U.S. Army Corps
of Engineers
Seattle District

Albeni Falls Dam: Pend Oreille River and Lake Pend Oreille Water Quality Monitoring Plan 2009

By Kent Easthouse
U.S. Army Corps of Engineers, Seattle District
Water Management Section

April 2009

Contents

Introduction....1

Project Organization and Schedule....2

Project Organization....2
U.S. Army Corps of Engineers, Seattle District....2
U.S. Army Corps of Engineers, Albeni Falls Dam....2
Aquatic Research, Inc.....2
Project Schedule....3

Project Description....4

Background Information....4
Project Goals and Objectives....6

Sampling Procedures....7

Sampling Design....7
Water Sampling....7
Equipment Decontamination....11
Field Notes....11
Sample Containers, Preservation, and Holding Times....11
Sample Identification and Labeling....12
Sample Handling....12

Analytical Procedures....13

Data Quality Objectives....14

Data Assessment Procedures and Corrective Actions....15

Completeness....15
Methodology....15
Holding Times....15
Blanks....16
Detection Limits....16
Laboratory Duplicates....16
Matrix Spikes....17
Control Standards....17

Data Management and Reporting....18

References....19

Figures

Figure 1. Location of the Clark Fork-Pend Oreille River watershed. 5
Figure 2. Location of the study area within the Clark Fork-Pend Oreille watershed.....8
Figure 3. Locations of water quality monitoring stations near Albeni Falls Dam. 9

Tables

Table 1. Methods and detection limits for water quality analyses. 10

Introduction

During calendar year 2009, the Seattle District Corps of Engineers proposes to continue a water quality study of Lake Pend Oreille and the Pend Oreille River, the waterway controlled by Albeni Falls Dam, that began in calendar year 2005. Additional water quality monitoring is needed to establish adequate baseline information on the physical, chemical, and biological condition of Lake Pend Oreille and the Pend Oreille River. This data will allow the Seattle District to define the relationship between Albeni Falls Dam and the water quality in the Pend Oreille River downstream of Lake Pend Oreille. An understanding of the possible impact of Albeni Falls Dam on the water quality in the Pend Oreille River is of paramount importance because of the current, proposed, and possible future Lake Pend Oreille and Pend Oreille River Total Daily Maximum Loads (TMDLs) for various water quality parameters that may be implemented by the Idaho Department of Environmental Quality (IDEQ), the Washington State Department of Ecology (Ecology) and the United States Environmental Protection Agency (EPA). Baseline data will allow the Seattle District to share data and work together with these agencies to develop meaningful Lake Pend Oreille and Pend Oreille River TMDLs. In addition, baseline water quality data will help the Seattle District define the relationship between Albeni Falls Dam and the water quality and beneficial uses in the lake and river, including fisheries, recreation, and water supply.

This sampling and analysis plan provides details on the methods and protocols that will be used for water quality sampling at Albeni Falls Dam. This monitoring plan was developed in accordance with *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology 2001), and includes the following elements:

- Project organization and schedule
- Project description
- Sampling procedures
- Analytical procedures
- Data quality objectives
- Data assessment procedures and corrective actions
- Data management procedures and reporting.

Project Organization and Schedule

The following section will outline the project organization and schedule for the Pend Oreille River and Lake Pend Oreille water quality monitoring project.

Project Organization

The Seattle District is the project proponent and lead agency for the Albeni Falls Dam water quality monitoring program. The Seattle District is responsible for conducting all water quality monitoring. Albeni Falls Dam personnel will assist the Seattle District with collecting water samples in the Pend Oreille River and Lake Pend Oreille. A Washington State Department of Ecology or U.S. EPA approved water quality laboratory will be responsible for analysis of the water samples. Specific responsibilities of key personnel are shown below:

U.S. Army Corps of Engineers, Seattle District

Hydrology and Hydraulics Section
Seattle, WA 98124
(206) 764-5523

Carolyn Fitzgerald	Program Manager
Kent Easthouse	Principal Investigator

U.S. Army Corps of Engineers, Albeni Falls Dam

Albeni Falls Dam Project Office
Old Town, ID 83822
(208) 437-3133

Joe Summers	Chief of Operations
Dennis Dopps	Boat Operator

Aquatic Research, Inc.

3927 Aurora Avenue North
Seattle, WA 98103
(206) 632-2715

Steven Lazoff	Laboratory Manager

Project Schedule

The 2009 water quality monitoring program shall collect periodic surface water samples in the Pend Oreille River and Lake Pend Oreille during the second year of a two year study. Water quality 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 Description

The following section will provide background information, project goals and objectives for the Pend Oreille River and Lake Pend Oreille temperature monitoring project.

Background Information

The Clark Fork-Pend Oreille River basin drains about 25,000 square miles in southern British Columbia, western Montana, northern Idaho, and northeastern Washington (Figure 1). The Clark Fork River originates in the Rocky Mountains of western Montana and flows northeast about 350 miles to Lake Pend Oreille. Major tributaries to the Clark Fork include the Flathead River, Blackfoot River, and Bitterroot River. The Pend Oreille River begins at the outlet of Lake Pend Oreille, flows eastward for about 29 miles to Albeni Falls Dam and then flows to the northeast for about 90 miles to the confluence with the Columbia River in British Columbia. Major tributaries to the Pend Oreille River include the Priest River (Figure 1).

Albeni Falls Dam is a United States Army Corps of Engineers (COE) project located near the Washington-Idaho border on the Pend Oreille River at river mile (RM) 90.1. The dam became operational in 1952 and is about 2.5 miles upstream and east of the city of Newport, Washington, 26 miles west of the city of Sandpoint, Idaho, and 29 miles downstream from Lake Pend Oreille (Figure 1). Lake Pend Oreille is a natural lake that is located in a glacially scoured basin in the Purcell Trench in Northern Idaho (Fields et al. 1996). The Clark Fork is the major inflow to the lake supplying about 85 percent of the surface water inflow to the lake and the outlet arm (Frenzel, 1991).

Although Lake Pend Oreille is a natural lake, Albeni Falls Dam is authorized for regulation of the lake level for flood control, navigation, fish and wildlife conservation, recreation, and power generation. Before the project became operational in 1952, the annual surface elevation of Lake Pend Oreille varied according to seasonal inflows, from an average fall/winter low of about 2,048.0 feet to an average spring runoff high of about 2,062.0 feet, with a maximum spring elevation of 2071.8 feet recorded on June 9, 1948 (COE 2000). After reaching a maximum elevation during spring runoff, the lake gradually receded to an elevation of about 2,050.0 feet by August and reached its minimum elevation of about 2,048.0 feet by October.

Current Lake Pend Oreille regulating procedures are briefly described below. After the spring runoff period is completed (usually late May to early July), Lake Pend Oreille is maintained in a 0.5-foot summer operation range between elevations 2,062.0 and 2,062.5 feet until the end of the summer recreation season. A fall drawdown generally begins after Labor Day and the lake is stabilized at a minimum control elevation of 2,051.0 feet for the winter typically by December 1. The lake is held at this minimum control elevation until April 1, after which spring runoff typically occurs and the lake is refilled during May and June. The current operation of Lake Pend Oreille maintains the lake at a summer elevation of about 2,062.0 to 2,062.5 feet compared to pre-dam conditions where summer elevations ranged from a high of about 2,062.0 feet in June

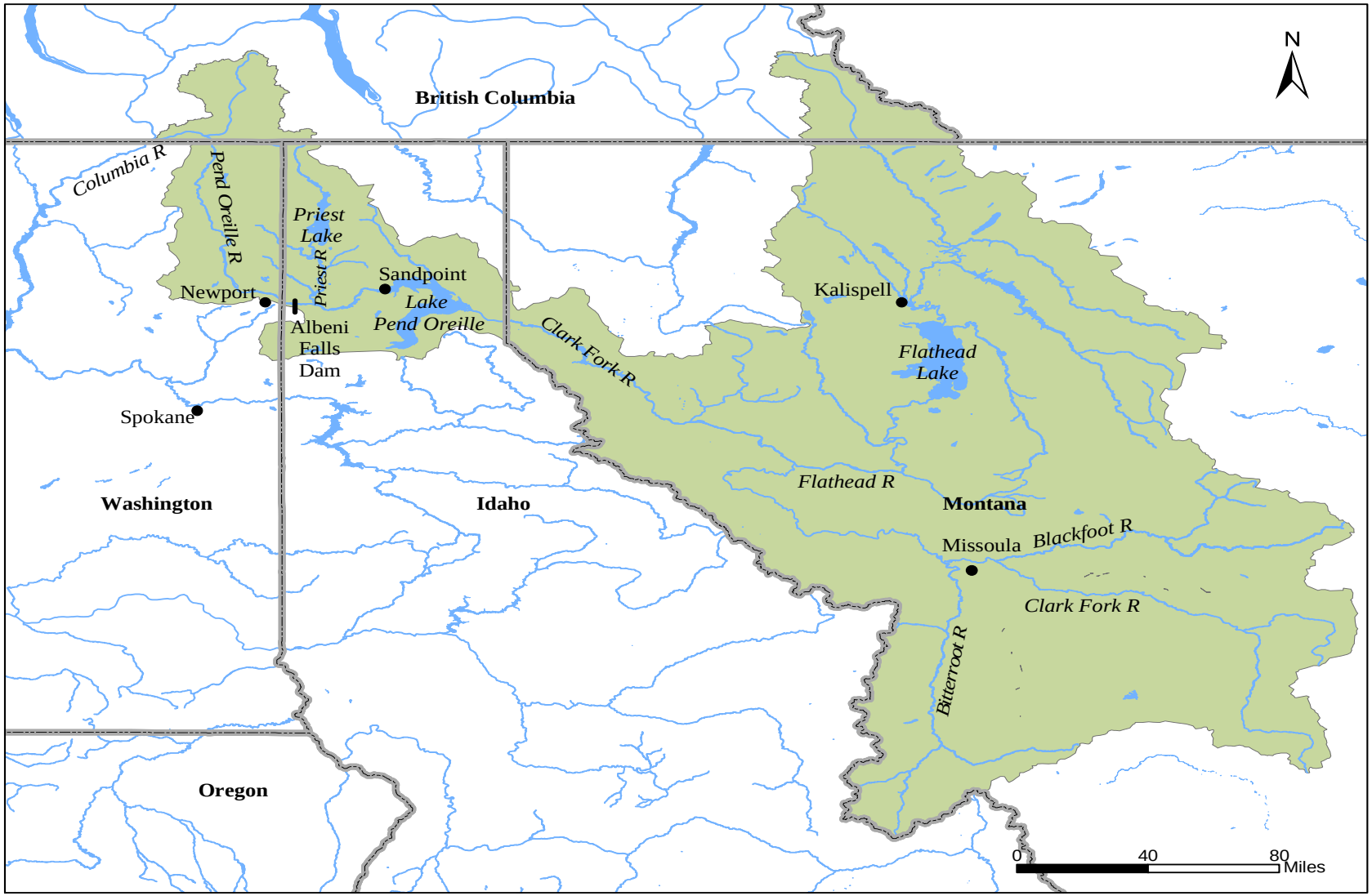


Figure 1. Location of the Clark Fork-Pend Oreille River watershed.

to a low of about 2,050.0 feet in August and September (COE 2000). Bathymetric data indicates that there is a 6.8 percent reduction in lake surface area and a 1.8 percent reduction in lake volume between lake elevations of 2,062.0 feet and 2,050.0 feet (Fields et al. 1996).

Project Goals and Objectives

The goal of the proposed sampling program is to establish baseline data for the Pend Oreille River at Albeni Falls Dam and for Lake Pend Oreille. This data will allow the Seattle District to properly address and respond to any future water quality criteria issues on the Pend Oreille River at Albeni Falls Dam. Although the most pressing water quality issues are currently total dissolved gas (TDG) and temperature TMDLs, it is possible that future water quality concerns in the Pend Oreille River will include nutrients, metals, and biological parameters. Baseline water quality data will allow the Seattle District to understand the relationship between Albeni Falls Dam and the water quality and beneficial uses in the Pend Oreille River and Lake Pend Oreille.

The objective of the monitoring program is to determine the existing physical, chemical, and biological condition of Lake Pend Oreille and the Pend Oreille River at Albeni Falls Dam. Meeting this objective will allow the Seattle District to compare existing water quality to Idaho and Washington State standards, determine any project related water quality impacts, and understand the role of Albeni Falls Dam on the water quality in the Pend Oreille River.

Sampling Procedures

Sampling procedures will generally follow Puget Sound Estuary Program (PSEP) protocols (U.S. EPA 1990, 1997) and United States Geological Survey (USGS) protocols (USGS 1999). 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.

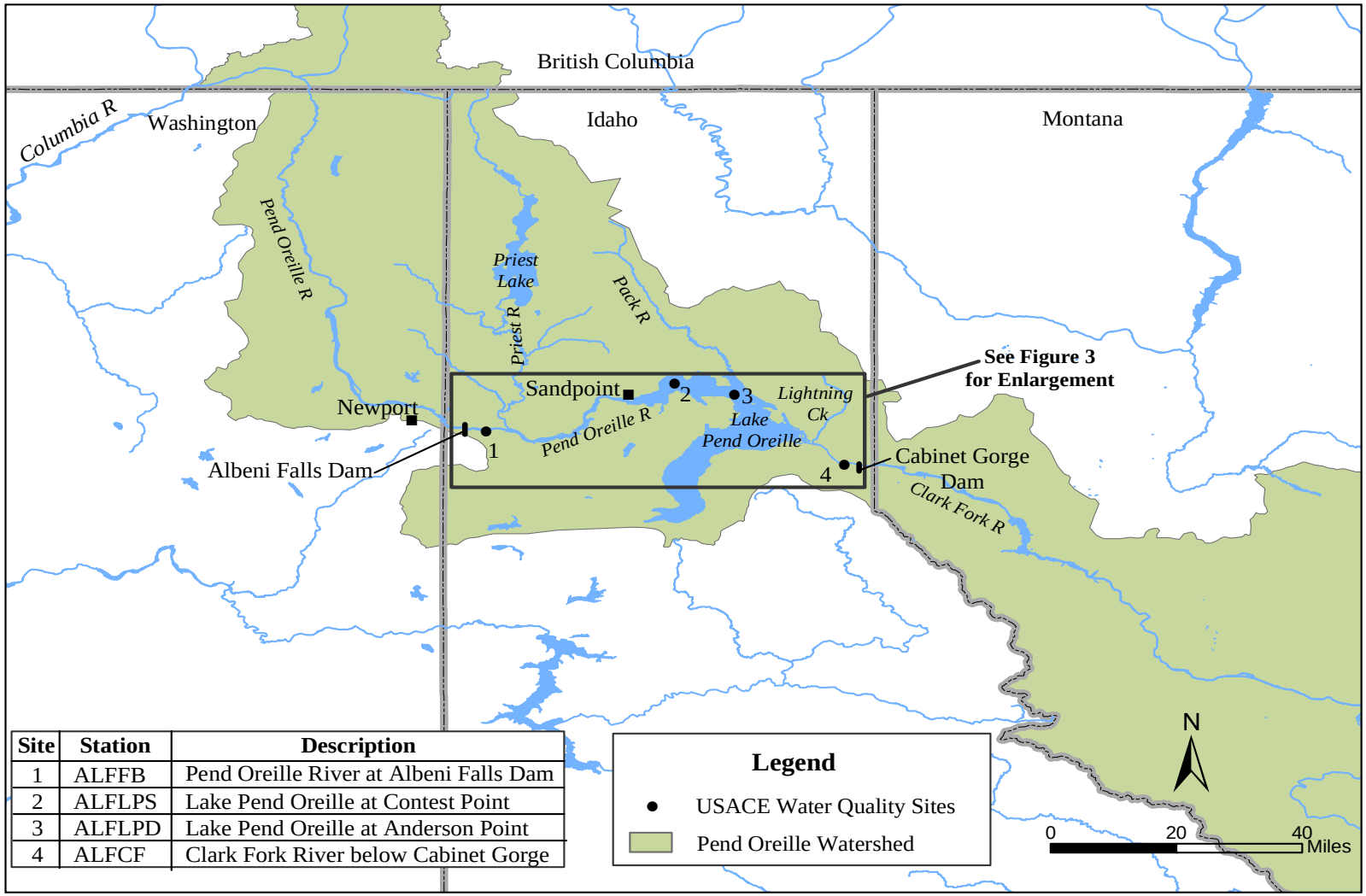
Sampling Design

To meet the project goals and objectives described in the previous section, water quality will be monitored at Albeni Falls Dam at one station upstream of Lake Pend Oreille, two in-lake stations, and one station located at the forebay (Figures 2 and 3). The upstream station (ALFCF) will be located on the Clark Fork River and collected at mid-channel from the railroad bridge at Clark Fork, Idaho. The in-lake stations will consist of one deep water pelagic site (ALFLPD) near Hope, Idaho and one shallow water pelagic site (ALFLPS) near Sandpoint, Idaho. The forebay station (ALFFB) will be located on the Pend Oreille River and collected from mid-channel at a point immediately upstream of the spillway. Water quality parameters of concern include temperature, pH, dissolved oxygen, alkalinity, nutrients (i.e. phosphorus and nitrogen), metals, and plankton (Table 1).

Water Sampling

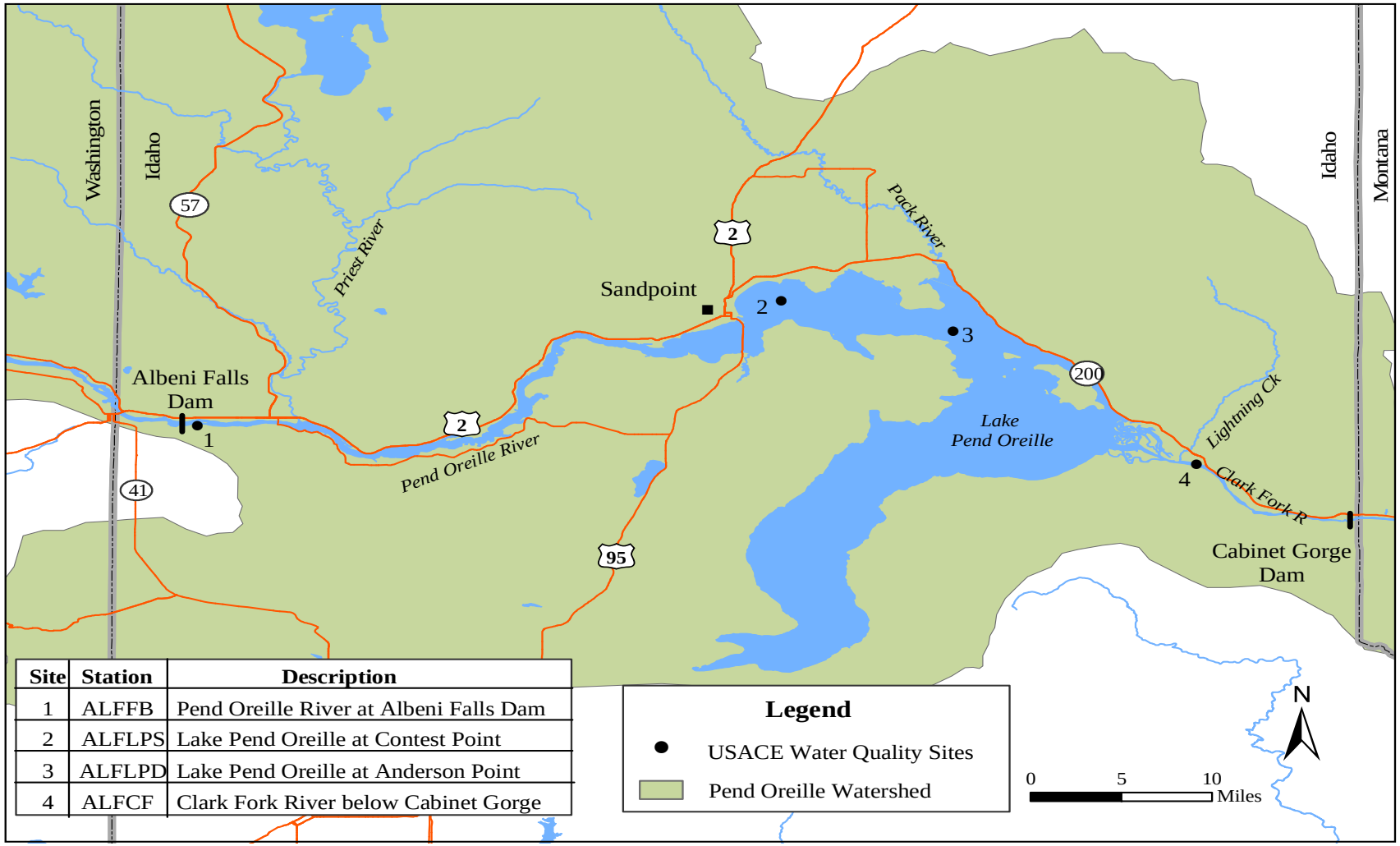
Between April and November 2009, water quality data will be collected at monthly intervals at one upstream river station, two in-lake stations, and one forebay station. Two sets of field duplicates will be collected to assess both environmental and analytical variability. Each sample will be analyzed for the parameters presented in Table 1, with the following exceptions. Metals, anions, and cations will be collected only in May, July, and October at all stations, and biological samples will not be collected at station ALFCF.

All water quality sampling will be performed by two field technicians wearing new vinyl gloves and practicing clean hands-dirty hands field techniques. In-lake (ALFLPD and ALFLPS) and forebay (ALFFB) samples will be collected by submerging a cleaned and decontaminated 2.2 liter (L) polycarbonate (Lexan) van-dorn style sampler with ultra-clean seals to depth and filling. If the lake is not stratified at the station, samples will be collected from four depths between the surface and bottom, and equally composited in laboratory-cleaned, prelabled sample containers at the surface. If the lake is stratified, samples will be collected from four depths in the epilimnion and hypolimnion, and equally composited in laboratory-cleaned, prelabled sample containers at the surface. Photic zone samples for chlorophyll a analysis will be collected from up to five depths in the photic zone, and compositing them into a clean 22 L bucket at the



Site	Station	Description
1	ALFFB	Pend Oreille River at Albeni Falls Dam
2	ALFLPS	Lake Pend Oreille at Contest Point
3	ALFLPD	Lake Pend Oreille at Anderson Point
4	ALFCF	Clark Fork River below Cabinet Gorge

Figure 2. Location of the study area within the Clark Fork-Pend Oreille watershed.



Site	Station	Description
1	ALFFB	Pend Oreille River at Albeni Falls Dam
2	ALFLPS	Lake Pend Oreille at Contest Point
3	ALFLPD	Lake Pend Oreille at Anderson Point
4	ALFCF	Clark Fork River below Cabinet Gorge

Figure 3. Locations of water quality monitoring stations near Albeni Falls Dam.

Table 1. Methods and detection limits for water quality analyses.

	Method Number [a]	Detection Limit/Unit	Container and Preservative	Holding Time	Water Quality Stations Key
Field Parameters					
Temperature	SM 2550-B	0.1°C	—	Analyze	A
pH	SM 4500-H	–	P/G, 4º C	3 hours	A
Conductivity	SM 2510-B	1 µS/cm	P/G, 4º C	28 days	A
Dissolved Oxygen	SM 4500-O-G	0.1 mg/L	G, Dark	8 hours	A
Laboratory Chemical Parameters					
Total Phosphorus	EPA 365.1	0.002 mg/L	P/G, 4° C, H_2SO_4 to pH<2	28 days	A
Soluble Phosphorus	EPA 365.1	0.001 mg/L	P/G, 4° C, filter immediately	48 hours	A
Total Nitrogen	SM204500N	0.050 mg/L	P/G, 4° C, H_2SO_4 to pH<2	28 days	A
Nitrate+Nitrite	EPA 353.2	0.010 mg/L	P/G, 4° C, H_2SO_4 to pH<2	28 days	A
Ammonia	EPA 350.1	0.005 mg/L	P/G, 4° C, H_2SO_4 to pH<2	28 days	A
Alkalinity	EPA 310.1	1.00 mg/L	P/G, 4º C	14 days	A
Hardness	SM182340B	1.00 mg/L	P/G, 4° C, HNO_3 to pH<2	6 months	B
Calcium	EPA 200.7	0.100 mg/L	P/G, 4° C, HNO_3 to pH<2	6 months	B
Magnesium	EPA 200.7	0.100 mg/L	P/G, 4° C, HNO_3 to pH<2	6 months	B
Potassium	EPA 200.7	0.700 mg/L	P/G, 4° C, HNO_3 to pH<2	6 months	B
Sodium	EPA 200.7	0.500 mg/L	P/G, 4° C, HNO_3 to pH<2	6 months	B
Sulfate	EPA 375.4	1.00 mg/L	P/G, 4º C	28 days	B
Chloride	EPA 325.3	0.50 mg/L	P/G, 4º C	28 days	B
Aluminum	EPA 202.2	0.003 mg/L	P/G, 4º C[b]	6 months	B
Arsenic	EPA 206.2	0.003 mg/L	P/G, 4º C[b]	6 months	B
Cadmium	EPA 213.2	0.0002 mg/L	P/G, 4º C[b]	6 months	B
Chromium	EPA 218.2	0.0020 mg/L	P/G, 4º C[b]	6 months	B
Copper	EPA 220.2	0.0010 mg/L	P/G, 4º C[b]	6 months	B
Lead	EPA 239.2	0.0010 mg/L	P/G, 4º C[b]	6 months	B
Zinc	EPA 200.7	0.005 mg/L	P/G, 4º C[b]	6 months	B
Laboratory Biological Parameters					
Phytoplankton	–	–	P/G, 4ºC, 1% Lugols	12 months	C
Zooplankton	–	–	G, 4ºC, 5% Formaldehyde	12 months	C
Chlorophyll a	SM 1810200	0.0001 mg/L	P, 4ºC, filter, add $MgCO_3$	28 days	C

[a] SM method numbers are from APHA et al. (2000); EPA method numbers are from U.S. EPA (1983, 1984, and 1992).
[b] Samples for analysis of total trace metals should be preserved within 24 hours with HNO_3 to pH<2. Samples for dissolved trace metals should be preserved within 24 hours with HNO_3 to pH<2 after filtration

A Stations ALFCF, ALFLPD, ALFLPS, ALFFB for all months
B Stations ALFCF, ALFLPD, ALFLPS, ALFFB for February, May, July, and October samples
C Stations ALFLPD, ALFLPS, ALFFB for all months

surface. Upstream in-river (ALFCF) samples will be collected from the center of the river by submerging laboratory-cleaned, prelabled sample containers below the water surface at mid-depth. Sample containers will be rinsed once prior to filling, capped with headspace for mixing or the addition of preservative, and immediately placed on ice in a cooler. Measurements of field parameters (see Table 1) will be performed in situ using a Hydrolab DataSonde 4a multiprobe coupled with a Surveyor 4 surface display and recording unit. Equipment used for field measurements will be calibrated prior to each sampling event.

Phytoplankton samples will be collected from the photic zone following the procedures used for chlorophyll a sample collection. Zooplankton samples will be collected by vertical tow from a depth of 10 meters to the surface using a 60 µm mesh net. When station depths do not allow a vertical tow of 10 meters, a tow will be collected from 1 meter off of the bottom to the surface. Phytoplankton and zooplankton samples will be immediately placed on ice in a cooler and preserved with either a 1-percent lugols solution (phytoplankton) or 25 percent Isopropyl Alcohol solution (zooplankton) within 12 hours of sample collection.

Equipment Decontamination

Sampling equipment used during the project will be decontaminated prior to collection of samples using the following procedure:

- Wash with phosphate-free detergent
- Rinse thoroughly with potable water
- Rise with a dilute ultra-pure nitric acid solution
- Rinse thoroughly with deionized water.

Field Notes

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

- Sampling 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 1997), U.S. EPA (40 Code of Federal Regulations [CFR] 136, July 1, 1992) and Ecology (2001) guidelines (see Table 1).

Sample Identification and Labeling

Each sample will be identified by its station number and the date of collection. Prior to filling, sample containers will be labeled with the following information using indelible ink:

- Station ID
- Date of collection (month/day/year)
- Time of collection (military format)
- Project ID
- Company/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 and detection limits and are presented in Table 1. Field measurements of temperature, pH, conductivity, turbidity and dissolved oxygen will be conducted in situ 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 (APHA et al. 2000; U.S. EPA 1983, 1984). These methods provide detection limits that are below the state and federal regulatory criteria or guidelines, and will enable direct comparison of analytical results with these criteria.

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 for all samples 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 1996) 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 equation:

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

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).

Data Management and Reporting

Water quality data will be entered in a numerical format in a Microsoft Excel spreadsheet following a quality assurance review. The results will be arranged chronologically for each station by sampling date across the spreadsheet columns. Data flags will be entered in separate columns adjacent to each data column using the following coding system:

- U = Analyte not detected at specified detection limit
- J = Estimated value
- R = Rejected value.

A monitoring report will be prepared upon completion of the data review and entry. This report will provide background information, data collection and analysis methods, tabulated and graphical presentations of the data, statistical test results, discussion of the results, conclusions, references, and appendices. Laboratory reports and quality assurance worksheets will be included in the monitoring report. Any problems and associated corrective actions taken will be reported. Specific quality assurance information that will be noted in the report includes the following:

- Changes in the monitoring/quality assurance plan
- Results of performance and/or system audits
- Significant quality assurance problems and recommended solutions
- Data quality assessment in terms of precision, accuracy, representativeness, completeness, comparability, and detection limits
- Discussion of whether the quality assurance objectives were met, and the resulting impact on decision-making
- Limitations on use of the measurement data.

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.

COE 2000. Albeni Falls Dam Pend Oreille River, Idaho Water Control Manual. U.S. Army Corps of Engineers, Seattle District.

Ecology. 2001. Guidelines for preparing quality assurance project plans for environmental studies. Washington State Department of Ecology, Environmental Assessment Program, Publication No. 01-03-003.

Fields, R.L., Woods, P. F., and C. Berenbrock. 1996. Bathymetric map of Lake Pend Oreille and Pend Oreille River, Idaho. United States Geological Survey Water Resources Investigations Report 96-4189.

Frenzel, S.A. 1991. Hydrologic budgets, Pend Oreille Lake, Idaho 1989-1990, *in* Hoelscher, B., Skille, J., and G. Rothrock (eds) Phase I diagnostic and feasibility analysis: A strategy for managing the water quality of Pend Oreille Lake.

U.S. EPA. 1983. Methods for chemical analysis of water and wastes. EPA-600/4-79-020. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

U.S. EPA. 1984. Guidelines Establishing Test Procedures for the Analysis of Pollutants under the Clean Water Act; Final Rule and Interim Final Rule. U.S. Environmental Protection Agency. CFR Part 136. Friday, October 26, 1984.

U.S. EPA. 1990. Recommended protocols for measuring conventional water quality variables and metals in fresh water of the Puget Sound region. Puget Sound Estuary Program U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, Washington.

U.S. EPA. 1992. NPDES [National Pollutant Discharge Elimination System] stormwater sampling guidance document. EPA 833-B-92-001. U.S. Environmental Protection Agency, Office of Water, Washington D.C.

U.S. EPA. 1997. Recommended protocols for measuring selected environmental variables in Puget Sound. U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, Washington.

USGS. 1999. National field manual for the collection of water quality data: Chapter A4 Collection of water samples. Edited by Wilde, F.D., Radtke, D.B., Gibs, Jacob, and Iwatsubo, R.T. United States Geological Survey Techniques of Water Resources Investigations, Book 9, Chapter A4.