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MEMORANDUM

TO: Michele DeHart

FROM: Erin E. Cooper

DATE: August 2, 2013

RE: Survival Testing at Wanapum and Priest Rapids Dams

At your request, I have reviewed reports (Appendix A) on performance testing at the Grant County Public Utility District Wanapum and Priest Rapids Dams. These studies were mandated by the Salmon and Steelhead Settlement Agreement (SSSA 2005), and are part of the hydropower “no net impact” goal (FERC License No. 2114). As part of the SSSA, juvenile survival through each dam must be at least 93%, or a cumulative project survival of 86.5%.

The reports provided to the FPC include Steelhead and Sockeye survival studies from 2008 to 2010. I have identified a number of issues with these tests that indicate that they may not be representative of actual survivals through the projects. However, in many instances the information available is insufficient to truly evaluate the reports. Our concerns are highlighted below, with more detailed descriptions following.

- These studies are unlikely to represent the run-at-large. When smolts are selected for tagging, some will be rejected for size or condition. Unfortunately, the rejection rates are not included in the final reports for these studies. The reported survival estimates likely represent only the largest and healthiest smolts.
- Survival estimates in these reports are potentially inflated by the double-release study design. If survival of the control group is low due to handling or predation effects not experienced by the experimental group, dam survival will appear to be higher than the actual survival values. Because the survivals of each group are not included in each report, it is impossible to evaluate the potential effect on survival estimates.

- Survival estimates through the project are counted towards the “no net impact” assessments required by the SSSA. However, survival estimates from these studies do not account for delayed mortality resulting from dam passage but manifesting as downstream, estuary or ocean mortality.
- The acoustic tags in these studies range from 1.65 g in 2009 to 0.65 g in 2010. Acoustic tags may affect the behavior of smolts and therefore overall survival estimates. The variety of tag burdens across years indicates that studies may not be entirely comparable.
- The reports provided to the FPC include Steelhead and Sockeye survival studies. Chinook studies were completed with a different methodology between 2003 and 2005, and have not been updated since. No survival estimates have been generated for subyearling Chinook. No Steelhead survival estimates have met the standards set by the SSSA. However, project operations have changed significantly over the past several years without confirming that old or new operations are appropriate for fish passage.
- Final reports for survival studies in Grant County have not been easily available and do not include information necessary to evaluate their accuracy in estimating survival of the run-at-large.

Studies do not represent the run-at-large

Not all smolts are suitable for acoustic tagging. Smolts may be rejected from tagging due to size. Because smaller fish have a larger tag burden, there may be effects on behavior and survival. Smolts may also be rejected due to health and condition. In the Snake and Lower Columbia studies, fish are rejected due to descaling, malformations, fungal or other infections, and physical injuries. Rejection rates at Snake and Lower Columbia projects due to condition range from 2% to 13% of collected smolts (FPC Memo January 4, 2013).

When fish are rejected from tagging studies, the survival estimates apply only to the healthiest and largest portion of the population. These survival estimates therefore cannot be extrapolated to the entire population. The rejection rates of smolts due to size and condition are not included in any of the final reports, so it is not possible to calculate how representative the studies are of the run at large. For more detail on this topic, please see FPC memos on March 24, 2011; February 15, 2012; March 23, 2012; and, January 4, 2013.

Inflation of survival estimates due to study design

Adjusted survival estimates are presented as a ratio of the survivals of S_1 (dam passage) to S_2 (control). A crucial assumption is that mortality through the reaches downstream of the control release is equal for both groups. If mortality in the control group is high, due to handling effects, predation, or other factors not experienced by the dam passage group, the value of S_1/S_2 will be artificially inflated.

There are several reasons why the control group, released below the dam, may show mortality not experienced by the upstream release. If the experimental group is released far enough up river of the dam, smolts will disperse and pass through the dam in a way that is representative of

the run at large (assuming there is no tag burden that affects dam passage route). Their entry into the tailrace will not be an even distribution across the river, but will reflect the usage of the possible dam passage routes. The control groups in these studies were released at a single location mid-channel, which does not reflect the actual conditions experienced by migrating smolts (FPC Memo January 4, 2013).

A certain degree of disorientation can be expected from fish immediately following release. For fish released in the tailrace of the dam, this disorientation will make them more susceptible to predation in the tailrace than smolts with a longer distance to acclimate. The tailrace is likely to have higher predator densities than the reservoir (Petersen 1994, Ward et al. 1995) so this may increase mortality in the control group, therefore inflating overall dam survival.

Project survival does not incorporate delayed mortality

The premise of accepting 93% juvenile survival through the Wanapum and Priest Rapids dams is a no net-impact on salmon populations by hydropower projects. Juvenile mortality of 7% is accepted at each project, with the difference to be made up in habitat restoration projects. However, mortality through the project as measured through short reach survival may severely underestimate juvenile mortality due to dam passage. Numerous analyses have shown that dam passage, particularly through juvenile bypass systems and turbines, can significantly reduce survival downriver, in the estuary, and first year in the ocean (Schaller and Petrosky 2007, Petrosky and Schaller 2010, Tuomikoski et al. 2010, Haeseker et al. 2012, and FPC Memos May 21, 2009; February 3, 2010; October 5, 2010; January 19, 2011; July 14, 2011; and, March 9, 2012). The performance testing does not incorporate this additional mortality due to bypass and turbine passage.

Tag burden may affect smolt behavior

The acoustic tags in these studies have ranged from 0.65 g to 1.65 g. Tags of these sizes may affect smolt swimming behavior, thereby changing which passage route is most likely taken. Because survival estimates are generated using survival through each passage route and the proportion of smolts using each route, any change in behavior may significantly alter survival estimates.

Operations have been modified without meeting survival standards

No survival studies have been provided for review to FPC for yearling Chinook or subyearling Chinook. I have found references to survival studies using yearling Chinook and PIT-tag detections in 2003, 2004, and 2005. These studies will have a very different design than the acoustic tag studies reviewed here, and therefore we cannot comment on their suitability. However, project operations have changed at both Priest Rapids and Wanapum Dams since 2005. These changes have included the amount of planned spill, the location of spill, and the primary passage routes for juvenile fish. Survival estimates generated for yearling Chinook may no longer be applicable to current project conditions, and the lack of any data for subyearling Chinook prevents any conclusions regarding suitability of operations.

Although survival studies were conducted for Steelhead smolts in 2008, 2009, and 2010, none of these years met the project-wide survival requirement of 86.5%. This failure has been assigned

to mortality within the reservoirs and to high rates of failure, factors which have not negatively affected similar studies.

In conclusion, we feel that these survival studies should be considered only with serious reservations. Many factors may affect the applicability of the survival estimates generated by these studies, including rejection of smolts due to condition or size, tag burden, and the distribution of release groups across the study area. Perhaps more importantly, many studies have recently shown that dam passage can cause significant mortality downstream, in the estuary, and during the first ocean year, factors which are not accounted for in these studies.

References

- Haeseker SL, McCann JM, Tuomikoski JE, Chockley, B. 2012. Assessing freshwater and marine environmental influences on life-stage-specific survival rates of Snake River spring/summer Chinook salmon and steelhead. *Transactions of the American Fisheries Society* 141:121–138.
- Petersen JH. 1994. Importance of spatial pattern in estimating predation of juvenile salmonids in the Columbia River. *Transactions of the American Fisheries Society* 14:924–930.
- Petrosky CE, Schaller HA. 2010. Influence of river conditions during seaward migration and ocean conditions on survival rates of Snake River Chinook salmon and steelhead. 19:520–536.
- Priest Rapids Project Salmon and Steelhead Settlement Agreement. 2005. FERC Project No. 2114. 50 pg.
- Schaller HA., Petrosky CE. 2007. Assessing hydrosystem influence on delayed mortality of Snake River stream-type Chinook salmon. *North American Journal of Fisheries Management* 27(3):810–824.
- Tuomikoski J, McCann J, Berggren T, Schaller H, Wilson P, Haeseker S, Fryer J, Petrosky C, Tinus E, Dalton T, Ehlke R. 2010. Comparative Survival Study (CSS) of PIT-tagged Spring/Summer Chinook and Summer Steelhead 2010 Annual Report.
- Ward DL, Petersen JH, Lock JJ. 1995. Index of predation of juvenile salmonids by Northern Squawfish in the lower and middle Columbia River and in the lower Snake River. *Transactions of the American Fisheries Society* 24:321–334.

Appendix A: Reports from Grant County PUD reviewed for this memo

Skalski JR, Townsend RL, Sullivan LS, Wright CD, Neelson PA, Ransom BH. 2009. Survival of acoustic-tagged Steelhead smolts through the Wanapum-Priest Rapids Project in 2008. Prepared for Public Utility District No. 2 of Grant County.

Skalski JR, Townsend RL, Timko MA, Sullivan LS. 2009. Survival of acoustic-tagged Steelhead and Sockeye salmon smolts through the Wanapum – Priest Rapids Projects in 2009. Prepared for Public Utility District No. 2 of Grant County.

Skalski JR, Townsend RL, Timko MA, Sullivan LS. 2011. Survival of acoustic-tagged Steelhead and Sockeye salmon smolts through the Wanapum – Priest Rapids Project in 2010. Prepared for Public Utility District No. 2 of Grant County.