MAUL FOSTER ALONGI

MEMORANDUM

To: Mr. Hunter Young

Date: January 20, 2020

From: Phil Wiescher, PhD, and Michael Murray, RG

Project No.: 8128.02.19

RE: Sediment Sampling Work Plan, Willamette River Mile 6.55 To 6.9 West

Maul Foster & Alongi, Inc. (MFA) prepared a May 30, 2019, sediment sampling work plan on behalf of its client, Siltronic Corporation (Siltronic). The work plan includes a quality assurance project plan and health and safety plan. The work plan describes the procedures and methodologies for sediment-sampling activities conducted on the west side of the Willamette River in Portland, Oregon, approximately 6.55 to 6.9 miles upstream of the confluence with the Columbia River (Willamette river mile 6.55 to 6.9 west), referred to as the Area of Interest (AOI). The AOI, which extends from the shoreline to the navigation channel, includes the in-water area adjacent to the Siltronic property located at 7200 NW Front Avenue in Portland, Oregon, and is part of the U.S. Environmental Protection Agency (USEPA) identified sediment decision unit RM 7 west.

The work plan is included in the data package submittal, at the request of the USEPA. The work plan was previously provided as a draft version (dated July 31, 2019)[1] for the USEPA's anticipated review. The USEPA declined review in an August 5, 2019, e-mail but agreed that it would review data received post-sampling to determine if they were of acceptable quality for use at the Portland Harbor Superfund Site.

Several planned changes were made to the work plan before sampling activities began in October 2019. These changes are not reflected in the attached work plan, since the USEPA declined review. Instead, the planned changes to the work plan and the basis for the changes, as well as deviations from the work plan, are summarized below:

- Target coordinates for locations SED-01, -02, -03 were adjusted to account for other another party's planned sampling activities in the AOI vicinity. The final locations targeted for sampling are shown in the attached Revised Figure 3-3.

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[1] The attached work plan is dated May 30, 2019, and is the same document provided as draft for USEPA review.

- The final locations/coordinates at which samples were collected are provided as part of the data package and in a few cases differed from the target locations; because of low water levels, these locations required field adjustment to account for vessel access.
- The subsurface sediment core processing location was moved from on-vessel (as proposed in the work plan) to a secure, covered upland location on Siltronic property. This change was made to facilitate sediment documentation efforts, account for potential inclement weather, provide ample lighting for sample documentation, and expedite core processing such that samples were obtained within 24 hours of sediment core collection. Sediment cores were stored upright on ice until processed. The change to upland expedited processing was made partly in response to the September 12, 2019, USEPA comments on the predesign investigation (PDI) evaluation report.[2]
- The work plan states that if potential nonaqueous-phase liquid (NAPL) is observed, then a jar water sheen test (i.e., "shake test") will be performed over the suspected NAPL interval to further estimate (qualitatively) the presence of NAPL (see Appendix C of the work plan for detailed procedures). This test was conducted as planned. In addition, the site-specific NAPL field test developed by Anchor-QEA for the Gasco Sediment Site (i.e., the "spoon test") was performed in two instances by MFA geologists in conjunction with the shake test. However, the spoon test was not further systematically performed by MFA geologists because the acceptance, utility, repeatability, and reliability of this test are unproven.
- Investigation-derived waste (IDW) management was slightly modified for liquid wastes. As stated in the work plan Section 4.2.3, excess sediment and decontamination fluids used for sampling equipment were stored in 55-gallon drums and staged at a designated upland area (Siltronic hazardous waste area—Bay 4). Sediments were characterized for disposal, and disposal was managed appropriately by a licensed hazardous-waste handler. For liquid IDW, disposal characterization was not conducted as planned. To minimize costs associated with analytical characterization, liquid IDW was assumed to be hazardous and was disposed of appropriately.

ATTACHMENTS

Revised Figure 3-3 (Proposed Sample Locations)
Sediment Sampling Work Plan, Willamette River Mile 6.55 to 6.9 West

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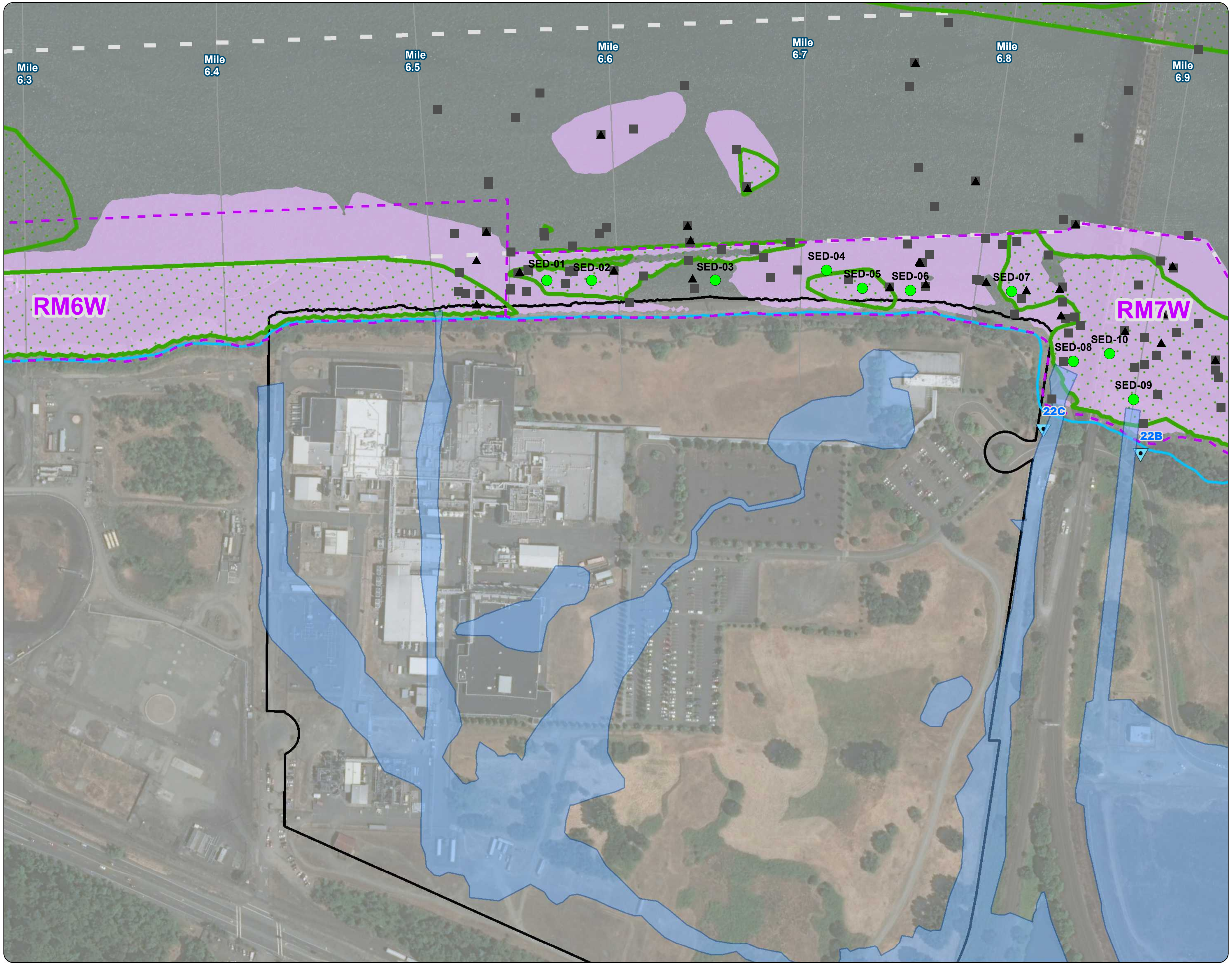
[2] USEPA. EPA review comments on PDI evaluation report and acoustic fish tracking study 12-month addendum. U.S. Environmental Protection Agency, September 12, 2019.



Revised Figure 3-3 Proposed Sampling Locations

Siltronic Corporation
Portland, Oregon

Legend

- ● Proposed Sediment Sampling Location
- ▼ Outfall Location (with Outfall ID)

Prior Sample Locations

- ▲ Subsurface
- ■ Surface
- 🟩 PDI SMA Footprint
- ☐ Ordinary High Water Mark (2004)
- ☐ Siltronic Property
- ╌ Navigation Channel
- ╌ SDU6W and SDU7W
- — River Mile Markers
- ▨ Alternative F Mod SMA Footprint
- ▨ Historical Surface Water Features

0 130 260
Feet

Notes:
PDI = Pre-Design Investigation.
SMA = sediment management area.

Source: Aerial photograph obtained from Esri ArcGIS Online; outfall locations obtained from City of Portland Bureau of Environmental Services; Decision Units SDU6W and SDU7W obtained from USEPA; Ordinary High Water Mark obtained from City of Portland Corporate GIS; parcel boundaries and railroad data obtained from Metro Regional Land Information System; navigation channel dataset obtained from Lower Willamette Group.

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Path: X:\8128.02 Siltronic Corp\05\03\Projects\Fig3.3_Proposed_Sampling_Locations.mxd
Print Date: 9/24/2019
Approved By:
Produced By: aguse
Project: 8128.02.05-03

SEDIMENT SAMPLING WORK PLAN, WILLAMETTE RIVER MILE 6.55 TO 6.9 WEST

SILTRONIC CORPORATION
PORTLAND, OREGON

Prepared for
SILTRONIC CORPORATION
PORTLAND, OREGON
May 30, 2019
Project No. 8128.02.05

Prepared by
Maul Foster & Alongi, Inc.
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MAUL
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ALONGI

SEDIMENT SAMPLING WORK PLAN, WILLAMETTE RIVER MILE 6.55 TO 6.9 WEST

SILTRONIC CORPORATION
PORTLAND, OREGON

The material and data in this work plan were prepared under the supervision and direction of the undersigned.

MAUL FOSTER & ALONGI, INC.

Phil Wiescher, PhD
Senior Environmental Scientist

Michael R. Murray, RG
Senior Hydrogeologist

Courtney Savoie

Courtney Savoie, RG
Project Geologist

CONTENTS

TABLES AND ILLUSTRATIONS

FOLLOWING PLAN:

TABLE

FIGURES

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
AOI	Area of Interest
ASTM	American Society for Testing and Materials
bml	below mudline
cm	centimeter
COC	contaminant of concern
DGPS	differential global positioning system
FSP	field sampling plan
MFA	Maul Foster & Alongi, Inc.
NAPL	nonaqueous-phase liquid
PAH	polycyclic aromatic hydrocarbon
PID	photoionization detector
Pre-RD Group	Pre-Remedial Design Group
PSEP	Puget Sound Estuary Program
QA/QC	quality assurance and quality control
QAPP	quality assurance project plan
RD	remedial design
RM	river mile
ROD	Record of Decision
Siltronic	Siltronic Corporation
SMA	sediment management area
TOC	total organic carbon
USEPA	U.S. Environmental Protection Agency

1 INTRODUCTION

Maul Foster & Alongi, Inc. (MFA) prepared this sediment sampling work plan on behalf of its client, Siltronic Corporation (Siltronic). This work plan describes sediment sampling activities for the west side of the Willamette River in Portland, Oregon, approximately 6.55 to 6.9 miles upstream of the confluence with the Columbia River (Willamette river mile [RM] 6.55 to 6.9 west), referred to as the Area of Interest (AOI). The AOI, which extends from the shoreline to the navigation channel, includes the in-water area adjacent to the Siltronic property located at 7200 NW Front Avenue in Portland, Oregon and is part of the U.S. Environmental Protection Agency (USEPA) identified sediment decision unit RM 7 west (see Figure 1-1).

1.1 Purpose

USEPA's Record of Decision (ROD) describes a post-ROD sampling effort for the Portland Harbor Superfund Site, to delineate and better refine the sediment management area (SMA) footprints, refine the conceptual site model, update current study area conditions, and support remedial design (RD) (USEPA, 2017). This work plan was prepared in order to address portions of the above-described sampling effort and is consistent with methodologies identified in the USEPA-approved Pre-Remedial Design Group (Pre-RD Group) work plan and field sampling plans (FSPs) to ensure data compatibility with the Pre-RD Group post-ROD sampling effort (AECOM and Geosyntec, 2018a,b). This work plan complies with the aforementioned USEPA-approved approaches for sediment sample collection to support a more comprehensive characterization of current surface and subsurface sediment conditions, sufficient to enable actual initiation of RD activities.

1.2 Objectives

The following objectives are identified for this work plan:

- Update and evaluate current sediment conditions in the AOI;
- Provide data that will be used to inform the scope and extent of SMAs in the vicinity, i.e., refining the horizontal and vertical extent of sediments exceeding cleanup level and remedial action levels. These data may be used to inform the need for or type of technology assignments consistent with the decision tree provided in the ROD; and,
- To support the third-party allocation by generating sediment data to evaluate potential contaminant transport pathways to the AOI.

1.3 Work Plan Organization

Investigation activities will include collection and analysis of surface and subsurface sediment samples to characterize chemicals present in the Willamette River in the AOI.

Standard field operating procedures for collecting sediment samples, sample description, and decontaminating non-dedicated equipment are described in the quality assurance project plan (QAPP) (Appendix A of this work plan). The QAPP also defines the laboratory and analytical quality procedures and the quality assurance and quality control (QA/QC) requirements for sampling and analysis. A health and safety plan specific to the activities described in this work plan is provided as Appendix B.

2 PROJECT MANAGEMENT PLAN

The following describes the duties and responsibilities of personnel and firms involved in the work; project organization; reporting relationships; lines of communication; and management authorities.

2.1 Project Organization

Project management for implementation of this work plan, including planning, coordination sampling, documentation, and reporting tasks, will be undertaken by MFA. All project work will be supervised by an Oregon-registered geologist employed at MFA. MFA will use subcontractors for a number of activities, including sediment sampling and laboratory services. Stakeholders and contractors involved with this project are listed below.

Project Management and Property Owner
Siltronic Corporation
7200 NW Front Avenue
Portland, Oregon 97202-8941
(503) 219-7832
Contact: Myron Burr, Director, EHS

Technical Consultant Project Management
MFA
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Portland, Oregon 97209
(971) 713-3579
Contact: Michael Murray, RG

Data Validation
AlterEcho
14500 Avion Parkway, Suite 300
Chantilly, Virginia 20151
(312) 345-8966
Contact: Rob Young

Subcontracted Services
Research Support Services, Inc.
321 NE High School Road, Suite D3/563
Bainbridge Island, Washington 98110
(206) 550-5202
Contact: Eric Parker

Apex Laboratories, LLC
12232 SW Garden Place
Tigard, Oregon 97223
(503) 718-2323
Contact: Philip Nerenberg

Specialty Analytical
9011 SE Jannsen Road
Clackamas, Oregon 97015
(503) 607-1331
Contact: Marty French

3 SCOPE OF WORK

3.1 Permit Applications

The following permits for conducting sediment sampling in the AOI will be completed and acquired before fieldwork is initiated:

- U.S. Army Corps of Engineers NW Permit 6;
- Oregon Department of State Lands Removal-Fill General Authorization; and,
- Oregon Department of Environmental Quality 401 Water Quality Certification

3.2 Sampling Design and Approach

3.2.1 Positioning Methodology

Prior surface and subsurface sediment sampling efforts in the AOI were conducted by the Pre-RD Group in 2018; NW Natural in 2010, 2011, and 2018; and the Lower Willamette Group in 1997, 2004, 2005, 2007 and 2008. Sampling locations for these earlier investigations are shown in Figures 3-1 and 3-2, respectively. The sampling efforts intend to build on the prior work and generate data of sufficient density to facilitate RD in the AOI.

Station positioning and vertical control procedures described herein are consistent with Section 4.2 of both the surface and subsurface FSPs (AECOM and Geosyntec, 2018a,b).

A differential global positioning system (DGPS) on the contractor support vessel will be used to locate the horizontal sampling position for each proposed sample station shown on Figure 3-3, using the coordinates listed in the attached table. Coordinates will be programmed into the navigation system on the contractor vessel. Sampling stations will be located to an accuracy of ± 2 meters. DGPS will be used to record the final location of each sample station.

Vertical positioning will be achieved by referencing the nearest staff gauge to the AOI, which is U.S. Geological Survey Gauge 14211720, for the Willamette River at Portland. The gauge is not visible from the AOI, so real-time river levels from this gauge will be downloaded from the Northwest River Forecast Center, where the gauge is identified with the number PRTO3. Gauge height will be converted from the Columbia River Datum to the North American Vertical Datum of 1988. Depth to the mudline will be measured to the nearest one tenth of a foot with a fathometer and lead line prior to surface or subsurface sediment sample collection.

3.2.2 Surface Sediment Sampling

Surface sediment sampling will be conducted consistent with Section 4.3 of the Pre-RD Group surface sediment FSP (AECOM and Geosyntec, 2018a). Sampling consists of targeted (not random) surface sediment samples to more fully characterize and refine historical and recent releases to the Willamette River. The targeted surface sediment samples may also inform refinement of the SMA footprints. Proposed surface sediment sample locations are shown in Figure 3-3.

A total of ten surface sediment samples will be collected in the AOI. All surface sediment samples will consist of a three-point composite collected with a power grab sampler or similar (e.g., van Veen grab sampler). At each proposed station, three grab samples will be collected within a relatively small footprint (i.e., less than 25 feet) where possible and composited into one sample for analysis. Surface sediment will be collected from a target depth of 0 to 30 centimeters (cm) below mudline (bml). Approximately 56 ounces (equal volume) of sediment will be collected from each of the three surface grabs. The sediment will be sampled using a stainless-steel spoon, then transferred to a stainless-steel bowl for compositing. Approximately 56 ounces (equal volume) of sediment will be collected from the composited sediment for analysis. The spoon and container will be rinsed free of solids between subsample composite stations, but not decontaminated. Decontamination of the sampling device and field equipment will take place between sample stations (see Appendix A for decontamination procedures). The volume of sediment from the three-point surface grabs will be homogenized until uniform in color and texture. Sediments will be collected from the center of the sampler, avoiding sediments in contact with the sides of the sampler. Large organisms and pieces of debris will be removed and noted in the field notes.

The following acceptance criteria will be used to guide surface sediment collection:

- No or minimal excess water leaking from the jaws of the sampler;
- No excessive turbidity in the overlying water of the sampler;
- Sampler did not over-penetrate;
- Sediment surface appears to be intact, with minimal disturbance; and,

- Program-specific penetration depth has been achieved (target of 20 cm to 30 cm, but less can be accepted after several attempts).

If varying substrate conditions prevent achievement of target penetration depths, the sample location will be identified as one of four substrate types and the following contingency plans will be implemented, as described in Sections 4.3.2 and 4.4 of the surface sampling FSP (AECOM and Geosyntec, 2018a):

- Substrate Bin #1—Soft Sediment: overpenetration may be expected and sampling weights adjusted.
  - A minimum 20-cm recovery depth is expected in each acceptable grab in this type of substrate. Sampler weights will be adjusted to minimize overpenetration. It is expected that a three-point composite can be obtained within the 25-foot radius of the proposed surface sediment location.
- Substrate Bin #2—Soft Sediment with Debris: silt, sandy silt, and silty sand with good recovery are expected; however, the presence of debris makes it difficult to consistently achieve a target recovery depth of >20 cm (especially when debris is caught in the grab sampler jaws and some material is lost during retrieval because the jaws did not make a tight seal). Debris is classified specifically as wood, trash, scrap metal, concrete, or subsurface obstructions such as steep slopes that prevent collection of soft sediment under Bin #1 conditions. The goal for minimum average composite recovery depth is 10 cm for each sample. Contingency plan and acceptance criteria for recovery depths include the following steps:
  - At the target surface sediment location, conduct up to six bucket attempts within a 50-foot radius to collect acceptable grabs (target three attempts within 25-foot radius and three attempts in 50-foot radius). All attempts will be logged and documented in the field notes. Retain the three best/deepest penetrating samples and calculate the average sample recovery depth.
- Substrate Bin #3—Natural Hard Sediment Bottom: this type of dense sand and gravel, stiff silt, or uncemented cobble substrate is expected to produce consistently low penetration depths (less than the target recovery depth of 20 cm) in each grab. Acceptance criteria and contingency planning at areas encountering low sample recoveries in Substrate #3 include the following steps:
  - At the surface sediment location, conduct up to six bucket attempts within a 50-foot radius, using all weights, and retain the three best/deepest bucket attempts. All attempts will be logged and documented in the field notes. Calculate the average sample depth of the three best samples.
- Substrate Bin #4—No Recoverable Sediment: this type of substrate is expected to be impenetrable bedrock, riprap, or very dense/cemented cobbles. Acceptance criteria and contingency planning for areas encountering Substrate #4 include the following steps:

  - At the surface sediment location, three attempts will be made to collect an acceptable sample within a 50-foot radius. If no acceptable sample is obtained after three attempts (e.g., no recoverable amount of sediment), the sample location will be modified in the field. All attempts will be logged and documented in the field notes.

Sample location coordinates and sample identification numbers are provided in the attached table. Samples will be processed on the sampling vessel and will be transported in coolers on ice (at 0 to 6 degrees Celsius [°C]) to the analytical laboratory. Surface sediment samples will be analyzed for the full ROD Table 17 suite of sediment contaminants of concern (COCs) and conventionals (i.e., grain size and total organic carbon [TOC]). Analysis will also be conducted for cyanide, polycyclic aromatic hydrocarbon [PAH] homologs, and chlorinated herbicides, as specified in the attached table.

Surface sediment procedures and analytical methods are described further in Appendix A.

3.2.3 Subsurface Sediment Sampling

Surface sediment sampling will be conducted consistent with Section 4.3 of the Pre-RD Group subsurface sediment FSP (AECOM and Geosyntec, 2018b). Ten sediment cores for collection of subsurface sediment will be completed in the AOI (see Figure 3-3). The cores will be colocated at surface sediment grab locations.

Subsurface sediment cores, collected with a vibracore sediment sampling device, will have a target collection depth of 15 feet bml or the depth of refusal. The attached table presents the location, core depths, location identification numbers, and collection depths. The visual appearance of the subsurface core samples will be logged and processed at 2-foot continuous intervals (based on the recovered depth) along the entire length of the accepted core. Subsurface samples will be collected at 2-foot intervals, unless lithology indicates otherwise, with a minimum interval thickness of 1 foot and a maximum thickness of 3 feet. The first sample will be collected beginning from the top of the core (e.g., 0-to-2-foot interval). Up to two additional samples will be collected, one at the middle and one at the bottom intervals of the core. Additional sampling intervals will be archived. Approximately 56 ounces (equal volume) of sediment will be collected from each sampling interval. The sediment interval will be sampled using a stainless-steel spoon, placed in a stainless-steel bowl for homogenizing, then placed in 8 or 16-ounce jars or similar containers.

Subsurface core collection will be performed consistent with Section 4.3 of the subsurface sediment FSP (AECOM and Geosyntec, 2018b):

- Core tube caps will be removed immediately before placement into the coring device in order to minimize potential core contamination;
- The position will be recorded when the vibracore first rests on the sediment surface;
- The vibracore will be advanced without power (under its own weight), then vibration will be applied until the core tube is advanced to the target depth or to refusal;

- After a brief pause, the core tube will be extracted from the sediment, using only the minimum vibratory power needed for extraction;
- As soon as the core tube daylights to the surface water/air interface, a bottom cap will be placed over the tube to prevent material loss from the core catcher; and,
- Inspect the exterior sidewalls of the core tube for signs of potential nonaqueous-phase liquid (NAPL) and scrapes/scoring of the walls from contact with dense gravel. If NAPL is suspected, then take appropriate field precautions as described in Appendix B-1 of the subsurface FSP, included as an attachment in Appendix C (AECOM and Geosyntec, 2018b). When coring in areas with potential NAPL, sorbent booms and pads may be proactively deployed around the coring area and the coring equipment/vessels to minimize dispersion of NAPL sheens that may appear on the water surface.
- While on the vessel, personnel will record the following core collection data in field notes and on a boring log form, included as Appendix D:
  - Date/Time. Local date and time when the vibracoring began at each station;
  - Depth to Mudline. Water depth at the sampling station at the time of core collection;
  - Total Drive Length. Core tube length and the depth of the core tube penetration into the subsurface;
  - Recovered Length. Thickness of the sediment column retained in the core tube before sectioning and removal of the core catcher;
  - Sediment Observation. Average grain size, color, notable odors, debris, etc. Visual description will follow the American Society for Testing and Materials (ASTM) visual-soil classification procedure (i.e. ASTM D2488);
  - The core will be accepted, rejected, or stored on the vessel pending another drive attempt. If a core sample does not meet the core acceptance criteria (listed below), then field protocols will be followed as described in Section 4.3.2 of the subsurface sediment FSP (AECOM and Geosyntec, 2018b) and as outlined below;
  - After core acceptance, water will be carefully decanted from the top of the core tube to minimize sediment disturbance. Cores will be cut into segments approximately 4 to 6 feet long for handling and storage. Core tubes will be capped with aluminum foil and plastic caps, and will be inscribed on the sidewalls with core and segment identification and "up" arrow; and,
  - Sediment cores will be processed on the sampling vessel.

The following acceptance criteria will be used to guide subsurface sediment collection:

- Overlying water is present and the sediment surface is intact;
- The core has 80 percent target recovery versus penetration (or document why recovery is less after three attempts);

- The core tube is in good condition (not excessively bent);
- The core appears representative of surrounding area; and,
- Target penetration depth has been achieved or bedrock is encountered. If the target depth is not reached because of cobbles, debris, refusal, or other difficult coring conditions, an additional core will be attempted as described in the contingency plan. Contingency plan procedures are discussed below.

If samples cannot be collected at a proposed sampling location because of substrate or other field conditions, no more than three attempts will be made to relocate the core within a 50-foot radius of the planned location if accessible (AECOM and Geosyntec, 2018b). If not accessible (i.e., under a structure/vessel, shallow water depth), then the target radius will be increased for sample collection (e.g., 125 feet). If the first core attempt meets the acceptance criteria, then no additional cores will be collected at that station. If not, then up to two additional cores will be attempted and retained (stored on vessel deck). The best (percent recovery) of three attempts will be retained and processed.

The subsurface sediment core will be processed on the vessel, consistent with Section 4.4 procedures of the subsurface sediment FSP noted below (AECOM and Geosyntec, 2018b):

- The core tube will be split open longitudinally to preserve the material stratigraphy inside, using a table saw, handheld circular saw, radial saw, shearing tool, X-ACTO® knife (if liner used), or similar device; and
- A photoionization detector (PID) with 10.6-electron volt lamp will be used for prescreening of each core. As soon as the core is split open, the PID monitor will be held in the ambient air space just above the open core and slowly moved down the core from top to bottom. PID readings will be recorded in the field notebook.
- If there is a "PID hit" or if sheens/petroleum-like odors are observed, then a headspace screening will be conducted. Head space screening will involve the following:
  - A small representative sample will be collected from each sample interval to be screened, using a decontaminated sampling spoon. The material will be placed in a resealable plastic bag or glass jar with a septum lid;
  - The bag or jar will be tightly sealed (the jar with aluminum foil and plastic lid with septum opening), and the material will be allowed to warm at least to the ambient temperature (>32 degrees Fahrenheit). The sample will be allowed to sit for at least ten to no more than 60 minutes to allow headspace concentrations to develop and will be shaken periodically for at least 30 seconds;
  - The PID probe tip will be inserted into the container within the headspace, with care taken to avoid taking sediment or moisture into the probe; and
  - The highest reading (excluding possible erratic readings) on the meter will be recorded for the sample.

- Cores will be photographed prior to sampling. The sample ID, date, and orientation of the core will be included in each photograph;
- The visual appearance of the sediment cores will be described following ASTM D-2488 Standard Practice for Identification of Soils (Visual-Manual Procedure, ASTM D-2488);
- If potential NAPL is observed, then a jar sheen test will be performed over the suspected NAPL interval to further estimate (qualitatively) the presence of NAPL (see Appendix C for detailed procedures);
- Subsurface sample intervals will be 2 feet unless field conditions indicate otherwise (e.g., a change in lithology, odor, sheen);
- After the cores have been described and the sample intervals have been determined, sediment will be collected within the determined sample interval, homogenized until uniform in color and texture, and placed into appropriate sample containers for laboratory analysis; and,
- Core lithology, PID readings, sample identifications, and sample depth intervals will be recorded in field notes.

Sample location coordinates and sample identification numbers are provided in the attached table. Samples will be processed on the sampling vessel and will be transported in coolers on ice (at 0 to 6ºC) to the analytical laboratory. Subsurface sediment samples will be analyzed for the full ROD Table 17 suite of sediment COCs and conventionals (i.e., grain size and TOC) (see the attached table). Analysis will also be conducted for cyanide, PAH homologs, and chlorinated herbicides, as specified in the attached table.

Subsurface sediment sampling procedures and analytical methods are described further in Appendix A.

3.3 Laboratory Analysis and Quality Assurance and Quality Control

Laboratory analyses will be completed consistent with the protocols described in the QAPP (Appendix A). The QAPP was designed to guide aspects of field sample handling and analytical laboratory procedures, including QA/QC requirements.

Sediment samples collected by MFA will be submitted under standard chain-of-custody procedures and will be analyzed for the following (see the attached table):

- Organochlorine pesticides (including 2,4’- and 4.4’-DDx (dichlorodiphenyltrichloroethane and its derivatives), total chlordane, and total toxaphene) by USEPA Method 1699;
- Semivolatile organic compounds (including 1,2-dichlorobenzene, bis2-ethylhexyl phthalate, and polycyclic aromatic hydrocarbons) by USEPA Method 8270D;

- Metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc) by USEPA Method 6020B;
- Total cyanide by USEPA Method 335.4;
- Polychlorinated biphenyl congeners by USEPA Method 1668C;
- Chlorinated herbicides by USEPA Method 8151A;
- Dioxins/furans by USEPA Method 1613B;
- Diesel- and lube-oil-range hydrocarbons by USEPA Method NWTPH-Dx;
- Tributyltin by Krone et al.;
- TOC by USEPA Method 9060A;
- Grain Size by Puget Sound Estuary Program (PSEP)/ASTM D422; and,
- Total solids by PSEP 1986.

Additional sediment sample volume will be submitted to the laboratory and archived at -18°C. Potential followup analyses include the following (see the attached table):

- Alkylated PAH homologs by USEPA 8270D modified.

All analyses will be reported on a dry-weight basis.

3.4 Reporting

MFA will prepare and submit a report describing the completed work, including description and documentation of the fieldwork, data validation memoranda, tables and figures summarizing the sampling effort, and evaluation of the analytical results.

4 SCHEDULE

The following is the anticipated schedule:

Task	Timeline to Completion
Sediment Sampling Work Plan	May 2019
Sampling Permits Applied for and Obtained	June 2019
Field Evaluations	July 2019
Data Report	October 2019–December 2019

LIMITATIONS

The services undertaken in completing this work plan were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This work plan is solely for the use and information of our client unless otherwise noted. Any reliance on this work plan by a third party is at such party's sole risk.

Opinions and recommendations contained in this work plan apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this work plan.

REFERENCES

AECOM and Geosyntec. 2018a. Surface sediment field sampling plan, Portland Harbor pre-remedial design investigation studies, Portland Harbor Superfund site. Prepared for U.S. Environmental Protection Agency, Seattle, Washington. AECOM, Portland, Oregon, and Geosyntec Consultants, Inc., Seattle, Washington. March 29 (revised September 27, 2018).

AECOM and Geosyntec. 2018b. Subsurface sediment coring field sampling plan, Portland Harbor pre-remedial design investigation studies, Portland Harbor Superfund site. Prepared for U.S. Environmental Protection Agency, Seattle, Washington. AECOM, Portland, Oregon, and Geosyntec Consultants, Inc., Seattle, Washington. April 3 (revised July 12, 2018).

USEPA. 2017. Record of decision, Portland Harbor Superfund site, Portland Oregon. U.S. Environmental Protection Agency Region 10, Seattle, Washington. January.

TABLE

Table
Sampling and Analyses Summary
Siltronic Corporation
Portland, Oregon

Location IDs	Sample Location		Sample Matrix	Total Depth (feet bml)	No. of Samples per Location[a]	Sample Depth(s) (feet bml)[b]	Analytical Suite												
	Latitude	Longitude					Organochlorine Pesticides by USEPA 1699	SVOCs by USEPA 8270D	Metals[c] by USEPA 6020B	Total Cyanide by ASTM D7511	PCB Congeners by USEPA 1668C	Chlorinated Herbicides by USEPA 8151A	PCDD/Fs by USEPA 1613B	Diesel and Lube Oil TPH by USEPA NWTPH-Dx	Tributyltin by Krone et al.	PCDD/Fs by USEPA 1613B	TOC by USEPA 9060A	Grain Size by PSEP/ASTM D422	PAH Homologs
SED-01	45.578351	-122.753321	Surface Sediment	1	1	0 - 1	x	x	x	x	x	x	x	x	x	x	x	x	o
			Subsurface Sediment	15	3	0 - 2	x	x	x	x	x	x	x	x	x	x	x	x	o
						2 - 4	o	o	o	o	o	o	o	o	o	o	o	o	o
						4 - 6	o	o	o	o	o	o	o	o	o	o	o	o	o
						6 - 8	x	x	x	x	x	x	x	x	x	x	x	x	o
						8 - 10	o	o	o	o	o	o	o	o	o	o	o	o	o
						10 - 12	o	o	o	o	o	o	o	o	o	o	o	o	o
						12 - 14	x	x	x	x	x	x	x	x	x	x	x	x	o
SED-02	45.578167	-122.753471	Surface Sediment	1	1	0 - 1	x	x	x	x	x	x	x	x	x	x	x	x	o
			Subsurface Sediment	15	3	0 - 2	x	x	x	x	x	x	x	x	x	x	x	x	o
						2 - 4	o	o	o	o	o	o	o	o	o	o	o	o	o
						4 - 6	o	o	o	o	o	o	o	o	o	o	o	o	o
						6 - 8	x	x	x	x	x	x	x	x	x	x	x	x	o
						8 - 10	o	o	o	o	o	o	o	o	o	o	o	o	o
						10 - 12	o	o	o	o	o	o	o	o	o	o	o	o	o
						12 - 14	x	x	x	x	x	x	x	x	x	x	x	x	o
SED-03	45.57806	-122.753017	Surface Sediment	1	1	0 - 1	x	x	x	x	x	x	x	x	x	x	x	x	o
			Subsurface Sediment	15	3	0 - 2	x	x	x	x	x	x	x	x	x	x	x	x	o
						2 - 4	o	o	o	o	o	o	o	o	o	o	o	o	o
						4 - 6	o	o	o	o	o	o	o	o	o	o	o	o	o
						6 - 8	x	x	x	x	x	x	x	x	x	x	x	x	o
						8 - 10	o	o	o	o	o	o	o	o	o	o	o	o	o
						10 - 12	o	o	o	o	o	o	o	o	o	o	o	o	o
						12 - 14	x	x	x	x	x	x	x	x	x	x	x	x	o
SED-04	45.577223	-122.750855	Surface Sediment	1	1	0 - 1	x	x	x	x	x	x	x	x	x	x	x	x	o
			Subsurface Sediment	15	3	0 - 2	x	x	x	x	x	x	x	x	x	x	x	x	o
						2 - 4	o	o	o	o	o	o	o	o	o	o	o	o	o
						4 - 6	o	o	o	o	o	o	o	o	o	o	o	o	o
						6 - 8	x	x	x	x	x	x	x	x	x	x	x	x	o
						8 - 10	o	o	o	o	o	o	o	o	o	o	o	o	o
						10 - 12	o	o	o	o	o	o	o	o	o	o	o	o	o
						12 - 14	x	x	x	x	x	x	x	x	x	x	x	x	o

	Sample Location						Analytical Suite												
Location IDs	Latitude	Longitude	Sample Matrix	Total Depth (feet bml)	No. of Samples per Location[a]	Sample Depth(s) (feet bml)[b]	Organochlorine Pesticides by USEPA 1699	SVOCs by USEPA 8270D	Metals[c] by USEPA 6020B	Total Cyanide by ASTM D7511	PCB Congeners by USEPA 1668C	Chlorinated Herbicides by USEPA 8151A	PCDD/Fs by USEPA 1613B	Diesel and Lube Oil TPH by USEPA NWTPH-Dx	Tributyltin by Krone et al.	PCDD/Fs by USEPA 1613B	TOC by USEPA 9060A	Grain Size by PSEP/ASTM D422	PAH Homologs
SED-05	45.576971	-122.750634	Surface Sediment	1	1	0 - 1	x	x	x	x	x	x	x	x	x	x	x	x	o
			Subsurface Sediment	15	3	0 - 2	x	x	x	x	x	x	x	x	x	x	x	x	o
						2 - 4	o	o	o	o	o	o	o	o	o	o	o	o	o
						4 - 6	o	o	o	o	o	o	o	o	o	o	o	o	o
						6 - 8	x	x	x	x	x	x	x	x	x	x	x	x	o
						8 - 10	o	o	o	o	o	o	o	o	o	o	o	o	o
						10 - 12	o	o	o	o	o	o	o	o	o	o	o	o	o
						12 - 14	x	x	x	x	x	x	x	x	x	x	x	x	o
SED-06	45.576771	-122.750215	Surface Sediment	1	1	0 - 1	x	x	x	x	x	x	x	x	x	x	x	x	o
			Subsurface Sediment	15	3	0 - 2	x	x	x	x	x	x	x	x	x	x	x	x	o
						2 - 4	o	o	o	o	o	o	o	o	o	o	o	o	o
						4 - 6	o	o	o	o	o	o	o	o	o	o	o	o	o
						6 - 8	x	x	x	x	x	x	x	x	x	x	x	x	o
						8 - 10	o	o	o	o	o	o	o	o	o	o	o	o	o
						10 - 12	o	o	o	o	o	o	o	o	o	o	o	o	o
						12 - 14	x	x	x	x	x	x	x	x	x	x	x	x	o
SED-07	45.576374	-122.749314	Surface Sediment	1	1	0 - 1	x	x	x	x	x	x	x	x	x	x	x	x	o
			Subsurface Sediment	15	3	0 - 2	x	x	x	x	x	x	x	x	x	x	x	x	o
						2 - 4	o	o	o	o	o	o	o	o	o	o	o	o	o
						4 - 6	o	o	o	o	o	o	o	o	o	o	o	o	o
						6 - 8	x	x	x	x	x	x	x	x	x	x	x	x	o
						8 - 10	o	o	o	o	o	o	o	o	o	o	o	o	o
						10 - 12	o	o	o	o	o	o	o	o	o	o	o	o	o
						12 - 14	x	x	x	x	x	x	x	x	x	x	x	x	o
SED-08	45.575696	-122.749148	Surface Sediment	1	1	0 - 1	x	x	x	x	x	x	x	x	x	x	x	x	o
			Subsurface Sediment	15	3	0 - 2	x	x	x	x	x	x	x	x	x	x	x	x	o
						2 - 4	o	o	o	o	o	o	o	o	o	o	o	o	o
						4 - 6	o	o	o	o	o	o	o	o	o	o	o	o	o
						6 - 8	x	x	x	x	x	x	x	x	x	x	x	x	o
						8 - 10	o	o	o	o	o	o	o	o	o	o	o	o	o
						10 - 12	o	o	o	o	o	o	o	o	o	o	o	o	o
						12 - 14	x	x	x	x	x	x	x	x	x	x	x	x	o

Table
Sampling and Analyses Summary
Siltronic Corporation
Portland, Oregon

Location IDs	Sample Location		Sample Matrix	Total Depth (feet bml)	No. of Samples per Location[a]	Sample Depth(s) (feet bml)[b]	Analytical Suite												
	Latitude	Longitude					Organochlorine Pesticides by USEPA 1699	SVOCs by USEPA 8270D	Metals[c] by USEPA 6020B	Total Cyanide by ASTM D7511	PCB Congeners by USEPA 1668C	Chlorinated Herbicides by USEPA 8151A	PCDD/Fs by USEPA 1613B	Diesel and Lube Oil TPH by USEPA NWTPH-Dx	Tributyltin by Krone et al.	PCDD/Fs by USEPA 1613B	TOC by USEPA 9060A	Grain Size by PSEP/ASTM D422	PAH Homologs
SED-09	45.575224	-122.748819	Surface Sediment	1	1	0 - 1	x	x	x	x	x	x	x	x	x	x	x	x	o
			Subsurface Sediment	15	3	0 - 2	x	x	x	x	x	x	x	x	x	x	x	x	o
						2 - 4	o	o	o	o	o	o	o	o	o	o	o	o	o
						4 - 6	o	o	o	o	o	o	o	o	o	o	o	o	o
						6 - 8	x	x	x	x	x	x	x	x	x	x	x	x	o
						8 - 10	o	o	o	o	o	o	o	o	o	o	o	o	o
						10 - 12	o	o	o	o	o	o	o	o	o	o	o	o	o
						12 - 14	x	x	x	x	x	x	x	x	x	x	x	x	o
SED-10	45.575604	-122.748682	Surface Sediment	1	1	0 - 1	x	x	x	x	x	x	x	x	x	x	x	x	o
			Subsurface Sediment	15	3	0 - 2	x	x	x	x	x	x	x	x	x	x	x	x	o
						2 - 4	o	o	o	o	o	o	o	o	o	o	o	o	o
						4 - 6	o	o	o	o	o	o	o	o	o	o	o	o	o
						6 - 8	x	x	x	x	x	x	x	x	x	x	x	x	o
						8 - 10	o	o	o	o	o	o	o	o	o	o	o	o	o
						10 - 12	o	o	o	o	o	o	o	o	o	o	o	o	o
						12 - 14	x	x	x	x	x	x	x	x	x	x	x	x	o

NOTES:

ASTM = American Society for Testing and Materials.

bml = below mudline.

ID = identification.

NWTPH = Northwest Total Petroleum Hydrocarbons.

o = archive.

PAH = polycyclic aromatic hydrocarbons.

PCB = polychlorinated biphenyl. - -

PCDD/Fs - polychlorinated dibenzo p dioxins and furans.

PSEP = Puget Sound Estuary Program.

SVOC = semivolatile organic compound.

TOC = total organic carbon.

TPH = total petroleum hydrocarbons.

USEPA = U.S. Environmental Protection Agency.

x = analyze.

[a] Surface sediment samples will consist of a three-point composite. Additional subsurface samples will be collected and archived.

[b] Sample depth intervals provided in this table are conceptual and based on a recovery depth of 14 feet. The midpoint and bottom depth sampling intervals will vary based on depth recovered and lithology. See Section 3.2.3 of work plan for details of sample collection depths.

[c] Metals = arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc.

FIGURES

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Print Date: 5/17/2019 Approved By: Produced By: jputnam Project: 8128.02.05-03

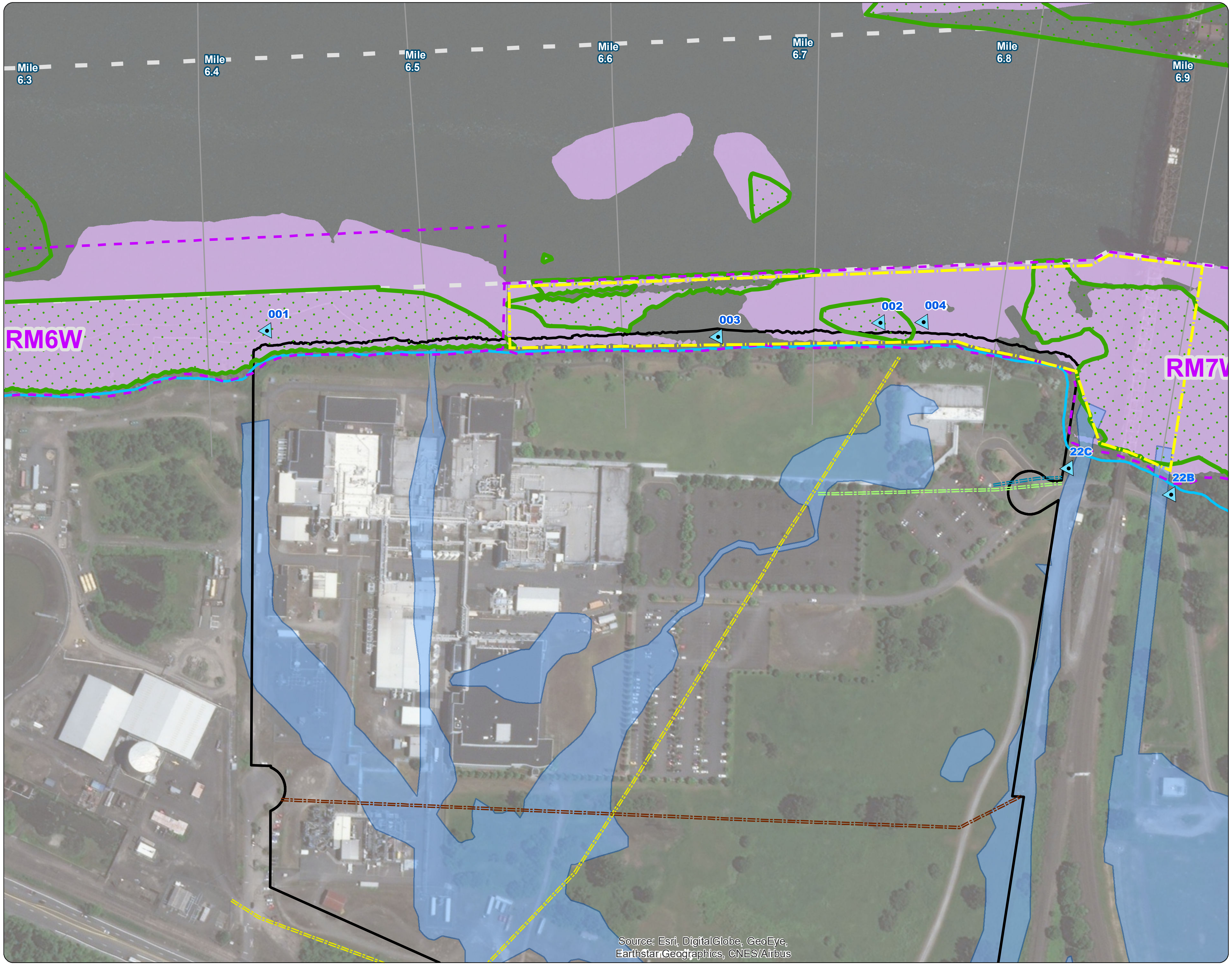

Figure 1-1
Area of Interest

Siltronic Corporation
Portland, Oregon

ATTORNEY/CLIENT PRIVILEGED

Legend

▼	Outfall Location (with Outfall ID)
- -	SDU6W and SDU7W
-·-·	Olympic Pipeline on Siltronic Property
-·-·	Approximate location of abandoned Portland Gas & Coke Company (NW Natural) Pipeline on Siltronic Property
-·-·	Approximate location of Union Oil Pipeline on Siltronic Property
-·-·	Approximate location of Standard Oil Pipeline on Siltronic Property
—	River Mile Markers
▭	Area of Interest
🟩	PDI SMA Footprint
▭	Ordinary High Water Mark (2004)
▭	Siltronic Property
- -	Nav Channel
■	Alternative F Mod SMA Footprint
■	Historical Surface Water Features

0 125 250
Feet

Notes:
PDI = Pre-Design Investigation.
SMA = sediment management area.

Source: Aerial photograph obtained from Esri ArcGIS Online; Decision Units SDU6W and SDU7W obtained from USEPA; ordinary high water mark obtained from City of Portland Corporate GIS; parcel boundaries and railroad data obtained from Metro Regional Land Information System; navigation channel dataset obtained from Lower Willamette Group.

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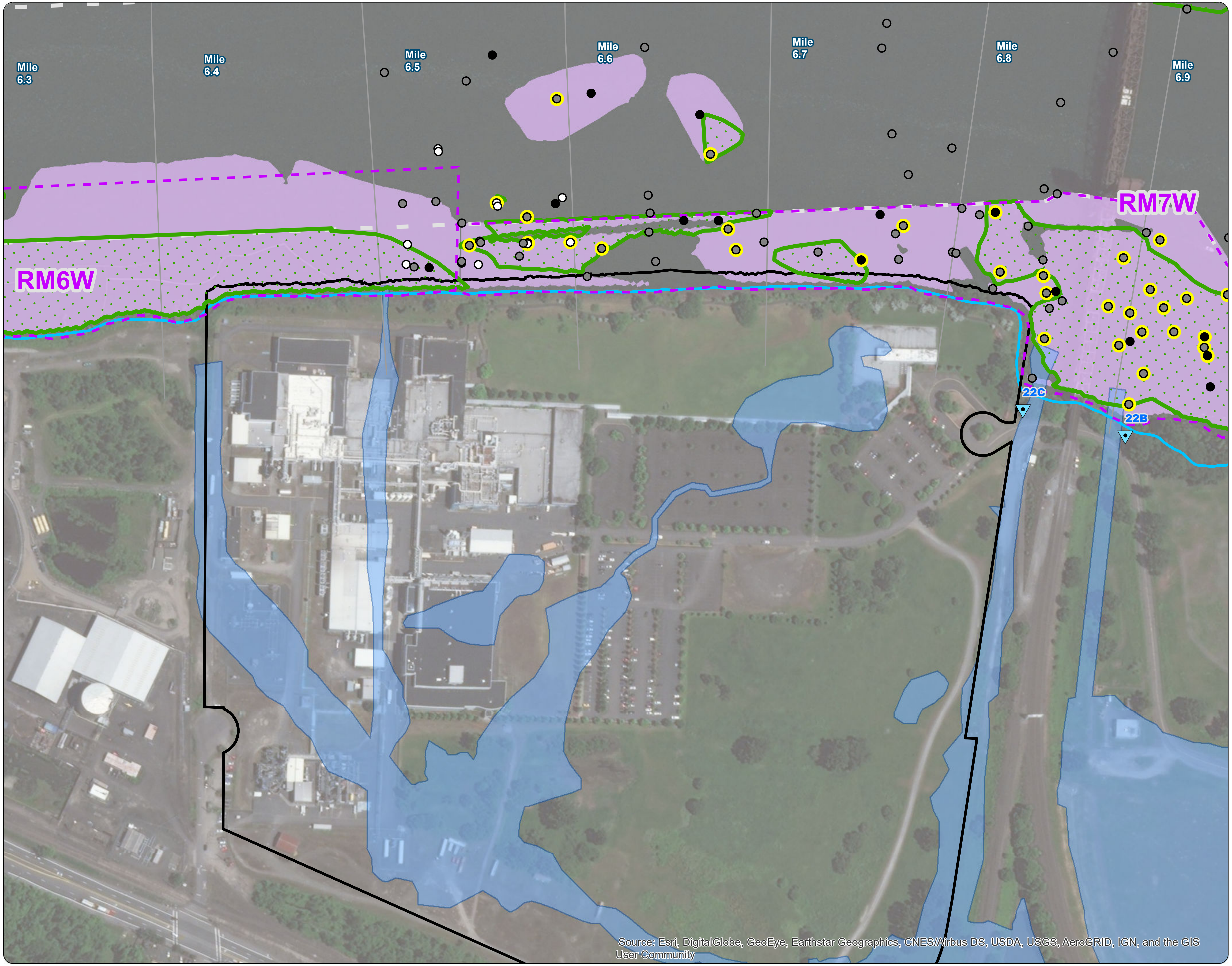
Path: X:\8128.02 Siltronic Corp\05\03\Projects\Fig3.1_Prior_Surface_Sediment_Results.mxd

Print Date: 5/30/2019

Approved By:

Produced By: aguse

Project: 8128.02.05-03



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Figure 3-1
Prior Surface Sediment Results

Siltronic Corporation
Portland, Oregon

ATTORNEY/CLIENT PRIVILEGED

Legend

Prior Suface Sampling Points

●	LWG
○	NWN
●	Pre-RD
●	Yellow halo indicated RAL or PTW Exceedances
▽	Outfall Location (with Outfall ID)
- -	SDU6W and SDU7W
—	River Mile Markers
▨	PDI SMA Footprint
☐	Ordinary High Water Mark (2004)
☐	Siltronic Property
- -	Nav Channel
■	Alternative F Mod SMA Footprint
■	Historical Surface Water Features

0 125 250
Feet

Notes:
Data are only shown between river miles 6.5 and approximately 7.0.
NWN did not analyze for PeCDD, PeCDF, or TCDD.
LWG = Lower Willamette Group.
NWN = NW Natural.
Pre-RD = Pre-Remedial Design Group.
PDI = Pre-Design Investigation.
PTW = principal threat waste.
RAL = remedial action level.
SMA = sediment management area.

Source: Aerial photograph obtained from Esri ArcGIS Online; Outfall locations obtained from City of Portland Bureau of Environmental Services; Decision Units SDU6W and SDU7W obtained from USEPA; Ordinary High Water mark obtained from City of Portland Corporate GIS; Parcel boudaries and railroad data obtained from Metro Regional Land Information System; Navigation channel dataset obtained from Lower Willamette Group.

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Path: X:\8128.02 Siltronic Corp\05\03\Projects\Fig3.2_Prior_Subsurface_Sediment_Results.mxd

Print Date: 5/30/2019   Approved By: Produced By: aguse   Project: 8128.02.05-03

Figure 3-2
Prior Suburface Sediment Results

Siltronic Corporation
Portland, Oregon

DRAFT

ATTORNEY/CLIENT PRIVILEGED

Legend

Prior Sempling Points

●	LWG
○	NWN
●	Pre-RD
●	Yellow halo indicates RAL or PTW Exceedance
▽	Outfall Location (with Outfall ID)
- -	SDU6W and SDU7W
—	River Mile Markers
- -	Nav Channel
▨	PDI SMA Footprint
☐	Ordinary High Water Mark (2004)
☐	Siltronic Property
■	Alternative F Mod SMA Footprint
■	Historical Surface Water Features

0 130 260
Feet

Notes:
Data are only shown between river miles 6.5 and approximately 7.0.
NWN did not analyze for PeCDD, PeCDF, or TCDD.
LWG = Lower Willamette Group.
NWN = NW Natural.
Pre-RD = Pre-Remedial Design Group.
PDI = Pre-Design Investigation.
PTW = principal threat waste.
RAL = remedial action level.
SMA = sediement management area.

Source: Aerial photograph obtained from Esri ArcGIS Online; Outfall locations obtained from City of Portland Bureau of Environmental Services; Decision Units SDU6W and SDU7W obtained from USEPA; Ordinary High Water mark obtained from City of Portland Corporate GIS; Parcel boudaries and railroad data obtained from Metro Regional Land Information System; Navigation channel dataset obtained from Lower Willamette Group.

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Print Date: 5/30/2019
Approved By:
Produced By: aguse
Project: 8128.02.05-03

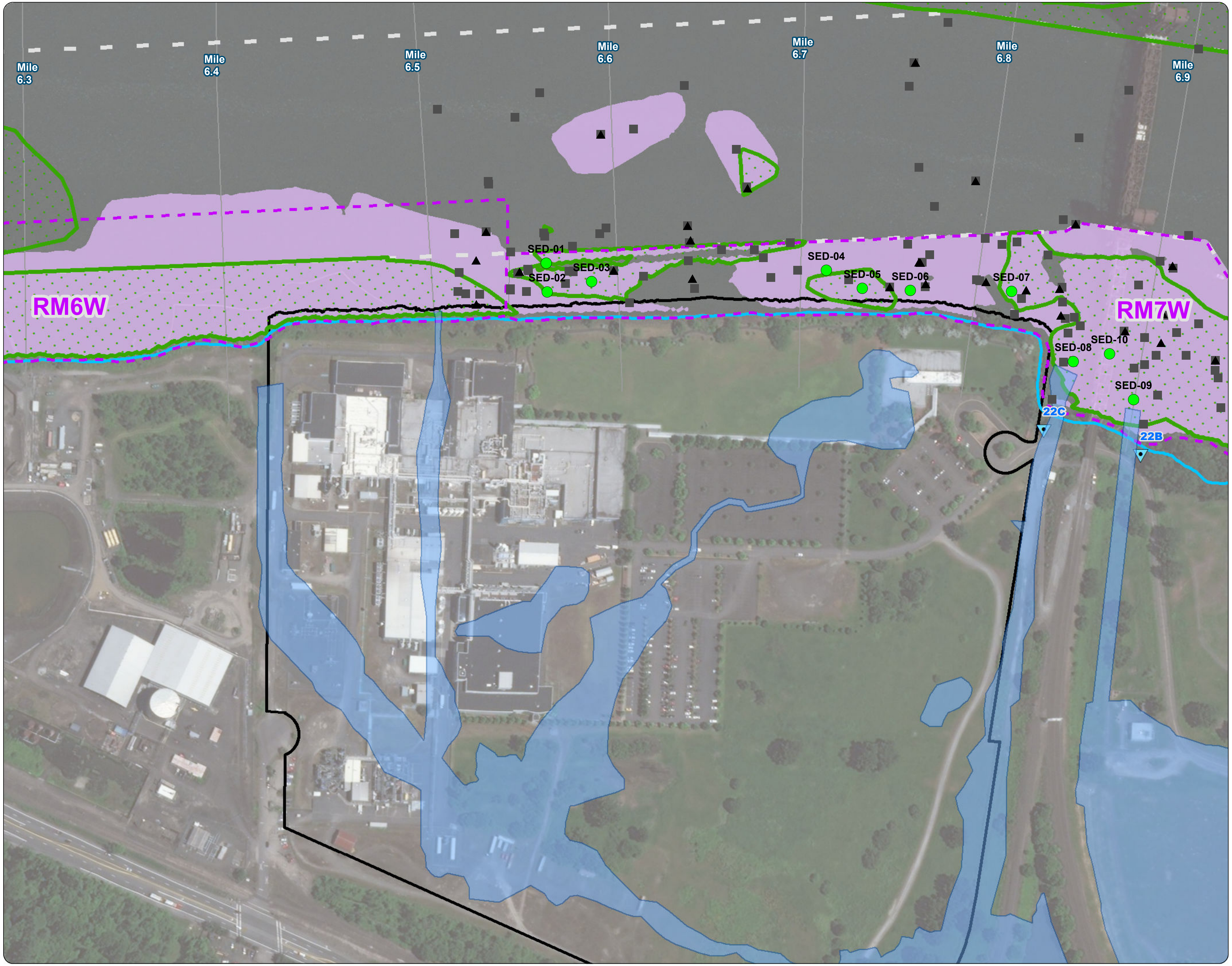

Figure 3-3
Proposed Samping Locations

Siltronic Corporation
Portland, Oregon

ATTORNEY/CLIENT PRIVILEGED

Legend

● Proposed Sediment Sampling Location
▽ Outfall Location (with Outfall ID)

Prior Sample Locations

▲ Subsurface
■ Surface
🟩 PDI SMA Footprint
☐ Ordinary High Water Mark (2004)
☐ Siltronic Property
Nav Channel
SDU6W and SDU7W
River Mile Markers
▨ Alternative F Mod SMA Footprint
▨ Historical Surface Water Features

0 130 260
Feet

Notes:
PDI = Pre-Design Investigation.
SMA = sediment management area.

Source: Aerial photograph obtained from Esri ArcGIS Online; outfall locations obtained from City of Portland Bureau of Environmental Services; Decision Units SDU6W and SDU7W obtained from USEPA; Ordinary High Water mark obtained from City of Portland Corporate GIS; Parcel boundaries and railroad data obtained from Metro Regional Land Information System; navigation channel dataset obtained from Lower Willamette Group.

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APPENDIX A

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN

SILTRONIC CORPORATION
PORTLAND, OREGON

Prepared for
SILTRONIC CORPORATION
PORTLAND, OREGON
May 30, 2019
Project No. 8128.02.05

Prepared by
Maul Foster & Alongi, Inc.
2001 NW 19th Avenue, Suite 200, Portland, OR 97209

MAUL
FOSTER
ALONGI

QUALITY ASSURANCE PROJECT PLAN
SILTRONIC CORPORATION

The material and data in this project plan were prepared under the supervision and direction of the undersigned.

MAUL FOSTER & ALONGI, INC.

Phil Wiescher, PhD
Senior Environmental Scientist

Michael R. Murray, RG
Senior Hydrogeologist

Courtney Savoie

Courtney Savoie, RG
Project Geologist

CONTENTS

TABLES AND ILLUSTRATIONS

FOLLOWING PLAN:

TABLES

ACRONYMS AND ABBREVIATIONS

AOI	area of interest
COC	contaminant of concern
DQO	data quality objective
EDD	electronic data deliverable
IDW	investigation-derived waste
LCS	laboratory control samples
LDS	laboratory duplicate samples
MFA	Maul Foster & Alongi, Inc.
MS/MSD	matrix spike and matrix spike duplicate
PCB	polychlorinated biphenyl
the Property	7200 NW Front Avenue in Portland, Oregon
QA/QC	quality assurance and quality control
QAM	quality assurance manager
QAPP	quality assurance project plan
RD	remedial design
RPD	relative percent difference
SMA	sediment management area
SOP	standard operating procedure
USEPA	U.S. Environmental Protection Agency
VOCs	volatile organic compounds
Work Plan	sediment sampling work plan

1 INTRODUCTION

This quality assurance project plan (QAPP) presents procedures for conducting field work and sampling to support the sediment sampling work plan (Work Plan) to which this QAPP is an appendix. This QAPP was prepared to provide specific details on how sediment samples will be collected; identify analytical methods associated reporting-limit and screening-level needs; and define field and laboratory quality assurance and quality control (QA/QC) requirements and procedures.

1.1 Objectives

The objectives of this QAPP are to establish protocols to ensure the data generated are of sufficient quality to support the data quality objectives (DQOs) and to ensure quality assurance and quality control QA/QC protocols to maintain consistency of field and laboratory aspects of data collection and generation. This QAPP was prepared utilizing procedures consistent with the Pre-Remedial Design (Pre-RD) Group U.S. Environmental Protection Agency (USEPA)-approved QAPP (AECOM, and Geosyntec, 2018). This QAPP is also consistent with the following USEPA guidance documents:

- Guidance for Quality Assurance Project Plans, USEPA QA/G-5 (USEPA, 2002)
- USEPA Requirements for Quality Assurance Project Plans, USEPA QA/R-5 (USEPA, 2001)

2 SPECIAL TRAINING AND CERTIFICATION

All personnel performing work at the Property will be health- and safety-trained as specified in the health and safety plan (see Appendix B of the work plan). The health and safety plan describes the specialized training and certification required for personnel and requisite documentation of this training.

3 DATA OBJECTIVES

3.1 Data Quality Objectives and Decision Criteria

The DQO process is a series of logical steps to plan for the resource-effective acquisition of environmental data. It is both flexible and iterative, and it applies to both decision-making (e.g., compliance/non-compliance with a standard) and estimation (e.g., ascertaining the mean concentration level of a contaminant). The DQO process is used to establish performance and acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the study (USEPA, 2006). The seven steps of the DQO process, as outlined by the USEPA, are listed below along with the specific DQOs of this QAPP:

1. State the problem—Define the problem; identify members of the planning team; define the budget and schedule.
    - This sampling effort is designed to update and evaluate current sediment conditions in the Area of Interest (AOI), defined in the Work Plan to which this QAPP is an appendix.
2. Identify the goal of the study—State how environmental data will be used to meet study objectives and solve the problem; identify study questions; define alternative outcomes.
    - The goal of the study to provide data to inform the nature and extent of sediment management areas (i.e., refining the horizontal and vertical extent of sediments exceeding remediation action levels) and evaluate potential contaminant transport pathways to the AOI.
3. Identify information inputs—Identify data and information needed to answer study questions.
    - Surface sediment samples and subsurface sediment cores will be collected at ten locations and analyzed within the AOI for sediment contaminants of concern (COCs) listed in Section 3.3. of the Work Plan.
4. Define the boundaries of the study—Specify target population and characteristics of interest; define spatial and temporal limits; define scale of inference.
    - The AOI is located on the west side of the Willamette River in Portland, Oregon, approximately 6.55 to 6.9 miles upstream of the confluence with the Columbia River (Willamette river mile 6.55 to 6.9 west). The AOI extends from the shoreline to the navigation channel. The AOI includes the in-water area adjacent to, and immediately southeast of, the Siltronic property located at 7200 NW Front Avenue in Portland, Oregon and is part of the USEPA identified sediment decision unit RM 7 west.
5. Develop the analytic approach—Define parameters of interest; specify type of inference; develop logic for drawing conclusions from findings.
    - Data will be collected from the surface and subsurface sediment, evaluated for the COCs listed in Section 3.3. of the Work Plan. Results from the sediment samples will be assessed against Record of Decision sediment criteria.
6. Specify performance or acceptance criteria—Specify criteria for new data collection (performance metrics) and decision making (probability limits).
    - The measurement performance criteria for data associated with the specific analyses include precision, accuracy, representativeness, completeness, comparability, and sensitivity. To meet these requirements, QC criteria are provided in the standard field and laboratory methods, as discussed below in this QAPP.
7. Develop the plan for obtaining data—Develop the QAPP.

- The basis of the sampling design and rationale for the sediment sampling is included in the Work Plan.

This QAPP presents the methods for collecting and analyzing data for the parameters of interest in the environmental media, as well as the associated performance metrics needed to achieve the DQOs.

3.2 Quality Objectives and Criteria of Measurement

3.2.1 Precision

Precision is the measure of agreement among repeated measurements of the same property under identical or substantially similar conditions, calculated as either the range or the standard deviation (USEPA, 2002). Precision is measured by making repeated analyses on the same analytical instrument (laboratory duplicates) or replicate collections of samples in the field (field duplicates). Precision criteria are expressed as the relative percent difference (RPD) between the primary and duplicate samples. The acceptance limits for RPD are based on the sample matrix and the analytical method used.

The RPD is calculated using the equation:

$$RPD = \frac{(X_s - X_d)}{(X_s + X_d)/2} \times 100\%$$

Where:
X_s = result for primary sample

X_d = result for duplicate sample

For field duplicates, the precision goals for this project are RPD = 50%. For laboratory duplicates (chemistry), the RPD goals are defined by the laboratory acceptance criteria determined from control limits or defined by the specific method. Regarding grain size analysis, laboratory triplicates and relative standard deviation goals are defined by the laboratory acceptance criteria as defined by the specific method.

3.2.2 Accuracy and Bias

Accuracy is defined as the measure of the overall agreement of a measurement to a known value and includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations (USEPA, 2002). Inasmuch as the “true” concentration of sampled media is not known, the degree of accuracy in the measurement is inferred from recovery data determined by sample spiking and/or the analyses of reference standards. The criterion for accuracy is expressed as the percent recovery of the sample spiking. The acceptance limits for percent recovery are based on the analytical method used.

Percent recovery is calculated using the equation:

$$Percent\ Recovery = \frac{X_{ss} - X_s}{T} \times 100\%$$

Where:

X_{ss} = result for spiked sample

X_s = result for sample

T = true value of added spike

Bias is defined as the systematic or persistent distortion of a measurement process that causes error in one direction (USEPA, 2002). Data bias is addressed in the field and the laboratory by calibrating equipment, collecting and analyzing QC blank samples, and analyzing QC standard samples.

3.2.3 Completeness

Data completeness is defined as a measure of the amount of valid data needed from a measurement system (USEPA, 2002). It is measured as the total number of samples collected, for which the valid analytical data are obtained, divided by the total number of samples collected, and multiplied by 100.

$$Percent\ Completeness = \frac{Valid\ Data}{Total\ Data\ Planned} \times 100\%$$

The QA objective for completeness for the parameters will be 90 percent.

3.2.4 Representativeness

Data representativeness is a qualitative term that expresses, "…the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition" (USEPA, 2002). Data representativeness is evaluated by assessing the accuracy and precision of the sampling program. The criterion for evaluating representativeness will be satisfied by confirming that the sample collection procedures are consistently followed. Sampling procedures are described in the Work Plan.

3.2.5 Comparability

Data comparability is a qualitative term that expresses the measure of confidence with which one data set can be compared to another and can be combined for decision-making purposes (USEPA, 2002). Data comparability will be achieved by using standard sampling and operating procedures and analytical methods. Data comparability will be assessed through documentation of QA/QC procedures.

3.2.6 Sensitivity

Data sensitivity is defined as the capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest (USEPA, 2002). Analytical sensitivity is readily evaluated by comparing method reporting limits and/or method detection limits to risk-based screening values, such as Record of Decision Table 17 COC cleanup levels. The method reporting limits specified through the DQO process are provided in Tables 3-1 and 3-2. Results measured between the reporting limits and method detection limits will be reported for all analytes and assigned the appropriate qualifier.

4 DATA GENERATION AND ACQUISITION

4.1 Sample Design

The Work Plan may be submitted for USEPA courtesy review and may not require formal approval before field work activities begin.

Below are sampling design overviews for the proposed sediment sampling. Complete sampling designs and rationales are described in the Work Plan.

4.1.1 Surface Sediment Sampling

Consistent with the methodology outlined in the Pre-RD QAPP, surface sediment data will be collected as co-located samples to correspond with ten sediment core samples (AECOM and Geosyntec, 2018). See the Work Plan to which this QAPP is an appendix for additional details on sampling procedures and approach.

4.1.2 Subsurface Sediment Sampling

Subsurface sediment coring is designed to refine the vertical and horizontal extent of contamination. Ten subsurface core locations are planned in targeted areas that have limited spatial coverage vertically and/or horizontally. Sediment cores will be collected and logged as described in the Work Plan to which this QAPP is an appendix.

4.2 Sample Methods

4.2.1 Nomenclature

The field personnel will be responsible for labeling samples and establishing identification. All data will be keyed to the sample's unique sample designation. The unique sample designation will be used on sample containers and associated field data forms and will be used to key the sample identification in the project database.

The field personnel will clearly label each sample container, using permanent ink on a waterproof sample label, as soon as possible following collection. At a minimum, the following information will be written on the sample label:

- Unique sample identification code
- Time and date of collection
- Project number
- Preservative, if appropriate

In order to maintain sample identification consistency in the project database, the unique sample identification code will be assigned according to the following convention: unique sample number-matrix type-depth (if applicable). The following codes and information will be included in the sample identification code:

- Matrix type codes include the following:
  - SS = surface sediment
  - SB = subsurface sediment
- Depth below mudline: the sample collection end depth will be used
- Field duplicate samples will include "DUP" at the end of the ID
- Equipment rinsate blanks will include "RB" at the end of the ID

For example, a surface sediment sample collected from core at location four from 0 to 1 feet bgs would have the following sample ID: SED-04-SS-1.0. A subsurface sediment sample collected from the same location at 13 to 15 feet bgs would be SED-04-SB-15.0, and a field duplicate of the subsurface sample would be SED-04-SB-15.0-DUP.

4.2.2 Collection Methods

The sample collection methods, location control, and field equipment to be used are described in detail in the Work Plan.

4.2.3 Investigation Derived Waste

Investigation-derived waste (IDW)—including excess sediment following sample collection, decontamination fluids used for sampling equipment (nonphosphate detergent wash, distilled water rinse, and methanol), and disposable wastes (i.e., gloves, paper towels, foil, etc.)—will be temporally stored in sealable 5-gallon buckets, then transferred to sealable 55-gallon drums. Sediment and liquid IDW will be stored in separate drums. Each of the sealed drums will then be staged at a designated upland area (Siltronic hazardous waste area Bay 4) for disposal characterization. Each drum will be labeled to indicate the date sealed, sampling location, and contents. Sediment and liquid IDW will be evaluated to determine whether it is characteristic hazardous waste. One composite sample per every five 55-gallon drums of sediment or liquid will be analyzed for ignitability (D001), corrosivity (D002), and toxicity (D004 to D043), consistent with 40 Code of Federal Regulations Part 261 subpart C. Additional analytical suites, which will be evaluated as part of the surface/subsurface sediment sampling programs that are not covered by D001 through D043, will also be run (e.g., dioxins) as specified in Table 4-1. A minimum of one sediment IDW and one liquid IDW sample will be analyzed. Analysis will be conducted by Specialty Analytical laboratory. Following IDW characterization, all IDW disposal will be managed appropriately by a licensed hazardous waste handler.

All disposable materials used in sample processing, such as paper towels and disposable coveralls and gloves, will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be removed from the AOI by sampling personnel and placed in an appropriate refuse container for disposal at a solid waste landfill.

4.3 Sample Handling

Field sampling personnel will be responsible for the collection, labeling, description, documentation, handling, packaging, storage, and shipping of investigative samples obtained in the field. Proper sample handling and custody procedures are required to retain sample integrity from collection in the field through laboratory analysis and data reporting.

The field investigation personnel and analytical laboratory contractor will be responsible for following sample custody procedures during sampling and analysis, as well as for providing sample tracking. Sample custody procedures will be used to document the history of samples from the time of sample collection through shipment, analysis, and disposal. Samples and sample documentation will be maintained in the physical possession of authorized field personnel or under control in a secure location.

4.3.1 Sample Custody in the Field

The field investigation contractor personnel will be responsible for completing the COC forms upon sample collection. Each COC form will contain, at a minimum, the following information:

- Project number
- Project name
- Project manager
- Unique sample identification code
- Time and date of collection
- Field personnel sampler’s name
- Separate shipping papers
- Signature, printed name, organization name, and date and time of transfer of all persons having custody of samples
- Sample matrix
- Quantity of sample containers

- Requested analyses for each sample
- Requested analytical turnaround time
- Any additional information on requested analysis, such as holding time, specific matrix spike and matrix spike duplicate (MS/MSD) samples

4.3.2 Sample Packaging and Shipment

Persons in possession of the samples will be required to sign and date the COC form whenever samples are transferred between individuals or organizations (with the exception of freight carriers). Samples will be placed in laboratory-provided coolers on ice (at 0 to 6 degrees Celsius) for transport to the laboratory. Containers associated with each sample will be packaged in plastic bags to prevent cross contamination. Packing material (e.g., bubble wrap) will be used in coolers to prevent breakage during transport to the laboratory.

Samples will be delivered to the laboratory by ground transportation (laboratory courier or field personnel), and the following custody procedures will be followed: samples will be packed in the appropriate shipping containers. The top copy of the COC form will accompany the samples. If transported by courier, the laboratory courier will retain a second copy of the COC and shipping forms to allow sample tracking. The COC form will accompany the samples from point of release from the sampling vessel to the laboratory. If transported to the laboratory by field personnel, COCs will be signed and copies distributed at the time of sample delivery to the laboratory.

The laboratory will implement its in-house custody procedures, which begin when sample custody is transferred to laboratory personnel.

4.3.3 Sample Custody in the Laboratory

The sample custodian of the analytical laboratory contractor will be responsible for handling and documentation of samples received at the laboratory. The designated sample custodian will accept custody of the received samples and will verify that the COC form matches the samples received. The shipping container, or set of containers, will be given a laboratory identification number, and each sample will be assigned a unique sequential identification number.

4.4 Laboratory Procedures

The analytical laboratories named in the Work Plan have established programs of sample custody that are designed to ensure that each sample is accounted for at all times. The objectives of these sample custody programs include the following:

- Unique identification of the samples, as appropriate for the data required
- Analysis of the correct samples and traceability to the appropriate record
- Preservation of sample characteristics

- Protection of samples from loss or damage
- Documentation of any sample alteration (e.g., filtration, preservation)
- Establishing a record of sample integrity for legal purposes

The standard operating procedures (SOPs) for sample custody protocol are maintained by the laboratories and adhered to by laboratory personnel. The sample custody SOPs are in the laboratories' SOP libraries and/or QA manuals.

4.4.1 Intra- and Inter-Laboratory Sample Transfer

The laboratory project manager will ensure that a sample-tracking record is maintained that follows each sample through all stages of laboratory processing. The sample-tracking record must contain, at a minimum, the names of individuals responsible for performing the analysis; the dates of sample extraction, preparation, and analysis; and the type of analysis being performed.

Any sample, homogenate, or sample extract that will need further analysis that is not performed by the initial contracted laboratory and that requires inter- or intra-laboratory transfer will be subject to all specifications described in the previous section. Sample matrices and analyses per specific laboratory, as shown in Tables 3-1 and 3-2, will not be subcontracted to outside laboratories or transferred to other laboratories within the specific laboratory organization without consultation with the quality assurance manager (QAM).

4.4.2 Archived Samples

All excess sediment samples submitted to the analytical laboratory will be archived at less than -18 degrees C. The laboratories will maintain chain-of-custody documentation and proper storage conditions for the entire time that the samples are in their possession. All laboratories for this project will store the excess samples for up to 12 months following completion of data validation. The laboratories will not dispose of the samples for this project until they are authorized to do so by the QAM.

4.5 Analytical Methods

All analytical methods used will comply with relevant requirements of applicable state or federal programs, or other EPA-approved methods. Analytical methods specific to this QAPP are provided in Tables 3-1 and 3-2.

4.5.1 Method Reporting Limits and Screening Level Values

The laboratory will make every effort to meet sample reporting limits that achieve the selected human health and ecological screening criteria specified in Tables 3-1 and 3-2. Unforeseen matrix interference could cause elevated quantitation limits for some compounds. All reasonable means, including additional cleanup steps and method modifications, will be used to bring sample reporting limits below the screening levels. Typical laboratory reporting limits are provided in Tables 3-1 and 3-2 and may change depending on the contracted laboratory.

USEPA Method 1613B (Dioxin/Furan), 1668C (Polychlorinated biphenyls [PCB] Congeners), and 1699 (Organochlorine Pesticides) results will also be evaluated and reported with estimated detection limits.

4.5.2 Holding Times and Sample Preservation

Sample preservation and holding times are summarized for each matrix and analysis in Tables 4-2 and 4-3. All samples will be preserved by storage at between 0 and 6 degrees C.

4.6 Quality Control

The quality of data will be monitored and verified by maintaining logs, documenting field activities, and collecting and analyzing field and laboratory QC samples. Table 4-4 summarizes the field and laboratory QC samples, along with the required collection frequency, for each sample matrix. The required field QC samples will be matrix-specific.

4.6.1 Field Quality Control Samples

The field QC samples will be used to assess the accuracy and precision of the field sample collection and handling activities.

4.6.1.1 Equipment Blanks

Field equipment blanks will be used to assess the introduction of chemical contaminants during sampling and field processing activities. Field equipment blanks will consist of rinsate blanks collected by pouring anywhere from 3 to 6 liters of de-ionized water over or through decontaminated sampling equipment and collected in the appropriate sample containers (1-liter amber glass). Equipment surfaces exposed during actual sampling will be rinsed. These samples will be analyzed along with the field samples. No rinsate blanks will be collected from disposable field equipment. Field equipment rinsate blanks will be generated for all chemical parameter groups, with one equipment blank being collected for every 20 analytical samples and submitted for analysis to the laboratory for the same constituents targeted in that day's sampling.

The criterion for field rinsate blanks is that analyte concentrations must be below the method reporting limits. Consistent with USEPA (2017a,b) data validation guidelines, analytical results for investigative samples will be qualified if the analyte is detected in the rinsate blank.

4.6.1.2 Trip Blanks

Trip blanks are collected for volatile organic compound sample analysis to assess the contamination of samples during transport to the Property, during collection of the sample, and during transport to the laboratory. Trip blanks are prepared in the laboratory using analyte-free water. Trip blanks should be inspected for air bubbles by both the laboratory (before shipping) and the field team. Any vials containing visible air bubbles should be discarded. One trip blank is included for each sample cooler collected for analysis of volatile organic compounds (i.e., VOCs by USEPA Method 8260C) and shipped to the laboratory. The criterion for trip blanks is that target analyte concentrations must be below the method reporting limits. Consistent with USEPA (USEPA, 2017b) data validation guidelines, analytical results for investigative samples will be qualified if the target analyte is detected in the trip blank. Trip blanks are not anticipated to be analyzed for this investigation as VOCs are not being analyzed.

4.6.1.3 Field Duplicates

Field duplicates are additional samples collected at a sampling location from the bowl or container of field-composite material and then split into two unique samples to enable statistical analysis of the resulting data. Two sets of samples from a single source are prepared, labeled with unique sample numbers, and submitted to the laboratory. One field duplicate will be prepared for every 20 environmental samples collected.

4.6.2 Laboratory Quality Control Samples

Samples will be submitted to an ORELAP- or NELAP-accredited laboratory or laboratories. The laboratories will follow the SOPs that have been developed consistent with the method requirements of the analytical methods, indicated in Tables 4-2 and 4-3, and with test methods for evaluating solid waste: physical/chemical methods EPA 530/SW-846 (USEPA, 1986).

The laboratory QC samples will be used to assess the accuracy and precision of the field sample collection and handling activities. Laboratory QC samples will be analyzed at the required frequency described in Table 4-4, as applicable, based on analytical method and sample matrix.

4.6.2.1 Calibration Verification

The laboratory calibration ranges specified in SW-846 (USEPA, 1986) will be followed.

Preventive maintenance of laboratory equipment will be the responsibility of the laboratory personnel and analysts. This maintenance includes routine care and cleaning of instruments, as well as inspection and monitoring of carrier gases, solvents, and glassware used in analyses. The preventive-maintenance approach for specific equipment will follow the manufacturers' specifications and good laboratory practices.

4.6.2.2 Matrix Spike/Matrix Spike Duplicate

Matrix spike samples are analyzed to assess the matrix effects on the accuracy of analytical measurements. MS/MSD samples will be prepared by spiking known amounts of analytes to investigative samples before extraction and preparation and analysis. The recoveries for the MS/MSD samples will be used to assess the accuracy and precision in the analytical method by measuring how well the analytical method recovers the target compounds in the investigative matrices. For each matrix type, at least one set of MS/MSD samples will be analyzed for each batch of samples for every 20 (or fewer) samples received. The MS/MSD samples will be designated on the COC form.

The criteria for acceptable percent recovery and RPD for MS/MSD samples are presented in Table 3-1 and 3-2.

4.6.2.3 Surrogate Spikes

Surrogate spiking consists of adding reference compounds to samples before sample preparation for organic analysis. Surrogate compound spiking is used to assess method accuracy on a sample-specific basis. Surrogate compounds will be added to samples, in accordance with the analytical method requirements. Surrogate spike percent recovery acceptance limits are determined by the analytical method. The surrogate spike percent recovery results will be reported by the laboratory.

4.6.2.4 Method Blanks

Method blanks are prepared using analyte-free (reagent) water and are processed with the same methodology (e.g., extraction, digestion) as the associated investigative samples. Method blanks are used to document contamination resulting from the analytical process in the laboratory. A method blank shall be prepared and analyzed in every analytical batch.

The method blank results are used to verify that reagents and preparation do not impart unacceptable bias to the investigative sample results. The presence of analytes in the method blank sample will be evaluated against method-specific thresholds. If analytes are present in the method blank above the method-specific threshold, corrective action will be taken to eliminate the source of contamination before proceeding with analysis. Investigative samples of an analytical batch associated with method blank results outside of acceptance limits will be qualified as appropriate by the QAM.

4.6.2.5 Laboratory Control Samples

Laboratory control samples (LCSs) are prepared by spiking laboratory-certified, reagent-grade water with the analytes of interest or a certified reference material that is prepared and analyzed. The result for percent recovery of the LCS is a data quality indicator of the accuracy of the analytical method and laboratory performance. The criteria for acceptable percent recovery of LCSs are presented in Tables 3-1 and 3-2.

4.6.2.6 Laboratory Duplicate Samples

Laboratory duplicate samples (LDSs) are prepared by the laboratory by splitting an investigative sample into two separate aliquots and performing separate sample preparation and analysis on each aliquot. The results for RPD of the primary investigative sample and the respective LDS are used to measure precision in the analytical method and laboratory performance. For nonaqueous matrices, sample heterogeneity may affect the measured precision for the LDS. The criteria for acceptable RPD of LDSs are presented in Table 3-1 and 3-2.

4.7 Instrument and Equipment Testing, Inspection, and Maintenance

Instruments for field parameter measurements will follow the sample and analysis plan protocol and manufacturers' recommendations for testing, inspection, and maintenance. Field equipment used for obtaining samples will be decontaminated as required and stored in a clean and secure location.

Laboratory instruments and equipment will comply with the contracted laboratories' QA/QC procedures for testing, inspection, and maintenance. Laboratory instrument and equipment testing, inspection, and maintenance documentation will be provided to the QAM if requested.

Instruments for field parameter measurements will follow the Work Plan requirements and manufacturers' recommendations for calibration. Calibration will be conducted at the beginning of each sampling event. Calibration checks will be conducted at the beginning of each sampling day. Calibration may be conducted again during a sampling event, as necessary, based on the results of the calibration check. Calibration records will be recorded in the field logbooks.

4.8 Inspection and Acceptance of Supplies and Consumables

The supplies and consumables that will be used during field operations include, though are not limited to, the following: decontamination fluids, preservatives, reagent water for equipment blanks, equipment tubing, and filters. No materials will be used after the manufacturers' expiration dates. Only water certified by the manufacturer will be used to prepare equipment blanks. If contamination is visible in materials, the item will be discarded. Non-dedicated field equipment will be decontaminated prior to use in accordance with Section 4.9.

The analytical laboratory will inspect supplies and consumables before their use in analysis. The materials description in the analytical methods will be used as a guideline for establishing acceptance criteria. Purity of reagents will be evaluated through analysis of LCSs and method blank samples. The laboratory shall maintain an inventory of supplies and consumables. No materials will be used after the manufacturers' expiration dates.

4.9 Sample Equipment Decontamination

Sampling equipment and reusable materials that contact sample media will be decontaminated between uses. Decontamination will generally involve the following:

- Initial rinse with vessel river water to dislodge particles
- Nonphosphate detergent wash, consisting of a dilute measure of Liqui-Nox or other phosphate-free detergent
- Distilled water rinse

Additional rinses with methanol are not anticipated but may be considered based on sample conditions (e.g., excessive oily/tar residue).

4.10 Non-direct Measurements

Non-direct measurements are defined as existing data obtained from non-measurement sources, such as literature files or existing databases. To assess data usability, historical data will be reviewed for accordance with project-specific DQOs and QA/QC criteria.

4.11 Data Management

4.11.1 Field Logbooks and Forms

Field investigation personnel will be responsible for maintaining a daily record of significant events, observations, and measurements during field investigations. Field records may be recorded in a bound logbook or paper or electronic field data sheets. A separate entry will be made for each sample collected. Specific field recording procedures will be identified in the Work Plan as needed. Field logbooks and forms will be included in the project files at the end of field activities to provide a record of sampling.

4.11.2 Laboratory Data

The laboratory shall record the results of each analysis in a Laboratory Information Management System in accordance with the contracted laboratory's quality assurance plan. Data will be provided to MFA as electronic data deliverables (EDDs). EDDs will be imported directly into an EQuIS database used for data storage. Validated laboratory results will be exported and provided as part of the final report for each project.

5 DATA QUALITY ASSESSMENT

5.1 Assessment and Response Actions

Performance and/or systems audits of field and laboratory activities are not anticipated as part of this QAPP. If performance and/or systems audits of field and laboratory activities are performed, they will be conducted consistent with the methodology outlined in Section 5 of the Pre-RD Group QAPP (AECOM and Geosyntec, 2018).

6 DATA VALIDATION AND USABILITY

This section describes the stages of data quality assessment after data have been received. It addresses data reduction, review, verification, and validation. It also discusses the procedures for evaluating the usability of data with respect to the DQOs set forth in Section 4.

6.1 Data Reduction, Validation, and Reporting

The analytical laboratory will submit a four-tab-delimited EDD containing all reported results. EDDs will be incorporated into MFA's EQuIS database. Analytical data will also be made available in PDF format. The analytical data package will include laboratory QA and QC results to permit independent and conclusive determination of data quality. Only the compounds presented in Tables 3-1 and 3-2, and associated QA/QC compounds, will be reported by the analytical laboratory. Data quality will be determined by using the data evaluation procedures described in this section. The results of the data evaluation will be used to determine if the project DQOs are being met and will be presented in a data validation memorandum as an appendix to the final report.

6.2 Laboratory Data Evaluation

Initial data reduction, evaluation, and reporting at the analytical laboratory will be carried out as described in USEPA SW-846 (USEPA, 1986), as appropriate. Additional laboratory data qualifiers may be defined and reported to further explain the laboratory's QC concerns about a particular sample result. All additional data qualifiers will be defined in the laboratory narrative report associated with each case.

6.3 Data Deliverables

Standard (Tier II) laboratory data deliverables will include:

- Transmittal cover letter
- Case narrative
- Analytical results
- COC
- Surrogate, labeled analogue, and internal standard recoveries
- Method blank results
- LCS/LCSD results
- MS/MSD results
- Laboratory duplicate results
- EDD

Tier IV laboratory deliverable will be provided as requested. In addition to the Tier II deliverable list, these will include:

- Calibration and calibration verification records
- Chromatograms and raw instrument data
- Preparatory records

6.4 Data Quality Assurance and Quality Control Review

Laboratory data will be evaluated for precision, completeness, accuracy, representativeness, comparability, sensitivity, and compliance with the analytical method and with the laboratory accuracy and precision performance criteria listed on Tables 3-1 and 3-2. A Tier II (Stage 2AVM) validation will be conducted, as defined in the USEPA Guidance for Labeling Externally Validated Data (USEPA, 2009), on 90 percent of the data. A Tier IV (Stage 4VM) validation (USEPA 2009) will be conducted on the remaining 10 percent of the data. Data qualifiers will be assigned to the sample results following applicable sections of the USEPA procedures for data review (USEPA, 2014, 2016, 2017a, 2017b, or most recent).

Data qualifiers, as defined by the USEPA, are used to classify sample data according to their conformance to QC requirements. The most common qualifiers are listed below.

- J—Estimate, qualitatively correct but quantitatively suspect.
- R—Reject, data not suitable for any purpose.
- U—Not detected at a specified reporting limit.

Poor surrogate recovery, blank contamination, and calibration problems, among other issues, can cause the sample data to be qualified. Whenever sample data are qualified, the reasons for the qualification will be stated in the data evaluation report.

Any USEPA Method 1613B, 1668C (PCB Congeners), and 1699 (Organochlorine Pesticides) estimated maximum possible concentration (EMPC) qualifiers assigned by the laboratory will be reported, along with any validation assigned qualifiers, with the final data. EMPCs will be evaluated consistent with USEPA Region 10 PCDD/PCDF DV (USEPA 2014) guidelines and USEPA NFG use of regional guidance and/or professional judgment in evaluating these results.

QC criteria not defined in the guidelines for evaluating analytical data are adopted, where appropriate, from the analytical method.

The components of data evaluation will be performed by the entities noted in the following list:

- Data reduction will be performed by the analytical laboratory.
- Data verification will be performed both by the laboratory and by the data validator (i.e., MFA and AlterEcho).
- Data validation and usability determination will be performed by the data validator (i.e., MFA and AlterEcho).

The following information will be reviewed during data evaluation, as applicable:

- Sampling locations and blind sample numbers
- Sampling dates
- Requested analysis

- COC documentation
- Sample preservation
- Holding times
- Method blanks
- Surrogate and internal standard recoveries
- MS/MSD results
- Laboratory duplicates
- Field duplicates
- Field blanks
- LCS/LCSD results
- Method reporting limits above requested levels
- Laboratory qualifiers
- Any additional comments or difficulties reported by the laboratory
- Overall assessment

The Tier IV data evaluation will also review:

- Calibration and calibration verification records
- Chromatograms and raw instrument data
- Calculation of instrument and sample results
- Preparatory records

While data verification is a technical process in which the data's adherence to precision, accuracy, representativeness, completeness, comparability, and sensitivity is evaluated, it still does not answer the final question of the usability of the data and the implications of any departures from data expectations. The data validation process is designed to answer these questions through: (1) the assignment of data qualifiers based on the data verification results; and (2) a case-by-case review of data quality issues with respect to QAPP objectives to render a final assessment of data usability.

The final step of data evaluation entails a comparison of data quality performance with the QAPP-specific DQOs. Section 3.2 of this QAPP discusses the DQOs. Validation of the analytical data is the process of determining that the data support the DQOs. Validation is performed by the independent validator (i.e., AlterEcho) as well as MFA. The results of the data evaluation review will be summarized for the data package. Data qualifiers will be assigned to sample results on the basis of USEPA guidelines, as applicable.

6.5 Data Management and Reduction

MFA uses EQuIS to manage all laboratory data. The laboratory will provide the analytical results in electronic EQuIS-deliverable format. After data evaluation, data qualifiers will be entered into the EQuIS database.

Data may be reduced to summarize particular data sets and to aid interpretation of the results. Statistical analyses may also be applied to results. Data-reduction QC checks will be performed on all hand-entered data, any calculations, and any data graphically displayed. Data may be further reduced and managed using one or more of the following computer software applications:

- Microsoft Excel® (spreadsheet)
- EQuIS (database)
- AutoCad and/or ArcGIS (graphics)
- USEPA ProUCL (statistical software)

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

REFERENCES

AECOM and Geosyntec, 2018. Quality assurance project plan, Portland Harbor pre-remedial design investigation and baseline sampling, Portland Harbor Superfund Site. Prepared for U. S. Environmental Protection Agency, Region 10, Seattle, Washington. Prepared by AECOM, Portland Oregon and Geosyntec consultants, Seattle, Washington. December 19.

USEPA. 2001. EPA requirements for quality assurance project plans. EPA QA/R-5. EPA/240-B-01/003. U.S. Environmental Protection Agency. March.

USEPA. 2002. Guidance for quality assurance project plans. EPA QA/G-5. EPA/240/R-02/009. U.S. Environmental Protection Agency. December.

USEPA. 2006. Guidance on systematic planning using the data quality objectives process. EPA QA/G-4. U.S. Environmental Protection Agency. February.

USEPA. 2009. Guidance for labeling externally validated laboratory analytical data for Superfund use. EPA 540/R-08/005. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. January.

USEPA. 2014. Region 10 data validation and review guidelines for polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofuran data (PCDD/PCDF) using method 1613B, and SW846 method 8290A. U. S. Environmental Protection Agency, Office of Environmental Assessment. May.

USEPA. 2016. National functional guidelines for high resolution superfund methods review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. April.

USEPA. 2017a. USEPA contract laboratory program, national functional guidelines for inorganic Superfund methods data review. EPA 540-R-2017-001. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. January.

USEPA. 2017b. USEPA contract laboratory program, national functional guidelines for Superfund organic methods data review. EPA 540-R-2017-002. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. January.

TABLES

Table 3-1
Sediment Analtyical Methods and Performance Criteria
Siltronic Corporation
Portland, Oregon

Analyte	Units	Method	PH ROD Table 17 Sediment CUL	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
Conventionals											
Total solids	%	PSEP 1986	--	--	1.0	--	--	--	--	10	90
Total Organic Carbon	mg/kg	USEPA 9060	--	--	200	--	--	90-110	--	20	90
Grain Size											
Gravel	%	ASTM D422	--	--	0.01	--	--	--	--	--	90
Coarse Sand	%	ASTM D422	--	--	0.01	--	--	--	--	--	90
Medium Sand	%	ASTM D422	--	--	0.01	--	--	--	--	--	90
Fine Sand	%	ASTM D422	--	--	0.01	--	--	--	--	--	90
Silt	%	ASTM D422	--	--	0.01	--	--	--	--	--	90
Clay	%	ASTM D422	--	--	0.01	--	--	--	--	--	90
Metals											
Arsenic	mg/kg	USEPA 6020A	3	0.481	0.962	75-125	40	80-120	20	40	90
Barium	mg/kg	USEPA 6020A	--	0.481	0.962	75-125	40	80-120	20	40	90
Cadmium	mg/kg	USEPA 6020A	0.51	0.0962	0.192	75-125	40	80-120	20	40	90
Chromium	mg/kg	USEPA 6020A	--	0.481	0.962	75-125	40	80-120	20	40	90
Copper	mg/kg	USEPA 6020A	359	1.92	3.85	75-125	40	80-120	20	40	90
Lead	mg/kg	USEPA 6020A	196	0.0962	0.192	75-125	40	80-120	20	40	90
Mercury	mg/kg	USEPA 6020A	0.085	0.0385	0.0769	75-125	40	80-120	20	40	90
Selenium	mg/kg	USEPA 6020A	--	0.481	0.962	75-125	40	80-120	20	40	90
Silver	mg/kg	USEPA 6020A	--	0.0962	0.192	75-125	40	80-120	20	40	90
Zinc	mg/kg	USEPA 6020A	459	1.92	3.85	75-125	40	80-120	20	40	90
Cyanide											
Total Cyanide	mg/kg	ASTM D7511	--	0.05	0.1	64-136	47	84-116	20	20	90
Dioxins/Furans											
1,2,3,4,6,7,8-HpCDD	ng/kg	USEPA 1613B	--	0.14	5	70-130	20	70-140	20	--	90
1,2,3,4,6,7,8-HpCDF	ng/kg	USEPA 1613B	--	0.103	5	70-130	20	82-122	20	--	90
1,2,3,4,7,8,9-HpCDF	ng/kg	USEPA 1613B	--	0.155	5	70-130	20	78-138	20	--	90
1,2,3,4,7,8-HxCDD	ng/kg	USEPA 1613B	--	0.125	5	70-130	20	70-164	20	--	90
1,2,3,4,7,8-HxCDF	ng/kg	USEPA 1613B	0.4	0.171	5	70-130	20	72-134	20	--	90
1,2,3,6,7,8-HxCDD	ng/kg	USEPA 1613B	--	0.128	5	70-130	20	76-134	20	--	90
1,2,3,6,7,8-HxCDF	ng/kg	USEPA 1613B	--	0.176	5	70-130	20	84-130	20	--	90
1,2,3,7,8,9-HxCDD	ng/kg	USEPA 1613B	--	0.131	5	70-130	20	64-162	20	--	90
1,2,3,7,8,9-HxCDF	ng/kg	USEPA 1613B	--	0.24	5	70-130	20	78-130	20	--	90
1,2,3,7,8-PeCDD	ng/kg	USEPA 1613B	0.2	0.121	5	70-130	20	70-142	20	--	90
1,2,3,7,8-PeCDF	ng/kg	USEPA 1613B	--	0.095	5	70-130	20	80-134	20	--	90
2,3,4,6,7,8-HxCDF	ng/kg	USEPA 1613B	--	0.183	5	70-130	20	70-156	20	--	90
2,3,4,7,8-PeCDF	ng/kg	USEPA 1613B	0.3	0.0812	5	70-130	20	68-160	20	--	90
2,3,7,8-TCDD	ng/kg	USEPA 1613B	0.2	0.0884	1	70-130	20	67-158	20	--	90

Table 3-1
Sediment Analtyical Methods and Performance Criteria
Siltronic Corporation
Portland, Oregon

Analyte	Units	Method	PH ROD Table 17 Sediment CUL	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
2,3,7,8-TCDF	ng/kg	USEPA 1613B	0.40658	0.094	1	70-130	20	75-158	20	--	90
OCDD	ng/kg	USEPA 1613B	--	0.183	10	70-130	20	78-144	20	--	90
OCDF	ng/kg	USEPA 1613B	--	0.179	10	70-130	20	63-170	20	--	90
PCB Congeners											
Total PCBs	ng/kg	USEPA 1668C/Calculation	9	--[a]	--[a]	50-150	35	60-135	30	--	90
Organochlorine Pesticides											
2,4'-DDD	ug/kg	USEPA 1699	--	0.006	0.05	50-150	25	50-150	25	25	90
2,4'-DDE	ug/kg	USEPA 1699	--	0.005	0.05	50-150	25	50-150	25	25	90
2,4'-DDT	ug/kg	USEPA 1699	--	0.006	0.05	50-150	25	50-150	25	25	90
4,4'-DDD	ug/kg	USEPA 1699	114	0.004	0.05	50-150	25	50-150	25	25	90
4,4'-DDE	ug/kg	USEPA 1699	226	0.004	0.05	50-150	25	50-150	25	25	90
4,4'-DDT	ug/kg	USEPA 1699	246	0.005	0.05	50-150	25	50-150	25	25	90
Total DDx	ug/kg	USEPA 1699/Calculation	6.1	--	--	--	--	--	--	--	90
Aldrin	ug/kg	USEPA 1699	2	0.013	0.05	50-150	25	50-150	25	25	90
alpha-BHC	ug/kg	USEPA 1699	--	0.004	0.05	50-150	25	50-150	25	25	90
alpha-Chlordane	ug/kg	USEPA 1699	--	0.003	0.05	50-150	25	50-150	25	25	90
beta-BHC	ug/kg	USEPA 1699	--	0.009	0.05	50-150	25	50-150	25	25	90
beta-Chlordane	ug/kg	USEPA 1699	--	0.003	0.05	50-150	25	50-150	25	25	90
Chlordane (Total)	ug/kg	USEPA 1699/Calculation	1.4	--	--	--	--	--	--	--	90
cis-Nonachlor	ug/kg	USEPA 1699	--	0.008	0.05	50-150	25	50-150	25	25	90
delta-BHC	ug/kg	USEPA 1699	--	0.006	0.05	50-150	25	50-150	25	25	90
Dieldrin	ug/kg	USEPA 1699	0.07	0.008	0.05	50-150	25	50-150	25	25	90
Endosulfan I	ug/kg	USEPA 1699	--	0.016	0.05	50-150	25	50-150	25	25	90
Endosulfan II (beta)	ug/kg	USEPA 1699	--	0.011	0.05	50-150	25	50-150	25	25	90
Endosulfan sulfate	ug/kg	USEPA 1699	--	0.014	0.05	50-150	25	50-150	25	25	90
Endrin	ug/kg	USEPA 1699	--	0.007	0.05	50-150	25	50-150	25	25	90
Endrin aldehyde	ug/kg	USEPA 1699	--	0.012	0.05	50-150	25	50-150	25	25	90
Endrin ketone	ug/kg	USEPA 1699	--	0.009	0.05	50-150	25	50-150	25	25	90
Heptachlor	ug/kg	USEPA 1699	--	0.008	0.05	50-150	25	50-150	25	25	90
Heptachlor epoxide	ug/kg	USEPA 1699	--	0.005	0.05	50-150	25	50-150	25	25	90
Hexachlorobenzene	ug/kg	USEPA 1699	--	0.011	0.05	50-150	25	50-150	25	25	90
Lindane	ug/kg	USEPA 1699	5	0.004	0.05	50-150	25	50-150	25	25	90
Methoxychlor	ug/kg	USEPA 1699	--	0.007	0.05	50-150	25	50-150	25	25	90
Mirex	ug/kg	USEPA 1699	--	0.005	0.05	50-150	25	50-150	25	25	90
Oxychlordane	ug/kg	USEPA 1699	--	0.012	0.05	50-150	25	50-150	25	25	90
trans-Nonachlor	ug/kg	USEPA 1699	--	0.005	0.05	50-150	25	50-150	25	25	90
Chlorinated Herbicides											

Table 3-1
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Siltronic Corporation
Portland, Oregon

Analyte	Units	Method	PH ROD Table 17 Sediment CUL	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
2,4,5-T	ug/kg	USEPA 8151A	--	5.6	100	17-123	25	40-108	25	25	90
2,4-D	ug/kg	USEPA 8151A	--	6.9	100	21-126	25	53-130	25	25	90
2,4-DB	ug/kg	USEPA 8151A	--	17	100	13-133	25	28-119	25	25	90
Dalapon	ug/kg	USEPA 8151A	--	19	100	9.6-101	25	17-122	25	25	90
Dicamba	ug/kg	USEPA 8151A	--	9	100	11-107	25	48-107	25	25	90
Dichlorprop	ug/kg	USEPA 8151A	--	7.1	100	44-133	25	45-117	25	25	90
Dinoseb	ug/kg	USEPA 8151A	--	3.8	150	0.1-72	25	0.1-83	25	25	90
MCPA	ug/kg	USEPA 8151A	--	790	15000	23-123	25	33-107	25	25	90
MCPP (Mecoprop)	ug/kg	USEPA 8151A	--	680	15000	24-120	25	34-117	25	25	90
Silvex	ug/kg	USEPA 8151A	--	7.2	100	15-126	25	38-108	25	25	90
Organotins											
Tributyltin	ug/kg	Krone et al.	3080	1.5	3	34-142	50	33-147	20	25	90
PAHs											
2-Methylnaphthalene	ug/kg	USEPA 8270D	--	2.5	5	38-122	30	38-122	30	30	90
Acenaphthene	ug/kg	USEPA 8270D	--	1.25	2.5	40-122	30	40-122	30	30	90
Acenaphthylene	ug/kg	USEPA 8270D	--	1.25	2.5	32-132	30	32-132	30	30	90
Anthracene	ug/kg	USEPA 8270D	--	1.25	2.5	47-123	30	47-123	30	30	90
Benzo(a)anthracene	ug/kg	USEPA 8270D	--	1.25	2.5	49-126	30	49-126	30	30	90
Benzo(a)pyrene	ug/kg	USEPA 8270D	--	1.87	3.75	45-129	30	45-129	30	30	90
Benzo(b)fluoranthene	ug/kg	USEPA 8270D	--	1.87	3.75	45-132	30	45-132	30	30	90
Benzo(ghi)perylene	ug/kg	USEPA 8270D	--	1.25	2.5	43-134	30	43-134	30	30	90
Benzo(k)fluoranthene	ug/kg	USEPA 8270D	--	1.87	3.75	47-132	30	47-132	30	30	90
Chrysene	ug/kg	USEPA 8270D	--	1.25	2.5	50-124	30	50-124	30	30	90
Dibenzo(a,h)anthracene	ug/kg	USEPA 8270D	--	1.25	2.5	45-134	30	45-134	30	30	90
Fluoranthene	ug/kg	USEPA 8270D	--	1.25	2.5	50-127	30	50-127	30	30	90
Fluorene	ug/kg	USEPA 8270D	--	1.25	2.5	43-125	30	43-125	30	30	90
Indeno(1,2,3-cd)pyrene	ug/kg	USEPA 8270D	--	1.25	2.5	45-133	30	45-133	30	30	90
Naphthalene	ug/kg	USEPA 8270D	--	2.5	5	35-123	30	35-123	30	30	90
Phenanthrene	ug/kg	USEPA 8270D	--	1.25	2.5	50-121	30	50-121	30	30	90
Pyrene	ug/kg	USEPA 8270D	--	1.25	2.5	47-127	30	47-127	30	30	90
Total PAHs	ug/kg	USEPA 8270D/Calculation	23000[b]	--	--	--	--	--	--	--	90
cPAH TEQ	ug/kg	USEPA 8270D/Calculation	12/3950[b]	--	--	--	--	--	--	--	90
SVOCs											
1,2,4-Trichlorobenzene	ug/kg	USEPA 8270D	--	3.12	6.25	34-120	30	34-120	30	30	90
1,2-Dichlorobenzene	ug/kg	USEPA 8270D	--	3.12	6.25	33-120	30	33-120	30	30	90
1,2-Dinitrobenzene	ug/kg	USEPA 8270D	--	31.2	62.5	44-120	30	44-120	30	30	90

Table 3-1
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Analyte	Units	Method	PH ROD Table 17 Sediment CUL	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
1,3-Dichlorobenzene	ug/kg	USEPA 8270D	--	3.12	6.25	30-120	30	30-120	30	30	90
1,3-Dinitrobenzene	ug/kg	USEPA 8270D	--	31.2	62.5	42-127	30	42-127	30	30	90
1,4-Dichlorobenzene	ug/kg	USEPA 8270D	--	3.12	6.25	31-120	30	31-120	30	30	90
1,4-Dinitrobenzene	ug/kg	USEPA 8270D	--	31.2	62.5	37-132	30	37-132	30	30	90
1-Methylnaphthalene	ug/kg	USEPA 8270D	--	2.5	5	40-120	30	40-120	30	30	90
2,2'-oxybis(1-chloropropane)	ug/kg	USEPA 8270D	--	3.12	6.25	33-131	30	33-131	30	30	90
2,3,4,6-Tetrachlorophenol	ug/kg	USEPA 8270D	--	6.25	12.5	44-125	30	44-125	30	30	90
2,3,5,6-Tetrachlorophenol	ug/kg	USEPA 8270D	--	6.25	12.5	40-120	30	40-120	30	30	90
2,4,5-Trichlorophenol	ug/kg	USEPA 8270D	--	6.25	12.5	41-124	30	41-124	30	30	90
2,4,6-Trichlorophenol	ug/kg	USEPA 8270D	--	6.25	12.5	39-126	30	39-126	30	30	90
2,4-Dichlorophenol	ug/kg	USEPA 8270D	--	6.25	12.5	40-122	30	40-122	30	30	90
2,4-Dimethylphenol	ug/kg	USEPA 8270D	--	6.25	12.5	30-127	30	30-127	30	30	90
2,4-Dinitrophenol	ug/kg	USEPA 8270D	--	31.2	62.5	5-137	30	5-137	30	30	90
2,4-Dinitrotoluene	ug/kg	USEPA 8270D	--	12.5	25	48-126	30	48-126	30	30	90
2,6-Dinitrotoluene	ug/kg	USEPA 8270D	--	12.5	25	46-124	30	46-124	30	30	90
2-Chloronaphthalene	ug/kg	USEPA 8270D	--	1.25	2.5	41-120	30	41-120	30	30	90
2-Chlorophenol	ug/kg	USEPA 8270D	--	6.25	12.5	34-121	30	34-121	30	30	90
2-Methylphenol	ug/kg	USEPA 8270D	--	3.12	6.25	32-122	30	32-122	30	30	90
2-Nitroaniline	ug/kg	USEPA 8270D	--	25	50	44-127	30	44-127	30	30	90
2-Nitrophenol	ug/kg	USEPA 8270D	--	12.5	25	36-123	30	36-123	30	30	90
3- & 4-Methylphenol (m,p-Cresol)	ug/kg	USEPA 8270D	--	3.12	6.25	34-120	30	34-120	30	30	90
3,3-Dichlorobenzidine	ug/kg	USEPA 8270D	--	24.9	50.1	22-121	30	22-121	30	30	90
3-Nitroaniline	ug/kg	USEPA 8270D	--	25	50	33-120	30	33-120	30	30	90
4,6-Dinitro-2-methylphenol	ug/kg	USEPA 8270D	--	31.2	62.5	29-132	30	29-132	30	30	90
4-Bromophenylphenyl ether	ug/kg	USEPA 8270D	--	3.12	6.25	46-124	30	46-124	30	30	90
4-Chloro-3-methylphenol	ug/kg	USEPA 8270D	--	12.5	25	45-122	30	45-122	30	30	90
4-Chloroaniline	ug/kg	USEPA 8270D	--	3.12	6.25	16-120	30	16-120	30	30	90
4-Chlorophenylphenyl ether	ug/kg	USEPA 8270D	--	3.12	6.25	45-121	30	45-121	30	30	90
4-Nitroaniline	ug/kg	USEPA 8270D	--	25	50	35-120	30	35-120	30	30	90
4-Nitrophenol	ug/kg	USEPA 8270D	--	12.5	25	30-132	30	30-132	30	30	90
Aniline	ug/kg	USEPA 8270D	--	6.25	12.5	7-120	30	7-120	30	30	90
Azobenzene	ug/kg	USEPA 8270D	--	3.12	6.25	39-125	30	39-125	30	30	90
Benzoic acid	ug/kg	USEPA 8270D	--	157	312	5-140	30	5-140	30	30	90
Benzyl alcohol	ug/kg	USEPA 8270D	--	6.25	12.5	29-122	30	29-122	30	30	90
Bis(2-chloroethoxy)methane	ug/kg	USEPA 8270D	--	3.12	6.25	36-121	30	36-121	30	30	90
Bis(2-chloroethyl)ether	ug/kg	USEPA 8270D	--	3.12	6.25	31-120	30	31-120	30	30	90

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Analyte	Units	Method	PH ROD Table 17 Sediment CUL	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
Bis(2-ethylhexyl)phthalate	ug/kg	USEPA 8270D	135	18.7	37.5	51-133	30	60-121	30	30	90
Butylbenzylphthalate	ug/kg	USEPA 8270D	--	12.5	25	48-132	30	48-132	30	30	90
Carbazole	ug/kg	USEPA 8270D	--	1.87	3.75	50-122	30	50-122	30	30	90
Di(2-ethylhexyl)adipate	ug/kg	USEPA 8270D	--	31.2	62.5	60-121	30	51-133	30	30	90
Dibenzofuran	ug/kg	USEPA 8270D	--	1.25	2.5	44-120	30	44-120	30	30	90
Diethyl phthalate	ug/kg	USEPA 8270D	--	12.5	25	50-124	30	50-124	30	30	90
Dimethyl phthalate	ug/kg	USEPA 8270D	--	12.5	25	48-124	30	48-124	30	30	90
Di-n-butyl phthalate	ug/kg	USEPA 8270D	--	12.5	25	51-128	30	51-128	30	30	90
Di-n-octyl phthalate	ug/kg	USEPA 8270D	--	12.5	25	44-140	30	44-140	30	30	90
Hexachlorobenzene	ug/kg	USEPA 8270D	--	1.25	2.5	44-122	30	44-122	30	30	90
Hexachlorobutadiene	ug/kg	USEPA 8270D	--	3.12	6.25	32-123	30	32-123	30	30	90
Hexachlorocyclopentadiene	ug/kg	USEPA 8270D	--	6.25	12.5	5-140	30	5-140	30	30	90
Hexachloroethane	ug/kg	USEPA 8270D	--	3.12	6.25	28-120	30	28-120	30	30	90
Isophorone	ug/kg	USEPA 8270D	--	3.12	6.25	30-122	30	30-122	30	30	90
Nitrobenzene	ug/kg	USEPA 8270D	--	12.5	25	34-122	30	34-122	30	30	90
N-Nitrosodimethylamine	ug/kg	USEPA 8270D	--	3.12	6.25	23-120	30	23-120	30	30	90
N-Nitrosodiphenylamine	ug/kg	USEPA 8270D	--	3.12	6.25	38-127	30	38-127	30	30	90
N-Nitrosodipropylamine	ug/kg	USEPA 8270D	--	3.12	6.25	36-120	30	36-120	30	30	90
Pentachlorophenol	ug/kg	USEPA 8270D	--	12.5	25	25-133	30	25-133	30	30	90
Phenol	ug/kg	USEPA 8270D	--	2.5	5	34-120	30	34-120	30	30	90
Pyridine	ug/kg	USEPA 8270D	--	6.25	12.5	5-120	30	5-120	30	30	90
PAH Homologs											
C1-Chrysenes/Benz(a)anthracenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C1-Fluoranthenes/Pyrenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C1-Fluorenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C1-Phenanthrenes/Anthracenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C2-Chrysenes/Benz(a)anthracenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C2-Fluorenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C2-Naphthalenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C2-Phenanthrenes/Anthracenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C3-Chrysenes/Benz(a)anthracenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C3-Fluorenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C3-Naphthalenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C3-Phenanthrenes/Anthracenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90
C4-Chrysenes/Benz(a)anthracenes	ug/kg	USEPA 8270D	--	--	25	--	--	--	--	30	90
C4-Naphthalenes	ug/kg	USEPA 8270D	--	--	12.5	--	--	--	--	30	90

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Portland, Oregon

Analyte	Units	Method	PH ROD Table 17 Sediment CUL	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
C4-Phenanthrenes/Anthracenes	ug/kg	USEPA 8270D	--	--	25	--	--	--	--	30	90
TPH											
Diesel Range Hydrocarbons	mg/kg	NWTPH-Dx	91	8.33	25	50-150	20	76-115	20	30	90
Lube Oil Range Hydrocarbons	mg/kg	NWTPH-Dx	--	16.7	50	--	--	--	--	30	90

NOTES:

Results reported by the laboratory on a dry-weight basis, and associated detection limits and/or quantitation limits are adjusted accordingly.

MS/MSD, LCS/LCSD and laboratory duplicate accuracy and/or precision criteria may be performance-based and updated by the laboratory.

% = percent.

-- = not applicable or no value available.

cPAHs = carcinogenic polycyclic aromatic hydrocarbons.

CUL = cleanup level.

LCS = laboratory control sample.

LCSD = laboratory control sample duplicate.

MDL = method detection limit.

mg/kg = milligrams per kilogram.

MS = matrix spike.

MSD = matrix spike duplicate.

ng/kg = nanograms per kilogram.

PAHs = polycyclic aromatic hydrocarbons.

PCB = polychlorinated biphenyls.

PH ROD = USEPA Portland Harbor Superfund Site Record of Decision (January 2017).

PQL = project quantitation limit.

RPD = relative percent difference.

SVOCs = semivolatile organic compounds.

TPH = total petroleum hydrocarbons.

ug/kg = micrograms per kilogram.

USEPA = U.S. Environmental Protection Agency.

[a] PCB congener results have sample-specific detection limits; typical detection limits range from 0.01 to 1.0 ng/kg and quantitation limits range from 10 to 40 ng/kg.

[b] The cleanup levels for PAHs are based on the Record of Decision and are currently being reviewed as part of the USEPA PAH Explanation of Significant Differences.

[b] PAH homolog batch precision is evaluated with USEPA Method 8270D SVOC LCS/LCSD.

Table 3-2
Aqueous Analtyical Methods and Performance Criteria
Siltronic Corporation
Portland, Oregon

Analyte	Units	Method	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
Metals										
Arsenic	ug/L	USEPA 6020A	0.5	1	75-125	20	80-120	20	40	90
Barium	ug/L	USEPA 6020A	0.5	1	75-125	20	80-120	20	40	90
Cadmium	ug/L	USEPA 6020A	0.04	0.2	75-125	20	80-120	20	40	90
Chromium	ug/L	USEPA 6020A	0.5	1	75-125	20	80-120	20	40	90
Copper	ug/L	USEPA 6020A	0.5	1	75-125	20	80-120	20	40	90
Lead	ug/L	USEPA 6020A	0.1	0.2	75-125	20	80-120	20	40	90
Mercury	ug/L	USEPA 6020A	0.04	0.08	75-125	20	80-120	20	40	90
Selenium	ug/L	USEPA 6020A	0.5	1	75-125	20	80-120	20	40	90
Silver	ug/L	USEPA 6020A	0.1	0.2	75-125	20	80-120	20	40	90
Zinc	ug/L	USEPA 6020A	2	4	75-125	20	80-120	20	40	90
Cyanide										
Total Cyanide	ug/L	USEPA 335.4	5	5	90-110	10	90-110	10	10	90
Dioxins/Furans										
1,2,3,4,6,7,8-HpCDD	pg/L	USEPA 1613B	2.08	50	70-130	20	70-140	20	--	90
1,2,3,4,6,7,8-HpCDF	pg/L	USEPA 1613B	1.12	50	70-130	20	82-122	20	--	90
1,2,3,4,7,8,9-HpCDF	pg/L	USEPA 1613B	1.71	50	70-130	20	78-138	20	--	90
1,2,3,4,7,8-HxCDD	pg/L	USEPA 1613B	1.21	50	70-130	20	70-164	20	--	90
1,2,3,4,7,8-HxCDF	pg/L	USEPA 1613B	0.936	50	70-130	20	72-134	20	--	90
1,2,3,6,7,8-HxCDD	pg/L	USEPA 1613B	1.15	50	70-130	20	76-134	20	--	90
1,2,3,6,7,8-HxCDF	pg/L	USEPA 1613B	0.942	50	70-130	20	84-130	20	--	90
1,2,3,7,8,9-HxCDD	pg/L	USEPA 1613B	1.2	50	70-130	20	64-162	20	--	90
1,2,3,7,8,9-HxCDF	pg/L	USEPA 1613B	1.37	50	70-130	20	78-130	20	--	90
1,2,3,7,8-PeCDD	pg/L	USEPA 1613B	1.11	50	70-130	20	70-142	20	--	90
1,2,3,7,8-PeCDF	pg/L	USEPA 1613B	0.818	50	70-130	20	80-134	20	--	90
2,3,4,6,7,8-HxCDF	pg/L	USEPA 1613B	1.03	50	70-130	20	70-156	20	--	90
2,3,4,7,8-PeCDF	pg/L	USEPA 1613B	0.784	50	70-130	20	68-160	20	--	90
2,3,7,8-TCDD	pg/L	USEPA 1613B	1.31	10	70-130	20	67-158	20	--	90
2,3,7,8-TCDF	pg/L	USEPA 1613B	2.02	10	70-130	20	75-158	20	--	90
OCDD	pg/L	USEPA 1613B	2.28	100	70-130	20	78-144	20	--	90
OCDF	pg/L	USEPA 1613B	2.72	100	70-130	20	63-170	20	--	90
PCB Congeners										
Total PCBs	pg/L	USEPA 1668C/Calculation	--[a]	--[a]	50-150	35	60-135	30	--	90

Table 3-2
Aqueous Analtyical Methods and Performance Criteria
Siltronic Corporation
Portland, Oregon

Analyte	Units	Method	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
Organochlorine Pesticides										
2,4'-DDD	ng/L	USEPA 1699	0.02	2	50-200	25	50-200	25	25	90
2,4'-DDE	ng/L	USEPA 1699	0.018	2	50-200	25	50-200	25	25	90
2,4'-DDT	ng/L	USEPA 1699	0.019	2	50-200	25	50-200	25	25	90
4,4'-DDD	ng/L	USEPA 1699	0.02	2	50-200	25	50-200	25	25	90
4,4'-DDE	ng/L	USEPA 1699	0.033	2	50-200	25	50-200	25	25	90
4,4'-DDT	ng/L	USEPA 1699	0.022	2	50-200	25	50-200	25	25	90
Total DDx	ng/L	USEPA 1699/Calculation	--	--	--	--	--	--	--	90
Aldrin	ng/L	USEPA 1699	0.028	2	50-200	25	50-200	25	25	90
alpha-BHC	ng/L	USEPA 1699	0.015	2	50-200	25	50-200	25	25	90
alpha-Chlordane	ng/L	USEPA 1699	0.019	2	50-200	25	50-200	25	25	90
beta-BHC	ng/L	USEPA 1699	0.029	2	50-200	25	50-200	25	25	90
beta-Chlordane	ng/L	USEPA 1699	0.018	2	50-200	25	50-200	25	25	90
Chlordane (Total)	ng/L	USEPA 1699/Calculation	--	--	--	--	--	--	--	90
cis-Nonachlor	ng/L	USEPA 1699	0.009	2	50-200	25	50-200	25	25	90
delta-BHC	ng/L	USEPA 1699	0.033	2	50-200	25	50-200	25	25	90
Dieldrin	ng/L	USEPA 1699	0.022	2	50-200	25	50-200	25	25	90
Endosulfan I	ng/L	USEPA 1699	0.041	2	50-200	25	50-200	25	25	90
Endosulfan II (beta)	ng/L	USEPA 1699	0.058	2	50-200	25	50-200	25	25	90
Endosulfan sulfate	ng/L	USEPA 1699	0.043	2	50-200	25	50-200	25	25	90
Endrin	ng/L	USEPA 1699	0.035	2	50-200	25	50-200	25	25	90
Endrin aldehyde	ng/L	USEPA 1699	0.051	2	50-200	25	50-200	25	25	90
Endrin ketone	ng/L	USEPA 1699	0.037	2	50-200	25	50-200	25	25	90
Heptachlor	ng/L	USEPA 1699	0.019	2	50-200	25	50-200	25	25	90
Heptachlor epoxide	ng/L	USEPA 1699	0.017	2	50-200	25	50-200	25	25	90
Hexachlorobenzene	ng/L	USEPA 1699	0.028	2	50-200	25	50-200	25	25	90
Lindane	ng/L	USEPA 1699	0.016	2	50-200	25	50-200	25	25	90
Methoxychlor	ng/L	USEPA 1699	0.025	2	50-200	25	50-200	25	25	90
Mirex	ng/L	USEPA 1699	0.026	2	50-200	25	50-200	25	25	90
Oxychlordane	ng/L	USEPA 1699	0.028	2	50-200	25	50-200	25	25	90
trans-Nonachlor	ng/L	USEPA 1699	0.008	2	50-200	25	50-200	25	25	90
Chlorinated Herbicides										

Table 3-2
Aqueous Analtyical Methods and Performance Criteria
Siltronic Corporation
Portland, Oregon

Analyte	Units	Method	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
2,4,5-T	ug/L	USEPA 8151A	0.13	0.25	15-159	25	39-151	25	25	90
2,4-D	ug/L	USEPA 8151A	0.21	0.5	17-180	25	56-164	25	25	90
2,4-DB	ug/L	USEPA 8151A	1.3	2.5	0.1-201	25	27-161	25	25	90
Dalapon	ug/L	USEPA 8151A	0.15	0.5	14-172	25	40-139	25	25	90
Dicamba	ug/L	USEPA 8151A	0.4	0.75	44-134	25	46-140	25	25	90
Dichlorprop	ug/L	USEPA 8151A	0.49	1	36-161	25	43-158	25	25	90
Dinoseb	ug/L	USEPA 8151A	0.19	0.5	53-146	25	42-146	25	25	90
MCPA	ug/L	USEPA 8151A	45	100	13-179	25	28-144	25	25	90
MCPP (Mecoprop)	ug/L	USEPA 8151A	63	100	30-154	25	31-153	25	25	90
Silvex	ug/L	USEPA 8151A	0.11	0.25	39-142	25	46-142	25	25	90
Organotins										
Tributyltin	ug/L	Krone et al.	0.0014	0.003	37-127	26	50-120	20	25	90
PAHs										
2-Methylnaphthalene	ug/L	USEPA 8270D	0.02	0.04	40-121	30	40-121	30	30	90
Acenaphthene	ug/L	USEPA 8270D	0.01	0.02	47-122	30	47-122	30	30	90
Acenaphthylene	ug/L	USEPA 8270D	0.01	0.02	41-130	30	41-130	30	30	90
Anthracene	ug/L	USEPA 8270D	0.01	0.02	57-123	30	57-123	30	30	90
Benzo(a)anthracene	ug/L	USEPA 8270D	0.01	0.02	58-125	30	58-125	30	30	90
Benzo(a)pyrene	ug/L	USEPA 8270D	0.015	0.03	54-128	30	54-128	30	30	90
Benzo(b)fluoranthene	ug/L	USEPA 8270D	0.015	0.03	53-131	30	53-131	30	30	90
Benzo(ghi)perylene	ug/L	USEPA 8270D	0.01	0.02	50-134	30	50-134	30	30	90
Benzo(k)fluoranthene	ug/L	USEPA 8270D	0.015	0.03	57-129	30	57-129	30	30	90
Chrysene	ug/L	USEPA 8270D	0.01	0.02	59-123	30	59-123	30	30	90
Dibenzo(a,h)anthracene	ug/L	USEPA 8270D	0.01	0.02	51-134	30	51-134	30	30	90
Fluoranthene	ug/L	USEPA 8270D	0.01	0.02	57-128	30	57-128	30	30	90
Fluorene	ug/L	USEPA 8270D	0.01	0.02	52-124	30	52-124	30	30	90
Indeno(1,2,3-cd)pyrene	ug/L	USEPA 8270D	0.01	0.02	52-133	30	52-133	30	30	90
Naphthalene	ug/L	USEPA 8270D	0.02	0.04	40-121	30	40-121	30	30	90
Phenanthrene	ug/L	USEPA 8270D	0.01	0.02	59-120	30	59-120	30	30	90
Pyrene	ug/L	USEPA 8270D	0.01	0.02	57-126	30	57-126	30	30	90
Total PAHs	ug/L	USEPA 8270D/Calculation	--	--	--	--	--	--	--	90

Table 3-2
Aqueous Analtyical Methods and Performance Criteria
Siltronic Corporation
Portland, Oregon

Analyte	Units	Method	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
cPAH TEQ	ug/L	USEPA 8270D/Calculation	--	--	--	--	--	--	--	90
SVOCs										
1,2,4-Trichlorobenzene	ug/L	USEPA 8270D	0.025	0.05	29-120	30	29-120	30	30	90
1,2-Dichlorobenzene	ug/L	USEPA 8270D	0.025	0.05	32-120	30	32-120	30	30	90
1,2-Dinitrobenzene	ug/L	USEPA 8270D	0.25	0.5	59-120	30	59-120	30	30	90
1,3-Dichlorobenzene	ug/L	USEPA 8270D	0.025	0.05	28-120	30	28-120	30	30	90
1,3-Dinitrobenzene	ug/L	USEPA 8270D	0.25	0.5	49-128	30	49-128	30	30	90
1,4-Dichlorobenzene	ug/L	USEPA 8270D	0.025	0.05	29-120	30	29-120	30	30	90
1,4-Dinitrobenzene	ug/L	USEPA 8270D	0.25	0.5	40-120	30	40-120	30	30	90
1-Methylnaphthalene	ug/L	USEPA 8270D	0.02	0.04	41-120	30	41-120	30	30	90
2,2'-oxybis(1-chloropropane)	ug/L	USEPA 8270D	0.025	0.05	37-130	30	37-130	30	30	90
2,3,4,6-Tetrachlorophenol	ug/L	USEPA 8270D	0.05	0.1	50-128	30	50-128	30	30	90
2,3,5,6-Tetrachlorophenol	ug/L	USEPA 8270D	0.05	0.1	50-121	30	50-121	30	30	90
2,4,5-Trichlorophenol	ug/L	USEPA 8270D	0.05	0.1	53-123	30	53-123	30	30	90
2,4,6-Trichlorophenol	ug/L	USEPA 8270D	0.05	0.1	50-125	30	50-125	30	30	90
2,4-Dichlorophenol	ug/L	USEPA 8270D	0.05	0.1	47-121	30	47-121	30	30	90
2,4-Dimethylphenol	ug/L	USEPA 8270D	0.05	0.1	31-124	30	31-124	30	30	90
2,4-Dinitrophenol	ug/L	USEPA 8270D	0.25	0.5	23-143	30	23-143	30	30	90
2,4-Dinitrotoluene	ug/L	USEPA 8270D	0.1	0.2	57-128	30	57-128	30	30	90
2,6-Dinitrotoluene	ug/L	USEPA 8270D	0.1	0.2	57-124	30	57-124	30	30	90
2-Chloronaphthalene	ug/L	USEPA 8270D	0.01	0.02	40-120	30	40-120	30	30	90
2-Chlorophenol	ug/L	USEPA 8270D	0.05	0.1	38-120	30	38-120	30	30	90
2-Methylphenol	ug/L	USEPA 8270D	0.025	0.05	30-120	30	30-120	30	30	90
2-Nitroaniline	ug/L	USEPA 8270D	0.2	0.4	54-127	30	54-127	30	30	90
2-Nitrophenol	ug/L	USEPA 8270D	0.1	0.2	47-123	30	47-123	30	30	90
3- & 4-Methylphenol (m,p-Cresol)	ug/L	USEPA 8270D	0.025	0.05	29-120	30	29-120	30	30	90
3,3-Dichlorobenzidine	ug/L	USEPA 8270D	0.5	1	27-129	30	27-129	30	30	90
3-Nitroaniline	ug/L	USEPA 8270D	0.2	0.4	41-128	30	41-128	30	30	90
4,6-Dinitro-2-methylphenol	ug/L	USEPA 8270D	0.25	0.5	44-137	30	44-137	30	30	90
4-Bromophenylphenyl ether	ug/L	USEPA 8270D	0.025	0.05	54-124	30	54-124	30	30	90
4-Chloro-3-methylphenol	ug/L	USEPA 8270D	0.1	0.2	52-120	30	52-120	30	30	90

Table 3-2
Aqueous Analtyical Methods and Performance Criteria
Siltronic Corporation
Portland, Oregon

Analyte	Units	Method	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
4-Chloroaniline	ug/L	USEPA 8270D	0.025	0.05	33-120	30	33-120	30	30	90
4-Chlorophenylphenyl ether	ug/L	USEPA 8270D	0.025	0.05	53-121	30	53-121	30	30	90
4-Nitroaniline	ug/L	USEPA 8270D	0.2	0.4	35-120	30	35-120	30	30	90
4-Nitrophenol	ug/L	USEPA 8270D	0.1	0.2	5-120	30	5-120	30	30	90
Aniline	ug/L	USEPA 8270D	0.05	0.1	6-120	30	6-120	30	30	90
Azobenzene	ug/L	USEPA 8270D	0.025	0.05	61-120	30	61-120	30	30	90
Benzoic acid	ug/L	USEPA 8270D	1.25	2.5	5-120	30	5-120	30	30	90
Benzyl alcohol	ug/L	USEPA 8270D	0.1	0.2	31-120	30	31-120	30	30	90
Bis(2-chloroethoxy)methane	ug/L	USEPA 8270D	0.025	0.05	48-120	30	48-120	30	30	90
Bis(2-chloroethyl)ether	ug/L	USEPA 8270D	0.025	0.05	43-120	30	43-120	30	30	90
Bis(2-ethylhexyl)phthalate	ug/L	USEPA 8270D	0.25	0.5	55-135	30	40-125	30	30	90
Butylbenzylphthalate	ug/L	USEPA 8270D	0.2	0.4	53-134	30	53-134	30	30	90
Carbazole	ug/L	USEPA 8270D	0.015	0.03	60-122	30	60-122	30	30	90
Di(2-ethylhexyl)adipate	ug/L	USEPA 8270D	0.2	0.4	40-125	30	55-135	30	30	90
Dibenzofuran	ug/L	USEPA 8270D	0.01	0.02	53-120	30	53-120	30	30	90
Diethyl phthalate	ug/L	USEPA 8270D	0.2	0.4	55-125	30	55-125	30	30	90
Dimethyl phthalate	ug/L	USEPA 8270D	0.2	0.4	45-127	30	45-127	30	30	90
Di-n-butyl phthalate	ug/L	USEPA 8270D	0.2	0.4	59-127	30	59-127	30	30	90
Di-n-octyl phthalate	ug/L	USEPA 8270D	0.2	0.4	50-140	30	51-140	30	30	90
Hexachlorobenzene	ug/L	USEPA 8270D	0.01	0.02	52-125	30	52-125	30	30	90
Hexachlorobutadiene	ug/L	USEPA 8270D	0.025	0.05	22-124	30	22-124	30	30	90
Hexachlorocyclopentadiene	ug/L	USEPA 8270D	0.05	0.1	5-127	30	5-127	30	30	90
Hexachloroethane	ug/L	USEPA 8270D	0.025	0.05	21-120	30	21-120	30	30	90
Isophorone	ug/L	USEPA 8270D	0.025	0.05	42-124	30	42-124	30	30	90
Nitrobenzene	ug/L	USEPA 8270D	0.1	0.2	45-121	30	45-121	30	30	90
N-Nitrosodimethylamine	ug/L	USEPA 8270D	0.025	0.05	6-120	30	6-120	30	30	90
N-Nitrosodiphenylamine	ug/L	USEPA 8270D	0.025	0.05	49-120	30	51-123	30	30	90
N-Nitrosodipropylamine	ug/L	USEPA 8270D	0.025	0.05	51-123	30	49-120	30	30	90
Pentachlorophenol	ug/L	USEPA 8270D	0.1	0.2	35-138	30	35-138	30	30	90
Phenol	ug/L	USEPA 8270D	0.2	0.4	5-120	30	5-120	30	30	90
Pyridine	ug/L	USEPA 8270D	0.1	0.2	5-120	30	5-120	30	30	90

Table 3-2
Aqueous Analtyical Methods and Performance Criteria
Siltronic Corporation
Portland, Oregon

Analyte	Units	Method	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)
PAH Homologs										
C1-Chrysenes/Benz(a)anthracenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C1-Fluoranthenes/Pyrenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C1-Fluorenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C1-Phenanthrenes/Anthracenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C2-Chrysenes/Benz(a)anthracenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C2-Fluorenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C2-Naphthalenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C2-Phenanthrenes/Anthracenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C3-Chrysenes/Benz(a)anthracenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C3-Fluorenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C3-Naphthalenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C3-Phenanthrenes/Anthracenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C4-Chrysenes/Benz(a)anthracenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C4-Naphthalenes	ug/L	USEPA 8270D	--	0.1	--	--	--	--[b]	30	90
C4-Phenanthrenes/Anthracenes	ug/L	USEPA 8270D	--	0.2	--	--	--	--[b]	30	90
TPH										
Diesel Range Hydrocarbons	ug/L	NWTPH-Dx	100	200	50-150	50	58-115	20	30	90
Lube Oil Range Hydrocarbons	ug/L	NWTPH-Dx	200	400	--	--	--	--	30	90

NOTES:

Results reported by the laboratory on a dry-weight basis, and associated detection limits and/or quantitation limits are adjusted accordingly.

MS/MSD, LCS/LCSD and laboratory duplicate accuracy and/or precision criteria may be performance-based and updated by the laboratory.

-- = not applicable or no value available.

cPAHs = carcinogenic polycyclic aromatic hydrocarbons.

LCS = laboratory control sample.

LCSD = laboratory control sample duplicate.

MDL = method detection limit.

MS = matrix spike.

MSD = matrix spike duplicate.

Table 3-2
Aqueous Analtyical Methods and Performance Criteria
Siltronic Corporation
Portland, Oregon

Analyte	Units	Method	MDL	PQL	MS/MSD Accuracy (Percent)	MS/MSD RPD (Percent)	LCS/LCSD Accuracy (Percent)	LCS/LCSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Completeness (RPD)

ng/L = nanograms per liter.
PAHs = polycyclic aromatic hydrocarbons.
PCB = polychlorinated biphenyls.
pg/L = picograms per liter.
PQL = project quantitation limit.
RPD = relative percent difference.
SVOCs = semivolatile organic compounds.
TPH = total petroleum hydrocarbons.
ug/L = micrograms per liter.
USEPA = U.S. Environmental Protection Agency.

[a] PCB congener results have sample-specific detection limits; typical detection limits range from 0.822 to 4.33 pg/L and quantitation limits range from 111 to 667 pg/L.

[b] PAH homolog batch precision is evaluated with USEPA Method 8270D SVOC LCS/LCSD.

Table 4-1
Investigation-Derived Waste Analyses
Siltronic Corporation
Portland, Oregon

Analysis	Method
Ignitability	SW1010
Corrosivity	SW9045D/SW9010C
TCLP Metals[a]	USEPA 1311/6020A
TCLP Mercury	USEPA 1311/7470A
TCLP VOCs[b]	USEPA 1311/8260D
TCLP Organochlorine Pesticides[c]	USEPA 1311/8081B
TCLP SVOCs	USEPA 1311/8270D or 8270E
TCLP Chlorinated Herbicides	USEPA 1311/8151A
Dioxins/Furans	USEPA 1613B or 8290A
Tributyltin	Krone et. al
Diesel- and Residual-Range Hydrocarbons	NWTPH-Dx
PCB Aroclors	USEPA 8082
Total Cyanide	SW9012B/USEPA 335.4
Percent Moisture	ASTM D2216

NOTES:

NWTPH = northwest total petroleum hydrocarbon.

PCB = polychlorinated biphenyl.

SVOC = semivolatile organic compound.

USEPA = U.S. Environmental Protection Agency.

[a] Metals include arsenic, barium, cadmium, chromium, copper, nickel, lead, mercury, selenium, and silver.

tetrachloroethene, trichloroethene, and vinyl chloride.

[c] Includes total Chlordane and total Toxaphene.

Table 4-2
Sediment Containers, Preservatives, and Holding Times
Siltronic Corporation
Portland, Oregon

Analysis	Method	Container[a]	Preservative	Holding Time (0-6 °C)	Holding Time (-18 °C)
Organochlorine Pesticides	USEPA 1699	8 oz glass	Cold Storage	14 days	1 year
PCB Congeners	USEPA 1668C	8 oz amber glass	Cold Storage	1 year	1 year
Dioxins/Furans	USEPA 1613B		Cold Storage	1 year	1 year
Chlorinated Herbicides	USEPA 8151A	8 oz glass	Cold Storage	14 days	1 year
Tributyltin	Krone et. al		Cold Storage	14 days	6 months
SVOCs	USEPA 8270D	16 oz glass	Cold Storage	14 days	1 year
Alkylated PAH Homologs	USEPA 8270D modified		Cold Storage	14 days	1 year
Metals, including mercury	USEPA 6020A		Cold Storage	6 months/28 days[b]	2 years/28 days[b]
Total Cyanide	ASTM D7511		Cold Storage	14 days	6 months
Diesel- and Residual-Range Hydrocarbons	NWTPH-Dx		Cold Storage	14 days	1 year
Total Solids	PSEP 1986		Cold Storage	14 days	6 months
Total Organic Carbon	USEPA 9060A		Cold Storage	28 days	6 months
Grain Size	ASTM D422 or PSEP	16 oz glass	NA	6 months	Do not freeze

Table 4-2
Sediment Containers, Preservatives, and Holding Times
Siltronic Corporation
Portland, Oregon

NOTES:

ASTM = American Society for Testing and Materials.

°C = degrees Celsius.

NA = not applicable.

NWTPH = northwest total petroleum hydrocarbon.

oz = ounces.

PAH = polycyclic aromatic hydrocarbon.

PCB = polychlorinated biphenyl.

PSEP = Puget Sound Estuary Program.

SVOC = semivolatile organic compound.

USEPA = US Environmental Protection Agency.

[a] Additional containers may be required for sediment samples with high moisture content. Fill containers no more than 90% to allow for expansion during freezing.

[b] Holding time for mercury is 28 days. Holding time of remaining USEPA Method 6020B metals is 6 months at 0-6 °C and 2 years at -18°C.

Table 4-3
Aqueous Containers, Preservatives, and Holding Times
Siltronic Corporation
Portland, Oregon

Analysis	Method	Container[a]	Container Size	Preservative	Holding Time (0-6 °C)
Organochlorine Pesticides	USEPA 1699	Amber Glass	1 Liter	None	7 days
PCB Congeners	USEPA 1668C	Amber Glass	1 Liter	None	1 year
Dioxins/Furans	USEPA 1613B	Amber Glass	1 Liter	None	1 year
Chlorinated Herbicides	USEPA 8151A	Amber Glass	1 Liter	None	7 days
Tributyltin	Krone et. al	Amber Glass	1 Liter	None	7 days
SVOCs	USEPA 8270D	Amber Glass	1 Liter	None	7 days
Alkylated PAH Homologs	USEPA 8270D modified				7 days
Metals, including mercury	USEPA 6020A	Polyethylene	250 mL	HNO_3 pH <2	6 months/28 days[a]
Total Cyanide	USEPA 335.4	Polyethylene	125 mL	NaOH pH >12	14 days
Diesel- and Residual-Range Hydrocarbons	NWTPH-Dx	Amber Glass	1 Liter	HCl pH <2	14 days

Table 4-3
Aqueous Containers, Preservatives, and Holding Times
Siltronic Corporation
Portland, Oregon

NOTES:

°C = degrees Celsius.

HCl = hydrochloric acid.

HNO_3 = nitric acid.

mL = milliliter.

NWTPH = northwest total petroleum hydrocarbon.

PAH = polycyclic aromatic hydrocarbon.

PCB = polychlorinated biphenyl.

SVOC = semivolatile organic compound.

[a] Holding time for mercury is 28 days. Holding time of remaining USEPA Method 6020B metals is 6 months at 0-6 °C.

Table 4-4
Quality Control Sample Requirement Summary
Siltronic Corporation
Portland, Oregon

Quality Control Check Sample	Sample Matrix		Frequency
	Sediment	Aqueous	
Equipment Rinsate Blanks	No	Yes	One per every twenty samples (or fewer) per equipment
Field Duplicate Samples	Yes	No	One per every twenty samples (or fewer) per sample matrix
Temperature Blank	Yes	Yes	One per sample cooler
Matrix Spike/Matrix Spike Duplicate	Yes	Yes	Each analytical batch of samples for every 20 (or fewer) samples received
Surrogate Spiking	Yes	Yes	Added to all project and QC samples (for organic analyses only)
Method Blanks	Yes	Yes	Each analytical batch of samples for every 20 (or fewer) samples received
Laboratory Control Sample	Yes	Yes	Each analytical batch of samples for every 20 (or fewer) samples received
Laboratory Duplicate Sample	Yes	Yes	Each analytical batch of samples for every 20 (or fewer) samples received

APPENDIX B

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN

SILTRONIC CORPORATION
PORTLAND, OREGON

Prepared for
SILTRONIC CORPORATION
PORTLAND, OREGON
May 30, 2019
Project No. 8128.02.05

Prepared by
Maul Foster & Alongi, Inc.
2001 NW 19th Avenue, Suite 200, Portland OR 97209

MAUL
FOSTER
ALONGI

HEALTH AND SAFETY PLAN
SILTRONIC CORPORATION
PORTLAND, OREGON

The material and data in this plan were prepared
under the supervision and direction of the undersigned.

MAUL FOSTER & ALONGI, INC.

Phil Wiescher, PhD
Senior Environmental Scientist

Courtney Savoie

Courtney Savoie, RG
Project Geologist

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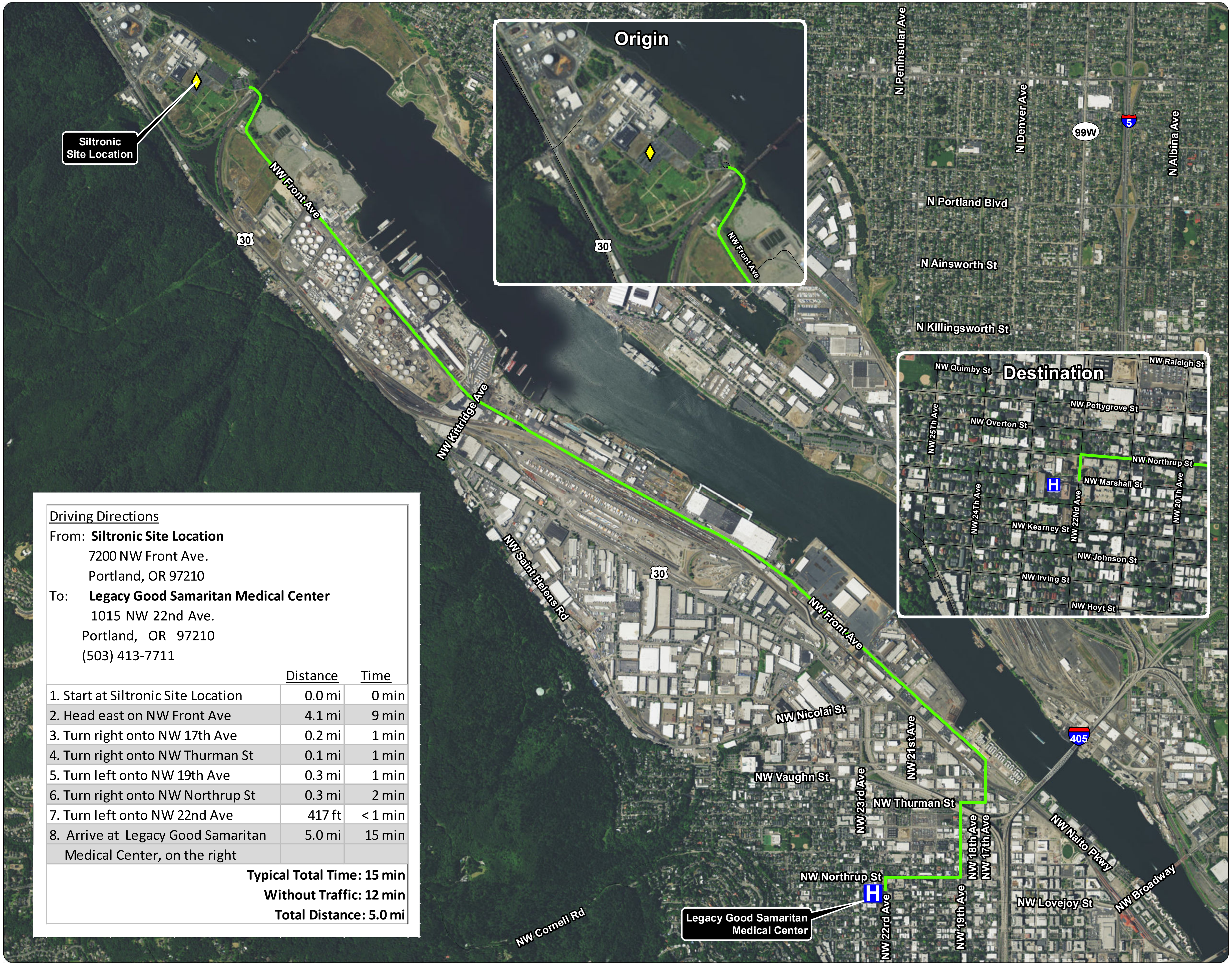
Print Date: 4/12/2016 Approved By: K. Gallagher Produced By: abrasch Project: 8128.01.22-05



Driving Directions

From: **Siltronic Site Location**
7200 NW Front Ave.
Portland, OR 97210

To: **Legacy Good Samaritan Medical Center**
1015 NW 22nd Ave.
Portland, OR 97210
(503) 413-7711

	Distance	Time
1. Start at Siltronic Site Location	0.0 mi	0 min
2. Head east on NW Front Ave	4.1 mi	9 min
3. Turn right onto NW 17th Ave	0.2 mi	1 min
4. Turn right onto NW Thurman St	0.1 mi	1 min
5. Turn left onto NW 19th Ave	0.3 mi	1 min
6. Turn right onto NW Northrup St	0.3 mi	2 min
7. Turn left onto NW 22nd Ave	417 ft	< 1 min
8. Arrive at Legacy Good Samaritan Medical Center, on the right	5.0 mi	15 min

Typical Total Time: 15 min
Without Traffic: 12 min
Total Distance: 5.0 mi

Figure
Hospital Access Route

Siltronic Corporation
Portland, Oregon

Legend

♦ Site Location

H Legacy Good Samaritan Medical Center

— Hospital Access Route

0 1,000 2,000
Feet

Sources: Basemap obtained from Esri ArcGIS Online; Legacy Good Samaritan Medical Center location obtained from Google Maps.

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1 NEAREST HOSPITAL/EMERGENCY MEDICAL CENTER

1.1 Nearest Hospital

Legacy Good Samaritan Hospital & Medical Center

1015 NW 22nd Avenue, Portland, Oregon 97210

Phone: (503) 413-7711

Distance: 5.0 miles

Travel Time: approximately 12 minutes without traffic

1.2 Route to Hospital from Site

See figure on first page of this document.

1.2.1 Driving Directions to Hospital from Site

1. Head east on Northwest Front Avenue (4.1 miles).
2. Turn right onto Northwest 17th Avenue (0.2 miles).
3. Continue on Northwest Thurman Street (0.1 miles).
4. Turn left on Northwest 19th Street (0.3 miles).
5. Bear right onto Northwest Northrup Street (0.3 miles).
6. Turn left onto Northwest 22nd Avenue (417 feet).
7. Arrive at Legacy Good Samaritan Hospital and Medical Center.

1.3 Emergency Phone Numbers

Siltronic maintains its own Emergency Response Team (ERT). The ERT is available 24 hours, seven days a week and is trained to respond to various types of emergencies, including, but not limited to, medical emergencies, spill response, and natural disasters. Should an emergency arise, Maul Foster & Alongi, Inc. (MFA) employees working at the Site (7200 NW Front Avenue, Portland, Oregon) are asked to contact the ERT instead of dialing 911. If necessary, the ERT team can contact 911 and guide them to the appropriate location at the Site. A radio capable of contacting the ERT can be obtained at the FAB-2 security desk when signing in at the start of a shift. The ERT team can also be reached by dialing 611 from any on-site landline or by dialing (503) 219-4300 from a mobile phone.

Ambulance, Police, Fire	**Dial 911**
Siltronic **Emergency Response Team**	Phone: **(503) 219-4300** From a Plant Phone: **611** Radio: **Channel 1**
Ted Wall Principal in Charge	Phone: **(503) 501-5210** Cell: **(503) 939-4849**
Michael Murray Project Manager	Phone: **(971) 713-3579** Cell: **(503) 310-0435**
Phil Wiescher Project Manager	Phone: **(360) 594-6267** Cell: **(503) 407-1036**
Courtney Savoie Field Personnel	Phone: **(503) 501-5220** Cell: **(503) 358-5950**
Emily Curtis Health and Safety Coordinator	Phone: **(503) 501-5233** Cell: **(503) 410-1524**
Bill Beadie Principal Industrial Hygienist	Phone: **(360) 947-2200** Cell: **(503) 740-6847**
Myron Burr **Siltronic—Primary Site Contact**	Phone: **(503) 219-7832** Cell: **(503) 807-9512** Blackberry: **(503) 807-9512**

2 PLAN SUMMARY

This health and safety plan (HASP) was developed to describe the procedures and practices necessary for protecting the health and safety of MFA employees conducting activities consistent with the sediment sampling work plan (Work Plan), to which this HASP is an appendix. For purposes of this HASP, the Site describes the study area in the Work Plan. Other employers, including contractors and subcontractors, are expected to develop and implement their own HASPs to manage the health and safety of their personnel.

MFA personnel conducting activities at the Site are responsible for understanding and adhering to this HASP. Before fieldwork begins, a site safety officer (SSO) who is familiar with health and safety procedures and with the Site will be designated by the on-site personnel. Safety deficiencies should be immediately communicated to the SSO and, if necessary, to MFA's health and safety coordinator (HSC).

All contractors and subcontractors have the primary responsibility for the safety of their own personnel on the Site. All personnel on the Site have "stop work" authority if they observe conditions that they believe create an imminent danger.

If MFA employees work on the Site for more than a year, this HASP will be reviewed at least annually. The plan will be updated as necessary to ensure that it reflects the known hazards, conditions, and requirements associated with the Site.

MFA personnel who will be working on the Site are required to read and understand this HASP. MFA personnel entering the work area must sign the Personnel Acknowledgment Sheet (Section 16), certifying that they have read and that they understand this HASP and agree to abide by it.

3 KEY PROJECT PERSONNEL

Name	Responsibility
Ted Wall	Project Director
Michael Murray	Project Manager
Phil Wiescher	Project Manager
Courtney Savoie	Lead Field Personnel
Bill Beadie	Principal Industrial Hygienist
Emily Curtis	Health and Safety Coordinator

4 SITE DESCRIPTION AND BACKGROUND

4.1 Type of Site

The Site is located within the Portland Harbor Superfund Site. Current operations within the Portland Harbor include bulk fuel storage, barge building, ship repair, automobile scrapping, recycling, steel manufacturing, cement manufacturing, transformer reconditioning, operation and repair of electrical transformers (including electrical substations), and many smaller industrial operations.

4.2 Building/Structures

No significant water features are present in the area proposed in the investigation. The railroad bridge is present at approximately river mile 6.9.

4.3 Topography

Not applicable–the Site is located in the water, off of the shoreline.

4.4 General Geologic/Hydrologic Setting

The Site is located along the Willamette River between river miles 6.5 and 6.9.

4.5 Site Status

The Site is located in the Portland Harbor Superfund Site. Contaminants and/or chemicals of interest associated with properties adjacent to the Site include:

- Manufactured gas plant waste, such as semi-volatile organic compounds that include naphthalene and benzo(a)pyrene
- Petroleum hydrocarbons
- Chlorinated volatile organic compounds
- Benzene, toluene, ethylbenzene, and total xylenes
- Metals, such as lead and arsenic
- Cyanide
- Pesticides and herbicides
- Dioxins/furans
- Polychlorinated biphenyls

4.6 General Site History

In 1978, Siltronic purchased the land adjacent to the Site for the purpose of silicon wafer manufacturing and continues to operate today.

5 HAZARD EVALUATION

5.1 Site Tasks and Operations

MFA has completed job hazard analyses (JHAs) for specific tasks that likely could be completed on the Site, depending on the scope of work. These tasks are provided in Appendix A. The following list generally summarizes planned tasks and operations:

- General work near heavy equipment
- Collecting sediment samples
- Working over water from boats and/or docks

The control measures that field personnel must use to eliminate or minimize these hazards, such as air monitoring, personal protective equipment (PPE), and decontamination procedures, are detailed in the JHAs and in subsequent sections of this plan.

5.2 Chemical Hazard Evaluation

Chemicals of potential concern (COPCs) on the Site are summarized in Appendix B. Action levels and associated controls are specified in Appendix C.

5.3 Physical Hazards

The specific physical hazards and associated controls for work on the Site are described in Appendix A, JHAs.

6 HEALTH AND SAFETY TRAINING

MFA personnel working on site and who could be exposed to COPCs will have completed training consistent with the Hazardous Waste Operations and Emergency Response requirements in 29 Code of Federal Regulations (CFR) 1910.120(e). The training will include:

- Identity of site safety and health personnel
- Safety and health hazards identified on the Site
- Proper use of required PPE
- Safe work practices required on the Site, e.g., fall protection, confined space entry procedures, hot work permits, general safety rules
- Safe use of engineering controls and equipment on the Site
- Medical surveillance requirements, including the recognition of signs and symptoms that might indicate overexposure to hazards
- The site emergency response plan/spill containment plan

The HSC will oversee training for site personnel. Training records, including an outline, sign-offs, and competency records, will be maintained by the HSC.

7 SAFETY EQUIPMENT

7.1 Personal Protective Equipment

PPE must be worn by individuals on the Site to protect against physical hazards. PPE required on the Site is modified Level D, which consists of:

- United States Coast Guard–approved personal floatation device, such as a life jacket
- Type 1 hard hat
- High-visibility vest
- Work boots
- Safety glasses with side shields
- Nitrile gloves or equivalent when handling known or potentially impacted media
- Hearing protection (during high-noise tasks)
- Work gloves (if handling materials that that might have sharp edges, protrusions, or splinters)

Additional PPE may be necessary for specific tasks with additional hazards. The SSO will be responsible for designating additional PPE for specific tasks. Depending on the activity, additional PPE may include:

- Chemical-resistant clothing, e.g., Tyvek® coveralls
- Chemical-resistant boots
- Chemical-resistant goggles
- Chemical-resistant gloves
- Faceshield
- Respiratory protection

Additional PPE may be required if workers discover unexpected contamination. Characteristics of unexpected contamination could include unusual odors, discolored media, a visible sheen, etc. The SSO and, if necessary, the HSC will be contacted as soon as possible after the discovery of unexpected contamination, and the SSO and/or the HSC will determine the need for additional controls and/or training.

PPE used at the Site must meet the requirements of recognized consensus standards (e.g., American National Standards Institute, National Institute for Occupational Safety and Health [NIOSH]), and respiratory protection shall comply with the requirements set forth in 29 CFR 1910.134.

Project personnel are not permitted to reduce the level of specified PPE without approval from the SSO or the HSC.

7.2 Safety Equipment

The SSO will be responsible for ensuring that the following safety equipment is available on site and is properly inspected and maintained:

- Soap and water for decontamination
- Caution tape, traffic cones, and/or barriers

- First-aid kit
- Fire extinguisher
- Fluids for hydration, e.g., drinking water or sports drink

7.3 Air Monitoring Equipment

The following air monitoring equipment will be available to identify site conditions that may require additional controls:

- Photoionization detection (PID) instrument

See Appendix C for specified action levels and follow-up actions.

7.4 Communications Equipment

MFA personnel should have a mobile phone or a radio available in case of emergency.

8 DECONTAMINATION PROCEDURES

8.1 Partial Decontamination Procedure

MFA employees will implement the following partial decontamination procedures when exiting the sampling vessel but remaining on the Site:

- Wash and rinse boots and outer gloves (if worn) in containers in the contamination-reduction zone.
- Inspect Tyvek® suit (if worn) for stains, rips, or tears. If suit is contaminated and is to be used again, full decontamination will be performed as described in Section 8.2. If the suit is damaged, it should not be reused.
- Remove outer gloves (if worn). Inspect and discard in a container labeled for disposable items if ripped or damaged.
- Remove respirator, if worn, and clean with premoistened alcohol wipes. Discard used cartridges at the frequency dictated by the SSO.
- Wash hands and face with soap and water.

8.2 Full Decontamination Procedures

MFA employees will follow the full decontamination procedures listed below when exiting the exclusion zone and leaving the Site, e.g., at the end of the work shift.

- Wash and rinse boots and outer gloves (if worn) in containers in the contamination-reduction zone.
- Remove outer gloves and Tyvek® suit (if worn) and deposit in a container labeled for disposable items.
- Remove respirator (if worn) and discard used cartridges at the frequency dictated by the SSO.
- Wash and rinse respirator (if worn) in a "respirators only" decontamination container.
- Remove work boots and put on street shoes. Place work boots in a plastic bag or container for later reuse.
- Remove inner gloves and deposit in a container labeled for disposable items.
- Wash hands and face with soap and water.
- Shower as soon after the work shift as practicable.

9 MEDICAL SURVEILLANCE

MFA will ensure that its employees who meet the following criteria are enrolled in a medical surveillance program consistent with 29 CFR 1910.120(f):

- The employees are, or may be, exposed to hazardous substances or health hazards at or above established permissible exposure limits for 30 or more days per year.
- The employees are required to wear a respirator for 30 or more days per year.

MFA employees who exhibit signs or symptoms consistent with overexposure to site contaminants will be offered medical surveillance consistent with Oregon Administrative Rule 1910.120(f)(iii).

MFA will ensure that its employees who are authorized to wear respirators are medically evaluated consistent with the respiratory protection standard (29 CFR 1910.134). The HSC or administrative designee (e.g., human resources manager) will maintain medical evaluation records.

10 AIR MONITORING

Based on site conditions, air monitoring is not anticipated; however, air monitoring equipment will be available in case workers encounter conditions that indicate the presence of unexpected contamination, such as unusual odors, discolored media, or a visible sheen. If such conditions are discovered, workers will exit the area and contact the SSO and, as needed, the HSC. If necessary, MFA will use the air monitoring equipment to evaluate the conditions and determine if additional controls and/or training are required. Action levels and follow-up actions are provided in Appendix C.

Air monitoring, if conducted, must be performed by individuals familiar with the calibration, use, and care of the required instruments. Measurements shall be documented, and the records should include the following information:

- The name of the person conducting the measurements
- The identity of workers, if any, who have exposure indicated by measurement result
- Information about the instrument, e.g., type, make, model, serial number
- The location of the measurement
- The measurement date and start/stop time
- Conditions represented by the measurement, including applicable activities, work practices, weather conditions, site conditions, and controls in place
- Measurement results
- Other relevant observations or notes

10.1 Air Monitoring Action Levels

If air monitoring is conducted, the results will be compared to the action levels provided in Appendix C. The air monitoring action levels are established to comply with Occupational Safety and Health Administration Permissible Exposure Levels, American Conference of Governmental Industrial Hygienists threshold limit values, and NIOSH recommendations for the chemicals that may be encountered on the Site. The action levels are also adjusted for the relative response of common PID instruments to motor-fuel vapors.

10.2 Explosion Hazard Action Levels

MFA employees working on site will take measurements when working near known or suspected sources of explosive gases or vapors. The instrument alarm should be set to sound at 10 percent of the lower explosive limit. When measurements exceed this level, MFA employees on site will:

1. Extinguish ignition sources and shut down powered equipment in the work area.
2. Move personnel at least 100 feet away from the work area.
3. Contact the SSO and the HSC.
4. At the instruction of the HSC and after waiting 15 minutes for explosive gases to dissipate, the SSO may use the combustible gas meter to approach the worksite to measure combustible gases in the work area. The SSO shall not enter (or allow any personnel to enter) any area where the combustible gas meter readings exceed the explosivity action level, nor shall the SSO approach if there is a potential for fire or explosion.

5. The SSO may authorize personnel to reenter the work area after the source of the combustible gases has been identified and controlled.

10.3 Instrument Calibrations

Instruments shall be calibrated consistent with manufacturers' recommendations. Calibrations shall be coordinated by the SSO. Calibration and monitoring records shall be maintained by the SSO and/or the project manager.

11 SITE CONTROL MEASURES

Access to the Site will be controlled as part of the site preparation. Control measures may include fencing, gates, and signs limiting access to everyone except authorized personnel.

MFA requires the "buddy system" if personnel conduct operations that may involve exposure to site hazards. The buddy system may involve working with non-MFA personnel.

12 EMERGENCY RESPONSE / SPILL CONTAINMENT / CONFINED SPACE

MFA employees on site will follow the emergency response, spill response, and confined space procedures described in the MFA Health and Safety Manual. Incidents will be documented on the incident report form included with Appendix D.

13 PRE-ENTRY BRIEFING

MFA employees on site will conduct pre-entry briefings, e.g., tailgate meetings, before starting work on the Site and/or as the scope of work changes throughout the project to ensure that employees are familiar with the HASP and that the plan is being followed. Attendance and discussion topics will be documented on sign-in sheets, which will be maintained by the SSO. A tailgate safety meeting checklist is provided in Appendix E.

14 PERIODIC EVALUATION

The project manager or designee will evaluate the effectiveness of this HASP. As part of the evaluation, the project manager or designee will track ongoing health and safety feedback from field personnel working on the project. This feedback will be reviewed and incorporated into either immediate or annual updates of the HASP. HASPs will be reviewed and updated at least annually. Updating the plan as necessary ensures that it reflects the known hazards, conditions, and requirements associated with the Site. MFA will maintain periodic evaluation records and will track all HASP revisions.

15 SAFE WORK PRACTICES

The following safe work practices are provided to supplement the other information included with this HASP:

1. Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of materials is prohibited in areas with potentially contaminated materials.
2. Field personnel will, whenever practicable, remain upwind of drilling rigs, open excavations, and other site-disturbing activities.
3. Subsurface work shall not be performed at any location until the area has been confirmed by a utility-locator firm to be free of underground utilities or other obstructions.

16 ACKNOWLEDGMENT

MFA cannot guarantee the health or safety of any person entering the Site. Because of the potentially hazardous nature of visits to active sites, it is not possible to discover, evaluate, and provide protection against all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at the Site. The health and safety guidelines in this plan were prepared specifically for the Site and should not be used on any other site without prior evaluation by trained health and safety personnel.

MFA personnel who will work at the Site are to read, understand, and agree to comply with the specific practices and guidelines described in this HASP regarding field safety and health hazards.

This HASP has been developed for the exclusive use of MFA personnel. MFA may make this plan available for review by contracted or subcontracted personnel for information only. This plan does not cover the activities performed by employees of any other employer on the Site. All contracted or subcontracted personnel are responsible for implementing their own health and safety program, including generating and using their own plan.

I have read and I understand this HASP and all attachments, and agree to comply with the requirements described herein:

Name	Title	Date

APPENDIX A

JOB HAZARD ANALYSES

Job Hazard Analysis (JHA)

Task/Operation: Sediment Sampling		
Project Number: 8128.02.05	**Location/Site where Task/Operation Performed:** Willamette River Mile 6.5 to 6.9 Siltronic Property, Portland, Oregon	
Date Prepared: 4/19/19	**Employee Preparing this JHA:** Carolyn Wise	
Date Reviewed: 5/17/19	**Employee Reviewing and Certifying this JHA:** Phil Wiescher	
Job/Task Description		
Employees will conduct work such as sediment sampling from a boat.		
Physical Hazards		
Physical Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Eye injury	Construction debris (e.g., soil) coming into contact with eyes.	Wear eye protection with side shields.
Injuries caused by improper lifting	Equipment, core sampler, sample coolers.	Use proper bending/lifting techniques by bending and lifting with legs and not with back. Do not twist at the waist when turning the core sampler. Use buddy system for heavy objects.
Accidents with equipment/tools	Sample collection equipment/tools.	Verify you have the appropriate equipment/tools for tasks. Use equipment/tools only as intended by the manufacturer. Stow all tools in vehicle properly; use appropriate cases and bags. Secure equipment in boat with netting or straps—do not leave loose.
Biological/Chemical Hazards		
Biological/Chemical Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Chemical	Personnel performing tasks may come into direct contact with contaminated materials in the soil.	If necessary, see Chemical Hazards Summary Table for applicable chemical hazards.

Additional Control Measures and Guidance

Engineering Controls: No engineering controls specified.

General Safe-Work Practices and Guidance:

- Triple-rinse sampling equipment using distilled or deionized water and alconox for first rinse, and distilled water for second and third rinses.
- Always clean materials between locations at the site to avoid cross-contamination.
- Do not take equipment from the site without first properly decontaminating said equipment.
- Sampling in boat—see JHA for working over water from boats.

Personal Protective Equipment: Hard hat, work boots, high-visibility vest, United States Coast Guard–approved personal floatation device such as a life jacket, safety glasses with side shields, nitrile gloves, and hearing protection if sampling using a drill-rig or around heavy equipment.

Job Hazard Analysis (JHA)

Task/Operation: Working Near Heavy Equipment

Project Number: 8128.02.05	**Location/Site Where Task/Operation Performed:** Willamette River Mile 6.5 to 6.9 Siltronic Property, Portland, Oregon
Date Prepared: 4/19/19	**Employee Preparing this JHA:** Carolyn Wise
Date Reviewed: 5/17/19	**Employee Reviewing and Certifying this JHA:** Phil Wiescher

Job/Task Description

Employees will conduct work, such as sediment sampling, using a Vibracore sampler. This will require working in close proximity to physical hazards associated with the drilling equipment.

Physical Hazards

Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Heat/cold/sunburn	Weather.	Wear sunscreen on exposed skin. Stop work and move to a shaded area to drink water if there are symptoms of heat stress. During cold conditions, wear adequate clothing to reduce the potential for hypothermia.
Bodily harm or death	Heavy equipment operating on site creates a potential for site workers to be struck, crushed, or impacted by moving parts.	Stay a safe distance from equipment and maintain eye contact with equipment operators. Wear a safety vest for enhanced visibility.
Eye injury	Construction debris (e.g., soil) coming into contact with eyes.	Wear eye protection with side shields.
Head injury	Heavy equipment and/or tools impacting the head.	Wear a hard hat.
Penetration of feet	Sharp objects that could be stepped on; large objects falling on feet.	Wear steel-toe boots with steel shank.
Hearing loss	Noise generated by heavy equipment/machinery.	Wear hearing protection such as ear plugs or ear muffs.
Hand injury	Pinch points.	Wear protective gloves whenever possible. Avoid placing hands near operating equipment.

Biological and Chemical Hazards

Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Site contaminants	Field personnel will be performing tasks that may cause them to come into direct contact with contaminated materials in sediment.	Always handle materials with nitrile gloves. If necessary, see Chemical Hazards Summary Table for applicable chemical hazards.

Additional Control Measures and Guidance

Engineering Controls: No engineering controls specified.

Task/Operation: Working Near Heavy Equipment
General Safe-Work Practices and Guidance: Personnel should stay upwind and out of the impact area of the heavy equipment, if feasible. Work conducted in the impact area must be coordinated with the equipment operator using pre-established methods of communication, such as direct eye contact, hand signals, and/or verbal communication.
Personal Protective Equipment: Hard hat, steel-toe work boots, high-visibility safety vest or outer garment, United States Coast Guard–approved personal floatation device such as a life jacket, safety glasses with side shields, nitrile gloves, and hearing protection, i.e., ear plugs or ear muffs.

Job Hazard Analysis (JHA)

Task/Operation: Working over Water from Boats and Docks

Project Number: 8128.02.05	**Location/Site where Task/Operation Performed:** Willamette River Mile 6.5 to 6.9 Siltronic Property, Portland, Oregon
Date Prepared: 4/19/19	**Employee Preparing this JHA:** Carolyn Wise
Date Reviewed: 5/17/19	**Employee Reviewing and Certifying this JHA:** Phil Wiescher

Job/Task Description

Employees will conduct work such as sediment sampling from a boat. This will require occasional work in close proximity to water.

Physical Hazards

Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
Drowning	Entering body of water where work is being conducted.	Wear a personal floatation device.

Biological and Chemical Hazards

Hazard/Risk	**Source of Hazard/Risk**	**Hazard/Risk Mitigation**
None	None specific to this JHA. Chemical hazards related to the site are described in the Chemical Hazards Summary Table.	None.

Additional Control Measures and Guidance

Engineering Controls: No engineering controls specified.

General Safe-Work Practices and Guidance: Personnel should stay upwind and out of the impact area of the heavy equipment, if feasible. Work conducted in the impact area must be coordinated with the equipment operator using pre-established methods of communication, such as direct eye contact, hand signals, and/or verbal communication.

Personal Protective Equipment: United States Coast Guard–approved personal floatation device such as a life jacket.

APPENDIX B

CHEMICALS OF POTENTIAL CONCERN

Table
Chemical Hazards
Siltronic Corporation
Portland, Oregon

	OSHA PEL (TWA)	ACGIH TLV (TWA)	NIOSH IDLH[a]	LEL (%)	IP (eV)	Other Hazard
TPH						
Diesel-Range Organics (TPH-D)	NA	100 mg/m^3	NA	NA	NA	E, F, P
PAHs						
Anthracene	0.2 mg/m^3	0.2 mg/m^3	80 mg/m^3	0.6	NA	F, P
Acenaphthene	NE	NE	NE	0.6	NA	F, P
Acenaphthylene	NE	NE	NE	NA	NA	F, P
Benzo(a)anthracene	NE	NE	NE	NA	NA	C, P
Benzo(a)pyrene	0.2 mg/m^3	0.2 mg/m^3	80 mg/m^3	NA	NA	C, P
Benzo(b)fluoranthene	NE	NE	NE	NA	NA	C, P
Benzo(g,h,i)perylene	NE	NE	NE	NA	NA	P
Benzo(k)fluoranthene	NE	NE	NE	NA	NA	C, P
Chrysene	0.2 mg/m^3	0.2 mg/m^3	80 mg/m^3	NA	7.59	C, P
Dibenz(a,h)anthracene	NE	NE	NE	NA	NA	C, P
Fluoranthene	NE	NE	NE	NA	NA	SC, P
Fluorene	NE	NE	NE	NA	NA	NA
Indeno(1,2,3-cd)pyrene	NE	NE	NE	NA	NA	SC
Naphthalene	10 ppm	10 ppm	250 ppm	0.9	8.12	SC, E, F, P
Phenanthrene	0.2 mg/m^3	0.2 mg/m^3	80 mg/m^3	NA	NA	NA
Pyrene	0.2 mg/m^3	0.2 mg/m^3	80 mg/m^3	NA	NA	P
1-Methylnaphthalene	NE	0.5 ppm	NE	NA	NA	SC, E, F, P
2-Methylnaphthalene	NE	0.5 ppm	NE	NA	NA	SC, E, F, P
Remaining PAH constituents	NA	NA	NA	NA	NA	NA
Metals						
Arsenic	0.01 mg/m^3	0.01 mg/m^3	5 mg/m^3	NA	NA	C, P
Barium	0.5 mg/m^3	0.5 mg/m^3	NE	NA	NA	R, P
Beryllium	0.002 mg/m^3	0.025 mg/m^3	4 mg/m^3	NA	NA	C
Cadmium	0.0050 mg/m^3	0.002 mg/m^3	9 mg/m^3	NA	NA	C
Chromium	1 mg/m^3	0.5 mg/m^3	250 mg/m^3	NA	NA	R, P
Chromium (VI)	0.001 mg/m^3	0.05 mg/m^3	15 mg/m^3	NA	NA	R, C
Copper	1 mg/m^3	0.2 mg/m^3	100 mg/m^3	NA	NA	NA
Lead	0.05 mg/m^3	0.05 mg/m^3	100 mg/m^3	NA	NA	C, P
Manganese	5 mg/m^3	0.02 mg/m^3	500 mg/m^3	NA	NA	NA
Mercury	0.1 mg/m^3 (Ce)	0.01 mg/m^3	2 mg/m^3	NA	NA	R, P
Nickel	0.1 mg/m^3	0.1 mg/m^3	10 mg/m^3	NA	NA	C
Selenium	0.2 mg/m^3	0.2 mg/m^3	1 mg/m^3	NA	NA	R, P
Silver	0.01 mg/m^3	0.1 mg/m^3	10 mg/m^3	NA	NA	R, P
Zinc	10 mg/m^3	2 mg/m^3	500 mg/m^3	NA	NA	NA
Additional						
Cyanide	5 mg/m^3	NE	25 mg/m^3	NA	NA	NA
Methane	NE	NE	NE	5	None	F, P

Table
Chemical Hazards
Siltronic Corporation
Portland, Oregon

NOTES:

ACGIH = American Conference of Governmental Industrial Hygienists®.

C = carcinogen.

Ce = ceiling concentration.

E = explosive.

F = flammable.

IDLH = immediately dangerous to life and health.

IP (eV) = ionization potential.

LEL = lower explosive limit.

mg/m^3 = milligrams per cubic meter.

NA = not available.

NE = not established.

NIOSH = National Institute for Occupational Safety and Health.

OSHA = Occupational Safety and Health Administration.

P = poison.

PAH = polycyclic aromatic hydrocarbon.

PEL = permissible exposure level.

ppm = parts per million.

R = reactive.

SC = suspected carcinogen.

TLV = threshold limit value.

TPH = total petroleum hydrocarbon.

TWA = time-weighted average.

[a] IDLH values taken from http://www.cdc.gov/niosh/idlh/intridl4.html.

APPENDIX C

AIR MONITORING ACTION LEVELS

Air Monitoring Procedures and Toxicity Action Levels

Instrument	Action Level	Initial Action	Follow-up Action
PID[a]	Detection of 10 ppm (above ambient) in breathing zone.	Upgrade to Level C and continue to monitor breathing zone. **If 50 or more ppm, leave exclusion zone**. Return only if levels decrease to below 50 ppm.	Ventilate area; always work upwind.

NOTES:

HASP = health and safety plan.

PID = photoionization detector.

ppm = parts per million.

[a] Some PIDs do not work in high (e.g., greater than 90 percent) humidity or rainy weather. Under these atmospheric conditions, only PIDs certified for use in high humidity should be used.

APPENDIX D
INCIDENT REPORT FORM

MAUL FOSTER & ALONGI, INC.
HEALTH & SAFETY INCIDENT REPORT

THIS REPORT MUST BE COMPLETED IN FULL AND SUBMITTED WITHIN 24 HOURS TO THE MFA HEALTH AND SAFETY COORDINATOR

Project Name: ______________________________

Project Number: ______________________________

Date of Incident: ______________________________

Time of Incident: ______________________________

Location: ______________________________

Type of Incident (Check all applicable items)

- ☐ **Illness**
- ☐ **Injury**
- ☐ **Property Damage**
- ☐ **Other (describe):** ______________________________
- ☐ **Health & Safety Infraction**
- ☐ **Fire, Explosion, Flash**
- ☐ **Unexpected Exposure**
- ☐ **Vehicular Accident**
- ☐ **Electric Shock**
- ☐ **Near Miss**

DESCRIPTION OF INCIDENT

(Describe what happened and the possible cause of the incident. Identify individual(s) involved, witnesses, and their affiliations. Describe emergency or corrective action taken. Attach additional sheets, drawings, or photographs as needed.)

INCIDENT REPORTER

______________________	______________________	______________
PRINT NAME	**SIGNATURE**	**DATE**

Site Safety Officer must deliver this report to the Health & Safety Coordinator within 24 hours. Reviewed by:

______________________	______________________	______________
PRINT NAME **MFA Health & Safety Coordinator**	**SIGNATURE** **MFA Health & Safety Coordinator**	**DATE**

APPENDIX E

TAILGATE SAFETY MEETING CHECKLIST

Tailgate Safety Meeting Checklist

MAUL FOSTER ALONGI

Client Name:	
Project No.:	
Communicated By:	
Date:	

Yes	**NA**	**Information Reviewed**
☐	☐	Emergency Procedures and Site Evacuation Routes
☐	☐	Route to Hospital
☐	☐	HASP Review and Location
☐	☐	Key Project Personnel
☐	☐	Emergency Phone Numbers
☐	☐	Stop-Work Authority
☐	☐	General Site Description/History and Chemical Hazards
☐	☐	For Active Sites—Site Activities and Vehicular/Equipment Traffic
☐	☐	Site-Specific Physical Hazards
☐	☐	Required Personal Protective Equipment
☐	☐	Available Safety Equipment and Location
☐	☐	Daily Scope of Work (Reference JHAs as applicable)
☐	☐	Decontamination Procedures
☐	☐	Identify Work Zones, Exclusion Zones, and Decontamination Zones
☐	☐	Hazardous Atmospheres
☐	☐	Air Monitoring Equipment and Procedures
☐	☐	Identify Potential Site-Specific Slip, Trip, and Fall Hazards
☐	☐	Dust and Vapor Control
☐	☐	Confined Space(s)
☐	☐	Open Pits and Excavation
☐	☐	Extreme Temperatures
☐	☐	Incident Reporting
☐	☐	Other: ____

Suggestions to Improve HS Practices

Attendees

Name	Signature	Company
1)		
2)		
3)		
4)		
5)		
6)		
7)		
8)		

APPENDIX C

APPENDIX B-1 EXCERPTED FROM SUBSURFACE FSP: PROCEDURES FOR NAPL IN SEDIMENT

APPENDIX B-1

Hydrocarbon Field Screening by Sheen Test and Field Description Key for Potential NAPL in Sediments

Appendix B-1

Standard Operating Procedure

Hydrocarbon Field Screening by Sheen Test

1.0 Purpose and Applicability

The Standard Operating Procedure (SOP) for sheen test describes a procedure to visually estimate areas of possible hydrocarbon impacts in soil or sediment. In addition, screening results can be used to aid in the selection of soil/sediment samples for chemical analysis. The field screening method includes a visual examination and water jar screening test.

Visual screening consists of inspecting the soil/sediment for stains, nonaqueous-phase liquids (NAPL), and/or sheens indicative of residual hydrocarbons. Visual screening is most effective at detecting heavy hydrocarbons, such as creosote, free-phase NAPL or high hydrocarbon concentrations. Water sheen screening from a representative soil/sediment sample is a more sensitive method at detecting the presence of hydrocarbons.

2.0 Responsibilities

The project manager is responsible for ensuring that a properly designed sampling program is prepared prior to any sample collection. The field sampling coordinator will have the responsibility to oversee and ensure that all sampling is performed in accordance with the project-specific sampling program and this SOP. In addition, the field sampling coordinator must ensure that all field workers are fully apprised of this SOP.

3.0 Health and Safety

This section presents the potential hazards associated with this technique. The site-specific Health & Safety Plan (HASP) will take precedence over this document. Note that sample collection usually requires Level D personal protection unless there is a potential for airborne or dermal exposures to site contaminants.

Health and safety hazards include but are not limited to the following:

- Dermal exposure to potentially contaminated media: proper personal protective equipment (PPE) is used to mitigate dermal contact including the impact of splashes of water or media to skin and/or eyes;
- Inhalation exposure when handling impacted media: respiratory protection should follow the procedures outlined in the project Site-Specific HASP; and
- Broken glass, in the event that a glass jar is used: use care when handling glassware.

4.0 Supporting Materials

The following materials must be on hand in sufficient quantity to ensure that proper screening procedures may be followed:

- Approximately one cubic-inch of media to be screened;
- 4 of 8 oz. wide-mouth, clear glass jar;
- Stirring devise (i.e. spoon);
- Squirt bottle; and
- Supply of distilled water.

5.0 Methods and Procedures

The strategy used to collect soil/sediment samples in the field for sheen testing will depend on the nature/grain size of the material and the type of hydrocarbon. Discrete samples may be collected from specific depths where NAPL is likely to occur. When lithology is course-grained material over fine-grained material, then a sample should be collected just above this interface where NAPL may be pooling above the "aquitard". Similarly, where fine-grained material overlies a coarse-grained layer with suspected impacts, the sample should be collected just below the contact. When lithology is fine-grained, then a sample should be collected near the contact with the coarse-grained layer. Alternatively, when lithology is finely bedded (< 1-inch thick), then homogenized samples may be collected over a larger depth interval to gain an "average" observation.

If the sample is being collected from inside a sediment core tube, the tube should be cut open longitudinally along the length of the core tube to prevent additional smearing. Make sure the interior of the sediment is exposed as a "fresh surface". Be sure to discard any material along the inside side-walls of the core tube; this is called the "smear zone". The smear zone may mask the true stratigraphy of a subsurface core sample. Then, use a spoon to scrap material across the "fresh" surface of the depth interval of interest, and place into sample jars for further observation. Once the sample volume is collected (approximately 1 oz or more depending upon grain size) the sample is examined and tested as described below.

Visual Examination

In the field, observe sediment core tubes or soil samples for evidence of NAPL. Look at the material and note color and type/nature of occurrence. Observe the exterior and interio sidewalls of the sampling container for signs of staining. If wet, observe the nature of liquid. Among gravels, observe the surface of the gravel for signs of sheen and/or NAPL.

Water Sheen Test

Water sheen screening involves placing soil/sediment in a clear glass jar or a black plastic pan partially filled with water, and observing the water surface for signs of a sheen. The volume of soil/sediment required for observation is approximately one cubic inch, or 10 mls, or about one tablespoon of media. For practical application in the field or lab, place about one cubic inch of soil/sediment (roughly 1 oz) in a 4 to 8 oz jar filled ¼-full with water. For larger volumes, use about 2 oz of material in an 8 oz wide-mouth glass jar filled ¼-full with water. Even larger volumes are needed for gravel. A plastic baggy may be substitute for a glass jar if field conditions require. Crush the material in the jar using a stirring devise (i.e., spoon), and shake the sealed jar vigorously for 30 seconds and allow the material to settle. Observe the water surface and sidewalls of the jar for signs of sheen, LNAPL, and DNAPL. Quantify the amount of sheen and blebs in the water surface using the following sheen classification:

No Sheen	No visible sheen on water surface
Slight Sheen	Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly
Moderate Sheen	Light to heavy sheen, may have some color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas without sheen on water surface
Heavy Sheen	Heavy sheen with color/iridescence; spread is rapid; entire water surface may be covered with sheen; visible droplets of immiscible liquids (i.e. NAPL)

Quantify the spatial coverage of sheen and size/diameter NAPL blebs if observed. The color is often described as rainbow or metallic for sheens and dark brown to black for blebs, droplets, and staining. Observe the sidewalls of the jar and estimate the thickness of LNAPL on the water surface and the thickness of DNAPL accumulated at the bottom of the jar. Record visual signs of staining on jar sidewalls and stirring devise.

Field screening results will be recorded on the field logs forms or in a field notebook. Field screening results are site-specific and location-specific. Factors that may affect the performance of this method include: operator experience (experimentation may be required before routine screening is started) ambient air temperature, soil type, soil moisture, organic content, and type of hydrocarbon. Headspace screening may be collected to help correlate results and observations.

6.0 Quality Assurance/Quality Control

Not applicable.

7.0 Documentation

Documentation may consist of all or part of the following:

- Field sampling forms;
- Field log book; and
- Chain-of-custody forms.

Field records should contain sufficient detail to provide a clear understanding of how and where samples were collected. All documentation shall be placed in the project files and retained following completion of the project.

Appendix B-1

Field Description Key for Potential NAPL in Sediment

The intent of this field description key is to provide field personnel with guidelines for logging and observing sediment conditions associated with potential presence of Non-Aqueous Phase Liquid (NAPL) in a consistent and factual manner.

VISUAL DESCRIPTORS

The range of conditions that could exist in sediments include:

- **NAPL** (Non-Aqueous Phase Liquid) – a separate phase liquid that may be lighter than water (LNAPL) or denser than water (DNAPL). NAPL can have varying consistency (viscosity) and can range from non-viscous to highly viscous (taffy-like). NAPL observations should be accompanied by applicable olfactory with smell (see descriptors below) and other visual observations (e.g., color and viscosity). The visual appearance of NAPL should be noted using descriptors below as appropriate. If NAPL is identified, then a sheen or shake test should be completed as described in this SOP in the Hydrocarbon Field Screening by Sheen Test portion.
    - **Free Product –** the entirety of the pore space for a sample interval is saturated with NAPL. Care should be taken to ensure that the saturation described is not related to water in the sample. Depending on the viscosity, NAPL saturated materials may freely drain from a soil sample and should be documented accordingly.
    - **Present–** In some cases, NAPL may be present in the pore spaces, or some of the pore spaces, but not coating the soil grains. The NAPL occurrence may be greater than blebs but not freely draining (saturated) and not hydraulically continuous. In these cases, the appearance/abundance of the NAPL should be noted.
    - **Blebs or Globules–** discrete, multi-shaped NAPL in or on the soil matrix. Include additional descriptors to the extent practicable such as the approximate size (typically ranging in size from 0.01 to 0.05 inches in diameter) and quantity (number of blebs or qualitative estimate) to the extent practical.
    - **Coated –** soil grains are coated with NAPL – there is not sufficient NAPL present to saturate the pore spaces. Use modifiers such as light, moderate or heavy to indicate the degree of coating.
    - **Semi-solid NAPL–** NAPL that is present as a super viscous liquid and appears in a solid or semi-solid phase. The magnitude of the observed solid NAPL should be described (discrete granules, tarry balls, taffy-like, or a solid layer).
- **Sheen –** iridescent sheen. The sheen characteristics need to be described in the field log, including the color, and iridescent sheens need to be distinguished from bacterial sheens which tend to break up at angles on the water surface; whereas a non-bacterial sheen will be continuous and will not break up. Sheens can be described as:
    - Discontinuous sheen (i.e., spotty, streaks, florets) within a section of core and does not fill sediment pore spaces.

    - Continuous sheen (i.e., covering an area greater than 1 square inch) within a section of core but does not fill pore spaces. Describe percent cover.
- **Stained** – visible, unnatural discoloration of the soil, with no visible NAPL.

Other Visual Impacts and Descriptors

In many cases, observed NAPL may be associated with a particular stratigraphic layer (e.g, sand lamination, woody debris layer, gravel lense), gas bubble, or void; NAPL distribution in relation to stratigraphy must be described. What does the material look like immediately above and below the area with suspected NAPL (e.g, clay). Impacts should be described using other visual descriptors as well, as applicable. Descriptors may include, but not be limited to, color, consistency, thickness, viscosity, water content, associated stratigraphy, presence shell or wood fragments or other debris, does NAPL flow out of the core tube, does it appear more or less viscous than water, results of jar sheen test, etc. Also note the staining of sampling equipment, and interior and exterior side-walls of the sampling tube, especially if entrainment of NAPL up the side-walls is suspected as an artifact of sample collection.

OLFACTORY DESCRIPTORS

Field personnel will not conduct olfactory testing as part of sample processing, because vapor inhalation is a potential health and safety risk. However, if incidental odors are noted by field personnel during regular sample processing activities, field personnel will record this observation in the field forms. General descriptors that could be used are the following:

- Note odors similar to mothballs, driveway sealer, highway paving oil, sewage or other odors that are acrid, burnt, or sulfur-like, etc.
- Other odors that are not believed to be natural should also be identified with descriptors such as organic, ammonia, sweet, chemical etc., as applicable.
- Use modifiers such as strong, moderate or slight to indicate intensity of the observed odor.
- In instances where multiple odors are present, a combination of descriptors should be used to clearly identify where these co-mingled impacts are present.

However, olfactory descriptions are more subjective than visual inspections. Visual inspection may be aided by a PID, ultraviolet (UV) fluorescence examination, shake test, or similar device, to monitor and record organic odors and suspected NAPL in the field. One may also consider collecting a sample of the suspected NAPL to assess physical characteristics and potential mobility.

Last revised by AGF and Geosyntec on 1/18/18
Saved in Seattle server in P:\Projects\Portland Pre-Design PNG0767A\600 Deliverables (AECOM&Geosyntec)\ FSP Subsurface Core\Appendices

APPENDIX D

BORING LOG FORM

MAUL FOSTER ALONGI

Boring/Well No.: ____________

Site: ____________

Location: ____________

Project #: ____________

Boring Log Form

Drill Rig		MFA Staff:		Hole Dia:		Total Depth:	
Drilling Co.:			Water Level:		WLE Note:		
Start Date:		End Date:		Water Level:		WLE Note:	
Notes:							

Completion		Sample				Soil Type:				Color:	
		Top:		Time:	Depth:	Top:		Fines:		Moisture:	
		Length:				Bottom:		Sand:		PID:	
		Type:		Sample ID		Soil Class:		Gravel:		Line Type:	
		% Recov:				Trace:				Impacts:	
						Notes:					
		Top:		Time:	Depth:	Soil Type:				Color:	
		Length:				Top:		Fines:		Moisture:	
		Type:		Sample ID		Bottom:		Sand:		PID:	
		% Recov:				Soil Class:		Gravel:		Line Type:	
						Trace:				Impacts:	
						Notes:					
		Top:		Time:	Depth:	Soil Type:				Color:	
		Length:				Top:		Fines:		Moisture:	
		Type:		Sample ID		Bottom:		Sand:		PID:	
		% Recov:				Soil Class:		Gravel:		Line Type:	
						Trace:				Impacts:	
						Notes:					
		Top:		Time:	Depth:	Soil Type:				Color:	
		Length:				Top:		Fines:		Moisture:	
		Type:		Sample ID		Bottom:		Sand:		PID:	
		% Recov:				Soil Class:		Gravel:		Line Type:	
						Trace:				Impacts:	
						Notes:					
		Top:		Time:	Depth:	Soil Type:				Color:	
		Length:				Top:		Fines:		Moisture:	
		Type:		Sample ID		Bottom:		Sand:		PID:	
		% Recov:				Soil Class:		Gravel:		Line Type:	
						Trace:				Impacts:	
						Notes:					
		Top:		Time:	Depth:	Soil Type:				Color:	
		Length:				Top:		Fines:		Moisture:	
		Type:		Sample ID		Bottom:		Sand:		PID:	
		% Recov:				Soil Class:		Gravel:		Line Type:	
						Trace:				Impacts:	
						Notes:					
		Top:		Time:	Depth:	Soil Type:				Color:	
		Length:				Top:		Fines:		Moisture:	
		Type:		Sample ID		Bottom:		Sand:		PID:	
		% Recov:				Soil Class:		Gravel:		Line Type:	
						Trace:				Impacts:	
						Notes:					
Borehole Notes:											

U:\Alan Hughes\Boring Log\Test lithology Log

Page ____ of Pages ____