



## **BAKER RIVER PROJECT**

### **DRAFT WATER QUALITY MONITORING PLAN**

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## **1.0 INTRODUCTION**

### **1.1 Background**

Puget Sound Energy (PSE) owns and operates the Baker River Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) No. 2150. On October 17, 2008, FERC issued a new 50-year license to PSE to operate the Project (FERC, 2008). Article 401 of the License requires PSE to prepare a Water Quality Monitoring Plan within six months of license issuance. Preparation of the Water Quality Monitoring Plan is also a requirement of Section 5.6 of the Project's water quality certification (WQC), Washington State Department of Ecology (Ecology) Order No. 2525. According to the license, the Water Quality Monitoring Plan must be approved by Ecology and FERC before monitoring can begin.

This Water Quality Monitoring Plan describes the procedures used to assess compliance with water quality standards during operation of the Project as summarized in Table 2 of the WQC. Ecology identified the following four water quality parameters of primary concern: temperature, dissolved oxygen (DO), turbidity, and total dissolved gas (TDG). Oil and grease has also been added to the monitoring program due to potential concerns of oil used in the operations at the Project's powerhouses.

This plan is prepared for Ecology staff that are familiar with the Project and the PSE staff who will implement the monitoring program. Water quality monitoring during construction and maintenance activities will be addressed in separate Water Quality Protection Plans prepared for these individual construction projects if required by other permitting requirements.

This plan includes an adaptive management section that accounts for interim conditions because changes to Project operations will take several years to implement. Also, it is anticipated that this plan will be modified as needed due to potential changes in the Project operations, regulatory requirements, and/or the assessment of water quality data.

## **1.2 Project Description**

The Project consists of the Upper Baker and Lower Baker Developments. Lake Shannon and Baker Lake are the reservoirs for the Lower Baker and Upper Baker Developments, respectively. Before the Upper Baker Dam was built, Baker Lake existed as a natural lake that occupied about 600 acres of the valley bottom within the northern half of the current footprint of the Baker Lake reservoir.

The Baker River Project study area addressed in this monitoring plan includes the major surface waters that could potentially be affected by the Project. These are (from upstream to downstream):

- Baker Lake<sup>1</sup>
- Upper Baker tailrace – the upper end of Lake Shannon
- Lake Shannon
- Lower Baker tailrace - the portion of Baker River downstream of Lake Shannon and upstream of the Skagit River
- Skagit River

Refer to **Figure 1** for locations of these waterbodies. In this plan, “Upper Baker River” refers to the river segment upstream of Baker Lake and “Lower Baker River” refers to the tailrace segment downstream of Lake Shannon.

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<sup>1</sup> Baker Lake and Lake Shannon are sometimes referred to as Upper Baker Reservoir and Lower Baker Reservoir, respectively. This plan uses the names Baker Lake and Lake Shannon for these waterbodies.

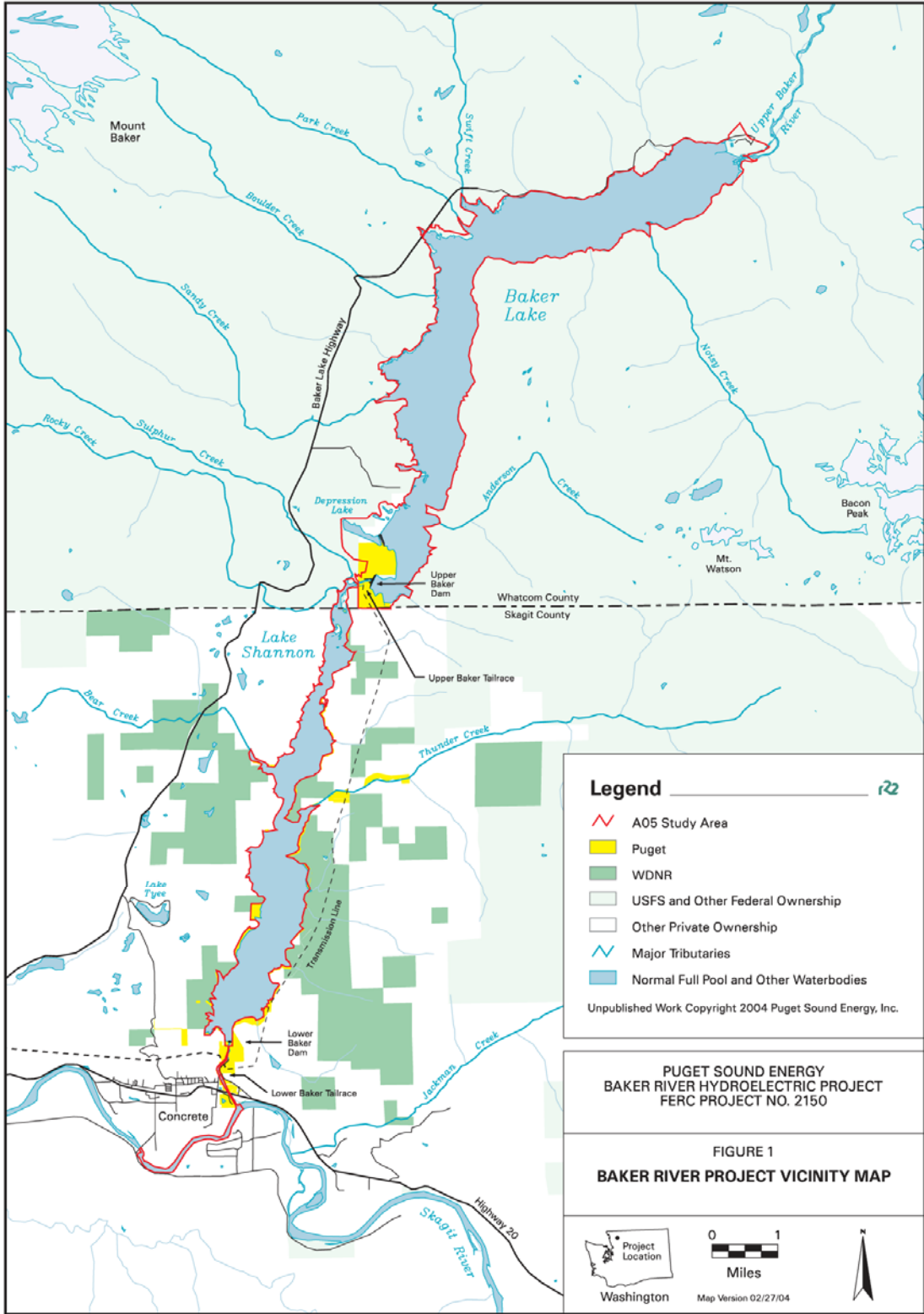


Figure 1. Baker River Project Vicinity Map

## 2.0 WATER QUALITY MONITORING PROGRAM

### 2.1 Monitoring Program Objective

The objective of the Water Quality Monitoring Program is to assess compliance with state water quality standards for Baker Lake, Lake Shannon, and the Baker River as a result of the operation of the Project.

### 2.2 Compliance Locations

The four compliance locations for the Baker River Project are:

- Baker Lake Forebay (Station B-19)
- Upper Baker Tailrace (UB-TR)
- Lake Shannon Forebay (Station SH-A)
- Adult Fish Trap in the Lower Baker Tailrace (FT)

The locations of these stations are shown in **Figure 2**.

### 2.3 Water Quality Parameters

This water quality monitoring plan addresses the following parameters:

- Temperature
- Dissolved oxygen
- Turbidity
- Total dissolved gas
- Oil and grease

The monitoring program required by the WQC is summarized in **Table 1**. The sampling schedule is shown schematically in **Figure 3**.

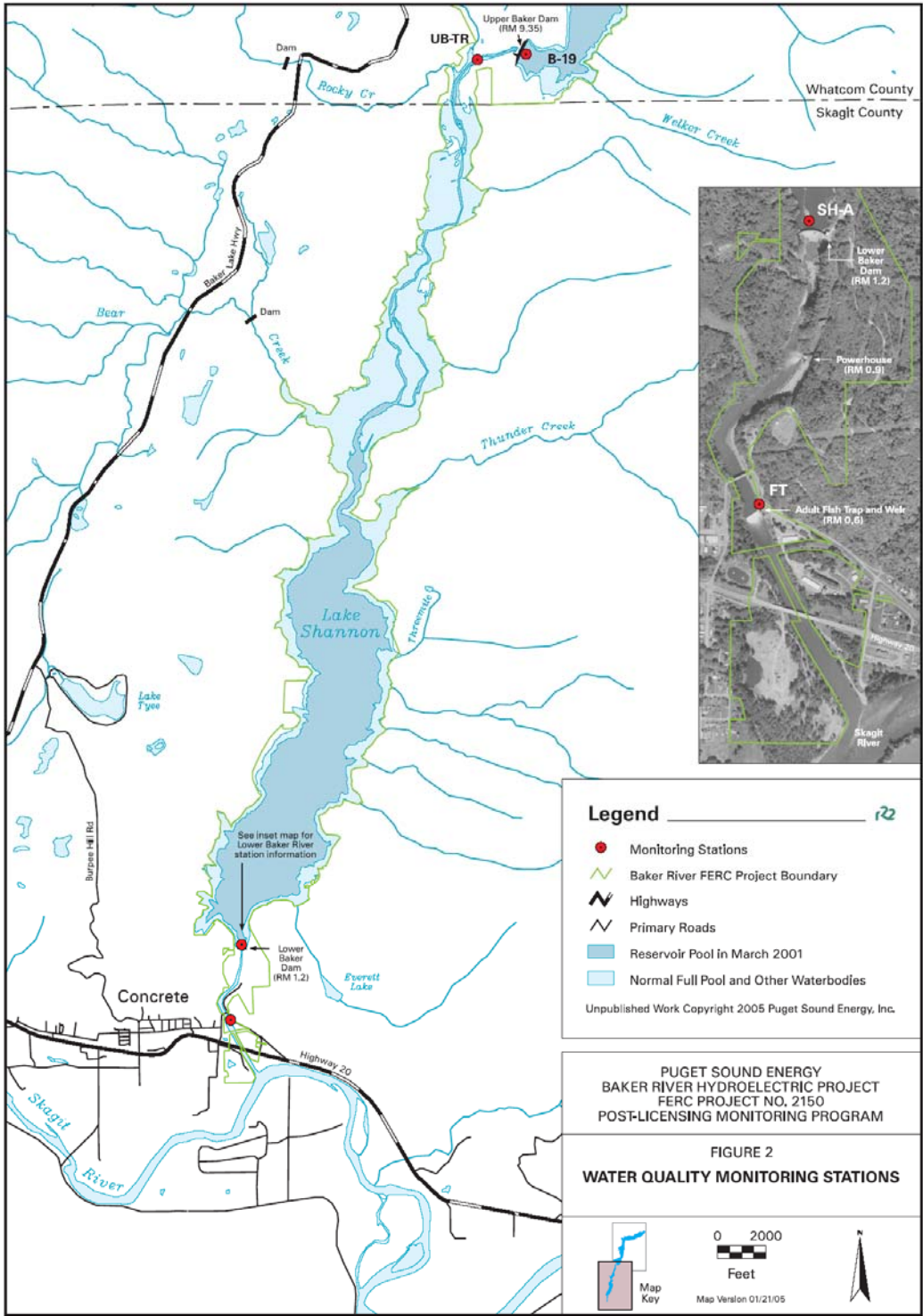


Figure 2. Water Quality Monitoring Stations

**Table 1. Summary of Water Quality Monitoring Program (Source: Baker River Project WQC)**

Parameter	Location	Depths (feet)	Frequency
Flow	Upper Baker Tailrace	--	Hourly
	Lower Baker River	--	15 minutes <sup>1</sup>
Total Dissolved Gas (TDG)	Baker Lake Forebay, B-19	--	No monitoring
	Upper Baker Tailrace, UB-TR	> 7	Spill events: As required in the TDG Abatement Plan
	Lake Shannon Forebay, SH-A	--	No monitoring
	Lower Baker Adult Fish Trap, FT	> 7	New turbine characterization: Hourly from one month before until a minimum of 3 months after installation. Spill events: As required in the TDG Abatement Plan
Temperature <sup>2</sup>	Baker Lake Forebay, B-19	1, 40, 80, 120, ~200	May 1–Oct 31: Hourly
	Upper Baker Tailrace, UB-TR	~1	May 1–Oct 31: Hourly
	Lake Shannon Forebay, SH-A	1, 40, 80, 120, ~200	May 1–Oct 31: Hourly
	Adult Fish Trap, FT	~10	May 1–Oct 31: Hourly
Turbidity	Baker Lake Forebay, B-19	surface	During drawdown <sup>3</sup> : Weekly
	Upper Baker Tailrace, UB-TR	surface	During drawdown <sup>3</sup> : Weekly
	Lake Shannon Forebay, SH-A	surface	During drawdown <sup>3</sup> : Weekly
	Lower Baker Adult Fish Trap, FT	surface	During drawdown <sup>3</sup> : Weekly Background characterization monitoring
Dissolved Oxygen <sup>4</sup>	Baker Lake Forebay, B-19	Every 20' from 0'--200'	1 time characterization May 1–Oct 31: Monthly @ all depths, twice daily (early morning and late afternoon) 1 time characterization Nov 1–April 30: Monthly @ single depth
	Upper Baker Tailrace, UB-TR	surface	Monthly, early morning
	Lake Shannon Forebay, SH-A	Every 20' from 0'--200'	1 time characterization May 1–Oct 31: Monthly @ all depths, twice daily (early morning and late afternoon) 1 time characterization Nov 1–April 30: Monthly @ single depth
	Lower Baker Adult Fish Trap, FT	~10	Monthly, early morning
Oil and Grease	Lower Baker Adult Fish Trap, FT	~1	Monthly

<sup>1</sup> Lower Baker River flow can be determined using data from USGS Station 12193500.

<sup>2</sup> Temperature monitoring shall begin 1 year prior to any project expected to have temperature impacts (e.g. FSC installations at upper and lower dams, new turbine installation). Monitoring shall continue at frequencies outlined above until a monitoring reduction is agreed upon by PSE and Ecology.

<sup>3</sup> Drawdown monitoring is triggered when reservoir elevations are within 5 feet of target elevations; monitoring shall continue for 30 days after reservoir levels are 5 feet above target elevations. Target elevations are 685' and 389' for Baker Lake and Lake Shannon, respectively.

<sup>4</sup> DO monitoring shall begin 1 year prior to any project expected to have DO impacts (e.g. FSC installations at upper and lower dams, new turbine installation). Monitoring shall continue at frequencies outlined above until a monitoring reduction is agreed upon by PSE and Ecology.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Temperature</b>												
Reservoirs												
Tailraces												
<b>Dissolved oxygen</b>												
Reservoirs												
Reservoirs												
Reservoirs												
Tailraces												
<b>Turbidity</b>												
LB Tailrace												
Drawdown Reservoir												
<b>Oil &amp; grease</b>												
<b>TDG monitoring</b>												

Stations	Depths (feet)	Frequency
B-19, SH-A	1, 40, 80, 120, ~200	Hourly
UB-TR, FT	1	Hourly
B-19, SH-A	Every 20 feet to ~200 feet	Monthly
B-19, SH-A	Every 20 feet to ~200 feet	Once - twice daily
B-19, SH-A	1	Monthly
UB-TR, FT		Monthly, early morning
FT	1	Hourly
B-19, SH-A	1	Whenever reservoirs are within 5 feet of the selected targets
Will be specified in the Water Quality Protection Plan		
Will be specified in the TDG Abatement Plan		

Figure 3. Baker River Project Water Quality Monitoring Schedule

## 3.0 METHODS

### 3.1. Temperature

Onset® HOBO® data loggers or their equivalent will be used to monitor hourly temperatures at the stations and depths identified in **Table 1**. A total of 12 temperature loggers will be used. The temperature logger's accuracy will be tested in an ice bath before deployment in May and after retrieval in November. The temperature loggers will be downloaded in June, August, and at the end of the monitoring season. Results of the ice bath tests will be maintained in PSE's records.

### 3.2 Dissolved Oxygen

Dissolved oxygen (DO) will be monitored by a Hach LDO™ sensor installed on a Hydrolab® water quality instrument. The current water quality instrument is a Hydrolab MiniSonde 5. The sensor will be calibrated and serviced according to the manufacturer's instructions ([http://www.hydrolab.com/pdf/Hach\\_LDO\\_Instructions.pdf](http://www.hydrolab.com/pdf/Hach_LDO_Instructions.pdf)).

The DO sampling program consists of 4 main elements:

- **Reservoir profiles** – Monthly sampling at various depths in the forebays of Baker Lake and Lake Shannon between May and October
- **Reservoir surface measurements** – Monthly surface sampling in the forebays of Baker Lake and Lake Shannon between November and April
- **Reservoir diurnal profiles** – Twice daily sampling (early morning and late afternoon) in the forebays of Baker Lake and Lake Shannon, once between May and October
- **Tailrace measurements** – Monthly surface sampling in Upper and Lower Baker tailraces

### 3.3 Turbidity

The turbidity monitoring program consists of two main elements:

- **Background turbidity in the Lower Baker Tailrace** – A Hydrolab water quality instrument with a self-cleaning turbidity sensor will be installed at or near the adult fish trap in the Lower Baker Tailrace. Turbidity will be recorded hourly. The current water quality instrument is a Hydrolab MiniSonde 5. The sensor will be calibrated and serviced according to the manufacturer's instructions ([http://www.hydrolab.com/pdf/Instructions\\_SC\\_Turb\\_S5.pdf](http://www.hydrolab.com/pdf/Instructions_SC_Turb_S5.pdf)). The data will be collected

to be used to establish target turbidity levels to assess compliance during Project operations.

- **Low reservoir turbidity sampling** – Weekly surface sampling will be conducted when the reservoirs are within 5 feet of the target elevations – 685 feet in Baker Lake and 389 feet in Lake Shannon. A portable turbidity meter (Hach 2100P) will be used to collect turbidity samples. Weekly sampling will continue for 30 days after the reservoir levels are 5 feet above the target elevations. The data collected will be used to assess the relative impact of low reservoirs to downstream turbidity levels and evaluate whether the target elevations established for the reservoirs in the Settlement Agreement are appropriate.

### **3.4 Total Dissolved Gas**

Total dissolved gas (TDG) monitoring for spills, if required, will be specified in the TDG Abatement Plan that will be submitted to Ecology and FERC by October 1, 2009. TDG monitoring for the new Lower Baker turbines will begin one month before the installation of the new turbines and continue at least 3 months after installation. Turbines at Lower Baker powerhouse are scheduled to be installed in 2014.

### **3.5 Oil and Grease**

Sampling for oil and grease (if required) will be addressed in the Water Quality Protection Plan for the Project.

## **4.0 REPORTING**

PSE will submit an Annual Water Quality Report to Ecology and FERC by June 30<sup>th</sup> of each year. The annual report will:

- Summarize descriptive statistics (mean, median, standard deviations, etc) for the monitored water quality parameters
- Document violations of water quality standards for the monitored parameters
- Recommend modifications to the monitoring program (if any)

PSE will maintain the water quality database and will supply the data in electronic format to Ecology and FERC in Excel spreadsheet format with the annual report if requested by these agencies. Adjustments to the raw data will be documented within the spreadsheet database and summarized in the Annual Water Quality Report.

## 5.0 QUALITY ASSURANCE AND QUALITY CONTROL

The quality assurance objective is to ensure that the data are of acceptable quality. Procedures outlined by the manufacturer's specifications will be used for operation and maintenance of the water quality instruments. Documentation of the calibration results and field sheets will be maintained by PSE and made available to Ecology as requested.

## 6.0 RESPONSIBILITIES

PSE will conduct the field monitoring, service the water quality instruments, maintain the field sheets and databases, and conduct quality assurance and control review of the data. PSE will submit the Annual Water Quality Reports to Ecology and FERC, documenting the water quality monitoring during the previous year.

## 7.0 ADAPTIVE MANAGEMENT PLAN

The program may be modified during the monitoring period as new data are collected and interim conditions change. Modifications to the monitoring program will require the approval by Ecology and FERC. Ecology will review the annual reports and consult with PSE regarding modifications to the monitoring plan proposed by either party. Ecology and FERC must approve any modifications to the monitoring plan.

Modifications to the monitoring program could occur if the Project demonstrates compliance with water quality standards, the new facilities that may affect water quality are installed, water quality standards change, Project operations change, or for other reasons.

## 8.0 REFERENCES

**Ecology, 2007.** Baker River Hydroelectric Project (FERC 2150), Order No. 2525. Water Quality Certification and Coastal Zone Management Consistency Determination.

**FERC, 2008.** Order on Offer Settlement, Issuing New License, and Dismissing Amendment Application as Moot. October, 17, 2008. Project Nos. 2150-033 and 027.

**GeoEngineers, Inc, 2008a.** Sampling Analysis Plan/Quality Assurance Project Plan, Outfall Discharge Characterization, PSE Lower Baker River Site, Concrete, Washington. August 4, 2006 (revised January 31, 2008).

**Hach 2006.** Hach LDO™ Sensor Instruction Sheet.

**Hach 2005.** Hach Self-cleaning Turbidity Sensor Instruction Sheet.