Sokolowski, Rosana

From: Frantz, Waikele M.
Sent: Thursday, March 29, 2012 11:36 AM
To: Sokolowski, Rosana; Bitterman, Deborah
Subject: FW: FINAL 2012 Gas Abatement Plans
Attachments: Response to Comments on the Draft Rocky Reach Gas Abatement Plan.docx; Final 2012 Rock Island GAP.docx; Final 2012 Rocky Reach GAP.docx; Response to Comments on the Draft Rock Island Gas Abatement Plan.docx

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From: Frantz, Waikele M.
Sent: Thursday, March 29, 2012 11:36 AM
To: 'Irle, Pat (ECY)'
Cc: McKinney, Charlie (ECY); Smith, Michelle
Subject: FINAL 2012 Gas Abatement Plans

PUBLIC UTILITY DISTRICT NO. 1 of CHELAN COUNTY
P.O. Box 1231, Wenatchee, WA 98807-1231 • 327 N. Wenatchee Ave., Wenatchee, WA 98801
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To: Pat Irle, Washington Department of Ecology
Charlie McKinney, Washington Department of Ecology

From: Waikele Frantz, Environmental Permit Coordinator
Public Utility District No. 1 of Chelan County (Chelan PUD)

Re: Rocky Reach Hydroelectric Project No. 2145 and Rock Island Hydroelectric Project No. 943
Final 2012 Total Dissolved Gas Abatement Plans

Thank you for your comments on the DRAFT 2012 Gas Abatement Plans and the phone conversation yesterday. The comments you provided have been incorporated into the plans and/or addressed in the attached response summaries.

Please find the FINAL GAPs attached, along with a response summary for each GAP.

Thank you,
Waikele Frantz
509-661-4627

Hi, Pat.
Have a great afternoon,

Waikele

ROCKY REACH
HYDROELECTRIC PROJECT
FERC No. 2145

2012

TOTAL DISSOLVED GAS ABATEMENT PLAN

Prepared by:

Waikele Hampton
Public Utility District No. 1 of Chelan County
Wenatchee, WA 98801

FINAL
March 29, 2012

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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 TDG criteria to aid fish 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 2012 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 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 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% as measured in the forebay of the next downstream dams and must not exceed an average of 120% 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% must not be exceeded during spill for fish passage.

The goal of the Rocky Reach 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 Rocky Reach HCP and Anadromous Fish Agreement. These plans are provided as Appendix A.

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 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 kcfs.
6. Implementing alternative spillway operations, using any of gates 2 to 12, to determine, in consultation with the Rocky Reach Fish Forum (RRFF) and HCP Coordinating Committee, whether TDG levels can be reduced without adverse effects on fish passage. If effective, implementing alternative spillway operations 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 U.S. Army Corps of Engineers Reservoir Control Center's website.
3. Prepare an annual report summarizing Chelan PUD's flow, TDG, GBT monitoring, and fish study results, and, in accordance with the previous (2011) GAP, submit to Ecology by December 31.

1. INTRODUCTION

Public Utility District No. 1 of Chelan County (Chelan PUD) owns and operates the Rocky Reach Hydroelectric Project (Project), located on the Columbia River downstream of Wells Dam (Figure 1). The Project is licensed as Project No. 2145 by the Federal Energy Regulatory Commission (FERC). The 401 Water Quality Certification (401 Certification) for the Project was issued by the Washington State Department of Ecology (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 total dissolved gas abatement plan (GAP) in accordance with Ecology's water quality standards for total dissolved gas (TDG) by 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 2012 fish spill season. This GAP provides details associated with proposed 2012 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 sub-surface cutoff 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 authorized installed capacity is 865.76 megawatts.

The Project contains an upstream fish passage facility consisting of a fish ladder located downstream of the forebay wall with three entrances, and a juvenile bypass system (JBS) which began operation in 2003 to provide downstream fish passage for juvenile salmon and steelhead. 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.

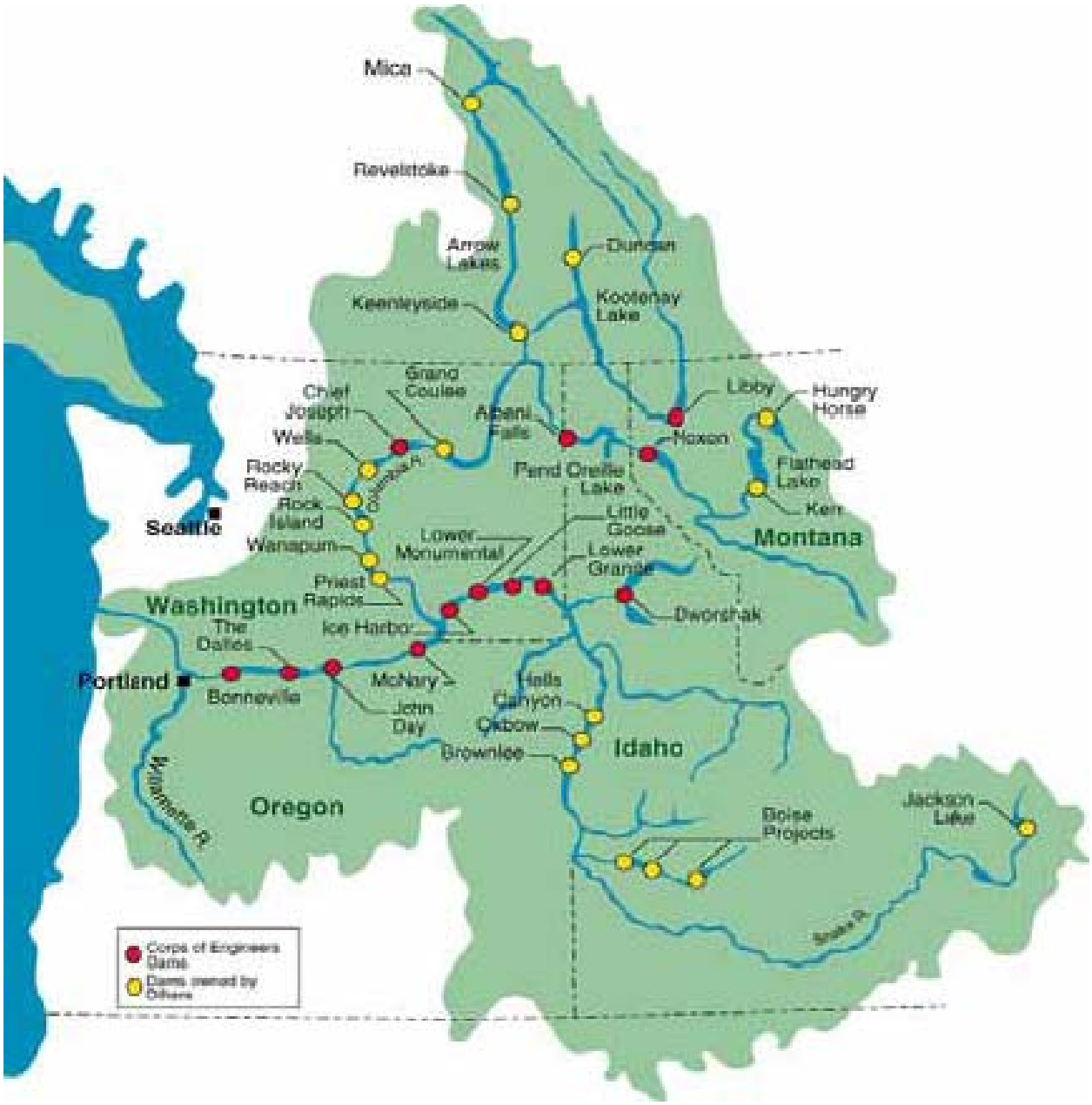

Figure 1. Location of Rocky Reach Hydroelectric Project on the Columbia River.

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 U.S. 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 2011 flows at the Rocky Reach Project is shown below.

Table 1. Comparison of 10-yr average flows to 2011 flows at the Rocky Reach Project.

Season	***10-yr ave flows (2001-2010)***	***2011 flows***	***% of 10-yr average***
Spring	115.5 kcfs	182.35 kcfs	155.88%
Summer	120.4 kcfs	202.8 kcfs	168.46%

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 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, 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 juvenile 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. The 7Q10 flood flow for the Rocky Reach Project was calculated to be 252 kcfs.

1.3.5 Total Dissolved Gas Total Maximum Daily Load

In 2004, WDOE established a TDG Total Maximum Daily Load (TMDL) for the mid-Columbia River which set TDG allocations for each dam (WDOE 2004). Since special criteria have been established in Washington for "voluntary" spills for 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 (HCA), which seeks to coordinate operations for all of the mid-Columbia projects for the best use of flows for generation and to meet fishery 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 2012 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 Operating Plan includes the following: (a) descriptions of fisheries 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 Rocky Reach 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 Rocky Reach Project on salmon and steelhead.

The Rocky Reach HCP (RR HCP) serves as the foundation for the fisheries management plan at Rocky Reach Dam. It fundamentally describes a 100% 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 RR 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 Juvenile Fish Bypass System (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 (with no spill).

1.4.3 Other International and Regional Agreements

The Columbia River is managed, and the Project is operated, for fish 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 (Corps), 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 NOAA Fisheries, 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, 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

The standard spill configuration used at Rocky Reach uses gates 2-8 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 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 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. The effect of different spill patterns on TDG may need to be reevaluated in the future if TDG standards cannot be met.

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

Fish Spill - Spill is an ineffective method of bypassing 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 fish passage at the Rocky Reach Project. The JBS does not require spill for its operation.

Spring Fish Spill Operations- Operating the JBS exclusively, *with no spill*, 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 2012.

Summer Fish Spill Operations- Summer spill at Rocky Reach for subyearling Chinook will be 9% 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% 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, US Army Corps of

Engineers, and Bonneville Power Administration) 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 U.S. Army Corps 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 (2011)

1.5.1 TDG Compliance 2011

Rocky Reach Tailrace 120% Standard

TDG data was collected on 153 days during the 2011 fish spill season in the Rocky Reach tailrace. However, of those 153 days 73 were omitted from the data set used for determination of compliance due to flows exceeding the 7Q10 flows or upstream forebay 12C-High TDG exceeding 115% .Of the remaining 80 days when flows were below the 7Q10 flow and the upstream forebay 12C-High TDG was below 115%, the tailrace 12C-High TDG exceeded 120% on **0 days**.

Compliance with this standard was 100%.

Rocky Reach Tailrace 125% Standard

Total hours of TDG data collected during the 2011 fish spill season in the Rocky Reach tailrace equaled 3,665. Of these 3,665 hours; however, 1,679 hours were omitted from the data set due to flows in exceedance of the 7Q10 flow or hourly forebay levels exceeding 115%. Of the remaining 1,986 hours when flows were below the 7Q10 flow and hourly forebay TDG <115%, hourly tailrace TDG levels exceeded 125% **for 0 hours**.

Compliance with this standard was 100%.

Downstream (Rock Island) Forebay 115% Standard

TDG data was collected on 153 days during the 2011 fish spill season in the Rock Island forebay. However, of those 153 days 73 were omitted from the data set used for determination of compliance due to flows exceeding the 7Q10 flows or upstream forebay 12C-High TDG exceeding 115% . Of the remaining 80 days when flows were below the 7Q10 flow and the upstream forebay 12C-High TDG was below 115%, the Rock Island forebay 12C-High TDG exceeded 115% on **one day**, July 29.

Compliance with this standard was 98.8%

At Rocky Reach average compliance for all three TDG standards was 99.6% during the 2011 fish passage season. This is exceptionally high compliance, given the significantly higher than average flows and incoming TDG levels experienced at the project.

Table 2. Summary of Spill and TDG Compliance at the Rocky Reach Project in 2011

Monitoring Dates	*% Spill (includes voluntary and involuntary)*	*Average Daily Spill Volume (kcfs)*	*% Compliance with 120% Tailrace Standard*	*% Compliance with 125% Tailrace Standard*	*% Compliance with 115% Downstream Forebay TDG Standard*	*Overall % Compliance (all standards combined)*
4/1 – 8/31	**15.3**	**38**	**100**	**100**	**98.8**	**99.6**

1.5.2 TDG Activities Implemented 2011

As defined in Section 5.4.1(b) of the 401 Certification, Chelan PUD implemented five 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.

1.5.3 TDG Structural Measures Implemented in 2011

No structural gas abatement measures were proposed or implemented at the Rocky Reach Project in 2011.

2. PROPOSED 2012 ACTION PLAN TO ACHIEVE TDG STANDARDS

The following sections describe TDG abatement measures proposed for implementation during 2012 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 Agreement. During the 2012 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 212 kcfs.**
6. **Implement alternative spillway operations,**
   Using any of gates 2 to 12, determine in consultation with the Rocky Reach Fish Forum (RRFF) and HCP Coordinating Committee, whether TDG levels can be reduced without adverse effects on fish passage. If effective, implement alternative spillway operations to reduce TDG. The standard spill configuration, which includes gates 2-8, is currently used during most spill events. For more detail on this configuration, please see Section 1.4.4 above and Appendix C.

   Chelan PUD is drafting a plan of study to investigate alternative spillway operations. A draft of the plan will be complete and ready for review by May 1, 2012, with the goal of having a final plan in place prior to high flows. Implementation of the plan is dependent on appropriate high flow conditions and approval of the HCP Coordinating Committee.

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.

2.2 Proposed Structural TDG Abatement Measures and Technologies

No structural gas abatement measures are planned at the Rocky Reach Project in 2012. Chelan PUD will continue to monitor and investigate the feasibility of implementing new technologies as they become available.

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 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) 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) is located approximately 0.38 mile 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 will enter into a Professional Services Agreement with Columbia Basin Environmental (CBE) to perform calibrations and equipment maintenance during the 2012 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.

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 April 1 all hourly data will be forwarded to Chelan PUD headquarters building and then onto the US Army Corps of Engineers Reservoir Control Center (http://www.nwd-wc.usace.army.mil/report/tdg.htm) where the data is currently 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 US Army Corps of Engineers Reservoir Control Center (http://www.nwd-wc.usace.army.mil/report/tdg.htm) where the data is currently posted on a nearly hourly basis.

Figure 2. Location of forebay and tailrace fixed monitoring stations at Rocky Reach Project.

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, U.S. Army Corps of Engineers, 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 (QAPP) (Appendix D) per Section 5.7.2 of the 401.

3.3 Biological (Gas Bubble Trauma) Monitoring Plan

Section 5.4.1 (c) of the 401 Certification requires Chelan PUD to prepare and implement a one-time study of Gas Bubble Trauma (GBT). In coordination with the RRFF and the HCP Coordinating Committee, Chelan PUD plans to prepare a one-time GBT study plan for resident species in the Rock Island reservoir by winter 2012/2013 and submit the plan to Ecology for their review and approval.

In addition, 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. The results of this monitoring effort will be included in the annual report (see Section 4.3 below). Though not required by the Rocky Reach 401 Certification, GBT data collected at Rock Island will be useful for the Year 5 Determination of Compliance (see Section 4.4 below).

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 U. S Army Corps of Engineers Reservoir Control Center (http://www.nwd-wc.usace.army.mil/report/tdg.htm) where the data is currently 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 GAP annual monitoring report (GAP 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 WQMP[1] used to predict compliance with TDG numeric criteria.

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 2009-2012 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 (February 2013 to January 2014) 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 will be submitted to Ecology by January 31, 2014.

[1]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.

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 Rocky Reach Fish Forum and develop an implementation plan. The implementation plan shall be included in the GAP for review and approval by Ecology.

6. CONCLUSIONS

Pending approval by Ecology, implementation of the measures presented in this 2012 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.

Literature Cited

Federal Energy Regulatory Commission (FERC). 2009. Order on Offer of Settlement and Issuing New License, Project No. 2145-060.

Schneider, M.L. and S.C. Wilhelms. 2005. Rocky Reach Dam: Operational and Structural Total Dissolved Gas Management. Prepared by COE, Engineer Research and Development Center, for Chelan PUD. July 2005. http://www.chelanpud.org/rr_relicense/study/reports/7773_1.pdf

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). 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

Rocky Reach Habitat Conservation Plan

The Rocky Reach Habitat Conservation Plan can be found at:

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

APPENDIX B

2012 Rocky Reach TDG Operational Plan

2012 Rocky Reach TDG Operational Plan

During Fish Spill Season (April 1 – 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***

    - 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 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 visa versa for the opening process.

APPENDIX C

Operations Plan

FERC License Requirement (Article 402)

The 2012 Rocky Reach Operations Plan can be found at the following link:

(The 2012 Rocky Reach Operations Plan is currently in a 30-day review period. The FINAL Operations Plan made available upon completion.)

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

2011 Gas Abatement Annual Report

The 2011 Gas Abatement Annual Report can be found at:

http://www.chelanpud.org/departments/licensingCompliance/rr_implementation/ResourceDocuments/38065.pdf

Response to Comments on the Draft Rocky Reach Gas Abatement Plan.		
Section, Paragraph	**Agency Comment** (provided in email dated 3/27)	**Chelan PUD Response**
Primary Comments		
Section 1.5.1	Under a new interpretation of the regulations and law by Ecology HQ, when incoming TDG levels exceed 115%, a project is determined to be in compliance when TDG in the tailrace and the downstream forebay does not exceed incoming TDG levels.	Pat and I spoke about this on the phone on 3/28 and my understanding is that if the incoming TDG level is between 115%-120%, tailrace TDG can reach 120%. If the incoming forebay TDG level >120%, tailrace TDG cannot exceed the incoming forebay TDG level (the project cannot add any TDG). Under both these scenarios, the next downstream dam's forebay cannot exceed the incoming (upstream) TDG levels. Please correct me if I am wrong. Chelan PUD will implement this interpretation in 2012 and will provide Ecology a revised analysis of 2011 data using this interpretation by June 1, 2012 (as discussed with Pat on 3/28).
Section 3.2	As noted in Section 3.2, Chelan PUD has developed QA/QC protocols. The results of implementing the QA/QC procedures for TDG should be provided each year, either within the GAP report or in the annual water quality report. The detailed description of the results of implementing each QA/QC step should be provided.	A bullet has been added to Section 4.3 (Annual Report) stating that results of QA/QC implementation will be included in the Annual GAP Report. During our phone conversation on 3/28, Pat indicated she did not have a preference as to which report this discussion should be added to.
Section 4.3	Data from 2011 and 2012 should be included as well (in regards to the refinement of regression equations).	2011 and 2012 have been added to the discussion regarding refinement of the regression equations.
General	The GAP should include monitoring for spill (or TDG) outside the fish spill season (per 401 Cert Section 5.4.1a, fourth sentence) and the GAP report should include the results of this monitoring for spill during the non-fish spill season.	Added two subsections to 3.1, one for fish spill season monitoring, and one for non-fish spill monitoring. Also added some additional information to the 4th bullet in Section 4.3 (Annual Report) that specifies that TDG levels will be reported for both fish spill season and non-fish spill season.
Minor Comments		
Table of Contents, Chapter 2	Should be "Proposed 2012" rather than "Proposed 201"	Suggested change made.
1.3.3	It is not clear why the first sentence is included in this section. I would just delete.	Suggested change made.

1.3.3	It is possible that TDG concentrations in the forebay are a result of activities of a number of upstream dams, including Grand Coulee. You might want to replace “Chief Joseph and Wells” with “upstream” dams.	Suggested change made.
1.4	Could you spell out NGVD?	The paragraph containing this abbreviation has been replaced with a couple paragraphs that I hope provide a better general description of how the Mid-C is coordinated using the Hourly Coordination Agreement. With this change, there is no need to spell out NGVD in the GAP. (NGVD stands for National Geodetic Vertical Datum.)
1.4	Could you include a sentence or two explaining who the coordinator is, what he does, and what items/conditions determine the content of the operation schedule.	The paragraph containing the mention of the coordinator has been replaced with a couple paragraphs that I hope provide a better general description of how the Mid-C is coordinated using the Hourly Coordination Agreement.
1.4.3	Please state whether Chelan PUD is a member of the Pacific Northwest Coordination Agreement.	Chelan PUD is a member of this agreement. A sentence has been added stating such.
3.1, paragraph 3, third sentence	There is a reference to the Corps’ World Wide Web site. Could you provide it here or reference Section 4.1 (if appropriate).	A hyperlink to the web site has been added to Sections 3.1.1 and 3.1.2.
4.4	It would be helpful to identify Year 5. Isn’t this from February 2013 to January 2014? So the report would be due by January 2014?	Suggested addition made.
General	It would be good to include a title and Section 1.5.3 “TDG Structural Measures in 2011”.	Suggested addition made.