Adaptive Management Structure
for the
Columbia and Snake River Total Dissolved Gas
Total Maximum Daily Load

September 2007

Background

The 2002 Lower Columbia River Total Dissolved Gas (TDG) Total Maximum Daily Load (TMDL) includes adaptive management for reviewing implementation of the TMDL. The 2003 and 2004 Middle Columbia and Snake River TMDLs have similar adaptive management clauses. The Adaptive Management Team (AMT) described in these TMDLs will be convened by the State of Washington represented by the Department of Ecology with representatives from the State of Oregon represented by the Department of Environmental Quality, tribes, federal agencies, and other interested parties.

The purpose of the AMT is to evaluate appropriate points of compliance for the TDG TMDLs and to ensure TMDL implementation. Based on the evaluations there may need to be additional studies conducted, or structural and operational gas abatement activities may need to be redirected or accelerated. The location of TDG monitors will be consistent with the TMDL adaptive management implementation strategy which may no longer require forebay monitors and may only require tailrace monitors as TMDL implementation transitions from short-term to long-term strategies.

This document provides the framework for adaptive management and an overview of the TDG TMDLs.

Adaptive Management Team (AMT)

Geographic Scope

The geographic scope of the AMT is the mainstem Columbia River as specified by the 2002 and 2004 TDG TMDLs (Bonneville, The Dallas, John Day, McNary, Priest Rapids, Wanapum, Rock Island, Rocky Reach, Wells, Chief Joseph, and Grand Coulee dams); and the lower Snake River in Washington as specified by the 2003 TDG TMDL (Ice Harbor, Lower Monumental Little Goose, and Lower Granite dams).

AMT Members

The AMT will consist of 10 member organizations, including the State of Oregon and State of Washington represented by their respective water quality agencies. The AMT membership is limited to 10 member organizations in-order to expedite technical review and decision making while still allowing for input from the multiple view points on TDG TMDL implementation.

Each member organization will be represented by one individual, and an alternate will be identified if the primary contact is not available to attend meetings. Each member will have the authority to make decisions for their member organizations, and have the authority to carry out any actions that may be required.

The role of the AMT members is to share and provide technical information to the group and advise the States of Washington and Oregon on TDG TMDL implementation.

AMT members will include:

1. State of Washington (Ecology co-chair)
2. State of Oregon (ODEQ co-chair)
3. NOAA Fisheries
4. USACE
5. Save our Wild Salmon
6. Colville Tribal Representative
7. CRITFC Tribal Representative
8. PUD Representative
9. EPA
10. NW River Partners
11. USFWS

A meeting summary and the decisions made will be posted to a public website after each AMT meeting. The website will be hosted by Ecology.

Decisions

Decisions affecting TMDL compliance, monitoring locations, and implementation are to be made by the TMDL authors, Oregon Department of Environmental Quality (ODEQ) and Washington Department of Ecology (Ecology). The AMT is a consultative body that will provide input into the decision making process. The ODEQ will be representing the State of Oregon position on the AMT and will consult with appropriate State Agencies for forming the State of Oregon position. Ecology will be representing the State of Washington. Oregon and Washington will make every attempt to agree on decisions, but may make different decisions based on unique circumstances in each State. Depending on the final decision, it may be necessary for Ecology to do a TDG standards change which may take a considerable amount of time; and in Oregon an Order signed by the ODEQ director may be issued. ODEQ will hold a 30 day public comment period prior to issuing an Order.

Issues facing the AMT

The AMT is a technical group. No policy issues will be addressed at the AMT.

A. The main technical issues that the AMT will discuss in detail during the initial part of the Adaptive Management process:

1. The need and location for the 115% forebay TDG monitoring requirement.

2. The location of tailrace TDG monitors.
   a. Movement of TDG monitors to their Load Allocation positions.
   b. There is no standard method of measuring the distance from the dam to the current tailrace TDG monitoring locations. For example, Bonneville Dam tailrace monitor is 450 yards downstream of the dam according to USGS or 200 yards downstream of the dam according to ACOE. There needs to be a consistent method of measuring the current tailrace monitor distance from a dam to eventually help identify the load allocation compliance monitoring location as specified in the TMDL.

B. Other technical issues that ODEQ and Ecology could address with comment from the AMT during the AM process:

1. Application of the TDG criteria. Should the TDG criteria be applied at any representative point, as the cross-sectional average, or at the point of maximum TDG?

C. Issues that may be discussed after resolution of the items above:

1. The timeline set out in the TMDL for phase I and II (a new timeline may be added for any new actions).
2. Compliance monitoring strategies that allow the use of synoptic surveys and statistical relationships.
3. Specific implementation activities.
4. The 120% criteria.

D. Issues that will not be discussed or addressed during the AM process:

1. Policy issues.
2. The 110% TDG criteria.
3. The end goals of the TMDL.
4. The margin of safety in the TMDL.
5. The load allocations.

Process

Every attempt will be made by ODEQ and Ecology to secure and implement decisions prior to the next year's fish passage spill season. Any rule change will take longer. The spill season begins as early as March, but is not in full effect until April of each year.

The AMT will meet on a monthly basis until the issues are resolved. Then meetings will occur on an as needed basis, when new information is available or resolution is required.

After each AMT meeting a brief summary will be sent to the AMT members for review and to record any decisions that may have been made. The meeting summary will then be posted to a public website hosted by Ecology.

Data Needs

Total dissolved gas is monitored at each of dams in the Columbia and Lower Snake rivers. It is anticipated that the AMT will need this data and summaries of TDG, flow, and general water quality information data for decision making.

Biological monitoring of fish for gas bubble disease is conducted by several entities on the Columbia and Lower Snake rivers. This information will be used to describe the TDG effects on fish, incidence of gas bubble trauma, and any other related information relative to fish and TDG in the system.

Timeline

The implemention timelines may differ between Oregon and Washington.

The forebay TDG monitor evaluation timeline presented below will guide the AMTs work. Every attempt will be made to meet the timeline and make decisions prior to the next spill season, April 1, 2008.

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The need and location of the 115% forebay TDG monitoring requirement

Step	Oregon Timeline	Washington Timeline
1. Review literature regarding biological effects of higher TDG. [Partially done]	September - October 2007	September - October 2007
2. Review literature or other studies regarding increase survival of fish due to higher spill allowed by removing 115% requirement.	September – October 2007	September – October 2007
3. Summarize (and compare) #1 and #2, share with AMT.	October - November 2007	October - November 2007
4. Gather input from AMT and their proposals/ideas.	December 2007 – January 2008	December 2007 – January 2008
5. ODEQ 30 day public comment period	February 2008	
6. ODEQ and Ecology make decision	March 2008	March 2008

7. Implement decision (In Washington, additional time may be needed to implement a decision if a change to the Washington water quality standard is necessary)	April 2008	April 2008

The tailrace TDG monitor evaluation timeline presented below will guide the AMTs work. Every attempt will be made to meet the timeline and make decisions prior to the next spill season in March, 2009.

The location of tailrace TDG monitors

Step	Oregon Timeline	Washington Timeline
1. Standardize method of measuring the distance from the dam to the current tailrace TDG monitoring locations.	June 2008	June 2008
2. Evaluate how the locations for TDG load allocation monitoring positions were determined in the TMDLs. There are two pieces: the methodology and the application of the methodology to determine the location.	July 2008	July 2008
3. Determine if new information warrants changes to the methodology for determining the locations. Solicit that information from AMT members.	August - October 2008	August – October 2008
4. Determine if new information warrants changes to the location, while keeping the same methodology. Solicit that information from AMT members.	October – December 2008	October – December 2008
5. ODEQ 30 day public comment period	January 2009	
6. ODEQ and Ecology make decision	February 2009	February 2009
7. Implement decision or begin process of implementing decision	March 2009	March 2009

Other

Ecology and ODEQ reviewed the steps that were taken to move the TDG forebay monitors in 2005 at McNary and in 2004 at John Day with appropriate representatives from the Federal Columbia River Power System Water Quality Team (WQT).

To date the following has occurred:

June 21 Oregon EQC approves two-year TDG waiver issued to the Federal Government.

July 2 Ecology and ODEQ meet to discuss formation, framework, and timeline of AMT.

August 7	Ecology and ODEQ met with ACOE, BPA, NW River Partners, Fish Passage Center, USFWS, and NOAA to discuss what information was provided and how decisions were made in order to gain agreement to move the forebay monitors at McNary in 2005 and John Day in 2004.
Sept 10	TDG Lit. Review DRAFT provided by WDOE
Sept 13	Agnes / Ron (ODFW) meet to discuss AMT concept and to provide Ron w/ DRAFT TDG Lit. Review
Sept 21	DEQ and ODFW Division Administrators conference call
Oct 5	Ron provides Agnes w/ feedback on DRAFT TDG Lit Review

TMDL Overview

The TMDL for Lower Columbia River Total Dissolved Gas is available at ODEQ's website: http://www.deq.state.or.us/wq/TMDLs/docs/columbiariver/tdg/tmdlwqmp.pdf. All three TMDLs can be found at http://www.ecy.wa.gov/programs/wq/tmdl/watershed/tmdl_info-columbia.html. The following summary of the lower Columbia River TMDL is similar to the other two TMDLs.

This TMDL addresses TDG in the mainstem Columbia River from its confluence with the Snake River to its mouth at the Pacific Ocean. The states of Oregon and Washington have both listed multiple reaches of the Lower Columbia River on their federal Clean Water Act 303(d) lists, due to TDG levels exceeding state water quality standards, 110% of saturation. The entire reach is considered impaired for TDG. Oregon and Washington jointly issued this TMDL in September 2002. Both the Washington State Department of Ecology and the Oregon Department of Environmental Quality are responsible for ensuring that water quality standards are met.

Federal and state laws and rules require compliance with state water quality standards, and therefore the ultimate goal of this TMDL is to achieve compliance with the 110% TDG water quality criterion. This TMDL is applicable for all spills below 7Q10 river flood flow conditions, regardless of the cause of the spill.

Lower Columbia River 7Q10 flood flows

Site	Flow (cfs)
Mc Nary Dam	447,000
John Day Dam	454,000
The Dalles Dam	461,000
Bonneville Dam	467,000

Elevated TDG levels are caused by spill events at four hydroelectric projects on the Lower Columbia River. Water plunging from a spill entrains TDG at high levels. High TDG can cause "gas bubble trauma" in fish, which can cause chronic or acute effects, depending on TDG levels. Spills can be caused by several conditions. "Voluntary" spills are provided to meet juvenile fish passage goals. "Involuntary" spills are caused by lack of powerhouse capacity for river flows. Involuntary spills can result from turbine maintenance or break-down, lack of power load demand, or high river flows. Elevated TDG levels also enter the TMDL area at the upstream boundary from sources outside the TMDL area.

Up to a point, the danger to fish from exposure to high TDG is overshadowed by the dangers to fish of going through the turbines. In response, the National Marine Fisheries Service performed a comparison risk analysis that forms the basis for modifications to both Washington and Oregon's water quality standard for TDG.

This implementation strategy therefore must take into account both requirements: to reduce high TDG generated at the dams by spilling water, and to provide the levels of spill under the

Biological Opinion to facilitate fish passage. Additional provision for spill is sometimes necessary for non-listed species.

The TDG data from the Fixed Monitoring Stations (FMS) consists of remotely monitored TDG pressure, dissolved oxygen, water temperature, and atmospheric pressure from a fixed location in the forebay and tailwater of each project. Data from the FMSs provide a long-term hourly record of TDG throughout the season, capturing detailed temporal and extreme events. However, the FMSs provide only limited spatial resolution of TDG distribution. In some cases, the TDG observed in the tailwater at the FMS location may not be representative of average spillway conditions and misrepresented the TDG loading at a dam.

For monitoring of long-term compliance, it will be necessary to monitor at the loading capacity compliance locations in the tailrace. However, it is not expected that these locations will lend themselves to a permanent remote monitoring setup. Compliance will be determined by a combination of periodic synoptic surveys, especially after structural changes have been completed, and continuous monitoring, using a statistical relationship between the continuous monitor and conditions at the compliance location. This allows long-term monitoring to be managed separately from monitoring for short-term operational needs.

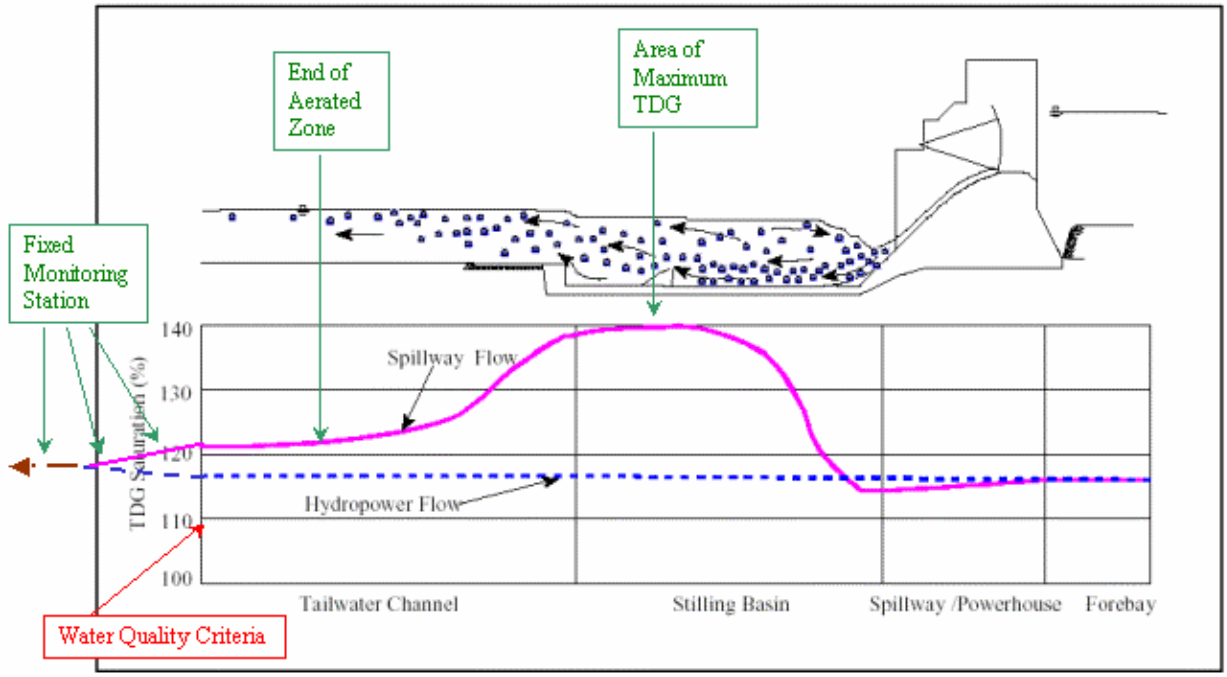
For short-term compliance, the FMS stations can continue to be used, or new FMS stations can be established. This will allow operational management that is linked to easily accessible data, based on overall environmental management needs and the realities imposed by structural characteristics. Thus, short-term compliance can remain adaptive and flexible, while long-term compliance remains fixed to firm goals.

The point of compliance for load allocations for the dams in this TMDL will be based on application of the mixing zone to the aerated zone immediately below the spillways of the dams. The points of compliance were determined from U.S. Army Corps of Engineers research which identified the location where degassing was mostly complete. This is a local area of impact with very dynamic conditions. Allocations for the dams must be met at points of compliance within each dam's tailrace at a specified distance below the spillway, corresponding to the end of the aerated zone. The upstream allocation must be met in the pool above McNary dam.

2002 TDG TMDL Load Allocation Compliance Locations

Project	2002 TDG TMDL Load Allocation Tailrace Locations	Current Locations, ACOE 2006 TDG Monitoring Report
Upstream Boundary	Below Snake River confluence (to be linked to upstream TDG TMDLs)	
McNary Dam spill	1000 feet below end of McNary spillway	6,864 feet (1.3 miles) d/s of the dam on the Washington shore
John Day Dam spill	1700 feet below end of John Day spillway	4,224 feet (0.8 miles) d/s of the dam on the Washington shore
The Dalles Dam spill	600 feet below end of The Dalles spillway	13,200 feet (2.5 miles) d/s of the dam on the Oregon shore
Bonneville Dam spill	1700 feet below end of spillway	600 feet (200 yards) d/s of the spill channel as per 2006 ACOE TDG Monitoring Report 1350 feet (450 yards, plus or minus 50 yards) d/s of the dam as identified by USGS

2002 TDG TMDL Possible Load Allocation Compliance Locations with Respect to TDG Levels



An implementation plan is provided that describes short-term compliance with Endangered Species Act requirements. Long-term compliance is described for both Endangered Species Act and TMDL requirements.

For short-term compliance, the FMS stations can continue to be used, or new FMS stations can be established. This will allow operational management that is linked to easily accessible data, based on overall environmental management needs and the realities imposed by structural characteristics. Thus, short-term compliance can remain adaptive and flexible, while long-term compliance remains fixed to firm goals.

Meeting the load allocations in this TMDL will fall into two phases. Phase I will involve improving water quality, while ensuring that salmonid passage is fully protected in accordance with the National Marine Fisheries Service's Biological Opinion. Phase II will involve structural and operational changes to dams to achieve the water quality standard for TDG.

The short-term actions in Phase I will focus on meeting the fish passage performance standards as outlined in the National Marine Fisheries Service 2000 Federal Columbia River Power System Biological Opinion through spills that generate gas no greater than the "waiver" levels of the water quality TDG standards (Oregon variances or Washington temporary special conditions). Water quality standards are measured at existing fixed monitoring stations managed by the U.S. Army of Engineers and U.S. Geological Survey. This phase will also include short-term structural modifications at the dams to achieve TDG reductions during periods of spill, while ensuring that the fish passage requirements of the 2000 Biological Opinion are met. As part of Phase II, a Detailed Implementation Plan or equivalent will be developed (possibly through the Water Quality Plan under the Biological Opinion).

Phase II will evaluate success from the short-term actions. The second phase will also move toward further structural modifications and reductions in fish passage spill if the Biological Opinion specified performance standards are being met and adequate survival is provided for non-listed species.

For monitoring of long-term compliance, it will be necessary to monitor at the loading capacity compliance locations in the tailrace. However, it is not expected that these locations will lend themselves to a permanent remote monitoring setup. Compliance will be determined by a combination of periodic synoptic surveys, especially after structural changes have been completed, and continuous monitoring, using a statistical relationship between the continuous monitor and conditions at the compliance location. This allows long-term monitoring to be managed separately from monitoring for short-term operational needs.

Short Term – Phase I

Short-term compliance and the effectiveness of operational implementation actions will be monitored at existing fixed monitoring station sites. The current fixed monitoring station TDG monitoring system consists of tailrace and forebay monitoring stations at each mainstem lower Snake and Columbia River dam and at key locations in some tributaries. While most of these stations do a credible job of reporting meaningful data, some have been shown to be questionable. This system is now undergoing a thorough review by the National Marine Fishery Service's Water Quality Team. Screening criteria will be developed and used to evaluate all existing monitoring stations. Stations that do not conform to these criteria will be relocated to more appropriate locations. This screening process will include consideration of how well the

station represents TDG and water temperature in a given river reach and how sensitive the station is to non-spill factors that affect TDG, such as temperature and aquatic plant respiration.

This phase is already underway, as a result of actions taken by the Corps, and will continue through 2010. As detailed above, the emphasis in this phase will be taking those actions that will result in reductions of TDG, while ensuring the fish passage requirements of the 2000 Biological Opinion are met. The Biological Opinion envisions spill for fish passage under modified water quality standards of Oregon and Washington, as have been provided for the past six years. Included in this program will be the near-term actions that have been identified in the Biological Opinion. Maintenance of required spill at the modified standards to allow for fish passage will be as measured at the fixed monitoring stations both in the forebay and the tailrace of each dam.

This phase will also address the first stages of reducing gas during spills due to high-flow events, turbine outages, and during lack of demand for electrical power.

Long Term – Phase II

Monitoring of long-term compliance with load allocations and the effect of structural changes will include an evaluation of previous and future near-field transect studies at the compliance location (the end of the aerated zone below each dam). Load allocation compliance monitoring will occur following major structural changes or immediately following the end of Phase I and Phase II. Also, statistical relationships may be developed between TDG levels at the continuous monitoring location and the compliance location that allow real-time and long-term trend evaluation of compliance. Prior to the initiation of a load allocation monitoring survey, a quality assurance project plan, or equivalent, must be approved by the Washington State Department of Ecology and the Oregon Department of Environmental Quality. The quality assurance project plan should address the safety and stability of the site to support monitoring equipment and activities when subject to the strong hydraulics below the dams. Due to these factors, it is possible that an alternate site may be needed. If so, some correlation to the load allocation compliance point will be necessary.

This phase will begin in 2011 and proceed through 2020. Actions taken in the previous phase will be reviewed for their efficacy, both in improving TDG levels and for protecting salmonid passage. The Biological Opinion survival goals are being met through fish passage actions other than spilling water. Reductions in gas entrainment through spill will be realized so that the required final goal of meeting the water quality standard for TDG can be met as measured at the end of the aerated zone below each dam.

The U.S. Army Corps of Engineers DGAS study identified a number of structural measures designed to abate TDG. Several of these measures should be evaluated for their efficacy in abating gas and ensuring that they provide safe and effective fish passage. If necessary, those measures found to be effective and safe should be identified for funding and implementation.