Lewis River Hydroelectric Projects Relicensing

Merwin Hydroelectric Project (FERC No. 935)
Yale Hydroelectric Project (FERC No. 2071)
Swift No. 1 Hydroelectric Project (FERC No. 2111)
Swift No. 2 Hydroelectric Project (FERC No. 2213)

USDA Forest Service
Gifford Pinchot National Forest

EXISTING INFORMATION ANALYSIS

2. Water Quality

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I. Existing Situation

The four Lewis River hydroelectric projects affect water temperature, total dissolved gas, nutrients, turbidity and other water quality parameters, which result in changes to the function of the aquatic ecosystem and contribute to the change in habitat for aquatic species and production capability of fish species in the Lewis Basin.

Temperature

The four Lewis River hydroelectric projects affect water temperatures by altering flow patterns, sediment transport and deposition and by reducing riparian vegetation. Water temperatures at the upper end of the Swift No 2 Bypass Reach exceed the Class A standard (18^{o}C) for streams. The upper end of the Swift Bypass Reach is a dewatered channel where base flows consists of groundwater accretion. The flow is slowed and/or ponded within the area of the wider Lewis River mainstem channel, which is devoid of shade producing vegetation resulting in maximum solar radiation to the water. Jobling (1981) found that most salmonids tolerate temperatures above 18^{o}C, however higher temperatures increase stress. Many populations of wild salmonids respond to natural temperature fluctuations by moving up or down stream when water temperatures become unsuitable (Mabbott 1982). Diminished flows are limiting areas where fish can exist in this reach. Warm water temperatures further limit these areas. Food webs are also altered in response to water temperature regimes (Power et al. 1996).

Large daily fluctuations (8-10^{o}C) occur at the Swift No. 1, Swift No. 2 and Yale tailraces as a result of power generation changing to meet electricity demands. The magnitude of fluctuations does not meet state standards for Lake class, which specifies no measurable change above natural levels. At the Yale tailrace these fluctuation are due to back-flow effects during off-line periods, when warmer surface waters enter the tailrace area (PacifiCorp and Cowlitz PUD,

2000). Fluctuations at Swift No. 2 need to be determined as data collected to date estimate warm water back-flow effects to varying degrees and extent.

Limiting off line periods or requiring instream flows with cool source waters during the summer could minimize warm temperature in the stream/lake reaches between the reservoirs.

Total Dissolved Gas

The projects have contributed to supersaturated dissolved gas levels in the Yale and Swift tailraces of the reservoirs, although recent operational changes have reduced the problem at the Yale tailrace. Elevated dissolved gas levels at tailrace sites have the potential to adversely affect fish and other aquatic organisms.

Total dissolved gas levels occasionally exceed the Washington State Department of Ecology (WDOE) standard of 110 percent in the Yale tailrace. After determining that elevated TDG occurred when discharges were less than 3,000 cfs, Pacific Corp initiated operational changes at the Yale Project which involved closing the air intake vent at low discharge levels and restricting the duration of mid-generation discharge to avoid elevated TDG (PacifiCorp and Cowlitz PUD, 2000). This operational regime is effective in maintaining TDG within state standards at the Yale tailrace. Similar elevated TDG levels exist at the Swift No. 1 and Swift No. 2 tailraces. TDG tends to dissipate downstream of the Yale and Merwin tailraces.

Nutrients

Reservoir retention time, releases, and timing of drawdowns in reservoirs may adversely affect nutrient cycling and delivery to downstream reaches due to the quality of water released from reservoirs. Project structures and operations disrupt the connectivity of necessary soil and water interactions which can affect water quality for aquatic communities and downstream transport of nutrients, dissolved substances, organic and inorganic matter.

Nitrogen to phosphorous ratios indicate a nitrogen limitation for tributaries to Swift Reservoir. Sites in the lower Swift Reservoir also appear to be nitrogen limited. Upper watershed nitrogen deficiency may be linked to volcanic soils in the area, which are typically nitrogen deficient. These results may also be influenced by the timing of the sampling during high run-off. (WAQ 2, 2002)

Deep intakes at Lake Merwin create quicker fall turnover than the other reservoirs. The effects of timing differences of each reservoir's fall turnover to downstream reaches are unknown.

Retention of sediments within the reservoirs reduces associated nutrients from downstream reaches. The effects of nutrient reduction in downstream aquatic habitat are not known. Within the aquatic system, organisms involved in nutrient cycling in streams (particularly bacteria, fungi and algae) reside on surfaces such as wood and rock. These organisms are capable of transforming nitrogen, phosphorus and other nutrients between inorganic and organic forms. Nitrate-nitrogen levels in streams with large amounts of in-channel large woody debris were higher than in streams with less in-channel woody debris (USDA, 1996). The Lewis River Projects impact the amount of in-channel large wood through removal of riparian vegetation and obstruction of delivery to channels from dam facilities.

Nitrite and nitrate levels are highest below Merwin during most of the year although nitrate levels are low during the growing season due to phytoplankton utilization (Initial Information Package, 2000). Elevated nitrate levels below Merwin Dam may be attributable to the relative lack of large woody debris complexes below Merwin Dam where historically massive and numerous large woody debris complexes existed.

The significant barriers posed by the three hydroelectric dams has been shown to decrease the potential contribution of nutrients by migrating salmon to tributaries in the upper Lewis River on National Forest System Lands (Cedarholm et al. 1989 and Bilby et al 1996). Ocean-derived nutrients benefit aquatic and riparian organisms and vegetation.

Turbidity

Releases and timing of drawdowns in reservoirs increase turbidity delivery to downstream reaches. Elevated turbidity may affect the movement or migration of aquatic species. Turbidity levels within the upper Lewis basin are high in reaches that were affected by the 1980 Mt. St. Helens eruption. Information concerning the potential affect of fish movement or migration to these reaches is not available.

Retention time and timing of drawdowns in reservoirs affect the delivery of turbid water to downstream reaches. Releases increase turbidity by flushing exposed surfaces and transporting sediments. Waters from turbine inflow have high turbidity levels because at deep turbine depths sediment is more concentrated. Releases during fall turnover in Merwin Reservoir could increase turbidity resulting from release waters with high concentrations of algae or organic matter from decomposition. Reservoir retention and subsequent solar radiation to surface waters increase the primary production and can result in algal blooms. Release during blooms can increase turbidity levels downstream during periods when turbidity levels would otherwise be low.

Other Water Quality Parameters

Additional water quality parameters that the Forest Service is interested in include dissolved oxygen, pH, chlorophyll, fecal coliform, mercury, metals, and other dissolved constituents. Standards are established by the WDOE. WAQ-1 measured these parameters.

II. Management Direction

The Gifford Pinchot National Forest Land and Resource Management Plan Amendment 11 (1995) provides the management direction for all National Forest System lands and their associated resources directly affected by or within the project vicinity of the four hydroelectric projects in the Lewis River system. Amendment 11 is a compilation of the prevailing direction and standards and guidelines from the Record of Decision pertaining to the Northwest Forest Plan (NFP) and the Gifford Pinchot National Forest Management Plan (1990).

The Aquatic Conservation Strategy (ACS), a core component of the Northwest Forest Plan (NFP page B-9), provides management direction aimed at maintaining or restoring the ecological health and functioning of watersheds and the aquatic ecosystems contained within them.

Specifically, objectives 2 and 4 pertain the most to this Existing Information Analysis. These objectives are stated as follows:

> *Objective 2 – Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.*
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> *Objective 4 – Maintain and restore water quality necessary to support healthy riparian, aquatic and wetland ecosystems. Water quality must remain within the range that maintains the biological , physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.*

Additionally, the Northwest Forest Plan Standard and Guideline LH-2 states: "For hydroelectric and other surface water development proposals, require in-stream flows and habitat conditions that maintain or restore riparian resources, favorable channel conditions, and fish passage. During the Relicensing of hydroelectric projects, (the Forest Service shall) provide written and timely license conditions to FERC that emphasize in-stream flows and habitat conditions that maintain or restore riparian resources and channel integrity." (NFP page C-36)

Most of the federally managed lands that flow into the uppermost reservoir in the Lewis Basin are designated as a Tier 1 Key Watershed. Tier 1 Key Watersheds were selected for directly contributing to anadromous salmonid and bull trout conservation. Key watersheds are highest priority for watershed restoration.

The Gifford Pinchot National Forest Land Management Plan (1990) objectives include meeting State Water Quality Standards established in accordance with The Federal Clean Water Act.

The Northwest Forest Plan Aquatic Conservation Strategy Objectives relies on striving to mimic natural processes to the greatest extent feasible with the desired goal for the downstream channel to reestablish proper function and provide the basis for healthy riparian and aquatic habitats.

III. Information Analysis

Five studies have been conducted to date that describe flow and sediment conditions in the Lewis River Basin:

- WAQ-1: Water Quality Monitoring and Assessment. The objectives of this study were to 1) determine the current water quality conditions in the study area, 2) to assess effects on water quality or water temperature that are attributable to the projects or to project operations, and 3) to determine if water quality in project-affected waters meets existing water quality standards of the State of Washington.

- WAQ-2: Total Dissolved Gas Study, 2000. The objectives of this study included: 1) develop an understanding of the movement and behavior of project-generated TDG pressures within and downstream of project tailwaters, including project reservoirs; 2) assess the potential for cumulative effects of passing water with elevated TDG pressures through the Lewis River hydropower system; 3) to test existing regression models at the Swift (1 and 2) and Yale tailraces; and 4) to define any relationships between turbine operation at the Merwin powerhouse and TDG pressures in the Merwin tailrace.

- WAQ-3: Polycyclic Aromatic Hydrocarbons in Yale Reservoir. Establish baseline description of PAH's in the concentration in reservoir water. Water was sampled at four boat launches to compare total PAH's to existing WDOE standards and other criteria designed to serve as thresholds of PAH toxicity to aquatic life.

- Total Dissolved Gas Study, 2001. See WAQ-2.

- WTS-4: Swift Bypass Reach Synthesis Study. This study was designed to document current environmental conditions of the Swift bypass reach, including aquatic, water quality and riparian habitat conditions, and project operations.

IV. Preliminary Forest Service Objectives

To meet Aquatic Conservation Strategy Objectives 2 and 4, operate the existing hydroelectric projects in the manner that improves impaired water quality within reservoirs and downstream from project facilities so that native aquatic species can utilize available habitat and maximize their productivity levels in the Lewis River Basin.

- Improve temperatures and total dissolved gas within Washington Department of Ecology Standards and maintain turbidity and nutrient regimes that avoid adverse effects to reservoir and downstream biota. Support WDOE objectives.

- Support reservoir levels that are consistent with agreed to agency salmonid reintroduction goals, protect archeological resources, reduces erosion, etc.

- Support recreation goals that manage use at Drift Creek.

V. Information Needs

1) Analyze existing water quality data from all sources to determine project effects and impacts to aquatic habitat. Provide a baseline survey of the following parameters: temperature, dissolved oxygen, total dissolved gas, nitrogen and phosphorus. (WAQ-1, WAQ-2, WAQ-3, WAQ-4).).

2) Analyze existing water temperature data from all sources to determine compliance with State and Federal Standards and the need for new sites. Continue ongoing temperature monitoring at existing sites. Determine reservoir influence on stream temperatures below Merwin Lake and the section of the Swift By-pass reach that is not considered Lake Class (WAQ-1, WTS-4, WDOE Water Quality Monitoring Plan –not completed).

3) Model temperatures under various flow regimes and operational scenarios in the Swift By-pass reach. Various operational scenarios include flow release sites that do not presently exist. Professional judgment predicting the source water temperatures from release sites of various operational scenarios would preliminarily be adequate to assess temperatures under various flow regimes (WAQ1, objective 2). The flow regimes analyzed could be the same flow regimes measured in relation to the Instream Flow Study (AQUA 2).

VI. References

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