U.S. Army Corps
of Engineers
Seattle District

Chief Joseph Dam Sediment Quality Sampling and Analysis Plan, 2004

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Introduction

The Seattle District Corps of Engineers proposes to conduct a sediment quality study of Lake Rufus Woods, the reservoir formed by Chief Joseph Dam, beginning in the fiscal year (FY) 2004. Sediment quality monitoring is needed to establish adequate baseline information on the physical, chemical, and biological condition of sediments in Lake Rufus Woods. This data will allow the Seattle District to define the relationship between Chief Joseph Dam and the sediment quality in the Columbia River downstream of Grand Coulee Dam and Lake Roosevelt. An understanding of Lake Rufus Woods' sediment quality is important because studies conducted during the past two decades have shown substantial sediment contamination of Lake Roosevelt and the upper Columbia River with metals. The Washington State Department of Health has issued a health warning to the public on consumption of fish from Lake Roosevelt due to high mercury concentrations in fish tissue. Moreover, future sediment Total Daily Maximum Loads (TMDLs) for several trace metals may be implemented by the Washington State Department of Ecology (Ecology) and the United States Environmental Protection Agency (EPA) for Lake Roosevelt and the upper Columbia River. Baseline sediment quality data will help the Seattle District define the relationship, if any, between contaminated sediments in Lake Roosevelt upstream of Grand Coulee Dam and sediments in Lake Rufus Woods, upstream of Chief Joseph Dam.

This sampling and analysis plan provides details on the methods and protocols that will be used for sediment quality sampling at Chief Joseph Dam. This sampling and analysis plan was developed in accordance with *Guidelines for Quality Assurance Project Plans* (U.S. EPA 1998).

Project Organization, Schedule, and Goals

The following section will outline the project organization, schedule and goals for the Chief Joseph Dam sediment quality monitoring project.

Project Organization

The Seattle District is the project proponent and lead agency for the Chief Joseph Dam sediment quality monitoring program. The Seattle District is responsible for conducting all sediment quality monitoring. A Washington State Department of Ecology or U.S. EPA approved sediment quality laboratory will be responsible for analysis of the sediment samples.

Project Schedule

The sediment quality monitoring program will be combined with the water quality program to reduce field and personnel costs. Sediment samples will be collected during a one or two day period in the low flow September/October time period. Samples will be delivered to the laboratory within 24 hours of collection. The laboratory will report the analytical results to the Seattle District project manager within 30 days. The sample and quality control data will be

reviewed by the quality assurance (QA) officer within 14 days. A draft project report will be completed within 6 weeks of receiving the final set of data from the laboratory. A final project report will be completed within 4 weeks of receiving comments on the draft project report.

Project Goals and Objectives

The goal of the proposed sampling program is to establish baseline data for Lake Rufus Woods downstream of Grand Coulee Dam and Lake Roosevelt. This data will allow the Seattle District to properly address and respond to any future sediment quality issues on the Columbia River upstream or downstream of Chief Joseph Dam. The most pressing sediment quality issues are currently focused on Lake Roosevelt upstream of Grand Coulee Dam. Baseline sediment quality data from Lake Rufus Woods will allow the Seattle District to understand the relationship between Chief Joseph Dam and Grand Coulee Dam, and to quantify the sediment quality in Lake Rufus Woods.

The objective of the monitoring program is to determine the existing physical, chemical, and biological condition of sediments in Lake Rufus Woods upstream of Chief Joseph Dam. Meeting this objective will allow the Seattle District to compare existing sediment quality to Washington State standards, determine any project related sediment quality impacts, and compare sediment quality to upstream (Grand Coulee Dam) projects.

Sampling Procedures

Sampling procedures will generally follow Puget Sound Estuary Program (PSEP) protocols (U.S. EPA 1997). Prior to each sampling event, the COE project manager will review sampling procedures and equipment needs with field technicians. This section identifies specific procedures for water sampling, preparing field notes, and decontaminating equipment. It also describes requirements for sample containers, preservation, holding times, identification, labeling, and handling.

Sampling Design

To meet the project goals and objectives described above, sediment quality will be monitored in Lake Rufus Woods at up to 10 stations between Chief Joseph Dam and Grand Coulee Dam (Figure 1). The exact number of samples collected and exact locations will be determined in the field based on environmental conditions at the time of sampling. Sediment quality parameters of concern are presented in Table 1. One set of field duplicates will be collected to assess both environmental and analytical variability.

All sediment quality sampling will be performed by two field technicians wearing new vinyl gloves and practicing clean hands-dirty hands field techniques. Sediment grab samples will be collected using a 0.1 square meter (m^2) stainless steel van Veen grab sampler. Each sediment stations sample will be a composite of up to three grabs. A grab sample will be considered acceptable if 1) overlying water is present and of low turbidity, 2) the sampler is not

overflowing, 3) the sediment surface is undisturbed, and 4) sampler penetration exceeds 10 centimeters (cm). Upon retrieval of an acceptable sample, the overlying water will be siphoned off and the top 10 cm will be retained for analysis. The samples will be collected by field personnel wearing new vinyl gloves using a decontaminated stainless steel spoon, and placed into a decontaminated stainless steel bowl, thoroughly mixed, placed into precleaned containers, and stored in a cooler with ice. Material touching the sidewall of the grab will not be retained.

All sampling equipment will be thoroughly cleaned and decontaminated between stations following PSEP protocols (EPA 1997). The equipment will be cleaned by washing in Liquinox detergent, followed by a tap water rinse, a 10 percent nitric acid rinse, and a final rinse using deionized water. The equipment will be air dried and wrapped in aluminum foil. Between sample cleaning of the van Veen grab will consist of brushing and rinsing with on-site water.

Field Notes

At each monitoring station, the following information will be recorded in a waterproof bound field notebook:

- Date and name of sampler
- Time of sample collection, measurement, or observation
- Station location
- Weather and flow conditions
- Calibration results for field instruments
- Field measurements
- Number and type of samples collected
- Modifications of established sampling procedures.

Sample Containers, Preservation, and Holding Times

Pre-cleaned sample containers will be obtained from the analytical laboratory for the required analyses. Spare sample containers will be carried by the sampling team in case of breakage or possible contamination. Sample containers, preservation techniques, and holding times will follow PSEP (U.S. EPA 1990), U.S. EPA (40 Code of Federal Regulations [CFR] 136, July 1, 1992) and Ecology (2001) guidelines.

Sample Location Identification

Each sample location will be identified by its station number and the date of collection. Prior to thermal logger deployment the following information will be collected:

- Station ID
- Date of deployment (month/day/year)
- Time of deployment (military format)
- Project ID
- Sampler initials.

Sample Handling

Pre-cleaned sample containers will be provided by the analytical laboratory and secured in a clean cooler prior to use. Samples will be stored at 4° C in a cooler and transported to the laboratory within 24 hours of collection. A chain-of-custody record will accompany the samples that clearly identifies the analytical parameters and methods.

Analytical Procedures

Analytical methods, detection limits, containers, and preservation techniques are presented in Table 1. Field measurements of water temperature, pH, conductivity, turbidity and dissolved oxygen will be conducted in situ at each sediment station using portable meters operated according to the manufacturer's directions and following standard measurement procedures (APHA, et al. 2000). Laboratory analytical procedures will follow U.S. EPA approved methods (U.S. EPA 1983, 1984, and 1992).

The laboratory used for this project will certified by Ecology and participate in audits and interlaboratory studies by Ecology and U.S. EPA. These performance and system audits have verified the adequacy of the laboratory standard operating procedures, which include preventative maintenance and data reduction procedures. The laboratory will report the analytical results within 30 days of receipt of the samples. Sample and quality control data will be reported in a standard format. The reports will also include a case narrative summarizing any problems encountered in the analyses.

Data Quality Objectives

The overall quality assurance objective is to ensure that data of known and acceptable quality are obtained. All measurements will be performed to yield consistent results that are representative of the media and conditions measured. Specific objectives and procedures for precision, accuracy, representativeness, completeness, and comparability are identified below. In this document, the term "detection limit" refers to the practical quantitation level established by the laboratory, not the method detection limit.

- **Precision.** Precision will be assessed using a laboratory duplicate that will be analyzed at random with every sample batch (i.e., sampling event) and a field duplicate that will be analyzed at a frequency of at least 5 percent of the total number of samples submitted (i.e., one in 20 samples). For inorganic analysis and total organic carbon, the relative percent difference (RPD) of laboratory duplicates will be less than or equal to 25 percent for values that are greater than 5 times the detection limit, and ±2 times the detection limit for values that are less than or equal to 5 times the detection limit.

- **Accuracy.** Accuracy will be assessed using laboratory preparation blanks, matrix spikes, and control standards. Where applicable, these quality control analyses will be performed for every sample batch at a frequency of at least 5 percent of the total number of samples submitted. The values for blanks will not exceed 2 times the detection limit. For inorganic analysis and total organic carbon, the percent recovery of matrix spikes will be between 75 and 125 percent. The percent recovery of control standards will be between 80 and 120 percent.
- **Representativeness.** Sample representativeness will be ensured by employing consistent and standard sampling procedures.
- **Completeness.** A minimum of 95 percent of the sample analysis results reported by the laboratory will be judged valid. It is anticipated that all samples will be collected. An equipment checklist will be used to prevent loss of data resulting from missing containers or inoperable instruments prior to embarking on field sampling trips.
- **Comparability.** Data comparability will be ensured through the application of standard sampling procedures, analytical methods, units of measurement, and detection limits. The results will be tabulated in standard spreadsheets for comparison with threshold limits and background data.

Data Assessment Procedures and Corrective Actions

Field and laboratory data will be reviewed by the quality assurance officer immediately upon receipt. Quality control problems and corrective actions will be summarized in a quality assurance worksheet. Values associated with minor quality control problems will be considered estimates and assigned a “J” qualifier. Values associated with major quality control problems will be rejected and assigned an “R” qualifier. Estimated values may be used for evaluation purposes, while rejected values will not be used. Data assessment procedures are described below for the following quality control elements:

- Completeness
- Methodology
- Holding times
- Blanks
- Detection limits
- Laboratory duplicates
- Matrix spikes
- Control standards.

Completeness

Completeness will be assessed by comparing valid sample data with this quality assurance project plan and the chain-of-custody records. Completeness will be calculated by dividing the number of valid values by the total number of values. Samples will be reanalyzed or re-collected if completeness is less than 95 percent.

Methodology

Methodology will be assessed by examination of the field notebook and laboratory reports for deviation from this quality assurance project plan. Unacceptable deviations will result in rejected values (R) and will be corrected for future analyses.

Holding Times

Analysis dates will be reported by the laboratory. Holding times will be assessed by comparing analytical dates to sample collection dates and times. Values that exceed the maximum holding time required by U.S. EPA (1992 and 1997) will be considered estimates (J), whereas severe exceedances will result in rejected values (R).

Blanks

Preparation blanks consisting of de-ionized distilled water will be analyzed and the results will be reported in each laboratory report. Sample values that are less than 5 times a detected blank value will be considered estimates (J).

Detection Limits

Detection limits will be reported in each laboratory report. If proposed detection limits are not met by the laboratory, the laboratory will be requested to reanalyze the samples and/or revise the method, if time permits.

Laboratory Duplicates

Precision of laboratory duplicate results will be presented in each laboratory report. Data for batch samples (i.e., samples from other projects analyzed with samples from this project) will be acceptable as long as project sample duplicates are analyzed at a frequency of at least 5 percent. Precision of field and laboratory duplicate results will be calculated according to the following:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

where:

RPD = relative percent difference

C_1 = larger of two values

C_2 = smaller of two values.

Laboratory duplicate results exceeding the objectives will be noted in the quality assurance worksheets, and associated values will be flagged as estimates (J). If the objectives are severely exceeded (e.g., more than twice the objective), then associated values will be rejected (R). Field duplicate results exceeding the objectives will be noted and only used to flag data upon consideration of all quality control data.

Matrix Spikes

Accuracy of matrix spike results will be presented in each laboratory report. Data for batch samples will be acceptable as long as spikes of project samples are analyzed at a frequency of at least 5 percent. Accuracy of matrix spike results will be calculated according to the following equation:

$$\%R = \frac{(S - U) \times 100\%}{C_{sa}}$$

where:

%R = percent recovery
S = measured concentration in spike sample
U = measured concentration in unspiked sample
C_{sa} = actual concentration of spike added.

If the analyte is not detected in the unspiked sample, then a value of zero will be used in the equation.

Results exceeding the objective will be noted in the quality assurance worksheets, and associated values will be flagged as estimates (J). However, if the percent recovery exceeds 125 and a value is less than the detection limit, the result will not be flagged as an estimate. Nondetected values will be rejected (R) if percent recovery is less than 30 percent.

Control Standards

Accuracy of control standards will be presented in each laboratory report and checked by the quality assurance officer. Accuracy for these elements will be calculated according to the following equation:

$$\%R = \frac{(M - T) \times 100\%}{T}$$

where:

%R = percent recovery
M = measured value
T = true value.

Results exceeding the objective will be noted in the quality assurance worksheets, and associated values will be flagged as estimates (J). If the objectives are severely exceeded (e.g., more than twice the objective), then associated values will be rejected (R).

Tasks and Deliverables

The Seattle District will perform the following tasks.

- Prepare all instrumentation and equipment for the study.
- Implement the study, collecting all pertinent information.
- Prepare a draft and final data report documenting the field study results.

References

APHA, AWWA, WEF. 2000. Standard methods for the examination of water and wastewater. 20th edition. Edited by A.E. Greenberg, American Public Health Association; A.D. Eaton, American Water Works Association; and L.S. Clesceri, Water Environment Federation.

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Table 1. Methods, detection limits, containers, preservation techniques and holding times for Sediment quality analyses.

	Matrix	Method Number [a]	Detection Limit/Unit	Container and Preservation	Holding Time
Field Parameters					
Temperature	Water	SM 2550-B	0.1°C	—	—
pH	Water	SM 4500-H	—	—	—
Conductivity	Water	SM 2510-B	1 µS/cm	—	—
Turbidity	Water	SM 2130-B	0.1 NTU	—	—
Dissolved Oxygen	Water	SM 4500-O-G	0.1 mg/L	—	—
Laboratory Chemical Parameters					
Arsenic	Sediment	EPA 7060	1.5 mg/kg	P/G, 4º C	6 Months
Cadmium	Sediment	EPA 6010	0.2 mg/kg	P/G, 4º C	6 Months
Chromium	Sediment	EPA 6010	0.5 mg/kg	P/G, 4º C	6 Months
Copper	Sediment	EPA 6010	0.5 mg/kg	P/G, 4º C	6 Months
Lead	Sediment	EPA 7421	0.1 mg/kg	P/G, 4º C	6 Months
Mercury	Sediment	EPA 7471	0.01 mg/kg	P/G, 4º C	28 Days
Nickel	Sediment	EPA 6010	0.25 mg/kg	P/G, 4º C	6 Months
Zinc	Sediment	EPA 6010	0.25 mg/kg	P/G, 4º C	6 Months
Total Organic Carbon	Sediment	EPA 9060	100 mg/kg	P/G, 4º C	28 Days
Total Solids	Sediment	EPA 160.3	0.1 %	P/G, 4º C	14 Days
Particle Size	Sediment	—	—	P/G, 4º C	6 Months

[a] SM method numbers are from APHA et al. (2000); EPA method numbers are from U.S. EPA (1983, 1984, and 1992).
mg/L Milligrams per liter
µS/cm Microsiemens per centimeter
NTU Nephelometric turbidity unit
Mg/kg Milligrams per kilogram
P/G Polyethylene or glass

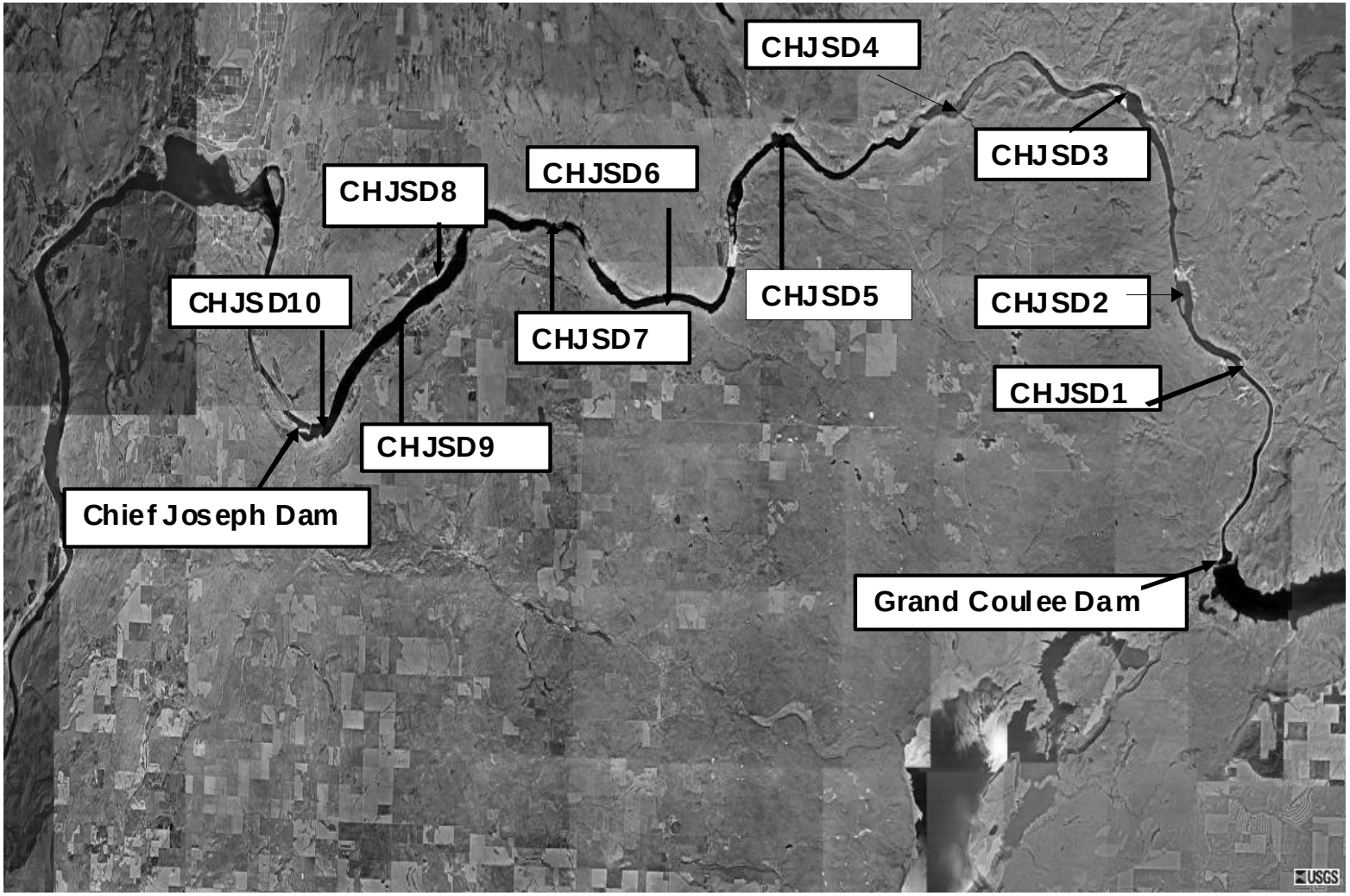

Figure 1. Location of Study.