APPENDIX 3A

1.2 MONITORING OF WATER TEMPERATURE AND WATER QUALITY CONDITIONS IN THE PROJECT AREA

FINAL
(PLENARY APPROVED)

Klamath Hydroelectric Project Study Plans
(FERC Project No. 2082)

1.2 Monitoring of Water Temperature and Water Quality Conditions in the Project Area

PacifiCorp
Portland, Oregon

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1.2 MONITORING OF WATER TEMPERATURE AND WATER QUALITY CONDITIONS IN THE PROJECT AREA

1.2.1 Description and Purpose

The purpose of this study is to obtain data to characterize water quality conditions within and downstream of the Klamath Hydroelectric Project (Project) area. The data from this study will also be used to support modeling and assessment of the Project's potential effects on water quality (as outlined in Study Plan 1.3). Important questions related to Project operations are (1) whether and how these operations might contribute to water quality conditions, and (2) whether and how Project operations might feasibly contribute to water quality improvements.

The Klamath River, from Upper Klamath Lake to the mouth, is listed as water quality limited by both Oregon and California under Section 303(d) of the federal Clean Water Act. Warm water temperatures and enriched nutrient conditions, particularly during summer, are the primary focuses of water quality management planning in the basin by Oregon and California water quality agencies[1]. One or more sections of the Klamath River in Oregon is 303(d)-listed for water temperature (summer), pH (summer), chlorophyll a (summer), dissolved oxygen (DO) (April 1 – November 30), and ammonia toxicity (summer and winter). The Klamath River in California is 303(d)-listed for water temperature, nutrients, organic enrichment, and DO.

1.2.2 Objectives

The objective of this study is to collect water quality data that, combined with the historic data from Study Plan 1.1, will be used to address the following key questions:

- What are the water quality conditions in key river, reservoir, and tributary areas within and downstream[2] of the Project area?

- Are Oregon and California water quality standards and objectives being met? Where and when?

- What are the potential factors driving water quality conditions in key river, reservoir, and tributary locations within and downstream[1] of the Project area?

In addition, the data from this study will be used to support modeling and assessment of the Project's potential effects on water quality and possible measures to protect, enhance, and mitigate where necessary (as described in Study Plan 1.3).

1.2.3 Relicensing Relevance and Use in Decisionmaking

The results of this study will be used to describe existing water quality conditions in the Project area. The information obtained in this study will help to determine the factors that contribute to water quality conditions, and how PacifiCorp's Project operations influence these conditions. Study emphasis is focused on water temperature and nutrient conditions because seasonally

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[1] The Klamath River in Oregon is scheduled to have development of total maximum daily load (TMDL) limits and implementation plans by December 31, 2004, and with TMDL implementation plans established by December 31, 2005~~4~~.

[2] See Section 1.2.4 for a description of the geographic scope of this study, including downstream extent.

warm water temperatures and enriched nutrient conditions appear to be the primary cause of water quality problems in the area.

Relicensing of the Project also will require certifications from California and Oregon water quality agencies that the Project complies with requirements of the federal Clean Water Act (Section 401). PacifiCorp will use information from this study to document water quality conditions and, with stakeholders, identify potential Project effects as they relate to water quality objectives and standards promulgated by these agencies.

1.2.4 Methods and Geographic Scope

1.2.4.1 Water Quality Monitoring During 2000 and 2001

PacifiCorp has been cooperating with the U.S. Bureau of Reclamation (USBR) in a water quality monitoring program to characterize water quality conditions in the Klamath River basin during 2000 and 2001. The program provided a data set that spans a 124-mile section of the Klamath River—from Link River dam (River Mile [RM] 253) to the Klamath River at Seiad Valley (RM 128.9). Key features of this program are summarized here because the data set will be of considerable value in characterizing water quality conditions in the Project area. The program consisted of six related tasks:

1. Semimonthly grab samples
2. Continuous water quality probe (hydrolab data-sonde) deployment
3. Water temperature monitoring
4. Attached algae sampling
5. Synoptic water quality surveys
6. Reservoir water quality surveys

Tasks 1 through 5 were funded and supported by USBR, and Task 6 was funded and supported by PacifiCorp and USBR. Tasks commenced in May 2000 and, except for Task 6, were concluded in April 2001. Sampling in the reservoirs was continued by PacifiCorp through November 2001. Data analysis is completed and a report on the results of the monitoring is being finalized.

Semimonthly Grab Samples

Semimonthly grab samples were obtained by USBR between May 2000 and April 2001. The objective of the semimonthly grab samples was to provide baseline information on main stem and tributary contributions for a representative suite of physical, chemical, and biological water quality constituents. Physical constituents, nutrients, algae (as chlorophyll-*a*), biochemical oxygen demand (BOD), and major ions were examined. Hydrolab water quality probes were used to examine water temperature, DO, pH, specific conductance, and redox at each location when grab samples were taken. The remaining constituents were analyzed under laboratory conditions with the exception of turbidity, which was measured with a field turbidimeter. These constituents were intended to provide general characterization of main-stem Klamath River waters, identify water quality constituents of concern within selected river reaches, and estimate input parameters for possible water quality modeling being considered by USBR.

The semimonthly grab sampling program included 10 locations in the Klamath Basin. The sites range from Miller Island (RM 246) near Klamath Falls to Seiad Valley (RM 128.9) and also included Klamath River at Keno Bridge (RM 235), Klamath River above Copco reservoir (RM 208), and Klamath River below Iron Gate dam (RM 190) in PacifiCorp's Klamath Hydroelectric Project area.

In addition to the semimonthly grab samples, fifteen trace elements and trace metals were screened at monthly intervals at four locations, including Klamath River at Link dam (RM 253), Klamath Straits Drain at Hwy 97, Klamath River at Keno Bridge (RM 235), and Klamath River below Iron Gate dam (RM 190). This broad-based screening was intended to determine baseline levels of trace elements and metals at selected locations and to identify those that may be of concern in the aquatic system.

Continuous Water Quality Data-Sonde Deployment

Continuous water quality data-sonde deployment was conducted by USBR between May 2000 and April 2001. The objective of the data-sonde deployment was to determine subdaily response of physical constituents for aquatic system characterization. Continuous-recording data-sondes were deployed at 13 locations in the Klamath Basin. The sites ranged from Miller Island (RM 246) near Klamath Falls to Seiad Valley (RM 128.9), and also included Klamath River at Keno Bridge (RM 235), Klamath River above Copco reservoir (RM 208), and Klamath River below Iron Gate dam (RM 190) in PacifiCorp's Klamath Project area.

The data-sonde deployment provided subdaily response of water temperature, DO, and pH. These data are critical to interpretation and definition of water quality response throughout the river system. The data provide valuable maximum, minimum, and mean values, as well as the rate of change of constituents. These water quality probes collected water temperature, DO, pH, specific conductance, and redox at 1-hour intervals. To minimize lost DO data due to bio-fouling of the DO membrane, probes were deployed for 1-week intervals.

Water Temperature Monitoring

Water temperature monitoring was conducted by USBR between May 2000 and April 2001. Main-stem and tributary water temperatures were monitored at 1-hour intervals at four locations in the Klamath River between Cottonwood Creek (RM 182) and the Scott River (RM 143.5). The temperature data are intended to complement the data-sonde water temperature data and are intended for use in simulation model calibration/validation and application that USBR is planning to perform. Temperature modeling efforts further rely on data-sonde recorded water temperatures (1) below Iron Gate dam and (2) near Seiad Valley.

In addition to this USBR water temperature monitoring task, PacifiCorp conducted water temperature monitoring in cooperation with the Oregon Department of Environmental Quality (ODEQ). This additional water temperature monitoring is described in Section 1.2.4.2.

Attached Algae Sampling

Attached algae sampling was conducted by USBR in June, July, and September 2000. The objective of attached algae sampling was to collect data to quantify impact of primary production downstream of Iron Gate dam and determine algae growth rates. Attached algae have been identified as a potentially important component of primary production affecting water quality in the mainstem Klamath River below Iron Gate dam. Artificial substrates were deployed at two locations: (1) Klamath River below Iron Gate dam (RM 190) and (2) Klamath River near Cottonwood Creek (RM 182).

Quantitative and qualitative methods were employed. Floating periphyton samplers and unglazed ceramic tiles were used to assess algae growth conditions. The floating samplers were employed to reduce the impacts of grazing, while the ceramic tiles were placed on the bed to determine the impacts of growth subject to grazing. The algae samples were collected from the floating samplers for laboratory analysis, while the unglazed ceramic tiles provided a qualitative assessment of changes in substrate composition and impacts of grazing.

Samples were gathered at weekly intervals in June, July, and September 2000 and processed under laboratory conditions to determine chlorophyll-*a* and ash-free dry weight. These data will be used in conjunction with chlorophyll-*a* data from the grab sample monitoring to estimate growth rates and response of algae throughout the monitoring period.

<u>Synoptic Water Quality Surveys</u>

Synoptic water quality surveys were conducted by USBR in June and August 2000. The objective of synoptic water quality surveys was to acquire the necessary subdaily water quality data to calibrate and validate a river simulation model for DO. However, it was surmised that these subdaily samples would provide further insight into the role of nutrient availability and the role of primary production in day-to-day water quality conditions below Iron Gate dam.

To effectively assess diel DO response of the Klamath River below Iron Gate dam and to support model application, subdaily data were collected, including DO, pH, redox potential, and dissolved organic forms of nitrogen and phosphorus. Samples were gathered three times per day (6 a.m., 11 a.m., and 4 p.m.) during June 5-7 and August 7-9 at four sites in the Klamath River from Iron Gate dam (RM 190) to Seiad Valley (RM 128.9). The June and August sampling periods were designed to coincide with periods when juvenile and adult fish, respectively, may occupy the study reach. Early August is typically the most adverse period of the summer for anadromous fish.

<u>Reservoir Water Quality Surveys</u>

The objective of reservoir water quality surveys was to obtain water quality data (profiles) in Iron Gate reservoir (RM 190.2), Copco reservoir (RM 198), J.C. Boyle reservoir (RM 225), and Keno reservoir (RM 233) because these main-stem reservoirs potentially play an important role in the quality of waters released to downstream reaches. As mentioned above, this task was originally scheduled to conclude in April 2001 along with other program tasks. However, PacifiCorp continued this task through November 2001 to supplement water quality data and information being compiled to support relicensing analyses. These data will be used to characterize water quality responses within the reservoirs, and to assist in interpretation of water quality in downstream river reaches.

Monitoring consisted of three primary tasks: (1) deployment of temperature loggers at preselected depths in the reservoirs, (2) monthly profiles of physical constituents, and (3) monthly water quality grab sampling surveys. Temperature loggers were deployed at predetermined depths in Iron Gate, Copco, J.C. Boyle, and Keno reservoirs, suspended from log booms upstream of the dams. The loggers recorded at hourly intervals and were downloaded approximately every 2 months. Loggers were deployed at the surface and every 10 feet in Iron Gate and Copco reservoirs and at the surface and every 5 feet in Keno and J.C. Boyle reservoirs.

Hydrolab water quality probes were used to conduct monthly profile measurements in each reservoir. Secchi depth was measured at each location. Water temperature, DO, pH, and specific conductance were measured at 1-meter intervals in the photic zone (≈3 times Secchi depth) and at a minimum of 3-meter intervals below the photic zone.

Water quality samples were collected monthly in the reservoirs. Water quality constituents sampled in the reservoirs included nutrients, BOD, and chlorophyll-*a*. Nutrients included ammonia, nitrate-plus-nitrite, total Kjeldahl nitrogen, orthophosphate, and total phosphorus. Samples were collected at three representative depths in Iron Gate and Copco reservoirs: epilimnion, metalimnion, and hypolimnion. These depths were estimated from the hydrolab profiles of water temperature. All epilimnion samples were obtained at depths of 1 meter. In the relatively shallow J.C. Boyle and Keno reservoirs, two depths were sampled: 1 meter and 8 meters.

1.2.4.2 Additional Water Temperature Monitoring During 2001

ODEQ has prioritized the Klamath and Lost River watersheds for development of a Total Maximum Daily Load (TMDL)/Water Quality Management Plan. During the summer of 2001, ODEQ undertook important tasks of the data collection component of the TMDL process, including season-long temperature monitoring, a synoptic longitudinal water quality study during the late-summer low-water period, flow measurements, and a habitat survey. As part of a commitment to support ODEQ's TMDL modeling efforts, PacifiCorp deployed continuous temperature recorders[3] at many locations in the Klamath River and tributaries in the Project area (Table 1.2-1). The primary goal of this extensive deployment was to collect additional water temperature data, supplemental to other already-existing data and ODEQ's effort, in order to characterize the thermal regime of the Upper Klamath River as it flows through the Project area.

[3] PacifiCorp deployed continuous temperature recorders from May 10-14, 2001.

Table 1.2-1. Sites for PacifiCorp/ODEQ Temperature Monitoring (with Approximate River Mile [RM] Locations)

PacifiCorp Site Locations	RM
Top of fish ladder at Link River dam	254.3
Upstream of East Side powerhouse in river	253.7
East Side powerhouse tailrace	253.6
Keno dam (Keno reservoir at log boom)	231.6
USGS gaging station below Keno dam	230.5
Upstream of J.C. Boyle reservoir backwater	227
Spencer Creek	225.8
J.C. Boyle dam (J.C. Boyle reservoir at log boom)	223.3
Downstream of J.C. Boyle dam (top of bypass reach)	223
J.C. Boyle bypass reach (middle of bypass reach)	222
Upstream of J.C. Boyle powerhouse tailrace (bottom of bypass reach)	220.4
J.C. Boyle powerhouse tailrace	220.4
USGS station below J.C. Boyle powerhouse	218
Stateline	208
Upstream of Copco reservoir	194.1
Copco 1 reservoir at log boom	199
Copco 2 reservoir	198.5
Downstream of Copco 2 dam (top of Copco 2 bypass reach)	198.2
Upstream of Copco 2 powerhouse (bottom of Copco 2 bypass reach)	197
Copco 2 powerhouse tailrace	196.9
Iron Gate reservoir	190.3
Iron Gate powerhouse tailrace	190
Fall Creek (four locations) *	
Jenny Creek	

* The Fall Creek locations are below the diversion dam (top of bypass reach), above the diversion dam, at the bottom of bypass reach, and below tailrace.

The specific temperature monitoring sites are listed in Table 1.2-1. Temperature recorders were deployed to sample on a continuous basis for approximately 1 year.

The monitoring program followed the standardized sampling protocols and procedures developed by ODEQ and other state and federal agencies. In general, sampling equipment and procedures were as defined in the *ODEQ Laboratory Field Sampling Reference Guide* (1998) and the *Oregon Plan Water Quality Monitoring Guidebook*. Pre- and post-deployment accuracy checks of temperature loggers were conducted using the protocol outlined in Chapter Six of the *Oregon Plan Water Quality Monitoring Guidebook*. Accuracy checks will use a thermometer that has a National Institute of Standards and Technology (NIST) Certificate of Calibration dated within the past year. Field audits were conducted at least three times during the sampling period, including immediately after deployment and immediately before retrieval.

Routine inspection and preventive maintenance of field/laboratory equipment and facilities, and calibration of sampling and analytical instruments, were done according to the procedures and protocols outlined in the *ODEQ Laboratory Field Sampling Reference Guide* (1998) and the *Oregon Plan for Salmon and Watersheds Water Quality Guidebook* (1999), Chapter Six. Instruments were maintained and calibrated according to the standards outlined in the *Oregon Plan Water Quality Monitoring Guidebook*. The results of calibrations and field audits were kept on file. Field data were supplied electronically to ODEQ staff upon completion of initial data analysis.

1.2.4.3 Water Quality Monitoring During 2002

In cooperation with USBR, PacifiCorp is conducting a comprehensive program for water quality sampling and data collection in 2002. This program will sample water quality in the Klamath River at 45 sites between the entrance to the A Canal (Upper Klamath Lake near Link River dam at RM 254.3) and the mouth of the Shasta River (RM 176.7). Additional cooperation is being pursued with other entities operating on the lower Klamath River to obtain data below the Shasta River, such as the Yurok Tribe and the U.S. Fish and Wildlife Service (USFWS).

Currently the amount of data available for the lower Klamath River is less that what is available in the Project area. To help address this issue, PacifiCorp is assisting the Yurok Tribe in conducting continuous water quality monitoring at two sites in the lower Klamath River: (1) above the Trinity River confluence (RM 43.5), and (2) at Martin's Ferry downstream of the Trinity River confluence.

The plan has three main components:

- Monthly or biweekly collection of grab samples and *in situ* measurements of 14 water quality parameters at 42 sites
- Automated data collection at hourly intervals of four water quality parameters at 13 sites
- Automated temperature monitoring at hourly intervals at 18 sites including vertical arrays in Keno, J.C. Boyle, Copco No. 1, and Iron Gate reservoirs.
- Multi-day synoptic sampling at 42 sites, including grab samples and additional automated hourly monitoring, to obtain sub-daily information needed for water quality modeling.

Sampling will be conducted from April through November 2002 with synoptic sampling events in May, July, and September 2002.

Monthly Sampling.

Samples will be collected monthly from 42 sites (47 samples[4]) in the Klamath Basin between Link River Dam and the Shasta River (RM 176.7) (Table 1.2-2, Figure 1.2-1). The USBR will collect 24 of these samples as part of their biweekly monitoring program (for sites listed in Sections I and II of Table 1.2-2), and PacifiCorp will collect 23 samples (for sites listed in Sections III – IV of Table 1.2-2). At each sample location, *in situ* measurements will be made of water temperature, specific conductance, dissolved oxygen, pH, and oxidation-reduction potential. At each sample location, grab samples will be collected for laboratory analysis of nitrate+nitrite nitrogen, ammonia nitrogen, total Kjeldahl nitrogen, total phosphorus, orthophosphate phosphorus, alkalinity, and biochemical oxygen demand. All sample collection and analysis will be governed by written standard operating procedures (SOP) and a formal Quality Assurance Project Plan (QAPP). Draft versions of the SOP and QAPP are included as Appendices 1 and 2, respectively, to this Study Plan. Final versions, when adopted by both PacifiCorp and USBR , will be posted to PacifiCorp's Klamath Relicensing web site.

Automated Multi-parameter Water Quality Data Collection

The USBR has installed multi-parameter water quality data loggers at five locations between Link River dam and Keno dam. These instruments will collect measurements of water temperature, DO, pH, specific conductance, and redox at 1-hour intervals from April through October 2002. They will be augmented by short-term deployments of similar instruments by PacifiCorp at eight additional sites. These 13 instruments (Table 1.2-3. Figure 1.2-2) will provide detailed information on sub-daily response of water quality throughout the Klamath River between Link River and Seiad Valley.

In addition to the multi-parameter instruments, water temperature data loggers will be deployed at 18 sites (Table 1.2-3, Figure 1.2-3) throughout the Project area including vertical arrays in the Keno, J.C. Boyle, Copco No. 1, and Iron Gate reservoirs (48 total instruments). These instruments will collect measurements of water temperature at 1-hour intervals from April through at least mid-November 2002. Deployment of these instruments will follow the procedures outlined in the *ODEQ Laboratory Field Sampling Reference Guide* (1998) and the *Oregon Plan for Salmon and Watersheds Water Quality Guidebook* (1999), Chapter Six.

Synoptic Sampling

On three occasions during 2002 (May, July, and September 2002), a three-day synoptic sampling event will be conducted. The purpose of this three-day effort is to collect data that represents smaller scale variation in time and space than will be obtained during the regular monthly sampling. The synoptic sample events have several components:

- Multiple sampling teams will visit all 47 monthly sample sites on the same day. This will provide a snapshot of conditions throughout the project on a single day.

[4] One grab sample will be collected at each site except at J.C. Boyle, Copco, and Iron Gate reservoir sites near the dams. Samples will be collected at three representative depths in Iron Gate and Copco reservoirs: epilimnion, metalimnion, and hypolimnion. These depths will be estimated from the vertical profiles of water temperature. All epilimnion samples will be obtained at depths of 1 meter. In the relatively shallow J.C. Boyle reservoir, two depths will be sampled: 1 meter and 8 meters.

- Additional daily samples will be collected at 12 sites on the day before and the day after the monthly samples (Table 1.2-2, Figure 1.2-4). The additional days provide information on the shorter term variability in the reservoirs, and a few other sites, that would be missed with only monthly sampling.

- Six additional multi-parameter data loggers will be deployed to augment the instruments deployed by the USBR. This sub-daily information is necessary to adequately represent the dynamic conditions for developing the computer models of the system.

- Hourly measurements will be made in Copco and Iron Gate reservoirs to document diurnal changes in water quality. These measurements are intended to address the regulatory concerns relating to diurnal variation in water quality, especially pH and dissolved oxygen, in the epilimnion of the reservoirs.

- Measurements will be made of physical parameters, vertical water quality profiles, and chlorophyll *a* at multiple locations in Iron Gate and Copco reservoirs. Such measurements are designed to address the stated concerns of some stakeholders that the spatial variability in the reservoirs is inadequately represented by the other aspects of the sampling program. Four additional profile sites and seven additional sample sites have been identified in Iron Gate Reservoir, and three additional profile sites and five additional sample sites have been identified in Copco reservoir. These sites were selected to assess areas in the reservoir that appear somewhat distinctive based on topographic and bathymetric maps (e.g., embayments). Additional sites may be sampled if warranted by distribution of algal blooms or other factors.

All work during the synoptic events will be governed by the project SOP and QAPP (see Attachments A and B to this study plan).

Table 1.2-2. Sample Sites Klamath River May, July, September 2002

Section	Site No.	Site Name	Monthly	Additional Synoptic	Additional Diel
I	1	Klamath Lake above Link Dam	✓	✓	
	2	Link Bypass 1	✓		
	3	Link Bypass 2	✓		
	4	Mouth of Link R (USBR 1)	✓	✓	
II	6	Lake Ewauna A (USBR 2)	✓		
	7	Lake Ewauna B (USBR 3)	✓		
	8	Lake Ewauna C (train trestle) (USBR 4)	✓		
	9	Klamath R at Highway 140 (USBR 5)	✓		
	10	Lost R Diversion Channel	✓		
	11	Klamath R at Highway 97 (USBR 6)	✓		
	12	Klamath R at Collins Forest Products (USBR 7)	✓		
	13	South Side Bypass	✓		
	14	Klamath R above Miller Island Boat Ramp	✓		
	15	Klamath R at Miller Island Boat Ramp	✓		
	16	Klamath R below Miller Island Boat Ramp	✓		
	17	Klamath R above North Canal (USBR 10)	✓		
	18	Klamath R b/t North Canal and Teeters Lndg (USBR 11)	✓		
	19	Klamath Straits Drain at Highway 97 (RM 2)	✓		
	20	Klamath R at Teeters Landing (USBR 12)	✓		
	21	Klamath R below Teeters Landing (USBR 12a)	✓		
	22	Klamath R above Highway 66 Bridge (USBR 13)	✓		
	23	Klamath R at HWY 66 Bridge (Keno Res) (USBR 14)	✓		
	24	Keno Reservoir	✓		
	25	Klamath R at Keno Dam (USBR 15)	✓		
III	26	Klamath R below Keno Dam	✓	✓	
	28	Klamath R above JC Boyle Reservoir	✓	✓	
	29	Spencer Creek	✓	✓	
	30	JC Boyle Reservoir Deepest	✓		✓
	31	JC Boyle Reservoir at Dam	✓	✓	✓
	32	Klamath R below JC Boyle Dam	✓	✓	
	32a	Bypass Reach accretion		✓	
	33	Klamath R Bypass Reach above Powerhouse	✓	✓	
	34	Klamath R below JC Boyle Powerhouse		✓	
	35	JC Boyle Powerhouse Release	✓	✓	
IV	36	Klamath R above Rock Creek			✓

Table 1.2-2. Sample Sites Klamath River May, July, September 2002

Section	Site No.	Site Name	Monthly	Additional Synoptic	Additional Diel
	37	Klamath R above Shovel Creek	✓		✓
	38	Shovel Creek	✓		✓
V	39	Copco Community Bridge			✓
	40	Copco near area of spring flow			✓
	41	Copco Reservoir at Dam	✓	✓	✓
	42	Klamath R above Iron Gate Reservoir	✓	✓	
	43	Fall Creek	✓	✓	
	44	Jenny Creek	✓	✓	
	45	Iron Gate Reservoir at Basalt Narrows			✓
	46	Iron Gate Reservoir above Dam	✓	✓	✓
VI	47	Klamath R below Iron Gate Dam	✓	✓	
	48	Klamath R above Shasta	✓	✓	
	49	Shasta R	✓	✓	

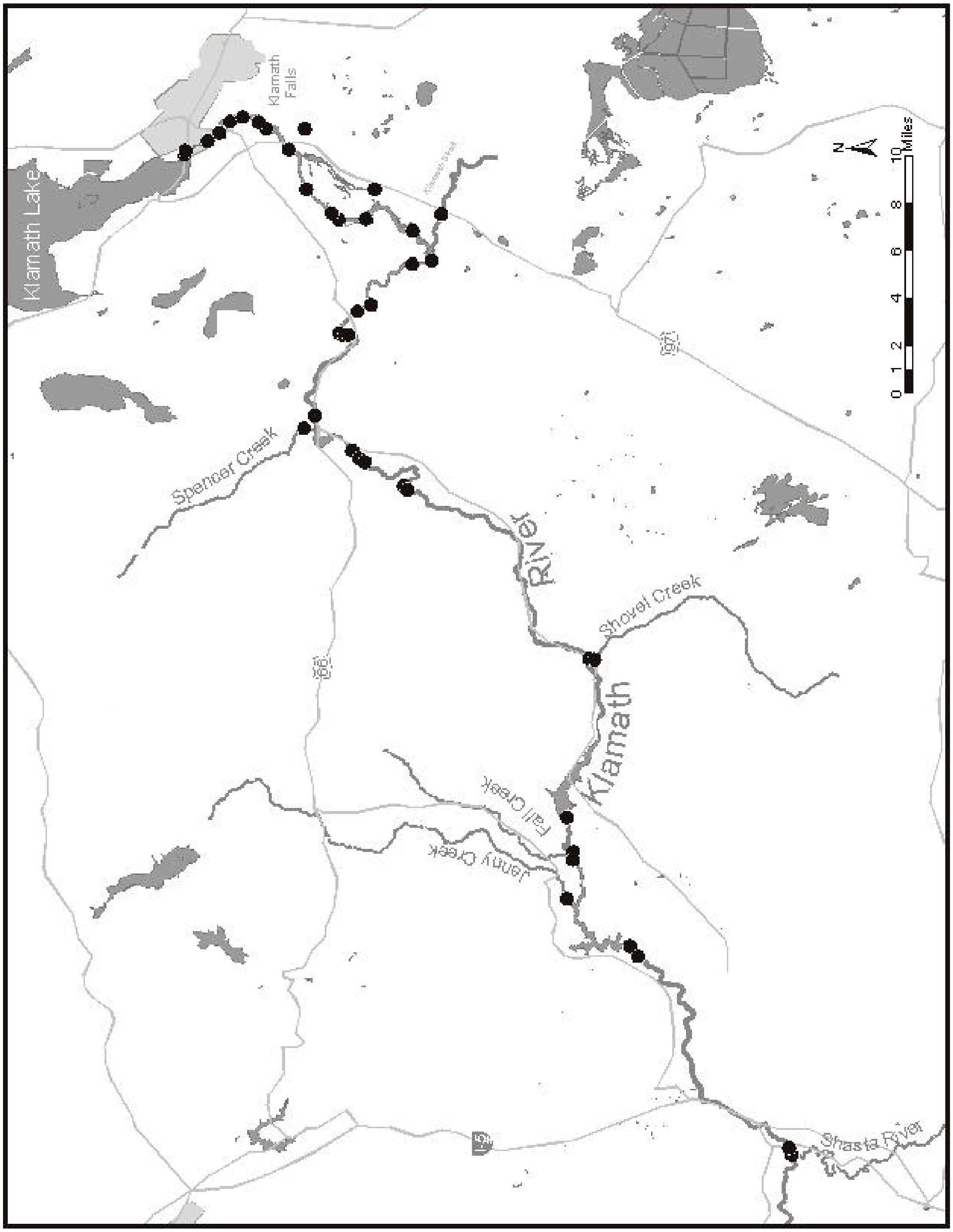

Figure 1.2-1. Monthly sampling site locations (as listed in Table 1.2-2).

Table 1.2-3. Instrument Data Recording Sites Klamath River 2002

Section	**Site No.**	**Site Name**	**Temperature**	**Multi-Parameter**
I	1	Klamath Lake above Link Dam		✓
	2	Link Bypass Upper	✓	
	3	Link Bypass Lower	✓	
	4	Mouth of Link R (USBR 1)		✓
III	15	Klamath R at Miller Island Boat Ramp		✓
	19	Klamath Straits Drain at Highway 97 (RM 2)		✓
	23	Klamath R at Hwy 66 Bridge (Keno Res) (USBR 14)		✓
	24	Keno Reservoir	✓	
III	26	Klamath R below Keno Dam	✓	
	28	Klamath R above JC Boyle Reservoir		✓
	29	Spencer Creek	✓	
	31	JC Boyle Reservoir at Dam	✓	
	32	Klamath R below JC Boyle Dam	✓	✓
	33	Klamath R Bypass Reach above Powerhouse	✓	✓
	34	JC Boyle Powerhouse Release	✓	✓
	35	Klamath R below JC Boyle Powerhouse	✓	
IV	36	Klamath R above Rock Creek		✓
	37	Klamath R above Shovel Creek	✓	✓
	38	Shovel Creek	✓	
VI	41	Copco Reservoir at Dam	✓	
	42	Klamath R above Iron Gate Reservoir	✓	
	43	Fall Creek	✓	
	44	Jenny Creek	✓	
	46	Iron Gate Reservoir above Dam	✓	
VI	47	Klamath R below Iron Gate Dam		✓
	49	Shasta R	✓	
	53	Seiad Valley		✓

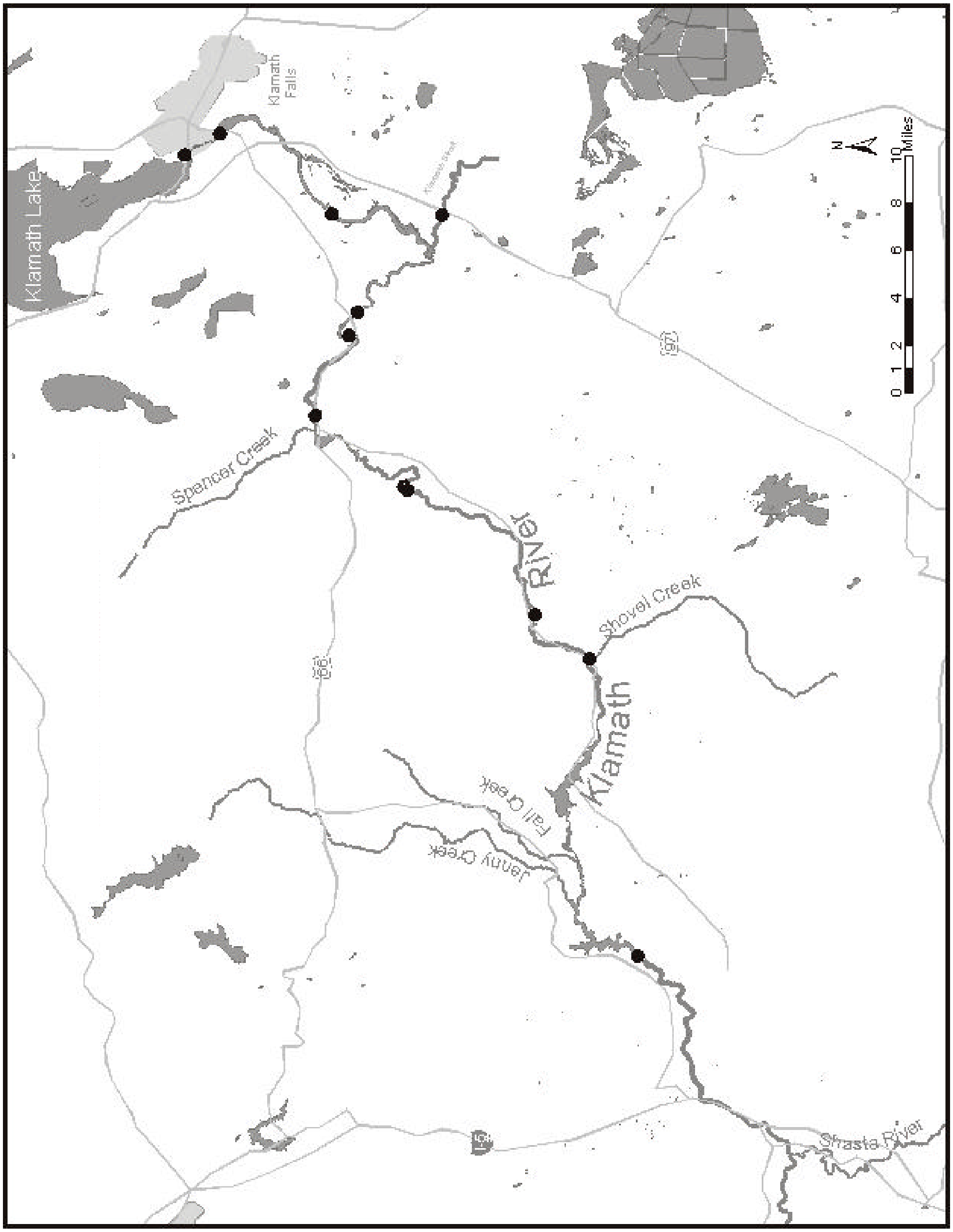

Figure 1.2-2. Automated multi-parameter sampling site locations (as listed in Table 1.2-3).

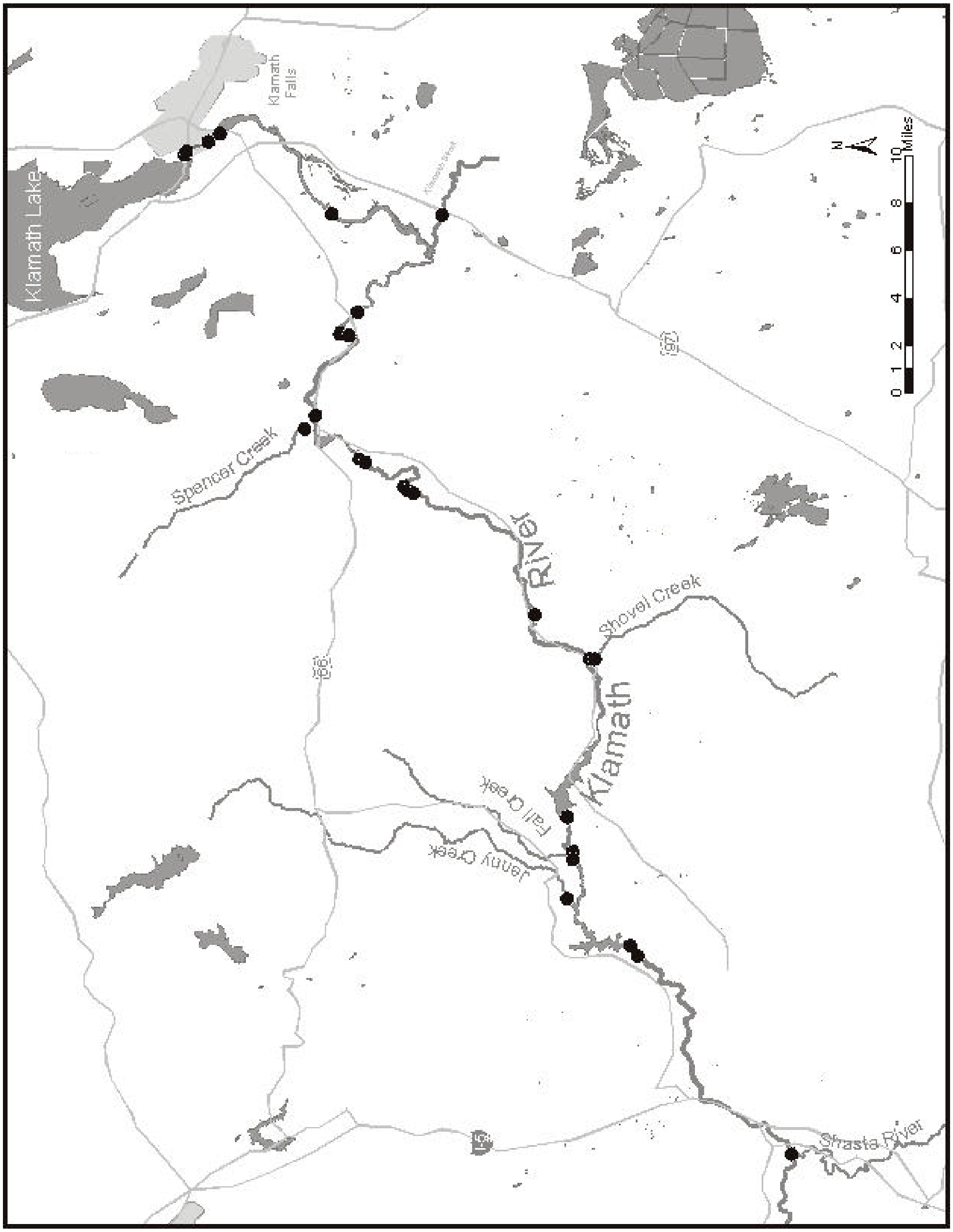

Figure 1.2-3. Water temperature data logger sampling site locations (as listed in Table 1.2-3).

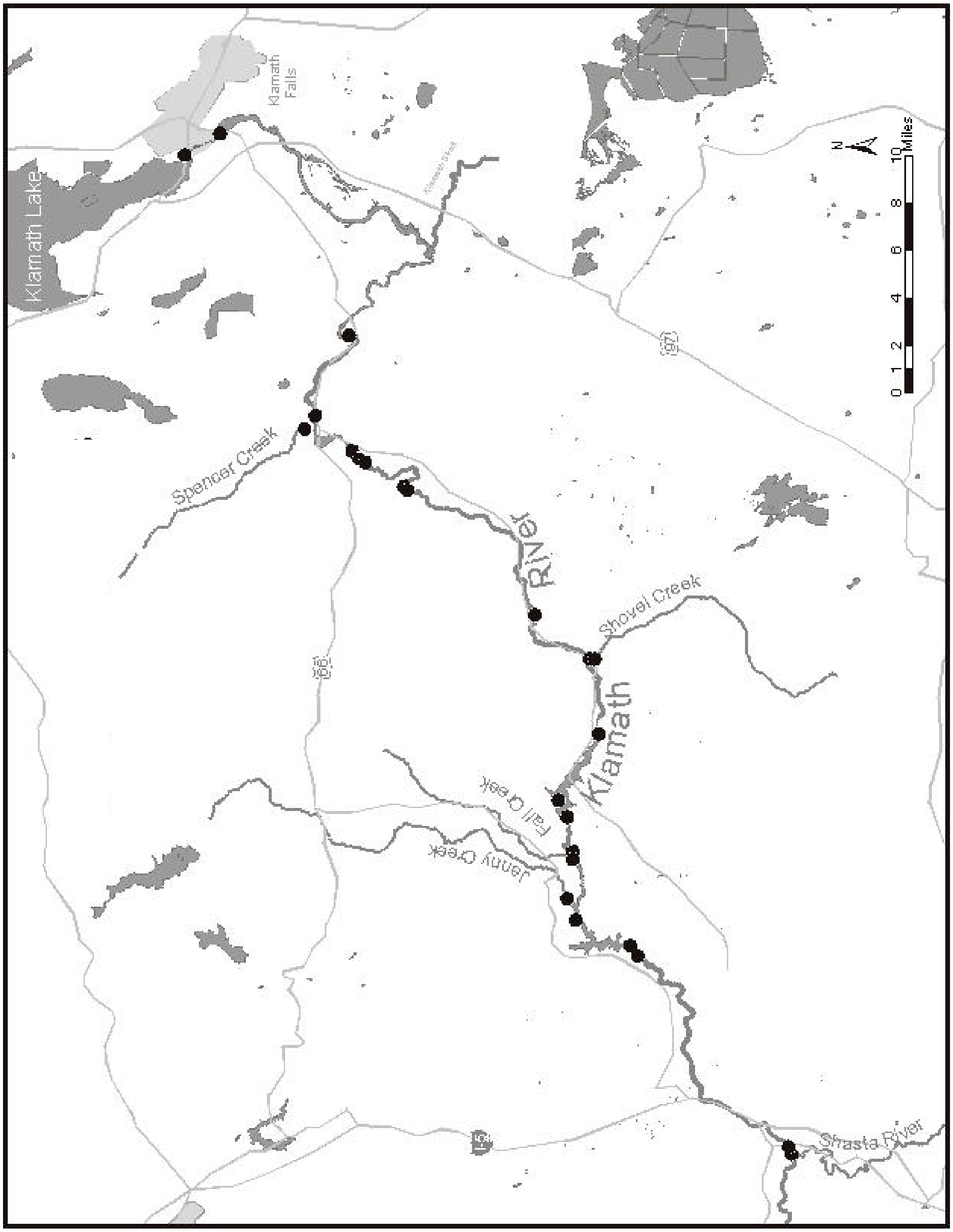

Figure 1.2-4. Synoptic water quality sampling site locations (as listed in Table 1.2-2).

1.2.4.4 Data Analysis and Simulation Modeling

Data obtained in this study will be incorporated in the database and analyzed as described in Study Plan 1.1. In addition, data obtained in this study will be available for water quality analysis and modeling tools as described in Study Plan 1.3 (Water Quality Analysis and Modeling Needs Assessment and Scoping Process).

1.2.4.5 Geographic Scope

Water quality data collection in 2000 and 2001 was focused on the Klamath River between Link River Dam (RM 254.3) and the USGS gage below Iron Gate Dam (RM 190). This is the area where PacifiCorp believes project operations have the most direct potential effect on water quality. It is clear, however, that the Klamath River hydroelectric project may influence water quality for some distance below Iron Gate Dam. For this reason, water quality sampling in 2000, 2001, and 2002 included efforts to collect data further downstream of Iron Gate Dam as far as Seiad Valley. For 2002, the sampling program outlined in this study plan also includes additional sites downstream to the Shasta River. Data collection also includes sites in tributaries to project waters to provide boundary and water quality inputs for water quality modeling efforts.

Process for Extending Water Quality Data Acquisition Below Seiad Valley

Some stakeholders have requested that the monitoring be extended to the mouth of the Klamath River (RM 0) or as far downstream as Project effects may occur. Proposed water quality monitoring described in this study plan includes the river downstream of the Project from Iron Gate dam (RM 190) to Seiad Valley (RM 129). PacifiCorp is developing water quality models of the Klamath River to examine water quality effects of the hydroelectric project to the mouth. Therefore, PacifiCorp is coordinating with other entities conducting similar water quality sampling in the lower basin to share water quality data to provide data coverage of the entire lower river. Currently the amount of data available for the lower Klamath River is less than what is available in the Project area. To help address this issue, PacifiCorp is assisting the Yurok Tribe in conducting continuous water quality monitoring at two sites in the lower Klamath River: (1) above the Trinity River confluence (RM 43.5), and (2) at Martin's Ferry downstream of the Trinity River confluence.

PacifiCorp plans to continue coordination with other entities in the basin that are also currently performing water quality monitoring.

1.2.5 Relationship to Regulatory Requirements and Plans

This study will help PacifiCorp address regulatory requirements and planning objectives related to Project effects on water quality. The information derived from this study will be used to help address FERC requirements (18 *Code of Federal Regulations* [CFR] 4.51 and 16.8) for information on water quality in the Project area and potential effects of Project operations on water quality.

Relicensing of the Project will require certifications from relevant agencies that the Project complies with requirements of Section 401 of the federal Clean Water Act. This study will provide information to help assess potential Project effects as they relate to water quality objectives and standards promulgated by these agencies. This study also will provide information to help assess potential Project effects as they relate to TMDLs to be developed by these agencies for conditions and locations of the Klamath River listed as water quality limited under Section 303(d) of the federal Clean Water Act.

Together with other hydrology and water quality studies conducted by PacifiCorp (Study Plans 1.1, 1.3, 1.4, 1.5, and 1.6), this study will provide information that can be used as necessary to address compliance with management objectives from various resource agencies, tribes, and other stakeholders that relate to water quality, including the following:

- Federal Clean Water Act regulations
- State of Oregon Water Quality Management Plan for the Klamath Basin (Basin Plan)
- State of California Water Quality Control Plan for the North Coast Region (Basin Plan)
- Federal Endangered Species Act regulations
- Tribal natural resources goals and objectives[5] and cultural values
- U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM) Aquatic Conservation Strategy objectives under the Northwest Forest Plan
- BLM Resource Management Plans
- USFS Land and Resource Management Plans
- Oregon Department of Fish and Wildlife (ODFW) Fish and Wildlife Habitat Mitigation Policy
- ODFW Klamath Basin Fish Management Plan
- California Department of Fish and Game management goals

This study's information also will help PacifiCorp develop protection, mitigation, and enhancement measures to meet the intention of the regulations and management objectives related to water quality.

1.2.6 Products, Maps, and Reports

At the conclusion of the studies, a Final Technical Report on Water Resources will be produced that describes the approaches, methods, and results of the water resources studies, including the monitoring of water temperature and water quality conditions in the Project area as described in this study plan. An annotated outline for the Final Technical Report on Water Resources will be produced during Spring – Summer 2002. The annotated outline will provide information on the proposed structure and content of the Final Technical Report and is intended as a tool for PacifiCorp and stakeholder work groups to discuss preliminary study results and flag important information needs to be addressed in the Final Technical Report. PacifiCorp plans to post the

[5] Including tribal water quality standards as promulgated.

Final Technical Report on the Project Web site so that it can be easily retrieved and reviewed by interested agencies and stakeholders.

1.2.7 Schedule

The timeline and milestones for this study are as follows:

Conduct 2000 – 2001 reservoir water quality surveys[6]	May 2000-November 2001
Perform 2001 – 2002 additional continuous temperature monitoring	May 2001-April 2002
Conduct additional 2002 monthly water quality monitoring	May – November 2002
Conduct continuous synoptic sampling	Three-day periods during May, July, and September 2002
Enter and analyze new monitoring data	Throughout 2002
Develop Final Technical Report Annotated Outline	Summer 2002
Develop Final Technical Report	Winter 2002-2003
Develop Draft License Application	Winter 2003
Additional monitoring (as necessary to complete final license application)	Spring-summer 2003
Submit Final License Application	March 2004
Continue monitoring as necessary.	Post Application Filing

1.2.8 Additional Considerations

PacifiCorp has produced three previous draft versions of this study plan for stakeholder review and comment. PacifiCorp also has conducted meetings with stakeholders in January 2001, March 2002, April 2002, May 2002, June 2002, and August 2002 to discuss various elements of this study plan, including plans for continued water quality monitoring in 2002. A number of comments were received from stakeholders that recommended modifications to the scope of the study plan or requested additional studies other than those proposed by PacifiCorp. PacifiCorp considered these comments and has revised the study plan to address or incorporate requested modifications and additional tasks. Study matters still being resolved are as follows:

[6] Task in the cooperative U.S. Bureau of Reclamation Klamath Basin water quality monitoring program funded, conducted, and extended by PacifiCorp.

- ODEQ and the SWRCB requested that PacifiCorp sample for presence of contaminants in sediments and aquatic biota in Project reservoirs to determine potential food chain uptake of contaminants. Discussions on purpose, approach, and methods for this sampling are still under way. It is expected that this sampling will be the subject of a separate new study plan rather than a newly revised part of this study plan 1.2.
- At the August 2002 meeting, Jim Henderson (Karuk Tribe) stated that the monitoring as described in this study plan 1.2 was inadequate, including the need for additional sampling sites, more frequent sampling, and additional parameters to be sampled.

ATTACHMENT A

QUALITY ASSURANCE PROJECT PLAN KLAMATH RIVER WATER QUALITY MONITORING PROGRAM
June 2003

1.1 PROJECT/TASK ORGANIZATION

The Klamath River Water Quality Monitoring Program (KRWQMP) is being operated out of the Klamath Basin Area Office of the U.S. Bureau of Reclamation (USBR). This office is responsible for overall field operations, sampling, and monitoring in the upper Klamath basin, from Link River to Keno Dam. PacifiCorp is responsible for overall field operations, sampling, and monitoring in the Lower Klamath basin, from downstream of Keno Dam to Seiad Valley, and at sites in the upper Klamath basin not monitored by USBR. The Regional Bureau of Reclamation Office in Sacramento, California (MP-Reclamation) is providing planning and Quality Assurance (QA) support.

1.2 PROBLEM DEFINITION/BACKGROUND

USBR's water quality monitoring program in 2002 is needed to support Klamath Project long-term operations planning, fish telemetry efforts in the upper Klamath basin, and to meet continuing commitments related to Endangered Species Act biological opinions. PacifiCorp's water quality monitoring in 2002 is needed to support the Federal Energy Regulatory Commission (FERC) re-licensing process for the Klamath River facilities.This program provides baseline information on main stem and tributary contributions on the Klamath River for a representative suite of physical, chemical, and biological water quality constituents. These constituents will be used to characterize water quality in the main stem Klamath River, identify water quality constituents of concern within selected river reaches, and estimate input parameters for water quality models. To achieve these objectives selected physical, chemical and biological constituents will be measured at frequencies ranging from sub-daily to monthly.

1.3 PROJECT/TASK DESCRIPTION

1.3.1 Sample Sites and Sub-programs

The KRWQMP monitors main stem Klamath River and major tributary water quality from Link Dam near Klamath Falls to Seiad Valley downstream of the Scott River approximately 129 river miles from the Pacific Ocean. Multiple sampling sub-programs are included within this program:

- Bi-weekly and monthly grab samples (Grab)
- Instantaneous acquisition of physical parameters with multi-probe instrumentation (Profile or Probe)
- Continuous acquisition of physical parameters with deployment of multi-probe instrumentation (DataSonde)
- Reservoir water quality sampling (Reservoir) by PacifiCorp

1.3.2 Water Temperature Study.

Table 1 on page 3 identifies site locations and sampling sub-programs. River miles for the main stem locations refer to distance from the mouth (ocean), while river miles on tributaries refer to distance upstream from the confluence with the Klamath River.

1.4 DATA QUALITY OBJECTIVES FOR MEASUREMENT DATA

1.4.1 Project Objective

The purpose of this program is to gather baseline water quality information for assessment of endangered/threatened fishes and determine data requirements and necessary information for use in water quality models for select reaches of the Klamath River. This information and available tools will be used to assess potential impacts of USBR and PacifiCorp operations on main stem Klamath River water quality. The physical, chemical and biological water quality data will establish the conditions that exist in the Klamath River watershed. The parameters were chosen to support, in part, Klamath Project long-term operations planning, fish telemetry efforts, to meet continuing commitments related to Endangered Species Act biological opinions, total maximum daily load studies, and for other analysis purposes.

1.4.2 Scope of Work

This program is scheduled to run from April to November 2002. Chemical, biological, and physical parameters affecting the water quality for aquatic life in the river will be measured.

1.4.3 Data Assessment

Table 2 summarizes the acceptance levels for the external check samples submitted to the laboratories with the production samples. All external check samples submitted to the laboratories are double-blind samples (sample is not identified as an external check sample). To evaluate external QA check samples, USBR and PacifiCorp will follow the protocol outlined in the QA Standard Operating Procedure (SOP) supplied by the MP-Reclamation Environmental Monitoring Branch (EMB) in Sacramento, CA. The Quality Assurance Team from MP-Reclamation will provide QA support. Part of this assessment process may involve the reanalysis of external QA check samples for project parameters or the whole sample set associated with the external QA samples for certain parameters if external QA check sample results are not confirmed upon reanalysis. The laboratory's Quality Control (QC) check samples must also meet certain levels of acceptability when analyzed with the production samples. Part of the data assessment process involves checking these laboratory QC check sample results to ensure they are within acceptable ranges. In order to ensure data quality, QA personnel will assess laboratory data packages to determine if all samples were analyzed within the holding times.

Table 1 Sample Sites and Associated Water Quality Sub-programs. Responsible entities include U.S. Bureau of Reclamation (USBR), PacifiCorp (PPC), and Water source Engineering (WC)

Site #	Agency	Location	Site ID Code	River Mile	Profile [a]	Sonde [b]	Grab [c]	Probe [d]	Tw [e]	Flow [f]
1	USBR / PPC[g]	Upper Klamath Lake above Link Dam	KLLD	255	X	X	X			X
2	PPC[g]	Link Bypass 1								X*
3	PPC[g]	Link Bypass 2								X*
4	USBR / PPC[g]	Mouth of Link R	KRLR		X	X	X			X
6	USBR	Lake Ewauna A	KRS2		X					
7	USBR	Lake Ewauna B	KRS3		X					
8	USBR	Lake Ewauna C.	KRS4		X					
9	USBR[j]	Klamath R at Highway 140	KRS5		X					
10	USBR	Lost R Diversion Channel	LRDC		X		X			X
11	USBR	Klamath R at Highway 97	KRS6		X					
12	USBR[j]	Klamath R at Collins Forest Products	KRS7		X					
14	USBR	Klamath R above Miller Island Boat Ramp	KRS8		X					
15	USBR	Klamath R at Miller Island Boat Ramp	KRMI	246	X	X	X			
16	USBR	Klamath R below Miller Island Boat Ramp	KRS9		X					
17	USBR[j]	Klamath R above North Canal	KRS10		X					
18	USBR	Klamath R b/t North Canal and Teeters Lndg	KRS11		X					
19	USBR	Klamath Straits Drain at Highway 97	KSD97	240.5	X	X	X			X
19a	USBR	KSD near Mouth at Klamath River	KSDNM							
20	USBR[j]	Klamath R at Teeters Landing	KRS12		X					
21	USBR	Klamath R below Teeters Landing	KRS12a		X					
22	USBR	Klamath R above Highway 66 Bridge	KRS13		X					
23	USBR[j]	Klamath R at HWY 66 Bridge.	KRS14	235	X	X	X			X
25	USBR	Klamath R at Keno Dam	KRS15		X					X
26	PPC	Klamath R below Keno Dam	23290							
27	PPC	Keno River Accretion								
28	PPC	Klamath R above JC Boyle Reservoir	22750				X	X	X	
29	PPC	Spencer Creek	SPC00				X	X	X	X
31	PPC	JC Boyle Reservoir at Dam	22460	226	X		X	X	X	
32	PPC	Klamath R below JC Boyle Dam	22400				X	X	X	X
32a	PPC	Bypass Reach accretion					?			?
33	PPC	Klamath R Bypass Reach above	22100				X	X	X	X

Table 1 Sample Sites and Associated Water Quality Sub-programs. Responsible entities include U.S. Bureau of Reclamation (USBR), PacifiCorp (PPC), and Water source Engineering (WC)

Site #	Agency	Location	Site ID Code	River Mile	Profile [a]	Sonde [b]	Grab [c]	Probe [d]	Tw [e]	Flow [f]
		Powerhouse								
35	PPC	JC Boyle Powerhouse Release	JCP00				X	X	X	X
36	PPC / WC[h]	Klamath R at State Line					X	X		
37	PPC / WC[h]	Klamath R above Shovel Creek	20645			X	X	X	X	X
38	PPC / WC[h]	Shovel Creek	SHC00	208			X	X	X	X
39	PPC	Klamath R above Copco								
41	PPC	Copco Reservoir at Dam	19855	198	X		X		X	
42	PPC	Klamath R above Irongate Reservoir	19630				X	X	X	X
43	PPC	Fall Creek	FLC00				X	X	X	X
44	PPC	Jenny Creek	JNC00				X	X	X	X
46	PPC	Irongate Reservoir above Dam	19010	190.2	X		X		X	
47	PPC	Klamath R below Irongate Dam	19000	190.1		X	X	X		X
48	PPC	Klamath R above Shasta at mouth	17670	176.7			X	X	X	
49	PPC	Shasta R	SHR00	176			X	X	[i]	X

[a] Profile = Tw, DO, pH, Spec Cond, ORP, collected with WQ probe at multiple locations

[b] Sonde =. Tw, DO, pH, Spec Cond, ORP, collected through a continuously deployed logger

[c] Grab =. USBR: TDS, Alkalinity, Ammonia, Nitrate-Nitrite, TKN, Total P, OP, BOD, Chlorophyll-a, Turbidity
PacifiCorp: Ammonia, Nitrate-nitrite, TKN, OP, TP, Alkalinity, Chlorophyll-a, BOD, Turbidity

[d] Probe = Tw, DO, pH, Spec Cond, ORP, collected with WQ probe at one location

[e] Tw = continuously deployed temperature logger

[f] Flow = gage (if *: requires gaging)

[g] During synoptic surveys, PPC will be sampling

[h] During synoptic surveys, WC will be sampling

[i] No temperature logger is included on the Shasta River as other agencies are already monitoring temperature in that river

[j] USBR sites where cross sectional profiles will be obtained

Table 2 Data Quality Objectives (from MP-Reclamation EMB SOP for QA, 2000).

Parameters	Reporting Limit (mg/L)	Accuracy (% Recovery)	Precision (% RPD)	Completeness (%)	Corrective Actions
Ammonia	0.05 mg/L	80%-120%	[>5x RL] = 0%-20% [≤ 5x RL] difference within ± RL	90%	Re-analyze sample and if not confirmed Re-analyze the batch
Nitrate + Nitrite as N	0.05 mg/L	80%-120%	[>5x RL] = 0%-20% [≤ 5x RL] difference within ± RL	90%	Re-analyze sample and if not confirmed Re-analyze the batch
Total Kjeldahl Nitrogen	0.1 mg/L	80%-120%	[>5x RL] = 0%-20% [≤ 5x RL] difference within ± RL	90%	Re-analyze sample and if not confirmed Re-analyze the batch
Orthophosphate	0.05 mg/L	80%-120%	[>5x RL] = 0%-20% [≤ 5x RL] difference within ± RL	90%	Re-analyze sample and if not confirmed Re-analyze the batch
Total Phosphorus	0.02 mg/L	80%-120%	[>5x RL] = 0%-20% [≤ 5x RL] difference within ± RL	90%	Re-analyze sample and if not confirmed Re-analyze the batch
Total Alkalinity	3 mg/L	80%-120%	[>5x RL] = 0%-20% [≤ 5x RL] difference within ± RL	90%	Re-analyze sample and if not confirmed Re-analyze the batch
Total Dissolved Solids	2 mg/L	80%-120%	[>5x RL] = 0%-20% [≤ 5x RL] difference within ± RL	90%	Re-analyze sample and if not confirmed Re-analyze the batch
Biological Oxygen Demand	3 mg/L	80%-120%	[>5x RL] = 0%-20% [≤ 5x RL] difference within ± RL	90%	Re-analyze sample and if not confirmed Re-analyze the batch
Chlorophyll a	2 µg/L	Not Established	[>5x RL] = 0%-20% [≤ 5x RL] difference within ± RL	90%	Re-analyze sample and if not confirmed Re-analyze the batch

RL = Reporting Limit [ ] = If concentration of determination is....

1.5 SAMPLING DESIGN (EXPERIMENTAL DESIGN)

This program is divided into 7 different sub-programs; each designed to provide an overall assessment of the KR watershed water quality and to support scientific studies that are underway as well as those that are planned.

- Continuous Deployment of Water Quality Probes (Sonde): Physical parameters are measured hourly with Hydrolab® Datasonde 3 multi-probe units at multiple sites from April to November 2002 (see Table 1). Parameters include temperature, dissolved oxygen, pH, specific conductance, and oxidation reduction potential (redox). Datasondes at sites upstream of Keno Dam are exchanged each week, and transported to the USBR Klamath Basin Area Office, where they are downloaded, cleaned, calibrated, and readied for field deployment the following week. Datasondes at sites below Keno dam will be installed for short-term (3-day) deployments in May, July, and September. The USBR Klamath Basin Area Office SOP is used for the calibration, usage, post-calibration, and maintenance of the deployed units. Table 1 outlines the locations and agency in charge.

- Instantaneous Acquisition of Physical Parameters (Profile or Probe): Physical parameters are measured on site every two weeks above Keno Dam and monthly below Keno Dam with multi-probe instrumentation (e.g., Hydrolab H20 or YSI 600) at multiple sites from April 16 to November 5, 2002 (see Table 1). Parameters include temperature, dissolved oxygen, pH, specific conductance, and/or redox. Turbidity will also be measured at river sites using a portable instrument when a profile is acquired. Measurements are obtained at 0.1m, 0.5m, 1.0m, and at one-meter intervals thereafter until the bottom is reached (profile). The probes of the unit should be approximately 0.1m above the sediment for the bottom reading. Stratification is not present at sites where adequate mixing occurs and a profile of the entire water column is not required. At sites where adequate mixing occurs a measurement is obtained at a convenient location or near the grab sample site. At sites where stratification occurs the measurement is obtained at mid-channel.

  At selected sites, Reclamation will obtain cross sectional profiles. Four other measurements of the water column will be obtained in addition to the mid-channel location. At the selected sites a total of five vertical profiles will be obtained; River left where the depth is approximately one meter, half the distance from river left to mid-channel, mid-channel, half the distance from mid-channel to river right, and river right where the depth is approximately one meter. Table 1 outlines the locations of these selected sites.

- Grab Samples (Grab): Water quality grab samples are collected every two weeks from April to October, 2002 above Keno Dam and every four weeks from March – November below Keno Dam. Total Dissolved Solids (TDS), total alkalinity, ammonia, nitrate + nitrite as N, Total Kjeldahl Nitrogen (TKN), total phosphorous, orthophosphate, chlorophyll a, and Biochemical Oxygen Demand (BOD) are measured. TDS will only be measured at USBR sites. Hydrolab profiles will be obtained, as described above, when a grab sample is collected. Turbidity will also be measured at USBR sites using a portable instrument when a grab sample is collected. Table 1 outlines the locations and agency in charge.

- 3-Day Synoptic Water Quality Surveys: Synoptic monitoring measures the short term changes in nutrient and physical parameters. Three synoptic sampling periods will occur: May 21-23, July 15-17 and September 9-11. Nutrient (referring to those nutrients listed above) levels and physical parameters will be measured at the synoptic sites once a day for a period of three days, as per Table 1. The samples are retained on site until the end of each day and then mailed to the lab. Datasondes at the synoptic sites record physical measurements continuously (hourly) during this program. Appropriate QA samples are included with each day's sampling.

- Water Temperature Study: Water temperature is monitored with remote logging thermocouples at multiple locations in the Klamath River and tributaries between Iron Gate Dam and Seiad Valley (See Table 1). Logger sampling frequency is one hour. These data are intended to augment multi-probe deployments and provide information for temperature analysis and modeling.Reservoir Water Quality Sampling: Surveys of the three reservoirs consist of monthly depth profiles of the same physical parameters measured in the rivers at the surface and at 1 meter (3.3 feet) intervals. This will end in November. Water quality sampling of JC Boyle, Copco, and Iron Gate Reservoirs occurs immediately following the physical profile. Nutrient, BOD, chlorophyll-a samples will be collected at three depths corresponding to a representative epilimnion, metalimnion, and hypolimnion sample in Irongate Reservoir and Copco Reservoir. In JC Boyle reservoir, samples will be collected at only two depths, 1 meter from the surface and one meter from the bottom.

- Algae Speciation: Samples will be collected once per month at reservoir, river and tributary sites visited by PacifiCorp. Samples may be collected, as per the SOP, during synoptic surveys as necessary.

1.6 SAMPLING METHOD REQUIREMENTS

For field sampling protocol, the "Standard Operating Procedure for Water Quality Grab Sampling" (SOP) is used. This document is included as Attachment B of this appendix.

All water samples will be collected using the grab-sample method. Samples will be collected using a clean sample bottle, churn splitter, Van Dorn sampler, or a submersible pump, as appropriate to the site. The SOP instructs how the monitoring and sampling will be performed and associated procedures for documenting the field activities. A multi-probe instrument (i.e. Hydrolab H20 or YSI 600) will be used to measure the physical parameters (pH, specific conductance, dissolved oxygen, and water temperature) of the environmental water. Reclamation will use Hach 2100P turbidimeter to measure this physical measurement.

1.7 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Water samples will be collected in high-density polyethylene (HDPE) bottles and preserved according to EPA, Standard Methods, or other approved analytical methodology. Samples collected in the field will be labeled with: sample identification.

- preservatives used
- constituent analyses required
- date and time sampled
- samplers initials

Sample volume is based on analytical requirements and is listed in Table 3. After collection, samples are kept in coolers on ice until delivered to the laboratory. All samples collected in the field require a chain of custody (COC) and field data sheet. The COC and field data sheet will clearly document all the samples collected during that sampling period, associated sample identification numbers, and the date and time of collection for each sample. The field data sheet **must** be completed in the field while sampling. The COC may be completed at the end of the day when sampling is finished. The COC sheet is placed in a zip-lock bag and is shipped in the ice chest with the samples. A custody seal is attached across the opening of the ice chest by the field sampler. A commercial package carrier will transport the ice chests. The original COC sheet will be kept on file at the laboratory and the other copy returned to the USBR Klamath Basin Area Office or PacifiCorp headquarters.

1.8 ANALYTICAL METHOD REQUIREMENTS

The analyses selected were based on previous analyses of basin water and requirements for water quality models. Basic Laboratory Incorporated (Basic) located in Redding, California will be responsible for analyzing the water samples for TDS, TKN, ammonia, nitrate + nitrite as N, total phosphorous, orthophosphate, and BOD. Samples analyzed for chlorophyll-a will be analyzed by Aquatic Analysts of Wilsonville, Oregon, or Aquatic Research Incorporated (ARI) located in Seattle, Washington. The following methods are utilized to determine the concentrations of these analyses in the water samples.

Constituents	2000 and 2001[1]	2002[2]	2003[2]
Ammonia	4500-NH_3	350.1	350.3
Total Kjeldahl Nitrogen	4500NORG	351.2	351.4, 351.2
Nitrate + Nitrite, as N	4500-NO_3	353.2	300.0-A
Ortho-Phosphate as P	4500-P	365.1	300.0-A
Total Phosphorus	4500-P	365.1	365.1
Total Alkalinity	2320	2320	----*
TDS	2540	----	----
TSS	----	----	160.2
TVS	----	----	160.4
BOD	5210	5210	405.1
Chlorophyll *a*	10200H	10200H	10200H

[1] Source of Standard Methods: Standard Methods for Examination of Water and Wastewater. American Public Health Association, current edition.

[2] Source of EPA Methods: Methods for Chemical Analysis of Water and Wastes. Revised March 1983. EPA 600/4-79-020. **OR** Methods for the Determination of Inorganic substances in Environmental Samples. August 1993. EPA 600/R-93-100.

1.9 SAMPLE BOTTLE REQUIREMENTS

The size of high-density polyethylene (HDPE) bottles required is listed in Table 3 for each constituent. All bottles are rinsed three times with the environmental water prior to filling with sample. Any filtration required will be done from the churn splitter in the field. All acid preservation is completed at the sampling site immediately after sample collection. A permanent waterproof-ink marker is used to write information about the sample on the bottle's label.

Table 3 Sample Bottles requirements, preservatives and hold times

Test	Filtered	Container	Preservatives	Hold Time
Biochemical Oxygen Demand	N	1,000 mL HDPE Clear	4^oC, none	48 hours
Chlorophyll a -USBR	N	1000 mL HDPE Amber	4^oC, keep in dark	7 days
Chlorophyll a - PacifiCorp	N	250 mL HDPE Amber	4^oC, keep in dark	7 days
NH4, (NO2+NO3) as N, TKN, total P	N	1,000 mL HDPE Clear	4^oC, 2 ml H_2SO_4	28 days

Orthophosphate*	Y/N	500 mL HDPE Clear	4^oC, none	48 hours
Total Alkalinity	N	250 mL HDPE Clear	4^oC, none	14 days
TDS	Y	250 mL HDPE Clear	4^oC, none	7 days
Algae speciation	N	250 ml HDPE Amber	4^oC, 5 ml Lugol	7 days

1.10 QUALITY CONTROL REQUIREMENTS

To check laboratory accuracy, precision, and contamination, each field crew will incorporate at least one blank sample, one duplicate sample, and one spike or QA reference sample per sampling event. Field samplers will label these external QA check samples with identifications similar to production samples so they can pass as double blind samples. The QA officer ensures that field personnel properly prepare external QA check samples. The Reclamation field crew will include a rinseate blank of the field sampling equipment at the last site after each sampling event. The laboratory will incorporate their own QC check samples, including spikes, duplicates and blanks, to ensure data reliability. For specific rates of laboratory QC check sample incorporations, refer to the laboratory QA manual. Laboratory QC check sample results are reported to the client as QC summary reports.

The specific standard operating procedures used by Basic and ARI to analyze the samples for this project can be found in their QA manuals.

1.11 INSTRUMENT CALIBRATION AND CALIBRATION FREQUENCY

The laboratory performs instrument calibrations following the procedures and frequencies stated in the analytical methods for each parameter.

The Hydrolab H20 instrument will be calibrated before it is to be used in the field. The calibrations will follow the USBR Klamath Basin Area Office Hydrolab Calibration Protocol (appendix C). Field personnel will record Hydrolab calibrations on calibration sheets, which will be filed at the field office where the calibration is performed. Any other field probes used for this monitoring effort shall be calibrated prior to use in the field following factory specifications and procedures.

1.12 ASSESSMENT AND RESPONSE ACTIONS

Review of field activities is the responsibility of the project manager, in conjunction with MP-Reclamation's Environmental Monitoring Branch (EMB) located in Sacramento, California.

Prior to selecting a laboratory as a participant in this program, their analytical skill was evaluated through the use of performance samples by MP-Reclamation. After demonstrating acceptable results on these performance samples, a system audit was performed on the laboratories. The system audit consisted of first reviewing the laboratory's QA manual and EPA WP/WS performance study results for the past three years. After reviewing these documents, a MP-Reclamation audit team visited the laboratories to make certain they had everything in place to perform the work.

1.13 DATA REVIEW, VALIDATION AND VERIFICATION REQUIREMENTS

USBR Klamath Basin Area Office and Watercourse Engineering, Inc. will review and verify all data generated from this program with the assistance of the MP-Reclamation EMB. USBR Klamath Basin Area Office and Watercourse Engineering, Inc. (? - please confirm) will follow MP-Reclamation protocol outlined in their QA SOP to review and verify the data from this program.

The laboratory's QC check samples must meet certain levels of acceptability when analyzed with the production samples. These levels of acceptability are set at certain limits found in the methods. Part of the data verification process involves checking these laboratory QC check sample results to ensure they are within acceptable ranges. If a laboratory QC check sample fails to demonstrate an acceptable result, the anomaly must be explained with a footnote or included in the case narrative section of the data report. In order to ensure data quality, QA personnel will assess laboratory data packages to determine if all samples were analyzed within the holding times.

1.14 REVIEW AND VERIFICATION METHODS

When USBR Klamath Basin Area Office or PacifiCorp incorporates external QA check samples into a batch of production samples submitted to a laboratory, the laboratory must meet certain standards of acceptance on these QA check samples for the data to be approved as reliable. For this project, the standards of acceptability (from MP-Reclamation EMB SOP for QA, 2000)for the external QA check samples are:

Duplicates:	For values > 5X Reporting Limit, %RPD ≤ 20%
	For values ≤ 5X Reporting Limit, values may vary ± Reporting Limit
Spikes:	Recovery should be 80%-120%
	Limit does not apply when sample value exceeds spike concentration by > 5 times
Reference Materials:	Recovery should be 80%-120% of certified value for values > 20X Reporting Limit
	For values < 20X Reporting Limit, recovery should be ± 2X Reporting Limit from the certified value
Blanks:	Blank concentration should be less than 10% of lowest sample concentration or less than or equal to two times the reporting limit.

Reclamation uses the following equations to validate data:

Relative percent difference:	A statistic for evaluating the precision of a duplicate set. For duplicate results X1 and X2:

$$RPD=((X1-X2)/(X1+X2/2))x100$$

Completeness:	The amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal operations. It is usually expressed as a percentage: % completeness =V/n x 100 where: V= number of measurements judged valid n = total number of measurements
Percent recovery:	A measure of accuracy determined from comparison of a reported spike value to its true spike concentration: % Rec. =((observed conc.-sample conc.)/(true spike conc.)) x 100
Accuracy:	Accuracy is a measure of the bias inherent in a system or the degree of agreement of a measurement with an accepted reference or true value. It is most frequently expressed as percent recovery.
Precision:	A measurement of mutual agreement (or variability) among individual measurements of the same property, usually under prescribed similar conditions. Precision is usually expressed in terms of relative percent difference, but can be expressed in terms of range.
Range:	The difference between the largest and smallest numbers in a set of numbers.

All data entered into tables by USBR Klamath Basin Area Office are subjected to a thorough secondary review before being released to clients.

1.15 RECONCILIATION WITH DATA QUALITY OBJECTIVES (DQO)

After each sampling event, calculations and determinations for precision, completeness and accuracy will be made immediately and corrective actions implemented if needed. If data quality indicators do not meet the project's specifications, data may be discarded and re-sampling may occur. The cause of failure will be evaluated. If the cause is due to equipment failure, calibration/maintenance techniques will be reassessed and improved. If the problem is determined to be a sampling error, team members will be retrained. If the problem is laboratory related, the laboratory program manager will be contacted and corrective actions implemented. Any limitations on data use will be detailed in both interim and final reports and other documentation as needed.

This QAPP will be revised if DQO failure occurs while following protocol. Revisions will be submitted to the review team, including the quality assurance group and technical advisors for approval.

ATTACHMENT B

STANDARD OPERATING PROCEDURE FOR WATER QUALITY GRAB SAMPLING

June 2002

Version 2.1

PRIOR TO LEAVING THE OFFICE

- Gather sampling equipment - see Equipment & Supplies List on page 11
- Inspect all sampling equipment for damage, dirt, etc.
- Pack a cell phone and telephone number directory
- Check equipment batteries, replace if expired and carry extras
- Verify that the multi-probe unit and turbidimeter have been recently calibrated by checking the calibration log.
- Pack field notebook, extra paper, SOP, QAPP, Chain Of Custody (COC) sheets, and shipping addresses (should be in QAPP or SOP)
- Check bottles needed for sampling - see Grab Sample List on page 2
- Affix labels to appropriate bottles or pack appropriate labels
- Prepare Blank samples and reference solution bottles (If applicable)
- Get Ice (Blue Ice or crushed ice)

AT THE SAMPLING SITE

- Fill in the labels on the bottles
- Collect all necessary samples - see the appropriate Quality Assurance Project Plan for a constituent/bottle list for the project
- Filter and preserve samples as needed - see Grab Sample List on page 2
- Store samples in a cooler on ice and cover with ice
- Fill out field notebook and field log (field log and field notebook are the same for Reclamation.) and COC sheet(s)

AFTER SAMPLING

- Package coolers for shipping (fill out shipping label, affix cooler seal). Place COC in plastic bag in cooler before sealing.
- Ship the samples at the end of each day of sampling

- Post-calibration of equipment
- Clean and store field equipment
- Copy pages from field notebook and store in a secure location in the office after sampling session.
- Copy field notebook, field log and COC and send to appropriate parties.

1.1 GRAB SAMPLING

The sample bottle or churn splitter is used to collect a water grab sample. Care is exercised not to disturb sediment while sampling. Avoid surface debris when collecting samples. The sample bottle and/or churn splitter is rinsed with environmental water three times. If bottles are pre-preserved, rinsing with environmental water is not appropriate. prior to collecting the sample and water is run through the pour spout of the churn splitter during each rinse. Do not disturb the location where sample is to be taken with discarded rinse water. The preferred method of collecting whole (unfiltered) samples is to dip the sample bottle with the mouth pointed up-stream in the current. Filtered and Quality Assurance (QA) samples must be collected in a churn splitter. If used, the churn splitter is cleaned at each site after sample collection by 1) carefully inspecting and removing any foreign material, 2) rinsing the exterior, and 3) rinsing the interior three times with De-Ionized (DI) water. Allow DI water to run through the pour spout during each rinse.

See Table 1 for a list of constituents, appropriate bottles, filtration, and sample preservation information.

Table 1. Grab Sample List

Constituents	Bottle	Filtered	Preservation
Nutrients: NH4, (NO_2+NO_3) as N, TKN, Total P	1,000 ml HDPE	No	4°C 2 ml H_2SO_4
Ortho PO_4	500 ml HDPE	No	4°C
Trace Metals: B, Mo, Se	500 ml HDPE (level one)	No	4°C 2 ml $HN0_3$
Trace Metals: Ag, Al, As, Cd, Cr, Cu, Fe, Ni, Pb, Sb, Tl, Zn, Ca+Mg	500 ml HDPE (level one)	Yes	4°C 2 ml $HN0_3$
Mercury	250 ml HDPE (level one)	Yes	4°C 1 ml $HN0_3$
Hydrogen Sulfide (Sulfide)	250 ml HDPE	No	4°C NaOH
Biological Oxygen Demand (BOD)	1,000 ml HDPE	No	4°C
Chlorophyll a (USBR)	1000 ml Dark HDPE	No	4°C Then Freeze
Chlorophyll a (PacifiCorp)	250 ml Dark HDPE	No	4°C Then Freeze
Total Dissolved Solids (TDS)	250 ml HDPE	Yes	4°C
Algae Speciation	250 ml HDPE	N	4^oC, 5ml Lugol

1.2 VAN DORN SAMPLER

The Van Dorn sampler is used to collect samples from a site where it is not possible to directly fill the sample bottles or churn splitter, such as reservoir sampling from a bridge. Rinse the Van Dorn sampler with environmental water three times prior to the collection of sample water. The Van Dorn sampler is lowered, the trigger mechanism activated, and then raised to the surface. The water is then poured from the Van Dorn sampler into the churn splitter. The Van Dorn sampler is cleaned at each site after sample collection by 1) carefully inspecting and removing any foreign material, 2) rinsing the exterior, and 3) rinsing the interior three times with DI water.

Samples may also be collected using a battery operated 12v DC submersible pump (Ben Meadows Model DC60, ABS body, stainless steel propellers and chemically inert seals). The pump fitted with 30 m of 3/8" ID Tygon tubing is lowered to the desired sampling depth and run until 5 tube volumes have been pumped. The sample bottles are then filled sequentially as the pump continues to operate. For QA samples (regular, duplicate, and spikes) the pump is used to fill the churn splitter. Sample bottles are filled from the churn splitter as described below. The pump is rinsed with distilled water between sample locations. At the end of the sampling period the pump and tubing are rinsed with distilled water followed by a dilute chlorine bleach solution.

1.3 CHURN SPLITTER

The churn splitter allows different sub-sample volumes to be obtained from the composite sample while still maintaining the same basic chemical and physical properties of the original sample. The volume of the churn splitter limits the volume of sample that can be divided. Suspended inorganic sediments coarser than 62 micrometers (um) cannot be split. Samples may be taken from a plastic (Nalgene™) churn splitter for analysis of all other dissolved and suspended inorganic constituents.

Sub-samples totaling 10 liters may be withdrawn from the 14-liter churn. The 4 liters remaining in the 14-liter churn should not be used for unfiltered sub-samples because they will not be representative. However, the sample water remaining in the churn splitter may be used for filtered sub-samples for the determination of dissolved constituents.

The procedure for cleaning and use of the churn splitter is as follows:

A. The Klamath Basin Area Office (KBAO) will clean the churn splitter between sampling events. They will use gloves while doing this. After removing any foreign material from the churn splitter with a nylon brush, soap & water, the churn splitter is rinsed three times with DI water.

B. Pour about 200 ml of dilute (i.e. 6%) nitric acid into the churn splitter (if sampling for low level metals constituents). Wet all inside surfaces of churn splitter with the acid. Acid is run through the pour spout. Dispose of dilute acid down a drain with a good flow of tap water.

C. Rinse the churn splitter with DI water three times. Drain DI water from the spout during each rinse. The churn splitter is now ready for field use.

D. The churn splitter is rinsed with environmental water three times in the field at each sample site prior to sample water collection. Drain environmental water through pour spout during each rinse.

E. Fill out the labels on all sub-sample containers. Set aside the filtered sample bottles (at the QA site there are multiple bottles to be filtered) that will contain filtered environmental water. These samples will be filtered from the remaining environmental water in the churn splitter after the other unfiltered samples have been collected. The remaining bottles (unfiltered sample bottles) are rinsed three times with environmental water after the churn splitter has been rinsed and filled. Only rinse the bottles that will contain water collected at the current site. The churn splitter is rinsed three times with DI water after each site.

F. If QA samples are not collected at a site, then approximately 6 liters of environmental water is required at each site. Fill the churn splitter so as to have enough water for all samples. The last 4 liters of sample in churn cannot be used for non-filtered samples. It is important to sufficiently fill the churn splitter to have adequate water supply for all samples.

G. For QA samples, the churn splitter may have to be filled more than once to collect all the required samples. Duplicate and triplicate (spike or reference) samples are collected at the QA site. Three sample bottles (regular, duplicate, and spike) are filled from the same churn splitter volume for most of the constituents. All three bottles for these constituents must be collected from the same churn splitter volume. Triplicate (spike) samples are collected for mercury, trace metals, Mg & Ca, orthophosphate, and nutrients. The field sampler adds a spike solution to a known volume of environmental water for these constituents. For some of the constituents, only two sample bottles (regular and duplicate samples) of environmental water are filled from the same churn splitter of water and the third is filled with a reference solution. A third bottle of environmental water is not collected for total alkalinity, BOD, or TDS triplicate (spike/reference) samples. A reference solution of known concentration is poured into the spike/reference bottle by the sampler for this constituent. Specific preparation of QA samples is discussed in the "Sample Quality Control and Quality Assurance" section of this SOP.

H. It is sometimes necessary to composite water into the churn splitter from a sampling devise. A Van Dorn sampler can be used for this. Where a Van Dorn sampler cannot be used, a sample bottle is used over and over to fill the churn splitter. Swirl the water in sample bottle prior to pouring into the churn splitter in order to minimize the amount of suspended material lost in transferring from the bottle to the churn splitter. As stated in the Grab Sampling section above, it is preferred to collect unfiltered environmental water directly into a sample bottle. QA samples (regular, duplicate, and triplicate) must be dispensed from a single churn splitter volume.

I. Churn the sample at a uniform rate of about 9 inches per second (in/s). The churning disc should touch the bottom of the tank on every stroke and the stroke length should be as long as possible without breaking the water surface. If the churning rate is significantly greater than 9 in/s or if the churning disc breaks the water surface, excessive air is introduced into the sample and may change the dissolved gases, bicarbonate, pH, and other characteristics of the sample. On the other hand, inadequate stirring may result in non-representative sub-samples.

J. After churning the sample in the splitter for at least 10 strokes to assure uniform dispersion of the suspended material, begin the withdrawal of sub-samples. As sub-samples are withdrawn and the volume of sample in the churn decreases, maintain the churning rate of about 9 in/s. If a break in churning is necessary, the stirring rate must be reestablished (i.e., 10 strokes) before withdrawals are continued.

K. While operating the churn, withdraw an adequate volume of sample water to field rinse bottles for unfiltered sub samples. Rinse each bottle three times with sample water.

L. Withdraw sub-samples for unfiltered samples first. The first sub-sample withdrawn should be the largest sub-sample required (usually 1 liter of sample).

M. After all the required unfiltered sub-samples have been withdrawn, the environmental water remaining in the churn may be filtered for sub-samples required for dissolved constituents. Remember to field rinse bottles three times with **filtered** sample water prior to filling. Procedures for filtering and preserving samples are described later.

N. After all filtered sub-samples have been withdrawn, empty the churn splitter and clean the mixing tank, lid, and churning disc three times with DI water. Allow the DI water to run through the pour spout during each rinse.

2.0 FILTERING WATER SAMPLES

Water samples are filtered using a peristaltic pump and 0.45um inline filter. The inlet tube to the pump is rinsed with environmental water then placed in the churn splitter. An inline filter is attached to the exit tube of the pump. About 500-ml of environmental water is pumped through filter before any sample water is collected. This water should not be used to rinse sample bottles. Rinse all filtered sample bottles three times with the filtered environmental water. Continue filtering until all filtered samples have been collected. After using the pump at a sample site, discard the inline filter and pump about a 500-ml of DI water through the tubing. Rinse the outside of the inlet and outlet tubing with DI water.

If the peristaltic pump fails or is unusable for any reason, samples can be filtered with a filter syringe. The filter syringe is used as follows: Disassemble a clean 100-ml filter syringe. Rinse the inside of syringe with environmental water three times. Place a new 0.45um disc style filter on the end of the syringe. Fill the filter syringe with environmental water. Push 10-15 ml of environmental water through the filter before any sample water is collected. Filter approximately half of the water in the syringe into the sample bottle and rinse. Shake sample bottle and discard water. Rinse the sample bottle three times with the filtered environmental water. Fill the sample bottle with filtered water using the syringe-filter procedure. Refill the syringe if more sample water is needed and the filter has not clogged. If filter is clogged, attach a new filter, rinse as stated above and continue.

2.1 WATER SAMPLE PRESERVATION

Physical preservation techniques are used for all samples and include cooling and keeping the samples out of the sunlight. Some of the water samples are also preserved with acid to prevent degradation of constituents before they are analyzed. Specific requirements for the field preservation of the samples are listed in the Grab Sample List (Table 1) on page two of this SOP. All samples will be preserved immediately at the collection site.

2.1.1 Metals

Preserve metals in water for a 6 month hold time with nitric acid. Mercury has a hold time of only 28 days. 1 ml of 70% nitric acid is used for each 250 ml of sample water. The sample is also chilled to 4^oC in the field.

2.1.2 Nutrients

The 1,000 ml nutrient suite bottle requires 2 ml of H_2SO_4 and has a hold time of 28 days. The sample is also chilled to 4^oC in the field.

2.1.3 Other Samples

No acid preservation is used for orthophosphate, BOD, total alkalinity, and TDS. Total alkalinity and TDS samples have a 14-day hold time. Orthophosphate samples have a 48-hour hold time. BOD samples have a 48-hour hold time. Hydrogen Sulfide (Sulfide) samples are preserved with NaOH and have a 7-day hold time. The samples are also chilled to 4^oC in the field.

If in doubt about any sample, it is best to keep it chilled and out of the sunlight.

2.2 DISPENSING ACID FROM AMPULE FOR PRESERVING SAMPLES

Rubber, latex or vinyl gloves and safety glasses are worn to prevent acid from contacting hands or eyes while preserving samples. If acid is present in the neck of the ampule, gently tap until all of the acid is in the body of the ampule. Place the provided ampule "breaker" over the ampule, point away from face, and apply steady pressure until the ampule snaps at the prescored line. Hold the ampule upside down over the sample bottle between the thumb and index finger of one hand. With the other index finger, lightly tap the bottom of the ampule until all of the acid is dispensed. Properly discard the empty acid ampules.

PacifiCorp site samples will be preserved using acid from re-closable plastic vials. Gloves and safety glasses are also worn during the use of the re-closable vials to protect hands and eyes from acid. Vials should also be properly discarded once empty.

2.3 SAMPLE HANDLING AND TRANSPORTATION

Sample handling and transportation vary depending upon the analysis requested, sample preservation requirements, and the distance to the laboratory. However, once preserved, some samples will remain stable for long periods of time. All samples for KBAO projects will be shipped overnight delivery on the day they are collected.

All water samples will be shipped in a cooler or ice chest. This provides protection, insulation, and containment in case of breakage or spillage. When shipping samples that require chilling, pack adequate quantities of frozen blue ice or crushed ice with the samples. Seal the ice chests securely with duct or packing tape to ensure they do not accidentally open.

2.4 SAMPLE QUALITY CONTROL AND QUALITY ASSURANCE

2.4.1 Objective

Quality control of samples during collection, transportation and processing is an integral part of a sampling program. Quality control procedures are implemented to assess potential sampling and analytical bias.

2.4.2 Techniques

2.4.3 Production Samples

A production sample is a sample taken at a site where no QA samples are collected. A production sample has the abbreviation of "P".

2.4.4 Regular Samples

A regular sample is the production sample at the QA site and has associated QA samples. A regular sample has the abbreviation of "R".

2.4.5 Duplicate Samples

A split sample is a portion or sub-sample of a total sample. The duplicate sample has an identical water matrix as the regular sample. This sample is used to determine analytical precision within a laboratory. A duplicate sample has the abbreviation of "D".

2.4.6 Triplicate Samples (Field Spikes and Reference Solutions)

These are reference solutions used to fill the sample bottles or chemical solutions (spikes) that are added to specified volumes of environmental water. A graduated cylinder is used to measure the volume of environmental water used for the "spiked" samples. All of the triplicate sulfide nutrient and trace metal samples are "spiked". Rinse the graduated cylinder three times with sample water. Using the graduated cylinder, measure out the appropriate volume of sample water (total triplicate sample volume – volume of spike = volume of environmental water). Pour approximately half of the sample water from the graduated cylinder into the sample bottle. Add the "spike" solution to the sample bottle. DO NOT add the spike to the graduated cylinder. Rinse the inside of the "spike" container with sample water from the graduated cylinder and add to the sample bottle. Pour the remaining half of the sample water from the graduated cylinder into the sample bottle. A reference solution is used for the total alkalinity BOD and TDS triplicate sample. In this case the triplicate (reference solution) is not mixed with environmental water, instead the reference solution is used to fill the entire sample bottle. A triplicate sample has the abbreviation of "S".

2.4.7 Blanks

A blank sample is used to test laboratory analysis and ensure the bottles are not contaminated. Blank sample bottles are rinsed three times with DI water. The sample bottles are then filled with DI water and corresponding preservatives are added. The blank should be prepared in the lab/office to avoid field contamination and carried in the field while sampling. A blank sample has the abbreviation of "B".

2.4.8 Rinsate Blanks

A rinseate blank tests the field crew techniques and sampling equipment for contamination. After the sampling equipment has been cleaned with DI water at the last sampling site, the rinseate blank is collected. Rinseate blanks are prepared by pouring DI water into the sample collection equipment (Van Dorn, etc). Wet all internal surfaces. The rinseate water is then collected into the churn splitter. The sample bottles are rinsed three times with the rinsate water before sample collection. Fill the sample bottles with rinsate water. Filter rinsate water for filtered constituents using a peristaltic pump and filter. Preservation is added to samples requiring it. A rinseate blank has the abbreviation of "RB."

2.4.9 Standards

Standards or reference materials are used for equipment that requires calibration. Use of reference standards is an integral component of quality control. Both field and laboratory equipment must be periodically calibrated to assure the instruments accuracy. Laboratories should calibrate equipment as required by the analysis method. The field equipment, such as the Hydrolab H20 unit and the Hach 2100P turbidity meter require regular calibration. The Hydrolab

H20 unit will be calibrated as described in the KBAO Hydrolab calibration SOP. PacifiCorp will calibrate the YSI 600 in the office and/or field as per manufacturer specifications. The manufacturer's instructions for calibrating the turbidimeter will be followed.

2.5 SAMPLE IDENTIFICATION

A unique sample identification (ID) number is used for samples collected at different sites. The same number is used for all sample bottles collected at a given site on a given day. A letter prefix associated to the specific sampling project precedes the sample ID number. For example, a letter prefix of KRWQ identifies the sample as part of the Klamath River Water Quality Monitoring Program. These sample identification numbers are pre-selected by the KBAO and/or other sampling agency.

2.6 FIELD NOTEBOOKS

A bound field notebook is used to document collection of a sample, sample ID number, field observations, and other pertinent information necessary to reconstruct the sample collection processes. All entries are made in permanent waterproof ink. Any corrections made to the field notebooks are lined out, initialed, and dated. The person who collected the sample signs the field notebook. Field personnel will carry the field notebook during sampling. Past physical measurements and observations can be compared to current conditions. The field crew will make copies of the field notebook once they have returned to the office. Making copies will minimize the amount of data lost in the event the field notebook gets lost or damaged.

Field notebooks include:

- Sample Identification Information (including Field ID)
- Field Measurements (Water temp., pH, DO, etc)
- Equipment Information (serial number, model number, manufacturer, etc.)
- Sample Types (P, R, D, S, B, RB)
- Sample Collection (what analysis/constituents requested, etc.)
- Sample Preservation Information
- Date and Time of Collection
- Weather Conditions
- Comments

Field notebooks provide a convenient system for tracking the monitoring and analysis requests for each site in a particular project. Further, the field ID provides the cross-reference to laboratory results and sampling locations. The field crew keeps the field notebooks on file when the program is complete.

2.7 CHAIN OF CUSTODY

A COC accompanies all samples to record possession and transportation of samples. Field identification number, sample type, requested analysis, date of collection, and time of collection as well as other information is recorded on the COC. COC's are completed with permanent ink. Any corrections made to the COC's are lined out, initialed, and dated. All samples are kept in a secured area accessible only to authorized personnel during sample collection and transport. Upon completion of the field collection of the samples, the COC sheet accompanies the samples to the lab. COC sheets are also legally binding and act as a work order for the laboratory. It is critical that the field identification numbers are properly recorded on the field notebook and COC forms. Sample collectors, individuals transferring samples, and those receiving samples, all sign the COC. The COC forms are in triplicate and field personnel should remove only the field copy (pink sheet).

2.8 CALIBRATION LOG

A bound calibration logbook is used to store calibration information for equipment requiring calibration. Calibration information for the Hydrolab H20 unit and Hach 2100P turbidimeter will be recorded in a bound calibration logbook. When instruments are calibrated in the field, all appropriate calibration information is recorded in the field notebook

2.9 RINGED FIELD BINDER

A ringed binder is used to store information pertinent to a sampling project. The binder can be used to store a copy of the SOP, Quality Assurance Project Plan, level one clean-bottle certificates, acid purity certificates, certificates for in-line filters, COC sheets, copy of field notebook, and other pertinent information.

2.10 SECURITY SHIPPING SEALS

When shipping samples a security seal is attached across the lid and side of the ice chests. The seal is signed and dated by the sampling personnel. The seal is attached so that it must be broken when the container is opened.

Equipment & Supplies List

Equipment and Supplies

- Field notebook
- Field datasheets
- Clipboard
- Chain Of Custody form
- Zip-lock bag for COC form
- "Sharpie" felt tip pens
- Ball point pens
- Van Dorn sampler with rope
- Churn splitter
- Peristaltic pump and in-line filters
- Prepared bottles and labels
- Extra sample bottles
- Extra bottle labels
- Sulfuric acid ampules
- Nitric acid ampules
- Waste container for broken acid ampules
- Rubber, latex, or vinyl gloves
- Safety glasses
- Spikes
- Graduated cylinder
- 10 gallons DI water
- Squeeze bottle for DI water
- Hydrolab H20 unit, spare battery and cables
- Bucket for Hydrolab
- Turbidity meter
- Ice chests
- Ice packs (Blue ice)
- Packing tape
- UPS overnight shipping forms
- Rope
- Waders (Waders may be knee, hip, or chest)
- Cell phone and telephone numbers
- Knife/scissors
- Maps
- Paper towels
- Camera and film
- GPS unit

Personal Supplies

Drinking water / food
Leather gloves
Sunglasses
Hat
Extra socks
Sun block
Anti-bacterial hand gel

- Extra batteries
- Tools
- Syringe filters (back-up filters)

2.11 CONTACT INFORMATION

Laboratory Addresses (Jason, Richard update as appropriate)

Basic Laboratory
2218 Railroad Ave
Redding, California 96001
(530) 243-7234

Parameters: BOD, Alk, PO_4, TP, NO_3-NO_2, NH_4, TKN

SEM

Aquatic Analysts
7975 SW Tennis Ct
Wilsonville, OR 97070
(503) 570-9007
(503) 349-2188
E-Mail: aaalgae@aol.com
Contact: Jim Sweet

Parameters: Algae speciation and chlorophyll a

Agency Addresses

U.S. Bureau of Reclamation
Klamath Basin Area Office
6600 Washburn Way
Klamath Falls, Oregon 97603
(541) 883-6935
Contact: Jason Cameron
Representative/Contact: Richard Raymond

U.S. Bureau of Reclamation
Mid-Pacific Regional Office
2800 Cottage Way
Sacramento, Ca. 95825
Contacts:
(916) 978-5285 (Victor)
(916) 978-5286 (Bruce)

E&S Environmental Chemistry, Inc.
2161 NW Fillmore St.
PO Box 609
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(541) 758-5518
(541) 758-4413 Fax
E-Mail: richard.raymond@eands.net

Watercourse Engineering, Inc.
1732 Jefferson Street, Suite 7
Napa, CA 94559
(707) 265-6560
Contact: Mike Deas