



PORTLAND HARBOR RI/FS
**ROUND 3B SEDIMENT
DATA REPORT**

DRAFT

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This document is currently under review by US EPA and its federal, state, and tribal partners, and is subject to change in whole or in part.

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Prepared for
The Lower Willamette Group

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LIST OF ACRONYMS

ARI	Analytical Resources, Inc.
CAS	Columbia Analytical Services
CLP	Contract Laboratory Program
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
EQuIS	Environmental Quality Information System
FSP	field sampling plan
FSR	field sampling report
LWG	Lower Willamette Group
LWR	lower Willamette River
NOAA	National Oceanic and Atmospheric Administration
PAH	polycyclic aromatic hydrocarbon
PARCC	precision, accuracy, representativeness, completeness, comparability
PCB	polychlorinated biphenyl
PCDD/F	polychlorinated dibenzo-p-dioxin/furan
QA	quality assurance
QC	quality control
QAPP	quality assurance project plan
RI/FS	remedial investigation and feasibility study
RM	river mile
SCRA	site characterization and risk assessment
SDG	sample delivery group
SICT	Seepage Induced Consolidation Test
SOP	standard operating procedure
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbon

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1.0 INTRODUCTION

The remedial investigation and feasibility study (RI/FS) of the Portland Harbor Superfund Site (Site) includes several rounds of field sampling activities to investigate the nature and extent of contamination at the Site, to assess potential risk to human health and the environment, and to develop cleanup alternatives.

This Round 3B Sediment Data Report summarizes the results from the November 13, 2007 to January 17, 2008, sample collection effort. These Round 3B data supplement the Round 1, Round 2, and Round 3A sediment and bioassay data, and represent the final collection effort conducted as part of the RI and risk assessments for the Site.

The Round 3B sediment field sampling activities were intended to collect data to address the data gaps related to site characterization, ecological and human health risks, and the FS. Sampling efforts included surface sediment chemistry, subsurface sediment chemistry, subsurface sediment physical data, and surface sediment bioassays. The geotechnical sampling activities performed during Round 3B were intended to determine the properties of the sediments for use in future dredging and capping projects. Sampling locations were selected within river mile (RM) 2 to RM 11 (i.e., the study area) of the lower Willamette River (LWR), as well as the upstream reach to RM 12.2. Additional sampling occurred in the upriver area (RM 15.3 to RM 26) between Ross Island and Willamette Falls, and within the Multnomah Channel. A detailed description of the Round 3B sediment sampling is included in the Round 3B Comprehensive Sediment and Bioassay Testing Field Sampling Report (FSR; Integral 2008).

This data report presents the chemical results from the Round 3B surface and subsurface sediment sampling; results from the associated bioassay testing have been summarized separately in the Round 3B Bioassay Testing Data Report (Windward 2008). Associated geotechnical analyses results are provided in Appendix G.

Except where noted, all Round 3B surface and subsurface sediment field activities, including vessel positioning, sample collection, sample handling and processing, and data management, followed guidelines specified in the Round 3B Field Sampling Plan for Comprehensive Sediment and Bioassay Sampling (Round 3B Sediment FSP; Integral 2007a), the Round 2 Quality Assurance Project Plan (QAPP; Integral and Windward 2004) and QAPP Addendum 10 (Integral 2007b), the Round 2 Health and Safety Plan (Integral 2004), and the Round 3B Sediment Sampling and Benthic Toxicity Testing Health and Safety Plan (Windward 2007).

1.1 ROUND 3B SAMPLING OBJECTIVES

The RI/FS objectives that the Round 3B sediment sampling efforts support include:

- Collect synoptic sediment chemistry and toxicity data to fill data gaps required to complete characterization of risks to the benthic community
- Collect surface sediment chemistry data from the upriver reach of the LWR to support the determination of final background sediment concentrations
- Collect surface sediment chemistry data from Multnomah Channel to evaluate the potential for contaminant migration from the Study Area to Multnomah Channel
- Refine the lateral and vertical extent of sediment contamination by filling data gaps within the Study to complete the RI and to support the FS
- Collect subsurface sediment chemistry data within the Study Area to complete characterization of subsurface sediment in areas where subsurface sediments posing potentially unacceptable risk may be exposed by future extreme high-flow flood events.

1.2 REPORT ORGANIZATION

The remaining sections of this document include a summary of the data collection activities (Section 2); details on the laboratory sample analyses, data quality reviews, and data management (Section 3); the chemical results (Section 4); and references (Section 5).

Supporting information is provided in the following seven appendices:

- **Appendix A:** EPA – LWG Communications
- **Appendix B:** Grab Description Forms
- **Appendix C:** Core Description Forms
- **Appendix D:** Data Quality Summary
- **Appendix E:** Data Validation Reports (Found on Accompanying CD)
- **Appendix F:** Summation Rules and SCRA Database, Excel Flat File Format (Found on Accompanying CD)
- **Appendix G:** Geotechnical Data Summary.

2.0 DATA COLLECTION ACTIVITIES

Surface and subsurface sediment samples were collected during Round 3B from November 13 to January 17, 2008, in three separate reaches within the Willamette River: 1) from RM 2 to RM 11 (study area) as well as the upstream reach to RM 12.2; 2) the upper reach of the Multnomah Channel (Figure 2-1a-1); and 3) upriver from RM 15.3 to RM 26 (Figure 2-2a-d). Surface sediment grabs were collected at 188 locations and subsurface cores were collected at 88 locations within these reaches.

All locations sampled during Round 3B are shown on Figures 2-1a-1 and 2-2a-d. Tables 2-1 and 2-2 summarize the analyses performed for the surface sediment grab samples and subsurface sediment core samples, respectively.

Round 3B sample collection and processing procedures followed guidelines specified in the Round 3B Sediment FSP (Integral 2007a), the Round 2 QAPP (Integral and Windward 2004), and QAPP Addendum 10 (Integral 2007b). Deviations from the FSP and QAPP are discussed in the FSR (Integral 2008) and summarized in Section 3.5 in this data report.

3.0 LABORATORY ANALYSES AND DATA MANAGEMENT

This section describes the laboratory methods used to analyze the sediment samples. Any deviations from the analytical methods detailed in the QAPP are described below. The data management subsection describes the data validation process from receipt of the laboratory data package to the generation of a final validated electronic data deliverable (EDD). Furthermore, it describes how the site characterization and risk assessment (SCRA) database was compiled into a series of compatible Excel tables, which were then distributed to the SCRA data users. A summary of Round 3B sediment data quality is provided in Appendix D, and the data validation reports are provided in Appendix E.

3.1 PHYSICAL AND CHEMICAL ANALYSES

Three laboratories conducted the chemical analyses of all sediment samples. Columbia Analytical Services (CAS; Kelso, WA) analyzed for conventional parameters (grain size, total solids, total organic carbon, ammonia, total sulfide and specific gravity), metals, semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), pesticides, and polychlorinated biphenyl (PCB) Aroclors. CAS (Houston, TX) completed all analyses for polychlorinated dibenzo-p-dioxin/furans (PCDD/Fs). Vista Analytical Laboratory in El Dorado Hills, CA, conducted the PCB congener analysis. Two additional laboratories conducted all geotechnical and physical testing. All geotechnical analyses except Seepage Induced Consolidation Test (SICT) were performed by Analytical Resources, Inc (ARI) in Seattle, WA. The SICT analyses were performed at the University of Colorado. Analytical methods followed those described in the Round 2 QAPP and QAPP Addendum 10; deviations from the QAPP were detailed in the Round 3B FSR and are summarized in Section 3.5 below.

The analytical methods used for the sediment samples are compiled in Table 3-1. The Round 3B sediment samples were analyzed for conventional parameters (grain size, total solids, total organic carbon, and specific gravity), metals, SVOCs, TPH, pesticides, and PCB Aroclors at all stations. Samples from selected locations were analyzed for additional parameters (i.e., alkylated polycyclic aromatic hydrocarbons [PAHs], PCB congeners or PCDD/Fs) in accordance with the Round 3B Sediment FSP (Integral 2007a). Surface samples collected from the bioassay stations were also analyzed for ammonia and sulfide. Samples from the geotechnical cores were analyzed for geotechnical index properties (Atterberg limits, grain size, specific gravity, and Vane Shear test) and SICT. The analyses are summarized by location in Tables 2-1 (surface sediments) and 2-2 (subsurface sediments).

3.2 DATA VALIDATION

As required by the Round 2 QAPP (Integral and Windward 2004), approximately 10% of the sediment data were fully validated, and the remaining data were subjected to Level 3 data validation, which includes the evaluation and assessment of the sample results and

applicable quality control results reported by the laboratory. The data validation subcontractor for the Round 3B sediment data was EcoChem, Inc., located in Seattle, WA.

The inorganic, organic, PCB congener and PCDD/F data were validated in accordance with guidance specified by the *USEPA Contract Laboratory Program [CLP] National Functional Guidelines for Inorganic and Organic Data Review* (EPA 1999a, 2002a), U.S. Environmental Protection Agency (EPA) Region 10 standard operating procedures (SOPs) for validation of PCB congener and PCDD/F data (EPA 1995, 1996), and *Guidance on Environmental Data Verification and Validation* (EPA 2002b). Modifications were made to the Functional Guidelines to accommodate quality assurance/quality control (QA/QC) requirements of the non-CLP methods that were used for this project. Data qualifiers were assigned during data validation if applicable control limits were not met, in accordance with the EPA data validation guidelines and the QC requirements included in the referenced methods. The data validation qualifiers and definitions are summarized in Table 3-2.

The following laboratory deliverables were reviewed during Level 3 and full data validation:

- The case narrative discussing analytical problems (if any) and procedures
- Chain-of-custody documentation and laboratory sample receipt logs
- Instrument calibration results
- Method blank results
- Results for laboratory quality control samples required by the referenced method, including laboratory control sample/laboratory control sample duplicate analyses, matrix spike/matrix spike duplicate analyses, surrogate recoveries, and other method specific quality control samples (e.g., serial dilutions for inductively coupled plasma analyses)
- Results for field quality control samples (i.e., equipment blanks, field duplicates, and field split samples)
- Analytical results for the sediment samples.

For data packages subjected to full validation, in addition to review and assessment of the documentation identified above, the validation included verification of reported concentrations for the field and QC samples, verification of intermediate transcriptions, and review of instrument data such as mass spectra to verify analyte identification procedures.

After completing the data validation activities for each sediment sample type, a data quality report and a tabular summary of qualified data were generated by EcoChem. The EcoChem data quality reports are included in Appendix E. EcoChem chemists added

data validation qualifiers that were assigned during validation to the laboratory report forms and to the laboratory EDDs. The revised EDDs and the hard-copy data validation reports were submitted as the project deliverable. The revised EDDs were then incorporated into the project database, as described in Section 3.6.

Two parent PAHs needed for the alkylated PAH analyses were omitted from the QAPP in error and were originally not reported by CAS. CAS includes these compounds in their calibration mixtures for alkylated PAHs and was able to reprocess the data files and provide results for these compounds. The data were reported in a separate data package containing results for only these two PAHs. In order to expedite the validation of these additional data, the validation was performed by Integral rather than EcoChem. EDDs of validated data were generated by Integral's validation chemist as described above for EcoChem. The Integral data quality report is included in Appendix E.

3.3 DATA QUALITY AND USABILITY

Data generated in the field and at the laboratories were verified and validated according to the criteria and procedures described in the Round 2 QAPP. Data quality and usability were evaluated based on the results of the data validation and the data quality objectives for the Round 2 data. The performance criteria in the QAPP included project analytical goals for precision, accuracy, representativeness, completeness, and comparability (PARCC) of the Round 2 data.

The precision, accuracy, representativeness, and comparability of the data were assessed during data validation, as described in the Round 2 QAPP. Completeness is calculated by comparing the total number of acceptable data (non-rejected data) to the total number of data points generated. Completeness for the Round 3B sediment sampling effort was greater than 99% overall, which exceeds the QAPP completeness objective of 95%. Completeness for the Round 3A data is summarized by parameter group in Table 3-3. Completeness ranged from 98 to 100% for the various parameter groups.

The data validation reports provide detailed information on the QA/QC results and data validation qualifiers for each parameter group, for each laboratory data package. Qualified chemistry data for Round 3B sediment samples are included in Tables 4-1 to 4-2. A complete list of qualified results with reason codes is provided in the data validation reports in Appendix E.

3.4 FIELD QUALITY CONTROL/QUALITY ASSURANCE

The types of QC samples that were collected during the Round 3B sediment sampling program are described below. The numbers of QC samples collected per analysis are summarized in Table 3-4.

3.4.1 Field Replicates

Field replicate samples were collected at 12 surface stations and 14 subsurface stations (a total of 26 replicate samples were analyzed, approximately 6% of all Round 3B sediment samples collected). The field replicates are indicated by the “-2” in the station ID extension, as shown in Tables 2-1 and 2-2. Replicates are samples from a second grab or core collected at a station to allow assessment of within-station variability. These samples were assigned unique identification numbers (see Tables 2-1 and 2-2) and were not identified as replicates to the laboratory. The total number of field replicate samples collected per analysis is listed in Table 3-4.

3.4.2 Field Splits

Field split samples were collected at selected stations where field replicates were also collected and are indicated by the “-3” station ID extension in Tables 2-1 and 2-2. Split samples were collected at five surface stations and nine subsurface stations (a total of 14 split samples were analyzed or approximately 3% of all Round 3B sediment samples collected). Split samples are multiple samples taken from a single sample composite after it is fully homogenized. The resulting data provide information on the variability associated with sample handling and laboratory analysis operations. These samples were also assigned unique identification numbers (see Tables 2-1 and 2-2) and were not identified as splits to the laboratory. The total number of field split samples collected per analysis is listed in Table 3-4.

3.4.3 Field Rinsate Blanks

Introduction of chemical contaminants during sampling and analytical activities was assessed by the analysis of blanks. Rinsate blanks, consisting of sampling equipment rinsates, were generated for all chemical parameter groups at a frequency of at least 5% of the sediment samples submitted for analysis to the laboratory. The total number of rinsate blanks collected per analysis is listed in Table 3-4.

3.4.4 Summary of Qualified Data

Selected data not meeting the data quality criteria were qualified as undetected, estimated, tentatively identified, or rejected during validation, in accordance with the Round 2 QAPP. A tabular summary of the results, with the data qualifiers, is included in Tables 4-1 and 4-2. Data qualified as undetected are usable for all intended purposes. Data qualified as estimated or tentatively identified are usable for all intended purposes, with the knowledge that these data may be less precise or less accurate than unqualified data. Rejected data are not usable for any purpose. Concentrations associated with rejected data have been removed from the database, and an “R” qualifier is retained to flag the results that were removed.

3.5 LABORATORY DEVIATIONS FROM ROUND 2 QAPP

Round 3B sediment samples were analyzed according to methods described in the Round 2 QAPP (Integral and Windward 2004) and Round 2 QAPP Addendum 10 (Integral 2007b) with the following exceptions:

- Laboratory analyses were conducted on the archived sediment for the following subsurface samples: MC002D, MC006D, MC008D, C602D, C604D, C613E, C614D, C636D and C658D. These are the lowest intervals within their respective cores, and were initially archived during sample processing. All chemical analyses were performed for these samples in accordance with the Round 3B Sediment FSP, except for grain size. Grain size could not be performed for these samples because no unfrozen sediment material was available for analysis.
- Sample LW3-G788 was initially collected on November 15, 2007, for analysis of metals, conventionals, pesticides, PCB Aroclors, SVOCs, and TPH. A second sample was collected from the same location on November 29, 2007, for analysis of dioxins and PCB congeners. The second grab sample has been labeled in the data set as LW3-G788-R to indicate this was a separate grab collection at same station.
- Sample LW3-G641 was initially collected November 27, 2007. A second sample from the same station was accidentally collected on December 3, 2007. By the time the field error was identified, chemistry analyses for both samples had already been initiated at the laboratory so the samples were renamed and treated as field replicates. The first sample collected November 27, 2007 is identified as LW3-G641-1. A second sample collected December 3, 2007 is identified as LW3-G641-2.
- Thirteen samples were analyzed for PCB Aroclors one day beyond the 40-day holding time for sample extracts specified in the project QAPP. All results for these analyses were qualified as estimated (J/UJ) during validation. Any effect of this holding time exceedance on data quality is expected to be minimal.
- Thirty-three samples were analyzed for sulfide beyond the 7-day holding time specified in the QAPP because of a misunderstanding at the laboratory: the CAS standard operating procedure (SOP) for the analysis of sulfide in sediment by EPA method 9030M allows a 14-day holding time, based on a similar EPA holding time for acid volatile sulfide in sediments. All sulfide analyses were performed within the 14-day holding time per the CAS SOP. All sulfide results for these samples were qualified as estimated (J/UJ) during validation because the holding time in the QAPP was exceeded. However, the data quality was not compromised by the use of the longer holding time.

The selected data qualified, as noted above, are fully usable for all data uses summarized in the Round 3B Sediment FSP.

3.6 DATA MANAGEMENT

Once the laboratories completed their internal QA/QC checks, they exported the analytical data (sample, test, batch, and result information) into comma-delimited text files with data columns arranged in an order that was recognized by the project's Environmental Quality Information System (EQuIS) database. These EDDs were e-mailed to Integral where they were checked for proper EQuIS structure and appended with specific information that was unknown by the labs, such as sampling location, composite information, and field replicate and split information. Any inconsistencies found in the structure of the EDDs were brought to the attention of the laboratory, which then corrected the problem and resubmitted the EDD. Each e-mailed EDD transmission with the original, unaltered EDD attachment was archived to document and track the laboratory's delivery of electronic data to Integral.

Corrected and complete EDDs were checked electronically by uploading them into the temporary section of Integral's Lower Willamette Group (LWG) project database. In the process of loading, EQuIS checked the EDDs for correct lookup codes (such as for analytes, test methods, and sample matrices); proper relationships for results, tests, batches, and samples (to ensure all results matched with a test, tests with samples, and sample/test pairs with batches); and that all derived samples (such as replicates, splits, and matrix spikes) had corresponding parent samples.

Additionally, EQuIS checks information such as date and time formats, and text field lengths to ensure consistency throughout the database. EQuIS prevents any EDD with code or format errors from successfully uploading until the error is corrected. EDDs with errors generated by the laboratory were returned to the laboratory, which then corrected the problem and resubmitted the EDD. Excel-related errors (i.e., the manner in which Excel automatically formats date and time fields) were corrected and steps were taken to mitigate future occurrences (e.g., changing default settings in the software). Original copies of the EDDs that were successfully uploaded were saved for purposes of documenting and tracking the data that were loaded into Integral's LWG project database.

Each verified and accurate EDD was provided to the data validation contractor (EcoChem, Seattle, WA) for data review and validation. These EDDs were also stored in a temporary section of the project database, where they could be queried and examined, if desired, until validation was complete. As EcoChem completed validation of the data by sample delivery group (SDG) or small groups of SDGs, the validator qualifiers and reason codes were applied to the data in the temporary section of the database. The validated data were then merged into the permanent project database. During the merging process, all previously performed electronic checks were repeated to ensure nothing was incorrectly modified with the application of the validation results.

Several queries were set up in the permanent project database to translate the data structure to a form compatible with the National Oceanic and Atmospheric Administration's (NOAA's) Query Manager. The data translation included creating

station and sample identifiers, converting the sample type code, and changing the date format. The translated data were imported into an Access file provided by NOAA that contained template tables for the Query Manager structure.

Integral's LWG project database contains all of the data reported by the analytical laboratories. This includes field and lab replicates, lab dilutions, results for the same analyte from multiple analytical methods (SW8270 and SW8270-SIM, for example), and laboratory QA samples such as matrix spikes, surrogates, and method blanks. The data handling rules described in *Portland Harbor RI/FS Technical Memorandum: Guidelines for Data Averaging and Treatment of Non-detected Values for the Round 1 Database* (Kennedy/Jenks et al. 2004) were used to create a data set for the SCRA data users that was simpler: the data set contained only one result per analyte per sample and excluded all of the laboratory QA results. This involved creating a SCRA database that excluded lab QA results, contained only the most appropriate dilution result and analytical method for each analyte, and contained the average of replicates. Excluding the lab QA results was a simple database querying step. Selection of the most appropriate dilution was either done by the reporting laboratory or by the data validator. Selection of the most appropriate analytical method was described in the guidelines document (Kennedy/Jenks et al. 2004) and was accomplished by flagging the appropriate method in the project database.

The guidelines document described the rules used for averaging data and carrying qualifiers. Because it was the most data manipulation intensive procedure, the data were divided into subgroups and approximately 40% of each subgroup was verified. If any problems were found with the averaging, then 100% of the subgroup was verified and problems were corrected. The preliminary SCRA database was compiled into a series of database-compatible Excel tables and distributed to the SCRA data users. The SCRA database is provided on CD in Appendix F.

4.0 ROUND 3B RESULTS

Results of the Round 3B sediment sampling effort are summarized in Table 4-1 (Surface Sediment Samples), and Table 4-2 (Subsurface Sediment Samples). Summary statistics are provided in Table 4-3 (Surface Sediment Samples) and Table 4-4 (Subsurface Sediment Samples). Summary statistics for both surface and subsurface sediment include detected and non-detected results. Summary statistics were calculated using the detection limit at full value for non-detected concentrations.

A total of 188 surface sediment samples were collected from 188 locations during Round 3B. Including field replicates and split samples, 205 surface sediment samples were submitted for chemical analyses, and 60 sediment samples were collected for bioassay testing from the 188 surface locations. Surface samples submitted for chemical and/or physical analyses are listed in Table 2-1.

A total of 94 subsurface sediment cores were collected from 88 stations during Round 3B. The difference between the number of cores and number of stations is due to additional QC cores collected at the same station. Including field replicates and homogenate split samples, a total of 244 subsurface sediment samples were submitted for chemical and/or physical analyses. Subsurface samples submitted for chemical and/or physical analyses are listed in Table 2-2.

Summation rules for the data are provided in Appendix F (SCRA database).

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