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LWG
LOWER WILLAMETTE GROUP

PORTLAND HARBOR RI/FS

ROUND 2A FIELD SAMPLING PLAN SURFACE WATER SAMPLING

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ACG	analytical concentration goal
AWQC	ambient water quality criteria
COIs	chemicals of interest
CRD	Columbia River Datum
DGPS	differential global positioning system
DOC	dissolved organic carbon
EDI	equal discharge increment
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
FSP	field sampling plan
HHRA	human health risk assessment
HSP	health and safety plan
ISA	initial study area
LWG	Lower Willamette Group
LWR	Lower Willamette River
MDL	method detection limit
MRL	maximum reporting limit
NRWQC	National Recommended Water Quality Criteria
ORNL	Oak Ridge National Laboratory
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PRG	Preliminary Remediation Goal
QA	quality assurance
QC	quality control
QAPP	quality assurance project plan
RI/FS	remedial investigation/feasibility study
RM	river mile
SOP	standard operating procedure
SVOCs	semivolatile organic compounds
TBT	tributyltin
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids

1.0 INTRODUCTION

This surface water field sampling plan (FSP) presents the approach and procedures to implement Round 2A surface water sampling activities for the remedial investigation/feasibility study (RI/FS) of the Portland Harbor Superfund Site (Site) (Figure 1-1). This FSP, in conjunction with the Round 2 Quality Assurance Project Plan (QAPP: Integral and Windward 2004) and Round 2 QAPP Addendum for Surface Water Sampling (Integral 2004b), describes the field sampling and laboratory analysis procedures to accomplish the following types of data collection:

- Surface water chemistry to characterize the nature and extent of contamination including contaminant distribution and identification of potential source effects to the river
- Surface water chemistry adjacent to amphibian habitats to support the ecological risk assessment (ERA)
- Surface water chemistry in generally quiescent areas adjacent to beaches that are used by swimmers to support the human health risk assessment (HHRA)
- Surface water chemistry and conventional water quality parameters to support the feasibility study.

Field sampling procedures for surface and subsurface sediment, shorebird areas and beach sediment, transition zone water, and natural attenuation studies are being submitted to the U.S. Environmental Protection Agency (EPA) as separate task-specific FSPs. In addition, a Round 2 QAPP and QAPP addenda detailing all laboratory procedures to be used in Round 2 for chemical and biological analyses are being provided to EPA under separate cover. Round 2 project organization, analytical methods, quality assurance (QA) procedures, quality assurance and quality control (QA/QC) requirements, and field-based data management for the Round 2 sampling program are described in the Round 2 QAPP and QAPP addenda.

The field study approach, sampling methods, and analyses for surface water sampling are described in this document. The surface water investigation approach presented here is based on the December 19, 2003 EPA surface water sampling approach (Appendix A) and subsequent discussions between EPA and the Lower Willamette Group (LWG). The rationale and general approach for the surface water investigation for the Site is provided in Section 7.2.2 of the Portland Harbor RI/FS Programmatic Work Plan (Work Plan; Integral et al. 2004). As indicated in the Work Plan, a Round 2B surface water sampling FSP will be developed if Round 2A surface water sampling results and evaluation of other Site information indicates that additional surface water characterization is necessary. The decision to conduct a Round 2B surface water investigation and the scope of that investigation will be developed in cooperation with EPA and its partners.

In preparation for the Round 2 sampling program, a health and safety plan (HSP; Integral 2004a) was submitted to EPA on June 15, 2004.

Although Round 2A will focus on the initial study area (ISA), additional sampling will occur both upstream and downstream of the ISA. The ISA concept, which was implemented by EPA in the Statement of Work (EPA 2001a), focuses the initial investigation and characterization efforts on the in-water portion of the 5.7-mile stretch of the lower Willamette River (LWR) from the southern tip of Sauvie Island at river mile (RM) 3.5 to the southern end of Swan Island at RM 9.2, and adjacent areas logically associated with investigation of this stretch of the river (see Figure 1-1).

1.1 OBJECTIVES OF ROUND 2A SURFACE WATER SAMPLING

The objectives of the Round 2A surface water sampling program are to assess water quality conditions in the ISA and adjacent areas under different flow conditions, provide water quality data for use in the ecological and human health risk assessments, and provide water quality data for the assessment of recontamination potential during the FS. In addition, surface water samples will be collected near a few potential upland source areas to determine the usefulness of surface water sampling in assessing source contribution to the river.

Surface water data will be used to:

- Determine if upland sources in the ISA are contributing to unacceptable risk from river water
- Support the ecological and human health risk assessments
- Determine if various river stages and flows and storm events have a measurable effect on the nature or concentration of surface water chemical constituents
- Assess the impact to the ISA of potential upstream sources of surface water chemical constituents
- Support use of a food web model
- Assess the potential presence of natural attenuation processes within the ISA
- Assess the potential for recontamination under remedial alternatives (examined in the FS).

1.2 DOCUMENT ORGANIZATION

The remaining sections of this document describe the sampling plan and field procedures that will be used to collect surface water samples during Round 2A. Section 2 describes the sampling approaches and proposed schedule. Section 3 summarizes procedures that will be used in the field, including specific sampling methods for collecting surface water. Section 4 summarizes how the data will be reported. Finally, references are provided in Section 5.

Appendix A contains EPA's surface water sampling approach. The transect composite water sampling method is described in Appendix B. Detailed standard operating procedures (SOPs) for surface water sampling are provided in Appendices C, D, and E. Field sampling forms are found in Appendix F.

2.0 SAMPLING DESIGN AND RATIONALE

This section describes data needs and the rationale for the surface water sampling program design that will support the Round 2A surface water sampling objectives.

2.1 DATA NEEDS

There are little existing surface water quality data for the LWR (Integral et al. 2004). Surface water samples will be collected in Round 2A to support site characterization, ERA, HHRA, and FS data needs.

Site Characterization

Surface water chemistry data are needed within and adjacent to the ISA to develop an understanding of the chemicals present in the water column and their concentration ranges under different flow conditions. Three river transect locations, just upstream of the ISA, mid-ISA, and near the downstream ISA boundary (Figure 2-1) will be sampled so that the potential influences of sources within and upstream of the ISA on water quality can be preliminarily assessed. Sampling also will be performed to help identify and evaluate the contribution from specific potential sources within the ISA. Surface water data generated to support the ERA and HHRA (see below) will also be used in this site characterization assessment.

Ecological Risk Assessment

Surface water chemistry data are needed for the assessment of direct toxicity of surface water to aquatic receptors. Surface water samples will be collected from 17 ERA stations (Figure 2-1). Surface water data will be compared to toxicity thresholds, such as EPA's 2002 chronic ambient water quality criteria (AWQC) (EPA 2002b), and 1996 Oak Ridge National Laboratory (ORNL) toxicity values (Sutter and Tsao 1996), to assess toxicity to aquatic life, including invertebrates, fish, and early life-stage amphibians. More information regarding these assessment methods is presented in Appendix B (Ecological Risk Assessment Approach) of the Work Plan (Integral et al. 2004).

Human Health Risk Assessment

Surface water chemistry data are needed for the baseline HHRA to evaluate risks from direct human contact with surface water. Dermal contact and ingestion of surface water are considered to be complete and possibly significant exposure pathways for some human uses of the river. Dermal contact with and incidental ingestion of surface water would occur while swimming in the river. Collection of river water by transients for use as drinking water also may occur. To evaluate human health risks, representative samples at designated shallow, nearshore sampling stations will be collected by integrating the sample throughout the water column. Samples collected from transects could also be used to evaluate potential direct human contact with surface water in non-quiescent areas of the ISA.

Chemicals detected in surface water will be compared to EPA Region 9 Preliminary Remediation Goals (PRGs) for tap water (EPA 2002a) to select chemicals of potential concern (COPCs) for the baseline HHRA. Details of the comparison to risk-based screening values that will be used to select COPCs in surface water for the baseline HHRA are included in Appendix C (Human Health Risk Assessment Approach) of the Work Plan.

Food Web Modeling

Surface water data also will be used to support food web modeling and may be used to understand the contribution of surface water to observed fish tissue concentrations and the associated risk to piscivorous wildlife.

Surface water chemistry data will be used as input to both the TrophicTrace and Arnot/Gobas food web models currently being evaluated for use in the RI for establishing the relationship between concentrations of selected chemicals of interest (COIs) in water, sediment, and tissue of resident fish species. The data aggregation methods specific to the food web modeling for the surface water chemistry data will be discussed with EPA prior to conducting the next round of modeling.

Feasibility Study

Surface water chemistry and total suspended sediment data are needed to develop a preliminary understanding of the contaminants sorbed to entrained sediment particles that may interact with the sediment bed. This information is useful in both understanding the potential for recontamination of the sediment bed and preliminary natural attenuation modeling. It should be noted that the Round 2A data alone are not sufficient to understand the fate and transport of particulate chemicals within the river system. However, these data, coupled with other data that will be collected in this round (i.e., sediment chemistry) and later rounds of sampling (see Work Plan), will provide the information necessary to estimate the potential for both recontamination and natural attenuation.

2.2 SAMPLE TYPES AND NUMBERS

Twenty-three stations in the lower Willamette River are proposed for Round 2A surface water sampling (Figure 2-1). Sample locations will be verified during a reconnaissance visit with the agencies before sampling is conducted. Table 2-1 summarizes the proposed Round 2A surface water sample numbers and analyses. Also, conditions encountered in the field during implementation of this plan may result in modifications to the sampling design; however, EPA will be contacted whenever significant changes in the sampling design occur.

Three types of samples will be collected, depending on the data needs for that particular station, using two different sampling methods (see Table 2-2):

- **Single-Point Near-Bottom Samples.** Surface water will be collected in water less than 20 feet deep as close to 1 foot off the river bottom as practicable, and in no case more than 3 feet off the bottom, at 17 ERA sampling stations by either peristaltic pump or the Infiltrex 300 system (XAD-2) described further below.

- **Cross-Sectional River Transect Water-Column Samples.** Composite samples from the water column will be collected at three river transects using both a peristaltic pump and the XAD-2 system. The river transect samples at RM 4, 6.3, and 11 will be spatially integrated across the entire width and depth of the channel based on a flow-weighted method (USGS 2000). At each transect, the river will be divided into equal flow sub-areas (i.e., equal discharge increments [EDIs]) using existing bathymetry and river flow data. A vertically integrated sample will be collected from 1 foot below the water surface to within 1-3 feet of the river bottom in each sub-area, and these samples will be combined to produce an integrated river cross-section composite sample. Details on this river transect sampling approach are provided in Appendix B.

- **Single-Point Water-Column Samples.** A peristaltic pump will be used to sample the three quiescent HHRA stations: W-14 (Willamette Cove), W-20 (Swan Island Lagoon), and W-10 (Cathedral Park). Samples of the water column will be integrated vertically from 1 foot below the water surface to within 1-3 feet of the river bottom.

Most samples will be collected using the Peristaltic pump method (Table 2-2). However, certain COIs in the LWR are hydrophobic and found at very low concentrations in the water column, and they are frequently undetected in surface water using standard analytical methods. They have the potential to accumulate in aquatic biota at concentrations that may pose a threat to human health and piscivorous wildlife. Therefore, very low analytical minimum reporting limits (MRLs) are needed to detect some of these chemicals at concentrations that can be compared to water quality criteria established for aquatic biota and the protection of human health via ingestion of fish. Conversely, relatively standard analytical MRLs are adequate to detect concentrations of most of these COIs for comparison to water quality criteria established for the protection of other ecological receptors and for human ingestion of water.

Collection of high volumes of water is the typical sampling approach used to achieve the very low MRLs for surface water. By passing high volumes of surface water (e.g., 1,000 liters) through XAD-2 resin columns, these very dilute COIs will be concentrated as they adsorb to the resin beads. Subsequently, the target compounds can be extracted from the resin and then analyzed.

Surface water samples will not be collected shallower than 1 foot below the water surface to avoid drawing air into the sample intake, which would substantially disrupt the sampling process. Surface water samples also will not be collected closer than 1

foot above the river bed to avoid collection of particulates associated with the river's bedload transport zone.

EPA has identified two surface water sample locations [W-13 (Willamette Cove) and W-15 (Rhone Poulenc)] as well as the three river transect sample locations that will require the high-volume, XAD-2 system surface water sampling method for analysis of dioxins/furans. EPA also identified two additional surface water sample locations, W-16 (ATOFINA), and W-18 (Portland Shipyard), that require high-volume sampling for analysis of pesticides and polychlorinated biphenyls (PCBs) (see Figure 2-1 and Table 2-2). All surface water samples collected by either peristaltic pump or by high-volume surface water collection will be considered composites.

Water collected using a peristaltic pump will be placed in a pre-cleaned container sufficiently large to accommodate all sampling volume needs, including all QC samples (20 liters). Once the container is full, a non-metallic stirring device will maintain the homogeneity of the sample until all sub-sampling of that composite is done. Both filtered and unfiltered samples will be collected from the same container. Filtered samples will be collected for the analysis of dissolved metals, dissolved organic carbon (DOC), and hardness (Table 2-1). Unfiltered samples will be collected for the analysis of total metals, selected organics, tributlytin (TBT), and conventionals (see Section 2.3).

All high-volume water samples collected with an XAD-2 column will be filtered. The associated pumping system has an inline filter placed before water passes through the XAD-2 resin column. The filter will be extracted and analyzed separately from the XAD-2 column extract to determine the concentrations of COIs sorbed to entrained sediment particles. The filtrate and XAD-2 resin analytical results can be combined to determine the total analyte concentration in the water column. These samples will be collected for the analysis of selected organic compounds (see Section 2.3).

Surface water samples will be collected at three different river flow regimes to measure seasonal variability of COI concentrations (Table 2-1). Surface water sampling is scheduled to occur during 1) low-flow conditions in the early fall, 2) the early rainy season in mid to late fall, and 3) late winter high-flow. Details of the proposed surface water sampling schedule are provided in Section 2.4.

2.3 SAMPLE ANALYSES

Surface water sample analyses for Round 2A are separated into two analyte groups:

- Ultra-low detection limits using high-volume surface water samples
- Standard detection limits using standard-volume surface water samples.

Table 2-1 summarizes the analytes and number of samples for each analyte group. Table 2-3 shows the analytical concentration goals (ACGs) for each analyte. The

analytical program for water samples along with detailed laboratory methods, QA procedures, and QA/QC requirements are described in the Round 2 QAPP and are summarized in Table 2-4.

All samples will be maintained according to the appropriate holding times and temperatures for each analysis, as summarized in Table 2-5. Field QC sample requirements are described in the Round 2 QAPP Addendum for Surface Water Sampling (Integral 2004b).

Ultra-low Detection Limits

Filtered high-volume surface water samples for ultra-low detection limits will be collected using filter cartridges and XAD-2 resin columns. Both the apparent dissolved fraction and the filtered particulate fraction will be analyzed. These low detection limits will be used for the analysis of the following constituents at the following stations.

Dioxins/Furans

Filtered surface water samples will be collected for dioxins/furans at the three river transects (W-5, W-11, and W-23) during each of the three seasonal sampling events. In addition, filtered surface water samples will be collected for analysis of dioxins/furans at low-flow conditions in early fall and early rainy season conditions in mid to late fall at two stations, W-13 (Willamette Cove) and W-15 (Rhone Poulenc).

PCBs, Pesticides, PAHs, and Phthalates

Samples from the five stations mentioned above for dioxins/furans plus two additional stations, W-16 (ATOFINA) and W-18 (Portland Shipyard), will be analyzed for trace concentrations of polychlorinated biphenyls (PCB) as Aroclors, organochlorine pesticides, polycyclic aromatic hydrocarbons (PAHs), and phthalate esters. Filtered surface water samples will be collected and analyzed for all of these chemicals at the three river transects (W-5, W-11, and W-23) during each of the three seasonal sampling events. Filtered surface water samples will be collected and analyzed for all of these chemicals at low-flow conditions in early fall and early rainy season conditions in mid to late fall at four stations: W-13 (Willamette Cove), W-15 (Rhone Poulenc), W-16 (ATOFINA), and W-18 (Portland Shipyard).

PCB Congeners

Aliquots of the extracts from the XAD-2 resin columns and filter cartridges will be archived for potential future analysis of PCB congeners. The decision to analyze the archived sample extracts will be made in consultation with EPA and its partners following evaluation of the PCB Aroclors analysis results for the high-volume surface water samples and initial food web modeling results.

Standard Detection Limits

Standard-volume surface water samples for standard detection limits will be collected using a peristaltic pump and analyzed for the following constituents at the following stations.

Metals
Both filtered (dissolved) and unfiltered (total) surface water samples will be analyzed for metals at all 23 sampling stations.

Conventionals
At all 23 stations, unfiltered surface water samples will be analyzed for total suspended solids (TSS) and total organic carbon (TOC). Filtered samples will be analyzed for TDS, DOC, and hardness (see Table 2-2).

PCBs, Pesticides, Herbicides, TBT, and SVOCs
Unfiltered surface water samples from 13 ERA and three HHRA locations will be analyzed for PCB Aroclors, organochlorine pesticides, chlorinated herbicides, and TBT. At all 23 stations, unfiltered surface water samples will be analyzed for the full list of semivolatile organic compounds (SVOCs) (see Tables 2-2 and 2-3).

Perchlorate
Near bottom surface water samples will be collected at station W-16 (ATOFINA) for perchlorate analysis (see Table 2-2).

General Water Quality Measurements

In-situ measurements of general water quality will be taken at all sampling stations, including conductivity, pH, temperature, dissolved oxygen, and oxidation reduction potential of the water column. These measurements will be made by lowering the appropriate probe into the water as described in Appendix E.

2.4 PROJECT SCHEDULE

Actual start dates for the sampling will be determined following EPA approval of this Round 2A Surface Water Sampling FSP. Other conditions that may affect the sampling schedule are weather, river flows and stages, and equipment conditions and availability. Currently, it is anticipated that the Round 2A surface water samples will be collected during fall 2004 and late winter 2005. Reporting of Round 2A surface water sampling results is discussed in Section 4.

The first sampling event will occur during early fall low-flow conditions when groundwater discharge effects to the water column are anticipated to be most pronounced. This sampling event is intended to occur after the sediment cap at the McCormick & Baxter Superfund site is in place but before any major precipitation runoff event has occurred. If substantial precipitation begins before the McCormick & Baxter sediment cap is completed, this event may be postponed to late summer/early fall of 2005; this determination will be made in consultation with EPA and its partners.

The second round of surface water samples will be collected during the early rainy season in mid to late fall 2004 after the McCormick & Baxter sediment cap is completed. This period represents the time of potential elevated chemical

concentrations in the river because particles and associated chemicals tend to accumulate in the watershed's drainage system over the dry season and this material is transported to the river during the first steady rains in the fall.

Surface water samples will also be collected during the late winter of 2005. This period will represent high-flow conditions and will also coincide with the early exposure period for amphibian egg masses.

3.0 SAMPLE COLLECTION AND PROCESSING PROCEDURES

The following sections describe the detailed sampling procedures, record keeping, sample handling, storage, and field quality control procedures that will be used during Round 2A surface water sampling. Procedures and details of chain-of-custody and sample shipping are addressed in the Round 2 QAPP (Integral and Windward 2004).

3.1 SAMPLING VESSELS

Two sampling vessels will be used to conduct the surface water sampling program. The larger vessel will have a deck large enough to accommodate three crewmembers in addition to the captain and a navigator. The vessel will have enough deck space to accommodate an Infiltrex 300 water collection system, a peristaltic pump, a portable 3000-Watt generator, four coolers, and sampling equipment boxes containing sample jars and other ancillary equipment. In addition, the deck or covered "wet-lab" area will be large enough to accommodate a workbox (approximately 40 inches wide, 30 inches deep and 30 inches high) on a bench top or table for filtration and collection of field samples. The vessel will include a capstan [minimum of 350-lb capacity davit (pulling winch)], navigational lights, anchors, and basic sonar. Station positioning from the sampling vessel will be accomplished using a DGPS, which consists of a GPS receiver on the sampling platform and a differential receiver located at a horizontal control point. A smaller boat will be available for the duration of the field effort and will be used to transport supplies (e.g., sample jars, coolers, ice), samples, and replacement personnel to and from the sampling boat, especially during high-volume surface water sampling.

3.2 STATION POSITIONING AND VERTICAL CONTROL

Latitude and longitude coordinates will be obtained using a differential global positioning system (DGPS). The standard projection method to be used during field activities is Horizontal Datum: North American Datum of 1983 (NAD83), State Plane Coordinate System, Oregon North Zone. The positioning objective is to accurately determine and record the positions of all sampling locations to within ± 2 meters.

Station positioning from the sampling vessel will be accomplished using a DGPS, which consists of a GPS receiver on the sampling platform and a differential receiver located at a horizontal control point. At the control point, the GPS-derived position is compared with the known horizontal location, offsets or biases are calculated, and the correction factors are telemetered to the GPS receiver located on the sampling platform. Positioning accuracies on the order of ± 2 meters can be achieved by avoiding the few minutes per day when the satellites are not providing the same level of signal. The GPS system provides the operator with a listing of the time intervals during the day when accuracies are decreased. Avoidance of these time intervals permits the operator to maintain better positioning accuracy. The GPS receiver routes latitude and longitude to

an integrated navigation system, which displays the platform's position in plan view. Navigation data, such as range and bearing from the target sampling location, are provided at a user-defined scale to guide the sampling platform's pilot to the desired location.

Vertical positioning is required to establish the elevation of the riverbed at the sampling locations. While the sampling device is in place at the sampling station, depth to mudline will be measured using a lead line or fathometer immediately prior to or during the sampling. Vertical measurements will be recorded to the nearest 0.1 foot. Water depths will be converted to elevations [feet Columbia River Datum (CRD)] based on the river stage at the time of sampling as recorded at the Morrison Street Bridge.

Water depth at each sampling location will be measured using a lead line or fathometer immediately prior to or during the sampling. Vertical measurements will be recorded to the nearest 0.1 foot. Following sampling, water depths will be converted to elevations (feet CRD) based on the river stage at the time of sampling as recorded at the Morrison Street Bridge.

3.3 FIELD LOGBOOK AND FORMS

All field activities and observations will be noted in a field logbook during fieldwork. The field logbook will be a bound document containing individual field and sample log forms. Information will include personnel, date, time, station designation, sampler, types of samples collected, and general observations. Any changes that occur at the site (e.g., personnel, responsibilities, deviations from the Work Plan or FSP) and the reasons for these changes will be documented in the field logbook.

Logbook entries will be clearly written with enough detail so that participants can reconstruct events later, if necessary. Requirements for logbook entries will follow the guidelines specified in the Round 2 QAPP (Integral and Windward 2004).

When field activity is complete, the logbook will be entered into the Portland Harbor project file.

A sample collection checklist will be produced prior to sampling and completed following sampling operations at each station. The checklist will include station designations, types of samples to be collected (e.g., one jar for metals), and whether blind field replicates or additional sample volumes for laboratory QC analyses are to be collected.

3.4 EQUIPMENT AND SUPPLIES

Equipment and supplies will include sampling equipment, utensils, decontamination supplies, sample containers, coolers, logbooks and forms, personal protection

equipment, and personal gear. Protective wear (e.g., hard hats, gloves), as required for health and safety of field personnel, will be as specified in the HSP (Integral 2004a). A detailed list of sampling equipment and supplies for surface water sampling (Table C-1) and high-volume surface water sampling methods (Table D-1) are included in Appendices C and D, respectively.

The analytical laboratory will supply sample containers and preservatives, as well as coolers and packing material. Commercially available pre-cleaned jars will be used, and the laboratory will maintain a record of certification from the suppliers. The bottle shipment documentation will record batch numbers for the bottles. With this documentation, bottles can be traced to the supplier, and bottle wash analysis results can be reviewed. The bottle wash certificate documentation will be archived in the Integral project file. Field personnel will not obstruct these stickers with sample labels.

Sample containers will be clearly labeled at the time of sampling. Labels will include the project name, sample location and number, sampler's initials, analysis to be performed, date, and time. The nomenclature used for designating field samples is described in Section 3.6.

3.5 EQUIPMENT DECONTAMINATION PROCEDURES

A peristaltic pump and an Infiltrex 300 system will be used for the collection of surface water samples. In addition, a multi probe YSI 650/600XLM unit will be used for *in-situ* measurement of conventional parameters (e.g., pH, temperature, dissolved oxygen). The following is a brief description of decontamination procedures for each set of equipment.

Peristaltic Pump

Sample tubing, filters and mixing jars for peristaltic pump sampling will be sent to the appropriate laboratory for decontamination. Details on laboratory decontamination and proper handling and shipping of decontaminated equipment to the field will be provided as an SOP attachment to the Round 2 QAPP Addendum for Surface Water Sampling (Integral 2004b). Decontamination of the peristaltic pump will be done according to the Round 2A Surface Water Sampling SOP in Appendix C.

Infiltrex 300 System

Sample tubing, filters, and XAD-2 columns for the Infiltrex 300 pump system will be sent to the appropriate laboratory for decontamination. Details on laboratory decontamination and proper handling and shipping of decontaminated equipment to the field will be provided as an SOP attachment to the Round 2 QAPP Addendum for Surface Water Sampling (Integral 2004b).

Decontamination of filter canisters and inline tubing of the Infiltrex 300 pump system will follow the decontamination procedures described in the High-volume Surface Water Sampling SOP in Appendix D.

Multi Probe YSI 650/600XLM

Decontamination of the multi probe YSI 650/600XLM will follow the decontamination procedures described in the Multi Probe YSI 650/600XLM SOP in Appendix E.

3.6 SURFACE WATER SAMPLE COLLECTION PROCEDURES

Two methods of surface water collection will be used during Round 2A:

1. Measurements of analytes and conventionals that do not require high-volume sampling will be collected using a peristaltic pump and Teflon™ tubing.

2. Extraction of ultra-low analyte concentrations from surface water will be collected by pumping high volumes of water through a stainless-steel column packed with XAD-2 resin using an Infiltrex 300 sampling device designed by Axys Environmental System, Ltd.

The SOP for surface water sampling will follow the guidelines in EPA's Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (EPA 1996), and by the *Field Sampling Manual for the Regional Monitoring Program for Trace Substances* (David et al. 2001) (Appendix C).

The SOP for high-volume surface water sampling will follow the guidelines established by EPA's SOP MSL-M-090-00 (EPA 1994) and by the *Total Maximum Daily Loads for Dioxins in the Houston Ship Channel Quality Assurance Project Plan* (Houston and TNRCC 2002) (Appendix D).

A transect composite water sampling method will be used at each of the three transect stations (downstream boundary of the ISA, mid-ISA, and upstream of the ISA) to collect a composite water sample that represents the flow passing through the river's cross section at that location. The water sampling approach along the transects in the LWR is based on the Equal-Discharge Increment Cross-Sectional Sampling method developed by the United States Geological Survey (USGS 2000). This method is designed to collect a composite sample that represents the flow passing through a stream cross section by obtaining a series of subsamples where each subsample represents equal volumes of the stream discharge. A description of this method is provided in Appendix B.

3.6.1 Summary of Surface Water Sampling (with peristaltic pump) Method

Surface water samples for standard chemical and conventional analyses will be collected using a peristaltic pump with an extended sampling tube lowered to the desired depth. These samples do not require the ultra-low detection units of other hydrophobic analytes, which will be collected using the high-volume sampling regime described in the next section.

Samples will be collected using the two-person "clean hands – dirty hands" method (EPA 1996). The peristaltic pump's water intake will be placed 15 feet away from the bow of the boat with a long pole. The outflow of the pump will be directed through a Y-splitter into two composite mixing containers for sampling. Equal volumes will be pumped into two large, pre-cleaned 10-liter or 20-liter mixing containers equipped with magnetic stirring devices. The first container, made of polycarbonate, will be used for compositing and mixing samples for subsequent analysis of trace metals, TBT, and conventionals. The second stainless-steel or glass container will be used for compositing and mixing samples for subsequent analysis of organic compounds. Following sample compositing in the mixing containers, appropriate sample bottles will be filled using a second peristaltic pump, with the outflow directed into the bottle. The sample jar will be held near the pump outlet, and the sample container will be rinsed several times and then filled. The sample containers will be capped, labeled, and placed in clean, double Ziploc™ bags, and then placed inside a cooler.

Two types of surface water samples will be collected: unfiltered and filtered for metals and DOC. For filtered metals samples the 0.45-um filter will be placed inline near the tubing outlet to filter samples immediately before the water will be discharged into the sample bottle. The filter size for DOC will be selected in consultation with EPA. Samples for TSS and TDS will be filtered at the laboratory. The filter size to be used for TSS and TDS analyses will be determined by EPA and LWG.

Surface water collected at cross-sectional stations using the flow-weighted method (see Appendix B) will be composited by collecting water using the same technique described above. Integrated samples of the water column will be collected by lowering and raising the sample tubing intake while pumping water from near surface to near bottom and back for a predetermined period at a predetermined rate.

In addition to surface water collection, general water quality parameters such as temperature, pH, dissolved oxygen, conductivity, and oxidation-reduction potential will be measured *in situ* at all sampling stations using a YSI 650/600XLM multiprobe sensor lowered into the water column (see Appendix E).

3.6.2 Summary of High-Volume Surface Water Sampling (with XAD-2 columns) Method

High-volume surface sampling will be accomplished using an Infiltrex 300 system connected to XAD-2 resin columns. This sampling method will be used to collect hydrophobic organic compounds from water that requires ultra-low analytical detection methods.

Large volumes of water will be pumped through Teflon™ tubing, glass fiber filter cartridges, and XAD-2 resin beads packed inside stainless-steel canisters; retaining particulates on the filters and extracting dissolved organic contaminants onto the resin. This method eliminates the need to collect, store, and transport large volumes of water.

A total volume of 1,000 liters will be pumped at each high-volume sample station at a flow rate of 1.25 liters per minute.

Similar to the surface water sampling procedure above, the water intake will be placed 15 feet away from the bow of the boat with a long pole. For river transect stations, once the required pumping duration at a particular EDI sampling station is determined, the operator will program the Infiltrex 300 system to collect a composite sample by setting the appropriate flow rate (1.25 liters per minute) and then monitor the system during the time period necessary for sample collection.

Glass fiber filters will be used to filter out the particulate fraction of the water. Since hydrophobic analytes are preferentially bound to particulates, this material will be isolated in the filter to determine the particulate-bound fraction of hydrophobic analytes present. The operator will monitor the in-line pressure and replace filters when necessary. The minimum filter pore size to be used will be determined in consultation with EPA and its partners before sampling is initiated.

Samples will be collected using the "clean hand – dirty hand" method. Once the desired volume is pumped, the column assembly will be removed and any residual water will be drained out. XAD-2 canisters will be labeled, wrapped appropriately, and then placed in a cooler with wet ice. The glass fiber filters will be removed, placed in sample jars, and stored in a cooler containing wet ice.

At the analytical laboratory, the column and filters will be analyzed individually to determine, respectively, the apparent dissolved and particulate concentrations of analytes in the samples. These analytical results can be later combined to determine the total analyte concentration in surface water.

3.7 SAMPLE IDENTIFICATION

A unique code will be assigned to each sample as part of the data record. This code will indicate the project phase, sampling location, sample type, sampling event, and level of replication/duplication.

All samples will be assigned a unique identification number based on a sample designation scheme designed to meet the needs of the field personnel, laboratory and LWG data management, validation chemists, and data users. Sample identifiers will consist of two to three components separated by dashes. The first component, LW2, identifies the data as belonging to the Lower Willamette River RI/FS, Round 2. The second component will begin with the abbreviation "SW" to designate the surface water sample, followed by a single-number code that designates the sampling event. The station number will complete the second component.

The following abbreviations will be used to designate the sampling events:

1 = First sampling event: low flow conditions (early fall)
2 = Second sampling event: early rainy season (mid to late fall)
3 = Third sampling event: high flow conditions (late winter)

Additional codes may be adopted, if necessary, to reflect sampling equipment requirements. Leading zeros will be used for stations with numbers below 100 for ease of data management and correct sorting.

The third component will be used to code field duplicate samples and splits. A single digit number will be used to indicate field duplicates or splits in the third component of the sample identifiers.

For equipment decontamination blanks, sequential numbers starting at 900 will be assigned instead of station numbers. The sample type code will correspond to the sample type for which the decontamination blank was collected.

Example sample identifiers are:

LW2-SW1022: surface water sample from Station 22 collected during low-flow conditions.
LW2-SW1022-1: surface water sample from Station 22 collected during low-flow conditions; field duplicates or splits are associated with this sample.
LW2-SW1022-2: duplicate or split surface water sample from Station 22 collected during low-flow conditions.
LW2-SW3902: equipment blank for the surface water samples collected during high-flow conditions.

3.8 SAMPLE HANDLING AND STORAGE

The analytical laboratory will supply sample containers and preservatives and pre-spiked XAD-2 resin columns for water samples. Details on types of sample jars, preservatives, spiking of XAD-2 columns will be provided in the Round 2 QAPP Addendum for Surface Water Sampling (Integral 2004b). The number, size, and type of sample containers needed for each sample are listed in Table 2-5. This table also includes the preservative and holding times for the various analyses.

In general, preservatives will be added to the sample containers by the analytical laboratory prior to shipment to the field. Field staff will confirm the presence or absence of preservative in the containers prior to filling. Any discrepancies with preservatives will be noted on the field sampling records, and corrective action will be initiated.

Once the sample is collected and preserved using the clean hands/dirty hands technique, the sample container will be capped, labeled, and placed in double-sealed polyethylene bags and stored on ice or refrigerated until shipped to the laboratory.

Each field storage freezer or refrigeration unit will be monitored daily to ensure temperature compliance. Each unit will have a separate log form containing date, time, and temperature information.

3.9 FIELD QC SAMPLES

Field QC samples are used to assess sample variability (e.g., replicates), evaluate potential sources of contamination (e.g., rinsate, decon, and trip blanks), or confirm proper storage conditions (e.g., temperature blanks). The estimated numbers of field and QC samples are listed in Table 2-5. Details on field replicate samples and field QC samples are described in the Round 2 QAPP Addendum for Surface Water Sampling (Integral 2004b).

4.0 REPORTING

4.1 LABORATORY CHEMICAL DATA

Validated analytical laboratory data will be provided to EPA in an electronic format within 90 days of completion of each sampling event [e.g., after low flow conditions (early fall) sampling]. A sampling event will generally be considered complete when the last sample of that type described in this FSP has been collected.

4.2 ROUND 2A REPORTING

A field sampling report will be prepared and submitted to EPA within 60 days of completing each Round 2A surface water field sample collection effort described in this FSP. The field sampling report will summarize field sampling activities, including sampling locations (maps), requested sample analyses, sample collection methods, and any deviations from the FSP.

Round 2A surface water chemistry results will be reported in tabular format in the Round 2A site characterization summary report that will be submitted to EPA within 120 days of completing sampling and analysis for all Round 2A surface water sampling activities. Surface water and other Round 2 information and data evaluations also will be included in the comprehensive Round 2 site characterization summary and data gaps analysis report and in the draft RI report and draft baseline risk assessments. The draft RI report will be prepared after all sampling and analysis rounds for the project are completed.

5.0 REFERENCES

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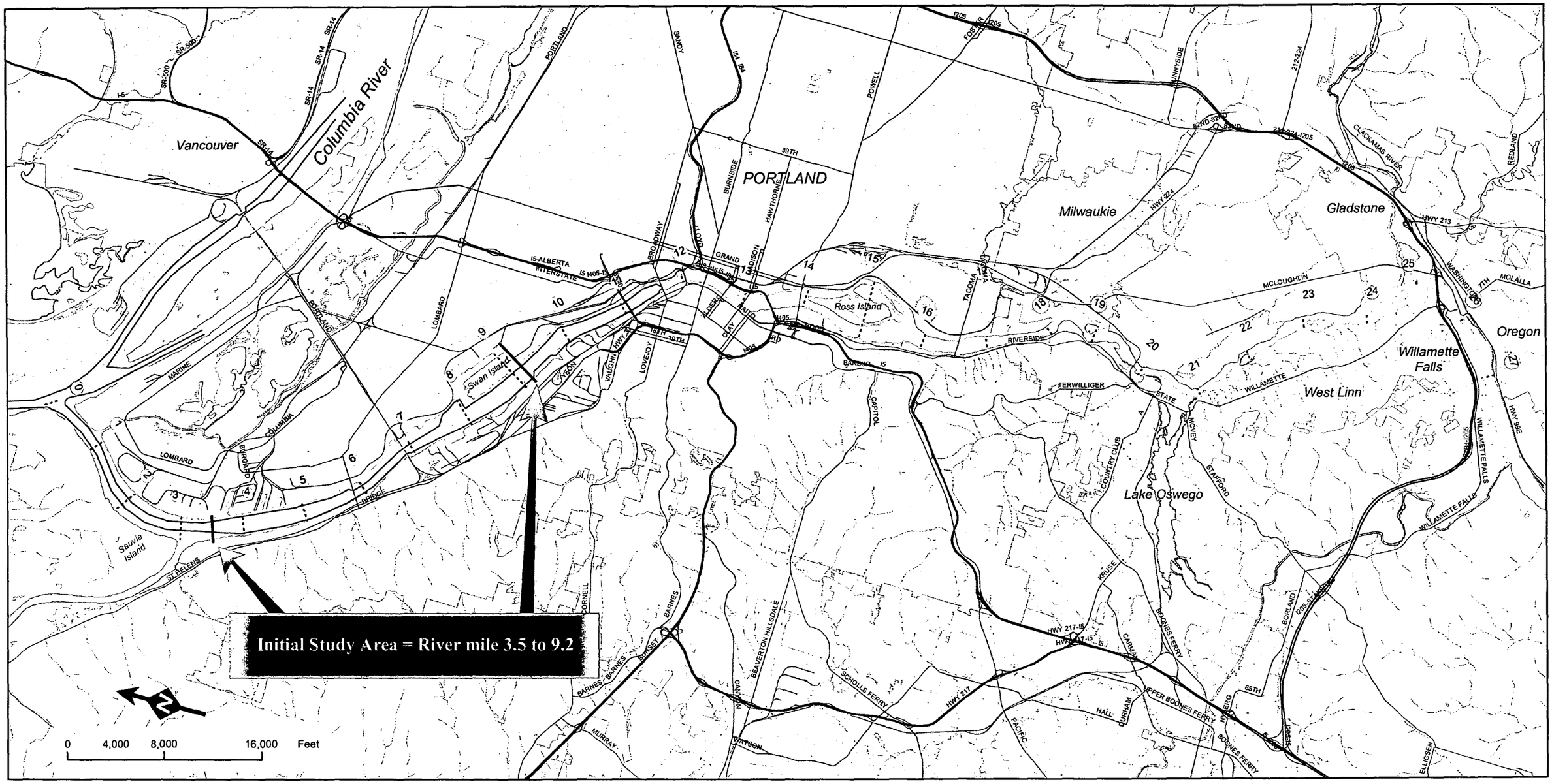
Figures



LWG Lower Willamette Group

integral consulting inc.

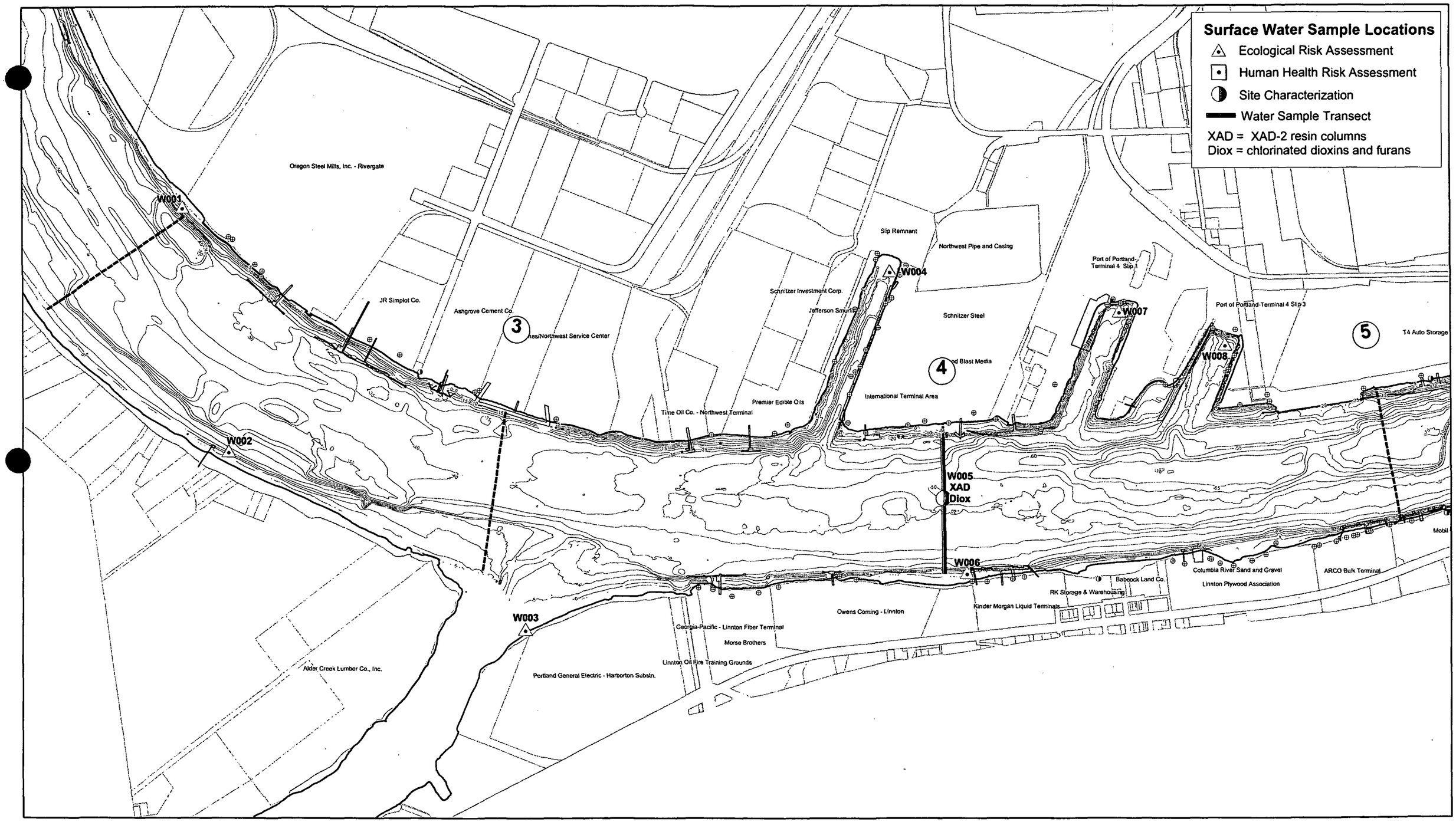
FEATURE SOURCES:
Transportation, Water, Property, Zoning or Boundaries: Metro RLIS .
Channel & River miles: Developed from US Army COE information.

File name: Site_Map_B.mxd
Plot Date: 12/16/03

LEGEND:
- Portland
- Other Cities
- Navigation Channel
- River Miles

Major Roads
- Freeways
- Major Streets

Figure 1-1
Portland Harbor RI/FS
Round 2A Field Sampling Plan
Site Map



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Channel & River miles: Developed from US Army Corps of Engineers information.
River Edge: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Docks & In-water Structures: created by heads-up digitizing from the October 2001 0.33 ft. resolution color orthophotos.
Map Document: (G:\Projects\Portland_Harbor\LWG-Map-Projects\FSP_04\WaterSamples.mxd)
Plot Date: 08/13/2004

Figure 2-1a
Portland Harbor
Round 2A Field Sampling Plan
Proposed Surface Water Sample Locations

LWG Lower Willamette Group

integral consulting inc

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Plot Date: 08/13/2004

0 500 1,000 2,000 Feet

N

Legend

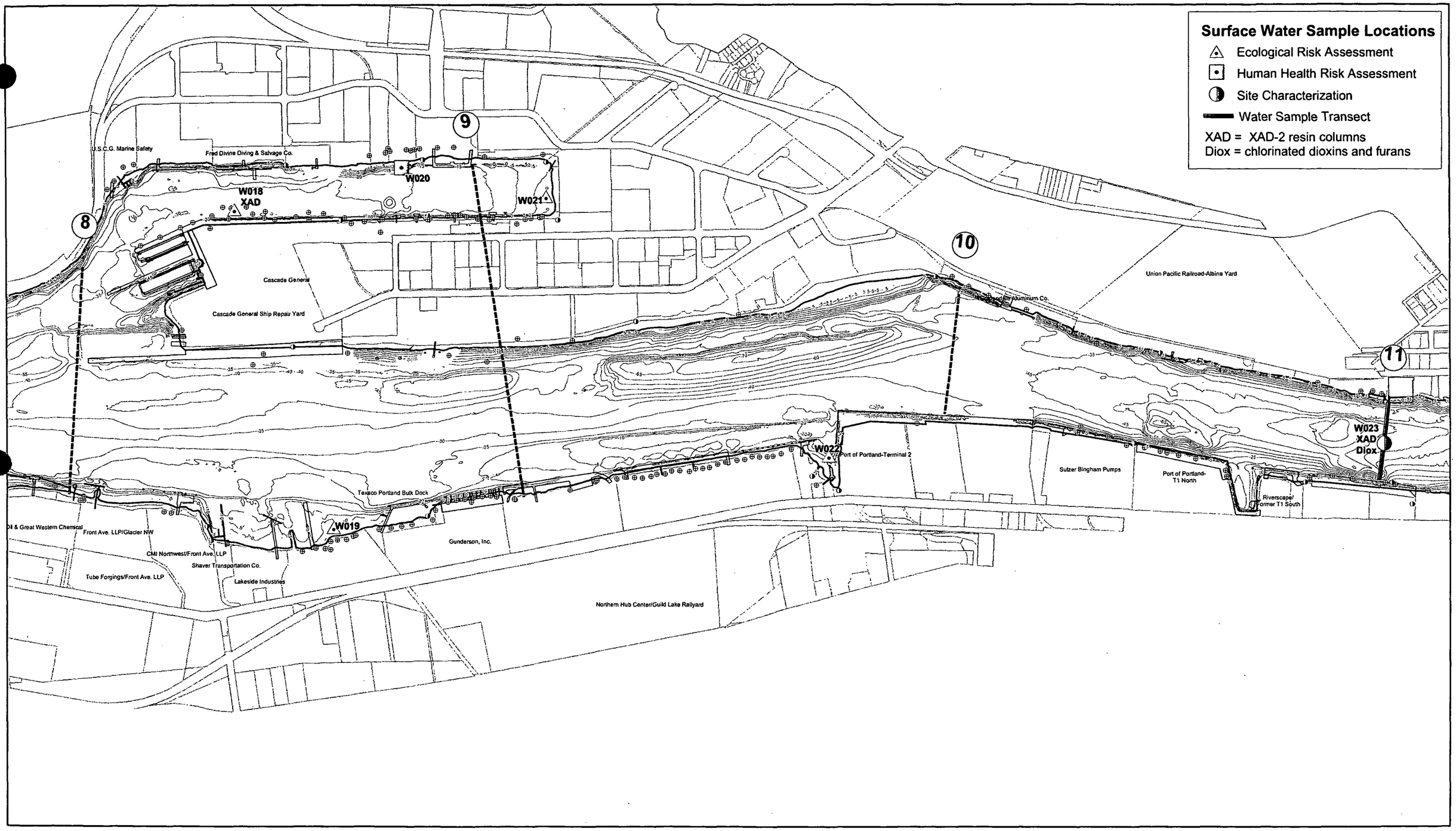
- City Outfalls
- Outfalls
- River Miles
- Docks & Structures
- 2003 Bathy Contours (5 Ft Inteval)
- Water Front Taxlots
- River Edge

Figure 2-1b
Portland Harbor
Round 2A Field Sampling Plan
Proposed Surface Water Sample Locations

Surface Water Sample Locations

- Ecological Risk Assessment
- Human Health Risk Assessment
- Site Characterization
- Water Sample Transect

XAD = XAD-2 resin columns
Diox = chlorinated dioxins and furans



LWG Lower Willamette Group
integral consulting inc.

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Plot Date: 08/13/2004

0 500 1,000 2,000 Feet

N

Legend

- City Outfalls
- Outfalls
- River Miles
- Docks & Structures
- 2003 Bathy Contours (5 Ft Inteval)
- Water Front Taxlots
- River Edge

Figure 2-1c
Portland Harbor
Round 2A Field Sampling Plan
Proposed Surface Water Sample Locations

Tables

Table 2-1. Summary of Round 2A Surface Water Samples and Analyses.

Analytes[2]	Number of Samples [1] Unfiltered	Filtered	Filtered (trace)[3]	Sampling Event[4]	Sampling Method
Metals	23	23	0	1/2/3	Peristaltic
PCB Aroclors [5]	16/16/20	0	7/7/3	1/2/3	Peristaltic and XAD-2
Chlorinated Herbicides	23	0	0	1/2/3	Peristaltic
Organochlorine Pesticides	16/16/20	0	7/7/3	1/2/3	Peristaltic and XAD-2
SVOCs	23	0	0	1/2/3	Peristaltic
Dioxins/Furans [6]	0	0	5/5/3	1/2/3	XAD-2
Phthalate Esters	0	0	7/7/3	1/2/3	XAD-2
PAHs	0	0	7/7/3	1/2/3	XAD-2
Butyltin compounds	23	0	0	1/2/3	Peristaltic
Perchlorate	1	0	0	1/2/3	Peristaltic
TSS	23	0	0	1/2/3	Peristaltic
TOC	23	0	0	1/2/3	Peristaltic
TDS	0	23	0	1/2/3	Peristaltic
DOC	0	23	0	1/2/3	Peristaltic
Hardness [7]	0	23	0	1/2/3	Peristaltic

Note:

[1] Field QC samples not included (see Table 2-4).

[2] Individual analytes for each analyte group are listed in Table 2-3.

[3] Samples analyzed for apparent dissolved trace analytes are collected using XAD-2 resin columns and wound glass fiber filter cartridges. Both the apparent dissolved fraction held on the resin column and the particulate fraction held on the filter cartridge will be analyzed. Trace level methods may be required during the third sampling event depending on the results of the first two trace-level analysis events.

[4] Sampling event: (1 = early fall low flow; 2 = mid-late fall early rainy season; 3 = late winter + amphibian eggs release)

[5] An aliquot of the XAD extracts will be archived for potential PCB congener analysis.

[6] Analysis of dioxins/furans only will be done at the three river transect stations (W-05, W-11, W-23) during early fall, mid-late fall, and late winter; and at Willamette Cove (W-13) and the Rhone Poulenc (W-15) at early fall and mid-late fall only.

[7] Hardness as mg/L $CaCO_3$

DOC = dissolved organic carbon
TOC = total organic carbon
TSD = total dissolved solids
TSS = total suspended solids

Table 2-2. Round 2A Surface Water Sampling Summary by Station.

Station ID	River Mile	Sampling Station Description	Data Use	Sample Depth	Analytes[1]	Collection Method	X Easting[2]	Y Northing[2]
W-01	MILE 2-3	Amphibian Habitat - Downstream East Bank, Oregon Steel Mills	ERA, SC	NB	CS	P	7617779.26	724956.43
W-02	MILE 2-3	Amphibian Habitat - Sauvie Island	ERA, SC	NB	CS	P	7615356.81	723513.69
W-03	MILE 3-4	Amphibian Habitat - near Multnomah Channel	ERA, SC	NB	CS	P	7614615.49	719642.82
W-04	MILE 3-4	Amphibian Habitat - International Slip	ERA, SC	NB	CS	P	7619853.80	717103.24
W-05	MILE 3-4	Downstream Transect - (RM 4.0)	SC	IWC	CS + dioxin	P & XAD	7616569.00	717979.00
W-06	MILE 4-5	Amphibian Habitat - Linnton, Kinder Morgan	ERA, SC	NB	CS	P	7616943.50	715108.03
W-07	MILE 4-5	Amphibian Habitat - T4/Slip 1	ERA, SC	NB	CS	P	7620319.26	714481.61
W-08	MILE 4-5	Amphibian Habitat - T4/Slip 3	ERA, SC	NB	CS	P	7620382.14	713206.40
W-09	MILE 5-6	Amphibian Habitat - Downstream from St. Johns Bridge	ERA, SC	NB	CS	P	7620757.79	708670.63
W-10	MILE 5-6	Human Use Contact Area - Cathedral Park	HHRA, SC	IWC	CS	P	7622813.64	708006.56
W-11	MILE 6-7	Midstream Transect - (RM 6.3)	SC	IWC	CS + dioxin	P & XAD	7623015.00	707022.00
W-12	MILE 6-7	Beach Area - Gasco	ERA, SC	NB	CS	P	7624207.31	705675.42
W-13	MILE 6-7	Amphibian Habitat - Willamette Cove	ERA, SC	NB	CS + dioxin	P & XAD	7627043.37	705735.04
W-14	MILE 6-7	Human Use Contact Area - Willamette Cove	HHRA, SC	IWC	CS	P	7627351.92	705751.04
W-15	MILE 6-7	Beach Area - Rhone Polenc	ERA, SC	NB	CS + dioxin	P & XAD	7626527.30	703940.97
W-16	MILE 7-8	Beach Area - ATOFINA	ERA, SC	NB	CS + perchlorate	P & XAD	7628359.73	702022.41
W-17	MILE 7-8	Amphibian Habitat - Saltzman Creek, Willbridge	ERA, SC	NB	CS	P	7628633.11	701534.73
W-18	MILE 8-9	Amphibian Habitat - Portland Ship Yard	ERA, SC	NB	CS	P & XAD	7633877.41	700887.58
W-19	MILE 8-9	Amphibian Habitat - Gunderson	ERA, SC	NB	CS	P	7632376.28	697293.60
W-20	MILE 8-9	Human Use Contact Area - Swan Island Lagoon	HHRA, SC	IWC	CS	P	7635700.93	699994.71
W-21	MILE 9-10	Amphibian Habitat - Swan Island Lagoon	ERA, SC	NB	CS	P	7636777.00	698643.32
W-22	MILE 9-10	Amphibian Habitat - Terminal 2	ERA, SC	NB	CS	P	7637396.00	694171.70
W-23	MILE 10-11	Upstream Transect - (RM 11)	SC	IWC	CS + dioxin	P & XAD	7642505.90	690067.93

Note:

[1] All metals and XAD samples include both filtered and unfiltered samples.

[2] Coordinates use Oregon State Plane North Zone NAD 83

ERA = ecological risk assessment

HHRA = human health risk assessment

SC = site characterization

NB = near bottom

IWC = integrated water column

CS = chemical suite (metals/inorganics, PCB Aroclors, chlorinated pesticides, chlorinated herbicides, SVOCs, PAHs, phthalates, TBT, conventionals)

P = peristaltic pump

XAD = Infiltrex 300 system with XAD-2 resin columns

Table 2-3. Method Reporting Limits and Analytical Concentration Goals for Surface Water.

										Laboratory MDLs and MRLs					
	Ecological Screening Values		Human Health Screening Values			Analytical Concentration Goals			Peristaltic Pump Samples				XAD-2 Samples[1]	
Analytes	AWQC[2]	ORNL[3]	EPA Region 9 Tap water PRG[4]	Fish Consumption Only[5]	Site-Specific Fish Consumption Only[6]	Level 1 ACG[7]	Level 2 ACG[8]	Level 3 ACG[9]	CAS MDL	CAS MRL	NEA MDL	NEA MRL	NEA MRL	Axys MDL
Conventional Analyses, mg/L (ppm)														
Total Suspended Solids						1[10]	1[10]	1[10]	1	1				
Total Dissolved Solids						NE[11]	NE	NE	5	5				
Total Organic Carbon						NE	NE	NE	0.07	0.5				
Dissolved Organic Carbon						NE	NE	NE	0.07	0.5				
Hardness (Ca, Mg)							NA	NA	0.2	1				
Metals/Inorganics, mg/L (ppm)														
Aluminum	0.087	0.46	36			0.087	0.087	0.087	0.0007	0.002				
Antimony		0.61	0.015	0.64	0.064	0.015	0.015	0.015	0.00002	0.00005				
Arsenic	0.15	0.914	0.000045	0.00014	0.000014	0.000045	0.000045	0.000014	TBD[12]	0.00005				
Cadmium[13]	0.000094	0.00015	0.018			0.000094	0.000094	0.000094	0.00001	0.00002				
Chromium, total						NE	NA[14]	NA[14]	0.00006	0.0002				
Chromium, hexavalent	0.011	0.002	0.11			0.002	0.002	0.002	0.003	0.010				
Copper[13]	0.00274	0.00023	1.5			0.00023	0.00023	0.00023	0.00004	0.0001				
Lead[13]	0.000541	0.012				0.000541	0.000541	0.000541	0.00001	0.00002				
Mercury	0.00077	<0.00023	0.011			<0.00023	<0.00023	<0.00023	0.0001	0.0002				
Nickel[13]	0.016	<0.005	0.73	4.6	0.46	<0.005	<0.005	<0.005	0.00004	0.0002				
Selenium	0.005	0.0883	0.18	4.2	0.42	0.005	0.005	0.005	0.0002	0.001				
Silver		0.00012	0.18			0.00012	0.00012	0.00012	0.00001	0.00002				
Zinc[13]	0.0365	0.03	11	26	2.6	0.03	0.03	0.03	0.0002	0.0005				
Perchlorate			0.0036			0.0036	0.0036	0.0036	0.0005	0.002				
Butyltins[15], µg/L (ppb)														
Monobutyltin						NE	NE	NE	0.0047	0.05				
Dibutyltin						NE	NE	NE	0.005	0.05				
Tributyltin	0.072		11			0.072	0.072	0.072	0.0071	0.02				
Tetrabutyltin						NE	NE	NE	0.0032	0.05				
PCBs Aroclors, µg/L (ppb)														
Aroclor 1016	0.23		0.96	0.000064	0.0000064	0.230	0.000064	0.0000064			TBD	0.0025	0.00006	
Aroclor 1221	0.014	60	0.034	0.000064	0.0000064	0.014	0.000064	0.0000064			TBD	0.0025	0.00006	
Aroclor 1232	0.014	124	0.034	0.000064	0.0000064	0.014	0.000064	0.0000064			TBD	0.0025	0.00006	
Aroclor 1242	0.014	4.9	0.034	0.000064	0.0000064	0.014	0.000064	0.0000064			TBD	0.0025	0.00006	
Aroclor 1248	0.0019		0.034	0.000064	0.0000064	0.0019	0.000064	0.0000064			TBD	0.00125	0.00003	
Aroclor 1254	0.0019	0.1	0.034	0.000064	0.0000064	0.0019	0.000064	0.0000064			TBD	0.00125	0.00003	
Aroclor 1260	0.014	2.3	0.034	0.000064	0.0000064	0.014	0.000064	0.0000064			TBD	0.0025	0.00006	
Aroclor 1262	0.014			0.000064	0.0000064	0.014	0.000064	0.0000064			TBD	0.0025	0.00006	
Aroclor 1268	0.014			0.000064	0.0000064	0.014	0.000064	0.0000064			TBD	0.0025	0.00006	
Total PCBs		0.1	0.034	0.000064	0.0000064	0.034	0.000064	0.0000064						

Table 2-3. Method Reporting Limits and Analytical Concentration Goals for Surface Water.

								Laboratory MDLs and MRLs					
	Ecological Screening Values		Human Health Screening Values			Analytical Concentration Goals			Peristaltic Pump Samples				XAD-2 Samples[1]	
Analytes	AWQC[2]	ORNL[3]	EPA Region 9 Tap water PRG[4]	Fish Consumption Only[5]	Site-Specific Fish Consumption Only[6]	Level 1 ACG[7]	Level 2 ACG[8]	Level 3 ACG[9]	CAS MDL	CAS MRL	NEA MDL	NEA MRL	NEA MRL	Axys MDL
Chlorinated Herbicides, µg/L (ppb)														
Dalapon			1100			1100	1100	1100	0.06	0.4				
Dicamba			1100			1100	1100	1100	0.071	0.4				
MCPA						NE	NE	NE	24	100				
Dichlorprop						NE	NE	NE	0.061	0.4				
2,4-D			360			360	360	360	0.079	0.4				
2,4,5-TP (Silvex)			290			290	290	290	0.085	0.2				
2,4,5-T			360			360	360	360	0.017	0.2				
2,4-DB			290			290	290	290	0.13	0.4				
Dinoseb			36			36	36	36	0.091	0.2				
MCPP			360			360	360	360	23	100				
Organochlorine Pesticides, µg/L (ppb)														pg/L (ppq)
a - BHC	0.004	95	0.011	0.0049	0.00049	0.004	0.0049	0.00049			TBD	0.0005		0.6-3.0
b - BHC	0.004	95	0.037	0.017	0.0017	0.004	0.017	0.0017			TBD	0.0005		0.6-3.0
g - BHC (Lindane)	0.08	3.3	0.052	0.063	0.0063	0.052	0.052	0.0063			TBD	0.0005		0.6-3.0
d - BHC	0.004	95	0.037			0.004	0.004	0.004			TBD	0.0005		0.6-3.0
Heptachlor	0.0038	1.26	0.015	0.000079	0.0000079	0.0038	0.000079	0.0000079			TBD	0.0005		0.6-3.0
Aldrin	3		0.004	0.00005	0.000005	0.004	0.00005	0.000005			TBD	0.0005		0.6-3.0
Heptachlor epoxide	0.0038		0.0074	0.000039	0.0000039	0.0038	0.000039	0.0000039			TBD	0.0005		0.6-3.0
g - Chlordane	0.0043	1.09	0.19	0.00081	0.000081	0.0043	0.00081	0.000081			TBD	0.0005		0.6-3.0
a - Chlordane	0.0043	1.09	0.19	0.00081	0.000081	0.0043	0.00081	0.000081			TBD	0.0005		0.6-3.0
Endosulfan I	0.051		220	89	8.9	0.051	0.051	8.9			TBD	0.0005		0.6-3.0
4,4'-DDE			0.2	0.00022	0.000022	0.2	0.00022	0.000022			TBD	0.0005		0.6-3.0
Dieldrin	0.056		0.0042	0.000054	0.0000054	0.0042	0.000054	0.0000054			TBD	0.0005		0.6-3.0
Endrin	0.036		11	0.06	0.006	0.036	0.036	0.006			TBD	0.0005		0.6-3.0
Endosulfan II	0.051		220	89	8.9	0.051	0.051	0.051			TBD	0.0005		0.6-3.0
4,4'-DDD		1.69	0.28	0.00031	0.000031	0.280	0.00031	0.000031			TBD	0.0005		0.6-3.0
Endrin aldehyde				0.3	0.03	NE	0.3	0.03			TBD	0.0005		0.6-3.0
4,4'-DDT	0.001	0.3	0.2	0.00022	0.000022	0.001	0.00022	0.000022			TBD	0.0005		0.6-3.0
Endosulfan sulfate				89	8.9	NE	89	8.9			TBD	0.0005		0.6-3.0
Endrin ketone						NE	NE	NE			TBD	0.0005		0.6-3.0
Methoxychlor	0.019		180			0.019	0.019	0.019			TBD	0.0005		0.6-3.0
Hexachlorobenzene			0.042	0.00029	0.000029	0.042	0.00029	0.000029			TBD	0.0005		0.6-3.0
Toxaphene	0.0002		0.061	0.00028	0.000028	0.0002	0.0002	0.000028			TBD	0.025		0.6-3.0
Hexachlorobutadiene			0.86	18	1.8	0.86	0.86	0.86			TBD	0.001		0.6-3.0
oxy chlordane			0.19			0.19	0.19	0.19			TBD	0.0005		0.6-3.0
cis - nonachlor			0.19			0.19	0.19	0.19			TBD	0.0005		0.6-3.0
trans - nonachlor			0.19			0.19	0.19	0.19			TBD	0.0005		0.6-3.0
2,4'-DDD	0.28					0.28	0.28	0.28			TBD	0.0005		0.6-3.0
2,4'-DDE	0.2					0.2	0.2	0.2			TBD	0.0005		0.6-3.0
2,4'-DDT	0.2					0.2	0.2	0.2			TBD	0.0005		0.6-3.0

Table 2-3. Method Reporting Limits and Analytical Concentration Goals for Surface Water.

										Laboratory MDLs and MRLs					
	Ecological Screening Values		Human Health Screening Values			Analytical Concentration Goals			Peristaltic Pump Samples				XAD-2 Samples[1]	
Analytes	AWQC[2]	ORNL[3]	EPA Region 9 Tap water PRG[4]	Fish Consumption Only[5]	Site-Specific Fish Consumption Only[6]	Level 1 ACG[7]	Level 2 ACG[8]	Level 3 ACG[9]	CAS MDL	CAS MRL	NEA MDL	NEA MRL	NEA MRL	Axys MDL
Semivolatile Organic Compounds, µg/L (ppb)														
Halogenated Compounds														
1,2-Dichlorobenzene	14		370	17000	1700	14	14	14	0.014	0.2				
1,3-Dichlorobenzene			5.5	960	96	5.5	5.5	5.5	0.011	0.2				
1,4-Dichlorobenzene			0.5	2600	260	0.5	0.5	0.5	0.014	0.2				
1,2,4-Trichlorobenzene	50		190	70	7	50	50	7	0.016	0.2				
Hexachlorobenzene			0.042	0.00029	0.000029	0.042	0.00029	0.000029	0.014	0.2				
2-Chloronaphthalene			490	1600	160	490	490	160	0.015	0.2				
Hexachloroethane			4.8	3.3	0.33	4.8	303.0	0.33	0.018	0.2				
Hexachlorobutadiene			0.86	18	1.8	0.86	0.86	0.86	0.019	0.2				
Hexachlorocyclopentadiene	5.2		220	1100	110	5.2	5.2	5.2	0.041	1				
2,2'-oxybis(1-chloropropane)						NE	NE	NE	0.017	0.2				
Bis-(2-chloroethoxy) methane	11000					11000	11000	11000	0.012	0.2				
Bis-(2-chloroethyl) ether			0.0098	0.53	0.053	0.0098	0.0098	0.0098	0.014	0.2				
4-Chlorophenyl-phenyl ether						NE	NE	NE	0.0084	0.2				
4-bromophenyl-phenyl ether	1.5					1.5	1.5	1.5	0.018	0.2				
3,3'-Dichlorbenzidine			0.15	0.028	0.0028	0.15	0.028	0.0028	0.43	2				
4-Chloroaniline	50		150			50	50	50	0.017	0.2				
Organonitrogen Compounds														
Nitrobenzene			3.4	690	69	3.4	3.4	3.4	0.0074	0.2				
Aniline			12			12	12	12	TBD	1				
2-Nitroaniline			1.0			1.0	1.0	1.0	0.015	0.2				
3-Nitroaniline						NE	NE	NE	0.23	1				
4-Nitroaniline						NE	NE	NE	0.16	1				
N-Nitrosodimethylamine			0.0013	3	0.3	0.0013	0.0013	0.0013	0.00026	0.002				
N-Nitroso-di-n-propylamine			0.0096	0.51	0.051	0.0096	0.0096	0.0096	0.032	0.2				
N-Nitrosodiphenylamine		332	14	6	0.6	14	6	0.6	0.028	0.2				
2,4-Dinitrotoluene			73	3.4	0.34	73	3.4	0.34	0.019	0.2				
2,6-Dinitrotoluene			36			36	36	36	0.0088	0.2				
Carbazole			3.4			3.4	3.4	3.4	0.013	0.2				
Oxygen-Containing Compounds														
Benzoic Acid	42	12,976	150000			42	42	42	1.71	5				
Benzyl Alcohol	8.6	589	11000			8.6	8.6	8.6	0.97	5				
Dibenzofuran	3.7	1003	24			3.7	3.7	3.7	0.013	0.2				
Isophorone			71	960	96	71	71	71	0.0084	0.2				
Phenols and Substituted Phenols														
Phenol		<200	22000	1700000	170000	22000	22000	22000	0.020	0.5				
2-Methylphenol	13		1800			13	13	13	0.059	0.5				
4-Methylphenol			180			180	180	180	0.051	0.5				
2,4-Dimethylphenol			730	850	85	730	730	85	0.32	2				
2-Chlorophenol			30	150	15	30	30	15	0.015	0.5				

Table 2-3. Method Reporting Limits and Analytical Concentration Goals for Surface Water.

	Ecological Screening Values		Human Health Screening Values			Analytical Concentration Goals			Laboratory MDLs and MRLs: Peristaltic Pump Samples				Laboratory MDLs and MRLs: XAD-2 Samples[1]	
Analytes	**AWQC[2]**	**ORNL[3]**	**EPA Region 9 Tap water PRG[4]**	**Fish Consumption Only[5]**	**Site-Specific Fish Consumption Only[6]**	**Level 1 ACG[7]**	**Level 2 ACG[8]**	**Level 3 ACG[9]**	**CAS MDL**	**CAS MRL**	**NEA MDL**	**NEA MRL**	**NEA MRL**	**Axys MDL**
2,4-Dichlorophenol			110	290	29	110	110	29	0.024	0.5				
2,4,5-Trichlorophenol	63		3600	3600	360	63	63	63	0.025	0.5				
2,4,6-trichlorophenol			3.6	2.4	0.24	3.6	2.4	0.24	0.037	0.5				
2,3,4,6-Tetrachlorophenol			1100			1100	1100	1100	TBD	TBD				
Pentachlorophenol	8.7		0.56	3	0.3	0.56	0.56	0.3	0.028	1				
4-Chloro-3-methylphenol						NE	NE	NE	0.029	0.5				
2-Nitrophenol						NE	NE	NE	0.014	0.5				
4-Nitrophenol	150					150	150	150	0.54	2				
2,4-Dinitrophenol			73	5300	530	73	73	73	0.53	4				
4,6-Dinitro-2-methylphenol				280	28	NE	280	28	0.013	2				
Phthalate Esters														**ng/L (ppt)**
Dimethylphthalate	3		360000	1100000	110000	3	3	3	0.013	0.2				0.3 - 3.0
Diethylphthlalate	3	85,600	29000	44000	4400	3	3	3	0.026	0.2				0.3 - 3.0
Di-n-butylphthalate	1.0		3600	4500	450	1	1	1	0.026	0.2				0.3 - 3.0
Butylbenzylphthalate	3		7300	1900	190	3	3	3	0.025	0.2				0.3 - 3.0
Di-n-octylphthalate	3		1500			3	3	3	0.032	0.2				0.3 - 3.0
bis(2-Ethylhexyl)phthalate	0.12	912	4.8	2.2	0.22	0.12	0.12	0.12	0.27	2				0.3 - 3.0
Polycyclic Aromatic Hydrocarbons														**ng/L (ppt)**
Naphthalene		620	6.2			6.2	6.2	6.2	0.014	0.02				0.1-0.6
2-Methylnaphthalene						NE	NE	NE	0.012	0.02				
Acenaphthylene						NE	NE	NE	0.0089	0.02				0.1-0.6
Acenaphthene	23	74	370	990	99	23	23	23	0.0097	0.02				
Fluorene	3.9		240	5300	530	3.9	3.9	3.9	0.011	0.02				0.1-0.6
Phenanthrene	6.3	200				6.3	6.3	6.3	0.013	0.02				0.1-0.6
Anthracene	0.73	0.09	1800	40000	4000	0.09	0.09	0.09	0.010	0.02				0.1-0.6
Fluoranthene	6.2	15	1500	140	14	6.2	6.2	6.2	0.013	0.02				0.1-0.6
Pyrene			180	4000	400	180	180	180	0.012	0.02				0.1-0.6
Benzo(a)anthracene	0.027	0.65	0.092	0.018	0.0018	0.027	0.018	0.0018	0.013	0.02				0.1-0.6
Chrysene			9.2	0.018	0.0018	9.2	0.018	0.0018	0.012	0.02				0.1-0.6
Benzo(b)fluoranthene			0.092	0.018	0.0018	0.092	0.018	0.0018	0.0098	0.02				0.1-0.6
Benzo(k)fluoranthene			0.92	0.018	0.0018	0.92	0.018	0.0018	0.011	0.02				0.1-0.6
Benzo(a)pyrene	0.14	0.3	0.0092	0.018	0.0018	0.0092	0.0092	0.0018	0.0087	0.02				0.1-0.6
Indeno(1,2,3-cd)pyrene			0.092	0.018	0.0018	0.092	0.018	0.0018	0.0087	0.02				0.1-0.6
Dibenz(a,h)anthracene			0.0092	0.018	0.0018	0.0092	0.0092	0.0018	0.0079	0.02				0.1-0.6
Benzo(g,h,i)perylene						NE	NE	NE	0.0090	0.02				0.1-0.6

Table 2-3. Method Reporting Limits and Analytical Concentration Goals for Surface Water.

								Laboratory MDLs and MRLs					
	Ecological Screening Values		Human Health Screening Values			Analytical Concentration Goals			Peristaltic Pump Samples				XAD-2 Samples[1]	
Analytes	AWQC[2]	ORNL[3]	EPA Region 9 Tap water PRG[4]	Fish Consumption Only[5]	Site-Specific Fish Consumption Only[6]	Level 1 ACG[7]	Level 2 ACG[8]	Level 3 ACG[9]	CAS MDL	CAS MRL	NEA MDL	NEA MRL	NEA MRL	Axys MDL
Chlorinated Dioxins and Furans, µg/L (ppb)														**pg/L (ppq)**
2,3,7,8,-TCDD (Toxicity Equivalence Quotient)			4.5E-07	5.1E-09		4.5E-07	5.1E-09							
2,3,7,8,-TCDD														0.003 - 0.01
2,3,7,8-TCDF														0.003 - 0.01
1,2,3,7,8-PeCDD														0.003 - 0.01
1,2,3,7,8-PeCDF														0.003 - 0.01
2,3,4,7,8-PeCDF														0.003 - 0.01
1,2,3,4,7,8-HxCDD														0.003 - 0.01
1,2,3,6,7,8-HxCDD														0.003 - 0.01
1,2,3,7,8,9-HxCDD														0.003 - 0.01
1,2,3,4,7,8-HxCDF														0.003 - 0.01
1,2,3,6,7,8-HxCDF														0.003 - 0.01
1,2,3,7,8,9-HxCDF														0.003 - 0.01
2,3,4,6,7,8-HxCDF														0.003 - 0.01
1,2,3,4,6,7,8-HpCDD														0.003 - 0.01
1,2,3,4,6,7,8-HpCDF														0.003 - 0.01
1,2,3,4,7,8,9-HpCDF														0.003 - 0.01
OCDD														0.003 - 0.01
OCDF														0.003 - 0.01
Total tetrachlorinated dioxins														0.003 - 0.01
Total pentachlorinated dioxins														
Total hexachlorinated dioxins														
Total heptachlorinated dioxins														
Total tetrachlorinated furans														
Total pentachlorinated furans														
Total hexachlorinated furans														
Total heptachlorinated furans														
PCB Congeners														**pg/L (ppq)**
All 209 PCB congener target analytes														0.03-3

Table 2-3. Method Reporting Limits and Analytical Concentration Goals for Surface Water.

Note:

[1] MDLs are provided for XAD filtrate and particulate samples. The particulate samples will be reported on a pg/L basis calculated from the volume of water pumped through the filter during sample collection.

[2] AWQC based on NRWQC freshwater aquatic life criteria (EPA 2002c).

[3] ORNL based on Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter and Tsao 1996) .

[4] Based on EPA Region 9 Preliminary Remediation Goals (PRGs) (EPA 2002b).

[5] Based on NRWQC human health criteria (EPA 2002c) and The Revised Human Health Water Quality Criteria (EPA 2003).

[6] Based on Portland Harbor site-specific fish consumption rates in HHRA work plan of up to 175 g/day.

[7] Level 1 ACGs are the lowest of the EPA Region 9 PRGs for Tap Water (EPA 2002b), NRWQC freshwater aquatic life criteria (EPA 2002c), or ORNL values (Suter and Tsao 1996).

[8] Level 2 ACGs are the lowest of the EPA Region 9 PRGs for Tap Water (EPA 2002b), NRWQC freshwater aquatic life criteria and human health criteria (EPA 2002c), ORNL values (Suter and Tsao 1996), and the fish consumption criteria from the Revised Human Health Water Quality Criteria (EPA 2003).

[9] Level 3 ACGs are the lowest of the EPA Region 9 PRGs for Tap Water (EPA 2002b), NRWQC freshwater aquatic life criteria and human health criteria (EPA 2002c), ORNL values (Suter and Tsao 1996), fish consumption criteria from the Revised Human Health Water Quality Criteria (EPA 2003), and site-specific fish consumption criteria.

[10] Required for natural attenuation evaluation (Anchor and Texas A&M University 2004)

[11] NE = Not Established.

[12] TBD = To be determined

[13] Parameters for calculating freshwater dissolved metals criteria that are hardness-dependent are from NRWQC (EPA 2002c). Hardness dependent criteria based on average hardness of 25 mg/L (CaCO3) (USGS database from 1974 to 1990).

[14] NA = Not Applicable

[15] Based on Notice of Availability of Final Aquatic Life Criteria Document for Tributyltin (69 Fed. Reg. 2, 342)

USGS web site (http://nwis.waterdata.usgs.gov/or/nwis/qwdata/?site_no=14211720&agency_cd=USGS).

AWQC = ambient water quality criteria
MRL = minimum reporting limit
NRWQC = National Recommended Water Quality Criteria
ORNL = Oak Ridge National Laboratory
PRG = preliminary remediation goals

Equations used for calculation of chronic screening values for each hardness dependent metal (EPA 2002c):

Cadmium = exp (0.7409[ln(hardness)]-4.719) *(1.101672-[(ln hardness)*(0.041838)])
Copper = exp (0.8545[ln(hardness)]-1.702) *0.960
Lead = exp (1.273[ln(hardness)]-4.705) *(1.46203-[(ln hardness)*(0.145712)])
Nickel = exp (0.8460[ln(hardness)]+0.0584) *0.997
Zinc = exp (0.8473[ln(hardness)]+0.884) *0.986

Equation used for calculation of chronic screening value for pH dependent chemical (EPA 2002b):

Pentachlorophenol = exp (1.005[pH]-5.134)

Table 2-4. Summary of Estimated Numbers of Field QC Samples for Round 2A Surface Water.

Parameter	Samples	Blind Field Replicates[1]	Blind Field Sample Splits[2]	Field Rinsate Blanks[3,4]	Decon Blank[5]	Total Number of Field Samples
Early Fall Sampling Event						
Peristaltic Pump						
Metals (unfiltered)	23	2	1	2	1	29
Metals (filtered)	23	2	1	2	1	29
PCB Aroclors	16	1	1	2	1	21
Chlorinated Herbicides	16	1	1	2	1	21
Organochlorine Pesticides	16	1	1	2	1	21
SVOCs	23	2	1	2	1	29
Butyltin compounds	16	1	1	2	1	21
Perchlorate	1	1	1	1	1	5
TSS	23	2	1	0	0	26
TDS	23	2	1	0	0	26
DOC	23	2	1	2	0	28
TOC	23	2	1	2	0	28
XAD-2 Resin						
PCB Aroclors[6]	7	1	0	1	0	9
Organochlorine Pesticides	7	1	0	1	0	9
Phthalate Esters	7	1	0	1	0	9
PAHs	7	1	0	1	0	9
Dioxins/Furans	5	1	0	1	0	7
Late Fall Sampling Event						
Peristaltic Pump						
Metals (unfiltered)	23	2	1	2	1	29
Metals (filtered)	23	2	1	2	1	29
PCB Aroclors	16	1	1	2	1	21
Chlorinated Herbicides	16	1	1	2	1	21
Organochlorine Pesticides	16	1	1	2	1	21
SVOCs	23	2	1	2	1	29
Butyltin compounds	16	1	1	2	1	21
Perchlorate	1	1	1	1	1	5
TSS	23	2	1	0	0	26
TDS	23	2	1	0	0	26
DOC	23	2	1	2	0	28
TOC	23	2	1	2	0	28
XAD-2 Resin						
PCB Aroclors[6]	7	1	0	1	0	9
Organochlorine Pesticides	7	1	0	1	0	9
Phthalate Esters	7	1	0	1	0	9
PAHs	7	1	0	1	0	9
Dioxins/Furans	5	1	0	1	0	7

Table 2-4. Summary of Estimated Numbers of Field QC Samples for Round 2A Surface Water.

Parameter	Samples	Blind Field Replicates[1]	Blind Field Sample Splits[2]	Field Rinsate Blanks[3,4]	Decon Blank[5]	Total Number of Field Samples
Late Winter High Flow Sampling Event						
Peristaltic Pump						
Metals (unfiltered)	23	2	1	2	1	29
Metals (filtered)	23	2	1	2	1	29
PCB Aroclors	20	1	1	2	1	25
Chlorinated Herbicides	23	1	1	2	1	28
Organochlorine Pesticides	20	1	1	2	1	25
SVOCs	23	1	1	2	1	28
Butyltin compounds	23	1	1	2	1	28
Perchlorate	1	1	1	1	1	5
TSS	23	2	1	0	0	26
TDS	23	2	1	0	0	26
DOC	23	2	1	2	0	28
TOC	23	2	1	2	0	28
XAD-2 Resin						
PCB Aroclors[6]	3	1	0	1	0	5
Organochlorine Pesticides	3	1	0	1	0	5
Phthalate Esters	3	1	0	1	0	5
PAHs	3	1	0	1	0	5
Dioxins/Furans	3	1	0	1	0	5

Note:

[1] Field QC sample numbers based on a frequency of 5%.

[2] At EPA's discretion, the field splits may be analyzed by EPA rather than LWG.

[3] A field rinsate blank will be collected near the beginning and end of each sampling event for the peristaltic pump

[4] A field blank, uninstalled XAD-2 resin column and a filter, will travel with the sampling team. It will be packed and placed in the coolers with the collected samples for analysis after the sampling event.

[5] Prior to the start of sample collection activities, a decon blank will be generated by the laboratory that conducts decontamination of the peristaltic pump sampling equipment.

[6] An aliquot of the XAD extracts will be archived for potential PCB congener analysis.

Table 2-5. Sample Containers, Preservation, Holding Times, and Sample Volumes for Surface Water.

	Container[1]		Additional	Preservation	Holding Time	Laboratory Sample Size
	Type	Size	for Lab QC[2]			
Sample collected by peristaltic pump						
Total Suspended Solids	HDPE	1 liter	2 liters	4±2°C	7 days	1 liter
Total Dissolved Solids	HDPE	500 mL	500 mL	4±2°C	7 days	250 ml
Total Organic Carbon	HDPE	250 mL	none	HCl or H_2SO_4 to pH <2; 4±2°C	28 days	50 ml
Dissolved Organic Carbon	HDPE	250 mL	none	HCl or H_2SO_4 to pH <2; 4±2°C	28 days	50 ml
Unfiltered metals	HDPE	1 liter	1 liter	5 ml of 1:1& HNO_3; 4±2°C	6 months/60 days[3]	300 ml
Filtered metals and hardness	HDPE	1 liter	1 liter	5 ml of 1:1& HNO_3; 4±2°C	6 months/60 days[3]	300 ml
Hexavalent chromium	HDPE	500 mL	none	4±2°C	24 hours	100 ml
Butyltin compounds	PC	1 liter	2 liters	4±2°C	7 days	1 liter
Perchlorate	HDPE	250 mL	none	4±2°C	28 days	10 mL
Chlorinated herbicides	AG	1 liter	2 liters	4±2°C	7 /40 days[4]	1 liter
Chlorinated pesticides	AG	1 liter	2 liters	4±2°C	7 /40 days[4]	1 liter
Polychlorinated biphenyls	AG	4 liters	8 liters	4±2°C	7 /40 days[4]	4 liters
Semivolatile organic compounds	AG	1 liter	2 liters	4±2°C	7 /40 days[4]	1 liter
Chlorinated dioxins and furans	AG	1 liter	2 liters	4±2°C	30/45 days[5]	1 liter
XAD-2 resin						
Chlorinated pesticides	XAD	250 g	1 column	0-4°C	NE[6]	1/6 of extract
Polychlorinated biphenyls					NE[6]	1/6 of extract
Phthalate esters					NE[6]	1/6 of extract
Polycyclic aromatic hydrocarbons					NE[6]	1/6 of extract
Chlorinated dioxins and furans					NE[6]	2/6 of extract
Filtered Particulate						
Chlorinated pesticides	Filter cartridge will be placed in 16 oz wide-mouth glass sample jar.		NA	0-4°C	NE[6]	1/6 of extract
Polychlorinated biphenyls					NE[6]	1/6 of extract
Phthalate esters					NE[6]	1/6 of extract
Polycyclic aromatic hydrocarbons					NE[6]	1/6 of extract
Chlorinated dioxins and furans					NE[6]	2/6 of extract

HDPE = High density polyethylene bottle
PC = Polycarbonate bottle
AG = Amber glass bottle with teflon-lined lid
XAD = XAD-2 resin in stainless steel column
NE = Not Established

[1] Sample container sizes may be modified to meet laboratory requirements.

[2] Extra sample volume will be collected at a frequency of 5% of samples to accommodate requirements for laboratory QC samples .

[3] The holding time for mercury is 60 days, based on CRITFC study (EPA 2002a) and EPA Method 1631 revision D (EPA 2001a). The holding time for the remaining metals is 6 months.

[4] The holding time is 7 days from collection to extraction and 40 days from extraction to analysis.

[5] The holding time is 30 days from collection to extraction and 45 days from extraction to analysis.

[6] A technical holding time has not been established for XAD extracts and filters. The contractual holding time is 30 days from collection to extraction and 30 days from extraction to analysis.

Appendix A

APPENDIX A

EPA COMMENTS ON ROUND 2A SURFACE WATER FSP, DECEMBER 19, 2003

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
OREGON OPERATIONS OFFICE
811 S.W. 6th Avenue
Portland, Oregon 97204

December 19, 2003

Mr. Jim McKenna
Port of Portland & Co-Chairman, Lower Willamette Group
121 NW Everett
Portland, Oregon 07209

Mr. Robert Wyatt
Environmental Compliance Specialist
Northwest Natural & Co-Chairman, Lower Willamette Group
220 Northwest Second Avenue
Portland, Oregon 97209

Re: Surface Water Sampling Approach

Dear Mr. McKenna and Mr. Wyatt:

The U.S. Environmental Protection Agency (EPA) and its partners have reviewed the surface water sampling approach as presented in the Round 2A Field Sampling Plan and Round 2A Quality Assurance Project Plan Addendum. Both documents are dated April 17, 2003. As follow-up to our November 6, 2003 letter, EPA and its partners have developed a surface water sampling approach in lieu of detailed comments. The rational for this approach along with an associated map and tables are attached.

EPA and its partners support many elements of the surface water approach developed by the LWG. In particular we agree with the rationale as presented in the FSP and many of the proposed sample locations and depths. However, a number of modifications to the approach are required to ensure that surface water at the Portland Harbor Superfund Site is properly characterized. Required modifications to the surface water sampling approach include:

- Lower reporting limits for bioaccumlative chemicals to support the human health and ecological risk assessments and development of the food web model.
- Additional sampling events to better understand the variability of surface water concentrations over time and space.
- Additional sampling locations to improve our understanding of upland source contributions to the site and to support the human health and ecological risk assessments.
- Additional analytes to address known contaminant sources within Portland Harbor.

Detailed information regarding each of the above topics is included in the attached documents.

Please have a surface water FSP which incorporates the attached surface water approach prepared and submitted to EPA by February 19, 2004.

EPA is available to meet with the Respondents' technical team to discuss the proposes surface water sampling approach. Please call Chip Humphrey at (503) 326-2678 or Eric Blischke at (503) 326-4006 arrange a meeting. All legal inquiries should be directed to Lori Cora at (206) 553-1115.

Sincerely,

Chip Humphrey
Eric Blischke
Remedial Project Managers

Enclosures

cc: John Crellin, ATSDR
Helen Hillman, NOAA
Ted Buerger, US Fish and Wildlife Service
Preston Sleeger, Department of Interior
Jim Anderson, DEQ
Kurt Burkholder, Oregon DOJ
Rick Keppler, Oregon Department of Fish and Wildlife
David Stone, Oregon Public Health Branch
Rod Thompson, Confederated Tribes of Grand Ronde
Tom Downey, Confederated Tribes of Siletz
Audie Huber, Confederated Tribes of Umatilla
Brian Cunninghame, Confederated Tribes of Warm Springs
Rick Eichstaedt, Nez Perce Tribe
Paul Ward, Confederated Tribes of Yakama Nation
Valerie Lee, Environment International
Keith Pine, Striplin Environmental Associates

SURFACE WATER CHARACTERIZATION APPROACH

Introduction:

The Lower Willamette Group developed a plan for characterizing water column chemistry in its April 17, 2003 Round 2A Field Sampling Plan (FSP). The Round 2A Quality Assurance Project Plan Addendum (QAPP) included information regarding sample analysis methods and minimum reporting limits (MRLs) for surface water samples.

The FSP identified the following data needs:

- Site Characterization: Surface water chemistry is needed to develop an understanding of the chemicals present and ranges of concentrations in the water column under different flow conditions and water depths.
- Ecological Risk Assessment: Surface water chemistry data are needed for the assessment of direct toxicity of surface water to aquatic receptors.
- Human Health Risk Assessment: Surface water chemistry data are needed for the baseline human health risk assessment.
- Feasibility Study: Surface water chemistry data are needed to develop a preliminary understanding of the water particulate chemistry that may interact with the sediment bed for the purpose of evaluating recontamination potential and natural attenuation processes (i.e., burial).

In addition, the Programmatic Work Plan (November 13, 2003) identified the following data uses for surface water samples:

- Determine if upland and in-water sources are contributing to unacceptable risk via surface water exposure pathway.
- Support the human health and ecological risk assessments
- Determine if river stage and flow and storm events result in measurable changes in surface water concentrations
- Determine the contribution from upstream sources
- Determine the potential presence of natural attenuation processes within ISA
- Determine the potential for recontamination

The FSP proposed the collection of surface water samples each at 3 transects (upstream of ISA (RM 9.2), within the ISA (RM 6) and downstream of the ISA (RM 3.5). Three surface water sample locations at two depths were proposed for a total of 18 samples. Each transect will be sampled twice to represent low flow conditions in the summer months and first flush conditions during a fall rain event. In addition, eight surface water sampling stations were selected to support the ecological risk assessment and at two locations to support the human health risk

assessment. Proposed sample analyses are metals, semivolatile organic compounds, pesticides, herbicides and polychlorinated biphenyls (PCBs). Analyses will be performed on unfiltered samples. For metals, both total and dissolved (filtered) analyses will be performed.

EPA and its partners have evaluated the surface water approach developed by the LWG and agree with many elements of it. In particular we agree with the rationale as presented in the FSP and many of the proposed sample locations and depths. However, EPA and its partners believe that the following modifications are required to ensure that surface water at the site is properly chracterized:

- Lower reporting limits for bioaccumlative chemicals to support the human health and ecological risk assessments and development of the food web model.
- Additional sampling events to better understand the variability of surface water concentrations over time and space.
- Additional sampling locations to improve our understanding of upland source contributions to the site and to support the human health and ecological risk assessments.
- Additional analytes to address known contaminant sources within Portland Harbor.

Reporting Limits

Minimum reporting limits (MRLs) must be adequate to meet the objectives of the RI/FS. The MRLs proposed in the Round 2 FSP are generally adequate with the exception of chlorinated pesticides, PCBs and a handful of other chemicals. The attached table compares MRL proposed in the FSP with ecological and human health screening values. Ecological screening values were obtained from either Ambient Water Quality Criteria (AWQC) or Oak Ridge National Laboratory. Human health screening values are taken from either AWQC for the protection of human health or EPA Region 9 Preliminary Remediation Goals (PRGs). The lowest available screening values was compared to the MRL to determine whether detection limits are adequate.

In cases where the proposed MRL exceeds screening criteria, EPA and its partners require the use of alternate sampling approaches such as high flow sampling techniques using XADII resins and/or semi-permeable membrane devices achieve lower reporting limits. Both techniques can used for metals, semivolatile organic compounds (SVOCs), pesticides, herbicides and PCBs. These techniques can also provide time integrated sampling results and, in the case of high volume sampling techniques, provide the opportunity for spatially integrated sample results as well. Adequate reporting limits are particularly critical for chemicals such as chlorinated pesticides, PCBs and polychlorinated dibenzo-p-dioxins and furans which are known to be present in fish at concentrations that may pose a threat to human health. The LWG must evaluate these two approaches to determine which approach will best achieve the objectives described above. One factor that must be considered is the ability of the methods to gather data on both total and dissolved concentrations.

In order to ensure that samples are representative of surface water conditions, grab samples must be properly agitated (rather than decanted) by the laboratory prior to analysis. This will ensure

that the proper amount of suspended sediment is included when preparing the sample for chemical analysis.

Sample timing

The proposed two rounds of sampling are inadequate to characterize surface water conditions a the Portland Harbor site. Surface water conditions are expected to be variable. As a result, surface water samples should be collected on a quarterly basis to provide a year round data set. In addition to summer low flow conditions and fall first flush conditions, samples should be collected in the winter to coincide with high flow conditions and in the spring to coincide with the release of amphibian egg masses. In addition to quarterly sampling, the use of alternative sampling approaches as described above can provide time integrated sample results to further compensate for the variability of surface water conditions at the site.

In the instance of sample events timed to flow events (fall first flush and high flow sample events) it is critical that these samples be collected at the proper time. As a result, the LWG must be prepared to mobilize sampling crews and equipment to capture these events

Sample Locations

In general, the sampling locations proposed by the LWG are adequate to meet the objectives described in the FSP. However, the surface water characterization would benefit from the inclusion of additional sample locations to support the human health risk and ecological risk assessments help estimate the contribution from upland contaminant sources. A map that depicts the location of each sample is attached. A table that cross references sample numbers and provides the rational for each location is also attached. Analyses should be performed on unfiltered samples with the exception of samples in the source areas which should include both filtered and unfiltered analyses.

Transects: Transects are useful to develop estimates of contaminants entering the site from upstream and exiting the site downstream. This information, in conjunction with flow data, can be used to estimate the load of contaminants entering the site under different conditions. Although EPA and its partners concur with the locations of the downstream transect (just upstream of the entrance to Multnomah Channel), the upstream transect should be moved to a point just upstream of the most upstream proposed sediment sample (G230). This corresponds approximately to River Mile (RM) 11. EPA and its partners concur that the transect just upstream from the St. Johns Bridge will provide a good estimate of surface water conditions in one of the most contaminated portions of the Portland Harbor site.

Ecological Risk Assessment: In addition to the eight locations selected to evaluate potential impacts to ecological receptors, EPA and its partners require nine additional sample locations to support the ecological risk assessment (ERA). Six of these sample locations coincide with source samples identified below. Sample locations coincide with the location of amphibian habitat and include samples from both the main channel and in quiescent areas of the site (e.g.,

slips and embayments). Samples to support the ERA should be collected in nearshore areas approximately one foot above the river bottom.

Human Health Risk Assessment: The two sample locations proposed to evaluate potential impacts to human health are in quiescent areas where human contact is expected. In addition to these locations, an additional sample location should be included at Cathedral Park due to potential for human contact with surface water at this location and because this area is downstream from some of the most contaminated areas of the site.

Contributions from Upland Sources: Additional sampling locations should be included to help understand the contribution of upland sources of contamination to the site. This information will allow us to determine whether surface water is impacted locally from key source areas within Portland Harbor. Samples should be located off shore of the following upland sites:

- GASCO
- Atofina
- Rhone Poulenc Outfall
- Portland Ship Yard
- Oregon Steel Mill
- Kinder Morgan

In addition to the sources identified above, samples W-13 and W-14 proposed by the LWG may also be used to evaluate the contribution from upland sources (Willbridge and Gunderson respectively). Samples collected to characterize upland sources should be collected approximately one foot above the river bottom analyzed for both total and dissolved constituents.

Analytes

The analytes proposed by the LWG are generally representative of sources know to be present within Portland Harbor or entering the site. However, there are known tributyltin (TBT) and dioxin sources within Portland Harbor. TBT is associated with ship maintenance and repair operations and is known to be present as sites such as the Portland Shipyard and Mar Com Marine. Dioxin is know to be present at sites such as Rhone Poulenc and McCormick and Baxter and is likely entering the site from upstream. As a result, the suite of parameters must be expanded to include TBT and polychlorinated dibenzo-p-dioxins and furans (dioxin). Due to costs associated with dioxin sampling, only the transects and samples collected in Willamette Cove and adjacent to the Rhone Poulenc outfall should be analyzed for dioxins.

Table 1 - Screening Criteria and Required Minimum Reporting Limits

Contaminant	LWG MRL	Ecological Screening Value (ug/l) Source	Criteria	Human Health Screening Value (ug/l) Fish and Water Consumption	Fish Consumption Only +	Region 9 Tap Water PRG +	Detection Limit Analysis Required MRL ++	Required MRL/LWG MRL Ratio	Adequate Detection Limit?
Metals									
Aluminum	50	Chronic AWQC	87				87.000	1.740	Yes
Antimony	0.2			5.6	640		5.6	28.000	Yes
Arsenic	0.5	Chronic AWQC	150	0.018	0.14		0.018	0.036	No
Cadmium	0.1	Chronic AWQC*	2.2			50	2.2	22.000	Yes
Chromium	5	Chronic AWQC*	11			50	11	2.200	Yes
Copper	2	Chronic AWQC*	9	1300			9	4.500	Yes
Lead	0.5	Chronic AWQC*	2.5			50	2.5	5.000	Yes
Mercury	0.1	Chronic AWQC	0.77			2	0.77	7.700	Yes
Nickel	10	Chronic AWQC*	52	610	4600		52	5.200	Yes
Selenium	0.5	Chronic AWQC	0.5	170	4200	10	0.5	1.000	No
Silver	0.5	Chronic AWQC	0.12			50	0.12	0.240	No
Zinc	6	Chronic AWQC*	110	7400	26000		110	18.333	Yes
PCBs									
Aroclor 1016	0.033	ORNL	0.23	0.000064	0.000064	0.96	0.000064	0.002	No
Aroclor 1221	0.067	Chronic AWQC**	0.014	0.000064	0.000064	0.034	0.000064	0.001	No
Aroclor 1232	0.033	Chronic AWQC**	0.014	0.000064	0.000064	0.034	0.000064	0.002	No
Aroclor 1242	0.033	Chronic AWQC**	0.014	0.000064	0.000064	0.034	0.000064	0.002	No
Aroclor 1248	0.033	ORNL	0.0019	0.000064	0.000064	0.034	0.000064	0.002	No
Aroclor 1254	0.033	ORNL	0.0019	0.000064	0.000064	0.034	0.000064	0.002	No
Aroclor 1260	0.033	Chronic AWQC**	0.014	0.000064	0.000064	0.034	0.000064	0.002	No
Aroclor 1262	0.033	Chronic AWQC**	0.014	0.000064	0.000064		0.000064	0.002	No
Aroclor 1268	0.033	Chronic AWQC**	0.014	0.000064	0.000064		0.000064	0.002	No
Herbicides									
Dalapon	2					1100	1100	550.000	Yes
Dicamba	0.5					1100	1100	2200.000	Yes
MCPA	500						No Criteria Available		
Dichlorprop	1						No Criteria Available		
2,4-D	1			100		360	100	100.000	Yes
2,4,5-T	0.25						No Criteria Available		
2,4,5-TP (Silvex)	0.25			10			10	40.000	Yes
2,4-DB	5					290	290	58.000	Yes
Dinoseb	1					36	36	36.000	Yes
MCPP	NE						No Criteria Available		
Pesticides									
alpha-BHC	0.001	ORNL	0.004	0.0026	0.0049	0.011	0.0026	2.600	Yes
beta-BHC	0.001	ORNL	0.004	0.0091	0.017	0.037	0.004	4.000	Yes

Table 1 - Screening Criteria and Required Minimum Reporting Limits

Contaminant	LWG MRL	Ecological Screening Value (ug/l) Source	Criteria	Human Health Screening Value (ug/l) Fish and Water Consumption	Fish Consumption Only +	Region 9 Tap Water PRG +	Detection Limit Analysis Required MRL ++	Required MRL/LWG MRL Ratio	Adequate Detection Limit?
gamma-BHC	0.001	Chronic AWQC	0.08	0.98	1.8	0.052	0.052	52.000	Yes
delta-BHC	0.001	ORNL	0.004				0.004	4.000	Yes
Heptachlor	0.001	Chronic AWQC	0.0038	0.000079	0.000079	0.015	0.000079	0.079	No
Aldrin	0.001	Acute AWQC	3	0.000049	0.000049	0.004	0.000049	0.049	No
Hepatchlor Epoxide	0.001	Chronic AWQC	0.0038	0.000039	0.000039	0.0074	0.000039	0.039	No
gamma-Chlordane	0.001	Chronic AWQC	0.0043	0.00008	0.000081	0.19	0.00008	0.080	No
alpha - Chlordane	0.001	Chronic AWQC	0.0043	0.00008	0.000081	0.19	0.00008	0.080	No
Endosulfan I	0.001	ORNL	0.051	62	89	220	0.051	51.000	Yes
4,4'-DDE	0.002			0.000022	0.000022	0.2	0.000022	0.011	No
Dieldrin	0.002	Chronic AWQC	0.056	0.000052	0.000054	0.0042	0.000052	0.026	No
Endrin	0.002	Chronic AWQC	0.036	0.059	0.06	11	0.036	18.000	Yes
Endosulfan II	0.002	ORNL	0.051	62	89	220	0.051	25.500	Yes
4,4'-DDD	0.002			0.000031	0.000031	0.28	0.000031	0.016	No
Endrin Aldehyde	0.002			0.29	0.3		0.29	145.000	Yes
4,4'-DDT	0.002	Chronic AWQC	0.001	0.000022	0.000022	0.2	0.000022	0.011	No
Endosulfan sulfate	0.002			62	89		62	31000.000	Yes
Methoxychlor	0.015	ORNL	0.019	100		100	0.019	1.267	Yes
Hexachlorobenzene	0.002			0.00028	0.00029	0.042	0.00028	0.140	No
Toxaphene	0.1	Chronic AWQC	0.0002	0.00028	0.00028	5	0.0002	0.002	No
Hexachlorobutadiene	0.002			0.44	18	0.86	0.44	220.000	Yes
oxy chlordane							No Criteria Available		
cis-nonachlor							No Criteria Available		
trans-nonaclor							No Criteria Available		
2,4'-DDD	0.002		0.28				0.28	140.000	Yes
2,4'-DDE	0.002		0.2				0.2	100.000	Yes
2,4'-DDT	0.002		0.2				0.2	100.000	Yes
Volatile Organic Compounds									
1,2,4-Trichlorobenzene	1	Chronic AWQC	50	35	70	190	35	35.000	Yes
1,2-dichlorobenzene	1	ONRL	14	420	13000	370	14	14.000	Yes
1,3-dichlorobenzene	1			320	960	5.5	5.5	5.500	Yes
1,4-dichlorobenzene	1			63	190	0.5	0.5	0.500	No
2,2'-oxybis(1-chloropropane)	1						No Criteria Available		
2,4-dinitrotoluene	5			0.11	3.4	73	0.11	0.022	No
2,6-dinitrotoluene	5					36	36	7.200	Yes
2-chloronaphthalene	1			1000	1600	490	490	490.000	Yes
2-Nitroaniline	5					1	1	0.200	No
3,3'-dichlorobenzidine	0.0075			0.021	0.028	0.15	0.021	2.800	Yes

Table 1 - Screening Criteria and Required Minimum Reporting Limits

Contaminant	LWG MRL	Ecological Screening Value (ug/l) Source	Criteria	Human Health Screening Value (ug/l) Fish and Water Consumption	Fish Consumption Only +	Region 9 Tap Water PRG +	Detection Limit Analysis Required MRL ++	Required MRL/LWG MRL Ratio	Adequate Detection Limit?
3-Nitroaniline	6						No Criteria Available		
4-Bromophenyl-phenyl ether	1	ONRL	1.5				1.5	1.500	Yes
4-Chloroaniline	1	Chronic AWQC	50			150	50	50.000	Yes
4-Chlorophenyl-phenyl ether	1						No Criteria Available		
4-Nitroaniline	5						No Criteria Available		
Aniline	1					12	12	12.000	Yes
Benzoic Acid	60	ONRL	42			150000	42	0.700	No
Benzyl Alcohol	5	ONRL	8.6			11000	8.6	1.720	Yes
Bis-(2-chloroethoxy) methane	1	Acute AWQC	11000				11000	11000.000	Yes
Bis-(2-chloroethyl) ether	0.003			0.03	0.53	0.00098	0.00098	0.327	No
Hexachlorobenzene	0.0015			0.00028	0.00029	0.042	0.00028	0.187	No
Hexachlorobutadiene	0.0015			0.44	18	0.86	0.44	293.333	Yes
Hexachlorocyclopentadiene	5	Chronic AWQC	5.2	40	1100	220	5.2	1.040	Yes
Hexachloroethane	0.0015			1.4	3.3	4.8	1.4	933.333	Yes
Isophorone	1			35	960	71	35	35.000	Yes
Nitrobenzene	1			17	690	3.4	3.4	3.400	Yes
N-Nitrosodimethylamine	0.0075			0.00069	3	0.003	0.00069	0.092	No
N-Nitoroso-di-n-propylamine	1					0.0096	0.0096	0.010	No
N-Nitrosodiphenylamine	1			3.3	6	14	3.3	3.300	Yes
Polycyclic Aromatic Hydrocarbons									
2-Methylnaphthalene	0.0015						No Criteria Available		
Acenaphthene	0.0015	ONRL	23	670	990	370	23	15333.333	Yes
Acentphthylene	0.0015						No Criteria Available		
Anthracene	0.0015	ONRL	0.73	8300	40000	1800	0.73	486.667	Yes
Benzo(a)anthracene	0.0015	ONRL	0.027	0.0038	0.018	0.092	0.0038	2.533	Yes
Benzo(a)pyrene	0.0015	ONRL	0.014	0.0038	0.018	0.0092	0.0038	2.533	Yes
Benzo(b)fluoranthene	0.0015			0.0038	0.018	0.092	0.0038	2.533	Yes
Benzo(k)fluoranthene	0.0015			0.0038	0.018	0.92	0.0038	2.533	Yes
Carbazole	0.0015					3.4	3.4	2266.667	Yes
Chrysene	0.0015			0.0038	0.018	9.2	0.0038	2.533	Yes
Dibenz(a,h)anthracene	0.0015			0.0038	0.018	0.0092	0.0038	2.533	Yes
Dibenzofuran	0.0015	ONRL	3.7			24	3.7	2466.667	Yes
Fluoranthene	0.0015	ONRL	6.2	130	140	1500	6.2	4133.333	Yes
Fluorene	0.0015	ONRL	3.9	1100	5300	240	3.9	2600.000	Yes
Indeno(1,2,3-cd)pyrene	0.0015			0.0038	0.018	0.092	0.0038	2.533	Yes
Naphthalene	0.0015					6.2	6.2	4133.333	Yes
Phenanthrene	0.0015	ONRL	6.3				6.3	4200.000	Yes

Table 1 - Screening Criteria and Required Minimum Reporting Limits

Contaminant	LWG MRL	Ecological Screening Value (ug/l) Source	Ecological Screening Value (ug/l) Criteria	Human Health Screening Value (ug/l) Fish and Water Consumption	Human Health Screening Value (ug/l) Fish Consumption Only +	Human Health Screening Value (ug/l) Region 9 Tap Water PRG +	Detection Limit Analysis Required MRL ++	Detection Limit Analysis Required MRL/LWG MRL Ratio	Detection Limit Analysis Adequate Detection Limit?
Pyrene	0.0015			830	4000	180	180	120000.000	Yes
Phenols									
2,3,4,6-Tetrachlorophenol	5					1100	1100	220.000	Yes
2,4,5-Trichlorophenol	5		63	1800	3600	3600	63	12.600	Yes
2,4,6-Trichlorophenol	5			1.4	2.4	3.6	1.4	0.280	No
2,4-Dichlorophenol	3			77	290	110	77	25.667	Yes
2,4-Dimethylphenol	3			380	850	730	380	126.667	Yes
2,4-Dinitrophenol	25			69	5300	73	69	2.760	Yes
2-Chlorophenol	1			81	150	30	30	30.000	Yes
2-Methylphenol	2	ONRL	13			1800	13	6.500	Yes
4,6-Dinitro-2-methylphenol	15			13	280		13	0.867	No
4-Nitrophenol	5		150				150	30.000	Yes
Pentachlorophenol	0.0075	Chronic AWQC***	6	0.27	3		0.27	36.000	Yes
Phenol	2			21000	1700000	110	110	55.000	Yes
Tetrachlorophenol	5					1100	1100	220.000	Yes
Phthalate Esters									
bis(2-ethylhexyl) phthalate	1	ONRL	0.12	1.2	2.2	4.8	0.12	0.120	No
Butyl benzyl phthalate	1	Chronic AWQC	3	1500	1900	7300	3	3.000	Yes
Diethyl phthalate	1	Chronic AWQC	3	17000	44000	29000	3	3.000	Yes
Dimethylphthalate	1	Chronic AWQC	3	270000	1100000	360000	3	3.000	Yes
Di-n-butylphthalate	1	ONRL	1	2000	4500	3600	1	1.000	No
Di-n-octylphthalate	1	Chronic AWQC	3			1500	3	3.000	Yes
Other									
Tributyltin	NA	Chronic AWQC	0.063				0.063	Not proposed by LWG	
2,3,7,8-TCDD (Dioxin)	NA				5.00E-009	5.1E-009	5E-009	Not proposed by LWG	

Footnotes:

+	Drinking water criteria are for screening purposes only
++	Required MRL based on minimum screeing criteria
*	Chronic AWQC is Hardness dependent; assumes 30 mg/l hardness
**	Chronic AWQC is not aroclor specific
***	Chronic AWQC is pH dependent; assumes pH of 6.9
NA	No MRL proposed by LWG
	Blank cell indicates that criteria is not available

Table 2 - Portland Harbor Surface Water Sampling Locations 12/18/2003

W-01	W-01	ERA		Amphibian Habitat near Multnomah Channel	Ecological Risk Assessment	MILE 3-4	7614615.49476	719642.81788
W-02	W-02	SC		Downstream Transect (RM3.5)	Site Characterization	MILE 3-4	7615894.00000	717823.00002
W-03	W-03	SC		Downstream Transect (RM3.5)	Site Characterization	MILE 3-4	7616569.00000	717979.00002
W-04	W-04	SC		Downstream Transect (RM3.5)	Site Characterization	MILE 3-4	7617369.56000	718097.25005
W-05	W-05	ERA		Amphibian Habitat - International Slip	Ecological Risk Assessment	MILE 3-4	7619853.80000	717103.24002
W-06	W-06	ERA		Amphibian Habitat - T4/Slip 1	Ecological Risk Assessment	MILE 4-5	7620319.26000	714481.61002
W-07	W-07	ERA		Amphibian Habitat - T4/Slip 3	Ecological Risk Assessment	MILE 4-5	7620382.14000	713206.40001
W-08	W-08	SC		Midstream Transect (RM 6)	Site Characterization	MILE 6-7	7623411.69000	707359.74005
W-09	W-09	SC		Midstream Transect (RM 6)	Site Characterization	MILE 6-7	7623015.00000	707022.00005
W-10	W-10	SC		Midstream Transect (RM 6)	Site Characterization	MILE 6-7	7622535.05342	706445.62171
W-11	W-11	ERA		Amphibian Habitat - Willamette Cove	Ecological Risk Assessment	MILE 6-7	7627043.37000	705735.04003
W-12	W-12	HHRA		Human Use Contact Area - Willamette Cove	Human Health Risk Assessment	MILE 6-7	7627351.92000	705751.04003
W-13	W-13	ERA	WILLBRIDGE	Amphibian Habitat - Saltzman Creek	Ecological Risk Assessment	MILE 7-8	7628633.11409	701534.73410
W-14	W-14	ERA-S	GUNDERSON	Amphibian Habitat-Gunderson	Ecological Risk Assessment - Source	MILE 8-9	7632376.27536	697293.60316
W-15	W-15	HHRA		Human Use Contact Area - Swan Island Lagoon	Human Health Risk Assessment	MILE 8-9	7635700.92750	699994.70630
W-16	W-16	ERA		Amphibian Habitat - Swan Island Lagoon	Ecological Risk Assessment	MILE 9-10	7636777.00174	698643.32304
W-17	W-17	SC		Upstream Transect (RM11)	Site Characterization	MILE 10-11	7642852.65478	690423.47341

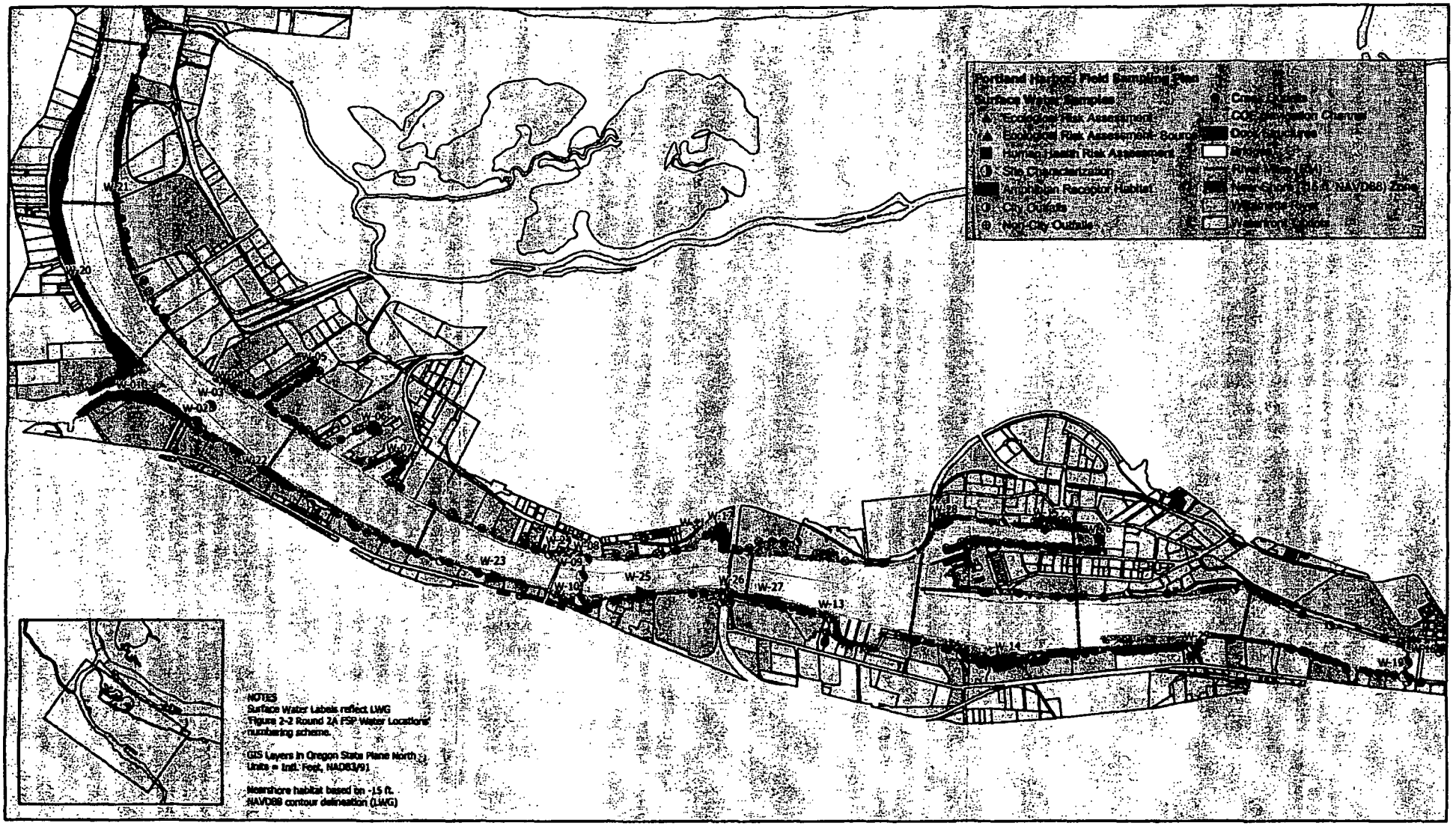
USEPA REGION 10,

OREGON DEQ AND TRUSTEES

W-18	W-18	SC		Upstream Transect (RM11)	Site Characterization	MILE 10-11	7642505.89827	690067.93003
W-19	W-19	SC		Upstream Transect (RM11)	Site Characterization	MILE 10-11	7642182.30623	689759.86557
W-20	amphib1	ERA		Amphibian Habitat - Sauvie Island	Ecological Risk Assessment	MILE 2-3	7615356.81022	723513.69465
W-21	amphib3	ERA	OSM	Amphibian Habitat - Downstream East	Ecological Risk Assessment	MILE 2-3	7617779.25547	724956.43145
W-22	amphib11	ERA	KINDER MORGAN	Amphibian Habitat - Linnton	Ecological Risk Assessment	MILE 4-5	7616943.49527	715108.02827
W-23	amphib12	ERA		Amphibian Habitat - Downstream from St. Johns Bridge	Ecological Risk Assessment	MILE 5-6	7620757.78722	708670.62571
W-24	cathedralpark	HHRA		Human Use Contact Area - Cathedral	Human Health Risk Assessment	MILE 5-6	7622813.64000	708006.56002
W-25	amphib15	ERA-S	GASCO	Beach Area/Source Characterization	Ecological Risk Assessment - Source	MILE 6-7	7624207.31214	705675.41822
W-26	amphib16	ERA-S	RPAC OUTFALL	Beach Area/Source Characterization	Ecological Risk Assessment - Source	MILE 6-7	7626527.29696	703940.96736
W-27	amphib17	ERA-S	ATOFINA	Beach Area/Source Characterization	Ecological Risk Assessment - Source	MILE 7-8	7627377.71234	703036.40391
W-28	amphib20	ERA-S	PORTLAND SHIPYARD	Amphibian Habitat - Mouth of Swan Island Lagoon	Ecological Risk Assessment - Source	MILE 8-9	7633170.37093	701922.58578
W-29	amphib25	ERA		Amphibian Habitat - Terminal 2	Ecological Risk Assessment	MILE 9-10	7637396.00140	694171.69504

USEPA REGION 10,

OREGON DEQ AND TRUSTEES



PORTLAND HARBOR SURFACE WATER SAMPLING LOCATIONS
RIVER MILES 2 - 11

Habitat based on USEPA Region 10, USF&WS and Oregon DEQ Field observations and interpretation of Windward Envir. LLC potential habitat delineations (3/20/03)

0 0.25 0.5 1 1.5 2 2.5 3 Miles

FINAL DRAFT

Appendix B

APPENDIX B

TRANSECT COMPOSITE SURFACE WATER SAMPLING METHOD FOR ROUND 2A

INTRODUCTION

The objective of the sampling procedure used at each of the three transect stations (downstream boundary of the ISA, mid-ISA, and upstream of the ISA) is to collect a composite surface water sample representative of cross-sectional river flow at that location.

The surface water sampling approach along transects in the lower Willamette River (LWR) will be based on the Equal-Discharge Increment Cross-Sectional Sampling method developed by the USGS (2000). This method is designed to collect a composite sample that represents the flow passing through a stream cross-section by obtaining a series of subsamples that each represents equal volumes of the stream discharge. The method requires that the cross-sectional area and total stream discharge be known or measured. These data can then be used to divide the cross-section into equal-discharge increments (EDIs). Subsamples representing equal discharge volume can then be collected within each EDI using a depth-integrating sampling technique.

The LWG has collected both accurate bathymetry and flow data in the LWR as part of previous Portland Harbor RI/FS physical system studies (e.g., SEA and DEA 2003). This information allows a modified version of the EDI methodology to be applied to the transect surface water sampling program planned for the RI/FS.

TRANSECT CROSS-SECTIONS AND FLOW DATA

Transect surface water samples will be collected at RM 4, representing the downstream end of the ISA; RM 6.3, the middle of the ISA; and RM 11, upstream of the ISA. The cross-sectional profiles of the riverbed at these locations are shown in Figures B-1a through B-1c (top panels). Representative flow regimes at these locations, sampled in April 2002, are shown in Figures B-2a through B-2c. The profiles at all three transect locations show similar patterns [i.e., flow direction at all locations was uniformly downstream with the exception of a small pocket of turbulence along the western shoreline at RM 11 (see velocity direction panels in Figures B-2a through B-2c)]. At all locations, the cross-sectional patterns in flow velocities also show similar patterns with higher velocities mid-stream and in the upper portions of the water column and lower velocities near-bottom and at the stream edges. These patterns reflect the boundary layer frictional drag on the flow.

DETERMINATION OF EQUAL DISCHARGE INCREMENTS

Using precision bathymetric data collected in the LWR in May 2003 and flow measurements obtained with an Acoustic Doppler Current Profiler meter (ADCP) in April 2002 along transects at RM 4, 6.3, and 11 (DEA 2002), it was possible to divide each transect into equal-discharge subareas using software provided with the ADCP instrument (WinRiver v. 1.03, RD Instruments, San Diego, CA).

During the ADCP survey, the total discharge (Q) was measured along each transect. WinRiver allows the transect to be divided into cross-sectional subareas representing target fractions of Q. The EDI method (USGS 2000) recommends that the number of EDIs should typically range from a minimum of 4 to a maximum of 9. Four increments were targeted at the narrowest transect of interest, RM 11. The lower panel of Figure B-1a shows a plan view of the cross-river transect at RM 11 and the breakpoints and central points for the four calculated EDIs. The EDI widths and target center points (x,y's) are listed in Table B1. Figures B-1b and B1-1c show the transect and calculated EDI for RM 6.3 and 4, respectively, and the EDI widths and central points are included in Table B-1. In subdividing the river transects into EDIs, an effort was made to ensure that each EDI had a consistent flow velocity regime and to maintain a minimum EDI width of approximately 150 feet. Consequently, the total number of EDIs varies depending primarily on the river width, and ranges from 4 at RM 11 to 6 at RM 4.

TRANSECT SAMPLING APPROACH

Table B-1 presents preliminary estimates of sampling durations and pump intake descent and ascent rates based on approximate EDI depths determined from 2003 precision bathymetry survey results. Actual EDI depths will be based on measurements made in the field at the time of sample collection. Once final EDI divisions and depths are determined, each river transect will sampled according to the following steps:

1. Estimate the total volume of water needed for each transect composite sample based on the target analytical concentration goals and the analytical laboratory method requirements.
2. Determine the optimum pumping or water collection rate of the sampling device.
3. Divide the total volume needed by the pumping rate to calculate the total on-transect surface water collection duration.
4. Divide the total on-station duration by the number of EDIs on that transect to obtain the sampling duration needed for each EDI.

5. Determine the x,y's of the EDI center points and EDI boundaries along the transect line and enter them into the integrated navigation database as the target waypoints for the transect water sampling program.

6. Following set-up and shakedown of the sampling equipment and on-water sampling logistics, develop transect-specific cruise plans to collect verticallyintegrated water samples at the center point of each EDI across the entire transect for the duration needed to collect the target volume. Design this plan such that each EDI is sampled for the duration calculated in Step # 4.

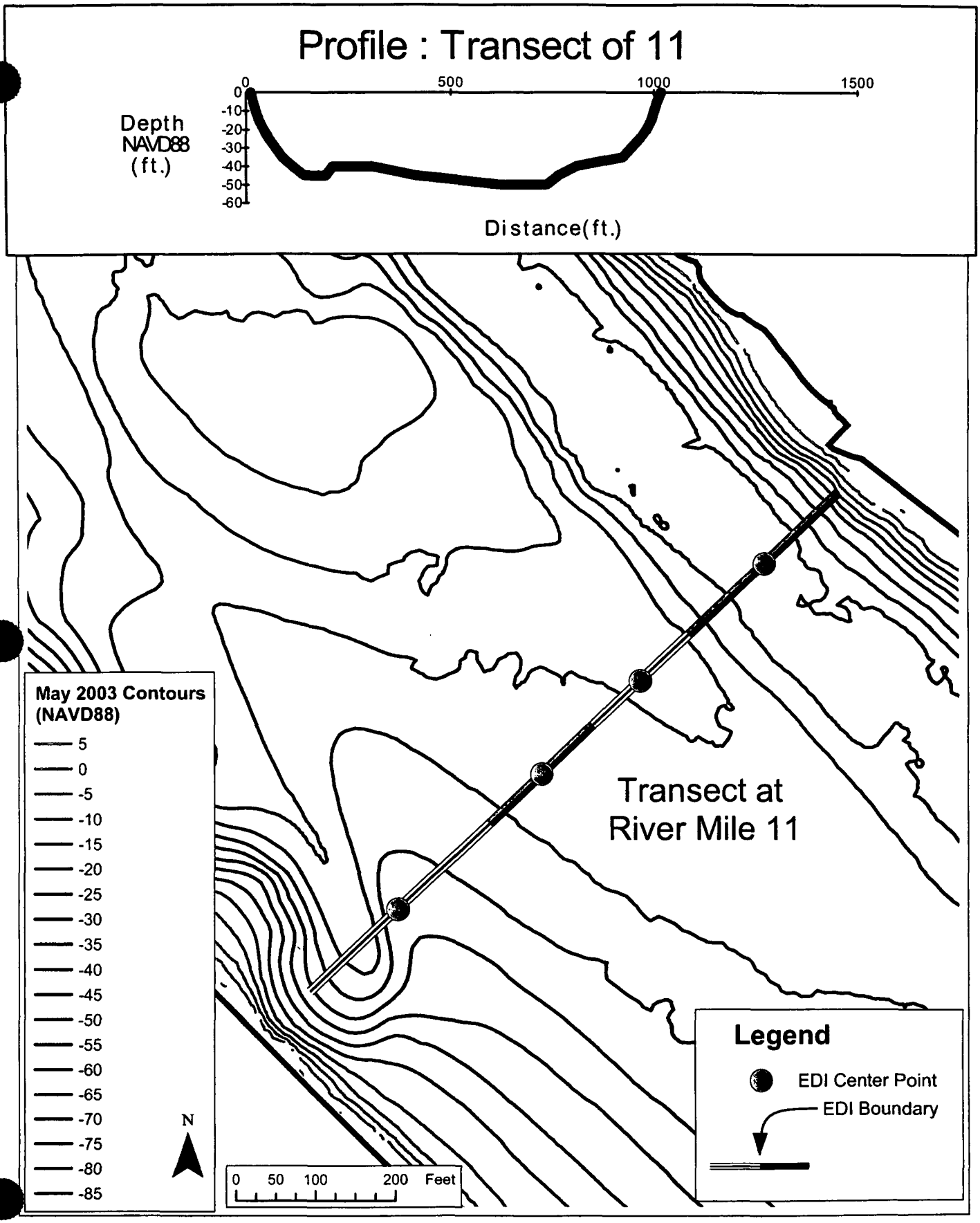
This transect water sampling approach results in the collection of a total volume of surface water that is representative of the cross-sectional flow (i.e., flow-weighted) at that transect location by spacing the specific vertically integrated sampling points along the transect in a manner that takes into account the cross-sectional flow variability.

REFERENCES

DEA. 2002. Willamette Acoustic Doppler Current Profiler Survey Results, June 2002. Prepared for Striplin Environmental Services, Inc., Olympia, WA. David Evans and Associates, Inc., Portland, OR.

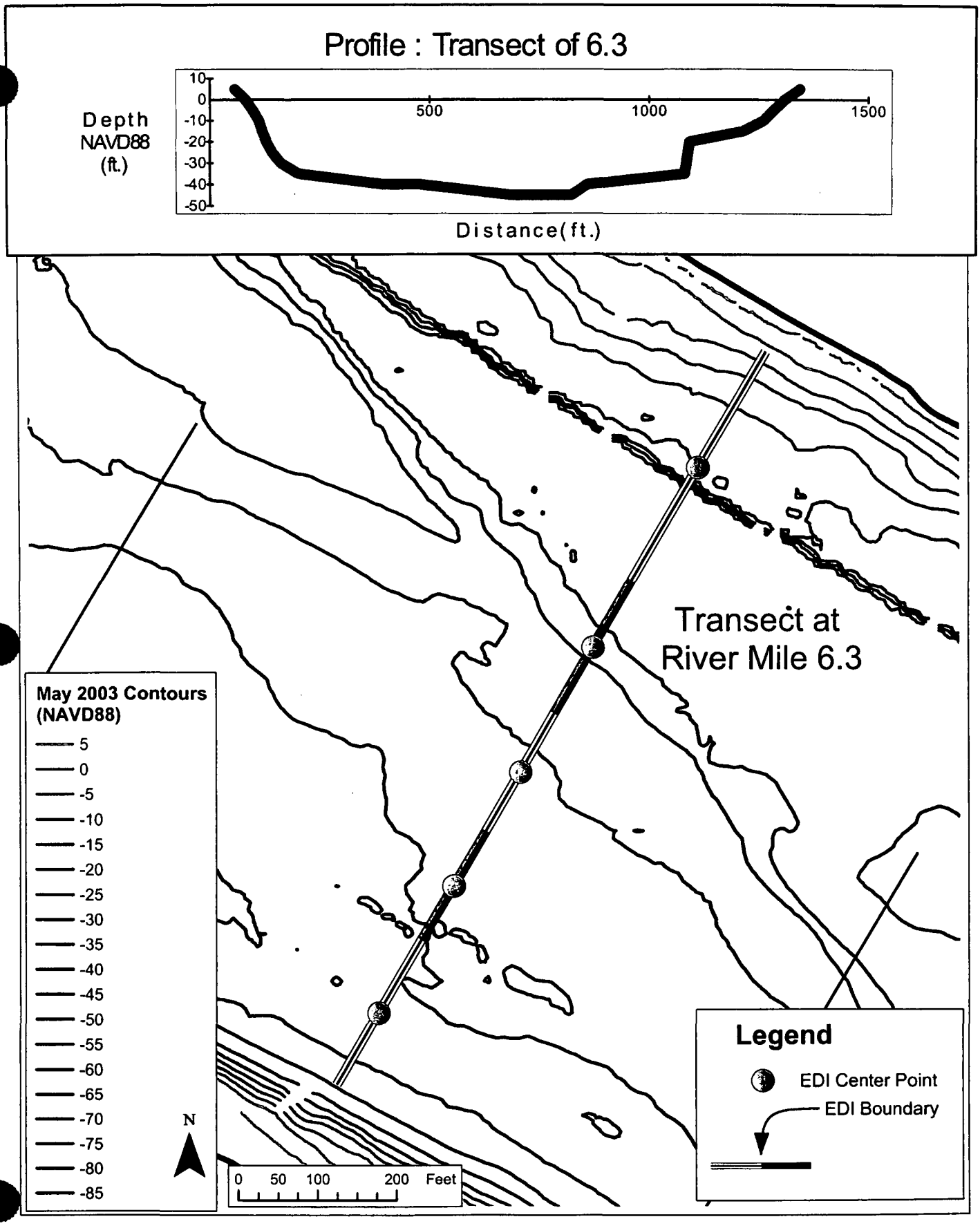
SEA and DEA. 2003. Lower Willamette River May 2003 Multibeam Bathymetric Survey Report. Draft. Prepared for the Lower Willamette Group. Striplin Environmental Services, Inc., Olympia, WA and David Evans and Associates, Inc., Portland, OR.

USGS. 2000. Interagency Field Manual for the Collection of Water Quality Data. USGS Open-File Report 00-213. U.S. Geological Survey in cooperation with the U.S. Environmental Protection Agency, Austin, TX.



Map Document: (G:\Projects\Portland_Harbor\LWG-Map-Projects\FSP_04\WaterSampling\WaterSampleTransects.mxd)
Plot Date: 08/03/2004

Figure B-1a
Portland Harbor
Water Sampling FSP
Sampling Transect for River Mile 11



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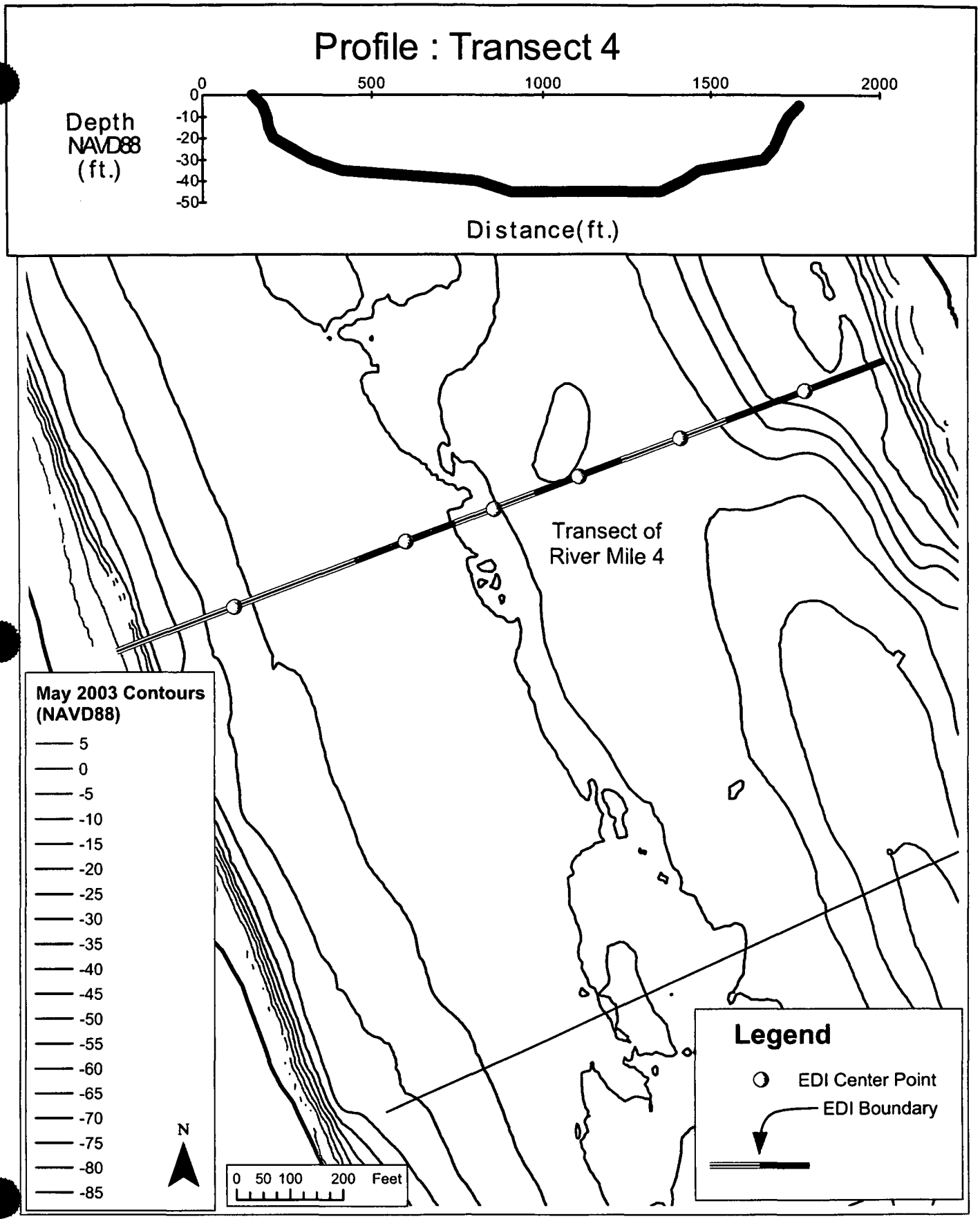
Map Document: (G:\Projects\Portland_Harbor\LWG-Map-Projects\FSP_04\WaterSampling\WaterSampleTransects.mxd)
Plot Date: 08/03/2004

Figure B-1b
Portland Harbor
Water Sampling FSP
Sampling Transect for River Mile 6.3



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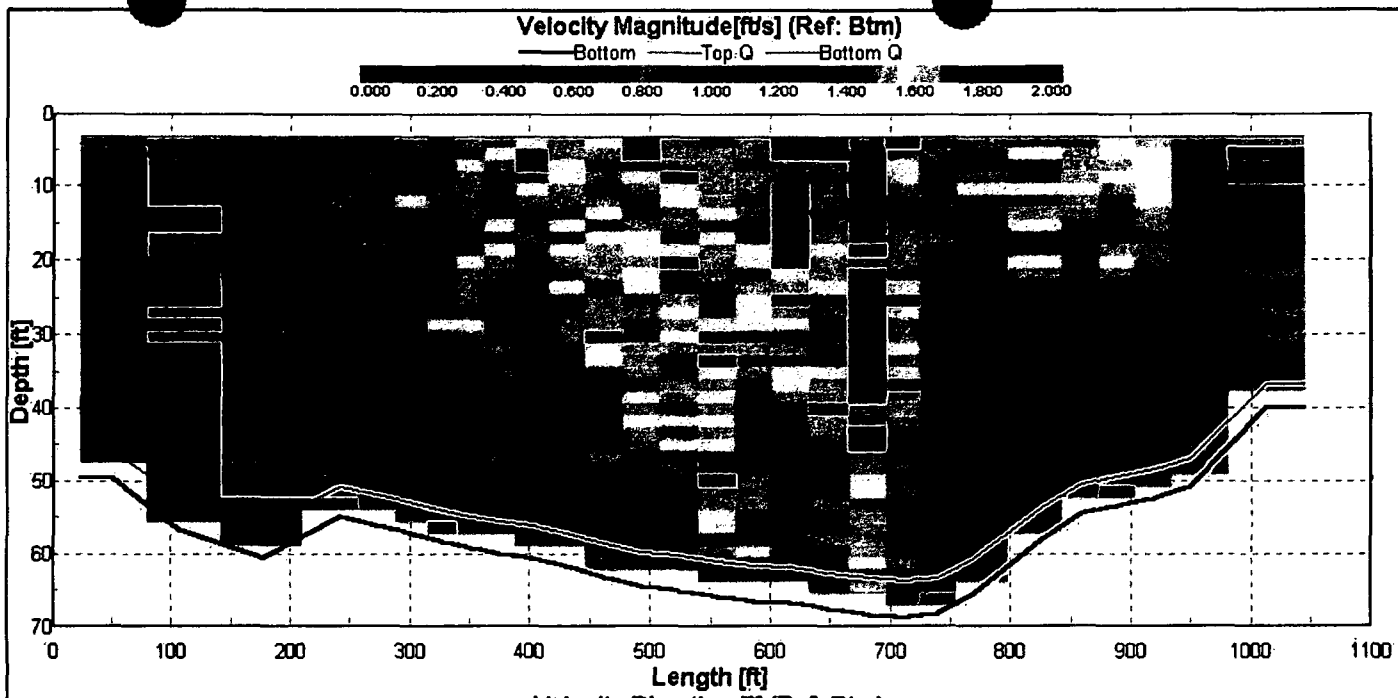
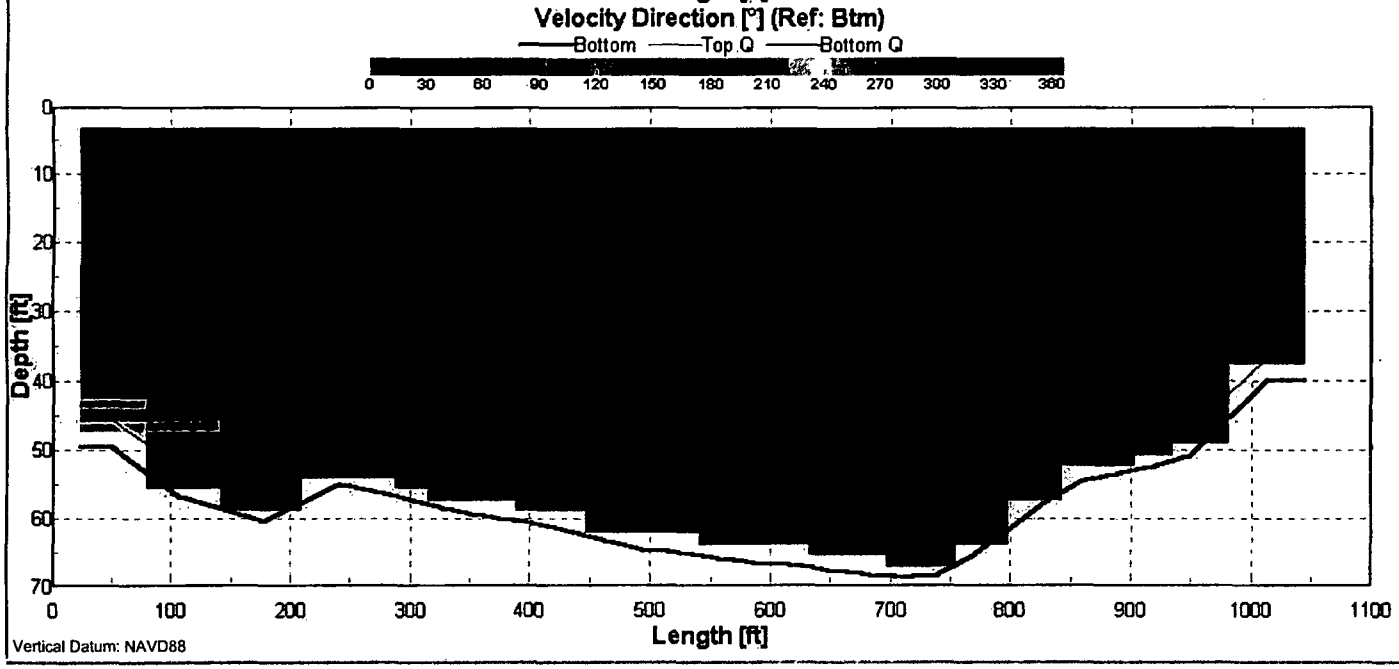
Map Document: (G:\Projects\Portland_Harbor\LWG-Map-Projects\FSP_04\WaterSampling\WaterSampleTransects.mxd)
Plot Date: 08/03/2004

Figure B-1c
Portland Harbor
Water Sampling FSP
Sampling Transect for River Mile 4





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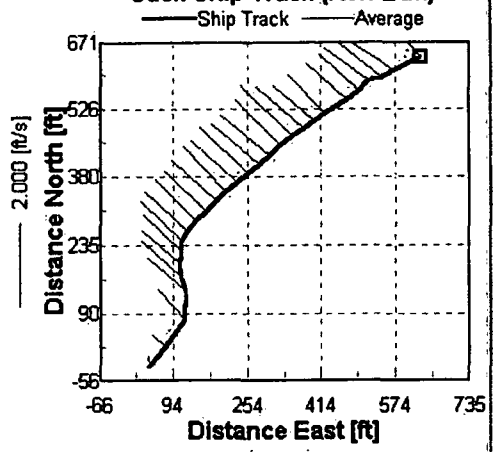

Discharge (Btm) Left to Right

# Ensembles	**277**	
Start Time	**15:04:34**	
Duration	**470.85**	[s]
Total Q	**69461.43**	[ft³/s]
Top Q	**4164.82**	[ft³/s]
Measured Q	**60211.81**	[ft³/s]
Bottom Q	**4129.83**	[ft³/s]
(T+M+B) Q	**68506.46**	[ft³/s]
Left Distance	**39.00**	[ft]
Left Velocity	**0.258**	[ft/s]
Left Depth	**49.45**	[ft]
Left Area	**964.32**	[ft²]
Left Q	**175.83**	[ft³/s]
Right Distance	**45.00**	[ft]
Right Velocity	**1.145**	[ft/s]
Right Depth	**42.79**	[ft]
Right Area	**962.67**	[ft²]
Right Q	**779.15**	[ft³/s]
Width	**978.90**	[ft]
Total Area	**55029.43**	[ft²]
Q/Area	**1.26**	[ft/s]
Flow Dir.	**312.84**	[°]
Avg Course	**44.51**	[°]
Boat Speed	**2.151**	[ft/s]

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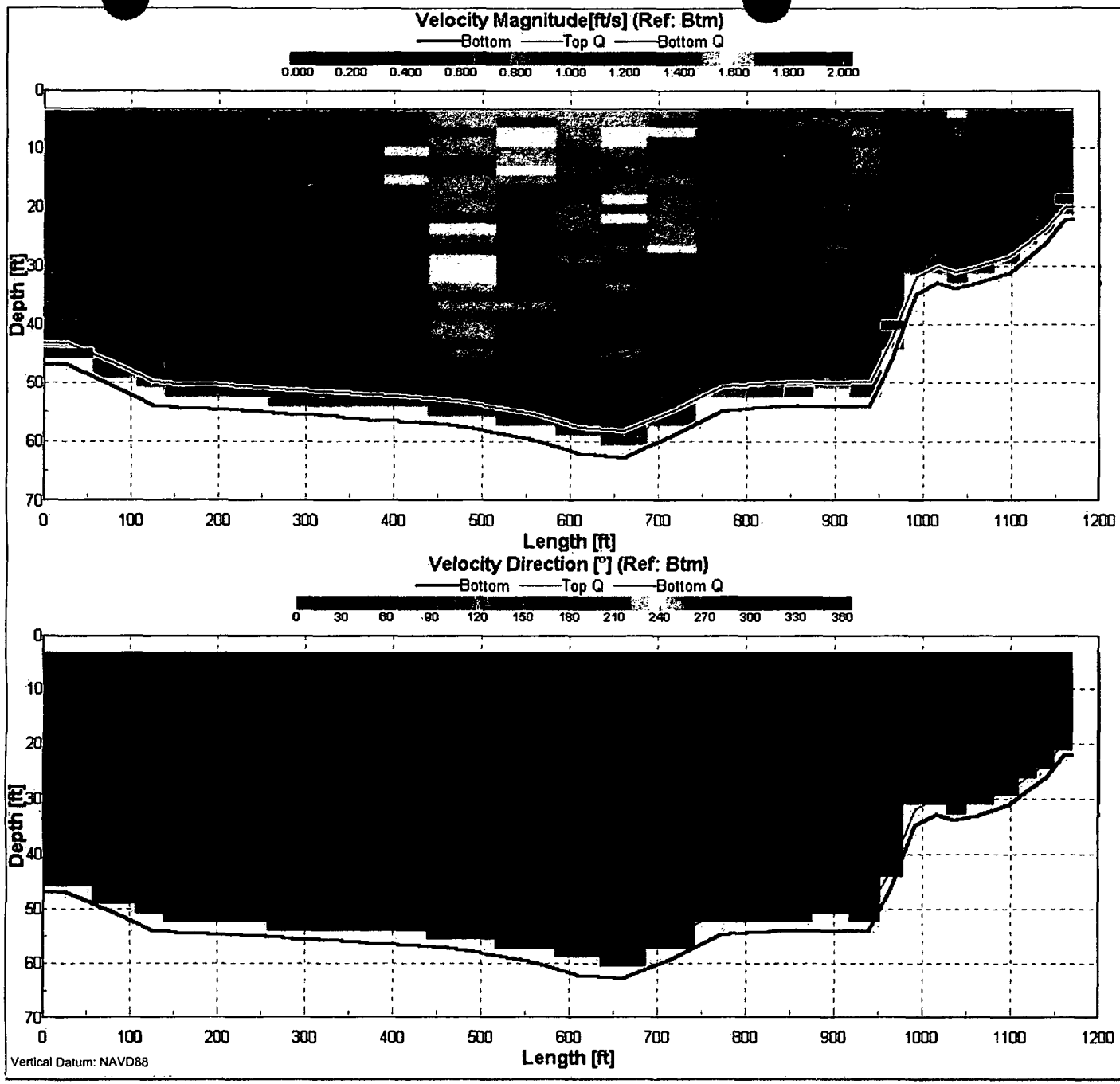
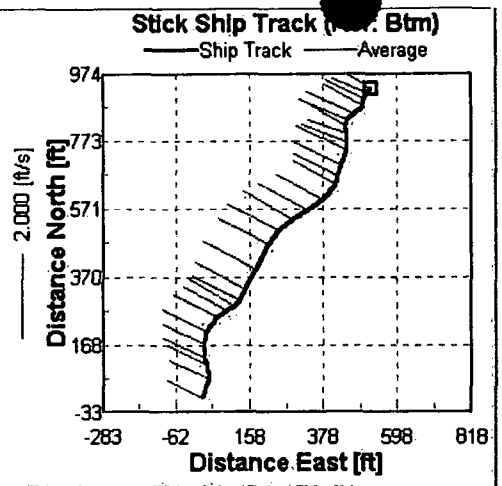
Figure B-2a
ADCP River Profile
River Mile 11





Discharge (Btm) Left to Right

# Ensembles	**297**	
Start Time	**16:37:55**	
Duration	**490.45**	[s]
Total Q	**71112.95**	[ft³/s]
Top Q	**4785.58**	[ft³/s]
Measured Q	**59850.41**	[ft³/s]
Bottom Q	**4429.64**	[ft³/s]
(T+M+B) Q	**69065.62**	[ft³/s]
Left Distance	**107.00**	[ft]
Left Velocity	**0.980**	[ft/s]
Left Depth	**46.82**	[ft]
Left Area	**2604.80**	[ft²]
Left Q	**1734.94**	[ft³/s]
Right Distance	**46.00**	[ft]
Right Velocity	**0.835**	[ft/s]
Right Depth	**22.99**	[ft]
Right Area	**528.85**	[ft²]
Right Q	**312.38**	[ft³/s]
Width	**1216.28**	[ft]
Total Area	**58114.85**	[ft²]
Q/Area	**1.22**	[ft/s]
Flow Dir.	**297.24**	[°]
Avg Course	**29.18**	[°]
Boat Speed	**2.366**	[ft/s]

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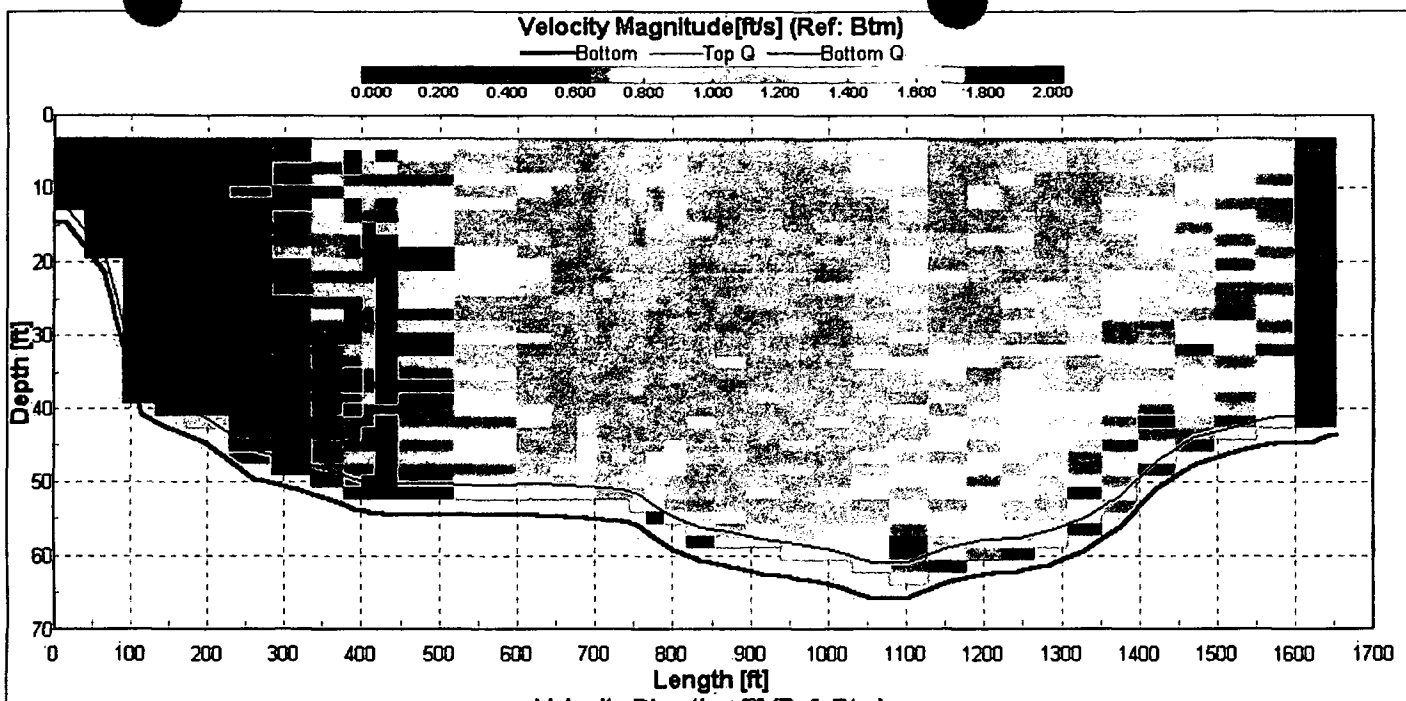
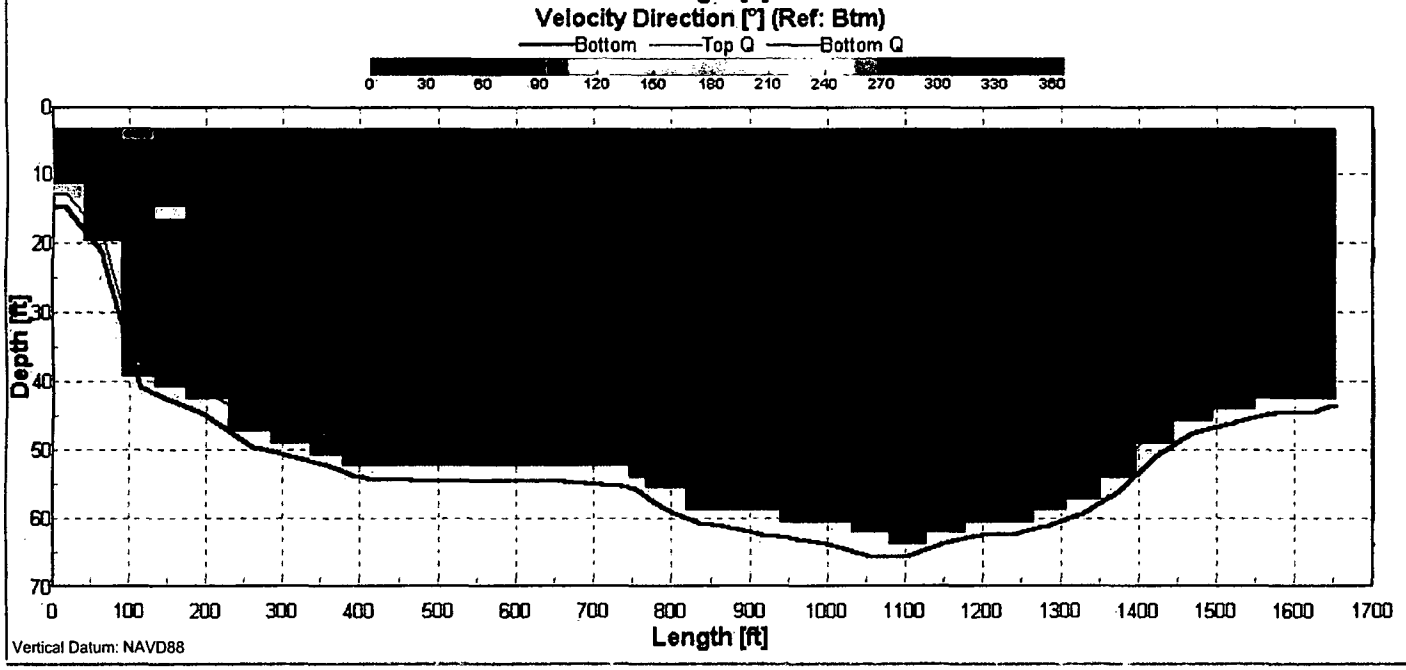
Figure B-2b
ADCP River Profile
River Mile 6.3





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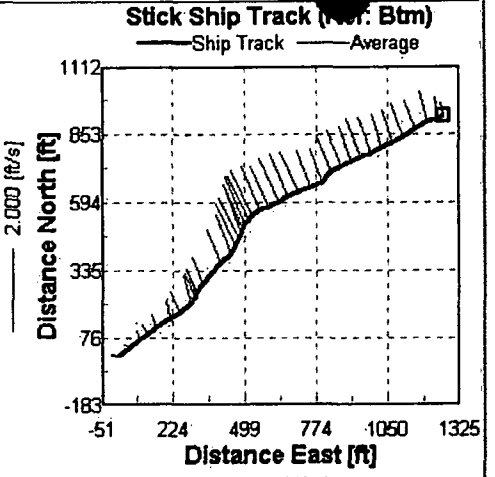

Discharge (Btm) Left to Right

# Ensembles	**396**	
Start Time	**17:24:59**	
Duration	**630.79**	[s]
Total Q	**67097.69**	[ft³/s]
Top Q	**4341.66**	[ft³/s]
Measured Q	**58340.24**	[ft³/s]
Bottom Q	**4128.72**	[ft³/s]
(T+M+B) Q	**66810.62**	[ft³/s]
Left Distance	**24.00**	[ft]
Left Velocity	**0.188**	[ft/s]
Left Depth	**14.50**	[ft]
Left Area	**174.04**	[ft²]
Left Q	**23.14**	[ft³/s]
Right Distance	**45.00**	[ft]
Right Velocity	**0.378**	[ft/s]
Right Depth	**43.85**	[ft]
Right Area	**986.66**	[ft²]
Right Q	**263.92**	[ft³/s]
Width	**1631.10**	[ft]
Total Area	**84249.57**	[ft²]
Q/Area	**0.80**	[ft/s]
Flow Dir.	**337.35**	[°]
Avg Course	**53.90**	[°]
Boat Speed	**2.604**	[ft/s]

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Figure B-2c
ADCP River Profile
River Mile 4

Table B-1. Estimated Surface Water Sampling Durations at River Transects using the Infiltrex 300 System and Peristaltic Pump.

		Infiltrex 300 (1000 L)[1]				Peristaltic Pump (20 L)[2]			Sample Location Coordinates	
Equal Discharge Increment (EDI)	Approximate Depth (feet)	Total Sampling Time per EDI (hour)[3]	Sampling Time per EDI (min)[3,4]	Intake Descending and Ascending Rate (ft/h)[4]	Intake Descending and Ascending Rate (in/min)	Total Sampling Time per EDI (min)[5]	Intake Descending and Ascending Rate (ft/h)	Intake Descending and Ascending Rate (in/min)	X	Y
River Mile 4, LW2-SWx005										
EDI 1[6]	35	2.2	33	126	25	33	126	25	7617062.99	715424.94
EDI 2	40	2.2	33	144	29	33	144	29	7617385.24	715547.35
EDI 3	45	2.2	33	162	32	33	162	32	7617549.59	715609.78
EDI 4	50	2.2	33	180	36	33	180	36	7617709.90	715670.68
EDI 5	45	2.2	33	162	32	33	162	32	7617901.59	715743.49
EDI 6	30	2.2	33	108	22	33	108	22	7618136.47	715832.71
River Mile 6.3, LW2-SWx011										
EDI 1	40	2.6	39	123	25	39	123	25	7624118.10	705783.09
EDI 2	45	2.6	39	138	28	39	138	28	7624212.17	705943.72
EDI 3	45	2.6	39	138	28	39	138	28	7624296.00	706086.85
EDI 4	35	2.6	39	108	22	39	108	22	7624388.24	706244.37
EDI 5	15	2.6	39	46	9	39	46	9	7624520.54	706470.28
River Mile 11, LW2-SWx023										
EDI 1	40	3.3	49	98	20	49	98	20	7642296.73	689880.24
EDI 2	50	3.3	49	123	25	49	123	25	7642476.57	690050.09
EDI 3	55	3.3	49	135	27	49	135	27	7642601.79	690168.35
EDI 4	40	3.3	49	98	20	49	98	20	7642757.36	690315.28

Note: Sampling time durations and intake descending/ascending rates are preliminary estimates since EDI depths are approximate. Actual durations and intake descending/ascending rates will be recalculated based on EDI depths measured during sample collection.

[1] Total sampling volume using Infiltrex 300 System is 1000 L with optimum flow rate of 1.25 L/min.

[2] Total sampling volume using a peristaltic pump is 20 L with optimum flow rate of 100 mL/min.

[3] Total sampling time is calculated by dividing total sampling volume by pump flow rate.

[4] Each EDI section will be sampled four times. Sampling will start from the west to the east side of the river and then sampled again from west to east.

[5] Each EDI will be sampled only once with the peristaltic pump.

[6] EDI divisions in each cross section are numbered sequencially from west to east.

Appendix C

APPENDIX C

SURFACE WATER SAMPLING SOP

SURFACE WATER SAMPLING AND PROCESSING

The purpose of this standard operating procedure (SOP) is to define and standardize the methods for collecting surface water samples from freshwater or marine environments using a peristaltic pump and Teflon™ tubing.

This SOP utilizes and augments the procedures outlined in the San Francisco Estuary Institute's *Field Sampling Manual for the Regional Monitoring Program for Trace Substances* (David et al. 2001), the *Interagency Field Manual for the Collection of Water-Quality Data* (USGS 2000), and U.S. Environmental Protection Agency (EPA) Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (EPA 1996). A goal of this SOP is to ensure that the highest quality, most representative data be collected, and that these data are comparable to data collected by different programs that follow EPA guidelines.

While sampling for trace metals, trace clean sampling techniques will be used for the collection of unfiltered organic compounds and conventionals, such as total suspended solids, dissolved organic carbon, and dissolved suspended solids. By following this SOP, the collection of other samples besides trace metals guarantees a high level of sample integrity and minimizes contamination during sample handling.

SUMMARY OF METHOD

Surface water samples for standard chemical and conventional analyses will be collected using a peristaltic pump with an extended sampling tube lowered to the desired depth. These samples do not require the ultra-low detection units of other hydrophobic analytes.

Samples are collected using the two-person "clean hands – dirty hands" method (EPA 1996). The peristaltic pump's water intake is placed 15 feet away from the bow of the boat with a long pole. The outflow of the pump is directed through a Y-splitter into two composite mixing containers for sampling. Equal volumes will be pumped into two large, pre-cleaned 10-liter or 20-liter mixing containers equipped with magnetic stirring devices (Figure C-1). The first container, made of polycarbonate, is used for compositing and mixing samples for subsequent analysis of trace metals, TBT, and conventionals. The second stainless-steel or glass container is used for compositing and mixing samples for subsequent analysis of organic compounds.

Following sample compositing in the mixing containers, appropriate sample bottles are filled using a second peristaltic pump, with the outflow directed into the bottle. The sample jar is held near the pump outlet, and the sample container is rinsed several times and then filled. The sample containers are capped, labeled, and placed in clean, double Ziploc™ bags, and then placed inside a cooler.

Two types of surface water samples will be collected: unfiltered and filtered. For filtered metals samples, the 0.45-µm filter is placed inline near the tubing outlet to filter samples immediately before the water is discharged into the sample bottle. The filter size for dissolved organic carbon will be selected in consultation with EPA. Samples for total suspended solids (TSS) and total dissolved solids (TDS) will be filtered at the laboratory. The filter size to be used for these analyses will be determined by EPA and LWG.

Surface water collected at cross-sectional stations using the flow-weighted method (see Appendix B) will be composited by collecting water using the same technique described above. Integrated samples of the water column are collected by lowering and raising the sample tubing intake while pumping water from near surface to near bottom and back for a predetermined period at a predetermined rate.

SUPPLIES AND EQUIPMENT

The general types of equipment that are required are described in this section. A detailed supply and equipment list is provided in Table 1-1. Additional equipment may be required depending on the project.

Two peristaltic pumps are used for collecting surface water samples. The first pump fills the mixing containers, and the second pump collects unfiltered and filtered split samples from the mixing container. A workbox made of PVC pipes and plastic sheeting is used to house two stir plates and a small peristaltic pump. A polycarbonate and a glass or stainless-steel 20-liter mixing containers are placed over the two stir plates. Each mixing container is equipped with a 5-inch-long Teflon™-coated stir-bar at the bottom and a lid containing an inflow, outflow, and vent Teflon™ spouts. For each sampling station, a filtering kit (laboratory pre-cleaned 0.45-µm filter with C-Flex™ and Teflon™ tubing placed in a double Ziploc™ bag) is assembled and attached to a peristaltic pump and mixing containers. A 10-µm pre-filter may be attached in-line to prolong the filtering capacity of the 0.45-µm filter. Four types of sampling tubing are required:

1. Shallow-water (near bottom sampling) intake tubing requires a 4-meter long Teflon™ tubing.

2. Deep-water (integrated water column sampling) intake tubing requires a 25-meter Teflon™ tubing.

3. Intake tubing kit for the mixing containers is composed of 30-cm C-Flex™ tubing, 1-meter Teflon™ tubing, and a 10-cm C-Flex™ tubing, placed sequentially.

4. Outlet tubing kit from the mixing containers is composed of 10-cm C-Flex™ tubing, 0.5-meter Teflon™ tubing, 30-cm C-Flex™ tubing and 30-cm Teflon™ tubing, placed sequentially.

Two filtering kits (0.45- and 10-µm) are composed of 10-cm C-Flex™ tubing, the filter cartridge, and another 10-cm C-Flex™ tubing, placed sequentially.

A 10-µm air filter kit is attached to the mixing container vent spout.

A portable 3000-watt power generator is used if on-board electricity is not available.

PROCEDURES

EQUIPMENT DECONTAMINATION

Each participating laboratory is responsible for preparing their equipment prior to the sampling cruise. Pre-designated commercial laboratories will decontaminate sample tubing, mixing containers, and sampling jars according to their specific SOPs [see attachments in the Round 2 QAPP Addendum for Surface Water Sampling (Integral 2004)]. Additional field equipment will be cleaned and decontaminated by Integral Consulting, Inc. (Integral), Olympia WA, as described below.

Surface Water Sampling Equipment Preparation

A sufficient amount of decontaminated sampling tubing and filtering kits is brought to the field in order to avoid performing decontamination procedures between stations. The following steps are taken to set up the peristaltic pump system.

Plastic Processing Chamber

A 3- by 3- by 3-foot cube is built with ¾-inch PVC tubing and covered with a 6-mil plastic sheet. One side of the box is left open for placing sampling equipment and sample containers. The chamber is placed over a pan, which is connected to a drain that will carry excess pumped water outside the boat. All components are washed with Alconox™, tap-water rinsed, acid washed, and deionized water (DIW) rinsed.

Stands and clamps used to secure the receiving Teflon™ tubing and filter cartridge are made of non-metallic components or resin-coated stainless steel and will be soap washed, tap-water rinsed, acid washed, and DIW rinsed.

Near-bottom Sampling Device

When near-bottom surface water samples are required to be sampled at a fixed depth from the bottom, a "near bottom sampling device" is used. Figure C-2 illustrates how the Teflon™ tubing inlet is attached to a vane, which will keep the water intake into the flow and elevated at a constant height from the bottom. The device, made of PVC tubing and a polypropylene vane, is weighted by PVC-coated lead weights and attached to the boat by a nylon or Kevlar rope. All components will be washed with Alconox™, tap-water rinsed, acid washed, and DIW rinsed.

Conventional Field Parameter Equipment Preparation

A YSI 650/600XLM multi probe is used for measuring surface water parameters, such as temperature, pH, dissolved oxygen, conductivity, oxidation-reduction potential. The unit will come pre-calibrated from the laboratory and will be checked daily for proper functioning and drift. If necessary, the multi probe can be calibrated in the field. The proper handling of the multi probe is described in detail in Appendix E.

Except for the probe sensor, all components are soap washed (Alconox™) and tap-water rinsed. Since this equipment will not be used in surface water sample collection, there is no need for a thorough decontamination. The handling of this equipment will be done exclusively by the "dirty hand" person (see below).

SURFACE WATER SAMPLE COLLECTION

Clean Hands/Dirty Hands Technique

The clean hands/dirty hands technique requires two or more people working together. At the field site, one person is designated as "clean hands" (CH) and a second person as "dirty hands" (DH). Although specific tasks are assigned at the start to CH or DH, some tasks overlap and can be handled by either as long as contamination is not introduced into the samples. Both CH and DH wear appropriate non-contaminating, disposable, powderless nitrile gloves during the entire sampling operation and change gloves frequently, usually with each change in task (wearing multiple layers of gloves allows rapid glove changes).

CH takes care of all operations that involve equipment that comes into contact with the sample, including the following responsibilities:

- Handles the surface-water sample bottle
- Handles the discharge end of the surface-water sample tube or line
- Prepares a clean workspace (inside boat)
- Sets up the processing and preservation chambers
- Sets the equipment (i.e., the sample bottles and the filtration and preservation equipment) inside the chambers
- Works exclusively inside the chambers during collection, processing, and preservation
- Changes the chamber covers as needed.

DH takes care of all operations that involve contact with potential sources of contamination, including the following responsibilities:

- Works exclusively exterior to the processing and preservation chambers
- Prepares and operates the sampling equipment, including the pumps and discrete samplers, peristaltic pump switch, pump controller, and manifold system
- Handles the generator or other power supply for samplers
- Handles the tools, such as hammers, wrenches, keys, locks, and sample-flow manifolds
- Handles the single or multiparameter instruments for field measurements
- Sets up and checks the field-measurement instruments
- Measures and records the water depths and field measurements.

Surface Water Sampling Procedures

Two persons are needed to conduct the sampling and a third person to keep track of sample logging and sample processing. In addition, the third person may be responsible for taking surface water parameters.

The following steps are taken in order to set up the surface water collection system and processing of samples:

1. Assemble and secure a Flexframe™ support rod and base onto the starboard rail and leave in place for the day.
2. Determine the correct position of the sampling station, have the captain anchor the vessel at the sample site and switch off the engines.
3. Set up a clean area for the workbox (done by CH).
4. Set up a workbox made of PVC pipes and plastic sheeting on a secure table or bench top on board the sampling vessel to house two stir plates and a small peristaltic pump. Provide enough space inside the workbox for a stand to hold the outlet tubing and filter and to collect surface water and processing sample jars.
5. Place two stirring plates inside the workbox and two mixing containers on top of each plate. Each container (a polycarbonate for metals and conventionals, and glass or stainless steel for organics) will be checked to ensure:

- Containers are properly wrapped by the labs and do not contain rips or holes that may have occurred during shipment to the field
- Each container contains a 5-inch stir-bar at the bottom
- All components, such as inflow and outflow tubing, are intact and securely placed on the cap.

6. Attach the outlet tubing kits to the mixing containers (Figure C-1). The kits are composed of 10-cm C-Flex™ tubing, 0.5-meter Teflon™ tubing, 30-cm C-Flex™ tubing, and 30-cm Teflon™ tubing, placed sequentially.

7. Place the small peristaltic pump inside the workbox but do not place tubing inside the pump head until all mixing containers have been filled.

8. Place a stand inside the working chamber and secure each tubing outlet from both mixing containers by clamps.

9. Attach a 4-meter (25-meter for deep water) Teflon™ tubing (collecting end) to 30-cm C-Flex™ tubing and a 1-meter Teflon™ tubing, sequentially, and then connect it to a mixing container (polycarbonate for metals and glass or stainless steel for organics). Clamp the C-Flex™ tubing section is firmly into place inside the large peristaltic pump head, which is placed outside the workbox.

10. Attach the intake part of the Teflon™ tubing to the end of a long aluminum pole. Take care not to remove a protective cap from the tip of the collecting tube until ready for submersion.

11. Secure the pump and pump speed controller just below the Flexframe™ assembly (by the DH) and connect them to the vessel's power source with an extension cord. If vessel power is not available, the pump can be operated under its own battery power supply.

12. Assemble an aluminum sampling pole with the sample tubing inlet secured to one end and with the tubing tip hanging loose approximately 2 feet off the pole end.

13. Remove the protective cap from the sampling tube and lower the pole gently below the water surface.

14. To sample water near-surface, submerge the sample tubing inlet approximately 0.3 to 1 meter (1-3 feet) below the surface of the water column.

15. To sample water near-bottom, submerge the sample tubing inlet approximately 0.3 to 1 meter (1-3 feet) above the bottom with the help of the near-bottom sampling device, which in turn is tethered to a nylon rope and looped through

the vessel's davit. If sampling near-bottom surface waters at depths greater than 2 meters is required, a device such as illustrated in Figure C-2 will maintain the sample tubing inlet into the current and at a constant depth (0.3 to 1 meter) above the sediment-water interface and 15 feet away from the boat with the help of the aluminum pole.

16. Switch the pump on and pump surface water through the sample tubing and into the mixing containers (done by DH). Once the water reaches one-third the container's volume, turn on the stir plates.

17. Turn off the pump once the mixing containers have been filled to ½ inch below the inflow spout.

18. Place the outflow tubing kit from the first container to be sampled inside the small peristaltic pump head and clamp firmly.

19. Make final adjustments to the stand holding the outflow spout before the small pump is turned on (done by CH).

    NOTE: The DH person assists the primary CH sampler by controlling the flow controller for the peristaltic pump, holding on to or adjusting the sample pole, adjusting the outlet tubing or filter cartridge, and handing sample containers to the CH person.

20. For trace element samples, drain the ultrapure water from the pre-cleaned sample bottle onto the bottle cap and pour the remaining ultrapure water over the bottle threads several times (done by CH). Rinse the sample container with the sample water 5 times, then fill up to the "neck" with sample water. The CH/DH system is not critical for the ancillary samples, and these bottles may be rinsed just 3 times with sample water before collecting the sample.

21. Without touching the trace-metal clean bottles, open the Ziploc™ bags (done by DH) so that the CH person may remove them from the bags. The CH person, wearing at least one pair of polyethylene gloves, does not touch anything with her/his hands except the inner Ziploc™ bag, the bottles, and the water.

22. Use the following sample collection sequence for total trace metals (unfiltered) sampling:

    - Total suspended solids (TSS) The laboratory will filter the samples for the analysis of TSS. The filter size for TSS will be selected by EPA and LWG.

    - Total dissolved solids (TDS). The laboratory will filter the samples for TDS. The filter size for TDS will be selected by EPA and LWG.

- Total bulk metals, total arsenic (As), selenium (Se)
- Total mercury (Hg).

23. After the above samples are collected, attach the filter cartridge to the sample tubing outlet and secure it to the stand with a clamp. Drain the storage solution inside the filter, and flush the entire sample tubing and filter assembly with sample water for 5 minutes. The sample collection sequence for dissolved metals and conventionals (filtered) sampling is as follows:

    - Dissolved bulk metals
    - Dissolved As, Se
    - Dissolved Hg
    - Dissolved organic carbon (if 0.45 μm filter is used for dissolved organic carbon). A separate filter cartridge will be added to the system if the filter size selected, in consultation with EPA, for dissolved organic carbon is not 0.45 μm..

24. As soon as a sample container is filled up, the DH turns off the peristaltic pump, and the CH seals the container and writes the label. The sampling label should contain the date, time, project name or number, sample ID, type of analysis required, and sampler initials.

The 0.45-μm filtration cartridge, 10-μm prefilter cartridge, and the dissolved organic carbon cartridge (filter size to be selected in consultation with EPA) are changed after each sampling site.

The appropriate number of sample replicates and splits are predetermined prior to starting the field sampling event and assigned to specific sampling stations.

After all sampling is done, surface water field parameters are measured by the DH using a hand-held YSI 650/600XLM multi probe sensor lowered into the water column. Detailed explanations on how to take measurements with the multi probe are described in Appendix E.

SAMPLE PROCESSING

Once a surface water sample container is properly closed, labeled, and then sealed inside a Ziploc™ bag by the CH person, the DH person seals the second Ziploc™ bag and places it inside a large plastic bag, which in turn is placed inside a cooler containing wet ice.

All samples are stored in sealed coolers with wet ice on board the vessel and transferred to the field laboratory at the conclusion of the cruise. Integral personnel will then transfer the samples to the laboratory. The field leader is responsible for maintaining sample integrity throughout the cruise. Once at the field lab, sample contamination is avoided by handling the double-bagged sample containers with clean gloves, and transferring the samples into clean refrigerators immediately after samples are brought back from the field.

Storage Temperature Quality Control

Each storage freezer or refrigeration unit is monitored daily to ensure temperature compliance. Each unit will have a separate log form containing date, time, and temperature information.

CHAIN-OF-CUSTODY

Field

The cruise leader or other designated field sample custodian is responsible for all sample tracking and chain-of-custody procedures until sample custody is transferred to the laboratory. Custody procedures in the field are as follows:

1. Record all field and sample collection activities (including sample identification number, collection time and date) in the field logbook. While being used in the field, the logbook remains with the field team at all times. Upon completion of the sampling effort, the logbook is reproduced and then kept in a secure area.
2. Complete a chain-of-custody form whenever samples are being transferred or removed from the custody of field sampling personnel. A sample form is provided in Appendix C (Integral 2004). Record each individual sample on the form. Include additional information to assist in sample tracking such as collection date and time, number of containers, and sample matrix. The chain-of-custody may also serve as the sample analysis request form, with the required analysis indicated for each individual sample.
3. Sign the form and ensure that the samples are not left unattended unless secured.
4. Store, pack, or ship samples as described in the following section. Place the original completed chain-of-custody form in a sealed plastic bag inside the shipping container. A copy is retained by the shipping party.
5. Complete a separate custody form for each individual shipping container or a single form for all samples in multiple shipping containers in a single shipment, with the number of containers noted on the custody form.

6. Attach completed custody seals to any shipping container that will be sent to the laboratory by delivery service or courier. Delivery personnel are not required to sign the custody form if custody seals are used. Custody seals are used to detect unauthorized tampering with the samples. Gummed paper or tape should be used so that the seal must be broken when the container is opened. The laboratory sample custodian (or other sample recipient) will establish the integrity of the seals.
7. The laboratory custodian (or other sample recipient) acknowledges receipt of the samples by signing, dating, and noting the time of transfer on the chain-of-custody form. The condition of the samples and any problems or irregularities (e.g., cracked or broken jars, loose lids, evidence of tampering) should also be recorded. Return a copy of the completed custody form to the project manger or designated sample coordinator.

Laboratory

The laboratory designates a sample custodian who is responsible for receiving samples and documenting their progress through the laboratory analytical process. Each custodian ensures that the chain-of-custody and sample tracking forms are properly completed, signed, and initialed on transfer of the samples. Specific laboratory chain-of-custody procedures should be in writing, included in the laboratory QA plan, and approved prior to beginning sampling and analysis. Laboratory custody procedures includes the following:

- A designated laboratory person initiates and maintains a sample tracking log that will follow each sample through all stages of laboratory processing and analysis.
- The laboratory tracking log includes, at a minimum, the sample number, location, and type of storage; date and time of each removal; and signature of the person removing or returning the sample.

The final disposition of the sample is recorded.

CHAIN-OF-CUSTODY QUALITY CONTROL PROCEDURES

Complete and correct chain-of-custody is essential to ensure and demonstrate sample integrity. Errors in entering information or transferring custody can result in analytical or data reporting errors. Inaccuracies or errors in sample tracking and custody records can compromise data usability, particularly as legal evidence.

Quality control (QC) procedures include the following:

- Allow adequate time to take accurate and complete field records and to carefully complete chain-of-custody forms.

- When possible, work in pairs or more to complete the chain-of-custody form and check for accurate information entry.
- Complete all custody records in ink; errors should be neatly crossed out and corrected and initialed by the person making the change.
- Immediately notify the project manager of any deviation from required custody procedures.

PACKING AND SHIPPING SAMPLES

Environmental samples are packed in a manner to reduce the chance of sample breakage, ensure sample integrity, and prevent material leakage and potential exposure to hazardous materials in the event of breakage. Samples are placed in sealed plastic bags and packed in a sturdy container with adequate packing material to prevent breakage. Ice or dry ice may be included to maintain sample storage conditions. Samples are transported by field personnel or shipped via courier or common carrier. Shipping procedures are in accordance with U.S. Department of Transportation regulations (49 CFR 173.6 and 49 CFR 173.24).

All preserved samples should be shipped as soon as possible after completion of sampling. This minimizes the number of people handling samples and protects sample quality and security.

Sample Packing

Upon completion of final sample inventory by the field sample custodian and completion of chain-of-custody, samples are packed as follows:

1. Line a cooler bottom with bubble wrap and place a large 30-gallon bag inside another bag of same size and place it inside the cooler. The cooler should have the drain sealed with duct tape.
2. Wearing disposable powderless nitrile gloves, wrap each doubly wrapped glass sample container in bubble wrap or place it in a bubble wrap plastic bag. [**NOTE**: When samples are being transported by field personnel directly from the field site to the laboratory (thereby ensuring careful handling), this step is recommended but may be omitted. However, this step is required when a courier or delivery service is transporting the samples.]
3. Place the samples tightly inside the double bag in the shipping container:
   - Use dividers or bubble wrap to separate all glass containers.
   - Seal large plastic bags with rubber bands or plastic tie.
   - Fill any empty space in the shipping cooler or box with packing material so that the jars are held securely.

4. Place the original completed chain-of-custody form in a sealed plastic bag and place it inside the shipping container. If using a cooler or ice chest, the form should be securely taped to the inside of lid.
5. If required to meet sample storage requirements, fill the ice chest with crushed or block ice, blue ice (refrigerated samples, 4°C) or dry ice (frozen samples). A temperature blank (provided by the laboratory) should be packed in each cooler.
6. Seal shipping container securely with packing or duct tape.
7. If the shipping container will be transported by anyone other than the person who completed and signed the chain-of-custody form, attach completed custody seals so that the shipping container cannot be opened without breaking the seal.
8. Attach a *This End Up* label to each side of the shipping container to ensure that jars are transported in an upright position. A *Fragile* label may also be attached to reduce rough handling of the samples.
9. Label the shipping container with all appropriate information (name of project, time and date, responsible person and company name, address and phone) to enable positive identification.

Sample Shipping

Packed containers may be delivered to the laboratory or storage facility by field personnel, courier, or common carrier (FedEx, UPS). However, any outside carrier or courier service must provide a delivery receipt. The carrier or courier must also ensure delivery time, if holding time and storage conditions are critical. Unless arranged in advance, shipping charges should be prepaid by sender to avoid confusion and possible rejection of the package by the laboratory.

The adequacy of handling and shipping procedures is reflected in the condition of the samples upon receipt by the laboratory:

- No jars are cracked or broken.
- There is no evidence of sample leakage.
- Measuring the temperature of the temperature black indicates that correct storage conditions have been maintained.

The sample custodian or other designated person is responsible for confirming that copies of all shipping documents, completed in full and correctly, are on file at Integral.

FIELD QUALITY CONTROL PROCEDURES

Field QC samples that may be collected during sediment coring are the same as for any field sampling program. The types and frequency of field QC sample collection

are project-specific. The most commonly collected field QC samples are described below (USGS 2000):

- **Field Blank**. A field blank is a sample of analyte-free water that is supplied by the laboratory. The field blank is generated by transferring the analyte-free water to another laboratory-supplied sample container while at the field sampling location. Field blank results are used to measure and document any possible onsite contamination.
- **Decon Blank**. Prior to the start of sample collection activities for each sampling event, a decon blank will be generated by the laboratory that conducts decontamination of the peristaltic pump sampling equipment to ensure that the decontamination procedure is adequate.

- **Field Split Sample**. A field split sample consists of aliquots of the same composited surface water sample that are equally distributed in two sets of sample containers. These samples may be analyzed identically or analyzed by different laboratories to evaluate repeatability of sample handling and analytical procedures, sample heterogeneity, and analytical procedures.

- **Field Replicate**. A field replicate consists of a second sample that is collected using the same sampling methodology used to obtain the first sample. It is collected at the same sampling location and as soon after the original sample as possible. Analysis of the field replicate allows evaluation of the repeatability of field sampling methodologies, as well as the heterogeneity of the sample matrix. Statistical analysis of multiple replicates may also be used to calculate the likely range of an analyte concentration at a given sampling location.

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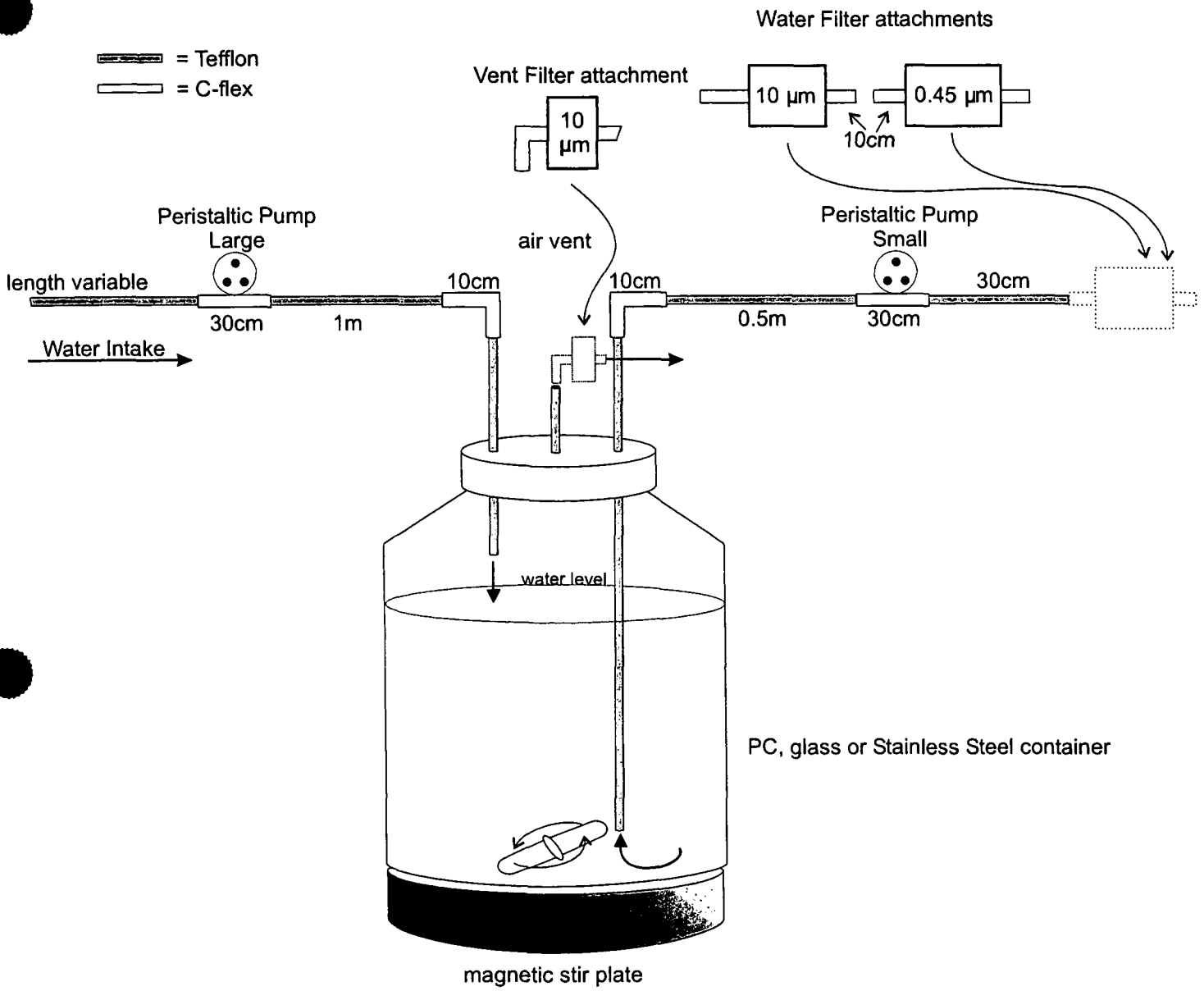

Figure C-1
Portland Harbor RI/FS
Peristaltic Pump Surface
Water Sampling System

Surface Water Sampler

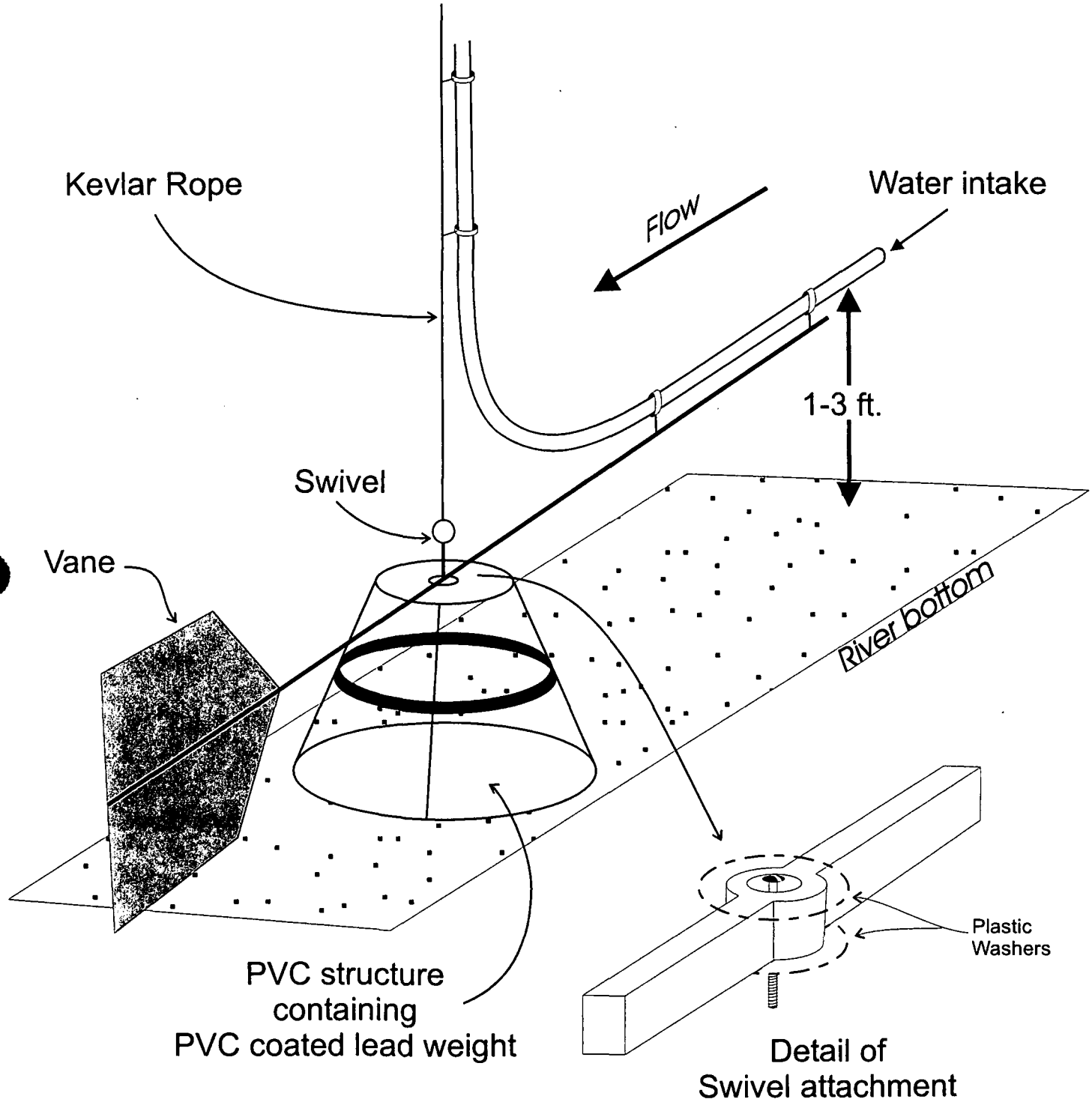

Figure C-2
Portland Harbor RI/FS
Water Sampling Device

Table C-1. Equipment List for Surface Water Sampling Using a Persitaltic Pump System

Quantity	*Description*
1	Masterflex™ peristaltic pump
2	Pump speed controller boxes
2	Pump heads
2	Spare pump head screws
2	Spare pump fuses (3 amp)
2	Electrical power extension cords, 25 foot
	Flexframe™ fittings and clamps (2 small to hold tubing and 2 large for filter cartridges)
1	1/2-inch aluminum support rod and plastic-covered base
1 each	Plastic, duct, and electrical tape
1	Hand tool box: screwdriver, pliers, crescent wrench
3	Stainless steel adjustable (screw-tighten) hose clamps (to hold sample poles together)
20	4-meter (3/16 ID), 890 Teflon™ resin FEP intake tubing for shallow water intake tubing
3	25-meter (3/16 ID), 890 Teflon™ resin FEP intake tubing for deep water
23	Kit: 30-cm C-Flex™ tubing, 1-meter (3/16 ID), 890 Teflon™ resin FEP tubing, and a 10-cm C-Flex™ tubing
23	10-cm (1/4 ID), C-Flex™ tubing (Masterflex), 0.5-meter (3/16 ID), 890 Teflon™ resin FEP tubing, 30-cm (1/4 ID), C-Flex™ tubing (Masterflex) and 30-cm Teflon™
3	20-liter polycarbonate carboy
3	20-liter glass carboy
20	10-liter polycarbonate carboy
20	10-liter glass carboy
2	Stir-plates
46	5-inch Teflon™-coated stir-bars
1	Ziploc™ tool
as needed	Straps, bungee cords, nylon rope, cable ties
	Additional Field Gear
1	15- to 20-foot sampling pole (2 pieces; 1 hollow, 1 with a telescopic insert)
1	Plastic work box (PVC tubing covered with 6-mil clear polypropylene sheet)
1	YSI 650/600XLM Multi-Probe System
1 each	Standard solutions for pH, conductivity, and oxidation reduction potential
1	Hand-held certified field thermometer (no mercury)

Table C-1. Equipment List for Surface Water Sampling Using a Persitaltic Pump System

Quantity	*Description*
5	10-L container with ultrapure, laboratory-grade deionized water
5	500-mL plastic beaker
2	1000-mL plastic container for storage of calibration fluids waste
2	Sampling buckets
2	Plastic chairs
30	10-µm pre-filter (Whatman Polycap 36HD)
30	0.45-µm filter cartridges (Whatman Polycap 36TC)
2	Coolers containing: 20 pounds wet ice/sampling day
1	Field log book
1	Field sampling plan
1	Health and safety plan with forms
	Tape: (2) plastic, (6) labeling
	Pens: (6) ballpoint, (6) Sharpies
1	Box of single edge razor blades
1	Box of trash bags (13 gal)
1	Box of trash bags (30 gal)
1 each	Ziploc™ bags (box each size; quart, gallon)
	Nylon gloves (4 pair, large; 2 pair, medium)
	Nitrile powderless gloves (3 boxes, large; 2 boxes, medium)
3 each	boxes of Kimwipes™ large and small
	Sun-protection lotion
	Spare batteries
	Bucket opener
	Foul weather gear

Appendix D

APPENDIX D

HIGH-VOLUME SURFACE WATER SAMPLING SOP

HIGH-VOLUME SURFACE WATER SAMPLING AND PROCESSING

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of high-volume water samples using an Infiltrex 300 sampling device designed by Axys Environmental Systems, Ltd. Samples are collected to quantify surface water concentrations of targeted organic chemicals (e.g., dioxins, PCBs, and pesticides) that are present at levels that cannot be detected using conventional sampling methods.

This SOP utilizes and augments the procedures outlined in the guidelines established by the *Total Maximum Daily Loads for Dioxins in the Houston Ship Channel Quality Assurance Project Plan* (University of Houston and TNRCC 2002) and by the U.S. Environmental Protection Agency (EPA) SOP MSL-M-090-00 (EPA 1994). A goal of this SOP is to ensure that the highest quality, most representative data be collected, and that these data are comparable to data collected by different programs that follow these same guidelines.

SUMMARY OF METHOD

The Infiltrex 300 system was designed to concentrate surface water dissolved chemicals of interest (COIs) during the collection process. Large volumes of water will be pumped through Teflon™ tubing, glass fiber filter cartridges, and Amberlite XAD-2 resin beads packed inside stainless-steel canisters. This procedure retains particulates on the filters and extracts dissolved organic contaminants onto the resin, eliminating the need to collect, store, and transport large volumes of water. A total volume of 1,000 liters will be pumped at each high-volume sample station at a flow rate of 1.25 liters per minute.

The water intake will be placed 15 feet away from the bow of the boat with a long pole. Once the required volume for a particular analyte is established, the operator will program the Infiltrex 300 system to collect a composite sample by setting the appropriate flow rate (i.e., 1.25 liters per minute) and then monitor the system during the time period necessary for sample collection. The operator will also monitor the in-line pressure and replace filters when necessary. Samples will be collected using the "clean hand – dirty hand" method. Once the desired volume is pumped, the column assembly will be removed and any residual water will be drained out. XAD-2 canisters will be labeled, wrapped appropriately, and then placed in a cooler with wet ice. Any additional glass fiber filters will be removed and placed in appropriate containers, labeled, placed in a polyethylene bag, and stored in a cooler containing ice.

At the analytical laboratory, the column and filters will be extracted and analyzed individually. Extraction of XAD-2 resins and filters will follow the laboratory SOP, which will be provided as an attachment to the Round 2 QAPP Addendum for Surface Water Sampling (Integral 2004).

SUPPLIES AND EQUIPMENT

The general types of equipment that are required are described in this section. A detailed supply and equipment list is provided in Table 1. Additional equipment may be required depending on project requirements.

The equipment used for water trace organics sampling consists of an Axys organics sampler (custom-manufactured to sample both particulate and dissolved fractions at the same time), XAD-2 resin columns (filtered and unfiltered) for organics extraction, and a sample tubing system composed of Teflon™ tubing and Swageloc™ stainless-steel fittings. Other than the columns used for sampling total organics and the filters used for sampling particulates, no containers are used for sample collection. Resin for filling stainless-steel columns and filters for sampling particulates will be prepared in the laboratory at Axys Environmental Services, Sydney B.C., Canada, at least 4 weeks before the start of a cruise.

For each sampling station, glass fiber filters and a XAD-2 column pre-spiked with standards from the laboratory are prepared. The filters and XAD-2 column assemblage is described in the attached Infiltrex 300 System User's Manual (Attachment D-1).

Two types of intake sample tubing are required.

1. Shallow-water (near-bottom sampling) intake tubing requires a 4-meter-long Teflon™ tubing.
2. Deep-water (integrated water column sampling) intake tubing requires a 25-meter-long Teflon™ tubing.

The two filters necessary for the use of the Infiltrex 300 system are a 140-µm pre-filter, which is used to remove any large particles that may damage the pumping system, and a second glass fiber filter that is used to capture the particulate phase to be used separately or in conjunction with the dissolved phase capture in the XAD-2 column. The nominal filter pore size used will be selected in consultation with EPA and its partners prior to mobilizing to the field sampling location.

A portable 3000-watt power generator will be used if on-board electricity is not available.

PROCEDURES

EQUIPMENT PREPARATION

Before sample collection begins, sample containers (for holding 140-µm pre-filters and pre-cleaned glass fiber filters) and coolers are cleaned with a mild soap and rinsed with distilled water. Sample containers and XAD resin columns are labeled with the date, sampling location, and a unique sample identification number using a permanent marker. Separate sample containers are used for the columns and filters as they are analyzed separately. Once cleaned and labeled, the sample containers are placed in coolers to keep from being contaminated during the sampling event. Date, site location, and sample identification numbers are noted on the field data sheet. A detailed site description with references to landmarks also is also provided.

Initial Setup

Prior to sampling, a clean, 140-µm in-line filter is placed on the intake port of the Infiltrex sampling unit. The Teflon™ intake line is then connected to an intake structure built of talon stainless-steel rods and connectors attached to the boat at a fixed depth (i.e., 1 meter). The outlet tubing is connected to a floating outlet greater than 10 feet from the boat, located downwind on the opposite end of the boat from the intake structure. The boat is anchored from the bow, and the intake is 10 feet off the port bow. The outlet is 10 feet off the stern, which maintains a distance of greater than 30 feet and prevents wind action and/or forward motion from causing mixing of the water. The outlet line is connected to the outlet port and the line positioned such that it drains outside the boat. The sampling unit can then be plugged into the generator for power.

Decontamination Procedures

Every day before sample collection begins, the sampler is completely cleaned and tested for leaks and other mechanical problems. The sampler is cleaned chemically after every sampling day. Clean latex gloves are worn during equipment decontamination. Once equipment has been cleaned, care should be taken to avoid touching or otherwise contaminating any surfaces that will come in contact with the sample water (e.g., inside surface of filter housings). Decontamination procedures are provided for the sampling unit, which also includes the filter housings and O-rings, as well as in-line filters, tongs, forceps.

Sampling Unit Decontamination

Decontaminating the sampling unit includes not only the unit but also the filter housings and O-rings. Procedures for decontaminating each of these parts are provided below.

Filter Housings and O-rings

1. Remove filter housings from unit.
2. Wash housings and O-rings using a scrub brush and lab-grade detergent.
3. Rinse housings and O-rings with deionized water. Use cleaned forceps to hold O-rings while rinsing.
4. Allow cleaned items to air dry on a clean plastic tarp. Place O-rings in filter housings, and reconnect housings to sampling unit.

Sampling Unit

1. Plug unit in (generator or wall outlet) and power up the sampling unit using the main toggle switch.
2. Check that the flow control valves on top of the unit both point in the same direction. The arrows on the valve handles point to the filter housing that water will be drawn through.
3. With the intake line submerged in warm water with lab-grade detergent, press the <ON> button on the control panel to start the pump.
4. Increase the RPMs of the pump until the pump is primed and water is flowing through the unit.
5. Draw 20 liters of soapy water through the system, followed by 5 liters of deionized water.
6. Repeat flushing process for the alternate flow path by turning the flow control valves so that they both point to the other filter housing.
7. Disconnect the post-column line where it reenters the pump housing and position the line so that it drains outside of the boat. This prevents solvents from passing through the volume totalizer unit.
8. Place the end of the intake line in a wash bottle with approximately 500 mL of acetone. Continue pumping until all of the solvent has been drawn into the tubing.

NOTE: If an initial detergent and deionized water rinse was performed prior to field deployment, begin this step with a 500-mL deionized water rinse prior to the acetone rinse.

9. Following the acetone rinse, place the end of the intake line in a wash bottle with approximately 500 mL of deionized water. Continue pumping until all of the water has been drawn through the tubing.
10. Repeat the acetone and deionized water rinse for the alternate flow path by turning the flow control valves so that the water passes through the other filter housing.
11. Place the intake line into water to be sampled (river or effluent stream) to push the solvent and deionized water through the unit. Continue pumping river water for approximately 1 minute through each filter housing to thoroughly flush the system.
12. Once both pathways have been cleaned, press <STOP> and reconnect the post-column line.

In-Line Filter Decontamination

1. Unscrew the top portion of the in-line from the filter housing.
2. Remove the inner filter element from the housing.
3. Place filter element and housing in warm detergent water and use a small brush to remove dirt particles.
4. If the filter element is still clogged or has become misshapen, replace the filter element.
5. Once all particles are removed, reassemble the in-line filter.
6. Using a wash bottle, squirt a small amount of acetone through the in-line filter. Once dry, the filter is ready to use. Keep all cleaned in-line filters that are not in use in sealable plastic bags.

Tong and Forceps Decontamination

1. Use a scrub brush with lab-grade detergent to thoroughly clean the tongs and forceps.
2. Rinse with deionized water, then with a small amount of acetone.
3. After cleaning, store the tongs and forceps in a clean storage container until needed. Once used, place the utensils in a separate container used only for contaminated items that need to be cleaned before use.

SURFACE WATER SAMPLE COLLECTION

Clean Hands/Dirty Hands Technique

Clean hands/dirty hands technique requires two or more people working together. At the field site, one person is designated as "clean hands" (CH) and a second person as "dirty hands" (DH). Although specific tasks are assigned at the start to CH or DH, some tasks overlap and can be handled by either as long as contamination is not introduced into the samples. Both CH and DH wear appropriate non-contaminating, disposable, powderless, nitrile gloves during the entire sampling operation and change gloves frequently, usually with each change in task (wearing multiple layers of gloves allows rapid glove changes).

CH takes care of all operations that involve equipment that comes into contact with the sample, including the following responsibilities:

- Handles the surface water sample bottle
- Handles the discharge end of the surface water sample tube or line
- Prepares a clean workspace (inside boat)
- Sets up the processing and preservation chambers
- Sets the equipment (i.e., the sample bottles and the filtration and preservation equipment) inside the chambers
- Works exclusively inside the chambers during collection, processing, and preservation
- Changes the chamber covers as needed.

DH takes care of all operations that involve contact with potential sources of contamination, including the following responsibilities:

- Works exclusively exterior to the processing and preservation chambers
- Prepares and operates the sampling equipment, including the pumps and discrete samplers, peristaltic pump switch, pump controller, and manifold system
- Handles the generator or other power supply for samplers
- Handles the tools, such as hammers, wrenches, keys, locks, and sample-flow manifolds
- Handles the single or multiparameter instruments for field measurements
- Sets up and checks the field-measurement instruments

- Measures and records the water depths and field measurements.

Surface Water Sampling Procedures

Two persons are needed to conduct the sampling and a third person to keep track of sample logging and sample processing. Samples are collected using the clean hand – dirty hand (CH/DH) method.

Step 1 – Insert Glass Fiber Filter

- Remove one filter housing from unit.
- Insert glass fiber filter into filter housing touching only the plastic wrapper. Do not directly touch any exposed surfaces of the filter. If the exposed filter comes in contact with anything other than the interior of the filter housing, the filter is discarded, and a new filter is used.
- Once the filter is in place, reconnect the filter housing to sampling unit.

Step 2 – Connect XAD Resin Column

- Remove nut from spiked end of column, and place nut back in sealable plastic bag that held the column from the lab.
- Connect the post-filter line to the spiked end of the resin column.
- Remove the nut from the other end of the column, and place nut in the plastic bag. Place the plastic bag in the labeled column sample container, which in turn is placed in a clean cooler.
- Connect the open end of the column to the post-column line.
- Attach the post-column line to the Infiltrex sampling unit just before the volume totalizer unit. (**NOTE**: If the resin column is not spiked with a surrogate target analyte, either end of the column can be attached to the post-filter line. In this case, the column is not directional.)

Step 3 – Reset Volume Meter

- Press <RESET> on the volume totalizer until the display reads 0.0.

Step 4 – Check Control Unit Settings

- Check the control unit to make sure the RPM light is on. If light is not on, press <STOP/RESET>.
- Make sure the FORWARD direction light is on. If the REVERSE light is on, press the <FORWARD/REVERSE> button.
- Make sure the PROGRAM light is NOT on. The pump will not operate in PROGRAM mode. If the PROGRAM light is on, press the <STOP/RESET> button.
- Use the UP and DOWN arrows to control the RPMs. A good initial starting point is 1200 RPMs.

Step 5 – Begin Pumping

- Press <ON> to begin pumping. It may be necessary to increase the RPMs to get the pump started. It takes a few moments to get water flowing through the entire system.
- The moment that water is observed in the post-column line, reset the volume totalizer to 0.0. This is necessary to get an accurate volume measurement, because the totalizer will measure the water that was already in the lines from the cleaning process even though this water did not pass through the filter and resin column.
- Adjust the RPMs until the flowmeter indicates that the unit is operating at the optimum pumping rate of 1.25 liters/minute.
- Check all fittings to make sure there are no leaks.
- Note on the field data sheet the start time, pumping rate, and initial pressure on the system.

Step 6 – Check System

- Check the sampling unit periodically (at least every hour) to ensure unit is operating correctly. Check and record the volume filtered, flow rate, and pressure.
- If the pressure reaches 20 psi, the glass fiber filter must be changed as described below and in Section 5.2 of Attachment D-1.
- If the flow rate has decreased, increase the RPMs to maintain the optimum pumping rate of 1.25 liters/minute. If increasing the RPMs does not help, either the glass fiber filter or the in-line filter must be changed (see Section 5.2 in Attachment D-1).

Step 7 – Complete Sample Collection

- Operate the sampling unit continuously until the desired volume of water has been filtered. For most in-stream samples, 1,000 liters of water are pumped through the system. However, smaller samples may be collected, depending on expected chemical concentrations.
- Once desired volume has been filtered, cease pumping by pressing <STOP> on the control unit.
- Record stop time and volume filtered on the data sheet.
- Turn main switch on unit to off.

Changing the Glass Fiber Filter

The glass fiber filter must be changed if the pressure reaches 20 psi, or if adjusting the RPMs does not increase the flow rate, by using the following procedure:

1. Insert a glass fiber filter in the unused filter housing as described in Step 1.
2. Press <STOP/RESET> to temporarily cease pumping.
3. Record the stop time and volume filtered.

4. Switch both directional flow valves to point in the direction of the filter housing containing the clean filter.
5. Press <START> to resume pumping. See Sample Handling Procedures (below) to remove the used filter from the filter housing.

Changing the In-Line Filter

The in-line filter should be changed when the optimum flow rate (1.25 L/min) cannot be maintained by adjusting the RPM. The following procedures are used to change the in-line filter:

1. Press <STOP/RESET> to temporarily cease pumping.
2. Switch both directional flow valves to point in the direction of the filter housing containing the clean in-line filter element.
3. Press <START> to resume pumping.
4. Record time and volume filtered on field data sheet.
5. Disconnect the used in-line filter, and replace with a clean filter element and housing. See Section 2.2.2 for decontamination procedures for in-line filters.

SAMPLE HANDLING PROCEDURES

The following procedures describe how the used filters and XAD resin columns must be handled once sampling is complete.

Glass Fiber Filters

1. Remove the lower filter housing unit while being careful not to spill any of the particulate laden inside.
2. Use clean tongs to remove the used filter from the housing and place the filter in a pre-cleaned glass jar. Note that more than a single filter and jar may be required if the sampled water is turbid.
3. Add any residual water and particulates from the lower housing to the glass jar containing the filter.
4. Label the jar(s) with date and sample ID number.
5. Place container on ice in a cooler.
6. Record sample identification number on field data sheet.

XAD Resin Columns

1. Unscrew the column from the post-filter line and replace the end cap.
2. Unscrew the column from the post-column line and replace the end cap.

3. Place the column in a sealable plastic bag, and label the bag with date and sample ID number.
4. Place the bag in a plastic container, and label the container with date and sample ID number.
5. Put the sample container immediately on ice in a cooler.

SAMPLE PROCESSING

Once a surface water XAD-2 column sample container is properly capped, labeled, and then sealed inside a Ziploc™ bag, it is placed inside a large plastic bag, which in turn is placed inside a cooler containing wet ice.

Sampled XAD-2 columns for trace organic analysis are maintained on board the vessel and transferred to the laboratory by Integral personnel. All trace organic samples are stored in sealed coolers with wet ice on board the vessel and transferred to the field laboratory at the conclusion of the cruise. The field leader is responsible for maintaining sample integrity throughout the cruise. Once at the field lab, sample contamination is avoided by handling the sample containers with clean gloves, and transferring the samples into clean refrigerators immediately after samples are brought back from the field.

Storage Temperature Quality Control

Each storage freezer or refrigeration unit is monitored daily to ensure temperature compliance. Each unit will have a separate log form containing date, time, and temperature information.

CHAIN-OF-CUSTODY

Field

The cruise leader or other designated field sample custodian is responsible for all sample tracking and chain-of-custody procedures until sample custody is transferred to the laboratory. Custody procedures in the field are as follows:

1. Record all field and sample collection activities (including sample identification number, collection time and date) in the field logbook. While being used in the field, the logbook remains with the field team at all times. Upon completion of the sampling effort, the logbook should be reproduced and then kept in a secure area.
2. Complete a chain-of-custody form whenever samples are being transferred or removed from the custody of field sampling personnel. A sample form is provided in Appendix F. Record each individual sample on the form. Include additional information to assist in sample tracking such as collection date and

time, number of containers, and sample matrix. The chain-of-custody may also serve as the sample analysis request form, with the required analysis indicated for each individual sample.

3. Sign the form and ensure that the samples are not left unattended unless secured.
4. Store, pack, or ship samples as described in the following section. Place the original completed chain-of-custody form in a sealed plastic bag inside the shipping container. A copy is retained by the shipping party.
5. Complete a separate custody form for each individual shipping container or a single form for all samples in multiple shipping containers in a single shipment, with the number of containers noted on the custody form.
6. Attach completed custody seals to any shipping container that will be sent to the laboratory by delivery service or courier. Delivery personnel are not required to sign the custody form if custody seals are used. Custody seals are used to detect unauthorized tampering with the samples. Gummed paper or tape should be used so that the seal must be broken when the container is opened. The laboratory sample custodian (or other sample recipient) will establish the integrity of the seals.
7. The laboratory custodian (or other sample recipient) acknowledges receipt of the samples by signing, dating, and noting the time of transfer on the chain-of-custody form. The condition of the samples and any problems or irregularities (e.g., cracked or broken columns, loose caps, evidence of tampering) should also be recorded. Return a copy of the completed custody form to the project manger or designated sample coordinator.

Laboratory

The laboratory will designate a sample custodian who is responsible for receiving samples and documenting their progress through the laboratory analytical process. Each custodian will ensure that the chain-of-custody and sample tracking forms are properly completed, signed, and initialed on transfer of the samples. Specific laboratory chain-of-custody procedures should be in writing, included in the laboratory QA plan, and approved prior to beginning sampling and analysis. Laboratory custody procedures should include the following:

- A designated laboratory person initiates and maintains a sample tracking log that will follow each sample through all stages of laboratory processing and analysis.
- The laboratory tracking log includes, at a minimum, the sample number, location and type of storage, date and time of each removal, and signature of the person removing or returning the sample.

The final disposition of the sample is recorded.

CHAIN-OF-CUSTODY QUALITY CONTROL PROCEDURES

Complete and correct chain-of-custody is essential to ensure and demonstrate sample integrity. Errors in entering information or transferring custody can result in analytical or data reporting errors. Inaccuracies or errors in sample tracking and custody records can compromise data usability, particularly as legal evidence.

Quality control (QC) procedures include the following:

- Allow adequate time to take accurate and complete field records and to carefully complete chain-of-custody forms.
- When possible, work in pairs or more to complete the chain-of-custody form and check for accurate information entry.
- Complete all custody records in ink; errors should be neatly crossed out and corrected and initialed by the person making the change.
- Immediately notify the project manager of any deviation from required custody procedures.

PACKING AND SHIPPING SAMPLES

Environmental samples are packed in a manner to reduce the chance of sample breakage, ensure sample integrity, and prevent material leakage and potential exposure to hazardous materials in the event of breakage. Samples are placed in sealed plastic bags and packed in a sturdy container with adequate packing material to prevent breakage. Ice for XAD columns and filters is included to maintain sample storage conditions. Samples are transported by field personnel or shipped via courier or common carrier. Shipping procedures are in accordance with U.S. Department of Transportation regulations (49 CFR 173.6 and 49 CFR 173.24).

All preserved samples should be shipped as soon as possible after completion of sampling. This minimizes the number of people handling samples and protects sample quality and security.

Sample Packing

Upon completion of final sample inventory by the field sample custodian and completion of chain-of-custody, samples are packed as follows:

XAD-2 Columns

1. Line the cooler bottom with bubble wrap and place a large 30-gallon bag inside another bag of same size and place it inside the cooler. Use a leak-proof, sturdy cooler that can withstand rough treatment during shipping. The cooler's drain should be securely plugged and sealed with duct tape.
2. Wearing disposable, powderless nitrile gloves, wrap each doubly wrapped XAD-2 column in bubble wrap. [**NOTE**: When samples are being transported

by field personnel directly from the field site to the laboratory (thereby ensuring careful handling), this step is recommended but may be omitted. However, this step is required when a courier or delivery service is transporting the samples.]

3. Place the samples tightly inside the doubled bag in the shipping container:
   - Use dividers or bubble wrap to separate all XAD-2 columns containers
   - Seal large plastic bags with rubber bands or plastic tie
   - Fill any empty space in the shipping cooler or box with packing material so that the columns are held securely.

4. Place the original completed chain-of-custody form in a sealed plastic bag and place it inside the shipping container. The form should be securely taped to the inside the cooler's lid.
5. If required to meet sample storage requirements, fill the ice chest with crushed or block ice, blue ice (refrigerated samples, 4°C). A temperature blank (provided by the laboratory) should be packed in each cooler.

Glass Fiber Filters

1. Line a small cooler bottom with bubble wrap and place a double 13-gallon bag inside. Use a leak-proof, sturdy cooler that can withstand rough treatment during shipping. The cooler's drain should be securely plugged and sealed with duct tape.
2. Place the filter sample jars tightly inside the doubled bag in the shipping container:
   - Use dividers or bubble wrap to separate all filter sample jars
   - Seal large plastic bags with rubber bands or plastic tie
   - Fill any empty space in the shipping cooler or box with packing material so that the jars are held securely.

3. Place the original completed chain-of-custody form in a sealed plastic bag and place it inside the shipping container. The form should be securely taped to the inside of the cooler's lid.
4. If required to meet sample storage requirements, fill the cooler with wet ice or blue ice packs. A temperature blank (provided by the laboratory) should be packed in each cooler.

Sealing and Labeling Shipping Containers

1. Seal shipping containers securely with packing or duct tape.
2. If the shipping containers will be transported by anyone other than the person who completed and signed the chain-of-custody form, attach completed custody seals so that the shipping containers cannot be opened without breaking the seal.

3. A *Fragile* label may also be attached to reduce rough handling of the samples.
4. Label the shipping container with all appropriate information (name of project, time and date, responsible person and company name, address and phone) to enable positive identification.

Sample Shipping

Packed containers may be delivered to the laboratory or storage facility by field personnel, courier, or common carrier (FedEx, UPS). However, any outside carrier or courier service must provide a delivery receipt. The carrier or courier must also ensure delivery time, if holding time and storage conditions are critical. Unless arranged in advance, shipping charges should be prepaid by sender to avoid confusion and possible rejection of the package by the laboratory.

The adequacy of handling and shipping procedures is reflected in the condition of the samples upon receipt by the laboratory:

- No columns are cracked or broken.
- No jars containing filters are cracked or broken.
- There is no evidence of sample leakage.
- Measuring the temperature of the temperature black indicates that correct storage conditions have been maintained.

The sample custodian or other designated person is responsible for confirming that copies of all shipping documents, completed in full and correctly, are on file at Integral.

FIELD QUALITY CONTROL PROCEDURES

Field QC samples that may be collected during sediment coring are the same as for any field sampling program. The types and frequency of field QC sample collection are project-specific and will be described in the project field sampling plan. The most commonly collected field QC samples are described below (USGS 2000):

- **Field Blank**. A field blank is a clean uninstalled XAD-2 resin column and a filter that will travel with the sampling team. It will be packed and placed in the coolers with the collected samples for analysis after the sampling event.

- **Field Split Sample**. A field split sample consists of aliquots of the same composited sample extract from the XAD-2 column that are equally distributed in two sets of sample containers. These samples may be analyzed identically or analyzed by different laboratories to evaluate repeatability of sample handling and analytical procedures, sample heterogeneity, and analytical procedures.

- **Field Replicate**. A field replicate consists of a second sample that is collected using the same sampling methodology used to obtain the first sample (i.e. another XAD-2 column is used). It is collected at the same sampling location and as soon after the original sample as possible. Analysis of the field replicate allows evaluation of the repeatability of field sampling methodologies, as well as the heterogeneity of the sample matrix. Statistical analysis of multiple replicates may also be used to calculate the likely range of an analyte concentration at a given sampling location.

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Table D-1. Equipment and Supplies List for High-Volume Surface Water Sampling

Quantity	*Description*
1	Axys™ Infiltrex 300 organics sampler
1	3000-watt generator
1	Field log book
1	Sample log form
1	Field sampling plan
1	Health and safety plan with forms
1	Drip pan
1	Sampler repair kit
1	Sampler manuals
1	Cotton tipped swabs
1	Micro-pump service repair kit
1	Extra screws, seals, and bushings
1	Bushing extractor and inserter
1	Magnet set height tool
1	Precision forceps
1	Torque wrench
1	Silicone lubricant
20	4-meter (3/16 ID), 890 Teflon™ resin FEP intake tubing for shallow water intake tubing
3	25-meter (3/16 ID), 890 Teflon™ resin FEP intake tubing for deep water
1	Sample tubing
1	Intake/Exit tubing
1	Spare intake tubing
1	Spare solvent rinsed tubing
1	Columns loaded with XAD-2 resin
1	Glass fiber filters, kilned and rinsed
2	Coolers with column racks
2	Coolers for wet and dry ice
2	Pack sample gloves and dry ice gloves
1	Plastic work box
1	Column assemblies closed with 2 tube to tube Gorilla-Grip™ unions
2	Jars each with 4 tube to column Gorilla-Grip™ unions
1	Plastic waste beaker
1	Container of spare Swageloc™ parts

Table D-1. Equipment and Supplies List for High-Volume Surface Water Sampling

Quantity	*Description*
1	Container of pre-filters, 140-m filter cups, and spare Gorilla-Grip™ unions and ferrules
1	Safety glasses
1	Heavy-duty aluminum foil
2	Solvent boxes
1	Large KimWipes™
1	Plastic bags for filters
1	Solvent squirt bottles for methanol
1	Bag of pens, sharpies, time tape, Teflon tape, and waterproof hockey tape
1	Mobile tool box with tools
2	Wooden column racks
2	Empty calibrated carboys with lids and handle
5	Carboys of distilled or reverse osmosis drinking water
6	Bottles of methanol (4 L)
2	Towels
1	Rope
1	Extension cord
as needed	Cable ties and garbage bags
	Foul weather gear

Attachment D-1

INFILTREX 300 SYSTEM USER'S MANUAL

USER'S MANUAL

INFILTREX 300

TRACE ORGANIC SAMPLING SYSTEM

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June 2002

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MODEL IDENTIFICATION

The *INFILTREX 300* is identified by a unique Serial Number. In any correspondence with AXYS Environmental Systems always provide the *INFILTREX 300* Serial Number.

This manual is supplied with, and is compatible with, the *INFILTREX 300* and Watchman 300 serial numbers identified below.

Item	Serial Number/Version
INFILTREX 300	

Location of Serial Numbers/Versions

The serial number for the *INFILTREX 300* is stamped onto the top of aluminum frame.

CONTENTS

Page

List of Tables

List of Figures

1.0 INTRODUCTION

1.1 DESCRIPTION AND FEATURES

INFILTREX 300 is a second-generation instrument designed specifically for the collection of samples of trace levels of organic impurities from large volumes of water. In the absence of *INFILTREX 300*, large volumes of sample water are collected which then require costly laboratory concentration before analysis can be done. *INFILTREX 300* samplers are designed to remove the particulate and dissolved fractions *in situ*, and to concentrate these during the sample collection process (hence INFILTREX: IN situ FILTRation and EXtraction). Using *INFILTREX 300* eliminates the need to collect, store, and transport large volumes of water. The *INFILTREX 300* allows for fast sampling flow rates of up to 2250 mL/minute. The maximum sampling flow rates are determined by the type of resin column/s chosen and the extraction efficiency for a given column size.

INFILTREX 300 is an operator actuated system requiring monitoring and adjustment through the course of the sampling process. The 'basic system' as supplied, consists of the main sampler, and several essential accessories. The basic system consists of a NEMA enclosure (containing the pump and flow meter), and an electronic control mounted on an aluminium frame. Further descriptions are detailed within this manual.

The concentration process is accomplished by pumping the sample water through an XAD-2 extraction column used to concentrate trace organic contaminants. AXYS Environmental Systems pre-packs XAD-2 into several sizes of extraction columns. Empty columns are available for users to fill with their own choice of materials.

The sample water feed is filtered before passing through the extraction column. This prevents suspended particulate matter from interfering with the extraction process, and allows separation of the dissolved from the suspended phase components. High capacity cartridge filters are used where the sampled water volumes are large, or where water sediment loads are high. Filters and holder components are easily removed for cleaning.

All materials used in the manufacture of the filter and column components have been specifically chosen to be non-contaminating. Also, to assure integrity of the sample, the components have been mechanically designed to be easily and completely cleanable,

1.2 *INFILTREX 300* SPECIFICATIONS

Features

The *INFILTREX 300* is a system that includes the following:

1. One *INFILTREX 300* high volume trace organic sampling system
2. Two 4" SS Cartridge Filter Housings
3. One set of interconnection TFE/SS tubing for the attachment of 75g or 250 g SPE columns
4. One set of manuals.

INFILTREX 300 Specifications

Overall Dimensions:	30" H * 17" W * 36" L weight: ~110 lbs.
Materials:	All wetted parts in sampling stream, stainless steel or Teflon; all instrument cases NEMA 4 rated
Sampling Components:	Single or dual TFE resin columns or single SS large volume columns; filter housings (2) stainless steel; filter elements: 4" glass wound with SS core.
Flow Measurement::	Optically sensed turbine flow meter, with redundant volumetric logs (Watchman, Totalizer/rate meter); magnetic level switch.
Pumps:	#1- positive displacement, gear type (220VAC) with feed back control from the flowmeter;
Flow Rates:	300 to 2,250 mL/min through resin columns; Long term average within ± 3%, while the control loop is operating in its linear range.
Total Volume:	± 3% at higher settings, ±10% at the 50 ml/min setting.
Power Supply:	Sampling System: 110 VAC mains, 750 Watts when pumping.
Control System:	Reliance Electric SP500 3PH Variable Frequency Motor Controller.
Temperature:	-40 to +40 C (water must be non-freezing).

The system is designed to be operated directly by an operator.

Column Specifications

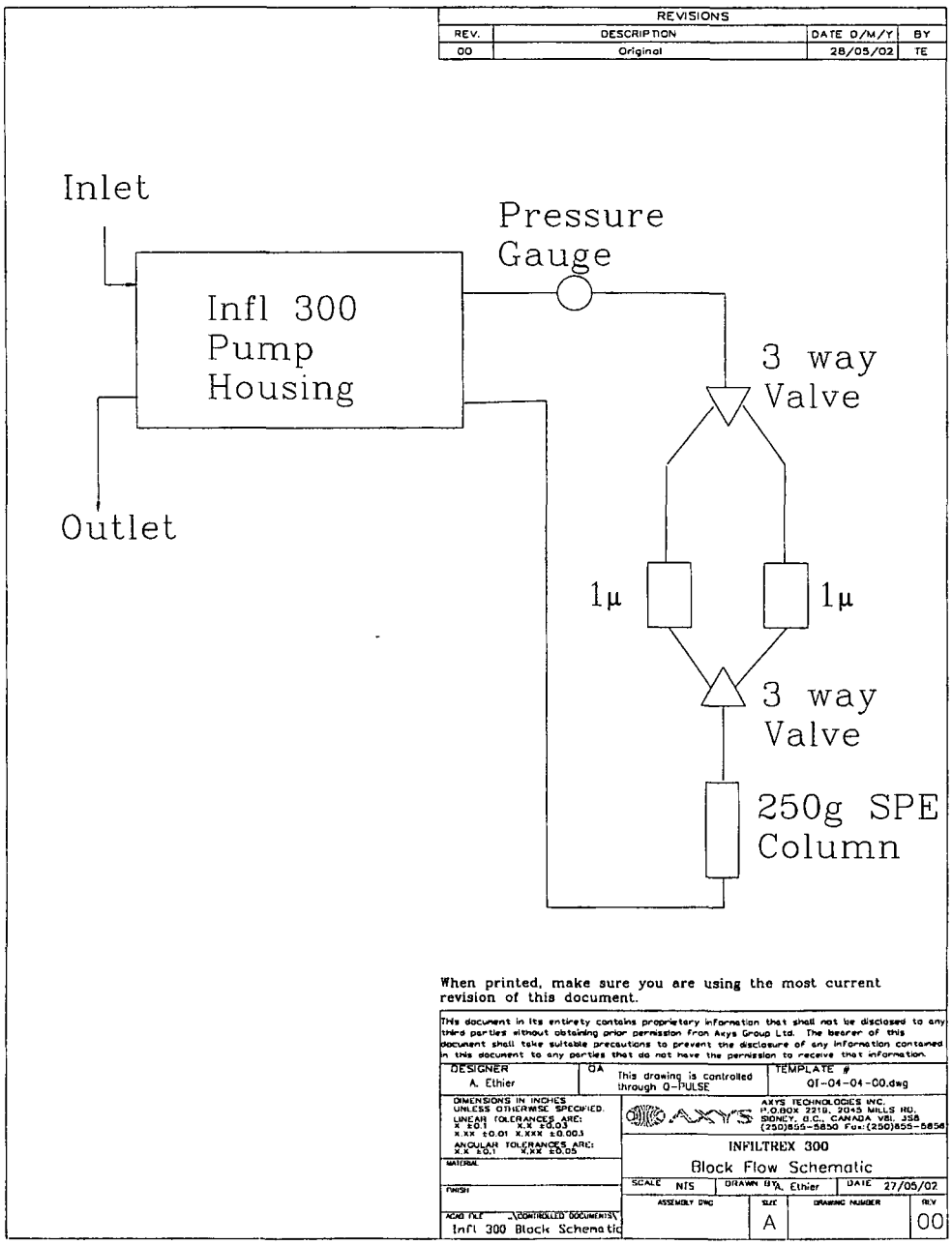
Physical Dimensions (75 g or 250 g column):	Length:	6 in
	Diameter:	1 in or 2.5 inches
Column Material:	Teflon or SS 316	
Trace Organics I (XAD-2):	Amberlite XAD-2 (A cross-linked polymer of styrene and divinylbenzene synthesised with control of pore size, pore size distribution and surface area. Amberlite XAD-2 is a Trade Mark of Rohm and Haas Co., Philadelphia, PA).	

Weight of Extraction
Material used in column: 75 grams or 250 grams

End Mesh Size: 210 micron

System Flow and Volume Specifications

Maximum Sample Rate 1.5 l/min based on SSLV 250 gram column
Maximum Sample Rate 0.5 l/min based on 75 gram TFE column



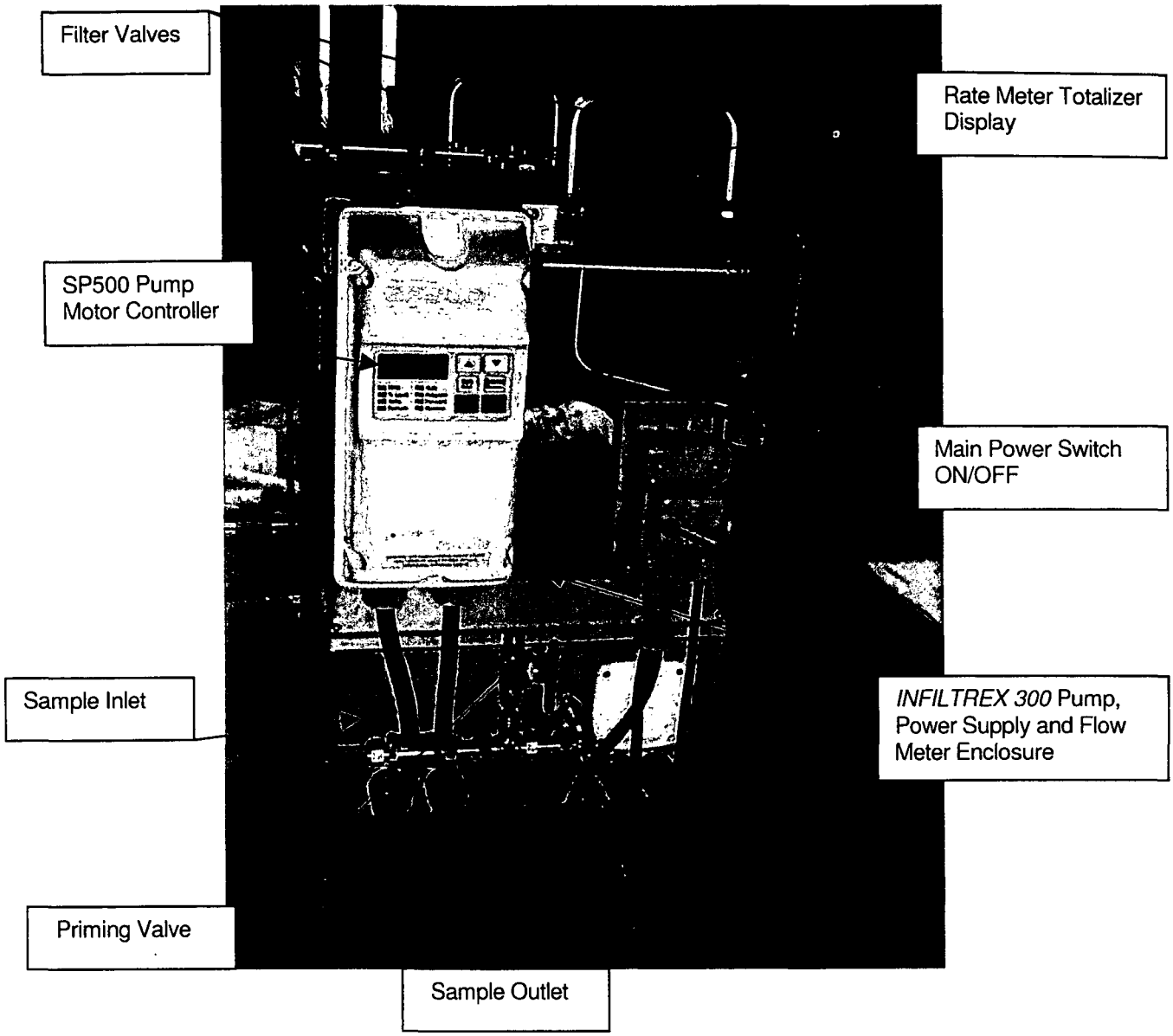


Figure 1. Side View of the *INFILTREX 300* Sampling System

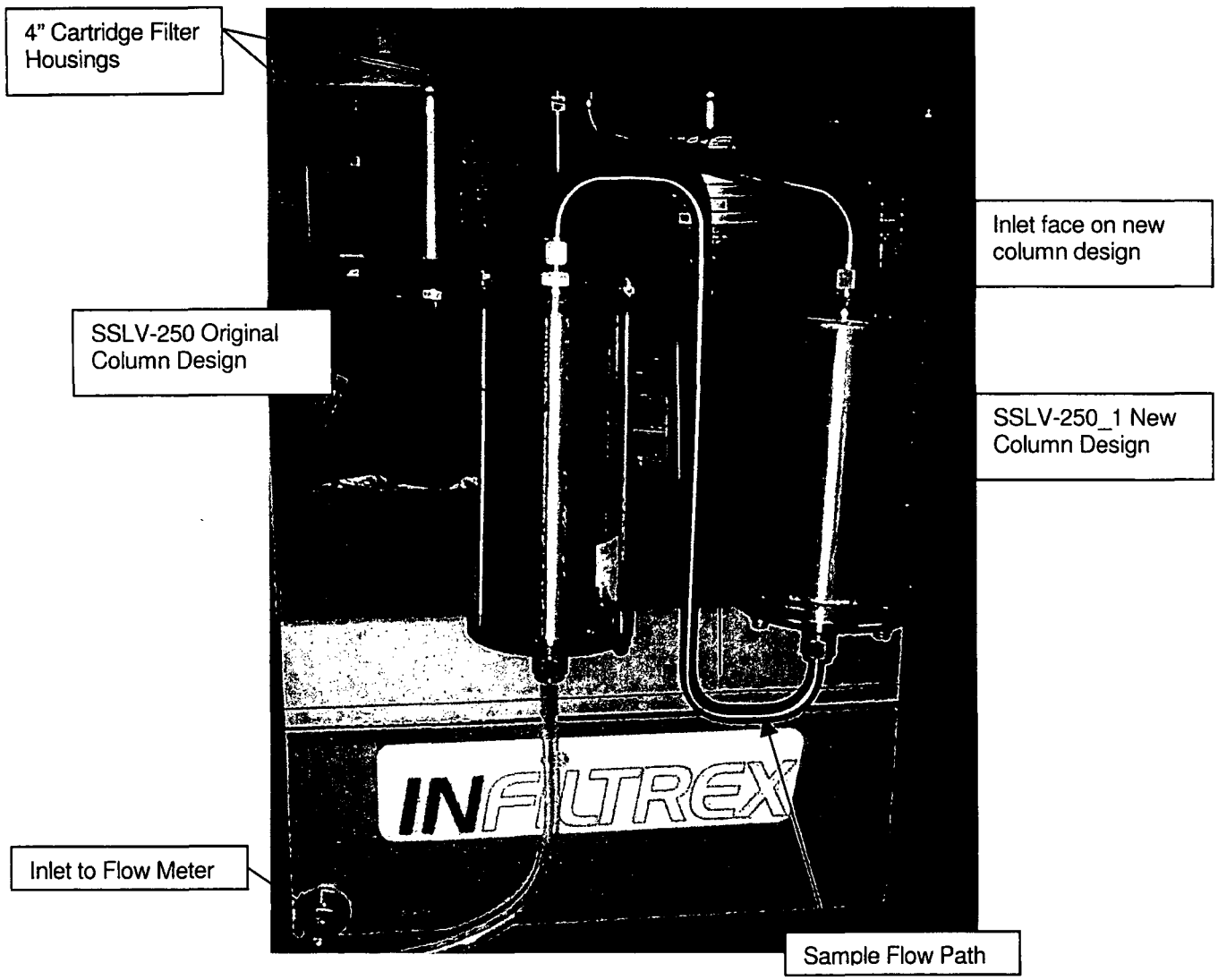


Figure 2. Front View of the *INFILTREX 300* Sampling System

1.3 BASIC OPERATION

The *INFILTREX 300* water sampler contains a pump whose flow rate can be controlled, a flow accumulator system to measure total volume/rates pumped and a power source (converts 110VAC to 220VAC).

The operator regulates the pump speed by manually adjusting the motor drive controller (SP500) to increase or decrease the motor RPM. The resulting flow rates are monitored on the Rate Meter/Totalizer installed on the upper bracket of the instrument.

The operator must determine the appropriate type of extraction material to use in the column and the volume of sample water to be pumped. The flow rate chosen must be slow enough to allow adequate water-to-extraction material contact to accomplish complete extraction of the desired impurities, and yet fast enough so that an adequate total volume can be sampled in a reasonable length of time.

If preloaded columns are purchased from AXYS Environmental Systems, they will have been pre-cleaned. "Blank Certification" is available at additional cost. If columns are being reused, or re-packed, they must be cleaned to the desired blank level. AXYS Environmental Systems offers a cleaning and/or Blank Certification service, as well as advice on cleaning or the use of columns. The inlet plumbing and filter components must also be similarly cleaned to the operator's standards.

The pump is located in the sampler upstream from the column and filter. It is a positive displacement gear. If the system is being used to sample at different sites, then rigorous cleaning of the pump and filter housing system must be made to the same degree of chemical purity as the column.

Do not pump harsh chemicals (acetone, hexane) which are incompatible with the materials of the plumbing, pump and flow meter. The system can be flushed with methanol to clean all wetted components without fear of damage.

Column and/or filter changes are required between consecutive samples taken in the field. Only the operator can determine the quality of cleaning necessary for the filter and plumbing components between such samples. Additional filter and plumbing components are available from AXYS Environmental Systems so that the operator may install cleaned sets to allow simple changes in the field.

1.4 CARE OF *INFILTREX 300*

INFILTREX 300 is constructed of aluminium, stainless steel, and various plastics - materials that need little care. As with any instrument, *INFILTREX 300* should be protected from shock and abrasion during storage, transportation, and use.

Never allow sand, dust, dirt or pieces of column resin to enter the *INFILTREX 300* plumbing itself. The clearances in the gear pump and flow meter are very small and will be jammed or damaged by dirt. To reduce this possibility, a 140 micron screen element is

mounted on the inlet pipe of the *INFILTREX 300*. Always use the in-line filter when pumping any fluid through the sampler. This filter should be removed and the screen carefully back-flushed (or replaced) regularly to keep it clean. Do not allow matter to enter the inlet pipe while this screen filter is off. There is no screen on the outlet and although it is far more difficult for particles to enter there, it should be similarly respected.

INFILTREX 300 should not be left with stagnant water in its plumbing as organisms will grow quickly and degrade the flow meter performance, often permanently. To allow the system to be cleaned after a sample has been taken, the columns and filter(s) should be removed promptly, capped, checked and stored. A cleaning kit consisting of connecting plumbing is provided to facilitate cleaning. As soon as convenient, clean water should be pumped through the plumbing to flush out the remaining sample water. This should be followed by a 10% solution of methanol to sterilize the system and inhibit organism growth in the little fluid that will inevitably remain. The *INFILTREX 300* should be pumped as dry as possible before being packed away.

If there is a chance of *INFILTREX 300* being stored below freezing, it should have a final rinse with pure methanol before being pumped dry so that any remaining liquid will not freeze.

2.0 SAMPLING PROCEDURES

2.1 XAD-2 COLUMN - INSTALLATION/REMOVAL

When shipped from AXYS Environmental Systems, prepared columns are packed in clean sealed bags. When ready to install, remove the caps from the ends of the column fittings. These caps will be used later to seal the column, so they should be stored in a non-contaminating, sealed package.

It is normal for a small amount of the alcohol or water buffer from the packing process to be released when the end caps are removed. Always visually confirm the integrity of the retaining screen in each end before installing the column on the instrument.

The *INFILTREX 300* inlet and filter-to-column piping must have been previously cleaned to the operator's satisfaction. Connect the fittings from the *INFILTREX 300* tubing to the column fittings using the following procedures.

(a) Connection Of The Xad-2 75 G Tfe Column

When ready to install, remove the caps from the ends of the column fittings. Remove only the nut from the end fitting - not the whole column end. The column end, which is also threaded, should not be removed in the field. It should only be removed to change the resin. After all the tubing for the columns and filters are connected and aligned, the tube fitting nuts should all be tightened securely, and checked.

The recommended method of installing and tightening these tube fitting nuts is as follows:

1. Push the tube into the column end fitting hole until it seats.
2. Hold it there and turn the fitting nut onto the threads until finger-tight.
3. Pull back on the tube lightly. It should move roughly a millimetre and stop as the grip inside the fitting nut drops into the groove on the tube.
4. Tighten the fitting nut 3/4 of a turn beyond finger-tight. It is not necessary or advisable to tighten further. Over-tightening will damage the TFE threads of the column union.

(b) Connection Of The Xad-2 250 G SS Column

When all the tubing for the columns and filters are connected and aligned, the tube fitting nuts should all be tightened securely and checked. This large capacity column makes use of SS Swagelok fittings that are less prone to damage. To tighten the fitting nuts, thread on finger-tight, then use a wrench to tighten half a turn more.

NOTE: There are two versions of the SSLV 250g columns. The latest version is a welded unit that is not symmetrical and has only one end cap. This column has a flow path indicated on the end caps, showing the "INLET" and "OUTLET". The operator needs to ensure that the columns are not mounted upside down, otherwise some of the solid phase resin may be lost.

2.2 PARTICULATE FILTERS - INSTALLATION/REMOVAL

Because of the large volumes of water pumped by *INFILTREX 300, a* particulate filter is absolutely necessary for most applications. It is strongly recommended for even the cleanest appearing water. If any particulate matter is allowed to enter the column it will soon coat the extraction material and either plug the flow totally or reduce the material's extraction efficiency.

The only choice of filter type on *INFILTREX 300* is a cartridge-type filter. Cartridge-type filtering elements for organic analysis are wound glass fibre with SS cores, with a nominal 1 micron extraction capability.

The two cartridge filter housings are located on the top of the assembly and are opened by completely loosening the 1" SS nut. This will allow the lower SS housing to be removed in order to access the used 4" cartridge or to load a new filter unit.

NOTE: When reloading filters, the filter bowl will contain water. Care should be taken not to spill particulate-laden water that is required for analysis. The recovered cartridge, plus residual water, should be put into a clean glass jar for analysis.

a) Wound Glass Fibre Cartridge Filter Element (Part Number Filterite G1A4SE)

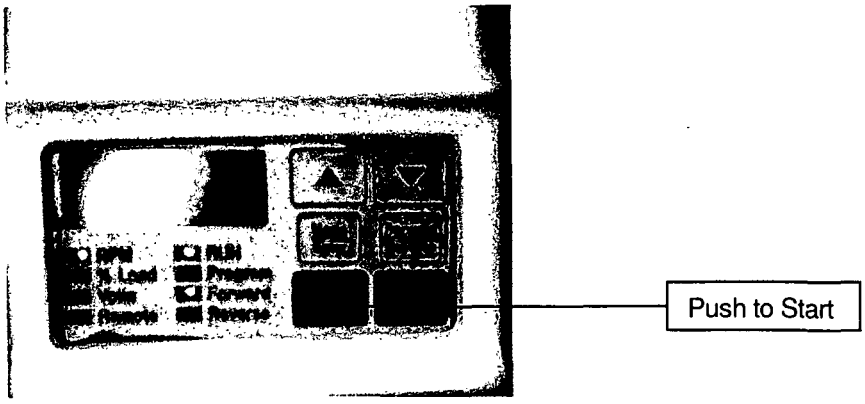
The cartridge element normally recommended for sampling for trace organic compounds is a Heat Purified Glass Fibre Wound element with a 1 micron filter rating. This is made by Filterite. The Filterite product number for this filter is 1A4SE. Other filter materials and pore sizes are available in the same series. Contact Filterite, Timonium, Maryland, USA, Telephone (301) 252-0800. The G1A4SE is also available individually from AXYS Environmental Systems

2.3 INITIATION AND FINAL CHECK

Once the column and filter components have been assembled, and the fittings tightened, the operator initiates the sampling by starting the pump. The pumping sequence is started by:

- turning the main power switch to the "ON" position.
- pressing the "Start" button on the SP500 control unit.
- The speed of the pump is controlled by pressing either the up arrow to increase the RPM or the down arrow to reduce the RPM. The number displayed on the unit is the motor RPM.

Three lights should be active in "Normal" sample mode: RPM, RUN and Forward". To stop a sample, press the "Stop" button on the controller or turn the power off. This control unit has many advanced features that are documented in the SP500AC Drive Installation and Operation Manual also accompanying this system.



Under ideal conditions the *INFILTREX 300* is capable of dry lifting a 3m head of sample water up the inlet line at maximum RPM. However, if the gears are slightly worn, or if there is a fitting not completely sealed, then the dry lift capability is reduced. There is a purge valve upstream of the inlet filter to allow the operator to prime the system plumbing with clean water and fill the inlet piping and pump head prior to starting the sample. In order to get maximum suction to start the pumping in a new location, the RPM may have to be increased to maximum to establish flow, then monitoring the Totalizer/Rate Meter reduce the pump RPM to the desired sample flow rates.

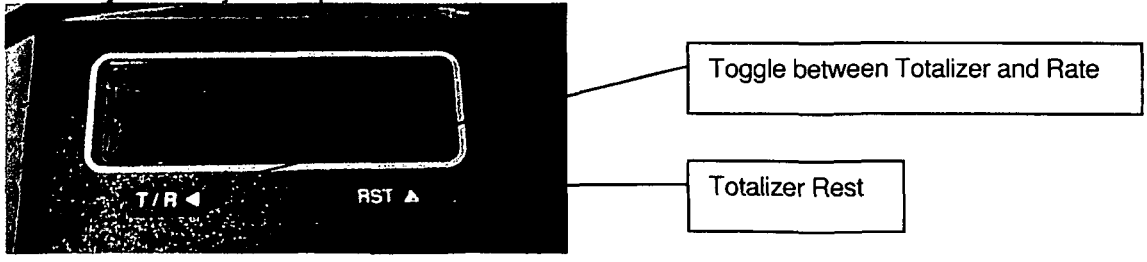
The Totalizer / Rate Meter is situated on the top of the sampler to allow for easy operator access. This unit with display either the accumulated total volume or the instantaneous flow rate. The units and time scale are all programmable features within this module (refer to trouble shooting and service to change the display). The default configuration delivered from Axys is:

- Litres to 0.000
- Flow rate is Litres (0.000) per minute

The operator resets the totalizer window to zero at the start of a sample event by pressing the reset switch. Once the *INFILTREX 300* is pumping, it is under the direct control of the operator who can manually adjust the sample stream flow rates to the desired values. There is a toggle switch on the display to change between the two modes: Totalizer and Rate Meter.

CAUTION: If the reset switch is enabled, care must be taken not to press this switch when in the Totalizer display or the current accumulated value will be reset to zero.

During the course of the sampling period, the operator should periodically check the metered flow rates against a known volume per time in a graduated vessel to ensure the accuracy of the systems performance.



3.0 POST RECOVERY PROCEDURES

3.1 PUMP DRY

There will still be water in the *INFILTREX 300* plumbing and filter housing cavities. As much water as possible should be pumped out before disassembly. Some of the particulate matter in the filter may not be adhere to the filter due to the jostling of recovery, and may be loose in the water in the filter housing cavity. If it is desired to recover the filter and filtrate for analysis, run the main pump for a time until as much water as possible has been expelled out of the *INFILTREX 300* plumbing system.

3.2 FILTER REMOVAL

When the *INFILTREX 300* plumbing is empty, the motor should be stopped before proceeding. If the *INFILTREX 300* is to be used immediately for another sample, place the filter bowl and O-ring in a clean location until it is reassembled.

If the instrument is to be used immediately for another sample, the filter housing must either be cleaned to the operator's satisfaction or replaced with another clean housing. A clean water rinse of the housing's interior may suffice until the *INFILTREX 300* is returned from the field when a proper cleaning can be done.

3.3 COLUMN REMOVAL

Loosen and pull back the tube fitting nuts at either end of the column, taking care not to loosen the threaded junction between the column end piece and the column. Remove the column. Reinstall the clean, previously stored caps onto the ends of the column and tighten securely. Put a label (or recheck the label) on the column and the filter before storage.

3.4 PREPARATION FOR STORAGE

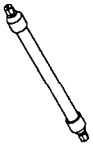
INFILTREX 300 must not be stored with water in its plumbing cavities as organisms may grow in the stagnant water and degrade the flow meter performance, often permanently. This abuse is not covered by warranty. The columns and filters should be removed, capped, and stored promptly after a sample has been taken. As soon as convenient, clean water should be pumped through the plumbing to flush out the remaining sample water. This should be followed by flushing with a 10% solution of methyl alcohol to sterilize the system before being pumped dry. The *INFILTREX 300* plumbing should be pumped as dry as possible before long term storage. If there is a chance of *INFILTREX 300* being stored below freezing, it should have a final rinse with pure methanol before being pumped dry so that any remaining liquid will not freeze.

A 140 micron screen is located in a small stainless steel housing on the inlet pipe of the *INFILTREX 300* to prevent particles from reaching the pump and flow meter. This filter

should be removed and the screen carefully back-flushed, or replaced regularly, to keep it clean. Beware of allowing matter to enter the inlet pipe while this screen filter is off. There is no screen on the outlet and, although it is far more difficult for particles to enter there, it should be similarly respected.

4.0 COLUMNS

4.1 GENERAL



The column design is optimised for use with the *INFILTREX* line of samplers. There are several sizes and types of SPE columns available (50g, 75g, and 250g). The ends of the column each have a screw on end piece, fitted with an internal screen to retain the column contents. The end pieces are in turn threaded to connect to the tube fittings on the *INFILTREX* assembly. When not in use, this thread is covered by a standard screw-on cap fitting to protect the integrity of the contents.

Bulk resins are available from AXYS Environmental Systems, to allow users to repack their own columns or to do laboratory experiments. These resins are cleaned, sorted and are of the same high quality as found in the pre-packed *INFILTREX* columns.

XAD-2 resin may be cleaned and re-used until the blank levels become unacceptably high.

The column may be disassembled for repacking by unscrewing the column end pieces from the column tube, and emptying out the resin. Each end piece has a press fitted screen to retain the resin. Removal of this screen from the end pieces should not be attempted. If the screen is damaged, the column must be returned to AXYS Environmental Systems for refurbishment.

4.2 DEFINITIONS

The parameters used to describe column performance are the Retention Efficiency, the Recovery Efficiency and the Column Efficiency.

The Retention Efficiency of a column is a measure of the ability of the column to extract a trace pollutant from water. It is determined by passing a known amount of the pollutant through a column and determining the amount retained by analysis of the input and output.

$$\text{Retention Efficiency} = \frac{(\text{Input - Output})}{\text{Input}}$$

The Recovery Efficiency is a measure of the effectiveness of the elution process used to recover a trace pollutant from the column. It is determined by eluting the retained pollutant from the column and analyzing the eluate.

$$\text{Recovery Efficiency} = \frac{(\text{Amount Recovered})}{(\text{Amount on Column Prior to Elution})}$$

The Column Efficiency is a measure of the overall performance of the column in both extracting a pollutant effectively from water and permitting effective elution from the column with solvent. Column efficiency is determined by obtaining the product of the retention efficiency and the recovery efficiency.

$$\text{Column Efficiency} = (\text{Retention Efficiency}) \times (\text{Recovery Efficiency})$$

The column efficiencies of some elements and compounds, as determined through experimental procedures, are given in the following sections.

4.3 TRACE ORGANICS RESIN XAD-2 COLUMN

(Part Number INAS0407, INAS0500, SSLV-250_1)

4.3.1 General

The Trace Organics Resin I (XAD-2™) column is designed for the extraction of non-polar and moderately polar organic compounds from seawater or fresh water. The column is filled with 50 to 250 g of Amberlite XAD-2 macroreticular resin packed in methanol. This is a cross linked polymer of styrene and divinylbenzene synthesised with control of pore size, pore size distribution and surface area. The first 200 to 1000 mL or so of water that passes through the column will flush out the methanol and hence the trace organics in this (very small) initial volume of water may not be fully extracted. This aspect should be considered when the water volume passed through the column is small. The column material is Teflon or Stainless Steel. The end screen is 297 micron size.

NOTE: XAD-2 is a trademark of the Rohm and Haas Co.

4.3.2 Trace Organics Resin I (XAD-2) Column Efficiency

A series of experiments determined the efficiencies of the Infiltrex Trace Organics Resin I (XAD-2) Column for extracting a selected group of PAHs, PCBs, pesticides and crude oil from filtered distilled and seawater. The results are summarized in Tables 1 to 4.

Calculated recovery efficiencies may exceed 100% when the blank levels and sample concentrations approach the lower limits of detection. Under those conditions experimental errors can be relatively large. Notice that in every case in which the column efficiency appears to exceed 100%, the experimentally determined value is within a standard deviation of 100%. Users are advised to determine the blank levels of each column for the compounds of interest before using the column to concentrate real samples.

Table 1.
PAHs in Distilled Water Experiments:
Retention, Recovery and Trace Organics Resin I (XAD-2) Column Efficiency

	Column		
Compound	Retention (%)	Recovery (%)	Efficiency (%)
Fluorene	100 ± 1	85.5 ± 4.6	85.5 ± 4.6
Phenanthrene	100 ± 1	84.3 ± 4.1	84.3 ± 4.1
Anthracene	100 ± 1	84.4 ± 4.0	84.3 ± 4.0
Fluoranthene	99.8 ± 0.1	96.6 ± 5.3	96.4 ± 5.3
Pyrene	99.7 ± 0.1	96.0 ± 4.4	95.7 ± 4.4
Benz9a)anthracene	98.2 ± 0.5	95.4 ± 10.6	93.7 ± 10.4
Chrysene	93.9 ± 1.6	92.6 ± 8.4	86.9 ± 8.0
Benzo(e)pyrene	91.6 ± 1.0	84.6 ± 6.6	77.6 ± 6.1
Benzo(a)pyrene	87.5 ± 3.8	97.7 ± 14.0	85.5 ± 12.8

Table 2
PAHs in Filtered Sea Water Experiments:
Retention, Recovery and Trace Organics Resin I (XAD-2) Column Efficiency

	Column		
Compound	Retention (%)	Recovery (%)	Efficiency (%)
Fluorene	100 ± 1	93.8 ± 1.5	93.8 ± 1.5
Phenanthrene	100 ± 1	94.1 ± 0.9	94.1 ± 0.9
Anthracene	99.6 ± 0.1	97.4 ± 3.7	97.0 ± 3.7
Fluoranthene	99.9 ± 0.1	102 ± 6	102 ± 6
Pyrene	99.8 ± 0.1	102 ± 5	102 ± 5
Benz9a)anthracene	98.5 ± 0.1	114 ± 14	112 ± 13
Chrysene	94.7 ± 0.8	134 ± 38	127 ± 36
Benzo(e)pyrene	93.8 ± 1.2	110 ± 19	103 ± 18
Benzo(a)pyrene	91.4 ± 2.0	112 ± 20	102 ± 19

Table 3
PCBs and Pesticides in Distilled Water:
Retention, Recovery and Trace Organics Resin I (XAD-2) Column Efficiency

	Column		
Compound	Retention (%)	Recovery (%)	Efficiency (%)
PCB	90.5 ± 1.2	100.5 ± 13.1	91.0 ± 11.9
heptachlor	98.0 ± 0.1	70.7 ± 4.5	69.3 ± 4.4
aldrin	97.6 ± 0.1	77.2 ± 2.4	75.3 ± 2.3
o,p'-DDE	97.6 ± 0.2	85.0 ± 4.5	80.3 ± 4.4
p,p'-DDE	96.2 ± 0.6	96.1 ± 10.8	92.4 ± 10.4
lindane	100 ± 1	89.3 ± 11.9	89.3 ± 11.9
heptachlor epoxide	99.6 ± 0.7	83.0 ± 8.2	82.6 ± 8.2
trans chlordane	98.9 ± 0.1	78.7 ± 8.3	77.8 ± 8.2
endosulfan	100 ± 1	76.3 ± 7.2	76.3 ± 7.2
cis chlordane	98.0 ± 0.1	75.7 ± 3.9	74.2 ± 3.8
dieldrin	100 ± 1	81.8 ± 6.6	81.8 ± 6.6
DDD	100 ± 1	95.2 ± 13.7	95.2 ± 13.7
endrin	100 ± 1	82.2 ± 5.4	82.2 ± 5.4
DDT	95.5 ± 0.4	73.3 ± 5.0	70.0 ± 4.8
methoxychlor	100 ± 1	90.8 ± 9.8	90.8 ± 9.8

Table 4
PCBs and Pesticides in Filtered Sea Water:
Retention, Recovery and Trace Organics Resin I (XAD-2) Column Efficiency

	Column		
Compound	Retention (%)	Recovery (%)	Efficiency (%)
PCB	85.8 ± 0.2	71.9 ± 2.1	61.7 ± 1.8
heptachlor	98.9 ± 0.2	107 ± 19	106 ± 19
aldrin	98.0 ± 0.1	91.0 ± 9.4	89.2 ± 9.2
o,p'-DDE	-	-	-
p,p'-DDE	93.9 ± 0.2	89.8 ± 2.6	84.3 ± 2.4
lindane	100 ± 1	102 ± 20	102 ± 20
heptachlor epoxide	100 ± 1	100 ± 5	100 ± 5
trans chlordane	98.1 ± 0.2	101 ± 6	99.3 ± 5.9
endosulfan	100 ± 1	78.9 ± 9.9	78.9 ± 9.9
cis chlordane	98.5 ± 0.1	95.3 ± 4.1	93.9 ± 4.0
dieldrin	100 ± 1	100 ± 6	100 ± 6
DDD	100 ± 1	113 ± 7	113 ± 7
endrin	100 ± 1	100 ± 7	100 ± 7
DDT	95.5 ± 0.6	80.3 ± 11.8	76.7 ± 11.3
methoxychlor	100 ± 1	108 ± 12	108 ± 12

4.4 ELUTION OF TRACE ORGANICS RESIN I (XAD-2) COLUMN

4.4.1 Procedure for the Elution of 50 g Columns

All elution solvents must be pesticide-grade or better to minimize contamination; all glassware and inorganic materials must be free of interfering organics.

Using an elution apparatus the column is first eluted with 200 mL of methanol to remove water. A second fraction is then collected by eluting with 200 mL dichloromethane. The dichloromethane fraction is concentrated by rotary evaporation until only the residual methanol (from the first elution step) remains.

The two fractions are then combined and their ionic strength is increased with 25 mL of a saturated NaCl solution that has been pre-extracted with hexane. The combined fractions are back-extracted into 3 x 100 mL pentane. The pentane extract is then dried over sodium sulphate and concentrated for analysis using standard analytical techniques.

An alternative procedure for eluting dioxins from XAD-2 resin with 15% acetone in hexane has been developed by the Carleton University group.

4.4.2 Procedure for the Elution of 75 and 250 g Columns

All elution solvents must be pesticide-grade or better to minimize contamination; all glassware and inorganic materials must be free of interfering organics.

The resin from the columns is removed and put into a soxhlet extraction apparatus.

4.5 TRACE ORGANICS RESIN I (XAD-2) COLUMN STORAGE

Remove the column and replace the end caps. The column can then be stored for up to three months prior to analysis with no special precautions. Columns should not be frozen, as freezing can break down the extraction material and cause alterations in the blank levels and the column performance.

If a filter has been used and is to be analyzed, it must be handled with solvent-cleaned metal tongs, wrapped in clean aluminum foil, and frozen until analyzed.

4.6 TRACE ORGANICS RESIN I (XAD-2) COLUMN REUSE

All solvents used in cleaning columns and resins should be the pesticide-grade or better.

After elution, the Trace Organics Resin I (XAD-2) Column can be re-used after a second rinse with 200 mL dichloromethane and a final rinse with 200 mL methanol. The columns should be left moist with methanol and not be allowed to dry out, since drying may cause the extraction material to crack. Columns can be cleaned and re-used until the blank

volume determined by the analysis of the rinse solvents becomes unacceptably high. The columns can then be repacked with fresh XAD-2 by the user if laboratory facilities to clean the packed columns are available. The columns may be cleaned on a modified Soxhlet apparatus (Figure 3) with fresh dichloromethane. Alternatively, the column can be returned to AXYS Environmental Systems for repacking or cleaning. Blank certification is available.

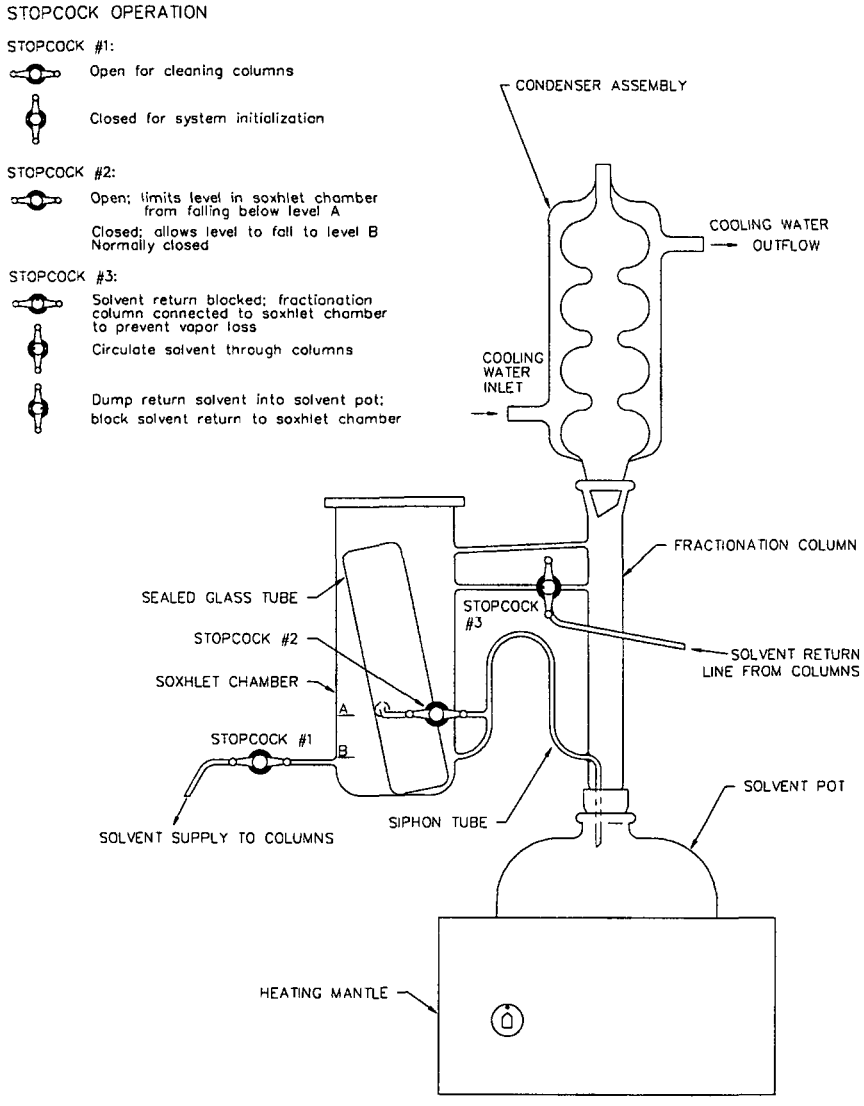


Figure 5. Soxhlet Apparatus for the Cleaning of XAD-2 Resin.

Appendix A

Warranty and Service

WARRANTY

LIMITED WARRANTY

AXYS TECHNOLOGIES INC ("AXYS") warrants that the Equipment shall conform to Specifications and shall remain free from defects in materials and workmanship for a period of twelve (12) months from the date of delivery (the "Warranty Period"); provided, however, that the Equipment is applied, installed, operated and used substantially in accordance with the Specifications.

AXYS shall, at AXYS' expense, replace or repair any Equipment within such warranty period, provided:
AXYS receives written notice of any non-conformance or defect within the Warranty Period;
after AXYS' authorisation, the Equipment is returned to AXYS' factory of origin or to an Authorised AXYS Distributor with all freight charges prepaid; and
AXYS determines the Equipment to have a non-conformance or defect covered under this warranty.
Any replacement Equipment shall be warranted for a further period that expires on the later occurrence of three (3) months from the date of shipment or the expiration of the original warranty period.

LIMITATION OF LIABILITY

AXYS does not grant any further representations or warranties on the Equipment than as expressly set forth above and expressly disclaims all other warranties, express or implied, including any warranties that the Equipment shall be merchantable, suitable or fit for any purpose other than expressly stated. Notwithstanding any other term of this Agreement, in no event shall AXYS be liable to the Customer, its officers, employees, agents or contractors for any lost or anticipated profits, for any incidental, consequential, exemplary or special damages whether or not AXYS was advised of such claim, or for damages and loss due to personal injury. In any event, AXYS' liability shall not exceed the purchase price of the Equipment.

WARRANTY OF AUTHORITY

AXYS represents and warrants that it has full and complete power and authority, corporate, legal and otherwise, to enter into and do all things required to be performed or done under this Agreement; that no litigation or other proceeding is pending or threatened against it, and that no order or judgement or ruling has been made which might adversely affect AXYS' right to enter into and do all things required to be done under this Agreement.

WARRANTY OF INFRINGEMENT AND INDEMNIFICATION

AXYS represents and warrants that it owns and/or has legal right to the hardware and software design, all applicable patents and other intellectual and proprietary property, including without limitation all patents, incorporated into, or to be used in connection with the Equipment. AXYS further represents, and warrants that the design, manufacture and sale of the Equipment, and the patents, patent applications and other rights used in connection with the Equipment, do not and will not infringe upon the patents, patent rights, copyrights, trade secrets or other property interests of third parties. All royalties or other charges for any patent, trademark or copyright to be used in connection with the Equipment and/or Services shall be considered as included in the purchase order price.

Notwithstanding any other provision contained in this Agreement, AXYS shall defend, indemnify and hold the Customer, its affiliates, directors, officers, agents, representatives and employees harmless against any and all suits, proceedings, actions, claims, demands, damages, losses, expenses or liabilities, in which it is claimed, asserted or alleged, whether or not rightfully, that the Equipment, Services, process, material or any part thereof, furnished by AXYS to the Customer, constitutes an infringement of patent, patent application, copyright, trade secret or other property interest of a third party, and AXYS shall pay all damages, expenses (including reasonable attorneys' fees) and costs awarded against or incurred by the Customer or any third party to which the Customer is responsible in connection therewith. In case the Equipment, process or material or any part thereof is held in such suit action or proceeding to constitute infringement and/or its use is enjoined or restricted, in addition to any other rights and remedies the Customer may have hereunder or at law or equity, AXYS shall, at its own expense, either procure for the Customer an irrevocable, royalty-free, fully paid up license to continue using the Equipment, process or material, or with the Customer's' prior written approval, replace the same with substantially equal but non-infringing Equipment or modify the Equipment so it becomes non-infringing, provided that no such replacement or modification shall in any way amend or relieve AXYS or its warranties and guarantees set forth in this Agreement.

The Customer shall give prompt notice to AXYS of any claim, suit or proceeding involving the Customer in which such infringement is alleged or asserted.

SERVICE

WARRANTY SERVICE

To obtain service under the warranty during the warranty period:

write, fax, e-mail or call AXYS Environmental Systems to describe precisely and completely the nature of the problem;

carry out any minor adjustments or service as instructed by AXYS technical personnel;

If proper operation is still not achieved, obtain an RMA (Return to Manufacturer Authorisation) number from AXYS and return the instrument, freight prepaid, to the factory or to an authorised Service Centre. The instrument will not be accepted by AXYS without an RMA. The instrument will be repaired and returned free of charge in accordance with the terms of the warranty.

NON-WARRANTY SERVICE

Proceed as for Warranty Service described above. If AXYS personnel can provide assistance by phone, letter, fax, or e-mail they will be pleased to do so at no charge.

As with Warranty Service, if the return of the instrument is necessary, an RMA number must be obtained from AXYS prior to shipping. The instrument must be returned to the Company freight prepaid. Once the instrument is received at the factory, a firm estimate of the repair cost will be provided.

MODEL UPGRADES

Enhancements to the product will be made from time to time. Whenever possible, earlier models of the product may be upgraded at a reasonable cost to provide the user with the new additional features and to extend the useful life of the product. All registered owners will be contacted when new design enhancements are implemented.

Appendix B

Trouble Shooting and Service

Trouble Shooting and Routine Service

1. No water pumped:
    a. Pump needs priming when dry to achieve more effective head suction.
        i. Use the bypass line to prime the pump head with "clean" water.
        ii. Fill the intake line with water to prime the pump, with a reduced overall head lift.
        iii. Increase the pump RPM to get more suction, once flow is established reduce to sample RPM.
    b. Head height too high.
        i. Need to reposition the sampling system closer to the water body to be sampled such that the overall height to draw the sample is less than 3m. If the pumping system cannot be relocated, then consider using an auxiliary submersible pumping system to fill a clean reservoir to draw from.
    c. Tubing resistance too high.
        i. Too long of tubing run. If this cannot be reduced, then consider using an auxiliary submersible pumping system to fill a clean reservoir to draw from.
        ii. Diameter of tubing too small of diameter.
    d. In line filter plugged.
        i. Disassemble the inline filter and clean out the SS strainer.
        ii. Check for foreign objects plugging the tubing inlet.
    e. Cartridge filter elements plugged.
        i. Change the filter element.
    f. Pump gears are worn or damaged. For normal operations when using the inline filter, the operator will be aware that the system will need to have progressively faster RPM's to maintain set flow rates. The gears can become damaged at any point if precautions are not followed with inline prefilters installed. The MicroPump Service Kit S/K G132/G152, MicroPump PN 83206 is required when doing any work on the pump head. Follow the service kit instructions for replacement of any pump components.
        i. Gear replacement can be done by simply removing the three screws securing the top of the pump head. The gears are just pulled out and replaced the same way. Replace the Teflon gasket.
        ii. Inspect the top and bottom SS surfaces for any excessive wear.
        iii. Once the replacement gears are installed check for any excessive free play on the shafts. If this is discovered, then the bushings need to be replaced. This will likely involve some disassembly of the pump head from the motor and is not easily done in the field.

2. Rate Meter Totalizer Display:
    a. Flow rate/Totalizer readings are incorrect.
        i. The rate meter has been programmed with incorrect coefficients. Set the Rate Meter/Totalizer to program mode. Check the coefficients provided with the system as delivered. Refer to the McMillian Model 220 Operating Manual for setup procedures. There is a software program provided to calculate the coefficient settings.
        ii. A new flow meter has been installed without the new coefficients being programmed. Refer to step 2-a-i.
        iii. The flow meter is defective. Replace the unit with a McMillian 101-8T.
        iv. Check that signal and power cables are all connected to the flow meter in the pump box and power supply. Same goes for the external Rate Meter/Totalizer.

v. The flow meter is not getting 12VDC power. With a volt meter check the power supply for 12 VDC when the system is powered. CAUTION should be observed when using probes on the power supply as 110 VAC is exposed in this area.
vi. If there is no display on the Rate Meter/Totalizer then the lithium battery in this unit must be replaced.

b. Want different Rate Meter Totalizer Display Units .
   i. Following the instructions as directed by the McMillan Model 220 Digital Rate Meter and Totalizer Operating Manual, the operator can reprogram these default display values to other units and time bases. To accomplish this the operator needs to activate the Rate Meter programming switch located in the pump enclosure. Once the Rate Meter is in "program mode", other coefficients and configuration setting can be set to change the display output.
   ii. If a new flow meter has been installed, then the new calibrated flow meter coefficients need to be programmed into the rate meter. Use the software provided from McMillan to calculate the coefficients and unit/rate display output.

Appendix E

APPENDIX E

YSI 650/600XLM MULTI PROBE SOP

MULTI PROBE YSI 650/600XLM PROCEDURES

The purpose of this standard operating procedure (SOP) is to describe the procedures for the measurement of general water quality parameters using a Multi Probe YSI 600XLM attached to an YSI 650 Multiparameter Display System (MDS) handheld unit. This multi-parameter system will be used to simultaneously measure dissolved oxygen, conductivity, temperature, depth, pH, and oxidation-reduction potential while in the field.

This SOP should be used in conjunction with the operating manual supplied by the manufacturer, *YSI 6-Series Environmental Monitoring Systems Operations Manual* (YSI Environmental, Yellow Springs, Ohio). A goal of this SOP is to ensure that the highest quality, most representative data be collected, and that these data are comparable to data collected by different programs that follow these same guidelines.

SUMMARY OF METHOD

The YSI 600XLM multi probe, or sonde, is used for measuring conventional water parameters in the field. A sonde is a torpedo-shaped water quality monitoring device that is placed in the water to gather water quality data. The 600XLM sonde has multiple probes. Each probe has sensors that read water quality data. The 600XLM sonde is attached to a YSI 650 Multiparameter Display System (650 MDS), handheld, microcomputer-based instrument that allows the user to display sonde readings, configure sondes, store and recall data, upload data from sondes and transfer data to computers for analysis and plotting.

After surface water samples are collected at each sampling station, the 600XLM sonde will be used for measuring parameters such as temperature, pH, dissolved oxygen, conductivity, oxidation-reduction potential, and depth. These measurements are then recorded in the same order as described in the water sample log sheet (Appendix F).

Once measurements are made *in situ,* the probe is rinsed with deionized water and replaced into the transport/calibration cup with 1/8 of the volume filled with deionized water.

Calibration checks will be performed, at a minimum, twice daily. The unit will be checked for calibration before each daily sampling begins and then again at the end of the sampling event or after every 10 stations are measured.

Note that a sample in this case corresponds to a sampling station. In the case of a river transect, the probe will be attached near the sampling tube inlet and measurements will be recorded continuously. The data will then be transferred to a computer, and an average reading for each parameter will then be calculated for that

transect. In addition, a reading will be taken from an aliquot of the final composite transect sample.

If necessary, the multi probe can be calibrated in the field using the procedures provided in the Operations Manual.

PROBE MODULE EQUIPMENT

The YSI 600XLM sonde is a rugged handheld unit with the sensors enclosed in a heavy-duty probe sensor guard with attached sinking weight. A 61-meter cable is directly connected to the probe module body making the entire unit waterproof. The following equipment is needed in the field to operate the unit:

- Instrument with barometer option
- 61-m cable and DO/temp/conductivity/pH/ORP probe
- Rechargeable battery pack kit (includes battery, adapter, charger)
- Charger, cigarette lighter (optional)
- Large carrying case, soft-sided (comes with 650 standard)
- Transport/calibration cup
- Probe sensor guard.

PROCEDURES

INSTRUMENT/CABLE CONNECTION

Line up the pins and guides on the cable with the holes and indentations on the cable connector at the bottom of the YSI 650 instrument. The other end of the cable is a military-style 8-pin connector (MS-8). Attach the cable to the instruments as follows:

1. To attach a field cable to the sonde connector, remove the waterproof cap from the sonde connector and set it aside for later reassembly during deployment or storage.
2. Connect the field cable to the sonde connector. Refer to Figure 38 in Section 2.3.4 of the *YSI 6-Series Environmental Monitoring Systems Operations Manual* (YSI Environmental, Yellow Springs, Ohio).
3. A built-in "key" will ensure proper pin alignment. Rotate the cable gently until the "key" engages and then tighten the connectors together by rotating clockwise.

4. Attach the strain relief connector to the sonde bail.
5. Rotate the strain relief connector nut to close the connector's opening.

EQUIPMENT PRE-TESTING

The following steps describe how each probe is checked everyday prior to sampling.

pH Measurements

To test the pH probe, two buffers of pH 4 and pH 7 are used. Different buffers may be used if the general pH range of the water to be sampled is higher. The pH probe will remain in pH 7 buffer solution between measurements. Prior to taking pH measurements, the pH probe is rinsed with deionized water and excess water gently shaken off before insertion into a buffer solution. Once measurement is made, the probe is again rinsed with deionized water and replaced into the container with deionized water. The pH probe is ready for field measurements.

Conductivity Measurements

To test the conductivity probe, a standard conductivity solution is used that is in the general range of conductivities expected from the water to be sampled. Temperature compensation is corrected using the appropriate scale for the temperature and conductivity of the calibration solution. The conductivity meter is adjusted until the conductivity reading agrees with the value of the standard solution. The probe is removed from the standard solution and rinsed with deionized water. The conductivity probe is ready for field measurements.

Dissolved Oxygen (DO) Measurements

The oxygen electrode is measured as % saturation inside a probe-specific measuring cup containing 1/8 inch of water. The probe is ready for measurements after saturation reading.

Temperature Measurements

Temperature is measured using a temperature probe attached to the multiprobe system. An additional certified glass thermometer filled with environmentally safe red liquid and protected with an armor casing is used to confirm accuracy of meter used. After temperature measurement with the probe is compared to reading of glass thermometer, the probe is ready for field measurements.

OPERATION OF THE MULTI PROBE

The unit is removed from its case and attached to the 61-meter cable by inserting the cable connector into the instrument as described above. Care should be taken when handling the probe at the other end of the cable.

Daily Check Procedures

1. Press the **On/off** key OR select Run from the main menu to display the run screen.
2. Make sure the probe transport/calibration cup is installed.
3. Add the appropriate standard solution, as described above, to the transport/calibration cup and gently hold the probe module in the solution. Be sure to completely immerse all the sensors.
4. Watch the readings on the display until they are stable.
5. Press the **Escape** key to display the main menu screen.
6. Use the arrow keys to highlight the **Sensor** selection.
7. Press the **Enter** key to display the sensors-enabled screen. A black dot to the left of a sensor indicates that sensor is enabled. Sensors with an empty circle are disabled.
8. Use the arrow keys to highlight the sensor to be changed, then press the **Enter** key to enable or disable it.
9. Repeat step 6 for each sensor to be changed.
10. Press the **Escape** key to return to the main menu screen.
11. Use the arrow keys to highlight the **Report** selection.
12. Press the **Enter** key to display the report setup screen.

    NOTE: A black dot to the left of a parameter indicates that parameter is selected for display. Parameters with an empty circle will not be displayed. It may be necessary to scroll down past the bottom of the screen to see all the parameters.

13. Use the arrow keys to highlight the parameter to be changed, then press the **Enter** key. If a parameter cannot be found, even after scrolling down past the bottom of the screen, the sensor used for that parameter is disabled.
14. If temperature, specific conductivity, conductivity, resistance, or total dissolved solids are selected, the Units screen will appear.
15. Use the arrow keys to select the units desired, then press the **Enter** key to return to the report setup screen.

16. If salinity, dissolved oxygen %, dissolved oxygen mg/L, pH, pH mv, or ORP mv are selected, the selection dot will simply toggle on or off.
17. Repeat steps 14 and 15 for each parameter needed to be changed.

    NOTE: All parameters may be enabled at the same time.
18. Press the **Escape** key to return to the Main menu screen.
19. Watch the readings on the display until they are stable.
20. Read the value for each parameter being measured and check against values of standard solution. Record all measurements in field log book.
21. Once all measurements are read, remove probe from last solution and rinse with deionized water.
22. Gently remove the probe guard and replace it with the transport/calibration cup.
23. Turn off instrument. Blot it dry with a paper towel, unscrew cable from unit, and place it back on its case.

    NOTE: If the YSI 650 unit displays high drift when measuring standard solutions, it may be required to re-calibrate the probe. See the *YSI 6-Series Environmental Monitoring Systems Operations Manual* for instructions on calibration procedures (YSI Environmental, Yellow Springs, Ohio).

Real-Time Data

Once all samples are collected, the measurement of general water quality parameters will be taken using the YSI 600XLM sonde unit.

Before measuring samples, the probe module must be prepared by removing the transport/calibration cup.

1. Press the **On/off** key OR select Run from the main menu to display the run screen.
2. Make sure the probe sensor guard is installed.
3. Place the probe module in the sample (e.g., river water). Be sure to completely immerse all the sensors.
4. Rapidly move the probe module through the sample to provide fresh sample to the DO sensor.
5. Watch the readings on the display until they are stable.
6. Read values top to bottom and from first column to second column to a dedicated recordkeeping person.

7. Once all measurements are read, remove probe from water and rinse with deionized water.
8. Gently remove the probe guard and replace it with the transport/calibration cup.
9. Turn off instrument. Blot it dry with a paper towel, unscrew cable from unit, and place it back on its case.

Appendix F

APPENDIX F

FORMS

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM

Page ______ of ______ Turn Around Requested: ________

Report to:	Phone:
Company:	Fax:
Address:	Proj Name:
City:	Proj Number:
State:	Sampler:
Zipcode:	

Sample ID	Sample Date	Sample Time	Sample Matrix	No. Containers	Analyses Requested										Notes/Comments

Relinquished: (Signature)	Received by: (Signature)	Special Instructions/Notes
Printed name:	Printed name:	
Company:	Company:	Number of Coolers:
		Cooler Temp(s):
Date: Time:	Date: Time:	COC Seals Intact?
		Bottles Intact?

CORRECTIVE ACTION RECORD

Page ____ of ____ Audit Report No.: _____ Date: _____

Report Originator: _____ Person Responsible for Response: _____

DESCRIPTION OF PROBLEM:

Date and Time Problem Recognized: _____ By: _____

Date of Actual Occurrence: _____ By: _____

Analyte: _____ Analytical Method: _____

Cause of Problem:

CORRECTIVE ACTION PLANNED:

Person Responsible for Corrective Action: _____ Date of Corrective Action: _____

Corrective Action Plan Approval: _____ Date: _____

DESCRIPTION OF FOLLOW-UP ACTIVITIES:

Person Responsible for Follow-up Activities: _____ Date of Follow-up Activity: _____

Final Corrective Action Approval: _____ Date: _____

FIELD CHANGE REQUEST

Page ____ of ____ Field Change No.: _____ Project Number: _____

Project Name: _____

CHANGE REQUEST

Applicable
Reference: _____

Description of Change:

Reason for Change:

Impact on Present and Completed Work:

Requested by: _____ Date: _____
(Field Scientist)

Acknowledged by: _____ Date: _____
(Field Task Leader)

SAMPLING AND ANALYSES COORDINATOR RECOMMENDATION

Recommended Disposition:

Recommendation by: _____ Date: _____

CERCLA COORDINATOR APPROVAL

LWG Notification Requred: Yes / No

Final Disposition:

Approved/Disproved by: _____ Date: _____

EPA PROJECT MANAGER APPROVAL

Approved/Disproved by: _____ Date: _____

WATER SAMPLE LOG

Survey _____ Crew _____ Date _____

Station	Time	Sample #	Replicate	Sample Depth (m below surface)	Bottom depth (m)	Temp (C)	DO (mg/l)	pH	Conduc-tivity (µS/cm)	ORP (mV)	Comments/Observations

COMMERCIAL INVOICE FOR INTERNATIONAL SHIPPING

DATE OF EXPORTATION:	EXPORTER REFERENCE (i.e., order no., invoice no., etc.):
SHIPPER/EXPORTER (complete name and address):	CONSIGNEE (complete name and address:
Country of Export:	REASON FOR SHIPMENT:
Country of Manufacture:	
Country of Ultimate Destination:	
International Air Waybill No.:	

MARKS / Nos.	No. of PKGS	TYPE OF PACKAGING	FULL DESCRIPTION OF GOODS	Qty.	UNIT OF MEASURE	WEIGHT	UNIT VALUE	TOTAL VALUE
	TOTAL NO. OF PKGS.					TOTAL WEIGHT		TOTAL INVOICE VALUE

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.
DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT.

SIGNATURE OF SHIPPER/EXPORTER (Type name and title, and sign). DATE

_____ _____

LWG LOWER WILLAMETTE GROUP

Transmittal

To:	Chip Humphrey (1 copy) Eric Blischke (1 copy) US Environmental Protection Agency, Region 10 811 SW 6th Avenue, 3rd Floor Portland, OR 97204 Tara Martich (4 copies) US Environmental Protection Agency, Region 10 1200 Sixth Ave, M/S ECL-115 Seattle, WA 98104	**From:**	Keith Pine Integral Consulting, Inc. 7900 SE 28th Street, Suite 303 Mercer Island, WA 98040
		Date:	August 13, 2004
Re:	Portland Harbor RI/FS	**Copies to:**	

We are sending the following items:

Number of Copies	Description
Varies	Portland Harbor RI/FS Draft Round 2 Quality Assurance Project Plan Addendum 1: Surface Water Portland Harbor RI/FS Round 2A Field Sampling Plan Surface Water Sampling July 2004 Progress Report

These are transmitted:

☐ For your information ☐ For action specified below ☐ For review and comment ☐ For your use ☒ As requested

Comments: