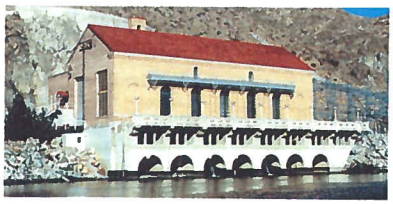




PUBLIC UTILITY DISTRICT NO. 1 *of* CHELAN COUNTY
P.O. Box 1231, Wenatchee, WA 98807-1231 • 327 N. Wenatchee Ave., Wenatchee, WA 98801
(509) 663-8121 • Toll free 1-888-663-8121 • www.chelanpud.org

April 30, 2014

VIA ELECTRONIC MAILING

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

Re: **Lake Chelan Hydroelectric Project No. 637**
Article 405 and Article 408 – 2013 Annual Flow and Water Temperature Report

Dear Secretary Bose and Deputy Secretary Davis:

On September 10, 2013, the Federal Energy Regulatory Commission (Commission) issued its order[1] revising the reporting date to April 30 of each year for the Annual Flow and Water Temperature pursuant to Articles 405 and 408 of the license, and the Water Quality Certificate Condition V.A.(iii) for the Lake Chelan Hydroelectric Project (Project).

Chelan PUD hereby files the 2013 Annual Flow and Water Temperature Report. On March 28, 2014, a final draft of this report was provided to the resource agencies, Tribes and non-governmental organizations specified for 30-day review, which ended April 28.[2] Please refer to Appendix D for the consultation documentation.

Please contact me or Steve Hays at (509) 661-4181 of my office regarding any questions or comments regarding this request.

Sincerely,

Michelle Smith
Licensing and Compliance Manager
michelle.smith@chelanpud.org
(509) 661-4180

cc: Erich Gaedeke, FERC Portland Regional Office
Pat Irle, Washington Department of Ecology
Chelan River Fish Forum
Enclosure: 2013 Annual Flow and Water Temperature Report

[1] 144 FERC ¶ 62,221
[2] *See* http://www.chelanpud.org/departments/licensingCompliance/LC_implementation/corres/42626.pdf

LAKE CHELAN ANNUAL FLOW AND WATER TEMPERATURE REPORT 2013

LICENSE ARTICLES 405 & 408

Final

LAKE CHELAN HYDROELECTRIC PROJECT
FERC Project No. 637

April 30, 2014

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

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Chelan PUD received a new license (License) from the Federal Energy Regulatory Commission (FERC) on November 6, 2006, authorizing Chelan PUD to operate the Lake Chelan dam and powerhouse for a period of 50 years. The License conditions require that Chelan PUD provide minimum flows to the Chelan River and monitor those flows and water temperatures at various locations. The License required the construction of a Low Level Outlet at Chelan Dam, a Reach 4 habitat channel and spawning areas in the tailrace, and operations to protect aquatic life through flow ramping rates and powerhouse operations. The License also requires that Chelan PUD file an Annual Flow and Temperature Report with the FERC documenting compliance with these License requirements.

Flow releases were provided throughout the year from the Low Level Outlet for minimum flows of at least 80 cfs in Reaches 1-3. The runoff forecast for 2013 indicated an average water year, thus minimum flow releases to Reaches 1-3 were at least 200 cfs from May 15 – July 15. Additional flow was provided from the Pump Station to the Reach 4 habitat channel for salmon and steelhead spawning during their respective spawning periods (October 15 – November 30 and March 15 – May 15). During the Chinook spawning period, the Chelan River Fishery Forum approved testing an alternative spawning flow using four instead of five pumps. The spawning flow levels during this test ranged from 279 cfs – 292 cfs. There were two brief deviations below minimum spawning flow requirements in 2013 due to mechanical failures at the Pump Station. The FERC determined that these deviations did not constitute a violation of Article 405 of the license.

Flows were released from the spillway, as needed for lake level control, from June 26 – July 6 and July 10 – July 13. Daily average flow releases for lake level control peaked at 2,987 cfs on July 3, whereas the highest hourly flows of 3,409 occurred during two hours on July 5. Flow releases from the Low Level Outlet were also managed to provide whitewater boating flows on September 21-22. Flows were ramped back down to minimum flows following the event, with ramping concluded on September 23.

In 2013, Chelan PUD implemented operating criteria for compliance with the two inches per hour ramping rates that were refined in 2011. The refined criteria performed well in 2012 and 2013 during the adjustments of spill flows and when ramping down from flows provided for whitewater boating in September. No further adjustments to the ramping rate operating criteria were needed in 2013.

There were 231 salmon redds with eggs incubating in the tailrace from spawning that occurred in 2012. Powerhouse operations for Chinook redd protection, based on results from the previous year's tests, were implemented and monitored to determine if adequate oxygen levels were maintained in Chinook salmon redds. During this study, the tests were designed to gradually approach testing periods of time with no powerhouse flow and the period of time with no powerhouse flow was limited to a maximum of three hours. The 2013 results indicated that dissolved oxygen levels above 6.0 mg/l can be maintained in most redds, even over repeating

cycles of three hours with no flow followed by one hour at minimum generation. After these studies concluded on March 22, the powerhouse operated at full capacity until April 17, by which time emergence of Chinook salmon had concluded.

The powerhouse was intermittently taken out of operation from April 18 – May 4 in order to manage lake refill to meet target elevations for Lake Chelan, then for the most part operated at full capacity through the rest of May. Steelhead spawning was observed in the Reach 4 habitat channel between late March and late April, with 20 redds in the habitat channel and one in the tailrace in flows originating from the habitat channel.

During the Chinook spawning period, powerhouse daily average flows were maintained above 2000 cfs from October 1 –November 21. Powerhouse flows from November 22 – December 1 remained above 850 cfs, with most daytime flows above 2000 cfs. A total count of 727 Chinook redds were estimated to have been deposited in the Chelan River Reach 4 (268), tailrace (319), and downstream in the Chelan/Columbia River confluence and Columbia River (140).

Water temperatures were monitored at seven locations in the Chelan River and tailrace. Water temperatures neither increased nor decreased during transit through the Reach 4 habitat channel. The maximum daily average water temperatures measured from upstream to downstream locations were 23.7 °C at the Low Level Outlet, 23.4 °C from top of Reach 1 through end of Reach 3, 23.5 °C at the bottom of Reach 4, and 24.1 °C in the tailrace. The highest hourly temperatures recorded at these locations were 24.1 °C, 26.1 °C, 26.3 °C and 24.5 °C, respectively. The highest 7-DADMax temperatures recorded were 23.8 °C at the top of Reach 1, 25.8 °C and 25.5 °C at the ends of Reaches 1 and 3, and 24.6 °C at the bottom of Reach 4.

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 Federal Energy Regulatory Commission (FERC) license for operation of this project, issued on November 6, 2006, authorizes Chelan PUD to operate the Lake Chelan dam and powerhouse for a period of 50 years. As part of the normal operation of the Project, Chelan PUD withdraws water from Lake Chelan for power generation and discharges that water through the powerhouse into an excavated tailrace, which leads to the confluence of the Chelan River and the Columbia River. Flows released from the Chelan Dam follow the natural channel of the Chelan River, joining with the powerhouse tailrace flows and discharging to the Columbia River. As a requirement of the new License, minimum flows were established for the Chelan River and that flow was initiated on October 14, 2009.

Chelan PUD filed an Operations Compliance Monitoring Plan (OCMP), as required in License Article 405, which describes how Chelan PUD operates to meet: (1) the instream flows, ramping rates, and tailrace flows as set forth in Article 7 of the Lake Chelan Settlement Agreement and Chapter 7 of the Comprehensive Plan attached to the Settlement Agreement; (2) and the lake levels as set forth in Article 8 of the Settlement Agreement and Chapter 8 of the Comprehensive Plan. The OCMP includes the specifics of flow measurement techniques, electronic flow data posting, quarterly and annual reporting requirements, and an implementation schedule.

Chelan PUD filed a Threatened and Endangered Species Protection Plan (TESPP), as required in License Article 408, which describes: (1) how Chelan PUD implemented provisions for timely development of a system to release water at the Lake Chelan Dam or pump water from the project powerhouse tailrace to the Chelan River, and subsequent operation of that system to continuously maintain flows equal to or greater than the flows required for Chelan River Reach 4; and (2) methods and schedules for monitoring of flows in the project tailrace and in Reach 4 of the Chelan River and annual reporting of the monitoring results, as set forth in Article 7 of the Lake Chelan Settlement Agreement and Chapter 7 of the Comprehensive Plan attached to the Settlement Agreement, and (3) methods for timely determination of the need to take actions to improve water quality characteristics adversely affecting anadromous fish, and identification and implementation of appropriate actions.

The OCMP and TESPP were submitted to the FERC on May 4, 2007 and the FERC issued an order approving the TESPP on November 28, 2007 and an order modifying and approving the OCMP on November 30, 2007. Both the OCMP and TESPP require the recording and reporting of flows in the Chelan River, to evaluate meeting minimum flow requirements, protection of fish habitat and protection of salmon and steelhead eggs incubating in the tailrace. The TESPP also includes annual reporting of water temperature monitoring required in the Lake Chelan Settlement Agreement. The order approving the OCMP requires that Chelan PUD shall file an Annual Flow Report with the FERC by February 28 of each year. Due to weather and snow conditions that frequently prevented retrieval of temperature loggers in January and February, the FERC granted a request from Chelan PUD to change the filing date of these annual reports to April 30. This Annual Flow and Temperature Report meets the flow and temperature reporting requirements of License Articles 405 and 408.

Chelan PUD manages the level of Lake Chelan and flow releases through the powerhouse and into the Chelan River channel at the dam for power generation and other purposes. License Article 405 requires management of lake levels with priority given to maintaining minimum flows in the Chelan River (initiated in 2009) and reducing high spillway flows into the Chelan River to protect fish habitat. This report includes two sections that correspond to the flow reporting requirements of the FERC order: Section 2, Chelan River Instream Flows and Section 3, Powerhouse Tailrace Security Flows. Section 4 of this report contains the water temperature monitoring that was conducted in 2013. In addition, the FERC order requires that Chelan PUD conduct general water quality assessments in years 6 (2012) and 8 (2014) sufficient to demonstrate that the Chelan River meets water quality standards for dissolved oxygen, total dissolved gas, turbidity and pH. Section 5 of this report documents water quality assessments that address this requirement.

SECTION 2: CHELAN RIVER INSTREAM FLOWS

2.1 Chelan River Instream Flows

Flow releases were provided throughout the year from the Low Level Outlet for minimum flows of at least 80 cfs in Reaches 1-3 (Figure 2-1). The runoff forecast for 2013 was 93 percent of average, which is classified as an "average year" for setting minimum flows during the annual runoff cycle. The 2013 minimum flow releases to Reaches 1-3 were at least 200 cfs from May 15 – July 15. Additional flow was provided from the Pump Station to the Reach 4 habitat channel for salmon and steelhead spawning during their respective spawning periods (Figure 2-2). There were two deviations below minimum flow requirements to the Reach 4 habitat channel in 2013, both due to mechanical failures at the Pump Station. The first incident was on March 18, when a pump tripped off-line due to a faulty valve in the intake screen air burst cleaning system. The second incident was on May 2, due to failure of the water seal in a pump, which remained unavailable for the remainder of the spring spawning flow period. In both cases, additional flow was provided from the Low Level Outlet to supplement the flow from the Pump Station, but due to the two - three hour time lag for water from the Low Level Outlet to travel to the Reach 4 habitat channel, there were short-term deviations from the 320 cfs minimum spawning flow requirement. The FERC determined that neither deviation constituted a violation of Article 405 of the license (Appendix C).

Flows were released from the spillway, as needed for lake level control, from June 26 – July 6 and July 10 – July 13. These flow releases were managed to meet lake level target elevations and to avoid high spill levels that could damage the Reach 4 habitat channel. Daily average flow releases for lake level control peaked at 2987 cfs on July 3, whereas the highest hourly flows of 3409 occurred during two hours on July 5. Flow releases from the Low Level Outlet were also managed to provide whitewater boating flows on September 21-22. Flows were ramped back down to minimum flows following the event, with ramping concluded on September 23.

Spawning flows were provided for steelhead trout from March 15 – May 14 and for Chinook salmon from October 15-November 30. The spawning flows were provided through the combination of the Low Level Outlet flows and Pump Station flows, maintaining flow levels of at least 320 cfs during the spring steelhead spawning period. During the Chinook spawning period, the Chelan River Fishery Forum approved testing an alternative spawning flow using four instead of five pumps. The spawning flow levels during this test ranged from 279 cfs – 292 cfs. At the end of each spawning period, flows from the Pump Station were ramped down one pump at a time to avoid fish stranding. Steelhead trout adults were observed spawning in the Reach 4 habitat channel beginning March 20. Spawning continued until April 23, with 21 redds counted in 2013. No new steelhead redds were observed in May, although surveys continued through June 7. Chinook fry were observed rearing in the Reach 4 habitat channel from mid April through June. Chinook spawning began on October 10 and was completed prior to November 27. There were a total of 727 redds counted in the Chelan River Reach 4, the tailrace and Columbia River at the confluence. There were 268 redds in the Reach 4 habitat channel and upstream pool, 319 in the tailrace and 140 in the Columbia River in Chelan River currents below the confluence.

A tabulation of average daily flows from the Low Level Outlet, Pump Station, combined flows into Reaches 1-3 and Reach 4, powerhouse discharge, spill discharge and hourly lake levels and powerhouse tailwater levels are presented in Appendix A. Quarterly hourly data is available at the internet site: http://www.chelanpud.org/lc-Resource-Documents.cfm.

Figure 2-1. Flow Releases to Reaches 1-3 of the Chelan River, 2013.

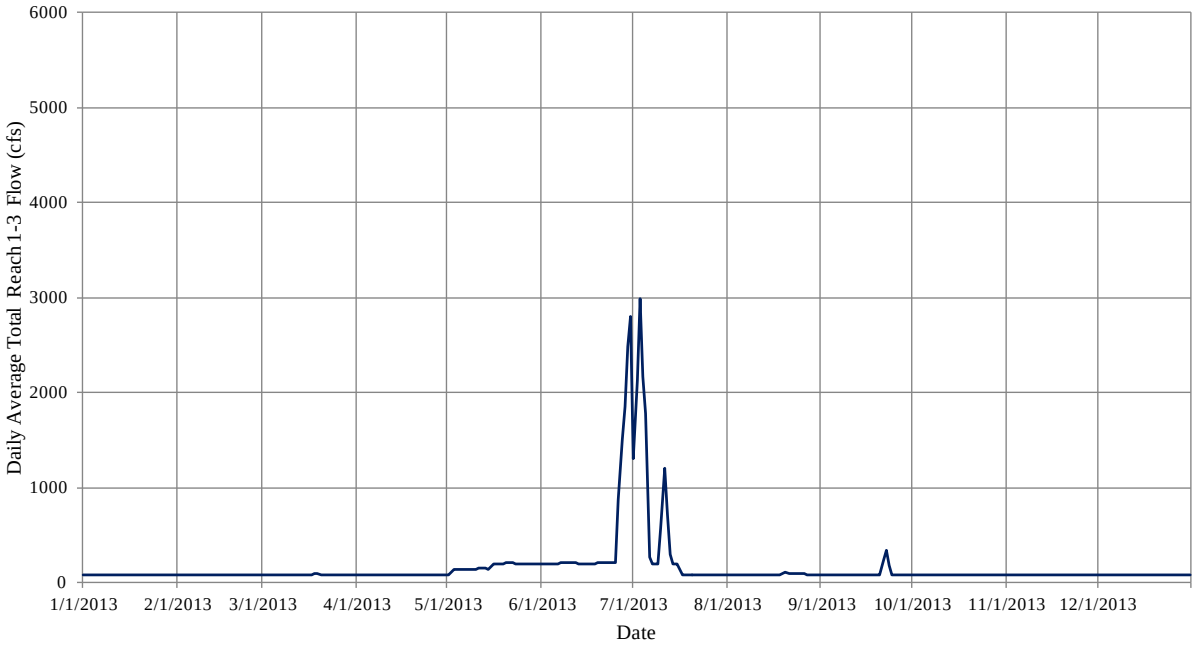
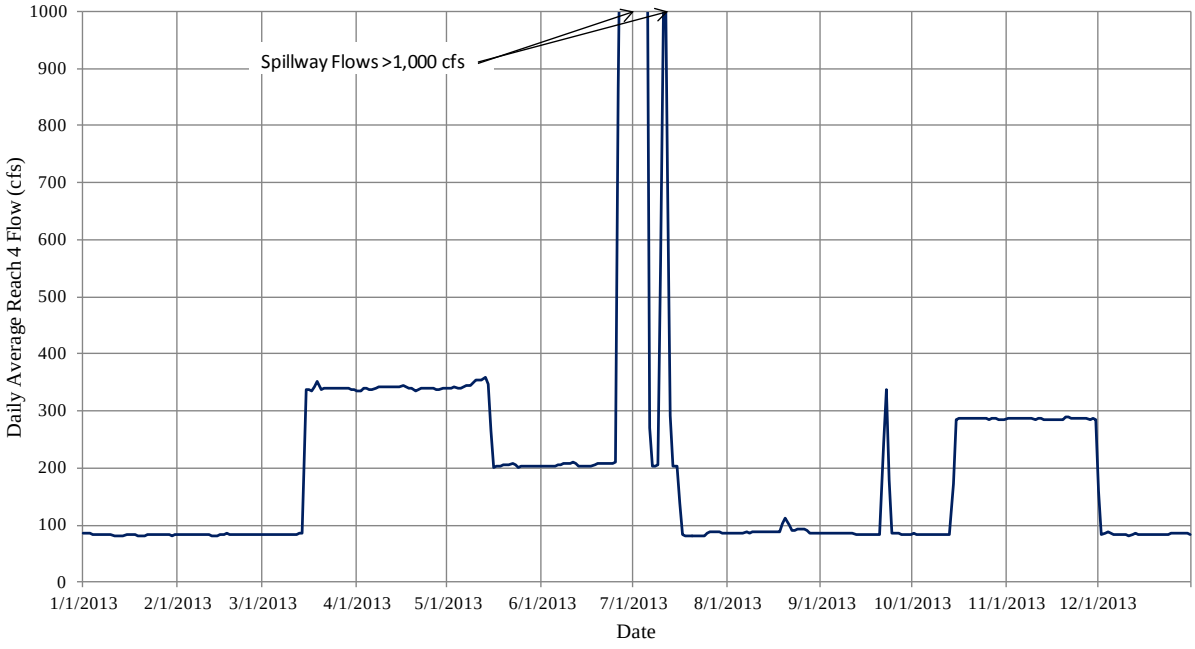


Figure 2-2. Flow Releases to Chelan River Reach 4, 2013.



2.2 Chelan River Ramping Rates

The Lake Chelan Settlement Agreement requires that ramping rates are to be established for the Chelan River to protect aquatic organisms from rapid fluctuations in water levels. The ramping rates for decreases in water levels are initially set at approximately two inches per hour during the period when juvenile salmon and steelhead fry may be present. The OCMP states that the two inches per hour ramping rates will remain in effect until biological evaluations have determined the actual ramping rates necessary to prevent stranding of fish in the Chelan River. The locations in the Chelan River where water level changes will be measured to determine operating criteria for compliance with ramping rates will be determined in consultation with the Chelan River Fishery Forum. A study is scheduled for 2014 to determine the operating criteria for changes in flow from the Low Level Outlet, spillway and Pump Station. The results of this study will establish ramping procedures in terms of allowable flow reductions per hour for these sources of flow releases. Biological evaluations will determine the periods of time during the year when ramping rates will be applied to protect fry from stranding.

The year 2013 was the fourth full year of minimum flow operations for the Chelan River since completion of the Low Level Outlet, Reach 4 habitat channel, and Pump Station. Biological evaluations of fish populations with snorkel surveys in the Chelan River Reaches 1-3 and Reach 4 began in 2012. Results of those surveys have been provided to the Chelan River Fisheries Forum and were included in the 2013 Biological Objectives Status Report. Observations during the snorkel surveys, steelhead spawning surveys (weekly March 15-June 1), summer observations during temperature logger replacement (monthly July, August, September) and fall during Chinook spawning surveys (weekly October – November) determined that Chinook salmon fry were present in the Reach 4 habitat channel during the months of April, May and June. No Chinook or steelhead fry were observed prior to mid April and after July. However, ramping rate operations for juvenile fish were followed throughout the year since the snorkel survey biological evaluations are just in their second year.

In 2013, Chelan PUD implemented operating criteria for compliance with the two inches per hour ramping rates that were refined in 2011 and managed flow releases using those operating criteria in conjunction with onsite monitoring of actual water level changes. Implementation of the refined criteria was successful in 2012 and 2013 during the adjustments of spill flows and when ramping down from flows provided for whitewater boating in September. No further adjustments to the ramping rate operating criteria (Table 2-1) were needed in 2013.

Table 2-1. Ramping Criteria (2013).

Decreasing Spill Ramping Rate Restrictions Except for Plant Safety and System Reliability, the following are License Compliance ramping rate restrictions when reducing spill:	
Maximum Spill Reduction Ramping Rates	
	Ramp Rate
Total Spill* cfs	cfs/hr
1000 < Total Spill	250
500 < Total Spill <= 1000	100
400 < Total Spill <= 500	50
220 < Total Spill <= 400	30
80 < Total Spill <= 220	20
* Total Spill = Low Level Outlet + Spill Gates Note: Only reduce spill during daylight hours (to aid fish movement from potential entrapment areas).	

SECTION 3: POWERHOUSE TAILRACE SECURITY FLOWS

3.1 Powerhouse Operations

There were 231 salmon redds with eggs incubating in the tailrace from spawning that occurred in 2012. Powerhouse operations for Chinook redd protection, based on results from the previous year's tests, were implemented and monitored to determine if adequate oxygen levels were maintained in Chinook salmon redds. During this study, the tests were designed to gradually approach testing periods of time with no powerhouse flow and the period of time with no powerhouse flow was limited to a maximum of three hours. The test cycles began with short periods of only minimum generation (about 800 cfs) with full flow (2,500 cfs) most of the time, which then progressed to running full time at only 800 cfs, then cycles of two hours at 800 cfs, followed by two hours of no flow. The final tests consisted of extended periods where either two or three consecutive hours with no powerhouse flow were followed by only one hour with the powerhouse at minimum generation. The 2013 results indicated that dissolved oxygen levels above 6.0 mg/l can be maintained in most redds, even over repeating cycles of three hours with no flow followed by one hour at minimum generation. After these studies concluded on March 22, the powerhouse operated at full capacity until April 17, by which time emergence of Chinook salmon had concluded. The powerhouse was intermittently taken out of operation from April 18 – May 4 in order to manage lake refill to meet target elevations for Lake Chelan.

During the spawning period for steelhead, the powerhouse operated as previously described until May 4, then for the most part operated at full capacity through the rest of May. Steelhead spawning was observed in the Reach 4 habitat channel in 2013 between late March and late April. Twenty Steelhead redds were located in the habitat channel and one in the tailrace in flows originating from the habitat channel.

During the Chinook spawning period in 2013, powerhouse daily average flows were maintained above 2000 cfs from October 1 – November 21. Powerhouse flows from November 22 – December 1 remained above 850 cfs, with most daytime flows above 2000 cfs. A total count of 727 Chinook redds were estimated to have been deposited in the Chelan River Reach 4 (268), tailrace (319), and downstream in the Chelan/Columbia River confluence and Columbia River (140). Powerhouse flows were above 850 cfs from December 1 – 31, with the exception of two daily periods of no flow (less than 3 hours each) from December 13 – 19 for installation of oxygen monitoring equipment in Chinook redds and cylindrical egg tubes with Chinook eggs for egg-emergence survival studies.

Water surface elevations in the tailrace can fluctuate by several feet over the course of a day due to changes in Columbia River flows that affect the backwater curve of the Rocky Reach reservoir. The water level fluctuations in the tailrace are reduced when the Chelan Powerhouse is operating. In past years, temporary dewatering of a few Chinook redds in shallow areas had been observed when the powerhouse was not operating and Columbia River flows were low. During tailrace spawning habitat construction in 2008 these areas were graded to prevent dewatering. The water levels in the tailrace remained above 707.5 feet most of the time and never dropped below 706.9 feet from January 1 – May 31 and October 15 – December 31. No dewatering of salmon redds was observed in 2013. The daily average tailwater levels measured at the powerhouse are shown in Figure 3-2.

Figure 3-1. Chelan Powerhouse Daily Average Flows, 2013.

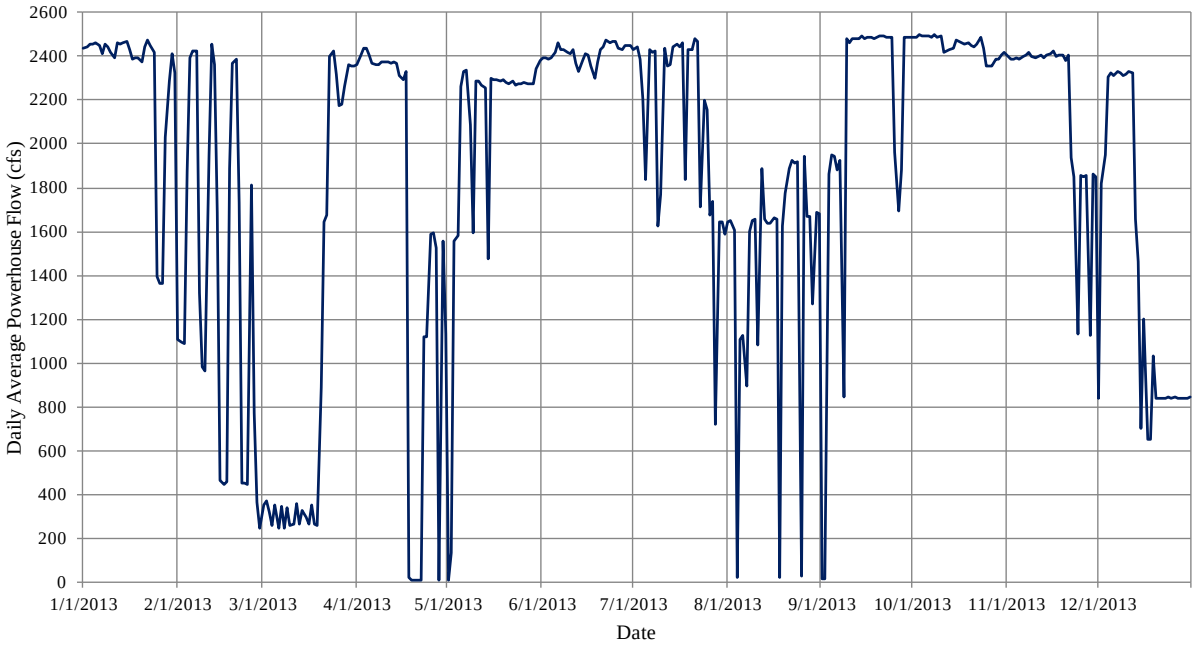
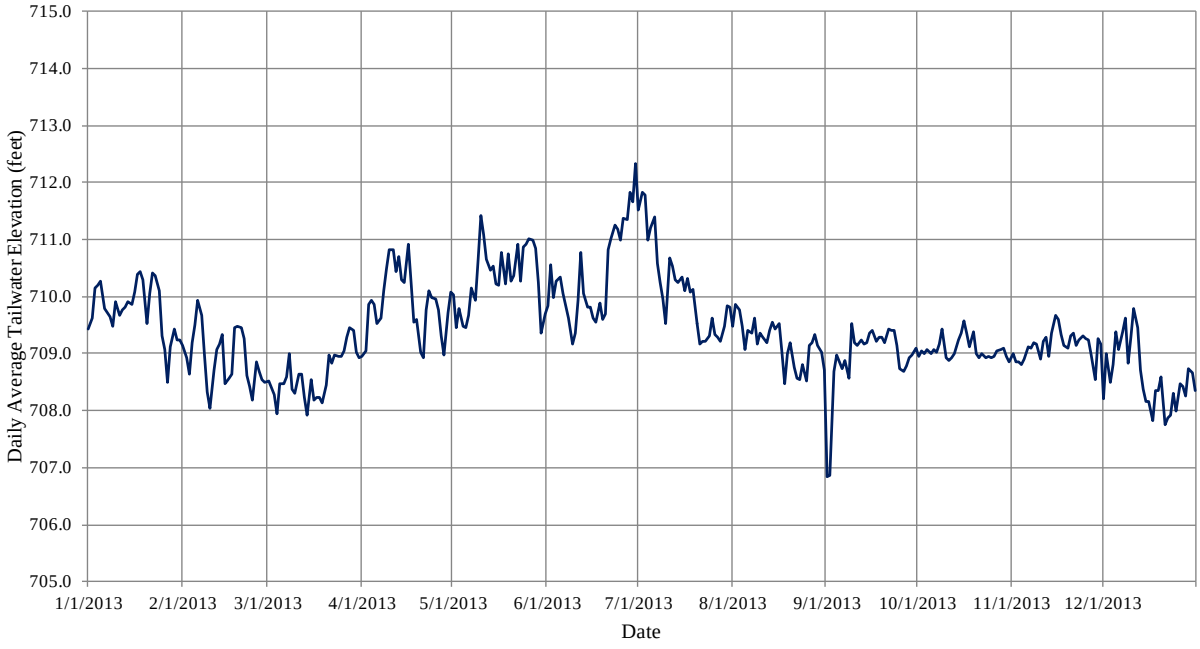


Figure 3-2. Chelan Powerhouse Daily Average Tailwater Elevations, 2013.



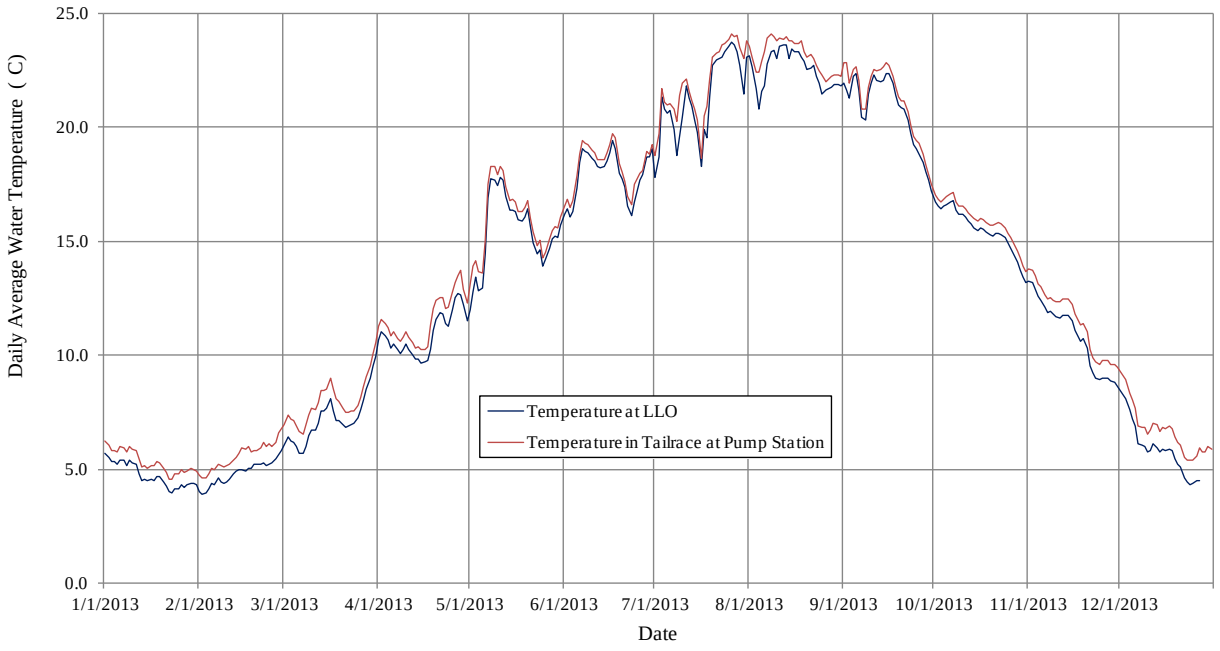
SECTION 4: WATER TEMPERATURE MONITORING

4.1 Water Temperatures Released to Chelan River and Tailrace

Automated water temperature monitoring equipment is installed at two locations, within the pipe that draws water from the base of the Chelan Dam and discharges to the Chelan River through the Low Level Outlet and in the Chelan Powerhouse Tailrace from a sensor mounted on the Pump Station intake screens. These monitoring locations measure the water temperatures that reflect the coolest water available for the Chelan River (Low Level Outlet temperature) and the average of water temperatures arriving at the face of Chelan Dam as drawn through the powerhouse intakes (Chelan Powerhouse Tailrace). Water temperatures measured in the tailrace also represent the temperature of water that is being discharged to the Reach 4 habitat channel when the Pump Station is in operation.

Water temperatures from these sources (Figure 4-1) generally show little stratification in water temperatures at the face of Chelan Dam. The maximum daily average water temperature measured in the Low Level Outlet pipe was 23.7 °C. Hourly water temperatures peaked at 24.1 °C on July 26. Tailrace maximum daily average temperature was 24.1 °C, while hourly temperatures peaked at 24.5 °C on July 28, August 8 and August 14.

Figure 4-1. Low Level Outlet and Tailrace Daily Average Water Temperatures.



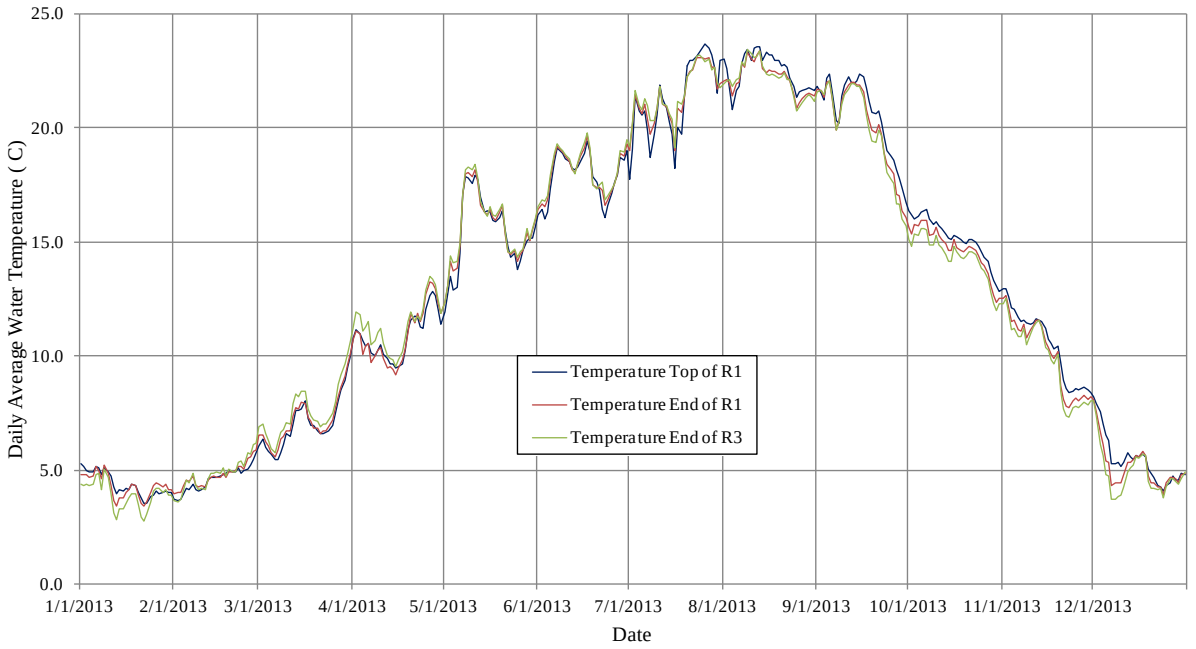
4.2 Water Temperatures in Chelan River Reaches 1-3.

Water temperatures are monitored at three locations with temperature recording data loggers (Onset HOBO Water Temp Pro v2) that are set to record the water temperature at hourly

intervals. These locations are at the top of Reach 1, which measures the temperature of water entering the Chelan River from the Low Level Outlet and the spillway. The location of this temperature logger is set below the mixing zone for these sources of water. The second location is at the end of Reach 1, which is the reach of the Chelan River that has the lowest gradient and least profile shading, thus the greatest potential for water temperature heating during the spring and summer. The third location is at the end of Reach 3, where the Chelan River exits the series of cascades and falls that are the upstream barrier to anadromous fish. The temperature loggers at each location are exchanged several times during the year to retrieve the data. These data are reported quarterly during most of the year, with monthly reporting for July, August and September. These data reports are available at http://www.chelanpud.org/lc-Resource-Documents-WaterQuality.cfm.

The water temperatures recorded at the monitored Reaches in 2013 demonstrated small differences in daily average water temperature between Reaches (Figure 4-2). However, the daily maximum water temperature increased above the temperature at the Low Level Outlet during summer and decreased during the fall. This is not unexpected because the water exiting Lake Chelan is affected by the heat sink effect of the lake's large volume. Water in Lake Chelan is still warming from March – August, but then retains this heat through the late summer and fall, thus water exiting the lake is cooler than sustainable at equilibrium with ambient solar and air temperature conditions through the summer, then tends to be warmer than sustainable through fall and early winter. The maximum daily average water temperatures recorded in 2013 were 23.4 °C at all locations. The highest hourly temperatures recorded were 24.0 °C, 26.1 °C, and 25.9 °C, respectively for the top of Reach 1, end of Reach 1 and end of Reach 3. The highest temperatures were recorded at the end of Reach 1 on July 25 and end of Reach 3 on July 23.

Figure 4-2. Chelan River Reaches 1-3 Daily Average Water Temperatures.

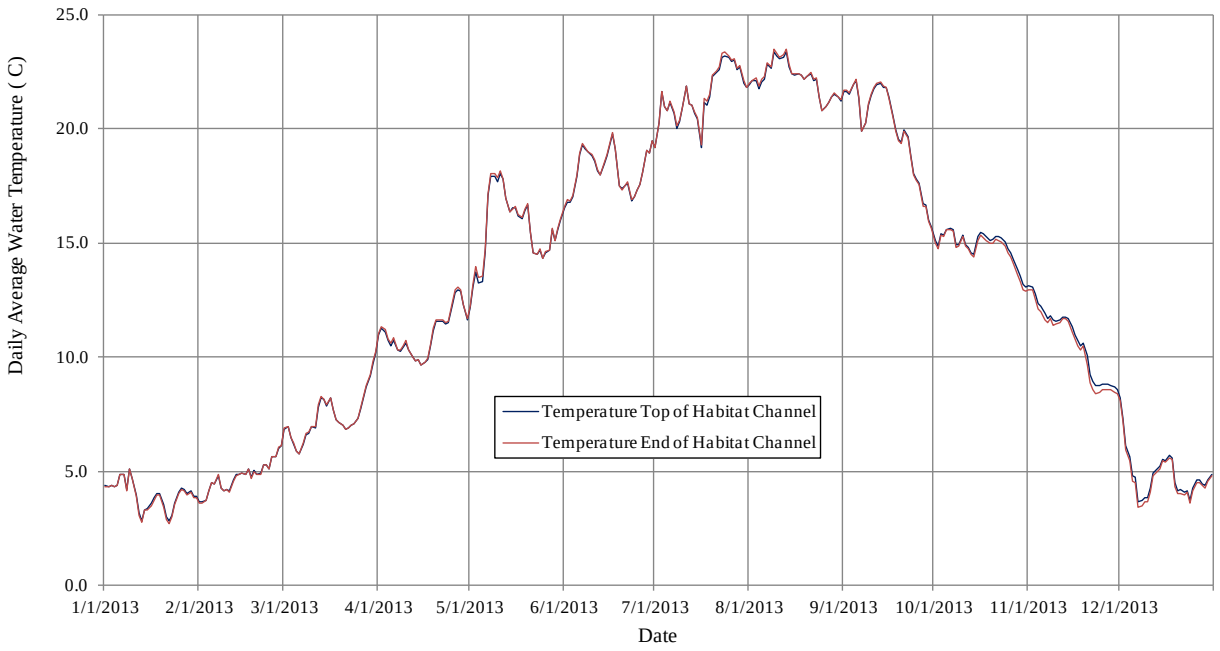


4.3 Water Temperatures in Chelan River Reach 4 Habitat Channel.

Water temperatures are monitored at hourly intervals at two locations (Onset HOBO Water Temp Pro v2), at the upper and lower end of the habitat channel. The upper location records either the water temperature exiting from the pool below the end of Reach 3 or the mixed flows from that source and the Pump Station canal outlet, when the pumps are in operation. The monitoring location at the end of the habitat channel is at the point where habitat channel flows enter into the tailrace, just upstream from where mixing of these flows is expected.

The daily average water temperature data from these locations did not show any evidence of heating as water passed through the habitat channel, despite the lack of significant shade from vegetation under current conditions (Figure 4-3). The maximum daily average temperatures recorded were 23.4 °C at the top and 23.5 °C at the end of the habitat channel. The maximum hourly temperatures were 26.1 °C and 26.3 °C at the upper and lower ends of the habitat channel. These peak temperatures were recorded on July 23.

Figure 4-3. Reach 4 Habitat Channel Daily Average Water Temperatures.



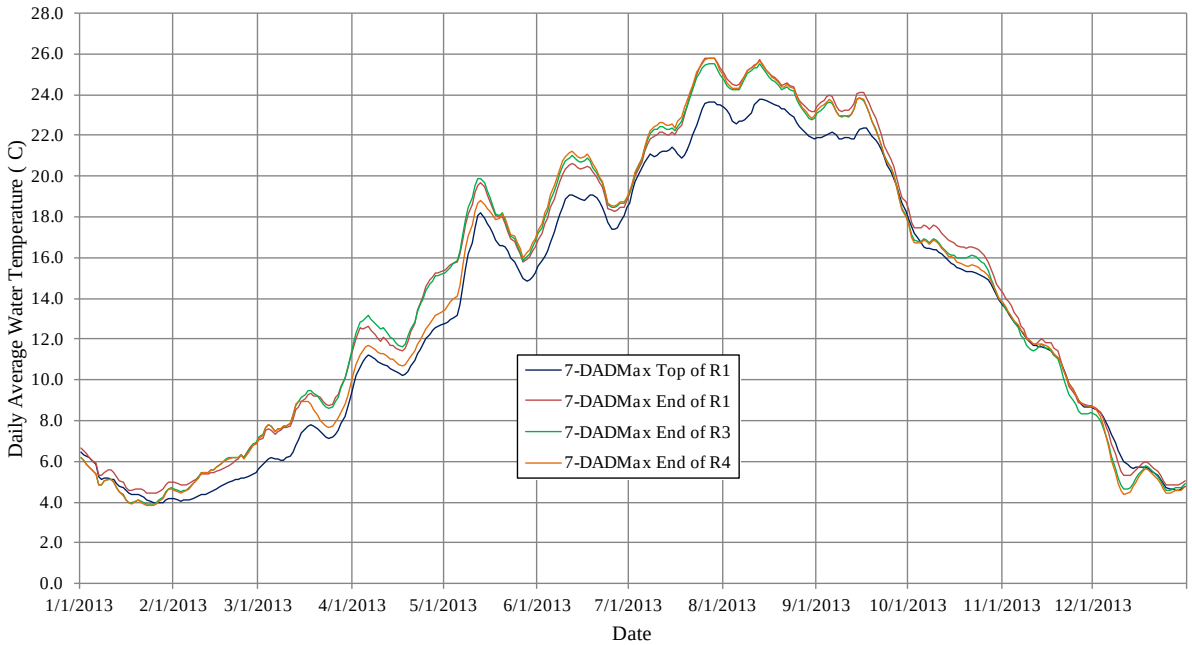
4.4 Chelan River 7-DADMax Water Temperatures Top Reach 1 to Bottom Reach 4.

Washington State water quality standards for temperature establish criteria based on the 7-DADMax (seven day average of daily maximum temperature). The 7-DADMax criterion for the Chelan River is currently 17.5 °C (see Section 5, Table 5-1), with an allowable human effect of 0.3 °C above natural conditions. Natural conditions have not been defined for the Chelan River due to its current status of a river in the initial stages of restoration. However, the temperature of water exiting Lake Chelan is the initial water temperature at the beginning of the

Chelan River. This water is either provided exclusively from the Low Level Outlet, which draws the coolest water available at the face of the Chelan Dam, or is from a mix of water from the spillway and the Low Level Outlet. As water flows through the Chelan River, it either heats or cools, depending on the time of year, since water exiting Lake Chelan is thermally buffered from daily and seasonal environmental influences. The 7-DADMax from the fall through early spring may be warmer at the upper Chelan River (top of Reach 1) than at the lower end where it merges with the tailrace (end of Reach 4). As solar radiation and warmer air temperatures increase from spring through summer, the 7-DADMax will increase as water flows down the Chelan River. The 7-DADMax may be nearly identical at different locations, indicating that the water temperature had reach equilibrium with the external sources of heat gain or loss prior to reaching the downstream monitoring locations.

The 7-DADMax water temperatures from four locations, top of Reach 1, end of Reach 1, end of Reach 3 and end of the Reach 4 Habitat Channel are shown in Figure 4-4. During the periods when flows in Reach 4 are increased for Chinook and steelhead spawning, the water temperatures measured at the end of the Reach 4 Habitat Channel reflects the mix of water from the tailrace and water exiting Reach 3. The difference in temperature is pronounced during the spring when steelhead spawning flows are provided by the pumping station (March 15 – May 15). Prior to and after the spring pumping period, the 7-DADMax at the end of Reach 3 and at the end of the Reach 4 Habitat Channel are nearly identical (Figure 4-4). The 7-DADMax at the top of Reach 1 exceeded the 17.5 °C criterion from June 7 – October 1, reaching a peak of 23.8 C on August 13. The 7-DADMax at the end of Reach 4 exceeded the criterion from May 10 – October 1. The highest 7-DADMax reached 25.8 °C on July 27, 28 and 29. The highest 7-DADMax at the ends of Reach 1 and Reach 3 were 25.8 °C and 25.5 °C, respectively.

Figure 4-4. The 7-DADMax Water Temperatures for Reaches 1 – 4.



SECTION 5: WATER QUALITY ASSESSMENT

General water quality assessment data was not collected in 2013. The requirement for general water quality assessment is that Chelan PUD conduct general water quality assessments in years 6 (2012) and 8 (2014) sufficient to demonstrate that the Chelan River meets water quality standards for dissolved oxygen, total dissolved gas, turbidity and pH. The 401 Certification specifies that this information is to be collected in Reach 4 for dissolved oxygen, turbidity and pH, whereas the total dissolved gas measurements are to be made in Reach 1 below the spillway of the Chelan Dam. Water quality criteria currently applicable to the Chelan River, which has designated aquatic life uses of salmonid spawning, rearing and migration, are shown in Table 5-1.

Table 5-1. Water Quality Criteria for Salmonid Spawning, Rearing and Migration.

	Water Temperature	Dissolved Oxygen	pH	Turbidity	Total Dissolved Gas
Criteria	7-DADMax <=17.5 °C	1 Day Min. 8.0 mg/l	6.5-8.5 Units	-	110 % Saturation
Allowable Human Effect	0.3 °C above natural conditions	0.2 mg/l	< 0.5 Units	5 NTU when Background <= 50 NTU	None

5.1 Assessment of Dissolved Oxygen, pH and Turbidity in Reach 4 Habitat Channel.

There were no measurements for dissolved oxygen, pH and turbidity collected in Reach 4 during 2013.

5.2 Assessment of Total Dissolved Gas in Reach 1 Below Chelan Dam Spillway.

There were no measurements for total dissolved gas taken below the Chelan Dam spillway in 2013. When spill was initiated, no safe location could be found for placing an instrument. A secure and representative method for placing an instrument for measuring TDG will be investigated in 2014.

SECTION 6: SUMMARY

Flow releases were provided throughout the year from the Low Level Outlet for minimum flows of at least 80 cfs in Reaches 1-3. The runoff forecast for 2013 indicated an average water year, thus minimum flow releases to Reaches 1-3 were at least 200 cfs from May 15 – July 15. Additional flow was provided from the Pump Station to the Reach 4 habitat channel for salmon and steelhead spawning during their respective spawning periods (October 15 – November 30 and March 15 – May 15). During the Chinook spawning period, the Chelan River Fishery Forum

approved testing an alternative spawning flow using four instead of five pumps. The spawning flow levels during this test ranged from 279 cfs – 292 cfs. There were two brief deviations below minimum spawning flow requirements in 2013 due to mechanical failures at the Pump Station. The FERC determined that these deviations did not constitute a violation of Article 405 of the license.

Flows were released from the spillway, as needed for lake level control, from June 26 – July 6 and July 10 – July 13. Daily average flow releases for lake level control peaked at 2987 cfs on July 3, whereas the highest hourly flows of 3409 occurred during two hours on July 5. Flow releases from the Low Level Outlet were also managed to provide whitewater boating flows on September 21-22. Flows were ramped back down to minimum flows following the event, with ramping concluded on September 23.

In 2013, Chelan PUD implemented operating criteria for compliance with the two inches per hour ramping rates that were refined in 2011 and managed flow releases using those operating criteria in conjunction with onsite monitoring of actual water level changes. The refined criteria performed well in 2012 and 2013 during the adjustments of spill flows and when ramping down from flows provided for whitewater boating in September. No further adjustments to the ramping rate operating criteria (Table 2-1) were needed in 2013.

There were 231 salmon redds with eggs incubating in the tailrace from spawning that occurred in 2012. Powerhouse operations for Chinook redd protection, based on results from the previous year's tests, were implemented and monitored to determine if adequate oxygen levels were maintained in Chinook salmon redds. During this study, the tests were designed to gradually approach testing periods of time with no powerhouse flow and the period of time with no powerhouse flow was limited to a maximum of three hours. The 2013 results indicated that dissolved oxygen levels above 6.0 mg/l can be maintained in most redds, even over repeating cycles of three hours with no flow followed by one hour at minimum generation. After these studies concluded on March 22, the powerhouse operated at full capacity until April 17, by which time emergence of Chinook salmon had concluded.

The powerhouse was intermittently taken out of operation from April 18 – May 4 in order to manage lake refill to meet target elevations for Lake Chelan, then for the most part operated at full capacity through the rest of May. Steelhead spawning was observed in the Reach 4 habitat channel in 2013 between late March and late April, with 20 redds in the habitat channel and one in the tailrace in flows originating from the habitat channel.

During the Chinook spawning period in 2013, powerhouse daily average flows were maintained above 2000 cfs from October 1 –November 21. Powerhouse flows from November 22 – December 1 remained above 850 cfs, with most daytime flows above 2000 cfs. A total count of 727 Chinook redds were estimated to have been deposited in the Chelan River Reach 4 (268), tailrace (319), and downstream in the Chelan/Columbia River confluence and Columbia River (140).

Water temperatures were monitored at seven locations in the Chelan River and tailrace. Water temperatures neither increased nor decreased during transit through the Reach 4 habitat channel.

The maximum daily average water temperatures measured from upstream to downstream locations were 23.7 °C at the Low Level Outlet, 23.4 °C from top of Reach 1 through end of Reach 3, 23.5 °C at the bottom of Reach 4, and 24.1 °C in the tailrace. The highest hourly temperatures recorded at these locations were 24.1 °C, 26.1 °C, 26.3 °C and 24.5 °C, respectively. The highest 7-DADMax temperatures recorded were 23.8 °C at the top of Reach 1, 25.8 °C and 25.5 °C at the ends of Reaches 1 and 3, and 24.6 °C at the bottom of Reach 4.

APPENDIX A: DAILY AVERAGE LAKE CHELAN ELEVATIONS, POWERHOUSE FLOWS, TAILWATER ELEVATIONS AND CHELAN RIVER FLOWS FROM SPILL, LOW LEVEL OUTLET AND PUMPING STATION

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
1/1/2013	1091.1	2437	709.4	86	0	86	0	86
1/2/2013	1091.0	2441	709.6	85	0	85	0	85
1/3/2013	1090.8	2455	710.2	85	0	85	0	85
1/4/2013	1090.7	2454	710.2	84	0	84	0	84
1/5/2013	1090.6	2458	710.3	84	0	84	0	84
1/6/2013	1090.5	2451	709.8	84	0	84	0	84
1/7/2013	1090.4	2414	709.7	83	0	83	0	83
1/8/2013	1090.3	2454	709.6	83	0	83	0	83
1/9/2013	1090.2	2443	709.5	83	0	83	0	83
1/10/2013	1090.1	2416	709.9	83	0	83	0	83
1/11/2013	1089.9	2395	709.7	82	0	82	0	82
1/12/2013	1089.8	2463	709.8	82	0	82	0	82
1/13/2013	1089.7	2456	709.8	81	0	81	0	81
1/14/2013	1089.5	2464	709.9	82	0	82	0	82
1/15/2013	1089.4	2469	709.9	84	0	84	0	84
1/16/2013	1089.3	2428	710.1	83	0	83	0	83
1/17/2013	1089.2	2388	710.4	83	0	83	0	83
1/18/2013	1089.0	2390	710.4	83	0	83	0	83
1/19/2013	1088.9	2393	710.3	82	0	82	0	82
1/20/2013	1088.8	2372	709.5	82	0	82	0	82
1/21/2013	1088.7	2445	710.1	81	0	81	0	81
1/22/2013	1088.5	2473	710.4	83	0	83	0	83
1/23/2013	1088.4	2446	710.4	84	0	84	0	84
1/24/2013	1088.3	2416	710.1	84	0	84	0	84
1/25/2013	1088.2	1398	709.3	83	0	83	0	83
1/26/2013	1088.1	1365	709.1	83	0	83	0	83
1/27/2013	1088.1	1362	708.5	83	0	83	0	83
1/28/2013	1088.0	2032	709.1	83	0	83	0	83
1/29/2013	1087.9	2283	709.4	82	0	82	0	82
1/30/2013	1087.8	2411	709.2	82	0	82	0	82
1/31/2013	1087.7	2325	709.2	82	0	82	0	82
2/1/2013	1087.6	1105	709.1	85	0	85	0	85
2/2/2013	1087.5	1096	708.9	84	0	84	0	84
2/3/2013	1087.5	1087	708.7	84	0	84	0	84
2/4/2013	1087.5	1877	709.2	84	0	84	0	84
2/5/2013	1087.4	2392	709.5	83	0	83	0	83
2/6/2013	1087.3	2421	709.9	83	0	83	0	83
2/7/2013	1087.2	2424	709.7	83	0	83	0	83
2/8/2013	1087.1	1322	709.0	83	0	83	0	83
2/9/2013	1087.0	982	708.3	83	0	83	0	83
2/10/2013	1087.0	964	708.1	83	0	83	0	83
2/11/2013	1086.9	1948	708.7	82	0	82	0	82
2/12/2013	1086.8	2453	709.1	82	0	82	0	82
2/13/2013	1086.7	2363	709.2	82	0	82	0	82
2/14/2013	1086.6	1689	709.3	81	0	81	0	81
2/15/2013	1086.5	466	708.5	83	0	83	0	83
2/16/2013	1086.5	449	708.6	85	0	85	0	85
2/17/2013	1086.6	460	708.7	85	0	85	0	85
2/18/2013	1086.5	1886	709.5	84	0	84	0	84
2/19/2013	1086.5	2368	709.5	83	0	83	0	83

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
2/20/2013	1086.4	2383	709.5	83	0	83	0	83
2/21/2013	1086.2	1732	709.3	83	0	83	0	83
2/22/2013	1086.2	454	708.6	83	0	83	0	83
2/23/2013	1086.2	452	708.4	83	0	83	0	83
2/24/2013	1086.2	448	708.2	83	0	83	0	83
2/25/2013	1086.2	1810	708.8	83	0	83	0	83
2/26/2013	1086.1	774	708.7	82	0	82	0	82
2/27/2013	1086.1	369	708.5	83	0	83	0	83
2/28/2013	1086.1	248	708.5	83	0	83	0	83
3/1/2013	1086.1	352	708.5	83	0	83	0	83
3/2/2013	1086.1	372	708.4	83	0	83	0	83
3/3/2013	1086.2	322	708.3	83	0	83	0	83
3/4/2013	1086.2	261	707.9	83	0	83	0	83
3/5/2013	1086.2	356	708.5	83	0	83	0	83
3/6/2013	1086.2	249	708.5	83	0	83	0	83
3/7/2013	1086.3	347	708.6	84	0	84	0	84
3/8/2013	1086.3	250	709.0	84	0	84	0	84
3/9/2013	1086.3	343	708.4	84	0	84	0	84
3/10/2013	1086.3	262	708.3	84	0	84	0	84
3/11/2013	1086.4	268	708.6	84	0	84	0	84
3/12/2013	1086.4	362	708.6	84	0	84	0	84
3/13/2013	1086.4	268	708.2	84	0	84	2	87
3/14/2013	1086.4	331	707.9	85	0	85	0	85
3/15/2013	1086.5	299	708.5	85	0	85	253	338
3/16/2013	1086.6	266	708.2	85	0	85	252	337
3/17/2013	1086.7	355	708.2	86	0	86	251	336
3/18/2013	1086.8	268	708.2	95	0	95	247	342
3/19/2013	1086.8	259	708.1	100	0	100	252	352
3/20/2013	1086.9	890	708.4	85	0	85	253	338
3/21/2013	1087.0	1645	709.0	85	0	85	254	339
3/22/2013	1086.9	1674	708.8	85	0	85	255	340
3/23/2013	1086.9	2395	709.0	84	0	84	255	340
3/24/2013	1086.8	2422	709.0	84	0	84	255	339
3/25/2013	1086.7	2320	709.0	84	0	84	255	339
3/26/2013	1086.6	2177	709.1	83	0	83	255	339
3/27/2013	1086.5	2180	709.3	83	0	83	256	339
3/28/2013	1086.5	2264	709.5	84	0	84	256	340
3/29/2013	1086.4	2359	709.4	83	0	83	256	339
3/30/2013	1086.3	2356	709.0	82	0	82	255	337
3/31/2013	1086.2	2355	708.9	82	0	82	254	336
4/1/2013	1086.2	2363	709.0	82	0	82	254	336
4/2/2013	1086.1	2408	709.1	82	0	82	254	336
4/3/2013	1086.1	2436	709.9	82	0	82	257	339
4/4/2013	1086.2	2438	709.9	82	0	82	257	339
4/5/2013	1086.2	2405	709.9	82	0	82	256	338
4/6/2013	1086.3	2365	709.5	83	0	83	255	338
4/7/2013	1086.4	2362	709.6	83	0	83	256	339
4/8/2013	1086.5	2360	710.1	83	0	83	258	341
4/9/2013	1086.6	2375	710.5	84	0	84	258	342
4/10/2013	1086.6	2374	710.8	84	0	84	259	343

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
4/11/2013	1086.6	2372	710.8	84	0	84	259	343
4/12/2013	1086.7	2367	710.4	84	0	84	258	342
4/13/2013	1086.7	2375	710.7	84	0	84	258	342
4/14/2013	1086.7	2368	710.3	84	0	84	258	342
4/15/2013	1086.7	2310	710.2	84	0	84	258	342
4/16/2013	1086.7	2291	710.9	84	0	84	260	344
4/17/2013	1086.6	2331	710.3	84	0	84	258	341
4/18/2013	1086.6	23	709.6	85	0	85	256	340
4/19/2013	1086.7	10	709.6	83	0	83	256	339
4/20/2013	1086.8	10	709.0	82	0	82	254	336
4/21/2013	1086.9	10	708.9	83	0	83	256	338
4/22/2013	1087.0	12	709.8	83	0	83	258	341
4/23/2013	1087.1	1118	710.1	83	0	83	258	341
4/24/2013	1087.2	1118	710.0	83	0	83	257	340
4/25/2013	1087.2	1590	710.0	83	0	83	257	340
4/26/2013	1087.3	1594	709.8	83	0	83	256	339
4/27/2013	1087.3	1524	709.3	83	0	83	253	337
4/28/2013	1087.4	10	709.0	85	0	85	252	337
4/29/2013	1087.6	1555	709.7	84	0	84	255	339
4/30/2013	1087.7	1134	710.1	83	0	83	257	339
5/1/2013	1087.8	12	710.0	83	0	83	256	340
5/2/2013	1087.9	133	709.5	108	0	108	231	339
5/3/2013	1088.0	1558	709.8	137	0	137	204	341
5/4/2013	1088.1	1582	709.5	138	0	138	203	341
5/5/2013	1088.2	2261	709.4	138	0	138	203	341
5/6/2013	1088.3	2328	709.7	139	0	139	203	342
5/7/2013	1088.6	2337	710.2	139	0	139	205	344
5/8/2013	1089.0	2085	709.9	141	0	141	204	345
5/9/2013	1089.5	1594	710.7	144	0	144	206	350
5/10/2013	1090.1	2284	711.4	146	0	146	208	353
5/11/2013	1090.7	2285	711.1	148	0	148	206	354
5/12/2013	1091.3	2268	710.7	150	0	150	204	354
5/13/2013	1091.9	2257	710.5	153	0	153	206	359
5/14/2013	1092.4	1474	710.5	139	0	139	207	347
5/15/2013	1092.7	2297	710.2	173	0	173	92	265
5/16/2013	1093.0	2295	710.2	202	0	202	0	202
5/17/2013	1093.2	2294	710.8	203	0	203	0	203
5/18/2013	1093.4	2285	710.2	204	0	204	0	204
5/19/2013	1093.6	2291	710.7	205	0	205	0	205
5/20/2013	1093.8	2282	710.3	205	0	205	0	205
5/21/2013	1094.0	2277	710.4	207	0	207	0	207
5/22/2013	1094.3	2286	710.9	208	0	208	0	208
5/23/2013	1094.5	2269	710.3	205	0	205	0	205
5/24/2013	1094.6	2272	710.9	202	0	202	0	202
5/25/2013	1094.7	2277	710.9	202	0	202	0	202
5/26/2013	1094.8	2279	711.0	202	0	202	0	202
5/27/2013	1094.9	2271	711.0	202	0	202	0	202
5/28/2013	1094.9	2272	710.8	202	0	202	0	202
5/29/2013	1095.0	2276	710.2	202	0	202	0	202
5/30/2013	1095.1	2343	709.3	203	0	203	0	203

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
5/31/2013	1095.2	2379	709.7	203	0	203	0	203
6/1/2013	1095.2	2393	709.8	203	0	203	0	203
6/2/2013	1095.3	2395	710.6	203	0	203	0	203
6/3/2013	1095.4	2385	710.0	204	0	204	0	204
6/4/2013	1095.5	2391	710.3	204	0	204	0	204
6/5/2013	1095.7	2419	710.4	204	0	204	0	204
6/6/2013	1096.0	2462	710.1	205	0	205	0	205
6/7/2013	1096.3	2430	709.8	206	0	206	0	206
6/8/2013	1096.5	2428	709.6	207	0	207	0	207
6/9/2013	1096.7	2416	709.2	208	0	208	0	208
6/10/2013	1096.9	2413	709.4	209	0	209	0	209
6/11/2013	1097.1	2427	709.9	210	0	210	0	210
6/12/2013	1097.2	2368	710.8	207	0	207	0	207
6/13/2013	1097.3	2329	710.1	203	0	203	0	203
6/14/2013	1097.4	2383	709.8	203	0	203	0	203
6/15/2013	1097.5	2408	709.8	203	0	203	0	203
6/16/2013	1097.5	2403	709.6	204	0	204	0	204
6/17/2013	1097.7	2354	709.6	204	0	204	0	204
6/18/2013	1097.9	2298	709.9	205	0	205	0	205
6/19/2013	1098.1	2377	709.6	207	0	207	0	207
6/20/2013	1098.2	2431	709.7	207	0	207	0	207
6/21/2013	1098.3	2441	710.8	207	0	207	0	207
6/22/2013	1098.4	2473	711.0	208	0	208	0	208
6/23/2013	1098.4	2462	711.3	208	0	208	0	208
6/24/2013	1098.6	2470	711.2	209	0	209	0	209
6/25/2013	1098.7	2466	711.0	209	0	209	0	209
6/26/2013	1098.8	2437	711.4	208	661	868	0	868
6/27/2013	1098.8	2429	711.4	206	1304	1509	0	1509
6/28/2013	1098.9	2447	711.8	206	1639	1845	0	1845
6/29/2013	1098.9	2446	711.7	206	2274	2480	0	2480
6/30/2013	1099.0	2449	712.3	206	2591	2797	0	2797
7/1/2013	1099.1	2427	711.5	203	1102	1306	0	1306
7/2/2013	1099.3	2443	711.8	201	1923	2124	0	2124
7/3/2013	1099.4	2385	711.8	204	2783	2987	0	2987
7/4/2013	1099.5	2205	711.0	203	1959	2162	0	2162
7/5/2013	1099.5	1837	711.2	204	1577	1781	0	1781
7/6/2013	1099.5	2429	711.4	203	67	271	0	271
7/7/2013	1099.6	2420	710.6	203	0	203	0	203
7/8/2013	1099.6	2421	710.2	203	0	203	0	203
7/9/2013	1099.7	1627	710.0	205	0	205	0	205
7/10/2013	1099.9	1770	709.5	204	361	565	0	565
7/11/2013	1099.9	2436	710.7	205	994	1199	0	1199
7/12/2013	1099.9	2354	710.5	204	513	717	0	717
7/13/2013	1099.8	2363	710.3	204	87	291	0	291
7/14/2013	1099.7	2444	710.2	204	0	204	0	204
7/15/2013	1099.7	2453	710.3	204	0	204	0	204
7/16/2013	1099.6	2441	710.1	138	0	138	0	138
7/17/2013	1099.6	2464	710.3	83	0	83	0	83
7/18/2013	1099.6	1835	710.1	82	0	82	0	82
7/19/2013	1099.7	2427	710.1	82	0	82	0	82

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
7/20/2013	1099.7	2429	709.5	82	0	82	0	82
7/21/2013	1099.6	2477	709.2	82	0	82	0	82
7/22/2013	1099.6	2467	709.2	82	0	82	0	82
7/23/2013	1099.6	1714	709.2	82	0	82	0	82
7/24/2013	1099.6	2200	709.3	82	0	82	0	82
7/25/2013	1099.6	2155	709.6	85	0	85	0	85
7/26/2013	1099.6	1674	709.3	87	0	87	0	87
7/27/2013	1099.6	1738	709.3	87	0	87	0	87
7/28/2013	1099.6	720	709.2	87	0	87	0	87
7/29/2013	1099.6	1643	709.5	87	0	87	0	87
7/30/2013	1099.5	1647	709.8	87	0	87	0	87
7/31/2013	1099.5	1585	709.8	85	0	85	0	85
8/1/2013	1099.5	1644	709.5	85	0	85	0	85
8/2/2013	1099.5	1649	709.9	85	0	85	0	85
8/3/2013	1099.5	1610	709.8	85	0	85	0	85
8/4/2013	1099.5	22	709.5	86	0	86	0	86
8/5/2013	1099.6	1111	709.1	86	0	86	0	86
8/6/2013	1099.6	1127	709.4	87	0	87	0	87
8/7/2013	1099.6	898	709.4	87	0	87	0	87
8/8/2013	1099.7	1599	709.6	87	0	87	0	87
8/9/2013	1099.6	1652	709.2	87	0	87	0	87
8/10/2013	1099.6	1658	709.4	87	0	87	0	87
8/11/2013	1099.7	1081	709.3	87	0	87	0	87
8/12/2013	1099.7	1890	709.2	87	0	87	0	87
8/13/2013	1099.7	1655	709.4	87	0	87	0	87
8/14/2013	1099.7	1641	709.5	88	0	88	0	88
8/15/2013	1099.7	1638	709.4	88	0	88	0	88
8/16/2013	1099.7	1665	709.5	87	0	87	0	87
8/17/2013	1099.6	1657	709.0	87	0	87	0	87
8/18/2013	1099.7	24	708.5	88	0	88	0	88
8/19/2013	1099.7	1625	709.0	32	70	102	0	102
8/20/2013	1099.6	1775	709.2	0	111	111	0	111
8/21/2013	1099.5	1890	708.8	0	100	100	0	100
8/22/2013	1099.5	1928	708.6	0	90	90	0	90
8/23/2013	1099.4	1910	708.6	38	53	91	0	91
8/24/2013	1099.3	1922	708.8	93	0	93	0	93
8/25/2013	1099.3	28	708.5	93	0	93	0	93
8/26/2013	1099.3	1946	709.2	93	0	93	0	93
8/27/2013	1099.2	1672	709.2	90	0	90	0	90
8/28/2013	1099.2	1670	709.3	87	0	87	0	87
8/29/2013	1099.2	1273	709.1	86	0	86	0	86
8/30/2013	1099.2	1687	709.0	86	0	86	0	86
8/31/2013	1099.2	1681	708.7	86	0	86	0	86
9/1/2013	1099.2	20	706.8	86	0	86	0	86
9/2/2013	1099.3	20	706.9	86	0	86	0	86
9/3/2013	1099.3	1861	708.7	86	0	86	0	86
9/4/2013	1099.2	1948	709.0	85	0	85	0	85
9/5/2013	1099.2	1943	708.9	85	0	85	0	85
9/6/2013	1099.2	1883	708.7	85	0	85	0	85
9/7/2013	1099.2	1925	708.9	85	0	85	0	85

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
9/8/2013	1099.3	847	708.6	86	0	86	0	86
9/9/2013	1099.3	2479	709.5	85	0	85	0	85
9/10/2013	1099.2	2463	709.2	85	0	85	0	85
9/11/2013	1099.1	2480	709.1	85	0	85	0	85
9/12/2013	1099.0	2478	709.2	84	0	84	0	84
9/13/2013	1098.9	2481	709.2	84	0	84	0	84
9/14/2013	1098.9	2490	709.2	84	0	84	0	84
9/15/2013	1098.8	2480	709.4	84	0	84	0	84
9/16/2013	1098.7	2488	709.4	84	0	84	0	84
9/17/2013	1098.7	2487	709.2	84	0	84	0	84
9/18/2013	1098.6	2483	709.3	84	0	84	0	84
9/19/2013	1098.4	2487	709.3	84	0	84	0	84
9/20/2013	1098.3	2491	709.2	83	0	83	0	84
9/21/2013	1098.2	2490	709.4	243	0	243	0	243
9/22/2013	1098.1	2488	709.4	337	0	337	0	337
9/23/2013	1097.9	2487	709.4	178	0	178	0	178
9/24/2013	1097.8	2484	709.1	86	0	86	0	86
9/25/2013	1097.7	1961	708.7	86	0	86	0	86
9/26/2013	1097.6	1693	708.7	85	0	85	0	85
9/27/2013	1097.6	1879	708.8	84	0	84	0	84
9/28/2013	1097.5	2485	708.9	84	0	84	0	84
9/29/2013	1097.5	2489	709.0	84	0	84	0	84
9/30/2013	1097.5	2483	709.1	84	0	84	0	84
10/1/2013	1097.4	2484	709.0	85	0	85	0	85
10/2/2013	1097.4	2485	709.0	84	0	84	0	84
10/3/2013	1097.3	2496	709.0	84	0	84	0	84
10/4/2013	1097.2	2494	709.1	84	0	84	0	84
10/5/2013	1097.1	2494	709.0	84	0	84	0	84
10/6/2013	1097.0	2493	709.1	84	0	84	0	84
10/7/2013	1097.0	2488	709.0	84	0	84	1	84
10/8/2013	1096.9	2498	709.2	83	0	83	0	83
10/9/2013	1096.8	2489	709.4	83	0	83	0	83
10/10/2013	1096.7	2491	708.9	83	0	83	0	83
10/11/2013	1096.6	2418	708.9	83	0	83	0	83
10/12/2013	1096.5	2425	708.9	82	0	82	0	82
10/13/2013	1096.4	2427	709.0	82	0	82	0	82
10/14/2013	1096.3	2439	709.2	82	0	82	89	171
10/15/2013	1096.2	2471	709.4	82	0	82	203	285
10/16/2013	1096.1	2469	709.6	83	0	83	204	287
10/17/2013	1096.0	2458	709.4	85	0	85	203	288
10/18/2013	1095.8	2453	709.1	85	0	85	202	287
10/19/2013	1095.7	2458	709.4	84	0	84	203	288
10/20/2013	1095.6	2448	709.0	84	0	84	202	286
10/21/2013	1095.5	2445	708.9	84	0	84	202	286
10/22/2013	1095.4	2454	709.0	84	0	84	203	286
10/23/2013	1095.3	2483	708.9	83	0	83	203	286
10/24/2013	1095.2	2435	708.9	83	0	83	203	286
10/25/2013	1095.1	2357	708.9	83	0	83	203	286
10/26/2013	1095.0	2354	709.0	83	0	83	203	286
10/27/2013	1094.9	2358	709.0	83	0	83	204	287

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
10/28/2013	1094.7	2387	709.1	82	0	82	206	288
10/29/2013	1094.6	2388	709.1	82	0	82	202	285
10/30/2013	1094.5	2405	708.9	82	0	82	203	285
10/31/2013	1094.4	2419	708.9	82	0	82	202	284
11/1/2013	1094.3	2400	709.0	84	0	84	203	287
11/2/2013	1094.2	2385	708.9	86	0	86	201	286
11/3/2013	1094.0	2389	708.9	86	0	86	202	288
11/4/2013	1093.9	2389	708.8	85	0	85	201	286
11/5/2013	1093.8	2387	708.9	85	0	85	203	288
11/6/2013	1093.7	2401	709.1	85	0	85	203	288
11/7/2013	1093.6	2406	709.1	84	0	84	202	287
11/8/2013	1093.5	2419	709.2	84	0	84	202	287
11/9/2013	1093.3	2398	709.2	84	0	84	203	287
11/10/2013	1093.2	2395	708.9	84	0	84	202	286
11/11/2013	1093.1	2401	709.2	83	0	83	203	286
11/12/2013	1093.0	2405	709.3	83	0	83	203	286
11/13/2013	1092.9	2391	708.9	83	0	83	201	284
11/14/2013	1092.8	2405	709.4	82	0	82	203	285
11/15/2013	1092.7	2413	709.7	82	0	82	202	285
11/16/2013	1092.6	2422	709.6	82	0	82	202	284
11/17/2013	1092.4	2401	709.3	82	0	82	202	284
11/18/2013	1092.3	2402	709.1	82	0	82	203	285
11/19/2013	1092.2	2407	709.1	83	0	83	200	284
11/20/2013	1092.1	2383	709.3	86	0	86	204	290
11/21/2013	1092.0	2406	709.4	85	0	85	203	288
11/22/2013	1091.9	1937	709.1	85	0	85	203	288
11/23/2013	1091.8	1847	709.2	85	0	85	203	288
11/24/2013	1091.7	1133	709.3	85	0	85	203	288
11/25/2013	1091.7	1859	709.3	84	0	84	203	287
11/26/2013	1091.6	1853	709.2	84	0	84	203	287
11/27/2013	1091.5	1859	709.0	84	0	84	202	286
11/28/2013	1091.4	1127	708.5	84	0	84	202	285
11/29/2013	1091.3	1862	709.3	83	0	83	204	287
11/30/2013	1091.2	1849	709.2	83	0	83	202	285
12/1/2013	1091.2	842	708.2	83	0	83	78	161
12/2/2013	1091.3	1819	709.0	83	0	83	0	83
12/3/2013	1091.1	1947	708.5	85	0	85	0	85
12/4/2013	1091.0	2305	708.8	87	0	87	0	87
12/5/2013	1090.9	2325	709.4	85	0	85	0	85
12/6/2013	1090.7	2309	709.1	84	0	84	0	84
12/7/2013	1090.6	2327	709.4	84	0	84	0	84
12/8/2013	1090.5	2324	709.6	83	0	83	0	83
12/9/2013	1090.4	2313	708.8	83	0	83	0	83
12/10/2013	1090.2	2320	709.3	82	0	82	0	82
12/11/2013	1090.1	2329	709.8	82	0	82	0	82
12/12/2013	1090.0	2323	709.5	83	0	83	0	83
12/13/2013	1089.9	1657	708.7	85	0	85	0	85
12/14/2013	1089.8	1465	708.4	84	0	84	0	84
12/15/2013	1089.8	705	708.2	84	0	84	0	84
12/16/2013	1089.7	1204	708.2	84	0	84	0	84

Date	Lake Chelan Elevation (ft)	Powerhouse Tailrace Flow (cfs)	Powerhouse Tailwater Elevation (ft)	Low Level Outlet Flow (cfs)	Spill Flow (cfs)	Chelan River Flow Reaches 1-3 (cfs)	Pump Station Flow (cfs)	Chelan River Flow Reach 4 (cfs)
12/17/2013	1089.7	652	707.8	84	0	84	0	84
12/18/2013	1089.7	651	708.4	84	0	84	0	84
12/19/2013	1089.7	1035	708.4	84	0	84	0	84
12/20/2013	1089.6	842	708.6	83	0	83	0	83
12/21/2013	1089.5	839	707.7	83	0	83	0	83
12/22/2013	1089.5	842	707.9	83	0	83	0	83
12/23/2013	1089.5	843	707.9	83	0	83	0	83
12/24/2013	1089.5	844	708.3	84	0	84	0	84
12/25/2013	1089.5	843	708.0	85	0	85	0	85
12/26/2013	1089.4	845	708.5	85	0	85	0	85
12/27/2013	1089.4	843	708.4	85	0	85	0	85
12/28/2013	1089.4	843	708.3	85	0	85	0	85
12/29/2013	1089.3	843	708.7	85	0	85	0	85
12/30/2013	1089.3	843	708.7	85	0	85	0	85
12/31/2013	1089.3	844	708.3	84	0	84	0	84

APPENDIX B: DAILY AVERAGE WATER TEMPERATURES

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
1/1/2013	5.7	5.3	4.8	4.4	4.4	4.3	6.2	5.7
1/2/2013	5.5	5.2	4.8	4.3	4.3	4.3	6.0	5.6
1/3/2013	5.3	5.0	4.8	4.4	4.4	4.4	5.8	5.3
1/4/2013	5.3	4.9	4.7	4.3	4.3	4.3	5.8	5.4
1/5/2013	5.2	4.9	4.8	4.4	4.4	4.4	5.8	5.3
1/6/2013	5.4	5.2	5.2	4.8	4.8	4.8	6.0	5.5
1/7/2013	5.4	5.1	5.0	4.8	4.8	4.8	5.9	5.5
1/8/2013	5.2	4.8	4.6	4.2	4.2	4.1	5.8	5.2
1/9/2013	5.4	5.1	5.2	5.1	5.1	5.1	6.0	5.5
1/10/2013	5.3	4.9	4.9	4.7	4.7	4.7	5.9	5.3
1/11/2013	5.2	4.8	4.3	3.9	3.9	3.9	5.8	5.3
1/12/2013	4.8	4.3	3.7	3.2	3.2	3.1	5.4	4.9
1/13/2013	4.5	4.0	3.4	2.8	2.8	2.7	5.1	4.6
1/14/2013	4.6	4.1	3.8	3.3	3.3	3.3	5.2	4.7
1/15/2013	4.5	4.1	3.8	3.3	3.3	3.3	5.0	4.5
1/16/2013	4.6	4.2	4.0	3.6	3.6	3.5	5.1	4.6
1/17/2013	4.5	4.2	4.2	3.8	3.8	3.7	5.1	4.6
1/18/2013	4.7	4.4	4.4	4.0	4.0	3.9	5.3	4.8
1/19/2013	4.7	4.4	4.3	4.0	4.0	3.9	5.3	4.7
1/20/2013	4.4	4.0	3.9	3.5	3.5	3.4	5.0	4.5
1/21/2013	4.3	3.8	3.5	3.0	3.0	2.9	4.9	4.3
1/22/2013	4.0	3.6	3.4	2.8	2.8	2.7	4.6	4.0
1/23/2013	3.9	3.6	3.6	3.0	3.1	3.0	4.6	4.0
1/24/2013	4.1	3.9	4.0	3.6	3.6	3.6	4.8	4.2
1/25/2013	4.2	3.9	4.3	4.1	4.1	4.0	4.8	4.2
1/26/2013	4.3	4.1	4.5	4.2	4.2	4.2	5.0	4.4
1/27/2013	4.2	4.0	4.4	4.2	4.2	4.2	4.9	4.3
1/28/2013	4.3	4.0	4.3	4.0	4.0	4.0	4.9	4.3
1/29/2013	4.4	4.1	4.4	4.1	4.1	4.1	5.0	4.4
1/30/2013	4.4	4.0	4.2	3.9	3.9	3.9	5.0	4.4
1/31/2013	4.3	4.0	4.2	3.9	3.9	3.8	4.9	4.4
2/1/2013	4.0	3.8	3.9	3.7	3.7	3.6	4.7	4.1
2/2/2013	3.9	3.7	4.0	3.6	3.6	3.6	4.6	4.0
2/3/2013	3.9	3.7	4.1	3.7	3.7	3.7	4.6	4.0
2/4/2013	4.1	3.9	4.3	4.2	4.1	4.1	4.8	4.2
2/5/2013	4.4	4.2	4.5	4.5	4.5	4.5	5.0	4.5
2/6/2013	4.3	4.2	4.5	4.5	4.4	4.4	5.0	4.4
2/7/2013	4.6	4.4	4.7	4.9	4.8	4.8	5.2	4.7
2/8/2013	4.5	4.2	4.4	4.3	4.3	4.3	5.2	4.5
2/9/2013	4.4	4.1	4.3	4.2	4.2	4.1	5.1	4.4
2/10/2013	4.5	4.2	4.3	4.2	4.2	4.2	5.2	4.5
2/11/2013	4.5	4.3	4.3	4.1	4.1	4.1	5.2	4.6
2/12/2013	4.8	4.6	4.6	4.6	4.6	4.6	5.4	4.9
2/13/2013	4.9	4.7	4.7	4.9	4.8	4.8	5.5	5.0
2/14/2013	5.0	4.7	4.7	4.9	4.9	4.9	5.7	5.0
2/15/2013	5.0	4.7	4.7	4.9	4.9	4.9	5.9	5.0
2/16/2013	4.9	4.7	4.7	4.9	4.9	4.9	5.9	5.0
2/17/2013	5.0	4.8	4.9	5.1	5.1	5.1	6.0	5.1
2/18/2013	5.1	4.9	4.7	4.7	4.7	4.7	5.8	5.1
2/19/2013	5.2	5.0	4.9	5.1	5.0	5.0	5.8	5.3

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
2/20/2013	5.2	4.9	4.9	4.9	4.9	4.8	5.8	5.3
2/21/2013	5.2	4.9	5.0	4.9	4.9	4.9	5.9	5.2
2/22/2013	5.3	5.1	5.2	5.3	5.3	5.3	6.2	5.4
2/23/2013	5.1	4.9	5.2	5.4	5.3	5.3	6.0	5.1
2/24/2013	5.2	5.0	5.1	5.2	5.1	5.1	6.1	5.3
2/25/2013	5.3	5.1	5.5	5.7	5.6	5.6	6.0	5.4
2/26/2013	5.5	5.2	5.6	5.7	5.6	5.6	6.2	5.5
2/27/2013	5.7	5.4	5.9	6.1	6.0	6.0	6.6	5.7
2/28/2013	5.8	5.7	5.9	6.2	6.1	6.1	6.8	5.9
3/1/2013	6.1	6.1	6.5	6.9	6.8	6.9	6.9	6.1
3/2/2013	6.4	6.4	6.5	7.0	6.9	7.0	7.4	6.5
3/3/2013	6.3	6.0	6.2	6.6	6.5	6.5	7.2	6.2
3/4/2013	6.2	5.8	6.1	6.3	6.2	6.2	7.1	6.1
3/5/2013	6.0	5.7	5.8	6.0	5.9	5.9	6.9	6.0
3/6/2013	5.7	5.5	5.6	5.8	5.8	5.7	6.6	5.7
3/7/2013	5.7	5.5	5.9	6.3	6.2	6.2	6.6	5.7
3/8/2013	6.0	5.8	6.3	6.7	6.6	6.7	6.9	6.1
3/9/2013	6.5	6.1	6.5	6.8	6.7	6.7	7.3	6.4
3/10/2013	6.7	6.6	6.7	7.1	7.0	7.0	7.7	6.7
3/11/2013	6.7	6.5	6.7	7.0	6.9	7.0	7.6	6.7
3/12/2013	7.0	7.0	7.4	7.9	7.8	7.9	7.9	7.1
3/13/2013	7.5	7.6	7.8	8.3	8.2	8.3	8.5	7.5
3/14/2013	7.6	7.6	7.7	8.2	8.1	8.2	8.5	7.6
3/15/2013	7.7	7.7	8.0	8.5	7.9	7.9	8.5	7.6
3/16/2013	8.1	8.1	7.9	8.5	8.2	8.2	9.0	8.0
3/17/2013	7.6	7.3	7.3	7.7	7.7	7.7	8.5	7.6
3/18/2013	7.2	6.9	7.1	7.4	7.3	7.3	8.1	7.2
3/19/2013	7.1	7.0	6.9	7.2	7.1	7.1	8.0	7.2
3/20/2013	7.0	6.7	6.8	7.1	7.0	7.0	7.7	7.1
3/21/2013	6.9	6.6	6.6	6.9	6.8	6.8	7.5	6.9
3/22/2013	6.9	6.6	6.7	7.0	6.9	6.9	7.5	7.0
3/23/2013	7.0	6.6	6.8	7.0	7.0	7.0	7.5	7.1
3/24/2013	7.0	6.7	6.9	7.2	7.1	7.1	7.6	7.1
3/25/2013	7.2	7.0	7.2	7.5	7.3	7.3	7.8	7.3
3/26/2013	7.6	7.5	7.7	8.0	7.7	7.8	8.1	7.7
3/27/2013	8.0	8.1	8.2	8.8	8.2	8.3	8.6	8.2
3/28/2013	8.5	8.5	8.6	9.2	8.7	8.8	9.1	8.7
3/29/2013	9.0	9.0	9.1	9.7	9.2	9.3	9.5	9.1
3/30/2013	9.5	9.5	9.7	10.1	9.7	9.8	10.1	9.7
3/31/2013	10.0	10.0	10.1	10.7	10.2	10.3	10.5	10.1
4/1/2013	10.7	10.8	10.7	11.3	11.0	11.0	11.3	10.9
4/2/2013	11.0	11.2	11.1	11.9	11.2	11.4	11.6	11.2
4/3/2013	10.8	11.0	11.0	11.8	11.1	11.2	11.4	11.0
4/4/2013	10.7	10.7	10.1	11.1	10.7	10.8	11.2	10.7
4/5/2013	10.3	10.4	10.5	11.3	10.5	10.6	10.9	10.5
4/6/2013	10.5	10.6	10.6	11.5	10.7	10.8	11.0	10.6
4/7/2013	10.3	10.1	9.7	10.5	10.3	10.3	10.8	10.3
4/8/2013	10.1	10.0	10.0	10.7	10.2	10.3	10.6	10.2
4/9/2013	10.3	10.3	10.3	11.0	10.4	10.5	10.8	10.4
4/10/2013	10.5	10.5	10.4	11.2	10.6	10.7	11.0	10.6

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
4/11/2013	10.2	10.1	9.9	10.6	10.3	10.3	10.8	10.3
4/12/2013	10.0	9.9	9.5	10.0	10.0	10.0	10.6	10.1
4/13/2013	9.8	9.6	9.5	9.9	9.9	9.9	10.3	9.9
4/14/2013	9.9	9.7	9.4	9.8	9.9	9.9	10.4	9.9
4/15/2013	9.7	9.5	9.2	9.5	9.7	9.6	10.2	9.7
4/16/2013	9.7	9.6	9.5	9.8	9.8	9.8	10.3	9.8
4/17/2013	9.8	9.7	9.9	10.2	9.9	9.9	10.4	9.9
4/18/2013	10.3	10.3	10.3	10.8	10.5	10.5	11.4	10.3
4/19/2013	11.1	11.2	11.1	11.5	11.2	11.3	12.0	10.9
4/20/2013	11.6	11.6	11.9	11.9	11.6	11.6	12.4	11.4
4/21/2013	11.9	11.8	11.5	11.5	11.6	11.6	12.5	11.4
4/22/2013	11.8	11.7	11.9	11.8	11.6	11.6	12.5	11.3
4/23/2013	11.4	11.3	11.5	11.6	11.4	11.5	12.1	11.3
4/24/2013	11.3	11.2	11.9	12.0	11.5	11.6	12.1	11.3
4/25/2013	12.0	12.1	12.7	12.9	12.3	12.4	12.8	12.1
4/26/2013	12.5	12.6	13.3	13.5	12.8	12.9	13.2	12.6
4/27/2013	12.7	12.8	13.2	13.4	13.0	13.0	13.5	12.8
4/28/2013	12.7	12.6	13.0	13.1	12.9	12.9	13.7	12.7
4/29/2013	12.2	12.1	12.3	12.5	12.3	12.3	12.9	12.2
4/30/2013	11.5	11.4	11.9	11.9	11.6	11.7	12.3	11.6
5/1/2013	12.0	11.9	12.4	12.4	12.2	12.2	13.1	12.1
5/2/2013	12.7	12.7	13.1	13.1	13.1	13.2	13.9	13.1
5/3/2013	13.4	13.5	14.2	14.4	13.7	13.9	14.1	13.5
5/4/2013	12.8	12.9	13.8	14.1	13.3	13.5	13.7	13.0
5/5/2013	13.0	13.0	13.9	14.2	13.3	13.5	13.6	13.1
5/6/2013	14.4	14.5	14.8	14.9	14.6	14.8	15.1	14.6
5/7/2013	16.9	17.1	17.1	17.1	17.1	17.1	17.5	17.0
5/8/2013	17.7	17.9	18.0	18.2	17.9	18.1	18.3	17.8
5/9/2013	17.7	17.8	18.0	18.3	17.9	18.0	18.3	17.7
5/10/2013	17.5	17.6	17.9	18.2	17.7	17.8	17.9	17.5
5/11/2013	17.8	17.9	18.1	18.4	18.0	18.2	18.3	17.9
5/12/2013	17.7	17.7	17.6	17.8	17.8	17.8	18.1	17.8
5/13/2013	17.0	16.9	16.6	16.8	17.0	17.0	17.4	17.0
5/14/2013	16.3	16.3	16.3	16.3	16.3	16.4	16.8	16.3
5/15/2013	16.4	16.4	16.2	16.1	16.6	16.5	16.8	16.5
5/16/2013	16.3	16.3	16.4	16.6	16.6	16.6	16.7	16.4
5/17/2013	16.0	15.9	16.1	16.2	16.2	16.2	16.3	15.9
5/18/2013	15.9	15.9	16.0	16.1	16.1	16.1	16.3	15.9
5/19/2013	16.1	16.1	16.3	16.4	16.4	16.5	16.5	16.1
5/20/2013	16.4	16.4	16.6	16.7	16.7	16.7	16.8	16.4
5/21/2013	15.6	15.6	15.4	15.5	15.5	15.5	16.0	15.6
5/22/2013	15.0	14.8	14.6	14.6	14.6	14.6	15.4	15.0
5/23/2013	14.4	14.3	14.5	14.5	14.5	14.5	14.8	14.4
5/24/2013	14.6	14.5	14.6	14.7	14.7	14.7	15.0	14.6
5/25/2013	13.9	13.8	14.2	14.3	14.3	14.3	14.3	13.8
5/26/2013	14.2	14.2	14.5	14.6	14.6	14.6	14.5	14.1
5/27/2013	14.7	14.6	14.6	14.7	14.7	14.7	15.1	14.7
5/28/2013	15.1	15.1	15.4	15.6	15.6	15.6	15.5	15.1
5/29/2013	15.2	15.2	15.1	15.1	15.1	15.1	15.7	15.3
5/30/2013	15.2	15.2	15.5	15.6	15.6	15.6	15.6	15.2

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
5/31/2013	15.7	15.7	15.9	16.0	16.0	16.1	16.1	15.7
6/1/2013	16.2	16.2	16.4	16.6	16.5	16.6	16.6	16.2
6/2/2013	16.4	16.4	16.7	16.8	16.8	16.9	16.8	16.5
6/3/2013	16.0	16.0	16.6	16.8	16.8	16.8	16.5	16.1
6/4/2013	16.3	16.3	16.8	17.0	17.0	17.1	16.8	16.4
6/5/2013	17.3	17.3	17.7	17.9	17.9	18.0	17.9	17.6
6/6/2013	18.4	18.5	18.7	18.9	18.9	19.0	18.8	18.5
6/7/2013	19.1	19.1	19.2	19.3	19.3	19.3	19.4	19.2
6/8/2013	19.0	19.0	19.1	19.1	19.1	19.2	19.3	19.0
6/9/2013	18.9	18.9	18.9	19.0	19.0	19.0	19.2	18.9
6/10/2013	18.7	18.6	18.8	18.8	18.8	18.9	19.0	18.7
6/11/2013	18.5	18.5	18.6	18.6	18.6	18.6	18.9	18.6
6/12/2013	18.3	18.2	18.2	18.2	18.2	18.2	18.6	18.3
6/13/2013	18.2	18.2	18.0	18.0	18.0	18.0	18.6	18.2
6/14/2013	18.3	18.3	18.4	18.5	18.5	18.5	18.6	18.3
6/15/2013	18.5	18.5	18.8	18.9	18.8	18.9	18.9	18.5
6/16/2013	18.9	18.9	19.2	19.3	19.3	19.4	19.2	18.9
6/17/2013	19.4	19.4	19.7	19.8	19.8	19.9	19.7	19.4
6/18/2013	19.0	19.0	19.0	19.1	19.1	19.1	19.5	19.2
6/19/2013	18.0	17.9	17.5	17.5	17.5	17.5	18.4	18.1
6/20/2013	17.7	17.6	17.4	17.4	17.4	17.3	18.0	17.7
6/21/2013	17.4	17.3	17.4	17.5	17.5	17.5	17.6	17.3
6/22/2013	16.5	16.4	17.3	17.6	17.6	17.7	16.9	16.6
6/23/2013	16.1	16.1	16.6	16.9	16.8	16.9	16.6	16.2
6/24/2013	16.7	16.6	16.8	17.0	17.0	17.0	17.5	17.2
6/25/2013	17.2	17.2	17.3	17.3	17.3	17.3	17.7	17.4
6/26/2013	17.7	17.7	17.6	17.6	17.6	17.6	18.0	17.7
6/27/2013	17.9	17.9	18.0	18.1	18.1	18.1	18.1	17.9
6/28/2013	18.7	18.7	18.9	19.0	19.1	19.1	19.0	18.7
6/29/2013	18.7	18.6	18.8	18.9	18.9	19.0	18.8	18.5
6/30/2013	19.1	19.0	19.3	19.5	19.5	19.5	19.2	19.0
7/1/2013	17.8	17.8	19.0	19.2	19.2	19.2	18.8	18.5
7/2/2013	18.7	19.1	20.1	20.2	20.3	20.3	19.7	19.5
7/3/2013	21.3	21.4	21.5	21.7	21.6	21.7	21.7	21.4
7/4/2013	20.8	20.8	20.9	21.0	21.0	21.0	21.1	20.8
7/5/2013	20.6	20.6	20.7	20.8	20.8	20.8	21.0	20.6
7/6/2013	20.8	20.8	21.0	21.3	21.2	21.2	21.0	20.8
7/7/2013	19.9	19.9	20.4	21.0	20.7	20.8	20.8	20.5
7/8/2013	18.7	18.7	19.7	20.3	20.0	20.1	20.2	20.0
7/9/2013	19.6	19.7	20.2	20.3	20.3	20.4	21.4	21.2
7/10/2013	20.4	20.6	20.8	20.9	20.9	20.9	21.9	21.7
7/11/2013	21.8	21.9	21.8	21.8	21.9	21.9	22.1	22.0
7/12/2013	21.3	21.3	21.0	21.1	21.1	21.1	21.6	21.4
7/13/2013	20.9	20.9	20.9	21.0	21.0	21.1	21.2	21.0
7/14/2013	20.3	20.3	20.5	20.6	20.6	20.7	20.8	20.7
7/15/2013	19.8	19.7	20.2	20.4	20.4	20.5	20.3	20.0
7/16/2013	18.3	18.2	19.0	19.2	19.2	19.3	18.6	18.4
7/17/2013	19.9	20.0	20.9	21.2	21.2	21.3	20.5	20.3
7/18/2013	19.5	19.7	20.7	21.1	21.0	21.2	20.9	20.6
7/19/2013	21.4	21.4	21.3	21.4	21.4	21.5	22.1	22.0

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
7/20/2013	22.7	22.7	22.3	22.3	22.3	22.4	23.1	22.9
7/21/2013	22.9	22.9	22.5	22.4	22.5	22.5	23.3	23.1
7/22/2013	23.0	23.0	22.6	22.6	22.6	22.7	23.3	23.1
7/23/2013	23.1	23.1	23.1	23.2	23.2	23.3	23.6	23.3
7/24/2013	23.3	23.3	23.1	23.2	23.2	23.3	23.7	23.6
7/25/2013	23.5	23.5	23.1	23.1	23.1	23.2	23.9	23.7
7/26/2013	23.7	23.7	23.0	22.9	22.9	23.0	24.1	23.8
7/27/2013	23.6	23.5	23.1	23.0	23.0	23.1	24.0	23.7
7/28/2013	23.3	23.2	22.6	22.6	22.6	22.7	24.0	23.5
7/29/2013	22.7	22.7	22.7	22.7	22.7	22.8	23.5	23.2
7/30/2013	21.4	21.5	21.7	22.0	22.0	22.1	23.0	22.7
7/31/2013	23.0	23.0	21.9	21.8	21.8	21.8	23.8	23.4
8/1/2013	23.1	23.0	22.1	21.9	22.0	22.0	23.5	23.2
8/2/2013	22.7	22.6	22.2	22.1	22.1	22.1	23.1	22.7
8/3/2013	21.7	21.7	22.0	22.1	22.1	22.2	22.4	22.0
8/4/2013	20.8	20.8	21.4	21.8	21.8	21.9	22.4	21.8
8/5/2013	21.6	21.6	22.0	22.1	22.1	22.2	22.9	22.4
8/6/2013	21.8	21.8	22.0	22.2	22.2	22.3	23.3	22.8
8/7/2013	22.8	22.8	22.9	22.9	22.8	22.9	23.9	23.5
8/8/2013	23.3	23.3	22.7	22.7	22.7	22.7	24.1	23.8
8/9/2013	23.4	23.4	23.3	23.4	23.4	23.5	24.0	23.6
8/10/2013	23.0	23.0	23.0	23.2	23.2	23.3	23.8	23.5
8/11/2013	23.5	23.5	22.9	23.1	23.1	23.1	23.9	23.6
8/12/2013	23.6	23.5	23.2	23.2	23.2	23.2	23.9	23.7
8/13/2013	23.6	23.6	23.4	23.4	23.4	23.5	24.0	23.7
8/14/2013	23.0	23.0	22.6	22.7	22.7	22.8	23.8	23.4
8/15/2013	23.4	23.3	22.4	22.4	22.4	22.4	23.8	23.5
8/16/2013	23.3	23.2	22.5	22.3	22.4	22.4	23.7	23.3
8/17/2013	23.3	23.2	22.5	22.4	22.4	22.4	23.7	23.4
8/18/2013	23.1	23.0	22.5	22.3	22.3	22.4	23.8	23.1
8/19/2013	22.9	23.0	22.3	22.2	22.2	22.2	23.3	23.1
8/20/2013	22.5	22.7	22.4	22.3	22.3	22.3	23.1	22.9
8/21/2013	22.6	22.8	22.5	22.4	22.4	22.5	23.2	23.0
8/22/2013	22.7	22.7	22.2	22.1	22.1	22.2	23.0	22.8
8/23/2013	22.3	22.2	22.1	22.1	22.2	22.2	22.7	22.4
8/24/2013	21.9	21.8	21.5	21.3	21.4	21.4	22.5	22.1
8/25/2013	21.4	21.4	20.9	20.8	20.8	20.8	22.3	21.7
8/26/2013	21.7	21.6	21.1	20.9	21.0	21.0	22.0	21.8
8/27/2013	21.7	21.6	21.3	21.1	21.2	21.2	22.1	21.8
8/28/2013	21.8	21.7	21.5	21.3	21.4	21.4	22.2	21.9
8/29/2013	21.9	21.8	21.5	21.5	21.5	21.6	22.3	22.0
8/30/2013	21.8	21.7	21.5	21.4	21.4	21.4	22.3	22.0
8/31/2013	21.8	21.7	21.4	21.2	21.2	21.3	22.2	21.9
9/1/2013	21.9	21.8	21.7	21.6	21.6	21.7	22.8	21.7
9/2/2013	21.6	21.5	21.6	21.6	21.7	21.7	22.8	22.0
9/3/2013	21.3	21.2	21.3	21.5	21.5	21.6	21.9	21.7
9/4/2013	22.2	22.2	22.0	21.9	21.9	22.0	22.5	22.4
9/5/2013	22.3	22.4	22.1	22.1	22.1	22.2	22.7	22.4
9/6/2013	21.6	21.6	21.3	21.3	21.4	21.4	22.0	21.8
9/7/2013	20.5	20.3	19.9	19.9	19.9	19.9	20.8	20.5

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
9/8/2013	20.3	20.2	20.3	20.2	20.3	20.3	20.8	20.5
9/9/2013	21.5	21.4	21.2	21.0	21.0	21.1	21.8	21.5
9/10/2013	21.9	21.9	21.6	21.4	21.5	21.5	22.2	22.0
9/11/2013	22.3	22.2	21.9	21.7	21.8	21.8	22.5	22.3
9/12/2013	22.1	22.0	22.0	21.9	22.0	22.0	22.5	22.3
9/13/2013	22.0	22.0	22.0	22.0	22.0	22.0	22.5	22.3
9/14/2013	22.1	22.1	21.9	21.8	21.8	21.9	22.7	22.5
9/15/2013	22.3	22.3	21.9	21.8	21.8	21.8	22.8	22.6
9/16/2013	22.4	22.3	21.6	21.4	21.4	21.3	22.7	22.4
9/17/2013	21.9	21.8	20.8	20.6	20.6	20.5	22.3	22.0
9/18/2013	21.4	21.2	20.3	19.9	20.0	19.9	21.8	21.5
9/19/2013	21.0	20.7	19.9	19.4	19.5	19.5	21.3	21.0
9/20/2013	20.8	20.6	19.8	19.4	19.4	19.4	21.2	20.9
9/21/2013	20.8	20.8	20.1	19.9	19.9	19.9	21.2	20.9
9/22/2013	20.3	20.3	19.7	19.7	19.7	19.6	20.7	20.3
9/23/2013	19.7	19.6	18.9	18.8	18.8	18.8	20.1	19.7
9/24/2013	19.2	19.0	18.4	18.0	18.0	18.0	19.6	19.2
9/25/2013	19.1	18.8	18.1	17.8	17.8	17.7	19.4	19.1
9/26/2013	18.8	18.6	18.0	17.6	17.6	17.6	19.3	18.8
9/27/2013	18.4	18.2	17.1	16.7	16.7	16.6	18.8	18.4
9/28/2013	18.0	17.8	17.0	16.7	16.7	16.6	18.3	18.0
9/29/2013	17.7	17.4	16.4	16.0	16.0	15.9	17.9	17.6
9/30/2013	17.2	16.8	16.1	15.7	15.7	15.6	17.5	17.1
10/1/2013	16.7	16.4	15.6	15.1	15.1	15.0	17.0	16.6
10/2/2013	16.6	16.2	15.3	14.8	14.9	14.7	16.8	16.5
10/3/2013	16.4	16.0	15.8	15.4	15.4	15.3	16.7	16.4
10/4/2013	16.5	16.1	15.7	15.3	15.3	15.3	16.8	16.5
10/5/2013	16.6	16.3	16.0	15.6	15.6	15.6	17.0	16.6
10/6/2013	16.7	16.4	16.0	15.6	15.6	15.6	17.1	16.7
10/7/2013	16.8	16.4	15.9	15.6	15.6	15.5	17.1	16.8
10/8/2013	16.4	16.0	15.3	14.9	14.9	14.8	16.7	16.4
10/9/2013	16.2	15.8	15.4	14.9	14.9	14.8	16.5	16.2
10/10/2013	16.2	15.9	15.6	15.3	15.3	15.3	16.5	16.2
10/11/2013	16.1	15.7	15.3	14.9	14.9	14.9	16.4	16.1
10/12/2013	15.9	15.6	15.1	14.7	14.8	14.7	16.3	15.9
10/13/2013	15.7	15.4	14.9	14.5	14.5	14.5	16.1	15.8
10/14/2013	15.6	15.2	14.6	14.2	14.5	14.4	16.0	15.6
10/15/2013	15.5	15.1	14.6	14.2	15.3	15.1	15.9	15.5
10/16/2013	15.6	15.3	15.1	14.8	15.5	15.4	16.0	15.6
10/17/2013	15.5	15.2	14.7	14.6	15.4	15.2	16.0	15.6
10/18/2013	15.4	15.1	14.6	14.3	15.3	15.1	15.8	15.4
10/19/2013	15.3	15.0	14.6	14.3	15.1	15.0	15.7	15.2
10/20/2013	15.3	15.0	14.7	14.4	15.2	15.0	15.7	15.2
10/21/2013	15.3	15.1	14.8	14.6	15.3	15.1	15.8	15.3
10/22/2013	15.3	15.1	14.8	14.6	15.3	15.1	15.8	15.3
10/23/2013	15.3	15.0	14.6	14.4	15.2	15.0	15.7	15.3
10/24/2013	15.1	14.8	14.4	14.2	15.0	14.8	15.6	15.1
10/25/2013	14.9	14.6	14.1	13.9	14.8	14.6	15.4	14.8
10/26/2013	14.7	14.3	14.0	13.8	14.6	14.4	15.1	14.6
10/27/2013	14.4	14.2	13.6	13.4	14.3	14.1	14.9	14.4

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
10/28/2013	14.1	13.7	13.1	12.8	13.9	13.6	14.5	14.0
10/29/2013	13.7	13.3	12.7	12.3	13.5	13.3	14.2	13.7
10/30/2013	13.4	13.1	12.4	12.0	13.2	13.0	13.9	13.3
10/31/2013	13.2	12.8	12.6	12.3	13.1	12.9	13.7	13.1
11/1/2013	13.2	12.9	12.6	12.3	13.1	12.9	13.8	13.2
11/2/2013	13.2	13.0	12.7	12.5	13.1	13.0	13.7	13.1
11/3/2013	12.9	12.6	12.1	11.9	12.7	12.5	13.5	12.8
11/4/2013	12.6	12.1	11.5	11.2	12.4	12.1	13.1	12.5
11/5/2013	12.4	12.1	11.6	11.2	12.3	12.0	13.0	12.3
11/6/2013	12.1	11.7	11.1	10.8	11.9	11.7	12.7	12.0
11/7/2013	11.9	11.5	11.1	10.9	11.7	11.5	12.5	11.8
11/8/2013	11.9	11.6	11.4	11.2	11.8	11.7	12.5	11.9
11/9/2013	11.8	11.4	10.8	10.5	11.6	11.4	12.4	11.7
11/10/2013	11.7	11.4	11.2	11.0	11.6	11.4	12.3	11.6
11/11/2013	11.7	11.5	11.4	11.3	11.6	11.5	12.3	11.6
11/12/2013	11.8	11.6	11.6	11.5	11.8	11.7	12.5	11.7
11/13/2013	11.7	11.6	11.6	11.6	11.8	11.7	12.4	11.7
11/14/2013	11.8	11.5	11.3	11.3	11.7	11.6	12.5	11.7
11/15/2013	11.5	11.2	10.6	10.4	11.3	11.1	12.2	11.4
11/16/2013	11.1	10.8	10.4	10.2	11.0	10.8	11.8	11.0
11/17/2013	10.9	10.6	10.1	9.8	10.7	10.5	11.6	10.8
11/18/2013	10.6	10.3	9.9	9.7	10.5	10.3	11.3	10.6
11/19/2013	10.7	10.5	10.2	10.1	10.6	10.5	11.4	10.7
11/20/2013	10.3	9.7	8.7	8.4	10.1	9.7	11.0	10.2
11/21/2013	9.6	8.9	8.1	7.7	9.3	8.9	10.2	9.4
11/22/2013	9.2	8.6	7.8	7.4	8.9	8.6	9.9	9.1
11/23/2013	9.0	8.4	7.8	7.3	8.7	8.4	9.7	8.9
11/24/2013	9.0	8.5	8.1	7.7	8.7	8.5	9.6	8.9
11/25/2013	9.0	8.6	8.1	7.8	8.8	8.6	9.8	9.0
11/26/2013	9.0	8.5	8.0	7.8	8.8	8.6	9.8	8.9
11/27/2013	9.0	8.6	8.2	7.9	8.8	8.6	9.8	9.0
11/28/2013	8.9	8.6	8.3	8.0	8.8	8.6	9.6	8.9
11/29/2013	8.8	8.5	8.1	7.8	8.7	8.5	9.6	8.7
11/30/2013	8.6	8.4	8.2	8.1	8.5	8.4	9.4	8.6
12/1/2013	8.5	8.2	8.1	8.0	8.2	8.1	9.3	8.5
12/2/2013	8.3	7.9	7.6	7.4	7.3	7.2	9.1	8.2
12/3/2013	8.1	7.6	6.6	6.1	6.1	5.9	8.9	8.0
12/4/2013	7.6	7.0	6.1	5.6	5.6	5.4	8.4	7.5
12/5/2013	7.2	6.5	5.4	4.8	4.8	4.6	8.0	7.1
12/6/2013	6.9	6.3	5.4	4.8	4.7	4.5	7.7	6.8
12/7/2013	6.1	5.3	4.3	3.7	3.7	3.4	6.9	6.0
12/8/2013	6.0	5.3	4.4	3.7	3.7	3.5	6.9	6.0
12/9/2013	6.0	5.3	4.5	3.9	3.8	3.6	6.8	5.9
12/10/2013	5.7	5.1	4.4	3.9	3.9	3.7	6.5	5.6
12/11/2013	5.8	5.3	4.8	4.3	4.3	4.1	6.7	5.8
12/12/2013	6.1	5.7	5.4	5.0	4.9	4.8	7.0	6.1
12/13/2013	5.9	5.6	5.4	5.1	5.1	5.0	7.0	6.1
12/14/2013	5.7	5.5	5.4	5.2	5.2	5.1	6.7	6.0
12/15/2013	5.9	5.6	5.7	5.6	5.5	5.5	6.8	6.0
12/16/2013	5.8	5.6	5.6	5.5	5.5	5.4	6.8	6.0

Date	Low Level Outlet Pipe -Auto- (Deg. C)	Top of Reach 1 -Logger- (Deg. C))	End of Reach 1 -Logger- (Deg. C)	End of Reach 3 -Logger- (Deg. C)	Top of R4 Habitat Channel -Logger- (Deg. C)	End of R4 Habitat Channel -Logger- (Deg. C)	Tailrace at Pump Intake -Auto- (Deg. C)	Tailrace at Pump Intake -Logger- (Deg. C)
12/17/2013	5.9	5.7	5.8	5.7	5.7	5.6	6.9	6.1
12/18/2013	5.8	5.6	5.6	5.6	5.6	5.5	6.8	5.8
12/19/2013	5.4	5.1	4.7	4.5	4.5	4.3	6.4	5.5
12/20/2013	5.2	4.9	4.4	4.2	4.1	4.0	6.2	5.2
12/21/2013	5.1	4.7	4.5	4.2	4.2	4.0	6.1	5.2
12/22/2013	4.6	4.3	4.3	4.1	4.1	4.0	5.5	4.6
12/23/2013	4.4	4.3	4.3	4.2	4.2	4.1	5.4	4.6
12/24/2013	4.3	4.1	3.9	3.8	3.7	3.6	5.4	4.5
12/25/2013	4.4	4.3	4.4	4.3	4.2	4.1	5.4	4.5
12/26/2013	4.5	4.5	4.7	4.6	4.6	4.5	5.6	4.6
12/27/2013	4.5	4.8	4.7	4.6	4.6	4.5	5.9	5.0
12/28/2013	N/A	4.6	4.6	4.5	4.5	4.4	5.7	4.8
12/29/2013	N/A	4.6	4.5	4.4	4.4	4.3	5.8	4.8
12/30/2013	N/A	4.8	4.8	4.6	4.6	4.5	6.0	5.0
12/31/2013	N/A	4.8	4.9	4.9	4.9	4.8	5.9	4.9

APPENDIX C: MINIMUM FLOW DEVIATION REPORTS

FEDERAL ENERGY REGULATORY COMMISSION
Washington, D. C. 20426

OFFICE OF ENERGY PROJECTS

Project No. 637-092-Washington
Lake Chelan Hydroelectric Project

July 26, 2013

Ms. Michelle Smith
Licensing & Compliance Manager
Public Utility District No. 1 of Chelan County
P.O. Box 1231
Wenatchee, WA 98807-1231

Subject: Minimum Flow Deviation Pursuant to Article 405 of the License

Dear Ms. Smith:

This is in response to your filing submitted on April 18, 2013, pertaining to an instream flow deviation that occurred at the Lake Chelan Hydroelectric Project, FERC No. 637. You submitted the filing pursuant to Article 405 of the license[1] and your approved Operations Compliance and Monitoring Plan (Plan).[2]

License Requirements

Article 405 of the license requires you to implement a Plan that describes how you will comply with the instream flows, ramping rates, and tailrace flows, as set forth in Article 7 of the Lake Chelan Settlement Agreement (Agreement) and Chapter 7 of the Comprehensive Plan attached to the Agreement. Under the Agreement, you are required to maintain a minimum flow requirement of 320 cubic feet per second (cfs) into the Chelan River Reach 4 from March 15 through May 15, for steelhead spawning. In addition, under Article 405 of the license you are required to notify the Washington Department of Ecology (Ecology) and the Commission within 48 hours after you became aware of any deviation from the minimum flow requirements.

In accordance with the approved Plan, you are required to file a report with the

[1] *Public Utility District No. 1 of Chelan County*, 117 FERC ¶ 62,129 (2006).
[2] *Public Utility District No. 1 of Chelan County*, 121 FERC ¶ 62,152 (2007).

Commission, within 30 days of any deviation from minimum flow requirements, lake levels or ramping rates. The report must to the extent possible, identify the cause, severity, and duration of the incident, and any observed or reported adverse environmental impacts resulting from the incident. The report must also include: operational data necessary to determine compliance with the license requirements regarding minimum flows, lake levels, and ramping rates, as appropriate; a description of any corrective measures implemented at the time of occurrence and the measures implemented or proposed to ensure that similar incidents will not recur; and comments or correspondence, if any, received from the resource agencies and others regarding the incident.

Instream Flow Deviation

In the filing, you explained that the required minimum flows of 320 cfs were in effect in the Reach 4 Habitat Channel beginning March 15, 2013. These flows were provided using a combination of 80 cfs from the Low Level Outlet (LLO) at the dam and at least 240 cfs from the tailrace pump station, which contains 5 pumps.

You reported that a minimum flow deviation occurred on March 18, 2013, at approximately 17:51 hours, when the low suction safety relay caused Pump 3 to shut down. Your operators at the Rocky Reach control room initiated a remote resetting of Pump 3, which in turn, caused a trip of the remaining four pumps. Therefore, your operators reset the station and all five pumps returned to service. However, you reported that for a total lapse of 13 minutes, pump 3 experienced a re-trip due to a loss of air pressure to the differential controls for monitoring intake screen cleanliness. You dispatched some Rocky Reach and Chelan operators to Lake Chelan headworks to manually open the LLO and flows were increased from 82 cfs to 124 cfs, replacing flow that would normally have been provided by Pump 3. The station was reset and flows were reestablished in Reach 4 at 384 cfs (124 LLO plus 260 cfs pumped), which caused flow fluctuations for a total lapse of 11 minutes. Your operators re-started the intake screen cleaning air burst/differential control system air compressor and re-programmed the pump system trip limits.

You report that this event resulted in brief drops in water levels in the pool at the pump station canal outlet structure at the head of the Reach 4 Habitat Channel. Also, the flow into Reach 4 of the Chelan River was below the required 320 cfs minimum flow for approximately two hours, based on the time lag necessary for increased flows from the LLO to arrive at Reach 4. The water level drop was approximately 4 inches over the time period from 17:52 to 18:52 hours, and then a short water level drop of about 9 inches occurred over a 12 minute period between 19:28 and 19:40 hours.

You reported that the failure was due to a faulty valve in the air blast screen cleaning system, which caused an erroneous differential signal and initiated the trip of Pump 3. You replaced the faulty valve on March 21, 2013.

You reported that no adverse environmental effects resulted from the short term loss of flow and drop in water levels. The incident did not cause any stranding of Chinook fry because water temperatures in Reach 4 were still quite cold at the time of the incident and Chinook fry were hiding in the substrate to avoid predators. Furthermore, you state that you reported the incident to the Commission's Portland Regional Office and Ecology via electronic correspondence on March 20, 2013, within 48 hours of when you became aware of the incident. No comments were received in reference to the incident.

Conclusion

After reviewing the information included in your report, we have determined that the minimum flow deviation that occurred on March 18, 2013, will not constitute a violation of Article 405 of the license. The incident was caused by a faulty valve in the air burst cleaning system, which was beyond your control. You took immediate corrective action and restored the flow in a prompt manner. No adverse biological impacts were observed as a result of the incident. Your filing adequately fulfills the reporting requirements pursuant to Article 405 of the license and your approved Plan.

Thank you for your cooperation. If you have any questions concerning this letter, please contact Anumzziatta Purchiaroni at (202) 502-6191, or by e-mail at anumzziatta.purchiaroni@ferc.gov.

Sincerely,

for Kelly Houff
Chief, Engineering Resources Branch
Division of Hydropower Administration
and Compliance



PUBLIC UTILITY DISTRICT NO. 1 *of* CHELAN COUNTY
P.O. Box 1231, Wenatchee, WA 98807-1231 • 327 N. Wenatchee Ave., Wenatchee, WA 98801
(509) 663-8121 • Toll free 1-888-663-8121 • www.chelanpud.org

April 18, 2013

VIA ELECTRONIC FILING

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

RE: Lake Chelan Hydroelectric Project No. 637 (Project)
Report on Minimum Flow Deviation for Chelan River

Dear Secretary Bose and Deputy Secretary Davis:

This letter is to provide you with Public Utility District No. 1 of Chelan County's (Chelan PUD) follow-up report on an instream flow deviation that occurred on March 18, 2013, on the Chelan River. This deviation was first reported by email to the Federal Energy Regulatory Commission (FERC) Portland Office (Douglas Johnson and Erich Gaedeke) and Washington Department of Ecology (Ecology) Central Regional Office (Charles McKinney and Patricia Irle) on March 20, 2013.

License Requirement

Article 405 requires Chelan PUD to implement the instream flows, ramping rates, and tailrace flows as set forth in Article 7 of the Lake Chelan Settlement Agreement and Chapter 7 of the Comprehensive Plan attached to the settlement agreement. The specific flow requirement that is the subject of this deviation report is to maintain a minimum flow of 320 cfs into the Chelan River Reach 4 from March 15-May 15 for steelhead spawning

Chelan PUD issued notifications of the flow deviation in accordance with FERC's Order Modifying and Approving Operations Compliance and Monitoring Plan, Article 405, issued November 30, 2007. When a flow deviation occurs, Chelan PUD is required to notify FERC and Ecology of the deviation within 48 hours of the time that Chelan PUD became aware of the deviation. Following the initial notification, Chelan PUD is required to file a report with the Commission within 30 days of any deviation from minimum flow requirements. The report shall, to the extent possible, identify the cause, severity, and duration of the incident, any observed or reported adverse environmental impacts resulting from the incident, a description of any

corrective measures implemented at the time of occurrence and the measures implemented or proposed to ensure that similar incidents do not recur; and comments or correspondence, if any, received from the resource agencies and others regarding the incident.

Summary of Deviation and Environmental Effects

Minimum flows of 320 cfs for steelhead spawning were in effect in the Reach 4 Habitat Channel beginning March 15, in accordance with requirements of Article 405 of the License. These flows were being provided using a combination of 80 cfs from the Low Level Outlet (LLO) at the dam and at least 240 cfs from the pumping station located within the powerhouse tailrace. A minimum flow deviation occurred during the evening of March 18, when the low suction safety relay caused Pump 3 (at the pumping station) to shut down. A remote reset operation on Pump 3 triggered all pumps to briefly trip off, but a station reset restarted all pumps. However, Pump 3 again tripped off and stayed off-line. Operators were dispatched to the LLO to increase the flow from that source to compensate for the loss of flow from Pump 3. Operators manually opened the LLO and flows were increased from 82 cfs to 124 cfs replacing flow that would normally have been provided by Pump 3. Operators inspected the Reach 4 pump station and experienced a second station trip due to a loss of air pressure to the differential controls for monitoring intake screen cleanliness. This also appears to be the cause of the Pump 3 trip. The station was reset and flows were reestablished in Reach 4 at 384 cfs (124 LLO plus 260 pumped), causing flow fluctuations for a total time lapse of 11 minutes. The intake screen cleaning air burst/differential control system air compressor was restarted and the pump system trip limits were re-programmed.

This event resulted in brief drops in water levels in the pool at the pump station canal outlet structure at the head of the Reach 4 Habitat Channel. The water level drop was approximately 4 inches over the time period from hours 17:52 – 18:52, then a water level drop of about 9 inches occurred over a 12-minute period between hours 19:28 – 19:40. Water levels were back to the previous level by hour 19:50. Also, the flow into Reach 4 of the Chelan River was below the 320 cfs minimum for approximately two hours, based on the time lag necessary for increased flows from the LLO to arrive at Reach 4.

No adverse environmental effects resulted from the short term loss of flow and drop in water levels. Steelhead adults had not yet initiated spawning. The first steelhead redd of the year was observed on March 20 and weekly surveys did not find any additional redds until April 2. Chinook fry did not yet inhabit shallow water at the time of the incident. Chinook fry have still not appeared in the shallows as of April 16.

Detail Regarding Flow Deviation, Cause of Incident and Corrective Measures

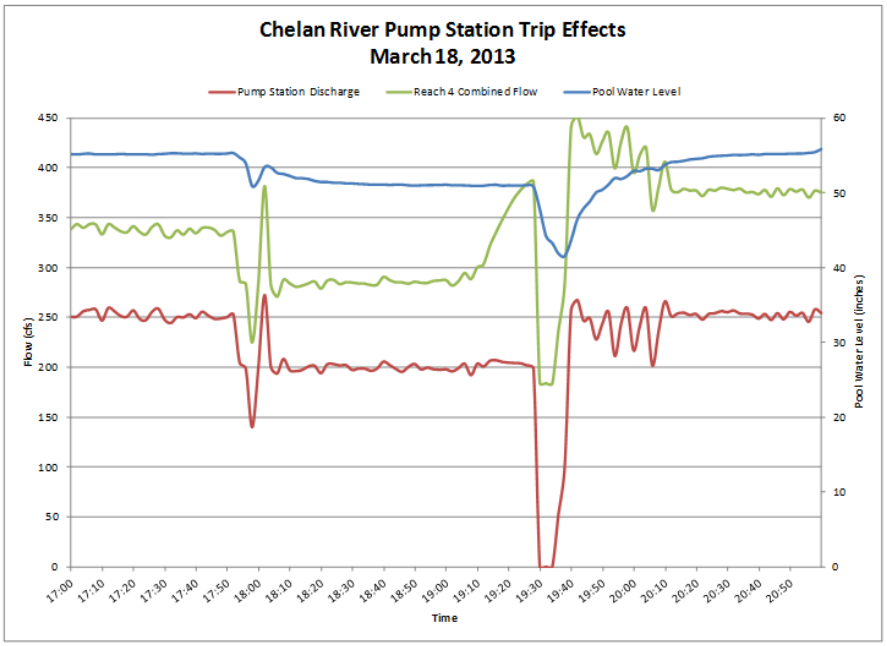
Spawning flows of 320 cfs minimum had been in effect in the Reach 4 Habitat Channel since March 15, 2013. These flows were being provided using a combination of 80 cfs from the Low Level Outlet (LLO) and at least 240 cfs from the tailrace pumping station. A minimum flow deviation occurred during the evening of March 18, when the low suction safety relay caused

Pump 3 to shut down. The low suction controls are designed to prevent damage to the pump or intake screens in the event that fouling reduces flow through the screens below safe operating levels. The screens were not plugged; rather the failure has been traced back to a faulty valve in the air blast screen cleaning system, causing a loss of air pressure in the system which, in turn, caused an automatic shutdown of Pump 3. Operators at the Rocky Reach control room initiated a remote resetting of Pump 3, which caused a trip of the remaining four pumps. A station reset was initiated and all five pumps were restored to service, resulting in a total time lapse of 13 minutes with no pumped flow into Reach 4. Pump 3 experienced a re-trip due to the same cause the first trip.

Rocky Reach and Lake Chelan operators were dispatched to Lake Chelan headworks to manually open the LLO and flows were increased from 82 cfs to 124 cfs replacing flow that would normally have been provided by Pump 3. Operators inspected the Reach 4 pump station and experienced a second station trip due to a loss of air pressure to the differential controls for monitoring intake screen cleanliness. This also appears to be the cause of the Pump 3 trip. The station was reset and flows were reestablished in Reach 4 at 384 cfs (124 LLO plus 260 pumped), causing flow fluctuations for a total time lapse of 11 minutes. The intake screen cleaning air burst/differential control system air compressor was restarted and the pump system trip limits were re-programmed.

This event resulted in brief drops in water levels in the pool at the pump station canal outlet structure at the head of the Reach 4 habitat channel. Also, the flow into Reach 4 of the Chelan River was below the 320 cfs minimum for approximately two hours, based on the time lag necessary for increased flows from the LLO to arrive at Reach 4. The water level drop was approximately 4 inches over the time period from hours 17:52 – 18:52, then a short water level drop of about 9 inches occurred over a 12-minute period between hours 19:28 – 19:40. Water levels were back to the previous level by hour 19:50. The flow and water level effects of the pump station trips, on two-minute intervals, are shown in the figure below.

Ms. Kimberly D. Bose, Secretary
Mr. Nathaniel J. Davis, Sr., Deputy Secretary
Federal Energy Regulatory Commission



The LLO was left at 124 cfs for the remainder of the night and was adjusted to 86 cfs over the course of the next day (March 19, 2013) with ramp rates observed. Programming for the screen cleaning air burst/differential control system air system was in manual mode (normal for current operations) and the compressor was in the off position. A faulty valve in the air burst system allowed pressure to deplete from the control system causing an erroneous differential signal which initiated the trip. The control system air compressor was left in the auto setting and the blast valve seat was tightened to minimize leakage. The faulty valve was identified, ordered and replaced on March 21, 2013. New LLO outlet controls are purchased and on site for May 2013 installation which will allow remote operation of the LLO.

Biological and Environmental Impacts

No adverse environmental effects resulted from the short term loss of flow and drop in water levels. Steelhead adults had not yet initiated spawning. The first steelhead redd of the year was observed on March 20 and weekly surveys did not find any additional redds until April 2. Chinook fry did not yet inhabit shallow water at the time of the incident, thus this incident was unlikely to have caused any stranding of Chinook fry. Water temperatures in Reach 4 were still quite cold and Chinook fry either had not yet emerged or were still hiding in the substrate to avoid predators. Water temperatures in Reach 4 were at or below 7 degrees C., while observations of Chinook fry during previous years have not observed them feeding in the shallows until water temperatures approach 10 degrees C. During a snorkel survey conducted in

Reach 4 on March 11, 2013, only one Chinook fry was observed, which was seen in the pool area. A snorkel survey on April 10 also did not detect any Chinook fry in the Reach 4 Habitat Channel. Observations from the surface during weekly steelhead spawning surveys have noted Chinook fry when they are using shallow water feeding areas and in the log structures. Chinook fry have still not appeared in the shallows as of April 16.

Please contact me or Steven Hays at (509) 661-4181 should you have any questions regarding this incident.

Thank you,

Michelle Smith
Licensing & Compliance Manager
michelle.smith@chelanpud.org
(509)661-4180

Attachment: Email from Chelan PUD to FERC and Ecology, March 20, 2013

cc: FERC, Erick Gaedeke and Doug Johnson
Washington Department of Ecology, Pat Irle and Charlie McKinney
Chelan River Fishery Forum

Sokolowski, Rosana

From:	Sokolowski, Rosana on behalf of Smith, Michelle
Sent:	Wednesday, March 20, 2013 12:56 PM
To:	'Douglas Johnson'; 'Erich Gaedeke'; 'Irle, Pat (ECY)'; cmck461@ECY.WA.GOV
Cc:	Truscott, Keith; Osborn, Jeff; Hays, Steve; Odell, Brian; Hudson, Kirk; Garrison, Dan; Sokolowski, Rosana; Bitterman, Deborah
Subject:	Lake Chelan Project No. 637: Chelan River Minimum Flow Deviation
Follow Up Flag:	Follow up
Due By:	Friday, April 19, 2013 8:00 AM
Flag Status:	Flagged

This email is to provide you notification regarding a pump station malfunction that resulted in momentary minimum flow and ramping rate deviations in the Chelan River near Chelan Falls. A detailed report will be filed within 30 days.

Spawning flows of 320 cfs minimum have been in effect in the Reach 4 Habitat Channel since March 15. These flows were being provided using a combination of 80 cfs from the Low Level Outlet (LLO) and at least 240 cfs from the tailrace pumping station. A minimum flow deviation occurred during the evening of March 18, when the low suction safety relay caused Pump 3 to shut down. The low suction controls are designed to prevent damage to the pump or intake screens in the event that fouling reduces flow through the screens below safe operating levels. The screens were not plugged, rather the failure has been traced back to a faulty valve in the air blast screen cleaning system, which caused a loss of air pressure in the system which, in turn, caused an automatic shutdown of Pump 3. Operators at the Rocky Reach control room initiated a remote resetting of Pump 3, which caused a trip of the remaining four pumps. A station reset was initiated and all five pumps were restored to service with Pump 3 experiencing a re-trip, resulting in a total time lapse of 13 minutes.

Rocky Reach and Lake Chelan operators were dispatched to Lake Chelan headworks to manually open the LLO and flows were increased from 82 cfs to 124 cfs replacing flow for Pump 3. Operators inspected the Reach 4 pump station and experienced a second station trip due to a loss of air pressure to the differential controls for monitoring intake screen cleanliness. This also appears to be the cause of the Pump 3 trip. The station was reset and flows were reestablished in Reach 4 at 384 cfs (124 LLO plus 260 pumped), which was a total time lapse of 11 minutes. The intake screen cleaning air burst/differential control system air compressor was restarted and the pump system trip limits were re-programmed.

This event resulted in brief drops in water levels in the pool at the pump station canal outlet structure at the head of the Reach 4 habitat channel. Also, the flow into Reach 4 of the Chelan River was below the 320 cfs minimum for approximately two hours, based on the time lag necessary for increased flows from the LLO to arrive at Reach 4. The water level drop was approximately 4 inches over the time period from hours 17:52 – 18:52, then a short water level drop of about 9 inches occurred over a 12-minute period between hours 19:28 – 19:40. Water levels were back to the previous level by hour 19:50. The flow and water level effects of the pump station trips, on two-minute intervals, are shown in the figure below.

This incident is unlikely to have caused any stranding of Chinook fry because water temperatures in Reach 4 are still quite cold and Chinook fry are still hiding in the substrate to avoid predators. Water temperatures in Reach 4 are at or below 7 degrees C., while observations of Chinook fry during previous years have not observed them feeding in the shallows until water temperatures approach 10 degrees C. During a snorkel survey conducted in Reach 4 on March 11, 2013, only one Chinook fry was observed, which was seen in the pool area. A steelhead spawning survey is scheduled for Reach 4 today, March 20, and observations

regarding presence of Chinook fry will be included in the detailed report that will be filed within 30 days.

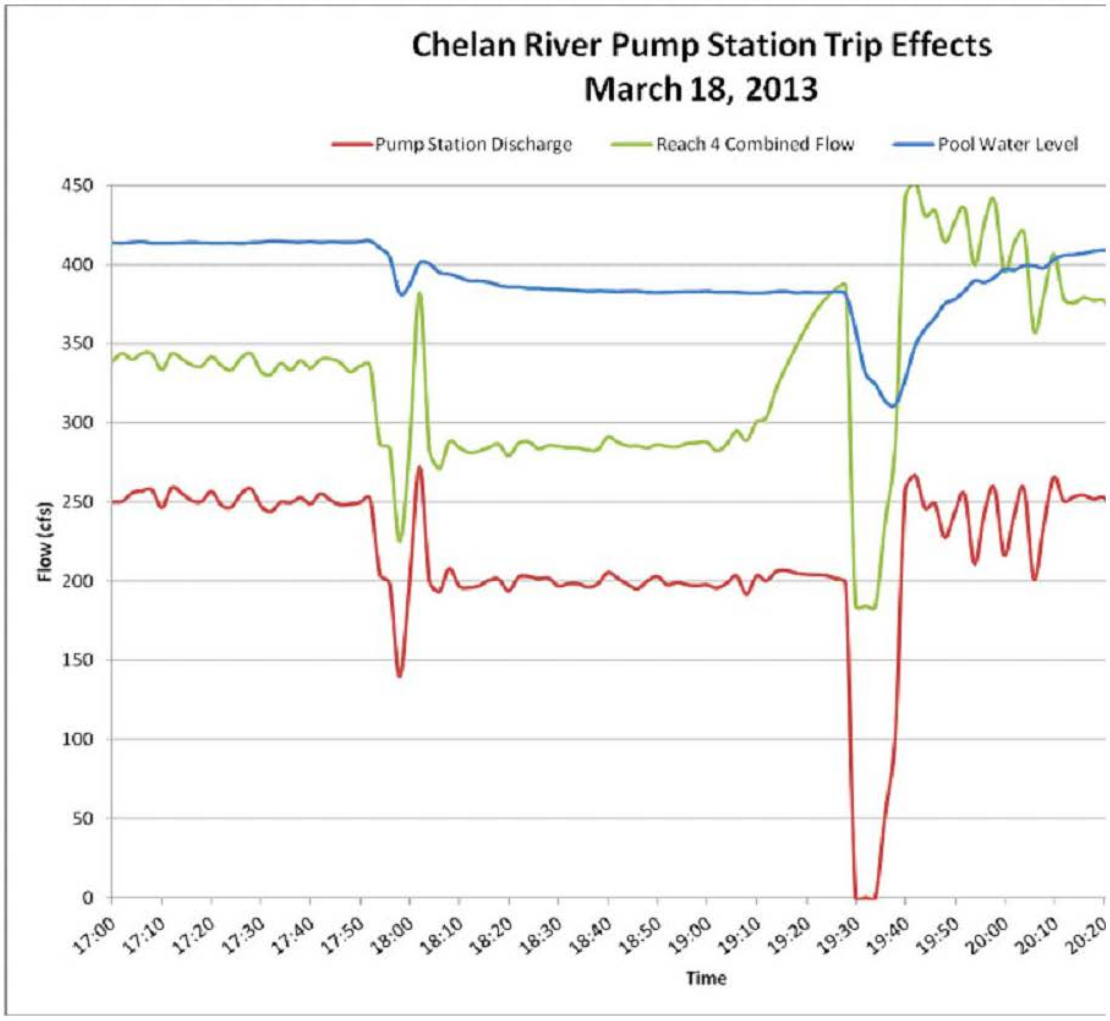
Attached to this email are copies of a report on the cause and response to this incident by Chelan PUD personnel. If you have any questions or require additional information, please contact Steven Hays at (509)661-4181 or me.

Thank you,

Michelle Smith
Licensing & Compliance Manager
(509)661-4180

3_18_13_R4_Deviation.docx

Ops_Log_R4_Deviation.pdf



3-19-2013

Minimum Flow Deviation: Chelan Reach 4

The minimum flow for the Reach 4 habitat between March 15 to May 15 and Oct. 15 to Nov. 30 is 320cfs by combination of pumping and LLO (low level outlet) flow/Spill. The Chelan Reach 4 pump station is comprised of 5-52cfs pumps providing a total of 260cfs flow into the Reach 4 habitat channel. On March 18, 2013 at approximately 17:51, pump 3 tripped on low suction. Operators at the Rocky Reach control room initiated a remote resetting of pump 3 which caused a trip of the remaining 4 pumps. A station reset was initiated and all 5 pumps were restored to service with pump 3 experiencing a re-trip, total time lapse was :13.

Rocky Reach and Chelan operators were dispatched to Chelan headworks to manually open the LLO and flows were increased from 82 to 124cfs replacing flow for pump 3. Operators inspected the Reach 4 pump station and experienced a second station trip due to a loss of air pressure to the differential controls for monitoring intake screen cleanliness, this also appears to be the cause of the pump 3 trip. The station was reset and flows were reestablished in the Reach 4 habitat at 384cfs (124 LLO-260 pumped) total time lapse :11. The intake screen cleaning air burst/differential control system air compressor was restarted and the pump system trip limits were reprogrammed.

The LLO was left at 124cfs for the remainder of the night and was adjusted to 86cfs during the course of the day (3-19-2013) with ramp rates observed. Programming for the screen cleaning air burst/differential control system air system was in manual mode (normal for current operations) and the compressor was in the off position. A faulty valve in the air burst system allowed pressure to deplete from the control system causing an erroneous differential signal which initiated the trip. The faulty valve was identified, ordered and is scheduled for replacement on 3-21-2013. The control system air compressor was left in the auto setting and the blast valve seat was tightened to minimize leakage.

Manual onsite response is required at the LLO for flow adjustments until upgraded controls are installed in May 2013, when remote operations will be available via SCADA.

The current lake elevation is below the spill gate sills precluding spill as an option for flow make up.

Deviations remained minimal throughout the course of events.

Hourly average Reach 4 flows for hours ending:

18:00- 320cfs

19:00- 290cfs

20:00- 280cfs

21:00- 380+cfs

21:00-08:00-380+cfs

With current program configuration and equipment repairs scheduled for 3-21-2013, we do not anticipate any further complications during the spring operating season.

Investigation is underway to install service/isolation valves in the air burst system to facilitate the maintenance and repair for key components during operation and in conjunction with the LLO control upgrade, will greatly enhance response capability in the future.

Brian C Odell

rpt001.vb
Mar-19-2013
Time: 12:21

Rocky Reach Hydro
Operations Log

from: Saturday, Mar 16, 2013 to: Monday, Mar 18, 2013

SEARCH: Reach 4

TIME	CATEGORY	ENTRY
Monday, Mar 18, 2013		
20:32	INFO	LLO FLOW CURRENTLY AT 124.7 CFS AND COASTING. REACH 4 TOTAL FLOW AT .376 CFS. CAMPBELL AND WHITEHALL HEADED HOME.
19:38	INFO	REACH 4 ALL PUMPS RUNNING. FLOW VALUE 366.8 CFS
19:27	INFO	REACH 4 PUMPS 1,2,4,5 HI HI DIFF ALARMS. ALL PUMPS SHUT DOWN. CAMPBELL AND WHITEHALL TROUBLESHOOTING. REACH 4 FLOW AT 184 CFS
19:14	INFO	REACH 4 FLOW AT 0.322CFS AND INCREASING
18:17	INFO	ATTEMPTED TO OPEN CHELAN SPILL GATE FOR REACH 4 MAKE UP WATER BUT THE LAKE ELEVATION IS STILL LOWER THAN THE SPILLGATE SEAL, CHELAN SPILL GATE BACK ON SEAL, NO WATER SPILLED
18:03	INFO	CHELAN REACH 4 PUMP #3 TRIPPED ON LOW SUCTION TRIED TO CALL CAMPBELL, NO ANSWER, WHITEHALL RESPONDING, REACH 4 AT 288CFS
17:57	INFO	CHELAN PUMP REACH 4 PUMP #3 TRIPPED DUE TO LOW SUCTION, HIT ALARM RESET AND ALARM CLEARED. COMPUTER WAS NOT RESTARTING THE PUMP SO I TOGGLED THE FLOW TO 208-232 AND THEN BACK TO 260-290 TO TRY AND RESET THE FLOW REQUEST. THIS ENDED UP CAUSING THE COMPUTER TO SHUT DOWN ALL THE PUMPS, AFTER THE PUMPS HAD ALL STOPPED WE RESTARTED THEM AND ALL 5 STARTED.
17:51	INFO	CHELAN REACH 4 PUMP #3 TRIPPED ON LOW SUCTION
Saturday, Mar 16, 2013		
22:06	INFO	CHELAN: REACH 4 FLOW RATE LO ALARM AT 0.3198, CLEARED 30 SECONDS LATER AT 0.335

Record Count: 9

Operator Initials _____

FEDERAL ENERGY REGULATORY COMMISSION
Washington, D. C. 20426

OFFICE OF ENERGY PROJECTS

Project No. 637-095--Washington
Lake Chelan Hydroelectric Project
Public Utility District No.1 of Chelan County

September 19, 2013

Ms. Michelle Smith
Licensing & Compliance Manager
Public Utility District No. 1 of Chelan County
P.O. Box 1231
Wenatchee, WA 98807-1231

Subject: Ramping Rate and Minimum Flow Deviations, Article 405

Dear Ms. Smith:

We received your letter filed June 3, 2013, reporting ramping rate and minimum instream flow deviations which occurred on May 2, 2013, at the Lake Chelan Hydroelectric Project No. 637. The report was filed under Article 405 of the license[1] and the approved Operations Compliance and Monitoring Plan (Plan).[2]

Requirements

Article 405 of the license requires you to implement a Plan that describes how you will comply with the instream flows, ramping rates, and tailrace flows, as set forth in Article 7 of the Lake Chelan Settlement Agreement (Agreement), and Chapter 7 of the Comprehensive Plan attached to the Agreement. Under the Agreement, you are required to maintain a minimum flow requirement of 320 cubic feet per second (cfs) into the Chelan River Reach 4 from March 15 through May 15, for steelhead spawning.

In addition, the Plan requires you to notify the Washington Department of Ecology and the Commission within 48 hours after you become aware of any deviation from the minimum flow requirements. You are also required to file a report with the Commission within 30 days of any deviation from minimum flow requirements, lake levels or ramping rates.

---

[1] *Public Utility District No. 1 of Chelan County*, 117 FERC ¶ 62,129 (2006).
[2] *Public Utility District No. 1 of Chelan County*, 121 FERC ¶ 62,152 (2007).

Deviation

You reported that at around 12:53 p.m., on May 2, 2013, one of the five pumps that delivered water from the project tailrace to the habitat channel (Channel) tripped off-line, reducing flows from the required 320 cfs to approximately 270 cfs. Water was immediately released from the low level outlet (Outlet) at the project dam to make up the difference. After the pump failed, the surface water elevation in the Channel dropped 4.25 inches, based on water level monitoring in the pool at the pump station. Subsequently, ramping rates were set at approximately 2 inches per hour during the period when fry might be present. The released water from the Outlet reached the Channel approximately 3 hours later, and water levels in the Channel returned to the previous levels by 4:30 p.m.

Review

You also reported that at the time of the incident, the licensee, Washington Department of Fish and Wildlife, and Washington Department Ecology biologists were in the habitat channel conducting depth and velocity transect studies. They observed what appeared to be a 4-inch to 5-inch drop in surface water elevation in the channel after the pump failed. While numerous Chinook fry were rearing in the channel, none were observed stranded due to the drop in water elevation. In addition, the pump would be repaired during its regular maintenance period, and would not resume operation until October 15, 2013.

To meet the 48-hour-notification requirement, you reported the May 2 incident to the Commission and Washington Department of Ecology on May 3, 2013. The pump's trip was caused by an operating emergency due to water leaking past the seal into the pump, which was beyond your control. You took immediate corrective action and restored the flow in a timely manner. No adverse biological impacts were observed as a result of the incident. Your filing fulfills the reporting requirements of Article 405 of the license and the approved Plan.

Thank you for your cooperation. If you have any questions concerning this letter, please contact Jake Tung at (202) 502-8757, or hong.tung@ferc.gov.

Sincerely,

Kelly Houff

Kelly Houff
Chief, Engineering Resources Branch
Division of Hydropower Administration
and Compliance



PUBLIC UTILITY DISTRICT NO. 1 *of* CHELAN COUNTY
P.O. Box 1231, Wenatchee, WA 98807-1231 • 327 N. Wenatchee Ave., Wenatchee, WA 98801
(509) 663-8121 • Toll free 1-888-663-8121 • www.chelanpud.org

June 3, 2013

VIA ELECTRONIC FILING

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

RE: Lake Chelan Hydroelectric Project No. 637 (Project)
Report on Ramping Rate Deviation for Reach 4 Stream Habitat Channel

Dear Secretary Bose and Deputy Secretary Davis:

This letter is to provide you with Public Utility District No. 1 of Chelan County's (Chelan PUD) follow-up report on a ramping rate deviation that occurred on Thursday, May 2, 2013, on the Chelan River. This deviation was first reported by email to the Federal Energy Regulatory Commission (FERC) Portland Office (Douglas Johnson and Erich Gaedeke) and Washington Department of Ecology (Ecology) Central Regional Office (Charles McKinney and Patricia Irle) on May 3, 2013.

License Requirement

Article 405 requires Chelan PUD to implement the instream flows, ramping rates, and tailrace flows as set forth in Article 7 of the Lake Chelan Settlement Agreement and Chapter 7 of the Comprehensive Plan attached to the settlement agreement. The specific flow requirement that is the subject of this deviation report is to maintain a minimum flow of 320 cfs into the Chelan River Reach 4 from March 15-May 15 for steelhead spawning

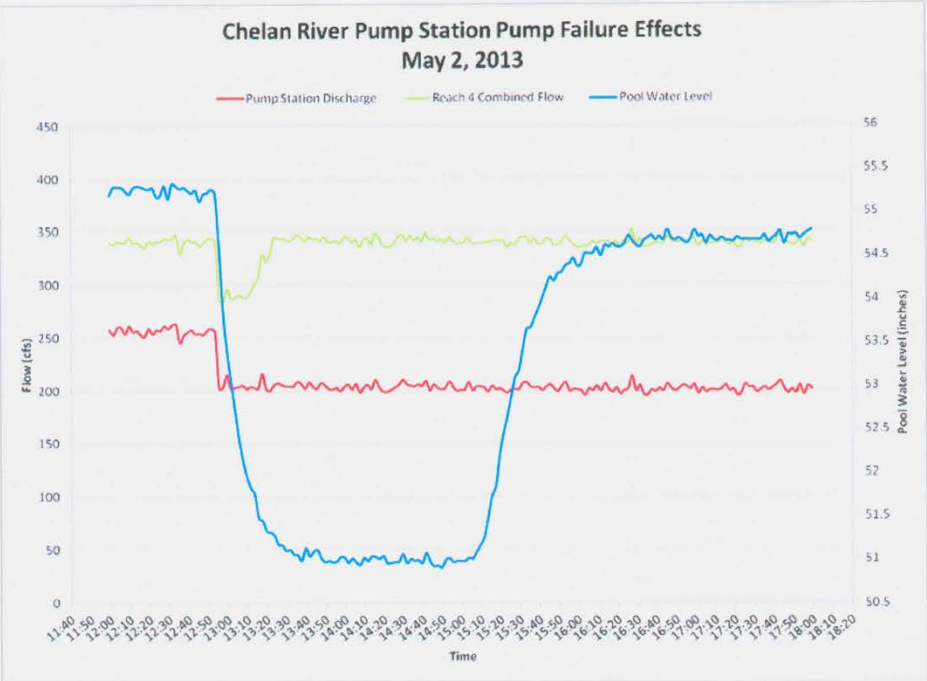
Chelan PUD issued notifications of the flow deviation in accordance with FERC's Order Modifying and Approving Operations Compliance and Monitoring Plan, Article 405, issued November 30, 2007. When a flow deviation occurs, Chelan PUD is required to notify FERC and Ecology of the deviation within 48 hours of the time that Chelan PUD became aware of the deviation. Following the initial notification, Chelan PUD is required to file a report with the Commission within 30 days of any deviation from minimum flow requirements. The report shall, to the extent possible, identify the cause, severity, and duration of the incident, any observed or reported adverse environmental impacts resulting from the incident, a description of any

proposed to ensure that similar incidents do not recur; and comments or correspondence, if any, received from the resource agencies and others regarding the incident.

Summary of Deviation and Environmental Effects

At approximately 12:53 pm on Thursday, May 2, one of the five pumps that delivers water from the Project tailrace to the Habitat Channel tripped off-line, reducing flows from the required 320 cfs to about 270 cfs. To bring flows back to 320 cfs, water was immediately released from the low level outlet at the Project dam. Coincidentally, Chelan PUD, Washington Department of Fish and Wildlife, and Ecology biologists were in the habitat channel conducting depth and velocity transect studies at the time of the event. They observed what appeared to be a 4-inch to 5-inch drop in surface water elevation in the habitat channel after the pump failed. There were no staff gauges or other indicators to determine a precise calculation of the water level change in the habitat channel. Water level monitoring in the pool at the pump station, which is continuously monitored, showed a drop in water level of 4.25 inches (see figure below). Ramping rates are set at approximately two inches per hour during the period when fry may be present. The drop was sustained for about three hours until water from the low level outlet reached the habitat channel. Water levels reached the previous points in the habitat channel by 4:30 pm. Though numerous Chinook fry were rearing in the habitat channel, none were observed stranded due to the drop in water elevation.

The pump alarm indicated that water had likely leaked past the seal into the pump. Since the schedule for pumped water to the habitat channel was due to end on May 15, the required flow was maintained between May 2 and May 15 by providing that flow from the low level outlet. After May 15, the required flow of 200 cfs for all sections of the Chelan River must be provided from the low level outlet; therefore, all pump station flow ended on May 15. The pump will be repaired during its regularly scheduled maintenance period in the summer. Pump station operation is not scheduled to resume until October 15, 2013.



Please contact me or Steven Hays at (509) 661-4181 should you have any questions regarding this incident.

Thank you,

Michelle Smith
Licensing & Compliance Manager
michelle.smith@chelanpud.org
(509)661-4180

Attachment: Email from Chelan PUD to FERC and Ecology, May 3, 2013

cc: FERC, Erick Gaedeke and Doug Johnson
Washington Department of Ecology, Pat Irle and Charlie McKinney
Chelan River Fishery Forum

Sokolowski, Rosana

From:	Smith, Michelle
Sent:	Friday, May 03, 2013 11:08 AM
To:	'douglas.johnson@ferc.gov'; 'erich.gaedeke@ferc.gov'; 'pirl461@ecy.wa.gov'; 'cmck461 @ECY.WA.GOV'
Cc:	Truscott, Keith; Osborn, Jeff; Hays, Steve; Odell, Brian; Hudson, Kirk; Garrison, Dan; Sokolowski, Rosana
Subject:	Lake Chelan Project No. 637: Ramping Rate Deviation Notification for the Reach 4 Stream Habitat Channel

This email is to provide you notification regarding a ramping rate deviation, which occurred yesterday in the Habitat Channel of the Chelan River near Chelan Falls.

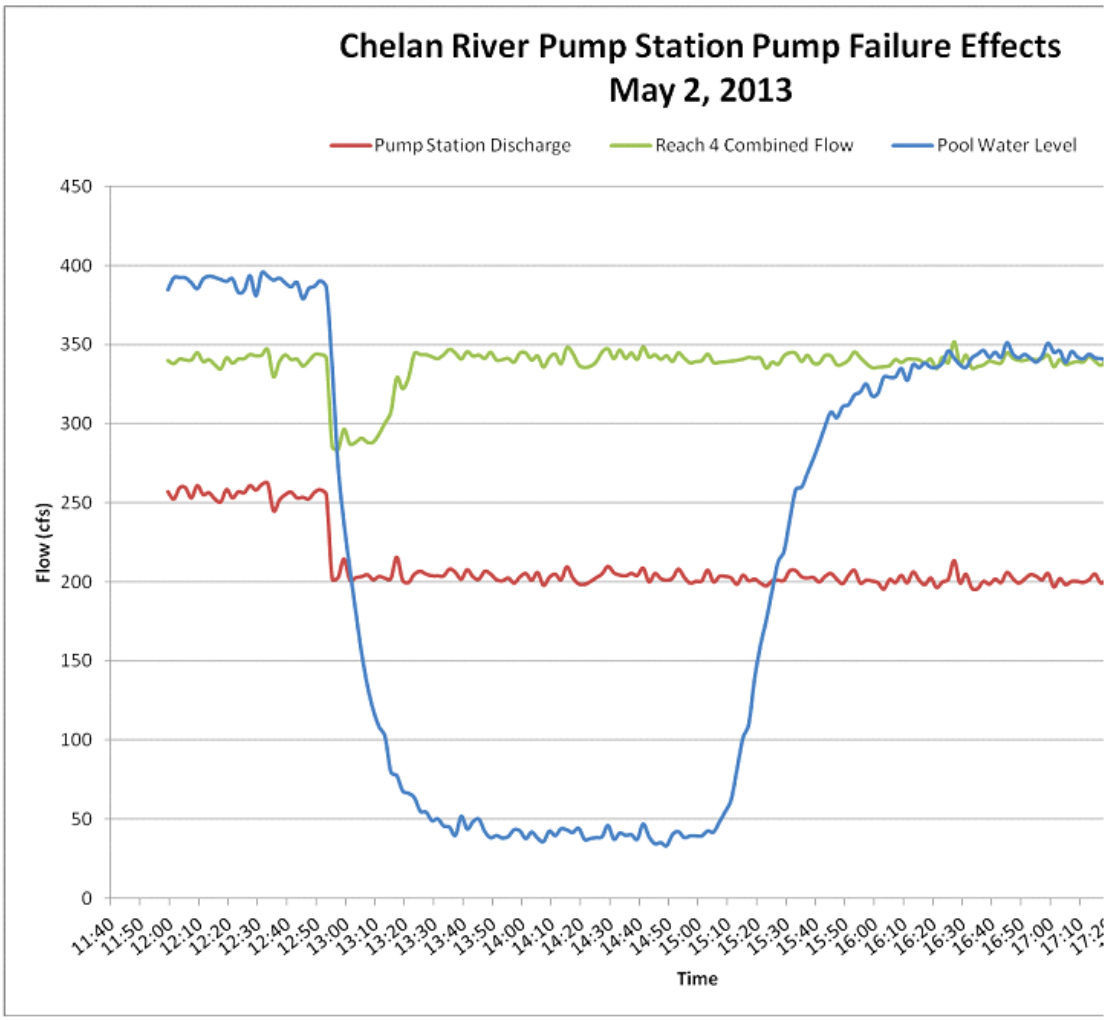
At approximately 12:53 pm on Thursday, May 2, one of the five pumps that delivers water from the Project tailrace to the Habitat Channel tripped off-line reducing flows from the required 320 cfs to about 270 cfs. To bring flows back to 320 cfs, water was immediately released from the Low Level Outlet at the Dam. Coincidentally, Chelan PUD, WDFW, and Ecology biologists were in the Habitat Channel conducting depth and velocity transect studies at the time of the event. They observed what appeared to be a 4" to 5" drop in surface water elevation in the Habitat Channel after the pump failed. There were no staff gauges or other indicators to determine a precise calculation of the water level change in the habitat channel. Water level monitoring in the pool at the pump station, which is continuously monitored, showed a drop in water level of 4.25 inches (see figure below). Ramping rates are set at approximately two inches per hour during the period when fry may be present. The drop was sustained for about 3 hours until water from the Low Level Outlet reached the Channel. Water levels reached the previous points in the Habitat Channel by 4:30 p.m.

Though numerous Chinook fry are currently rearing in the Habitat Channel, none were observed stranded due to the drop in water elevation.

Until the cause of the pump failure is known and repairs are made, flows of 320 cfs are being provided through combination of pumps and the Low Level Outlet. A detailed report will be filed within 30 days.

Thank you,
Michelle

Michelle Smith
License & Environmental Compliance Manager
Chelan County PUD
(509)661-4180



APPENDIX D: CONSULTATION RECORD

Chelan PUD provided a draft of the 2013 Annual Flow Report to the USGS and members of the CRFF and LCRF in accordance with the requirements of the FERC Order Modifying and Approving Operations Compliance and Monitoring Plan, Article 405, under Ordering Paragraph (B):

> "The licensee shall allow the resource agencies, Tribes and non-governmental organizations specified under Article 405, 30 days to provide comments and/or recommendations on their report before filing with the FERC. The filing shall include comments and/or recommendations from the consulted entities and the licensee's response to any comments. If the licensee does not adopt a recommendation, the report shall include the licensee's reasons, based on project-specific information."

The following individuals were sent draft copies for review. No comments were received by the end of the 30 day review period.

NAME	***AGENCY***	***Comments***
Irle, Pat	Washington State Department of Ecology	
Coffin, Chris	Washington State Department of Ecology	
McKinney, Charlie	Washington State Department of Ecology	
Pacheco, Jim	Washington State Department of Ecology	
Korth, Jeffrey	Washington State Department of Fish and Wildlife	
Simon, Graham	Washington State Department of Fish and Wildlife	
Heiner, Bruce	Washington State Department of Fish and Wildlife	
Maitland, Travis	Washington State Department of Fish and Wildlife	
McCoy, Gina	Washington State Department of Fish and Wildlife	
Grover Wier, Kari	United States Department of Agriculture – Forest Service	
Martinez, Alex	United States Department of Agriculture – Forest Service	
Glesne, Reed	National Park Service	
Lewis, Steve	United States Fish and Wildlife Service	
Yeager, Justin	National Marine Fisheries Services	
Towey, Bill	Confederated Tribes of the Colville Reservation	
Rose, Bob	Yakama Indian Nation	
Merkle, Carl	Confederated Tribes of the Umatilla Indian Reservation	
Goedde, Robert	City of Chelan	
Archibald, Phil	Lake Chelan Sportsman Association	
Elwell, Nick	United States Geological Survey	
Ernsberger, Tom	Washington State Parks and Recreation Commission	
Snell, Nona	Washington State Recreation and Conservation Office	
Petersen, Wai	Manson Parks and Recreation Department	
Uhlhorn, Richard	Lake Chelan Recreation Association	
O'Keefe, Thomas	American Whitewater	

Document Content(s)