

APPENDIX A

The following discussion includes those projects requiring explanation beyond the summaries provided in Chapter 1 for ranking, sampling plan development, chemical testing, biological testing, or those for which the DMMP agencies used best professional judgment as part of the decision-making process.

Dredging Year 1996

High Cascade International. This project is located at Stevenson, Washington, on the lower Columbia River. A Tier I evaluation under the draft Inland Testing Manual was undertaken, reviewing known sources and site history to determine the potential for contaminants in the area. Section 404 of the Clean Water Act provides that in areas of high current, with a high proportion of sand, and lacking sources of contamination, material does not require chemical characterization prior to disposal in an aquatic environment. To confirm that the material to be dredged consisted of sand, grain size analysis was performed. The material was determined to be predominantly sand, and in an area generally free from sources of contamination, and therefore suitable for aquatic disposal.

Dredging Year 1997

City of Bellevue, Meydenbauer Bay Yacht Club. The City of Bellevue proposed to dredge approximately 2500 cubic yards of sediment from the Meydenbauer Yacht Club in Lake Washington. This area was ranked high due to the presence of stormwater outfalls in an urban environment. Samples were taken in two locations and composited for one analysis. The chemical analysis showed five exceedances of Dredging Year 1996 maximum levels. The applicants chose not to pursue biological testing, and the application for open-water disposal was withdrawn. A later application to dredge a small portion of the material (150 cubic yards) and place it upland in a confined facility was approved.

Crowley Marine Services, 8th Avenue Terminal Facilities Slip 4. Sediment characterization of the 13,000 cubic yards of proposed maintenance material at Slip 4 consisted of the collection of three samples from each of the four surface DMMUs. Three samples were composited for each of the DMMU rather than one as usually called for in high concern areas, to provide better spatial coverage and resolution of the material proposed for dredging.

Chemical analysis results demonstrated that all four dredged material management units characterized contained screening level exceedances of chemicals of concern, principally

HPAHs and PCBs, which were found in all DMMUs. One DMMU (S1) had multiple SL exceedance and one chemical, fluoranthene, which exceeded both the maximum level and the bioaccumulation trigger. A second bioaccumulation trigger for PCBs was exceeded in a second DMMU (S4). Normal bioassay testing was initiated on all four DMMUs, before proceeding with bioaccumulation testing for the two DMMUs with BT exceedances.

The DMMU (S1) with the fluoranthene BT exceedance passed PSDDA bioassay interpretive guidelines, and subsequently underwent 28-day bioaccumulation testing to assess fluoranthene human health and ecological risks. The remaining DMMU (S4) with the BT exceedance for PCBs failed the bioassay guidelines and no further biological testing was initiated.

The 28-day bioaccumulation test was conducted at Battelle Northwest Laboratory, Sequim, Washington. The protocol followed and approved by the PSDDA agencies consisted of testing with the adult bivalve, *Macoma nasuta* and the adult polychaete, *Nephtys caecoides*. The species were co-tested in the same aquaria and exposed to sediments from DMMU-S1 over a 28-day exposure period. The 8-liter aquaria utilized a flow-through seawater system. Because there was insufficient sediment from DMMU-1 archived for potential bioaccumulation testing, resampling of the three stations initially sampled and composited for DMMU-S1 was required. Reanalysis of the resampled composite occurred at the same time as tissue analyses, and demonstrated a five-fold decrease in fluoranthene compared with the initial concentration measured. The PSDDA agencies determined that these bioaccumulation results were suitable for regulatory decisionmaking. The results demonstrated significant bioaccumulation of fluoranthene by both species. To provide for an environmentally conservative evaluation and to adjust for the discrepancy in the initial sediment versus resampled fluoranthene concentrations, tissue concentrations were multiplied by 5.3 to provide a correction for the human health and ecological health evaluation summarized below:

Bioaccumulation Testing Evaluation Summary for DMMU-S1 relative to Fluoranthene.

Sediment/Tissue Ratios:

Initial Sediment = 8,500 ppb (dry); Resampled sediment = 1,600 ppb (dry)

Macoma Tissue = 427.4 ppb (dry) = 68.4 ppb (wet) = 84% moisture/16% solids

Nephtys Tissue = 167.5 ppb (dry) = 28.5 ppb (wet) = 83% moisture/17% solids

Ratio: *Macoma* Tissue: 427.4 / Resampled Sediment: 1,600 = 0.267 (26.7%)

Ratio: *Nephtys* Tissue: 167.5 / Resampled Sediment: 1,600 = 0.105 (10.5%)

Thus, no apparent potential for bioconcentration (biomagnification) is apparent relative to sediments.

Human Health Evaluation: Tissue Comparison to PSDDA Tissue Criteria (MPR II, Table A-9) for Fluoranthene:

Tissue (*Macoma*) = 0.0684 ppm (wet) / PSDDA Criterion = 8,400 ppm (wet) = 8.14×10^{-6}

adjusting tissue for Initial/Resampled Sediment: Tissue *Macoma*) = 0.0684 ppm (wet) x 5.3 = 0.3625 ppm (wet) = 4.316×10^{-5}

Tissue (*Nephtys*)= 0.0285 ppm (wet) / PSDDA Criterion=8,400 ppm (wet) = 3.39×10^{-6}
Adjusting tissue for Initial/Resampled Sediment: Tissue *Nephtys*) = 0.0285 x 5.3 = 0.151 ppm (wet)/8,400 ppm(wet) = 1.80×10^{-5}

Conclusion: These results do not demonstrate a human health concern.

Ecological Health Evaluation: Statistical comparisons (t-test) of observed tissue burdens (28-day exposures) from tested DMMU sediment (S1) exposures and reference sediment tissue exposures demonstrated a significant bioaccumulation potential in the tested DMMU-S1 relative to reference.

Reference sediment tissue mean (*Macoma*) = 2.5 ppb (@ ½ detection limit -wet weight);
Test sediment (DMMU-S1) mean (*Macoma*) = 68.4 ppb (wet)
Ratio *Macoma*: Test/Reference tissue = 27.4
Ratio *Macoma*: Test tissue 68.4 ppb (wet) x 5.3 (Initial/Resampled difference) = 362.5 ppb (wet)/Reference tissue = 145 fold increase after adjustment

Reference sediment tissue mean (*Nephtys*) = 2.5 ppb (@ ½ detection limit - wet weight);
Test sediment (DMMU-S1) mean (*Nephtys*) = 28.5 ppb (wet)
Ratio *Nephtys*: Test/Reference tissue = 11.4
Ratio *Nephtys*: Test tissue x 5.3 (Initial/Resampled difference) = 151 ppb (wet)/Reference tissue = 60.4 fold increase after adjustment

Conclusion: This comparison demonstrates a significant tissue accumulation and potential ecological health concern. Therefore, DMMU-S1 was determined to be not suitable for unconfined open-water disposal.

Port of Everett Marine Terminal Improvements Project

Stage I of the Port of Everett Marine Terminal Improvements Project included dredging of 422,000 cubic yards of sediment. Of this volume, 183,000 cubic yards were covered by an earlier suitability determination. Subsequent to that determination, the Port of Everett revised its design requirements and requested a suitability determination for an additional 239,000 cubic yards of material.

The additional proposed volume included three fractions. The largest fraction consisted of native material, which lay beneath the original project volume. Second, a portion of the revised footprint fell just outside the DMMUs addressed in the previous determination. Finally, a pocket of wood debris was identified within the project footprint during geotechnical sampling.

As a result of a partial characterization conducted in 1992, the DMMP agencies determined that native sediment underlying the proposed dredging project was suitable for open-water disposal with no additional testing required. This determination logically extended to the additional volume of native sediment proposed for dredging in the revised design. The sediment falling outside the original project footprint was found suitable for open-water disposal based on evidence available from previous sediment and groundwater analyses. The woody debris was tested and found to be chemically similar to surrounding sediments. However, because this material was predominantly wood waste, the DMMP agencies determined that it was unsuitable for open-water disposal.

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Tributyltin testing. The DMMP evaluation guidelines for tributyltin (TBT) were in a state of flux during this project. At the time of SAP development, PSDDA required bulk sediment testing for TBT in areas of concern such as East Waterway. The SL and BT at the time were 30 and 219 ug/kg TBT (as tin) respectively. However, an interagency workgroup was in the process of developing guidance for use by EPA Region 10 in the evaluation of TBT at Superfund sites. Based on this work, the DMMP agencies proposed revised guidelines which included pore water testing to better determine the bioavailable fraction of TBT.

Under the revised guidelines, an exceedance of 0.15 ug/l TBT (as TBT) in the interstitial water triggers bioaccumulation testing. Because the Port of Seattle had already conducted bulk sediment testing for TBT, a compromise was reached between the Port and DMMP agencies which called for calculation of theoretical pore water concentrations using a relationship developed by the National Marine Fisheries Service. The Port of Seattle agreed to conduct pore water testing on archived sediment for those DMMUs with calculated interstitial TBT concentrations exceeding 0.15 ug/l (as TBT). Fifteen DMMUs were extracted for pore water and tested for TBT. Only two of the fifteen DMMUs exceeded 0.15 ug/l (as TBT) and required bioaccumulation testing. One of these two DMMUs exceeded the tissue residue limit established for TBT and was found unsuitable for open-water disposal.

Amphipod bioassay. For the amphipod test, the DMMP agencies required the use of *Eohaustorius* on the basis of data from the National Marine Fisheries Service indicating a greater sensitivity of this genus to environmental TBT than other amphipod genera. The Port of Seattle elected to use *Eohaustorius estuarius* collected from Beaver Creek, Oregon. This strategy for TBT testing was later overcome by events as the DMMP agencies shifted focus to pore water analysis and bioaccumulation testing.

The Port of Seattle expressed concern regarding potential ammonia toxicity in the amphipod test and proposed reducing ammonia concentrations to nontoxic levels prior to testing using a purging protocol recommended by EPA and the Corps of Engineers. The DMMP agencies agreed to this procedure. A threshold of 15 mg/l (pore water) was used

to determine which DMMUs required ammonia adjustment. For DMMUs exceeding the ammonia threshold, replacement of two volumes of water per day and constant aeration were used to reduce the concentrations. Periodic monitoring of interstitial ammonia levels provided the feedback required to determine when to terminate the purging process and initiate the bioassay.

Bioaccumulation testing. Bioaccumulation testing was performed with *Macoma nasuta*, a suspension-feeding/filter-feeding bivalve and *Nephtys caecoides*, a burrowing deposit-feeding polychaete. The two species were tested together in the same aquaria. The standard DMMP bioaccumulation test duration is 28 days. However, to avoid extrapolation of 28-day results to theoretical steady-state conditions, the Port of Seattle proposed extending the test to 45 days to provide a better experimental approximation of steady-state tissue concentrations. The agencies approved this approach subsequent to a review of available literature and national EPA/Corps guidance. The actual test was terminated at 44 days due to an increased rate of mortality near the end of the test period.

The DMMP agencies agreed that statistical difference from reference was a necessary, but not sufficient, condition to determine a DMMU unsuitable for open-water disposal. For those DMMUs which were statistically greater than reference, a more in-depth evaluation was required to determine the significance of the bioaccumulation that had occurred. This evaluation focused on a) Food and Drug Administration (FDA) Actions Levels for Poisonous and Deleterious Substances in Fish and Shellfish for Human Food; b) PSDDA Target Tissue Concentration Values for Chemicals of Concern to Human Health; and c) ecological effects data from the literature.

It was clear that for PCBs and mercury, human health concerns occurred at lower tissue concentrations than did ecological effects. Conversely, for TBT and DDT, ecological effects occurred at lower concentrations than human health effects. The following tissue residue limits were established:

mercury:	1.0 ppm ww
Total DDTs:	3.0 ppm ww
PCBs:	2.0 ppm ww
TBT:	2.0 ppm ww (as TBT)

The agencies used best professional judgment in developing these interpretation guidelines to meet PSDDA disposal site management objectives; achievement of other sediment management objectives will require additional evaluation. These guidelines are subject to change for future DMMP projects as additional bioaccumulation data become available.

The dredger's option. For DMMUs with multiple ML exceedances, or with a single chemical exceeding an ML by a factor of two, the "dredger's option" can be invoked. In addition to standard biological testing, the "dredger's option" entails more extensive sediment evaluation procedures, the requirements for which are to be determined by the DMMP agencies on a case-by-case basis.

The Port of Seattle invoked the dredger's option on two DMMUs. The first had a single chemical, benzyl alcohol, which exceeded the ML by greater than a factor of two. This DMMU caused no adverse effects in any of the PSDDA bioassays, either acute or sublethal. In addition, benzyl alcohol is not a bioaccumulative chemical of concern, thus posing no adverse ecological or human health effects due to long-term uptake or trophic transfer. There was no reason to believe that this DMMU poses an undue environmental risk, therefore the DMMP agencies determined that this DMMU was suitable for open-water disposal.

The second DMMU for which the dredger's option was invoked had ML exceedances for PCBs and DDT. While no adverse effects were found in any of the PSDDA bioassays, the DMMP agencies were concerned with the possibility of trophic transfer, biomagnification and potential adverse effects on birds or marine mammals. The Port of Seattle agreed to conduct an ecological risk assessment specific to disposal of PCB-contaminated sediment at the Elliott Bay site. However, the agencies and the Port did not come to agreement concerning assumptions underlying the modeling effort and the risk assessment was not completed. Therefore, this DMMU was found unsuitable for open-water disposal.

USACE Everett Downstream Channel and Settling Basin

A single SL exceedance occurred, with one DMMU having diethyl phthalate detected just marginally above the SL. A screening level exceedance normally triggers the requirement to run bioassays. But because phthalates are common laboratory contaminants, the PSDDA agencies do not require biological testing based solely on a phthalate exceedance of SL [EPTA, 1988, see pages II-100, II-123, II-209]. Therefore, no bioassays were performed. However, to verify or refute the diethylphthalate exceedance, Seattle District performed three additional analyses on frozen archived sediment. Diethylphthalate was undetected in all three analyses at a level below the SL.

Port of Tacoma, Blair Turning Basin. The initial project ranking for this area was moderate, base on guidance provided in the Management Plan Report, Phase II. The project was down-ranked two levels to low, based on previous testing data, lack on in-water or upland source of contamination, and the probability that most of the material was native sediment. All material tested for this project was found suitable for open-water disposal.

Weyerhaeuser, Mt. Coffin Channel. Weyerhaeuser Inc. proposed to dredge approximately 200,000 cubic yards from the Mt. Coffin Channel in the Columbia River, with flow-lane disposal in the Columbia River near River Mile 62. This project underwent evaluation under the Section 404 guidelines, similar to the process described for the High Cascade International project described previously. Seven samples were taken of material from the dredge prism, and grain size analysis was performed. The material was all medium to coarse sand. All samples were at least 99 percent sand. Based on this

information, and the absence of sources of contamination in the vicinity of dredging, the material was determined to be suitable for in-water disposal.