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MEMORANDUM

TO: Michele DeHart

FROM: Erin E. Cooper

DATE: July 11, 2013

RE: Survival Testing at Rocky Reach and Rock Island Dams

At your request, I have reviewed reports (Appendix A) on performance testing at the Chelan Public Utility District Rocky Reach and Rock Island Dams. These studies were mandated by the Habitat Conservation Plans (HCP), and are part of the hydropower “no net impact” goal (FERC License No. 943). As part of the HCP, juvenile survival through each project must be at least 93%.

These reports span a wide range of salmonid species, runs, river conditions, dam operations, tagging protocols, and experimental designs over 10 years. 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. My 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 toward the “no net impact” assessments required by the HCP. 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 0.65 g in recent years to 1.5 g in earlier studies. 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.
- These studies show high variability in survival estimates among years, many of which do not meet the requirements of 93% project survival. How each of these studies is averaged for an overall, inter-annual estimate of survival is unclear.
- Although numerous studies have been done to compare inter-annual variation and test survival under different operations for sockeye, steelhead, and yearling Chinook, subyearling Chinook survival requirements have not been met. However, summer operations continue without testing at Rocky Reach and Rock Island Dams.

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 largest and healthiest 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 dated 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, and, therefore, inflate overall dam survival.

Project survival does not incorporate delayed mortality

The premise of accepting 93% juvenile survival through the Rocky Reach and Rock Island 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 dated May 21, 2009; February 3, 2010; October 5, 2010; January 19, 2011; July 14, 2011; and, March 9, 2012). This is of particular concern when considering survival estimates at Rocky Reach, where all passage is via the juvenile bypass or turbines.

Tag burden may affect smolt behavior

The acoustic tags in these studies have ranged from 0.65g to 1.5g. 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.

Subyearling Chinook not included in performance testing

Survival estimates for subyearling Chinook have not been tested since 2004, when survival at Rocky reach was 0.69 and Rock Island was 0.910. Both of these survival estimates fall far below the 0.930 survival standard required by the HCP. Despite those low survival estimates, planned summer operations at both dams have not changed since 2004.

Reporting requirements are unclear and reports contain mistakes

Although FPC has reviewed all the reports which have been made available by Chelan County PUD, some reports have not been provided. Perhaps most importantly, studies utilizing the Rocky Reach juvenile bypass system in 2003 indicated that spill was not required for outmigrating yearling Chinook and steelhead smolts. These studies have not been made available for FPC review.

Many of the reports provided by Chelan County PUD are lacking in critical information, such as smolt rejection rates and the survival estimates used in the calculation of overall project survival.

In 2011, a summary table of HCP compliance testing at Rocky Reach was provided, with averaging across years. This table indicates that HCP compliance has been achieved for Sockeye, Steelhead, and yearling Chinook. Subyearling Chinook are not included. The data presented in this table for Sockeye survival estimates does not include studies done in 2005 (survival estimate of 0.892) or 2007 (survival estimate of 0.838). If 2005 and 2007 are included, the average survival across years would be reduced from the reported 0.936 (meeting HCP guidelines) to 0.908 (below HCP guidelines). The reasons for excluding these tests were unclear. If only the best survival estimates are included in generating average project survivals, they will not accurately reflect conditions through the project.

In the 2013 Comprehensive Progress Report, the three most recent study years are used for the average for each species. For Sockeye at Rocky Reach, the average project survival is reported as 93.6% and is generated using 2006, 2008, and 2009, with no explanation as to why studies from 2007 were excluded. If 2007 was used instead of 2006, the average project survival would be 90.5%, far below HCP guidelines.

Also in the survival summary included in the 2011 report are the yearling Chinook estimates. The 2004 study is reported as testing run-of-river, but that study was actually on hatchery Chinook and sourced from Turtle Rock Island Hatchery and so should not be included in this comparison. This mistake is also reported in the 2013 Comprehensive Progress Report.

In conclusion, I 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, an effect which is 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. *Ecology of Freshwater Fish 2010* 19:520–536.
- Rock Island Hydroelectric Project. 2002. Anadromous Fish Agreement and Habitat Conservation Plan. FERC License No. 943.
- 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 Chelan County PUD reviewed for this memo.

Skalski JR, Townsend RL, Steig TW, Horchik JW, Tritt GW, Grassell A. 2003. Estimation of Rock Island Project Passage Survival of Yearling Chinook Salmon Smolts in 2003 Using Acoustic and PIT-Tag Release-Recapture Methods. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW, Nealsen PA, Kumagai KK, Grassell A. 2005. Estimation of Survival of Yearling and Subyearling Chinook, and Sockeye Salmon Smolts, and Steelhead at Rocky Reach and Rock Island Projects in 2004 Using Acoustic and PIT-Tag Release-Recapture Methods. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW, Nealsen PA, Grassell A. 2006. Survival of Yearling Chinook, Sockeye Salmon, and Steelhead Smolts through Rocky Reach and Rock Island Projects in 2005. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW, Nealsen PA, Grassell A. 2007. Survival of Sockeye Salmon and Steelhead Smolts through Rocky Reach and Rock Island Projects in 2006. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW, Nealsen PA, Grassell A. 2008. Acoustic-Tag Investigations of Sockeye Salmon Smolt Survival and Migration Dynamics at Rocky Reach Dam in 2007. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW, Nealsen PA, Grassell A. 2008. Survival of Yearling Chinook Salmon Smolts through the Rock Island Project in 2007. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW, Nealsen PA, Hemstrom S. 2008. Survival of Yearling Chinook Salmon, Steelhead, and Sockeye Salmon Smolts through the Rock Island Project in 2008. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW, Nealsen PA, Hemstrom S. 2008. Acoustic-Tag Investigations of Sockeye Salmon Smolt Survival and Migration Dynamics at Rocky Reach Dam in 2008. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW, Nealsen PA. 2009. Survival of Sockeye Salmon Smolts Through The Rock Island Project in 2009. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW, Nealsen PA. 2010. Survival, Diel Passage, and Migration Dynamics of Sockeye Salmon Smolts at Rocky Reach Dam in 2009. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW. 2010. Survival of Yearling Chinook Salmon and Steelhead Smolts Through the Rock Island Project in 2010. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW, Neelson PA. 2011. Survival, Diel Passage, and Migration Dynamics of Yearling Chinook Salmon Smolts at Rocky Reach Dam in 2010. Prepared for Public Utility District No. 1 of Chelan County.

Skalski JR, Townsend RL, Steig TW, Neelson PA. 2012. Survival, Diel Passage, and Migration Dynamics of Yearling Chinook Salmon Smolts at Rocky Reach Dam in 2011. Prepared for Public Utility District No. 1 of Chelan County.