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Subject: FINAL 2015 Total Dissolved Gas Annual Report
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Re: FINAL 2015 Total Dissolved Gas Annual Report for Rocky Reach and
Rock Island Hydroelectric Projects

Mr. McKinney, Mr. Peterschmidt and Ms. Harris:

Attached is the FINAL 2015 Total Dissolved Gas Annual Report for Rocky Reach
and Rock Island Hydroelectric Projects.

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

Thank you,

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**2015
TOTAL DISSOLVED GAS
ANNUAL REPORT**

FINAL

**ROCKY REACH HYDROELECTRIC PROJECT
FERC Project No. 2145
and
ROCK ISLAND HYDROELECTRIC PROJECT
FERC Project No. 943**

December 4, 2015



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

TERMS AND ABBREIATIONS

7Q10	highest seven consecutive day average flow with a 10-year recurrence frequency
cfs	cubic feet per second
CCT	Confederated Tribes of the Colville Reservation
Chelan PUD	Public Utility District No. 1 of Chelan County
Ecology	Washington State Department of Ecology
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FPC	Fish Passage Center
FMS	fixed monitoring station
GAP	Gas Abatement Plan
Grant PUD	Public Utility District No. 2 of Grant County
GBT	gas bubble trauma
HCP	Anadromous Fish Agreement and Habitat Conservation Plan
HCP CC	Habitat Conservation Plan Coordinating Committee
JBS	juvenile bypass system
kcfcs	thousand cubic feet per second
msl	mean sea level
NMFS	National Marine Fisheries Service
project	Hydroelectric Project
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RM	river mile
RRFF	Rocky Reach Fish Forum
SCADA	supervisory control and data acquisition
standards	Washington State water quality standards
TDG	total dissolved gas
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WQC	water quality certification
WQMP	Water Quality Management Plan

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EXECUTIVE SUMMARY

Chelan County Public Utility District No.1 (Chelan PUD) has prepared this annual report to summarize the results of the 2015 total dissolved gas (TDG) monitoring, associated spill, biological monitoring and gas abatement methods during the fish-spill period (April 1 through August 31) within the Rocky Reach and Rock Island Hydroelectric Projects.

Over the course of the 2015 fish-spill season, there were no exceedances of the total dissolved gas (TDG) numeric criteria in either the forebays or tailrace of Rocky Reach and Rock Island dams, nor at the forebay of Wanapum Dam.

Mean daily flow discharges during the 2015 fish-spill season were lower than the 2005-2014 average (about 71.6% of average at Rocky Reach, and 73% of average at Rock Island dams) over the entire fish-spill season.

In 2015, spill events at Rocky Reach Dam were involuntary April 1 through May 31 and both voluntary and involuntary June 1 through August 7 (summer fish-spill period). Between June 1 and the end of summer fish-spill on August 7, 98% of the total volume spilled was voluntary, while 2% was involuntary (forced) spill due to repairs on units with mechanical issues discovered in 2013.

At Rock Island Dam, there was no spill until April 14 with the placement of the over/under gates in preparation for the start of the spring fish-spill season. All spill during the spring and summer spill periods (April 16 through May 31 and June 1 through August 11, respectively) was voluntary spill for fish. From August 12 through August 31, there was no spill that occurred with the exception minimal spill due to the removal of the over/under gates on August 12.

To achieve the Anadromous Fish Agreement and Habitat Conservation Plan (HCP) passage requirements for subyearling (summer) Chinook salmon, Chelan PUD maintained a target spill level of 9% of daily average river flow at the Rocky Reach Dam for a duration covering 95% of the subyearling outmigration during the summer of 2015. The summer spill program for subyearling passage began on June 1 and ended on August 11. Percent daily river flow spilled during the summer period was 9%.

Spill through modified gates remains the primary fish passage measure used to meet HCP survival standards at the Rock Island Project. Spring fish-spill of 10% of total river flow began on April 16 and was continued through May 31. During the spring fish-spill period, 10% of total river flow was spilled. Of that 10%, 100% of it was voluntary spill for fish. Rock Island fish-spill increased to 20% upon onset of the summer outmigration of subyearling Chinook salmon. Summer spill began on June 1 and continued through August 11. During the summer fish-spill period, 20% of total river flow was spilled. Of that 20% of total river flow, 100% of it was voluntary spill for fish.

As part of the Fish Passage Center's (FPC) Smolt Monitoring Program at Rock Island Dam, yearling and subyearling Chinook salmon and steelhead were examined for evidence of gas bubble trauma (GBT) between April 17 and July 16, 2015. During 2015 monitoring, 2,650 smolts were examined for GBT. Of these, 10, or 0.38%, showed signs of GBT.

In 2015, Chelan PUD implemented gas abatement measures as outlined in the Washington State Department of Ecology (Ecology) 401 Water Quality Certification (WQC) (Ecology, 2006). Chelan PUD will continue to closely monitor TDG levels during the fish-spill season, while implementing the abatement measures outlined in Ecology's approved Gas Abatement Plans (GAP), the WQC (Ecology, 2006), and the Rocky Reach Hydroelectric Project Quality Assurance Project Plan (QAPP) (Chelan PUD, 2010b).

SECTION 2: INTRODUCTION

2.1 Report Organization

Specific requirements of this annual report are listed below as defined in Appendix A of the Federal Energy Regulatory Commission (FERC) License Order (FERC, 2009), Section 5.4(4) of the WQC (Ecology, 2006).

5.4(4). Total Dissolved Gas Annual Report

- a) Flow over the preceding year (cubic feet per second over time)
- b) Spill over the preceding year (cubic feet per second and duration)
- c) Reasons for spill (e.g., for fish, turbine down time)
- d) TDG levels during spill (hourly)
- e) Summary of TDG exceedances and what was done to correct the exceedances
- f) Results of the fish passage efficiency (FPE) studies and survival per the Habitat Conservation Plan (HCP)
- g) Analysis of monitoring data for confirmation or refinement of the regression equations in the Water Quality Management Plan (WQMP) (Table 2-7 Analysis of the TDG monitoring in comparison to the regression equations use to predict compliance with the TDG numeric criteria
- h) All monitoring and studies performed for TDG control and abatement

Chelan PUD has prepared this annual report to address the requirements of the WQC. The following Sections of the report specifically address the listed requirements for the fish-spill period as follows:

Section 1 – Project Description	<ul style="list-style-type: none"> • Project description • fixed monitoring stations • regulatory framework • HCP results
Section 2 – Operations	<ul style="list-style-type: none"> • Flow • Spill • Fish-spill programs
Section 3 – Results	<ul style="list-style-type: none"> • Monitoring results <ul style="list-style-type: none"> ○ TDG ○ biological (gas bubble trauma or GBT) ○ regression analysis ○ discussion of exceedances
Section 4 – Abatement measures and Corrective Actions	<ul style="list-style-type: none"> • Abatement measures • Corrective actions
Section 5 - Conclusions	<ul style="list-style-type: none"> • Summary

2.2 Project Description

The Columbia River watershed lies east of the Cascade Mountains and west of the Rocky Mountains and encompasses parts of British Columbia, Idaho, Montana, Nevada, Oregon, and Washington. The Rocky Reach and Rock Island projects are located in mid-Washington State on the mainstem of the Columbia River and are owned and operated by Chelan PUD. This area is 59 river miles (RM), from the forebay of Rocky Reach Dam (RM 474) downstream to the forebay of Wanapum Dam (RM 415) owned and operated by the Public Utility District No. 1 of Grant County (Figure 1-1). There are 21 RM between Rocky Reach and Rock Island dams and 38 RM between Rock Island and Wanapum dams.

2.2.1 Rocky Reach Project Description

The powerhouse at Rocky Reach Dam contains a total of 11 vertical axis-generating units and is situated on the west half of the river parallel to the flow. The spillway houses 12 individually opening 170-ton tainter gates arranged on the east half of the river, perpendicular to the river flow (Figure 1-2). The normal maximum reservoir water surface elevation is 707 feet with an average tailrace water surface elevation of 618 feet, providing a gross head of 89 feet. The depth of the stilling basin immediately downstream of the project is approximately 40 feet at average tail water elevation.

In 2003, Chelan PUD began operation of the juvenile bypass system (JBS), which continues to be the primary juvenile non-turbine passage route at Rocky Reach Dam. Testing completed during the first year of operation enabled Chelan PUD to determine the juvenile guidance efficiency of the JBS and estimate the level of spill necessary to meet the HCP survival standards. Voluntary spill is used at Rocky Reach Dam to supplement the effectiveness of the JBS, when needed, to maintain survival goals of the HCP (See Section 2.3 for details). Due to the effectiveness of the JBS, Chelan PUD has reduced or eliminated spill levels used to supplement the JBS for juvenile salmonid passage since 2007. During the migration season for yearling Chinook and steelhead (generally mid-April to early-June), Chelan PUD has not needed to use spill to supplement the JBS. During the subyearling Chinook migration (generally mid-June to mid/late August), a spill level of 9% of daily flow (reduced from 15%) has been provided.

The 2015 fish-spill program at Rocky Reach Dam was managed to maximize fish passage, maintain HCP requirements, minimize voluntary spill, and still stay within the terms of Ecology's TDG fish-spill water quality criteria. Voluntary spill levels were managed in real time as detailed in the TDG Operational Plan (Appendix A) for Rocky Reach Dam.

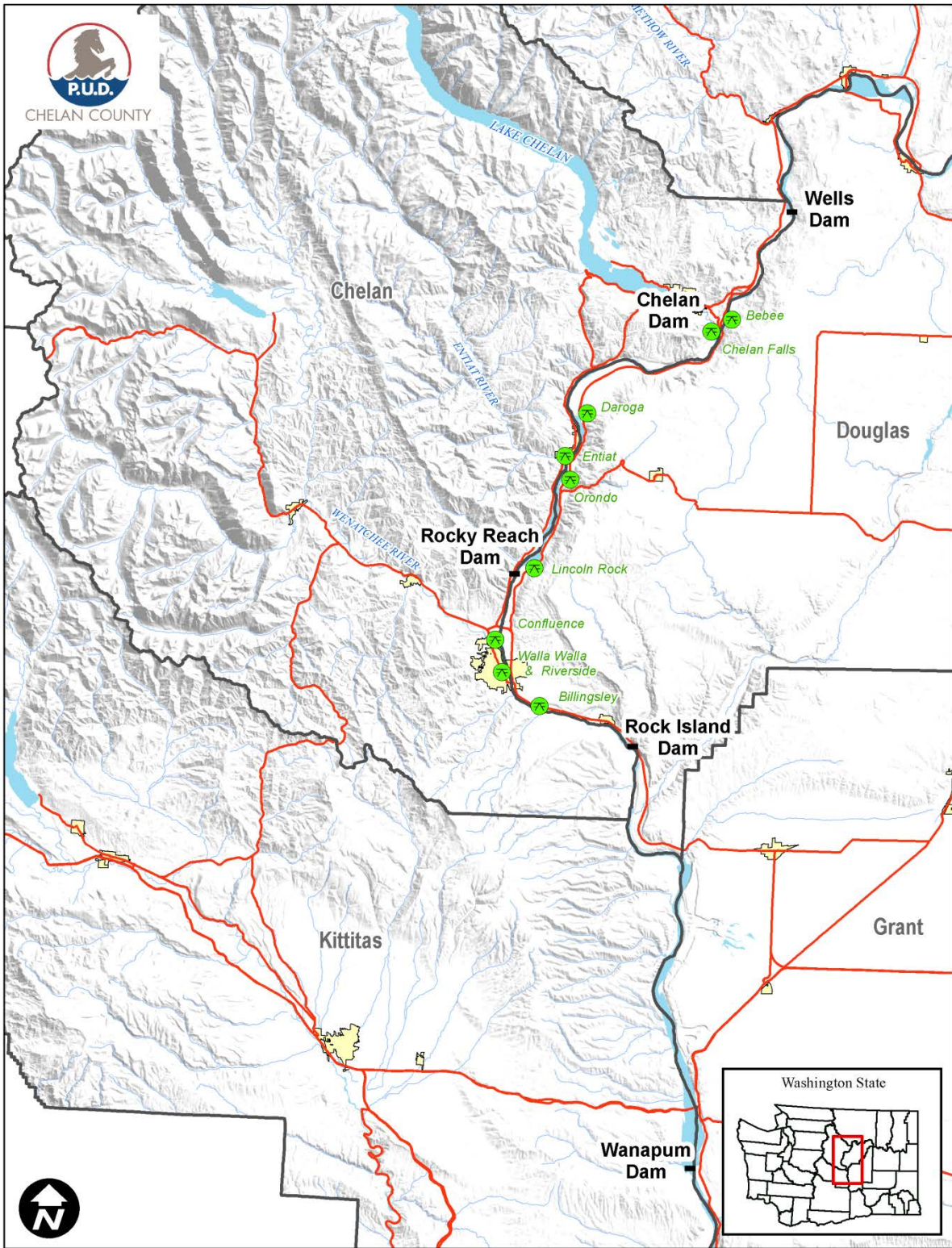


Figure 2-1: Project Location

2.2.2 Rock Island Project Description

The Rock Island Project consists of two separate powerhouses connected by a spillway. There are a total of 18 generating units; ten vertical axis Kaplan and Nagler turbines in the first powerhouse on the east shore, and eight horizontal axis bulb turbine generators in the second powerhouse on the west side of the river. The spillway is 1,184 feet long and houses 31 spillgates divided by a center adult fishway. The east spillway contains a total of 14 gates, arranged perpendicularly to the river flow. The west spillway has 17 gates, situated at a slight angle to the river flow. Spillways are either 33 or 55 feet deep and have two or three spillgates stacked in the gate slot. Lifting one or more of these crest gates regulates spill volume. Each gate is 30 feet wide by 11 or 22 feet high. A total of nine gates have been modified or constructed to provide relatively low volume (1,850 or 2,500 cubic feet per second or cfs) surface spill for fish bypass. The normal maximum reservoir elevation of Rock Island project is 613 feet with a tailrace elevation of 572 feet, with a total head of 41 feet. Tailrace bathymetry below Rock Island is complex, and ranges in elevation from approximately 580 feet below bays 21-23 to approximately 520 feet below Bay 1. Chelan PUD has installed the following three TDG abatement structures at Rock Island:

1. Notched gates

Gates 1, 16, 18, 24, 26, and 29 are equipped with notched gates that reduce TDG by reducing the volume of water necessary for voluntary fish passage.

2. Spill deflector in Bay 16

The main objective for the design of this deflector was to reduce the uptake of TDG per total volume of water and to safely pass downstream migrants during the fish-spill season. Studies conducted on the deflector have shown that it can reduce TDG by 2.7%.

3. Three over/under gates

The over/under gates are unique in that they pass water using the gate well as a water column. Water is released through a six-inch gap at the bottom of the downstream gate slot below the surface of the tail water thus reducing TDG when compared to water plunging through open spill gates. The gates are typically installed when fish-spill begins in April and kept in place for the duration of the season. When in use the gates are installed at the south end of the spillway in slots 30, 31, and 32.

Testing of the first gate installed indicated a reduction in TDG uptake by 8.5 - 13.5% points, as compared to the existing notched gate method, and by additional 2.5 - 4.5 % points as compared to deflectors. Fish passage survival tests performed indicated that overall survival was between 99% and 100%. Because the original over/under gate was successful at reducing TDG and maintaining fish survival, Chelan PUD made the decision to have three (gates 30, 31, and 32) in place prior to the initiation of the 2007 spill season and has been utilized since.

2.3 Fixed Monitoring Stations

In accordance with Section 5.4.1(a) of the 401 WQC (Ecology, 2006), Chelan PUD currently operates and maintains four fixed-site water quality monitoring stations (FMS) that record barometric pressure (millimeters of mercury (mm/Hg)), TDG % saturation, and temperature (degrees Celsius). Barometric pressure, TDG percentage saturation, and temperature are recorded

at 15-minute intervals, throughout the year in accordance with Chelan PUD's Ecology and the FERC approved QAPP (Chelan PUD, 2010b).

TDG data enables plant operators to adjust spill volumes to maintain gas levels to reduce the likelihood of exceeding the TDG criteria. These 15-minute intervals are averaged into hourly readings for use in compiling daily and 12-hour averages. All hourly data are forwarded to Chelan PUD headquarters building and then onto the United States Army Corps of Engineers (USACE) Reservoir Control Center and posted at their site on the World Wide Web: http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/.

Each Chelan PUD FMS is equipped with a Hydrolab® Minisonde® 5, enclosed in a submerged conduit (Figures 1-2 through 1-4). These Hydrolab® Minisonde® 5's or probes are connected to an automated system that allows Chelan PUD to monitor barometric pressure, TDG, and water temperature on an hourly basis. Probes are maintained and calibrated as outlined in the QAPP.

Forebay FMS were located at fixed sites on the upstream face of Rocky Reach and Rock Island dams (Figures 1-2 and 1-3, respectively). The probes were lowered down a conduit, secured to the upstream face of each project, and submerged to a depth of approximately 15 feet.

Tailrace monitoring stations are located downstream of both projects. The Rocky Reach Dam monitoring station is located approximately one third of a mile downstream of the spillway on the JBS outfall (Figure 1-2), as required by the 401 WQC (Ecology, 2006). This location was chosen because it was the most feasible location near the end of the aerated zone, which is the compliance point for the Mid-Columbia TDG Total Maximum Daily Load (TMDL).

No bridge or other permanent in-water structure is available downriver of Rock Island Dam on which to attach a monitoring station. For this reason, Chelan PUD developed a monitoring station about 1.5 miles downriver from the project on the eastern shoreline (Figure 1-4). This FMS has two means of deploying the probe; scaffolding that holds a carriage system with a cable attached to an ecology block in the river, and a fixed pipe attached to the scaffold. The fixed pipe was installed August 25, 2014 due to the extreme fluctuations of the Rock Island Dam tailrace as a result of the Wanapum Reservoir drawdown emergency.



Figure 2-2: Rocky Reach Dam, forebay, tailrace and fixed monitoring stations.



Figure 2-3: Rock Island Dam, forebay fixed monitoring station.



Figure 2-4: Rock Island Dam, tailrace fixed monitoring station.

2.4 Regulatory Framework

The Washington State water quality numeric criteria for TDG (Washington Administrative Code (WAC) 173-201A-200(1)(f)) address standards for the surface waters of Washington State. Under the water quality standards (standards), TDG shall not exceed 110% at any point of measurement in any state water body. However, the TDG criteria may be adjusted to aid fish passage over hydroelectric dams when consistent with an Ecology approved gas abatement plan. This plan must be accompanied by fisheries management and physical and biological monitoring plans. Ecology may approve, on a per application basis, a temporary exemption to the TDG standard (110%) to allow spill for juvenile fish passage on the Columbia and Snake rivers (WAC 173-201A-200(1)(f)(ii)). On the Columbia and Snake rivers, there are three separate standards with regard to the TDG exemption: 1) in the tailrace of a dam, TDG shall not exceed 125% as measured in any one hour period and 2) TDG shall not exceed 120% in the tailrace of a dam and shall not exceed 115% in the forebay of the next dam downstream as measured as an average of the 12 highest consecutive (12C-High) hourly readings in any one day (24-hour period).

It is important to note that the TDG water quality standards identified above are intended to help protect aquatic life designated uses within the project. This includes Ecology's allowance of higher TDG levels during the fish-spill season, which allow dams to spill water to help achieve juvenile salmonid passage performance standards.

Specific passage performance or survival standards for the project are outlined in the HCP for the Rocky Reach Project. Specifically, the HCP provides that Chelan PUD achieve and maintain combined adult and juvenile project survival. The combined adult juvenile survival standard is 91%. The 91% standard is composed of 98% adult project passage survival and 93% juvenile project survival.

Chelan PUD is currently in Phase III - Standards Achieved. This means that the 91% adult-juvenile combined survival standard is achieved for the spring migrating HCP species; sockeye and spring Chinook salmon, and steelhead. Summer/fall subyearling Chinook salmon are in Phase III - Additional Juvenile Studies, due to limitations on acoustic tag technology for subyearlings and the unpredictable migration behavior of these Upper Columbia River subyearling Chinook salmon. Coho salmon, the last HCP species, is in Phase III - Standards Achieved - Interim.

Achieving the survival standards as described above and in addition to meeting TDG numeric criteria as outlined in WAC 173-201A-200(1)(f), are an integral part of meeting the water quality standards as described in the project's 401 WQC (Ecology, 2006).

2.4.1 7Q10 Flows

Section 5.4.1(b) of the 401 WQC (Ecology, 2006) and WAC 173-201A-200(f)(i) state that the water quality criteria for TDG shall not apply when the stream flow exceeds the seven-day, ten-year frequency flood stage (7Q10). The 7Q10 flood flow for Rocky Reach Dam was calculated to be 252 thousand cubic feet per second (kcfs), and 264 kcfs at Rock Island Dam.

2.4.2 Daily Total Dissolved Gas Compliance Value Calculation Method

Prior to 2008, the method used to calculate the daily TDG compliance value during the fish-spill season was based on the average of the twelve highest hourly values in a twenty-four hour period, starting at 0100 hours and ending at 2359 hours. This method was based on Ecology's 1997 water quality standards. In Ecology's 2006 revision to the water quality standards (which were not approved by the Environmental Protection Agency (EPA), and thus not effective, until 2008) the method for calculating the TDG compliance value was changed. The new method provided that the TDG compliance value be determined by calculating the average of the twelve highest consecutive hourly values in a twenty-four hour period. Prior to the 2008 fish-spill season, there was discussion amongst the Columbia and Snake River dam operators on how to properly implement the "rolling average" method, especially as it related to what time the rolling average began. There were concerns related to the addition of the previous day's last eleven hours to the compliance value calculation on the next day.

On May 21, 2008, Ecology requested, via memo, that all Columbia and Snake River dam operators use a rolling average method for calculating the twelve highest consecutive hourly TDG readings in a twenty-four hour period, beginning at 0100 hours, based on Ecology's 2006 revised water quality standards (Ecology, 2008). Using a rolling average method that begins at 0100 hours results in counting the hours 1400 through 2359 twice: in the average calculations on the day they occur and on the next reporting day. As a result, a TDG water quality standard exceedance may be indicated on two separate days based on the same group of hours. For the 2015 fish-spill period, there were no TDG exceedances and therefore, no double counting occurred.

SECTION 3: OPERATIONS

3.1 Description of 2015 Fish-Spill Season Flow Characteristics

Mean daily discharge during the 2015 fish-spill season was compared to the 10-year average of mean daily discharge from 2005-2014, as measured at Rocky Reach (Figure 2-1) and Rock Island dams (Figure 2-2). Mean daily flow discharges during the 2015 fish-spill season were lower than the 2005-2014 average (about 71.6% of average at Rocky Reach, and 73% of average at Rock Island dams) over the entire fish-spill season.

Average flow for all months during the spill season was lower than the monthly 10-year average at both projects. The maximum hourly flows observed at Rocky Reach and Rock Island dams during the spill season were 138 kcfs and 147 kcfs, respectively, on April 3. Of the 153 days during the spill season (April 1 through August 31), there were no instances where the daily average flows exceeded the 7Q10 value at Rocky Reach or Rock Island dams.

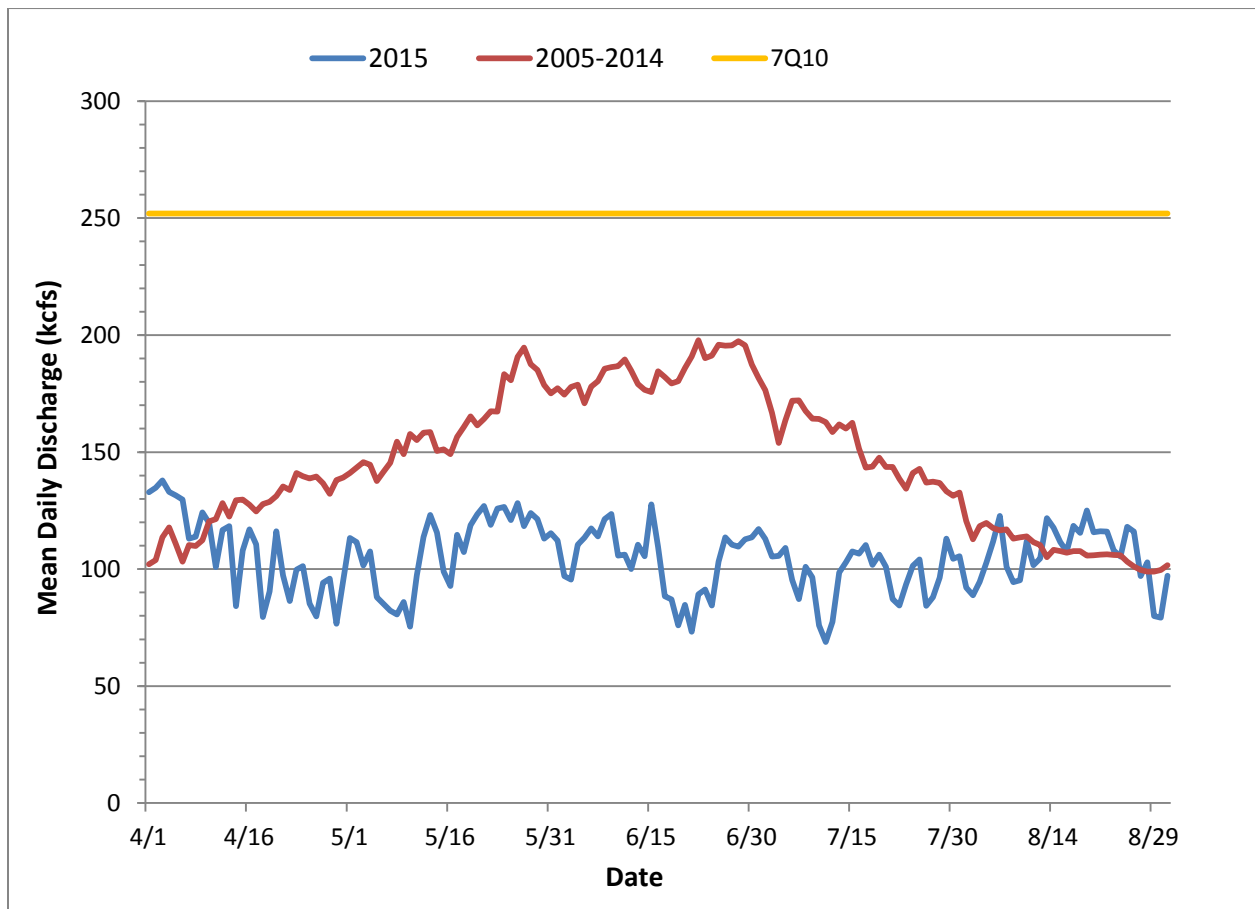


Figure 3-1: Comparison of 2015 vs. previous 10-year average (2005-2015) of mean daily discharge at Rocky Reach Dam.

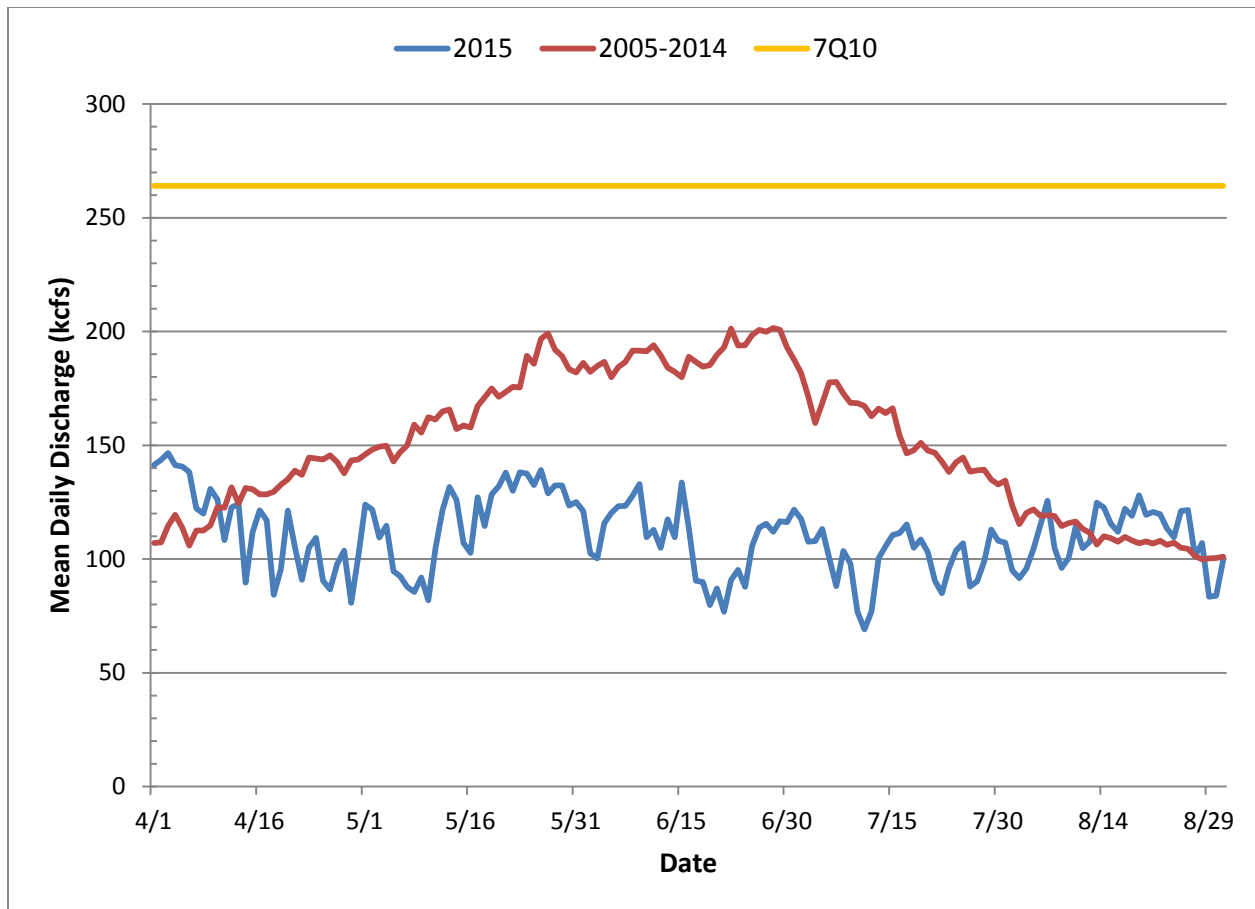


Figure 3-2: Comparison of 2015 vs. previous 10-year average (2005-2014) of mean daily discharge at Rock Island Dam.

3.2 Spill Configurations

The spill levels for fish passage set forth below are subject to real-time modification to meet TDG standards, in accordance with a real-time operational plan. The project operators are instructed to monitor the tailrace TDG level and reduce spill if TDG levels specified in the TDG Operational Plan (Appendix A) are exceeded. The operators at Rock Island Dam are also instructed to inform the operators at Rocky Reach Dam when the Rock Island Dam forebay TDG level exceeds 115%. Since implementation of this plan, the number of TDG exceedances in the tailrace of each project has been reduced.

3.2.1 *Rocky Reach Dam*

The standard spill configuration used at Rocky Reach Dam uses gates 2 through 8 with a minimum discharge per spill bay of about four kcfs. The standard spill configuration was designed to create a crown-shaped pattern of turbulent flow below the spillway with decreasing velocities leading toward the fishway entrances.

This spill pattern provides favorable guidance conditions for adult migrant salmon and steelhead. The same pattern is used for juvenile fish passage spill. During spill operations, whether for juvenile fish passage, TDG management, or for other purposes, the gates are operated via a

computer-automated system that follows the spill pattern. Gates 9 through 12 are used only in high flow conditions when gates 2 through 8 cannot pass enough water. The standard spill pattern is deviated from only when needed during high flow and spill events.

3.2.2 Rock Island Dam

Spill at Rock Island Dam is provided to cover 95% of the juvenile outmigration for steelhead, and sockeye, yearling and subyearling Chinook salmon.

Optimizing spill efficiency and reducing TDG levels has been a key task for Chelan PUD at Rock Island Dam. To accomplish this task, nine of the 32 spill gates have been modified with notches (notched spill gate) in the upper section of the spill gate, in order to provide efficient spill that also provides high juvenile salmonid passage survival. In addition to notched spill gates, three spill gates have been modified to pass spill over one gate and under another, termed over/under spill gates, effectively passing juvenile fish and reducing TDG levels in the tailrace associated with spill.

3.2.2.1 Existing Spill Plan

The existing juvenile fish-spill plan at Rock Island Dam is implemented for normal forebay and tail water elevations. The usual operating range for the Rock Island Dam forebay is 612 ft to 613 feet mean sea level (msl) and tail water is 570 feet. Spill for juvenile fish passage is provided between the first of April and up to the end of August each year.

Notched spill gates are numbers 1, 16, 18, 24, 26, and 29. These gates can be opened or closed sequentially by the operators using electric hoists. Over/under spill gates are numbers 30, 31, and 32. Once these gates are installed prior to the start of spring fish-spill season, they remain open until the close of the season. A mechanic crew installs the gates (in their operating configuration) with a crane, so the operators themselves cannot sequentially open or close the over/under gates as they do with the notched gates. As a result, Rock Island Dam can spill no less than 7.2 kcfs (total discharge for the three gates) from the date of installation (late March/early April) to the date of removal (late August/early September). Sequencing of the notched and over/under spill gates vary from year to year depending upon inflows, headwater control, and any scheduled maintenance of the gates.

3.3 Fish-Spill Programs

Specific survival standards for the project are outlined in the HCP for the Rocky Reach and Rock Island projects. Chelan PUD is required to meet and maintain survival standards for fish migrating through the projects. Reservoir and dam passage survival are the key components of project survival. Chelan PUD uses a different combination of tools to facilitate fish passage at the Rocky Reach and Rock Island dams because of each dam's unique features. At Rocky Reach Dam, passage is facilitated by the JBS, which is the primary method to increase juvenile dam passage survival. The efficiency of the JBS has allowed for elimination of the need to spill for fish during the spring migration season, thereby reducing TDG levels.

At Rock Island Dam, spill is still the preferred method of moving fish past the dam, with most of the spill being passed through the modified notched spill gates. Results of survival studies

conducted at Rock Island Dam have enabled Chelan PUD to reduce voluntary (fish) spill in the spring from 20% of the daily average flow to 10% of the daily average flow. Summer spill at Rock Island Dam remains at 20% of the daily average flow.

The fish-spill programs implemented by Chelan PUD at each project are dictated by the timing and duration of each species of outmigration. In the spring, generally mid-April through early- June, yearling Chinook salmon, steelhead and sockeye migrate past the projects, while subyearling Chinook salmon migrate during the summer, generally mid-June to mid/late-August. Appendix B contains the specific 2015 Fish-Spill Season Memoranda announcing the spring and summer fish-spill periods.

During the spring of 2015, Chelan PUD operated the JBS exclusively with no voluntary spill for yearling Chinook salmon, steelhead, and sockeye passage. Spring fish-spill began at Rock Island Dam on April 16, 2015 at 0001 hours and ended May 31, 2015 at 2400 hours (see Appendix D).

Summer fish-spill began on June 1, 2015 at 0001 hours immediately following the end of the spring fish-spill season and continued through 2400 hours on August 7, 2015 at Rocky Reach and August 11, 2015 at Rock Island dams (see Appendix B). Tables 2-1 and 2-2 provide a summary of the 2015 fish-spill for Rocky Reach and Rock Island dams respectively.

Table 3-1: Summary of fish-spill operations at Rocky Reach Dam.

Rocky Reach Dam			
Date	Juvenile Fish Passage Program	Quantity	Notes
1-Apr	JBS Operation Began		Operated exclusively with no fish-spill during the spring (April 1 – May 31) ¹
1-June	Summer Spill Initiated	9% of daily average river flow	Spill for sub-yearling (summer) Chinook salmon
7-Aug	End of summer spill		
31-Aug	JBS Operation Ended		
Notes: ¹ The efficiency of the JBS has allowed for elimination of the need to spill for fish during the spring migration season, thereby reducing TDG levels.			

Table 3-2: Summary of fish-spill operations at Rock Island Dam.

Rock Island Dam		
Date	Juvenile Fish Passage Program	Quantity
1-Apr	Fish Bypass Operation Began	
16-Apr	Spring Spill Initiated	10% daily average river flow
31-May	End of Spring Spill	
1-June	Start of Summer Spill	20% of daily average river flow
11-Aug	End of Summer Spill	
31-Aug	Fish Bypass Operation Ended	

3.4 Fish-Spill Quantities and Duration

Spill scenarios can be divided into two categories: fish-spill (voluntary) and non fish-spill (involuntary). Non-fish/involuntary spill scenarios may include, but are not limited to:

- Flow in excess of hydraulic capacity
- Plant load rejection spill
- Immediate replacement spill
- Maintenance spill
- Error in communication spill
- Spill past unloaded units

Tables 2-3 and 2-4 show the monthly averages for river flow, total spill, fish-spill, and other spill for the Rocky Reach and Rock Island dams.

Table 3-3: Average monthly total flow, spill, and percent of total flow spilled for different purposes at Rocky Reach Dam, April 1 through August 31, 2015.

Month	Average Flow kcfs	Average Spill kcfs	Spill Purpose					
			Fish-Spill			Other		
			Spill kcfs	% of flow	% of Total Spill	Spill kcfs	% of flow	% of Total Spill
April	107.4	0.5	0.0	0.0	0.0	0.5	0.4	100.0
May	108.9	0.3	0.0	0.0	0.0	0.3	0.2	100.0
June	103.6	9.6	9.5	9.2	99.0	0.1	0.1	1.0
July	98.4	8.5	8.4	8.5	98.4	0.1	0.1	1.6
August	106.2	2.9	2.1	2.0	72.3	0.8	0.8	27.7

Table 3-4: Average monthly total flow, spill, and percent of total flow spilled for different purposes at Rock Island Dam, April 1 through August 31, 2015.

Month	Average Flow kcfs	Average Spill kcfs	Spill Purpose					
			Fish-Spill			Other		
			Spill kcfs	% of flow	% of Total Spill	Spill kcfs	% of flow	% of Total Spill
April	113.7	5.2	5.2	4.5	100.0	0.0	0.0	0.0
May	117.3	11.5	11.5	9.8	100.0	0.0	0.0	0.0
June	107.5	21.3	21.3	19.8	100.0	0.0	0.0	0.0
July	100.2	19.3	19.3	19.2	100.0	0.0	0.0	0.0
August	109.5	7.5	7.5	6.9	100.0	0.0	0.0	0.0

3.4.1 Voluntary and Involuntary Spill

In 2015, spill events at Rocky Reach Dam were involuntary (forced) April 1 through May 31 and both voluntary and involuntary June 1 through August 7 (summer fish-spill period). Between June 1 and the end of summer fish-spill on August 7, 98% of the total volume spilled was voluntary, while 2% was involuntary (forced) spill due to repairs on units with mechanical issues discovered in 2013.

At Rock Island Dam, there was no spill until April 14, with the placement of the over/under gates in preparation for the start of the spring fish-spill season. All spill during the spring and summer spill periods (April 16 through May 31 and June 1 through August 11, respectively) was voluntary spill for fish. From August 12 through August 31, there was no spill that occurred with the exception minimal spill due to the removal of the over/under gates on August 12.

To achieve HCP passage requirements for subyearling (summer) Chinook salmon, Chelan PUD maintained a target spill level of 9% of daily average river flow at the Rocky Reach Dam for a duration covering 95% of the subyearling outmigration during the summer of 2015. The summer spill program for subyearling passage began on June 1 and ended on August 11. Percent daily river flow spilled during the summer period was 9%.

Spill through modified gates remains the primary fish passage measure used to meet HCP survival standards at the Rock Island Hydroelectric Project. Spring fish-spill of 10% began on April 16 and was continued through May 31. During the spring fish-spill period, 10% of total river flow was spilled. Of that 10%, 100% of it was voluntary spill for fish. Rock Island Dam fish-spill increased to 20% upon onset of the summer outmigration of subyearling Chinook. Summer spill began on June 1 and continued through August 11. During the summer fish-spill period, 20% of total river flow was spilled. Of that 20%, 100% of it was voluntary spill for fish.

SECTION 4: RESULTS

The following sections describe the 2015 fish-spill season flow characteristics compared to the previous ten-year average, the 2015 fish-spill season programs, the 2015 biological TDG monitoring results, and the TDG data for the fish-spill season.

4.1 Biological Evaluations

The following sections provide a summary of fisheries management and results from GBT monitoring. Note that no survival studies were conducted in 2015.

No survival studies on spring migrants (yearling Chinook and sockeye salmon and steelhead) were conducted in 2015 as HCP survival standards have been achieved for all three species at both projects. Additionally, due to tag technology limitations and uncertainties regarding their life history (outmigration behavior) no survival studies for summer/fall subyearling Chinook have been conducted since 2004.

4.1.1 Gas Bubble Trauma Monitoring

GBT monitoring is not conducted on an annual basis at Rocky Reach Dam. However, Section 5.4(1)(c) of the Rocky Reach Project WQC (Ecology, 2006) requires Chelan PUD to develop and implement a plan to study GBT below Rocky Reach Dam. On April 21, 2014, Chelan PUD received a letter from Ecology postponing the GBT monitoring until such a time as is determined to be appropriate by Ecology. Ecology is currently evaluating the need for future GBT studies below Rocky Reach Dam. Currently, Chelan PUD conducts a Smolt Monitoring Program at Rock Island Dam.

As part of the Fish Passage Center's (FPC) Smolt Monitoring Program at Rock Island Dam, yearling and subyearling Chinook salmon and steelhead were examined for evidence of GBT between April 17 and July 16, 2015. Each week a random sample of up to 100 fish composed of both yearling Chinook salmon and steelhead were examined in April and May, two days per week. In June, the sample was changed from yearling to subyearling Chinook salmon when the subyearling Chinook salmon collection exceeded the yearling Chinook salmon collection. A random sample of up to 100 subyearling was examined two days per week. Examinations followed FPC standardized procedure as outlined by FPC (2009). During 2015 monitoring, 2,650 smolts were examined for GBT. Of these, 10, or 0.38%, showed signs of GBT. Table 3-1 provides the summary results of 2015 GBT monitoring.

Table 4-1: Number salmon and steelhead smolts examined for external signs of GBT of at Rock Island Dam in 2015.

Species	Number of fish examined	Fish with GBT		Location with GBT			
				Fins		Eyes	
		N	%	N	%	N	%
Chinook yearling	846	4	0.47%	4	0.47%	0	0.00%
Steelhead	642	2	0.31%	2	0.31%	0	0.00%
Chinook Sub-yearling	1,162	4	0.34%	4	0.34%	0	0.00%
<i>Total</i>	<i>2,650</i>	<i>10</i>	<i>0.38%</i>	<i>10</i>	<i>0.38%</i>	<i>0</i>	<i>0.00%</i>

4.2 Data Evaluation and Analyses

Data collection, quality assurance/quality controls (QA/QC), and analyses of TDG values were conducted in accordance with the QAPP for the FMS (Chelan PUD, 2010b). For this report, hourly TDG data recorded during 2015 were analyzed for apparent exceedances of current water quality standards. TDG values are rounded to the nearest number for example; 115.2 is rounded to 115, 115.5 is rounded to 116.

All of the TDG probes used during 2015 were calibrated and maintained in accordance with the methods and schedules described in the QAPP (Chelan PUD, 2010b). TDG probes that did not pass calibration tests were sent back to the manufacture for repair and/or replaced prior to deployment. Calibration reports are included in Appendix C of this report. Suspect or clearly erroneous TDG values were omitted from the analysis, but are included, as well as explanation for omission, in Appendix D of this report.

The data QA/QC issues during 2015 were related to the following issues; program upgrades, communication errors, and/or down time during calibration. Overall, data loss for Chelan PUD operated FMS during the 2015 fish-spill season was 38 hourly readings or 0.26% of the total available data collection hours. Table 3-2 displays the number of TDG values that were omitted from the dataset due to QA/QC issues during the 2015 fish-spill season.

Table 4-2: Overview of total dissolved gas data set during 2015 fish-spill season April 1 through August 31.

Location	Available data hours	Number of omitted/lost hourly readings ¹	Percent data loss (%)
RRFB	3,672	2	0.05
RRTR	3,672	3	0.08
RIFB	3,672	13	0.35
RITR	3,672	20	0.54
<i>Total</i>	<i>14,688</i>	<i>38</i>	<i>0.26</i>

Note: RRFB = Rocky Reach Dam Forebay, RRTR = Rocky Reach Dam Tailrace, RIFB = Rock Island Dam Forebay, RITR = Rock Island Dam Tailrace.

¹See Appendix D for dates, times, and circumstances relating to omitted/lost data

4.3 Total Dissolved Gas Monitoring During the Fish-Spill Season

The following sections discuss the results of TDG monitoring from the 2015 fish-spill season within the project and at the Wanapum Dam forebay compliance point location. Specific sections of this document include TDG averages with associated figures for each FMS compliance point location, a breakdown of all TDG exceedances and possible explanations for those exceedances, and the connection between elevated TDG levels and involuntary spill during the 2015 fish-spill season. Summary values for all hourly average TDG measurements taken from each FMS during the 2015 fish-spill season are presented in Table 3-4 below.

Table 4-3: Summary of hourly averages total dissolved gas measurements from each FMS during the 2015 fish-spill season.

Location	Data Interval	Mean	Standard Deviation	Minimum	Maximum
RRFB	04/01 – 08/31	108.1	1.9	102.4	111.1
RRTR	04/01 – 08/31	109.8	3.3	101.6	120.2
RIFB	04/01 – 08/31	108.0	2.2	101.8	115.3
RITR	04/01 – 08/31	111.7	3.4	101.9	119.4
WANF	04/01 – 08/31	109.5	2.8	102.3	115.0
Notes: Values represent % saturation RRFB = Rocky Reach Dam forebay, RRTR = Rocky Reach Dam tailrace, RIFB = Rock Island Dam forebay, RRTR = Rocky Reach Dam tailrace, WANF = Wanapum Dam forebay					

4.3.1 Total Dissolved Gas Averages

Total dissolved gas averages during the fish-spill season in Figures 3-1 through 3-9 display the average of the 12-highest consecutive hourly readings, spill vs. TDG, and a regression analysis of predicted TDG levels vs. actual TDG at Rocky Reach Dam tailrace. Figure 4-8 shows that actual 2015 TDG fish-spill data was lower than predicted regression equations in the WQMP, Table 2-7 (Chelan PUD, 2006). The average of the 12-highest consecutive hourly TDG readings from each day during the spring and summer fish-spill seasons from each FMS is presented in Appendix E of this report.

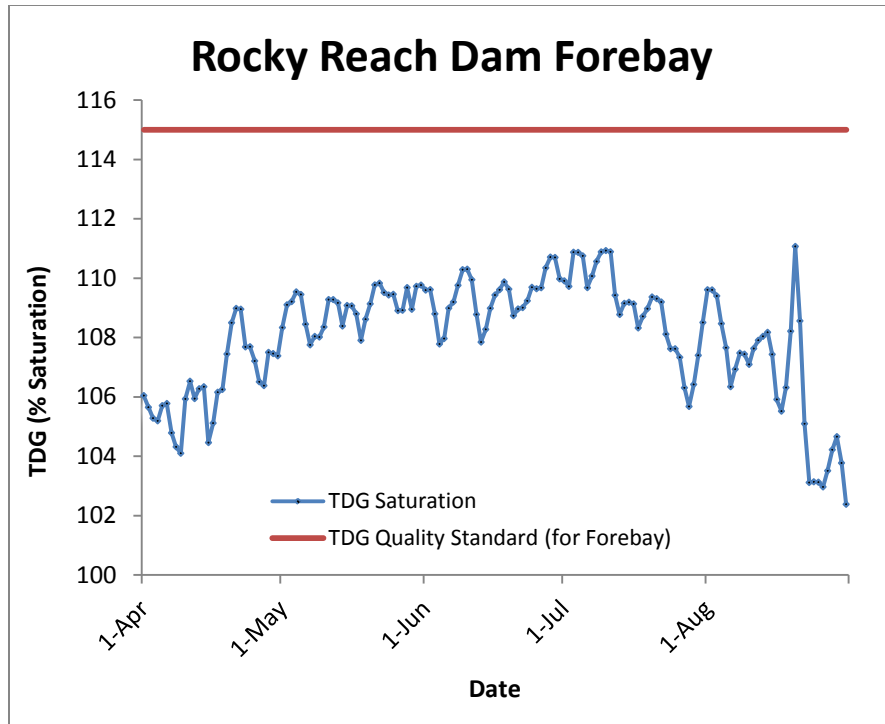


Figure 4-1: Total dissolved gas measurements (average of the 12-highest consecutive hourly TDG readings in a 24-hour period) from the 2015 fish-spill season recorded at the Rocky Reach Dam forebay FMS.

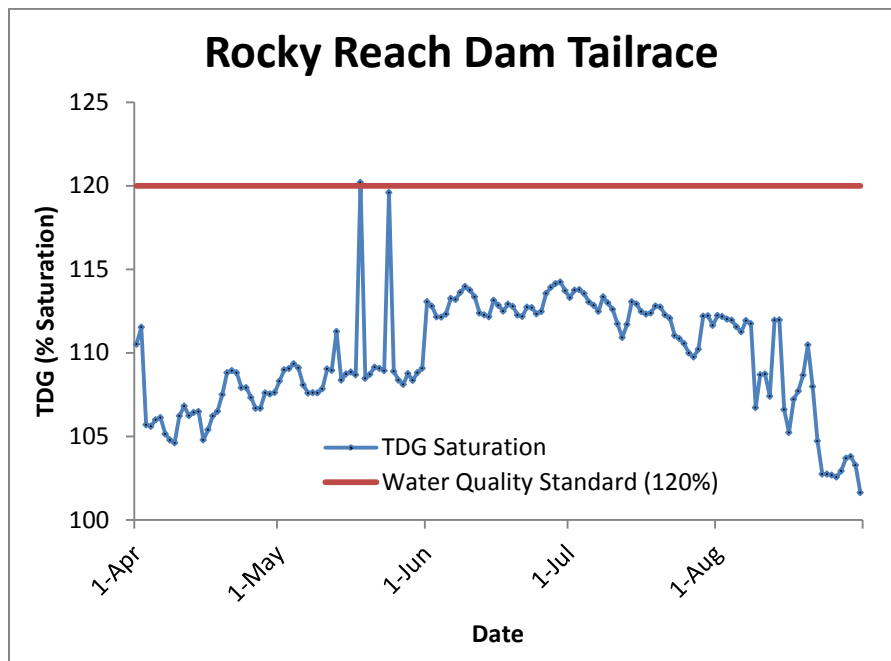


Figure 4-2: Total dissolved gas measurements (average of the 12-highest consecutive hourly TDG readings in a 24-hour period) from the 2015 fish-spill season recorded at the Rocky Reach Dam tailrace FMS.

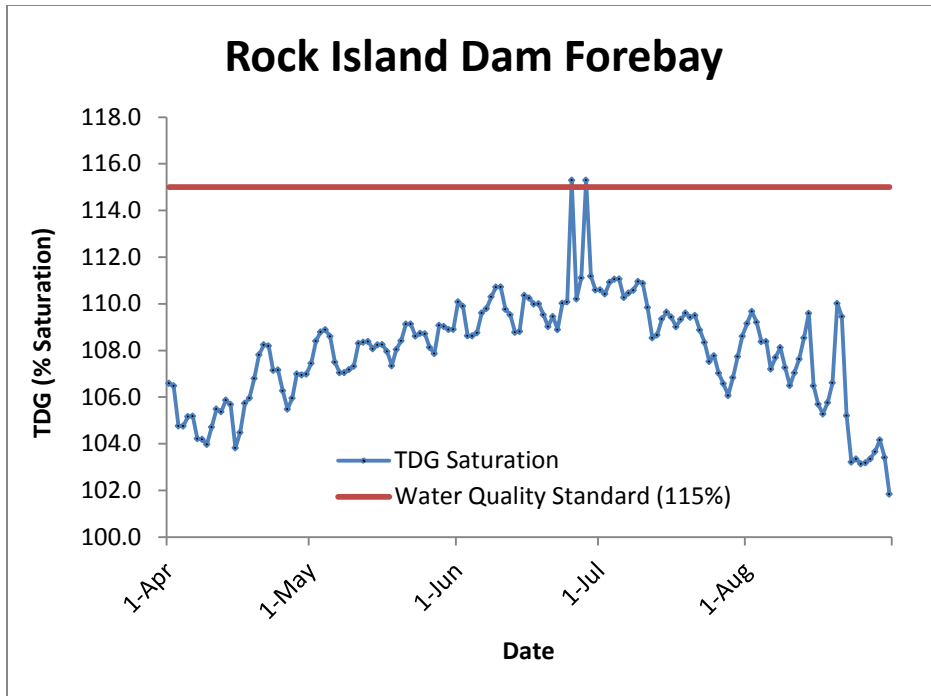


Figure 4-3: Total dissolved gas measurements (average of the 12-highest consecutive hourly TDG readings in a 24-hour period) from the 2015 fish-spill season recorded at the Rock Island Dam forebay FMS.

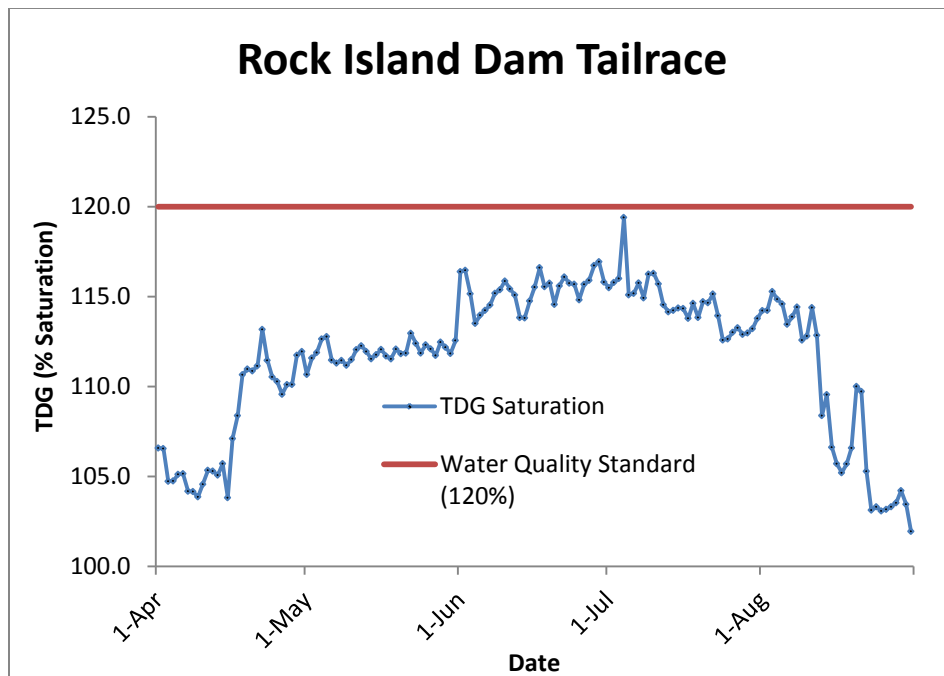


Figure 4-4: Total dissolved gas measurements (average of the 12-highest consecutive hourly TDG readings in a 24-hour period) from the 2015 fish-spill season recorded at the Rock Island Dam tailrace FMS.

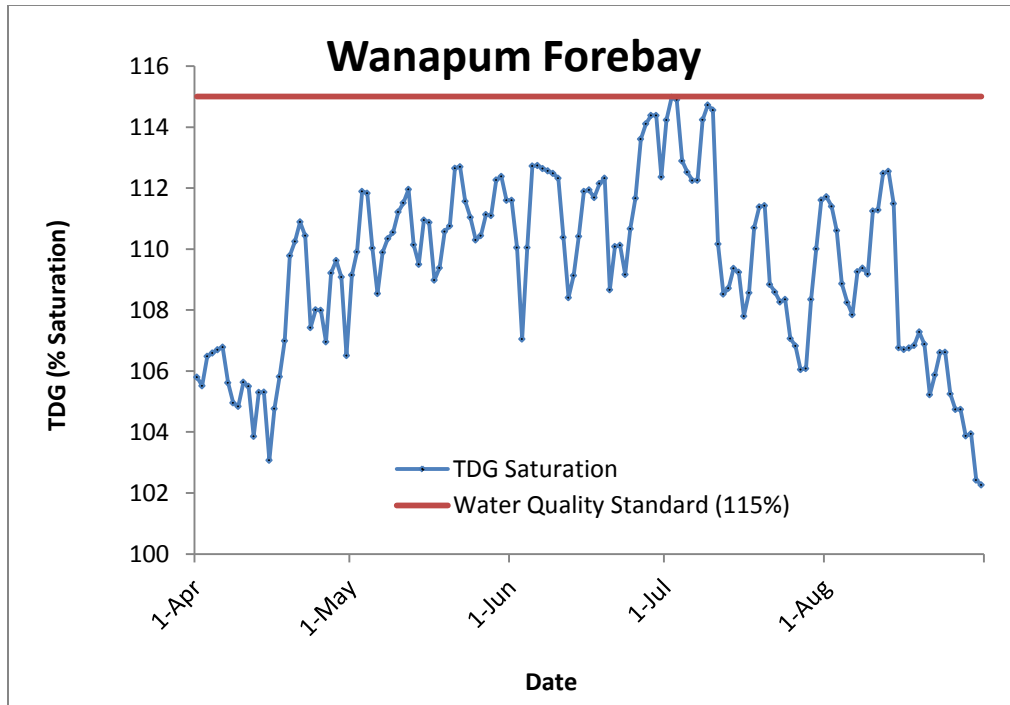


Figure 4-5: Total dissolved gas measurements (average of the 12-highest consecutive hourly TDG readings in a 24-hour period) from the 2015 fish-spill season recorded at the Wanapum Dam forebay FMS.

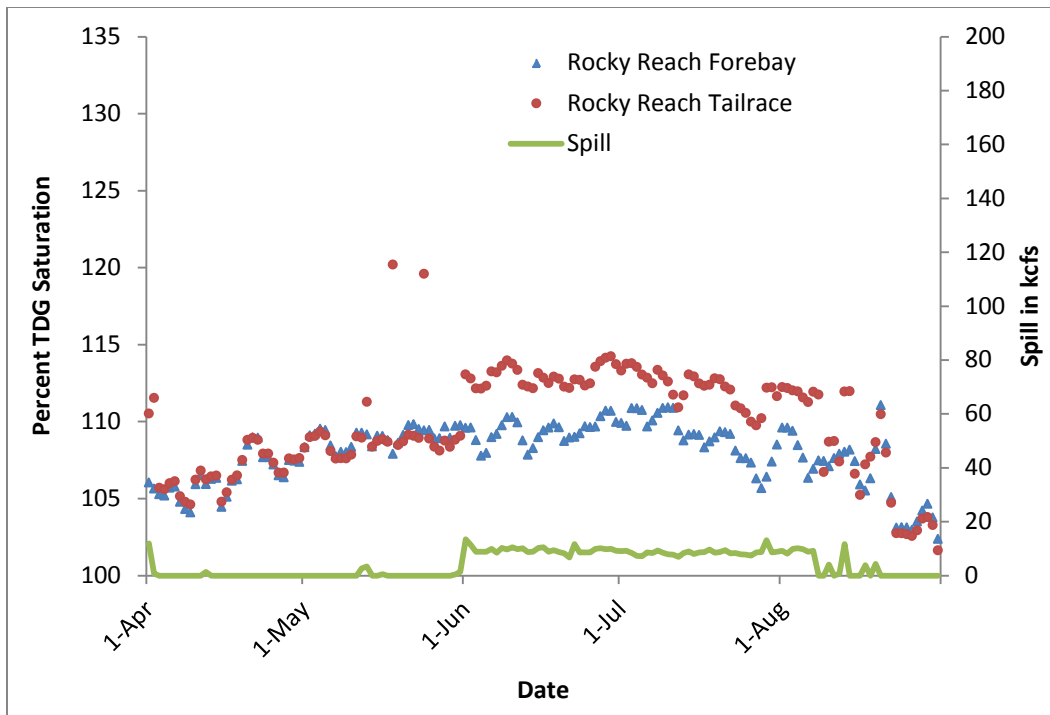


Figure 4-6: Spill and total dissolved gas measurements (average of the 12-highest consecutive hourly TDG readings in a 24-hour period) from the 2015 fish-spill season recorded at the Rocky Reach Dam forebay and tailrace FMS.

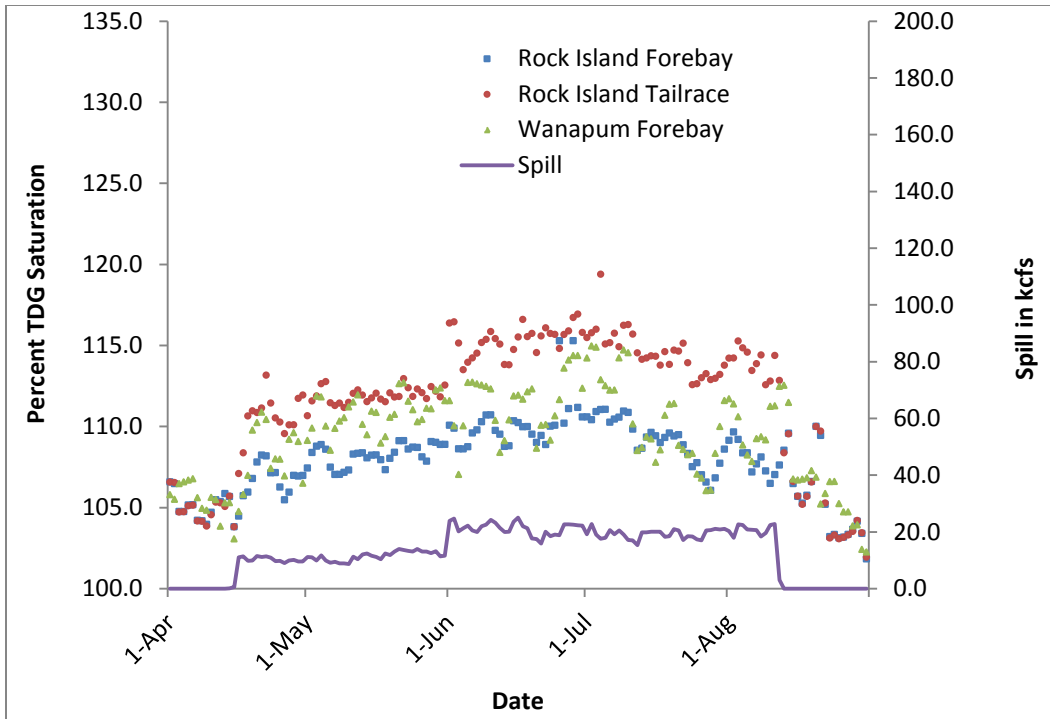


Figure 4-7: Spill and total dissolved gas measurements (average of the 12-highest consecutive hourly TDG readings in a 24-hour period) from the 2015 fish-spill season recorded at the Rocky Island Dam forebay and tailrace and the Wanapum Dam forebay FMS.

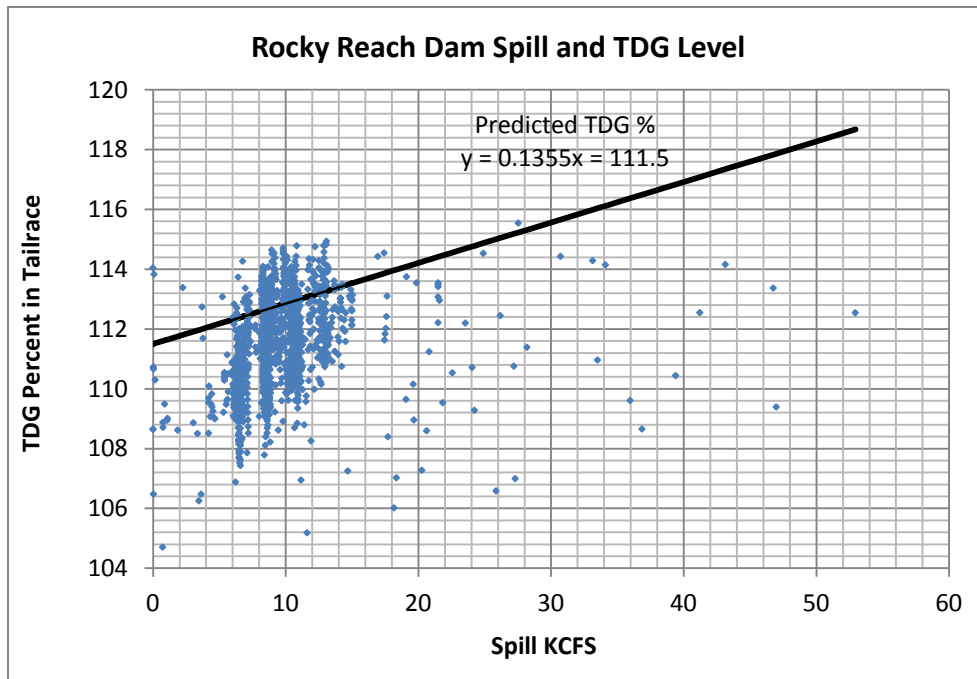


Figure 4-8: 2015 Rocky Reach Dam tailrace TDG % vs. predicted TDG %.

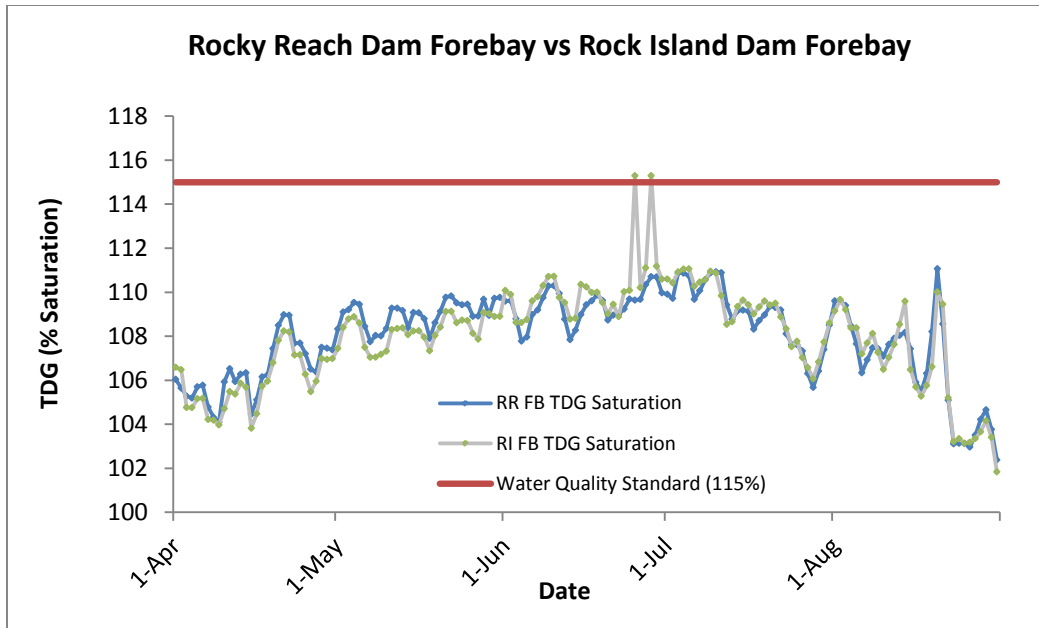


Figure 4-9: Total dissolved gas measurements (average of the 12-highest consecutive hourly TDG readings in a 24-hour period) from the 2015 fish-spill season recorded at the Rocky Reach and Rock Island dam forebays FMS.

4.3.2 Total Dissolved Gas Exceedances

During the 2015 fish-spill season, TDG levels never exceeded the current water quality standards as measured at each of Chelan PUD’s FMS as well as the Wanapum Dam forebay compliance point (owned/operated by Grant PUD). All TDG data is presented in Appendix E of this report.

4.3.3 Discussion of Exceedances

There were no exceedances of the numeric criteria for the Rocky Reach, Rock Island, and the forebay of Wanapum dams.

SECTION 5: TOTAL DISSOLVED GAS ABATEMENT MEASURES AND CORRECTIVE ACTIONS IMPLEMENTED IN 2015

5.1 Operational

Due to the success of the JBS at Rocky Reach Dam and survival studies at both projects, Chelan PUD has been able to reduce spill at both Rocky Reach and Rock Island dams for at least a portion of the spill season, thereby reducing the generation of total dissolved gas in the project waters.

5.1.1 Rocky Reach Project

Results of survival studies have allowed Chelan PUD to greatly reduce spill and eliminate for fish at Rocky Reach Dam. The JBS is now operated exclusively, with no spill, for spring migrants; and spill during the summer migration has been reduced to 9% of the daily average flow. Spill levels from 2003 to 2015 are shown in Table 4-1 below. The JBS continues to be the most efficient non-turbine route for fish passage and does not require spill for its operation.

Table 5-1: Rocky Reach Dam fish-spill Comparison 2003-2015.

Year	Season	Spill Start Date	Spill Stop Date	Days of Spill	Spill Level¹
2003	Spring	20-Apr	29-May	40	15% / 25%
2003	Summer	30-May	14-Aug	77	15%
Total				117	
2004	Spring	6-May	6-Jun	31.5	0% / 24%
2004	Summer	7-Jun	21-Aug	70	9%
Total				101.5	
2005	Spring	10-May	9-Jun	18.5	0% / 24% ²
2005	Summer	10-Jun	15-Aug	67	9%
Total				85.5	
2006	Spring	2-May	1-Jun	19.0	0% / 24% ²
2006	Summer	2-Jun	11-Aug	71	9%
Total				90	
2007	Spring	No Spill	No Spill	0	0%
2007	Summer	2-Jun	21-Aug	81	9%
Total				81	
2008	Spring	No Spill	No-Spill	0	0%
2008	Summer	8-Jun	31-Aug	81	9%
Total				81	
2009	Spring	No Spill	No Spill	0	0%
2009	Summer	10-Jun	31-Aug	78	9%
Total				78	
2010	Spring	No Spill	No Spill	0	0%
2010	Summer	9-Jun	20-Aug	73	9%
Total				73	
2011	Spring	No Spill	No Spill	0	0%

Year	Season	Spill Start Date	Spill Stop Date	Days of Spill	Spill Level ¹
2011	Summer	4-Jun	12-Aug	70	9%
Total				70	
2012	Spring	No Spill	No Spill	0	0%
2012	Summer	26-May	9-Aug	76	9%
Total				76	
2013	Spring	No Spill	No Spill	0	0%
2013	Summer	5-June	21-August	78	9%
Total				78	
2014	Spring	No Spill	No Spill	0	0%
2014	Summer	24-May	24 - August	93	9%
Total				93	
2015	Spring	No Spill	No Spill	0	0%
2015	Summer	1-June	11-August	73	9%
Total				73	9%

Notes: ¹ Percentage of daily average river flow at Rocky Reach Dam. Two values in this column represents two different spill levels during the season (first value is the spill level for yearling Chinook and steelhead, second value is the spill level for sockeye.)
²24 days of on/off spill test for sockeye

The goal of the Rocky Reach Project GAP (Appendix E), approved by Ecology in April of 2015 is to implement measures to achieve compliance with the standards for TDG in the Columbia River at the project while continuing to meet the fish passage and survival standards set forth in the HCP and Fish Management Plan. To meet this goal, Chelan PUD implemented the following operational measures:

1. Minimized voluntary spill – no fish (voluntary) spill planned for the spring migration, 9% of the daily average river flow for the summer migration.
2. During fish passage, managed voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria, using the TDG Operational Plan (Appendix A).
3. Minimized spill, to the extent practicable, by scheduling maintenance based on predicted flows.
4. Avoided spill, to the extent practicable, by continuing to participate in the Hourly Coordination Agreement, to the extent it reduces TDG.
5. Maximized powerhouse discharge as appropriate up to 212 kcfs.
6. Continued the analysis of the three alternate spillway configurations that were tested in 2011 and 2012 (Chelan PUD, 2013b) to determine if any would be efficient at minimizing TDG. Chelan PUD is currently in the process of writing the program for gate operation in order to implement the flattened spill gate configuration during the non-fish-spill period.

5.1.2 Rock Island Project

After meeting the HCP juvenile survival standards for all spring migrating species under a 20% spring spill regime in 2006, Chelan PUD has implemented a spill reduction study resulting in spring (voluntary) fish-spill being reduced to 10% of the daily average river flow. Spill levels from 2003 to 2015 are shown in Table 4-2 below.

Table 5-2: Rock Island Dam fish-spill comparison, 2003-2015.

Year	Season	Spill Start Date	Spill Stop Date	Days of Spill	Spill Level ¹
2003	Spring	17-Apr	31-May	45	20%
2003	Summer	1-Jun	16-Aug	77	20%
Total				122	
2004	Spring	17-Apr	8-Jun	53	20%
2004	Summer	9-Jun	4-Aug	57	20%
Total				110	
2005	Spring	17-Apr	9-Jun	54	20%
2005	Summer	10-Jun	9-Aug	61	20%
Total				115	
2006	Spring	17-Apr	13-Jun	58	20%
2006	Summer	14-Jun	11-Aug	59	20%
Total				117	
2007	Spring	17-Apr	1-Jun	46	10%
2007	Summer	2-Jun	21-Aug	81	20%
Total				127	
2008	Spring	17-Apr	7-Jun	52	10%
2008	Summer	8-Jun	16-Aug	70	20%
Total				122	
2009	Spring	17-Apr	9-Jun	54	10%
2009	Summer	10-Jun	17-Aug	69	20%
Total				123	
2010	Spring	17-Apr	8-Jun	53	10%
2010	Summer	9-Jun	20-Aug	73	20%
Total				126	
2011	Spring	17-Apr	3-Jun	48	10%
2011	Summer	4-Jun	24-Aug	82	20%
Total				130	
2012	Spring	17-Apr	27-May	41	10%
2012	Summer	28-May	18-Aug	83	20%
Total				124	
2013	Spring	17-Apr	4-June	49	10%
2013	Summer	5-June	18-Aug	75	20%
Total				124	
2014	Spring	17-Apr	23 - May	37	10%
2014	Summer	24 - May	24 - Aug	93	20%
Total				130	

Year	Season	Spill Start Date	Spill Stop Date	Days of Spill	Spill Level ¹
2015	Spring	16-Apr	23 – May	46	10%
2015	Summer	1-Jun	11 - Aug	72	20%
Total				128	
Notes: Percentage of daily average river flow at Rock Island Dam					

The goal of the Rock Island Project GAP (Appendix G) approved by Ecology in April of 2015, is to implement measures to achieve compliance with the Washington state water quality standards for TDG in the Columbia River at the project while continuing to meet the fish passage and survival standards set forth in the HCP and Fish Management Plan. To meet this goal, Chelan PUD implemented the following operational measures:

1. Minimized voluntary spill – due to the success thus far of the HCP survival studies, Chelan PUD has been able to reduce spring fish (voluntary) spill from 20% to 10% of the daily average river flow.
2. During fish passage, managed voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria, using the TDG Operational Plan (Appendix A).
3. Minimized spill, to the extent practicable, by scheduling maintenance based on predicted flows.
4. Avoided spill, to the extent practicable, by continuing to participate in the Hourly Coordination Agreement, to the extent it reduces TDG.

As well as the Hourly Coordination Agreement, Chelan PUD participates in various water quality forums. The USACE hosts a year-end TDG Monitoring and QA/QC meeting, at which presentations are made from the various agencies conducting TDG and other water quality monitoring within the Columbia River Basin. Topics include data completeness, quality, calibration results, new or improved monitoring methods, etc. Agencies presenting at this meeting included the United States Geological Services, USACE, other mid-Columbia River PUDs, and private consultants. Chelan PUD has participated in these yearend meetings.

Chelan PUD has also regularly attended the Transboundary Gas Group meetings since early in its history. Although the frequency of the Transboundary Gas Group meetings has lessened, Chelan PUD will attend the next scheduled meeting.

5.2 Structural

No structural modifications were made or utilized at Rocky Reach or Rock Island dams in 2015.

5.3 Corrective Actions

Actions taken to maintain/regain compliance with the TDG standards in 2015 included:

- Implementation of the TDG Operational Plan.
- Chelan PUD adjusted spill, as possible, at both projects; and adjusted gate configurations at Rock Island Dam to reduce TDG, when possible. These actions were consistent with the Operational Plans for TDG.
- Attempted to maximize turbine flows by setting minimum generation requirements, which included establishing a common methodology for setting minimum generation requirements specific to Rocky Reach and Rock Island dams for the management of TDG. Each dam's minimum generation requirements were then allocated to power purchasers that receive a percentage of the projects' output.
- Participation in regional spill/project operation meeting in the spring. This meeting brought together representatives from Natural Resources, Marketing, and Operations from Chelan, Douglas, and Grant PUDs, as well as representatives from Bonneville Power Administration (BPA) and the Corps. Discussions included topics such as:
 - Each project's operational limitations, competing regulations, fish studies, and/or other natural resources requirements (e.g. Hanford Reach fall Chinook salmon flow protection requirements).
 - The possibility of shifting generation away from those projects that produce relatively low levels of TDG to those that have the propensity to produce higher TDG levels (e.g. reevaluation of the regional Spill Priority List).
 - Each project's planned maintenance schedules and how it may limit ability to spill water through spillways and/or pass water through turbine units.
- Implementation of the Spill Priority List which included, for example, having the Mid-Columbia project (i.e. Grant, Chelan, and Douglas PUDs) operators working to coordinate spill to reduce the overall TDG on the entire Columbia River system. The Columbia River Basin projects Spill Priority List provided guidance to federal river operators when there was insufficient generation request available to pass the needed amount of water through the Federal Columbia River Power System. A mechanism through hourly coordination was used to shift load from the non-federal projects to the federal projects (by mutual agreement) to reduce the amount of spill (and associated TDG levels) that would otherwise occur at the federal projects using the Spill Priority List. Although this measure may not have resulted in direct decreases in TDG at Chelan PUD's projects (and in some cases it may have increased TDG within Chelan PUD's project if spill was shifted to either Rocky Reach or Rock Island dams in order to reduce spill at another project within the system), it was meant to help mitigate high TDG levels throughout the entire Columbia River system.
- Preemptive spill can be used to coordinate spill sought to manage both the spill rate and the forebay elevation for better TDG management. The spill rate could be stabilized if a project's storage was used to absorb flow fluctuations from upstream projects. Generally, a target operation of one foot from the allowed maximum at each project could be used. When flows spike high, the storage could be used to lower the need for spill; when flows

drop, the storage quantities could be reestablished by maintaining spill rates. Allowing a greater amount of storage to absorb variations can be an effective method in stabilizing spill flows but it can also provide adequate time for adjusting spill to meet survival study objectives and TDG requirements.

SECTION 6: *CONCLUSIONS*

During the 2015 fish-spill season, TDG levels never exceeded the current numeric water quality standards as measured at each of Chelan PUD's FMS as well as the Wanapum Dam forebay compliance point (owned/operated by Grant PUD).

Chelan PUD will continue to closely monitor TDG levels during the fish-spill season in accordance with Ecology approved GAPS, the Rocky Reach Project 401 WQC (Ecology, 2006), and the Rocky Reach Project QAPP (Chelan PUD, 2010b).

SECTION 7: LIST OF LITERATURE

- Chelan PUD. 2006. Rocky Reach Comprehensive Settlement Agreement, Attachment B, Rocky Reach Comprehensive Plan, Chapter 2, Water Quality Management Plan. Chelan PUD, Wenatchee, WA.
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- Schneider, Michael L., and Steven C. Wilhelms. 2005. Rocky Reach Dam: Operational and Structural Total Dissolved Gas Management. U.S. Army Engineer Research and Development Center, Vicksburg.
- Washington State Department of Ecology (Ecology). 2006. Water Quality Certification for the Rocky Reach Project. Order No. 3155 dated March 17, 2006.

Washington State Department of Ecology (Ecology). 2008. Memo to Columbia and Snake River Dam Operators; RE: Method for averaging 12 consecutive daily average high TDG readings in any one day. Sent by Mr. Chris Maynard on April 2, 2008.

Washington State Department of Ecology (Ecology). 2008a. Memo to Columbia and Snake River Dam Operators; RE: Clarification of WAC 201A-200(1)(f)(ii), Measuring Total Dissolved Gas (TDG) During Fish-spill on the Columbia and Snake Rivers. Sent by Susan Braley on May 21, 2008.

APPENDIX A: 2015 TDG OPERATION PLANS

2015 Rocky Reach Operational Plan
for Total Dissolved Gas During Fish Spill Season

April 1 – August 31

(All spill between these dates is subject to the actions contained in this plan.)
(Applies only when not spilling for headwater control)

Protocol

1. If tailrace TDG average is greater than **120% for the 6-hour average**
 - reduce spill by 3 kcfs
 - monitor for 1 hour
 - if the 6-hr average TDG >120%, reduce spill by another 2 kcfs
 - monitor for 1 hour
 - continue reducing spill by 2 kcfs until 6-hr average TDG is less than 120% for one full hour
 - **if after reducing spill to control TDG levels, TDG drops below 118% for one full hour, increase spill by 2 kcfs and monitor ****

2. If tailrace TDG is greater than **125% for 1 hr**
 - follow protocol outlined above, but instead, use **one-hour TDG levels of 125%** as the metric
 - continue until TDG is less than 125% for 1 hr and until the 6-hr average TDG <120%

If you receive a call from RI advising that the RI forebay is out of compliance (greater than 115%) and the RR forebay is 115% or less, reduce spill by 3 kcfs. Two hours after reducing spill, call RI to determine what the RI forebay gas levels are. If still above 115%, reduce spill another 2 kcfs. If after reducing spill for this reason, the Rock Island forebay drops to less than 113%, Rock Island will call again and advise. At this point, increase back to the hourly spill volume target by increasing spill in the reverse order it was decreased. For example, if to bring the RI forebay back into compliance, it was necessary to reduce spill by a total of 5 kcfs, begin by increasing spill by 2 kcfs, wait two hours, and call RI to determine what the forebay TDG levels are. If TDG is still below 115%, increase spill by 3 kcfs (back to the target volume in this case). This will allow for a ramping effect, rather than an open/shut effect which could bump the Rock Island forebay TDG levels back out of compliance (>115%).

**** Note:** It will not be necessary to monitor for one full hour after re-opening gates if it appears that TDG is approaching the upper threshold, rather, the procedure will repeat upon reaching the threshold. It is anticipated that in time, the operators will “get a feel” for how much change in TDG will occur as a result of opening or closing gates and it will be possible to hold the TDG around 118% or 119% or so. Once the operators have this down, instead of closing a gate entirely, it may only be necessary to close partially, and vice versa for the opening process.

2015 Rock Island Operational Plan
for Total Dissolved Gas During Fish Spill Season
(Applies only when not spilling for headwater control)

Protocol

1. If tailrace TDG average is greater than **120% for the 6-hour average**
 - monitor for 2 hours, re-check 6-hour average
 - if TDG >120% for 6-hr average, shift spill from gate 17 to 27
 - monitor for 2 hours, re-check 6-hour average
 - if TDG >120% for 6-hr average, open gate 17 and close 2 notched gates (closure order is listed below)
 - monitor for 2 hrs; re-check 6-hour average
 - if TDG >120% for 6-hr average, close two more notched gates
 - **if after closing gates to control TDG levels, the TDG 1-hr average drops below 118%, re-open notched gates in the reverse order of closure****

Order of notched gate closure: 29, 24, 18, 16

2. If tailrace TDG is greater than **125% for 1 hr**
 - follow protocol outlined above, but instead, use **one-hour TDG levels of 125%** as the metric
 - continue until TDG is less than 125% for 1 hr and until the 6-hr average TDG <120%
3. If forebay TDG exceeds 115% for greater than one hour, call Rocky Reach and advise that the RI forebay is out of compliance. Rocky Reach will then reduce spill, but only if the RR forebay TDG is 115% or less. Once RI forebay TDG levels reduce to 113% call RR again so that they may return to previous spill operations.
4. If it becomes necessary to implement any further actions to attain TDG compliance, please contact Thad Mosey (661-4451) and Marcie Steinmetz (661-4186) immediately so they can determine the next steps to take.

**** Note:** It will not be necessary to monitor for one full hour after re-opening if it appears that TDG is approaching the upper threshold again, rather, the procedure will repeat upon reaching the threshold. It is anticipated that in time, the operators will “get a feel” for how much change in TDG will occur as a result of opening or closing gates and it will be possible to hold the TDG around 118% or 119% or so. Once the operators have this down, instead of closing a gate entirely, it may only be necessary to close partially and vice versa for the opening process.

APPENDIX B: FISH-SPILL MEMOS

From: [Pwr Mgt - Chelan Environmental](#)
To: [Baker, Megan \(Avista\)](#); [Bill C. Key \(NextEraEnergy\)](#); [Caramanolis, Ath \(Morgan Stanley\)](#); [Esch, Steve \(Avistacorp\)](#); [Fee, Mike \(Morgan Stanley\)](#); [Follini, Robert \(Avista\)](#); [Frank, Jennifer \(Avista\)](#); [Johnson, Bill \(Avista\)](#); [Kikkert, Sabrina \(Morgan Stanley\)](#); [Killam, Ryan \(Morgan Stanley\)](#); [Locke, Kathy \(Avista\)](#); [Loder, David \(NextEraEnergy\)](#); [Lucas, John \(Morgan Stanley\)](#); [Mattern, Kim \(Avista\)](#); [Mymko, Ryan \(Morgan Stanley\)](#); [Neff, Christin S. \(NexteraEnergy\)](#); [Ohm, Jennifer \(Avista\)](#); [Patrick Maher \(Avista\)](#); [Silkworth, Steve \(Avista\)](#); [Spannagel, Dave \(Avista\)](#); [Ward, Suzette \(Avista\)](#); [West Power Trading](#); [West Realtime \(Constellation RT\)](#); [Wilkinson, John \(Morgan Stanley\)](#); [Wilson, Craig \(Avista\)](#); [Wright, Jasper \(Morgan Stanley\)](#); [Constellation Wholesale Trading & Portfolio Operations](#); [Brennan Mueller](#); [Bryant, Tom](#); [Buehn, Scott](#); ["Cash_desk@powerex.com"](#); [Fields, Willard](#); [Gray, Jim](#); [Netik, Irena \(PSE\)](#); [Jaspers, Janet](#); [Taylor, Joe \(Mid-C\)](#); ["Joel Molander"](#); ["Josh Jacobs"](#); [Keller, Lance](#); [Ken Finicle](#); [Owen, Hugh](#); ["Paul Wetherbee"](#); [pwxrealtime](#); ["Load Office PSE"](#); [Pwr Mgt - Chelan Preschedule](#); [RI Chief Operators](#); [RI Senior Operators](#); ["Salvador Avalos"](#); [System Operations](#); [Garrison, Dan](#); [Cronrath, Chris W.](#); [Myers, Devin P.](#); [West, Todd](#); [Hemstrom, Steven](#); [Nystrom, Chris](#); [Whitehall, Brad](#); [Steinmetz, Marcie](#); [Underwood, Alene](#); ["centralsupport@GCPUD.org"](#); [Carrington, Gregg E.](#)
Subject: Start of 2015 Spring Fish Spill at the Rock Island Project - Thursday, 16 April
Date: Tuesday, April 14, 2015 4:18:12 PM
Importance: High

Good Afternoon, Everyone.

The purpose of this email is to notify all of you that Rock Island Dam will begin spring fish spill on **Thursday, 16 April 2015, at 00:00 hours**. The daily spill percentage will be **10% of the day average river flow forecasted for the Project**.

Consistent with the past 12 years, spill will be "shaped" in hourly blocks within each 24-hour day to provide slightly more spill volume during periods when juvenile salmon are passing the dam, and less volume during hours with lower fish passage. The average spill rate of all blocks will equal 10% of day average river flow.

Spring spill normally continues through the end of May at 10%. Summer fish spill will be 20% of the day average flow and usually begins the first week of June.

Please call or send an email, if you have any questions regarding Rock Island's fish spill program for 2015.

Thank you.

Thad

Thad Mosey

Chelan County PUD

(509) 670-5594

ROCK ISLAND FISH SPILL MEMORANDUM

To: Rock Island Operators and System Operators

From: Thad Mosey (Ext. 4451) cell: 670-5594

Date: May 31, 2015

Subject: Summer fish spill for June 1 - 2, 2015

Rock Island will spill an average of **20% of the daily average river flow** during summer 2015. Below are spill rates shaped by hourly blocks, and they sum to 20% of the total estimated daily average flow rate at Rock Island.

Rock Island Spill for smolt passage: **Monday and Tuesday, June 1 - 2, 2015**

Spill Type	Start Date	Start Time	Stop Date	Stop Time	Spill (Kcfs)	
Fish	6/1/15	0001	6/1/15	0100	28.3	
Fish	6/1/15	0100	6/1/15	0200	23.4	
Fish Mon	6/1/15	0200	6/1/15	1000	17.5	
Fish	6/1/15	1000	6/1/15	1100	23.4	
Fish	6/1/15	1100	6/1/15	2400	28.3	day ave 24.3
Fish	6/2/15	0001	6/2/15	0100	29.2	
Fish	6/2/15	0100	6/2/15	0200	24.1	
Fish Tues	6/2/15	0200	6/2/15	1000	17.5	
Fish	6/2/15	1000	6/2/15	1100	24.1	
Fish	6/2/15	1100	6/2/15	2400	29.2	day ave 24.9

2015 – RI Operators

Please use gates in the following sequence for fish spill and any additional forced spill: **32, 31, 30, 1, 26, 18, 24, 29, and 16**. If total spill volume exceeds capacity of the three over/under gates and six notched gates listed, please use the full gates located in bays **17, 19, 20, 22, 25, 7, and 8** in the sequence shown. If it is necessary to spill more water for headwater control than the gates listed above can handle, take whatever action is necessary to maintain plant safety.

If inflow is insufficient to maintain both headwater and spill, reduce generation as necessary, then call Thad Mosey (4451) or Lance Keller (4299) to get information on current spill balance and options. If you have questions, please call Thad at Ext. 4451, cell 670-5594, or home 782-2428. Thank you.

**ROCKY REACH
FISH SPILL MEMORANDUM**

To: Rocky Reach Operators, Energy Resources, and System Operators

From: Thad Mosey (Ext. 4451); Cell: 670-5594

Date: May 31, 2015

Subj: **Rocky Reach Summer Spill for June 1 and 2, 2015**

Summer spill at Rocky Reach for subyearling Chinook smolts is 9% of the daily average river flow. This spill level will be in place through the first part of August. Spill is shaped to aid passage of Chinook smolts.

Spill Type	Start Date	Start Time	Stop Date	Stop Time	Spill (kcfs)
Fish	6/1/15	0000	6/1/15	0100	10.6
Fish	6/1/15	0100	6/1/15	0700	7.1
Fish Mon	6/1/15	0700	6/1/15	0900	10.6
Fish	6/1/15	0900	6/1/15	1500	14.2
Fish	6/1/15	1500	6/1/15	2400	10.6 day ave 10.6
Fish	6/2/15	0000	6/2/15	0100	11.1
Fish	6/2/15	0100	6/2/15	0700	7.4
Fish Tues	6/2/15	0700	6/2/15	0900	11.1
Fish	6/2/15	0900	6/2/15	1500	14.8
Fish	6/2/15	1500	6/2/15	2400	11.1 day ave 11.1

Please put fish spill, immediate replacement spill, or spill for headwater control at Rocky Reach Dam through spill gates in the “normal” pattern in the automated gate control program **using gates 7 – 2. If additional spill is necessary to maintain headwater control, use whatever additional gates are necessary to maintain Plant safety.**

If you have questions or comments, please call Thad Mosey at 509-661-4451, by cell phone 670-5594 or at home any time day or night, at 509-782-2428. Please call Thad (ext. 4451) or Lance Keller (ext. 4299) if you need assistance with any of the fish spill operations above. Thank you.

From: [Pwr Mgt - Chelan Environmental](#)
To: [Hemstrom, Steven](#); [All RR Operators](#); [Buehn, Scott](#); [Todd V](#); [Jaspers, Janet](#); [Taylor, Joe \(Mid-C\)](#); [Keller, Lance](#); [Owen, Hugh](#); "Powerex"; [pwxrealtime](#); [Pwr Mgt - Chelan Preschedule](#); [RR/Ch/Steh Management](#); [System Operations](#); [Slice Customers - Fish Spill](#); "Bob Huber"; [Brennan Mueller](#); [True, Bruce \(PGN\)](#); [jeff j](#); "Greg Lange"; [Netik, Irena \(PSE\)](#); "Joel Molander"; "Josh_jacobs"; [Ken Finicle](#); "Paul Wetherbee"; "Salvador Avalos"; "Simon Arlen"; "Steve Pope"; [West, Todd](#); [Lucas, Terry](#); "Irogers@gcpud.org"; "mehinge@gcpud.org"; "rrecten@gcpud.org"; [Steinmetz, Marcie](#); [Nystrom, Chris](#); [Underwood, Alene](#); "centralsupport@GCPUD.org"; [Carrington, Gregg E.](#)
Cc: [Truscott, Keith](#); [Smith, Jeff](#); [Hays, Steve](#); [Osborn, Jeff](#); [Craig, Kimberlee](#)
Subject: Confirmation - Rocky Reach Dam will end fish spill at midnight tonight, 7 August
Date: Friday, August 07, 2015 3:56:42 PM
Importance: High

Hello Everyone.

This email is intended to provide confirmation that Chelan PUD *will end summer fish spill* for the season at the Rocky Reach Project tonight, 7 August, at 2400 hours (midnight).

Please disregard the previously sent spill memo for 8 August.

Thank you.

Thad

From: [Pwr Mgt - Chelan Environmental](#)
To: [Baker, Megan \(Avista\)](#); [Bill C. Key \(NextEraEnergy\)](#); [Caramanolis, Ath \(Morgan Stanley\)](#); [Esch, Steve \(Avistacorp\)](#); [Fee, Mike \(Morgan Stanley\)](#); [Follini, Robert \(Avista\)](#); [Frank, Jennifer \(Avista\)](#); [Johnson, Bill \(Avista\)](#); [Kikkert, Sabrina \(Morgan Stanley\)](#); [Killam, Ryan \(Morgan Stanley\)](#); [Locke, Kathy \(Avista\)](#); [Loder, David \(NextEraEnergy\)](#); [Lucas, John \(Morgan Stanley\)](#); [Mattern, Kim \(Avista\)](#); [Mymko, Ryan \(Morgan Stanley\)](#); [Neff, Christin S. \(NexteraEnergy\)](#); [Ohm, Jennifer \(Avista\)](#); [Patrick Maher \(Avista\)](#); [Silkworth, Steve \(Avista\)](#); [Spannagel, Dave \(Avista\)](#); [Ward, Suzette \(Avista\)](#); [West Power Trading](#); [West Realtime \(Constellation RT\)](#); [Wilkinson, John \(Morgan Stanley\)](#); [Wilson, Craig \(Avista\)](#); [Wright, Jasper \(Morgan Stanley\)](#); [Constellation Wholesale Trading & Portfolio Operations](#); [Brennan Mueller](#); [Bryant, Tom](#); [Buehn, Scott](#); ["Cash_desk@powerex.com"](#); [Fields, Willard](#); [Gray, Jim](#); [Netik, Irena \(PSE\)](#); [Jaspers, Janet](#); [Taylor, Joe \(Mid-C\)](#); ["Joel Molander"](#); ["Josh Jacobs"](#); [Keller, Lance](#); [Ken Finicle](#); [Owen, Hugh](#); ["Paul Wetherbee"](#); [pwxrealtime](#); ["Load Office PSE"](#); [Pwr Mgt - Chelan Preschedule](#); [RI Chief Operators](#); [RI Senior Operators](#); ["Salvador Avalos"](#); [System Operations](#); [Garrison, Dan](#); [Cronrath, Chris W.](#); [Myers, Devin P.](#); [West, Todd](#); [Hemstrom, Steven](#); [Whitehall, Brad](#); [Steinmetz, Marcie](#); [Underwood, Alene](#); ["centralsupport@GCPUD.org"](#); [Carrington, Gregg E.](#); ["PS_ATF@gcpud.org"](#); [Truscott, Keith](#)
Cc: [Truscott, Keith](#); [Smith, Jeff](#); [Hays, Steve](#); [Osborn, Jeff](#); [Craig, Kimberlee](#)
Subject: Confirmation - Rock Island Dam will end fish spill at midnight tonight, 11 August
Date: Tuesday, August 11, 2015 3:44:59 PM
Importance: High

Hello Everyone.

This email is intended to provide confirmation that Chelan PUD **will end summer fish spill** for the season at the Rock Island Project tonight, 11 August, at 2400 hours (midnight).

Thank you.

Thad

APPENDIX C: CALIBRATION REPORTS



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 20-Jan-15 **Site:**
Arrival Time: 10:10 **RRDW**
Departure Time: 11:00

FMS ID	65718		65718	
Time	10:25		10:50	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	758.2	754		754
Temp °C		4.0		4.0
TDGsat		97.2		99.7
TDG mmHg		733		752

Comments:

Calibration Type: Field **Probe ID:** 65718
Date: 20-Jan-15 **BP Station:** 758.2mmHg
Time: 10:30

	Std	Initial	Final
Temperature °C	3.89	4.0	N / C
TDG 100%	758.2	758	N / C
TDG 113%	858.2	858	N / C
TDG 126%	958.2	957	N / C
TDG 139%	1058.2	1057	N / C
Depth m	N/A		

Comments: 962/1133



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	20-Jan-15	Site:	RRH
Arrival Time:	11:05	Site:	RRH
Departure Time:	11:40		

FMS ID	65720		65720	
Time	11:10		11:35	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	756.5	754	756.2	754
Temp °C		4.0		4.0
TDGsat		95.6		97.5
TDG mmHg		721		735

Comments:

Calibration Type: Field	Probe ID: 65720
Date: 20-Jan-15	BP Station: 756.5 mmHg
Time: 11:15	

	Std	Initial	Final
Temperature °C	4.20	4.3	N / C
TDG 100%	756.5	756	N / C
TDG 113%	856.5	856	N / C
TDG 126%	956.5	956	N / C
TDG 139%	1056.5	1056	N / C
Depth m	N/A		

Comments: 977/1164



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	20-Jan-15	Site:
Arrival Time:	13:25	RIS
Departure Time:	14:00	

FMS ID	65719		65719	
Time	13:30		13:55	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	758.7	759	758.4	758
Temp °C		4.1		4.1
TDGsat		96.4		98.2
TDG mmHg		732		744

Comments:

Calibration Type: Field	Probe ID: 65719
Date: 20-Jan-15	BP Station: 758.3mmHg
Time: 13:35	

	Std	Initial	Final
Temperature °C	4.09	4.2	N / C
TDG 100%	758.3	757	N / C
TDG 113%	858.3	857	N / C
TDG 126%	958.3	957	N / C
TDG 139%	1058.3	1057	N / C
Depth m	N/A		

Comments: 970/1140



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 20-Jan-15 **Site:**
Arrival Time: 14:20 **RIGW**
Departure Time: 15:10

FMS ID	65721		65721	
Time	14:25		15:00	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	758.5	758	758.1	758
Temp °C		4.1		4.1
TDGsat		96.4		99.5
TDG mmHg		731		754

Comments:

Calibration Type: Field **Probe ID:** 65721
Date: 20-Jan-15 **BP Station:** 758.8mmHg
Time: 14:35

	Std	Initial	Final
Temperature °C	4.93	5.1	N / C
TDG 100%	758.8	759	N / C
TDG 113%	858.8	859	N / C
TDG 126%	958.8	959	N / C
TDG 139%	1058.8	1060	N / C
Depth m	N/A		

Comments: 957/1105



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	16-Mar-15	Site:	RRDW
Arrival Time:	9:05		
Departure Time:	9:55		

FMS ID	65718		65718	
Time	9:20		9:50	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	750.6	748	751.0	749
Temp °C		5.7		5.2
TDGsat		104.9		106.3
TDG mmHg		785		796

Comments:

Calibration Type: Field	Probe ID: 65718
Date: 16-Mar-15	BP Station: 750.7 mmHg
Time: 9:25	

	Std	Initial	Final
Temperature °C	5.99	6.1	N / C
TDG 100%	750.7	752	751
TDG 113%	850.7	853	851
TDG 126%	950.7	954	951
TDG 139%	1050.7	1055	1051
Depth m	N/A		

Comments: 960/1155; new TDG membrane



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	16-Mar-15	Site:	RRH
Arrival Time:	10:05	RRH	
Departure Time:	10:40		

FMS ID	65720		65720	
Time	10:10		10:30	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	749.3	749	749.0	749
Temp °C		5.7		5.7
TDGsat		104.4		103.6
TDG mmHg		782		776

Comments:

Calibration Type: Field	Probe ID: 65720
Date: 16-Mar-15	BP Station: 749 mmHg
Time: 10:15	

	Std	Initial	Final
Temperature °C	14.24	14.3	N / C
TDG 100%	749.0	751	749
TDG 113%	849	852	849
TDG 126%	949	953	949
TDG 139%	1049	1054	1049
Depth m	N/A		

Comments: 951/1165; New TDG membrane



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	16-Mar-15	Site:
Arrival Time:	11:20	RIGW
Departure Time:	12:15	

FMS ID	65721		65721	
Time	11:30		12:00	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	752.7	754	752.4	754
Temp °C		5.7		5.8
TDGsat		103.6		105.6
TDG mmHg		781		796

Comments:

Calibration Type: Field	Probe ID: 65721
Date: 16-Mar-15	BP Station: 752.6 mmHg
Time: 11:35	

	Std	Initial	Final
Temperature °C	14.20	14.3	N / C
TDG 100%	752.6	756	753
TDG 113%	852.6	857	853
TDG 126%	952.6	958	953
TDG 139%	1052.6	1059	1053
Depth m	N/A		

Comments: 948/1141; New TDG membrane



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 16-Mar-15 **Site:**
Arrival Time: 13:05 **RIS**
Departure Time: 13:45

FMS ID	65719		65719	
Time	13:15		14:40	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	750.9	753	750.2	753
Temp °C		5.8		5.8
TDGsat		103.7		105.6
TDG mmHg		781		795

Comments:

Calibration Type: Field **Probe ID:** 65719
Date: 16-Mar-15 **BP Station:** 750.8mmHg
Time: 13:20

	Std	Initial	Final
Temperature °C	6.38	6.5	N / C
TDG 100%	750.8	752	751
TDG 113%	850.8	853	851
TDG 126%	950.8	954	951
TDG 139%	1050.8	1055	1051
Depth m	N/A		

Comments: 942/1175; New TDG membrane



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 13-Apr-15 **Site:**
Arrival Time: 9:30 **RRDW**
Departure Time: 10:20

FMS ID	65718		65718	
Time	9:50		10:15	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	742.8	741	742.8	741
Temp °C		7.4		7.4
TDGsat		105.7		106.9
TDG mmHg		783		792

Comments:

Calibration Type: Field **Probe ID:** 65718
Date: 13-Apr-15 **BP Station:** 742.8mmHg
Time: 9:55

	Std	Initial	Final
Temperature °C	7.20	7.3	N / C
TDG 100%	742.8	743	N / C
TDG 113%	842.8	843	N / C
TDG 126%	942.8	943	N / C
TDG 139%	1042.8	1043	N / C
Depth m	N/A		

Comments: 946/1163, New TDG membrane



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	13-Apr-15	Site:
Arrival Time:	10:25	RRH
Departure Time:	11:00	

FMS ID	65720		65720	
Time	10:30		10:55	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	740.9	741	740.7	740
Temp °C		7.3		7.3
TDGsat		105.3		104.3
TDG mmHg		780		772

Comments:

Calibration Type: Field	Probe ID: 65720
Date: 13-Apr-15	BP Station: 740.9mmHg
Time: 10:40	

	Std	Initial	Final
Temperature °C	7.40	7.5	N / C
TDG 100%	740.9	741	N / C
TDG 113%	840.9	840	N / C
TDG 126%	940.9	940	N / C
TDG 139%	1040.9	1040	N / C
Depth m	N/A		

Comments: 952/1169, New TDG membrane.



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	13-Apr-15	Site:
Arrival Time:	11:30	RIS
Departure Time:	12:10	

FMS ID	65719		65719	
Time	11:40		12:05	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	742.7	745	742.5	745
Temp °C		7.3		7.3
TDGsat		104.6		106.3
TDG mmHg		779		792

Comments:

Calibration Type: Field	Probe ID: 65719
Date: 13-Apr-15	BP Station: 742.5mmHg
Time: 11:45	

	Std	Initial	Final
Temperature °C	7.29	7.4	N / C
TDG 100%	742.5	742	N / C
TDG 113%	842.5	843	N / C
TDG 126%	942.5	943	N / C
TDG 139%	1042.5	1042	N / C
Depth m	N/A		

Comments: 934/1149, New TDG membrane.



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	13-Apr-15	Site:
Arrival Time:	12:30	RIGW
Departure Time:	13:25	

FMS ID	65721		65721	
Time	12:35		13:20	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	742.5	744	741.9	744
Temp °C		7.3		7.4
TDGsat		104.7		106.2
TDG mmHg		779		790

Comments:

Calibration Type: Field	Probe ID: 65721
Date: 13-Apr-15	BP Station: 742.4 mmHg
Time: 12:45	

	Std	Initial	Final
Temperature °C	7.80	7.9	N / C
TDG 100%	742.4	743	N / C
TDG 113%	842.4	843	N / C
TDG 126%	942.4	943	N / C
TDG 139%	1042.4	1042	N / C
Depth m	N/A		

Comments: 940/1167, New TDG membrane.



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	12-May-15	Site:	RRDW
Arrival Time:	9:25		
Departure Time:	10:25		

FMS ID	65718		65718	
Time	9:35		10:30	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	739.7	738		738
Temp °C		10.9		10.9
TDGsat		109.5		107.5
TDG mmHg		808		793

Comments:

Calibration Type: Field	Probe ID: 65718
Date: 12-May-15	BP Station: 740.2mmHg
Time: 9:55	

	Std	Initial	Final
Temperature °C	11.05	11.2	N / C
TDG 100%	740.2	740	N / C
TDG 113%	840.2	841	N / C
TDG 126%	940.2	941	N / C
TDG 139%	1040.2	1041	N / C
Depth m	N/A		

Comments: 940



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	12-May-15	Site:	RRH
Arrival Time:	10:30		
Departure Time:	11:05		

FMS ID	65720		65720	
Time	10:35		11:00	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	738.4	738	738.3	738
Temp °C		10.8		10.8
TDGsat		108.5		110.0
TDG mmHg		801		812

Comments:

Calibration Type: Field	Probe ID: 65720
Date: 12-May-15	BP Station: 738.3mmHg
Time: 10:40	

	Std	Initial	Final
Temperature °C	11.05	11.2	N / C
TDG 100%	738.3	739	N / C
TDG 113%	838.3	839	N / C
TDG 126%	938.3	939	N / C
TDG 139%	1038.3	1039	N / C
Depth m	N/A		

Comments: 934



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	12-May-15	Site:	RIS
Arrival Time:	11:35		
Departure Time:	12:15		

FMS ID	65719		65719	
Time	11:30		12:10	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	740.1	743		743
Temp °C		11.0		11.0
TDGsat		107.1		108.6
TDG mmHg		796		807

Comments:

Calibration Type: Field	Probe ID:	65719
Date: 12-May-15	BP Station:	740.6mmHg
Time: 11:50		

	Std	Initial	Final
Temperature °C	11.30	11.5	N / C
TDG 100%	740.6	740	N / C
TDG 113%	840.6	840	N / C
TDG 126%	940.6	941	N / C
TDG 139%	1040.6	1041	N / C
Depth m	N/A		

Comments: 936



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	12-May-15	Site:
Arrival Time:	12:35	RIGW
Departure Time:	13:20	

FMS ID	65721		65721	
Time	12:40		13:15	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	741.0	743	741.0	743
Temp °C		11.0		10.9
TDGsat		107.8		109.8
TDG mmHg		801		816

Comments:

Calibration Type: Field	Probe ID: 65721
Date: 12-May-15	BP Station: 741.3mmHg
Time: 12:45	

	Std	Initial	Final
Temperature °C	10.94	11.1	N / C
TDG 100%	741.3	742	N / C
TDG 113%	841.3	842	N / C
TDG 126%	941.3	942	N / C
TDG 139%	1041.3	1042	N / C
Depth m	N/A		

Comments: 932



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 10-Jun-15 **Site:**
Arrival Time: 8:00 **RRDW**
Departure Time: 8:35

FMS ID	65718		65718	
Time	8:15		8:30	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	738.2	736	738.0	736
Temp °C		15.6		15.6
TDGsat		111.8		112.4
TDG mmHg		823		827

Comments:

Calibration Type: Field **Probe ID:** 65718
Date: 10-Jun-15 **BP Station:** 738.2mmHg
Time: 8:15

	Std	Initial	Final
Temperature °C	16.09	16.2	N / C
TDG 100%	738.2	739	N / C
TDG 113%	838.2	839	N / C
TDG 126%	938.2	939	N / C
TDG 139%	1038.2	1039	N / C
Depth m	N/A		

Comments: 930



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	10-Jun-15	Site:	RRH
Arrival Time:	8:40		
Departure Time:	9:15		

FMS ID	65720		65720	
Time	8:50		9:10	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	736.1	736	736.1	736
Temp °C		15.6		15.6
TDGsat		109.8		108.7
TDG mmHg		808		800

Comments:

Calibration Type: Field	Probe ID: 65720
Date: 10-Jun-15	BP Station: 736.3mmHg
Time: 8:55	

	Std	Initial	Final
Temperature °C	16.45	16.6	N / C
TDG 100%	736.3	737	N / C
TDG 113%	836.3	837	N / C
TDG 126%	936.3	937	N / C
TDG 139%	1036.3	1037	N / C
Depth m	N/A		

Comments: 929



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	10-Jun-15	Site:	
Arrival Time:	10:00	RIGW	
Departure Time:	10:45		

FMS ID	65721		65721	
Time	10:10		10:35	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	739.2	741	739.0	741
Temp °C		15.7		15.7
TDGsat		113.8		112.7
TDG mmHg		843		835

Comments:

Calibration Type: Field	Probe ID: 65721
Date: 10-Jun-15	BP Station: 739.3mmHg
Time: 10:15	

	Std	Initial	Final
Temperature °C	16.76	16.9	N / C
TDG 100%	739.3	741	739
TDG 113%	839.3	841	839
TDG 126%	939.3	941	939
TDG 139%	1039.3	1040	1039
Depth m	N/A		

Comments: 935



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	10-Jun-15	Site:	RIS
Arrival Time:	11:05		
Departure Time:	11:35		

FMS ID	65719		65719	
Time	11:15		11:30	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	737.9	740	737.9	740
Temp °C		15.8		15.8
TDGsat		109.5		110.3
TDG mmHg		810		816

Comments:

Calibration Type: Field	Probe ID: 65719
Date: 10-Jun-15	BP Station: 737.9mmHg
Time: 11:20	

	Std	Initial	Final
Temperature °C	16.30	16.4	N / C
TDG 100%	737.9	738	N / C
TDG 113%	837.9	838	N / C
TDG 126%	937.9	938	N / C
TDG 139%	1037.9	1038	N / C
Depth m	N/A		

Comments: 922



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 08-Jul-15 **Site:**
Arrival Time: 9:00 **RRDW**
Departure Time: 9:50

FMS ID	65718		65718	
Time	9:25		9:45	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	740.2	738		738
Temp °C		18.3		18.3
TDGsat		110.8		112.1
TDG mmHg		818		827

Comments:

Calibration Type: Field **Probe ID:** 65718
Date: 08-Jul-15 **BP Station:** 740.2mmHg
Time: 9:30

	Std	Initial	Final
Temperature °C	18.70	18.8	N / C
TDG 100%	740.2	741	N / C
TDG 113%	840.2	841	N / C
TDG 126%	940.2	941	N / C
TDG 139%	1040.2	1042	N / C
Depth m	N/A		

Comments: 942



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 08-Jul-15 **Site:**
Arrival Time: 9:55 **RRH**
Departure Time: 10:25

FMS ID	65720		65720	
Time	10:00		10:20	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	738.5	738	737.4	737
Temp °C		18.3		18.3
TDGsat		108.9		109.9
TDG mmHg		804		810

Comments:

Calibration Type: Field **Probe ID:** 65720
Date: 08-Jul-15 **BP Station:** 738.3mmHg
Time: 10:05

	Std	Initial	Final
Temperature °C	18.79	18.9	N / C
TDG 100%	738.3	738	N / C
TDG 113%	838.3	838	N / C
TDG 126%	938.3	939	N / C
TDG 139%	1038.3	1039	N / C
Depth m	N/A		

Comments: 952



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 08-Jul-15 **Site:**
Arrival Time: 11:00 **RIS**
Departure Time: 11:45

FMS ID	65719		65719	
Time	11:05		11:25	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	740.1	742	740.0	742
Temp °C		18.7		18.7
TDGsat		109.3		111.1
TDG mmHg		811		824

Comments:

Calibration Type: Field **Probe ID:** 65719
Date: 08-Jul-15 **BP Station:** 740 mmHg
Time: 11:10

	Std	Initial	Final
Temperature °C	18.90	19.0	N / C
TDG 100%	740.0	739	N / C
TDG 113%	840	840	N / C
TDG 126%	940	940	N / C
TDG 139%	1040	1040	N / C
Depth m	N/A		

Comments: 932



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 08-Jul-15 **Site:**
Arrival Time: 12:00 **RIGW**
Departure Time: 12:40

FMS ID	65721		65721	
Time	12:15		12:30	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	740.2	742	739.4	741
Temp °C		18.7		18.7
TDGsat		115.1		114.2
TDG mmHg		854		846

Comments:

Calibration Type: Field **Probe ID:** 65721
Date: 08-Jul-15 **BP Station:** 740.1 mmHg
Time: 12:20

	Std	Initial	Final
Temperature °C	19.65	19.8	N / C
TDG 100%	740.1	739	N / C
TDG 113%	840.1	840	N / C
TDG 126%	940.1	940	N / C
TDG 139%	1040.1	1041	N / C
Depth m	N/A		

Comments: 929



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	11-Aug-15	Site:	RRDW
Arrival Time:	7:55		
Departure Time:	9:00		

FMS ID	65718		65718	
Time	8:25		8:55	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	742.4	741	742.3	740
Temp °C		20.0		20.0
TDGsat		105.9		107.0
TDG mmHg		785		792

Comments:

Calibration Type: Field	Probe ID: 65718
Date: 11-Aug-15	BP Station: 742.4 mmHg
Time: 8:30	

	Std	Initial	Final
Temperature °C	19.91	20.0	N / C
TDG 100%	742.4	743	742
TDG 113%	842.4	844	842
TDG 126%	942.4	945	942
TDG 139%	1042.4	1045	1042
Depth m	N/A		

Comments: 948



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	11-Aug-15	Site:	RRH
Arrival Time:	9:10		
Departure Time:	9:45		

FMS ID	65720		65720	
Time	9:20		9:40	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	740.5	740	740.5	740
Temp °C		20.0		20.0
TDGsat		106.8		107.2
TDG mmHg		790		793

Comments:

Calibration Type: Field	Probe ID: 65720
Date: 11-Aug-15	BP Station: 740.5mmHg
Time: 9:25	

	Std	Initial	Final
Temperature °C	20.67	20.8	N / C
TDG 100%	740.5	741	741
TDG 113%	840.5	842	841
TDG 126%	940.5	942	941
TDG 139%	1040.5	1043	1041
Depth m	N/A		

Comments: 941



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	11-Aug-15	Site:	RIS
Arrival Time:	10:20		
Departure Time:	10:55		

FMS ID	65719		65719	
Time	10:30		10:50	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	742.8	745	742.8	745
Temp °C		20.1		20.1
TDGsat		107.1		107.7
TDG mmHg		798		802

Comments:

Calibration Type: Field	Probe ID: 65719
Date: 11-Aug-15	BP Station: 742.8mmHg
Time: 10:35	

	Std	Initial	Final
Temperature °C	20.28	20.4	N / C
TDG 100%	742.8	742	743
TDG 113%	842.8	843	843
TDG 126%	942.8	944	943
TDG 139%	1042.8	1044	1043
Depth m	N/A		

Comments: 936



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 11-Aug-15
Arrival Time: 11:20
Departure Time: 12:05
Site:
RIGW

FMS ID	65721		65721	
Time	11:30		12:00	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	743.3	745	743.1	745
Temp °C		20.1		20.1
TDGsat		111.8		113.2
TDG mmHg		833		843

Comments:

Calibration Type: Field **Probe ID:** 65721
Date: 11-Aug-15 **BP Station:** 743.3mmHg
Time: 11:35

	Std	Initial	Final
Temperature °C	20.74	20.9	N / C
TDG 100%	743.3	743	N / C
TDG 113%	843.3	843	N / C
TDG 126%	943.3	944	N / C
TDG 139%	1043.3	1044	N / C
Depth m	N/A		

Comments: 937



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 09-Sep-15	Site:
Arrival Time: 9:40	RRDW
Departure Time: 10:40	

FMS ID	65718		65718	
Time	10:05		10:35	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	743.8	742	743.6	742
Temp °C		18.6		18.6
TDGsat		100.4		102.3
TDG mmHg		745		759

Comments:

Calibration Type: Field	Probe ID: 65718
Date: 09-Sep-15	BP Station: 743.6mmHg
Time: 10:10	

	Std	Initial	Final
Temperature °C	18.69	18.8	N / C
TDG 100%	743.6	742	744
TDG 113%	843.6	842	844
TDG 126%	943.6	943	944
TDG 139%	1043.6	1043	1044
Depth m	N/A		

Comments: 949



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	09-Sep-15	Site:	RRH
Arrival Time:	10:55	RRH	
Departure Time:	11:35		

FMS ID	65720		65720	
Time	11:00		11:30	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	741.5	742	741.1	741
Temp °C		18.7		18.6
TDGsat		101.5		103.2
TDG mmHg		753		765

Comments:

Calibration Type: Field	Probe ID: 65720
Date: 09-Sep-15	BP Station: 741.3mmHg
Time: 11:05	

	Std	Initial	Final
Temperature °C	18.75	18.8	N / C
TDG 100%	741.3	740	N / C
TDG 113%	841.3	840	N / C
TDG 126%	941.3	940	N / C
TDG 139%	1041.3	1041	N / C
Depth m	N/A		

Comments: 947



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	09-Sep-15	Site:	RIS
Arrival Time:	12:20		
Departure Time:	13:15		

FMS ID	65719		65719	
Time	12:30		13:05	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	743.3	746	743.0	746
Temp °C		18.7		18.8
TDGsat		101.1		102.8
TDG mmHg		754		767

Comments:

Calibration Type: Field	Probe ID: 65719
Date: 09-Sep-15	BP Station: 743.1 mmHg
Time: 12:35	

	Std	Initial	Final
Temperature °C	19.38	19.5	N / C
TDG 100%	743.1	746	742
TDG 113%	843.1	845	842
TDG 126%	943.1	945	943
TDG 139%	1043.1	1045	1043
Depth m	N/A		

Comments: 951



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 09-Sep-15	Site:
Arrival Time: 13:30	RIGW
Departure Time: 15:00	

FMS ID	65721		65721	
Time	13:40		14:15	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	744.0	746	743.6	746
Temp °C		18.7		18.7
TDGsat		101.2		102.8
TDG mmHg		755		767

Comments:

Calibration Type: Field	Probe ID: 65721
Date: 09-Sep-15	BP Station: 743.8mmHg
Time: 13:45	

	Std	Initial	Final
Temperature °C	19.87	20.0	N / C
TDG 100%	743.8	745	744
TDG 113%	843.8	846	843
TDG 126%	943.8	946	943
TDG 139%	1043.8	1047	1044
Depth m	N/A		

Comments: 935



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 21-Oct-15 **Site:**
Arrival Time: 9:15 **RRDW**
Departure Time: 10:00

FMS ID	65718		65718	
Time	9:35		9:55	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	748.7	747	748.5	747
Temp °C		15.9		15.9
TDGsat		99.6		101.9
TDG mmHg		744		761

Comments:

Calibration Type: Field **Probe ID:** 65718
Date: 21-Oct-15 **BP Station:** 748.7mmHg
Time: 9:40

	Std	Initial	Final
Temperature °C	15.69	15.8	N / C
TDG 100%	748.7	750	N / C
TDG 113%	848.7	850	N / C
TDG 126%	948.7	950	N / C
TDG 139%	1048.7	1050	N / C
Depth m	N/A		

Comments: 956



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 21-Oct-15 **Site:**
Arrival Time: 10:10 **RRH**
Departure Time: 10:45

FMS ID	65720		65720	
Time	10:20		10:40	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	746.3	747	745.6	746
Temp °C		15.9		15.9
TDGsat		98.9		98.8
TDG mmHg		739		737

Comments:

Calibration Type: Field **Probe ID:** 65720
Date: 21-Oct-15 **BP Station:** 746.3mmHg
Time: 10:25

	Std	Initial	Final
Temperature °C	15.81	15.9	N / C
TDG 100%	746.3	747	746
TDG 113%	846.3	848	846
TDG 126%	946.3	948	946
TDG 139%	1046.3	1048	1046
Depth m	N/A		

Comments: 950



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date:	21-Oct-15	Site:
Arrival Time:	11:15	RIS
Departure Time:	12:00	

FMS ID	65719		65719	
Time	11:25		11:55	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	748.3	752	748.2	751
Temp °C		15.9		15.9
TDGsat		97.9		99.9
TDG mmHg		736		750

Comments:

Calibration Type: Field	Probe ID: 65719
Date: 21-Oct-15	BP Station: 748.3mmHg
Time: 11:30	

	Std	Initial	Final
Temperature °C	15.52	15.7	N / C
TDG 100%	748.3	746	748
TDG 113%	848.3	847	848
TDG 126%	948.3	948	948
TDG 139%	1048.3	1048	1048
Depth m	N/A		

Comments: 944



Site Visit / Calibration Report

Client: Public Utility District No. 1 of Chelan County

Date: 21-Oct-15 **Site:**
Arrival Time: 12:20 **RIGW**
Departure Time: 13:20

FMS ID	65721		65721	
Time	12:30		13:05	
	2°std	FMS	2°std	FMS
Depth m				
BP mmHg	748.9	751	748.6	750
Temp °C		15.9		15.9
TDGsat		98.9		100.8
TDG mmHg		743		756

Comments:

Calibration Type: Field **Probe ID:** 65721
Date: 21-Oct-15 **BP Station:** 748.8mmHg
Time: 12:35

	Std	Initial	Final
Temperature °C	16.01	16.1	N / C
TDG 100%	748.8	747	749
TDG 113%	848.8	847	849
TDG 126%	948.8	948	949
TDG 139%	1048.8	1048	1049
Depth m	N/A		

Comments: 948

APPENDIX D: 2015 DATA LOSSES

Hours of Data losses at Rocky Reach and Rock Island Dams during the fish-spill season

Date	Rocky Reach			Rock Island		
	Forebay	Tailrace	Reason	Forebay	Tailrace	Reason
4/13/2015		1	Calibration	1	1	Calibration
5/12/2015	1	1	Calibration	1	1	Calibration
5/28/2015					1	Server Patch
5/29/2015					1	Server Patch
6/10/2015	1	1	Calibration	3	5	Calibration and fuse blown on radio
6/15/2015				3	3	SCADA server down
8/3/2015					1	SCADA server down
8/11/2015				1	1	Calibration
8/12/2015					2	Data cable replacement
8/17/2015				4	4	Solar panel service
Total	2	3		13	20	

Notes:

Calibration = probe is taken off line while calibration occurs

Communication error = probe not communicating/downloading data

Server patch = Upgrades to the server

Site maintenance = while Chelan PUD was upgrading the carriage that holds the probe, it was disconnected

System Control and Data Acquisition (SCADA) server down = Chelan PUD's data server was down

APPENDIX E: 2015 DATA

Hourly Total Dissolved gas readings during the 2015 fish-spill season

Notes:
FONT = Exceedances of the water quality TDG numeric criteria are in bold red. Note, all exceedances in the Rocky Reach Forebay are for the upstream Wells Dam Project. TDG is rounded to the nearest number: 115.2 is rounded to 115, therefore not in exceedance)
 121.2 (119.6) = Instances of "double counting", value in parentheses represents the TDG value used to eliminate "double counting"
 110.8 = Not counted toward exceedances because RR FB > 115 (for RI FB) or RI FB > 115 (for Wanapum FB).

2015	Rocky Reach Forebay			Rocky Reach Tailrace			Rock Island Forebay			Rock Island Tailrace			Wanapum Forbay		Average Daily Spill		Total Flow		% Flow Spilled		Rocky Reach		Rock Island	
	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	High	RR	RI	RR	RI	RR	RI	Other	Fish	Other	Fish
1-Apr	106.0	105.7	106.3	110.5	109.7	115.6	106.6	105.6	108.4	106.6	105.6	108.2	105.8	105.9	12.0	0.0	132.4	142.0	8.9	0.0	11.82	0.00	0.00	0.00
2-Apr	105.7	104.9	105.7	111.5	106.4	111.6	106.5	105.3	106.5	106.6	105.3	106.5	105.5	105.6	0.7	0.0	134.5	143.0	0.5	0.0	1.33	0.00	0.00	0.00
3-Apr	105.3	104.8	105.3	105.7	105.1	105.5	104.8	104.6	105.0	104.7	104.6	104.9	106.5	106.8	0.0	0.0	136.3	146.8	0.0	0.0	0.00	0.00	0.00	0.00
4-Apr	105.2	104.9	105.4	105.6	105.2	105.9	104.8	104.4	104.9	104.8	104.4	104.9	106.6	107.2	0.0	0.0	132.5	140.7	0.0	0.0	0.00	0.00	0.00	0.00
5-Apr	105.7	105.4	105.9	106.0	105.8	106.3	105.2	104.9	105.3	105.1	104.9	105.2	106.7	107.0	0.0	0.0	131.2	141.3	0.0	0.0	0.00	0.00	0.00	0.00
6-Apr	105.8	105.0	105.8	106.1	105.4	106.2	105.2	104.4	105.1	105.2	104.5	105.1	106.8	106.9	0.0	0.0	129.1	137.9	0.0	0.0	0.00	0.00	0.00	0.00
7-Apr	104.8	104.4	104.7	105.2	104.8	105.0	104.2	104.0	104.4	104.2	104.0	104.3	105.6	105.5	0.0	0.0	111.9	121.2	0.0	0.0	0.00	0.00	0.00	0.00
8-Apr	104.3	103.9	104.2	104.8	104.4	104.7	104.2	103.6	104.0	104.2	103.6	103.9	105.0	105.3	0.0	0.0	112.9	121.0	0.0	0.0	0.00	0.00	0.00	0.00
9-Apr	104.1	103.8	104.2	104.6	104.4	104.9	104.0	103.4	104.2	103.9	103.4	104.1	104.8	105.4	0.0	0.0	123.4	131.3	0.0	0.0	0.00	0.00	0.00	0.00
10-Apr	105.9	105.1	106.5	106.2	105.5	107.1	104.7	104.2	105.1	104.6	104.1	104.9	105.6	106.1	0.0	0.0	119.2	126.8	0.0	0.0	0.00	0.00	0.00	0.00
11-Apr	106.5	106.2	106.8	106.8	106.5	107.0	105.5	105.3	105.7	105.3	105.2	105.6	105.5	105.1	0.0	0.0	100.4	107.4	0.0	0.0	0.00	0.00	0.00	0.00
12-Apr	105.9	105.0	105.5	106.2	105.7	108.4	105.4	104.7	105.6	105.3	104.7	105.5	103.9	103.8	1.3	0.0	115.5	124.1	1.1	0.0	1.05	0.00	0.00	0.00
13-Apr	106.3	105.6	106.6	106.4	106.0	106.8	105.9	105.1	106.9	105.1	102.2	106.0	105.3	105.9	0.0	0.0	117.4	122.7	0.0	0.0	0.00	0.00	0.00	0.00
14-Apr	106.3	105.0	106.2	106.5	105.3	106.3	105.7	104.0	105.2	105.7	104.2	105.5	105.3	104.8	0.0	0.1	84.0	89.3	0.0	0.2	0.00	0.00	0.06	0.00
15-Apr	104.5	103.8	104.1	104.8	104.3	104.6	103.8	103.5	104.2	103.8	103.5	104.0	103.1	103.6	0.0	0.5	109.6	113.8	0.0	0.4	0.00	0.00	0.04	0.04
16-Apr	105.1	104.4	105.5	105.4	104.8	105.9	104.5	103.8	104.8	107.1	106.6	108.0	104.8	105.4	0.0	11.1	116.5	120.4	0.0	9.6	0.00	0.00	10.98	11.00
17-Apr	106.2	105.7	106.4	106.2	105.9	106.5	105.7	105.1	106.1	108.4	107.7	109.6	105.8	107.1	0.0	11.4	107.9	115.5	0.0	10.6	0.00	0.00	11.50	11.50
18-Apr	106.2	106.0	106.4	106.5	106.3	106.8	106.0	105.3	106.4	110.7	109.6	112.9	107.0	108.6	0.0	9.8	78.3	85.2	0.0	13.1	0.00	0.00	9.81	9.80
19-Apr	107.4	106.8	107.8	107.5	106.9	107.9	106.8	106.4	107.1	111.0	110.1	113.6	109.8	111.5	0.0	9.9	90.5	96.2	0.0	12.0	0.00	0.00	9.81	9.81
20-Apr	108.5	107.9	108.8	108.8	108.2	109.4	107.8	107.3	108.1	110.9	110.0	111.8	110.3	110.6	0.0	11.6	116.2	122.3	0.0	10.4	0.00	0.00	11.57	11.56
21-Apr	109.0	108.8	109.2	108.9	108.7	109.2	108.2	107.8	108.8	111.1	110.7	114.5	110.9	111.9	0.0	11.2	95.8	102.7	0.0	14.9	0.00	0.00	11.31	11.30
22-Apr	109.0	107.7	108.5	108.8	107.7	108.1	108.2	106.4	107.3	113.2	110.9	115.0	110.4	108.3	0.0	11.4	86.5	92.3	0.0	16.5	0.00	0.00	11.37	11.36
23-Apr	107.7	107.5	107.9	107.9	107.7	108.2	107.1	106.8	107.3	111.5	110.2	114.1	107.4	108.2	0.0	10.9	100.2	105.7	0.0	11.9	0.00	0.00	10.99	10.99
24-Apr	107.7	107.2	107.5	107.9	107.4	107.7	107.2	106.2	106.9	110.5	109.2	112.0	108.0	108.3	0.0	9.8	99.6	107.9	0.0	10.1	0.00	0.00	9.83	9.82
25-Apr	107.2	106.7	107.1	107.3	106.9	107.2	106.3	105.6	106.1	110.3	109.3	111.6	108.0	107.7	0.0	9.9	86.3	92.2	0.0	11.5	0.00	0.00	9.82	9.81
26-Apr	106.5	105.7	106.1	106.7	105.9	106.3	105.5	104.9	105.2	109.6	107.9	110.1	107.0	107.1	0.0	9.1	79.1	85.9	0.0	10.8	0.00	0.00	9.02	9.01
27-Apr	106.4	106.0	106.6	106.7	106.3	107.0	106.0	105.5	106.2	110.1	109.1	112.1	109.2	111.0	0.0	9.9	95.1	99.1	0.0	11.3	0.00	0.00	9.83	9.83
28-Apr	107.5	107.1	107.7	107.6	107.3	107.8	107.0	106.5	107.3	110.1	109.7	111.9	109.6	111.0	0.0	10.1	93.8	102.0	0.0	11.1	0.00	0.00	10.14	10.14
29-Apr	107.5	106.9	107.3	107.5	106.7	107.0	107.0	105.8	106.2	111.7	109.8	113.4	109.1	106.8	0.0	9.6	76.2	80.8	0.0	13.1	0.00	0.00	9.51	9.51
30-Apr	107.4	107.0	107.6	107.6	107.1	107.8	107.0	106.3	107.7	111.9	110.2	115.5	106.5	107.6	0.0	9.6	95.8	103.3	0.0	14.6	0.00	0.00	9.48	9.49
1-May	108.3	107.8	108.6	108.3	107.8	108.5	107.4	107.2	107.7	110.7	109.9	111.4	109.1	109.9	0.0	11.1	112.0	122.4	0.0	9.9	0.01	0.00	11.73	11.06
2-May	109.1	108.8	109.3	109.0	108.6	109.3	108.4	107.6	108.8	111.6	110.5	112.8	109.9	110.7	0.0	11.1	111.2	120.4	0.0	10.3	0.00	0.00	10.47	10.46
3-May	109.2	109.0	109.4	109.1	108.7	109.6	108.8	108.2	109.1	111.9	111.0	113.1	111.9	113.3	0.0	9.9	101.3	109.2	0.0	9.5	0.00	0.00	9.84	9.83

2015	Rocky Reach Forebay			Rocky Reach Tailrace			Rock Island Forebay			Rock Island Tailrace			Wanapum Forbay		Average Daily Spill		Total Flow		% Flow Spilled		Rocky Reach		Rock Island	
	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	High	RR	RI	RR	RI	RR	RI	Other	Fish	Other	Fish
4-May	109.5	109.2	109.8	109.4	109.0	109.5	108.9	108.4	109.2	112.6	111.7	113.8	111.8	111.9	0.0	11.8	106.5	114.4	0.0	11.4	0.00	0.00	11.75	11.75
5-May	109.5	108.7	109.0	109.1	108.3	108.7	108.6	107.4	107.7	112.8	110.8	113.5	110.0	108.8	0.0	10.0	86.7	93.9	0.0	11.8	0.00	0.00	10.05	10.04
6-May	108.4	107.7	108.2	108.1	107.4	107.9	107.5	106.9	107.3	111.5	109.7	114.5	108.5	108.8	0.0	9.2	83.6	90.7	0.0	14.4	0.00	0.00	9.06	9.04
7-May	107.8	107.2	108.1	107.6	106.9	107.5	107.0	106.8	107.2	111.3	110.4	113.8	109.9	111.6	0.0	9.5	81.3	87.6	0.0	12.7	0.00	0.00	9.51	9.50
8-May	108.0	107.6	108.4	107.6	107.2	107.8	107.1	106.7	107.2	111.5	109.9	114.5	110.3	110.3	0.0	8.9	80.4	85.5	0.0	14.7	0.00	0.00	9.02	9.00
9-May	108.0	107.4	108.0	107.6	107.1	107.6	107.2	106.8	107.4	111.2	109.6	112.6	110.5	111.1	0.0	8.9	85.7	91.9	0.0	11.3	0.00	0.00	9.02	9.01
10-May	108.4	107.9	109.2	107.9	107.4	108.1	107.3	107.1	107.7	111.5	110.1	113.2	111.2	112.3	0.0	8.7	75.1	80.4	0.0	12.0	0.00	0.00	8.68	8.68
11-May	109.3	108.9	109.7	109.0	108.6	109.5	108.3	107.9	108.6	112.1	111.4	114.2	111.5	112.8	0.0	11.3	96.7	104.1	0.0	15.0	0.00	0.00	11.27	11.27
12-May	109.3	108.8	109.2	109.0	108.8	110.7	108.4	107.6	108.2	112.3	110.6	114.3	112.0	111.5	2.6	10.4	114.1	122.6	2.7	10.9	1.63	0.00	10.33	10.32
13-May	109.2	108.8	109.3	111.3	109.8	114.8	108.4	107.9	110.5	111.9	111.3	114.1	110.1	110.3	3.4	12.1	121.6	130.8	3.4	11.3	4.63	0.00	12.09	12.09
14-May	108.4	108.2	108.5	108.4	108.1	108.5	108.1	107.4	108.3	111.5	111.1	112.9	109.5	110.2	0.0	12.4	115.4	126.4	0.0	10.9	0.00	0.00	12.53	12.52
15-May	109.1	108.8	109.5	108.7	108.5	109.1	108.2	107.8	108.6	111.8	111.5	113.2	111.0	112.0	0.0	11.6	97.3	109.0	0.0	11.1	0.07	0.00	11.77	11.78
16-May	109.1	108.8	109.3	108.9	108.6	109.5	108.3	107.6	108.2	112.1	111.1	113.6	110.9	109.7	0.6	11.2	93.7	102.5	0.4	12.6	0.28	0.00	11.05	11.04
17-May	108.8	107.6	108.0	108.7	107.7	108.2	108.0	106.7	107.6	111.7	109.5	112.1	109.0	109.5	0.0	10.4	111.4	125.1	0.0	9.2	0.00	0.00	10.43	10.43
18-May	107.9	107.6	108.0	120.2	107.2	107.9	107.3	106.9	107.7	111.5	110.9	114.4	109.4	110.2	0.0	12.4	106.0	116.0	0.0	11.9	0.00	0.00	12.38	12.39
19-May	108.6	108.2	108.8	108.5	107.9	108.7	108.0	107.3	108.6	112.1	110.8	116.2	110.6	110.8	0.0	11.9	117.0	125.9	0.0	13.6	0.00	0.00	11.72	11.73
20-May	109.1	108.7	109.5	108.7	108.3	109.0	108.4	107.8	108.8	111.8	111.1	113.1	110.8	111.3	0.0	13.1	122.7	131.6	0.0	11.6	0.00	0.00	13.23	13.23
21-May	109.8	109.5	110.0	109.1	108.9	109.4	109.1	108.5	109.7	111.9	111.6	112.6	112.7	114.5	0.0	14.0	127.0	138.6	0.0	10.9	0.00	0.00	13.30	13.30
22-May	109.8	109.5	109.8	109.1	108.8	109.4	109.1	108.4	109.1	113.0	111.9	114.4	112.7	113.0	0.0	13.6	118.7	129.7	0.0	10.9	0.00	0.00	13.62	13.61
23-May	109.5	109.0	109.4	108.9	108.6	109.1	108.6	108.0	108.8	112.4	111.4	112.8	111.6	113.3	0.0	13.3	125.7	137.9	0.0	10.0	0.00	0.00	13.26	13.26
24-May	109.4	109.2	109.8	119.6	108.7	109.2	108.7	108.1	109.2	111.9	111.6	112.5	111.0	110.8	0.0	13.1	125.2	137.5	0.0	9.7	0.00	0.00	13.16	13.16
25-May	109.5	108.9	109.3	108.9	108.3	108.7	108.7	107.9	108.5	112.3	111.5	113.0	110.3	111.1	0.0	14.0	122.0	132.6	0.0	10.9	0.00	0.00	13.34	13.33
26-May	108.9	108.4	108.7	108.4	107.8	108.1	108.1	107.5	108.1	112.1	111.1	113.1	110.4	110.9	0.0	13.1	128.2	138.8	0.0	9.7	0.00	0.00	13.36	13.37
27-May	108.9	108.4	109.9	108.1	107.6	108.8	107.9	107.3	108.2	111.7	111.1	112.7	111.1	111.5	0.0	13.1	117.9	127.6	0.0	10.5	0.00	0.00	13.15	13.14
28-May	109.7	109.2	109.9	108.8	108.5	109.0	109.1	108.3	109.6	112.5	111.5	114.4	111.1	111.1	0.0	12.5	123.7	132.7	0.0	10.5	0.00	0.00	12.54	12.54
29-May	109.0	108.6	109.2	108.4	108.0	108.6	109.0	107.9	108.5	112.2	111.3	113.4	112.3	112.9	0.0	13.2	120.4	131.9	0.0	10.6	0.00	0.00	13.38	13.39
30-May	109.7	109.4	110.0	108.8	108.5	109.5	108.9	108.3	109.4	111.8	111.4	112.6	112.4	112.1	0.4	11.4	112.7	123.5	0.4	9.7	0.48	0.00	11.30	11.31
31-May	109.8	109.3	109.7	109.1	108.7	110.4	108.9	108.4	108.9	112.6	111.6	113.6	111.6	111.6	1.4	11.6	114.8	126.1	1.1	9.7	1.25	0.00	11.32	11.32
1-Jun	109.6	109.5	109.9	113.1	112.7	113.3	110.1	109.1	110.4	116.4	115.2	117.0	111.6	111.6	13.5	24.0	110.8	119.5	12.6	21.1	13.14	12.97	23.77	23.77
2-Jun	109.6	108.9	109.4	112.8	112.2	113.1	109.9	108.6	109.2	116.5	114.8	116.4	110.0	109.0	11.4	24.7	97.3	101.1	12.0	25.1	11.35	11.34	25.00	25.02
3-Jun	108.8	108.0	108.6	112.2	111.2	112.8	108.6	108.4	108.8	115.2	113.7	116.4	107.0	107.8	8.9	20.2	94.8	100.7	9.8	22.0	8.96	8.96	20.41	20.42
4-Jun	107.8	107.3	107.9	112.1	111.2	112.6	108.6	107.6	108.8	113.5	112.7	114.3	110.1	112.0	8.8	21.3	110.4	117.1	8.3	19.5	8.88	8.87	21.22	21.21
5-Jun	108.0	107.5	108.2	112.3	111.3	112.5	108.8	108.2	109.3	114.0	113.8	117.3	112.7	113.8	8.9	22.2	113.4	120.1	8.7	21.0	8.87	8.88	22.59	22.60
6-Jun	109.0	108.5	109.2	113.3	112.2	113.5	109.6	108.9	110.2	114.2	113.8	115.1	112.7	113.8	10.0	20.6	117.0	123.2	8.7	17.0	10.01	10.01	20.77	20.78
7-Jun	109.2	109.0	109.4	113.2	112.2	113.5	109.8	109.3	110.3	114.5	114.0	115.0	112.6	113.0	8.5	19.9	112.4	121.4	7.8	16.9	8.58	8.59	19.80	19.80
8-Jun	109.8	109.4	109.9	113.6	112.8	114.0	110.3	109.6	111.0	115.2	114.8	117.7	112.6	114.7	10.2	22.0	121.6	127.8	9.5	19.6	10.22	10.22	22.25	22.25
9-Jun	110.3	110.0	110.4	114.0	113.3	114.4	110.7	110.0	111.2	115.4	115.1	115.7	112.5	113.6	9.6	22.6	121.7	131.1	8.3	17.7	9.68	9.67	22.51	22.50
10-Jun	110.3	109.9	110.6	113.8	112.6	113.8	110.7	109.5	110.5	115.9	115.4	117.1	112.3	111.6	10.5	24.2	105.4	109.7	10.3	23.4	10.70	10.71	24.36	24.35
11-Jun	109.9	109.0	109.5	113.4	112.1	113.2	109.8	109.0	109.9	115.4	114.3	117.9	110.4	109.4	9.8	23.2	104.8	113.5	10.3	24.6	9.59	9.59	22.83	22.67
12-Jun	108.8	107.9	108.2	112.4	111.6	112.9	109.5	108.1	109.3	115.1	113.8	117.1	108.4	108.2	10.1	21.4	98.6	104.2	10.9	22.6	10.14	10.14	21.50	21.50
13-Jun	107.8	107.4	107.8	112.3	111.3	112.3	108.8	108.2	109.2	113.8	113.2	114.4	109.1	110.6	8.7	20.0	109.6	116.7	8.2	17.6	8.73	8.74	20.00	20.01
14-Jun	108.3	107.8	108.7	112.2	111.2	112.4	108.8	108.0	109.3	113.8	113.2	114.3	110.4	111.1	8.9	20.1	104.1	109.7	8.8	18.8	8.82	8.82	20.01	20.01

2015	Rocky Reach Forebay			Rocky Reach Tailrace			Rock Island Forebay			Rock Island Tailrace			Wanapum Forbay		Average Daily Spill		Total Flow		% Flow Spilled		Rocky Reach		Rock Island	
	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	High	RR	RI	RR	RI	RR	RI	Other	Fish	Other	Fish
15-Jun	109.0	108.6	109.1	113.1	111.9	113.7	110.4	98.9	111.0	114.8	114.6	117.5	111.9	112.8	10.3	23.6	128.1	132.1	9.4	22.2	10.40	10.40	23.44	23.44
16-Jun	109.4	109.1	109.7	112.9	111.9	113.3	110.2	109.4	110.6	115.5	115.1	117.1	111.9	112.8	10.5	25.0	107.6	112.6	10.2	24.3	10.60	10.59	25.14	24.93
17-Jun	109.6	109.5	110.4	112.5	111.3	112.8	110.0	109.6	110.3	116.6	115.1	117.7	111.7	110.3	8.9	22.0	87.5	90.3	11.5	27.9	8.88	8.89	22.05	21.74
18-Jun	109.9	109.5	110.4	112.9	111.6	113.3	110.0	109.3	109.9	115.6	114.9	118.2	112.2	113.8	9.5	21.3	86.1	90.3	11.9	26.5	9.43	9.42	20.80	20.80
19-Jun	109.6	108.3	108.7	112.8	110.8	112.0	109.5	108.8	109.7	115.7	114.5	118.8	112.3	111.4	8.8	17.7	75.1	77.9	13.2	27.0	8.75	8.75	17.75	17.74
20-Jun	108.7	108.3	109.5	112.3	111.2	113.0	109.0	108.4	109.9	114.6	114.3	117.0	108.7	109.5	8.2	17.5	84.1	88.9	11.1	22.8	8.13	8.12	17.71	17.71
21-Jun	109.0	108.4	109.5	112.2	110.1	111.3	109.5	108.9	109.8	115.6	115.0	119.3	110.1	111.0	6.7	15.9	73.2	75.2	10.2	26.4	6.67	6.66	15.98	15.97
22-Jun	109.0	108.6	109.7	112.7	111.3	113.1	108.9	108.3	109.6	116.1	114.9	119.0	110.1	109.8	11.7	20.1	89.6	93.5	14.4	25.8	11.93	9.53	20.33	20.33
23-Jun	109.2	108.7	109.9	112.7	111.7	113.1	110.0	109.3	110.7	115.7	114.8	119.0	109.2	110.3	8.6	18.5	90.3	93.4	10.7	24.0	8.72	8.72	18.42	18.42
24-Jun	109.7	109.3	110.2	112.3	111.2	112.0	110.1	109.4	109.9	115.7	114.5	118.8	110.7	111.1	8.7	19.1	84.3	87.1	11.4	25.1	8.64	8.64	19.15	19.16
25-Jun	109.6	108.8	109.3	112.5	111.2	113.1	115.3	109.0	110.1	114.8	113.8	118.1	111.7	112.2	8.6	18.9	103.2	106.0	9.8	21.9	8.68	8.68	18.85	18.86
26-Jun	109.7	109.1	110.0	113.6	112.2	114.1	110.2	109.7	110.8	115.7	115.3	117.6	113.6	114.3	10.0	22.7	114.0	114.8	9.5	22.5	9.98	9.99	22.75	22.75
27-Jun	110.3	110.0	111.0	113.9	113.1	114.4	111.1	110.4	111.7	115.9	115.5	117.2	114.1	114.9	10.2	22.7	109.8	115.1	9.9	21.4	10.15	10.16	22.62	22.62
28-Jun	110.7	110.4	111.7	114.1	113.2	114.7	115.3	110.6	111.7	116.7	116.2	117.9	114.4	115.9	9.8	22.6	109.2	110.7	9.6	22.7	9.72	9.71	22.75	22.75
29-Jun	110.7	109.9	110.3	114.2	113.1	115.0	111.2	110.3	111.3	116.9	115.4	117.8	114.4	113.3	9.9	22.4	111.7	115.4	9.3	21.0	10.22	9.95	22.60	22.59
30-Jun	110.0	109.7	110.2	113.7	112.3	114.9	110.6	109.9	111.3	115.8	115.2	118.3	112.4	113.5	9.2	22.2	113.5	115.8	8.9	22.3	9.30	9.30	22.43	22.43
1-Jul	109.9	109.3	109.8	113.3	112.2	114.6	110.6	109.6	111.1	115.5	114.3	117.2	114.2	115.3	9.1	19.2	115.5	121.2	8.8	18.5	9.13	8.94	19.55	19.55
2-Jul	109.7	109.2	110.3	113.8	112.4	114.2	110.4	109.6	111.4	115.8	115.2	116.3	115.0	116.0	9.3	22.8	112.0	116.8	8.7	20.6	9.40	9.40	22.83	22.83
3-Jul	110.9	110.4	111.5	113.8	112.6	114.1	110.9	110.2	111.6	116.0	114.6	116.4	114.9	113.5	8.4	19.1	105.0	107.4	8.3	19.0	8.38	8.38	19.05	19.05
4-Jul	110.9	110.4	111.4	113.6	112.3	114.5	111.1	110.5	111.8	119.4	114.9	116.3	112.9	113.7	7.3	17.6	106.4	109.4	7.5	17.3	7.40	7.38	17.42	17.42
5-Jul	110.8	109.6	110.2	113.1	111.6	113.3	111.1	109.7	110.4	115.1	114.1	115.7	112.5	112.3	7.2	17.9	108.2	113.9	6.8	16.0	7.14	7.15	17.68	17.68
6-Jul	109.7	109.1	110.0	112.8	111.7	113.6	110.3	109.6	111.2	115.2	114.8	117.9	112.3	113.8	8.6	20.7	95.4	98.7	9.9	24.6	8.53	8.54	20.65	20.66
7-Jul	110.1	109.5	110.9	112.5	111.2	112.7	110.5	109.6	110.3	115.8	114.5	116.6	112.3	113.0	8.4	19.1	87.7	88.8	10.1	23.3	8.64	8.65	19.11	19.10
8-Jul	110.6	109.8	111.1	113.4	111.9	114.5	110.6	109.9	111.2	114.9	114.8	116.9	114.2	115.0	9.4	20.5	101.6	104.6	9.9	23.1	9.33	9.33	20.80	20.81
9-Jul	110.9	110.5	111.2	113.0	111.8	113.7	111.0	110.5	111.3	116.3	115.4	118.0	114.7	115.5	8.4	19.1	95.6	97.2	9.4	21.5	8.37	8.39	19.45	19.32
10-Jul	110.9	110.8	111.2	112.6	111.2	112.9	110.9	109.9	110.8	116.3	115.2	117.8	114.6	113.1	7.9	17.1	75.1	75.5	11.5	25.8	8.01	8.01	17.08	17.08
11-Jul	110.9	109.6	110.4	111.7	110.2	110.8	109.8	108.9	109.6	115.7	114.9	117.5	110.2	109.2	7.8	17.0	67.9	67.6	12.2	28.0	7.87	7.87	17.03	17.02
12-Jul	109.4	108.7	109.1	110.9	110.2	111.3	108.5	107.9	108.5	114.5	113.9	116.7	108.5	107.9	7.0	15.4	76.8	76.9	9.5	21.8	6.96	6.96	15.40	15.39
13-Jul	108.8	108.4	108.8	111.7	110.8	112.7	108.7	108.3	109.3	114.2	113.7	116.7	108.7	109.6	8.4	19.8	99.3	100.8	9.1	21.6	8.35	8.35	19.57	19.56
14-Jul	109.2	108.7	109.4	113.1	111.6	113.8	109.4	108.7	110.3	114.2	113.7	116.8	109.4	110.6	8.9	19.9	102.3	105.5	9.2	20.5	8.85	8.85	19.85	19.85
15-Jul	109.2	109.0	109.5	112.9	112.0	113.6	109.6	108.9	109.9	114.4	113.9	115.3	109.2	108.4	8.0	20.1	107.0	110.6	7.5	18.3	8.02	8.00	19.95	19.94
16-Jul	109.1	108.2	108.8	112.5	111.8	113.1	109.4	108.3	109.2	114.3	113.3	114.5	107.8	107.5	8.7	20.0	106.1	111.4	8.3	18.2	8.63	8.63	19.98	19.98
17-Jul	108.3	107.9	108.7	112.3	111.5	112.9	109.0	108.2	109.6	113.8	113.1	114.2	108.6	109.5	8.7	20.1	109.1	115.0	8.1	17.6	8.74	8.74	20.13	20.13
18-Jul	108.7	108.4	109.1	112.4	111.7	113.0	109.3	108.8	110.0	114.6	113.8	115.9	110.7	111.5	9.7	18.3	103.8	105.6	9.9	19.2	8.43	7.81	18.38	18.38
19-Jul	109.0	108.6	109.3	112.8	111.9	113.5	109.6	108.9	109.7	113.8	113.3	114.3	111.4	112.2	8.5	18.5	106.0	108.8	8.1	17.3	8.53	8.53	18.42	18.41
20-Jul	109.4	109.1	109.9	112.8	111.8	113.1	109.4	109.1	109.7	114.7	114.5	115.4	111.4	110.9	8.8	21.0	100.2	101.8	8.9	21.1	8.70	8.69	21.05	21.05
21-Jul	109.3	108.9	109.7	112.3	111.6	113.0	109.5	108.7	109.5	114.7	114.3	116.8	108.8	108.9	9.5	20.6	86.5	89.2	11.1	24.2	9.39	9.39	20.85	20.86
22-Jul	109.2	107.9	108.6	112.1	110.6	112.5	108.9	108.2	108.8	115.1	114.0	116.7	108.6	108.1	8.3	17.2	84.2	85.7	10.7	23.8	8.34	8.33	17.18	17.18
23-Jul	108.1	107.2	107.8	111.0	110.2	111.7	108.3	107.5	108.4	113.9	112.9	115.5	108.3	109.4	8.4	18.5	91.8	94.2	9.7	21.1	8.37	8.36	18.58	18.58
24-Jul	107.6	107.3	107.9	110.9	110.2	111.8	107.5	107.0	108.2	112.6	112.1	114.2	108.4	107.7	7.9	18.4	101.6	103.8	8.0	18.4	7.98	8.00	18.41	18.40
25-Jul	107.6	107.3	107.6	110.6	110.1	111.2	107.8	107.0	108.0	112.6	112.1	113.7	107.1	107.0	7.8	17.3	104.5	107.4	7.6	16.4	7.80	7.79	17.41	17.41
26-Jul	107.3	106.5	107.0	110.0	109.2	110.2	107.0	106.5	107.2	113.0	111.8	116.1	106.8	106.6	7.4	17.1	83.0	87.7	10.0	22.4	7.40	7.39	16.89	16.88

2015	Rocky Reach Forebay			Rocky Reach Tailrace			Rock Island Forebay			Rock Island Tailrace			Wanapum Forbay		Average Daily Spill		Total Flow		% Flow Spilled		Rocky Reach		Rock Island	
	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	24-hr Avg	High	12-hr Avg	High	RR	RI	RR	RI	RR	RI	Other	Fish	Other	Fish
27-Jul	106.3	105.3	105.8	109.8	109.0	110.2	106.6	105.6	106.4	113.3	112.6	115.0	106.1	105.2	8.6	20.5	87.2	90.0	10.3	24.0	8.62	8.62	20.52	20.52
28-Jul	105.7	105.3	105.9	110.2	109.2	110.6	106.1	105.5	106.7	112.9	112.3	114.6	106.1	107.4	8.7	20.7	94.6	97.9	9.9	23.1	8.69	8.68	20.59	20.59
29-Jul	106.4	105.9	106.7	112.2	110.7	113.6	106.8	106.4	107.4	113.0	112.5	114.6	108.3	109.0	13.1	21.1	113.7	115.0	11.3	19.3	12.89	8.67	21.31	21.31
30-Jul	107.4	106.9	107.8	112.2	110.4	111.6	107.7	107.3	108.2	113.2	112.8	114.3	110.0	111.3	8.6	20.9	103.2	106.2	8.5	20.3	8.70	8.70	21.00	20.99
31-Jul	108.5	108.0	109.1	111.7	110.8	112.0	108.6	107.8	109.5	113.8	113.2	114.2	111.6	112.3	8.8	21.1	105.4	107.1	8.6	20.2	8.75	8.76	21.21	21.21
1-Aug	109.6	109.1	110.3	112.2	111.2	112.9	109.2	108.5	110.2	114.2	113.8	115.5	111.7	112.9	9.2	20.3	89.9	93.0	10.7	23.7	9.16	9.17	20.52	20.52
2-Aug	109.6	109.0	109.9	112.2	111.0	112.3	109.7	108.9	110.1	114.2	113.9	114.8	111.4	111.6	8.2	17.9	88.2	90.9	9.7	21.8	8.15	8.16	17.76	17.76
3-Aug	109.4	108.6	109.0	112.0	111.3	112.6	109.2	108.3	109.4	115.3	114.9	116.8	110.6	110.0	9.9	22.7	94.1	94.9	10.8	25.7	9.89	9.89	22.80	22.80
4-Aug	108.5	107.8	108.2	112.0	111.0	112.2	108.4	108.2	108.6	114.9	114.3	115.6	108.9	108.7	10.1	22.4	101.7	102.4	10.3	23.7	10.15	10.15	22.67	22.67
5-Aug	107.7	106.5	107.0	111.6	110.7	112.1	108.4	107.1	108.1	114.6	112.7	115.6	108.3	107.9	9.8	20.8	111.0	115.7	8.9	18.3	9.79	9.80	21.06	21.06
6-Aug	106.3	105.6	105.9	111.3	110.3	111.4	107.2	106.7	107.5	113.5	112.1	114.0	107.9	108.4	8.8	20.7	122.3	126.4	7.2	16.6	8.72	8.71	20.58	20.57
7-Aug	106.9	106.4	107.2	111.9	110.7	112.4	107.7	106.9	108.5	113.9	113.3	116.6	109.3	109.7	9.2	20.7	99.6	101.6	10.3	24.9	9.83	9.83	20.88	20.88
8-Aug	107.5	107.3	107.7	111.8	107.3	110.0	108.1	107.4	108.4	114.4	112.6	116.0	109.4	109.6	0.0	18.4	95.4	98.5	0.0	19.8	0.00	0.00	18.42	18.42
9-Aug	107.4	106.9	107.3	106.7	106.1	106.6	107.3	105.9	106.7	112.6	111.7	115.5	109.2	109.2	0.0	19.6	93.4	99.2	0.0	22.2	0.00	0.00	19.48	19.49
10-Aug	107.1	106.7	107.2	108.7	107.1	111.6	106.5	106.1	106.6	112.8	112.5	116.4	111.2	111.7	4.1	22.4	110.8	113.7	2.7	22.9	4.82	0.00	22.70	22.69
11-Aug	107.6	107.2	108.1	108.7	106.1	106.7	107.0	105.3	107.8	114.4	113.6	117.8	111.3	113.3	0.0	22.8	102.0	105.9	0.0	26.3	0.00	0.00	22.71	22.71
12-Aug	107.9	107.7	108.0	107.4	106.7	108.5	107.6	106.9	108.2	112.8	107.9	111.2	112.5	113.6	0.7	3.0	105.5	107.6	0.6	6.8	0.90	0.00	3.17	0.01
13-Aug	108.0	107.7	108.3	112.0	110.1	114.6	108.5	107.5	109.8	108.4	107.5	109.8	112.5	112.9	11.7	0.0	121.6	125.4	7.8	0.0	11.58	0.00	0.00	0.00
14-Aug	108.2	107.8	108.2	112.0	107.3	108.7	109.6	107.7	110.6	109.6	107.9	110.5	111.5	110.3	0.0	0.0	118.0	121.7	0.0	0.0	0.00	0.00	0.00	0.00
15-Aug	107.4	106.2	107.0	106.6	105.5	106.3	106.5	105.3	106.2	106.6	105.4	106.2	106.8	105.0	0.0	0.0	110.7	115.5	0.0	0.0	0.00	0.00	0.00	0.00
16-Aug	105.9	104.9	105.4	105.2	104.2	104.4	105.7	104.4	105.1	105.7	104.5	105.0	106.7	107.5	0.0	0.0	107.6	112.3	0.0	0.0	0.00	0.00	0.00	0.00
17-Aug	105.5	105.2	105.7	107.2	105.7	110.0	105.3	104.6	105.5	105.2	104.7	105.4	106.8	105.9	3.9	0.0	118.5	121.6	2.8	0.0	3.71	0.00	0.00	0.00
18-Aug	106.3	105.9	106.5	107.7	105.5	106.6	105.8	105.5	106.0	105.7	105.6	106.0	106.8	107.3	0.0	0.0	115.3	118.6	0.0	0.0	0.00	0.00	0.00	0.00
19-Aug	108.2	107.3	111.6	108.7	107.1	111.6	106.6	106.0	106.9	106.6	106.0	106.9	107.3	108.1	4.4	0.0	125.6	128.2	3.2	0.0	4.14	0.00	0.00	0.00
20-Aug	111.1	109.7	112.0	110.5	108.8	110.9	110.0	108.7	110.6	110.0	108.7	110.7	106.9	105.8	0.0	0.0	115.5	119.1	0.0	0.0	0.00	0.00	0.00	0.00
21-Aug	108.6	106.2	108.0	108.0	105.8	107.4	109.5	105.8	107.3	109.7	105.9	107.8	105.2	104.8	0.0	0.0	114.2	119.8	0.0	0.0	0.00	0.00	0.00	0.00
22-Aug	105.1	102.9	104.0	104.7	102.7	103.5	105.2	103.1	104.2	105.3	103.2	104.4	105.9	106.7	0.0	0.0	116.5	120.0	0.0	0.0	0.00	0.00	0.00	0.00
23-Aug	103.1	103.0	103.3	102.8	102.6	103.0	103.2	102.6	103.5	103.1	102.6	103.4	106.6	107.3	0.0	0.0	106.7	112.4	0.0	0.0	0.00	0.00	0.00	0.00
24-Aug	103.1	103.0	103.2	102.7	102.6	102.8	103.3	102.8	103.3	103.3	102.8	103.3	106.6	105.9	0.0	0.0	106.1	108.3	0.0	0.0	0.00	0.00	0.00	0.00
25-Aug	103.1	102.9	103.2	102.7	102.5	102.7	103.1	102.6	103.5	103.1	102.6	103.4	105.3	105.5	0.0	0.0	118.4	123.0	0.0	0.0	0.00	0.00	0.00	0.00
26-Aug	103.0	102.7	103.2	102.6	102.2	102.4	103.2	102.4	103.1	103.2	102.5	103.1	104.7	105.3	0.0	0.0	115.1	120.6	0.0	0.0	0.00	0.00	0.00	0.00
27-Aug	103.5	103.2	103.9	102.9	102.7	103.1	103.4	102.7	103.6	103.3	102.8	103.6	104.7	104.2	0.0	0.0	96.7	102.3	0.0	0.0	0.00	0.00	0.00	0.00
28-Aug	104.2	104.0	104.3	103.7	103.4	103.9	103.7	103.3	104.2	103.5	103.3	104.1	103.9	104.1	0.0	0.0	103.1	106.8	0.0	0.0	0.00	0.00	0.00	0.00
29-Aug	104.7	104.3	104.9	103.8	103.5	104.3	104.2	103.7	104.2	104.2	103.8	104.4	103.9	104.0	0.0	0.0	79.4	82.3	0.0	0.0	0.00	0.00	0.00	0.00
30-Aug	103.8	102.6	103.4	103.3	102.1	103.0	103.4	102.3	103.5	103.5	102.4	103.5	102.4	102.1	0.0	0.0	77.9	83.4	0.0	0.0	0.00	0.00	0.00	0.00
31-Aug	102.4	101.9	102.1	101.6	101.4	101.8	101.8	101.7	101.9	101.9	101.7	101.9	102.3	102.6	0.0	0.0	96.5	100.2	0.0	0.0	0.00	0.00	0.00	0.00

APPENDIX F: ROCKY REACH PROJECT GAP

2015 TOTAL DISSOLVED GAS ABATEMENT PLAN

FINAL

**ROCKY REACH HYDROELECTRIC PROJECT
FERC Project No. 2145**

April 2015



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

TERMS AND ABBREVIATIONS

401 Certification	Washington State Department of Ecology 401 Water Quality Certification
7Q10	highest seven consecutive day average flow with a 10-year recurrence frequency
cfs	cubic feet per second
Chelan PUD	Public Utility District No. 1 of Chelan County
CCT	Confederated Tribes of the Colville Indian Reservation
BPA	Bonneville Power Administration
Douglas PUD	Public Utility District No. 1 of Douglas County
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
FCRSP	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
FPC	Fish Passage Center
FPE	Fish Passage Efficiency
FMS	fixed monitoring station
GAP	Gas Abatement Plan
GBT	gas bubble trauma
Grant PUD	Public Utility District No. 2 of Grant County
HCP	Habitat Conservation Plan
HCP CC	Habitat Conservation Plan Coordinating Committee
kcfs	thousand cubic feet per second
JBS	juvenile bypass system
NMFS	National Marine Fisheries Service
MCHCA	Mid Columbia Hourly Coordination Agreement
Project	hydroelectric project
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RRFF	Rocky Reach Fish Forum
TDG	total dissolved gas
TMDL	total maximum daily load
UCR	Upper Columbia River
USACE	United States Army Corps of Engineers
USBR	United State Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WQMP	Water Quality Management Plan
WQS	Water quality standards

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APPENDIX E:.....2014 GAS ABATEMENT ANNUAL REPORT
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EXECUTIVE SUMMARY

This Total Dissolved Gas Abatement Plan (GAP) is being submitted to the Washington State Department of Ecology (Ecology) as required by the 401 Water Quality Certification (401 Certification) for the Rocky Reach Hydroelectric Project (Project) and by Washington Administrative Code (WAC) 173-201A-200. This section of the WAC allows Ecology to temporarily adjust total dissolved gas (TDG) criteria to aid downstream migrating juvenile fish¹ passage past hydroelectric dams when consistent with an Ecology-approved gas abatement plan. Chelan County Public Utility District No.1 (Chelan PUD) has prepared this annual GAP to provide an overview of operational implementation actions Chelan PUD will take at the Project during 2015 to meet TDG requirements, while ensuring the fish passage requirements are met as set forth in the Rocky Reach Habitat Conservation Plan (HCP) and Anadromous Fish Agreement. This GAP includes plans for physical and biological monitoring and is accompanied by the fisheries management plan (HCP), Rocky Reach Operations Plan, TDG Operational Plan, a Quality Assurance Project Plan (QAPP) for Rocky Reach Water Quality Monitoring and Reporting, and the Gas Abatement Annual Report.

Washington State water quality standards provide for a temporary exemption for elevated TDG levels to allow increased downstream migrating juvenile fish passage without causing more harm to fish populations than caused by turbine fish passage. Washington state water quality standards provide different standards for TDG during the non-fish and fish-spill seasons to aid fish passage. In the 401 Certification for the Rocky Reach Project, the non-fish spill season is defined as September 1 through March 31 and the fish-spill season is April 1 through August 31. The following special fish passage exemptions for the Snake and Columbia Rivers apply when spilling water at dams is necessary to aid fish passage

TDG must not exceed an average of 115 percent as measured in the forebay of the next downstream dams and must not exceed an average of 120 percent as measured in the tailraces of each dam (these averages are measured as an average of the twelve highest consecutive hourly readings in any one day, relative to atmospheric pressure). A maximum TDG one hour average of 125 percent must not be exceeded during spill for fish passage.

The goal of the GAP is to implement measures to achieve compliance with the Washington state water quality standards for TDG in the Columbia River at the Project while continuing to meet the fish passage and survival standards set forth in the Rocky Reach HCP and Anadromous Fish Agreement. These plans are provided as Appendix A.

¹ Unless otherwise noted “fish” refers to downstream migrating juveniles.

To meet the above stated goal, Chelan PUD plans to implement applicable operational measures specified in Section 5.4.1(b) of the 401 Certification. These measures include, but are not limited to:

1. Minimizing voluntary spill.
2. During downstream migrating juvenile fish passage, managing voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria, using the TDG Operational Plan (Appendix B).
3. Minimizing spill, to the extent practicable, by scheduling maintenance based on predicted flows.
4. Avoiding spill by continuing to participate in the Hourly Coordination Agreement or any successor agreement to which Chelan PUD is a party, to the extent it reduces TDG.
5. Maximizing powerhouse discharge as appropriate up to 212 thousand cubic feet per second kcfs.
6. Implement alternative spillway operations, using of gates 2 through 12, to determine whether TDG levels can be reduced without adverse effects on fish passage. If effective, implement to reduce TDG.

Additionally, Chelan PUD proposes to implement the following measures, as required by the 401 Certification:

1. Consult with Ecology if there are any non-routine operational changes that may affect TDG.
2. Monitor for TDG at Chelan PUD's fixed-site monitoring stations. TDG data will be collected on an hourly basis throughout the year and will be reported to United States Army Corps of Engineers (USACE) Reservoir Control Center's website.
3. Prepare an annual report summarizing Chelan PUD's flow, TDG, gas bubble trauma (GBT) monitoring, and fish study results, and, in accordance with the previous (2014) GAP, submit to Ecology by December 31.

SECTION 1: INTRODUCTION

Chelan PUD owns and operates the Rocky Reach Hydroelectric Project, located on the Columbia River downstream of Wells Dam (Figure 1-1). The Project is licensed as Project No. 2145 by the Federal Energy Regulatory Commission (FERC). The 401 Certification for the Project was issued by Ecology on March 17, 2006. The 401 Certification terms and conditions are incorporated in the new FERC license to operate the Project which was issued on February 19, 2009. Section 5.4.3 of the 401 Certification requires Chelan PUD to submit an annual GAP in accordance with Ecology's water quality standards for total dissolved gas TDG beginning on April 1 of the year of implementation.

This GAP is being submitted to Ecology as a condition of the 2006 Special Fish Passage Exemption (WAC 173-201A-200(1)(f)) and Section 5.4.3 of the 401 Certification. Chelan PUD respectfully submits this GAP with the goal of receiving a temporary exemption for TDG commencing with the 2014 fish¹ spill season. This GAP provides details associated with proposed 2015 operations and activities to achieve TDG standards, a review of any proposed structural TDG abatement measures and technologies, and physical and biological monitoring plans.

1.1 Project Description

The Rocky Reach Project is owned and operated by Chelan PUD and is located on the Columbia River at river mile 474, about seven miles upstream of the city of Wenatchee. Construction of the dam and powerhouse began in 1956 and the Project was completed and put into production in 1961. The impounding structures are a mass of reinforced concrete consisting of a forebay wall section about 460 feet long, a combined intake and powerhouse section 1,088 feet long, a non-overflow center dam spillway that is 740 feet long consisting of 12 bays, each controlled by a 50 foot wide, 58 foot high radial gate. A 2,000 foot subsurface cutoff wall consisting of a grout curtain and a compacted impervious barrier limits seepage through a terrace forming the east bank.

The forebay wall consists of mass concrete gravity blocks of various heights, with a maximum height of 118 feet. The service bay connects the forebay wall to the powerhouse. The powerhouse contains 11 units, each 86 feet wide and about 200 feet long. The Project's FERC license authorized installed capacity is 865.76 megawatts (MW).

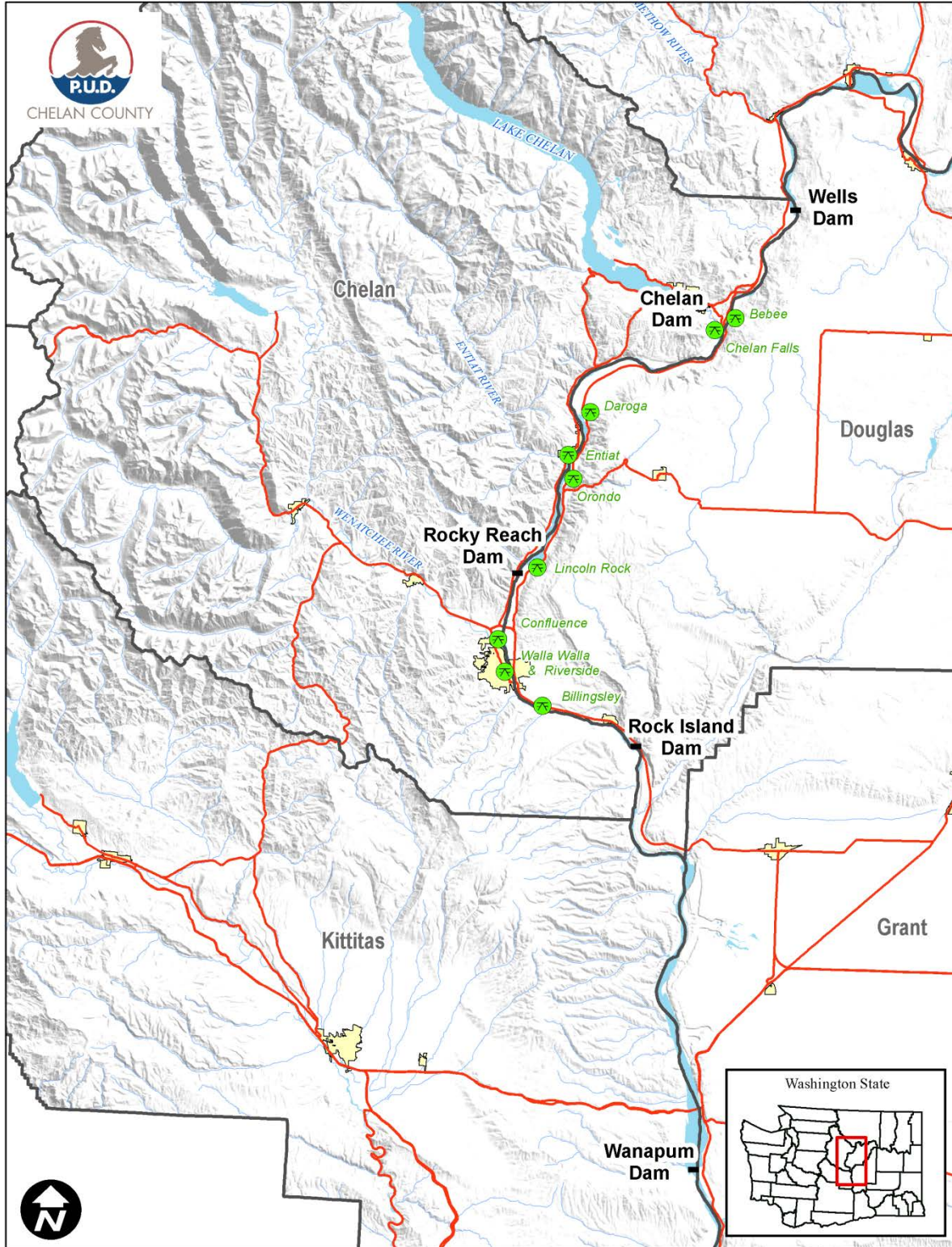


Figure 1-1: Location of Rocky Reach Hydroelectric Project on the Columbia River.

The Project contains an adult fishway to provide upstream fish passage and a juvenile fish bypass system (JBS) which began operation in 2003 to provide downstream fish passage for juvenile salmon and steelhead. The fishway consists of a fish ladder, transportation channel, collection channel and three entrances. The JBS consists of a surface collection system adjacent to the forebay wall, intake screens, and a bypass conduit routed along the downstream side of the powerhouse and spillway, through a fish collection facility, and to an outfall downstream of the Project near the dam’s left abutment.

1.2 River Flows

The climate of the Columbia Basin in eastern Oregon, Washington and British Columbia is best described as desert. The major portion of the precipitation experienced within the basin falls in the form of snow during the period of November through March of each year. Runoff usually occurs from mid-April through July, with the historical peak occurring during the month of June. Storage dams in the United States and Canada capture spring and summer high flows to hold for release in the winter months. A comparison of the 10-year average flows to 2014 flows at the Rocky Reach Project is shown below in Table 1-1.

Table 1-1: Comparison of 10 year average flows to 2014 flows at the Rocky Reach Project.

Season	10 Year Average Flows (2004-2013)	2014 Flows	Percent of 10 Year Average
Spring (4/1-5/23)	130.43 kcfs	154.8 kcfs	118.7%
Summer (5/24-8/31)	147.4 kcfs	151.4 kcfs	102.7%

1.3 Regulatory Framework

1.3.1 Total Dissolved Gas Standards

The Washington State water quality numeric criteria for TDG (WAC 173-201A-200(1)(f)) address standards for the surface waters of Washington State. Under the water quality standards (WQS), TDG shall not exceed 110 percent at any point of measurement in any state water body. However, the TDG criteria may be adjusted to aid fish passage over hydroelectric dams when consistent with an Ecology-approved gas abatement plan. This plan must be accompanied by fisheries management and physical and biological monitoring plans. Ecology may approve, on a per application basis, a temporary exemption to the TDG standard (110 percent) to allow spill for juvenile fish passage on the Columbia and Snake rivers (WAC 173-201A-200(1)(f)(ii)). On the Columbia and Snake rivers there are three separate standards with regard to the TDG exemption. First, in the tailrace of a dam, TDG shall not exceed 125 percent as measured in any one-hour period. Further, TDG shall not exceed 120 percent in the tailrace of a dam and shall not exceed 115 percent in the forebay of the next dam downstream as measured as an average of the 12 highest consecutive (12C-High) hourly readings in any one day (24-hour period). The increased levels of spill resulting in elevated TDG levels are intended to allow increased fish passage without causing more harm to fish populations than caused by turbine fish passage. This TDG exemption provided by Ecology is based on a risk analysis study conducted by the National Marine Fisheries Service (NMFS, 2000).

1.3.2 Fish-Spill Season

Section 5.4.2 of the Rocky Reach 401 Certification defines the fish-spill (for downstream migrating juveniles) season as April 1 through August 31 of each year. Non-fish spill season is defined as September 1 through March 31, unless otherwise specified in writing to Ecology following consultation with the Rocky Reach Fish Forum and the HCP Coordinating Committee.

1.3.3 Incoming Total Dissolved Gas Levels

During the fish passage season, TDG concentrations in the Rocky Reach Project forebay are primarily determined by the upstream water management activities of upstream dams.

1.3.4 Flood Flows - 7Q10

WAC 173-201A-200(f)(i) states that the water quality criteria for TDG shall not apply when the stream flow exceeds the seven-day, ten-year frequency flood stage (7Q10). The 7Q10 flood flow for the Rocky Reach Project was calculated to be 252 kcfs (Pickett, et al., 2004).

1.3.5 Total Dissolved Gas Total Maximum Daily Load

In 2004, Ecology established a TDG Total Maximum Daily Load (TMDL) for the mid-Columbia River which set TDG allocations for each dam (Pickett, et al., 2004). Since special criteria have been established in Washington for “voluntary” spills for downstream migrating juvenile fish passage under an approved plan, the TMDL sets TDG loading capacities and allocations for the Mid-Columbia River and Lake Roosevelt, both in terms of percent saturation for fish passage and excess pressure above ambient for non-fish passage. Allocations are specified for each dam and for upstream boundaries. Fish passage allocations must be met at fixed monitoring stations. Non-fish passage allocations must be met in all locations, except for an area below each dam (other than Grand Coulee) from the spillway downstream to the end of the aerated zone. Attainment of allocations will be assessed at monitoring sites in each dam’s forebay and tailrace and at the upstream boundaries.

Section 5.4.7 of the Rocky Reach Project 401 Certification states: “*This certification, along with the WQMP and the updated GAP, is intended to serve as the Rocky Reach Project’s portion of the Detailed Implementation Plan (DIP) for the Mid-Columbia River and Lake Roosevelt TDG TMDL*”.

1.4 Project Operations

The Project is an integral part of the seven-dam Mid-Columbia River Hydroelectric System (Grand Coulee to Priest Rapids). Each of the seven dams is operated in accordance with the terms of the Mid-Columbia Hourly Coordination Agreement (MCHCA), which seeks to coordinate operations for all of the mid-Columbia projects for the best use of flows for generation and to meet fishery (juvenile and adult) and other environmental resource needs.

Under the Hourly Coordination Agreement, power operations are coordinated to meet daily load requirements through the assignment of "coordinated generation" through Central Control hosted at the Public Utility District No. 2 of Grant County (Grant PUD). Automatic control logic is used to maintain pre-set reservoir levels in order to meet load requirements and minimize involuntary spill. These pre-set reservoir levels are maintained at each project through management of a positive or negative "bias" which assigns a project more or less generation depending on whether

the reservoir elevation should be increased or decreased in order to maximize system benefits and minimize involuntary spill.

In addition to the HCA discussed above, the Project operates within the constraints of its FERC regulatory and license requirements, as well as the plans and agreements discussed below.

1.4.1 2015 Rocky Reach Operations Plan

Article 402 of the Rocky Reach License requires an annual Operations Plan be submitted to the FERC by February 15 each year for approval (revised submittal date of March 30). This Operations Plan includes the following: (a) descriptions of fisheries (juvenile and adult) and water quality-related operating criteria for the Project turbines, the downstream fish passage facility, fishways, spillways, and sluiceways; (b) descriptions of fisheries- and water-quality-related protocols for startup, in-season operation, shutdown, and inspection of the Project turbines, the downstream passage facility, fishways (including fish salvage), spillways, and sluiceways; and (c) an annual schedule for operation and inspection of these facilities. The information contained in the annual Operations Plan is relevant to Chelan PUD's TDG abatement activities and is therefore attached for reference as Appendix C to this GAP.

1.4.2 Habitat Conservation Plan

In 2004, the FERC amended the existing license to include the Anadromous Fish Agreement and HCP for the Rock Island Project. The HCP is a programmatic approach developed by Chelan PUD and the fishery agencies and tribes for reducing and eliminating the effects of the Rock Island Project on salmon and steelhead.

The Rocky Reach HCP serves as the foundation for the fisheries management plan at Rocky Reach Dam. It fundamentally describes a 100 percent No Net Impact (NNI) concept with necessary outcomes required for mainstem passage, habitat improvement and protection, and hatchery programming. All measures proposed in the HCP are intended to minimize and mitigate impacts to the Plan species, to the "maximum extent practicable" as required by the Endangered Species Act (ESA). Plan species include: Upper Columbia River (UCR) steelhead, UCR yearling spring Chinook, UCR subyearling summer/fall Chinook, Okanogan River sockeye, and coho salmon. The Rock Reach HCP provides for optional tools Chelan PUD may implement to aid in juvenile fish passage past the Project, including spill and the use of the JBS. Chelan PUD implements these tools to aid in juvenile fish passage as necessary to ensure success toward NNI.

HCP Phase III (Standards Achieved) has been met for all spring migrants (spring/yearling Chinook, steelhead, and sockeye) at Rocky Reach while operating the JBS exclusively.

1.4.3 Other International and Regional Agreements

The Columbia River is managed, and the Project is operated, for fish (juvenile and adult) habitat and flow by the following international and regional agreements:

- *Columbia River Treaty*: An agreement between Canada and the United States in which Canada has agreed to provide storage for improving flow in the Columbia River to maximize power and flood control.

- *Pacific Northwest Coordination Agreement*: An agreement among the United States Bureau of Reclamation (USBR), the Bonneville Power Administration (BPA), the United States Army Corps of Engineers (USACE), and 15 public and private generating utilities to maximize usable hydroelectric energy. Chelan PUD is a member of this agreement.
- *Mid-Columbia Hourly Coordination Agreement*: An agreement whereby the mid-Columbia PUDs (Chelan, Douglas, and Grant PUDs), the USACE, the USBR, and BPA coordinate operations in order to maximize the output of hydroelectric power. Effects have included reducing forebay elevation fluctuations and spill.
- *The Federal Columbia River Power System (FCRPS) Biological Opinion*: by NMFS, applies to actions by the Corps, the USBR, and BPA for impacts on ESA listed salmon and steelhead on the Columbia River system. A Technical Management Team sets flow releases and other operations of the FCRPS that determines the daily and weekly flows that will pass through the Project.
- *Hanford Reach Fall Chinook Protection Program Agreement*: The three mid-Columbia PUDs, NOAA Fisheries, Washington Department of Fish and Wildlife (WDFW), U.S. Fish and Wildlife Service (USFWS), Confederated Tribes of the Colville Indian Reservation (CCT), and BPA have agreed to river flow management actions to support Grant PUD's effort the manage flow in the Hanford Reach to protect fall Chinook salmon redds and pre-emergent fry during the spawning to emergence periods (typically October to May).

1.4.4 Spill Operations

1.4.4.1 Spill Gate Configuration

The standard (fish) spill configuration used at Rocky Reach uses gates 2 through 8 with a minimum discharge per spill bay of about 4 kcfs. The standard spill configuration was designed to create a crown-shaped pattern of turbulent flow below the spillway with decreasing velocities leading toward the upstream migrating adult fishway entrances.

This spill pattern provides favorable guidance conditions for adult migrant salmon and steelhead. This spill configuration and alternate patterns were tested and it was determined this pattern was as good as, if not better than, the alternate patterns for upmigrating salmonids (Schneider and Wilhelms, 2005). The same pattern is used for juvenile downstream migrating fish passage spill. During spill operations, whether for juvenile fish passage, TDG management, or for other purposes, the gates are operated via a computer automated system that follows the spill pattern.

Note that although the above referenced crown-shaped pattern may be as good as, if not better, than tested alternate patterns for upmigrating salmonids, it may not be ideal for TDG. According to Section 5.4(1)(b)(6) of the 401 Certification, Chelan PUD shall study alternative spillway operations using any of gates 2 through 12. In 2011 and 2012, Chelan PUD studied alternative spillway flow distribution patterns, in order to evaluate the potential to reduce total dissolved gas TDG levels, particularly during high spill levels (above 50 kcfs). Generally, all of the three alternative spill patterns studied resulted in lower TDG levels than the standard spill pattern. Of the three alternative patterns, the flat spill pattern (flow distributed evenly between spillway gates) had a slightly better TDG performance than the other two alternative patterns. Chelan PUD has presented these findings to Ecology, the Rocky Reach Fish Forum (RRFF) and Habitat Conservation Plan Coordinating Committee (HCP CC).

Chelan PUD, through the consultation process with Ecology, the RRFF, and the HCP CC, will develop a schedule to make the necessary changes to perform the new spill configuration. This schedule may include but not be limited to; computer automation of spill gates (2015), and/or changes to system operations and monitoring. Chelan PUD will operate the new spill configuration as a pilot or test spill and further evaluate the results for a designated period of time. Chelan PUD shall develop a monitoring schedule to test operations under the new spill configuration. If upon operating under the new spill configuration data show that optimal results are not occurring as previously evaluated, Chelan PUD shall implement adaptive management in coordination with the RRFF and HCP CC.

1.4.4.2 Spill Scenarios

There are six main scenarios that may result in spill at Rocky Reach Dam. These are described below:

Fish Spill

Spill is an ineffective method of bypassing downstream migrating juvenile fish away from the turbines at Rocky Reach Dam (Steig et. al., 1997) and, consequently, is not considered as the solution for the long-term fish passage program. To minimize or eliminate the need for fish spill, Chelan PUD is focusing its efforts on increasing the fish passage efficiency and survival through the juvenile fish bypass system (JBS).

The JBS continues to be the most efficient non-turbine route for downstream migrating juvenile fish passage at the Rocky Reach Project. The JBS does not require spill for its operation.

Spring Fish Spill Operations

Operating the JBS exclusively, Chelan PUD has been able to meet the HCP survival standards for the three spring migrants (spring/yearling Chinook, steelhead, and sockeye). Chelan PUD will continue operating the JBS exclusively, with no voluntary spill, during the spring of 2015.

Summer Fish Spill Operations

Summer spill at Rocky Reach for subyearling Chinook will be nine percent of day average flow. Commencement of summer spill will be determined using run-timing information at Rocky Reach. Summer spill generally begins in early June and ends in mid-August when 95 percent of the migration of subyearling Chinook has passed the Project.

Due to tag technology limitations and uncertainties regarding their life history (outmigration behavior) no survival studies for subyearling Chinook have been conducted since 2004, nor are any planned at this time.

Additional information about the HCP standards, including annual progress reports are included in Appendix A of this GAP.

Flow in Excess of Hydraulic Capacity

The minimal storage and limited hydraulic capacity of the Project occasionally force Chelan PUD to spill water past the Project. This spill is required to maintain headwater elevations within the limits set by the Project's FERC license (707 feet), to prevent overtopping of the Project, and

to maintain optimum operational conditions. When spilling for fish or due to excess inflow or generation, the spillway is operated using gate settings that have been shown to limit TDG production and meet fish passage requirements (Schneider and Wilhelms, 2005). To reduce negative impacts of flow in excess of hydraulic capacity Chelan PUD completed and implemented a TDG Operational Plan. This plan is attached as Appendix B. Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Plant Load Rejection Spill

This type of spill occurs when the plant is forced off line by an electrical fault, which trips breakers, or any activity forcing the units off line. This is an emergency situation and generally requires emergency spill. When the units cannot pass flow, the flow must be passed by other means, such as spill, to avoid overtopping the dam. During emergency spill, Chelan PUD will implement the TDG Operational Plan. This plan is attached as Appendix B.

Immediate Replacement Spill

Immediate replacement spill is used to manage TDG levels throughout the Columbia River basin. The Technical Management Team (including NMFS, USACE, and BPA) manages this spill. Immediate replacement spill occurs when TDG levels are significantly higher in one river reach than they are in another reach. To balance the TDG levels throughout the basin, spill is reduced and generation increased in the reach with high TDG levels and the energy is transferred to reaches with lower TDG levels where spill is increased. The result is higher generation in the reaches with high TDG levels, increased spill in reaches with lower TDG levels, and equal distribution of TDG levels throughout the basin.

To control TDG levels that may result from immediate replacement spill, Chelan PUD will implement the TDG Operational Plan (Appendix B).

Maintenance Spill

Maintenance spill is utilized for any maintenance activity that requires spill to assess the routine operation of individual spillways and turbine units. These activities include forebay debris flushing, checking gate operation, gate maintenance, and all other maintenance that would require spill. The Federal Energy Regulatory Commission requires that all spillway gates be operated once per year. This operation requires a minimal amount of spill for a short duration annually and is generally accomplished in conjunction with fish passage spill operations.

To control TDG levels that may result from maintenance spill, Chelan PUD will implement the TDG Operational Plan (Appendix B). Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Error in Communication Spill

Error in communication with the USACE Reservoir Control Center, including computer malfunctions or human error in transmitting proper data, can contribute to spill. Hourly coordination between hydroelectric projects on the river minimizes this type of spill, but it does occur occasionally.

To control TDG levels that may result from error in communication spill, Chelan PUD will implement the TDG Operational Plan (Appendix B). Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Reduced Generation Spill

Reduced electric demand on the system can, at times, result in the need to spill water at run-of-the-river projects such as Rocky Reach. Hourly coordination between hydroelectric projects on the river can minimize this type of spill, but it does occur.

To control TDG levels that may result from reduced generation spill, Chelan PUD will implement the TDG Operational Plan (Appendix B), when possible. Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

1.5 Spill and Total Dissolved Gas Compliance - Previous Year 2014

1.5.1 TDG Compliance 2014

Information regarding spill and TDG for 2014 are displayed in Tables 1-2 and 1-3 and further described below.

Tailrace 120 percent Standard

TDG data was collected on 153 days during the 2014 fish-spill season in the Rocky Reach tailrace. None of the data was omitted from the data set due to flows exceeding the 7Q10 flows. The tailrace 12C-High TDG exceeded 120 percent on 11 days. Compliance with this standard was 92.8 percent.

Tailrace 125 percent Standard

Total hours of TDG data collected during the 2014 fish spill season in the Rocky Reach tailrace equaled 3,672. No hours were eliminated from the data set due to flows in exceedance of the 7Q10 flow. Hourly tailrace TDG levels exceeded 125 percent for 18 hours. Compliance with this standard was 99.9 percent.

Downstream (Rock Island) Forebay 115 percent Standard

TDG data was collected on 141 days during the 2014 fish spill season in the Rock Island forebay. However, of those 141 days 12 were omitted from the data set used for determination of compliance due to upstream forebay 12C-High TDG exceeding 115 percent. The Rock Island forebay 12C-High TDG exceeded 115 percent on 7 days. Compliance with this standard was 95.0 percent.

Table 1-2: Summary of Spill at the Rocky Reach Project in 2014

Date	Fish Spill Average kcfs	Total Spill Average kcfs	River Flow Average kcfs	% Total Spill	% Fish Spill of Total River	% Fish spill of Total Spill
4/1 - 8/31	8.4	14.6	150.3	9.7	5.6	57.5

Table 1-3: Summary of TDG Compliance at the Rocky Reach Project in 2014

Date	% Compliance with 120% Tailrace Standard	% Compliance with 125% Tailrace Standard	% Compliance with 115% Downstream Forebay TDG Standard
4/1 - 8/31	92.8	99.9	95.0

1.5.2 TDG Activities Implemented 2014

As defined in Section 5.4.1(b) of the 401 Certification, Chelan PUD implemented six actions to minimize voluntary and involuntary spill at Rocky Reach in order to meet TDG water quality standards. The primary operational action to reduce spill at the Rocky Reach Project was the implementation of the operational spill programs and the ability to minimize spill through operation of the JBS. These efforts included:

- Minimizing voluntary spill.
- During fish passage, managing voluntary spill levels in real time to meet TDG numeric criteria.
- Minimizing spill, to the extent practicable, by scheduling maintenance based on predicted flows.
- Avoiding spill by continuing to participate in the Hourly Coordination Agreement.
- Maximizing powerhouse discharge as appropriate up to 212 kcfs.
- Contracted with Parametrix to have the data gathered during the 2011 and 2012 testing of alternative spillway configurations analyzed and summarized. The report has been reviewed by Ecology, the HCP CC and the RRFF. The results of the report are briefly summarized in Section 1.4.4.1.

1.5.3 TDG Structural Measures Implemented in 2014

No structural gas abatement measures were proposed or implemented at the Rocky Reach Project in 2014.

SECTION 2: PROPOSED 2015 ACTION PLAN TO ACHIEVE TDG STANDARDS

The following sections describe TDG abatement measures proposed for implementation during 2014 to achieve compliance with TDG water quality standards.

2.1 Operational TDG Abatement Measures

Section 5.4.1(b) of the 401 Certification requires Chelan PUD to manage spill toward meeting water quality criteria for TDG during all flows below 7Q10 levels, but only to the extent consistent with meeting the passage and survival standards set forth in the HCP and Anadromous Fish Agreement². During the 2015 fish spill season, Chelan PUD proposes to use a combination of the following measures as needed to meet water quality criteria for TDG:

1. Minimize voluntary spill

Success of the JBS has enabled Chelan PUD to reduce spill required for fish passage.

2. Manage voluntary spill in real time

During fish passage, manage voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria, using the TDG Operational Plan (Appendix B). The TDG Operational Plan is updated annually and routed to the Project operators. It provides the operators a list of actions they are to follow if TDG meets the designated thresholds.

3. Minimize involuntary spill

Minimize involuntary spill, to the extent practicable, by scheduling maintenance based on predicted flows.

4. Participate in Hourly Coordination Agreement

Chelan PUD endeavors to avoid involuntary spill by continuing to participate in the Hourly Coordination Agreement, or any successor agreement to which Chelan PUD is a party, to the extent it reduces TDG.

5. Maximize powerhouse discharge as appropriate up to hydraulic capacity

6. Implement alternative spillway operation

Chelan PUD will develop a proposal in 2015 to present to the HCP Coordinating Committee and Rocky Reach Fish Forum.

Per Section 5.4(5) of the 401 Certification, operational and structural changes that may affect TDG must be subject to review and approval by Ecology during the design and development phase to assure that such changes incorporate consideration of TDG abatement, when appropriate.

² Additional conditions used to determine compliance with the water quality criteria for TDG can be found in Sections 5.4(1)(d)-(g) of the 401 Certification, as well as Section 4.4 of this Plan.

2.2 Proposed Structural TDG Abatement Measures and Technologies

No structural gas abatement measures are planned at the Rocky Reach Project in 2015. Chelan PUD will continue to monitor and investigate the feasibility of implementing new technologies as they become available.

SECTION 3: PHYSICAL AND BIOLOGICAL MONITORING AND QUALITY ASSURANCE

The following sections describe Chelan PUD's TDG compliance monitoring program. The program includes a fixed-site monitoring program and a QAPP.

3.1 Fixed-Site Monitoring Stations for TDG

Chelan PUD currently maintains two fixed monitoring stations (FMS) at the Rocky Reach Project to monitor hourly TDG levels annually from April through August. The fixed monitoring stations are installed to a depth of approximately 15 feet. This depth varies as the forebay and tailrace river elevations fluctuate with river flows. This depth variation is not expected to affect the accuracy of the TDG readings because the instruments are located below the depth where gas bubbles form on the membrane and are deep enough in the water column to not be affected by near surface temperature gradients.

The forebay fixed monitoring station (Figure 2-1) is located on the upstream side of the dam, affixed to the corner between the powerhouse and spillway, approximately mid-channel. The tailrace fixed monitoring station (Figure 2-2) is located approximately 0.38 miles downstream of the dam. The standpipe is affixed to the downstream side of a pier nose supporting the juvenile bypass system outfall pipe. This location is east of mid-channel, and is minimally impacted by powerhouse flows when the Project is passing water over the spillway (Schneider and Wilhelms, 2005).

Chelan PUD has entered into a Professional Services Agreement with Columbia Basin Environmental to perform calibrations and equipment maintenance during the 2015 monitoring season. Calibration and equipment maintenance will be conducted monthly during the fish spill season, and every other month during the non-fish spill season. It is anticipated at this time that Chelan PUD will continue to contract with CBE into the future. Quality assurance/quality control (QA/QC) measures will be accomplished through training in instrument maintenance, operation, and factory prescribed calibration methods. A detailed log will be maintained for all work done on the monitoring equipment, including monthly maintenance, calibration, exchange of instruments, and any other pertinent information. Redundant measurements with a mobile instrument to verify the accuracy of the in-situ instruments will be conducted during the calibrations.



Figure 3-1: Location of forebay fixed monitoring station at Rocky Reach Hydroelectric Project.

3.1.1 Fish Spill Season (April 1 through August 31)

TDG measurements will be recorded throughout the fish spill season at 15-minute intervals, enabling plant operators to adjust spill volumes to maintain gas levels to prevent exceedances of the TDG criteria. These 15-minute intervals will be averaged into hourly readings for use in compiling daily and 12-hour averages. Beginning on April 1 all hourly data will be forwarded to Chelan PUD headquarters building and then onto the USACE Reservoir Control Center at: http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/, where the data is posted on a nearly hourly basis.

3.1.2 Non-Fish Spill Season (September 1 through March 31)

TDG measurements will be recorded throughout the non-fish spill season at 15-minute intervals, enabling plant operators to adjust spill volumes to maintain gas levels to prevent exceedances of the TDG criteria. These 15-minute intervals will be averaged into hourly readings for use in compiling daily and 12-hour averages. Beginning on April 1 all hourly data will be forwarded to Chelan PUD headquarters building and then onto the USACE Reservoir Control Center at: http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/, where the data is posted on a nearly hourly basis.

3.2 Quality Assurance

Section 5.7.3 of the 401 Certification requires Chelan PUD to maintain a TDG monitoring program that is at least as stringent as the QA/QC calibration and monitoring procedures and protocols developed by the USGS monitoring methodology for the Columbia River.

Chelan PUD has developed its QA/QC protocols following established protocols by other resource agencies conducting similar monitoring programs, such as the USGS, USACE, and other mid-Columbia River Dam operators, as well as Hydro Lab Corporation's recommendations. These QA/QC protocols are included in Chelan PUD's QAPP (Appendix D) per Section 5.7(2) of the Rocky Reach 401 Certification.

3.3 Biological (Gas Bubble Trauma) Monitoring Plan

GBT monitoring is not conducted on an annual basis at Rocky Reach Dam. However, Section 5.4(1)(c) of the Rocky Reach 401 Water Quality Certification requires Chelan PUD to develop and implement a plan to study GBT below Rocky Reach Dam. Ecology has recommended Chelan PUD postpone any GBT study and native fish and/or invertebrates until such time as it may be required. Ecology is currently evaluating the need for future GBT studies.

Chelan PUD, in conjunction with the Fish Passage Center (FPC), will continue to conduct (GBT) monitoring at the Rock Island Bypass Trap. Random samples of 100 spring Chinook, steelhead and subyearling chinook will be examined two days per week during the sampling season (April 1st to August 31st). Examinations for GBT symptoms will follow a standardized FPC protocol (FPC, 2009). The results of this monitoring effort will be included in the annual report (see Section 4.3 below).

SECTION 4: TDG COMPLIANCE REPORTING METHODS

4.1 Water Quality Web-Site

Section 5.7.6 of the 401 Certification requires hourly TDG information be made available to the public via Chelan PUD's website, as close to the time of occurrence as technologically feasible. To meet this requirement, Chelan PUD maintains a link on its website that directs the public to the USACE Reservoir Control Center at: http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/, where the data is posted on a nearly hourly basis.

4.2 Notifications

Chelan PUD shall notify Ecology, Central Regional Office, Water Quality Program within 48 hours (either before or after) of any TDG spill; this includes the start of spill for fish, as defined in Section 1.2.1 above, and any deviation from the TDG Operational Plan or the fish spill plan that adversely affects TDG levels. This notification may be either electronic or by letter.

4.3 Annual Report

Chelan PUD will provide Ecology with a draft Gas Abatement Annual Monitoring Report by October 31 of each year for initial review and comment. Chelan PUD will submit the final report by December 31 of that same year. The GAP Report will include:

- Flow over the preceding year (cfs over time);
- Spill over the preceding year (cfs and duration);
- Reasons for spill (e.g. for fish, turbine down time);
- TDG levels during spill (hourly)(to include fish spill season and non-fish spill season);
- Summary of exceedances and what was done to correct the exceedances;
- Results of the fish passage efficiency (FPE) studies and survival per the HCP;
- Result of biological monitoring (gas bubble trauma) at Rock Island Bypass Trap (conducted in conjunction with the Fish Passage Center);
- Results of QA/QC implementation
- Analysis of monitoring data for confirmation or refinement of the regression equations in the WQMP³ used to predict compliance with TDG numeric criteria.

³ The WQMP is a response to Ecology's request that the PUD provided the scientific and biological basis for Ecology's Section 401 certification. It is the principal supporting document for the 401. As stated in Chapter 2 of the Comprehensive Plan (Attachment B to the Rocky Reach Settlement Agreement):

"Ecology is a participant in the Settlement Group negotiating conditions for relicensing of the Project, and has requested that Public Utility District No. 1 of Chelan County (Chelan PUD) help provide the scientific and biological basis for Ecology's Section 401 Certification. The Settlement Group has developed a Comprehensive Plan that provides the rationale and details behind proposed license articles that the Settlement Group will recommend for inclusion in the New License to be issued by FERC. The Rocky Reach Water Quality Management Plan is in response to Ecology's request and is contained in this chapter of the Comprehensive Plan.

The WQMP includes Project background; background water quality; management considerations and options investigated; and protection, mitigation, and enhancement measures.

The analysis of monitoring data for confirmation or refinement of the regression equations in the WQMP used to predict compliance with TDG numeric criteria will include the following steps:

- Input relevant 2008 (post relocation of tailrace fixed monitoring site) and 2009-2013 data,
- Analyze to see if the relationship between quantity of spill and TDG yields a similar or different regression than that predicted for site FOP1 (located just downstream and landward of the current tailrace monitoring site (Figure 2)) in Schneider and Wilhelms (2005),
- If regression is different, look for patterns that may explain the difference,
- Determine if any differences in the regression affect the predictions in Schneider and Wilhelms (2005) to meet TDG standards up to 7Q10 flows.

4.4 Determination of Compliance in Year 5

As per Section 5.4(1)(d) of the 401 Certification, in Year 5 of the effective date of the New License, Chelan PUD shall prepare a report summarizing the results of all TDG studies performed to date, and describing whether compliance with the numeric criteria has been attained.

This report was submitted as a Draft to Ecology and the RRFF on October 31, 2014 and the HCP CC on November 25, 2014. The HCP CC requested an additional 30 day comment period extending the final due date to Ecology on January 30, 2015. Ecology approved the extension and final due date. Comments were received and incorporated into the final report submitted to Ecology on January 30, 2015. Chelan PUD is awaiting Ecology's notification regarding the next actions.

SECTION 5: UPDATES TO THE GAS ABATEMENT PLAN

As per Section 5.4(3) of the 401 Certification, the GAP will be revised annually, to reflect any new or improved information and technologies, and submitted to Ecology for review and approval, by April 1 of the year of implementation.

Additionally, beginning in year 10, and every 10 years thereafter, the revised annual GAP shall include a review of reasonable and feasible gas abatement options to incrementally reduce TDG caused by the Project, in light of new information and technology. If any reasonable and feasible measures are identified, Chelan PUD shall present the data and analysis to the RRFF and develop an implementation plan. The implementation plan shall be included in the GAP for review and approval by Ecology.

SECTION 6: CONCLUSIONS

Pending approval by Ecology, implementation of the measures presented in this 2015 GAP are intended to ensure compliance with the Washington state water quality standards for TDG in the Columbia River at the Rocky Reach Project during the fish spill season while continuing to meet the fish passage and survival standards set forth in the Rocky Reach HCP and Anadromous Fish Agreement. This GAP will be updated annually to reflect any changes in implementation schedules, new or improved technologies, or TDG abatement measures.

SECTION 7: LITERATURE CITED

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- Steig, T.W., R. Adeniyi, and V. Locke. 1997. Hydroacoustic evaluation of the fish passage through the powerhouse, the spillway, and the surface collector at Rocky Reach Dam in the spring and summer of 1997. Report by Hydroacoustic Technology, Inc. to Chelan Co. PUD, Wenatchee, Wash.
- Washington State Department of Ecology (Ecology). 2006. Section 401 Water Quality Certification for the Rocky Reach Hydroelectric Project. Order# 3155 dated March 17, 2006.

APPENDIX A: ROCKY REACH HABITAT CONSERVATION PLAN

The Rocky Reach Habitat Conservation Plan can be found at:

http://www.midcolumbiahcp.org/RR_HCP.pdf

APPENDIX B: 2015 ROCKY REACH TDG OPERATIONAL PLAN

2015 Rocky Reach Operational Plan
for Total Dissolved Gas During Fish Spill Season

April 1 through August 31

(All spill between these dates is subject to the actions contained in this plan.)
(Applies only when not spilling for headwater control)

Protocol

1. If tailrace TDG average is greater than ***120% for the 6-hour average***
 - reduce spill by 3 kcfs
 - monitor for 1 hour
 - if the 6-hr average TDG >120%, reduce spill by another 2 kcfs
 - monitor for 1 hour
 - continue reducing spill by 2 kcfs until 6-hr average TDG is less than 120% for one full hour
 - **if after reducing spill to control TDG levels, TDG drops below 118% for one full hour, increase spill by 2 kcfs and monitor****

2. If tailrace TDG is greater than ***125% for 1 hr***
 - follow protocol outlined above, but instead, use **one-hour TDG levels of 125%** as the metric
 - continue until TDG is less than 125% for 1 hr and until the 6-hr average TDG <120%

If you receive a call from RI advising that the RI forebay is out of compliance (greater than 115%) and the RR forebay is 115% or less, reduce spill by 3 kcfs. Two hours after reducing spill, call RI to determine what the RI forebay gas levels are. If still above 115%, reduce spill another 2 kcfs. If after reducing spill for this reason, the Rock Island forebay drops to less than 113%, Rock Island will call again and advise. At this point, increase back to the hourly spill volume target by increasing spill in the reverse order it was decreased. For example, if to bring the RI forebay back into compliance, it was necessary to reduce spill by a total of 5 kcfs, begin by increasing spill by 2 kcfs, wait two hours, and call RI to determine what the forebay TDG levels are. If TDG is still below 115%, increase spill by 3 kcfs (back to the target volume in this case). This will allow for a ramping effect, rather than an open/shut effect which could bump the Rock Island forebay TDG levels back out of compliance (>115%).

**** Note:** It will not be necessary to monitor for one full hour after re-opening gates if it appears that TDG is approaching the upper threshold, rather, the procedure will repeat upon reaching the threshold. It is anticipated that in time, the operators will “get a feel” for how much change in TDG will occur as a result of opening or closing gates and it will be possible to hold the TDG around 118% or 119% or so. Once the operators have this down, instead of closing a gate entirely, it may only be necessary to close partially, and vice versa for the opening process.

APPENDIX C: OPERATIONS PLAN

FERC License Requirement (Article 402)

The 2015 Rocky Reach Operations Plan can be found at the following link:
http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/44507.pdf

APPENDIX D: 2010 QUALITY ASSURANCE PROJECT PLAN

Rocky Reach Water Quality Monitoring and Reporting

The 2010 Quality Assurance Project Plan can be found at:

http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/33937.pdf

APPENDIX E: 2014 GAS ABATEMENT ANNUAL REPORT

The 2014 Gas Abatement Annual Report can be found at:

http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/43948.pdf

APPENDIX F: RESPONSE TO COMMENTS

Ecology was sent a Draft Gas Abatement Plan for Rocky Reach on February 13, 2015 for review and comment. On March 13, 2015, Ecology sent Chelan PUD an email stating that they had reviewed and approved the Gas Abatement Plan. Both emails are included below.

From: [Steinmetz, Marcie](#)
To: ["McKinney, Charlie \(ECY\)"; "Coffin, Chris \(ECY\)"](#)
Cc: [Smith, Michelle](#); [Osborn, Jeff](#); [Sokolowski, Rosana](#); [Bitterman, Deborah](#)
Subject: Draft 2015 Gas Abatement Plans for Rocky Reach and Rock Island dams
Date: Friday, February 13, 2015 10:34:00 AM
Attachments: [44505 DRAFT 2015 Rocky Reach GAP 021015.docx](#)
[44506 DRAFT 2015 Rock Island GAP 021015.docx](#)

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

To: Chris Coffin, Washington Department of Ecology
Charlie McKinney, Washington Department of Ecology

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

Re: Rocky Reach Hydroelectric Project No. 2145 and Rock Island
Hydroelectric Project No. 943
DRAFT 2015 Total Dissolved Gas Abatement Plans

Please find attached the 2015 DRAFT Rocky Reach and Rock Island Total Dissolved Gas Abatement Plans for your review. Please submit your comments on or before 5:00 p.m., March 13, 2015 to me via email at marcie.steinmetz@chelanpud.org.

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

Thank you,

Marcie Steinmetz | Water Resource Specialist
Chelan County Public Utility District No.1 | 327 N. Wenatchee Ave. |
Wenatchee, WA 98801
509.661.4186 (w) | 509.280.1955 (c) | marcie.steinmetz@chelanpud.org

From: [McKinney, Charlie \(ECY\)](#)
To: [Steinmetz, Marcie](#)
Cc: [Coffin, Chris \(ECY\)](#)
Subject: Approvals for GAPS & OPS Plan
Date: Friday, March 13, 2015 9:55:49 AM
Importance: High

March 13, 2015

To: Marcie Steinmetz, Chelan PUD No. 1

From: Charles McKinney, WA Dept. of Ecology, Water Quality Program

The WA Department of Ecology (Ecology) has reviewed and approves the **Draft 2015 Total Dissolved Gas Abatement Plans submitted by Chelan PUD for the Rocky Reach and Rock Island Projects.**

Ecology has also reviewed and approves the **Draft 2015 Operations Plan for the Rocky Reach Project.**

Ecology grants Chelan PUD an adjustment to the 110% TDG standard for the purposes of the 2015 Spill Season, as authorized under WAC 173-201A-200(1)(f)(ii), in order to facilitate the passage of ESA listed salmonids at the Project.

Thank you for your cooperation. Please let me know if you have any questions.

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

APPENDIX G: ROCK ISLAND PROJECT GAP

2015 TOTAL DISSOLVED GAS ABATEMENT PLAN

FINAL

**ROCK ISLAND HYDROELECTRIC PROJECT
FERC Project No. 943**

April 2015



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

TERMS AND ABBREVIATIONS

401 Certification	Washington State Department of Ecology 401 Water Quality Certification
7Q10	highest seven consecutive day average flow with a 10-year recurrence frequency
cfs	cubic feet per second
Chelan PUD	Public Utility District No. 1 of Chelan County
CCT	Confederated Tribes of the Colville Indian Reservation
BPA	Bonneville Power Administration
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
FCRSP	Federal Columbia River Power System
FERC	Federal Energy Regulatory Commission
FPC	Fish Passage Center
FMS	fixed monitoring station
GAP	Gas Abatement Plan
GBT	gas bubble trauma
Grant PUD	Public Utility District No. 2 of Grant County
HCP	Habitat Conservation Plan
HCP CC	Habitat Conservation Plan Coordinating Committee
kcfs	thousand cubic feet per second
NMFS	National Marine Fisheries Service
MCHCA	Mid Columbia Hourly Coordination Agreement
Project	hydroelectric project
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RI HCP	Rock Island Habitat Conservation Plan
TDG	total dissolved gas
TMDL	total maximum daily load
UCR	Upper Columbia River
USACE	United States Army Corps of Engineers
USBR	United State Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WQMP	Water Quality Management Plan

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EXECUTIVE SUMMARY

This Total Dissolved Gas Abatement Plan (GAP) is being submitted to the Washington State Department of Ecology (Ecology) as required by Washington Administrative Code (WAC) 173-201A-200. This section of the WAC allows Ecology to temporarily adjust total dissolved gas (TDG) criteria to aid fish¹ passage past hydroelectric dams when consistent with an Ecology-approved gas abatement plan. Chelan County Public Utility District No.1 (Chelan PUD) has prepared this annual GAP to provide an overview of operational implementation actions Chelan PUD will take at the Project during 2015 to meet TDG requirements, while ensuring the fish passage requirements are met as set forth in the Rock Island Habitat Conservation Plan (HCP) and Anadromous Fish Agreement. This GAP includes plans for physical and biological monitoring and is accompanied by the fisheries management plan (HCP), TDG Operational Plan, the Quality Assurance Project Plan for Rocky Reach Water Quality Monitoring and Reporting, and the Gas Abatement Annual Report.

Washington State water quality standards provide for a temporary exemption for elevated TDG levels to allow increased fish passage without causing more harm to fish populations than caused by turbine fish passage. Washington state water quality standards provide different standards for total dissolved gas (TDG) during the non-fish and fish-spill seasons to aid fish passage. In Ecology's 401 Water Quality Certification (401 Certification) for the Rocky Reach Project, the non-fish spill season is defined as September 1 through March 31 and the fish-spill season is April 1 through August 31. Chelan PUD assumes these dates apply to Rock Island Dam as well. The following special fish passage exemptions for the Snake and Columbia Rivers apply when spilling water at dams is necessary to aid fish passage:

- TDG must not exceed an average of 115 percent as measured in the forebay of the next downstream dams and must not exceed an average of 120 percent as measured in the tailraces of each dam (these averages are measured as an average of the twelve highest consecutive hourly readings in any one day, relative to atmospheric pressure).
- A maximum TDG one hour average of 125 percent must not be exceeded during spill for fish passage.

The goal of the Rock Island Total Dissolved Gas Abatement Plan (GAP) is to implement measures to achieve compliance with the Washington state water quality standards for TDG in the Columbia River at the Project while continuing to meet the fish passage and survival standards set forth in the Rock Island HCP and Anadromous Fish Agreement. These plans are provided as Appendix A.

¹ Unless otherwise noted "fish" refers to downstream migrating juveniles.

To meet the above stated goal, Chelan PUD plans to implement the following applicable operational measures:

1. Minimizing voluntary spill.
2. During fish passage, managing voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria, using the TDG Operational Plan (Appendix B).
3. Minimizing spill, to the extent practicable, by scheduling maintenance based on predicted flows.
4. Avoiding spill by continuing to participate in the Hourly Coordination Agreement or any successor agreement to which Chelan PUD is a party, to the extent it reduces TDG.
5. Maximizing powerhouse discharge as appropriate up to hydraulic capacity.

Additionally, Chelan PUD proposes to implement the following measures:

1. Consult with Ecology if there are any non-routine operational changes that may affect TDG.
2. Monitor for TDG at Chelan PUD's fixed-site monitoring stations. TDG data will be collected on an hourly basis throughout the year and will be reported to U.S. Army Corps of Engineers Reservoir Control Center's website.
3. Prepare an annual report summarizing Chelan PUD's flow, TDG, gas bubble trauma (GBT) monitoring, and fish (could include juvenile and adult) study results, and, in accordance with the previous (2014) GAP, submit to Ecology by December 31.

SECTION 1: INTRODUCTION

Chelan PUD owns and operates the Project, located on the Columbia River approximately 12 miles downstream of the city of Wenatchee (Figure 1-1). The Project is licensed as Project No. 943 by the Federal Energy Regulatory Commission (FERC).

This GAP is being submitted to Ecology as a condition of the 2006 Special Fish Passage Exemption (WAC 173-201A-200(1)(f)). Chelan PUD respectfully submits this GAP with the goal of receiving a temporary exemption for TDG commencing with the 2015 fish¹ spill season. This GAP provides details associated with proposed 2015 operations and activities to achieve TDG standards, a review of any proposed structural TDG abatement measures and technologies, and physical and biological monitoring plans.

A 401 Certification for the operation of Chelan PUD's Rocky Reach Hydroelectric Project was issued by the Ecology on March 17, 2006. The 2015 Rock Island TDG monitoring and reporting will be conducted in a manner consistent with the TDG and Gas Abatement monitoring and reporting requirements within the Rocky Reach 401 Certification.

1.1 Project Description

Rock Island Project is owned and operated by Chelan PUD. The structure is 3,800 feet in length and is constructed from reinforced concrete. The dam is located at Columbia River mile 453.4, about 12 miles downstream from the city of Wenatchee. The Project contains a reservoir extending 21 miles upriver to the tailrace of Rocky Reach Dam and covers 3,300 acres. The Rock Island Project has no significant water storage capabilities. The normal maximum reservoir elevation of Rock Island Project is 613 feet with a tailrace elevation of 572 feet and a head of 41 feet. The Project discharges into a reservoir ponded by Wanapum Dam located 37.6 miles downstream.

The Project consists of two powerhouses. Powerhouse 1 is located on the east bank of the Project at a 45-degree angle from the bank. The powerhouse consists of 10 vertical shaft turbines with a rated output of 212 mega watts (MW). Powerhouse 2 is located on the west bank and is 470 feet wide, housing eight horizontal shaft turbines with a rated power output of 410 MW. The combined hydraulic capacity of both powerhouses is 220 thousand cubic feet per second (kcfs).

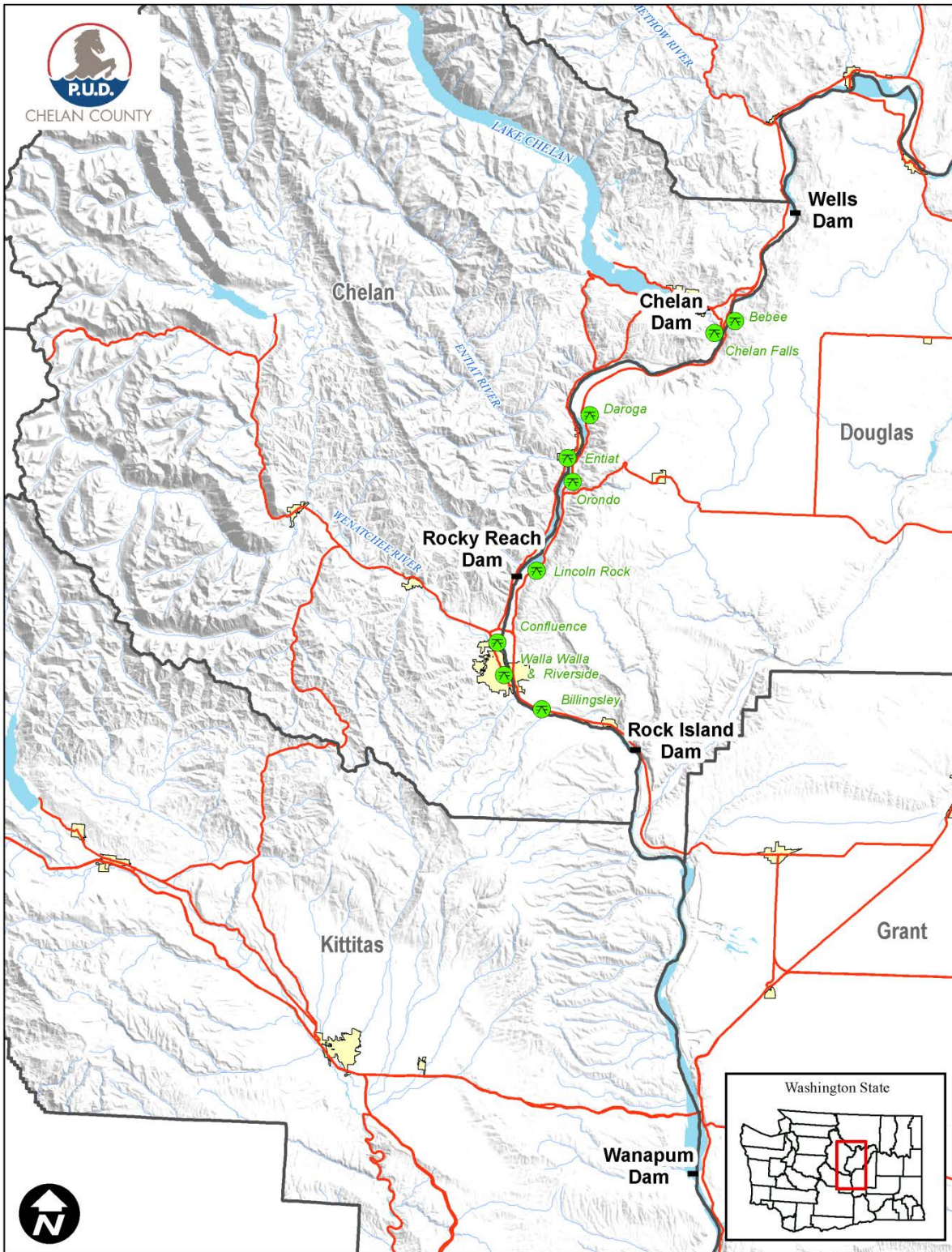


Figure 1-1: Location of Rock Island Hydroelectric Project on the Columbia River.

The Project configuration includes a spillway of 32 bays with a total length of 1,184 feet. Gates are separated by a middle adult fish ladder (located at bay 15) that divides the spillway into east and west sections. The west (Chelan County side) spillway consists of seven deep bays and ten shallow bays, and the east (Douglas County side) spillway consists of six deep bays and eight shallow bays. Each spillway has two or three crest gates, which are stacked one on top of the other. The crest gates are 30 feet wide and either 11 or 22 feet high. The larger crest gates are positioned closest to the water surface, and when fully raised, spill approximately 10 kcfs.

The deep bays have a sill elevation of 559 feet, which is about 13 feet below the average tailwater elevation of 572 feet. The shallow bays have a sill elevation of 581.5 feet, which is about 9.5 feet above the average tailwater elevation.

The focus of juvenile fish bypass at Rock Island Dam has been directed towards optimizing the efficiency of fish passage via spill. To achieve this, nine of the thirty-two spill bays have had their spill gates modified to provide surface spill. Surface spill was accomplished by putting notches in the upper sections of the spill gates. Six of the nine gates have notches that are 8 feet wide by 17 feet deep and can spill up to 2,500 cubic feet per second (cfs). The remaining gates have notches that are smaller and pass less volume (approximately 1,850 cfs). The total amount of water that can be passed through the notched gates is approximately 21,000 cfs. Three of the modified gates have had further modification and now have a “over-under” design which enables surface flow attraction and delivers water in the tailrace towards the surface, thus reducing the uptake of atmospheric gases.

1.2 River Flows

The climate of the Columbia Basin in eastern Oregon, Washington and British Columbia is best described as desert. The major portion of the precipitation experienced within the basin falls in the form of snow during the period of November through March of each year. Runoff usually occurs from mid-April through July, with the historical peak occurring during the month of June. Storage dams in the United States and Canada capture spring and summer high flows to hold for release in the winter months. A comparison of the 10 year average flows to 2014 flows at the Rock Island Project is shown below in Table 1-1.

Table 1-1: Comparison of 10 year average flows to 2014 flows at the Rock Island Project.

Season	10 Year Average Flows (2004-2013)	2014 Flows	% of 10 Year Average
Spring (4/1-5/23)	145.3	175	120.4
Summer (5/28-8/31)	151	157.8	Stet.

1.3 Regulatory Framework

1.3.1 Total Dissolved Gas Standards

The Washington State Administrative Code (WAC) water quality numeric criteria for TDG (WAC 173-201A-200(1)(f)) address standards for the surface waters of Washington State. Under

the water quality standards (WQS), TDG shall not exceed 110 percent at any point of measurement in any state water body. However, the TDG criteria may be adjusted to aid fish passage over hydroelectric dams when consistent with an Ecology approved gas abatement plan. This plan must be accompanied by fisheries management and physical and biological monitoring plans. Ecology may approve, on a per application basis, a temporary exemption to the TDG standard (110 percent) to allow spill for juvenile fish passage on the Columbia and Snake rivers (WAC 173-201A-200(1)(f)(ii)). On the Columbia and Snake rivers there are three separate standards with regard to the TDG exemption. First, in the tailrace of a dam, TDG shall not exceed 125 percent as measured in any one-hour period. Further, TDG shall not exceed 120 percent in the tailrace of a dam and shall not exceed 115 percent in the forebay of the next dam downstream as measured as an average of the 12 highest consecutive (12C-High) hourly readings in any one day (24-hour period). The increased levels of spill resulting in elevated TDG levels are intended to allow increased fish passage without causing more harm to fish populations than caused by turbine fish passage. This TDG exemption provided by Ecology is based on a risk analysis study conducted by the National Marine Fisheries Service (NMFS, 2000).

1.3.2 Fish-Spill Season

Section 5.4.2 of the Rocky Reach 401 Certification defines the fish-spill season as April 1 through August 31 of each year. Non-fish spill season is defined as September 1 through March 31. Chelan PUD has assumed these dates also apply to Rock Island Dam.

1.3.3 Incoming Total Dissolved Gas Levels

During the fish passage season, TDG concentrations in the Rock Island Project forebay are primarily determined by the upstream water management activities of upstream dams.

1.3.4 Flood Flows - 7Q10

WAC 173-201A-200(f)(i) states that the water quality criteria for TDG shall not apply when the stream flow exceeds the seven-day, ten-year frequency flood stage (7Q10). The 7Q10 flood flow for the Rock Island Project was calculated to be 264 kcfs (Pickett, et al., 2004).

1.3.5 Total Dissolved Gas Total Maximum Daily Load

In 2004, Ecology established a TDG Total Maximum Daily Load (TMDL) for the mid-Columbia River which set TDG allocations for each dam (Pickett, et al., 2004). Since special criteria have been established in Washington for “voluntary” spills for downstream migrating juvenile fish passage under an approved plan, the TMDL sets TDG loading capacities and allocations for the Mid-Columbia River and Lake Roosevelt, both in terms of percent saturation for fish passage and excess pressure above ambient for non-fish passage. Allocations are specified for each dam and for upstream boundaries. Fish passage allocations must be met at fixed monitoring stations. Non-fish passage allocations must be met in all locations, except for an area below each dam (other than Grand Coulee) from the spillway downstream to the end of the aerated zone. Attainment of allocations will be assessed at monitoring sites in each dam’s forebay and tailrace and at the upstream boundaries.

1.4 Project Operations

The Project is an integral part of the seven-dam Mid-Columbia River Hydroelectric System (Grand Coulee to Priest Rapids). Each of the seven dams is operated in accordance with the terms of the Mid-Columbia Hourly Coordination Agreement (MCHCA), which seeks to coordinate operations for all of the mid-Columbia Projects for the best use of flows for generation and to meet fishery (juvenile and adult) and other environmental resource needs.

Under the Hourly Coordination Agreement, power operations are coordinated to meet daily load requirements through the assignment of "coordinated generation" through Central Control hosted at the Public Utility District No. 2 of Grant County (Grant PUD). Automatic control logic is used to maintain pre-set reservoir levels in order to meet load requirements and minimize involuntary spill. These preset reservoir levels are maintained at each Project through management of a positive or negative "bias" which assigns a Project more or less generation depending on whether the reservoir elevation should be increased or decreased in order to maximize system benefits and minimize involuntary spill.

In addition to the HCA discussed above, the Project operates within the constraints of its FERC regulatory and license requirements, as well as the plans and agreements discussed below.

1.4.1 Habitat Conservation Plan

In 2004, the FERC amended the existing license to include the Anadromous Fish Agreement and HCP for the Rock Island Project. The HCP is a programmatic approach developed by Chelan PUD and the fishery agencies and tribes for reducing and eliminating the effects of the Rock Island Project on salmon and steelhead.

The Rock Island HCP (RI HCP) serves as the foundation for the fisheries management plan at Rock Island Dam. It fundamentally describes a 100 percent No Net Impact (NNI) concept with necessary outcomes required for mainstem passage, habitat improvement and protection, and hatchery programming. All measures proposed in the HCP are intended to minimize and mitigate impacts to the Plan species, to the "maximum extent practicable" as required by the Endangered Species Act. Plan species include: Upper Columbia River (UCR) steelhead, UCR yearling spring Chinook, UCR subyearling summer/fall Chinook, Okanogan River sockeye, and coho salmon. The RI HCP provides for optional tools Chelan PUD may implement to aid in juvenile fish passage past the Project, including, but limited to, spill and powerhouse operations. Chelan PUD implements these tools to aid in juvenile fish passage as necessary to ensure success toward NNI.

HCP Phase III (Standards Achieved) has been met for all spring migrants (spring/yearling Chinook, steelhead, and sockeye) at Rock Island under 10 percent spill operations.

1.4.2 Other International and Regional Agreements

The Columbia River is managed, and the Project is operated, for fish (juvenile and adult) habitat and flow by the following international and regional agreements:

- *Columbia River Treaty*: An agreement between Canada and the United States in which Canada has agreed to provide storage for improving flow in the Columbia River to maximize power and flood control.

- *Pacific Northwest Coordination Agreement*: An agreement among the U.S. Bureau of Reclamation (USBR), the Bonneville Power Administration (BPA), the U.S. Army Corps of Engineers (USACE), and 15 public and private generating utilities to maximize usable hydroelectric energy. Chelan PUD is a member of this agreement.
- *Mid-Columbia Hourly Coordination Agreement*: An agreement whereby the mid-Columbia PUDs (Chelan, Douglas, and Grant), the Corps, the USBR, and BPA coordinate operations in order to maximize the output of hydroelectric power. Effects have included reducing forebay elevation fluctuations and spill.
- *The Federal Columbia River Power System (FCRPS) Biological Opinion*: by NMFS, applies to actions by the Corps, the USBR, and BPA for impacts on Endangered Species Act (ESA) listed salmon and steelhead on the Columbia River system. A Technical Management Team sets flow releases and other operations of the FCRPS that determines the daily and weekly flows that will pass through the Project.
- *Hanford Reach Fall Chinook Protection Program Agreement*: The three mid-Columbia PUDs, NOAA Fisheries, Washington Department of Fish and Wildlife (WDFW), U.S. Fish and Wildlife Service (USFWS), Confederated Tribes of the Colville Indian Reservation (CTT), and BPA have agreed to river flow management actions to support Grant PUD's effort to manage flow in the Hanford Reach to protect fall Chinook salmon redds and pre-emergent fry during the spawning to emergence periods (typically October to May).

1.4.3 Spill Operations

It is recognized that achieving regulatory TDG levels may not be possible during spill associated with large flood (7Q10) events. However, at Rock Island Dam it may be possible to achieve current regulatory TDG levels during releases for fish bypass and up to the 7Q10 flows (264 kcfs) by selective operation of spillway bays. The Rock Island Project is unique due to the diversity of variations in how flow is released, which may assist in the development of spill scenarios that could result in a reduction of gas in the tailrace.

There are six main scenarios that may result in spill at Rock Island Dam. These are, but are not limited to:

Fish Spill

As part of the Rock Island HCP, Chelan PUD is required to meet survival standards for fish migrating through the Projects. Juvenile dam passage survival is a key component of Project survival. At Rock Island, spill is still the preferred method of moving fish past the Project, with most of the spill being passed through the modified "notched" spill gates. Results of survival studies conducted at Rock Island have enabled Chelan PUD to reduce voluntary (fish) spill in the spring from 20 percent of the daily average flow to 10 percent of the daily average flow. Summer spill at Rock Island remains at 20 percent of the daily average flow. This summer spill was level was set by the HCP in 2002 and will remain at 20 percent until such time Chelan PUD is able to test survival of subyearling (summer) Chinook. To date, Chelan PUD has not been able to test survival due to tag technology limitations and uncertainties regarding the life history (migration

behavior) of subyearling Chinook. The 20 percent spill level must be maintained until tag technology becomes available that will enable us to accurately measure survival at the current spill level.

Spring Fish Spill Operations

HCP Phase III (Standards Achieved) has been met for all spring migrants (spring/yearling Chinook, steelhead, and sockeye) at Rock Island under 10 percent spill operations. Chelan PUD will continue spilling 10 percent through the spring migration. Spring fish spill will begin no later than April 17 and will continue until the end of the spring outmigration (95 percent passage point), and subyearling Chinook have arrived at the Project.

Summer Fish Spill Operations

Summer spill at Rock Island for subyearling Chinook will be 20 percent of day average flow over 95 percent of the summer outmigration. Summer spill will commence after the completion of spring spill. Summer spill for subyearling Chinook generally ends no later than August 15 when 95 percent of the migration of subyearling Chinook has passed the Project.

Due to tag technology limitations and uncertainties regarding their life history (outmigration behavior) no survival studies for subyearling Chinook have been conducted since 2004, nor are any planned at this time.

Additional information about the HCP standards, including annual progress reports are included in Appendix A of this GAP.

Flow in Excess of Hydraulic Capacity

The minimal storage and limited hydraulic capacity of the Project occasionally force Chelan PUD to spill water past the Project. This spill is required to maintain headwater elevations within the limits set by the Project's FERC license, to prevent overtopping of the Project, and to maintain optimum operational conditions. With this type of release, flows up to, and in excess of the 7Q10 flood flows (264 kcfs) can be accommodated. To reduce negative impacts of flow in excess of hydraulic capacity Chelan PUD completed and implemented a TDG Operational Plan. This plan is attached as Appendix B. Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Plant Load Rejection Spill

This type of spill occurs when the plant is forced off line by an electrical fault, which trips breakers, or any activity forcing the units off line. This is an emergency situation and generally requires emergency spill. When the units cannot pass flow, the flow must be passed by other means, such as spill, to avoid overtopping the dam. During emergency spill, Chelan PUD will implement the TDG Operational Plan. This plan is attached as Appendix B.

Immediate Replacement Spill

Immediate replacement spill is used to manage TDG levels throughout the Columbia River basin. The Technical Management Team (including NMFS, USACE, and BPA) manages this spill. Immediate replacement spill occurs when TDG levels are significantly higher in one river

reach than they are in another reach. To balance the TDG levels throughout the basin, spill is reduced and generation increased in the reach with high TDG levels and the energy is transferred to reaches with lower TDG levels where spill is increased. The result is higher generation in the reaches with high TDG levels, increased spill in reaches with lower TDG levels, and equal distribution of TDG levels throughout the basin.

To control TDG levels that may result from immediate replacement spill, Chelan PUD will implement the TDG Operational Plan (Appendix B).

Maintenance Spill

Maintenance spill is utilized for any maintenance activity that requires spill to assess the routine operation of individual spillways and turbine units. These activities include forebay debris flushing, checking gate operation, gate maintenance, and all other maintenance that would require spill. The Federal Energy Regulatory Commission requires that all spillway gates be operated once per year. This operation requires a minimal amount of spill for a short duration annually and is generally accomplished in conjunction with fish passage spill operations.

To control TDG levels that may result from maintenance spill, Chelan PUD will implement the TDG Operational Plan (Appendix B). Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Error in Communication Spill

Error in communication with the USACE Reservoir Control Center, including computer malfunctions or human error in transmitting proper data, can contribute to spill. Hourly coordination between hydroelectric projects on the river minimizes this type of spill, but it does occur occasionally.

To control TDG levels that may result from error in communication spill, Chelan PUD will implement the TDG Operational Plan (Appendix B). Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

Reduced Generation Spill

Reduced electric demand on the system can, at times, result in the need to spill water at run-of-the-river projects such as Rock Island. Hourly coordination between hydroelectric projects on the river can minimize this type of spill, but it does occur.

To control TDG levels that may result from reduced generation spill, Chelan PUD will implement the TDG Operational Plan (Appendix B), when possible. Chelan PUD anticipates implementation of the TDG Operational Plan to be an operational function, requiring no structural modification to the Project.

1.5 Spill and Total Dissolved Gas Compliance - Previous Year 2014

1.5.1 TDG Compliance 2014

Information regarding spill and TDG are for 2014 are displayed in Tables 1-2 and 1-3 and further described below.

Tailrace 120 percent Standard

TDG data was collected on 146 days during the 2014 fish spill season in the Rock Island tailrace. No days were omitted from the data set used for determination of compliance due to flows exceeding the 7Q10 flows. The tailrace 12C-High TDG exceeded 120 percent on 7 days. Compliance with this standard was 95.2 percent.

Tailrace 125 percent Standard

Total hours of TDG data collected during the 2014 fish spill season in the Rock Island tailrace equaled 3,654. No hours were omitted from the data set due to flows in exceedance of the 7Q10 flow. Hourly tailrace TDG levels exceeded 125 percent for 0 hours. Compliance with this standard was 100 percent.

Downstream (Wanapum) Forebay 115 percent Standard

TDG data was collected on 153 days during the 2014 fish spill season in the Wanapum forebay. However, of those 153 days 5 were omitted from the data set used for determination of compliance due upstream forebay 12C-High TDG exceeding 115 percent. The Wanapum forebay 12C-High TDG exceeded 115 percent on 24 days. Compliance with this standard was 84.3 percent.

Table 1-2: Summary of Spill at the Rock Island Project in 2014

Date	Fish Spill Average kcfs	Total Spill Average kcfs	River Flow Average kcfs	% Total Spill	% Fish Spill of total River	% Fish spill of Total Spill
4/1 – 8/31	23.5	31.6	156.2	20.2	15.0	74.4

Table 1-3: Summary of TDG Compliance at the Rock Island Project in 2014

Date	% Compliance with 120% Tailrace Standard	% Compliance with 125% Tailrace Standard	% Compliance with 115% Downstream Forebay TDG Standard
4/1 – 8/31	95.2	100	84.3

1.5.2 TDG Activities Implemented in 2014

In 2014 Chelan PUD implemented five actions to minimize voluntary and involuntary spill at Rock Island in order to meet TDG water quality standards. The primary operational action to reduce spill at the Rock Island Project was the implementation of the operational spill programs and the ability to minimize spill through success of survival studies. These efforts included:

- Minimizing voluntary spill.
- During fish passage, managing voluntary spill levels in real time to meet TDG numeric criteria.
- Minimizing spill, to the extent practicable, by scheduling maintenance based on predicted flows.
- Avoiding spill by continuing to participate in the Hourly Coordination Agreement.
- Maximizing powerhouse discharge as appropriate up to hydraulic capacity.

1.5.3 TDG Structural Measures Implemented in 2014

No structural gas abatement measures were proposed or constructed in 2014. However, Chelan PUD continues to utilize the over/under gates that were installed in 2007 to reduce TDG generation at the Project.

SECTION 2: PROPOSED 2015 ACTION PLAN TO ACHIEVE TDG STANDARDS

The following sections describe TDG abatement measures proposed for implementation during 2015 to achieve compliance with TDG water quality standards.

2.1 Operational TDG Abatement Measures

Chelan PUD will manage spill toward meeting water quality criteria for TDG during all flows below 7Q10 levels, but only to the extent consistent with meeting the passage and survival standards sets forth in the HCP and associated Anadromous Fish Agreement. During the 2015 fish spill season, Chelan PUD proposes to use a combination of the following measures as needed to meet water quality criteria for TDG:

1. Minimize voluntary spill
Success of the survival studies have allowed Chelan PUD to reduce spring spill required for fish passage.
2. Manage voluntary spill in real time
During fish passage, manage voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria,
3. Minimize involuntary spill
Minimize involuntary spill, to the extent practicable, by scheduling maintenance based on predicted flows.
4. Participate in Hourly Coordination Agreement
Chelan PUD endeavors to avoid involuntary spill by continuing to participate in the Hourly Coordination Agreement, or any successor agreement to which Chelan PUD is a party, to the extent it reduces TDG.
5. Maximize powerhouse discharge as appropriate up to hydraulic capacity

Operational and structural changes that may affect TDG must be subject to review and approval by Ecology during the design and development phase to assure that such changes incorporate consideration of TDG abatement, when appropriate.

2.2 Proposed Structural TDG Abatement Measures and Technologies

No structural gas abatement measures are planned at the Rock Island Project in 2015. Chelan PUD will continue to monitor and investigate the feasibility of implementing new technologies as they become available.

SECTION 3: PHYSICAL AND BIOLOGICAL MONITORING AND QUALITY ASSURANCE

The following sections describe Chelan PUD's TDG compliance monitoring program. The program includes a fixed-site monitoring program and a quality assurance protection plan.

3.1 Fixed-Site Monitoring Stations for TDG

Chelan PUD currently maintains two fixed monitoring stations (FMS) at the Rock Island Project to monitor hourly TDG levels annually from April through August. The fixed monitoring stations are installed to a depth of approximately 15 feet. This depth varies as the forebay and tailrace river elevations fluctuate with river flows. This depth variation is not expected to affect the accuracy of the TDG readings because the instruments are located below the depth where gas bubbles form on the membrane and are deep enough in the water column to not be affected by near surface temperature gradients.

The Rock Island forebay fixed monitoring station (Figure 3-1) is affixed to the Project, located on the west side of the river, near the right bank fishway and Powerhouse 2, approximately 70 feet from the shore. The standpipe is installed to a depth of approximately 15 feet, though this depth varies as the forebay river elevation fluctuates with river flows and project operations. The site was chosen based on accessibility and is thought to be representative of forebay TDG because water is as well mixed and flow is as constant as at any other location in the forebay. No bridge or other permanent in-water structure is available downriver of Rock Island Project on which to attach a monitoring station. For this reason, Chelan PUD developed a monitoring station about 1.5 miles downriver from the Project on the eastern shoreline (Figure 3-2). This FMS has two means of deploying the dissolved gas probe, a carriage system with a cable attached to an ecology block in the river, and a fixed pipe attached to the scaffold that holds the carriage system.

Chelan PUD has entered into a Professional Services Agreement with Columbia Basin Environmental (CBE) to perform calibrations and equipment maintenance during the 2015 monitoring season. Calibration and equipment maintenance will be conducted monthly during the fish spill season, and every other month during the non-fish spill season. It is anticipated at this time that Chelan PUD will continue to contract with CBE into the future. QA/QC measures will be accomplished through training in instrument maintenance, operation, and factory prescribed calibration methods. A detailed log will be maintained for all work done on the monitoring equipment, including monthly maintenance, calibration, exchange of instruments, and any other pertinent information. Redundant measurements with a mobile instrument to verify the accuracy of the in-situ instruments will be conducted during the calibrations.



Figure 3-1: Location of forebay fixed monitoring station at Rock Island Hydroelectric Project.



Figure 3-2: Location of tailrace fixed monitoring station below Rock Island Hydroelectric Project.

3.1.1 Fish Spill Season (April 1 – August 31)

TDG measurements will be recorded throughout the fish spill season at 15-minute intervals, enabling plant operators to adjust spill volumes to maintain gas levels to prevent exceedances of the TDG criteria. These 15-minute intervals will be averaged into hourly readings for use in compiling daily and 12-hour averages. Beginning on April 1 all hourly data will be forwarded to Chelan PUD headquarters building and then onto the USACE Reservoir Control Center at: http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/, where the data is posted on a nearly hourly basis.

3.1.2 Non-Fish Spill Season (September 1 – March 31)

TDG measurements will also be recorded throughout the non-fish spill season at 15-minute intervals. These 15-minute intervals will be averaged into hourly readings for use in determining daily high TDG levels. All hourly data will be forwarded to Chelan PUD headquarters building and then onto the USACE Reservoir Control Center at: http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/, where the data is posted on a nearly hourly basis.

3.2 Quality Assurance

Chelan PUD has developed its Quality Assurance/Quality Control (QA/QC) protocols following established protocols by other resource agencies conducting similar monitoring programs, such as the USGS, USACE, and other mid-Columbia River Dam operators, as well as HydroLab Corporation's recommendations. These QA/QC protocols are included in Chelan PUD's Quality Assurance Project Plan (Appendix D) per Section 5.7(2) of the Rocky Reach 401 Certification.

3.3 Biological (Gas Bubble Trauma) Monitoring Plan

Chelan PUD, in conjunction with the Fish Passage Center (FPC), will continue to conduct GBT monitoring at the Rock Island Bypass Trap. Random samples of 100 spring chinook, steelhead and subyearling chinook will be examined two days per week during the sampling season (April 1 to August 31). Examinations for GBT symptoms will follow a standardized FPC protocol (FPC, 2009). The results of this monitoring effort will be included in the Gas Abatement Annual Report (see Section 4.3 below).

SECTION 4: TDG COMPLIANCE REPORTING METHODS

4.1 Water Quality Web-Site

TDG information will be made available to the public via Chelan PUD's website, as close to the time of occurrence as technologically feasible. Chelan PUD has added a link to the website to direct the public to the USACE Reservoir Control Center at: http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/, where the data is posted on a nearly hourly basis.

4.2 Notifications

Chelan PUD shall notify Ecology, Central Regional Office, Water Quality Program within 48 hours (either before or after) of any TDG spill; this includes the start of spill for fish, as defined in Section 1.2.1, and any deviation from the TDG Operational Plan or the fish spill plan that adversely affects TDG levels. This notification may be either electronic or by letter.

4.3 Gas Abatement Annual Report

Chelan PUD will provide Ecology with a draft TDG annual monitoring report by October 31 of each year for initial review and comment. Chelan PUD will submit the final report by December 31 of that same year. The TDG Annual Monitoring Report will include:

- Flow over the preceding year (cfs over time);
- Spill over the preceding year (cfs and duration);
- Reasons for spill (e.g. for fish, turbine down time);
- TDG levels during spill (hourly)(to include fish spill season and non-fish spill season);
- Summary of exceedances and what was done to correct the exceedances;
- Results of the fish passage efficiency (FPE) studies and survival per the HCP;
- Result of biological monitoring (GBT) at Rock Island Bypass Trap (conducted in conjunction with the Fish Passage Center);
- Results of QA/QC implementation

SECTION 5: UPDATES TO THE GAS ABATEMENT PLAN

Consistent with WAC 173-201A-200(1)(f)(ii), the GAP will be revised annually, to reflect any new or improved information and technologies, and submitted to Ecology for review and approval, by April 1 of the year of implementation.

SECTION 6: CONCLUSIONS

Pending approval by Ecology, implementation of the measures presented in this 2015 GAP are intended to ensure compliance with the Washington state water quality standards for TDG in the Columbia River at the Rock Island Project during the fish spill season while continuing to meet the fish passage and survival standards set forth in the Rock Island HCP and Anadromous Fish Agreement. This GAP will be updated annually to reflect any changes in implementation schedules, new or improved technologies, or TDG abatement measures.

SECTION 7: LITERATURE CITED

- Fish Passage Center (FPC). 2009. GBT monitoring program protocol for juvenile salmonids. FPC, Portland, OR.
- National Marine Fisheries Service (NMFS). 2000. Endangered Species Act – Section 7 Consultation: Biological Opinion. Consultation on Remand for Operation of the Columbia River Power System and 19 Bureau of Reclamation Projects in the Columbia Basin. F/NWR/2004/00727. November 30, 2005. Pages 5-6, 5-7, 5-53, 10-9, and Appendix E: Risk Analysis.
- Pickett, P.J., H. Rueda, and M. Herold. 2004. Total Maximum Daily Load for Total Dissolved Gas in the Mid-Columbia River and Lake Roosevelt. Submittal Report. Prepared jointly by the U.S. Environmental Protection Agency and the Washington State Department of Ecology in cooperation with the Spokane Tribe of Indians. Ecology Publication Number 04-03-002. June 2004.
- Washington State Department of Ecology (Ecology). 2006. Section 401 Water Quality Certification for the Rocky Reach Hydroelectric Project. Order# 3155 dated March 17, 2006.

APPENDIX A: ROCK ISLAND HABITAT CONSERVATION PLAN

The Rock Island Habitat Conservation Plan can be found at:

http://www.midcolumbiahcp.org/RI_HCP.pdf)

APPENDIX B: 2015 ROCK ISLAND TDG OPERATIONAL PLAN

2015 Rock Island TDG Operational Plan

During Fish Spill Season (April 1 through August 31)

(All spill between these dates is subject to the actions contained in this plan.)

Protocol

1. If tailrace TDG average is greater than ***120% for the 6-hour average***
 - monitor for 2 hours, re-check 6-hour average
 - if TDG >120% for 6-hr average, shift spill from gate 20 to 27
 - monitor for 2 hours, re-check 6-hour average
 - if TDG >120% for 6-hr average, open gate 20 and close 2 notched gates (closure order is listed below)
 - monitor for 2 hrs; re-check 6-hour average
 - if TDG >120% for 6-hr average, close two more notched gates
 - **if after closing gates to control TDG levels, the TDG 1-hr average drops below 118%, reopen notched gates in the reverse order of closure**

Order of notched gate closure: **29, 24, 18, 16**

2. If tailrace TDG is greater than ***125% for 1 hr***
 - follow protocol outlined above, but instead, use **one-hour TDG levels of 125%** as the metric
 - continue until TDG is less than 125% for 1 hr and until the 6-hr average TDG <120%
3. If forebay TDG exceeds 115% for greater than one hour, call Rocky Reach and advise that the RI forebay is out of compliance. Rocky Reach will then reduce spill, but only if the RR forebay TDG is 115% or less. Once RI forebay TDG levels reduce to 113% call RR again so that they may return to previous spill operations.
4. If it becomes necessary to implement any further actions to attain TDG compliance, **please contact Thad Mosey (661-4451, cell 670-5594) and Marcie Steinmetz (661-4186, cell (509) 280-1955) immediately** so they can determine the next steps to take.

**** Note:** It will not be necessary to monitor for one full hour after re-opening if it appears that TDG is approaching the upper threshold, rather, the procedure will repeat upon reaching the threshold. It is anticipated that in time, the operators will “get a feel” for how much change in TDG will occur as a result of opening or closing gates and it will be possible to hold the TDG around 118% or 119% or so. Once the operators have this down, instead of closing a gate entirely, it may only be necessary to close partially and vice versa for the opening process.

APPENDIX C: 2010 QUALITY ASSURANCE PROJECT PLAN

Rocky Reach Water Quality Monitoring and Reporting

The 2010 Quality Assurance Project Plan can be found at:

http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/33937.pdf

APPENDIX D: 2014 GAS ABATEMENT ANNUAL REPORT

The 2014 Gas Abatement Annual Report can be found at:

http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/43948.pdf

APPENDIX E: RESPONSE TO COMMENTS

Ecology was sent a Draft Gas Abatement Plan for Rock Island on February 13, 2015 for review and comment. On March 13, 2015, Ecology sent Chelan PUD an email stating that they had reviewed and approved the Gas Abatement Plan. Both emails are included below.

From: [Steinmetz, Marcie](#)
To: ["McKinney, Charlie \(ECY\)"; "Coffin, Chris \(ECY\)"](#)
Cc: [Smith, Michelle](#); [Osborn, Jeff](#); [Sokolowski, Rosana](#); [Bitterman, Deborah](#)
Subject: Draft 2015 Gas Abatement Plans for Rocky Reach and Rock Island dams
Date: Friday, February 13, 2015 10:34:00 AM
Attachments: [44505 DRAFT 2015 Rocky Reach GAP 021015.docx](#)
[44506 DRAFT 2015 Rock Island GAP 021015.docx](#)

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

To: Chris Coffin, Washington Department of Ecology
Charlie McKinney, Washington Department of Ecology

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

Re: Rocky Reach Hydroelectric Project No. 2145 and Rock Island
Hydroelectric Project No. 943
DRAFT 2015 Total Dissolved Gas Abatement Plans

Please find attached the 2015 DRAFT Rocky Reach and Rock Island Total Dissolved Gas Abatement Plans for your review. Please submit your comments on or before 5:00 p.m., March 13, 2015 to me via email at marcie.steinmetz@chelanpud.org.

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

Thank you,

Marcie Steinmetz | Water Resource Specialist
Chelan County Public Utility District No.1 | 327 N. Wenatchee Ave. |
Wenatchee, WA 98801
509.661.4186 (w) | 509.280.1955 (c) | marcie.steinmetz@chelanpud.org

From: [McKinney, Charlie \(ECY\)](#)
To: [Steinmetz, Marcie](#)
Cc: [Coffin, Chris \(ECY\)](#)
Subject: Approvals for GAPS & OPS Plan
Date: Friday, March 13, 2015 9:55:49 AM
Importance: High

March 13, 2015

To: Marcie Steinmetz, Chelan PUD No. 1

From: Charles McKinney, WA Dept. of Ecology, Water Quality Program

The WA Department of Ecology (Ecology) has reviewed and approves the **Draft 2015 Total Dissolved Gas Abatement Plans submitted by Chelan PUD for the Rocky Reach and Rock Island Projects.**

Ecology has also reviewed and approves the **Draft 2015 Operations Plan for the Rocky Reach Project.**

Ecology grants Chelan PUD an adjustment to the 110% TDG standard for the purposes of the 2015 Spill Season, as authorized under WAC 173-201A-200(1)(f)(ii), in order to facilitate the passage of ESA listed salmonids at the Project.

Thank you for your cooperation. Please let me know if you have any questions.

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

APPENDIX H: COMMENTS

From: [McKinney, Charlie \(ECY\)](#)
To: [Steinmetz, Marcie](#)
Cc: [Peterschmidt, Mark F. \(ECY\)](#)
Subject: RE: DRAFT 2015 Total Dissolved Gas Annual Report
Date: Wednesday, November 25, 2015 12:16:13 PM

November 25, 2015

To: Marcie Steinmetz, Public Utility District No. 1 of Chelan County

From: Charlie McKinney, WA Department of Ecology

Thank you for the Draft 2015 Total Dissolved Gas Annual Report for the Rocky Reach (FERC Proj. No. 2145) and Rock Island (FERC Proj. No. 943) Hydroelectric Projects. Ecology has reviewed the Report and hereby gives our approval. We have determined that this Report complies with the requirement in the Section 401 Water Quality Certifications for these projects.

Please contact me if you have any questions.

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