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MEMORANDUM

TO: Ed Bowles, ODFW
Rick Kruger, ODFW

FROM: Michele DeHart

DATE: March 16, 2012

RE: FCRPS Juvenile Performance Standard and Metrics

In response to your request, the FPC staff reviewed the Draft document entitled, "Federal Columbia River Power System Juvenile Dam Passage Performance Standard and Metrics", (the document) dated January 2012. The document summarizes the Biological Opinion performance standard language and describes the "Virtual Paired Release" study design utilized at The Dalles, John Day and Bonneville dams. The objective of the document is to describe the basis of decisions, establishing a decision framework for specific hydroelectric project operations such as spill level. The document states that these decisions will be based upon 1) the results of the Virtual Paired release studies and, 2) on past studies according to criteria identified in Appendix B. A Decision Framework, as described in the scientific literature, is defined as a method of organizing and evaluating information, leading eventually to the making of a decision. The subject document proposes to base the decision of hydroelectric project operations entirely on a single source of information, either the results of virtual paired release acoustic tag studies when current studies are implemented or, historic study results, when new virtual paired release studies have not been implemented.

Our overall conclusion is that the approach described in this document is too limited to provide a basis for hydro project operations decisions and is inconsistent with the adaptive management approach described in the Biological Opinion. Recent data and analyses indicate that hydro project operations and passage through hydro projects has impacts on subsequent life stage survival. Decisions, as proposed in this document, based upon the one set of data with its significant limitations, could result in erroneous, regrettable,

management actions. Following for your consideration are our specific comments followed by a detailed discussion of each comment. We also submit a proposed Alternative Decision Framework that incorporates a more appropriate approach.

- **The document is inconsistent with the "FCRPS Adaptive Management Implementation Plan, 2008-2018, (2009), which states that:**
  "These programs are informed by on-going research, monitoring and evaluation (RM&E) about the status of the listed species and the effects of the RPA. The Action Agencies and NOAA Fisheries are managing the RPA actions adaptively, through 2018, to insure they incorporate the best available science….."

  And further states:
  "The 2008 RPA uses adaptive management to respond to results of new research and other scientific information on fish survival. As more is learned over time, mitigation action and studies will be updated to reflect the best available scientific information and to achieve the biological opinion performance standards and survival improvements….."

- **The document is inconsistent with Adaptive Management because it does not incorporate new information and the best available science. The document proposes to base specific hydroelectric project operations decisions on one limited set of acoustic tag data, ignoring other recent data and analyses. In particular the document does not incorporate new data and analyses that indicate that significant delayed mortality is associated with powerhouse passage, resulting in reduction in smolt-to-adult return rate.**

- **Significant technical issues and limitations regarding the implementation and analyses of acoustic tag study results, preclude their use as the singular basis of project operations decisions as proposed in the draft document**.

- **Important fish passage metrics, spill passage efficiency and forebay delay are not fully considered in project operations decisions in the document.** The decision process described in the proposed document, regarding operations does not include improvement of these metrics which as indicated in recent analyses are important in subsequent life stage survival.

- **We disagree with the utilization of historic studies to evaluate performance standards as described in Appendix B.** Historical "at concrete" survival estimates all have the same drawbacks as recent project survival estimates. In addition the historic studies were designed for differing purposes. Each individual study, design, methodology, implementation and analyses must be reviewed to determine whether application to the performance standard question is advisable.

The document is inconsistent with adaptive management because it does not incorporate new information and the best available science.

A central tenet of the Adaptive Management approach involves a continual learning process (Walters 1986). This document does not incorporate what has been learned through new data and analyses regarding the impacts of hydroelectric project operations on salmon and steelhead. The document does not address a fundamental component of all environmental assessments; that events in one place can re-emerge as impacts at distant places (Holling 1978). Specifically, the document, regarding at dam performance standards should incorporate new science to be consistent with the Adaptive Management component of the Biological Opinion. An emerging body of data and analyses indicate that "at concrete evaluation of survival" as proposed in the document, will ignore important and significant impacts of project passage on latter parts of the life cycle of salmon and steelhead. These new data and analyses indicate that hydroelectric project operations have far reaching impacts on salmon and steelhead life-cycle survival including, juvenile reach survival, juvenile fish travel time, early ocean survival and adult return rates. The "at concrete evaluation of survival" as proposed in the document, will fail to address important and significant impacts of project passage on the life cycle of salmon and steelhead and subsequent adult returns. In addition, the apparent significant technical issues and limitations regarding the implementation and analyses of acoustic tag study results preclude their use as the singular basis of project operations decisions as proposed in the draft document. The document is inconsistent with adaptive management because it does not incorporate new information and the best available science.

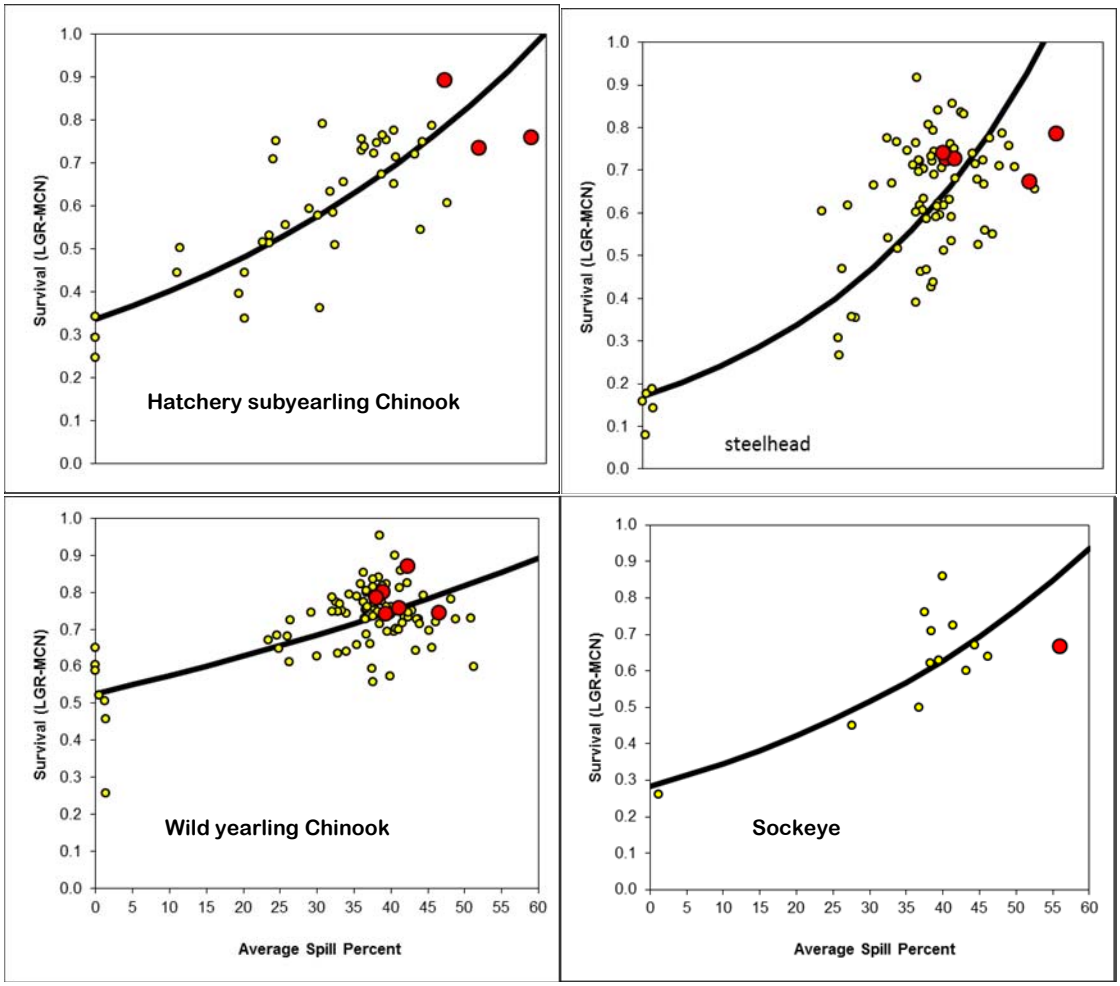
Juvenile passage through powerhouses and bypass systems is now known to have a significant impact on adult returns that is not represented by the immediate project survival estimates generated from acoustic tagging studies. The NPCC, Independent Scientific Advisory Board (ISAB) concluded that the available evidence demonstrates that fish bypass systems are associated with some degree of latent mortality (ISAB 2012-1). The analyses conducted in the Comparative Survival Study (CSS) for juvenile PIT tagged Chinook and steelhead that migrated past hydroelectric projects via bypass or non-bypassed routes showed reduced adult returns in the group that migrated via the juvenile bypass systems (Tuomikoski et al. 2010).

Numerous published analyses indicate that freshwater migration conditions are related to early ocean and estuarine survival. Petrosky and Schaller (2010) showed that lower survival rates for Chinook salmon are related to warmer ocean conditions, reduced upwelling in the spring and with slower river velocity or multiple passage through powerhouses at dams. In another published analyses of Columbia River spring Chinook, delayed mortality persisted even under favorable ocean conditions, indicating that the operation of the hydroelectric system is a key element contributing to delayed mortality (Schaller and Petrosky 2007). CSS analyses indicate that juvenile fish travel time and reach survival are related to project spill levels, surface spill bypass and water travel time. For sockeye salmon, spill was the primary variable affecting fish travel time (Tuomikoski et al. 2011). In three separate memorandums the Fish Passage Center concluded that there is a there is a broad range of evidence indicating that delayed and or latent mortality is associated with juvenile fish bypass through powerhouses (FPC Memos May 21, 2009: Feb 3, 2010; Oct 6, 2010; Jan 19, 2011). Recent published analyses found that improvements in life stage-specific and smolt-to-adult survival may be achievable across a range

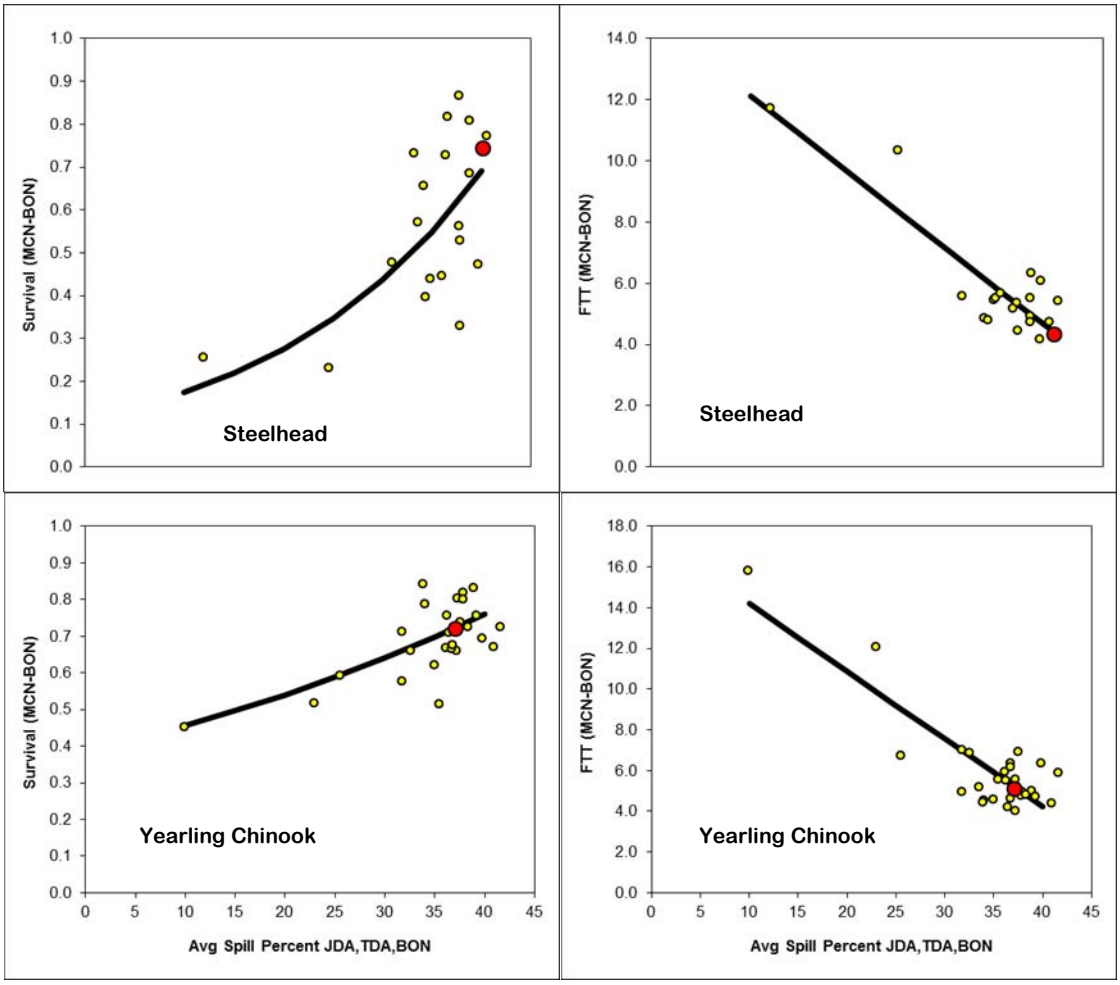
of marine conditions through increasing spill percentages and reducing water transit times during juvenile salmon out-migration (Haeseker et al. 2012).

Faulkner et al. (2010) concluded that, despite relatively lower flows and water velocities in 2010, yearling Chinook salmon and steelhead migration rates through the hydropower system were near average, and faster (i.e., travel times shorter) than those in years with similar levels of flow. Relatively high spill proportions and the use of surface collectors at most projects likely helped compensate for the lower water velocities by shortening fish travel times. The following figures show the relationship of project spill level to reach survival and fish travel time.

Lower Granite to McNary 1998-2011 juvenile reach survival versus annual spill percentage



McNary to Bonneville 1998 -2011, juvenile survival and juvenile travel time versus annual spill percentage



Establishing at project spill levels on the basis of "at concrete" project survival estimates as proposed in the document, does not incorporate or address new knowledge regarding the delayed effects of hydroelectric project operations, and the wide range of life cycle benefits resulting from higher spill levels. In addition establishing project spill levels as proposed in the document only provides partial mitigation for the impacts of specific hydroelectric project operations.

Significant technical issues regarding the implementation and analyses of acoustic tag study results, preclude their use as the singular basis of project operations decisions as proposed in the draft document.

The document does not provide a decision framework because it fails to address the significant recognized limitations of the acoustic tag virtual paired release study design, including concerns regarding representation of the run-at-large, recognized potential for results that are biased high and the subjective nature of analyses and development of results. These issues have become apparent in the implementation of acoustic tag studies conducted at Bonneville, The Dalles and John Day dams. Comments received on the virtual release study design, when it was originally proposed raised significant issues and doubts regarding the limitations of these data.

The virtual release study design, which includes two control groups, has generated concern about the potential for dam survival estimates to be biased high. This may result from random effects whose significance increases due to the inclusion of a second control group (Beeman et al. 2011). Although these effects are small in absolute numbers, the inflation of dam survival estimates may be enough to artificially indicate that performance standards have been met.

If both control groups do not experience the same mortality levels, the result will be systematically inflated dam survival estimates. Because the control groups are released in different stretches of river, the assumption of equal mortality is not trivial. If predation rates are higher in the dam tailrace than elsewhere in the study region, estimates of dam survival will be significantly higher than in the single-release design. Predator densities in the tailrace of the dam may be higher than elsewhere in the river (Poe and Rieman 1988). For a detail description of an upward bias in dam survival estimates, please see the March 24, 2011 FPC Memo and Beeman et al. 2011.

The process of marking fish with acoustic tags has serious limitations regarding how representative results are of the overall population. The size of tags requires fish smaller than 95 mm to be rejected from the study. A number of fish conditions, including disease and descaling, can cause fish that are the correct size to still be rejected from the study. In 2010, 16% of fish collected randomly from the population of fish collected at John Day Dam were rejected from acoustic tagging studies due to size or condition. The survival estimates from these studies reflect survival only for the largest and healthiest 84% of the fish population, and is not representative of the total effect of the project on the run-at-large. This issue has been raised in previous FPC memos, including: June 24, 2009; March 24, 2011; and February 15, 2012.

Furthermore if acoustic tags affect fish behavior, the rate at which fish choose various passage routes may be affected. Project survival is a function of survival through each passage and the percentage of fish that take each route, so any study methodologies that affect behavior may bias total project survival in a way that is not representative of the run-at-large. Effects of tags on fish behavior have been raised by FPC Memos on June 24, 2009 and February 15, 2012.

The lack of a public acoustic tag data base and rigorous protocols for the selection of data prior to analyses has created problems for the repeatability of analyses and results. Acoustic tag data analyses are inherently dependent upon subjective selection of detection data analyzed. The

criteria, method or basis for including detection data into the analyses is not described. The subjective nature of detection data selection and the lack of a public acoustic tag data base preclude the replication of results and conclusions. For example, when the FPC analyzed acoustic tag survival estimates, developed by PNNL, with two different spill operations, the FPC results were opposite those published by Pacific Northwest National Laboratories (PNNL). Subsequent examination showed that PNNL utilized a sub-set of the acoustic tag detections, while FPC utilized all of the data. Although PNNL selected a subset of the total available data, their criteria for excluding data was not described. The FPC memos from July 29, 2010; February 16, 2011; and June 21, 2011 provide extensive detail about these methodological problems and the apparent subjectivity of acoustic tag data.

The problems with acoustic tagging studies including systemic biases, tag size requirements, and the post-hoc selection of data has led us to the conclusion that there are inherent issues and limitations with this method for estimating dam survival. Due to these limitations, it is clear that acoustic studies should not be utilized as the exclusive measure of hydro system performance.

Important fish passage metrics, spill passage efficiency and forebay delay are not fully considered in project operations decisions in the document.

The emerging body of data and analyses indicating that spill level and juvenile route of project passage affects not only juvenile reach survival and juvenile fish travel time, but also subsequent life stages such as first year ocean survival and adult return elevates the importance of passage metrics such as spill passage efficiency and forebay delay in decisions regarding the best hydro project operations for fish survival. Recent CSS analyses (Tuomikoski et al. 2011) indicate that juvenile spill way passage assessed using spill proportion is a primary variable affecting juvenile reach survival and juvenile fish travel time. SPE and forebay delay metrics relate directly to the relationship of hydroelectric project operation on juvenile reach survival and juvenile fish travel time. In addition, Scheuerell et al. (2009) found that juvenile migration timing plays a large role in juvenile-to-adult survival in Snake River spring/summer Chinook and steelhead. In particular, early migrating individuals had higher juvenile-too-adult survivals than those migrating later in the season. Scheuerell et al. (2009) went on to suggest that management strategies that increase downstream migration of juvenile Chinook and steelhead, allowing them to reach the estuary sooner, may be beneficial. This earlier timing may be achieved by increasing flows through the FCRPS or increasing the amount of water spilled over the dams

We disagree with the utilization of historic studies to evaluate performance standards as described in Appendix B.

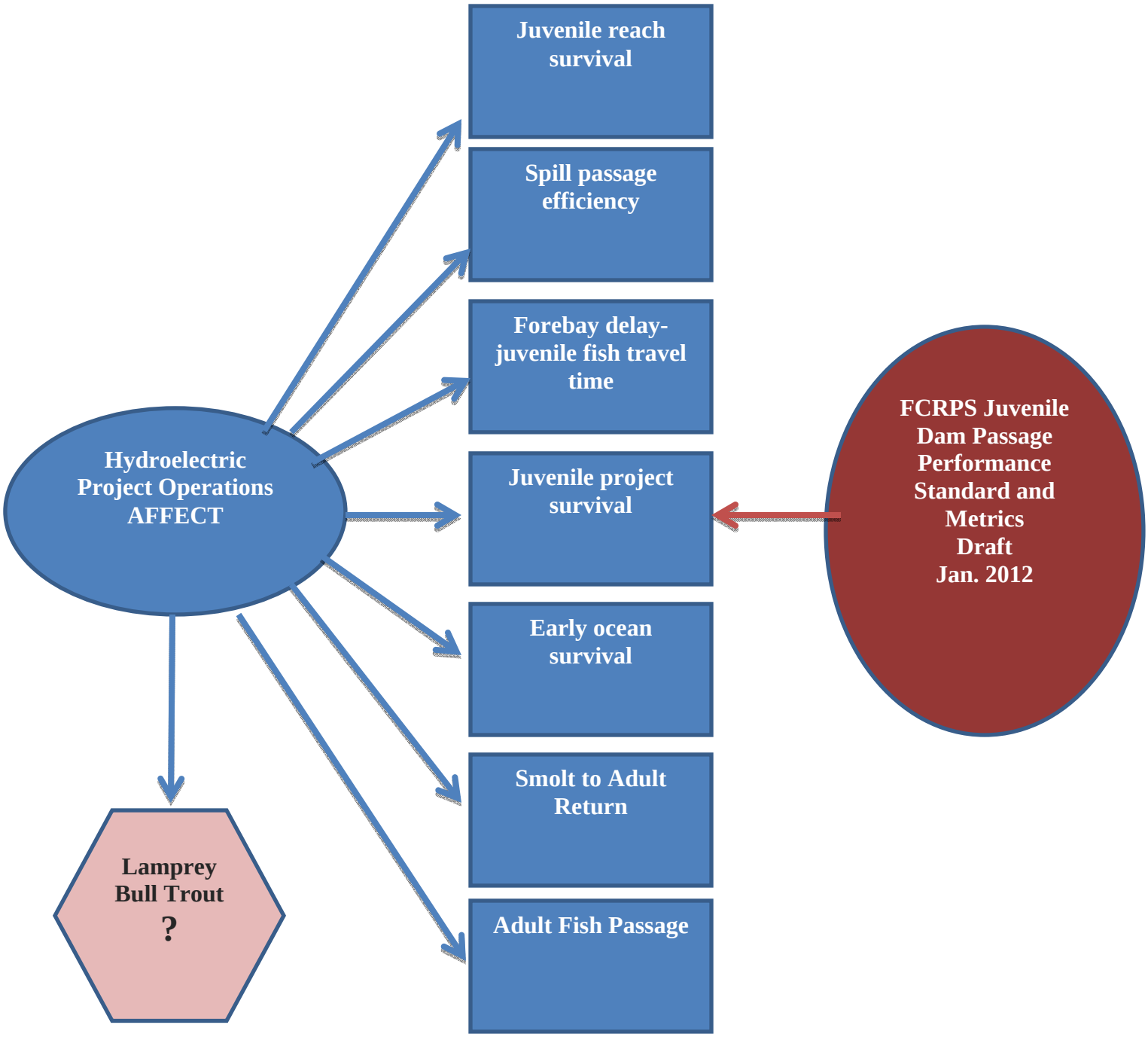
At project survival estimates whether completed in past years or recent years cannot be utilized to establish project spill passage levels because they all suffer the same fatal flaws of the virtual release acoustic tag performance standard studies described in the document; they do not incorporate the long term delayed effects of hydroelectric project operations on subsequent life stages and adult returns. In addition, fundamental elements of the historic studies such as selection criteria or in other words, high grading of test fish are not documented, potential subjective data processing is not documented in these historic studies and the purpose of these studies was not to evaluate performance standards. These issues limit the application of the

historic study results to the run-at-large as is expected in performance standard evaluations. Each historic study proposed for application to performance standard evaluation should be reviewed specifically to assess, representation of the run at large by test groups, application to the entire passage distribution of the run at large, study methodology and analyses.

Alternative Decision Framework

A decision framework to determine hydro project operations should be based upon an ecosystem approach and should incorporate the apparent impacts of hydro project operations on all salmon, steelhead and lamprey life stages. Linkov (2006) suggests multi-criteria decision analysis and adaptive management as a viable approach to ecosystem management decisions. The document is inconsistent with the NOAA FCRPS Biological Opinion multi-level life cycle (NOAA 2008) basis of the Biological Opinion analyses, by not addressing the hydro project operations extended life cycle effects on salmon, steelhead and lamprey. An alternate decision framework that is consistent with adaptive management would incorporate all of the impacts of hydroelectric project operations, on all species and life stages, into the management decision determination specific project operations. This should include all facets of project operations such as operating pool elevation, level of spill, timing of spill and duration of spill for fish passage. A complete decision frame work would include all impacts of project operations including; smolt-to-adult return, spill passage efficiency, forebay passage delay, juvenile reach survival, fish travel time, project survival, early ocean survival, and other species such as lamprey and bull trout. It is important to address all of the life cycle impacts of hydroelectric project operations in determining the most direct and efficient mitigation measures and hydroelectric project operations. If the document does not address all of the known extended impacts of hydroelectric project operations, the mitigation decision will fall short and hydroelectric project impacts will be addressed indirectly, perhaps inefficiently or incompletely by other actions or other resource allocation decisions. In a hypothetical example, an incomplete decision framework which does not address all of the impacts of hydroelectric project operations might result in not addressing delayed mortality associated with power house passage. This in turn would reduce smolt-to-adult return which could reduce adult return benefits from habitat improvement projects, hatchery improvement projects, and could impact harvest management and other components of resource management. The unaddressed impacts of hydroelectric project operations could require other resource allocations and mitigation measures to address the unaddressed impacts of hydroelectric project operations.

Although hydroelectric project operations have been shown to affect multiple components of the juvenile life stage and have been shown to have far reaching effects throughout the salmon and steelhead life cycle, the federal agencies FCRPS Juvenile Dam Passage Performance Standard and Metrics Draft, January 2012, only addresses one component of one life stage, and does not address any impacts on other species.



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