Columbia River Regional Forum
Regional Review of 2011 Post-Spill Season Monitoring Program
November 16, 2011
Portland, Oregon

1. Meeting Purpose and General Overview

The 2011 post-spill season review hosted by the U.S. Army Corps of Engineers (USACE) Northwestern Division Reservoir Control Center (USACE-RCC) was chaired and facilitated by Scott English. Representatives of the USACE Portland, Seattle and Walla Walla Districts; the U.S. Geological Survey (USGS) Oregon and Washington Water Science Centers (WSC); Bureau of Reclamation (BOR); Chelan County PUD; and Douglas County PUD reported on water quality monitoring activities and results in their areas during the 2011 spill season.

Each slideshow presentation included a system overview, description of fixed monitoring stations (FMS) and equipment in the area; a review of data completeness and quality; and a summary of seasonal compliance with applicable standards. The presentations are available on the USACE-RCC water quality webpage at http://www.nwd-wc.usace.army.mil/tmt/wqnew/, under TDG Monitoring Review Meetings.

2. Portland District

Tina Lundell, Portland District, and Dwight Tanner, USGS, reported. The Portland District manages 8 water quality FMSs in the lower Columbia, four of which operate year-round. The FMS gauges monitor water quality at Bonneville, John Day and The Dalles dams.

Equipment: The Portland District is using the same field and lab equipment as last year – Hydrolab minisondes, analog Vaisala barometers, and Sutron DCP data relay equipment. All equipment has been working well.

Season summary: High flows and spill in summer 2011 destroyed the Bonneville Dam tailwater FMS, and partially flooded the John Day Dam tailwater FMS. However, the Warrendale FMS remained operational and provided analog readings representative of Bonneville tailwater conditions, despite being found tipped on its side in September with the high river flow conditions. The John Day tailwater FMS kept transmitting data despite partial inundation, which corroded the connectors. Bonneville Dam and John Day Dam tailwater FMSs will all be reinstalled at higher elevations on the bank and operational by next spring.

During spill season there were several exceedances of 115% TDG saturation in forebay sites and 120% saturation in tailwater sites due to record high flows. A graph of the Warrendale FMS shows TDG levels in the Bonneville Dam tailrace exceeded 120% when spill was 300 kcfs. On May 24, spill of 270 kcfs destroyed the Bonneville Dam tailwater FMS.

Data completeness: Field checks were within ±1% saturation, barometric pressure readings were within ±1 mm Hg, and water temperature readings were within ±0.2°C. Lab checks of field instruments correlated within 0.5% TDG saturation. Data collection from all 8 sites averaged 93.5% complete and passed QA/QC.

Destruction of the Bonneville Dam tailwater FMS caused most of the missing data this season. On September 14, the floating dock that houses the Warrendale FMS was found tipped on its side. While some data were lost because the antenna was pointing in the wrong direction, the equipment was not damaged.

3. Seattle District

Kent Easthouse and John Lemons reported. The Seattle District monitors 5 FMSs – Chief Joseph Dam forebay and tailwater, Albeni Falls Dam forebay and tailwater, and Libby Dam tailwater. As a headwater project, Libby Dam doesn't have forebay FMS. All 5 sites are operated from April 1 through the end of September and calibrated every 2 weeks.

Equipment: All sites have the same equipment – Hydrolab minisondes, a Sutron barometer and Sutron DCP, operated on AC or solar power. Libby Dam operates completely on solar power. Albeni Falls Dam has AC power in the forebay FMS and solar power at the tailwater station. The tailwater FMS at Chief Joseph Dam represents undiluted spillway flow; it is not a mixed-river station. The Albeni Falls Dam forebay FMS is located on the left bank to accommodate the confluence of the Priest and Pend Oreille rivers. The Libby Dam FMS is half a mile downstream of the dam.

In 2011 there were problems with the clock in the Chief Joseph Dam forebay FMS, as well as barometer and DEP data transmission problems at Chief Joseph Dam. Occasionally the DCP at Libby Dam failed to transmit data.

Data completeness: Completeness of TDG data was high this year at around 98%, which is better than in previous years. This year there were data collection problems at Libby Dam, Albeni Falls Dam, and equipment failure in the Chief Joseph Dam forebay. Most of the data collected in 2011 has passed all QA checks.

Temperature data completeness was also around 98% and passing QA checks for all sites except Libby Dam, which was 50%. Calibration of data from laboratory and field readings was within 0.1°C - 0.2°C for temperatures, and within the ±10 mm Hg for TDG readings. Barometric data were within 2 mm Hg.

Season summary: On June 9 the Chief Joseph Dam tailrace FMS probe was enclosed in a pipe to protect it from high flows. Since 2009 it had been deployed outside the pipe because it had been found to respond slowly to changes in spill and TDG levels. When the probe was redeployed outside the pipe in 2009, it responded

faster and gave more accurate readings. The probe had been deployed outside the pipe from 2009 until the high flows of 2011.

On June 28, the probe was redeployed outside the pipe and a logger placed inside the pipe through July 24 so TDG readings from the two locations could be compared. Readings from inside and outside the pipe showed minimal disparities in saturation, rarely more than 1-2 mm Hg. In light of these findings, the Seattle District believes the Chief Joseph Dam tailrace TDG readings from June 9-28 are accurate and valid.

In summer 2011, Chief Joseph Dam had TDG readings of up to 140% in the forebay, caused by high spill through the outlet tubes at Grand Coulee. An unusual phenomenon has been observed in the Chief Joseph Dam tailwater: higher elevations produce higher gas levels. Apparently TDG levels at Chief Joseph depend on both tailwater elevation and the number of bays spilling. The maximum undiluted tailwater TDG reading in 2011 was 124% during 145 kcfs spill over only 17 bays. Spill over all 19 bays lowers tailrace TDG levels. When spill through all 19 bays resumed, tailrace TDG readings at Chief Joseph Dam dropped to less than 120%.

This year's data for Chief Joseph Dam spillway, undiluted by powerhouse flows, indicate that the flow deflectors are effectively reducing TDG in the river. For most of the 2011 spill season, TDG readings were less than 120% in the tailrace, even with TDG readings of up to 140% in the forebay and 145 kcfs spill through only 17 bays.

Because there is little stratification at Chief Joseph Dam, forebay and tailwater temperatures were nearly identical. Temperatures in the forebay exceeded 16°C from late July through end September and 18°C from late August through end September.

Forebay TDG at Albeni Falls Dam is largely dependent on flows from upstream. Cabinet Gorge and Noxon Rapids dams precede Lake Pend Oreille, providing distance for degassing to occur. Albeni Falls Dam forebay levels went as high as 122% TDG this year. The highest tailrace reading was 124% TDG when the project was spilling through 6 of 10 bays. Forebay TDG levels, head, and the number of spill bays in service all factor into tailrace TDG readings.

However, higher spill volumes at Albeni Falls Dam are not linked to higher gas levels because the project goes on free flow when spill volumes are high. There is little difference between forebay and tailrace TDG levels when the bays are open, an operation that produces no gas. On May 15, Albeni Falls Dam went on free flows, and data from that period confirm that forebay and tailrace TDG levels were almost identical.

Temperatures were cool on the Pend Oreille this year, with late warming and few days that exceeded the Idaho standard of 22°C (usually the river is warm for most of August). When Albeni Falls Dam went off free flows, TDG levels spiked at 124% for a few hours because spill was restricted to 4 bays. Typical spill at Albeni Falls Dam increases TDG levels 3-5% from forebay to tailwater. Temperature differences,

however, were nonexistent. Damage to the sensor at Albeni Falls Dam will be repaired before next spring.

Libby Dam has a maximum tailwater reading of 137% during 5 kcfs of sluiceway spill. Temperatures remained under 16°C, making 2011 an unusually cool year. Sluiceway spill at Libby Dam increased TDG levels significantly. Tailwater temperatures barely reached 15°C.

Bill Proctor, USACE RCC, asked whether there are temperature problems in Pend Oreille Lake late in the season. Yes, the Seattle District has done lots of temperature monitoring for bull trout, Kent Easthouse said. Dwight Tanner, USGS, asked whether Seattle District has tried using the new Hydrolab probes to speed up response time. Not yet, John Lemons said; the slow responses were probably caused by a TDG membrane issue.

4. Walla Walla District

Kevin Wright, USGS, and Dewey Copeland, USGS, reported. The Walla Walla District operates 15 FMSs (5 forebay and 6 tailwater) on the mid-Columbia, lower Snake and Clearwater rivers. Six of the FMSs are monitored year-round; the other 9 are seasonal. All FMSs are monitored weekly during spill season, and the 6 year-round stations are monitored monthly during non-spill season.

Equipment: The District uses 37 mini 4a and mini 5 sondes, a Heise calibrated digital pressure gage, digital thermometers, and a ParoScientific digital barometer that doesn't need to be recalibrated. All FMSs have Sutron barometers. The Walla Walla District purchases 25 membranes annually, and this year bought a new hand-held digital field barometer. New sensors that were replaced in 2010 seem to be working well but not as well as they did at first. District representatives will meet with Hydrolab soon to work on improving sensor performance.

Data completeness: This year data completeness averaged 99.7% for barometric pressure, 98.8% for TDG, and 99% for water temperatures. Dworshak Dam accounts for 71.7% of the missing or bad data; there was additional bad data from the Peck and Ice Harbor Dam tailwater FMSs. The Dworshak Dam DCP modem failure accounted for 1,200 of the 1,370 total hours of data lost in 2011. When the phone modem was replaced in June, the project lost only 18 hours of data. Data transmission problems at Dworshak Dam have been difficult to solve because the site is a four-hour drive from the lab. The District tried a number of remedies over the past two years and nothing worked until the modem was replaced.

Other data losses were caused by membrane or communication cord failures. After Dworshak, the stations with the most data lost were Ice Harbor Dam tailwater and the Clearwater River near Peck. The 15 FMSs lost 2.2% of data during spill season, slightly more than usual, but most of that resulted from the Dworshak Dam DCP failure.

The good news this year is that data completeness was 100% from the lower Snake River Anatone site as well as the forebay sites at Little Goose, Lower Monumental, McNary and Ice Harbor dams. The Anatone FMS transmitted good data despite breaking loose and floating downstream. It is being repaired now.

TDG pressure readings were within an average of 0.5 mm Hg pre- and post-deployment, with the largest span being 1.4 mm Hg. Water temperature readings were within 0.01^{o}C - 0.03^{o}C, barometric pressure readings were within an average of 0.2 mm Hg, and water temperature readings were within zero to one half degrees C.

Season summary: Solving the problems at Dworshak Dam FMS was a major accomplishment this year. Median differences between field and lab readings indicate that overall temperature and TDG readings were reliable.

5. Bureau of Reclamation

Norbert Cannon, BOR, and John Lemons, Columbia Basin Environmental, reported. The BOR maintains several water quality sites in the upper Columbia, beginning with the international boundary two miles downstream of the US-Canada border, several stations at Lake Roosevelt, Grand Coulee Dam forebay and tailwater, and Hungry Horse Dam tailwater. Most of these FMSs are maintained year-round. The Hungry Horse Dam tailwater FMS is maintained from March-September only.

Equipment: The Hungry Horse Dam tailwater monitoring equipment was newly installed this year and is well secured by a high fence.

Data completeness: All data received were within 0.5 % TDG saturation, and 0.5^{o}C.

Season summary: There were some DCP transmission problems in switching to the new Hungry Horse Dam tailwater FMS this year, but those were resolved quickly. The pipe had to be re-anchored during high flows but no data were lost.

6. Chelan County PUD

John Lemons, Columbia Basin Environmental, reported. Chelan County PUD maintains forebay and tailwater FMSs at Rocky Reach and Rock Island dams. Rock Island Dam has two powerhouses.

Equipment: Chelan PUD uses Hydrolab mini sondes. The Rock Island Dam tailwater gage rides out into the river on a cable. High flows jammed a log into the cage and the equipment continued to function, although there was no compensation depth. The tailwater FMS was quickly repaired and fewer than 24-hours of data were lost.

Data quality: Equipment calibrations were within 0.5% TDG saturation and one half degree C at all sites.

7. Grant County PUD

This live presentation was canceled, but the slideshow is posted online.

8. Douglas County PUD

John Lemons, Columbia Basin Environmental, and Beau Patterson, Douglas PUD, reported. Douglas County PUD maintains water quality FMS in the forebay and tailwater of Wells Dam. Wells Dam is a hydro-combine, meaning the powerhouse and spillway are in over-under configuration.

Equipment: The Wells Dam tailwater FMS, located 3 miles downstream of the project, runs on a solar panel. On June 11 the conduit pipe to the equipment was mangled by debris. Douglas PUD installed a probe outside the pipe when flows subsided. When the response was slow to changes in dam operations, at first this was attributed to a bad membrane. Extensive damage to the conduit became apparent when flows subsided. The station has been redeployed in a cage.

Data completeness: Data from Wells Dam FMSs were reliable but not on a real-time basis. Average readings were accurate; however, hourly measurements were less sensitive without the conduit. Douglas PUD will construct a new conduit before next spill season to recapture the lost sensitivity.

A new gas abatement plan requires Douglas County PUD to do additional water quality monitoring when TDG levels are above 125% at the Rocky Reach smolt bypass. There were a few instances of gas bubble trauma (GBT) at Rocky Reach Dam this year. However, sampling of spring chinook adults at the fish ladder found no cases of GBT, despite exposure to TDG saturation levels of well over 130% for sustained periods.

Season summary: The biggest challenge this year was having Wells Dam units 4 and 7 out of service during the freshet. Unit 7 is needed to keep spill shallow, and unit 4 remained offline until July. The two unit outages meant Wells Dam lost about 40 kcfs of powerhouse capacity while spilling much higher volumes than normal. Despite this constraint, there were no TDG exceedances in the Wells Dam tailwater during the rare periods when water coming into the project was below 115% saturation and flows were below the 7Q10 standard for water quality control. There were 6 days of exceedances in the Rocky Reach forebay downstream.

9. Wrap Up

Scott English asked for suggestions on the approach and format of next year's post-spill review meeting. There was continued interest in meeting face-to-face with the same meeting format. A participant expressed preference for meeting mid-month rather than early November.

Discussion turned to the 2011 TDG and Water Temperature Monitoring report. The narrative and appendices will contain essentially the same information as in previous years, except that not all appendices will be in printed format this year, English said. In response to a USACE survey of which sections get frequent use, the temperature graphs (previously Appendix H) will be posted online, with hyperlinks published in the annual report. Further, appendices A, B, C, E, J, K, and L will also be provided online. Appendices D, F, G, H, L and M will be provided in print. It was also discussed that there is strong consideration to only provide electronic copies of the annual report beginning 2012 (however, ODEQ and WDOE would continue to receive hardcopies in this scenario).

Norbert Cannon, BOR, asked whether there will be annual water quality reviews of the upper Willamette River. Tina Lundell, USACE team lead for Willamette BiOp implementation, said temperature concerns are the primary focus of the Willamette BiOp and TDG levels are not monitored in the Willamette Basin as they are in the Columbia and Snake rivers.

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