  

PUBLIC UTILITY DISTRICT NO. 1 *of* CHELAN COUNTY
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April 15, 2015

VIA ELECTRONIC FILING

Honorable Kimberly D. Bose, Secretary, and
Nathaniel J. Davis, Sr., Deputy Secretary
FEDERAL ENERGY REGULATORY COMMISSION
888 First Street, NE
Washington, DC 20426

Mr. Chris Coffin, Hydropower Projects Manager
Washington Department of Ecology
Central Regional Office
15 West Yakima Avenue, Suite 200
Yakima, WA 98902-3452

Re: **Lake Chelan Hydroelectric Project No. 637**
License Article 401 and Water Quality Certification (WQC) Condition V.B
Revised Water Quality *Monitoring* Quality Assurance Project Plan, Version 2.0

Dear Secretary Bose, Deputy Davis, and Mr. Coffin:

On November 30, 2007, the Federal Energy Regulatory Commission's (Commission) issued its "*Order Modifying and Approving Quality Assurance Project Plan, Article 401 and WQC Condition V.B,*"[1] approving the detailed monitoring plan and the monitoring schedule.[2]

In accordance with WQC Condition V.B(v),[3] the Public Utility District No. 1 of Chelan County (Chelan PUD) re-evaluated the 2007 Quality Assurance Project Plan's (QAPP) water quality monitoring portions only. Revisions included changes in the Washington Department of Ecology's (WDOE) surface water quality standards, WDOE's updated Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies, staffing changes at Chelan PUD, reporting dates and equipment upgrades with improved technology. The frequency of monitoring, parameters monitored, quality assurance and reporting measures did not change from the 2007 QAPP.

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[1] 121 FERC ¶ 62,154 (2007)

[2] Please note that this filing addresses the water quality monitoring portion only. A separate QAPP for the Chelan River water quality temperature *modeling* study is subject to the filing requirements of Ordering Paragraphs (B) and (C).

[3] The 2007 order mistakenly identifies this condition as V.B(iv).

Chelan PUD submitted the draft revised Water Quality *Monitoring* QAPP to WDOE on March 16, 2015, for its review and comment. No comments were received from WDOE other than approving the revised QAPP on April 3, 2015. Please refer to Appendix C for the consultation record.

Chelan PUD hereby files the revised Water Quality *Monitoring* QAPP, Version 2.0, for the Commission's approval pursuant to License Article 401.

Please contact Marcie Steinmetz at (509)661-4186 if you would like to discuss this work or if additional information would be helpful.

Sincerely,

Jeffrey G. Osborn

Jeffrey G. Osborn
Compliance Program Supervisor
jeff.osborn@chelanpud.org
(509)661-4176

Attachment: Revised Water Quality *Monitoring* Quality Assurance Project Plan, Version 2.0

QUALITY ASSURANCE PROJECT PLAN
WATER QUALITY MONITORING
LAKE CHELAN HYDROELETRIC PROJECT

Version 2.0

LAKE CHELAN HYDROELECTRIC PROJECT
FERC Project No. 637

April 15, 2015

CHELAN COUNTY
POWER

Public Utility District No. 1 of Chelan County
Wenatchee, Washington

In accordance with the State of Washington Order Number: 1233
(Amended Order Number. DE 03WQCR-5420)
Licensing of the Lake Chelan, Hydroelectric Project (FERC No. 637),
Chelan County, Washington

Approved by:

Jeffrey G. Osborn   4/8/15

Jeff Osborn, Compliance Program Supervisor, Chelan County PUD   Date

Keith Truscott   4/8/15

Keith Truscott, Director of Natural Resources, Chelan County PUD   Date

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- Marcie Steinmetz
- Steve Hays
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- Keith Truscott

Washington Department of Ecology
- Chris Coffin
- Charlie McKinney

ACRONYMS AND ABBREVIATIONS LIST

401 Certification	Washington State Department of Ecology 401 Water Quality Certification
7-DADMax	7-day average of the daily maximum
cfs	cubic feet per second
Chelan PUD	Public Utility District Number 1
CRBEIP	Chelan River Biological Evaluation and Implementation Plan
DO	dissolved oxygen
DQO	data quality objectives
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
ft/mi	feet per mile
GPS	Global Positioning System
kcfs	thousands of cubic feet per second
LLO	low level outlet
mmHg	millimeters of mercury
MQO	measurement quality objective
MW	megawatts
N/A	not applicable
NTU	nephelometric turbidity unit
PI	database system that specializes in handling real-time data by OSIsoft
Project	Lake Chelan Hydroelectric Project
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RPD	relative percent difference
SOPs	standard operating procedures
SPCC	Spill Prevention Control and Countermeasure
TIV	turbine inlet valve
TDG	total dissolved gas
TMDL	Total Maximum Daily Load
QAPP	Quality Assurance Project Plan
QC	quality control
WAC	Washington Administrative Code

EXECUTIVE SUMMARY

The Public Utility District No. 1 of Chelan County (Chelan PUD) submits this updated Quality Assurance Project Plan (QAPP) for Water Quality Monitoring for the Lake Chelan Hydroelectric Project (Project) as required by Ordering Paragraph F and Article 401 of the Federal Energy Regulatory Commission (FERC) License (License) (FERC, 2006); and Appendix D, Condition V.B of the 401 Water Quality Certification (401 Certification) issued by the Washington Department of Ecology (Ecology) (Ecology, 2004).

Article 401 of the License requires that the QAPP for water quality monitoring and temperature modeling be submitted to FERC and Ecology for approval within one year of the date of issuance of the License and any proposed revisions to the plan by April 30 of Year 6 (2012) of the License. On May 4, 2007, Chelan PUD filed with FERC a water quality monitoring QAPP, requesting that a separate temperature modeling QAPP be filed due to the complexity of the water temperature modeling in the Chelan River. FERC approved the water quality monitoring QAPP.

In 2009, Chelan PUD had completed the structures necessary to provide flows to the Chelan River and subsequently had to revise reporting schedules for studies and monitoring related to these flows in the river. Chelan PUD with approval from Ecology and FERC, revised the schedule accordingly; Year 1 was defined as October 15, 2009 to December 31, 2010 and annually per calendar year thereafter. Therefore Year 6 resets to 2015.

Chelan PUD submits this updated Water Quality Monitoring QAPP to satisfy only the water quality monitoring portion of Article 401 of the license and Appendix D, Condition V.B(v) of the 401 Certification. This QAPP provides revisions to the 2007 QAPP to meet conditions of the 401 Certification issued by Ecology.

Updates to this QAPP were made to revise the 2007 QAPP regarding changes in Ecology's surface water quality standards, Ecology's updated Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies, staffing changes at Chelan PUD, reporting dates and equipment upgrades with improved technology. The frequency of monitoring, parameters monitored, quality assurance and reporting measures have not changed from the 2007 QAPP.

Water quality parameters that will be monitored under this QAPP include temperature, flow, dissolved oxygen (DO), turbidity, pH, total dissolved gas (TDG), petroleum products, and intragravel DO. Water quality monitoring conducted under this QAPP will be performed by Chelan PUD's staff. Information provided in this QAPP includes the following:

- Purpose and objectives
- List of parameters to be monitored
- Organization and schedule
- Data quality objectives
- Descriptions of the monitoring locations
- Monitoring methods, procedures, and equipment

- Analytical methods
- Quality control procedures, including descriptions of calibration, maintenance, and data handling and assessment procedures
- Reporting protocols

The purpose of Chelan PUD's water quality monitoring will be to continue to provide information on water quality conditions within the Lake Chelan Hydroelectric Project, as well as verify compliance with applicable water quality standards and conditions within the 401 Certification. Implementation of this QAPP will continue to assure that water quality data collected by Chelan PUD will be credible data, according to Ecology's Water Quality Program Policy 1-11 (Ecology, 2006). It is necessary to note that some of the monitoring described in this QAPP may not be conducted if unsafe conditions exist. At this time it is not possible to know if unsafe conditions exist, and if so, whether they are temporary or permanent. If permanently unsafe conditions exist or potential changes to monitoring methods, locations or other updates are needed, Chelan PUD will consult with Ecology to determine an appropriate alternative.

SECTION 1: INTRODUCTION

The Lake Chelan Hydroelectric Project (Project) is owned and operated by the Public Utility District No. 1 of Chelan County (Chelan PUD). The Project is authorized by the Federal Energy Regulatory Commission (FERC) under Project No. 637. On June 1, 2004, the Washington State Department of Ecology (Ecology) amended and reissued a 401 Water Quality Certification, Order 1233 (401 Certification) to Chelan PUD for the Project. This 401 Certification followed a decision from the Washington State Pollution Control Hearing Board including additional specific clarifications and requirements. On November 6, 2006, FERC issued a license to Chelan PUD to operate the project for 50 years. Additionally, in 2008, under the provisions of 33 USC 1341 (FWPCA § 401), Chelan PUD submitted an application to Ecology to amend the 401Certification as part of a license amendment to modernize generating units at the Project. In November 2008, Ecology issued a 401 Certification (Ecology Order 6215) for the amendment. On May 31, 2012, Chelan PUD requested an amendment to the 401 Certification to modify the hydraulic capacity of the Project. Subsequently, on August 28, 2012, Ecology issued a modified and amended 401 Certification, Ecology Order No. 9389

Ordering Paragraph F and Article 401 of the FERC License (License) (FERC, 2006); and Appendix D, Condition V.B of the 401 Certification requires Chelan PUD to prepare a QAPP for water quality monitoring and temperature modeling, and revise this QAPP. On May 4, 2007, Chelan PUD filed its QAPP with FERC proposing to file a separate QAPP for its temperature modeling study in the Chelan River due to the complexity of the water temperature modeling. FERC approved the water quality monitoring QAPP.

Chelan PUD submits this updated Water Quality Monitoring Quality Assurance Project Plan for the Lake Chelan Hydroelectric Project to satisfy only the water quality monitoring portion of the FERC and Ecology conditions.

Updates to this QAPP were made to revise the 2007 QAPP regarding changes in Ecology's surface water quality standards, Ecology's updated Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies, staffing changes at Chelan PUD, reporting dates and equipment upgrades with improved technology. The frequency of monitoring, parameters monitored, quality assurance and reporting measures have not changed from the 2007 QAPP.

This QAPP was prepared using the following publications and references as guidelines, as applicable to the goals and objectives of Chelan PUD's water quality monitoring program:

1. Ecology guideline publication for preparing QAPPs (Ecology, 2004);
2. Ecology Field Sampling and Measurement Protocols for the Watershed Assessments Section, (Ecology, 1993); and
3. Chelan PUD's 1999 Water Quality Monitoring Report for Lake Chelan Hydroelectric Project (Chelan PUD, 2000) that identifies water quality monitoring methods, and Quality Assurance and Quality Control (QA/QC) procedures.

The purpose of Chelan PUD's water quality monitoring will be to continue to provide information on water quality conditions within the Lake Chelan Hydroelectric Project, as well as verify compliance with applicable water quality standards and conditions within the 401 Certification. Implementation of this QAPP will continue to assure that water quality data collected by Chelan PUD will be credible data according to Ecology's Water Quality Program Policy 1-11 (Ecology, 2006). It is necessary to note that some of the monitoring described in this QAPP may not be conducted if unsafe conditions exist. At this time it is not possible to know if unsafe conditions exist, and if so, whether they are temporary or permanent. If permanently unsafe conditions exist or potential changes to monitoring methods, locations or other updates are needed, Chelan PUD will consult with Ecology to determine an appropriate alternative.

SECTION 2: PROJECT

Chelan PUD owns and operates the Lake Chelan Hydroelectric Project located on the Chelan River in Chelan, Washington. The Lake Chelan Hydroelectric Project (Project) is located approximately 32 miles north of the city of Wenatchee in Chelan County, near the geographic center of Washington State (Figure 2-1). Lake Chelan is a natural body of water that developed within a broad glacial trough. The 15.8 million acre-foot lake averages 1.03 miles in width, and has depths up to 1,486 feet. It is bordered by more than two million acres of National Forest Lands, more than half of which are designated wilderness. The Project generates 64 megawatts (MW) of hydropower.

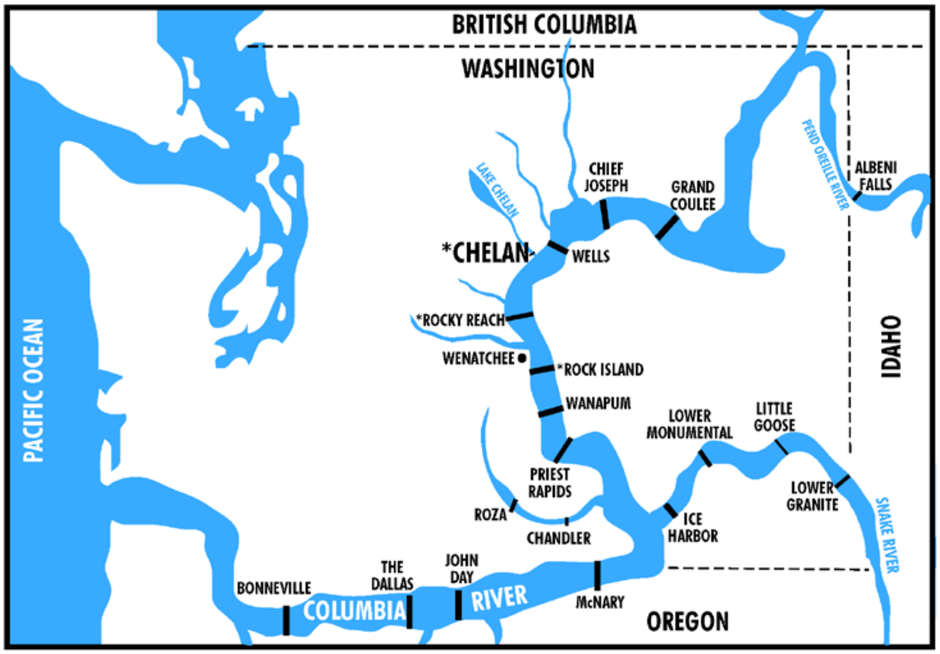

Figure 2-1: Project Location

The Project includes a diversion dam at the head of the Chelan River, which is located at the southeasterly end of 50.4-mile-long Lake Chelan, adjacent to the city of Chelan (Figures 2-2 through 2-4). The dam is 40 feet high and approximately 490 feet long and controls the elevation of Lake Chelan and the flow to the Chelan River. The Chelan River is 3.91 miles long and empties into the Columbia River. Historically, most of the annual flow out of Lake Chelan was diverted to the power tunnel, except during high inflows when the lake was full, leaving the Chelan River dry for an approximate time period of 79 years (1929-2008).

The Project's Powerhouse is located near the Columbia River and the community of Chelan Falls (Figure 2-4). Except during spring and summer in years with above average snowfall or rain, most of Lake Chelan outflow, averaging approximately 2,041 cubic feet per second (cfs), was diverted through the intake at the face of the dam prior to 2009 into a 14 foot diameter, 2.2 mile long power tunnel which transitions to a 12 foot diameter pipe prior to bifurcating to form two, 9 foot diameter penstocks, each 90 feet in length. The penstocks convey the water to the powerhouse for power production. From the powerhouse, the water empties into the powerhouse tailrace, about 1,700 feet from the Columbia River, just south of the mouth of the Chelan River (Figure 2-4).

Figure 2-2: Lake Chelan Dam

Figure 2-3: Chelan Hydroelectric Powerhouse

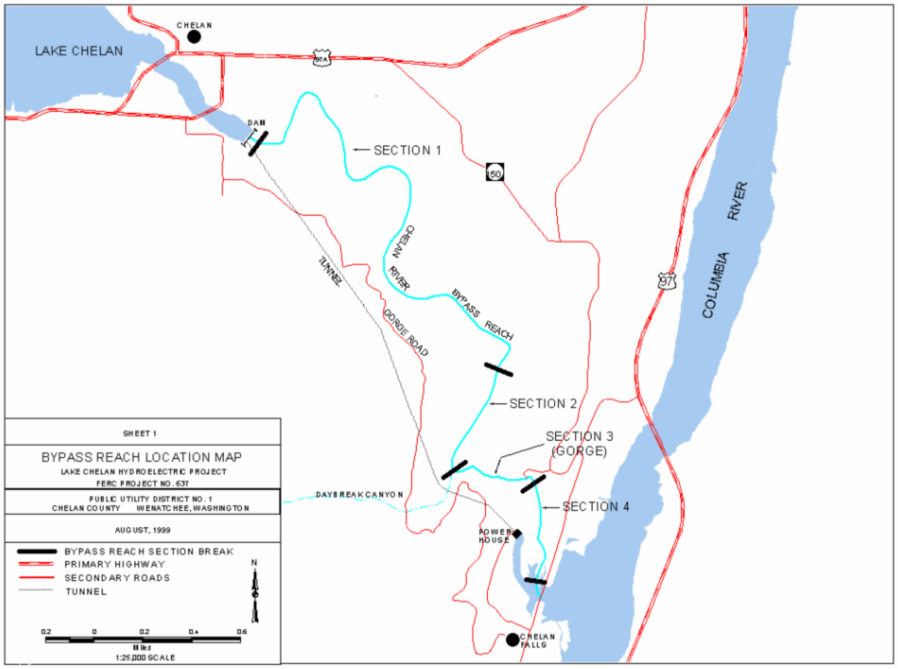

Figure 2-4: Detail of the Project

During peak spring and summer runoff conditions prior to 2009, water not diverted to the tunnel and penstock system for power generation flows down the Chelan River bypassed reach, which is comprised of four distinct reaches or sections (Figure 1-2). The upper two sections, Reaches 1 and 2, are relatively low gradient areas (approximately 55 and 57 feet per mile (ft/mi), respectively) extending a length of 2.29 and 0.75 miles, respectively. Reach 3, referred to as the gorge, is 0.38 miles long with steep and narrow canyon walls. The gradient in this part of the channel is very steep, approximately 480 ft/mi, or approximately nine percent. Waterfalls, from five to 20 feet high, numerous cascades, bedrock chutes, and large deep pools characterize the stream channel in the gorge reach. Finally, Reach 4 is 0.49 miles long and is characterized by a wide flood plain. This section of the bypass reach has a low gradient (22 ft/mi) and substrate comprised of gravel, cobble, and boulders. Reach 4 extends from the bottom of the gorge section to the confluence with the powerhouse tailrace and Columbia River.

2.1 __Historical Water Quality Information__

This water body has a 401 Certification designed to address any impacts to the Chelan River from ongoing Project operations. The development of the 2007 QAPP was meant to initiate the data collection and analysis phase of 401 Certification requirements. This updated QAPP is intended to continue the quality and quantity of data collected for the 401 Certification requirements.

Previous historical water quality data were only available for the associated reaches during studies conducted for relicensing of the Project because the Chelan River bypassed reach had historically been dry for a period of approximately 79 years (1929-2008) except during high flow spill conditions. These studies found little change in water quality between the lake outlet and the confluence of the Chelan River with the Columbia River, except for water temperature, due to limited residence time of water discharged through the bypass reach or Chelan River. The assessments of DO, pH, TDG and turbidity defined later in this QAPP are intended to confirm this finding.

2.2 __Implementation Studies and Construction to Provide Minimum Flows__

2.2.1 Low Level Outlet

Chelan PUD planned, designed and constructed a flow release outlet structure to provide minimum instream flows to the Chelan River (referred to the bypassed reach prior to 2009), consistent with the 401 Certification. This outlet structure or Low Level Outlet (LLO) is capable of withdrawing water from Lake Chelan under the full range of headwater elevations (1079 feet – 1100 feet) allowed by the Project License. Feasibility analyses identified two possible locations for the construction of the outlet structure. These locations are on opposite sides of the Chelan Dam and have different approaches for withdrawing water from the base of the dam. A forebay water temperature study was conducted to determine whether there were any differences between the two proposed design options that would influence the potential for cold water withdrawal from the forebay. The 401 Certification required Chelan PUD to "design the new outlet structure to maximize the potential for cold water withdrawal at the base of the dam". The results of the study indicated that there was no lateral temperature variation in the forebay, thus the lateral position of the structure along the dam would not affect the temperature of the water withdrawn. However, due to the observation of temporary vertical thermal gradients at the face of the dam, the depth of the withdrawal would influence the temperature discharged when such thermal gradients are present. The LLO was designed to withdraw water from the Lake Chelan Dam forebay by tapping into an existing power tunnel intake structure that was part of the original construction of the Lake Chelan Project, but was never developed for additional power production. The intake structure draws water from approximately the same elevation as the river bed at the face of the dam, which is where the coldest water layers were observed in the forebay. Selection of this design option for the LLO insured compliance with the 401 Certification's requirement that Chelan PUD maximize the potential for cold water withdrawal at the base of the dam.

2.2.2 Tailrace Pump Station

The Project License (Article 408) requires that Chelan PUD develop and operate a system to release water at the Lake Chelan Dam or pump water from the project powerhouse tailrace to the Chelan River at rates sufficient to continuously maintain flows equal to or greater than the flows required for Reach 4 of the Chelan River. The Settlement Agreement defines those flows as 80 cfs measured at the Lake Chelan Dam and 240 cfs measured at the dam or through calibrated pump discharge curves. The intent of the Settlement Agreement is that Chelan PUD would have the option of pumping 240 cfs of water from the powerhouse tailrace as a cost-saving measure, rather than releasing that additional water from the Lake Chelan Dam. The use of pumped water would require that the water be released at the beginning of the constructed fish habitat in Reach 4 of the Chelan River.

Chelan PUD designed and developed the following tailrace pump station as the system to release water at the Lake Chelan Dam or pump water from the powerhouse tailrace: The powerhouse tailrace pump station includes: a pump station intake structure equipped with fish screens; mechanical and electrical equipment including pumps, motors, control valves, discharge manifold, distribution power line feed, and transformers; a conveyance structure (canal) to carry the pump station flow; and an outlet structure to release the flow into Reach 4 of the Chelan River.

SECTION 3: REGULATORY FRAMEWORK

This QAPP is meant to update the previous QAPP and to continue the data collection and analysis phase of 401 Certification requirements. Changes to the previous 2007 QAPP were made to update changes in Ecology's surface water quality standards, Ecology's updated Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies, staff at Chelan PUD and equipment upgrades with improved technology. The frequency of monitoring, parameters monitored, quality assurance and reporting measures have not changed from the 2007 QAPP.

This water body has a 401 Certification designed to address any impacts to the Chelan River from ongoing Project operations. Various Sections of the 401 Certification and the Chelan River Biological Evaluation and Implementation Plan (CRBEIP) contain water quality conditions that Chelan PUD must follow, such as monitoring temperature, flow, dissolved oxygen (DO), turbidity, pH, total dissolved gas (TDG), petroleum products, and intragravel DO. The following sections detail the water quality monitoring requirements and numeric standards for each parameter to be monitored.

3.1 Temperature

WAC 173-201A-200 designates the Chelan River as salmonid spawning, rearing, and migration, and therefore water temperature must remain below 17.5°C, as measured by the 7-day average of the daily maximum temperatures (7-DADMax). When a water body's temperature is warmer than the criteria (or within 0.3°C of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the 7-DADMax temperature of that water body to increase more than 0.3°C.

3.2 Flow

Section III.A of the 401 Certification states the following condition for Instream Flows for Fish:

III. Instream Flows for Fish

A. Minimum Instream Flow Requirements

i) The project shall provide and maintain the minimum instream flows for the Chelan River as described in the CRBEIP (revised April 18, 2003), Table 7-3. These flows are specified below. The definitions of dry, average and wet years are provided in Section 2.6.5 of the CRBEIP (revised April 18, 2003).

Table 3-1: Minimum Instream Flow Requirements

Reach	Dates	Dry year (cfs)	Average year (cfs)	Wet year (cfs)
1, 2 & 3[1]	July 16- May 14	**80** all months	**80**	**80**
	May 14		ramp up to **200**	Ramp up to **320**
	May 15- July 15		**200**	**320**
	July 16		ramp down to **80**	Ramp down to **80**
4[2] Spawning flow	March 15 - May 15; and Oct. 15 - Nov.30	80 + 240 pumped (**320**)	**320** by combination of spill & pumping Incubation flow, as needed	**320** by combination of spill & pumping Incubation flow, as needed

[1] Flows measured at the dam by calibrated gate rating.
[2] Flows measured at the dam or through calibrated pump discharge curves.

3.3 <u>Dissolved Oxygen and Intragravel Dissolved Oxygen, Turbidity, pH and petroleum products</u>

The water quality criteria for DO within the Project require that DO be greater than 8.0 milligrams per liter (mg/L). When DO is lower than the criteria (or within 0.2 mg/L of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the DO of that water body to decrease more than 0.2 mg/L (WAC 173-201A-200(1)(d)). Intragravel DO is not a surface water quality criteria, but was measured to assist in evaluating redd egg to emergence survival. Methods and procedures for intragravel DO monitoring are covered in greater detail in the Chelan River Biological Objective Status Reports (Chelan PUD, 2013)
http://www.chelanpud.org/departments/licensingCompliance/lc_implementation/ResourceDocuments/40533.pdf

WAC 173-201A-200 (1)(e) provides that turbidity levels shall not be 5 Nephelometric Turbidity Units (NTU) over background turbidity when the background is 50 NTU or less or a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

WAC 173-201A-200(1)(g) provides that pH shall be within the range of 6.5 to 8.5 units with a human-caused variation within the above range of less than 0.5 units.

3.4 <u>Total Dissolved Gas</u>

WAC 173-201A-200(1)(f) provides that TDG is measured in percent saturation and levels shall not exceed 110 percent of saturation at any point of sample collection.

*3.5 **Petroleum Products***

Section V.(iv) of the 401 Certification states that Petroleum products (visible sheen) in the tailrace shall be monitored by visual observation on a weekly basis and reported annually, or in accordance with Sections E(i)(Water Quality Violations) and VII.C(ii)(Oil Spill Prevention, Containment and Countermeasure Plan) of the 401 Certification.

SECTION 4: PROJECT PLAN DESCRIPTION

This QAPP provides details on Chelan PUD's water quality monitoring project plan for the Lake Chelan Hydroelectric Project. In general, this QAPP provides descriptions of the following:

- Purpose and objectives
- List of parameters to be monitored
- Organization and schedule
- Data quality objectives
- Descriptions of the monitoring locations
- Monitoring methods, procedures, and equipment
- Analytical methods
- Quality control procedures, including descriptions of calibration, maintenance, and data handling and assessment procedures
- Reporting protocols

4.1 __Purpose and Objectives__

The purpose of monitoring water quality parameters at the Project is to continue to provide information on water quality conditions within the Project, as well as verify compliance with applicable water quality standards and conditions within the 401 Certification. The following are the monitoring requirements of the 401 Certification:

- Conducting hourly monitoring of the temperature of the water in the Lake Chelan Dam forebay (LLO), at the end of Reaches 1, 3 and 4 of Chelan River, and in the powerhouse tailrace;
- Collecting and recording hourly flow data through the Chelan River reaches and in the penstock;
- Assessing the DO, turbidity, and pH levels in the water in Reach 4 and the TDG in the spillway during Years 3 (2012) and 5 (2014); and
- Weekly visually monitoring of the powerhouse tailrace for a visible sheen indicating petroleum products.

The reporting of these data includes submitting:

- Flow and temperature data on the Chelan PUD website on a monthly basis (no later than the 30th day of the month following the reporting period) during July through September annually, and quarterly the remainder of the year;
- An annual report to Ecology in an approved format that includes a data assessment of compliance with state water quality criteria, summaries of the data, and a list of any water quality exceedances;
- DO, TDG, turbidity, and pH data in the annual reports in the fourth and sixth years; and
- A report of observed dying fish or violations water quality criteria in the Chelan River reaches specific for pH, temperature, DO, TDG, turbidity, or sheen within 48 hours with an explanation of cause and notification for the course of action.

The following are the additional monitoring requirements for intragravel DO, during years one through five, as described in Table 7-10 of Chapter 7 of the Lake Chelan Comprehensive Plan:

- In the powerhouse tailrace hourly during all scheduled (non-emergency) powerhouse shutdowns; and
- Weekly in the powerhouse tailrace and Reach 4 hourly for at least one 24-hour period during incubation (estimated to be from November to February).

Intragravel DO monitoring will be conducted in accordance with previous studies conducted as a basis for the CRBEIP (BioAnalysts, 2003).

The purpose and objectives of the water quality monitoring program will be met using the following basic methods. Because Chelan PUD's monitoring program has been in place since 2007, no new actions are required to begin the program. The water quality monitoring program's purpose and objectives will be met by simply continuing Chelan PUD's current water quality monitoring program with a few minor additions as equipment has changed since 2007. Additional details on the program will be presented in the following sections. The generalized list below provides a summary of actions that will be continued and maintained to meet the purpose and objectives:

- Continue to use HOBO® (or equivalent) for temperature monitoring of the Chelan River reaches and Hydrolab® (or equivalent) multi-parameter water quality probes to collect TDG, DO, pH, and turbidity data;

- Maintain current water quality monitoring locations used to continually monitor water quality parameters within the Project area;

- Maintain current data transmission software/hardware that allows for flow data to be transmitted to Chelan PUD's data base;

- Maintain current quality assurance and quality control procedures to assure data is accurate and reliable; and

- Maintain flexibility by adaptively managing the water quality monitoring program, allowing for changes, modifications, and improvements based on monitoring results, safety restrictions, regulatory changes, operational or structural changes to the Lake Chelan Hydroelectric Project, requirements in Total Maximum Daily Loads (TMDLs), etc. Chelan PUD will review and update this QAPP, annually as needed, and implement any changes to the plan pending Ecology and FERC approval.

4.2 Parameters to be Monitored

A summary of water quality parameters to be monitored are in Table 4-1 below.

Table 4-1: Water quality parameters to be monitored

Parameter	Location(s)	Minimum Frequency	Metric	Standards
Temperature	Forebay(LLO), Powerhouse Tailrace, End Reaches 1, 3 and 4	Hourly	degrees Celsius	Natural ≤17.5 7DADMax, <2.8 increase Natural > 17.5 7DADMax, <0.3 increase
Flow	Penstock, Low Level Outlet	Hourly	cfs	Minimum flow in Chelan River of 80 – 320 cfs (location and time dependent – see 401; Penstock measured to calculate total flow, no criteria apply)
DO	Reach 4 (Years 3 (2012) & 5 (2014))	Hourly, one day/week in years 3 & 5	mg/L	DO in mixed flow ≥8.0
Turbidity	Reach 4	2/month in years 3 & 5	NTU	Background ≤ 50: ≤ 5 increase Background >50: < 10% increase
pH	Reach 4	Hourly, one day/week in years 3 & 5	pH units	6.5 – 8.5
TDG	Below spillway	Hourly, 2/month in years 3 & 5 when spilling	% Saturation	110%
Petroleum products	Powerhouse Tailrace	Weekly	N/A	No spills or visual sheen
Intragravel DO	Reach 4 Powerhouse shutoff	Hourly during shutoff	mg/L	Biological Objective DO in intragravel averages >6.0 mg/L
	Reach 4 / Powerhouse Tailrace incubation	Hourly for 24-hours per week during incubation	mg/L	Biological Objective DO in intragravel averages >6.0 mg/L
cfs = cubic feet per second mg/L = milligrams per liter NTU = nephelometric turbidity unit N/A = not applicable				

SECTION 5: ORGANIZATION AND SCHEDULE

This section includes key personnel assigned to the project and time schedules for monitoring and reporting.

5.1 Key Personnel

This project is to be conducted primarily by Chelan PUD personnel, with assistance as needed, to expedite the process, reduce costs, or improve quality (if needed). All personnel conducting work will have sufficient skills and experience to complete the necessary tasks at a high level of quality. This plan has been designed by Chelan PUD, and is anticipated to be conducted by the personnel outlined in Table 0-3.

Table 5-1: List of Key Personnel

Personnel	Responsibility
Chelan PUD	
Marcie Steinmetz	*Chelan PUD Water Resources Specialist / Program Manager*. Lead responsible for project management, jointly responsible for report generation, data interpretation, field sampling methodology development, and sampling and monitoring.
Steven Hays	*Chelan PUD Fish and Wildlife Senior Advisor.* Jointly responsible for report generation and/or review, data interpretation, and field sampling methodology development. Senior technical review for all reports.
Jeff Osborn	*Chelan PUD Compliance Program Supervisor.* Responsible for QAPP and report review and approval, and funding approval.
Rosana Sokolowski	*Chelan PUD Licensing & Compliance Coordinator.* Responsible for administrative support of QAPP, sampling, data entry, and reporting.
Keith Truscott Michelle Smith	*Chelan PUD Natural Resources Director.* Responsible for QAPP and report review. *Chelan PUD License Environmental Manager*. Responsible for QAPP and report review
Scott Kardos	*Control Systems Engineer*. Responsible for providing assistance with data management and recovery.
Ron Franklin	*Health and Safety Officer*. Responsible for overall aspects of health and safety for the QAPP project work.
Ecology	
Charlie McKinney Chris Coffin	*Ecology, Section Manager – Water Quality Program, Central Regional Office (CRO).* Oversight of Ecology participation in implementation of the 401 Certification. *Ecology, Unit Supervisor - Water Quality Program, Central Regional Office (CRO).* Oversight of Ecology participation in implementation of the 401 Certification.
Vacant	*Hydropower Projects Manager, CRO.* Contact for review of reports and the QAPP and assistance in meeting requirements as defined in the 401 Certification.

5.2 Schedule

5.2.1 Monitoring Schedule

Water quality monitoring began immediately upon initiation of the minimum flows and as directed by the 401 Certification. The schedule is described in Table 5-2.

Table 5-2: Monitoring Schedule

Parameter	Monitoring Schedule	Comments
Flow	Hourly upon initiation of minimum flow	
Temperature	Hourly upon initiation of minimum flow	
DO	Years 3 (2012) & 5 (2014) 2 samples/month	Samples will be taken during the most biologically productive months of the year (July – September). DO will also be sampled more frequently during the heat of the summer for an equivalent of 2 samples per month, or 24 samples per year.
	During scheduled Powerhouse shutdowns	Powerhouse tailrace intragravel DO will be monitored hourly, during low water years. It is estimated powerhouse shutdowns, necessitating this monitoring, will occur up to three times from year one to five after initiation of minimum flow.
	During incubation of salmonid eggs and alevins	Powerhouse tailrace and Reach 4 intragravel DO will be monitored hourly, one day per week, during incubation. This is expected to occur each of years one through five after initiation of minimum flow in the months of November through February.
pH	Years 3 (2012) & 5 (2014) 2 samples/month	Samples will be taken during the most biologically productive months of the year (July – September).
Turbidity	Years 3 (2012) & 5 (2014) 2 samples/month	Samples will be taken during the most biologically productive months of the year (July – September). Samples will be obtained during as many different flows as possible, with an emphasis on high flow when turbidity is likely to be higher.
TDG	Years 3 (2012) & 5 (2014) 2 samples/month	Samples will be obtained during as many different flows as possible and only during times of spill.
Petroleum Products	Weekly upon initiation of minimum flow.	A visual inspection for sheen will be made and any sheen observed reported.

5.2.2 Reporting Schedule

Chelan PUD will report hourly average and daily average instream flows as recorded from the LLO, pumping station, spillway and powerhouse. In addition, hourly and daily lake level and tailwater elevation readings will be reported. This information will be provided in written form to the Chelan River Fishery Forum (CRFF) and posted electronically to the Lake Chelan Implementation web page (http://www.chelanpud.org/lake-chelan-implementation.html) on a quarterly basis. Real-time flows, lake levels and tailwater levels will also be provided at this site.

Temperature data will be made available on a monthly basis from July to September and quarterly the rest of the year. The information will include hourly, daily maximum, minimum and average temperatures, and also present any observable water quality exceedances and measures taken by the Chelan PUD in conformance with the CRBEIP. The data will be available no later than the 30th of the month following the reporting period and will be posted on the Chelan PUD's website.

Chelan PUD shall conduct general water quality assessment in years 6 and 8 sufficient to demonstrate that the Chelan River meets water quality standards for dissolved oxygen, total dissolved gas, turbidity and pH to Ecology and the CRFF. The results shall be reported no later than April 30 of Year 9 (2018), included as part of Annual Temperature Report to FERC, Ecology and CRFF.

The Chelan PUD will report exceedances of the water quality criteria within 48 hours to Ecology's Central Regional Office. It is important to note that it may not be possible to provide temperature exceedances that are based on shifts in the temperature from natural because modeling is required to determine this type of exceedance.

Results of the DO, turbidity, pH, and TDG monitoring will be reported to Ecology in the annual reports no later than April 30th of Years 4 (2013) and 6 (2015).

The results of petroleum product monitoring will be reported annually, unless sheen is observed. If sheen is observed, it will be reported to Ecology within 48 hours of observation. The occurrence of any detection will be sent in a notification describing the likely cause of the sheen and the proposed course of action to be taken. Additionally, in the case of a spill, the conditions of the Chelan PUD Spill Prevention Control and Countermeasure (SPCC) plan will apply. These provisions include the immediate report of any spills to Ecology's 24-hour phone number (509) 575-2490 and a submittal of a detailed written report to Ecology within five days of such observation.

SECTION 6: DATA QUALITY OBJECTIVES (DQO)

The primary objective for collecting data is to track compliance with water quality standards. The purpose of the QAPP is to identify the methods and standards used to make that determination. Data quality objectives (DQOs) are statistical statements of the level of uncertainty that a decision-maker is willing to accept in results derived from environmental data. They describe what data are needed, and how the data will be used to address the concerns being investigated. The DQOs also establish numeric limits that ensure the data collected are of sufficient quality and quantity for data user applications.

The overall DQO is to ensure that data of known and acceptable quality are provided. Proper execution of each task will yield consistent results that are representative of the media and conditions measured. All data will be calculated and reported in conventional units to allow comparability of the data. There are two types of DQOs, including decision quality objectives and measurement quality objectives (MQOs).

The acquired data will be used to characterize the water quality of the Chelan River reaches. Decision quality objectives to obtain this information are to:

- Generate scientific data of sufficient quality to withstand scientific and legal scrutiny.
- Gather and develop data in accordance with procedures appropriate for its intended use.
- Conduct all methods/procedures specified for this project in compliance with Ecology requirements for environmental investigations.

To ensure that the MQOs of the monitoring effort are within the limits of the work, specific criteria for data parameters have been established as appropriate.

6.1 Decision Quality Objectives

For this effort, the data collection must be designed in such a manner that the results can be used to determine if the water quality criteria have been met; therefore, quality objectives at the level of the decision are required. These objectives will be met by carefully determining the number of measurements taken to represent a given condition. The success of obtaining these objectives can be measured by ensuring that the representativeness, completeness and comparability are controlled. Each objective is described below.

6.2 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. For this investigation, representativeness is a qualitative parameter that is primarily concerned with proper design of the sampling program, and can be best satisfied by ensuring that the monitoring locations are properly located with a sufficient number of data collected.

6.3 Comparability

The comparability criterion is a qualitative characteristic that expresses the confidence with which one data set can be compared to another. Principal comparability issues are field sampling techniques, and standardized concentration units and reporting formats. Data comparability is achieved using standard field sampling techniques and measuring methods; however, comparability is limited by the other MQOs because only when precision and bias (accuracy) are known can data sets be compared with confidence.

6.4 Completeness

Completeness is defined as the percentage of valid analytical determinations compared to the total number of determinations. A reasonable completeness goal is 90 percent. Typical field or electronics problems may result in completeness of less than 100 percent. Completeness will be evaluated and documented throughout all monitoring, and corrective actions taken as warranted on a case-by-case basis.

6.5 Measurement Quality Objectives (MQOs)

The term "data quality" refers to the level of uncertainty associated with a particular data set. Data quality associated with environmental measurement is a function of the sampling plan rationale and procedures used to collect the samples, as well as the monitoring methods and instrumentation used in making the measurements. Uncertainty cannot be eliminated entirely from environmental data. However, quality assurance (QA) programs effective in measuring uncertainty in data are employed to monitor and control deviation from the desired DQOs. Sources of uncertainty that can be traced to the sampling component are poor sampling plan design, incorrect sample handling, faulty sample transportation (if applicable), and inconsistent use of standard operating procedures (SOPs). The most common sources of uncertainty that can be traced to the analytical component of the total measurement system are calibration and contamination (i.e. equipment not "resetting" or fully equilibrating in a new sampling location).

One of the primary goals of this QAPP is to ensure that the data collected are of known and documented quality and useful for the purposes for which they are intended. The procedures described are designed to obtain data quality indicators for each field procedure and analytical method. To ensure that quality data continues to be produced, systematic checks must show that test results and field procedures remain reproducible, and that the methodology employed is actually measuring the parameters in an acceptable manner.

For the field measurements to be conducted under this QAPP (including pH, visual petroleum observations, DO, turbidity, temperature, flow, and TDG) many MQOs can be specified. Each of the MQOs that pertain to this QAPP is further discussed below. The goals for this effort are outlined in Table 0-5**.** Note that it is not possible to develop MQOs for visual petroleum observations because it is a human test that is a "pass/fail" based on whether it is observable.

Table 6-1: MQOs

Parameter	Smallest Reference Level for Decision Making	Range of Instrument	Precision (Duplicate Samples)	Bias/Accuracy	Sensitivity/ Resolution
Flow	10-25/200* cfs	0-500/0-2,200 * cfs	N/A	5% of flow / 200*cfs	1% / 100*cfs
Temperature	0.3°C	-5 to 50°C	20% RPD or ±0.05 units, whichever is least	± 0.1°C	0.01°C
DO	0.2 mg/L	0 to 50 mg/L	20% RPD or ±0.05 mg/L, whichever is least	±0.2 mg/L at ≤20 mg/L ±0.6 mg/L at >20 mg/L	0.01 mg/L
pH	0.2 units	0 to 14 units	20% RPD or ±0.05 units, whichever is least	±0.2 units	0.01 units
Turbidity	5 NTU	0 to 3,000 NTU	N/A	1% up to 100 NTU 3% for 100 – 400 NTU 5% for 400-3000 NTU	0.1 NTU up to 400 NTU 1.0 NTU for 400-3000 NTU
TDG	1% saturation	400 – 1,300 mmHg	N/A	±0.1 % of span	1 mmHg

RPD = relative percent difference
cfs = cubic feet per second
NTU = nephelometric turbidity unity
TDG = total dissolved gas
mmHg = millimeters of mercury
DO = dissolved oxygen
mg/L = milligrams per liter
* The first value is for the low level outlet; the second is for the penstock flow. If a range is given, it is flow dependent. The smaller value is for a lower flow and the larger for a higher flow.

*6.6 **Precision***

Precision is a measure of the reproducibility of an analysis or set of analyses under a given set of conditions, and generally refers to the distribution of a set of reported values about the mean. The overall precision of a sampling event has both a sampling and an analytical component. The precision provides transparency into presence of random error such as field sampling procedures, handling, and data collection and analysis. A reduction of precision could be introduced to this work in several ways including using equipment that is not sensitive enough (see Sensitivity below), collecting measurements over a large spatial or temporal regime, using a wide range of types of equipment, etc.

6.7 Bias

Bias (otherwise known as accuracy) is the difference between the population mean and the true value of the parameter being measured. Bias in measurements obtained under this QAPP may be introduced by faults in the sampling design (e.g. all of the temperature measurements collected in one location that is not indicative of the mixed flow or strata of interest), inability to measure all forms of the parameter of interest (e.g. inability of a thermometer to reach a temperature regime needed due to physical obstacles), improper or insufficient calibration of instrumentation and/or equipment. Bias will be minimized by following standard protocols for calibration and maintenance, and by following field protocols for stabilization of meter readings.

6.8 Sensitivity

Sensitivity denotes the rate at which the analytical response varies with the concentration of the parameter being measured, or the lowest concentration of a parameter that can be detected (often referred to as "resolution" for water quality equipment). For this work, equipment must be selected that provides tight enough tolerances to ensure that the data collected are described to the necessary precision. For example, if water criterion for temperature is concerned with a temperature shift of greater than 0.3 degrees Celsius, then the equipment should be able to measure the water temperature with sensitivity less than 0.3 degrees Celsius, preferably by an order of magnitude. Often, the accuracy is much larger than the resolution. If this is the case, the accuracy is the smallest verifiable value reported by the instrument.

SECTION 7: METHODS

7.1 Monitoring Locations

As stated in the 401 Certification, the general locations for measurements have been identified. These locations are included in Table 3-1.

The locations for hourly monitoring will be placed such that the equipment can function properly, be easily placed and removed, is protected from vandals and natural forces (e.g. being swept away in current, beat against rocks, etc.) to the extent possible. The locations for parameters to be evaluated in years three and five years can be more flexible, but must further consider personnel safety due to the increased numbers of visits of personnel to the monitoring locations. Because the non-hourly sampling is conducted with a portable unit, as opposed to the fixed measurement stations, the description of the location must be made using a fixed coordinate system. Each monitoring location has been identified with coordinates obtained using a Global Positioning System (GPS) instrument.

The approximate monitoring locations for each area of concern (the forebay or LLO, end of Reaches 1, 3, and 4, and powerhouse tailrace) are depicted in Figure 0-5 through Figure 0-11.

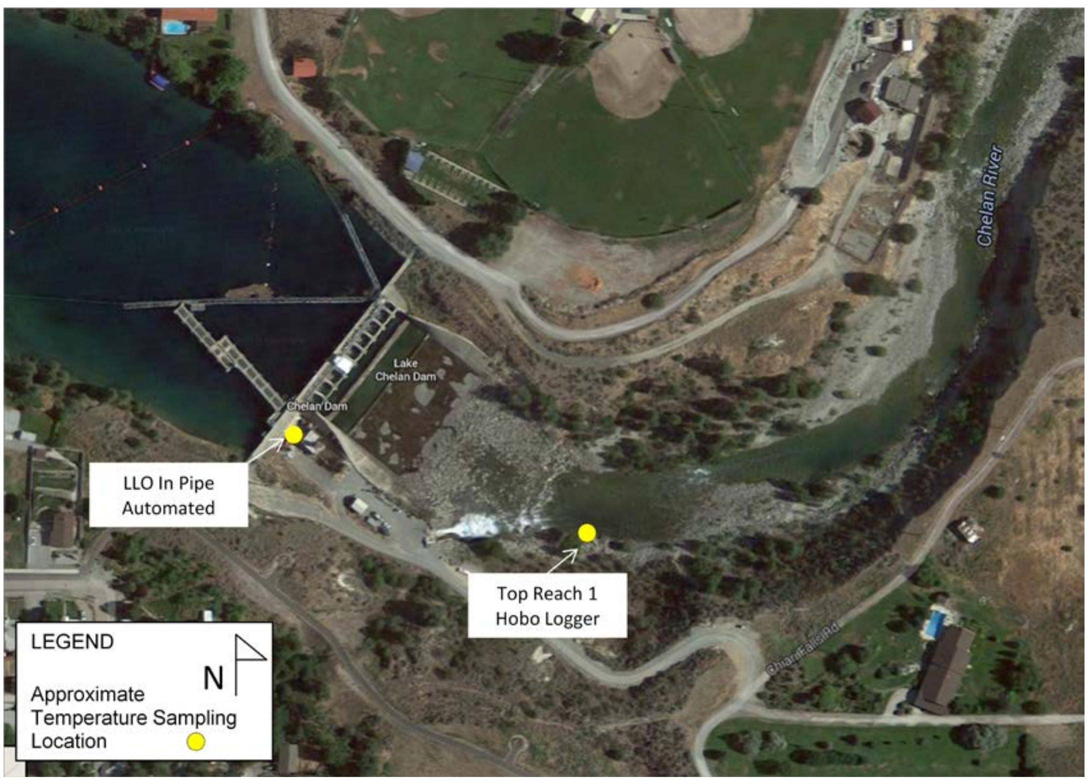

Figure 7-1: Approximate Temperature Sampling Location, LLO and Reach 1

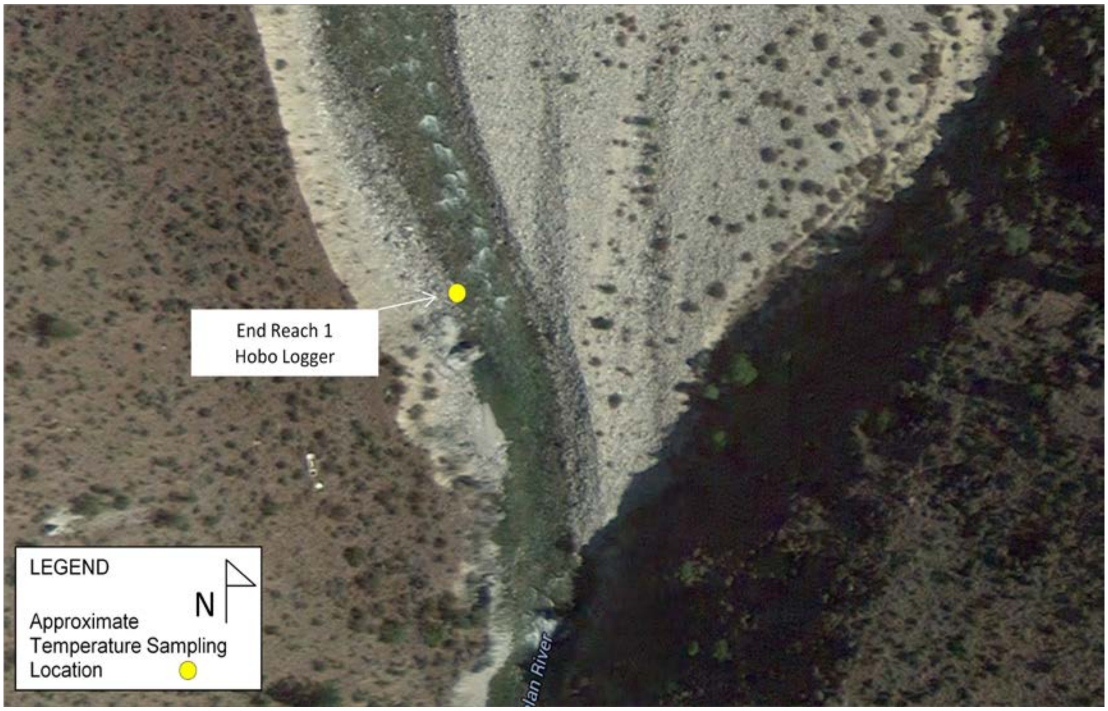

Figure 7-2: Approximate Temperature Sampling Location, End of Reach 1 of the Chelan River

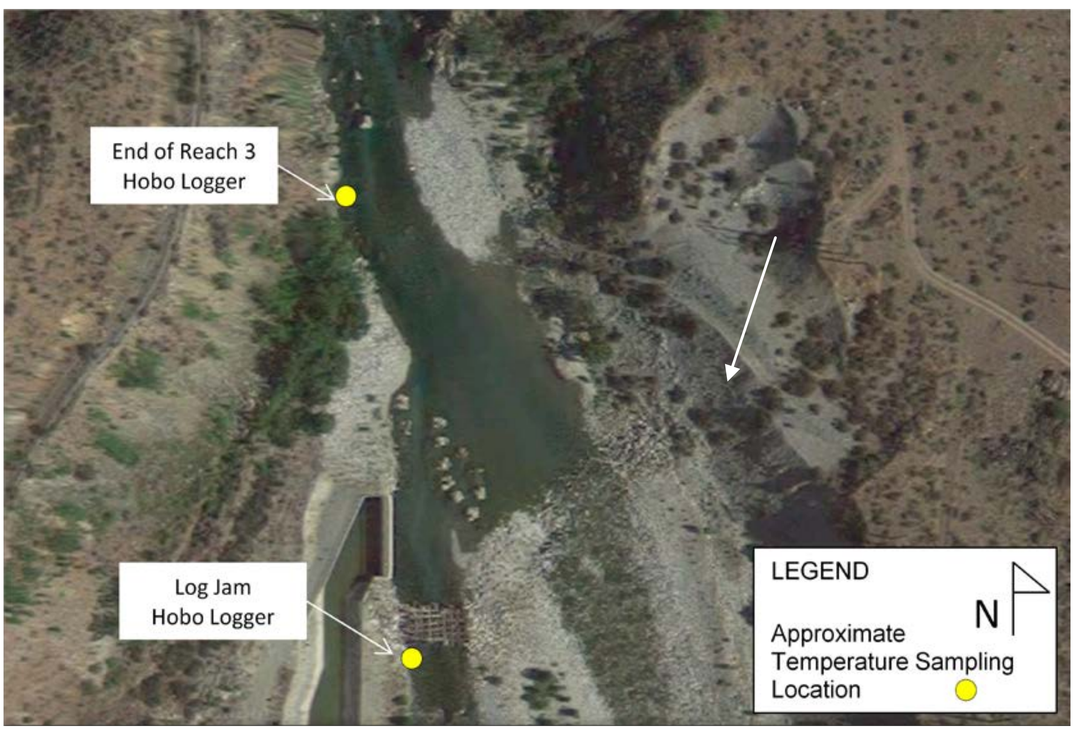

Figure 7-3: Approximate Temperature Sampling Location, End of Reach 3 and Log Jam of the Chelan River

Figure 7-4: Approximate Temperature Sampling Location, End of Reach 4 of the Chelan River

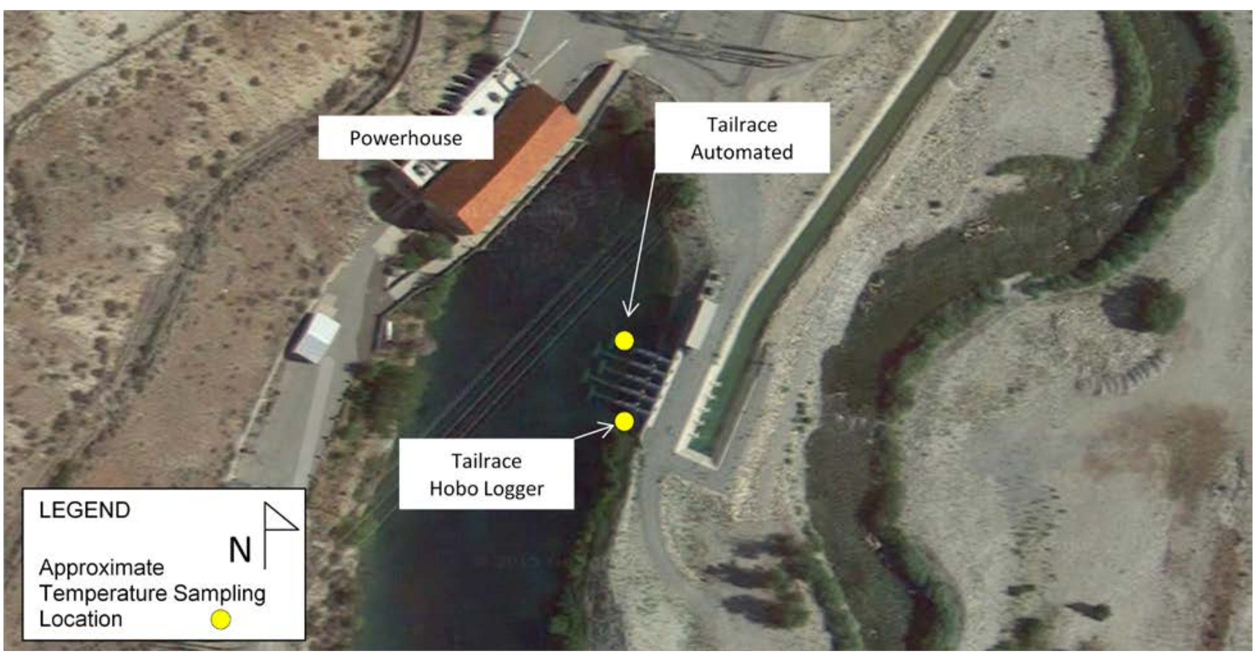

Figure 7-5: Approximate Temperature Sampling Location, Tailrace of the Powerhouse

Figure 7-6: Approximate Turbidity, DO, pH Sampling Locations, Reach 4

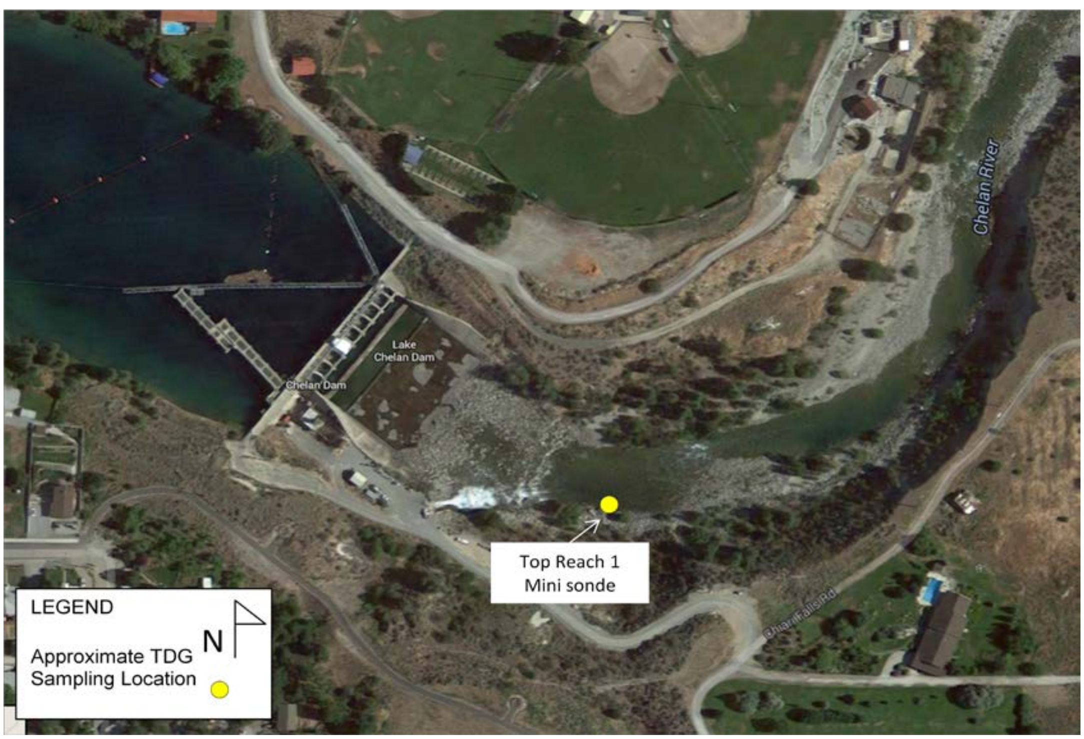

Figure 7-7: Approximate TDG Sampling Location in the Spillway

7.2 Monitoring Procedures

The data will be collected with equipment and in such a manner to ensure that the MQOs are met. The equipment and methodologies will be discussed in this section.

7.2.1 Frequency

Table 3-1 and 5-2 provide the frequency that each water quality parameter will be measured. These frequencies follow the requirements of the 401 Certification. Water temperature must be measured hourly for water entering the Chelan River at the Chelan Dam, at the end of Reaches 1, 3 and 4 of the Chelan River, and in the powerhouse tailrace leaving the Lake Chelan Project Powerhouse.

As per the 401 Certification, data will be collected during Years 3 (2012) and 5 (2014), at a frequency sufficient to demonstrate compliance with water quality criteria. The Chelan PUD has generally defined this to be hourly during the most productive months of the year (July through September). The DO will be sampled more frequently during the heat of the summer, and as required to ensure that DO is sufficient to meet biological requirements. Turbidity and TDG will be sampled during as many different flow conditions as possible in order to better understand what effect each condition has on these parameters; however, TDG will be sampled only during those years when it is necessary to spill water. Since TDG is a function of spill levels, sampling will be done only as necessary to determine the TDG effects of different spill levels.

MQOs have also been established for pH, DO, and TDG (Table 0-5). The data will be collected with equipment and in such a manner to ensure that the MQOs are met. The equipment and methodologies will be discussed in this section.

Petroleum monitoring is to be conducted in two ways: the first is a weekly visual inspection of the powerhouse tailrace for sheen; the second is the report of any spills in compliance with the SPCC plan. The petroleum monitoring will be conducted by the dam operators. They will be required to fill out a form indicating that they have completed the inspection, whether any sheen was observed, and if sheen was observed who they notified.

7.2.2 Monitoring Depth

The TDG, DO, pH, and turbidity should be measured as consistently as possible at the same depths during each monitoring event, while prioritizing the goal of capturing the condition of the mixed flow. The depth of measurement is approximately six inches from the bottom of the river.

To obtain data that are representative of mixed flow in the Chelan River, temperature equipment is located somewhere between the bottom and two feet from the bottom of the river in sampling locations where there is a strong flow. The equipment will be housed in an aluminum sleeve attached to a steel T-post. The steel T-posts with attached sleeve have been driven into the river bottom to hold the equipment in its desired location. The desired location of the temperature monitoring is the depth that is indicative of the mixed flow of the river.

For the DO monitoring conducted for the biological objectives evaluation, the goal is to determine the intragravel DO. For this monitoring, equipment will be imbedded in the gravels by divers as was conducted in previous studies of this nature (BioAnalysts, Inc., 2003).

7.2.3 Equipment

The data will be collected with equipment and in such a manner to ensure that the MQOs are met. The equipment and methodologies will be discussed in this section.

7.2.3.1 Flow Equipment

The flow will be monitored at the penstock and flow into the Chelan River at the LLO, spillway and pump station. Flow through the penstock is currently being monitored as a part of normal Lake Chelan Hydroelectric operations. These measurements are reported directly as the powerhouse flow. Additional measuring equipment is not needed to monitor penstock flow. Currently, the penstock flow is reported in the thousands of cubic feet per second (kcfs) of water passing through it. Flows discharged from the turbines into the project powerhouse tailrace are measured using an ultrasonic flow meter. The device uses ultrasonic sound wave sensors to measure the velocity of the water in a cross section of the penstock. The sensors are located approximately 30-feet upstream of the turbine inlet valve (TIV), with one flow meter in each leg of the bifurcation from the main power tunnel. Combining the two measurements provides the total flow through the penstock, including turbine, irrigation and raw water flows. The data are already electronically transmitted to a central server which can easily be accessed using the database system that specializes in handling real-time data referred to as PI, from any of several computers within the Chelan PUD.

The spillway flow is measured by calculating flow from lake level readings and gate settings, for which rating tables exist. The rating tables have been conformed to accuracy standards in cooperation with the United States Geological Survey (USGS) through river stage and flow measurements in the river channel at an existing USGS stream hydrology station located a short distance downstream from the spillway apron. This gauging site is known as USGS 12452500 Chelan River at Chelan, which combines powerhouse discharge flows reported by Chelan PUD with the spillway flows, as corroborated with the stream gauging site.

Flows from the LLO are be measured with an ultrasonic flow meter located along the pipe that routes flow to the Chelan River below the spillway apron. Flows from the pump station into Reach 4 of the Chelan River would also be measured with an ultrasonic flow meter or similar device, located within the conveyance canal. The data collected is then transmitted electronically to the PI database system. Using existing software called PI ProcessBook a simple interface has been established that allows real-time observance of all of the flow data and hourly averages for reporting.

7.2.3.2 Temperature Equipment

All temperature monitoring equipment will be of sufficient quality to meet the MQOs (Table 0-5). The monitoring equipment that will be used for data collected on monthly or quarterly basis collection will be Onset Hobo Water Temperature Pro Data Loggers, or equivalent. Specifications for all types of equipment described herein are provided in Appendix A. Any of these types of monitoring equipment are referred to as merely equipment in the following discussion.

To help correlate water temperature to the climatic conditions, the Chelan PUD may use a weather station sited at the forebay and/or the powerhouse. If used, the weather station is anticipated to be Hobo Weather Station, or equivalent. This QAPP does not cover how the climatic conditions may be correlated to water temperature; that will be covered in a subsequent document. Mention of the collection of data is made herein because the longer the period of record, the easier any subsequent analysis.

The water temperature equipment will be installed in the water in areas which are representative of the surrounding environment and are shaded from direct sunlight. The goal is to obtain the temperature of the mixed flow of water. To do so, the depth of the equipment must be secured. To safeguard against data loss, the loggers will be placed in a location that is difficult to see and safe from natural weather conditions.

The equipment will be housed in an aluminum sleeve attached to a steel T-post. The steel T-posts with attached sleeve have been driven into the river bottom to hold the equipment in its desired location. The desired location of the temperature monitoring is the depth that is indicative of the mixed flow of the river.

7.2.3.3 DO, pH Turbidity, and TDG Equipment

The Chelan PUD will use Hydrolab DataSondes or MiniSondes, or equivalent, with internal data logging for the collection of DO, pH, turbidity, and TDG data (See Appendix A for Equipment Specifications). To the extent possible, sampling methods will follow protocol established by Hydrolab (or alternative manufacturer), the most current version of the Ecology Field Sampling and Measurements Protocols for the Watershed Assessment Section (Ecology, 1993), and this QAPP. In the currently manufactured versions of the proposed equipment, one unit can be equipped with the four necessary probes to collect all of the pertinent data.

The data for intragravel DO has been and will continue to be collected hourly to ensure that redds are receiving enough oxygen will be collected on a data logger. During all scheduled (non-emergency) powerhouse shutdowns during egg incubation, powerhouse tailrace and Reach 4 intragravel DO will be monitored hourly each week for at least one 24-hour period. It is anticipated that these data will be collected from equipment placed by divers and left in the powerhouse tailrace and Reach 4 substrate.

Monitoring of DO will detect if serious oxygen depletion is occurring in the redds in the powerhouse tailrace, which provides for proactive triggering of decisions to protect redds before survival is seriously affected. The objective is to maintain oxygen levels in the redds at or above 6.0 mg/l. Additional monitoring to determine survival, the result of all potential causative factors, including those beyond the Project's influence, will be done to establish a complete basis for evaluating the achievement. This additional monitoring includes ratios of dead/live eggs and dead/live alevins, and snorkel surveys for fry presence during the emergence period.

7.3 <u>Calibration and Maintenance</u>

The field technician will ensure the calibration of each of the pieces of equipment prior to going to the field according to manufactures specifications.

7.3.1 Flow

The powerhouse penstock flow meters are highly accurate. The measurement system is an eight path Accusonic 7500 panel. Each bifurcation has an eight path setup to measure flows. Overall accuracy of the system is +/- 1% of maximum scale (+/-26 cfs total in this installation). The accuracy (calibration) is defined by having precise as-built values of the distance between sensors on each path, functioning sensors and electronics. Typically these flow meters loose accuracy by having the surface of the sensor scoured by debris in the water. This occurs very slowly over time, particularly since the water from Lake Chelan contains very little suspended material. To calibrate these meters, a technician from Accusonic measures the reads on each individual channel to verify the integrity of the sensors and performs diagnostics on the computer boards in the panel. It is not necessary to calibrate frequently. The last calibration was performed in September 2005.

Spillway rating curves for low volume discharge (80 cfs – 500 cfs) were compared for accuracy with USGS estimates of streamflow at the hydrology station during temperature modeling studies conducted in 2002. Spillway rating curves for higher discharges had been compared with USGS measurements in earlier years. Spillway flow calculations have a precision of about 5 to 10 percent of the measured flow. The USGS streamflow estimates likely are less precise, but provide a basis for comparison to assure that spillway rating tables are within the norms of accuracy for streamflow calculations. The location of the USGS gauging site (USGS 12452500 Chelan River at Chelan) is described by USGS as: Latitude 47°50'05", Longitude 120°00'43", in SE 1/4 NE 1/4 Section 30, Township 27 North, Range 23 East, in Chelan County, Hydrologic Unit 17020009, at Chelan River powerplant tailrace, 4.3 miles downstream from control dam at outlet of Lake Chelan, 3.0 miles southeast of Chelan, and at river mile undetermined. Datum of gage is 1,074.66 feet above NGVD of 1912. (http://waterdata.usgs.gov/nwis/dv/?site_no=12452500).

The ultrasonic flow meters installed in the LLO and pump station have been factory calibrated and installed following the manufacturer's instructions for calibration testing. The accuracy of these flow meters has been determined using field verification techniques, which included comparison with other flow measurement procedures, such as open channel flow measurements at outlet structures or streamflow estimation in the river channel. The precision of the ultrasonic flow meters is within two to five percent of the maximum discharge of each conveyance pipe or channel. The precision of open-channel flow measurement and/or streamflow estimation in the river channel will be lower, but by comparison with these methods is operating accurately.

The frequency of maintenance and re-calibration of the above flow measurement devices and methods will follow manufacturer's recommendations for the new flow meters and will be on an as-needed basis for the lake level gauge following maintenance or any observed malfunction. Comparison of spillway discharge, LLO flows and powerhouse discharge with USGS streamflow estimations will be pursuant to USGS standards, which have been developed over the history of the Lake Chelan Project. The USGS relies on the spillway and powerhouse discharge calculations for their reporting of Chelan River flows and Chelan PUD has and will continue to coordinate with USGS in maintaining the accuracy of these flow measurements, as well as new flow measurements from the LLO.

7.3.2 Temperature

For all field-deployed equipment, a pre-and post-calibrated protocol will be conducted in accordance with the manufacturer's recommendations to document instrument bias and performance at representative temperatures.

Additionally, each month or quarter when the data are downloaded from the loggers the Chelan PUD staff will inspect the equipment to ensure it has not been damaged, has sufficient battery power (with the exception of equipment that does not show battery life, which will be replaced prior to expected battery failure), shows no signs of biofouling, and is generally in good condition. It will be cleaned as needed and replaced if damaged. The real-time equipment will be inspected and maintained in accordance with the manufacturer's recommendations.

7.3.3 DO, TDG, Turbidity and pH

Pre- and post-calibration for pH will consist of comparisons to two reference standards immediately before and after each sampling event. The two standards will be composted of pH values just outside the range of 6.5 to 8.5 units; such as 4.0 ph units and 10.0 pH units. Pre and post-calibration for TDG and DO sampling will follow manufacturer's instructions. Pre and post-calibration for turbidity will consist of comparisons to reference standards provided with the equipment immediately before and after each sampling event.

Meters will be checked for proper performance at the deployment site at the beginning and end of each deployment. After calibration and prior to each deployment, meters will be placed side by side and readings reviewed to ensure the data are acceptable for reporting. A significant discrepancy between readings will result in a review of meter performance.

7.4 <u>Analytical Methods</u>

The analytical methods for data collected under this QAPP will center on two principle objectives:

1. The data will be collected with equipment and in such a manner to ensure that the MQOs are met; and
2. The equipment and methodologies will be discussed in this section.

Analytical methods for each parameter to be monitored are included below.

7.4.1 Flows

Flows discharged from the turbines into the project powerhouse tailrace are measured using an ultrasonic flow meter. The device uses ultrasonic sound wave sensors to measure the velocity of the water in a cross section of the penstock. The sensors are located approximately 30-feet upstream of the turbine inlet valve (TIV), with one flow meter in each leg of the bifurcation from the main power tunnel. Combining the two measurements provides the total flow through the penstock, including turbine, irrigation and raw water flows. The data are already electronically transmitted to a central server which can easily be accessed using the database system that specializes in handling real-time data referred to as PI, from any of several computers within the Chelan PUD.

7.4.2 Temperature

Water temperature data collected will be analyzed on a yearly basis by calculating mean-daily, maximum, and minimum values. Calculations will also be made to determine the 7-DADMax temperatures. Tabular and graphical displays of the mean-daily, maximum, minimum, and 7-DADMax temperature values will also be provided in annual water quality monitoring reports to Ecology.

7.4.3 DO, pH, Turbitidy and TDG

Measurements of DO, pH turbidity, and TDG are obtained using Hydrolab MS5 Minisondes programmed to record data every hour and will be displayed tabular and graphically.

7.4.4 Petroleum Products

Petroleum monitoring is to be conducted in two ways: the first is a weekly visual inspection of the powerhouse tailrace for sheen; the second is the report of any spills in compliance with the SPCC plan. The petroleum monitoring will be conducted by the dam operators. They will be required to fill out a form indicating that they have completed the inspection, whether any sheen was observed, and if sheen was observed who they notified. The SPCC plan is an independent document that describes the process to be followed if a spill occurs. A copy can be made available upon request.

7.4.5 Intragravel DO

The data for intragravel DO will be collected hourly to ensure that redds are receiving enough oxygen will be collected on a data logger. During all scheduled (non-emergency) powerhouse shutdowns during egg incubation, powerhouse tailrace and Reach 4 intragravel DO will be monitored hourly each week for at least one 24-hour period. It is anticipated that these data will be collected from equipment placed by divers and left in the powerhouse tailrace and Reach 4 substrate.

Monitoring of DO will detect if serious oxygen depletion is occurring in the redds in the powerhouse tailrace, which provides for proactive triggering of decisions to protect redds before survival is seriously affected. The objective is to maintain oxygen levels in the redds at or above 6.0 mg/l. Additional monitoring to determine survival, the result of all potential causative factors, including those beyond the Project’s influence, will be done to establish a complete basis for evaluating the achievement. This additional monitoring includes ratios of dead/live eggs and dead/live alevins, and snorkel surveys for fry presence during the emergence period.

SECTION 8: DATA MANAGEMENT PROCEDURES

The data collected from this effort will vary depending on whether it is collected occasionally (TDG, DO, turbidity and pH), weekly (petroleum visual inspections), or hourly (temperature and flow). The data management for each will be discussed in this section.

8.1 Management for Hourly Data

Data management will vary depending on whether it is transmitted in real-time or logged and downloaded periodically. The data that are collected in real-time will be automated to be transmitted directly into Chelan PUD's PI database system as they are collected. This data management system is used on a regular basis across the Chelan PUD to manage power, flows, temperatures and many other parameters. Data that are logged and downloaded monthly or quarterly (including the DO monitoring conducted in accordance with the Comprehensive Plan), will be saved in a separate database for ease of availability and safe, archived keeping.

The reported data are anticipated to include the location of collection, the time of collection (by the interval determined if real-time), hourly data (averaged over the hour if more than one reading is collected per hour), and the date of collection.

8.2 Management for Weekly Data

The weekly data consists only of the reported visual inspections for petroleum. For the sake of reliability and simplicity, an online form will be used by the project operators to report that they have conducted the inspections and what the outcome is. The form will be stored on the Chelan PUD intranet, filled out and downloaded monthly. The data that are downloaded will be stored on the Chelan PUD server in a secure folder. The server is backed up regularly to protect the data.

8.3 Management for Years Three and Five Data

The data collected during the years three and five will be collected using portable equipment and data loggers. The device will be taken back to Chelan PUD headquarters and the downloaded data imported to a desktop personal computer. The downloaded files will be arranged in a spreadsheet with necessary qualifying information (e.g. dates and time sampled, locations sampled, parameters evaluated, units of interest, etc.), reviewed and verified, and saved to the Chelan PUD server, which is backed up regularly. Data will not be deleted from the hand-held device until it is confirmed that the spreadsheet of corresponding data are securely stored on the server.

SECTION 9: AUDITS

Two forms of audits will be conducted in this effort: field audits and reporting audits. Each will be discussed in this section.

9.1 Field Audits

Once per year the Chelan PUD will send an additional person into the field to monitor and audit all field activities including equipment set up, data downloads, hand-held monitoring (if any), and safety. The auditor will focus on ensuring that all SOPs are followed, calibrations are conducted in compliance with manufacturers' specifications when applicable, and this QAPP is followed. The auditor will provide a brief write up of their observations including any deviations from plan and whether the plan should be changed or the process in the field needs to be addressed.

The project manager will be responsible for ensuring that if needed, any corrective actions meet Ecology's approval, and that each corrective action is implemented. A subsequent audit may be required to ensure that the change has been successfully implemented.

9.2 Reporting Audits

It is the responsibility of the Chelan PUD to ensure that all of the reporting requirements of the 401 Certification have been met. The project manager will be responsible for keeping track of the mandated reporting and confirming that it has been met. Specifically, the project manager will access the website monthly or quarterly, as appropriate, to check that the necessary data are present, legible and correct. Additionally, the project manager will review the annual reports to make sure that the data presented are accurate, and verifiable. Any deviations from requirements will be rectified and Ecology will be notified of the deviation and corrective action.

SECTION 10: DOCUMENTATION AND REPORTS

Reporting will be conducted in a variety of ways, which will vary primarily on the frequency of monitoring. Additionally, there will be multiple levels of documentation that will occur during the project. Each is described in this section.

10.1 Monitoring Logs

Monitoring logs will be maintained for all monitoring that occur in the field except the real-time data collection. All logged data, visual inspections, and hand reading activities will have logs associated with them. A standardized form has been generated weekly petroleum visual observations. A proposed version of each monitoring form is presented as Appendix B.

10.2 Periodic Updates

Data collected will be evaluated and flagged to indicate any water quality exceedances and measures taken by the Chelan PUD in conformance with the CRBEIP (Chelan PUD, 2003). The data will be available no later than the 30th of the month following the reporting period and will be posted on the Chelan PUD's website. The Chelan PUD will report exceedances of the water quality criteria within 48 hours to the Central Regional Office. If sheen is observed, it will be considered a violation of surface water quality and will be reported to Ecology within 48 hours of observation. The occurrence of any detection will be sent in a notification describing the likely cause of the sheen and the proposed course of action to be taken. Additionally, in the case of a spill, the conditions of the Chelan PUD SPCC plan will apply. These provisions include the immediate report of any spills to Ecology's 24-hour phone number (509) 575-2490 and a submittal of a detailed written report to Ecology within five days of the event.

10.3 Annual Reports

As required by the 401 Certification, formal reports must be generated throughout the monitoring period. A summary data report (Annual Flow and Water Temperature Report) will be submitted to Ecology by April 30 of each year, providing the data assessment described herein to determine compliance with state water quality criteria (WAC 173-201A). Each year these reports will include temperature and flow data on a monthly basis, from July to September, and quarterly the rest of the year, the results of petroleum product monitoring will be reported annually, unless sheen is observed. In Years 4 (2013) and 6 (2015), results of the DO, turbidity, pH, and TDG monitoring will be reported as a part of the annual report.

The Annual Flow and Water Temperature Report (report) generally will include the results of all field activities, sampling and measurement procedures, conclusions, and recommendations for further action, if necessary. Additionally, the report will include a location map, a site map illustrating the location of the sampling positions and the values observed for each parameter. Chelan PUD will prepare project results reports that will include a discussion of the work and recommendations for further investigation, or actions based on the monitoring results. Each report will contain all monitoring data, data review and verification write ups, non conformance with this plan, and completed monitoring logs reports. A scale drawing approximating sampling locations and sample identification numbers will be included. On-site obstacles will also be noted. Color photographs will be used to document sampling as needed.

SECTION 11: DATA REVIEW, VERIFICATION, AND QUALITY ASSESSMENT

Data will be downloaded from the PI database system to a spreadsheet and reviewed for outliers and values not conforming to the MQOs. Outliers and data not within the MQO tolerances will be evaluated for the cause of the problem. Slight non-conformances will be tolerated, with the data qualified and the poorer precision taken into account in data analysis. Non-conformances that can be traced to membrane or other equipment failure will result in rejection of the data.

Data completeness will be adequate if monitoring is completed with data meeting the MQOs at least 90 percent of the time. A lower rate of data completeness may be acceptable, which will be determined in an overall review of data. All data meeting MQOs will be used.

The results analyses will be evaluated for compliance with acceptance criteria. This evaluation will include collection of temperature data for subsequent modeling, and a statistical evaluation of other data to the numeric criteria. It is anticipated that the average and variance of all data will be assessed to determine the frequency that any numeric water quality criteria have been exceeded, if any. Once the data have been reviewed, verified, and validated, the project manager will determine if the data are of usable quality to make decisions for which the study was designed.

SECTION 12: REFERENCES

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BioAnalysts, Inc., 2003. Effects of Powerhouse Operations on Intragravel Flows and Water Quality within Chinook Redds, First Draft. Lake Chelan Hydroelectric Project FERC Project No. 637. June 30, 2003.

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APPENDIX A: SPECIFICATIONS FOR PROPOSED EQUIPMENT

HOBO® Water Temp Pro v2 (U22-001) Manual

The HOBO Water Temp Pro v2 logger is designed with a durable, streamlined, UV-stable case for extended deployments measuring temperature in fresh or salt water. The small size of the logger allows it to be easily mounted and/or hidden in the field. It is waterproof up to 120 m (400 feet) and rugged enough to withstand years of use, even in stream conditions. It has enough memory to record over 42,000 12-bit temperature measurements.

The logger uses an optical USB communications interface for launching and reading out the logger. The optical interface allows the logger to be offloaded without compromising the integrity of the seals. The USB compatibility allows for easy setup and fast downloads.

HOBO Water Temp Pro v2

U22-001

Included Item:

- Communications window protective cap

Required Items:

- Coupler (COUPLER-C) and USB Optic Base Station (BASE-U-4)
  or
  HOBO Waterproof Shuttle (U-DTW-1)
- HOBOware®

Accessories:

- Protective boot; black (BOOT-BLK) or white (BOOT-WHT)
- Replacement communications window protective caps (U22-U24-CAP)

Specifications

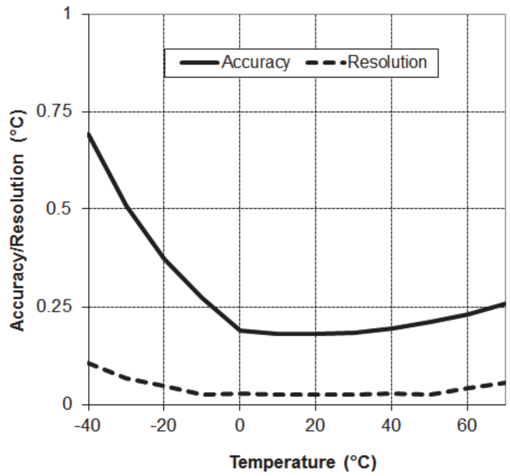
Temperature Sensor

Operation Range	-40° to 70°C (-40° to 158°F) in air; maximum sustained temperature of 50°C (122°F) in water
Accuracy	±0.21°C from 0° to 50°C (±0.38°F from 32° to 122°F), see Plot A
Resolution	0.02°C at 25°C (0.04°F at 77°F), see Plot A
Response Time (90%)	5 minutes in water; 12 minutes in air moving 2 m/sec (typical)
Stability (Drift)	0.1°C (0.18°F) per year

Logger

Real-time Clock	± 1 minute per month 0° to 50°C (32° to 122°F)
Battery	2/3 AA, 3.6 Volt Lithium, factory-replaceable ONLY
Battery Life (Typical Use)	6 years with 1 minute or greater logging interval
Memory (Non-volatile)	64K bytes memory (approx. 42,000 12-bit temperature measurements)
Weight	42 g (1.5 oz)
Dimensions	3.0 cm (1.19 in.) maximum diameter, 11.4 cm (4.5 in.) length; mounting hole 6.3 mm (0.25 inches) diameter
Wetted Materials	Polypropylene case, EPDM o-rings, stainless steel retaining ring
Buoyancy (Fresh Water)	+13 g (0.5 oz.) in fresh water at 25°C (77°F); +17 g (0.6 oz.) with optional boot
Waterproof	To 120 m (400 ft.)
Shock/Drop	1.5 m (5 ft.) drop at 0°C to 70°C (32°F to 150°F)
Logging Interval	Fixed-rate or multiple logging intervals, with up to 8 user-defined logging intervals and durations; logging intervals from 1 second to 18 hours. Refer to the HOBOware software manual.
Launch Modes	Immediate start and delayed start
Offload Modes	Offload while logging; stop and offload
Battery Indication	Battery voltage can be viewed in status screen and optionally logged in datafile. Low battery indication in datafile.
NIST Certificate	Available for additional charge
CE	The CE Marking identifies this product as complying with all relevant directives in the European Union (EU).

Specifications (continued)

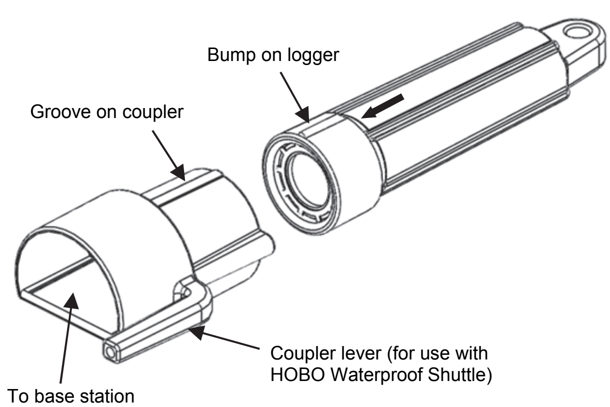


Plot A

Connecting the Logger

The HOBO Water Temp Pro v2 requires a coupler and USB Optic Base Station or HOBO Waterproof Shuttle to connect to the computer.

1. Install the logger software on your computer before proceeding.
2. Follow the instructions that came with your base station or shuttle to attach the base station or shuttle to a USB port on the computer.
3. Make sure the logger's communications window is clean and dry. (Use a clean, nonabrasive cloth, if necessary.) If the logger is wet, wipe off excess moisture.
4. Attach the coupler to the base station or shuttle, then insert the logger into the coupler so that the bump on the logger slides into the groove of the coupler. There is also an arrow etched on the logger case showing the direction the logger should be inserted into the coupler.



If you are using an older model of this logger and the arrow is not visible, hold the curved side of the coupler up as shown above. Insert the logger with the flat side up (the side in line with the flat side of the mounting hole).

5. If you are using the HOBO Waterproof Shuttle, briefly press the coupler lever to put the shuttle into base station mode.
6. If the logger has never been connected to the computer before, it may take a few seconds for the new hardware to be detected by the computer.
7. Use the logger software to launch the logger. You can check the logger's status, read out the logger while it continues to log, stop it manually with the software, or let it record data until the memory is full.

Refer to the software user's guide for complete details on launching, reading out, and viewing data from the logger, including multiple logging intervals.

Important: USB communications may not function properly at temperatures below 0°C (32°F) or above 50°C (122°F).

Note: The logger consumes significantly more power when it is "awake" and connected to a base station or shuttle. To conserve power, the logger will go into a low-power (sleep) mode if there has been no communication with your computer for 30 minutes. To wake up the logger, remove the logger from the coupler, wait a moment, then re-insert the logger.

Note: The first time you launch the logger, the deployment number will be greater than zero. Onset launches the loggers to test them prior to shipping.

Operation

A light (LED) in the communications window of the logger confirms logger operation. (In brightly lit areas, it may be necessary to shade the logger to see the LED blink.) The following table explains when the light blinks during logger operation:

When:	The Light Does this:
The logger is logging	Blinks once every one to four seconds (the shorter the logging interval, the faster the light blinks); blinks when logging a sample.
The logger is awaiting a start because it was launched in Start At Interval or Delayed Start mode	Blinks once every eight seconds until logging begins

Sample and Event Logging

The logger can record two types of data: samples and events. Samples are the sensor measurements recorded at each logging interval (for example, temperature every minute). Events are independent occurrences triggered by a logger activity, such as Bad Battery or Host Connected. Events help you determine what was happening while the logger was logging.

The logger stores 64K of data, and can record over 42,000 12-bit temperature measurements.

Deploying and Protecting the Logger

Follow these guidelines for deploying and protecting the logger:

Some monitoring applications require precise placement of the temperature sensor, such as measuring the temperature of a flow at the bottom of a stream or river. Ensure that the logger is appropriately secured so that the temperature sensor is in the desired measurement location.

Important: The plastic case will become brittle at temperatures lower than -20°C. If the logger is deployed in a location where the temperature drops below -20°C, make sure the logger remains stationary and is not pulled on or struck. Return the logger to above -20°C before handling.

- The opening at the sensor end of the logger accepts 1/4 inch (6.35mm) diameter nylon cord or other strong cable. If wire is wrapped through the sensor end to secure the logger, make sure the wire loop is snug to the sensor end. Any slack in the loop may cause excessive wear.
- The logger is slightly positive buoyant so that it will float if it is inadvertently dropped in the water or breaks free from its mooring. You may want to mark or label the logger with contact information in case the logger is lost.
- Use the included cap to protect the communications window in the logger from fouling and abrasion. Place the protective cap over the communications window before deploying the logger.
- As an alternative to the included protective cap, use the optional boot (Part # BOOT-BLK or BOOT-WHT) for high fouling environments and for protection against very cold temperatures (which can make the case brittle and prone to fracture) or repeated pounding and abrasion caused by turbulent flow. The boot slides over the logger, has a removable end cap, and is flexible enough to allow you to attach the coupler without removing the boot. To attach the base station, remove the end cap and firmly insert the logger until the boot folds back. Insert the logger into the coupler so that the bump on the logger slides into the groove of the coupler as shown on page 2.

  Although the boot does not cover the sensor end of the logger, the temperature response time (to 90% of final value) in water increases slightly from 5 to 8 minutes due to the increased mass.
- Depending on water conditions and desired measurement location, the logger should be appropriately weighted, secured, and protected.
- An alternative to the optional boot in high fouling environments is to protect the logger with plastic wrap that can be removed and replaced as needed.
- This logger should not be immersed for extended periods in any liquid other than fresh or salt water. To do so may void the warranty (refer to the Service and Support section). If you have any questions about chemical resistance, call Onset.
- Prolonged exposure to chlorinated water is not recommended.
- To clean the logger, rinse it in warm water. Use a mild dishwashing detergent if necessary. Do not use harsh chemicals, solvents, or abrasives, especially on the communications window.

Battery

The battery in the HOBO Water Temp Pro v2 is a 3.6 Volt lithium battery. The battery life of the logger should be about six years. Actual battery life is a function of the number of deployments, logging interval, and operation/storage temperature of the logger. To obtain a six-year battery life, a logging interval of one minute or greater should be used and the logger should be operated and stored at temperatures between 0° and 25°C (32° and 77°F). Frequent deployments with logging intervals of less than one minute, and continuous storage/operation at temperatures above 35°C, will result in significantly lower battery life. For example, continuous logging at a one-second logging interval will result in a battery life of approximately one month.

The logger can report and log its own battery voltage. If the battery falls below 3.1 V, the logger will record a “bad battery” event in the datafile. If the datafile contains “bad battery” events, or if logged battery voltage repeatedly falls below 3.3 V, the battery is failing and the logger should be returned to Onset for battery replacement.

To have your logger’s battery replaced, contact Onset or your place of purchase for return arrangements. Do not open the case or attempt to replace the battery yourself. There are no user-serviceable parts inside. If you open the case, the warranty will be voided, and the logger may no longer be waterproof.

⚠ **WARNING:** Do not cut open, incinerate, heat above 100°C (212°F), or recharge the lithium battery. The battery may explode if the logger is exposed to extreme heat or conditions that could damage or destroy the battery case. Do not dispose of the logger or battery in fire. Do not expose the contents of the battery to water. Dispose of the battery according to local regulations for lithium batteries.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SUPERIOR SENSOR TECHNOLOGY
Hydrolab sondes are built with the industry's best sensor technology, to provide high quality data that you can trust.
UNSURPASSED RELIABILITY
Hydrolab sondes are built to withstand the harshest environmental conditions so you can be confident that your data will be correct at every site, every time.
LONG-TERM VALUE
Hydrolab sondes are built to last, easy to use, and simple to maintain—saving you time and money throughout your ownership of the instrument.
MS 5
Be Right.
The Environment is Worth it.

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Water Quality Instruments

SONDES

MS5

- Four built-in expansion ports configured to fit your specific needs
- Measures up to 10 parameters simultaneously
- Compact and lightweight 1.75" diameter housing fits into groundwater wells
- Used for attended or unattended monitoring

DS5

- Seven built-in expansion ports configured to fit your specific needs
- Measures up to 15 parameters simultaneously
- Capable of measurements using any of Hydrolab's 15 sensors
- Used for attended or unattended monitoring

DS5X

- Ideal for "X-tended" deployments in environments where fouling and sediment are abundant
- Central cleaning system wipes away fouling from adjacent sensors to reduce the maintenance frequency
- Seven built-in expansion ports configured to fit your specific needs
- Measures up to 15 parameters simultaneously

COMMUNICATIONS

SURVEYOR

- Complete set-up capability allows users to leave their laptops in their offices
- Designed specifically for use in severe field conditions, the Surveyor can take a beating on land or in the water and still deliver your data
- Displays data in real-time or can store up to 375,000 measurements
- Oversize screen with backlight allows data to be viewed in any conditions
- Available with optional GPS and Barometric Pressure capabilities

HYDRAS 3 LT

- Real-time, multi-parameter time series graphing and vertical profiling
- Simple, point and click calibration of any parameter
- One-click download for field data collection
- User-programmable stability check on each sensor
- Included free with every Series 5 sonde

Hach LDO®

- Longest lasting calibrations
- Features the best accuracy available for DO measurement
- No membranes so maintenance is simple
- Clark Cell also available

Conductivity

- Open cell allows reliable measurements in any environmental condition —sediment falls to the bottom and bubbles rise to the top

pH

- Reference electrode is easily refilled in seconds—independent of the pH sensor
- pH sensor does not need replacement when reference electrode is depleted; simply refill the reference

Turbidity: Self-Cleaning

- User-programmable self-cleaning system can perform up to 10 cleaning cycles before each reading
- 3000 NTU range allows Turbidity tracking even during rain storms or other events that could cause abnormally high readings
- 4-Beam and Standard Turbidity also available

Depth

- Optimized for depths down to 10m, 25m, 100m, or 200m

Chlorophyll a

- Ultra-compact size designed by Turner Designs specifically for integration into Hydrolab sondes
- Provides the most accurate measurement of Chlorophyll a because of electronic filtration of ambient light, efficient optical coupling, and quality optical components.

Blue-Green Algae

- Real-time measurement identifies potential algal blooms before they become problematic, allowing time for corrective action
- Ultra-compact size designed by Turner Designs specifically for integration into Hydrolab sondes
- Provides the most accurate measurement of phycocyanin or phycoerythrin because of electronic filtration of ambient light, efficient optical coupling and quality optical components

Ion-Selective Electrodes

- Available for monitoring Ammonia/ Ammonium, Nitrate, or Chloride

ORP

- Uses a simple platinum band that donates or accepts electrons to monitor chemical reactions, quantify ion activity, or determine the oxidizing or reducing properties of a solution

Total Dissolved Gas

- Real-time measurement indicates water supersaturated with atmospheric gases, which can cause gas bubble gill disease in aquatic organisms

Rhodamine WT

- Ultra-compact size designed by Turner Designs specifically for integration into Hydrolab sondes
- Provides the most accurate measurement of Rhodamine WT because of electronic filtration of ambient light, efficient optical coupling, and quality optical components

PAR

- Provides a real-time measurement of sunlight intensity, which influences biota that rely on photosynthesis for nutrition

Temperature

- Provides critical compensation for Dissolved Oxygen, Conductivity, pH, and nutrient sensors
- Included with every sonde

HYDROLAB®

SPECIFICATIONS

Sondes

Size
DataSonde:
Outer diameter – 3.5"/8.9 cm
Length – 23"/58.4 cm
MiniSonde:
Outer diameter – 1.75"/4.4 cm
Length – 29.5"/74.9 cm (with battery pack)

Weight
DataSonde:
7.4 lbs/3.35 kg (typical)
MiniSonde:
2.9 lbs/1.3 kg
(typical with battery pack)

Communication Interface
RS-232, SDI-12, RS-485

Memory
Up to 120,000 measurements

Battery Supply
DataSonde: 8 C batteries
MiniSonde: 8 AA batteries

Operating Temperature
-5 to 50°C

Maximum Depth
200 m

Sensors

	Range	*Accuracy*	*Resolution*
Hach LDO™	0 to 60* mg/L *Exceeds maximum natural concentrations	± 0.1 mg/L @ ≤ 8 mg/L ± 0.2 mg/L @ > 8 mg/L ± 10% reading > 20 mg/L	0.01 mg/L
Polarographic DO	0 to 50 mg/L	± 0.2 mg/L @ ≤ 20mg/L ± 0.6 mg/L @ > 20 mg/L	0.01 mg/L
Conductivity	0 to 100 mS/cm	± (0.5% of reading + 0.001 mS/cm)	
Salinity	0 to 70 ppt	± 0.2 ppt	0.01 ppt
pH	0 to 14 pH units	± 0.2 units	0.01 units
Turbidity, Self-Cleaning	0-3000 NTU	*Compared to StablCal* ± 1% up to 100 NTU ± 3% from 100-400 NTU ± 5% from 400-3000 NTU	0.1 NTU from 0-400 NTU; 1 NTU for >400 NTU
Turbidity, 4-Beam	0-1000 NTU	± (5% of reading + 1 NTU)	0.1 NTU from 0-100 NTU; 1 NTU for >100 NTU
Depth	0 to 10m (Vented Level) 0 to 25m 0 to 100m 0 to 200m	± 0.003 meters ± 0.05 meters ± 0.05 meters ± 0.1 meters	0.001 meters 0.01 meters 0.01 meters 0.1 meters
Chlorophyll a	*Dynamic Range* Low sensitivity: 0.03-500 µg/L Med. sensitivity: 0.03-50 µg/L High sensitivity: 0.03-5 µg/L	± 3% for signal level equivalents of 1 ppb rhodamine WT dye or higher using a rhodamine sensor	0.01 µg/L
Blue-Green Algae (fresh water or marine)	*Dynamic Range* Low sensitivity: 150-2,000,000 cells/mL Med. sensitivity: 150-200,000 cells/mL High sensitivity: 150-20,000 cells/mL	± 3% for signal level equivalents of 1 ppb rhodamine WT dye or higher using a rhodamine sensor	20 cells/mL
Rhodamine WT	*Dynamic Range* Low sensitivity: 0.04-1000 ppb Med. sensitivity: 0.04-100 ppb High sensitivity: 0.04-10 ppb	± 3% for signal level equivalents of 1 ppb rhodamine WT dye or higher using a rhodamine sensor	0.01 ppb
Ion Selective Electrodes			
Ammonia Max Depth: 15 meters	0 to 100 mg/L-N	Greater of ± 5% of reading, or ± 2 mg/L-N	0.01 mg/L-N
Nitrate Max Depth: 15 meters	0 to 100 mg/L-N	Greater of ± 5% of reading, or ± 2 mg/L-N	0.01 mg/L-N
Chloride Max Depth: 15 meters	0.5 to 18000 mg/L	Greater of ± 5% of reading, or ± 2 mg/L	4 digits
TDG (Total Dissolved Gas)	400 to 1400 mmHg	± 1.5 mmHg	1.0 mmHg
ORP	-999 to 999 mV	± 20 mV	1 mV
PAR	0 to 10,000 µmol $s^{-1}m^{-2}$	± 5% of reading	1 µmol $s^{-1}m^{-2}$
Temperature	-5 to 50°C	± 0.10°C	0.01°C

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APPENDIX B: MONITORING LOGS

PETROLEUM PRODUCT VISUAL OBSERVATION

Date*	Time	Personnel	Location	Sheen observed?	If yes, reported?
5/2/2005	12:05	Bob Smith	Chelan Powerhouse Tailrace	No	NA
5/9/2005	14:22	Carol Jones	Chelan Powerhouse Tailrace	Yes	Yes
5/16/2005					
5/23/2005					
5/30/2005					
6/6/2005					
6/13/2005					
6/20/2005					
6/27/2005					
7/4/2005					
7/11/2005					
7/18/2005					
7/25/2005					
8/1/2005					
8/8/2005					
8/15/2005					
8/22/2005					
8/29/2005					
9/5/2005					
9/12/2005					
9/19/2005					
9/26/2005					
10/3/2005					
10/10/2005					
10/17/2005					
10/24/2005					
5/2/2005					
5/9/2005					
5/16/2005					
5/23/2005					
5/30/2005					

* Note: These are example dates. When monitoring begins actual weekly dates will be substituted. The dates will be provided to ensure that no weekly inspections are missed.

TDG, DO, Turbidity and pH Monitoring Sheet

Date:			**Personnel:**	
Monitoring Equipment:				
Location	**Start Time**	**End Time**	**Parameters**	**QA/QC samples**

APPENDIX C: CONSULTATION RECORD

Chelan PUD submitted the draft Quality Assurance Project Plan for Water Quality Monitoring to Ecology on March 16, 2015 for their review and comment. Ecology approved the Plan on April 3, 2015. Emails regarding the aforementioned consultation are provided below. No comments were received from Ecology other than approving the Plan as final.

From:	McKinney, Charlie (ECY)
To:	Steinmetz, Marcie
Cc:	Smith, Michelle; Coffin, Chris (ECY)
Subject:	QAPP Approval, Lake Chelan Project
Date:	Friday, April 03, 2015 1:53:19 PM

April 3, 2015

To: Marcie Steinmetz, Chelan County PUD

From: Charlie McKinney, Water Quality Section Manager, CRO
WA Dept. of Ecology (Ecology)

Ecology has reviewed the **REVISED QUALITY ASSURANCE PROJECT PLAN FOR WATER QUALITY MONITORING** FOR THE **LAKE CHELAN HYDROELECTRIC PROJECT (FERC PROJECT # 637).**
We find this to be an accurate update and that this plan fulfills the requirements under the 401 Water Quality Certification. We have no recommended changes.

Thank you for your cooperation.

Charlie McKinney
Water Quality Section Manager
Central Region Office, Yakima
Washington Dept. of Ecology
509-457-7107

From:	Steinmetz, Marcie
To:	"McKinney, Charlie (ECY)"; Coffin, Chris (ECY)
Cc:	Smith, Michelle; Osborn, Jeff; Sokolowski, Rosana; Bitterman, Deborah
Subject:	For your review - DRAFT REVISED Water Quality Monitoring QAPP for the Lake Chelan Hydroelectric Project No. 637
Date:	Monday, March 16, 2015 4:46:00 PM
Attachments:	Draft Revised 2015 QAPP Water Quality Monitoring for the Lake Chelan Hydroelectric Project.docx

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PUBLIC UTILITY DISTRICT NO. 1 of CHELAN COUNTY
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To: Chris Coffin, Washington Department of Ecology
Charlie McKinney, Washington Department of Ecology

From: Marcie Steinmetz, Water Resources Specialist
Public Utility District No. 1 of Chelan County (Chelan PUD)

Re: Lake Chelan Hydroelectric Project, FERC Project No. 637
REVISED DRAFT 2015 Quality Assurance Project Plan for Water Quality Monitoring

Please find attached the REVISED DRAFT 2015 Quality Assurance Project Plan for your review, in accordance with Section V.B. of the 401 Certification and Article 401 of the license.

Updates to this QAPP were made to revise the 2007 QAPP regarding changes in Ecology's surface water quality standards, Ecology's updated Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies, staffing changes at Chelan PUD and equipment upgrades with improved technology. The frequency of monitoring, parameters monitored, quality assurance and reporting measures have not changed from the 2007 QAPP.

Please submit your comments on or before 3:00 p.m., April 16, 2015 to me via email at marcie.steinmetz@chelanpud.org.

If you have any questions, please do not hesitate to contact me.

Thank you,

Marcie Steinmetz | **Water Resource Specialist**
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