-21

Depth (ft)		Concentration	
0	2	170	mg/kg
2	4	7	mg/kg

TP-25

Depth (ft)		Concentration	
0	0.6	0.6 U	mg/kg
0.6	2	0.5 U	mg/kg



NOTES:
- One-half the detection limit was included for non-detected values in calculating total concentrations
- 'COB data source' in the legend indicates that the data provided by / sourced from the City of Bellingham
- Sampling locations and creek centerline points were surveyed by Larry Steele & Associates (on Dec. 12, 2005, and Feb. 9, 16, and 17, and April 25 2006)
- Survey data horizontal datum is WA State Plane 1983, WA-North, NAD83-HARN, US Feet
- Survey data vertical datum is NAVD88
- Topographic contour lines are from City of Bellingham using their vertical datum (Add 1.7 ft to convert to NAVD88)
- Soil/sediment borings and groundwater well data are shown in tables
- Surface samples including surface water, soil, and sediment are labeled next to the station identification.
- Surface samples including surface water, soil, and sediment are labeled next to the station identification.
- Sediment Ecological Indicator Concentration is 200mg/kg.
- MTCA Method A Soil Cleanup Level is 2,000 mg/kg.
- MTCA Method A Groundwater Cleanup Level is 500 µg/L.

integral consulting inc.

N

0 50 100 200 Feet

Figure 5-25
Upper and Historical Creek Diesel-Range Organics Results
Little Squalicum Park RI, Bellingham, WA

Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_diesel_table_figure.mxd) TWC -- 10/12/2007 -- 2:11:54 PM

SB-09

Depth (ft)		Concentration	
0	1	215	mg/kg
1	2	13 U	mg/kg
5	6	12 U	mg/kg
6	7	120 U	mg/kg
7	8	250 U	mg/kg
8	9	380	mg/kg
9	10	130	mg/kg
GW		1000 U	ug/l

SB-11

Depth (ft)		Concentration	
0	1	2400	mg/kg
1	2	2900	mg/kg
2	3	170	mg/kg
4	5	200	mg/kg
6	7	26	mg/kg
GW		500 U	ug/l

SB-12

Depth (ft)		Concentration	
0	1	160	mg/kg
1	2	160	mg/kg
4	5	250	mg/kg

SB-13

Depth (ft)		Concentration	
0	1	30	mg/kg
1	2	13 U	mg/kg
6	7	14 U	mg/kg
GW		500 U	ug/l

SB-14

Depth (ft)		Concentration	
0	1	15 U	mg/kg
1	2	13 U	mg/kg
4	5	13 U	mg/kg
5	6	14 U	mg/kg
6	7	78 U	mg/kg
8	9	21	mg/kg
9	10	12 U	mg/kg
10	11	14	mg/kg
GW		500 U	ug/l

SB-15

Depth (ft)		Concentration	
0	1	44	mg/kg
1	2	13 U	mg/kg

SB-16

Depth (ft)		Concentration	
0	1	66	mg/kg

SB-17

Depth (ft)		Concentration	
0	1	13	mg/kg
1	2	100	mg/kg

SB-21

Depth (ft)		Concentration	
GW		500 U	ug/l

SB-22

Depth (ft)		Concentration	
25.5	27	13 U	mg/kg
27	28.5	150	mg/kg
28.5	29.6	31	mg/kg
29.6	30	12 U	mg/kg
30	31	12 U	mg/kg
GW		500 U	ug/l

SB-23

Depth (ft)		Concentration	
GW		500 U	ug/l

SB-24

Depth (ft)		Concentration	
GW		500 U	ug/l

SB-25

Depth (ft)		Concentration	
0	1	76	mg/kg
1	2	73	mg/kg
GW		500 U	ug/l

SB-26

Depth (ft)		Concentration	
GW		500 U	ug/l

SB-27

Depth (ft)		Concentration	
GW		500 U	ug/l

SB-28

Depth (ft)		Concentration	
0	1	53	mg/kg
1	2	21	mg/kg
GW		500 U	ug/l

SB-29

Depth (ft)		Concentration	
0	1	77	mg/kg
1	2	50	mg/kg
5	5.5	46	mg/kg
7	7.3	460	mg/kg
10	10.6	140	mg/kg
GW		500 U	ug/l

SB-30

Depth (ft)		Concentration	
0	1	47.5	mg/kg
GW		500 U	ug/l

SB-31

Depth (ft)		Concentration	
7	8	12 U	mg/kg
8	9	620	mg/kg
9	9.6	130	mg/kg
9.6	10	29	mg/kg
10.2	11	12 U	mg/kg

SB-32

Depth (ft)		Concentration	
GW		500 U	ug/l

MWLSC02

Depth (ft)		Concentration	
GW		500 U	ug/l
GW		500 U	ug/l

MWLSC03

Depth (ft)		Concentration	
GW		500 U	ug/l
GW		500 U	ug/l

SB-34

Depth (ft)		Concentration	
0	1.1	990	mg/kg

SB-35

Depth (ft)		Concentration	
0	1	1000	mg/kg
1	1.8	2700	mg/kg
1.8	3.2	190	mg/kg

SB-36

Depth (ft)		Concentration	
0	0.8	890	mg/kg
0.8	1.8	13 U	mg/kg

SB-37

Depth (ft)		Concentration	
0	1.2	1600	mg/kg
1.2	2	570	mg/kg
2	3.1	83	mg/kg

SB-38

Depth (ft)		Concentration	
0	1	1650	mg/kg
1	1.9	215	mg/kg
1.9	2.4	170	mg/kg

SB-39

Depth (ft)		Concentration	
0	0.7	280	mg/kg
0.7	2	190	mg/kg

TP-15

Depth (ft)		Concentration	
0	1	35	mg/kg
3	4	12 U	mg/kg

TP-16

Depth (ft)		Concentration	
0	2	760	mg/kg
2	4	110	mg/kg

TP-17

Depth (ft)		Concentration	
0	1	110	mg/kg
1	2	480	mg/kg
2	3	55	mg/kg
3	4	40	mg/kg

TP-21

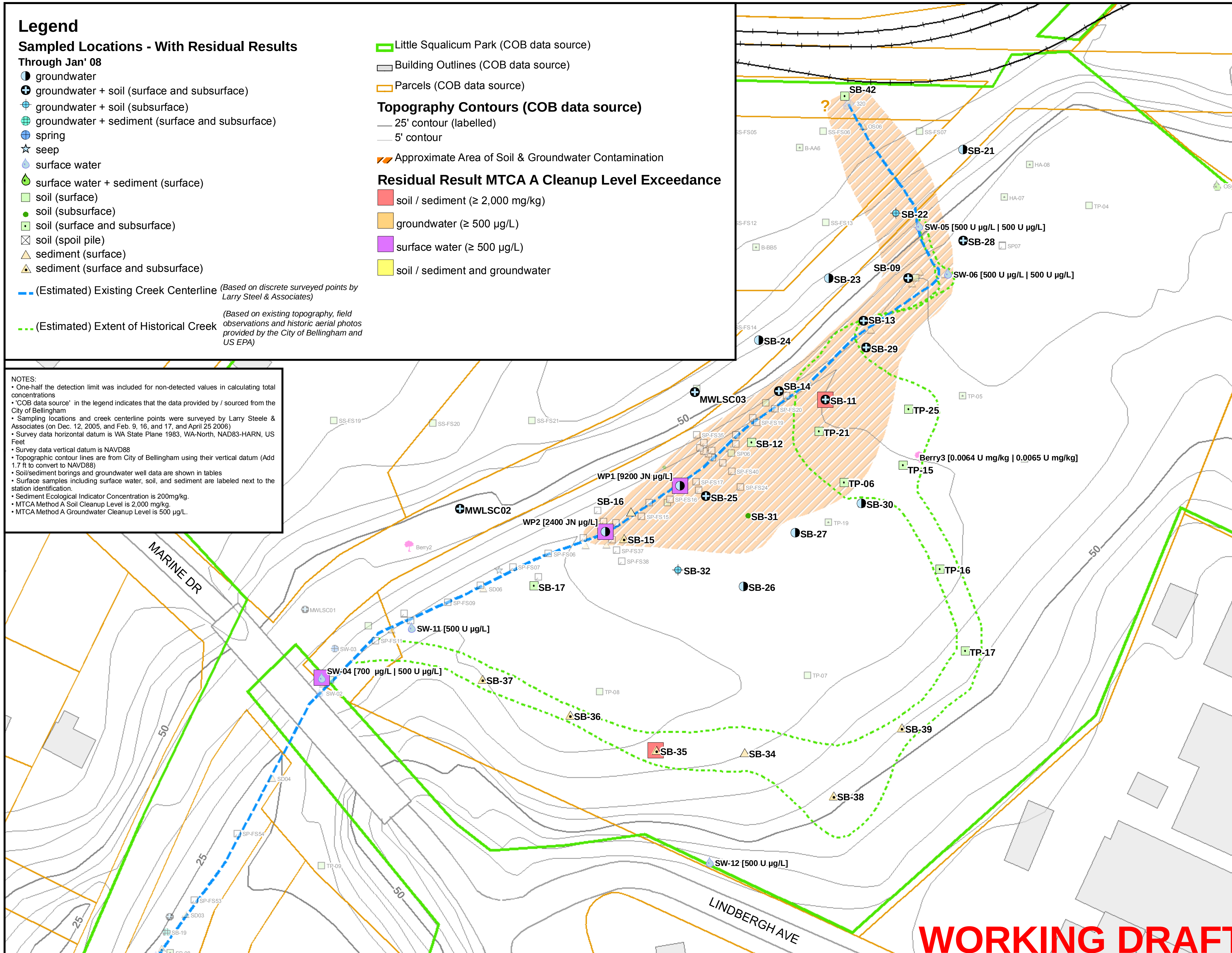
Depth (ft)		Concentration	
0	2	390	mg/kg
2	4	22	mg/kg

TP-25

Depth (ft)		Concentration	
0	0.6	27	mg/kg
0.6	2	12 U	mg/kg

SB-42

Depth (ft)		Concentration	
34	35.5	11 U	mg/kg
36.5	38	55	mg/kg



integral consulting inc.

N

0 50 100 200 Feet

Figure 5-26
Upper and Historical Creek Residual-Range Organics Results
Little Squalicum Park RI, Bellingham, WA

Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_RRO_table_figure.mxd) TWC -- 10/11/2007 -- 11:52:52 AM

SB-09

Depth (ft)		Concentration	
0	1	5.6 J	mg/kg
6	7	66	mg/kg
7	8	534	mg/kg
8	9	767	mg/kg
9	10	243	mg/kg
GW		1391	ug/l

SB-11

Depth (ft)		Concentration	
0	1	19.5	mg/kg
1	2	78 J	mg/kg
6	7	0.36 J	mg/kg
GW		259	ug/l

SB-12

Depth (ft)		Concentration	
4	5	224	mg/kg

SB-13

Depth (ft)		Concentration	
GW		2.51 J	ug/l

SB-14

Depth (ft)		Concentration	
4	5	0.57	mg/kg
5	6	2.2	mg/kg
6	7	54	mg/kg
8	9	25	mg/kg
9	10	7.8	mg/kg
10	11	3.7	mg/kg
GW		379	ug/l

SB-21

Depth (ft)		Concentration	
GW		0.47 UJ	ug/l

SB-22

Depth (ft)		Concentration	
25.5	27	0.089	mg/kg
27	28.5	41	mg/kg
28.5	29.6	17	mg/kg
29.6	30	0.22 J	mg/kg
30	31	0.062 J	mg/kg
GW		381	ug/l

SB-23

Depth (ft)		Concentration	
GW		0.47 UJ	ug/l

SB-24

Depth (ft)		Concentration	
GW		0.47 UJ	ug/l

SB-25

Depth (ft)		Concentration	
GW		216 J	ug/l

SB-26

Depth (ft)		Concentration	
GW		2.7 J	ug/l

SB-27

Depth (ft)		Concentration	
GW		0.47 UJ	ug/l

SB-28

Depth (ft)		Concentration	
GW		2.6 J	ug/l

SB-29

Depth (ft)		Concentration	
5	5.5	0.37 J	mg/kg
7	7.3	114	mg/kg
10	10.6	429	mg/kg
GW		3770	ug/l

SB-30

Depth (ft)		Concentration	
GW		0.47 UJ	ug/l

SB-31

Depth (ft)		Concentration	
7	8	0.12 J	mg/kg
8	9	1044	mg/kg
9	9.6	305	mg/kg
9.6	10	56	mg/kg
10.2	11	1.8	mg/kg

SB-32

Depth (ft)		Concentration	
GW		1.7 J	ug/l

MWLSC01

Depth (ft)		Concentration	
0	0.17	0.96	mg/kg
10	12	0.0021 U	mg/kg
18	20	0.0024 U	mg/kg
34	36	0.02	mg/kg
GW		0.072 J	ug/l
GW		0.046	ug/l
GW		0.155	ug/l

MWLSC02

Depth (ft)		Concentration	
0	0.17	0.232	mg/kg
10	12	0.0021 U	mg/kg
22	24	0.0022 U	mg/kg
30	32	0.0107	mg/kg
GW		0.061 J	ug/l
GW		0.068	ug/l
GW		1.98	ug/l
GW		0.47 UJ	ug/l
GW		0.47 UJ	ug/l

MWLSC03

Depth (ft)		Concentration	
0	0.5	0.0289	mg/kg
28	30	0.012	mg/kg
32	34	0.01	mg/kg
GW		0.223	ug/l
GW		0.071	ug/l
GW		0.161	ug/l
GW		0.47 UJ	ug/l
GW		0.47 UJ	ug/l

MWLSC04

Depth (ft)		Concentration	
0	0.5	0.116	mg/kg
4	6	0.0021 U	mg/kg
12	14	0.002 U	mg/kg

SB-34

Depth (ft)		Concentration	
0	1.1	0.655	mg/kg

SB-35

Depth (ft)		Concentration	
0	1	0.605	mg/kg
1	1.8	8.647 J	mg/kg

SB-36

Depth (ft)		Concentration	
0	0.8	4.98	mg/kg

SB-37

Depth (ft)		Concentration	
0	1.2	1.035 J	mg/kg
1.2	2	0.207 J	mg/kg

SB-38

Depth (ft)		Concentration	
0	1	10.845 J	mg/kg
1	1.9	0.237 J	mg/kg

SB-39

Depth (ft)		Concentration	
0	0.7	4.272 J	mg/kg

TP-16

Depth (ft)		Concentration	
0	2	21.885 J	mg/kg

TP-17

Depth (ft)		Concentration	
1	2	12.13	mg/kg

TP-21

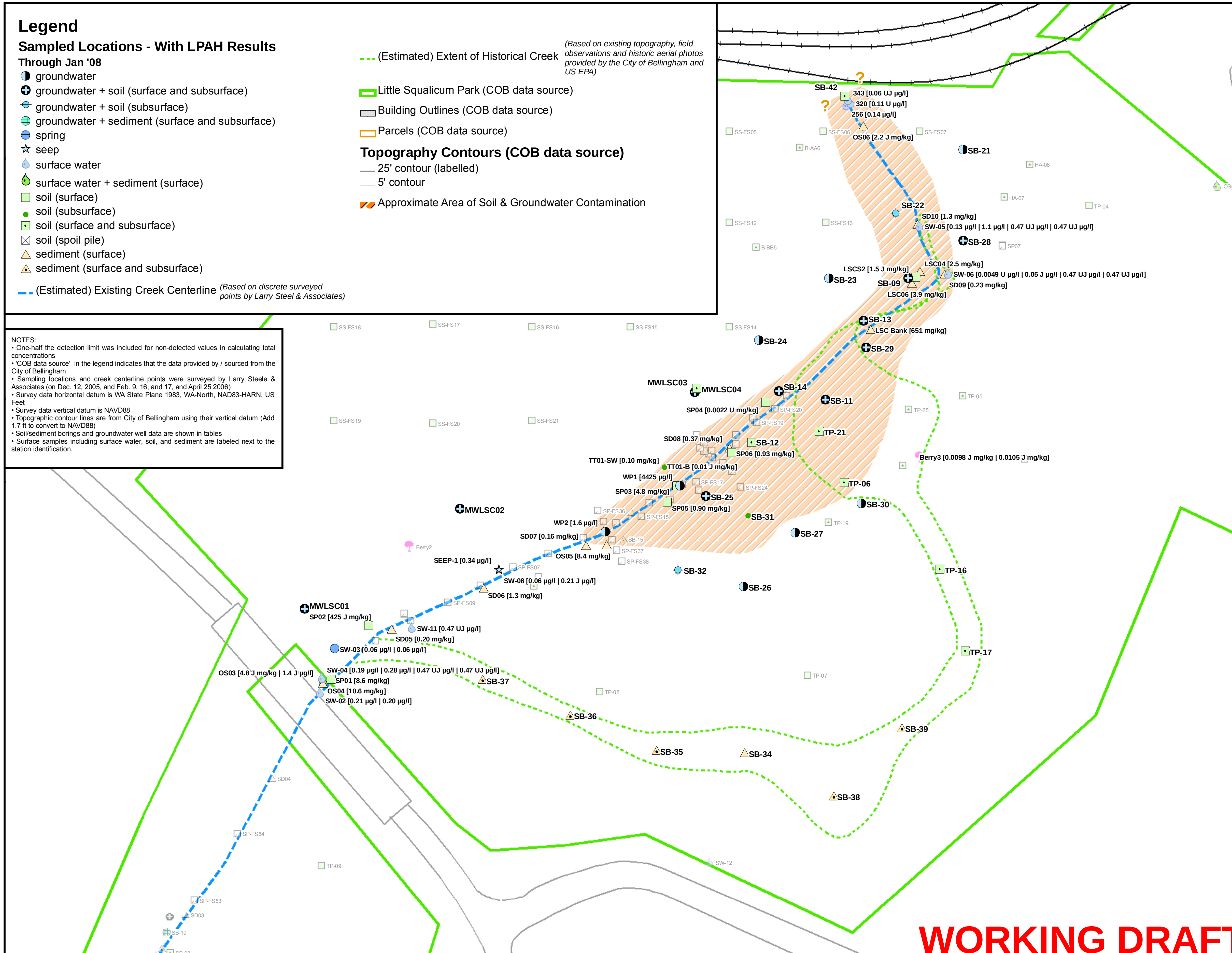
Depth (ft)		Concentration	
0	2	0.7035	mg/kg

TP-06

Depth (ft)		Concentration	
0	1	5.76 J	mg/kg
1	2	2204	mg/kg
2	3	494	mg/kg
3	4	77.1 J	mg/kg
4	4	25.1	mg/kg

SB-42

Depth (ft)		Concentration	
36.5	38	8.753	mg/kg



NOTES:
- One-half the detection limit was included for non-detected values in calculating total concentrations
- 'COB data source' in the legend indicates that the data provided by / sourced from the City of Bellingham
- Sampling locations and creek centerline points were surveyed by Larry Steele & Associates (on Dec. 12, 2005, and Feb. 9, 16, and 17, and April 25 2006)
- Survey data horizontal datum is WA State Plane 1983, WA-North, NAD83-HARN, US Feet
- Survey data vertical datum is NAVD88
- Topographic contour lines are from City of Bellingham using their vertical datum (Add 1.7 ft to convert to NAVD88)
- Soil/sediment borings and groundwater well data are shown in tables
- Surface samples including surface water, soil, and sediment are labeled next to the station identification.

integral consulting inc.

N

0 50 100 200 Feet

Figure 5-27
Upper and Historical Creek LPAH Results
Little Squalicum Park RI, Bellingham, WA

Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_LPAH_table_figure.mxd) TWC -- 10/29/2007 -- 11:41:21 AM

Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_HPAH_table_figure.mxd) TWC -- 6/10/2008 -- 2:52:26 PM

SB-09

Depth (ft)		Concentration	
0	1	77	mg/kg
6	7	34	mg/kg
7	8	275	mg/kg
8	9	406	mg/kg
9	10	108	mg/kg
GW		50 J	ug/l

SB-11

Depth (ft)		Concentration	
0	1	668 J	mg/kg
1	2	1990	mg/kg
6	7	6.9 J	mg/kg
GW		9.6 J	ug/l

SB-12

Depth (ft)		Concentration	
4	5	146	mg/kg

SB-13

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-14

Depth (ft)		Concentration	
4	5	0.20 J	mg/kg
5	6	1.6	mg/kg
6	7	30	mg/kg
8	9	16	mg/kg
9	10	5.1 J	mg/kg
10	11	2.6 J	mg/kg
GW		55 J	ug/l

SB-21

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-22

Depth (ft)		Concentration	
25.5	27	0.14 J	mg/kg
27	28.5	63	mg/kg
28.5	29.6	25	mg/kg
29.6	30	0.38 J	mg/kg
30	31	0.02 U	mg/kg
GW		56 J	ug/l

SB-23

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-24

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-25

Depth (ft)		Concentration	
GW		11.46 J	ug/l

SB-26

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-27

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-28

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-29

Depth (ft)		Concentration	
5	5.5	12	mg/kg
7	7.3	338	mg/kg
10	10.6	174	mg/kg
GW		83 J	ug/l

SB-30

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-31

Depth (ft)		Concentration	
7	8	0.23 J	mg/kg
8	9	476	mg/kg
9	9.6	148	mg/kg
9.6	10	80	mg/kg
10.2	11	0.96 J	mg/kg

SB-32

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

MWLSC01

Depth (ft)		Concentration	
0	0.17	0.23 J	mg/kg
10	12	0.021 U	mg/kg
18	20	0.024 U	mg/kg
34	36	0.030 J	mg/kg
GW		0.048 U	ug/l
GW		0.023	ug/l
GW		0.022	ug/l

MWLSC02

Depth (ft)		Concentration	
0	0.17	0.20 J	mg/kg
10	12	0.021 U	mg/kg
22	24	0.022 U	mg/kg
30	32	0.026 U	mg/kg
GW		0.048 U	ug/l
GW		0.0047 U	ug/l
GW		0.121	ug/l
GW		0.48 UJ	ug/l
GW		0.72 UJ	ug/l

MWLSC03

Depth (ft)		Concentration	
0	0.5	0.053 J	mg/kg
28	30	0.024 UJ	mg/kg
32	34	0.024 UJ	mg/kg
GW		0.052 J	ug/l
GW		0.0047 U	ug/l
GW		0.0048 U	ug/l
GW		0.48 UJ	ug/l
GW		0.72 UJ	ug/l

MWLSC04

Depth (ft)		Concentration	
0	0.5	1.03 J	mg/kg
4	6	0.021 U	mg/kg
12	14	0.02 U	mg/kg

SB-34

Depth (ft)		Concentration	
0	1.1	3.12	mg/kg

SB-35

Depth (ft)		Concentration	
0	1	2.21	mg/kg
1	1.8	62.24	mg/kg

SB-36

Depth (ft)		Concentration	
0	0.8	42.09	mg/kg

SB-37

Depth (ft)		Concentration	
0	1.2	5.65	mg/kg
1.2	2	1.556 J	mg/kg

SB-38

Depth (ft)		Concentration	
0	1	343.3	mg/kg
1	1.9	6.2	mg/kg

SB-39

Depth (ft)		Concentration	
0	0.7	47.33	mg/kg

TP-16

Depth (ft)		Concentration	
0	2	670.4	mg/kg

TP-17

Depth (ft)		Concentration	
1	2	324.9	mg/kg

TP-21

Depth (ft)		Concentration	
0	2	18.08	mg/kg

TP-06

Depth (ft)		Concentration	
7	8	113.2 J	mg/kg
8	9	1191	mg/kg
9	9.6	518.1	mg/kg
9.6	10	5.08	mg/kg
10.2	11	8.01 J	mg/kg

SB-42

Depth (ft)		Concentration	
36.5	38	15.26	mg/kg

Legend

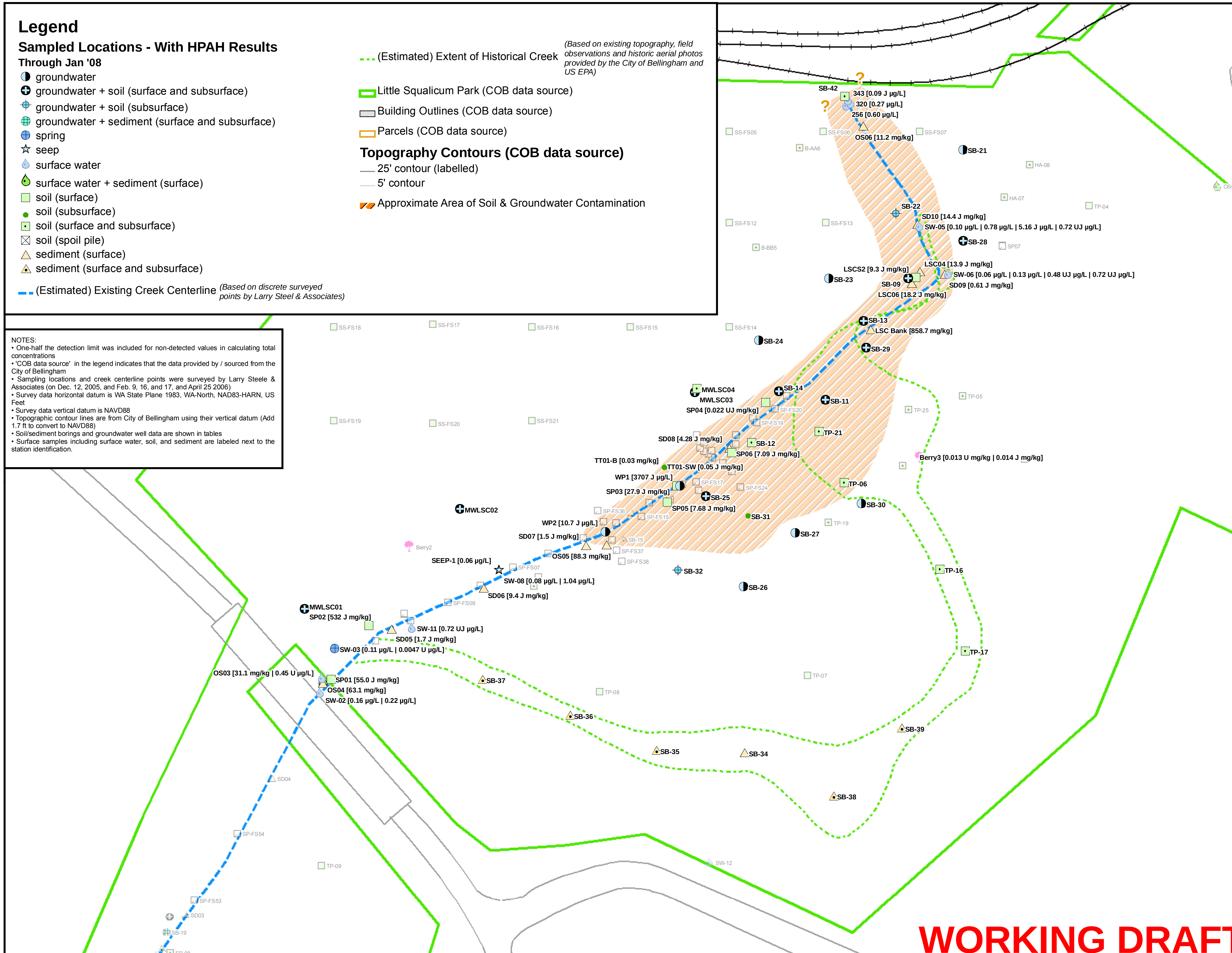
Sampled Locations - With HPAH Results Through Jan '08

- groundwater
- groundwater + soil (surface and subsurface)
- groundwater + soil (subsurface)
- groundwater + sediment (surface and subsurface)
- spring
- seep
- surface water
- surface water + sediment (surface)
- soil (surface)
- soil (subsurface)
- soil (surface and subsurface)
- soil (spoil pile)
- sediment (surface)
- sediment (surface and subsurface)
- (Estimated) Existing Creek Centerline *(Based on discrete surveyed points by Larry Steel & Associates)*
- (Estimated) Extent of Historical Creek *(Based on existing topography, field observations and historic aerial photos provided by the City of Bellingham and US EPA)*
- Little Squalicum Park (COB data source)
- Building Outlines (COB data source)
- Parcels (COB data source)

Topography Contours (COB data source)

- 25' contour (labelled)
- 5' contour
- Approximate Area of Soil & Groundwater Contamination

NOTES:
- One-half the detection limit was included for non-detected values in calculating total concentrations
- 'COB data source' in the legend indicates that the data provided by / sourced from the City of Bellingham
- Sampling locations and creek centerline points were surveyed by Larry Steele & Associates (on Dec. 12, 2005, and Feb. 9, 16, and 17, and April 25 2006)
- Survey data horizontal datum is WA State Plane 1983, WA-North, NAD83-HARN, US Feet
- Survey data vertical datum is NAVD88
- Topographic contour lines are from City of Bellingham using their vertical datum (Add 1.7 ft to convert to NAVD88)
- Soil/sediment borings and groundwater well data are shown in tables
- Surface samples including surface water, soil, and sediment are labeled next to the station identification.



N

Feet
0 50 100 200

integral consulting inc.

Figure 5-28
Upper and Historical Creek HPAH Results
Little Squalicum Park RI, Bellingham, WA

SB-09

Depth (ft)		Concentration	
0	1	82.9 J	mg/kg
6	7	99.9	mg/kg
7	8	809	mg/kg
8	9	1173	mg/kg
9	10	351	mg/kg
GW		1441 J	ug/l

SB-11

Depth (ft)		Concentration	
0	1	687 J	mg/kg
1	2	2068 J	mg/kg
6	7	7.21 J	mg/kg
GW		269 J	ug/l

SB-12

Depth (ft)		Concentration	
4	5	370	mg/kg

SB-13

Depth (ft)		Concentration	
GW		4.2 J	ug/l

SB-14

Depth (ft)		Concentration	
4	5	0.77 J	mg/kg
5	6	3.84	mg/kg
6	7	84	mg/kg
8	9	41.1	mg/kg
9	10	13 J	mg/kg
10	11	6.27 J	mg/kg
GW		433.8 J	ug/l

SB-21

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-22

Depth (ft)		Concentration	
25.5	27	0.23 J	mg/kg
27	28.5	104	mg/kg
28.5	29.6	42	mg/kg
29.6	30	0.6 J	mg/kg
30	31	0.16 J	mg/kg
GW		436.2 J	ug/l

SB-23

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-24

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-25

Depth (ft)		Concentration	
GW		227.4 J	ug/l

SB-26

Depth (ft)		Concentration	
GW		4.43 J	ug/l

SB-27

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-28

Depth (ft)		Concentration	
GW		4.33 J	ug/l

SB-29

Depth (ft)		Concentration	
5	5.5	12.7 J	mg/kg
7	7.3	452	mg/kg
10	10.6	603	mg/kg
GW		3853 J	ug/l

SB-30

Depth (ft)		Concentration	
GW		0.72 UJ	ug/l

SB-31

Depth (ft)		Concentration	
7	8	0.35 J	mg/kg
8	9	1520	mg/kg
9	9.6	453	mg/kg
9.6	10	136	mg/kg
10.2	11	2.77 J	mg/kg

SB-32

Depth (ft)		Concentration	
GW		3.43 J	ug/l

MWLSC01

Depth (ft)		Concentration	
0	0.17	1.18 J	mg/kg
10	12	0.021 U	mg/kg
18	20	0.024 U	mg/kg
34	36	0.050 J	mg/kg
GW		0.12 J	ug/l
GW		0.069	ug/l
GW		0.177	ug/l

MWLSC02

Depth (ft)		Concentration	
0	0.17	0.44 J	mg/kg
10	12	0.021 U	mg/kg
22	24	0.022 U	mg/kg
30	32	0.04	mg/kg
GW		0.109 J	ug/l
GW		0.087	ug/l
GW		2.1	ug/l
GW		0.48 UJ	ug/l
GW		0.72 UJ	ug/l

MWLSC03

Depth (ft)		Concentration	
0	0.5	0.082 J	mg/kg
28	30	0.036 J	mg/kg
32	34	0.034 J	mg/kg
GW		0.275 J	ug/l
GW		0.09	ug/l
GW		0.18	ug/l
GW		0.48 UJ	ug/l
GW		0.72 UJ	ug/l

MWLSC04

Depth (ft)		Concentration	
0	0.5	1.15 J	mg/kg
4	6	0.021 U	mg/kg
12	14	0.02 U	mg/kg

SB-34

Depth (ft)		Concentration	
0	1.1	3.775	mg/kg

SB-35

Depth (ft)		Concentration	
0	1	2.815	mg/kg
1	1.8	70.887 J	mg/kg

SB-36

Depth (ft)		Concentration	
0	0.8	47.07	mg/kg

SB-37

Depth (ft)		Concentration	
0	1.2	6.685 J	mg/kg
1.2	2	1.763 J	mg/kg

SB-38

Depth (ft)		Concentration	
0	1	354.145 J	mg/kg
1	1.9	6.437 J	mg/kg

SB-39

Depth (ft)		Concentration	
0	0.7	51.602 J	mg/kg

TP-16

Depth (ft)		Concentration	
0	2	692.285 J	mg/kg

TP-17

Depth (ft)		Concentration	
1	2	337.03	mg/kg

TP-21

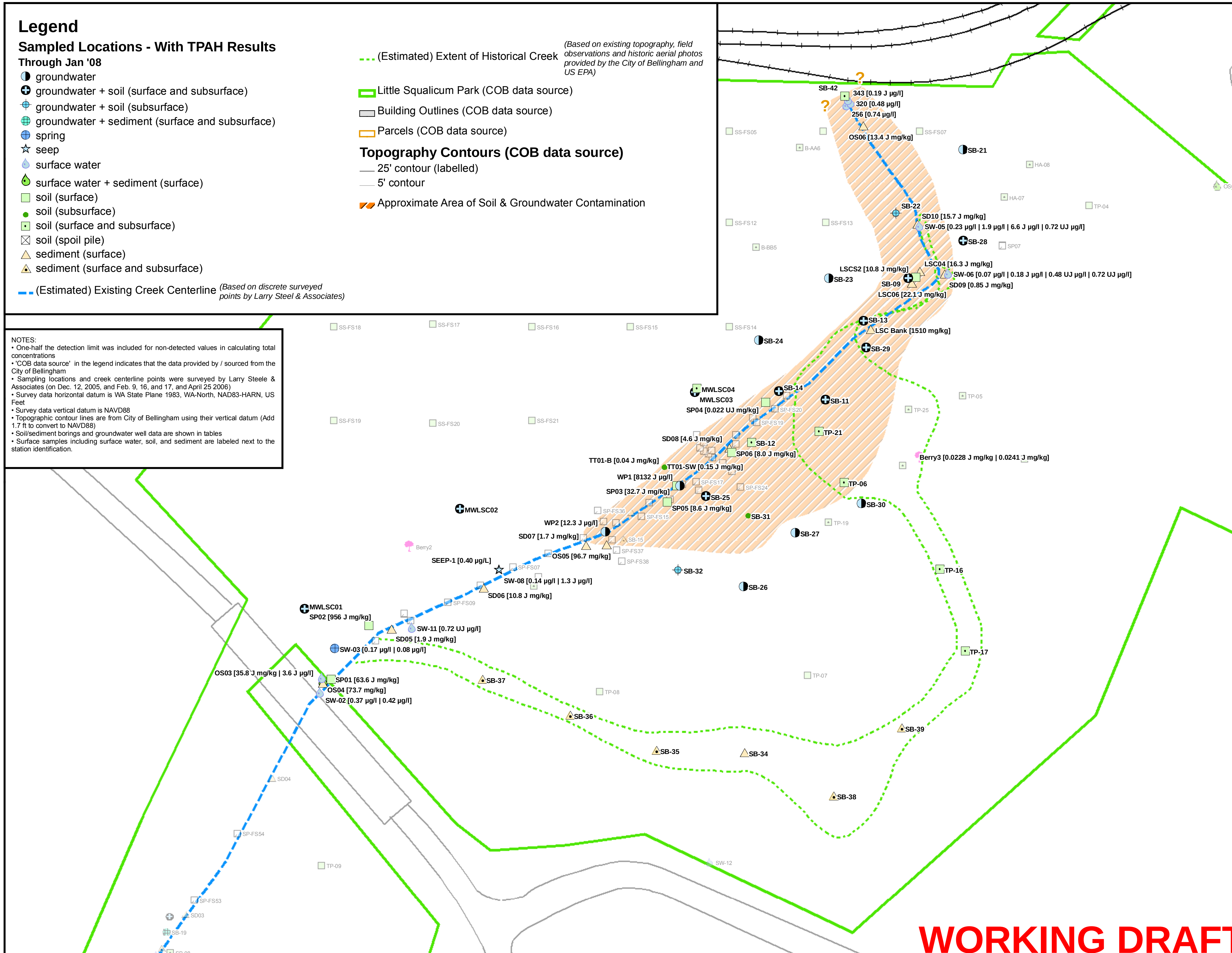
Depth (ft)		Concentration	
0	2	18.7835	mg/kg

TP-06

Depth (ft)		Concentration	
0	1	119.0 J	mg/kg
1	2	3395	mg/kg
2	3	1012	mg/kg
3	4	82.2 J	mg/kg
4	4	33.1 J	mg/kg

SB-42

Depth (ft)		Concentration	
36.5	38	24.013	mg/kg



NOTES:

- One-half the detection limit was included for non-detected values in calculating total concentrations
- 'COB data source' in the legend indicates that the data provided by / sourced from the City of Bellingham
- Sampling locations and creek centerline points were surveyed by Larry Steele & Associates (on Dec. 12, 2005, and Feb. 9, 16, and 17, and April 25 2006)
- Survey data horizontal datum is WA State Plane 1983, WA-North, NAD83-HARN, US Feet
- Survey data vertical datum is NAVD88
- Topographic contour lines are from City of Bellingham using their vertical datum (Add 1.7 ft to convert to NAVD88)
- Soil/sediment borings and groundwater well data are shown in tables
- Surface samples including surface water, soil, and sediment are labeled next to the station identification.

integral consulting inc.

Figure 5-29
Upper and Historical Creek TPAH Results
Little Squalicum Park RI, Bellingham, WA

Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_TPAH_table_figure.mxd) TWC -- 10/12/2007 -- 3:38:20 PM

SB-09			
Depth (ft)		Concentration	
0	1	13.79	mg/kg
6	7	2.292	mg/kg
7	8	18.121	mg/kg
8	9	26.97	mg/kg
9	10	6.987	mg/kg
GW		2.647 J	ug/l

SB-11			
Depth (ft)		Concentration	
0	1	144 J	mg/kg
1	2	443.6	mg/kg
6	7	1.645 J	mg/kg
GW		0.72 UJ	ug/l

SB-12			
Depth (ft)		Concentration	
4	5	7.616	mg/kg

SB-13		
Depth (ft)	Concentration	
GW	0.72 UJ	ug/l

SB-14			
Depth (ft)		Concentration	
4	5	0.01788 J	mg/kg
5	6	0.0944	mg/kg
6	7	1.539	mg/kg
8	9	1.099	mg/kg
9	10	0.30355	mg/kg
10	11	0.14965 J	mg/kg
GW		4.391 J	ug/l

SB-21		
Depth (ft)	Concentration	
GW	0.72 UJ	ug/l

SB-22			
Depth (ft)		Concentration	
25.5	27	0.01512 J	mg/kg
27	28.5	4.405	mg/kg
28.5	29.6	1.8315	mg/kg
29.6	30	0.02772 J	mg/kg
30	31	0.02 U	mg/kg
GW		4.422 J	ug/l

SB-23		
Depth (ft)	Concentration	
GW	0.72 UJ	ug/l

SB-24		
Depth (ft)	Concentration	
GW	0.72 UJ	ug/l

SB-25		
Depth (ft)	Concentration	
GW	0.2645 J	ug/l

SB-26		
Depth (ft)	Concentration	
GW	0.72 UJ	ug/l

SB-27		
Depth (ft)	Concentration	
GW	0.72 UJ	ug/l

SB-28		
Depth (ft)	Concentration	
GW	0.72 UJ	ug/l

SB-29			
Depth (ft)		Concentration	
5	5.5	2.818	mg/kg
7	7.3	21.94	mg/kg
10	10.6	11.4	mg/kg
GW		3.674 J	ug/l

SB-30		
Depth (ft)	Concentration	
GW	0.72 UJ	ug/l

SB-31			
Depth (ft)		Concentration	
7	8	0.03119 J	mg/kg
8	9	28.22	mg/kg
9	9.6	9.7	mg/kg
9.6	10	6.495	mg/kg
10.2	11	0.05889 J	mg/kg

SB-32		
Depth (ft)	Concentration	
GW	0.72 UJ	ug/l

SB-34			
Depth (ft)		Concentration	
0	1.1	0.4059	mg/kg

SB-35			
Depth (ft)		Concentration	
0	1	0.2815	mg/kg
1	1.8	12.89	mg/kg

SB-36			
Depth (ft)		Concentration	
0	0.8	5.611	mg/kg

SB-37			
Depth (ft)		Concentration	
0	1.2	0.8104	mg/kg
1.2	2	0.2304	mg/kg

SB-38			
Depth (ft)		Concentration	
0	1	79.44	mg/kg
1	1.9	0.984	mg/kg

SB-39			
Depth (ft)		Concentration	
0	0.7	10.272	mg/kg

MWLSC01			
Depth (ft)		Concentration	
0	0.166667	0.021695 J	mg/kg
10	12	0.0021 U	mg/kg
18	20	0.0024 U	mg/kg
34	36	J	mg/kg
GW		0.0048 U	ug/l
GW		0.0048 U	ug/l
GW		0.0049 U	ug/l

MWLSC02			
Depth (ft)		Concentration	
0	0.166667	0.017255 J	mg/kg
10	12	0.0021 U	mg/kg
22	24	0.0022 U	mg/kg
30	32	0.0026 U	mg/kg
GW		0.004108	ug/l
GW		0.0048 U	ug/l
GW		0.0047 U	ug/l
GW		0.48 UJ	ug/l
GW		0.72 UJ	ug/l

MWLSC03			
Depth (ft)		Concentration	
GW		0.0048 U	ug/l
0	0.5	J	mg/kg
28	30	0.0024 U	mg/kg
32	34	0.0024 U	mg/kg
GW		0.0049 U	ug/l
GW		0.0047 U	ug/l
GW		0.48 UJ	ug/l
GW		0.72 UJ	ug/l

MWLSC04			
Depth (ft)		Concentration	
0	0.5	0.2803 J	mg/kg
4	6	0.0021 U	mg/kg
12	14	0.002 U	mg/kg

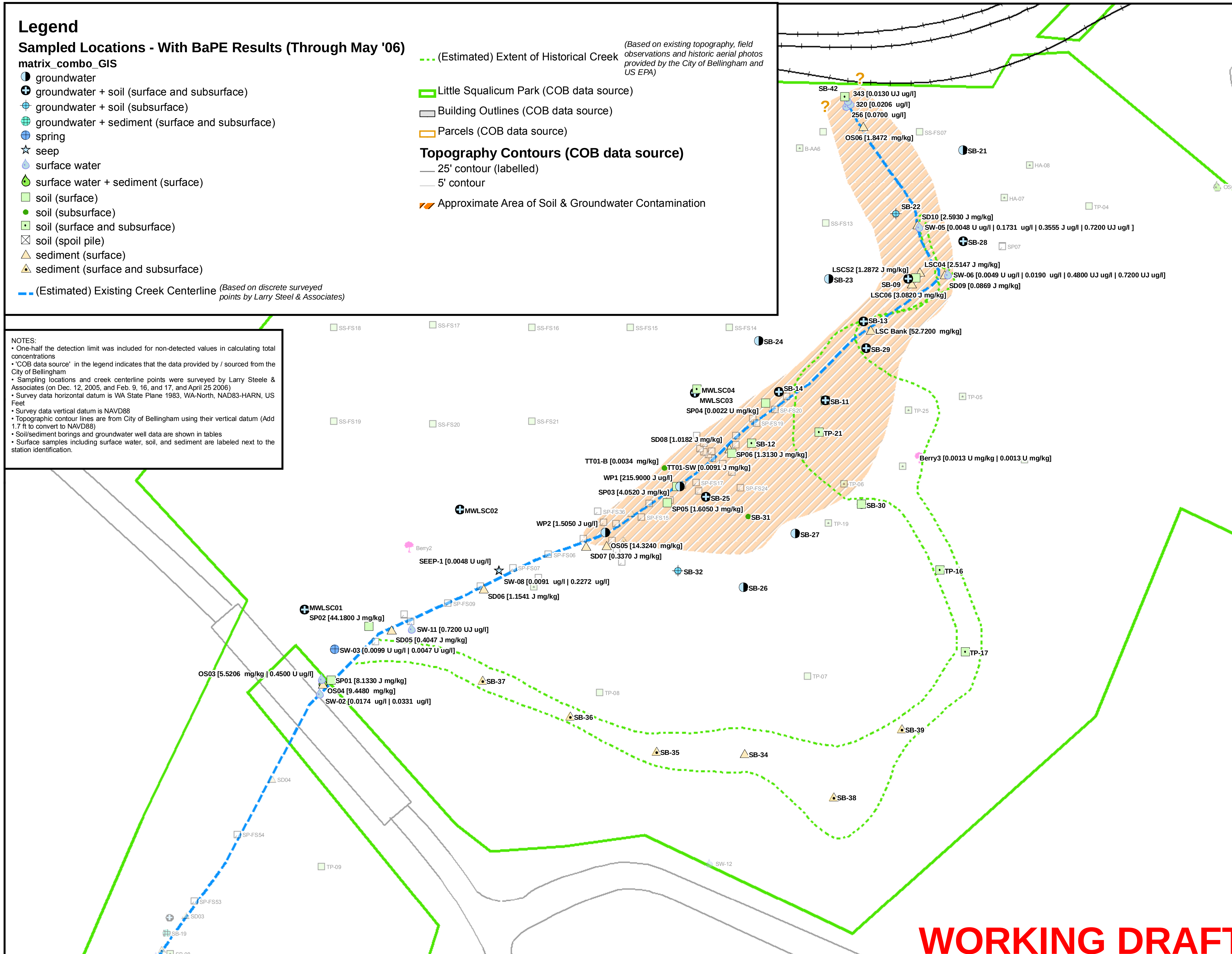
TP-06			
Depth (ft)		Concentration	
0	1	23.28	mg/kg
1	2	102.79	mg/kg
2	3	46.92	mg/kg
3	4	0.823	mg/kg
4	4	0.4545	mg/kg

TP-16			
Depth (ft)		Concentration	
0	2	93.94	mg/kg

TP-17			
Depth (ft)		Concentration	
1	2	66.16	mg/kg

TP-21			
Depth (ft)		Concentration	
0	2	3.873	mg/kg

SB-42			
Depth (ft)		Concentration	
36.5	38	3.294	mg/kg



Feet
0 50 100 200

integral consulting inc.

Figure 5-30
Upper and Historical Creek BaPE Results
Little Squalicum Park RI, Bellingham, WA

MWLSC01

Depth (ft)		Concentration	
0	0.17	0.026	mg/kg
10	12	0.01 UJ	mg/kg
18	20	0.012 UJ	mg/kg
34	36	0.011 UJ	mg/kg
GW		0.024 U	ug/l
GW		0.025	ug/l
GW		0.025	ug/l

MWLSC02

Depth (ft)		Concentration	
0	0.17	0.015	mg/kg
10	12	0.011 U	mg/kg
22	24	0.011 U	mg/kg
30	32	0.013 U	mg/kg
GW		0.024 U	ug/l
GW		0.058	ug/l
GW		0.17	ug/l
GW		0.91 UJ	ug/l
GW		0.91 UJ	ug/l

MWLSC03

Depth (ft)		Concentration	
0	0.5	0.0056 J	mg/kg
28	30	0.012 U	mg/kg
32	34	0.012 U	mg/kg
GW		0.37	ug/l
GW		0.024 U	ug/l
GW		0.054	ug/l
GW		0.91 UJ	ug/l
GW		0.91 UJ	ug/l

MWLSC04

Depth (ft)		Concentration	
0	0.5	0.41	mg/kg
4	6	0.011 UJ	mg/kg
12	14	0.01 UJ	mg/kg

SB-09

Depth (ft)		Concentration	
0	1	0.375	mg/kg
6	7	0.46	mg/kg
7	8	4.4	mg/kg
8	9	6.4	mg/kg
9	10	2	mg/kg
GW		90	ug/l

SB-11

Depth (ft)		Concentration	
0	1	0.24 J	mg/kg
1	2	1 UJ	mg/kg
6	7	0.046 UJ	mg/kg
GW		0.91 UJ	ug/l

SB-12

Depth (ft)		Concentration	
4	5	1.2	mg/kg

SB-13

Depth (ft)		Concentration	
GW		0.91 UJ	ug/l

SB-14

Depth (ft)		Concentration	
4	5	0.1 UJ	mg/kg
5	6	0.047 UJ	mg/kg
6	7	0.16	mg/kg
8	9	0.14 UJ	mg/kg
9	10	0.14 UJ	mg/kg
10	11	0.14 UJ	mg/kg
GW		0.91 UJ	ug/l

SB-21

Depth (ft)		Concentration	
GW		0.91 UJ	ug/l

SB-22

Depth (ft)		Concentration	
25.5	27	0.1 UJ	mg/kg
27	28.5	0.064 J	mg/kg
28.5	29.6	0.14 UJ	mg/kg
29.6	30	0.098 J	mg/kg
30	31	0.14	mg/kg
GW		0.91 UJ	ug/l

SB-42

Depth (ft)		Concentration	
36.5	38	0.13	mg/kg

SB-23

Depth (ft)		Concentration	
GW		5.1	ug/l

SB-24

Depth (ft)		Concentration	
GW		0.91 UJ	ug/l

SB-25

Depth (ft)		Concentration	
GW		460	ug/l

SB-26

Depth (ft)		Concentration	
GW		0.91 UJ	ug/l

SB-27

Depth (ft)		Concentration	
GW		0.91 UJ	ug/l

SB-28

Depth (ft)		Concentration	
GW		0.91 UJ	ug/l

SB-29

Depth (ft)		Concentration	
5	5.5	0.38	mg/kg
7	7.3	1.1	mg/kg
10	10.6	0.32 J	mg/kg
GW		16	ug/l

SB-30

Depth (ft)		Concentration	
GW		0.91 UJ	ug/l

SB-31

Depth (ft)		Concentration	
7	8	0.11	mg/kg
8	9	6.3	mg/kg
9	9.6	2.1	mg/kg
9.6	10	1	mg/kg
10.2	11	0.1 UJ	mg/kg

SB-32

Depth (ft)		Concentration	
GW		0.91 UJ	ug/l

SB-34

Depth (ft)		Concentration	
0	1.1	0.28 UJ	mg/kg

SB-35

Depth (ft)		Concentration	
0	1	0.28 UJ	mg/kg
1	1.8	7.3	mg/kg

SB-36

Depth (ft)		Concentration	
0	0.8	7.9	mg/kg

SB-37

Depth (ft)		Concentration	
0	1.2	1.3	mg/kg
1.2	2	0.15 J	mg/kg

SB-38

Depth (ft)		Concentration	
0	1	3.6	mg/kg
1	1.9	0.14 UJ	mg/kg

SB-39

Depth (ft)		Concentration	
0	0.7	2.7	mg/kg

TP-16

Depth (ft)		Concentration	
0	2	7.1	mg/kg

TP-17

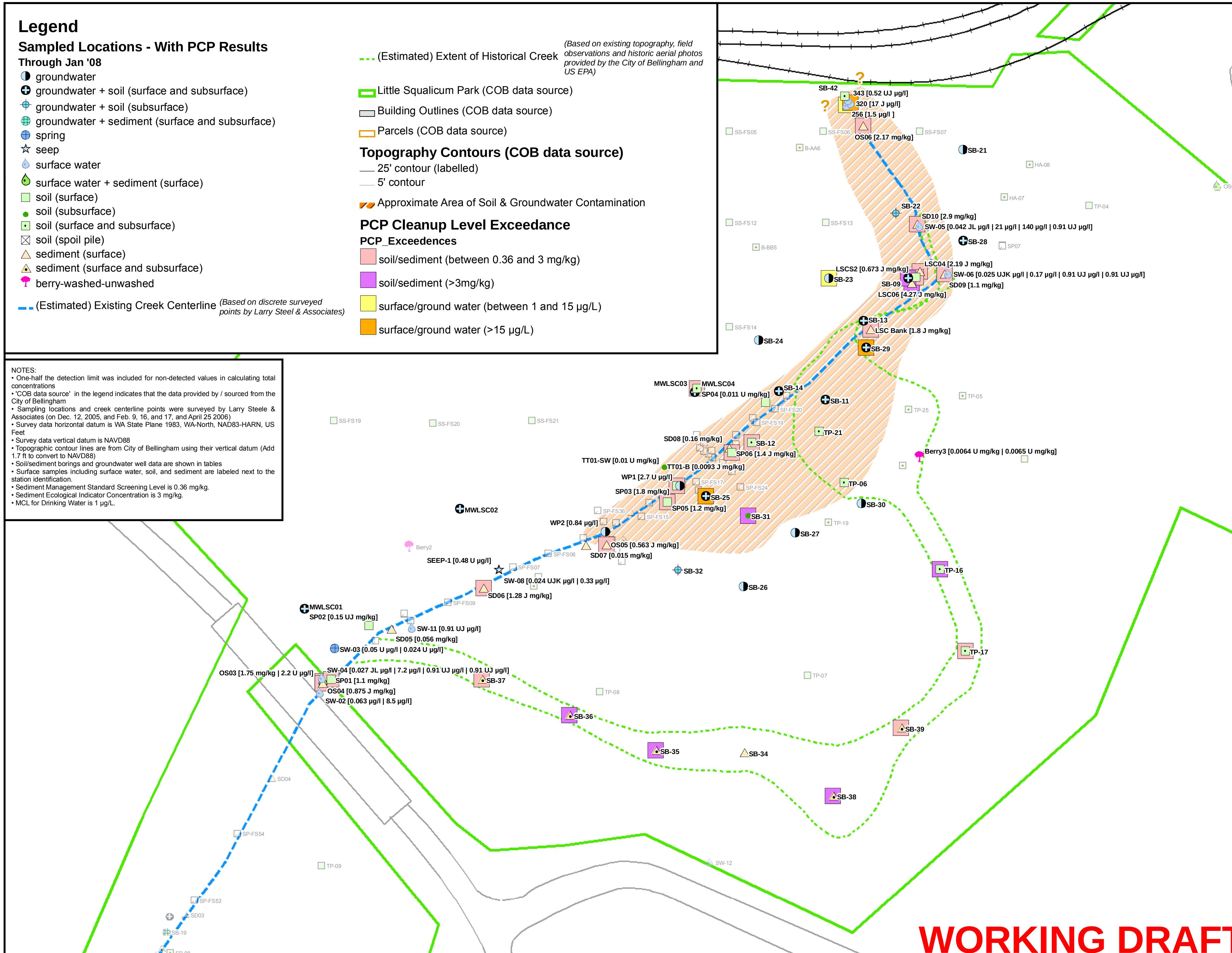
Depth (ft)		Concentration	
1	2	0.54 J	mg/kg

TP-21

Depth (ft)		Concentration	
0	2	0.14 UJ	mg/kg

TP-06

Depth (ft)		Concentration	
0	1	1.1 J	mg/kg
1	2	3.5	mg/kg
2	3	0.18 J	mg/kg
3	4	0.045 UJ	mg/kg
4	4	0.046 UJ	mg/kg



NOTES:
- One-half the detection limit was included for non-detected values in calculating total concentrations
- 'COB data source' in the legend indicates that the data provided by / sourced from the City of Bellingham
- Sampling locations and creek centerline points were surveyed by Larry Steele & Associates (on Dec. 12, 2005, and Feb. 9, 16, and 17, and April 25 2006)
- Survey data horizontal datum is WA State Plane 1983, WA-North, NAD83-HARN, US Feet
- Survey data vertical datum is NAVD88
- Topographic contour lines are from City of Bellingham using their vertical datum (Add 1.7 ft to convert to NAVD88)
- Soil/sediment borings and groundwater well data are shown in tables
- Surface samples including surface water, soil, and sediment are labeled next to the station identification.
- Sediment Management Standard Screening Level is 0.36 mg/kg.
- Sediment Ecological Indicator Concentration is 3 mg/kg.
- MCL for Drinking Water is 1 μg/L.

Map Document: (F:\local_working_files\C075_Little-Squalicum_COB\C075_LSP_PCP_table_figure.mxd) TWC -- 10/29/2007 -- 11:52:30 AM

integral consulting inc.

Figure 5-31

Upper and Historical Creek Pentachlorophenol Results

Little Squalicum Park RI, Bellingham, WA

SB-09

Depth (ft)		Concentration		
0	1	1.68E-04	J	mg/kg
7	8	2.32E-05	J	mg/kg

SB-11

Depth (ft)		Concentration		
GW		6.81E-06	J	ug/l

SB-12

Depth (ft)		Concentration		
4	5	3.90E-04	J	mg/kg

SB-14

Depth (ft)		Concentration		
GW		2.77E-05	J	ug/l

SB-21

Depth (ft)		Concentration		
GW		9.33E-06	J	ug/l

SB-22

Depth (ft)		Concentration		
GW		1.85E-04	J	ug/l

SB-24

Depth (ft)		Concentration		
GW		5.33E-05	J	ug/l

SB-25

Depth (ft)		Concentration		
GW		5.04E-06	J	ug/l

SB-29

Depth (ft)		Concentration		
7	7.3	1.04E-04	J	mg/kg
GW		8.91E-06	J	ug/l

SB-31

Depth (ft)		Concentration		
8	9	4.04E-04	J	mg/kg

SB-32

Depth (ft)		Concentration		
GW		6.64E-06	J	ug/l

MWLSC01

Depth (ft)		Concentration		
0	0.17	2.94E-05		mg/kg
GW		4.02E-06	U	ug/l
GW		1.30E-05	U	ug/l

MWLSC02

Depth (ft)		Concentration		
0	0.17	2.36E-05		mg/kg
GW		2.63E-05	U	ug/l
GW		1.23E-05		ug/l
GW		1.25E-05	J	ug/l
GW		4.54E-06	J	ug/l

MWLSC03

Depth (ft)		Concentration		
0	0.5	1.40E-05		mg/kg
32	34	1.39E-05	U	mg/kg
GW		2.10E-05	U	ug/l
GW		4.16E-05	U	ug/l
GW		6.46E-06		ug/l
GW		1.33E-05	J	ug/l
GW		1.13E-05	J	ug/l

MWLSC04

Depth (ft)		Concentration		
0	0.5	1.27E-04		mg/kg

SB-37

Depth (ft)		Concentration		
0	1.2	1.50E-03	J	mg/kg

SB-38

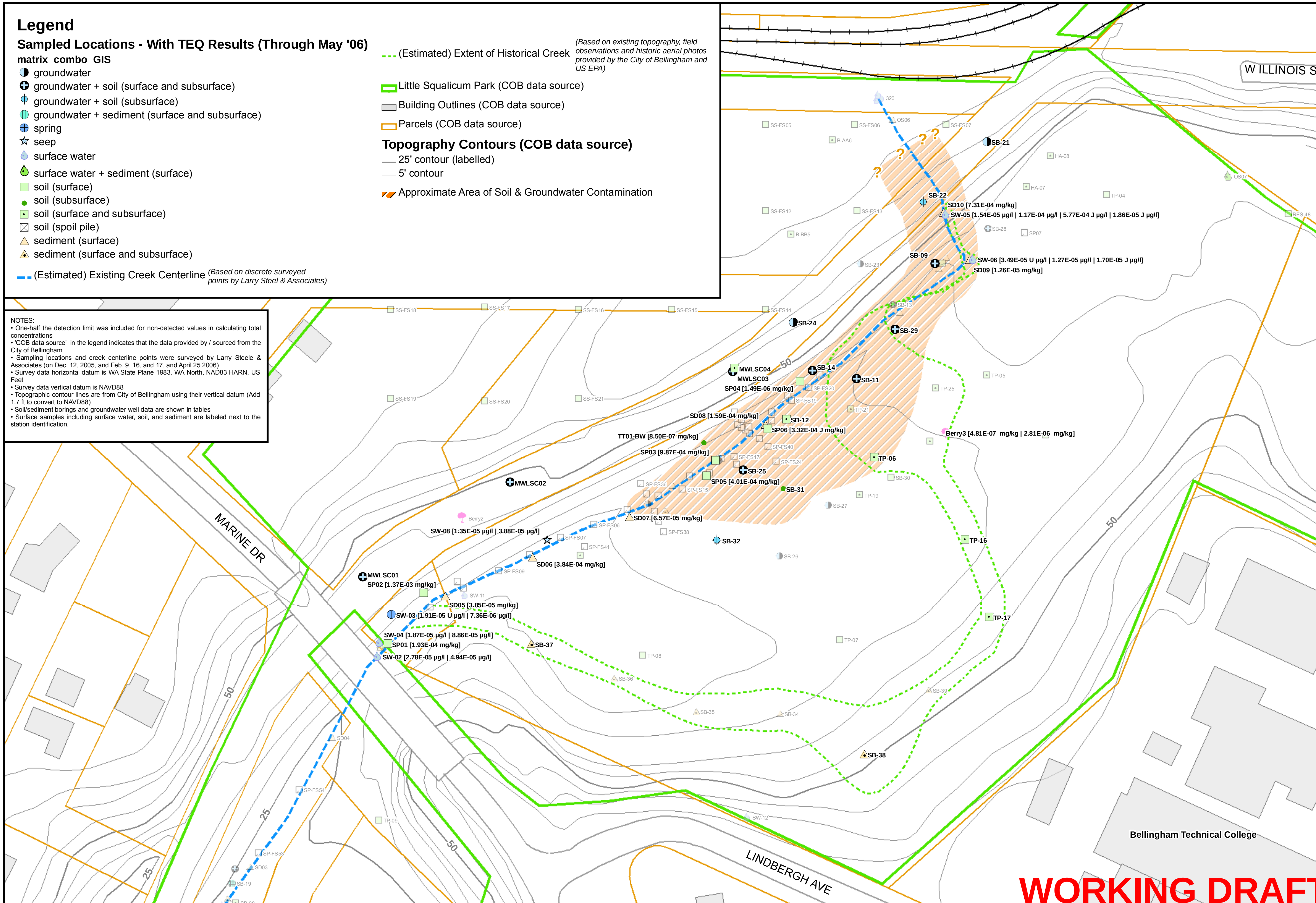
Depth (ft)		Concentration		
0	1	6.86E-04	J	mg/kg

TP-16

Depth (ft)		Concentration		
0	2	1.33E-03	J	mg/kg

TP-17

Depth (ft)		Concentration		
1	2	3.59E-04	J	mg/kg



NOTES:

- One-half the detection limit was included for non-detected values in calculating total concentrations
- 'COB data source' in the legend indicates that the data provided by / sourced from the City of Bellingham
- Sampling locations and creek centerline points were surveyed by Larry Steele & Associates (on Dec. 12, 2005, and Feb. 9, 16, and 17, and April 25 2006)
- Survey data horizontal datum is WA State Plane 1983, WA-North, NAD83-HARN, US Feet
- Survey data vertical datum is NAVD88
- Topographic contour lines are from City of Bellingham using their vertical datum (Add 1.7 ft to convert to NAVD88)
- Soil/sediment borings and groundwater well data are shown in tables
- Surface samples including surface water, soil, and sediment are labeled next to the station identification.

N

Feet 0 50 100 200

integral consulting inc.

Figure 5-32

Upper and Historical Creek TEQ Results

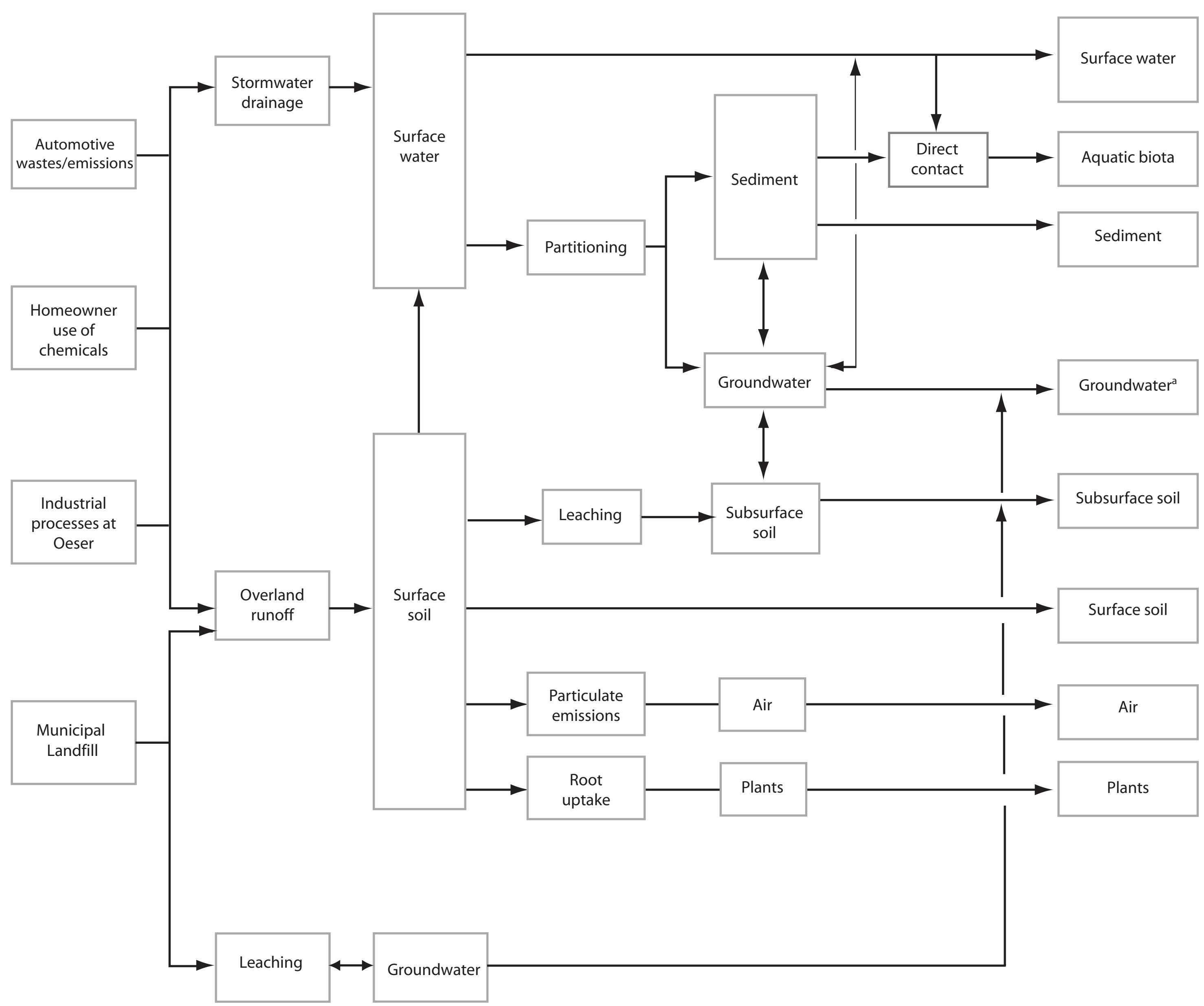
Little Squalicum Park RI, Bellingham, WA

Map Document: (\\192.168.1.11\gis\mi\C075_Little-Squalicum_COB\C075_LSP_TEQ_table_figure.mxd) TWC -- 10/12/2007 -- 5:01:17 PM

Figure 5-33. Conceptual Diagram of Reconnaissance Creek Survey Results, Dec. 8, 2005.

GJC @ 12-07-05

C:\GIS_projects\C075-0303_Little-Squalicum_COB\C075_LS-locations-map_12-05-05.mxd



Human Receptors of Concern

Exposure Medium	Exposure Pathway	Park Workers	Park Visitors	Transients
Surface water	Ingestion	□	□	■
	Dermal contact	■	■	■
	Inhalation of volatiles	x	x	x
Aquatic biota	Ingestion	x	■	■
	Dermal contact	□	□	□
Sediment	Ingestion	■	■	■
	Dermal contact	■	■	■
Groundwater[a]	Ingestion	x	x	x
	Dermal contact	x	x	x
	Inhalation of volatiles	x	x	x
Subsurface soil	Ingestion	■	□	□
	Dermal contact	■	□	□
	Inhalation of volatiles	x	x	x
Surface soil	Ingestion	■	■	■
	Dermal contact	■	■	■
	Inhalation of volatiles	x	x	x
Air	Inhalation	□	□	□
	Dermal contact	□	□	□
Plants	Ingestion	□	■	■
	Dermal contact	□	□	□

LEGEND

■ = Complete and potentially important exposure pathway

□ = Complete but not likely important exposure pathway

x = Incomplete exposure pathway

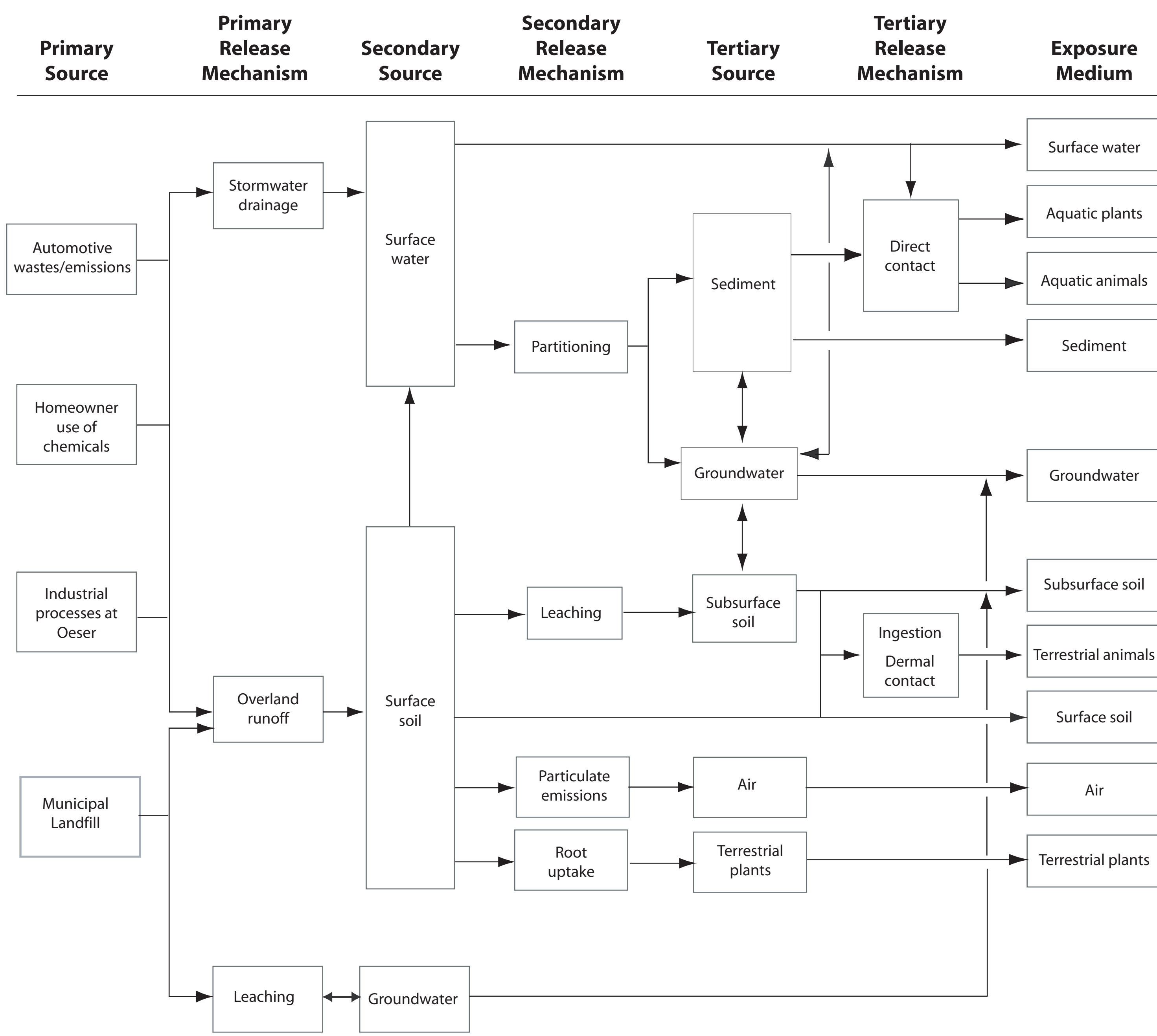
NOTES

CSM represents current and future site conditions.

[a] There are potential future exposures to groundwater through ingestion and dermal contact for local residents.

integral consulting inc.

Figure 6-1. Little Squalicum Park – Conceptual Site Model for Human Health



Ecological Receptors of Concern

Exposure Medium	Exposure Pathway	Terrestrial Receptors: Terrestrial Plants	Soil Invertebrates	Terrestrial Birds	Terrestrial Mammals[a]	Aquatic Receptors: Aquatic Plants	Aquatic Invertebrates	Fish	Semi-aquatic Birds[b]	Semi-aquatic Mammals[c]
Surface water	Ingestion	X	X	□	□	X	■	■	■	□
	Contact	X	X	□	□	■	X	X	X	X
Aquatic plants	Ingestion	X	X	X	X	X	□	□	□	□
Aquatic animals	Ingestion	X	X	X	X	X	X	■	■	□
Sediment	Ingestion	X	X	X	X	X	■	■	■	□
	Contact	X	X	X	X	□	■	□	□	□
Groundwater	Ingestion	X	X	X	X	X	X	X	X	X
	Contact	X	X	X	X	X	X	X	X	X
Subsurface soil	Ingestion	X	□	X	□	X	X	X	X	X
	Contact	■	□	X	□	X	X	X	X	X
Terrestrial animals	Ingestion	X	□	■	■	X	X	X	□	□
Surface soil	Ingestion	X	■	■	■	X	X	X	X	X
	Contact	■	■	■	□	X	X	X	X	X
Air	Inhalation	X	X	X	X	X	X	X	X	X
Terrestrial plants	Ingestion	X	X	□	■	X	X	X	□	□

LEGEND

■ = Complete and potentially important exposure pathway

□ = Complete but not likely important exposure pathway

X = Incomplete exposure pathway

NOTE

CSM represents current and future site conditions.
[a] Terrestrial mammals includes domestic pets.
[b] Includes puddle ducks.
[c] Includes raccoon.

Figure 6-2. Little Squalicum Park – Conceptual Site Model for Ecological Receptors

Notes: The following abbreviations are used in Figures 6-3 through 6-6.

Nap	= Naphthalene
2-Mnap	= 2-Methylnaphthalene
C1-Nap	= Methylnaphthalenes
Acy	= Acenaphthylene
Ace	= Acenaphthene
Flu	= Fluorene
Phen	= Phenanthrene
Anth	= Anthracene
Fla	= Fluoranthene
Pyr	= Pyrene
BaA	= Benz[a]anthracene
Chr	= Chrysene
BbF	= Benzo[b]fluoranthene
BkF	= Benzo[k]fluoranthene
BaP	= Benzo[a]pyrene
Ind	= Indeno[1,2,3-cd]pyrene
DahA	= Dibenzo[a,h]anthracene
BghiP	= Benzo[ghi]perylene

Y-axis presents the ratio of the individual PAH concentration divided by the total PAH concentration in a sample.

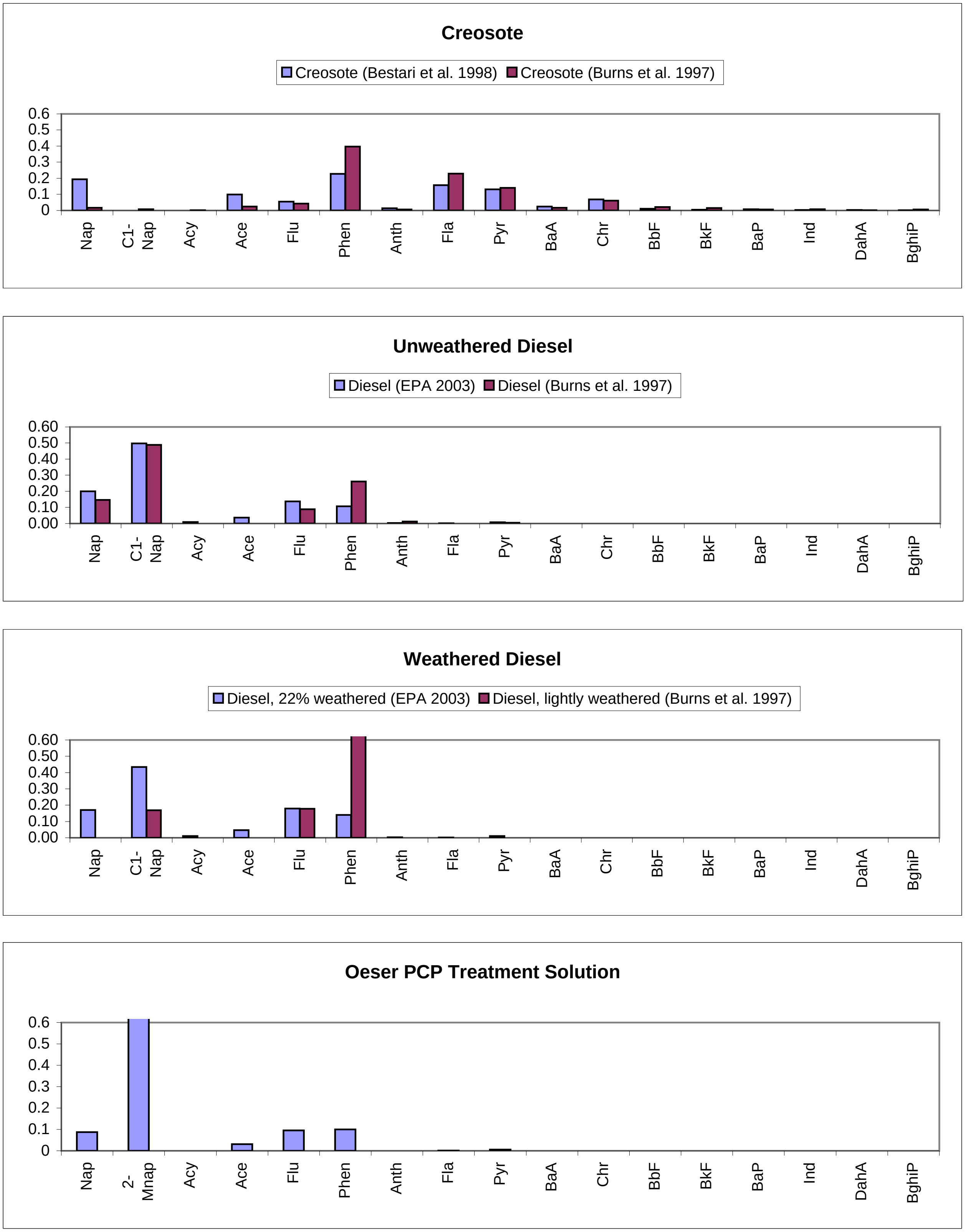
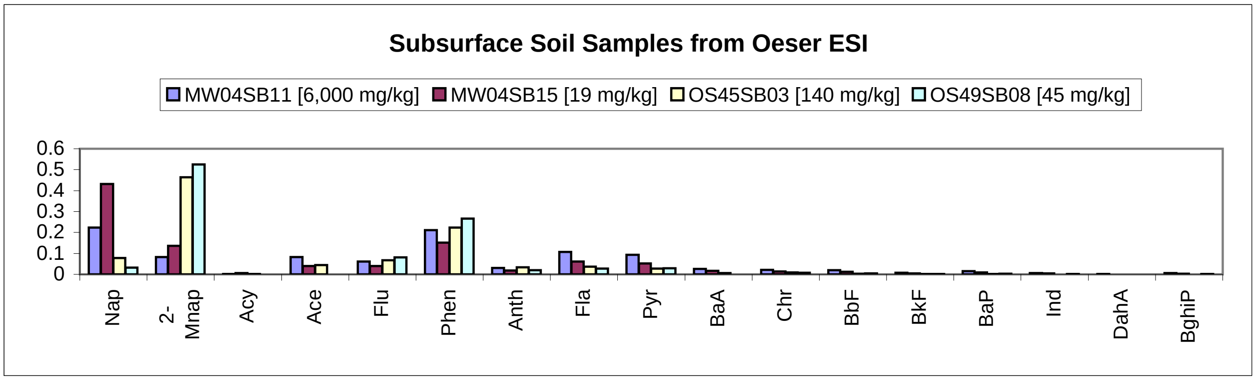
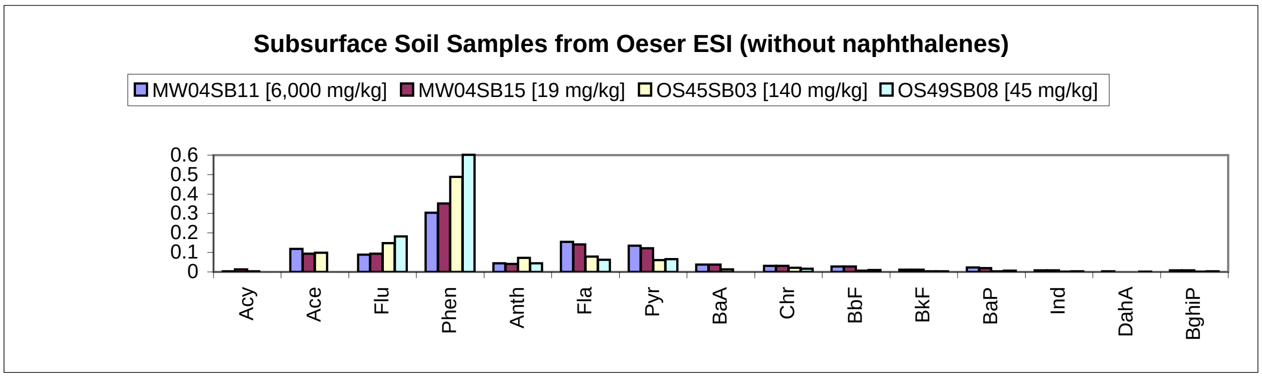
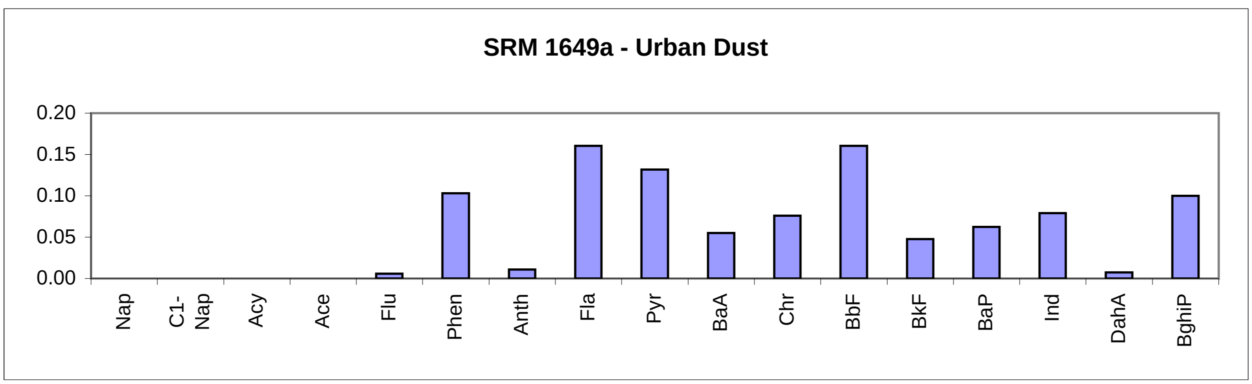


Figure 6-3. PAH Composition of Potential Source Materials







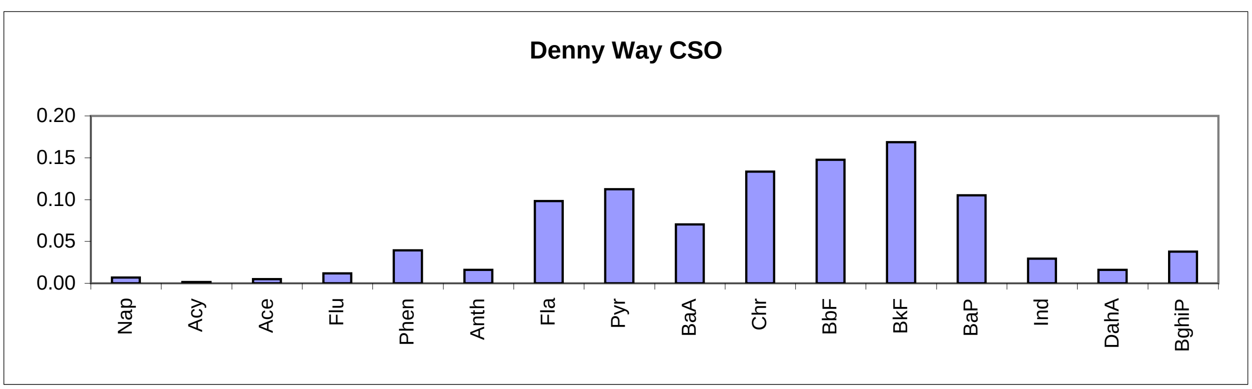
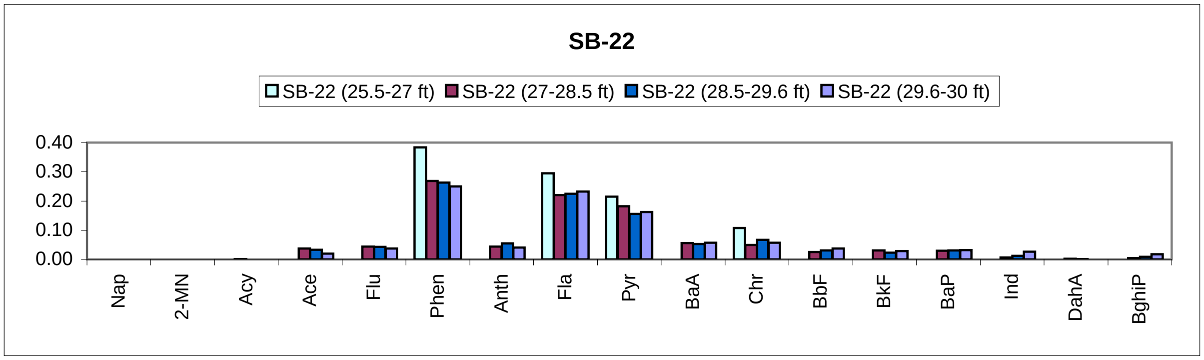
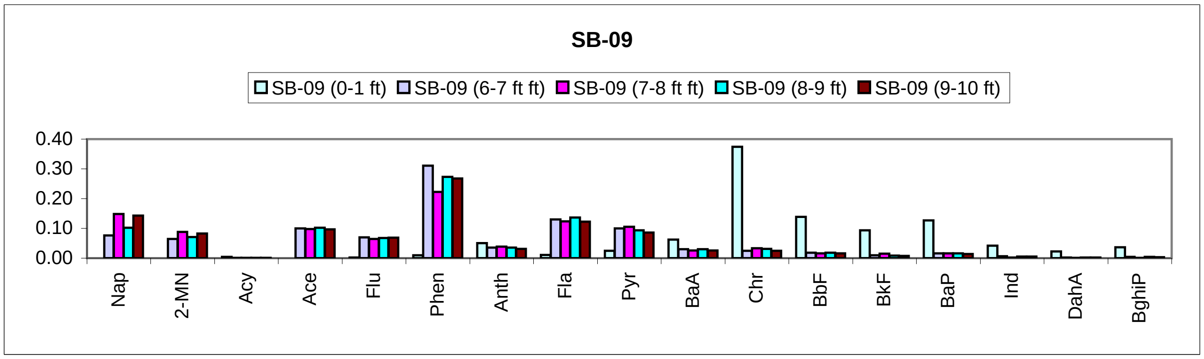
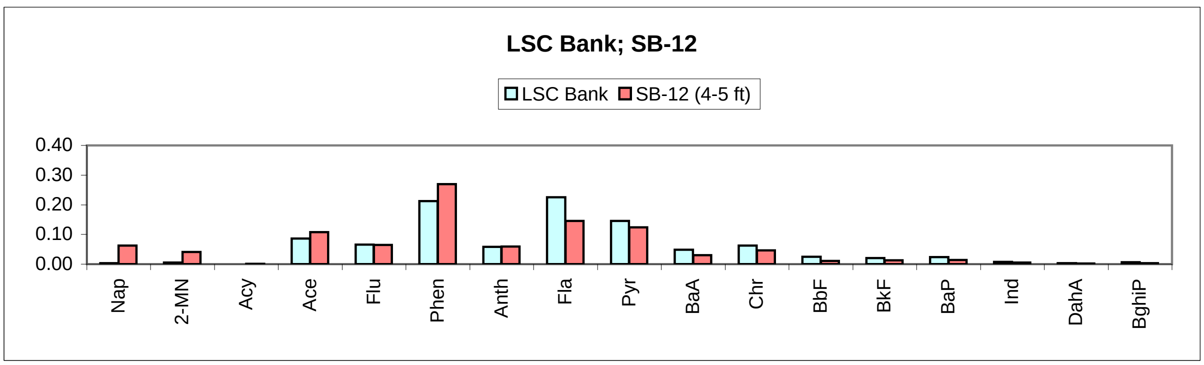


Figure 6-3. PAH Composition of Potential Source Materials (continued)







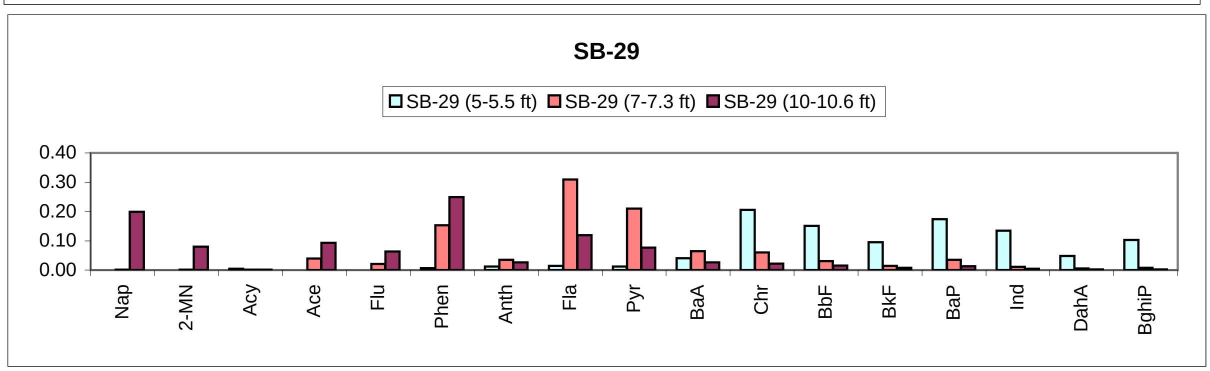
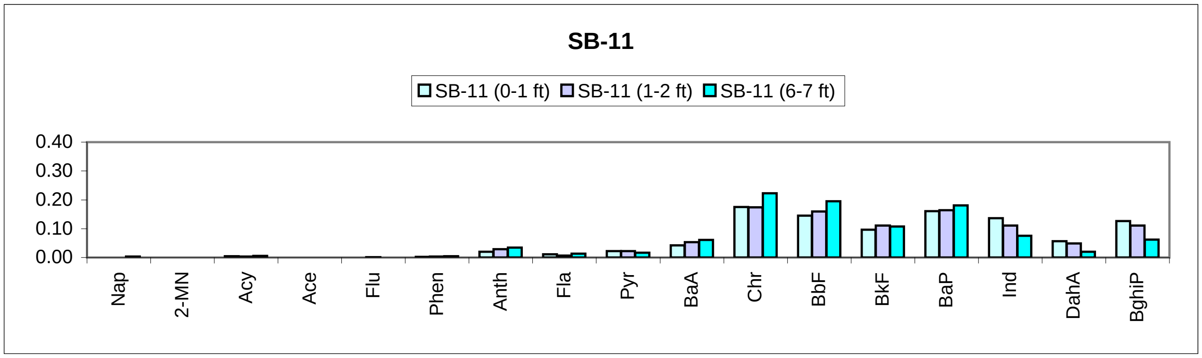
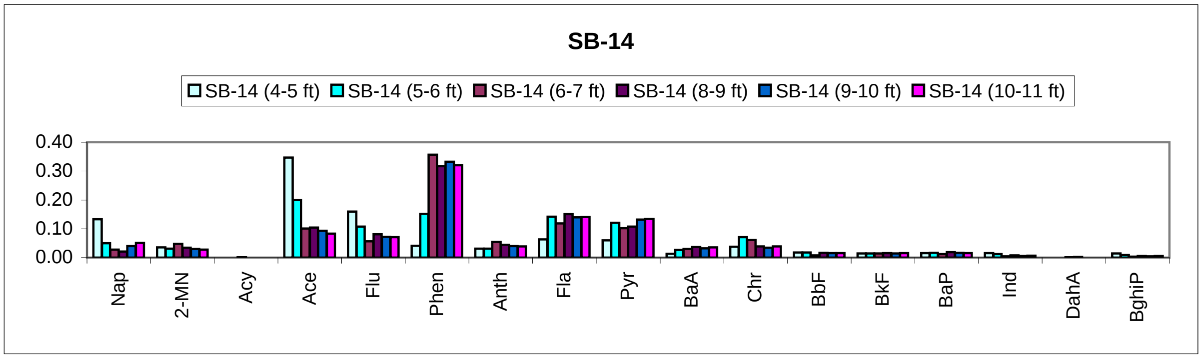


Figure 6-4. PAH Composition of Upper Creek Area Samples





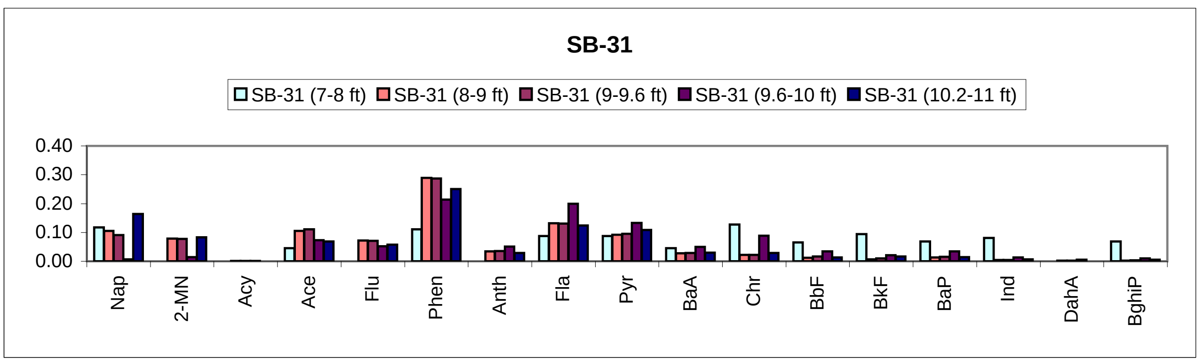
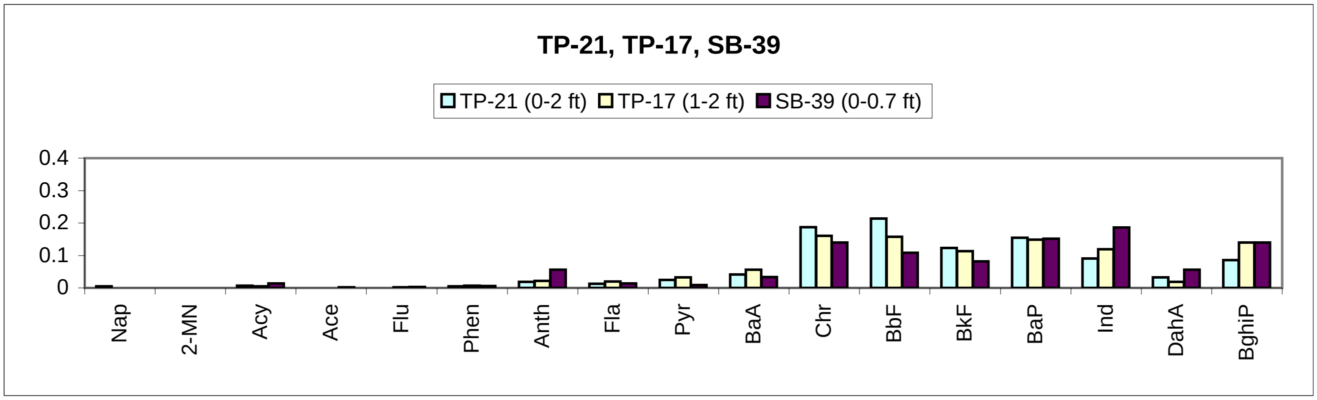
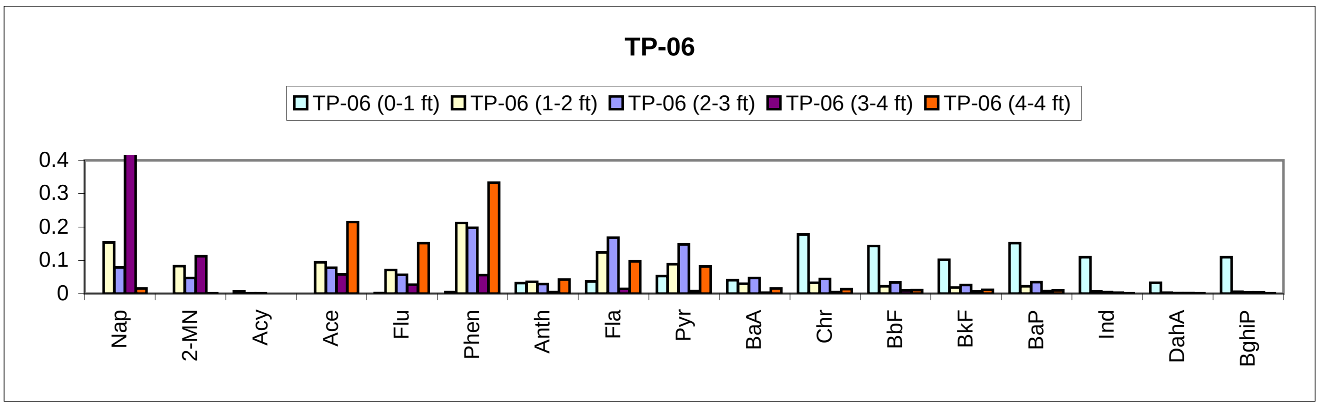
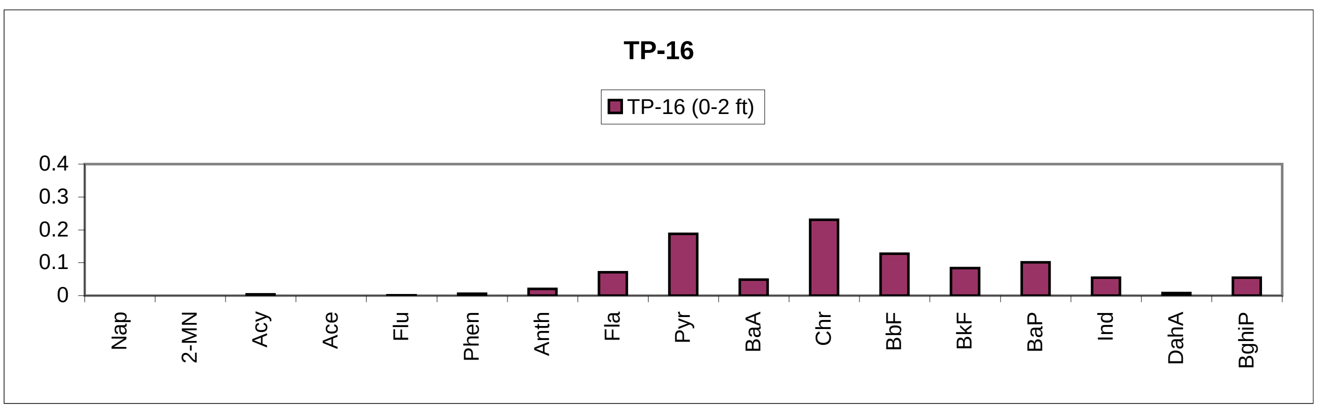


Figure 6-4. PAH Composition of Upper Creek Area Samples (continued)







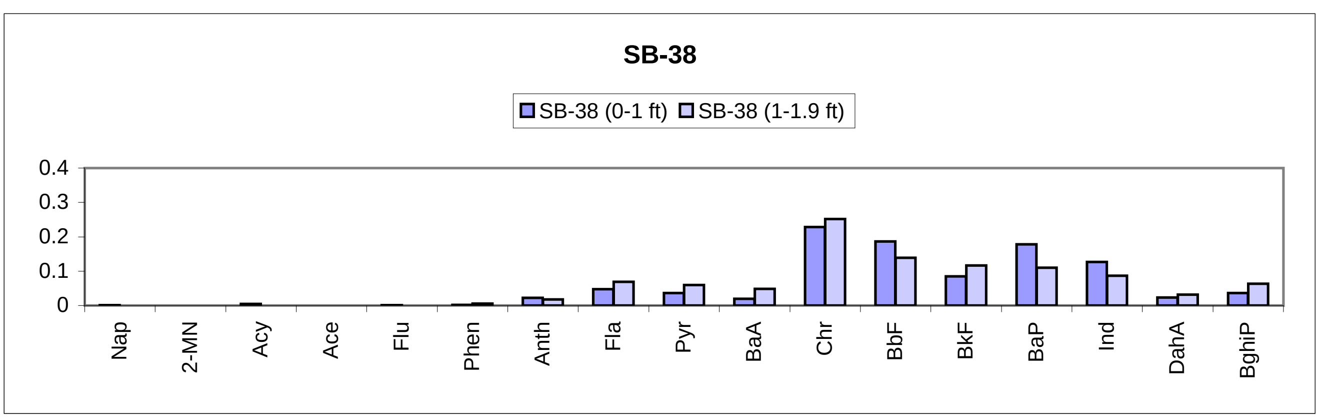
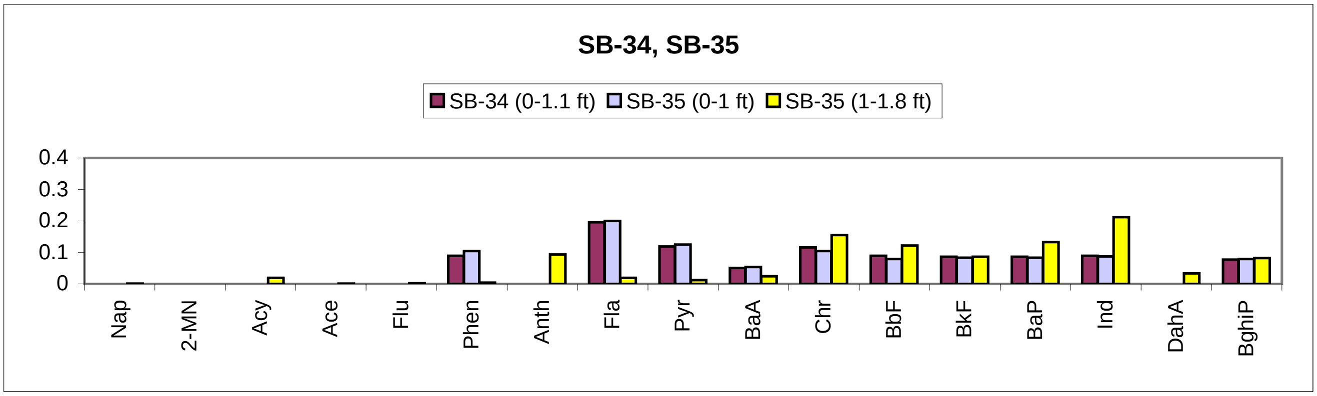


Figure 6-5. PAH Composition of Historic Creek Area Samples



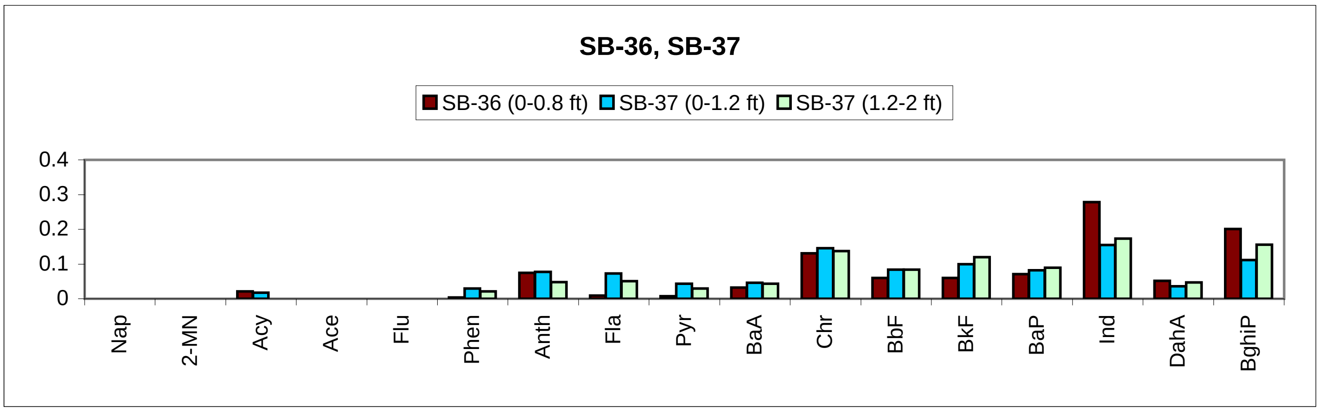
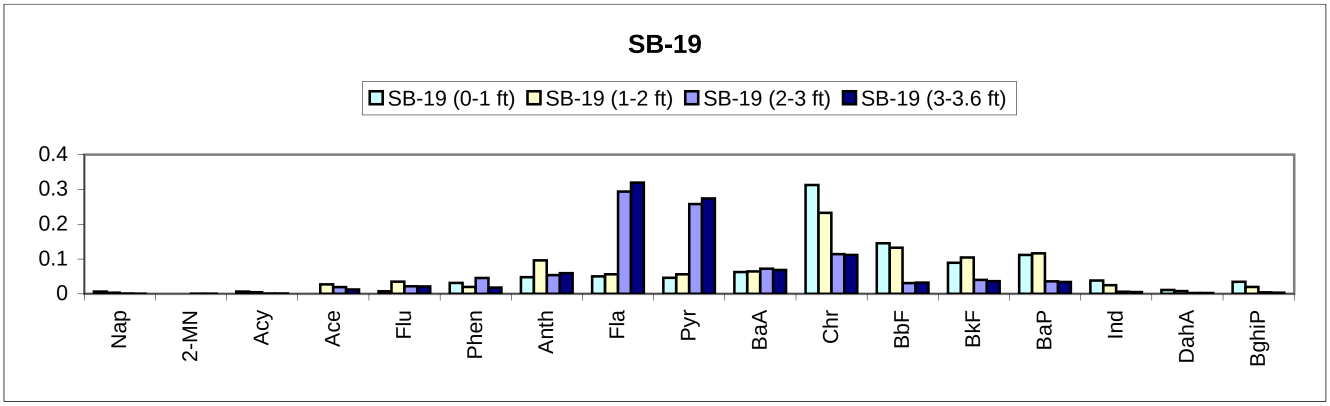


Figure 6-5. PAH Composition of Historic Creek Area Samples (continued)



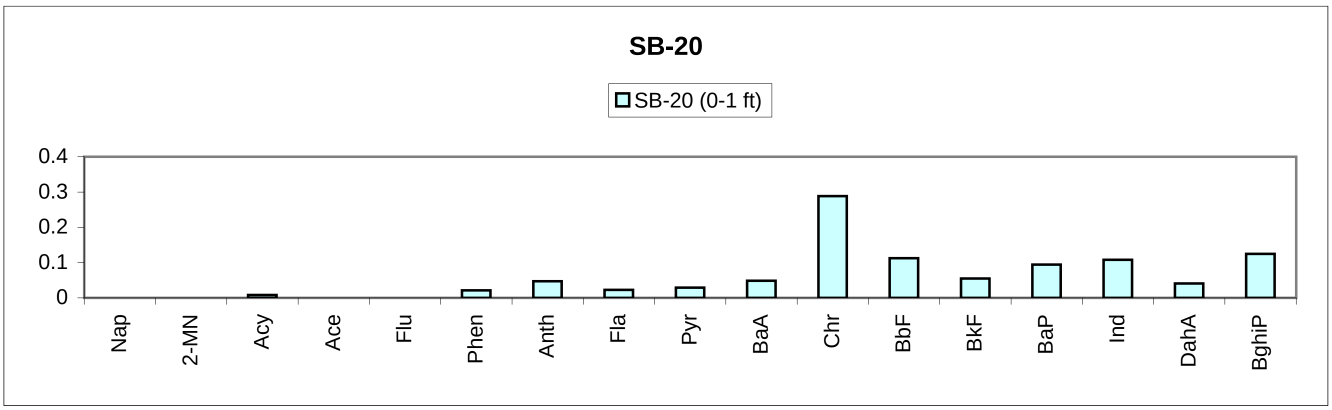


Figure 6-6. PAH Composition of Lower Creek Area Samples

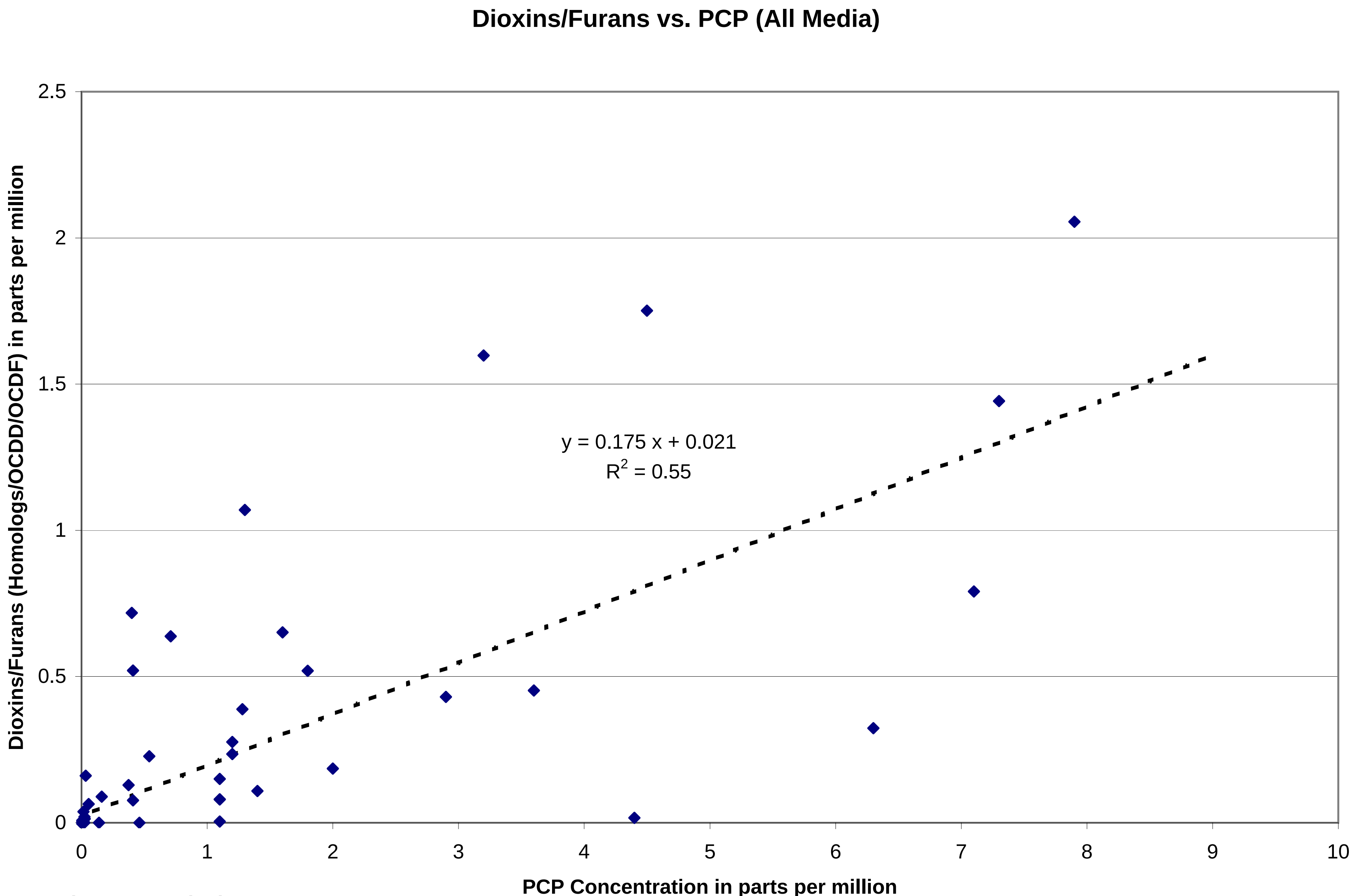
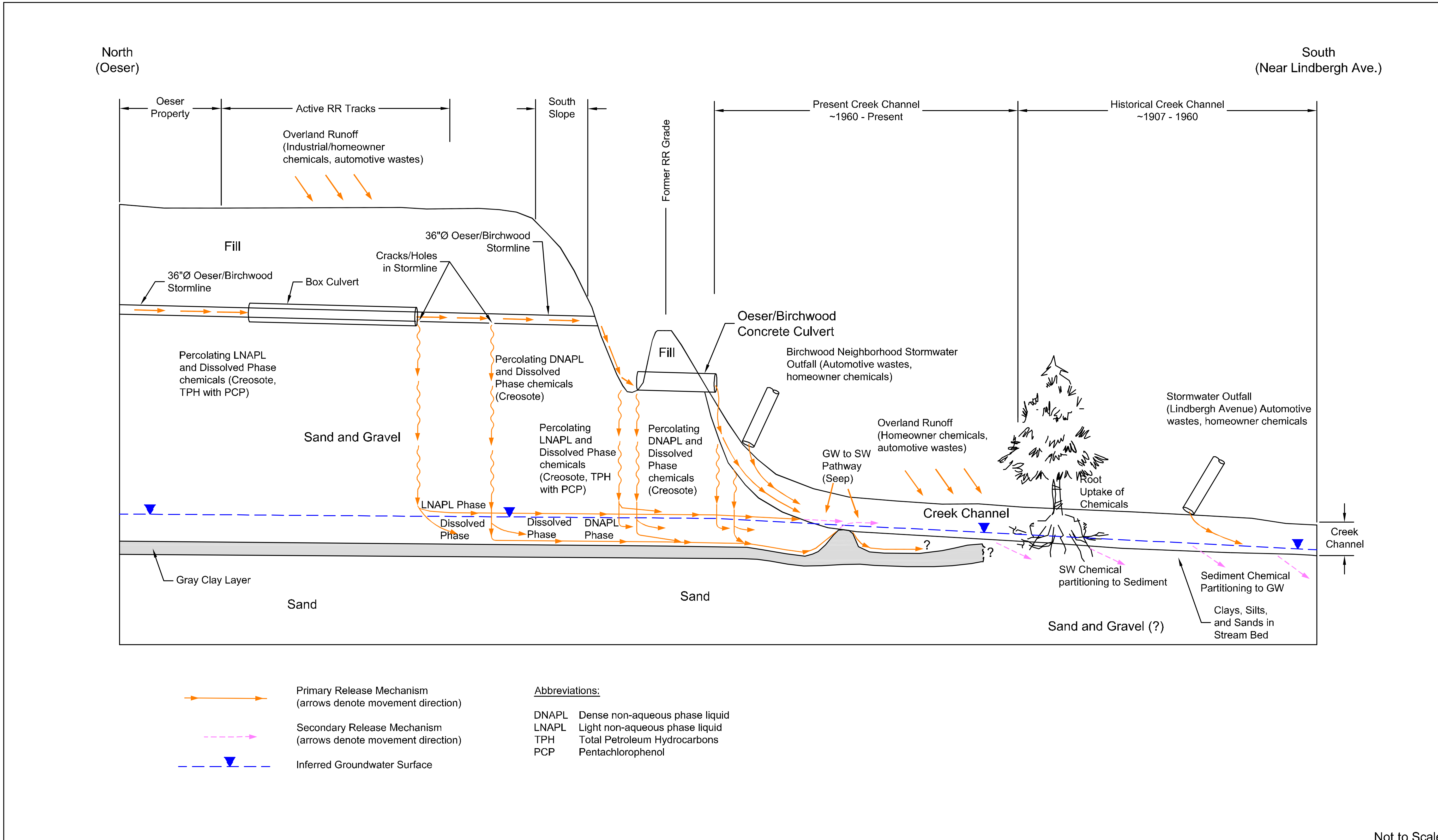
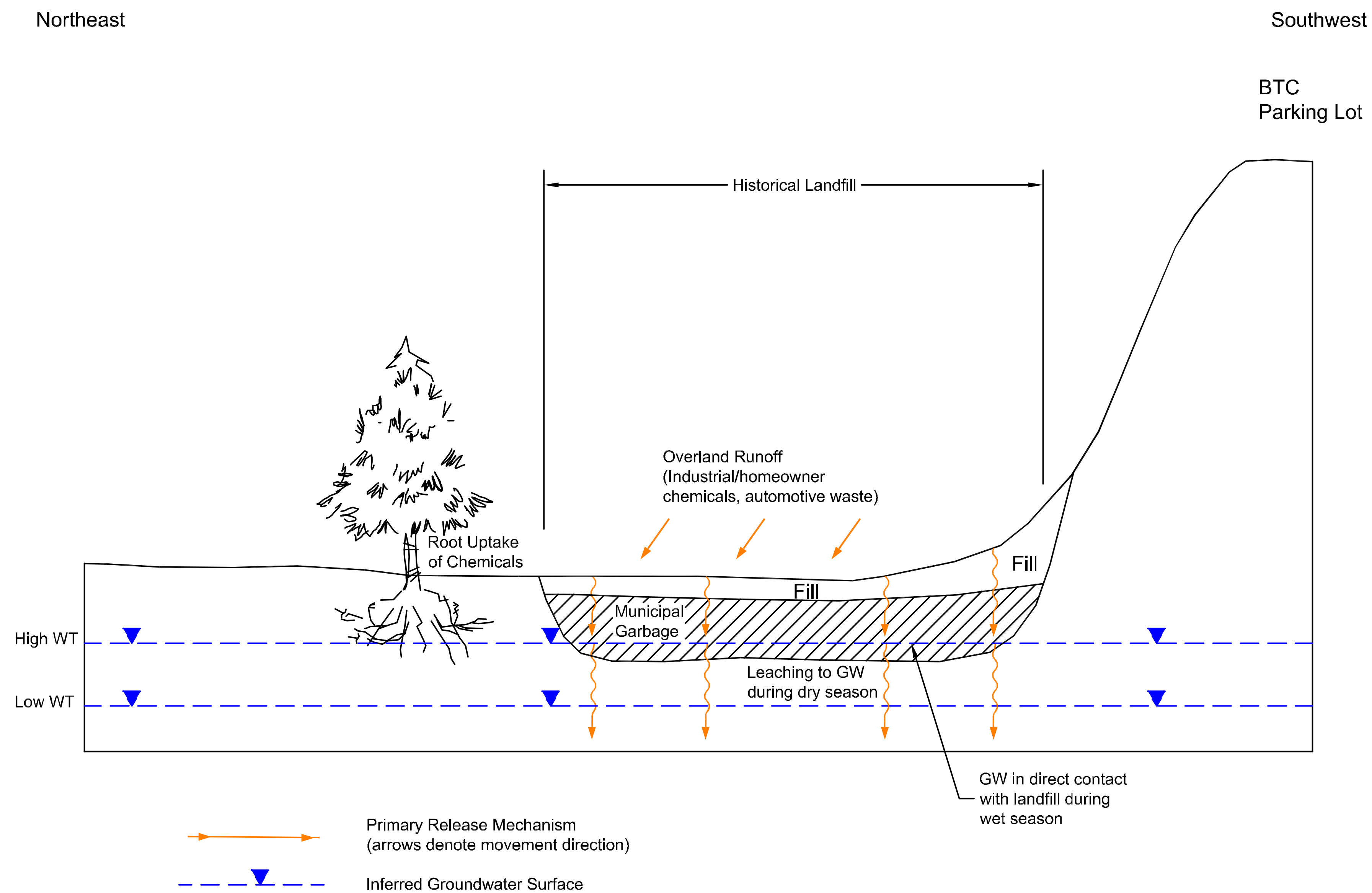


Figure 6-7. Dioxins vs. PCP



integral consulting inc.

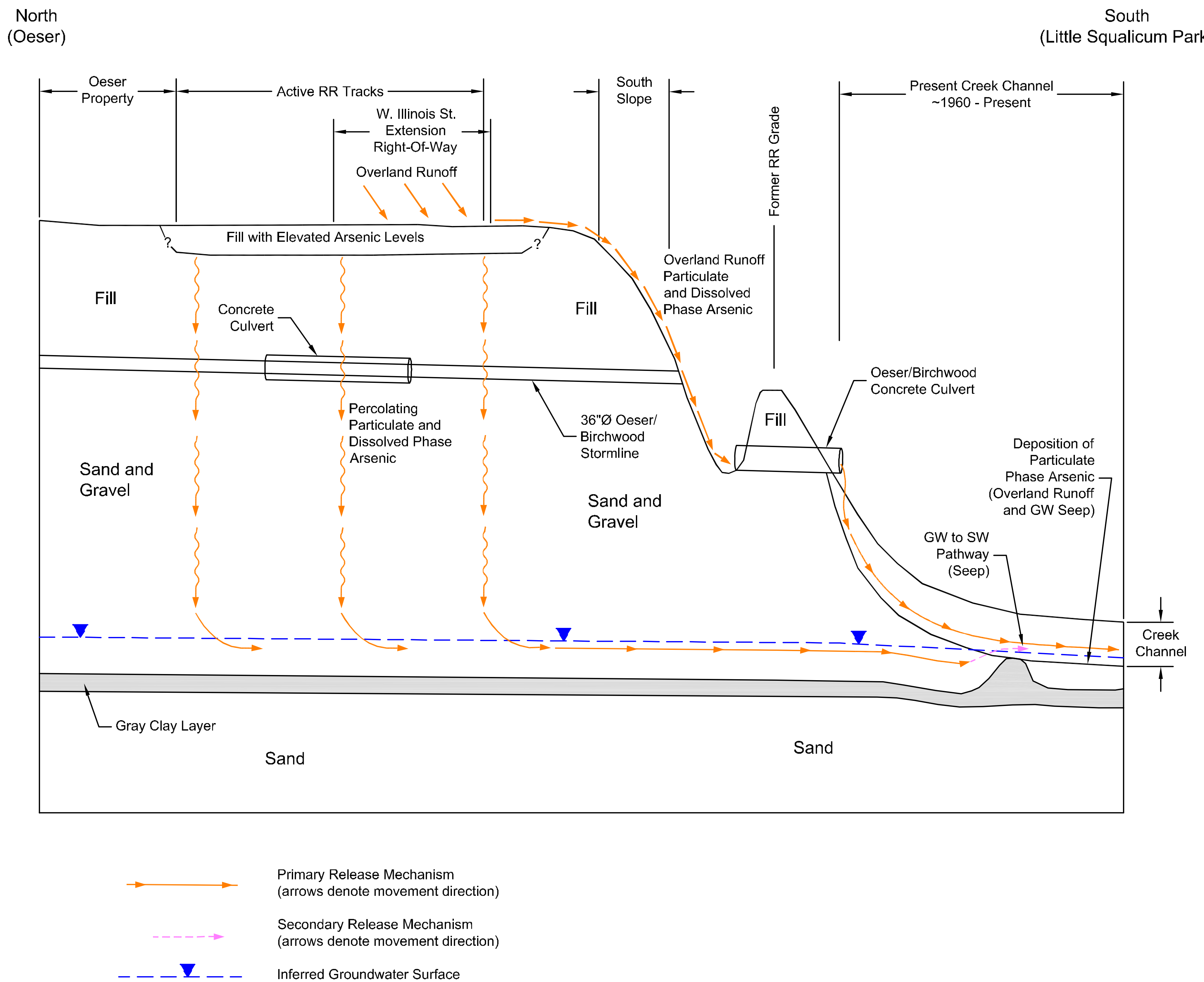
Figure 6-8
Conceptual Site Model of Contaminant Transport in the Vicinity of Little Squalicum Park



Not to Scale

integral consulting inc.

Figure 6-9
Conceptual Site Model of Contaminant
Transport in the Vicinity of the Historical Landfill



Not to Scale

Figure 6-10
Conceptual Site Model of Contaminant
Transport in West Illinois Street Extension Area