CHAPTER 6

SAMPLING AND ANALYSIS PLAN

6.1 OVERVIEW

The development of a sampling and analysis plan by the dredging proponent is the next step in the tiered evaluation process for those projects found to require additional information following review under Tier I. The basic sampling and analysis structure that follows is patterned after those developed for Puget Sound and Grays Harbor. This manual includes guidelines that take into account the fact that the Lower Columbia River Management Area (LCRMA) is a very large and dynamic river/estuarine system.

6.2 INFORMATION IN A DRAFT SAMPLING AND ANALYSIS PLAN

A sampling plan serves as the main source of information about a proposed dredging project and the project site. A sampling and analysis plan (SAP) should contain the following general categories of information in as much detail as possible. Some of these categories of information are further described in subsequent sections of this chapter. Examples of SAPs are presented in Appendices 6-A and 6-B.

< **Tier I Information:** site history, current site use, identification of potential sources of contamination, past permitting and present rank. Rank affects the number of sediment samples and analyses required of the project. More than one rank could be assigned to a single project depending upon the size of the proposed dredging area and the distribution of potential contaminant sources.

< **Project Description:** a plan view of the site, one or more cross-sections of the dredging prism, and the type and volume of sediment to be dredged. Dredged material volume is another factor that affects the number of sediment samples and analyses required of a dredging project. This proposed dredging plan should contain such information as the depth and physical nature of the sediments; side slope and overdepth dredging; practicable widths and depths of dredging; and available dredging methods and equipment.

< **Computation of Sampling and Analysis Requirements**: project rank and volume of dredged material, development of a proposed dredging plan; identification of dredged material management units; allocation of field samples and development of a compositing plan.

- **Sampling Procedures:** 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.

- **Physical and Chemical Testing:** grain-size analysis, sediment conventionals, chemicals-of-concern, extraction/digestion methods, analysis methods, holding time requirements and quality assurance requirements.

- **Biological Testing:** holding time requirements, proposed testing sequence, bioassay protocols and quality assurance requirements.

- **Personnel Responsibilities:** individual roles and responsibilities, project planning and coordination, field sampling, chemical and biological testing, QA/QC management, and final report preparation.

- **Reports:** draft SAP submitted to DMMO/DMMT, comments or concerns by agencies addressed in final SAP, results of sampling and analyses written up in standard format and submitted to DMMO/DMMT for review and concurrence of the RMT.

6.3 DETERMINATION OF DREDGED MATERIAL VOLUMES

The volume of dredged material determines, in part, the minimum number of sediment samples and analyses required for full characterization of a dredging project. The potential volume of sediment is usually determined from a pre-sampling bathymetric survey. The calculation of dredged material volume must include:

- sediments anticipated to slough from the side slopes and from under piers and wharves during dredging,

- "overdepth dredging" - a term used to account for the limitation of dredges to achieve a precise depth of cut. Overdepth dredging refers to the removal of sediment one to two feet deeper than the planned depth of dredging, and

- “advanced maintenance dredging" - a term used to described additional dredging cut or width in locations known to shoal very rapidly. Advance maintenance refers to the

removal of a sufficient volume of sediment to ensure a reasonable length of time before having to dredge again.

The calculation and/or differentiation of dredged volume may be affected by one of the following variables:

a) Heterogeneous Sediments. Heterogeneous sediments are those in which the physical characteristics are dissimilar within the sampling depth. Characteristics of such sediments include obvious layering of sediments, lenses of dissimilar material (either in grain size or color), or obvious gradation of sediment size. Sediments that are deposited over a long period of time may be heterogeneous in nature.

In heterogeneous sediments, the volume of dredged material may be differentiated either by discreet sediment lenses or by depth. If a discreet lens is present in the sediment profile, then volumes may be calculated on the basis of that lens. However, to qualify for a separate characterization, the volume of the discreet lens must be amenable to being dredged separately from other sediment occurring in the dredging prism.

Lacking discreet lenses, projects with heterogeneous sediment greater than four feet deep must divide the volumes between a "surface layer" (generally the top four feet) and a "subsurface layer" (the next 4-foot layer) down to the bottom of the planned dredge cut. The volumes comprising each of the 4-foot layers must be calculated separately. A four-foot cut is considered a manageable unit of dredged material as it represents the typical depth achieved by one drop of the bucket of a moderately-sized clamshell dredge in unconsolidated sediments.

b) Homogeneous Sediment. The majority of sediments dredged in the LCRMA are homogeneous. The sediments appear the same in physical characteristics throughout the sampling depth and lack obvious color striations, layering, or sorting of grain size. For shoals which are dredged frequently or new projects which involve the dredging of native material, the entire dredging prism may be considered homogeneous and the volume need not distinguish between surface and subsurface layers.

6.4 DETERMINATION OF SAMPLING AND ANALYSIS REQUIREMENTS

The following guidelines specify the maximum volume of dredged material that can be represented by a single analysis. The guidelines are considered "the minimum requirements" in that the dredging proponent may opt, or regulatory agencies may require, additional analyses for volumes less than the maximum.

a) Dredged Material Management Units. In determining the number of samples and analyses required to fully characterize project sediments, the concept of a "dredged material management unit" (DMMU) is used. A DMMU can represent the total volume of sediment to be dredged for a small project or can be a sub-unit of the total volume of a larger project. Typically, a DMMU represents a unit of sediments similar in nature that can be characterized by a single sediment analysis. Thus, a separate decision can be made for a management unit that can be characterized and dredged separately from other sediment in the project. The acceptability of dredged material for unconfined aquatic disposal is determined for individual DMMUs independently of other management units within the project, and is based on the results of the analysis representing that DMMU.

Table 6-1 presents the maximum volume of sediment in a DMMU that can be characterized by a single analysis based on area ranking. The presence of heterogeneous or discreet layers in the dredge cut may warrant further sub-sampling or assignment of a smaller DMMU. Dredging proponents have the option to propose smaller DMMUs. For example, if 25% of the sample volume is visually different from the rest of the sediment profile, and can be sampled and dredged separately, then an additional DMMU may be warranted.

b) Sampling Intensity Within a DMMU. The number of samples required of a proposed project, or that can be composited or combined for a single analysis, will be determined on a case-by-case basis using best professional judgment. The number of samples and the compositing scheme will vary depending upon such factors as (1) a reason to believe that contamination may exist at the surface or in subsurface sediments, (2) the heterogeneity of the sediments, (3) the project rank, (4) the aerial extent of a DMMU, and (4) the proposed depth of dredging. In general, sampling intensity will increase with suspected contamination, higher project ranking, greater aerial extent, increasing depth, or the occurrence of stratification. In heterogeneous sediments, a minimum of three samples composited for one analysis will be required to characterize a single DMMU.

6.5 PREPARATION AND SUBMITTAL OF A DRAFT SAMPLING AND ANALYSIS PLAN

A draft sampling and analysis plan is prepared once the number of samples and analyses have been calculated in conjunction with the dredging plan. The draft plan identifies specific sampling locations for the dredged material management units (DMMUs) and, if applicable, specifies the compositing of samples for individual analyses.

In applying the above concepts to a workable draft sampling plan, it is not necessary or always desirable to restrict the volumes characterized by each individual sample or DMMU in the

field to the minimums specified in Table 6-1. Additional sampling and/or analyses beyond the minimum number may be required to achieve an appropriate dredging plan. Sample stations may be added and/or moved to select different, equally representative spots to insure uniformity of acceptability throughout the project. Stations may be moved or added in response to information on point sources, spills, or new chemicals of concern, or to acquire data that helps draw boundaries between clean and contaminated sediments.

TABLE 6-1. DREDGED MATERIAL MANAGEMENT UNITS

Ranking	**Heterogeneous**	**Homogeneous**
(Volumes in cubic yards)		
Exclusionary	NA	NA
Low	50,000	100,000
Low-Moderate	35,000	70,000
Moderate	20,000	40,000
High	5,000	10,000

The draft sampling and analysis plan must be submitted to the DMMO/DMMT for review by the agencies comprising the RMT. The DMMO/DMMT will then prepare a letter of approval to proceed with the sampling effort with recommended corrections or changes to the draft SAP. Such corrections and changes must be reflected in the final SAP that is submitted to the DMMO/DMMT with the report containing the results of the sampling and analysis effort.

6.6 SAMPLING AND ANALYSIS CONSIDERATIONS FOR SPECIAL CASES

The following sections discuss special types of sediment evaluation for the Lower Columbia River Management Area. These special cases will be evaluated by the RMT on a case-by-case basis. These include the requirements for establishing exclusionary status, methods for evaluating sediment in areas of rapid shoaling, methods for confirming project ranking, exceptions for small projects and evaluation of sediment exposed by dredging.

6.6.1 Establishment of Exclusionary Status

This section provides a process to establish an exclusionary status for projects or project locations that would likely qualify as exclusionary but which are lacking data to validate such a determination. Typically such areas or projects would already be ranked low or low-moderate and exist in a high current location. Three factors have to be considered in order to establish an exclusionary status: (1) the potential influence of active point sources of contamination on the sediments to be dredged, (2) the grain size of the sediments, and (3) the total volatile solids contents in the sediments.

The latter two criteria trigger the need to do sediment sampling if sufficient data are not available. The intensity of sampling and analysis to establish an exclusionary ranking will be based upon the existing rank of the project or project location and the volume of sediment to be dredged. For projects below 300,000 cubic yards, testing is conducted at the same intensity as a low-ranked homogeneous project. For projects between 300,000 and one million cubic yards, four samples are required. Above one million cubic yards, five samples are required.

Sediment samples obtained for the initial determination of an exclusionary status should be taken to the full depth of the proposed dredge cut by a core sampling device. Core sampling indicates the grain size distribution of the sediments for the entire depth of the dredge cut. However, core sampling is not always possible in the Lower Columbia River. Some reaches of the river can not be sampled by coring devices because of the inability to position a research vessel in high currents or to drive a coring device into very compact, coarse sandy sediment. In such cases, the inability to use a coring device will have to be documented in the final sampling report. Sediment samples obtained to "confirm" an existing exclusionary status (see Section 6.6.2) may be taken with a suitable grab sampler.

6.6.2 Confirmation of Project Ranking

Confirmatory sampling and analysis is primarily intended for application to frequently dredged projects ranked low or exclusionary. It should be done at least as often as called for under the frequency guidelines. The main purpose of confirmatory sampling is to reaffirm the historical record and to show that no significant environmentally unacceptable changes have occurred to the project sediments. It is also intended to be accomplished at lesser cost but with an acceptable level of confidence in support of an existing project ranking or suitability determination. Confirmatory sampling shall duplicate earlier sediment testing as much as possible and thereby provide spatial and analytical consistency between testing periods.

If the results of confirmatory sampling and analysis indicate that the project or shoal sediments have changed significantly to the worse, project reranking to a higher level and further sampling may be necessary.

6.6.3 Rapid Shoaling Events

Many reaches of the Lower Columbia River and some tributaries are affected by a rapid build up of shoals that pose serious risk to the navigation of commercial vessels. Shoaling typically occurs following major storm events in December through February, but may occur at any time as a result of bedload redistribution. In general, the largest number of recurring shoals are dredged by the Corps of Engineers from the mainstem navigation channel. However, some shoal locations involve non-Corps dredging.

Because of rapid shoaling events, a port or other water dependent enterprise may be faced with a situation where a particular shoal must be dredged as soon as possible. The situation may be complicated by the fact that some dredging is restricted to an operating period of only four months, that being from November 1 to February 28 of any year due to endangered species concerns. In that time frame, the size of a potential problem shoal can increase substantially from what was there during a prior sampling effort to characterize the sediment already in the shoal. The following guidelines address the rapid buildup of new shoal material in locations where sediment characterization has been done and is still valid under Recency Guidelines. These guidelines do not apply to shoal locations ranked Exclusionary.

a) No additional testing required. For projects or shoal locations where historical information documents the occurrence of sediments suitable for unconfined aquatic disposal for two dredging cycles, no additional testing will be required regardless of the depth of the new shoal material.

b) Lack of sufficient historical record and in a location ranked low or low-moderate. No additional testing will be required if the newly deposited shoal material averages less than two feet in depth. If greater than two feet in depth, the dredging proponent will be required to obtain grab samples to characterize the new shoal sediments. The number of grab samples/analyses required will be determined by the ranking of the location and the estimated volume of new material.

c) Lack of sufficient historical record and in a location ranked moderate or high. The dredging proponent will be required to obtain grab samples to characterize newly deposited sediments/shoal material if the material averages more than one foot in depth

The number of grab samples/analyses required will be determined by the ranking of the location and the estimated volume of new material.

6.6.4 Exceptions for Small Projects

For small projects (as defined in Table 6-2), the cost of testing must be balanced against the environmental risks posed by a very small volume of dredged material. Small volumes generally represent low potential risk that unacceptable adverse effects will result at the disposal site from the specific and/or cumulative discharges. As a result, a small volume of sediment to be removed at a dredging site can obviate the need for testing.

To clearly define what constitutes a small project, there are two key qualifiers. First, intentional partitioning of a dredging project to reduce or avoid testing requirements is not acceptable. Second, recognizing that multiple small discharges can cumulatively affect the disposal site, "project volumes" are defined in as large a context as possible. One example of this latter qualifier is recurring maintenance dredging of a small marina where "project volume" will be the projected dredging volume over 5 years. Another example is a multiple-project dredging contract where a single dredging contractor conducts dredging for several projects under a single contract or contract effort. Again, the "project volume" will be summed across all projects, as will any sampling and compositing efforts prior to testing.

For small projects in low, low-moderate, or moderately ranked areas, volumes for which no testing need be conducted are shown in Table 6-2. There is no "no test" volume for high-ranked areas. In the absence of conclusive evidence of unsuitable sediments, projects with these or lesser volumes will be considered suitable for unconfined aquatic disposal.

TABLE 6-2
"NO TEST" VOLUMES FOR SMALL PROJECTS

Ranking	**"No-Test" Volume**
Low	Less than 10,000 cy
Low-Moderate	Less than 1000 cy
Moderate	Less than 1000 cy
High	Not Applicable

6.6.5 New Sediment Surface Exposed by Dredging

Dredging operations can alter the condition of a project site by exposing a new surface layer of bottom material to direct contact with biota and the water column. This aspect of dredging must be considered during preparation of the SAP because, for some projects, the newly exposed surface could have greater concentrations of chemicals-of-concern (CoCs) than existed before dredging.

Where there exists a reason-to-believe the new surface material (NSM) could be contaminated, the material will be included in the sampling effort by obtaining a core sample to a depth of at least one foot below the planned depth of dredging. The NSM from each sampling location will be archived for possible future analyses. Chemical analysis of the NSM will be required only if the sediment immediately above the NSM has concentrations of chemicals-of-concern exceeding screening levels and fails the applicable biological tests (see Section 7.6). Chemical analysis of the exposed surface will not be required if the overlying sediments pass the biological tests.

Several options were considered for inclusion as decision guidelines pertaining to the issue of newly exposed surface material. One of the following courses of action may be triggered to address the disposition of, and responsibility for NSM that might be left following a dredging operation:

< If dredging results in the exposure of NSM having higher chemical concentrations than the sediment that was dredged, the dredging proponent may be required to over-dredge the site or cap the newly exposed bottom material. Final decisions pertaining to the need to over-dredge or to cap will be based upon the results of appropriate biological tests.

< If dredging results in the exposure of NSM as clean as, or cleaner than, the overlying sediments, no additional requirements are triggered under this manual.

< If surface sediments with elevated concentrations of CoCs are present adjacent to the dredging site, but not in the site proposed to be dredged, nothing in this guidance manual requires a dredging proponent to address the fate of the sediment in the adjacent area. The issue to be considered, however, is the potential impact of the adjacent contaminated sediments on the cleaner sediments in the area to be dredged.

6.7 SAMPLING AND ANALYSIS FOR SITE-SPECIFIC DOWNRANKING

Areas or reaches of the Lower Columbia River where dredging has occurred or is expected to occur were ranked by the RMT (see Table 5-3). These rankings reflect the most current condition of sediment quality at a particular dredging site at the time this manual was developed. Two downranking options are provided in this manual to allow dredging proponents the opportunity to provide new information to rerank a specific site lower than the initial ranking.

A project site can be ranked lower either on a temporary or a permanent basis. Two rounds of full sediment characterization are required to downrank a dredging location or project site on a permanent basis.

Temporary downranking can be achieved by a process called "partial characterization" or PC. A partial characterization is intended to be a relatively low cost method of providing a reasonable level of data in support of a reranking decision by the RMT. In practice, partial characterization has been used in connection with relatively large dredging projects where significant cost savings have been gained because of reduced testing and analysis requirements. However, the potential cost savings have to be weighed against the added cost of potentially undertaking two separate sediment sampling efforts.

a) Sampling and Analysis Plan for Partial Characterization (PC). An approved sampling and analysis plan (SAP) is required for a partial characterization. The SAP must be prepared in coordination with, and submitted to the DMMO/DMMT. The purpose of the PC effort must be clearly stated in the SAP, such as to partially characterize an entire dredging site or only a subunit or subunits of the total site.

The focus of a typical PC is to obtain the chemical analysis of a limited number of surface samples, surface meaning the top four feet of sediment. In some cases, the sampling stations will be located to help determine "worst-case" sediment quality relative to known point sources of contamination. In addition, a dredging proponent may opt or may be required to perform subsurface sampling and analysis for a PC if there is reason to believe that subsurface sediments are also contaminated.

The number of samples and analyses required for a temporary downranking is based on a percentage of the number of samples and analyses that would be required for a full characterization (FC) under the current ranking. To lower a site by one rank, ten percent of the FC minimum analysis requirements must be obtained for the PC. To lower a ranking two levels, 20 percent of the FC minimum requirement must be obtained. For either option, a minimum of three samples must be analyzed. For the PC of a subunit of a larger site, a minimum of two

samples must be analyzed. No compositing is allowed for partial characterization; each sediment sample requires a separate analysis. PC samples must be analyzed for the full list of chemicals-of-concern (see Table 8-1) including sediment conventionals and any relevant "chemicals-of-concern for limited areas."

b) Decision Guidelines for Downranking. The decision to downrank a site or subunit within a site will be based on the results of the sediment sample having the highest level of chemicals-of-concern. Ranking guidelines based on partial characterization data are shown in Table 6-3.

TABLE 6-3
RANKING GUIDELINES BASED ON PC DATA

Ranking	**PC Guideline**
Low	All chemicals #SL
Low-Moderate	At least one chemical > SL and # (SL + ML)/2
Moderate	At least one chemical > (SL +ML)/2 and #ML
High	At least one chemical > ML

The results of a PC can be used to downrank a project on a one-time basis only. Two cycles of full characterization (FC) are necessary for a permanent downranking (see Chapter 5). Data from the PC may also be used as a basis to screen out certain chemicals-of-concern, or groups of chemicals (such as PCBs). If a chemical is not found in the PC and is not available from nearby sources, the chemical may be deleted from the requirements of the subsequent full characterization. In addition, the data from a PC may be used in partial fulfillment of full characterization requirements.

If the PC data indicate a higher rank is warranted at a particular unit, subunit or sampling station, then that area will be ranked higher and the FC will be conducted in that area on the basis of the higher rank.