Supplemental Bioassay and Bioaccumulation Testing Report Lower Willamette River Navigational Channel Characterization Portland, Oregon

Prepared for
Portland District Corps of Engineers

December 30, 2004
15443-00

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1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Portland District, conducted sediment sampling and testing in support of the planned maintenance dredging within the Willamette River Federal Navigational Channel (Channel) (Figure 1). The USACE proposes dredging up to 1,052,600 cubic yards (cy) of Channel sediments. The results of this dredged material characterization study, which are presented in a separate report entitled, Willamette River Federal Navigational Channel, Operation and Maintenance Sediment Characterization Report (Hart Crowser, 2004), which will be used to determine whether the proposed dredge material is suitable for unconfined open water disposal or other alternative disposal methods (e.g., confined in-water or upland).

As part of the dredged material characterization study, subsurface sediment coring was completed within the Channel at 53 locations on September 18 through 20, 22, and 23, 2003. Samples were grouped to form 19 separate composites. The 19 composited sediment samples (CSSs) were submitted for chemical analyses. Reference sediment samples for this dredge material characterization study were collected from two locations within the Lower Willamette River on September 25, 2003.

The purpose of this supplemental study was to conduct additional long-term bioassay and bioaccumulation tests to evaluate sediments in a manner that will assist the agencies comprising the Regional Dredging Team (RDT), which consists of federal and state agencies with regulatory responsibilities for managing sediments. The RDT is beginning the revision process for the existing Dredge Material Evaluation Framework (DMEF) for the Lower Columbia River Management Area manual (USACE et al., 1998). The Regional Sediment Evaluation Team (RSET), a multiagency group, has been formed under the auspices of the RDT to revise the existing regional DMEF for use by all Northwest USACE Districts, EPA Region 10, NOAA Fisheries, USFWS, and other federal and state agencies that require sediment quality evaluation procedures.

The results of the long-term bioassay tests and 28-day bioaccumulation testing with two species of freshwater organisms are presented in this report. This study will provide RSET with the opportunity to obtain pertinent information regarding biological issues discussed in a technical scoping workshop conducted in September 2002. Specifically, this study will aid in the evaluation and development of freshwater sediment toxicity testing methodologies and bioaccumulation testing and data interpretation issues.

The characterization of the proposed dredge material was performed in general accordance with the Sampling and Analysis Plan (SAP) (Hart Crowser, 2003) developed for this study and the DMEF (USACE et al., 1998), including Tier II physical and chemical testing and Tier III bioassay and bioaccumulation testing. This study was conducted under Contract Number DACW57-02-D-0010 Task Order 4 for the USACE, Portland District.

1.1 Site Location and Description

In December 2000, the Environmental Protection Agency (EPA) placed the Lower Willamette River on the nationwide Superfund cleanup list. According to the Department of Environmental Quality (DEQ) and the EPA, there may be unacceptably high levels of chemical contamination, especially in sediments, in the Willamette River. The contamination is attributed to a century of industrial, maritime, and development activity in and along the river. The EPA has implemented an Initial Study Area (ISA) concept for sampling in the Administrative Order on Consent (AOC). The ISA concept allows for the initial focus of the sampling effort to be the 5.7-mile stretch of the Lower Willamette River from approximately the southern tip of Sauvie Island at Willamette River Mile (WRM) 3.5 to the southern end of Swan Island at WRM 9.2, and adjacent areas logically associated with an evaluation of the in-water portion of this stretch of the river.

It is understood that this dredge material characterization study was collecting a portion of sediment samples within the ISA; however, sampling activities for this study were to support maintenance dredging within the Channel for assessing the quality of dredge material and its acceptability for disposal. All sampling activities were conducted in accordance with Section 404 of the Clean Water Act.

Maintenance dredging within the Channel is proposed to maintain a depth of -40 feet Columbia River Datum (CRD), plus 2 feet of overdredge allowance; therefore, portions of the existing 600- to 1,900-foot-wide, 40-foot-deep navigational channel would be deepened to -42 feet CRD from WRM 0 to 11.6.

Because significant reaches of the existing Channel are deeper than -42 feet CRD, only specific areas will require dredging. The locations of the proposed dredging will be limited to select shoaled areas near WRM 2, and between WRM 7 and 10.1, near the Broadway Bridge in Portland (Figures 2 and 3).

1.2 Report Organization

The main text of the supplemental bioassay and bioaccumulation testing report discusses the site location and description, presents the supplemental biological testing objectives, and presents the chemical and biological testing programs and results. The text portion of the report is followed by tables and figures. Tables and figures are presented in order as referenced in the text.

This supplemental bioassay and bioaccumulation testing report contains two appendices that include supporting information and documentation. Appendix A presents the chemical validation report for chemical analyses of sediment. Appendix B includes copies of the sediment analytical laboratory reports and certifications prepared by Columbia Analytical Services (CAS). Appendix C presents the biological testing validation report for bioassay and bioaccumulation analyses. Appendix D presents the analytical laboratory reports and certifications prepared by Northwestern Aquatic Sciences (NAS). Appendix E presents the chemical validation report for chemical analyses of tissue from the bioaccumulation testing studies. Appendix F includes copies of the tissue analytical laboratory reports and certifications prepared by CAS.

1.3 Limitations

Hart Crowser performed this work in accordance with generally accepted professional practices related to the nature of the work accomplished, in the same or similar localities, at the time the services were performed. This supplemental bioassay and bioaccumulation testing report is for the specific application to the referenced project and for the exclusive use of the USACE.

2.0 SUPPLEMENTAL INVESTIGATION OBJECTIVES

The objectives of the supplemental remedial investigation are as follows:

- Test sediments with multiple levels of chemical concentrations to evaluate the sensitivity of the 10-day bioassay vs. a long-term bioassay (up to 28-days). To achieve this objective supplemental biological testing activities were tested on all 19 CSSs and two reference sediments for both the 10-day bioassay and long-term bioassay.
- Bioaccumulation testing was conducted on two CSSs (CSS 2 and CSS 10) and two reference sediments with two species of freshwater aquatic invertebrates (*Lumbriculus variegates* and *Corbicula fluminea*) to develop a protocol for a second freshwater bioaccumulation species.

3.0 SUMMARY OF SAMPLING AND ANALYSIS ACTIVITIES

The sediment sampling and compositing schemes used to obtain representative samples of the proposed dredge prisms are discussed below. All work was performed in accordance with the SAP (Hart Crowser, 2003) developed for this study.

3.1 Field Operations and Equipment

The sampling vessel employed for the subsurface sampling program was provided by Hickey Marine of Vancouver, Washington. The Tug Nova, an 800-horsepower engine vessel directed the sample barge, Derrick Sealion, into position during sampling activities. The Derrick Sealion is a 50 x 103 x 8-foot barge with a 3900 Manitowoc crane equipped with hydraulic winch. To obtain subsurface samples, sediment was collected using a vibracore deployed from the barge. The vibracore collects subsurface sediment by vibrating a 4-inch diameter aluminum barrel down into the sediment. A catcher connected to the bottom of the barrel retains sediment in the barrel as the sample is brought on board the sampling barge for processing. The vibracore operations were performed by TEG Oceanographic Services of Santa Cruz, California. TEG Oceanographic Services and Hickey Marine performed this work under subcontract to Hart Crowser.

3.2 Sampling and Compositing Scheme

Subsurface sediment samples were collected from 53 locations and divided into 19 dredge prisms identified as CSSs as shown on Figures 2 through 4. Table 1 presents the sediment sample identification and compositing scheme for each CSS, core coordinates, mudline elevations, and sample recovery intervals. Table 2 presents the sediment grain size results for each CSS. Table 3 presents the analytical chemistry results for each CSS. Additional details regarding sample collection and handling are provided in the SAP (Hart Crowser, 2003).

CSS 1. Subsurface sediment coring was completed at three locations from a shoal on the east edge of the main Channel within the CSS at WRM 2 to 2.3 (Figure 2). The sediment cores were taken to the maximum removal depth of -42 feet CRD, and composited into one CSS.

CSS 2. Subsurface sediment coring was completed at three locations on the east edge of the main Channel within the CSS at WRM 7.45 to 8 (Figure 4a). The sediment cores were taken to the maximum removal depth of -42 feet CRD, and composited into one CSS.

CSS 3. Subsurface sediment coring was completed at two locations from a small shoal on the west edge of the main Channel within the CSS at WRM 7.3 (Figure 4a). The sediment cores were taken to the maximum removal depth of -42 feet CRD, and composited into one CSS.

CSSs 4 through 17. Subsurface sediment coring was completed at three locations on the west edge of the main Channel within each CSS starting at WRM 7.4 extending to WRM 9.4 (Figures 4a, 4b, and 4c). The sediment cores were depth integrated up to the maximum removal depth of -42 feet CRD, and composited into one sample within each CSS.

CSS 18. Subsurface sediment coring was completed at two locations from a shoal on the west edge of the main Channel within the CSS at WRM 9.4 to 10 (Figure 4c). The sediment cores were taken to the maximum removal depth of -42 feet CRD, and composited into one sample.

CSS 19. Subsurface sediment coring was completed at one location from a shallow shoal on the west edge of the main Channel within the CSS at WRM 9.35 (Figure 4c). This small area is only maintained to a depth of -25 feet CRD. Therefore, the sediment core was taken to the maximum removal depth of -25 feet CRD.

Compaction Correction for Core Sub-Sampling. To determine the most accurate depths for subsampling and compositing, compaction corrections were applied to the cores during logging and processing. The compaction correction is the length of sample recovery divided by the length of core penetration. Typically, sampling-induced compaction of the sediments will cause the recovery to be less than the total penetration. During logging and processing, the sample length was determined by dividing the actual recovery depth by the compaction correction factor.

General Compositing Procedures. Sediment cores were extruded into a clean laboratory container (stainless steel bowl) and the contents (i.e., up to -42 feet CRD) from each core tube was combined and homogenized thoroughly to create one composite sample that is representative of the dredge prism in each CSS. The sediment was homogenized mechanically using a stainless steel electrical paddle until both color and texture were uniform.

Biological Testing Requirements. Since all 19 CSSs were being evaluated for supplemental biological testing to aid in the effort to develop freshwater screening levels that will be used in the revised DMEF, a sufficient volume of sediment from each CSS was collected for biological testing. Additional details regarding sample collection for biological testing requirements are provided in the SAP (Hart Crowser, 2003) developed for this study.

3.3 Reference Area Sediment Sampling

In 2001, the USACE conducted a study to identify three reference areas within the Lower Willamette River with varying grain sizes suitable for use as reference sediment sources for biological testing under Tier III requirements of the DMEF (Hart Crowser, 2001). The study identified three reference areas that correspond to the established sediment grain size classes for fine-grained (between 70 to 80 percent fines), medium-grained (between 50 to 60 percent fines), and coarse-grained (between 2 to 10 percent fines) sediment found in the Lower Willamette River.

During the subsurface sediment sampling activities a portion of sediment from each of the 19 CSSs was analyzed in the field for sediment grain size distribution using a volumetric wet sieve method. The wet sieving results were used to aid in the collection of reference sediment samples that were targeted to be as similar as practicable to the proposed dredge material (i.e., grain size and total organic carbon [TOC]) and serve as a point of comparison during bioassay testing to identify potential effects of contaminants in the proposed dredged material.

Reference sediment samples for this dredge material characterization study were collected from two identified locations (Figures 5 and 6). These two reference areas are defined as medium-grained sediment located within Cedar Island Cove and fine-grained sediment located by Elk Rock (Hart Crowser, 2001). Table 1 presents the two reference area sampling coordinates and approximate mudline depths. Table 2 presents the reference sediment grain size results.

An air powered van Veen "grab" type sampler was used to collect two reference sediment samples (HC-REF-01 and HC-REF-02). Undisturbed sediment samples were collected from 0 to 10 centimeters (cm) in depth using the grab sampler. Operation of the sampling equipment and work vessel for the reference sediment sampling was conducted by Mr. John Vlastelicia, who is the owner and operator of a 29-foot vessel which is equipped with an A-frame and winch used to deploy and retrieve the van Veen grab sampler. Mr. Vlastelicia performed his work under subcontract to Hart Crowser.

3.4 Physical and Chemical Analysis

3.4.1 Physical Analysis

All 19 CSSs from the Channel and the two reference sediment samples were analyzed for grain size (Modified ASTM method), total volatile solids (Puget Sound Estuarine Protocols [PSEP]), and total solids (PSEP).

3.4.2 Chemical Analysis

All 19 CSSs from the Channel and the two reference sediment samples were analyzed for the following DMEF constituents:

- Conventionals (including ammonia, sulfide, TOC, total volatile solids, and total solids);
- Metals (Sb, As, Cd, Cu, Hg, Ni, Ag, and Zn);
- TBT in filtered porewater;
- Semivolatile organics (including polycyclic aromatic hydrocarbons [PAHs], phenols, phthalates, and miscellaneous compounds); and
- Pesticides/Polychlorinated biphenyls (PCBs).

Analytical results for sediment quality are presented in Table 3 and are discussed below.

4.0 SEDIMENT CHEMICAL DETERMINATIONS

This section discusses chemical testing results for the 19 CSSs and the two reference sediment locations.

4.1 Sediment Quality Criteria

Chemical concentrations detected in composite sediment samples collected from each CSS were compared to the DMEF screening criteria (Screening Levels [SLs] and Maximum Levels [MLs]). These SLs were developed to characterize dredged material for the suitability for open-water disposal. The more conservative SL values provide a regulatory benchmark by identifying sediments that are not predicted to result in unacceptable adverse effects on biological resources. The higher ML values identify sediments that are likely to cause adverse effects on biological resources. A third chemical screen, the Bioaccumulation Trigger (BT) has been determined for some chemicals of concern. When the BT is exceeded bioaccumulation testing is required in order to determine whether dredge material is suitable for unconfined, aquatic disposal.

4.2 Sediment Quality Evaluation

The overall data quality objectives (DQOs) for collection and chemical testing of sediment samples were met, as set forth in the SAP (Hart Crowser, 2003), and the data for this project are acceptable for use as qualified. Appendix A presents the chemical validation report for chemical analyses of sediment. Appendix B includes copies of the sediment analytical laboratory reports and certifications prepared by CAS.

Sediment chemical results are tabulated and compared to DMEF SLs, MLs, and BTs in Table 3. These comparison results are summarized below.

Metals. Analytical results for metals were below DMEF SLs at all 19 CSSs and the two reference sediment locations.

Tributyltin. Analytical results for porewater TBT were below DMEF SLs at all 19 CSSs and the two reference sediment locations with exception to CSSs 2 through 4. CSS 2 detected porewater TBT at 3.9 μg/L, exceeding its SL of 0.15 μg/L. CSSs 3 and 4 detected porewater TBT at 0.18 μg/L and 0.16 μg/L, respectively, slightly exceeding its SL of 0.15 μg/L. Additionally, the DMEF BT for TBT (0.15 μg/L) was exceeded in CSSs 2 through 4.

Semivolatile Organics. Analytical results for semivolatiles (including PAHs, phenols, phthalates, and miscellaneous compounds) were below DMEF SLs at all 19 CSSs and the two reference sediment locations.

Pesticides. Analytical results for pesticides were below DMEF SLs at all 19 DMMUs and the two reference sediment locations with exception to CSSs 1 through 3. CSSs 1, 2, and 3 detected total DDT at 14.3 μg/kg , 7.45 μg/kg, and 16.6 μg/kg, respectively, exceeding its SL of 6.9 μg/kg.

PCBs. Analytical results for PCB aroclors were below DMEF SLs at all 19 CSSs and the two reference sediment locations.

5.0 BIOASSAY COMPARISON

As part of this supplemental biological testing study, sediments from the 19 CSSs and two reference locations, with multiple levels of chemical concentrations were tested to evaluate the sensitivity and reliability of the short-term bioassay (10-day) vs. a long-term bioassay (up to 28-days). Bioassay testing was conducted in accordance with DMEF guidance (USACE et. al., 1998). Appendix C presents the biological testing validation report for bioassay and bioaccumulation analyses. Appendix D presents the analytical laboratory reports and certifications prepared by NAS.

5.1 Bioassay Testing

The following seven bioassay tests were conducted on all 19 CSSs and two reference sediments for purposes of the supplemental biological testing program:

- 10-Day Amphipod Survival Test (*H. azteca*);
- 28-Day Amphipod Survival Test (*H. azteca*);
- 28-Day Amphipod Growth Test (*H. azteca*);
- 10-Day Midge Survival *(C. tentans*);
- 10-Day Midge Growth Test (*C. tentans*);
- 20-Day Midge Survival Test (*C. tentans*); and
- 20-Day Midge Growth Test (*C. tentans*).

These freshwater sediment toxicity tests were conducted in accordance with available standard guidance (EPA, 2000; ASTM, 1995) and the laboratory protocol presented in the SAP (Hart Crowser, 2003). The QA review of the performance criteria for the toxicity test is presented in Appendix A.

5.2 Short-Term (10-Day) Bioassay Testing Interpretive Criteria

The short-term (10-day tests) sediment bioassay results were interpreted in accordance with the DMEF guidance as presented in the SAP (Hart Crowser, 2003). The response of bioassay organisms exposed to a test sediment is compared to the response of these organisms in both control and reference sediments. This comparison determines if the test sediment sample has passed or failed the sediment bioassays.

Biological test interpretation relies on two levels of observed response in the test organism. These are known as "one-hit" and "two-hit" criteria failures. The bioassay-specific guidelines for each of these response categories are listed below. In general, a one-hit failure is a marked response in any one biological test. A marked response in comparison to the reference sediment in any one of the three sediment bioassays will result in the test sediment failing bioassay analyses. A two-hit failure exhibits a lower intensity response, which must be present in two or more biological tests for the test sediment to fail bioassay analyses.

5.2.1 One-Hit Criteria

When any one of the three biological tests shows a test sediment response relative to the reference sediment that exceeds the bioassay-specific response guidelines (presented below), and if that response is statistically different from the reference, the test sediment is judged to have failed the bioassay. The method for determining statistical significance is presented below.

In accordance with the DMEF, the bioassay-specific response guidelines for evaluating the one-hit criteria are as follows:

Amphipod Bioassay. Mean test mortality is greater than 15 percent over the mean reference response and is statistically different from the reference (alpha = 0.05); and

Midge Bioassay. Mean mortality in the test sediment is 20 percent over reference and statistically different from reference (alpha = 0.05). For the growth test, a mean biomass is achieved that is less than 60 percent of the reference sediment response and statistically different from the reference (alpha = 0.05). If either or both endpoints fail the guideline, the test is considered a hit.

A "statistically different" response is defined as having a mortality or growth response that is greater than 20 percent difference from that of the control, and is statistically different (a = 0.05) from that of the reference sediment.

5.2.2 Two-Hit Criteria

When any two of the three biological tests show test sediment responses that are less than the bioassay specific guidelines noted above for a one-hit failure, but are significantly different statistically from the reference sediment, the test sediment is considered to have failed the bioassay.

5.3 Long-Term (20- or 28-Day) Bioassay Testing Interpretive Criteria

The long-term (20- or 28-day tests) sediment bioassay results interpretation was conducted as described in Development of Freshwater Sediment Quality Values for use in Washington State, Phase 1 Task 6: Final Report, September 2002 for the Sediment Quality Standards (SQS) endpoint criteria (Ecology, 2002).

In accordance with the SQS endpoint criteria, the bioassay-specific response guidelines for one-hit criteria are as follows:

***Hyalella azteca* 28-Day Mortality and Growth Bioassay.** For a test sediment to be classified as a "hit", the mean test mortality must be statistically significantly greater (a = 0.05) than that of the reference sediment and greater than 10 percentage points over the reference sediment result or the mean individual test weights must be statistically significantly less (a = 0.05) than that of the reference sediment and less than 75 percent than that of the reference sediment.

***Chironomus tentans* 20-Day Mortality and Growth Bioassay.** For a test sediment to be classified as a "hit" either the mean test mortality must be statistically significantly greater (a = 0.05) than that of the reference sediment and greater than 15 percentage points over the reference sediment result or the mean individual test weight must be statistically significantly less (a = 0.05) than that of the reference sediment and less than 75 percent than that of the reference sediment.

A "statistically different" response is defined as having a mortality or growth response that is greater than 20 percent difference from that of the control, and is statistically different (a = 0.05) from that of the reference sediment.

5.4 Interpretation of Bioassay Results

The results of the 10-day and 20 or 28-day amphipod and midge bioassays are presented in Tables 4 through 6. These tables list the sediment samples tested, the corresponding reference sediment sample (HC-REF-02 - based on similar grain size characteristics), the test endpoint, comparison with the one-hit and two-hit interpretative criteria, and the overall results of whether the test sediment passed or failed the biological effects interpretive criteria.

For the purposes of this Supplemental Biological Testing Report, test sediments from all 19 CSSs were subjected to the suite of bioassays described above, regardless of whether there were any analytical results that exceeded corresponding DMEF SLs. One objective of this study was to determine the overall reliability of the longer-term bioassays on test sediments with low detected concentrations of constituents to evaluate the test response on sediments that should be non-toxic.

5.4.1 10-Day Amphipod Survival Bioassay Results

The mean percent mortality in the 19 test sediments for the 10-day amphipod bioassay (*H. azteca*) ranged from 0.0 to 6.3 percent in the bioassays (Table 4). None of the 19 CSSs tested were considered failures under the "one-hit" or "two-hit" rules.

5.4.2 28-Day Amphipod Survival Bioassay Results

The mean percent mortality in the 19 test sediments for the 28-day amphipod bioassay (*H. azteca*) ranged from 6.3 to 82.5 percent in the bioassays (Table 4). Eleven of the 19 test sediments were considered failures under the SQS endpoint criteria.

5.4.3 28-Day Amphipod Growth Bioassay Results

The mean test individual biomass for the 28-day amphipod growth bioassay ranged from 0.09 to 0.20 milligrams (mg) in the bioassays (Table 4). The individual biomass in the reference sediment was reported as 0.16 mg. Three of the 19 test sediments were considered failures under the SQS endpoint criteria.

5.4.4 10-Day Midge Survival and Growth Bioassay Results

The mean percent mortality in the test sediments for the 10-day midge bioassay (*C. tentans*) ranged from 10.0 to 32.5 percent in the bioassays (Table 5). The mean test individual biomass for the 10-day midge growth bioassay ranged from 0.62 to 0.89 mg in the bioassays. The individual biomass in the reference sediment was reported as 0.70 mg. None of the 19 CSSs tested were considered failures under the "one-hit" or "two-hit" rules.

5.4.5 20-Day Midge Survival Bioassay Results

The mean percent mortality in the 19 test sediments for the 20-day midge bioassay (*C. tentans*) ranged from 11.3 to 50.0 percent in the bioassays (Table 5). Two of the 19 CSSs were considered failures under the SQS endpoint criteria.

5.4.6 20-Day Midge Growth Bioassay Results

The mean test individual biomass for the 20-day midge growth bioassay ranged from 1.50 to 2.32 mg in the bioassays (Table 5). The individual biomass in the reference sediment was reported as 1.44 mg. None of the 19 CSSs were considered failures under the SQS endpoint criteria.

5.4.7 Summary of Bioassay Results

The objective of the comparison of the 10-day versus longer-term sediment bioassays was to evaluate whether the long-term tests are more sensitive than the 10-day tests because of the longer exposure period for the 20-day and 28-day bioassays. The results of the 10-day tests for both the amphipod and midge indicated that all 19 CSSs passed biological effects interpretative criteria. However, as shown on Table 6, for the 28-day amphipod test, 11 of the 19 test sediments were determined as having failed the SQS biological interpretive criteria and for the 20-day midge test, two of the 19 test sediments were determined as having failed the SQS biological interpretive criteria.

To assess whether the additional bioassay test failures were due to increased test sensitivity or to test variability, the bioassay test results were evaluated in conjunction with the analytical chemistry results for the test sediments (discussed in Section 4.2 and presented in Table 3). As discussed in Section 4.2, there were only four test sediments (CSS 1, CSS 2, CSS 3, and CSS 4) that had any constituents detected above DMEF screening criteria. Additionally, CSS 1 and CSS 4 had only one analyte (total DDT and TBT, respectively) that exceeded corresponding SLs and CSS 2 and CSS 3 had only two compounds exceeding corresponding SLs (total DDT and TBT). Therefore, these sediments are not considered highly contaminated and it was not unexpected that all 19 CSSs passed biological testing interpretative criteria for the 10-day sediment bioassays.

As shown on Table 6, while the test sediments that failed the SQS biological interpretative criteria for the 28-day amphipod growth and survival test did include the four test sediments that had exceedences of DMEF SLs, the majority of the test sediments that failed the 28-day amphipod bioassay (seven of 11) do not have any detected analytes that exceed DMEF SLs and exhibit relatively low concentration of analytes.

For the 20-day midge growth and survival test, there were only two of the 19 test sediments that were determined to have failed biological interpretative criteria. Again, these two test sediments (CSS 13 and CSS 14; Table 6) did not have any detected analytes that exceed DMEF SLs and exhibit relatively low concentration of analytes.

Therefore, the increased number of bioassay test "failures" indicated by the long-term tests, especially the 28-day amphipod survival bioassay, does not appear to be indicative of increased "sensitivity" of the bioassay to chemical contamination present in the test sediments. To evaluate whether the increased number of test failures could be the result of common "confounding factors" that can influence sediment bioassay results, the geographic location of test sediments that failed and also the interstitial water ammonia levels of the test sediments were evaluated.

A concern regarding the interpretation of the performance of the long-term sediment bioassays was that the additional test failures could be the result of contaminants that were not analyzed as part of the routine analytical program required under the DMEF guidance. In addition, there was a concern that the test sediments were "clustered" geographically within the Channel suggesting a source of contaminants that could influence the sediment toxicity in the specific region (e.g., proximity to a city outfall or identified upland source of contaminants). By comparing the locations of the test sediments that failed the 28-day amphipod sediment bioassay (Table 6) with the locations of these composite samples within the Channel (Figures 2 and 3), it was clear that the test sediments that "failed" the biological interpretive criteria were scattered over approximately three river miles and not located within one geographical location or region in the navigation channel. Therefore, it is unlikely that an unidentified source of contamination or an unanalyzed contaminant could be the cause of the bioassay "failures" that were documented for the long-term bioassays.

To investigate whether interstitial water concentrations of ammonia could be responsible for long-term test failures, the interstitial ammonia levels in the test sediments were measured and are presented in Table 1 of Appendix D. While all the test sediments exhibited interstitial water concentrations of total ammonia greater than that observed in the reference sediments, the test sediments with the highest concentrations of interstitial total ammonia (CSS 16, CSS 17, and CSS 18; Table 1, Appendix D) passed the interpretative criteria for all the sediment bioassays conducted on these test sediments (Table 6). In addition, ammonia is a very labile compound in sediments and would be expected to exhibit any toxicity in the 10-day tests rather than the long-term tests, as ammonia levels will significantly decrease with time. Therefore, it does not appear that interstitial water ammonia levels are responsible for the long-term sediment bioassay "failures" observed in this biological testing program.

In summary, evaluation of the test sediment analytical results and common factors that are known to confound sediment bioassay results was not able to identify the source of the toxicity observed in the long-term survival bioassays, especially for the 28-day amphipod survival test. This unexplained variability in the performance of the 28-day amphipod test is of concern as regulatory agencies are considering using this test for regulatory decision-making. It is recommended that further evaluation of these shorter and longer-term tests be conducted with both contaminated and uncontaminated sediments to determine the cause of the unexplained variability in bioassay results.

6.0 BIOACCUMULATION TEST ORGANISM COMPARISON

For this project, 28-day laboratory bioaccumulation testing was conducted on two test sediments (CSS 2 and CSS 10) and one reference sediment. The objective of this testing was to assist in the development of a protocol for a second freshwater bioaccumulation species (*C. fluminea*). Appendix E presents a chemical data quality review of the tissue analytical results. Appendix F includes copies of the tissue analytical laboratory reports and certifications prepared by CAS.

6.1 Bioaccumulation Tests

For purposes of the supplemental biological testing program the following bioaccumulation tests were conducted on two test sediments (CSS 2 and CSS 10) and one reference sediment (HC-REF-02):

- 28-Day Bioaccumulation Test *L. variegatus*; and
- 28-Day Bioaccumulation Test *C. fluminea*.

These freshwater sediment bioaccumulation tests were conducted in accordance with available standard guidance (ASTM, 1997, EPA/USACE, 1998, and EPA, 2000) and the laboratory protocol presented in the SAP (Hart Crowser, 2003). *L. variegatus* is the standard freshwater bioaccumulation testing organism but has limited tissue biomass available for analytical chemistry testing of tissues, which limits the types of chemical analyses that can be conducted on tissues at the conclusion of the standard 28-day laboratory bioaccumulation test. Therefore, for this project, the bivalve *C. fluminea* was also tested, as these are larger organisms and provide greater tissue mass for chemical analyses.

The two test sediments were selected for bioaccumulation testing prior to the field collection program. These sediments were located in areas of the navigation channel adjacent to sources known to have released bioaccumulative chemicals of concern. The analytical chemistry results for these two test sediments are presented in Table 3. Test sediment CSS 2 detected both TBT in pore water and total DDT above the DMEF SL. Additionally, TBT in pore water was detected above the DMEF BT. CSS 2 also had detectable levels of Aroclor 1254 but this concentration was below both the DMEF SL and BT for total PCBs. Test sediment CSS 10 exhibited low detected concentrations of TBT in pore water, total DDT, Aroclor 1248, and Aroclor 1260. All of these detected concentrations were below DMEF SLs and BTs, with the exception of the TBT concentration, which was an estimated concentration (J-flagged) slightly above the DMEF SL (0.16 ug/l versus the SL of 0.15 ug/L). Because this value was an estimated value reported by the laboratory, there is considerable uncertainty in the actual concentration of TBT in this sample.

Because of limited sediment volumes available for conducting bioaccumulation testing, only three replicate tests were conducted on each test and reference sediment rather than the five replicates that are normally included in the test protocols. This deviation from test protocols had no impact on program objectives.

6.2 Bioaccumulation Testing and Tissue Analytical Chemistry Results

The *L. variegatus* bioaccumulation testing of sediments was initiated on November 18, 2003, and completed on December 16, 2003. No significant Quality Assurance/Quality Control (QA/QC) issues were encountered with the *L. variegatus* bioaccumulation tests, and the results of this test are considered acceptable for use as intended for this project.

The Time Zero (Test Initiation) and Day 28 (Test Completion) tissue samples were delivered to CAS between December 3 and December 19, 2003. The limited tissue mass available for Day 28 (Test Completion) *L. variegatus* samples (average sample wet weight per test sediment replicate was approximately 12.5 grams) made it impossible to analyze these tissues for all classes of chemical constituents. Based on the analytical chemistry results for test sediment CSS 2 (Table 3) the following classes of analytes were quantitated in the tissue for *L. variegatus* (Table 7); TBT, semi-volatile organics, and PCBs. For test sediment CSS 10, the following classes of analytes were quantitated in the tissue for *L. variegatus* (Table 7); metals, semi-volatile organics, and PCBs. For the reference sediment HC-REF-02, the following classes of analytes were quantitated in the tissue for *L. variegatus* (Table 7); metals, TBT, semi-volatile organics, and PCBs.

The *C. fluminea* bioaccumulation testing of sediments was initiated on November 11, 2003, and completed on December 9, 2003. No significant QA/QC issues were encountered with the *C. fluminea* bioaccumulation tests, and the results of this test are considered acceptable for use as intended for this project.

For *C. fluminea,* the average sample wet weight per test sediment replicate was approximately 49.9 grams. Based on the analytical chemistry results for test sediment CSS 2 (Table 3) the following classes analytes were quantitated in the tissue for *C. fluminea* (Table 8); metals, TBT, semi-volatile organics, dibenzofuran, two phthalate compounds, and pesticides/PCBs. For test sediment CSS 10, the following classes analytes were quantitated in the tissue for *C. fluminea* (Table 8): metals, TBT, semi-volatile organics, and pesticides/PCBs. For the reference sediment HC-REF-02, the following classes analytes were quantitated in the tissue for *C. fluminea* (Table 8); metals, TBT, semi-volatile organics, dibenzofuran, two phthalate compounds, and pesticides/PCBs.

Because of a laboratory error, lipid analysis was not conducted on all tissue samples that were originally requested. As the tissue samples had already been extracted by the time this error was identified by CAS, there was only very limited tissue mass available to complete the lipid analysis, essentially scrapping off whatever sample was left in the sample jars. The lipid results that Hart

Crowser received for these two organisms were very different from the lipid results obtained during the bioaccumulation testing of these two species that were conducted in October/November 2002, as part of the Lower Willamette River Reference Area Study (Hart Crowser, 2002).

Because of the uncertainty in the lipid results conducted as part of this bioaccumulation testing program, the percent lipids measured in the two species of test organisms as part of the Lower Willamette River Reference Area Study (Hart Crowser, 2002) were used to lipid normalize the tissue analytical results (Table 9 and 10).

The results of the 28-day laboratory bioaccumulation tissue results for both *L. variegates* and *C. fluminea* are discussed in further detail in the following sections.

6.2.1 *Lumbriculus variegatus* Bioaccumulation Tissue Analysis Results

The analytical chemistry results for the Time Zero, Negative Control, Day 28 tissue residue concentrations from exposure to sediment samples CSS 2, CSS 10, and HC-REF-02 are presented in Table 7. Table 7 presents the individual replicate results (three replicates per treatment) and also the mean tissue concentration for each treatment. Mean tissue concentrations were calculated based on detected values and J-flagged estimated values amongst the replicates. Non-detects in the replicates were not utilized in calculating mean tissue values.

The lipid normalized values for the organic analytes and TBT for *L. variegatus* are presented in Table 8. As previously discussed, due to laboratory error, the lipid values measured for *L. variegatus* as part of the bioaccumulation evaluation conducted for the Lower Willamette River Reference Area Study was used (Hart Crowser, 2002).

Metal Results. The tissue concentrations of various metals were measured in Day 28 tissue for test sediment CSS 10 and HC-REF-02 (Table 7). While the sediment concentrations for metals were elevated in CSS 10 versus those observed the reference sediment (Table 3) the tissue burdens for the metals were either very similar or greater in the reference sediment 28-day tissue compared to CSS 10 tissue (Table 7). This result suggests that the difference in sediment concentrations of metals observed in these two sediments were not sufficient enough to cause differential uptake and the result was the same level of uptake between the two sediments.

PAH Results. The wet weight tissue results (Table 7) and the lipid normalized tissue results (Table 8) for the 28-day test sediments CSS 2, CSS 10, and the HC-REF-02 show a consistent pattern that the sediments that exhibit the highest PAH concentrations in sediment (CSS 2) is also associated with the highest PAH tissue concentrations.

PCBs Results. PCBs were detected in both test sediments and in HC-REF-02, at very low levels (Table 3). As expected in test sediment CSS 2, which had detectable levels of Aroclor 1254 in sediment, the 28-day tissue also contained detectable concentrations of Aroclor 1254 (Tables 7 and 8). Unexpectedly, in test sediment CSS 10, which had detectable concentrations of Aroclors 1248 and 1260 in sediment (Table 3), the tissue residue results for the 28-day tissue indicates that Aroclor 1254 was the only detected Aroclor (Tables 7 and 8). This underscores the fact that differential uptake of individual PCB congeners by aquatic organisms may change the fingerprint of congeners so that the expected Aroclor mixture is not observed in the tissue. Finally, HC-REF-02 that contained a very low concentration of Aroclor 1254 in sediment (4.7 ug/kg) was not sufficient enough to cause detectable concentrations of any Aroclor mixture in tissue (Tables 7 and 8).

6.2.2 *Corbicula fluminea* Bioaccumulation Tissue Analysis Results

The analytical chemistry results for the Time Zero, Negative Control, Day 28 tissue residue concentrations from exposure to sediment samples CSS 2, CSS 10, and HC-REF-02 are presented in Table 9. Table 9 presents the individual replicate results (three replicates per treatment) and also the mean tissue concentration for each treatment. Mean tissue concentration were calculated based on detected values and J-flagged estimated values amongst the replicates. Non-detects in the replicates were not used in calculating mean tissue values.

The lipid normalized values for the organic analytes and TBT for *C. fluminea* are presented in Table 10. As previously discussed, due to laboratory error, the lipid values measured for *C. fluminea* as part of the bioaccumulation evaluation conducted for the Lower Willamette River Reference Area Study was used (Hart Crowser, 2002).

Metal Results. The tissue concentrations of various metals were measured in Day 28 tissue for test sediment CSS 10 and HC-REF-02 (Table 9). While the sediment concentrations of metals were elevated in CSS 10 versus those observed in the reference sediment (Table 3) the tissue burdens for the metals were either very similar or greater in HC-REF-02 28-day tissue compared to CSS 10 (Table 9). This result suggests that the difference in sediment concentrations of metals observed in these two sediments were not elevated enough to cause differential uptake and the result was the same level of uptake between the two sediments.

PAH Results. The wet weight tissue results (Table 9) and the lipid normalized tissue results (Table 10) for the 28-day test sediments CSS 2 and HC-REF-02 show very little accumulation of PAHs, with only one PAH (phenanthrene) at a detectable concentration in tissue. The 28-day tissue concentrations of PAHs in CSS 10 were the only tissue samples that contained detectable concentrations of multiple PAHs at the termination of the tests (Tables 9 and 10).

6.2.3 Comparison of Uptake of *Corbicula fluminea* Versus *Lumbriculus variegatus* for Bioaccumulation Tissue Analysis Results

To compare the uptake of metals between these two species, the mean wet weight 28-day tissue concentrations detected in the two species were compared (Tables 7 and 9). Only test sediment CSS 10 and HC-REF-02 had metals analyses performed for both species. Comparing the tissue residue results between the two species reveals that for some metals (Cd, Cu, Hg, and Ag) the bivalve *C. fluminea* accumulated a higher tissue burden of metals than did the worm *L. variegatus.* For the remaining metals (Sb, As, Pb, Ni, and Zn) accumulation in *L. variegatus* was generally greater than in *C. fluminea.* However, the metal results tended to be mixed when comparing the two species.

To compare uptake of organics between the two species, the lipid normalized concentrations detected in the two species were compared (Tables 8 and 10). For the test and reference sediments, the only class of organic analytes that were analyzed in both sets of tissues were PAHs and PCBs. As shown on the Tables 8 and 10, the concentrations of PAHs detected in *L. variegatus* tissue were consistently higher than the concentrations detected in *C. fluminea,* with an average concentration in *L. variegatus* being about three times the detected concentration in *C. fluminea.*

The difference in uptake was much more noticeable for PCBs which were detected in both the test sediment exposures for *L. variegatus* but was not detected in any of the test sediment exposures for *C. fluminea* (Tables 8 and 10).

6.3 Bioaccumulation Testing Conclusions

The results of the comparison of uptake of metals and organic compounds between the two species tested in the bioaccumulation testing program revealed that for some metals, the bivalve *C. fluminea* accumulated a greater tissue burden than the worm *L. variegatus*. However, depending on the specific metals this pattern was either reversed or inconsistent.

For organics, comparing lipid normalized concentrations of PAHs and PCBs in tissue between the two species revealed that the worm *L. variegatus* consistently accumulated a higher tissue burden than the bivalve *C. fluminea* with the difference being much more pronounced for PCBs than for PAHs.

7.0 CONCLUSIONS

The following are the general conclusions from this supplemental biological testing project.

- The objective of the comparison of the 10-day versus longer-term sediment bioassays was to evaluate whether the long-term tests are more sensitive than the 10-day tests because of the longer exposure period for the 20-day and 28-day bioassays. The results of the 10-day tests for both the amphipod and midge indicated that all 19 of the tests sediments passed biological effects interpretative criteria. However, as shown on Table 6, for the 28-day amphipod test, 11 of the 19 tests sediments were determined as having failed the SQS biological interpretive criteria and for the 20-day midge test, two of the 19 tests were determined as having failed the SQS biological interpretive criteria. The evaluation of the test sediment analytical chemistry and common factors that are known to confound sediment bioassay results was not able to identify the source of the toxicity observed in the long-term survival bioassays, especially for the 28-day amphipod survival test. This unexplained variability in the performance of the 28-day amphipod test is of concern as regulatory agencies are considering utilizing this test for regulatory decision-making. It is recommended that further evaluation of this test be conducted with both contaminated and uncontaminated sediments to determine the cause of the unexplained variability in bioassay results.

- The results of the comparison of uptake of metals and organic compounds between the two species tested in the bioaccumulation testing program revealed that for some metals, the bivalve *C. fluminea* accumulated a greater tissue burden than the worm *L. variegatus*. However, depending on the specific metals this pattern was either reversed or inconsistent. For organics, comparing lipid normalized concentrations of PAHs and PCBs in tissue between the two species revealed that *L. variegatus* consistently accumulated a higher tissue burden than *C. fluminea* with the difference being much more pronounced for PCBs than for PAHs.

8.0 REFERENCES

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Table 1 - Sample Locations, Compositing Plan, Mudline Elevations, and Recovery Intervals
Willamette River Federal Navigation Channel
Portland, Oregon

CSS Identification	Discrete Sample Identification	Latitude	Longitude	Northing	Easting	Approximate Water Depth (CRD)	Dredging Depth (CRD)	Core Depth (CRD)	Core Length (ft)
CSS 1	HC-VC-01	45° 37.8680	122° 47.2457	724475.32	1414915.86	-38	-42	-43	5
	HC-VC-02	45° 37.8106	122° 47.2825	724131.08	1414749.15	-38	-42	-43	5
	HC-VC-03	45° 37.7370	122° 47.3144	723687.85	1414600.52	-38	-42	-43	5
CSS 2	HC-VC-04	45° 34.1502	122° 43.6721	701465.57	1429523.43	-38	-42	-43	5
	HC-VC-05	45° 34.0997	122° 43.6393	701154.95	1429654.91	-35	-42	-43	8
	HC-VC-06	45° 34.0924	122° 43.5903	701104.84	1429862.76	-35	-42	-43	8
CSS 3	HC-VC-07	45° 34.1484	122° 44.1924	701515.98	1427303.19	-36	-42	-43	7
	HC-VC-08	45° 34.1115	122° 44.1777	701290.10	1427359.70	-36	-42	-43	7
CSS 4	HC-VC-09	45° 34.0484	122° 44.0464	700891.30	1427909.32	-39	-42	-43	4
	HC-VC-10	45° 33.9978	122° 43.9911	700577.40	1428136.77	-37	-42	-43	6
	HC-VC-11	45° 33.9754	122° 43.9279	700433.88	1428402.67	-38	-42	-43	5
CSS 5	HC-VC-12	45° 33.9396	122° 43.8735	700210.00	1428628.78	-38	-42	-43	5
	HC-VC-13	45° 33.8966	122° 43.8695	699948.32	1428638.64	-36	-42	-43	7
	HC-VC-14	45° 33.8781	122° 43.7796	699825.35	1429019.13	-37	-42	-43	6
CSS 6	HC-VC-15	45° 33.8299	122° 43.6675	699519.36	1429489.39	-36	-42	-43	7
	HC-VC-16	45° 33.7485	122° 43.5442	699010.39	1430001.89	-36	-42	-43	7
	HC-VC-17	45° 33.6979	122° 43.4630	698693.48	1430339.92	-34	-42	-43	9
CSS 7	HC-VC-18	45° 33.6831	122° 43.3955	698595.64	1430625.48	-39	-42	-43	4
	HC-VC-19	45° 33.6296	122° 43.3110	698260.74	1430977.12	-39	-42	-43	4
	HC-VC-20	45° 33.6004	122° 43.2422	698075.29	1431265.84	-38	-42	-43	5
CSS 8	HC-VC-21	45° 33.5748	122° 43.1933	697914.04	1431470.24	-37	-42	-43	6
	HC-VC-22	45° 33.5534	122° 43.1292	697776.53	1431740.20	-38	-42	-43	5
	HC-VC-23	45° 33.5170	122° 43.1026	697552.30	1431847.64	-36	-42	-43	7
CSS 9	HC-VC-24	45° 33.5146	122° 43.2982	697610.52	1431323.61	-32	-42	-43	11
	HC-VC-25	45° 33.4915	122° 43.2172	697410.84	1431354.34	-32	-42	-43	11
	HC-VC-26	45° 33.4605	122° 43.1965	697220.10	1431437.50	-32	-42	-43	11
CSS 10	HC-VC-27	45° 33.4719	122° 43.1429	697283.07	1431668.14	-33	-42	-43	10
	HC-VC-28	45° 33.4462	122° 43.1319	697125.66	1431710.79	-33	-42	-43	10
	HC-VC-29	45° 33.4601	122° 43.1000	697206.36	1431849.25	-31	-42	-43	12
CSS 11	HC-VC-30	45° 33.4997	122° 43.0339	697439.16	1432137.93	-37	-42	-43	6
	HC-VC-31	45° 33.4640	122° 43.0198	697220.65	1432192.15	-37	-42	-43	6
	HC-VC-32	45° 33.4692	122° 42.9528	697244.39	1432478.94	-32	-42	-43	11
CSS 12	HC-VC-33	45° 33.4211	122° 42.9302	696949.56	1432567.38	-34	-42	-43	9
	HC-VC-34	45° 33.4359	122° 42.8773	697033.27	1432795.60	-38	-42	-43	5
	HC-VC-35	45° 33.4038	122° 42.8367	696833.53	1432963.51	-36	-42	-43	7
CSS 13	HC-VC-36	45° 33.3743	122° 42.7661	696646.08	1433259.90	-38	-42	-43	5
	HC-VC-37	45° 33.3388	122° 42.7214	696425.21	1433444.76	-36	-42	-43	7
	HC-VC-38	45° 33.3131	122° 42.6545	696261.27	1433725.99	-37	-42	-43	6
CSS 14	HC-VC-39	45° 33.2878	122° 42.6067	696102.01	1433925.78	-36	-42	-43	7
	HC-VC-40	45° 33.2643	122° 42.5862	695956.86	1434009.37	-31	-42	-43	12
	HC-VC-41	45° 33.2625	122° 42.5293	695939.28	1434251.90	-35	-42	-43	8
CSS 15	HC-VC-42	45° 33.2372	122° 42.4721	695778.92	1434491.82	-35	-42	-43	8
	HC-VC-43	45° 33.2003	122° 42.4262	695549.42	1434681.59	-31	-42	-43	12
	HC-VC-44	45° 33.1992	122° 42.3738	695536.63	1434905.04	-33	-42	-43	10
CSS 16	HC-VC-45	45° 33.1825	122° 42.3280	695429.85	1435097.74	-33	-42	-43	10
	HC-VC-46	45° 33.1509	122° 42.2675	695230.84	1435350.71	-34	-42	-43	9
	HC-VC-47	45° 33.1292	122° 42.2477	695096.72	1435431.62	-35	-42	-43	8
CSS 17	HC-VC-48	45° 33.1002	122° 42.1776	694912.40	1435726.00	-34	-42	-43	9
	HC-VC-49	45° 33.0707	122° 42.1128	694725.66	1435997.68	-35	-42	-43	8
	HC-VC-50	45° 33.0500	122° 42.0436	694591.86	1436289.60	-37	-42	-43	6
CSS 18	HC-VC-51	45° 33.0251	122° 42.0043	694436.04	1436453.22	-37	-42	-43	6
	HC-VC-52	45° 32.9673	122° 41.9556	694079.27	1436651.51	-36	-42	-43	7
CSS 19	HC-VC-53	45° 33.0334	122° 42.1589	694504.44	1435794.74	-22	-25	-26	4
Reference Area Locations									
HC-REF-01		45° 28.7404	122° 39.8817	668169.00	7646915.00	-11.8	--	--	--
HC-REF-02		45° 23.2303	122° 37.5673	634435.30	7655924.60	-6.5	--	--	--

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Notes:
Lat/Long in NAD 83 Oregon North. State Plane Coordinates in NAD 27 Oregon North.

Table 2 - Sediment Physical Characteristics
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	%Sand/Gravel >75 µm	%Silt/Clay <75 µm	%Moisture	Material Description
CSS 1	16.2	83.8	79	Silt with sand
CSS 2	6.1	93.9	94	Silt
CSS 3	9.9	90.1	89	Silt
CSS 4	10.3	89.7	94	Silt
CSS 5	8.9	91.1	95	Silt
CSS 6	13.4	86.6	84	Silt
CSS 7	19.8	80.2	95	Silt with sand
CSS 8	19.7	80.3	88	Silt with sand
CSS 9	15.7	84.3	87	Silt with sand
CSS 10	15.9	84.1	86	Silt with sand
CSS 11	21.0	79.0	81	Silt with sand
CSS 12	24.5	75.5	85	Silt with sand
CSS 13	21.9	78.1	89	Silt with sand
CSS 14	20.3	79.7	88	Silt with sand
CSS 15	22.3	77.7	99	Silt with sand
CSS 16	20.7	79.3	105	Silt with sand
CSS 17	15.6	84.4	92	Silt with sand
CSS 18	16.4	83.6	98	Silt with sand
CSS 19	10.8	89.2	65	Silt
HC-REF-01	47.9	52.1	68	Sandy silt
HC-REF-02	26.2	73.8	101	Silt with sand

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Notes:

% Silt/Clay = % Fines (e.g., material less than 75 µm).

Table 3 - Analytical Results for Sediment Samples
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	DMEF Screening Criteria			CSS 1	CSS 2	CSS 3	CSS 4	CSS 5	CSS 6	CSS 7	CSS 8	CSS 9	CSS 10	CSS 11	CSS 12	CSS 13	CSS 14	CSS 15	CSS 16	CSS 17	CSS 18	CSS 19	HC-REF-01	HC-REF-02
	SL	BT	ML																					
Conventionals in mg/kg																								
Ammonia as Nitrogen	--	--	--	290	240	305	295	294	300	87	104	233	258	128	132	148	157	214	224	251	229	106	54	52
Sulfide	--	--	--	1.5	1.7	1.9	1.1	2.2	1.5	1.1	1.3	1.2	1	1	1.1	1.1	0.9	4.6	1.6	2.3	4.1	6.6	5	1.7
Conventionals in Percent																								
Carbon, Total Organic (TOC)	--	--	--	2.31	2.12	2.27	2.51	2.59	2.47	1.89	1.98	2.16	2.52	1.82	1.72	2.06	4.19	3.52	4.29	3.7	4.25	3.59	1.21	1.71
Total Volatile Solids	--	--	--	6.89	4.38	6.84	7.41	7.63	7.46	7	6.59	7.2	7.14	6.42	6.96	7	7.4	7.9	8.33	8.16	8.19	5.03	5.1	6.33
Total Solids	--	--	--	52.5	49.6	53.7	51	49.7	54.4	49.9	52.3	52.1	52.9	53.9	53	52	51.3	50.8	50.5	49.8	48.4	59.5	53.5	51.1
Metals in mg/kg																								
Antimony, Total	150	150	200	0.14 N	0.22 N	0.16 N	0.19 N	0.15 N	0.16 N	0.1 N	0.13 N	0.15 N	0.12 N	0.15 N	0.11 N	0.11 N	0.13 N	0.17 N	0.11 N	0.14 N	0.14 N	0.1 N	0.1 N	0.11 N
Arsenic, Total	57	507	700	3.7	4.6	3.7	3.6	3.3	3.5	3.3	3.3	3.5	4	3.9	3.1	3.4	3.7	3.8	3.5	3.7	3.9	2.4	2.9	2.5
Cadmium, Total	5.1	--	14	0.43	0.33	0.36	0.3	0.25	0.29	0.26	0.22	0.27	0.31	0.28	0.21	0.23	0.24	0.23	0.23	0.3	0.25	0.18	0.21	0.21
Copper, Total	390	--	1,300	38.5	116	45.1	41.4	36.2	39.4	36.1	35.2	38.7	42.8	40.9	33.2	35.4	37.3	38.1	36.2	39.5	39.5	26.3	30.7	30.4
Lead, Total	450	--	1,200	15.8	22.3	24.9	14.6	13.5	16.8	11	11	14.2	16.7	13.8	11.8	10.5	10.9	11.3	10.9	12.4	13.5	12.3	7.48	7.18
Mercury, Total	0.41	1.5	2.3	0.08	0.08	0.08	0.06	0.07	0.08	0.05	0.25	0.07	0.07	0.06	0.05	0.05	0.04	0.05	0.05	0.05	0.06	0.05	0.03	0.03
Nickel, Total	140	370	370	23.8	24.3	25.5	24.1	20.2	23.4	23.2	22.7	23.3	27.1	26.8	22	23.4	25.1	24.5	22.1	24.5	24.7	17.6	22.8	21.9
Silver, Total	6.1	6.1	8.4	0.19	0.31	0.33	0.27	0.28	0.29	0.18	0.14	0.21	0.24	0.25	0.14	0.14	0.16	0.16	0.17	0.37	0.18	0.1	0.09	0.09
Zinc, Total	410	--	3,800	105	133	112	97.2	86.1	95	79.7	75.4	86.1	97.2	95.6	72.7	78.2	83.9	84.5	77.2	86.1	86.1	82	68.5	67.4
Butyltins in µg/L																								
Tributyltin (TBT)	0.15*	0.15	--	0.008 J	3.9 D	0.18	0.16	0.07	0.11	0.004 U	0.006 U	0.012 J	0.016 J	0.016 J	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.006 J	0.0039 U	0.0039 U
LPAHs in µg/kg																								
Acenaphthene	500	--	2,000	50	19	8.7 J	3 J	3.1 J	5 J	2.1 U	2 U	4.7 J	1.9 U	1.9 U	1.9 U	2 U	2.8 J	2.0 U	2.0 U	2.1 U	2.1 U	4.2 J	1.9 U	2 U
Acenaphthylene	560	--	1,300	12	10 J	8.7 J	5.9 J	3.9 J	7 J	2.9 U	2.7 U	6.1 J	4.2 J	6.6 J	2.7 U	2.7 U	4.4 J	2.8 U	3.0 J	2.9 U	2.9 U	10	2.7 U	2.8 U
Anthracene	960	--	13,000	32	27	11	5.8 J	4.5 J	5.4 J	3.1 J	4.7 J	10 J	4.1 J	5.4 J	3.9 J	2.7 U	4.4 J	3.2 J	5.7 J	4.7 J	5.4 J	11	2.7 U	2.8 U
Fluorene	540	--	3,600	35	25	13	5.2 J	5 J	5 J	3.5 U	3.3 U	5.2 J	4.9 J	4.3 J	3.3 U	3.3 U	4 J	3.4 U	3.4 U	3.5 U	3.6 U	6.4 J	3.2 U	3.4 U
Naphthalene	2,100	--	2,400	200	20	32	14	10 J	23	5.7 J	6.8 J	11	12	15	7.7 J	2.5 U	10 J	5.0 J	5.1 J	5.2 J	4.2 J	6.4 J	4.1 J	3.2 J
Phenanthrene	1,500	--	21,000	150	120	45	23	19	24	10 J	15	32	19	17	11	5.3 J	20	12 J	14	13	15	45	4.3 J	3.9 J
2-Methylnaphthalene	670	--	1,900	49	9 J	11	3.6 J	3 J	6.7 J	2.5 U	2.3 U	4.7 J	3.8 J	3.6 J	2.8 J	2.4 U	3.8 J	2.4 U	2.4 U	2.6 J	2.5 U	3.0 J	2.3 U	2.4 U
Total LPAHs	5,200	--	29,000	528	230	129.4	60.5	48.5	76.1	24.3	31.65	73.7	48.95	52.85	29.35	13.1 J	49.4	25.5	30.2	29.75	30.15	67	14.8	13.8
HPAHs in µg/kg																								
Benz(a)anthracene	1,300	--	5,100	51	73	23	14	12 J	14	8 J	14	26	10 J	16	9.1 J	5.7 J	15	7.7 J	14	9.0 J	12 J	37	4.6 J	5 J
Benzo(a)pyrene	1,600	3,600	3,600	70	86	26	14	18	18	7 J	13	19	7.2 J	3 U	11	10 J	7.4 J	10 J	12 J	13	12	57	6.9 J	3.5 J
Total Benzofluoranthenes (b+k)	3,200	--	9,900	96	157	51	29	26 J	33	16 J	32	46	24.2 J	39	16.3 J	8.65 J	25	17	23	19.8	24	83	4.7 U	4.9 U
Benzo(g,h,i)perylene	670	--	3,200	63	48	30	16	15	18	4.7 U	4.4 U	4.5 U	4.4 U	4.3 U	12	5.7 J	4.5 U	14	12	12 J	14	62	5.8 J	4.6 U
Chrysene	1,400	--	21,000	65	88	35	18	15	21	9.3 J	18	34	14	18	10 J	8.1 J	16	11 J	22	13	15	52	6 J	5.5 J
Dibenz(a,h)anthracene	230	--	1,900	10 J	16	4.1 U	4.4 U	4.5 U	4.1 U	4.5 U	4.3 U	4.3 U	4.2 U	4.1 U	4.2 U	4.3 U	4.3 U	4.4 U	4.4 U	4.5 U	4.6 U	6.8 J	4.2 U	4.4 U
Fluoranthene	1,700	4,600	30,000	130	160	59	33	26	36	17	26	46	28	22	18	11	33	19	21	23	29	110	8.3 J	9.4 J
Indeno(1,2,3-cd)pyrene	600	--	16,000	55	63	21	14	12	13	5.6 J	10 J	11	7.5 J	3.6 U	11 J	7.1 J	8.1 J	6.8 J	9.8 J	12	11 J	50	6.2 J	4.1 J
Pyrene	2,600	--	16,000	150	140	58	33	27	34	17	28	44	20	11	17	8.1 J	22	19	20	20	25	110	7.7 J	8.3 J
Total HPAHs	12,000	--	69,000	690	831	305.1	173.2	153.3	189.1	84.5	145.4	230.4	115.2	113.5	106.5	66.5	130.9	106.7	136	124.1	144.3	567.8	49.95	42.75
Phenols in µg/kg																								
2,4-Dimethylphenol	29	--	210	11 U	12 U	11 U	11 U	12 U	11 U	12 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	11 U	12 U	12 U	9.3 U	11 U	11 U
2-Methylphenol	63	--	77	6.5 U	6.9 U	6.4 U	6.7 U	6.9 U	6.3 U	6.9 U	6.6 U	6.6 U	6.5 U	6.4 U	6.5 U	6.6 U	6.7 U	6.7 U	6.8 U	6.9 U	7.1 U	5.8 U	6.4 U	6.7 U
4-Methylphenol	670	--	3,600	65	43	70	40	24	66	15	13	80	94	39	19	11	28	37	60	49	8.7 J	14	5.5 U	6.4 J
Pentachlorophenol (PCP)	400	504	690	17 U	18 U	16 U	17 U	18 U	16 U	18 U	17 U	17 U	17 U	16 U	17 U	17 U	17 U	17 U	17 U	18 U	18 U	15 U	16 U	17 U
Phenol	420	876	1,200	12 J	21 J	22 J	16 J	16 J	15 J	3.9 U	13 J	13 J	12 J	14 J	21 J	9.4 J	10 J	15 J	12 J	12 J	16 J	8.8 J	15 J	15 J
Semivolatiles in µg/kg																								
Benzoic Acid	650	--	760	190 U	200 U	180 U	190 U	200 U	180 U	200 U	190 U	190 U	190 U	180 U	190 U	190 U	190 U	190 U	200 U	200 U	200 U	170 U	180 U	190 U
Benzyl Alcohol	57	--	870	7.1 U	7.5 U	6.9 U	7.3 U	7.5 U	13	7.5 U	11 J	7.2 U	7 U	6.9 U	7 U	7.2 U	7.3 U	13	10 J	7.5 U	7.7 U	6.3 U	7 U	7.3 U
Dibenzofuran	540	--	1,700	13	10 J	7 J	2.6 U	2.7 U	4.5 J	2.7 U	2.5 U	2.8 J	2.5 U	2.5 U	2.5 U	2.5 U	3.4 J	2.6 U	2.6 U	2.7 U	2.7 U	2.2 U	2.5 U	2.6 U
Hexachlorobutadiene	29	212	270	2.7 U	2.9 U	2.7 U	2.8 U	2.9 U	2.6 U	2.9 U	2.7 U	2.7 U	2.7 U	2.6 U	2.7 U	2.7 U	2.8 U	2.8 U	2.8 U	2.9 U	2.9 U	2.4 U	2.7 U	2.8 U
Hexachloroethane	1400	10,220	14,000	4.2 U	4.5 U	4.1 U	4.4 U	4.5 U	4.1 U	4.5 U	4.3 U	4.3 U	4.2 U	4.1 U	4.2 U	4.3 U	4.3 U	4.4 U	4.4 U	4.5 U	4.6 U	3.7 U	4.2 U	4.4 U
N-Nitrosodiphenylamine	28	130	130	4.2 U	4.5 U	4.1 U	4.4 U	4.5 U	4.1 U	4.5 U	4.3 U	4.3 U	4.2 U	4.1 U	4.2 U	4.3 U	4.3 U	4.4 U	4.4 U	4.5 U	4.6 U	3.7 U	4.2 U	4.4 U
1,2-Dichlorobenzene	35	37	110	2.5 U	2.7 U	2.5 U	2.6 U	2.7 U	2.4 U	2.7 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.6 U	2.6 U	2.6 U	2.7 U	2.7 U	2.2 U	2.5 U	2.6 U
1,3-Dichlorobenzene	170	1,241	--	3.1 U	3.3 U	3 U	3.2 U	3.3 U	3 U	3.3 U	3.1 U	3.1 U	3.1 U	3 U	3.1 U	3.1 U	3.2 U	3.2 U	3.2 U	3.3 U	3.4 U	2.7 U	3 U	3.2 U
1,4-Dichlorobenzene	110	120	120	3.7 U	3.9 U	3.6 U	3.8 U	3.9 U	3.5 U	3.9 U	3.7 U	3.7 U	3.6 U	3.6 U	3.6 U	3.7 U	3.8 U	3.8 U	3.8 U	3.9 U	4.0 U	3.2 U	3.6 U	3.8 U
1,2,4-Trichlorobenzene	31	--	64	2.9 U	3.1 U	2.8 U	3 U	3.1 U	2.8 U	3.1 U	2.9 U	2.9 U	2.9 U	2.8 U	2.9 U	2.9 U	3 U	3.0 U	3.0 U	3.1 U	3.1 U	2.6 U	2.9 U	3 U
Hexachlorobenzene	22	168	230	4 U	4.3 U	4 U	4.2 U	4.3 U	3.9 U	4.3 U	4.1 U	4.1 U	4 U	3.9 U	4 U	4.1 U	4.1 U	4.2 U	4.2 U	4.3 U	4.4 U	3.6 U	4 U	4.2 U

Please refer to Notes at the end of this table.

Table 3 - Analytical Results for Sediment Samples
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	DMEF Screening Criteria SL	BT	ML	CSS 1	CSS 2	CSS 3	CSS 4	CSS 5	CSS 6	CSS 7	CSS 8	CSS 9	CSS 10	CSS 11	CSS 12	CSS 13	CSS 14	CSS 15	CSS 16	CSS 17	CSS 18	CSS 19	HC-REF-01	HC-REF-02
Phthalates in µg/kg																								
bis(2-Ethylhexyl) Phthalate	8,300	13,870	--	45 J	560	290	87 J	61 J	65 J	58 J	110 J	78 J	65 J	62 J	58 J	39 J	510	75 J	75 J	280	97 J	71 J	14 J	29 J
Butyl Benzyl Phthalate	970	--	--	2.9 U	20	2.8 U	17	3.1 U	2.8 U	11 J	15	15	13	8.5 J	2.9 U	2.9 U	3 U	5.8 J	3.0 U	10 J	3.1 U	2.6 U	2.9 U	3 U
Di-n-butyl Phthalate	5,100	10,220	--	6.9 J	26	12	15	8.9 J	7.9 J	13	8.3 J	12	11	11 J	7.3 J	64	9.1 J	7.6 J	6.4 J	7.9 J	7.5 J	4.9 J	12	5.1 U
Di-n-octyl Phthalate	6,200	--	--	2.3 U	2.5 U	2.3 U	2.4 U	2.5 U	2.3 U	2.5 U	2.3 U	2.4 U	2.3 U	2.3 U	2.3 U	2.4 U	2.4 U	2.4 U	2.4 U	33	11 J	2.1 U	2.3 U	2.4 U
Diethyl Phthalate	1,200	--	--	6.7 U	7.1 U	12	11 J	13	6.5 U	8 J	8.4 J	6.8 U	6.7 U	6.5 U	7.6 J	6.8 U	8 J	6.9 U	7.0 U	7.1 U	7.3 U	5.9 U	6.6 U	6.9 U
Dimethyl Phthalate	1,400	1,400	--	3.5 U	3.7 U	3.4 U	3.6 U	3.7 U	3.4 U	3.7 U	3.5 U	3.5 U	3.5 U	3.4 U	3.4 U	3.5 U	3.6 U	3.6 U	3.6 U	3.7 U	3.8 U	3.1 U	3.4 U	3.6 U
Pesticides/PCBs in µg/kg																								
4,4'-DDE	--	--	--	4.4	3.8	4.6	2.6	2.6	2.7	1.7	1.7	3.6	2.9	2	1.7	1.4	1.7	1.7	1.8	2	1.8	2.4	1.3	1.3
4,4'-DDD	--	--	--	7.6	2.6	4.7	2	1.6	1.3	0.88 J	0.82 J	2.2	1.4	1	0.84 JP	0.91 J	0.95 J	0.99	0.91 J	1.1 J	0.97 J	1.7	0.18 U	0.54 UJ
4,4'-DDT	--	--	--	2.3	2.1 UJ	7.3	0.34 U	1.1 UJ	1.3 UJ	0.35 U	0.33 U	0.33 U	1.6 P	0.32 U	0.33 U	0.33 U	0.34 U	1.1 P	0.34 U	0.35 U	1.3 P	0.93 UJ	1.0 JP	0.34 U
Total DDT	6.9	50	69	14.3	7.45	16.6	4.6	4.2	4	2.58	2.52	5.8	5.9	3	2.54	2.31	2.65	3.79	2.71	3.1	4.07	4.1	2.39	1.74
gamma-BHC (Lindane)	10	--	--	0.19 U	1 UJ	1 UJ	0.2 U	0.2 U	1 UJ	0.2 U	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.21 U	0.17 U	0.19 U	0.20 U
Heptachlor	10	37	--	0.19 U	0.2 U	0.19 U	0.2 U	0.2 U	0.18 U	0.2 U	0.19 U	0.19 U	0.19 U	0.18 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U	0.2 U	0.21 U	0.17 U	1.1 UJ	1.1 UJ
Aldrin	10	37	--	0.48 U	0.51 U	0.47 U	0.5 U	0.51 U	0.46 U	0.51 U	0.48 U	0.48 U	0.48 U	0.47 U	0.48 U	0.49 U	0.49 U	0.5 U	0.5 U	0.51 U	0.52 U	0.43 U	0.47 U	0.49 U
gamma-Chlordane	--	--	--	0.073 U	1 UJ	0.071 U	0.77 UJ	0.26 JP	0.28 UJ	0.91 UJ	1.1 UJ	0.94 UJ	0.35 JP	0.24 JP	0.68 UJ	0.96 UJ	1.1 UJ	0.41 JP	0.99 UJ	1.1 UJ	1.1 UJ	0.84 UJ	0.35 JP	0.12 UJ
alpha-Chlordane	10	37	--	0.28 J	0.48 J	0.3 J	0.27 J	0.28 J	0.29 J	0.13 U	0.94 UJ	0.49 J	0.28 J	0.2 J	0.94 UJ	0.12 U	0.13 U	0.98 UJ	0.13 U	1.1 UJ	1.1 UJ	0.36 J	0.12 U	0.13 U
Dieldrin	10	37	--	0.25 JP	0.43 JP	0.16 U	0.17 U	0.17 U	0.16 U	0.17 JP	0.27 JP	0.19 JP	0.51 JP	0.16 U	0.16 U	0.19 JP	0.21 JP	0.31 J	0.21 J	0.23 J	0.19 JP	0.17 JP	0.16 U	0.17 U
Aroclor 1016	--	--	--	3.5 U	3.7 U	3.4 U	3.6 U	3.7 U	3.4 U	3.7 U	3.5 U	3.5 U	3.5 U	3.4 U	3.4 U	3.5 U	3.6 U	3.6 U	3.6 U	3.7 U	3.8 U	3.1 U	3.4 U	3.6 U
Aroclor 1221	--	--	--	3.5 U	3.7 U	3.4 U	3.6 U	3.7 U	3.4 U	3.7 U	3.5 U	3.5 U	3.5 U	3.4 U	3.4 U	3.5 U	3.6 U	3.6 U	3.6 U	3.7 U	3.8 U	3.1 U	3.4 U	3.6 U
Aroclor 1232	--	--	--	3.5 U	3.7 U	3.4 U	3.6 U	3.7 U	3.4 U	3.7 U	3.5 U	3.5 U	3.5 U	3.4 U	3.4 U	3.5 U	3.6 U	3.6 U	3.6 U	3.7 U	3.8 U	3.1 U	3.4 U	3.6 U
Aroclor 1242	--	--	--	3.5 U	3.7 U	3.4 U	3.6 U	3.7 U	3.4 U	3.7 U	3.5 U	3.5 U	3.5 U	3.4 U	3.4 U	3.5 U	3.6 U	3.6 U	3.6 U	3.7 U	3.8 U	3.1 U	3.4 U	3.6 U
Aroclor 1248	--	--	--	3.5 U	3.7 U	3.4 U	3.6 U	3.7 U	3.4 U	3.7 U	3.5 U	11	7.4 J	3.4 U	3.4 U	3.5 U	3.6 U	3.6 U	3.6 U	3.7 U	3.8 U	3.1 U	3.4 U	3.6 U
Aroclor 1254	--	--	--	22	32	32	12	14	18	3.7 U	3.5 U	3.5 U	3.5 U	3.4 U	3.4 U	3.5 U	3.6 U	3.6 U	3.6 U	3.7 U	3.8 U	3.1 U	3.4 U	4.7 J
Aroclor 1260	--	--	--	3.5 U	3.7 U	3.4 U	3.6 U	3.7 U	3.4 U	6.7 J	5.1 J	11	14	6.8 J	6 JP	5.8 JP	6.7 J	7.7 J	6.7 J	8.2 J	7.7 J	21	3.4 U	3.6 U
Total PCBs	130	38[†]	3,100	22	32	32	12	14	18	6.7 J	5.1 J	22	21.4	6.8 J	6 JP	5.8 JP	6.7 J	7.7 J	6.7 J	8.2 J	7.7 J	21	3.4 U	4.7 J

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Notes:
DMEF SL = Dredge Material Evaluation Framework Screening Level; BT = Bioaccumulation Trigger; and ML = Maximum Level.
-- = Not available.
U = Not detected at the indicated detection limits.
J = Estimated value.
N = The matrix spike sample recovery is not within control limits.
P = The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than the 40% between the two analytical results (25% for CLP Pesticides).
* Porewater analysis in µg/L.
† This value is normalized to TOC and is expressed in mg/kg (TOC normalized).
Sums for total LPAHs, HPAHs and total DDT include adding half of the indicated detection limit.
Shading indicates an exceedence of DMEF-SL.
☐ Indicates an exceedence of DMEF-BT.

Table 4 - *Hyalella azteca* 10-Day (P699-1) & 28-Day (P699-7) Tests – Comparison of Results
Willamette River Federal Navigation Channel
Portland, Oregon

	10-Day *Hyalella azteca* Test Results[1]		28-Day *Hyalella azteca* Test Results[2]			
Sample Identification	**Percent mortality (Mean ± SD)**	**Statistically significantly different than that of the reference?**	**Percent mortality (Mean ± SD)**	**Statistically significantly different than that of the reference?**	**Average dry wt/amphipod (mg) (Mean ± SD)**	**Statistically significantly different than that of the reference?**
Control (NAS#8593F)	1.3 ± 3.5	No	7.5 ± 8.9	No	0.21 ± 0.03	No
CSS 1 (NAS#8555F)	5.0 ± 10.7	No	26.3 ± 19.2	**Yes**	0.15 ± 0.04	No
CSS 2 (NAS#8556F)	5.0 ± 14.1	No	45.0 ± 16.0	**Yes**	0.11 ± 0.02	**Yes**
CSS 3 (NAS#8557F)	3.8 ± 7.4	No	82.5 ± 19.1	**Yes**	0.09 ± 0.02	**Yes**
CSS 4 (NAS#8558F)	2.5 ± 4.6	No	31.3 ± 19.6	**Yes**	0.15 ± 0.03	No
CSS 5 (NAS#8559F)	5.0 ± 7.6	No	28.8 ± 20.3	**Yes**	0.14 ± 0.02	No
CSS 6 (NAS#8560F)	0.0 ± 0.0	No	60.0 ± 14.1	**Yes**	0.10 ± 0.03	**Yes**
CSS 7 (NAS#8561F)	3.8 ± 5.2	No	10.0 ± 7.6	**Yes**	0.20 ± 0.02	No
CSS 8 (NAS#8562F)	3.8 ± 7.4	No	15.0 ± 15.1	**Yes**	0.18 ± 0.03	No
CSS 9 (NAS#8563F)	3.8 ± 5.2	No	27.5 ± 13.9	**Yes**	0.14 ± 0.03	No
CSS 10 (NAS#8564F)	3.8 ± 7.4	No	22.5 ± 16.7	**Yes**	0.15 ± 0.01	No
CSS 11 (NAS#8565F)	3.8 ± 7.4	No	13.8 ± 10.6	**Yes**	0.15 ± 0.03	No
CSS 12 (NAS#8566F)	3.8 ± 5.2	No	11.3 ± 8.3	**Yes**	0.18 ± 0.03	No
CSS 13 (NAS#8567F)	1.3 ± 3.5	No	8.8 ± 9.9	No	0.16 ± 0.02	No
CSS 14 (NAS#8568F)	0.0 ± 0.0	No	17.5 ± 12.8	**Yes**	0.21 ± 0.03	No
CSS 15 (NAS#8569F)	1.3 ± 3.5	No	10.0 ± 7.6	**Yes**	0.18 ± 0.02	No
CSS 16 (NAS#8570F)	5.0 ± 7.6	No	6.3 ± 11.9	No	0.19 ± 0.02	No
CSS 17 (NAS#8571F)	6.3 ± 7.4	No	12.5 ± 10.4	**Yes**	0.21 ± 0.06	No
CSS 18 (NAS#8572F)	1.3 ± 3.5	No	8.8 ± 8.3	No	0.18 ± 0.02	No
CSS 19 (NAS#8573F)	5.0 ± 9.3	No	32.5 ± 13.9	**Yes**	0.14 ± 0.02	No
HC-REF-01 (NAS#8574F)	0.0 ± 0.0	No	16.3 ± 13.0	**No**	0.14 ± 0.02	No
HC-REF-02 (NAS#8575F)*	6.3 ± 10.6	No	3.8 ± 7.4	---	0.16 ± 0.03	---

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Note:
* Reference sediment

[1] Data interpretation was conducted as described in *Dredged Material Evaluation Framework, Lower Columbia River Management Area* - November 1998 (U.S. Army Corps of Engineers, Seattle District; U.S. Environmental Protection Agency, Region 10, Washington Department of Natural Resources, Washington Department of Ecology, and Oregon Department of Environmental Ecology). For a test sediment to fail under the single hit rule (a "hit"), the mean test mortality must be greater than 15 percentage points over the reference sediment response and "statistically different" from the reference sediment. A "statistically different" response is defined in the "Evaluation Framework" as having a mortality response that is greater than 20 percent difference from that of the control, and is statistically different (a = 0.05) from that of the reference sediment.

[2] Data interpretation was conducted as described in *Development of Freshwater Sediment Quality Values for Use in Washington State, Phase 1, Task 6: Final Report,* September 2002 for the Sediment Quality Standards (SQS) endpoint criteria (Ecology 2002). For a survival test sediment to fail, the mean test mortality must be greater than 10 percentage points over the reference sediment response and "statistically different" from the reference sediment. For a growth test to fail, a relative decrease in weight of greater than 25 percent of the reference and a "statistically different" response from the refernce sediment is required. Statistical difference is detremined using standard SMS/PSDDA statistical protocols.

Table 5 - *Chironomus tentans* 10-Day (P699-2) & 20-Day (P699-4) Tests – Comparison of Results
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	10-Day *Chironomus tentans* Test Results[2]				20-Day *Chironomus tentans* Test Results[2]			
	Percent mortality (Mean ± SD)	Statistically significantly different than that of the reference?	Average ash-free dry wt/midge (mg) (Mean ± SD)	Statistically significantly different than that of the reference?	Percent mortality (Mean ± SD)	Statistically significantly different than that of the reference?	Average ash-free dry wt/midge (mg) (Mean ± SD)	Statistically significantly different than that of the reference?
Control (NAS#8593F)	13.8 ± 20.0	No	0.83 ± 0.11	No	11.3 ± 11.3	No	1.93 ± 0.30	No
CSS 1 (NAS#8555F)	27.5 ± 11.6	**Yes**	0.65 ± 0.14	No	25.0 ± 12.0	No	1.63 ± 0.50	No
CSS 2 (NAS#8556F)	21.3 ± 11.3	**Yes**	0.62 ± 0.13	No	21.3 ± 18.1	No	1.55 ± 0.29	No
CSS 3 (NAS#8557F)	32.5 ± 18.3	**Yes**	0.76 ± 0.15	No	20.0 ± 16.9	No	1.50 ± 0.31	No
CSS 4 (NAS#8558F)	25.0 ± 13.1	**Yes**	0.70 ± 0.10	No	33.8 ± 21.3	No	1.81 ± 0.35	No
CSS 5 (NAS#8559F)	25.0 ± 14.1	No	0.68 ± 0.09	No	26.3 ± 24.5	No	1.66 ± 0.28	No
CSS 6 (NAS#8560F)	21.3 ± 11.3	**Yes**	0.74 ± 0.09	No	18.8 ± 20.3	No	1.58 ± 0.18	No
CSS 7 (NAS#8561F)	10.0 ± 10.7	No	0.68 ± 0.09	No	18.8 ± 15.5	No	1.69 ± 0.26	No
CSS 8 (NAS#8562F)	25.0 ± 21.4	No	0.70 ± 0.18	No	11.3 ± 13.6	No	1.54 ± 0.21	No
CSS 9 (NAS#8563F)	20.0 ± 18.5	No	0.73 ± 0.10	No	26.3 ± 19.2	No	1.76 ± 0.59	No
CSS 10 (NAS#8564F)	17.5 ± 13.9	No	0.82 ± 0.07	No	23.8 ± 25.0	No	1.62 ± 0.25	No
CSS 11 (NAS#8565F)	28.8 ± 15.5	**Yes**	0.85 ± 0.25	No	31.3 ± 25.9	No	1.79 ± 0.42	No
CSS 12 (NAS#8566F)	25.0 ± 18.5	No	0.78 ± 0.07	No	18.8 ± 14.6	No	1.64 ± 0.19	No
CSS 13 (NAS#8567F)	26.3 ± 20.7	No	0.76 ± 0.14	No	35.0 ± 22.7	**Yes**	1.93 ± 0.50	No
CSS 14 (NAS#8568F)	18.8 ± 11.3	No	0.76 ± 0.09	No	50.0 ± 30.7	**Yes**	2.32 ± 0.70	No
CSS 15 (NAS#8569F)	30.0 ± 15.1	**Yes**	0.89 ± 0.14	No	21.3 ± 18.1	No	1.76 ± 0.19	No
CSS 16 (NAS#8570F)	26.3 ± 9.2	**Yes**	0.87 ± 0.18	No	25.0 ± 14.1	No	1.94 ± 0.46	No
CSS 17 (NAS#8571F)	22.5 ± 20.5	No	0.75 ± 0.11	No	27.5 ± 28.7	No	1.88 ± 0.35	No
CSS 18 (NAS#8572F)	25.0 ± 15.1	No	0.81 ± 0.13	No	37.5 ± 37.7	No	1.59 ± 0.17	No
CSS 19 (NAS#8573F)	15.0 ± 14.1	No	0.68 ± 0.08	No	20.0 ± 19.3	No	1.70 ± 0.25	No
HC-REF-01 (NAS#8574F)	21.3 ± 15.5	No	0.68 ± 0.13	No	32.5 ± 27.6	No	1.78 ± 0.60	No
HC-REF-02 (NAS#8575F)*	12.5 ± 10.4	---	0.70 ± 0.07	---	17.5 ± 10.4	---	1.44 ± 0.21	---

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Notes:
*Reference sediment

[1] Data interpretation was conducted as described in *Dredged Material Evaluation Framework, Lower Columbia River Management Area* - November 1998 (U.S. Army Corps of Engineers, Seattle District; U.S. Environmental Protection Agency, Region 10, Washington Department of Natural Resources, Washington Department of Ecology, and Oregon Department of Environmental Ecology). For a test sediment to fail under the single hit rule (a "hit"), the mean test mortality must be greater than 20 percentage points over the reference sediment response and "statistically different" from the reference sediment. Alternatively, if the reduction in the mean individual biomass is greater than 40 percent than that of the mean reference weight and is statistically different from the reference then the one hit rule also applies. A "statistically different" response is defined in the "Evaluation Framework" as having a mortality or growth response that is greater than 20 percent difference from that of the control, and is statistically different (a = 0.05) from that of the reference sediment. If either or both endpoints fail the guideline, the test is considered a hit.

[2] Data interpretation was conducted as described in *Development of Freshwater Sediment Quality Values for Use in Washington State, Phase 1, Task 6: Final Report,* September 2002 for the Sediment Quality Standards (SQS) endpoint criteria (Ecology 2002). For a survival test sediment to fail, the mean test mortality must be greater than 15 percentage points over the reference sediment response and "statistically different" from the reference sediment. For a growth test to fail, a relative decrease in weight of greater than 25 percent of the reference and a "statistically different" response from the refernce sediment is required. Statistical difference is detremined using standard SMS/PSDDA statistical protocols.

Table 6 - Comparison of Short-Term Freshwater Acute Test "Hits" Versus Long-Term Test "Hits"
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	10-Day *Hyalella azteca* test P699-1 — Classified as a "Hit[1]"?	28-Day *Hyalella azteca* test P699-7 — Classified as a "Hit[3]"?	10-Day *Chironomus tentans* test P699-2 — Classified as a "Hit[2]"?	20-Day *Chironomus tentans* test P699-4 — Classified as a "Hit[4]"?
Control (NAS#8593F)	---	---	---	---
CSS 1 (NAS#8555F)	No	**Yes**	No	No
CSS 2 (NAS#8556F)	No	**Yes**	No	No
CSS 3 (NAS#8557F)	No	**Yes**	No	No
CSS 4 (NAS#8558F)	No	**Yes**	No	No
CSS 5 (NAS#8559F)	No	**Yes**	No	No
CSS 6 (NAS#8560F)	No	**Yes**	No	No
CSS 7 (NAS#8561F)	No	No	No	No
CSS 8 (NAS#8562F)	No	**Yes**	No	No
CSS 9 (NAS#8563F)	No	**Yes**	No	No
CSS 10 (NAS#8564F)	No	**Yes**	No	No
CSS 11 (NAS#8565F)	No	No	No	No
CSS 12 (NAS#8566F)	No	No	No	No
CSS 13 (NAS#8567F)	No	No	No	**Yes**
CSS 14 (NAS#8568F)	No	**Yes**	No	**Yes**
CSS 15 (NAS#8569F)	No	No	No	No
CSS 16 (NAS#8570F)	No	No	No	No
CSS 17 (NAS#8571F)	No	No	No	No
CSS 18 (NAS#8572F)	No	No	No	No
CSS 19 (NAS#8573F)	No	**Yes**	No	No
HC-REF-01 (NAS#8574F)	No	No	No	No
HC-REF-02 (NAS#8575F)*	---	---	---	---
Total "Hits"	**0**	**11**	**0**	**2**

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Notes:
*Reference sediment

[1] Data interpretation was conducted as described in *Dredged Material Evaluation Framework, Lower Columbia River Management Area* - November 1998 (U.S. Army Corps of Engineers, Seattle District; U.S. Environmental Protection Agency, Region 10, Washington Department of Natural Resources, Washington Department of Ecology, and Oregon Department of Environmental Ecology). For a test sediment to fail under the single hit rule (a "hit"), the mean test mortality must be greater than 15 percentage points over the reference sediment response and "statistically different" from the reference sediment. A "statistically different" response is defined in the "Evaluation Framework" as having a mortality response that is greater than 20 percent difference from that of the control, and is statistically different (a = 0.05) from that of the reference sediment.

[2] Data interpretation was conducted as described in *Dredged Material Evaluation Framework, Lower Columbia River Management Area* - November 1998 (U.S. Army Corps of Engineers, Seattle District; U.S. Environmental Protection Agency, Region 10, Washington Department of Natural Resources, Washington Department of Ecology, and Oregon Department of Environmental Ecology). For a test sediment to fail under the single hit rule (a "hit"), the mean test mortality must be greater than 20 percentage points over the reference sediment response and "statistically different" from the reference sediment. Alternatively, if the reduction in the mean individual biomass is greater than 40 percent than that of the mean reference weight and is statistically different from the reference then the one hit rule also applies. A "statistically different" response is defined in the "Evaluation Framework" as having a mortality or growth response that is greater than 20 percent difference from that of the control, and is statistically different (a = 0.05) from that of the reference sediment. If either or both endpoints fail the guideline, the test is considered a hit.

[3] Data interpretation was conducted as described in *Development of Freshwater Sediment Quality Values for Use in Washington State, Phase 1, Task 6: Final Report, September 2002* for the Sediment Quality Standards (SQS) endpoint criteria. For a test sediment to be classified as a "hit" either the mean test mortality must be statistically significantly greater (a = 0.05) than that of the reference sediment and greater than 10 percentage points over the reference sediment result or the mean individual test weight must be statistically significantly less (a = 0.05) than that of the reference sediment and less than 75 percent than that of the reference sediment.

[4] Data interpretation was conducted as described in *Development of Freshwater Sediment Quality Values for Use in Washington State, Phase 1, Task 6: Final Report, September 2002* for Sediment Quality Standards (SQS) endpoint criteria. For a test sediment to be classified as a "hit" either the mean test mortality must be statistically significantly greater (a = 0.05) than that of the reference sediment and greater than 15 percentage points over the reference sediment result or the mean individual test weight must be statistically significantly less (a = 0.05) than that of the reference sediment and less than 75 percent than that of the reference sediment.

Table 7 - Tissue Results from Bioaccumulation Testing for *Lumbriculus variegatus*
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	Day 0			Day 0 Mean	Day 28 for Control Exposure			Control Day 28 Mean	Day 28 for CSS 2 Exposure			CSS 2 Day 28 Mean	Day 28 for CSS 10 Exposure			CSS 10 Day 28 Mean	Day 28 for HC-REF-02 Exposure			HC-REF-02 Day 28 Mean
Replicate Number	1	2	3		1	2	3		1	2	3		1	2	3		1	2	3	
Conventionals as Wet Wt.																				
Sample Weight in grams	32.9	33	34.1	**33.3**	15.4	11.7	14.1	**13.7**	10.9	10.6	13	**11.5**	11.4	11.8	13.6	**12.3**	17	14.5	13.2	**14.9**
Total Lipids in %	n/a	n/a	0.24	**0.2**	n/a	0.7	0.8	**0.8**	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	**n/a**
Total Solids in %	11.5	10.6	11.1	**11.1**	13.8	15.1	13.7	**14.2**					15.4	15.7	15.7	**15.6**	14.6	14.1	15	**14.6**
Metals in mg/kg as Dry Wt.																				
Antimony	0.009 J	0.008 J	0.009 J	**0.01**	0.025 J	0.027 J	0.027 J	**0.03**	NA	NA	NA		0.018 J	0.026 J	0.023 J	**0.02**	0.037 J	0.033 J	0.222 J	**0.10**
Arsenic	1.76	1.85	1.71	**1.8**	14.5	14.8	15.1	**14.8**	NA	NA	NA		4.84	5.05	4.85	**4.9**	11.7	10.5	10.3	**10.8**
Cadmium	0.21	0.21	0.19	**0.2**	0.23	0.24	0.25	**0.2**	NA	NA	NA		0.25	0.27	0.25	**0.3**	0.27	0.26	0.26	**0.3**
Copper	27.7	26.9	26.2	**26.9**	25.8	25.1	26.7	**25.9**	NA	NA	NA		34.6	36.1	35.2	**35.3**	33.5	32.2	36.8	**34.2**
Lead	0.527	0.578	0.542	**0.5**	0.881	0.909	0.858	**0.9**	NA	NA	NA		0.905	1.26	1.17	**1.1**	0.894	0.938	1	**0.9**
Mercury	0.04	0.02 J	0.02	**0.03**	0.03 J	0.03 J	0.04	**0.03**	NA	NA	NA		0.02 U	0.02 J	0.02 J	**0.02**	0.02 J	0.03 J	0.04	**0.03**
Nickel	2.42	2.23	2.54	**2.4**	2.4	2.39	2.45	**2.4**	NA	NA	NA		3.17	3.91	3.67	**3.6**	3.87	3.5	3.39	**3.6**
Silver	0.019 J	0.02 J	0.017 J	**0.02**	0.025	0.028	0.024	**0.03**	NA	NA	NA		0.03	0.038	0.042	**0.04**	0.03 J	0.035	0.035	**0.03**
Zinc	208	208	199	**205**	229	236	254	**240**	NA	NA	NA		246	256	249	**250**	281	238	244	**254**
Butyltins in µg/kg as Wet Wt.																				
Tri-n-butyltin (TBT)	0.45 U	0.45 U	0.33 U	--	1.5 U	NA	1.3 U	--	340	440	350 D	376.67	NA	NA	NA		0.58 U	1.2 U	1.4 U	
Semivolatiles in µg/kg as Wet Wt.																				
Acenaphthene	0.31 J	0.29 J	0.34 J	**0.3**	1.1 J	1.3 J	0.6 J	**1.0**	1.9 J	2.4 J	1.5 J	**1.9**	0.94 J	1.1 J	1.1 J	**1.0**	0.81 J	0.76 J	0.78 J	**0.8**
Acenaphthylene	0.16 J	0.12 J	0.2 J	**0.2**	0.78 J	1.1 J	0.38 J	**0.8**	0.91 J	1.3 J	1.4 J	**1.2**	0.92 J	0.94 J	0.84 J	**0.9**	0.37 J	0.47 J	0.39 J	**0.4**
Anthracene	0.2 J	0.18 J	0.11 U	**0.1**	1.4 J	3 J	0.57 J	**1.7**	4.7 J	5 J	4 J	**4.6**	1.7 J	1.9 J	1.3 J	**1.6**	2.8 J	1.2 J	1.5 J	**1.8**
Fluorene	0.4 J	0.44 J	0.58 J	**0.5**	1.6 J	2.8 J	1 J	**1.8**	3.6 J	5.2 J	3.6 J	**4.1**	1.6 J	1.8 J	1.5 J	**1.6**	1.7 J	1.4 J	1.7 J	**1.6**
Naphthalene	0.83 J	0.86 J	1.2 J	**1.0**	1.4 J	1.9 J	3.1 J	**2.1**	2.4 J	2.9 J	2.3 J	**2.5**	2.9 J	2.7 J	2.4 J	**2.7**	2.1 J	2.4 J	2.2 J	**2.2**
Phenanthrene	2.6 J	2.3 J	2.5 J	**2.5**	4 J	6.4 J	3.1 J	**4.5**	27	30	22 J	**26.3**	7.3 J	8.7 J	8.6 J	**8.2**	7.6 J	5 J	6.4 J	**6.3**
2-Methylnaphthalene	0.55 J	0.54 J	0.74 J	**0.6**	1.2 J	1.4 J	1.4 J	**1.3**	1.8 J	1.9 J	1.6 J	**1.8**	1.6 J	1.5 J	1.5 J	**1.5**	1.5 J	1.9 J	1.5 J	**1.6**
Benz(a)anthracene	0.25 J	0.21 J	0.11 U	**0.2**	0.77 J	1.3 J	0.76 J	**0.9**	25 J	26	23 J	**24.7**	5.6 J	7.9 J	6.3 J	**6.6**	2.2 J	2.5 J	2.4 J	**2.4**
Benzo(a)pyrene	0.095 U	0.22 J	0.16 U	**0.1**	0.19 U	0.38 U	0.38 U	--	14 J	15 J	13 J	**14.0**	3 J	5.2 J	3.5 J	**3.9**	1.3 J	1.5 J	1.3 J	**1.4**
Benzo(b)fluoranthene	0.29 J	0.26 J	0.34 J	**0.3**	0.94 J	1.9 J	1 J	**1.3**	21 J	23 J	22 J	**22.0**	6.4 J	9.2 J	7.1 J	**7.6**	2.9 J	3.2 J	3.3 J	**3.1**
Benzo(k)fluoranthene	0.34 J	0.22 J	0.35 J	**0.3**	0.76 J	1.3 J	0.41 U	**0.7**	17 J	18 J	17 J	**17.3**	4.4 J	7.3 J	4.4 J	**5.4**	2 J	1.6 J	2.4 J	**2.0**
Benzo(g,h,i)perylene	0.33 J	0.23 J	0.29 J	**0.3**	0.68 J	3.5 J	0.86 J	**1.7**	9.5 J	11 J	11 J	**10.5**	4.9 J	8.8 J	5.2 J	**6.3**	2.5 J	2.8 J	2.7 J	**2.7**
Chrysene	0.91 J	0.84 J	0.9 J	**0.9**	1.4 J	2.1 J	1.4 J	**1.6**	47	50	43	**46.7**	13 J	17 J	15 J	**15.0**	4.9 J	5.7 J	5.3 J	**5.3**
Dibenz(a,h)anthracene	0.22 J	0.29 J	0.16 U	**0.2**	0.81 J	0.4 U	0.4 U	**0.5**	2.8 J	3 J	4.9 J	**3.6**	0.87 J	3.5 J	1.2 J	**1.9**	0.68 J	0.6 J	0.4 U	**0.4**
Fluoranthene	2.2 J	1.9 J	2.3 J	**2.1**	2.9 J	5.2 J	3.4 J	**3.8**	62	65	55	**60.7**	14 J	17 J	17 J	**16.0**	8.6 J	7.5 J	7.6 J	**7.9**
Indeno(1,2,3-cd)pyrene	0.21 J	0.2 J	0.24 J	**0.2**	0.55 J	1.7 J	0.57 J	**0.9**	5.3 J	5.9 J	7.6 J	**6.3**	2.2 J	5.3 J	2.7 J	**3.4**	1.2 J	1.3 J	1.2 J	**1.2**
Pyrene	2.6 J	2.5 J	2.6 J	**2.6**	2 J	4 J	2.2 J	**2.7**	75	77	64	**72.0**	15 J	18 J	17 J	**16.7**	7.4 J	6.7 J	7.3 J	**7.1**
Phenols in µg/kg as Wet Wt.																				
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorophenol (PCP)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Please refer to notes at the end of this table.

Table 7 - Tissue Results from Bioaccumulation Testing for *Lumbriculus variegatus*
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	Day 0			Day 0 Mean	Day 28 for Control Exposure			Control Day 28 Mean	Day 28 for CSS 2 Exposure			CSS 2 Day 28 Mean	Day 28 for CSS 10 Exposure			CSS 10 Day 28 Mean	Day 28 for HC-REF-02 Exposure			HC-REF-02 Day 28 Mean
Replicate Number	1	2	3		1	2	3		1	2	3		1	2	3		1	2	3	
Misc. Semivolatiles in µg/kg as Wet Wt.																				
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzyl Alcohol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenzofuran	0.42	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phthalates in µg/kg																				
Bis(2-ethylhexyl) Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Butyl Benzyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dimethyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pesticides/PCBs in µg/kg as Wet Wt.																				
4,4'-DDD	0.26 U	0.26 U	0.26 U	--	0.53 U	0.83 U	0.52 U	--	--	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDE	3 P	3.7 P	3.7 P	**3.47**	3.8 JP	5.4	4.9	**4.70**	--	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDT	3.1 P	2.9 P	2.8 P	**2.93**	1.6 U	1.6 U	1.6 U	--	--	--	--	--	--	--	--	--	--	--	--	--
Total DDT								--	--	--	--	--	--	--	--	--	--	--	--	--
Aldrin	0.4 U	0.4 U	0.4 U	--	0.8 U	0.8 U	0.8 U	--	--	--	--	--	--	--	--	--	--	--	--	--
alpha-Chlordane	0.72 U	0.72 U	0.72 U	--	1.5 U	1.5 U	1.5 U	--	--	--	--	--	--	--	--	--	--	--	--	--
gamma-Chlordane	0.28 U	0.28 U	0.28 U	--	0.56 U	0.56 U	4 U	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	0.96 JP	0.86 JP	0.64 JP	**0.82**	1.1 JP	1.2 J	0.87 J	**1.06**	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor	0.89 U	0.9 U	0.9 U	--	1.8 U	1.8 U	1.8 U	--	--	--	--	--	--	--	--	--	--	--	--	--
gamma-BHC (Lindane)	0.56 U	0.56 U	0.56 U	--	1.2 U	1.2 U	1.2 U	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1016	4 U	4 U	4 U	--	8 U	8 U	8 U	--	8 U	8 U	8 U	--	6.7 U	5.8 U	5.8 U	--	8 U	8 U	8 U	--
Aroclor 1221	6.2 U	6.2 U	6.2 U	--	13 U	13 U	13 U	--	13 U	13 U	13 U	--	11 U	8.9 U	8.9 U	--	13 U	13 U	13 U	--
Aroclor 1232	4 U	4 U	4 U	--	8 U	8 U	8 U	--	8 U	8 U	8 U	--	6.7 U	5.8 U	5.8 U	--	8 U	8 U	8 U	--
Aroclor 1242	7 U	7 U	7 U	--	14 U	14 U	14 U	--	14 U	14 U	14 U	--	12 U	10 U	10 U	--	14 U	14 U	14 U	--
Aroclor 1248	1.6 U	1.6 U	1.6 U	--	3.1 U	3.1 U	3.1 U	--	3.1 U	3.1 U	3.1 U	--	2.6 U	2.2 U	2.2 U	--	3.1 U	3.1 U	3.1 U	--
Aroclor 1254	3 U	3 U	3 U	--	6 U	6 U	6 U	--	56	64	65	**61**	37	33	37	**36**	6 U	6 U	6 U	--
Aroclor 1260	9.3 U	9.4 U	9.4 U	--	19 U	19 U	19 U	--	19 U	19 U	19 U	--	16 U	14 U	14 U	--	19 U	19 U	19 U	--

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Notes:
U = Not detected at the indicated method reporting limits (MRL).
J = Estimated concentration that is less than the MRL but greater than or equal to the MDL.
D = Reported result is from dilution.
P = Confirmation criteria was exceeded. The relative percent difference is greater than 25 percent between the two analytical results.
-- = Not analyzed/Not applicable.
Mean = Mean tissue concentrations of constituents were calculated using one-half of the MRL for non-detected replicates (see laboratory certificates in Appendix B).

Table 8 - Tissue Results (Lipid Normalized) from Bioaccumulation Testing for *Lumbriculus variegatus*
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	Day 0			Day 0 Mean	Day 28 for Control Exposure			Control Day 28 Mean	Day 28 for CSS 2 Exposure			CSS 2 Day 28 Mean	Day 28 for CSS 10 Exposure			CSS 10 Day 28 Mean	Day 28 for HC-REF-02 Exposure			HC-REF-02 Day 28 Mean
Replicate Number	1	2	3		1	2	3		1	2	3		1	2	3		1	2	3	
Conventionals as Wet Wt.																				
Sample Weight in grams	32.9	33	34.1	**33.3**	15.4	11.7	14.1	**13.7**	10.9	10.6	13	**11.5**	11.4	11.8	13.6	**12.3**	17	14.5	13.2	**14.9**
Total Lipids in %	n/a	n/a	0.24	**0.2**	n/a	0.7	0.8	**0.8**	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	**n/a**
Total Solids in %	11.5	10.6	11.1	**11.1**	13.8	15.1	13.7	**14.2**					15.4	15.7	15.7	**15.6**	14.6	14.1	15	**14.6**
Metals in mg/kg as Dry Wt.																				
Antimony	0.009 J	0.008 J	0.009 J	**0.01**	0.025 J	0.027 J	0.027 J	**0.03**	NA	NA	NA		0.018 J	0.026 J	0.023 J	**0.02**	0.037 J	0.033 J	0.222 J	**0.10**
Arsenic	1.76	1.85	1.71	**1.8**	14.5	14.8	15.1	**14.8**	NA	NA	NA		4.84	5.05	4.85	**4.9**	11.7	10.5	10.3	**10.8**
Cadmium	0.21	0.21	0.19	**0.2**	0.23	0.24	0.25	**0.2**	NA	NA	NA		0.25	0.27	0.25	**0.3**	0.27	0.26	0.26	**0.3**
Copper	27.7	26.9	26.2	**26.9**	25.8	25.1	26.7	**25.9**	NA	NA	NA		34.6	36.1	35.2	**35.3**	33.5	32.2	36.8	**34.2**
Lead	0.527	0.578	0.542	**0.5**	0.881	0.909	0.858	**0.9**	NA	NA	NA		0.905	1.26	1.17	**1.1**	0.894	0.938	1	**0.9**
Mercury	0.04	0.02 J	0.02	**0.03**	0.03 J	0.03 J	0.04	**0.03**	NA	NA	NA		0.02 U	0.02 J	0.02 J	**0.02**	0.02 J	0.03 J	0.04	**0.03**
Nickel	2.42	2.23	2.54	**2.4**	2.4	2.39	2.45	**2.4**	NA	NA	NA		3.17	3.91	3.67	**3.6**	3.87	3.5	3.39	**3.6**
Silver	0.019 J	0.02 J	0.017 J	**0.02**	0.025	0.028	0.024	**0.03**	NA	NA	NA		0.03	0.038	0.042	**0.04**	0.03 J	0.035	0.035	**0.03**
Zinc	208	208	199	**205**	229	236	254	**240**	NA	NA	NA		246	256	249	**250**	281	238	244	**254**
Butyltins in µg/g																				
Tri-n-butyltin (TBT)	0.45 U	0.45 U	0.33 U	--	1.5 U	NA	1.3 U	--	321.97	416.67	331.44 D	356.69	NA	NA	NA		0.58 U	1.2 U	1.4 U	
Semivolatiles in µg/g																				
Acenaphthene	0.29 J	0.27 J	0.32 J	**0.3**	1.04 J	1.23 J	0.57 J	**0.9**	1.80 J	2.27 J	1.42 J	**1.8**	0.89 J	1.04 J	1.04 J	**1.0**	0.77 J	0.72 J	0.74 J	**0.7**
Acenaphthylene	0.15 J	0.11 J	0.19 J	**0.2**	0.74 J	1.04 J	0.36 J	**0.7**	0.86 J	1.23 J	1.33 J	**1.1**	0.87 J	0.89 J	0.80 J	**0.9**	0.35 J	0.45 J	0.37 J	**0.4**
Anthracene	0.19 J	0.17 J	0.11 U	**0.1**	1.33 J	2.84 J	0.54 J	**1.6**	4.45 J	4.73 J	3.79 J	**4.3**	1.61 J	1.80 J	1.23 J	**1.5**	2.65 J	1.14 J	1.42 J	**1.7**
Fluorene	0.38 J	0.42 J	0.55 J	**0.4**	1.52 J	2.65 J	0.95 J	**1.7**	3.41 J	4.92 J	3.41 J	**3.9**	1.52 J	1.70 J	1.42 J	**1.5**	1.61 J	1.33 J	1.61 J	**1.5**
Naphthalene	0.79 J	0.81 J	1.14 J	**0.9**	1.33 J	1.80 J	2.94 J	**2.0**	2.27 J	2.75 J	2.18 J	**2.4**	2.75 J	2.56 J	2.27 J	**2.5**	1.99 J	2.27 J	2.08 J	**2.1**
Phenanthrene	2.46 J	2.18 J	2.37 J	**2.3**	3.79 J	6.06 J	2.94 J	**4.3**	25.57	28.41	20.83 J	**24.9**	6.91 J	8.24 J	8.14 J	**7.8**	7.20 J	4.73 J	6.06 J	**6.0**
2-Methylnaphthalene	0.52 J	0.51 J	0.70 J	**0.6**	1.14 J	1.33 J	1.33 J	**1.3**	1.70 J	1.80 J	1.52 J	**1.7**	1.52 J	1.42 J	1.42 J	**1.5**	1.42 J	1.80 J	1.42 J	**1.5**
Benz(a)anthracene	0.24 J	0.20 J	0.11 U	**0.2**	0.73 J	1.23 J	0.72 J	**0.9**	23.67 J	24.62	21.78 J	**23.4**	5.30 J	7.48 J	5.97 J	**6.3**	2.08 J	2.37 J	2.27 J	**2.2**
Benzo(a)pyrene	0.095 U	0.21 J	0.16 U	**0.1**	0.19 U	0.38 U	0.38 U	**--**	13.26 J	14.20 J	12.31 J	**13.3**	2.84 J	4.92 J	3.31 J	**3.7**	1.23 J	1.42 J	1.23 J	**1.3**
Benzo(b)fluoranthene	0.27 J	0.25 J	0.32 J	**0.3**	0.89 J	1.80 J	0.95 J	**1.2**	19.89 J	21.78 J	20.83 J	**20.8**	6.06 J	8.71 J	6.72 J	**7.2**	2.75 J	3.03 J	3.13 J	**3.0**
Benzo(k)fluoranthene	0.32 J	0.21 J	0.33 J	**0.3**	0.72 J	1.23 J	0.41 U	**0.7**	16.10 J	17.05 J	16.10 J	**16.4**	4.17 J	6.91 J	4.17 J	**5.1**	1.89 J	1.52 J	2.27 J	**1.9**
Benzo(g,h,i)perylene	0.31 J	0.22 J	0.27 J	**0.3**	0.64 J	3.31 J	0.81 J	**1.6**	9.00 J	10.42 J	10.42 J	**9.9**	4.64 J	8.33 J	4.92 J	**6.0**	2.37 J	2.65 J	2.56 J	**2.5**
Chrysene	0.86 J	0.80 J	0.85 J	**0.8**	1.33 J	1.99 J	1.33 J	**1.5**	44.51	47.35	40.72	**44.2**	12.31 J	16.10 J	14.20 J	**14.2**	4.64 J	5.40 J	5.02 J	**5.0**
Dibenz(a,h)anthracene	0.21 J	0.27 J	0.16 U	**0.2**	0.77 J	0.4 U	0.4 U	**0.5**	2.65 J	2.84 J	4.64 J	**3.4**	0.82 J	3.31 J	1.14 J	**1.8**	0.64 J	0.57 J	0.4 U	**0.4**
Fluoranthene	2.08 J	1.80 J	2.18 J	**2.0**	2.75 J	4.92 J	3.22 J	**3.6**	58.71	61.55	52.08	**57.4**	13.26 J	16.10 J	16.10 J	**15.2**	8.14 J	7.10 J	7.20 J	**7.5**
Indeno(1,2,3-cd)pyrene	0.20 J	0.19 J	0.23 J	**0.2**	0.52 J	1.61 J	0.54 J	**0.9**	5.02 J	5.59 J	7.20 J	**5.9**	2.08 J	5.02 J	2.56 J	**3.2**	1.14 J	1.23 J	1.14 J	**1.2**
Pyrene	2.46 J	2.37 J	2.46 J	**2.4**	1.89 J	3.79 J	2.08 J	**2.6**	71.02	72.92	60.61	**68.2**	14.20 J	17.05 J	16.10 J	**15.8**	7.01 J	6.34 J	6.91 J	**6.8**
Phenols in µg/g																				
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorophenol (PCP)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Please refer to notes at the end of this table.

Table 8 - Tissue Results (Lipid Normalized) from Bioaccumulation Testing for *Lumbriculus variegatus*
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	Day 0			Day 0 Mean	Day 28 for Control Exposure			Control Day 28 Mean	Day 28 for CSS 2 Exposure			CSS 2 Day 28 Mean	Day 28 for CSS 10 Exposure			CSS 10 Day 28 Mean	Day 28 for HC-REF-02 Exposure			HC-REF-02 Day 28 Mean
Replicate Number	1	2	3		1	2	3		1	2	3		1	2	3		1	2	3	
Misc. Semivolatiles in µg/g																				
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzyl Alcohol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenzofuran	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phthalates in µg/g																				
Bis(2-ethylhexyl) Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Butyl Benzyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dimethyl Phthalate	--	--	--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pesticides/PCBs in µg/g																				
4,4'-DDD	0.26 U	0.26 U	0.26 U		0.53 U	0.83 U	0.52 U		--	--	--	--	--	--	--		--	--	--	--
4,4'-DDE	2.84 P	3.50 P	3.50 P	**3.28**	3.60 JP	5.11	4.64	**4.45**	--	--	--	--	--	--	--		--	--	--	--
4,4'-DDT	2.94 P	2.75 P	2.65 P	**2.78**	1.6 U	1.6 U	1.6 U		--	--	--	--	--	--	--		--	--	--	--
Total DDT																				
Aldrin	0.4 U	0.4 U	0.4 U	--	0.8 U	0.8 U	0.8 U	--	--	--	--	--	--	--	--	--	--	--	--	--
alpha-Chlordane	0.72 U	0.72 U	0.72 U	--	1.5 U	1.5 U	1.5 U	--	--	--	--	--	--	--	--	--	--	--	--	--
gamma-Chlordane	0.28 U	0.28 U	0.28 U	--	0.56 U	0.56 U	4 U	--	--	--	--	--	--	--	--	--	--	--	--	--
Dieldrin	0.91 JP	0.81 JP	0.61 JP	**0.78**	1.04 JP	1.14 J	0.82 J	**1.00**	--	--	--	--	--	--	--	--	--	--	--	--
Heptachlor	0.89 U	0.9 U	0.9 U	--	1.8 U	1.8 U	1.8 U	--	--	--	--	--	--	--	--	--	--	--	--	--
gamma-BHC (Lindane)	0.56 U	0.56 U	0.56 U	--	1.2 U	1.2 U	1.2 U	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1016	4 U	4 U	4 U	--	8 U	8 U	8 U	--	8 U	8 U	8 U	--	6.7 U	5.8 U	5.8 U	--	8 U	8 U	8 U	--
Aroclor 1221	6.2 U	6.2 U	6.2 U	--	13 U	13 U	13 U	--	13 U	13 U	13 U	--	11 U	8.9 U	8.9 U	--	13 U	13 U	13 U	--
Aroclor 1232	4 U	4 U	4 U	--	8 U	8 U	8 U	--	8 U	8 U	8 U	--	6.7 U	5.8 U	5.8 U	--	8 U	8 U	8 U	--
Aroclor 1242	7 U	7 U	7 U	--	14 U	14 U	14 U	--	14 U	14 U	14 U	--	12 U	10 U	10 U	--	14 U	14 U	14 U	--
Aroclor 1248	1.6 U	1.6 U	1.6 U	--	3.1 U	3.1 U	3.1 U	--	3.1 U	3.1 U	3.1 U	--	2.6 U	2.2 U	2.2 U	--	3.1 U	3.1 U	3.1 U	--
Aroclor 1254	3 U	3 U	3 U	--	6 U	6 U	6 U	--	53.03	60.61	61.55	**58.4**	35.04	31.25	35.04	**33.8**	6 U	6 U	6 U	--
Aroclor 1260	9.3 U	9.4 U	9.4 U	--	19 U	19 U	19 U	--	19 U	19 U	19 U	--	16 U	14 U	14 U	--	19 U	19 U	19 U	--

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Notes:
Total lipids for *Lumbriculus variegatus* of 1.06 (average of Day 0, Day 28 sediment sample CSS 8, and Day 28 sediment sample CSS 10)
U = Not detected at the indicated method reporting limits (MRL).
J = Estimated concentration that is less than the MRL but greater than or equal to the MDL.
D = Reported result is from dilution.
P = Confirmation criteria was exceeded. The relative percent difference is greater than 25 percent between the two analytical results.
-- = Not analyzed/Not applicable.
Mean = Mean tissue concentrations of constituents were calculated using one-half of the MRL for non-detected replicates (see laboratory certificates in Appendix B).

Table 9 - Tissue Results from Bioaccumulation Testing for *Corbicula fluminea*
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	Day 0			Day 0 Mean	Day 28 for Control Exposure			Control Day 28 Mean	Day 28 for CSS 2 Exposure			CSS 2 Day 28 Mean	Day 28 for CSS 10 Exposure			CSS 10 Day 28 Mean	Day 28 for HC-REF-02 Exposure			HC-REF-02 Day 28 Mean
Replicate Number	1	2	3		1	2	3		1	2	3		1	2	3		1	2	3	
Conventionals as Wet Wt.																				
Sample Weight in grams	44.5	49.6	50	**48.0**	73.1	73.3	75.4	**73.9**	67.2	65.8	57.7	**63.6**	47.1	37.3	44.4	**42.9**	41.2	45.7	43.4	**43.4**
Total Lipids in %	0.35	0.23	0.21	**0.3**	0.25	n/a	0.29	**0.3**	n/a	0.2	0.43	**0.3**	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	**n/a**
Total Solids in %	8.83	8.38	8.11	**8.4**	5.04	4.62	4.92	**4.9**	4.83	5.06	5.46	**5.1**	6.74	6.81	6.66	**6.7**	7.2	7.15	7.37	**7.2**
Metals in mg/kg as Dry Wt.																				
Antimony	0.009 J	0.007 J	0.006 J	**0.01**	0.009 J	0.009 J	0.01 J	**0.01**	0.009 J	0.009 J	0.009 J	**0.01**	0.009 J	0.012 J	0.009 J	**0.01**	0.007 J	0.009 J	0.007 J	**0.01**
Arsenic	5.24	5.48	5.52	**5.4**	6.37	6.82	6.83	**6.7**	6.66	6.55	6.39	**6.5**	5.98	5.94	6.37	**6.1**	5.35	5.54	5.06	**5.3**
Cadmium	0.56	0.62	0.61	**0.6**	0.75	0.75	0.8	**0.8**	0.78	0.78	0.74	**0.8**	0.71	0.7	0.72	**0.7**	0.59	0.62	0.62	**0.6**
Copper	42.4	44.5	45.3	**44.1**	53	51.6	56.6	**53.7**	54.6	52	50.8	**52.5**	50.9	46.7	53.1	**50.2**	48.3	44.2	43.3	**45.3**
Lead	0.761	0.799	0.751	**0.8**	0.608	0.628	0.624	**0.6**	0.568	0.57	0.611	**0.6**	0.578	0.569	0.571	**0.6**	0.53	0.489	0.48	**0.5**
Mercury	0.09	0.08	0.1	**0.09**	0.13	0.16	0.11	**0.13**	0.12	0.11	0.12	**0.12**	0.08	0.14	0.11	**0.11**	0.1	0.11	0.09	**0.10**
Nickel	2.38	2.73	1.41	**2.2**	1.47	1.87	1.72	**1.7**	1.98	1.98	1.49	**1.8**	1.5	1.84	1.7	**1.7**	2.77	1.41	1.03	**1.7**
Silver	0.151	0.142	0.149	**0.15**	0.16	0.16	0.162	**0.16**	0.167	0.171	0.175	**0.17**	0.167	0.157	0.178	**0.17**	0.151	0.153	0.142	**0.15**
Zinc	207	215	206	**209**	208	216	209	**211**	197	205	205	**202**	193	182	186	**187**	194	183	163	**180**
Butyltins in µg/kg as Wet Wt.																				
Tri-n-butyltin (TBT)	0.6 U	0.33 U	0.33 U	--	0.33 J	0.33 U	0.66 U	0.275	120 D	97 D	130	115.67	0.87 J	NA	0.86 J	0.865	0.88 U	0.43 U	0.54 U	--
Semivolatiles in µg/kg as Wet Wt.																				
Acenaphthene	4.5 U	4.5 U	4.5 U	--	0.17 J	0.21 J	0.16 J	**0.2**	4.5 U	4.5 U	4.5 U	--	0.31 J	0.37 U	0.19 J	**0.2**	4.5 U	4.5 U	4.5 U	--
Acenaphthylene	5.2 U	5.2 U	5.2 U	--	0.15 J	0.19 J	0.16 J	**0.2**	5.2 U	5.2 U	5.2 U	--	0.31 J	0.31 J	0.22 J	**0.3**	5.2 U	5.2 U	5.2 U	--
Anthracene	5.8 J	4.7 U	4.7 U	--	0.39 J	0.4 J	0.41 J	**0.4**	4.7 U	4.7 U	4.7 U	--	0.7 J	0.81 J	0.66 J	**0.7**	4.7 U	4.7 U	4.7 U	--
Fluorene	6 J	6 U	6 U	--	0.44 J	0.49 J	0.44 J	**0.5**	6 U	6 U	6 U	--	0.67 J	0.85 J	0.57 J	**0.7**	6 U	6 U	6 U	--
Naphthalene	4 U	4 U	4 U	--	0.51 J	0.54 J	0.48 J	**0.5**	4 U	4 U	4 U	--	0.63 J	1.4 J	0.45 J	**0.8**	4 U	4 U	4 U	--
Phenanthrene	9.7 J	9.2 J	5 U	**7.1**	3 J	2.8 J	2.8 J	**2.9**	5.2 J	5 U	5.7 J	**4.5**	3.8 J	4.4 J	3.8 J	**4.0**	6.5 J	5.5 J	5 U	**4.8**
2-Methylnaphthalene	4 U	4 U	4 U	--	0.35 J	0.36 J	0.37 J	**0.4**	4 U	4 U	4 U	--	0.51 J	0.8 J	0.36 J	**0.6**	4 U	4 U	4 U	--
Benz(a)anthracene	5.5 U	5.5 U	5.5 U	--	0.054 U	0.26 J	0.41 J	**0.2**	5.5 U	5.5 U	5.5 U	--	0.51 J	0.27 U	0.68 J	**0.4**	5.5 U	5.5 U	5.5 U	--
Benzo(a)pyrene	3.4 U	3.4 U	3.4 U	--	0.076 U	0.076 U	0.076 U	**0.1**	3.4 U	3.4 U	3.4 U	--	0.076 U	0.38 U	0.076 U	**0.1**	3.4 U	3.4 U	3.4 U	--
Benzo(b)fluoranthene	3.5 U	3.5 U	3.5 U	--	0.045 U	0.22 J	0.73 J	**0.3**	3.5 U	3.5 U	3.5 U	--	0.43 J	0.23 U	0.56 J	**0.4**	3.5 U	3.5 U	3.5 U	--
Benzo(k)fluoranthene	3.4 U	3.4 U	3.4 U	--	0.081 U	0.2 J	0.67 J	**0.3**	3.4 U	3.4 U	3.4 U	--	0.4 J	0.41 U	0.54 J	**0.4**	3.4 U	3.4 U	3.4 U	--
Benzo(g,h,i)perylene	5.3 U	5.3 U	5.3 U	--	0.097 U	0.27 J	0.78 J	**0.4**	5.3 U	5.3 U	5.3 U	--	0.32 J	0.49 U	0.71 J	**0.4**	5.3 U	5.3 U	5.3 U	--
Chrysene	2.8 U	2.8 U	2.8 U	--	0.48 J	0.59 J	0.81 J	**0.6**	2.8 U	2.8 U	2.8 U	--	1.7 J	1.8 J	2.2 J	**1.9**	2.8 U	2.8 U	2.8 U	--
Dibenz(a,h)anthracene	6 U	6 U	6 U	--	0.079 U	0.36 J	1.1 J	**0.5**	6 U	6 U	6 U	--	0.57 J	0.4 U	0.72 J	**0.5**	6 U	6 U	6 U	--
Fluoranthene	6.7 U	6.7 U	6.7 U	--	2.1 J	2 J	2.1 J	**2.1**	6.7 U	6.7 U	6.7 U	--	4.4 J	4.6 J	5.3	**4.8**	6.7 U	6.7 U	6.7 U	--
Indeno(1,2,3-cd)pyrene	3.1 U	3.1 U	3.1 U	--	0.088 J	0.23 J	1.1 J	**0.5**	3.1 U	3.1 U	3.1 U	--	0.28 J	0.37 J	0.5 J	**0.4**	3.1 U	3.1 U	3.1 U	--
Pyrene	8.2 U	8.2 U	8.2 U	--	1 J	1 J	1.2 J	**1.1**	8.2 U	8.2 U	8.2 U	--	3.6 J	4.8 J	4.5 J	**4.3**	8.2 U	8.2 U	8.2 U	--
Phenols in µg/kg as Wet Wt.																				
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorophenol (PCP)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Please refer to notes at the end of this table.

Table 9 - Tissue Results from Bioaccumulation Testing for *Corbicula fluminea*
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	Day 0			Day 0	Day 28 for Control Exposure			Control Day 28	Day 28 for CSS 2 Exposure			CSS 2 Day 28	Day 28 for CSS 10 Exposure			CSS 10 Day 28	Day 28 for HC-REF-02 Exposure			HC-REF-02
Replicate Number	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Day 28 Mean
Misc. Semivolatiles in µg/kg as Wet Wt.																				
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzyl Alcohol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenzofuran	6 J	5.9 J	5.3 U	**5.9**	--	--	--	--	5.3 U	5.3 U	5.3 U	--	--	--	--	--	6.7 J	8.1 J	9.8 J	**8.2**
Hexachlorobutadiene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
N-Nitrosodiphenylamine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phthalates in µg/kg																				
Bis(2-ethylhexyl) Phthalate	140 U	140 U	140 U	--	--	--	--	--	140 U	140 U	140 U	--	--	--	--	--	140 U	140 U	140 U	--
Butyl Benzyl Phthalate	19 U	19 U	19 U	--	--	--	--	--	19 U	19 U	19 U	--	--	--	--	--	19 U	19 U	19 U	--
Di-n-butyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dimethyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pesticides/PCBs in µg/kg as Wet Wt.																				
4,4'-DDD	1 U	0.13 U	0.51 U	--	0.26 U	1 U	1.4 U	--	0.62 J	1 U	1 U	**0.6**	1.4 P	1.6 P	1.3 P	**1.4**	1.7 P	1	0.47 U	**1.4**
4,4'-DDE	0.12 U	0.12 U	0.12 U	--	0.69 J	0.35 J	0.55 JP	**0.40**	0.12 U	0.74 U	0.91 U	--	0.86 JP	0.95 JP	0.96 JP	**0.9**	0.67 J	0.68 JP	0.12 U	**0.7**
4,4'-DDT	2.2 J	1.7	1.7	**1.9**	1.8 JP	1.5 P	2.3 P	**0.3**	1.4	1.4	1.6	**1.5**	2.5	2.4	2.2	**2.4**	3.1 P	3.1 P	2.3 P	**2.8**
Total DDT																				
Aldrin	0.2 U	0.2 U	0.2 U	--	0.4 U	0.2 U	0.4 U	--	0.2 U	0.2 U	0.2 U	--	0.2 U	0.2 U	0.2 U	--	0.2 U	0.2 U	0.2 U	--
alpha-Chlordane	0.59 J	0.36 U	0.36 U	--	0.72 U	0.36 U	0.72 U	--	0.36 U	0.36 U	0.36 U	--	0.36 U	0.53 J	0.65 JP	**0.5**	0.36 U	0.57 J	1.1 P	**0.7**
gamma-Chlordane	0.85 J	0.68 J	0.6 J	**0.7**	0.35 J	0.23 J	0.35 J	**0.3**	0.47 J	0.79 JP	0.8 J	**0.7**	0.88 J	0.97 J	0.99 J	**1.0**	0.66 J	0.92 J	0.48 J	**0.7**
Dieldrin	1 U	1 U	1 U	--	0.22 U	0.96 U	0.64 JP	**0.6**	0.11 U	1 U	0.11 U	--	1 U	0.11 U	0.11 U	--	1 U	1 U	1.5 P	**1.5**
Heptachlor	0.62 U	0.72 U	0.67 U	--	0.9 U	0.45 U	0.9 U	--	0.45 U	0.45 U	0.45 U	--	0.45 U	0.45 U	0.45 U	--	1 U	1 U	1.8	**1.8**
gamma-BHC (Lindane)	0.28 U	0.28 U	0.28 U	--	0.56 U	0.28 U	0.56 U	--	0.28 U	0.29 U	0.32 U	--	0.28 U	0.28 U	0.28 U	--	0.28 U	0.28 U	0.28 U	--
Aroclor 1016	5.7 U	6.9 U	6.6 U	--	4 U	10 U	6 U	--	7.7 U	8.2 U	9.1 U	--	8.9 U	7.9 U	13 U	--	6.2 U	8.3 U	9.6 U	--
Aroclor 1221	25 U	19 U	17 U	--	16 U	9.8 U	15 U	--	17 U	14 U	20 U	--	34 U	20 U	19 U	--	34 U	35 U	23 U	--
Aroclor 1232	29 U	18 U	17 U	--	19 U	24 U	51 U	--	26 U	25 U	38 U	--	44 U	29 U	34 U	--	38 U	42 U	21 U	--
Aroclor 1242	7.7 U	9.1 U	8.8 U	--	7 U	10 U	20 U	--	11 U	11 U	13 U	--	12 U	11 U	17 U	--	8.2 U	11 U	13 U	--
Aroclor 1248	4.9 U	5.6 U	4.5 U	--	6.2 U	8.8 U	19 U	--	14 U	9.9 U	7.8 U	--	5.6 U	6.6 U	6.6 U	--	3.9 U	4.4 U	4.1 U	--
Aroclor 1254	15 U	14 U	14 U	--	6.7 U	5.8 U	7.4 U	--	12 U	14 U	14 U	--	13 U	16 U	15 U	--	14 U	13 U	13 U	--
Aroclor 1260	13 U	12 U	13 U	--	10 U	8.1 U	11 U	--	9.3 U	11 U	11 U	--	12 U	13 U	12 U	--	12 U	13 U	12 U	--

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Notes:
U = Not detected at the indicated method reporting limits (MRL).
J = Estimated concentration that is less than the MRL but greater than or equal to the MDL.
D = Reported result is from dilution.
P = Confirmation criteria was exceeded. The relative percent difference is greater than 25 percent between the two analytical results.
-- = Not analyzed/Not applicable.
Mean = Mean tissue concentrations of constituents were calculated using one-half of the MRL for non-detected replicates (see laboratory certificates in Appendix B).

Table 10 - Tissue Results (Lipid Normalized) from Bioaccumulation Testing for *Corbicula fluminea*
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	Day 0			Day 0	Day 28 for Control Exposure			Control Day 28	Day 28 for CSS 2 Exposure			CSS 2 Day 28	Day 28 for CSS 10 Exposure			CSS 10 Day 28	Day 28 for HC-REF-02 Exposure			HC-REF-02
Replicate Number	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Day 28 Mean
Conventionals as Wet Wt.																				
Sample Weight in grams	44.5	49.6	50	**48.0**	73.1	73.3	75.4	**73.9**	67.2	65.8	57.7	**63.6**	47.1	37.3	44.4	**42.9**	41.2	45.7	43.4	**43.4**
Total Lipids in %	0.35	0.23	0.21	**0.3**	0.25	n/a	0.29	**0.3**	n/a	0.2	0.43	**0.3**	n/a	n/a	n/a	**n/a**	n/a	n/a	n/a	**n/a**
Total Solids in %	8.83	8.38	8.11	**8.4**	5.04	4.62	4.92	**4.9**	4.83	5.06	5.46	**5.1**	6.74	6.81	6.66	**6.7**	7.2	7.15	7.37	**7.2**
Metals in mg/kg as Dry Wt.																				
Antimony	0.009 J	0.007 J	0.006 J	**0.01**	0.009 J	0.009 J	0.01 J	**0.01**	0.009 J	0.009 J	0.009 J	**0.01**	0.009 J	0.012 J	0.009 J	**0.01**	0.007 J	0.009 J	0.007 J	**0.01**
Arsenic	5.24	5.48	5.52	**5.4**	6.37	6.82	6.83	**6.7**	6.66	6.55	6.39	**6.5**	5.98	5.94	6.37	**6.1**	5.35	5.54	5.06	**5.3**
Cadmium	0.56	0.62	0.61	**0.6**	0.75	0.75	0.8	**0.8**	0.78	0.78	0.74	**0.8**	0.71	0.7	0.72	**0.7**	0.59	0.62	0.62	**0.6**
Copper	42.4	44.5	45.3	**44.1**	53	51.6	56.6	**53.7**	54.6	52	50.8	**52.5**	50.9	46.7	53.1	**50.2**	48.3	44.2	43.3	**45.3**
Lead	0.761	0.799	0.751	**0.8**	0.608	0.628	0.624	**0.6**	0.568	0.57	0.611	**0.6**	0.578	0.569	0.571	**0.6**	0.53	0.489	0.48	**0.5**
Mercury	0.09	0.08	0.1	**0.09**	0.13	0.16	0.11	**0.13**	0.12	0.11	0.12	**0.12**	0.08	0.14	0.11	**0.11**	0.1	0.11	0.09	**0.10**
Nickel	2.38	2.73	1.41	**2.2**	1.47	1.87	1.72	**1.7**	1.98	1.98	1.49	**1.8**	1.5	1.84	1.7	**1.7**	2.77	1.41	1.03	**1.7**
Silver	0.151	0.142	0.149	**0.15**	0.16	0.16	0.162	**0.16**	0.167	0.171	0.175	**0.17**	0.167	0.157	0.178	**0.17**	0.151	0.153	0.142	**0.15**
Zinc	207	215	206	**209**	208	216	209	**211**	197	205	205	**202**	193	182	186	**187**	194	183	163	**180**
Butyltins in µg/g																				
Tri-n-butyltin (TBT)	0.6 U	0.33 U	0.33 U	--	0.391 J	0.33 U	0.66 U	0.2953	142.18 D	114.93 D	154.03	137.05	1.0308 J	NA	1.019 J	1.0249	0.88 U	0.43 U	0.54 U	--
Semivolatiles in µg/g																				
Acenaphthene	4.5 U	4.5 U	4.5 U	--	0.20 J	0.25 J	0.19 J	**0.2**	4.5 U	4.5 U	4.5 U	--	0.37 J	0.37 U	0.23 J	**0.3**	4.5 U	4.5 U	4.5 U	--
Acenaphthylene	5.2 U	5.2 U	5.2 U	--	0.18 J	0.23 J	0.19 J	**0.2**	5.2 U	5.2 U	5.2 U	--	0.37 J	0.37 J	0.26 J	**0.3**	5.2 U	5.2 U	5.2 U	--
Anthracene	6.87 J	4.7 U	4.7 U	--	0.46 J	0.47 J	0.49 J	**0.5**	4.7 U	4.7 U	4.7 U	--	0.83 J	0.96 J	0.78 J	**0.9**	4.7 U	4.7 U	4.7 U	--
Fluorene	7.11 J	6 U	6 U	--	0.52 J	0.58 J	0.52 J	**0.5**	6 U	6 U	6 U	--	0.79 J	1.01 J	0.68 J	**0.8**	6 U	6 U	6 U	--
Naphthalene	4 U	4 U	4 U	--	0.60 J	0.64 J	0.57 J	**0.6**	4 U	4 U	4 U	--	0.75 J	1.66 J	0.53 J	**1.0**	4 U	4 U	4 U	--
Phenanthrene	11.49 J	10.9 J	5 U	**8.3**	3.55 J	3.32 J	3.32 J	**3.4**	6.16 J	5 U	6.75 J	**5.1**	4.50 J	5.21 J	4.50 J	**4.7**	7.70 J	6.52 J	5 U	**5.6**
2-Methylnaphthalene	4 U	4 U	4 U	--	0.41 J	0.43 J	0.44 J	**0.4**	4 U	4 U	4 U	--	0.60 J	0.95 J	0.43 J	**0.7**	4 U	4 U	4 U	--
Benz(a)anthracene	5.5 U	5.5 U	5.5 U	--	0.054 U	0.31 J	0.49 J	**0.3**	5.5 U	5.5 U	5.5 U	--	0.60 J	0.27 U	0.81 J	**0.5**	5.5 U	5.5 U	5.5 U	--
Benzo(a)pyrene	3.4 U	3.4 U	3.4 U	--	0.076 U	0.076 U	0.076 U	**0.1**	3.4 U	3.4 U	3.4 U	--	0.076 U	0.38 U	0.076 U	**0.1**	3.4 U	3.4 U	3.4 U	--
Benzo(b)fluoranthene	3.5 U	3.5 U	3.5 U	--	0.045 U	0.26 J	0.86 J	**0.4**	3.5 U	3.5 U	3.5 U	--	0.51 J	0.23 U	0.66 J	**0.4**	3.5 U	3.5 U	3.5 U	--
Benzo(k)fluoranthene	3.4 U	3.4 U	3.4 U	--	0.081 U	0.24 J	0.79 J	**0.4**	3.4 U	3.4 U	3.4 U	--	0.47 J	0.41 U	0.64 J	**0.4**	3.4 U	3.4 U	3.4 U	--
Benzo(g,h,i)perylene	5.3 U	5.3 U	5.3 U	--	0.097 U	0.32 J	0.92 J	**0.4**	5.3 U	5.3 U	5.3 U	--	0.38 J	0.49 U	0.84 J	**0.5**	5.3 U	5.3 U	5.3 U	--
Chrysene	2.8 U	2.8 U	2.8 U	--	0.57 J	0.70 J	0.96 J	**0.7**	2.8 U	2.8 U	2.8 U	--	2.01 J	2.13 J	2.61 J	**2.3**	2.8 U	2.8 U	2.8 U	--
Dibenz(a,h)anthracene	6 U	6 U	6 U	--	0.079 U	0.43 J	1.30 J	**0.6**	6 U	6 U	6 U	--	0.68 J	0.4 U	0.85 J	**0.6**	6 U	6 U	6 U	--
Fluoranthene	6.7 U	6.7 U	6.7 U	--	2.49 J	2.37 J	2.49 J	**2.4**	6.7 U	6.7 U	6.7 U	--	5.21 J	5.45 J	6.28	**5.6**	6.7 U	6.7 U	6.7 U	--
Indeno(1,2,3-cd)pyrene	3.1 U	3.1 U	3.1 U	--	0.10 J	0.27 J	1.30 J	**0.6**	3.1 U	3.1 U	3.1 U	--	0.33 J	0.44 J	0.59 J	**0.5**	3.1 U	3.1 U	3.1 U	--
Pyrene	8.2 U	8.2 U	8.2 U	--	1.18 J	1.18 J	1.42 J	**1.3**	8.2 U	8.2 U	8.2 U	--	4.27 J	5.69 J	5.33 J	**5.1**	8.2 U	8.2 U	8.2 U	--
Phenols in µg/g																				
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pentachlorophenol (PCP)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Please refer to notes at the end of this table.

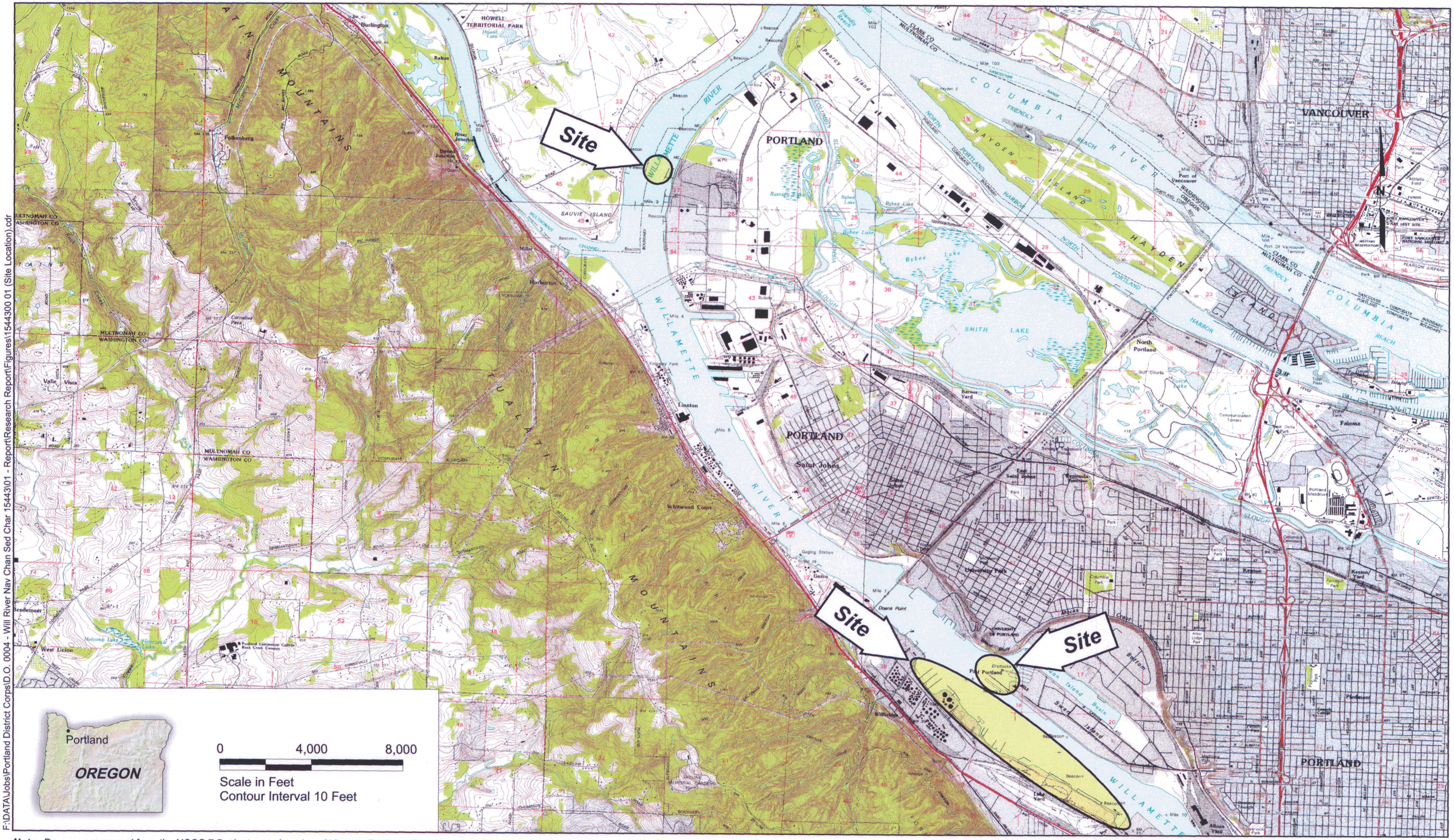
Table 10 - Tissue Results (Lipid Normalized) from Bioaccumulation Testing for *Corbicula fluminea*
Willamette River Federal Navigation Channel
Portland, Oregon

Sample Identification	Day 0			Day 0	Day 28 for Control Exposure			Control Day 28	Day 28 for CSS 2 Exposure			CSS 2 Day 28	Day 28 for CSS 10 Exposure			CSS 10 Day 28	Day 28 for HC-REF-02 Exposure			HC-REF-02
Replicate Number	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Mean	1	2	3	Day 28 Mean
Misc. Semivolatiles in µg/g																				
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzyl Alcohol	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dibenzofuran	7.11 J	6.99 J	5.3 U		--	--	--	--	5.3 U	5.3 U	5.3 U	--	--	--	--	--	7.94 J	9.60 J	11.61 J	--
Hexachlorobutadiene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--
Hexachloroethane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--
N-Nitrosodiphenylamine	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--
1,2-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--
1,3-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--
1,4-Dichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--
Hexachlorobenzene	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--		--
Phthalates in µg/g																				
Bis(2-ethylhexyl) Phthalate	140 U	140 U	140 U	--	--	--	--	--	140 U	140 U	140 U	--	--	--	--	--	140 U	140 U	140 U	--
Butyl Benzyl Phthalate	19 U	19 U	19 U	--	--	--	--	--	19 U	19 U	19 U	--	--	--	--	--	19 U	19 U	19 U	--
Di-n-butyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Diethyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dimethyl Phthalate	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pesticides/PCBs in µg/g																				
4,4'-DDD	1 U	0.13 U	0.51 U	--	0.26 U	1 U	1.4 U	--	0.73 J	1 U	1 U	**0.73**	1.66 P	1.90 P	1.54 P	1.7	2.01 P	1.18	0.47 U	1.59
4,4'-DDE	0.12 U	0.12 U	0.12 U	--	0.82 J	0.41 J	0.65 JP	**0.62**	0.12 U	0.74 U	0.91 U	--	1.02 JP	1.13 JP	1.14 JP	**1.09**	0.79 J	0.81 JP	0.12 U	**0.57**
4,4'-DDT	2.61 J	2.01	2.01	**2.2**	2.13 JP	1.78 P	2.73 P	**2.20**	1.66	1.66	1.90	**1.74**	2.96	2.84	2.61	**2.80**	3.67 P	3.67 P	2.73 P	**10.07**
Total DDT																				
Aldrin	0.2 U	0.2 U	0.2 U	--	0.4 U	0.2 U	0.4 U	--	0.2 U	0.2 U	0.2 U	--	0.2 U	0.2 U	0.2 U	--	0.2 U	0.2 U	0.2 U	--
alpha-Chlordane	0.70 J	0.36 U	0.36 U	**0.7**	0.72 U	0.36 U	0.72 U	--	0.36 U	0.36 U	0.36 U	--	0.36 U	0.63 J	0.77 JP	**0.58**	0.36 U	0.68 J	1.30 P	**0.99**
gamma-Chlordane	1.01 J	0.81 J	0.71 J	**0.8**	0.41 J	0.27 J	0.41 J	**0.36**	0.56 J	0.94 JP	0.95 J	**0.81**	1.04 J	1.15 J	1.17 J	**0.37**	0.78 J	1.09 J	0.57 J	**0.81**
Dieldrin	1 U	1 U	1 U	--	0.22 U	0.96 U	0.76 JP	**0.76**	0.11 U	1 U	0.11 U	--	1 U	0.11 U	0.11 U	--	1 U	1 U	1.78 P	**1.78**
Heptachlor	0.62 U	0.72 U	0.67 U	--	0.9 U	0.45 U	0.9 U	--	0.45 U	0.45 U	0.45 U	--	0.45 U	0.45 U	0.45 U	--	1 U	1 U	2.13	**2.13**
gamma-BHC (Lindane)	0.28 U	0.28 U	0.28 U	--	0.56 U	0.28 U	0.56 U	--	0.28 U	0.29 U	0.32 U	--	0.28 U	0.28 U	0.28 U	--	0.28 U	0.28 U	0.28 U	--
Aroclor 1016	5.7 U	6.9 U	6.6 U	--	4 U	10 U	6 U	--	7.7 U	8.2 U	9.1 U	--	8.9 U	7.9 U	13 U	--	6.2 U	8.3 U	9.6 U	--
Aroclor 1221	25 U	19 U	17 U	--	16 U	9.8 U	15 U	--	17 U	14 U	20 U	--	34 U	20 U	19 U	--	34 U	35 U	23 U	--
Aroclor 1232	29 U	18 U	17 U	--	19 U	24 U	51 U	--	26 U	25 U	38 U	--	44 U	29 U	34 U	--	38 U	42 U	21 U	--
Aroclor 1242	7.7 U	9.1 U	8.8 U	--	7 U	10 U	20 U	--	11 U	11 U	13 U	--	12 U	11 U	17 U	--	8.2 U	11 U	13 U	--
Aroclor 1248	4.9 U	5.6 U	4.5 U	--	6.2 U	8.8 U	19 U	--	14 U	9.9 U	7.8 U	--	5.6 U	6.6 U	6.6 U	--	3.9 U	4.4 U	4.1 U	--
Aroclor 1254	15 U	14 U	14 U	--	6.7 U	5.8 U	7.4 U	--	12 U	14 U	14 U	--	13 U	16 U	15 U	--	14 U	13 U	13 U	--
Aroclor 1260	13 U	12 U	13 U	--	10 U	8.1 U	11 U	--	9.3 U	11 U	11 U	--	12 U	13 U	12 U	--	12 U	13 U	12 U	--

Notes:

Total lipids for *Corbicula fluminea* of 0.84 (average of Day 0, Day 28 sediment sample CSS 8, and Day 28 sediment sample CSS 10)
U = Not detected at the indicated method reporting limits (MRL).
J = Estimated concentration that is less than the MRL but greater than or equal to the MDL.
D = Reported result is from dilution.
P = Confirmation criteria was exceeded. The relative percent difference is greater than 25 percent between the two analytical results.
-- = Not analyzed/Not applicable.
Mean = Mean tissue concentrations of constituents were calculated using one-half of the MRL for non-detected replicates (see laboratory certificates in Appendix B).

Site Location Map
U.S. Army Corps of Engineers
Portland, Oregon



F:\DATA\Jobs\Portland District Corps\D.O. 0004 - Will River Nav Chan Sed Char 15443\01 - Report\Research Report\Figures\1544300 01 (Site Location).cdr

Note: Base map prepared from the USGS 7.5-minute quadrangles of Linnton, Portland, Savuie Island, Hillsboro, and Dixie Mt., dated 1990.

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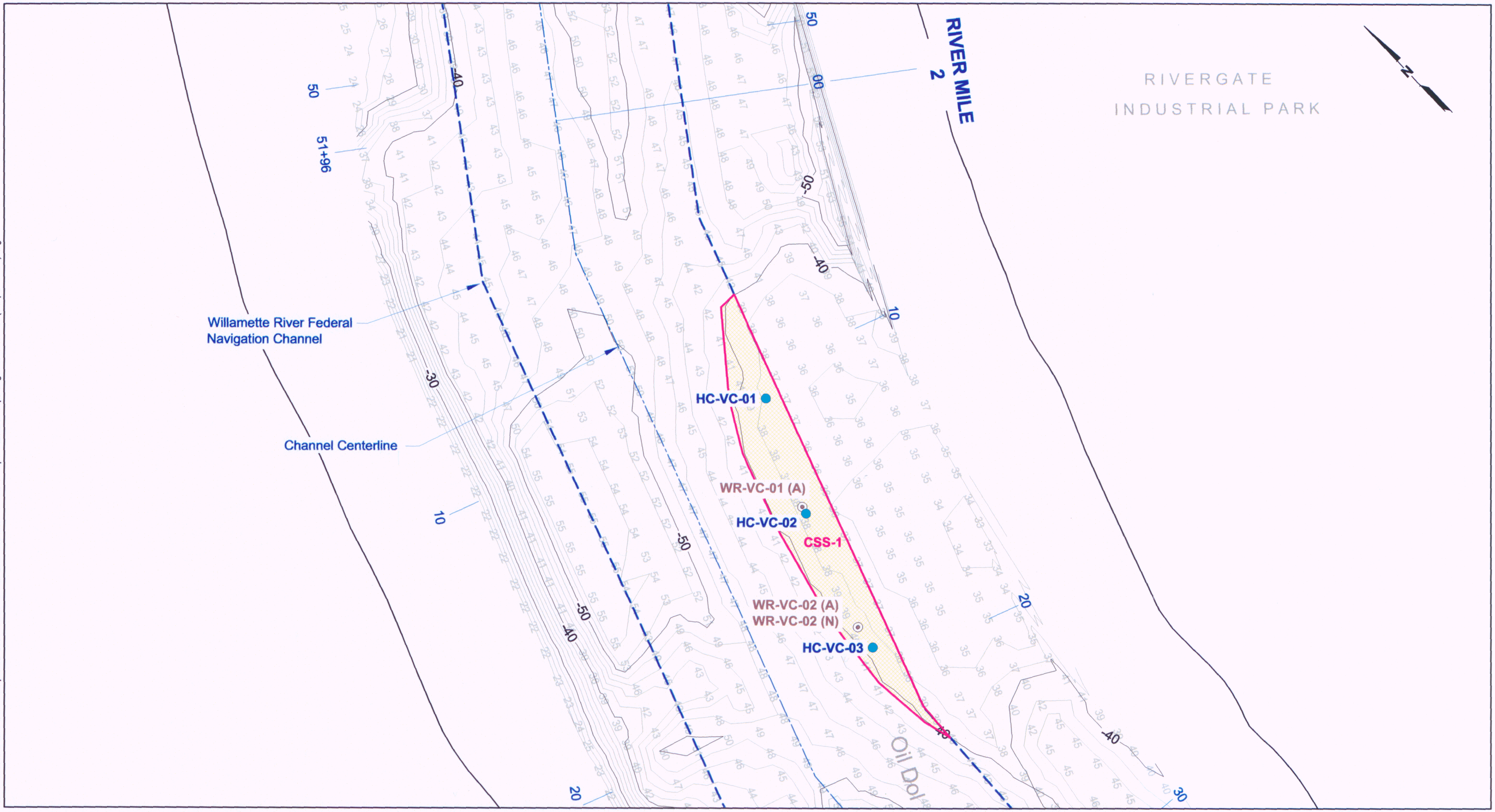
15443-00 *8/04*
Figure 1

Sediment Sampling Locations - CSS-1
U.S. Army Corps of Engineers
Portland, Oregon



JAB

F:\DATA\Jobs\Portland District Corps\D.O. 0004 - Will River Nav Chan Sed Char 15443\01 - Report\Research Report\Figures\1544300 02 (Site plan smu-1).dwg

Notes: 1. Base map prepared from a Corps of Engineers AutoCAD file. 2. Coordinates are based on the Lambert Projection for Oregon, North Zone (NAD 27).
3. Datum is Columbia River Datum. (CRD is 1.74 feet above National Geodetic Vertical Datum)

Legend:

WR-VC-01 (A) ⊙ Approximate Previous Sediment Sample Location and Number
(A) Sampled 4/29/99
(N) Sampled 10/29/99

HC-VC-01 ● Sediment Sampling Location and Number

CSS-1 CSS Area and Designation

0 300 600
Scale in Feet

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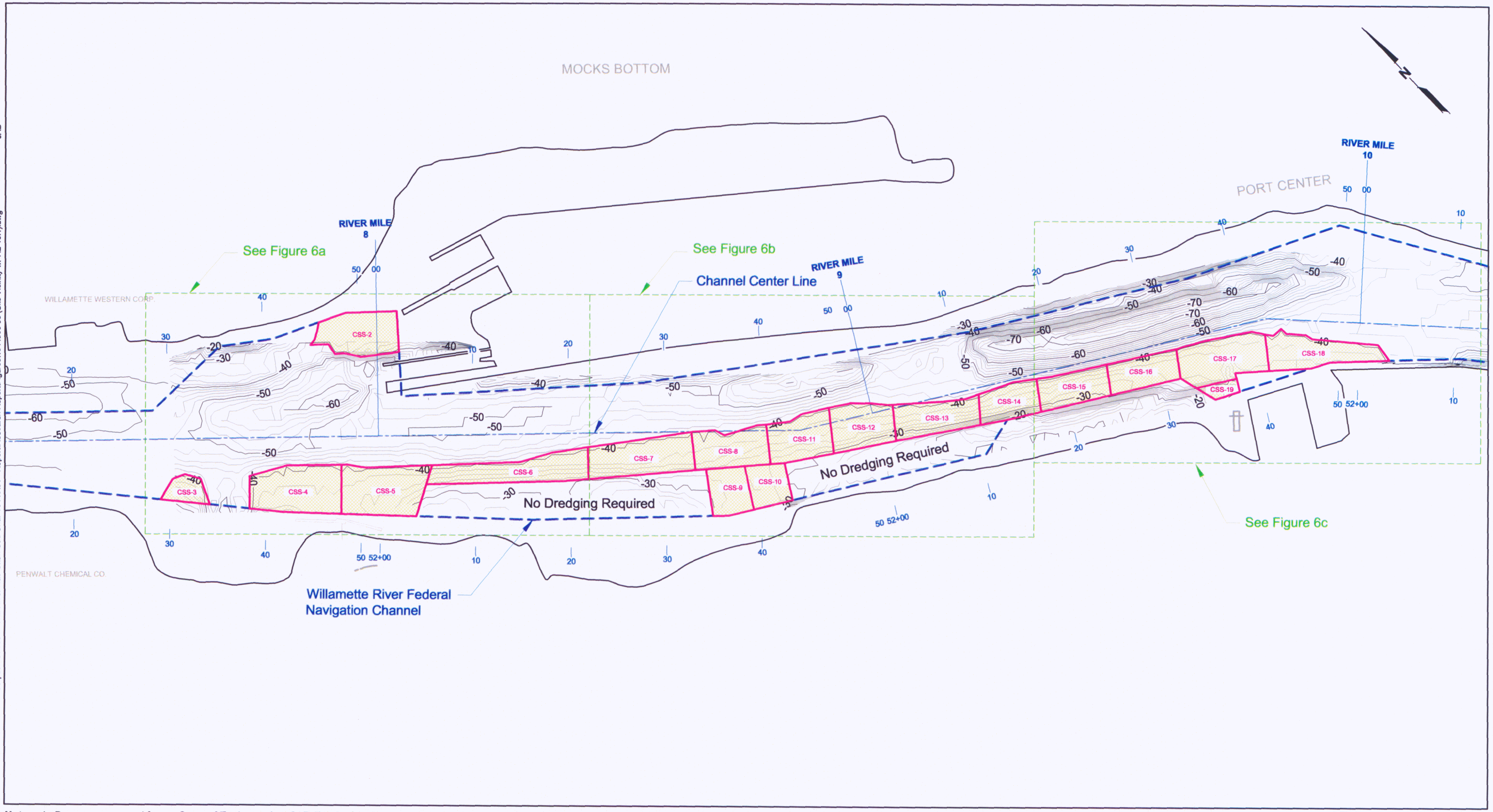
15443-00 ***8/04***

Figure 2

Site Vicinity Plan - CSS-2 through 19
U.S. Army Corps of Engineers
Portland, Oregon



Notes: 1. Base map prepared from a Corps of Engineers AutoCAD file. 2. Coordinates are based on the Lambert Projection for Oregon, North Zone (NAD 27).
3. Datum is Columbia River Datum. (CRD is 1.74 feet above National Geodetic Vertical Datum)

Legend:

CSS-2 — CSS Area and Designation

0 1,000 2,000
Scale in Feet

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Figure 3

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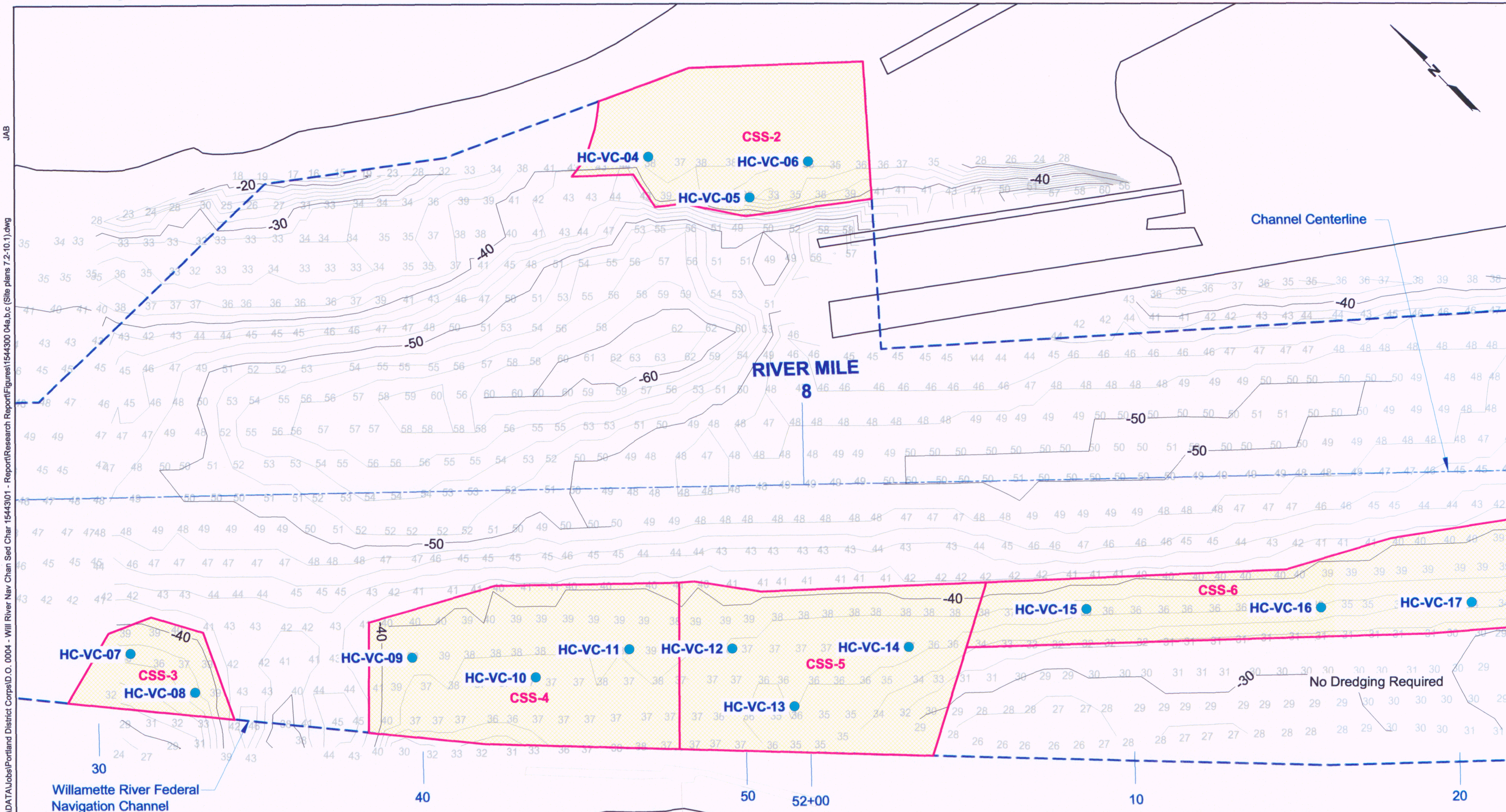
JAB

Sediment Sampling Locations - CSS-2 through 6
U.S. Army Corps of Engineers
Portland, Oregon



Notes: 1. Base map prepared from a Corps of Engineers AutoCAD file. 2. Coordinates are based on the Lambert Projection for Oregon, North Zone (NAD 27).
3. Datum is Columbia River Datum. (CRD is 1.74 feet above National Geodetic Vertical Datum)

Legend:

CSS-2 CSS Area and Designation

HC-VC-04 ● Sediment Sampling Location and Number

0 300 600
Scale in Feet

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15443-00 *8/04*
Figure 4a

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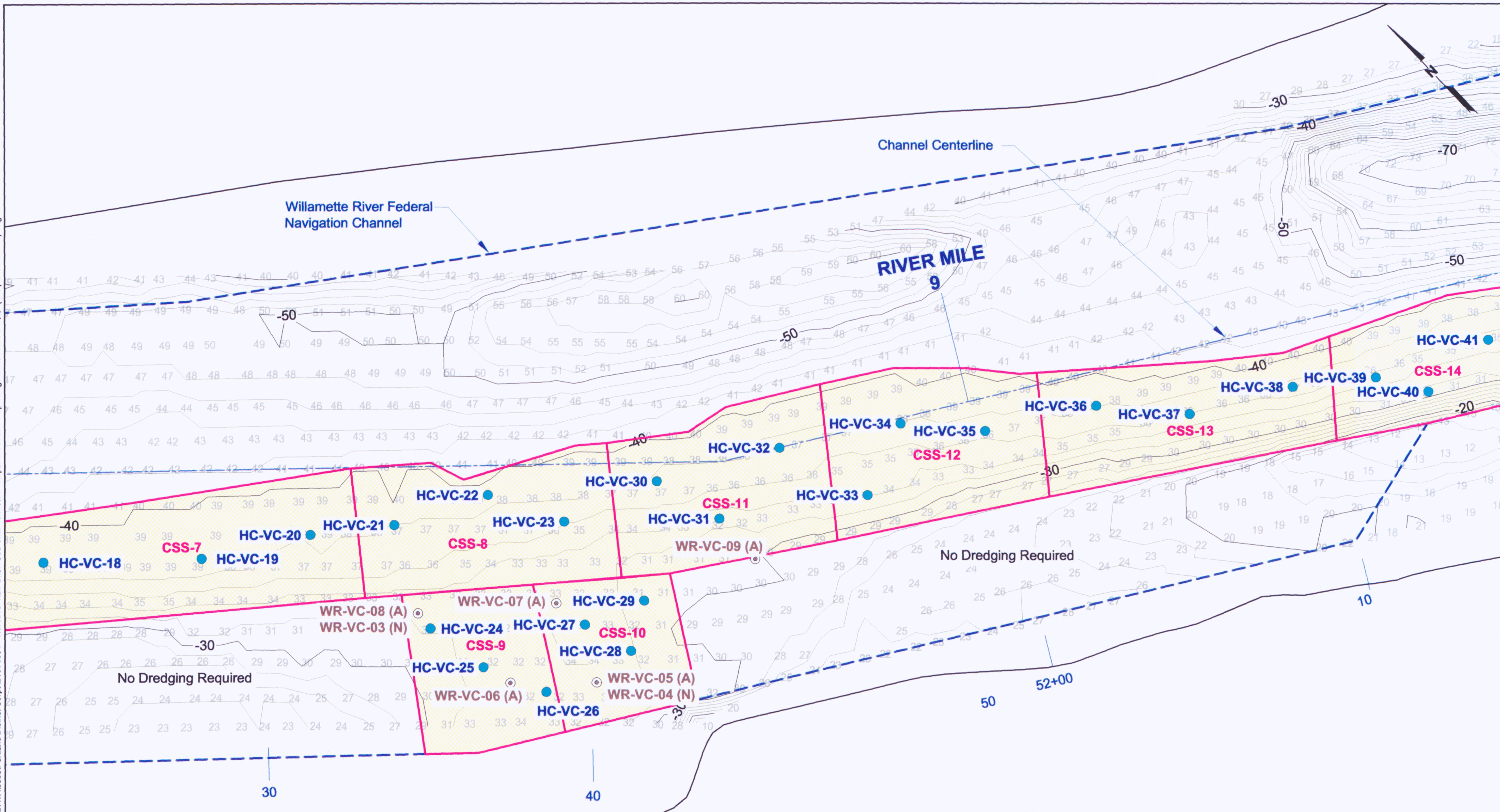
JAB

Sediment Sampling Locations - CSS-7 through 14
U.S. Army Corps of Engineers
Portland, Oregon



Notes: 1. Base map prepared from a Corps of Engineers AutoCAD file. 2. Coordinates are based on the Lambert Projection for Oregon, North Zone (NAD 27).
3. Datum is Columbia River Datum. (CRD is 1.74 feet above National Geodetic Vertical Datum)

Legend:

WR-VC-07 (A) ⊙ Approximate Previous Sediment Sample Location and Number
(A) Sampled 4/29/99
(N) Sampled 10/29/99

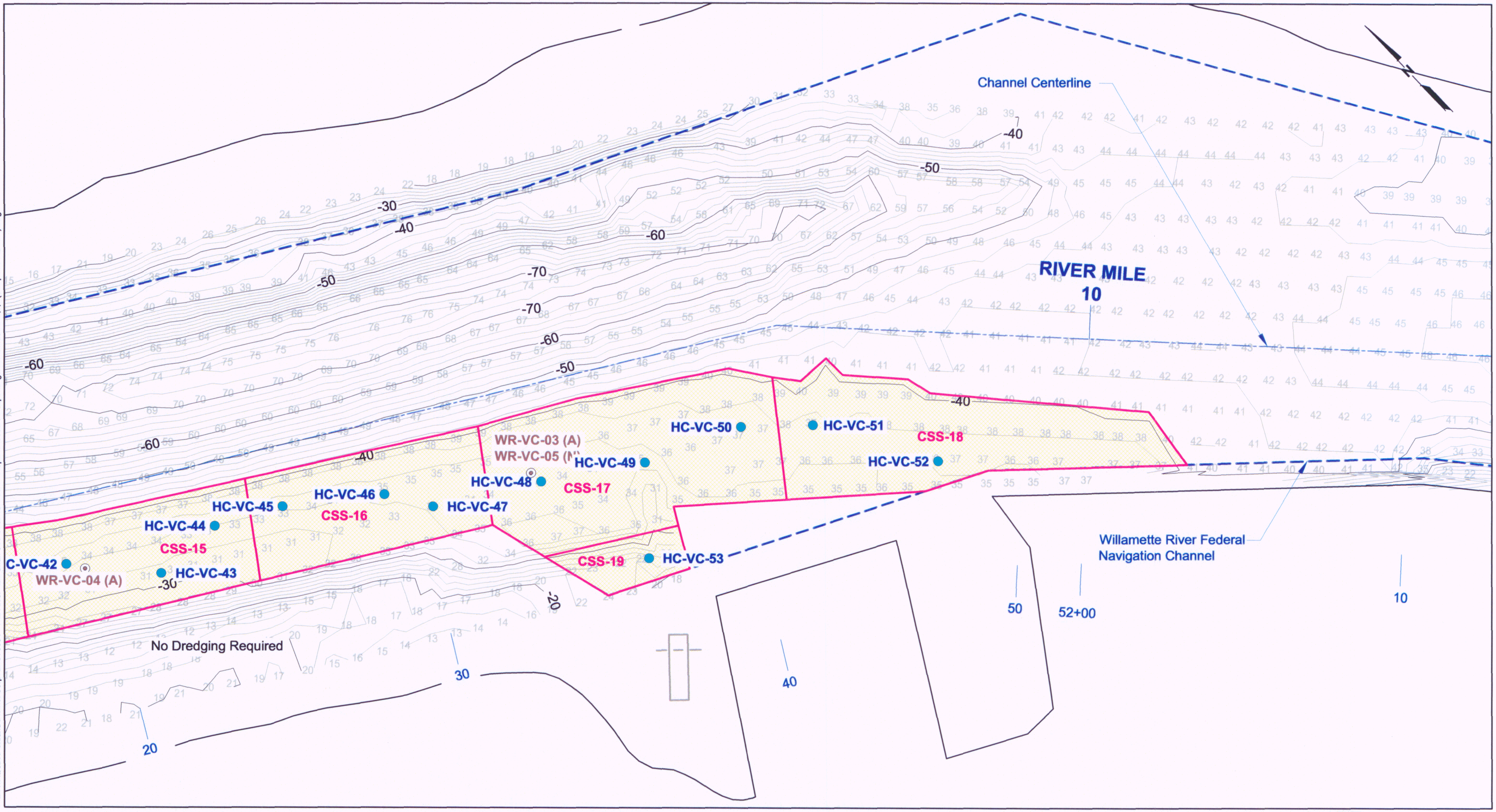
HC-VC-18 ● Sediment Sampling Location and Number

CSS-11 CSS Area and Designation

0 300 600
Scale in Feet

HARTCROWSER
15443-00 *8/04*
Figure 4b

Sediment Sampling Locations - CSS-15 through 19
U.S. Army Corps of Engineers
Portland, Oregon



JAB

F:\DATA\Jobs\Portland District Corps\D.O. 0004 - Will River Nav Chan Sed Char 15443\01 - Report\Research Report\Figures\15443 00 04a,b,c (Site plans 7.2-10.1).dwg

Notes: 1. Base map prepared from a Corps of Engineers AutoCAD file. 2. Coordinates are based on the Lambert Projection for Oregon, North Zone (NAD 27). 3. Datum is Columbia River Datum. (CRD is 1.74 feet above National Geodetic Vertical Datum)

Legend:

WR-VC-03 (A) ⊙ Approximate Previous Sediment Sample Location and Number
(A) Sampled 4/29/99
(N) Sampled 10/29/99

HC-VC-42 ● Sediment Sampling Location and Number

CSS-17 CSS Area and Designation

0 300 600
Scale in Feet

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15443-00 8/04
Figure 4c

Reference Area Sediment Sample Location - HC-REF-01
U.S. Army Corps of Engineers
Portland, Oregon

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Note: Base map prepared from the USGS 7.5-minute quadrangle of Lake Oswego, Oregon, dated 1990.

0 1,000 2,000

Approximate Scale in Feet

Legend:

HC-REF-01 ⊙ Reference Sediment Grab Sample Location and Number

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15443-00 8/04

Figure 5

Reference Area Sediment Sample Location - HC-REF-02
U.S. Army Corps of Engineers
Portland, Oregon

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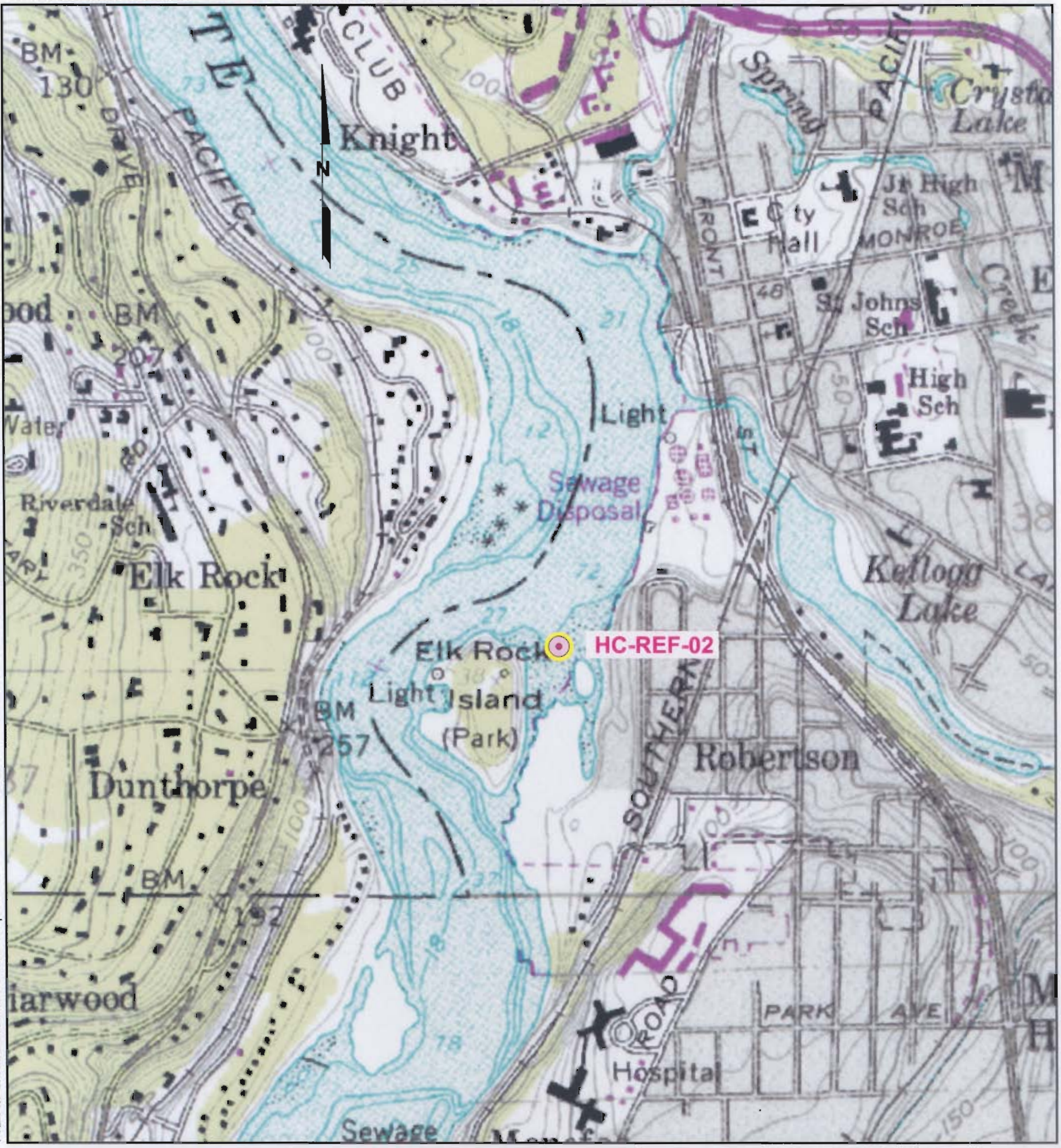

Note: Base map prepared from the USGS 7.5-minute quadrangle of Lake Oswego, Oregon, dated 1990.

0 1,000 2,000

Approximate Scale in Feet

Legend:

HC-REF-02 ⊙ Reference Sediment Grab Sample Location and Number

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Figure 6