Portland Sediment Evaluation Team

Supplemental Guidance for the Portland District:

Sampling and Analysis Plan Preparation under the 2009 *Sediment Evaluation Framework for the Pacific Northwest*

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Acronyms and Abbreviations

BMPs	best management practices
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoCs	chemicals of concern
Corps	US Army Corps of Engineers
CSM	conceptual site model
CWA	Clean Water Act
DMMP	Dredged Material Management Program (Washington)
DMMU	dredged material management unit
Ecology	Washington Department of Ecology
EPA	Environmental Protection Agency
ESA	Endangered Species Act
MB	megabyte
MLLW	mean lower low water
MPRSA	Marine Protection, Research, and Sanctuaries Act
NMFS	National Marine Fisheries Service
NPDES	non-point discharge elimination system
NSM	new surface material
ODEQ	Oregon Department of Environmental Quality
PDF	portable document format (Adobe)
PM	project manager
PSET	Portland Sediment Evaluation Team
QA/QC	quality assurance/quality control
RSET	Regional Sediment Evaluation Team
SAP	sampling and analysis plan
SCR	sediment characterization report
SEF	*Sediment Evaluation Framework for the Pacific Northwest*
SL	benthic toxicity screening level (marine or freshwater)
USFWS	U.S. Fish and Wildlife Service

1 Introduction

1.1 Overview

The US Army Corps of Engineers (Corps) and US Environmental Protection Agency (EPA) share responsibility for regulating:

- The transport and disposal of dredged material within ocean waters under Sections 102 and 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) and
- The discharge of dredged material into waters of the United States under Section 404 of the Clean Water Act (CWA).

Dredged material evaluation and testing is a requirement under both Acts.

National guidance developed to satisfy MPRSA dredged material testing requirements is provided in the 1991 *Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual* (Ocean Testing Manual). National sediment testing guidance to satisfy CWA requirements is provided in the 1998 *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual* (Inland Testing Manual). Both of these national manuals encourage the development of regional implementation manuals. The regional implementation manual for the Pacific Northwest (i.e., the States of Oregon, Washington, and Idaho) is the *Sediment Evaluation Framework for the Pacific Northwest* (SEF) (Corps et al., 2009).

The SEF is used to determine the suitability of dredged material for unconfined, aquatic disposal or placement; a secondary use of the SEF is to evaluate the need to manage the exposure of the new surface material (NSM), i.e., the post-dredge surface. Evaluations under the SEF are also used to support other federal and state agency authorities, such as the CWA Section 401 water quality certifications by the States and interagency consultations under Section 7 of the Endangered Species Act (ESA) by the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS).

The SEF guidance is primarily applicable to dredging projects (both Regulatory and Civil Works projects); however, the SEF may also be used to evaluate sediment quality in habitat restoration and hydropower projects. In addition to the Corps and EPA, the States of Washington, Oregon, and Idaho, USFWS, and NMFS are signatory agencies to the SEF.

The interagency Portland Sediment Evaluation Team (PSET[1]) implements the SEF guidance for the Portland District. This companion guidance is a local supplement to the SEF, and it provides guidance for dredging project proponents to prepare the Level 1 site history information, including the conceptual site model (CSM), and the Level 2 sampling and analysis plan (SAP). It also includes the procedures for coordination with the PSET to facilitate dredging project review. The PSET strongly recommends that permit applicants and Civil Works project managers use this companion guidance for the preparation of SEF documentation by permit applicants and project managers (PMs).

[1] The PSET Agencies include the Corps (lead), EPA – Region 10 (co-lead), National Marine Fisheries Service, U.S. Fish and Wildlife Service, Oregon Department of Environmental Quality, and Washington Department of Ecology.

Purpose of this SAP Guidance
The PSET's SAP guidance was prepared in accordance with the SEF; content from the Washington *Dredged Material Management Program Users' Manual* (DMMP, 2009) was also adapted in this document. The purpose of this guidance is to:

- Improve the content and completeness of SAPs submitted to the PSET.
- Improve consistency of dredged material evaluations between district and state boundaries.
- Improve the consistency of reviews between Portland District Civil Works and Regulatory projects.
- Describe procedures for project proponents to coordinate with the PSET
- Clarify site history and SAP development as described in the SEF.
- Outline the thought processes behind site history and SAP preparation, including the development of the project CSM.
- Increase consistency in the content and format of site history and SAP submittals by project proponents.
- Ensure the consistent application of the SEF guidance to projects permitted by the Portland District's Regulatory Program and Portland District Civil Works projects requiring sediment characterization, and upland or aquatic placement of sediment.

Geographic Scope
This supplementary SAP guidance applies to projects within the Portland District Regulatory and Civil Works boundaries. The Portland District Regulatory Program boundary encompasses the State of Oregon and its territorial seas, extending westward to the edge of the outer continental shelf. The Portland District Regulatory Branch also reviews projects proposed by Washington public ports on the length of the Columbia River shared by Oregon and Washington. The Portland District Civil Works Regulatory boundaries appear in Figure 1.

1.2 Role of the Portland Sediment Evaluation Team

The PSET, co-chaired by the Portland District and EPA, provides one-stop service for dredged material evaluations. The PSET staff is available during weekly teleconference calls to answer questions, assist in the development of SAPs, and help troubleshoot during sediment sampling and testing. The PSET reviews Level 1, Level 2A SAP and sediment quality data, and Level 2B special evaluations for consistency with the SEF guidance.

The primary product of each PSET review is the dredged material/ NSM suitability determination and technical memorandum. If the material to be dredged and/or the NSM are found unsuitable after exhausting biological testing options, then the PSET will strive to collaboratively work with the project proponent to help identify project risks and strategies that may avoid or minimize project impacts. It is incumbent upon the project proponent to identify scientifically sound, logistically feasible, and economically viable sediment management options that address contamination issues in the dredging project.

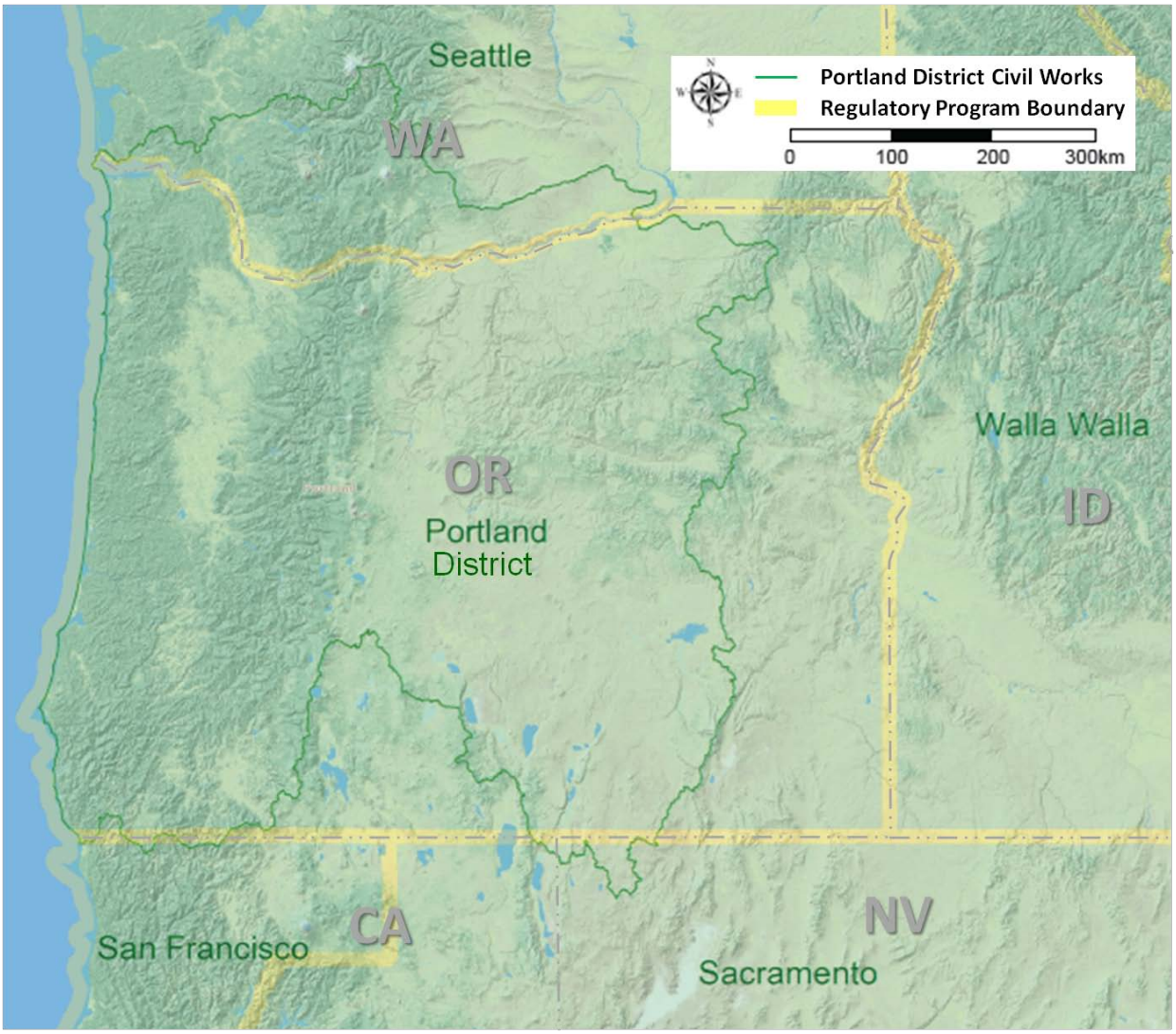


Figure 1. Portland District Civil Works and Regulatory Program boundaries.

1.3 Project Coordination

Coordination for Projects Requiring Corps of Engineers Permits

SEF information and data submittals need to be addressed to the Corps' Portland District Regulatory PM, even if a Joint Permit Application has not been submitted. Permit applicants should strive to keep individual files under 10 MB in size for ease of distribution. Adobe PDF submittals with selectable text are preferred. SEF documentation may be submitted to the Regulatory PM by email or on disk (CD or DVD). Army policy prohibits the use of jump drives.

The Portland District Regulatory Branch is committed to running SEF review as a pre-application process, and strongly encourages advanced coordination of project proponents with PSET. There are several advantages to this approach:

- Endangered Species Act (ESA) Section 7 consultation – The Oregon State Habitat Office of the National Marine Fisheries Service (NMFS) and State Offices of the U.S. Fish and

Wildlife Service (when applicable) commonly need the sediment quality evaluation to complete their reviews for ESA consultation.

- CWA Section 401 state water quality certifications – Similarly, the Oregon Department of Environmental Quality (ODEQ) and Washington State Department of Ecology (Ecology) typically require the sediment quality evaluation prior to completing their project review prior and issuing (or denying) the CWA Section 401 water quality certification.
- Issues with project changes after application – The sediment quality evaluation may result in dramatic changes to the project. For example, the dredged material disposal site and/or disposal methods may change as a result of the sediment quality evaluation. Also, NSM management may be necessary. These changes can cause permit process delays:
    - If there are significant changes, the Corps must re-issue the public notice (for a 15- to 30-day comment period).
    - Project changes feed directly back into the ESA consultation, which can cause delays.
    - Project changes feed directly back into the 401 water quality certification review, resulting in delays.

The Regulatory PM will log submittals into the project file and initiate PSET coordination by email. The PSET Lead will distribute the information submittal to the PSET for review. Each step of the PSET review (i.e., review of SAP, review of sediment characterization report [SCR]), takes approximately 30 days. Once PSET has concluded its review of a SAP, the Regulatory PM will receive a technical memorandum from the PSET documenting the SAP's consistency with the SEF.

For SCRs, the PSET will review the sampling narrative to ensure that the SAP was followed and that any deviations from the SAP were sufficiently documented. The PSET will review the sediment quality data presented in the SCR to ensure that SEF data quality guidelines are met, and compare the data with the appropriate marine or freshwater benthic toxicity screening levels. The PSET will prepare a memorandum documenting dredged material suitability for aquatic placement and NSM suitability.

During the review period, and prior to the PSET submitting the technical memorandum to the PM, permit applicants, the applicant's agent(s), and/or Regulatory PMs, may call into one or more of the weekly PSET conference calls to discuss the project and the proposed sampling design and subsequent sediment quality data. After reviewing the PSET's technical memorandum, the Regulatory PM will forward it to the permit applicant (or authorized agent). Questions regarding the content of the PSET technical memoranda can be directed to the Regulatory PM or directly to the PSET Lead.

Corps Civil Works Project Coordination

The process for coordinating Civil Works projects with the PSET is similar to the Regulatory process outlined above. Each PSET review takes up to 30 days, and the Corps' Civil Works PM will receive a technical memorandum following PSET's completion of their review of either the SAP or SCR. After reviewing the PSET's technical memorandum, if the Civil Works PM has questions regarding the technical memorandum, these can be directed to the PSET Lead.

Points of Contact
Any questions pertaining to this SAP guidance or SEF implementation in the Portland District should be directed to:

Primary
James M. McMillan
Portland Sediment Evaluation Team Lead
Hydraulics and Hydrology Branch
Corps of Engineers – Portland District
Tel: (503) 808-4376
Fax: (503) 808-4875

Secondary
Jonathan Freedman
Pacific Northwest Ocean Dumping Coordinator
Sediment Mgmt. and Ocean Dumping Program
Environmental Protection Agency – Region 10
Tel: (206) 553-0266
Fax: (206) 553-1775

1.4 Dispute Resolution

The project proponent may disagree with a technical memorandum prepared by the PSET for one of several reasons: 1) PSET initial assessment of site contamination risk; 2) PSET-recommended DMMU configurations and sample locations; 3) list of chemicals of concern (CoCs) to analyze; 4) PSET interpretation of sediment characterization results; 5) PSET recommendation for biological testing; 6) PSET interpretation of biological testing results; 7) PSET identification of the need to manage dredge prism and/or the NSM; and/or 8) the PSET technical memorandum is unclear to the proponent. The following dispute resolution process applies to both Regulatory and Civil Works projects:

- If the project proponent disagrees with the content of the PSET's technical memorandum (i.e., for reasons 1-7, above), then the proponent should attempt to clarify their position to the PSET and/or provide additional information that supports their position.
- If the project proponent needs clarification on a technical memorandum prepared by the PSET Lead (per reason no. 8 above), then the proponent should seek clarification through the PSET Lead. If the PSET Lead is unable to satisfy the proponent's request, then the PSET Lead will expeditiously issue the proponent's request for clarification to the PSET and seek timely resolution of the issue.
- If the dispute cannot be resolved within the PSET, then the proponent will ask the PSET Lead to elevate the issue. Regulatory projects will be elevated to the Portland District Regulatory Chief and coordinated with his/her PSET agency counterparts and the proponent. A meeting will be conducted to discuss the point(s) of disagreement, and the agencies will attempt to find common ground with the proponent and identify solutions that meet the proponent's needs and satisfy the regulatory requirements/trust responsibilities of each agency.
- If the PSET agency managers and the Regulatory project proponent cannot find common ground, then the point(s) of dispute will be elevated to Corps' Northwestern Division through the Regional Sediment Evaluation Team (RSET) and Regional Dredging Team hierarchy (Figure 2).
- Disputes regarding Civil Works projects will be elevated directly to the RSET.

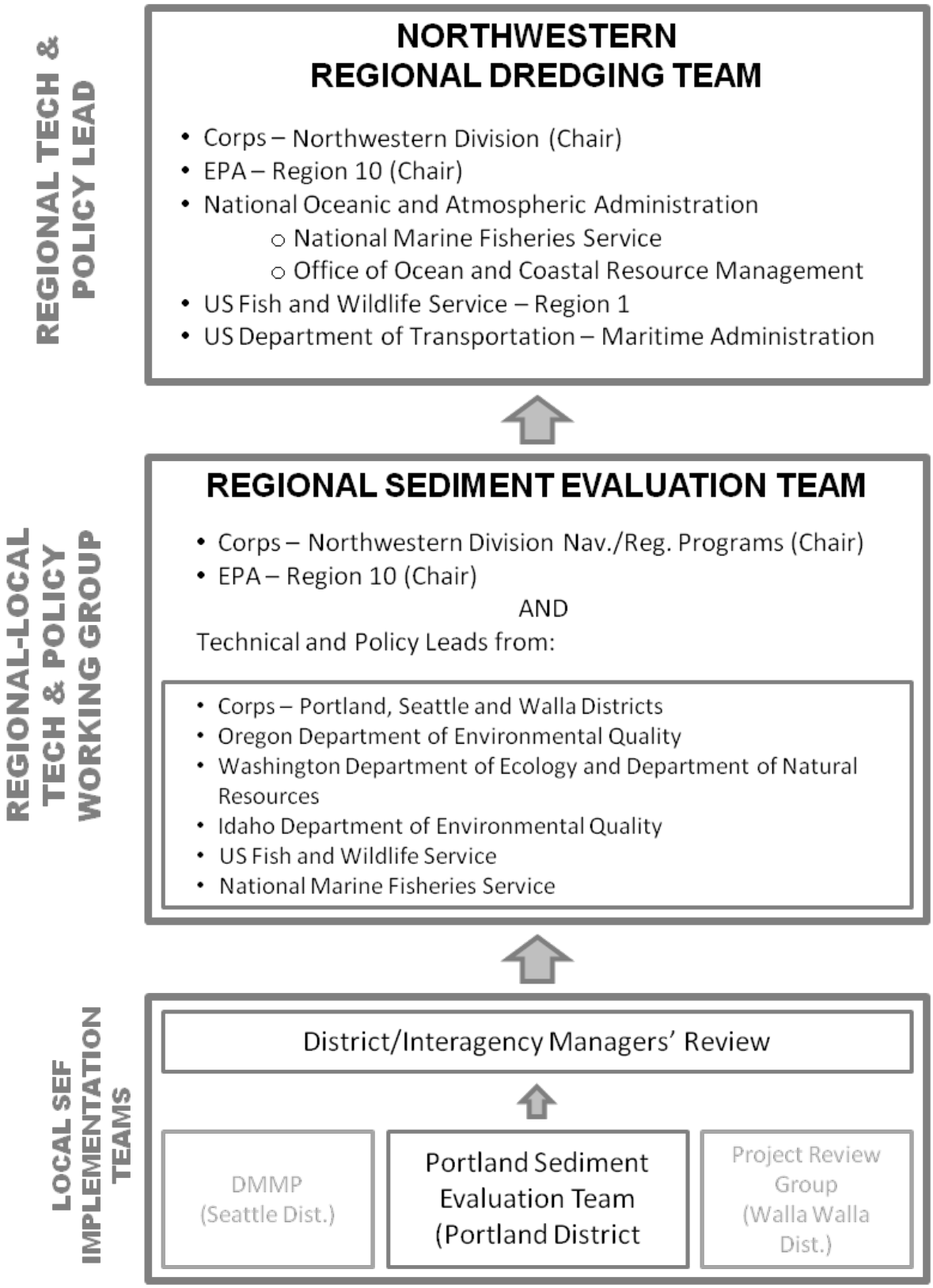


Figure 2. Dispute resolution hierarchy; arrows denote elevation of dispute.

2 Development of the Level 1 Information

2.1 Overview

Aquatic organisms can be exposed to harmful concentrations of CoCs released from sediment during dredging or from the aquatic placement of dredged material. To help identify the potential for CoCs to occur in sediments and minimize any release of CoCs, site history information must be developed. The Level 1 site history and project information review process uses multiple lines of evidence and a weight of evidence approach to help Corps Regulatory and Civil Works project managers document the decision to sample and test dredged materials under the SEF Level 2 review.

Subpart G of the CWA 404(b)(l) guidelines requires the use of available information to make a preliminary determination concerning the need for testing of the material proposed for dredging. This principle is commonly known as "reason to believe." The decision to not perform testing based on prior information must be documented in order to provide a "reasonable assurance that the proposed discharge material is not a carrier of contaminants" (by virtue of the fact that it is sufficiently removed from sources of pollution).

For example, dredged material is most likely to be free of CoCs if the material is composed primarily of sand, gravel, or other inert material and is found in areas of high current or wave energy. In addition, knowledge of the proposed dredging site's proximity to other sources of CoCs, as well as prior data from previous testing of the area to be dredged, may be used to conclude that there is no reason to believe that CoCs are present at elevated levels and, therefore, no need for testing or conducting a Level 2 analysis (EPA and Corps, 1998).

The primary problem to address in the Level 1 review is summarized as follows: In order to determine if sediment can be dredged and disposed of without additional physical and chemical characterization or sampling, information on CoCs sources, site conditions and characteristics, potential pathways of chemicals to receptors, and any prior sediment chemistry results needs to be identified and described by the project proponent.

The primary questions that must be addressed by the project proponent in order to resolve this Level 1 problem statement are:

1. Is there a known or suspected source of contaminants at the dredging site, or could the site receive depositional material from a known source of CoCs?
2. Are there any receptors of concern at the dredging site, and is there a potentially complete pathway for contaminants to reach these receptors?
3. Are existing physical and chemistry results for the site lacking that would otherwise help complete the conceptual site model?
4. Are there any proposed plans by the applicant to address concerns regarding known sources (containment, special disposal, etc.), and are they adequate?

If the resulting answer to any of questions 1 through 3 is yes, or if there is insufficient information to address the question, then additional site characterization is needed and the project proponent must prepare a SAP (see Level 2A) for the site. If the answer to question 4 is yes, a SAP may not be

required. The decision to sample or not sample is made by the PSET, after consideration of information provided by the project proponent.

Figure 3 illustrates the Level 1 site history and SAP review process. Additional information below and Section 4.2 in the SEF describe the Level 1 review process in greater detail. A complete Level 1 submittal should contain the site history information (Section 2.2), a conceptual dredging plan (Section 2.3), and a conceptual site model (Section 2.4).

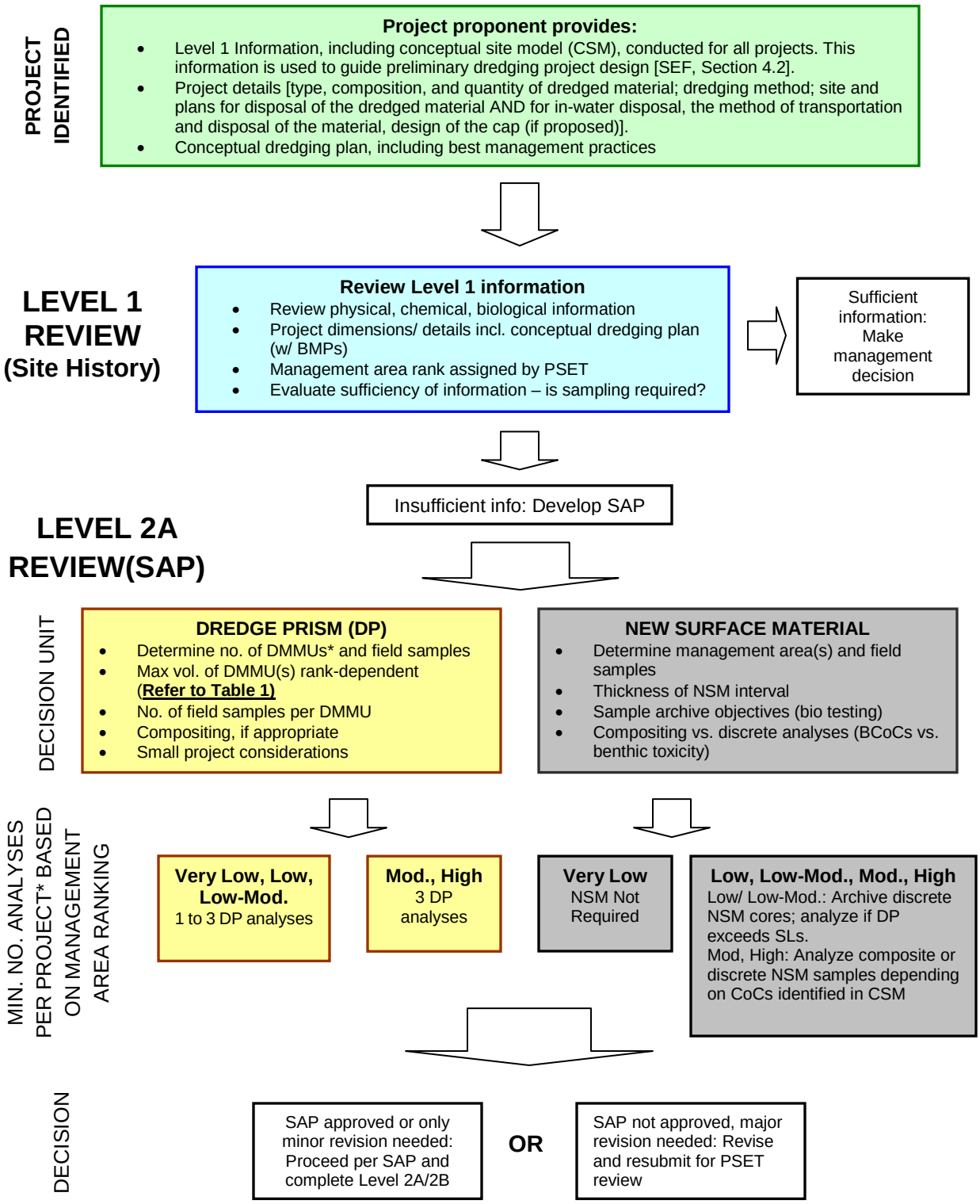
2.2 Site History Information

Site history information must be developed by the project proponent to help identify if CoCs occur in sediments and evaluate the potential for aquatic organisms to be exposed to CoCs released from dredging or disposal activities. The Level 1 site history should summarize past and present sources of CoCs in the proposed dredging area. A site history characterizes known activity at the dredging site, in near-shore areas, and on adjacent properties. It identifies past activities, and describes the CoCs that may have been released from those activities. Information on adjacent upland areas should be included if they can potentially impact sediments (adjacent upland cleanup activities, leaking underground storage tanks, groundwater contamination, etc.). The CSM is developed from this information (see Section 2.4 for details). The PSET uses the site history information to establish the management area ranking, and uses the ranking to determine the number of field samples and dredged material management units (DMMUs) necessary to adequately characterize the dredged material (Sections 3.4 and 3.5) and NSM (Section 3.6), if applicable.

The following outline identifies the type of information necessary for site history review. Emphasis should be placed on those activities that took place since the last dredging cycle (unless this is the first dredging event). Previous sampling data crucial to the site history evaluation should also be summarized in the SAP. It is important to identify whether the proposed dredging project is within, or adjacent to, an EPA-listed CERCLA site or state-listed environmental cleanup site. Providing this information will facilitate the PSET's review and coordination process among agencies.

Level 1 site history information should include:

1. A map showing the project site location (include river mile if applicable), layout, existing storm drainages and outfalls, and special aquatic sites (e.g., wetlands, eelgrass beds, ponds, lakes).
2. Current project area land uses and history of site ownership and prior land uses.
3. Current and prior adjacent property land uses, especially those properties up gradient or upstream/current from the project site.
4. Site characteristics that could affect movement of CoCs (i.e. prop wash, barge/ferry traffic, port traffic, dredged navigational channels, bar scalping, instream dredging sites).
5. Outfalls information, such as construction year, type, flow volume (capacity), and non-point discharge elimination system (NPDES) data. Industrial processes at or near the site and hazardous substances used/generated at these sites.
   (Continued on p. 10)



* A DMMU represents a unit of sediment similar in nature that can be characterized by a single sediment analysis.

Figure 3. Level 1 Site History and SAP review process.

6. Specific information on Environmental Cleanup, brownfields, leaking storage tanks, etc., for the State of Oregon can be found at: http://www.oregon.gov/DEQ/. Specific site information on Oregon Cleanup Sites can be found at: http://www.deq.state.or.us/lq/ECSI/ecsi.htm.
   Information on one-time or short-term toxic substance releases in Oregon can be found at: http://www.oregon.gov/DHS/ph/envtox/programs.shtml.
7. In the State of Washington, this information can be found at http://www.ecy.wa.gov/cleanup.html or http://www.ecy.wa.gov/programs/tcp/mtca_gen/hazsites.html.
8. CERCLA-listed site information. See http://www.epa.gov/superfund/sites/npl/index.htm and information listed in no. 3, above.
9. Spill events. These sites may provide information:
   http://www.ecy.wa.gov/programs/spills/incidents/main.html
   http://www.deq.state.or.us/pubs/factsheets.htm
   http://www.fws.gov/oregonfwo/Contaminants/.
10. Results of any previous sampling and/or testing.
11. Any dredging activity and data/information from that activity.
12. Conceptual Site Model (see Section 2.4 below).

2.3 Conceptual Dredging Plan

While construction-level detail is not required at this point in the process, project-specific information is important to develop the conceptual dredging plan. This plan considers the acreage of the project, depth and physical characteristics of the sediment, side slopes, practicable dredge cut widths and depths, dredge volumes, dredging along pier faces, other physical and logistical constraints, available dredging methods and equipment, proposed disposal methods, and conventional construction practices at similar dredging projects. If the project is in an area of known contamination and special dredging and disposal plans are proposed to minimize exposure, the project proponent should include them in the conceptual dredging plan.

2.4 Conceptual Site Model

The CSM is a critical component of Level 1 review and of the overall SEF review process. Figure 4 displays the CSM worksheet that can be used to graphically map exposure pathways and potential receptors in the Level 1 site history submittal. The CSM identifies how CoCs *could* move from the dredged material to receptor organisms, if the CoCs occur in the project. The CSM narrows the scope of the SAP and limits the sampling effort to specifically address only those potential pathways that are complete and of greatest concern (i.e., there would be no reason to collect and analyze samples if no receptors are present during dredging or at the disposal site). Figure 4 is meant to trigger thought processes relevant to pathways through which receptors could be exposed to CoCs, and can be adapted to suit specific needs. For example, if both salmon and sturgeon may occur in the project area, then there may be value in tracing receptor pathways for each species separately.

As Figure 4 indicates, the primary media of concern is sediment proposed for dredging. When this sediment is disturbed, CoCs or chemicals associated with particles can be released into the

environment by the process of 1) resuspension into the water column during dredging and disposal; 2) redeposition or resettling of materials disturbed by dredging or disposal onto the sediment surface layer (generated residuals); and 3) uncovering and exposing NSM that has higher concentrations of CoCs than the materials removed by dredging (undisturbed residuals). These processes can expose receptors to harmful concentrations of CoCs directly through the water column or by dietary pathways, and can result in biomagnification of bioaccumulative CoCs into tissues of prey at levels harmful to predators.

A properly developed SAP should be designed to answer specific questions resulting from the CSM. For instance, the SAP may incorporate chemical analysis of samples from the dredge prism layer, the NSM, and possibly from elutriate testing. The PSET compares chemical results from the dredge prism material and from elutriate testing (if required) to sediment quality guidelines, sediment bioaccumulation triggers (if available), and water quality guidelines to evaluate risk to receptors from CoCs associated with the dredge prism that could be released through resuspension or residuals generated from dredging or disposal. Chemical results from the NSM samples are used by the PSET to evaluate risk from the undisturbed residuals and address anti-degradation (addressed in Section 3.6).

Results from these tests and comparison to the SEF guidelines provide information used by the PSET to determine the suitability of the dredged material for unconfined, aquatic placement; and the suitability of the NSM for unconfined, aquatic exposure. Sediments that exceed the SEF sediment quality guidelines may require further characterization through biological testing (bioassays and/or bioaccumulation studies).

The CSM can be used during conceptual dredging plan development to minimize or eliminate certain receptor pathways (e.g., deployment of a turbidity curtain in low-energy, shallow environments could reduce or eliminate resuspension of CoCs). Knowledge of seasonal salmonid movements in the system relative to the dredging project schedule may also be factored into the CSM to temporally partition the dredging project and the species, thereby reducing exposure risk to listed species. Additional information regarding CSM development can be found in Section 4.2.3 of the SEF.

The CSM must be presented in narrative format and should be presented graphically as well, per Figure 4. The CSM narrative should support and justify each complete pathway checked in the CSM figure, and it should also explain why a pathway is potentially complete or incomplete. Complete pathways through which receptors could be exposed to CoCs are the most intuitive to map. However, potentially complete and incomplete pathways are often incorrectly mapped. The following scenarios provide examples of complete, potentially complete, and incomplete pathways, for various exposure pathways, but are by no means a comprehensive listing.

Complete Pathways

Examples of complete pathways can include direct exposure to CoCs in resuspended sediments to fish and benthic organisms (high concentrations can be acutely toxic even under short exposure durations expected during dredging). NSM may have both direct contact (acute toxicity) and bioaccumulative impacts, so complete pathways are possible for all potential receptors. In-water

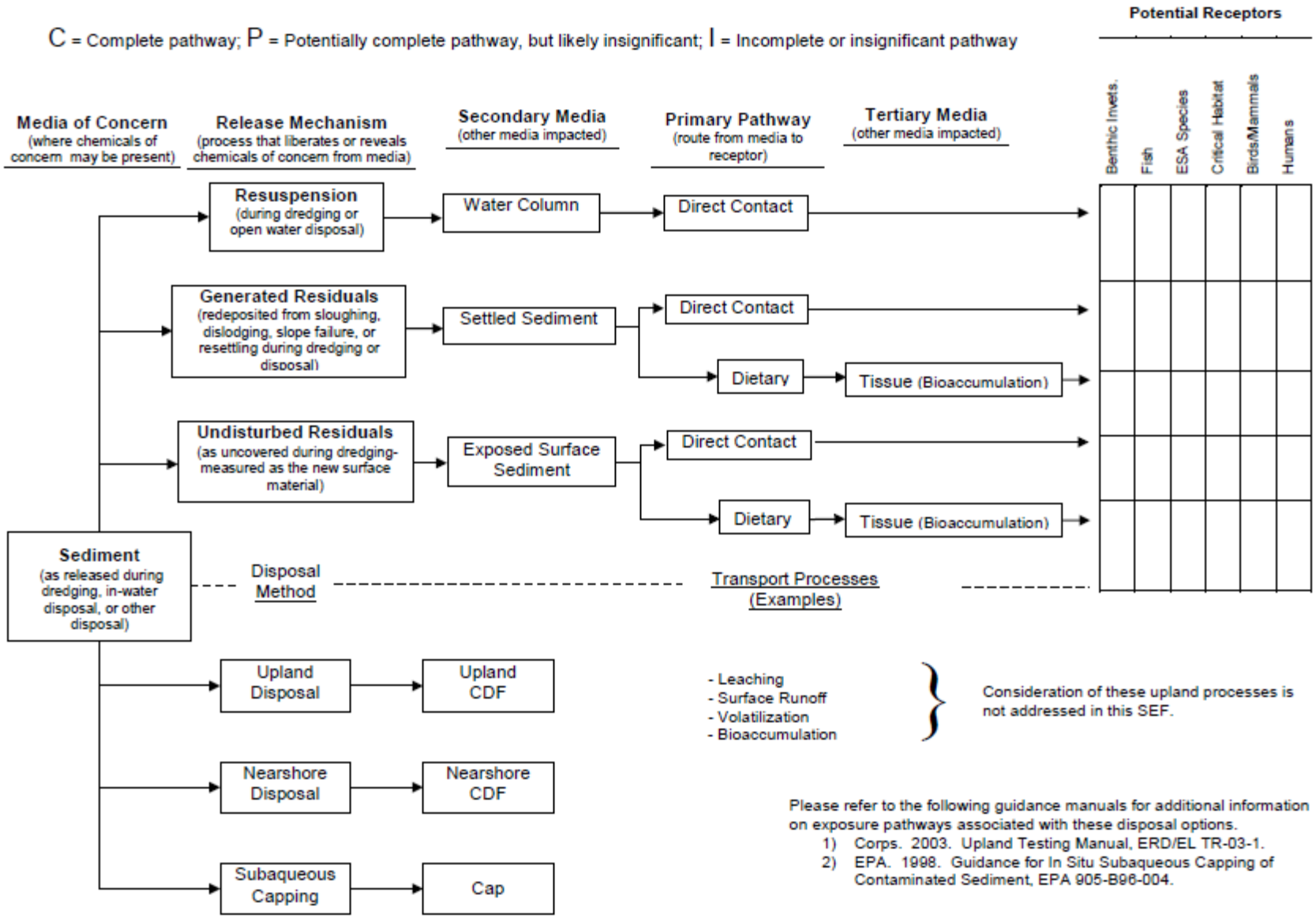


Figure 4. Conceptual site model worksheet.

disposal of materials containing CoCs typically has complete contaminant pathways for all potential receptors.

Potentially Complete Pathways, but Likely Insignificant

For dredging resuspension, potentially complete but insignificant pathways may include critical habitat (if the habitat is sufficiently far away from the site that it is unlikely to be impacted), or birds and mammals since actual exposure to resuspended sediments may be low. For NSM, humans could be considered in this category of potentially complete but insignificant pathway if the dredge area is not readily accessible to humans and the area is small enough not to contribute greatly to bioaccumulative risks due to consumption of organisms that use the area. For unconfined, aquatic placement of dredged material, special cases such as non-dispersive deep water sites could result in potentially complete but insignificant impacts to birds/mammals. Use of best management practices (BMPs) such as silt curtains or other containments could render most dredging resuspension pathways potentially incomplete but insignificant.

Incomplete or Insignificant Pathways

Choosing alternative disposal methods, such as upland disposal, eliminates bioaccumulative issues for aquatic species, but terrestrial species and other issues need to be evaluated (leaching, runoff, volatilization, upland terrestrial bioaccumulation). At locations where the PSET agrees that effective capping or covering of the exposed surface can be accomplished and maintained, all potential pathways to receptors at the dredge site can be rendered incomplete. Additional evaluation of potential receptor exposure to CoCs may be needed for aquatic placement of material at the disposal site.

3 Development of the Sampling and Analysis Plan (Level 2A)

3.1 Overview

A well-designed sampling and analysis plan (SAP) is essential when evaluating the potential impact of a dredging project upon the aquatic environment. The SAP is submitted to the PSET Lead for coordinated review and approval by regulatory agencies before any sampling is initiated, as described above. This coordination, including full and open disclosure of information, can reduce the chance of having to repeat costly sampling and laboratory analyses and can assist in keeping projects on schedule. While construction-level detail is not required at this point in the process, a realistic conceptual dredging plan will aid in the delineation of dredged material management units (DMMUs) and avoid the situation in which a regulatory determination could negatively impact dredging project design and schedule. A recommended SAP outline appears in Attachment A at the end of this document.

It is strongly recommended that the project proponent provide copies of the approved SAP to the sampling contractor and the laboratory to avoid field sampling and analytical errors. Also, the SAP preparer should meet with the sampling contractor prior to sampling to ensure that the SAP is properly implemented.

3.2 Objectives and Contents of a SAP

The primary problem to address when developing the Level 2A SAP can be stated as follows:

> Prior to dredging and placing the dredged material, concentrations of CoCs (identified in the 2009 SEF) in the dredge prism material and NSM are required to evaluate potential risks to aquatic receptors during the dredging operation.

To resolve the Level 2A problem statement, the project-specific SAP needs to be developed and implemented to address the following primary questions:

1. Do concentrations of CoCs in dredge prism samples exceed SEF screening levels considered protective of benthic organisms or trigger risk concerns to listed species at the dredge or disposal site?
2. Do CoCs concentrations in NSM samples exceed screening levels considered protective of benthic organisms or trigger risk concerns to listed species at the dredge site?
3. Are primary bioaccumulative compounds (listed in Appendix C of the 2009 SEF) present at the dredge site, and do concentrations in dredge prism or NSM represent a bioaccumulative risk to human or ecological receptors of concern? Do bioaccumulative CoCs concentrations exceed sediment bioaccumulation triggers, if available[2]?
4. Is there a need for more detailed information due to uncertainty in data quality, potential release of CoCs and impacts at or down-current from the dredge site, or additional information on the sediment or water column?
5. Do concentrations of CoCs in dredge prism samples exceed levels of concern for upland disposal? In Oregon, the project proponent needs to coordinate with ODEQ's Solid Waste Program. In Washington, the project proponent needs to consult with the local health jurisdiction (county or city).

[2] ODEQ has issued guidance for the State of Oregon on bioaccumulative CoCs in their 2007 *Guidance for Assessing Bioaccumulative Chemicals of concern in Sediment.*

If the answers to any of the questions one through four are yes, and aquatic placement of dredged material is still desired, then Level 2B testing is required. If only the NSM contains elevated levels of CoCs, then additional options, such as dredging and covering the contaminated surface with clean sediment, can be considered. If upland disposal is desired, then question five must be addressed by the project proponent to resolve how and where material will be disposed of in an upland facility based on state regulations, if applicable.

A recommended SAP outline appears in Attachment A. For the PSET agencies to determine the adequacy of the sediment sampling design, the SAP should contain the following minimum information:

1. Level 1 information, including site history, existing data, current site use, identification of sources of CoCs, past permitting (including NPDES permits as well as dredging permits issued by the Corps Regulatory Program), and the CSM. See section 2.2 for details.
2. Project description, including a plan view of the site, recent bathymetric survey data, one or more cross-sections of the dredging prism, type and volume of sediment, and conceptual dredging plan. See section 2.3 for more details.
3. Personnel involved with the project and their respective responsibilities, including project planning and coordination, field sampling, chemical and biological testing labs, QA management and final report preparation.
4. Computation of sampling and analysis requirements, identification and rationale for dredged material management units and NSM interval, allocation of field samples and development of a compositing plan (see Sections 3.2 through 3.6). For composited samples, representative volumes of sediment should be removed from each core section or grab sample comprising a composite. The composited sediment should be mixed until homogenized to a uniform color and consistency, and should continue to be stirred while individual samples are taken of the homogenate. This will ensure the mixture remains homogenous and settling of coarse-grained sediments does not occur. Compositing is discussed briefly in the 2009 SEF (see Appendix A).
5. Sampling procedures, including field sampling schedule, sampling technology, positioning methodology, decontamination of equipment, sample collection and handling protocols, core logging, sample extrusion, sample compositing and subsampling, sample transport and chain of custody.
6. Physical and chemical laboratory testing, including sediment conventionals, chemicals-of-concern, extraction/digestion methods, analysis methods, holding time requirements and quality assurance requirements. *Project proponents should ensure that the contract laboratory is aware of the minimum sediment sample quantitation limits outlined in Table 6-1 of the SEF.*
7. Biological testing, including holding time requirements, proposed testing sequence, bioassay protocols and quality assurance requirements. *For bioaccumulation studies, project proponents should ensure that the contract laboratory is aware of the minimum tissue sample quantitation limits outlined in Table 6-2 of the SEF.*
8. Reporting requirements, including the SCR. When in doubt, project proponents should contact the PSET Lead (Corps) or Pacific Northwest Ocean Dumping Coordinator (EPA) for the most recent marine and freshwater benthic toxicity screening levels.

3.3 Determining the Volume of Material to be Dredged

The project proponent needs to determine the physical geometry and volume of sediments proposed for dredging from a pre-sampling bathymetric survey. The dredging prism volume calculation should include the volume of material within the authorized navigation prism, side slopes cuts, and the overdepth volume (if proposed). Sediments anticipated to slough from under piers and wharves should also be accounted for, if sloughing material would be dredged to achieve the desired project depth.

Dredging contracts routinely include overdepth material allowance that is typically one to three feet below the required dredging depth. Figure 5 illustrates a conceptual dredging project and the depth and slope factors that should be considered when determining dredging volumes. In shallow-draft projects, the proponent may decide to minimize the overdepth volume for cost control. However, if an overdepth allowance is not planned, significant incursions below the authorized project depth may result in permit non-compliance penalties, re-initiation of ESA consultation, and additional sampling requirements to ensure project compliance with state and federal laws. Therefore, it is important for the project proponent to develop an accurate volume estimate of material to be dredged. To minimize permit or other environmental clearance violations, project proponents should follow the following guidelines:

1. Take pre-sampling surveys as close in time as possible to the sampling event to get the best possible bathymetric data for volume estimates.
2. Include allowable overdepth for the entire dredging prism, including sideslopes in pre-sampling volume estimates. Include technical justification for the selected angle of repose for the sideslopes in the SAP.
3. When a box cut is proposed along a pier face, sloughing from under the pier can be anticipated in most cases (Figure 6). Technical justification, by a qualified engineer or contractor, for the selected angle of repose for sideslopes under piers must be included in the SAP. The dredging proponent should ensure that all necessary geotechnical or under-pier survey data be provided to the contractor estimating the dredged material volume.

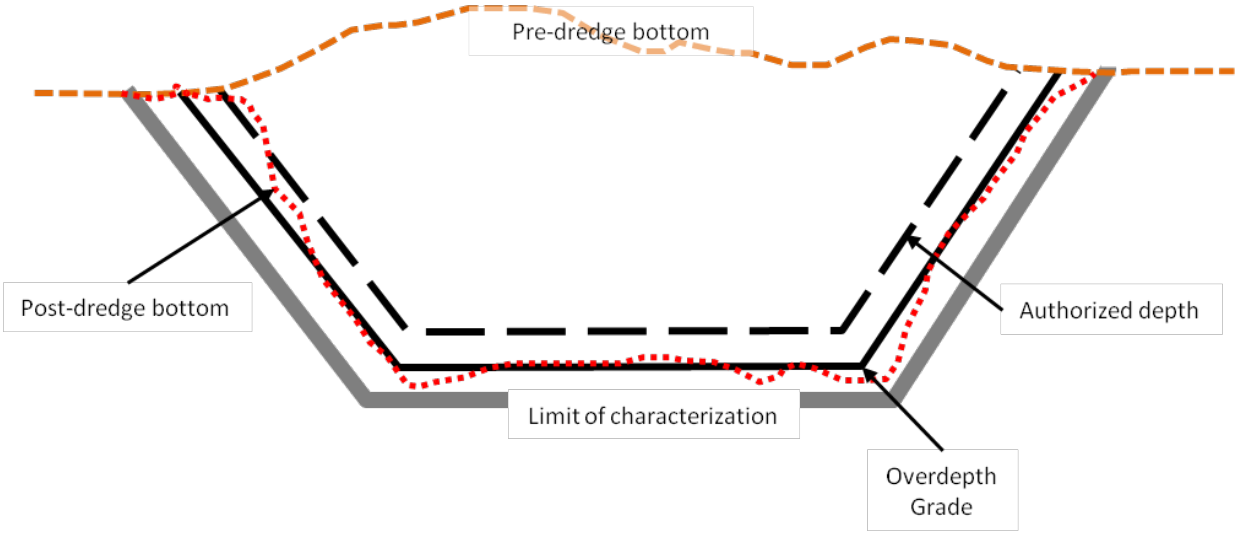


Figure 5. Typical channel cross-section and dredging project parameters.

Some areas, particularly channels and settling basins, are characterized by rapid shoaling during winter storm events. Since sampling and testing are required to be conducted prior to dredging, not all of the sediments to be dredged will have been deposited at the time of sampling. In such instances, project proponents should use the most recent hydrosurveys, records from previous dredging events, and best professional judgment, to estimate the volume of sediments likely to be dredged.

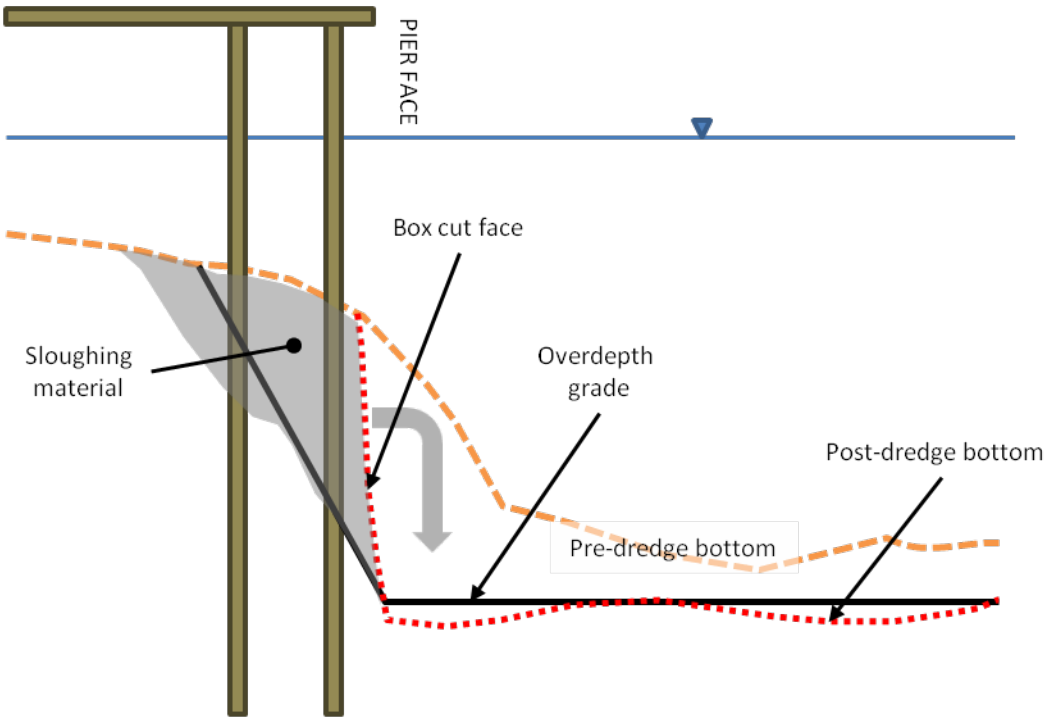


Figure 6. Cross-section view of a typical berth-pier face dredging project.

3.4 Dredged Material Management Units (DMMUs)

A DMMU represents a unit of sediment similar in nature that can be characterized by a single sediment analysis. It is the smallest volume of dredged material that is truly "dredgeable" (i.e., capable of being dredged independently from adjacent sediments) and also for which a separate disposal decision can be made by the PSET agencies. Though "dredgeability" often defines the minimum volume in a given DMMU, the maximum volume is based on the project rank, dredging depth, and extent of mixing in the dredge prism. Thus, a given volume of sediment can only be considered a DMMU if it is capable of being dredged, evaluated and managed separately from all other sediment in the project.

Each DMMU is independently evaluated by the PSET for suitability for unconfined, aquatic placement.

Determining the Number of DMMUs and Field Samples

The allocation and configuration of DMMUs across any given project depend on several factors, including:

1. project rank
2. location of the project relative to potential or known sources of contaminants
3. dredging method
4. dredge prism thickness
5. areal extent of the dredging project
6. anticipated sloughing areas for box cuts at pier faces
7. frequency of dredging (i.e., infrequent or new dredging vs. frequent maintenance dredging)

Project proponents need to pay particular attention to these factors when assigning DMMUs to a project. The DMMU volume threshold guidelines presented in Table 1 identify the maximum volume of dredged material that can be represented by a single laboratory analysis based on the management area rank (management area ranking definitions appear in SEF Table 4-2, p. 4-11). These thresholds are guidelines, and it may be prudent to establish smaller or slightly larger DMMUs than prescribed in Table 1, as informed by the Level 1 review. However, the project proponent should provide rationale for exceeding the maximum recommended DMMU volume in the SAP.

Table 1. Recommended DMMU volume thresholds.

Management Area Rank	Volume Threshold (cubic yards)
Very Low	300,000
Low	100,000
Low-Moderate	70,000
Moderate	40,000
High	5,000

The number of field samples and laboratory analyses must be sufficient to allow for an adequate assessment of dredged material suitability throughout the project. Figure 3 should be consulted for guidance on the project management area ranking and the minimum number of analyses per project. Field samples representing the sediment in a given DMMU are typically composited for a single laboratory analysis, with results applicable to the entire DMMU. For details on compositing, please consult the Appendix A of the 2009 SEF.

The number of DMMUs and field samples proposed to characterize project sediments are subject to PSET approval. Additional considerations regarding DMMU and field sample configuration and allocation appear in the section below.

Defining and Delineating the DMMUs for the Project

Once the required numbers of DMMUs and field samples have been calculated and a dredging plan conceived using Figure 3 and Table 1, the project proponent must delineate the DMMUs, propose field sample locations, and develop a compositing scheme (if compositing is proposed). Best professional judgment is necessary in the allocation of DMMUs and the development of a sampling and compositing plan. The DMMUs and field samples should be distributed within the dredge prism in a manner consistent with the definition of a DMMU. Project-specific constraints or special circumstances (e.g., presence of a known source, such as an outfall) should also be factored into the sampling design.

Flexibility should be built into the SAP by the project proponent to cover unanticipated sediment changes that would warrant the delineation of additional DMMU(s). If the PSET finds an individual DMMU (represented by one or more field samples) unsuitable for unconfined aquatic placement, then that unit of material must be capable of being dredged independently from adjacent sediment.

Field samples (typically core samples) should be processed in a field laboratory or protected area. Cores brought to the field laboratory should be split, and the materials collected from a specific layer (i.e. dredge prism layer and/or the NSM layer, if collected) should be analyzed separately. If proposed, compositing of field samples can be accomplished in the field or by the contract laboratory. In either case, the compositing scheme should be clearly defined for the sampling contractor or the contract laboratory. If acutely toxic chemicals are anticipated in the NSM, compositing may not be appropriate.

Additional DMMUs, beyond the minimum number, may be required by the PSET to adequately characterize the dredge area (e.g., different sediment types or physically separated areas may warrant separate DMMUs). The allocation of DMMUs and field samples are subject to PSET review and approval.

3.5 Consideration of New Surface Material (NSM)

Dredging operations can alter the condition of the surface sediments in the dredging area by exposing new sediments (i.e., the NSM) to direct contact with biota and the water column. Collecting NSM information is directly related to resolving the Level 2A problem statement (see Section 3.1 above). The purpose of sampling the NSM separately is to identify differences between the two sample layers, which would indicate non-uniform or heterogeneous accretion between the dredge prism and NSM. If the NSM has substantially higher concentrations of CoCs than the dredge prism layer, then listed species and other receptors might be exposed to CoCs remaining as a result of dredging. This could violate state-specific anti-degradation policies.

The need to evaluate the NSM should be solely based on the site history, CSM, and other Level 1 information, as described above. The NSM sampling interval selected for analysis depends on the type of dredge used. The NSM interval is typically two feet thick, and it should not extend below the anticipated maximum depth (i.e., the NSM interval characterized should factor-in overdepth allowance and the dredging method to ensure that incursions below the characterized sediment do not occur). For example, in a project authorized to -22 ft. MLLW +2 ft. overdepth allowance (i.e., dredging occurs to a maximum depth of -24 ft. MLLW), the NSM sample should be collected between -24 and -26 ft. MLLW.

If a different interval is proposed, then the project proponent should document the rationale in the SAP. NSM sample collection and analysis guidance for project proponents are as follows:

- NSM samples need to be collected and archived for every core sampling location for all projects in all management rankings, with the exception of projects ranked “very low,” which do not require NSM sampling. Archived sediment must be maintained at -18° C. NSM samples for ammonia and sulfide analysis cannot be frozen (archived) and need to be analyzed within holding times.

- If tributyltin porewater testing is required for the project, interstitial water from an unfrozen sediment subsample must be extracted within seven days of field collection. The porewater extract must be maintained at -18°C.
- It is likely that the holding time for mercury will be exceeded prior to any testing of archived sediment. The results should be flagged as having exceeded the holding time. If level 1 information indicates mercury is a contaminant of concern at the project site, NSM material should be analyzed within the holding time (expedited analysis of the dredged prism may be required to meet holding times, or NSM samples can be submitted for analysis along with the dredge prism samples).
- Archived sediment cannot be tested for volatile organics. Therefore, the requirement to test for the volatiles is waived unless there is reason to believe these chemicals are a problem at the project site (as informed by the Level 1 review and/or data from sediment characterization).
- If a surface DMMU is found to be unsuitable for unconfined, aquatic placement, and the underlying DMMU is also unsuitable for unconfined, aquatic placement or has not been adequately characterized, then archived NSM samples must be analyzed to verify the sediment quality of the NSM interval. Per Figure 3, the PSET recommends analysis of NSM samples for all moderate- and high-ranked sites.
- If the need for biological testing of the NSM is anticipated by the project proponent, then sufficient NSM sample should be collected during the initial sampling event to perform the biological testing. Advanced planning for biological testing eliminates the need for the project proponent to remobilize and collect additional sample.

4 Biological Testing or Other Special Evaluations (Level 2B)

Level 2B testing consists of biological testing (bioassays or tissue analyses) or other special evaluations that are completed to provide more empirical evidence (beyond simple comparisons to regional or national screening levels) regarding the potential for CoCs in sediment in the project area to have adverse effects on receptors. These evaluations are often undertaken when available screening levels are exceeded, excessive uncertainty of data quality exists, or if other analytical results indicate a need for more detailed assessment of the sediment or water column. Tests involving whole sediment identify potential CoCs that could affect bottom-dwelling (benthic) organisms. Tests using suspension/elutriates of dredged material are used to assess the potential effects to the water column and associated receptors. The primary problem to address when developing the Level 2B evaluation can be stated as follows:

> In order to determine if the CoCs in site sediments are at concentrations that could be released into the water column, impact the benthic community, bioaccumulate in tissues, or potentially impact listed species at the dredge or disposal site, direct measurements of sediment toxicity, bioaccumulation in tissues from site sediment, or water column tests from dredge prism and new surface material site sediments are needed.

The primary questions that must be addressed by the project proponent in order to resolve the Level 2B problem statement when completing special evaluations at a site proposed for dredging are:

1. Do elutriate test results indicate material can easily be released into the water column at concentrations that are harmful to aquatic organisms?
2. Do bioassay results exceed guidance indicating material is harmful to benthic organisms?
3. Do bioaccumulation bioassay results indicate chemicals can bioaccumulate in tissue and threaten aquatic resources?
4. Does the sampling effort adequately characterize the materials in the dredge prism or new surface area, or do sample results indicate a high degree of uncertainty and likely high heterogeneity in sample material?
5. Does the new surface material indicate the potential for elevated CoCs in residuals such that post dredge monitoring at the site is needed to better characterize threats to the benthic community and listed species?

If the answers to any of questions 1 through 3 are yes, then alternative disposal methods (e.g., upland disposal), best management practices to prevent materials from leaving a site, or capping of material is required. Positive answers to questions 4 or 5 would require additional conservative approaches to manage risk or additional sampling and analysis using a sample design more tailored to the specific problem.

Please see the SEF Section 4.3.3 and Chapters 7 thru 10 for more information on special evaluations.

5 References

Dredged Material Management Program. 2009. *Dredged Material Management Program Users' Manual.* November 2009, *by* USACE-Seattle District, EPA Region 10, Washington Department of Ecology, and Washington Department of Natural Resources. Seattle, Washington, 105 pp.

Environmental Protection Agency and U.S. Army Corps of Engineers. 1998. *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual* (Inland Testing Manual. EPA-823 -B-98 -004, Washington, D.C.

Environmental Protection Agency and U.S. Army Corps of Engineers. 1991. *Evaluation of Dredged Material for Ocean Disposal – Testing Manual* (Green Book). EPA 503/8-91/001, Washington, D.C.

Oregon Department of Environmental Quality. 2007. *Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment*. *Prepared by* ODEQ's Environmental Cleanup Program, April 2007, Report No. 07-LQ-023A. Portland, Oregon, 18 pp. + Appendices.

U.S. Army Corps of Engineers, Environmental Protection Agency (Region 10), Washington Department of Ecology, Washington Department of Natural Resources, Oregon Department of Environmental Quality, Idaho Department of Environmental Quality, National Marine Fisheries Service, and U.S. Fish and Wildlife Service. 2009. *Sediment Evaluation Framework for the Pacific Northwest.* May 2009. Portland, Oregon, 138 pp. + Appendices.

ATTACHMENT A – PSET-Recommended SAP Outline

PORTLAND SEDIMENT EVALUATION TEAM
RECOMMENDED SAP OUTLINE

I. Project Description

A. Plan view and narrative description of the proposed action
    1. Depth and physical nature of material to be dredged
    2. Advanced maintenance, side slope and overdepth dredging
    3. Practicable depths and widths of dredging project
    4. Dredging methods

B. All potential disposal methods and locations (unconfined/confined; upland/aquatic)

C. For contaminated sediment projects, add identification of areas of potential concern for effective/complete sediment characterization

D. Conceptual dredging plan

II. Level 1 Site History Information

A. Site history

B. Current site use

C. Identification of all potential contaminant sources throughout site history

D. Adjacent land info (CoCs or cleanup sites)

E. Past permitting

F. Data from prior sediment evaluations onsite or in the proximity

G. Conceptual Site Model (CSM) and narrative, which considers:
    1. Identification and description of all potential contaminant sources throughout site history [redundant of Level 1 info above]
    2. Processes (fluvial/contaminant dispersion) linking sources to sediments at the site, and include any known data and cleanup resolution of sources
    3. In-situ chemical, physical, and biological processes affecting exposure
    4. How receptors of concern are/could be exposed to contaminants (describe complete, partially complete, and incomplete pathways)

III. Computation of Sampling and Analysis Requirements

A. Volume of dredged material

B. Project rank (informed by CSM and to be concurred with by PSET)

C. Proposed dredging plan

D. Identification of DMMUs and respective volumes

E. Field sample locations/allocations
    1. Site bathymetry
    2. Core locations to full depth of prism and leave surface
    3. Cross-section of dredging prism (and type and volume of sediment to be dredged)
    4. NSM sample discussion/rationale
    5. Plan view of site with proposed sampling locations

F. If applicant proposes sampling that is different from SAP guidance, provide the applicant-suggested sampling strategy and rationale for strategy (to be verified by the PSET).

IV. Sampling Procedures Including but not limited to: field QA project planning, sampling schedule, sampling techniques/ equipment, positioning methods, decontamination of equipment, sample collection and handling, core logging, sample extrusion, sample compositing and sub-sampling, transport, chain of custody.

V. Physical and Chemical Testing

A. Particle size analysis; sediment conventionals
B. CoCs, extraction/digestion methods, analysis methods, detection limits, holding times, laboratory QA project planning

VI. Biological Testing Including, but not limited to: holding time requirements, proposed testing sequence, bioassay protocols, bioaccumulation testing, QA project planning.

VII. Personnel Responsibilities Including, but not limited to: project planning/coordination, field sampling, chemical/physical testing, QA/QC management, report preparation.