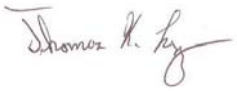
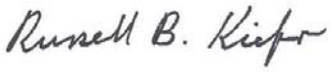
State, Federal and Tribal Fishery Agencies Joint Technical Staff Memo

To: Ms. Agnes Lut, Columbia River Coordinator
Oregon Department of Environmental Quality

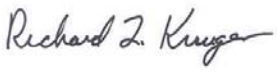
From:



Tom Lorz, Columbia River Inter-Tribal Fish Commission



Russ Kiefer, Idaho Department of Fish and Wildlife



Rick Kruger, Oregon Department of Fish and Wildlife

Cindy LeFleur, Washington Department of Fish and Wildlife

David Wills, US Fish and Wildlife Service

Dave Statler, Nez Perce Tribe

Date: **March 20, 2009**

Subject: **Technical Comments on the U.S. Army Corps of Engineers' application for a waiver to Oregon's total dissolved gas standard**

Contained within this memorandum are our technical comments on the U.S. Army Corps of Engineers' application for a waiver to Oregon's total dissolved gas standard for the purpose of voluntarily spilling water at the four lower Columbia River dams to assist in the passage of out migrating threatened and endangered salmonids (salmon and trout) and other anadromous species such as Pacific lamprey. The spilling of water introduces air into the spilled water and

results in total dissolved gas saturation in excess of Oregon's total dissolved gas water quality standard, 110 percent relative to atmospheric pressure. Dissolved gas super-saturation can produce a variety of physiological signs which are harmful or fatal to fish and other aquatic organisms and these signs are referred to as gas bubble trauma (GBT) or gas bubble disease.

The goal of the spill program is to provide benefits to migrating juvenile salmonids and other fish as they pass over dams, while not imposing harm from exposure to dissolved gas that outweighs the benefits of spill. The original waiver criteria for total dissolved gas (TDG) were established in 1994. This was the first time a waiver had been requested from the water quality agencies for variation from the national standard with the intent of providing survival benefits to migrating juvenile salmonids through additional spill passage. The waiver has been in place every year since 1994 and we support the continuation of this waiver for the requested five year period.

However, the applicant requests continuing the current total dissolved gas waiver limits of 120 percent TDG in the tailrace and 115 percent TDG in the forebay. The applicant requests waiver compliance to be measured by fixed monitoring stations located in the tailwater downstream of the aerated zone below the spillway at each mainstem dam, and in the forebay of the next project downstream. The applicant's request for measuring compliance at the forebay monitors and at the Camas/Washougal station is not consistent with the Oregon DEQ findings under the current Oregon DEQ Order, and the Oregon DEQ final decision under the Adaptive Management process. We support this application with the compliance monitoring wording contained in the proposed order that Oregon DEQ developed:
http://www.deq.state.or.us/wq/tmdls/docs/columbiariver/tdg/ProposedWaiver.pdf .

Biological Rationale

Juvenile Salmonids

Since 1995, the biological monitoring program has annually recorded the effects of the FCRPS biological opinion spill program and effects of TDG on incidence of GBT. The data observed over the years through the biological monitoring has consistently shown very low incidence of GBT when gas levels are at the 120% tailrace criteria. When fish are exposed to gas levels greater than 120%, there is an increasing trend in incidence and severity of these signs (Figure 1). For all fish examined through the Smolt Monitoring Program for signs of GBT when tailrace TDG levels were 120% or less the incidence of any fin signs observed in that population was less than 1%. This demonstrates a minimal effect of biological opinion spill levels over the last 11 years with TDG levels managed to 120% in the project tailrace. The percentage of fish with severity of GBT symptoms begins to increase above 120% and then dramatically increases above 125%, beyond the levels of the voluntary spill program.

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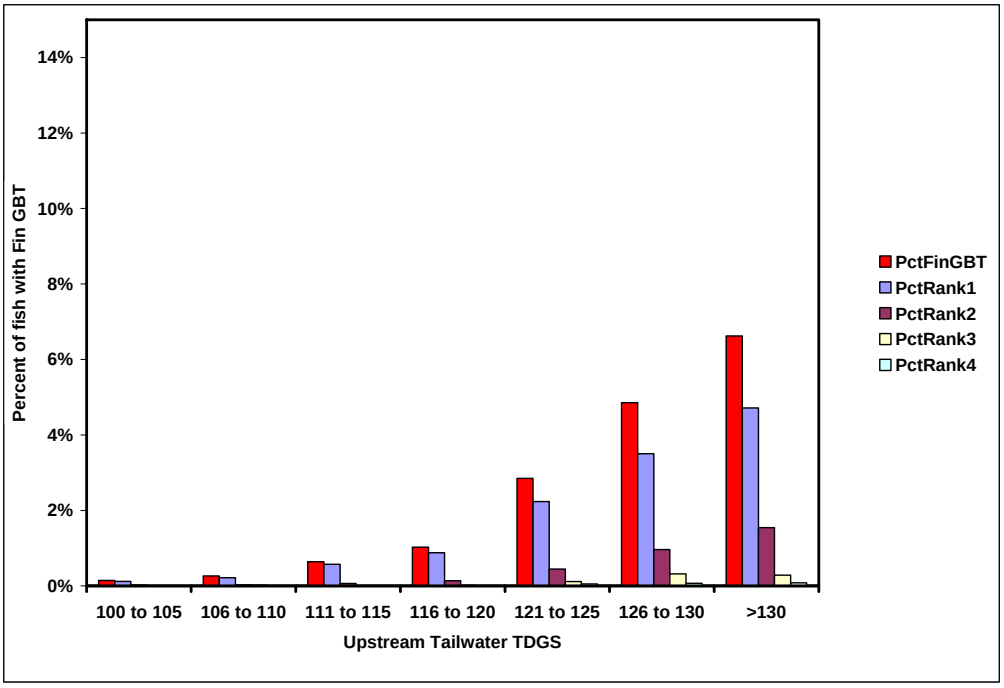

Figure 1. Percentage of all fish examined for GBT at Little Goose, Lower Monumental, McNary and Bonneville dams from 1995 to 2007 that showed GBT symptoms in fins by severity rank and TDG exposure based on upstream tailwater monitor and fish travel time from that site. Fin ranks are: rank 1 – less than 5% fin area covered with bubbles, rank 2 – 5 to 25%, rank 3 – 26 to 50% and rank 4 – greater than 50%.

Adult Salmon

Adult salmonids were monitored for signs of GBT through the 1999 spill season. Few signs of GBT were observed at TDG levels within the waivers. Additionally, juveniles are more susceptible to GBT, and if they are being monitored adequately the adults will also be protected (L. Marsh, Oregon Department of Environmental Quality, memorandum to the Environmental Quality Commission, March 27, 2000). Physical handling of adults adds extra stress.

Backman and Evans (2002b) found that in samples of 4,667 adult chinook salmon, fish were rarely observed with gas bubble trauma, despite sampling large numbers when total dissolved gas exceeded 130% saturation. Specifically, Backman and Evans (2002b) found no statistically significant relation between total dissolved gas and gas bubble trauma for chinook salmon. For adult sockeye and steelhead, Backman and Evans (2002b) found that most gas bubble trauma symptoms were minor (>5% fin occlusion) with severe bubbles (>26% fin occlusion) being observed only when total dissolved gas exceeded 126%, again beyond the levels of the voluntary spill program.

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Resident Fish and Invertebrates

The requested TDG variance is expected to have minimal impacts on resident fish or macro invertebrates in the Columbia River. The NMFS monitored resident fishes and aquatic invertebrates in the Columbia River downstream from Bonneville Dam for signs of GBT in

1993, 1994, 1995, and 1996. Organisms sampled included northern pikeminnow, bass, perch, catfish, crappie, sturgeon, shad, suckers, chub, sculpins, sticklebacks, minnows, crayfish and other crustaceans, clams, snails, and insects. Sampling in 1993 revealed a very low incidence of GBT in prickly sculpin (0.6%; 1 of 174 fish); peamouth chub, (0.4%; 1 of 238 fish); and threespine stickleback (0.2%; 2 of 906 fish). No signs of GBT were seen in the three species of invertebrates (crayfish, Asian clam, and dragonfly larvae) that were examined (Toner and Dawley, 1995). In 1994, no signs of GBT were observed in any of the 4,955 resident fish or 3,928 invertebrates that were examined (Toner et al., 1995). During 1995, signs of GBT were noted in five species of resident fish, but never exceeded 1% of those fish examined (Dawley and Schrank, 1995).

In 1997, resident fish were collected and examined for the TDG biological monitoring program in the Columbia River. Fish that were examined included peamouth, largescale sucker, mountain whitefish, northern pikeminnow, stickleback, redside shiner, sculpin, sandroller, pumpkinseed, and carp. A total of 214 individual fish of these resident species were examined for external signs of GBD. No signs of GBT were seen on any of those fish.

In 1998, only largescale suckers and mountain whitefish were examined. No signs of GBT were observed in these fish. In 1999, largescale sucker, northern pikeminnow, stickleback and sculpin were examined. Again, no signs of GBT were observed.

In addition, many of these resident species occupy shallow near shore areas that are out of the main current of the Columbia River. Such areas typically have lower total dissolved gas concentrations than those in the main current. Toner et al. (1995) indicated that the lower TDG levels in the shallow backwater and shoreline areas may be due to the lack of exchange with higher TDG water in the main river. Faster dissipation of gas from shallow water was also thought to occur because of its higher surface area to volume ratio.

Ryan et al. (2000) found only 3.9% of the almost 40,000 non-salmonid resident fish sampled (27 species) in the mid-Columbia and lower Snake rivers, Washington, showed signs of GBT during spring spill periods in 1994-1997, with TDG reaching above 135%. They concluded that GBT signs were rare in non-salmonid resident fish when TDG levels were less than 120%. Signs of GBT were rare with the invertebrate samples taken.

In work conducted with resident fish behavior relative to TDG supersaturation in the Lower Clark Fork River in Idaho, Weitkamp et al. (2003a) concluded that the fish behavior of the resident fish greatly influenced the degree of supersaturation the fish actually experience. In further work on the Lower Clark Fork River, Weitkamp et al. (2003b) found that the occurrence and severity of GBT was greatly lower than expected for the TDG levels measured (120-150%). Their conclusion was "... the majority of fish are spending sufficient time at depths that avoid or mediate both the incidence and severity of GBT when TDG supersaturation is in the range of 120-130% of saturation."

Fish benefits from maintaining spill at the 120% tailrace level.

Spill has been a key measure in NOAA Fisheries Biological Opinions to mitigate for the construction and operation of the Federal Columbia River Power System. The benefits of spill include the following:

- Spill provides a non-turbine, non-bypass route of passage past a hydroelectric project that has a higher associated juvenile survival benefit than turbine and screened system passage routes (NOAA 2000a). In addition, recent data suggests there may be some delayed effects of hydrosystem passage especially with bypass routes that are not manifested in juvenile survival. These delayed effects show in smolt to adult survival rates. Passage through multiple bypass systems seems to exacerbate these delayed effects, reinforcing the positive benefits of spill.
- The Fish Management agencies and tribes have consistently recommended a spread-the-risk management strategy between juvenile fish transportation and allowing fish to migrate in-river primarily through spill and/or other surface passage routes. Managing spill to the 120% tailrace level will assist in successfully implementing the spread-the-risk management strategy.
- Spill decreases forebay residence time, decreases migration rate (or travel time) and increases survival. Decreasing travel time has been shown to decrease exposure time to in-river predation. Also, survival to adult is increased when travel time is decreased and fish arrive at the estuary during the "optimal" biological window (Marmorek et al. 2004; Williams et al. 2005).
- Turbulence in tailraces from spill disperses predators and improves survival through this area.

Summary

In conclusion, we recommend managing fish spill and total dissolved gas based on 120% TDG measured in dam tailraces. The fishery agencies and tribes' "Spill and 1995 Risk Management" assessment originally established a range of 120-125% TDG as the transition zone where the effects of TDG would be increasing, but still very low. This has been reaffirmed by 1) the updated Risk Assessment for the Spill Program in the NOAA 2000 FCRPS Biological Opinion, 2) 14 years of physical and biological monitoring, 3) an independent scientific assessment and, 4) studies in the peer-reviewed literature. Over 200,000 salmonids have been evaluated for signs of GBT and less than 2% of those fish were observed with the most minor signs of GBT (less than 5% of a fin covered with bubbles) when spill levels were managed to 120% in the tailraces of dams. This is far less than the biological criteria established for the voluntary spill program of 15% of fish affected with minor signs. This shows that managing spill to 120% TDG criteria in the tailraces is conservative, and best protects the listed and non-listed fish populations of the Columbia River.

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