State of Oregon
Department of Environmental Quality Memorandum

Date: June 2, 2014

To: Environmental Quality Commission

From: Dick Pedersen, Director

Subject: Agenda item G, Informational item: Request from U.S. Army Corps of Engineers for a waiver renewal to the total dissolved gas water quality standard on the Columbia River for fish passage

Purpose of item

This item will inform the commission on the U.S. Army Corps of Engineers' request to renew the five-year total dissolved gas waiver applicable to four Columbia River dams.

Why this is important

Releasing water over a dam's spillway is an anadromous salmonid fishery-management tool used to assist out-migrating juvenile salmonids on the Columbia River. However, spilling water over dams increases the level of total dissolved gas in the river. Water plunging from a spillway traps air and carries it to a depth where the pressure forces the gas to dissolve into water. Total dissolved gas levels above 110 percent of saturation can cause gas bubble trauma in fish.

Oregon adopted EPA's total dissolved gas criteria of 110 percent of saturation. The 110 percent total dissolved gas standard protects beneficial uses of the Columbia River, and protects aquatic life, such as endangered and threatened salmon and trout salmonid species.

The U.S. Army Corps of Engineers is requesting a waiver to Oregon's 110 percent total dissolved gas water quality standard. The waiver would allow the voluntary spilling of water at the Bonneville Dam, The Dalles Dam, John Day Dam and McNary Dam along the Columbia River to assist fish passage of out-migrating juvenile salmon and trout salmonids balanced against the increased risk of gas bubble disease.

Background

The Corps operates the voluntary spill program designed to improve juvenile salmonid migration past the dams while minimizing risk from total dissolved gas.

Fish migration

In order to survive, juvenile fish must be able to migrate downstream past the Columbia River dams. Turbines at these hydro electric dams hinder migration, so water is deliberately spilled from McNary, John Day, The Dalles, and Bonneville Columbia River dams to improve fish passage by passing fish over

the spillway instead of through the turbines. This is commonly referred to as voluntary fish passage spill. These spills, however, increase total dissolved gas to levels greater than the water quality standard of 110 percent.

When total dissolved gas levels are too high it can harm migrating juvenile and adult salmonids by causing gas bubble trauma, similar to the bends in humans.

Historic choice of voluntary spills

EQC has granted waivers to the U.S. Army Corps of Engineers for total dissolved gas since 1994. EQC granted the waivers because of the low incidence of gas bubble trauma and the effectiveness of voluntary spill for fish passage. The U.S. National Oceanic and Atmospheric Administration National Marine Fisheries Service has identified voluntary spill as the safest, most effective tool available for improving downstream smolt survivorship.

Biological Opinion

The Biological Opinion is published by the National Marine Fisheries Service. The opinion states whether a federal action is likely to jeopardize the continued existence of a threatened or endangered species or result in the destruction or adverse modification of critical habitat. The Federal Columbia River Power System Biological Opinion requires voluntary fish passage spill at Columbia River dams to support fish migration even when it results in total dissolved gas super-saturation above the state's 110 percent standard. The Corps operates in accordance with the 2014 Federal Columbia River Power System Supplemental Biological Opinion reasonable and prudent alternative actions.

Total Maximum Daily Load allows spills

In 2002, Oregon and Washington issued a Lower Columbia River total dissolved gas total maximum daily load that was approved by EPA. The TMDL allows fish passage spills until 2020 with a provision that operational and structural modifications that reduce total dissolved gas generated during spill must be in place by that time. The goal of the TMDL is to meet the 110 percent total dissolved gas state criteria while allowing for voluntary fish passage spill.

The Corps operates the dams and is responsible for implementing the operational and structural modifications identified in the TMDL.

Terms of current waiver

The current waiver allows for voluntary fish passage spill April 1 through August 31 at Bonneville, The Dalles, John Day and McNary dams. The waiver

requires physical monitoring of total dissolved gas below the dam in the tailrace with a limit of 120 percent measured as the 12 highest hours in a day, biological monitoring of gas bubble trauma in fish during the spill period and annual reporting to DEQ. The waiver also has a provision allowing DEQ to approve the total dissolved gas criteria modification outside of April 1 through August 31 for purposes such as maintenance activities and studies of prototype fish passage devices. The current total dissolved gas waiver is in attachment A.

Request to renew the total dissolved gas waiver

U.S. Army Corps of Engineers request for a waiver

On April 4, DEQ received a request from the Corps, with support from the National Marine Fisheries Service, to renew the waiver to the state's total dissolved gas standard. EQC approved the current total dissolved gas waiver in 2009 for a five-year period. The waiver will expire for the purpose of juvenile salmonid migration at midnight on Aug. 31, 2014. The requested waiver must be in place by April 1, 2015 to allow spill for juvenile salmonid migration. The Corps did not request substantial changes to the current waiver.

Factors associated with total dissolved gas exceedances

At the March 2014 EQC meeting, DEQ provided the commission with a memorandum summarizing information from the Corps' annual report on the 2013 Columbia River total dissolved gas and spill for juvenile salmonid migration. The commission posed a question on whether or not the Corps addressed reasons for exceedances of the total dissolved gas waiver limit.

The March memorandum stated that 2013 exceedances were due to several factors:

- The Corps' uncertainty when applying fish passage spill guidance criteria at the dams, such as not properly accounting for runoff patterns from watersheds, water travel time, degassing of total dissolved gas, water temperature effects and spill gate patterns
- Malfunctioning monitoring gauges at McNary and Bonneville dams and
- Powerhouse capacities and power load requirements relative to high flows.

The U.S. Army Corps of Engineers differentiates spill activities as voluntary or involuntary. Voluntary spill occurs for the purpose of juvenile salmonid migration. Factors leading to exceedances during voluntary spill include hydrologic and water quality conditions that do not align with forecasted variables such as flow, water temperature and wind. The Corps uses a model, SYSTDG, to help manage spill for total dissolved gas levels on a system-wide basis. The system includes the Columbia River from Grand Coulee Dam to Bonneville Dam, the Snake River from Lower Granite Dam to the confluence

with the Columbia River, and from Dworshak Dam on the Clearwater to its confluence with the Snake River. SYSTDG is statistically evaluated annually and recalibrated when structural changes, which affect total dissolved gas levels, are made to a dam in the system. Although the Corps conducts long-term and short-term forecasting of total dissolved gas, quickly changing environmental conditions that are not reflected in model simulations can lead to total dissolved gas exceedances.

Exceedances associated with malfunctioning monitoring gauges, powerhouse capacities and load requirements are related to involuntary spill. Involuntary spill results from factors outside the Corps' control. These factors include high flows that exceed the capacity of a dam to either temporarily store water upstream of the dam or pass the water through its turbines. As a result, water must be released as spill. Involuntary spill can also occur due to passing debris, turbine unit outages, transmission outages and required operational and maintenance activities.

Experimental spill management test

Entities including the Oregon Department of Fish and Wildlife, a coalition of environmental stakeholders and the Nez Perce tribe are interested in conducting a 10-year experimental spill management test requiring total dissolved gas criteria modification to 125 percent from April through mid-June at the four lower Snake River dams and the four downstream Columbia River dams operating under Oregon's total dissolved gas waiver. The spill experiment would test the hypothesis that increasing spill will result in greater benefit in aiding Endangered Species Act listed salmonid recovery than harm from an increasing potential for total dissolved gas-related mortality. The spill experiment is based on results of prospective modeling using the Comparative Survival Study. Bonneville Power Administration funds the CSS, which is a long-term study within the Northwest Power and Conservation Council's Columbia Basin Fish and Wildlife Program. Entities involved with CSS design, analysis and prospective modeling are the Fish Passage Center and the CSS Oversight Committee including representation from Columbia River Inter-Tribal Fish Commission, U.S. Fish and Wildlife Service, and the fish and wildlife agencies of the northwest states.

The Northwest Power and Conservation Council's Independent Scientific Advisory Board and the National Marine Fisheries Service each evaluated the proposed large-scale study by reviewing CSS reports and other materials related to the topic. Both entities have concerns regarding the underlying basis of the experiment, which relies on correlative associations. Although the U.S. Army Corps of Engineers' waiver renewal request is not related to the experimental

spill management test, DEQ anticipates receiving comments concerning the spill experiment during the public comment period on the waiver. As such, DEQ is informing the commission about the interest in the spill experiment and the impact it would have on total dissolved gas in the Columbia River in relation to Oregon's waiver allowing a criteria adjustment of 120 percent for juvenile salmonid migration.

Next steps

The U.S. Army Corps of Engineers will provide DEQ with a requested addendum to the document it submitted in support of the waiver request. DEQ expects receipt of the addendum by May 30. DEQ will then issue a public notice opening a 30-day public comment period. This comment period will be underway during the June EQC meeting. DEQ will present the waiver request as an action item to the EQC during the August meeting.

Attachments

A. Current Total Dissolved Gas Waiver

Approved:

Program: _____

Section: _____

Report prepared by: Paula Calvert

Order Approving the U.S Army Corps of Engineer's Request for a Waiver to the State's Total Dissolved Gas Water Quality Standard

BEFORE THE ENVIRONMENTAL QUALITY COMMISSION

In the matter of the U.S. Army Corps of Engineers' request to spill water to assist out-migrating threatened and endangered salmon smolts	))))	FINDINGS and ORDER

Findings

1. The Department of Environmental Quality received a request from the U.S. Army Corps of Engineers dated January 09, 2009, to adjust the 110 percent t total dissolved gas water quality standard as necessary to spill water over McNary, John Day, The Dalles and Bonneville dams on the Lower Columbia River to assist out-migrating threatened and endangered salmon smolts during the fish passage season of Apr. 1 to Aug. 31. The application sought approval for five years. The public was notified of the request on Feb. 19, 2009 and given the opportunity to provide written comments until 5:00 p.m. on Mar. 23, 2009.

2. Acting under **OAR 340-041-0104(3)** the commission finds that:

   (a) *Failure to act would result in greater harm to salmonid stock survival through in-river migration than would occur by increased spill:*

   Biological assessments and opinions have concluded that providing project spill for fish passage at levels that result in exceeding the 110 percent total dissolved gas water quality standard is necessary to assure adequate passage conditions for Endangered Species Act listed fish species. The National Marine Fisheries Service Federal Columbia River Power System Biological Opinion concluded that the risk associated with a managed fish passage spill program to a 120 percent total dissolved gas level is warranted by the projected 4 percent to 6 percent increase in system survival of juvenile salmonids. The opinion estimated mortality from fish passing through turbines between 7 and 14 percent, and mortality due to fish passage spill between 0 to 2 percent. Barge and truck transport are alternative modes of fish transport to voluntary spill. The mortality associated with truck and barge transport is difficult to estimate due to the potential for latent mortality. However, the US Fish and Wildlife Service studied the transport of fall Chinook salmon directly from Spring Creek Hatchery by barge to a release site below Bonneville Dam. A high percentage of the adult returns from the barged groups strayed to other hatcheries, and the return rates to Spring Creek Hatchery were significantly lower for the barge test groups than for the voluntary spill control group. The US Fish and Wildlife Service also evaluated the possibility of raising and releasing additional fish to make up for those fish that would be lost to turbines or other causes during passage at Bonneville Dam in the

absence of spill. The USFWS concluded that it would not be possible to raise additional fish because rearing space, water supply, and waste treatment capability are limited. It would also not be feasible to release fish at a later date because of limited hatchery capacity since these fish would continue to grow and exceed hatchery capacity.

(b) The modified total dissolved gas criteria associated with the increased spill provides a reasonable balance of the risk of impairment due to elevated total dissolved gas to both resident biological communities and other migrating fish and to migrating adult and juvenile salmonids when compared to other options for in-river migration of salmon:

The Fish Passage Center estimates a 1.4 percent incidence of gas bubble trauma in salmon smolts in the Columbia River when total dissolved gas levels are managed to 120 percent in the tailrace. This estimate is based on smolt monitoring information collected between 1995 and 2007.

When the in-river total dissolved gas levels are below 120 percent, few adult fish (in some cases none) display signs of gas bubble trauma. Investigators have observed adult tolerance to total dissolved gas and hypothesized that it was attributable to the migration depth of adult salmonids. Depth-sensitive radio tags used in adult migration studies confirmed that adults migrate at depths up to 4 meters and find depth compensation protection from gas bubble trauma. For every meter below the surface water, a reduction of 10 percent total dissolved gas is measured in the water column. Resident fish and aquatic invertebrates in the Columbia River downstream of Bonneville Dam have been monitored by National Marine Fisheries Service for signs of gas bubble disease from 1993 to 1998. There were no signs of gas bubble disease observed in the aquatic invertebrates examined. There was a low incidence of gas bubble disease (less than one percent) in resident fish examined in 1993 and 1995 while in 1994, 1997 and 1998 none of the fish observed had signs of gas bubble disease. Signs of gas bubble disease were prevalent in 1996 but this was a high flow year with large volumes of involuntary spill and total dissolved gas levels above 120 percent in the tail races of dams. Given the past monitoring of gas bubble disease, the levels requested in this petition strike a reasonable balance between increased survival due to reduced turbine mortality and the risk of mortality from gas bubble disease.

c) Adequate data will exist to determine compliance with the standards:

Physical in-river total dissolved gas monitoring will be conducted at the tailraces of McNary, John Day, The Dalles, and Bonneville Dams. Hourly data will be available on the Corps' website. The Corps has submitted a physical monitoring plan. The physical monitoring plan of action is available at:
http://www.nwdwc.usace.army.mil/tmt/wq/tdg_monitoring/2010-14_final.pdf
Implementation of the physical monitoring plan will ensure that data will exist to determine compliance with the standards for the voluntary spill program identified in this Order. The Corps will report each year's physical monitoring results to DEQ.

d) Biological monitoring is occurring to document that the migratory salmonid and resident biological communities are being protected:

The corps has submitted a biological monitoring plan. Biological monitoring will occur according to the "Fish Passage Center Gas Bubble Trauma Monitoring Program Protocol for Juvenile Salmonids" document, available at: ftp://ftp.fpc.org/gbtprogram/ . Juvenile salmonids will be collected at Bonneville and McNary Dams and examined and evaluated for incidence of gas bubble trauma, and will be assigned ranks based on severity of their symptoms. The corps will report each year's biological monitoring results to the DEQ.

Order

1. The Environmental Quality Commission approves a modification to the 110 percent total dissolved gas water quality standard for voluntary fish passage spill at McNary, John Day, The Dalles and Bonneville Dams on the Lower Columbia River, subject to the following conditions:

   (i) A modified total dissolved gas standard for the Columbia River applies:

   a) during the voluntary spill period from midnight on Apr. 1 to midnight on Aug. 31 for the purpose of fish passage; and

   b) during any period of voluntary spill that occurs outside the periods specified in 1(i)(a) above, if the spill is for the purpose of Spring Creek Hatchery fish release, maintenance activities and/or biological or physical studies of spillway structures and prototype fish passage devices, then the U.S. Army Corps of Engineers must have approval from the Department prior to such spill. The corps must notify the DEQ in writing describing the action, the purpose of the action and dates of action at least one week prior to the voluntary spill for the purpose of informing DEQ and having the DEQ make a final determination of approval. The U.S. Army Corps of Engineers will conduct physical and biological monitoring during these periods of voluntary spill.

   (ii) The modified total dissolved gas criteria will apply for five-years, 2010, 2011, 2012, 2013 and 2014.

   (iii) Spill must be reduced when the average total dissolved gas concentration of the 12 highest hourly measurements per calendar day exceeds 120 percent of saturation in the tailraces of McNary, John Day, The Dalles, and Bonneville Dams monitoring stations.

   (iv) Spill must be reduced when instantaneous total dissolved gas levels exceed 125 percent of saturation for any 2 hours during the 12 highest hourly measurements per calendar day in the tailraces of McNary, John Day, The Dalles, and Bonneville Dams monitoring stations.

(v) If either 15 percent of the fish examined show signs of gas bubble disease in their non-paired fins, or five percent of the fish examined show signs of gas bubble trauma in their non-paired fins where more than 25 percent of the surface area of the fin is occluded by gas bubbles, the DEQ director will halt the spill program.

(vi) The Corps must provide written notice to DEQ within 24 hours of any violations of the conditions in the modification as it relates to voluntary spill. Such notice must include actions proposed to reduce total dissolved gas levels or the reason(s) for no action.

(vii) No later than Dec. 31 for each year of this waiver, the corps must provide an annual written report to DEQ detailing the following:
a) flow and runoff descriptions for the spill season;
b) spill quantities and durations;
c) quantities of water spilled for fish versus spill for other reasons for each project;
d) data results from the physical and biological monitoring programs, including incidences of gas bubble trauma;
e) description and results of any biological or physical studies of spillway structures and prototype fish passage devices to test spill at operational levels; and
f) progress on implementing the gas abatement measures contained in the 2002 Lower Columbia River total dissolved gas total maximum daily load and other gas abatement activities identified through adaptive management.

(viii) If requested, the corps must report to the commission on any of the above matters or other matters relevant to this order.

(ix) The commission reserves the right to terminate or modify this modification at any time.

Adaptive Management

The process for reviewing the implementation of the 2002 Lower Columbia River total dissolved gas total maximum daily load will continue. The Washington State Department of Ecology will convene an advisory group with representatives from Oregon DEQ, tribes, federal and state agencies to evaluate appropriate points of compliance for this total maximum daily load. Based on these findings, further studies may be needed, and structural and operational gas abatement activities will be redirected or accelerated if needed.

Dated: 6-27-09

ON BEHALF OF THE COMMISSION

Director