

STUDY NO. 3: TURBINE PASSAGE SURVIVAL ANALYSIS

3.1 Goals and Objectives - §5.9(b)(1) — Describe the goals and objectives of each study proposal and the information to be obtained

ODFW Proposal:

The U. S. Bureau of Reclamation (USBR) and Ochoco Irrigation District currently manage Bowman Dam operations primarily for irrigation storage, recreation and fish and wildlife. With the potential of hydroelectric development there is the potential for entrainment of fish through the proposed hydro-turbines. This potential entrainment is a resource issue requiring further analysis.

The proposed study would analyze the seasonal water-year rule-curve, as well as the annual variation associated with the range of low runoff years and high runoff years and how this affects the depth of the pool over the intake structure and the effects on the rates of entrainment. ODFW suspects that as pool elevation decreases entrainment may be more likely (ODFW 1996).

Additional specific concerns include determining what time of year oxygen and other water quality parameters might limit fish access to the outlet intake which might to some degree decrease entrainment potential. ODFW recommends seasonal temperature, pH and oxygen profiles be compiled to investigate this potential.

ODFW recommends that OID conduct an analysis of annual variation of the reservoir water level for mean, dry, and wet years. ODFW recommends modeling how future operational changes that may be contemplated will affect the reservoir rule curves for filling and discharging. Changes due to natural variation of the hydrograph and changes to the operating rule curve for the project may affect reservoir water quality, elevation, magnitude and condition and of entrained fish.

The proposed Project turbine configuration includes installing two vertical Francis turbines. It is unclear what the operational head range of the project would be. ODFW recommends that the report include an analysis of the operational range of head, including a generation exceedance curve. The report should also include an analysis of the magnitude of fish passage at various pool elevations (and head), turbine efficiency, and the predicted effects on fish.

The proposed Project will use the dams' existing deep-water intake. Resident fish that have acclimated to those depths and abruptly pass downstream through the existing intake would likely experience mortality due to sudden pressure changes, as the rapid transit time does not allow sufficient time for fish to make adjustments in swim bladder volume to accommodate pressure changes (Cada 1990). Fish that are not acclimated to depths may survive passage at a higher rate, which raises concern regarding survival of non-native fish species and hatchery-raised trout impacting anadromous fish present in the system, once they are entrained through the intake.

OID Response:

It is important that ODFW and others understand that the project would not control the reservoir operations and releases made from the reservoir. The amounts of water to be released to meet downstream water uses including fish and wildlife benefits are defined by the Crooked River Collaborative Water Security and Jobs Act of 2014. The timing of these releases are established by existing contracts and water rights and releases for fish and wildlife benefits are the subject of ongoing negotiations. USBOR manages reservoir elevations and releases and power generation by the proposed project would utilize USBOR's release schedule but will not regulate them.

This ODFW proposed study appears to seek information regarding factors that might influence entrainment such as depth, release flows and timing, and water quality parameters. These conditions would not change with the proposed project. The addition of pressure reducing valves and hydropower turbines will change how water is released on the downstream end of the passage likely reducing total dissolved gases and benefiting the native fishery below the dam.

3.2 Relevant Resources Management Goals - §5.9(b)(2) — If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.

ODFW Proposal:

ODFW has multiple resource management goals derived from Oregon statute and adopted rules that guide our recommendations in hydro licensing processes. Permeating each of these policies is the goal of protecting and restoring native fish and wildlife populations for use and enjoyment by present and future generations. Key directives to ODFW for implementing fish and wildlife management strategies include; avoidance of impacts to these populations, protection of genetic diversity, and protection and restoration of natural habitats on which these populations are dependent.

Oregon’s fish screen law (Oregon Revised Statute 498.306) may require the owner or operator of a diversion located in waters in which native and naturally spawning fish are currently present to address fish screen requirements.

OID Response:

OID understands and supports ODFW’s statutes and rules that govern its management policies. However, ODFW does not describe its management goals for Prineville Reservoir or the Crooked River downstream of Bowman Dam. Based on the goals and objectives described for other study requests, OID assumes the management goals and objectives are to protect and manage the reservoir fishery through artificially stocking rainbow trout and managing the reservoirs warm water fishery. Downstream of the dam ODFW’s goal is to protect the native wild redband trout and mountain whitefish fishery and passage of reservoir species to the lower river may be negatively impactful. For example, if rainbow trout are able to survive passage from Prineville Reservoir to the Crooked River downstream, there would be a potential for these fish to hybridize with the native redband trout and compromise their genetic integrity. Additionally, passage of warm water fish could cause predation on the native fish in the river. Both potential results of passage are incongruous with the identified management goals.

3.3 Background and Existing Information - §5.9(b)(4) — Describe existing information concerning the subject of the study proposal, and the need for additional information.

ODFW Proposal:

The proposed project would utilize the USBOR’s Bowman Dam, which is operated for irrigation storage and flood control. The dam is an earth-fill structure with a height of 245 feet, crest length of 800 feet, and a spillway consisting of an uncontrolled-crest inlet structure, discharge chute, and stilling basin. The outlet has a 120-foot deep intake structure with an 11-foot diameter circular tunnel upstream from the gate chamber, an 11-foot, modified horseshoe tunnel downstream from the gate chamber, and a stilling basin shared with the spillway. While the outlet is located at a depth of 120 feet, this elevation is not constant. Intake depth may be 120 feet at full pool, but when the pool elevation is reduced, which occurs often, the depth of the outlet is reduced as well.

The proposed Project turbine configuration includes installing two vertical Francis turbines. It is unclear what the operational head range of the project would be. ODFW recommends that the report include an analysis of the operational range of head, including a generation exceedance curve. The report should also include an analysis of the magnitude of fish passage at various pool elevations (and head), turbine efficiency, and the predicted effects on fish.

The proposed Project will use the dams' existing deep-water intake. Resident fish that have acclimated to those depths and abruptly pass downstream through the existing intake would likely experience mortality due to sudden pressure changes, as the rapid transit time does not allow sufficient time for fish to make adjustments in swim bladder volume to accommodate pressure changes (Cada 1990). Fish that are not acclimated to depths may survive passage at a higher rate, which raises concern regarding survival of non-native fish species and hatchery-raised trout impacting anadromous fish present in the system, once they are entrained through the intake.

As a part of an earlier desktop study for a previous Bowman dam hydropower application (Kleinschmidt 2012), data when graphed, shows larger fish have a better chance of survival. This point relates directly back to ODFW's concerns about non-native and hatchery-raised fish being passed through the intake and surviving in the river, below Bowman Dam. ODFW knows this currently occurs and does not want to have a situation created that would increase the number of these undesirable fish species where they would negatively impact re-introduction and establishment of anadromous fish in the Crooked River.

As previously mentioned, while some data is available from the Kleinschmidt desktop study, there is a need to address a number of variables that were omitted or not considered as a part of the study. Additionally it is important that the information collected as part of this study be paired with the results of the Study 2: Prineville Reservoir Fish Entrainment Study, which will provide field data obtained via, e.g. screw trap sampling or other sampling methods relative the turbine strike potential impacts.

OID Response:

Kevin: OID requests the following information:

- *Range of the operational head*
- *Generation exceedance curve*
- *Turbine efficiency curve*
- *Maximum and minimum flow through each unit*
- *Can you give an estimate of the pressure gradient any entrained fish may experience?*
- *Can you give an estimate of the dimensions of the two units, wicket gate openings, etc. that may affect fish passage.*

It is OID's understanding that this requested study is a desktop analysis to estimate the potential for entrained fish to survive passage through the dam outlet and powerhouse turbines. ODFW indicates that fish do survive but does not provide the evidence supporting this statement. ODFW also refers to a Kleinschmidt 2012 study but does not provide the full citation. OID requests that ODFW provide the cited evidence that reservoir species are able to survive entrainment and the Kleinschmidt 2012 report.

3.4 Project Nexus - §5.9(b)(5) — Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.

ODFW Proposal:

ODFW has multiple resource management goals derived from Oregon statute and adopted rules that guide our recommendations in hydro licensing processes. Permeating each of these policies is the goal of protecting and restoring native fish and wildlife populations for use and enjoyment by present and future generations. Key directives to ODFW for implementing fish and wildlife management strategies include; avoidance of impacts to these populations, protection of genetic diversity, and protection and restoration of natural habitats on which these populations are dependent.

OID Response:

ODFW only states that it has multiple management goals derived from Oregon statutes and adopted rules. It does not explain the nexus between project operations and effects on the resource being studied. However, OID understands ODFW's goal is to prevent reservoir fish from being entrained from Prineville Reservoir and passing through the dam outlet and powerhouse turbines into the river downstream. ODFW has expressed knowledge that undesirable fish are currently surviving entrainment and passage. Therefore this study should focus on the survivability during passage through the proposed outlet energy dissipater and powerhouse turbines.

3.5 Proposed Methodology - §5.8(b)(6) — Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field seasons(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.

ODFW Proposal:

While a desk analysis of existing data used at some project developments, including one collected as part of an earlier Bowman Dam Hydropower FERC application (Symbiotics LLC. – FERC No 11925) are available, it is not one that ODFW believes is fully comprehensive and inclusive of the all necessary information to fully inform the turbine strike analysis effects.

The report should analyze the seasonal water-year rule-curve, as well as the annual variation associated with the range of low runoff years and high runoff years and how this affects the depth of the pool over the intake structure and the effects on the rates of entrainment. ODFW suspects that as pool elevation decreases entrainment may be more likely (ODFW 1996).

OID Response:

OID agrees to a desktop analysis of the survivability of entrained fish passing through the proposed energy dissipater and powerhouse turbines. The project would not change the configuration of the intake or operations of the reservoir; therefore, the rate of entrainment is unlikely to be affected. However, in conjunction with the proposed Study #2, OID agrees to evaluate the effects of the project on potential entrainment survival.

3.6 Level of Effort and Cost - §5.9(b)(7) — Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

ODFW Proposal:

The study would be done during first year of the TLP study period. Two analysts would be expected to work for approximately 30 days on the analysis and report preparation. The total cost for conducting the analysis and preparing the report is estimated to be approximately \$20,000

OID Response:

The total cost of the desktop analysis and report preparation will be approximately \$30,000 to \$40,000.