**Endangered Species Act**
**Section 7(a)(2) Consultation**

# Biological Opinion

**and**

# Magnuson-Stevens Fishery Conservation and Management Act Consultation

**Operation of the Cowlitz River Hydroelectric Project (FERC No. 2016) through 2038**

**Cowlitz River, HUC 17080005**
**Lewis County, Washington**

| | |
|---|---|
| Action Agency: | Federal Energy Regulatory Commission |
| Consultation Conducted by: | NOAA Fisheries<br>Northwest Region<br>Hydropower Division |
| NOAA Fisheries Log Number: | F/NWR/2001/02045 |
| Date Issued: | March **, 2004 |

**TABLE OF CONTENTS**

## LIST OF TABLES

## LIST OF FIGURES

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| BA | biological assessment |
| cfs | cubic feet per second |
| Corps | U.S. Army Corps of Engineers |
| CR | Columbia River |
| cy | cubic yard |
| DO | dissolved oxygen |
| EFH | essential fish habitat |
| ESA | Endangered Species Act |
| ESU | evolutionarily significant unit |
| FERC | Federal Energy Regulatory Commission |
| FGE | fish guidance efficiency |
| FHMP | Fisheries and Hatcheries Management Plan |
| FPA | Federal Power Act |
| FPS | fish passage survival |
| FR | Federal Register |
| ft | foot, feet |
| FTC | Fisheries Technical Committee |
| HAG | Habitat Advisory Group |
| LCR | lower Columbia River |
| LCR/SW | lower Columbia River/Southwest Washington |
| LWD | large woody debris |
| MSA | Magnuson-Stevens Fishery Conservation and Management Act |
| MW | megawatt |
| NEPA | National Environmental Policy Act |
| NOAA Fisheries | National Marine Fisheries Service |
| NTU | nephelometric turbidity unit |
| Opinion | Cowlitz River Hydroelectric Project Biological Opinion |
| PFC | properly functioning condition |
| RM | river mile |
| RPA | reasonable and prudent alternative |
| RPM | reasonable and prudent measure |
| USC | United States Code |
| USFS | U.S. Forest Service |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geologic Survey |
| VSP | viable salmonid population |
| WCSBRT | West Coast Salmon Biological Recovery Team |
| WDF | Washington Department of Fisheries |
| WDG | Washington Department of Game |
| WDOE | Washington Department of Ecology |
| WDFW | Washington Department of Fish and Wildlife |

| | |
|---|---|
| WLCTRT | Willamette/Lower Columbia Technical Recovery Team |

# 1. INTRODUCTION AND CONSULTATION HISTORY

## 1.1 Introduction

This is an interagency consultation between the Federal Energy Regulatory Commission (FERC) and the National Marine Fisheries Service (NOAA Fisheries) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) and Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). NOAA Fisheries is responsible for administration of the ESA with respect to anadromous salmonids. NOAA Fisheries is likewise responsible for administration of the MSA and consultations conducted pursuant to the MSA's essential fish habitat (EFH) consultation requirements.

Section 7(a)(2) of the ESA requires Federal agencies to ensure their actions avoid jeopardizing the continued existence of listed species or adversely modifying designated critical habitat. Section 305(b)(2) of the MSA requires Federal agencies to consult with NOAA Fisheries if their actions may adversely affect EFH. The Federal Power Act (FPA) authorizes FERC to license non-Federal hydroelectric projects. FERC conditions such licenses for the protection and mitigation of damages to environmental resources, including ESA-listed species and critical habitat. Consequently, FERC must initiate consultation with NOAA Fisheries under these statutes if their actions may affect ESA-listed species, or may adversely affect EFH.

FERC proposes to allow Tacoma Power to continue operating the Cowlitz River Hydroelectric Project (FERC No. 2016) under an existing License. Tacoma Power owns and operates the Cowlitz River Hydroelectric Project (hereinafter, the Project) located on the Cowlitz River in southwestern Washington State. A primary purpose of the Project is to generate and sell electricity, while providing adequate fish protection. FERC issued an original License for the Project in 1951. That License expired on December 31, 2001, and after that the Project operated under annual licenses until the new License was issued (effective July 18, 2003).

## 1.2 Pre-Consultation Background

For close to four years, multiple parties worked on the relicensing effort for this Project. During that time, many alternatives were assessed and considered (see the Draft Environmental Assessment and Final Environmental Impact Statement, as well as other supporting documents). On September 11, 2000, Tacoma Power filed with FERC an offer of settlement for a new License for the Project. The offer contained a comprehensive settlement agreement (Settlement Agreement) that is intended to resolve all issues associated with issuance of a new License for the Project regarding fish passage, fish production, fish habitat, water quality, instream flows, wildlife, recreation, and cultural and historic resources. The Settlement Agreement represents the culmination of an open, collaborative, consensus-building consultation process following FERC's alternative licensing procedures, approved for use in this proceeding on February 24, 1998. Although not all the parties involved in the relicensing effort signed, 12 entities are signatories to the Settlement Agreement: Tacoma Power, WDFW, Washington Department of Ecology (WDOE), Washington State Parks and Recreation Commission, U.S. Fish and Wildlife Service (USFWS), NOAA Fisheries, U.S. Forest Service (USFS) for the Gifford Pinchot National Forest, Interagency Committee for Outdoor Recreation, Lewis County, Confederated Tribes and Bands of the Yakama Nation, Washington Council of Trout Unlimited, and American Rivers.

### 1.3 Consultation History

By an April 25, 2001, letter and accompanying biological assessment (BA), pursuant to Section 7 of the ESA, FERC initiated Section 7 consultation with NOAA Fisheries with respect to Lower Columbia River (LCR) chinook salmon *(Oncorhynchus tshawytscha*), LCR steelhead (*O. mykiss)*, Columbia River (CR) chum salmon (*O. keta*), and Lower Columbia River/Southwest Washington (LCR/SW) coho salmon (*O. kisutch)*. By letter dated January 29, 2002, NOAA Fisheries responded to the request for formal consultation by proposing a schedule to complete consultation by September 2002, in order to coordinate the consultation with the ongoing consultation for the Cowlitz Falls project (FERC No. 2833). By letter dated February 25, 2002, FERC rejected this proposal. On March 13, 2002, FERC issued a license order approving the Settlement Agreement and adopting the Settlement Agreement license articles and agency conditions and prescriptions, effective April 12, 2002. On April 12, 2002, FERC stayed the new License[1] due to a stay on the State of Washington's water quality certification for the Project. In a March 27, 2003, letter, NOAA Fisheries again requested a different consultation schedule due to a backlog of consultations. FERC responded on April 18, 2003, that it was unable to agree to the extension of time to complete formal consultation. On June 18, 2003, the State of Washington resolved the pending issues and via a July 18, 2003, order, FERC modified the License to adopt the new conditions added to the State of Washington's water quality certificate and lifted its stay of the new License.

On April 11, 2002, NOAA Fisheries filed a petition for rehearing contesting FERC's issuance of a new License before completing an ESA Section 7 formal consultation. FERC denied this request for rehearing and the License became effective on July 18, 2003. FERC added an article (Article 408) to the new License that reserved its authority to require Tacoma Power to take whatever action FERC deemed necessary as a result of this biological opinion (hereinafter referred to as the Opinion).

In accordance with the Secretarial Order concerning American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the ESA (June 5, 1997), NOAA Fisheries has conducted government-to-government consultation meetings and additional technical meetings with the Cowlitz Indian Tribe regarding this ESA consultation. These meeting dates were May 9, 2003; July 18, 2003; September 16, 2003; September 22, 2003; November 12, 2003; February 25,

---

[1]The Project continued operations under an annual license.

2004; and March 12, 2004. There were also telephone exchanges during this time period. In addition, NOAA Fisheries received memorandums and proposals including:

- X An April 24, 2003 e-mail that attached November 15, 2002, and January 22, 2003, memorandums from Cleve Steward to individuals of the Cowlitz Indian Tribe and an attorney.
- X An April 2003 proposal on Fish Passage, Hatchery Production, Instream Flow, and Habitat Protection and Restoration on the Cowlitz River: Recommendation of the the Cowlitz Indian Tribe prepared by Cleve Steward and received on May 9, 2003.
- X A July 7, 2003, e-mail that attached comments on the draft BA and final Settlement Agreement.
- X A July 17, 2003, e-mail that attached Tribal Testimony on Natural Resource Issues.
- X A September 19, 2003, e-mail that attached a memorandum on policy discussion points regarding Section 7 consultation on the Lewis and Cowlitz Rivers.
- X A September 24, 2003, e-mail that attached a memorandum regarding a recap of the September 22, 2003, meeting between the Yakama Nation, Cowlitz Indian Tribe, and NOAA Fisheries.
- X A November 17, 2003, e-mail that attached a memorandum regarding a recap of meeting between NOAA Fisheries and the Cowlitz Indian Tribe (this communication addressed unpublished TRT data relevant to the status of populations of listed species in the action area).

NOAA Fisheries sought from the Tribes information, traditional knowledge, or comments applicable to this consultation.

The Yakama Nation was present at the September 22, 2003, meeting, but NOAA Fisheries has not had as many exchanges with them since they became a signatory to the Settlement Agreement. The draft Opinion was provided to the Yakama Nation through the FERC Service List. A four-week comment period followed release of the draft Opinion. NOAA Fisheries conducted a government-to-government consultation through a meeting with the Cowlitz Indian Tribe. The Yakama Nation did not request a government-to-government consultation during the comment period.

### 1.4 Approach

The standards for determining jeopardy are set forth in Section 7(a)(2) of the ESA as defined by 50 CFR §402.02 (the consultation regulations). In conducting analyses of habitat-altering actions under Section 7 of the ESA, NOAA Fisheries uses the following steps of the consultation regulations:

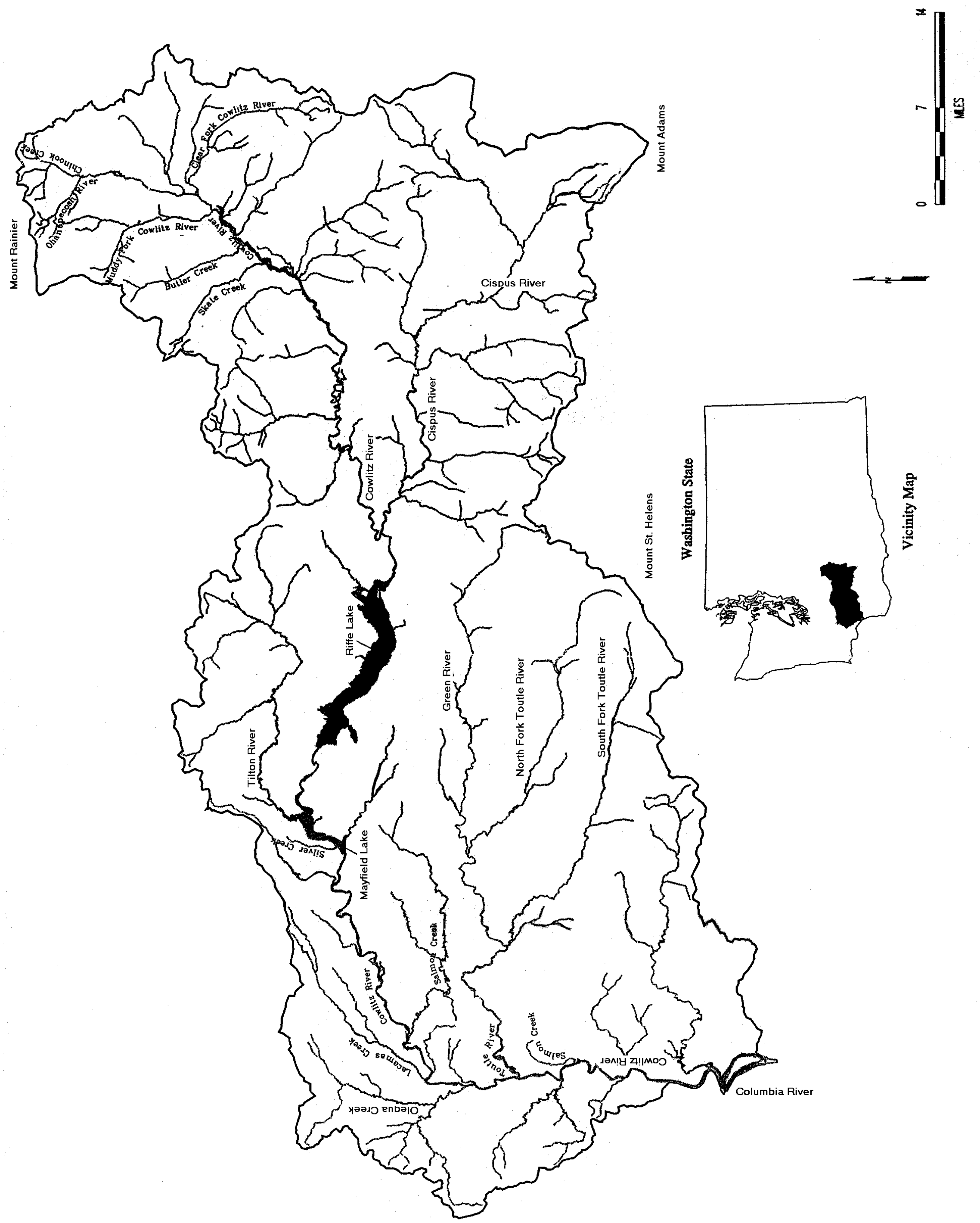
1. Consider the status and biological requirements of the species at the evolutionarily significant unit (ESU) level and within the particular action area.
2. Evaluate the relevance of the environmental baseline in the action area to action-area biological requirements and the species' current rangewide and action-area status.
3. Determine the effects of the proposed or continuing action on the species.
4. Consider cumulative effects.
5. Evaluate whether the effects of the proposed action, taken together with any cumulative effects and added to the environmental baseline, can be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the affected species, or is likely to destroy or adversely affect their designated critical habitat. (50 CFR §402.14(g).)

In completing step 5, NOAA Fisheries determines whether the action under consultation, together with all cumulative effects when added to the environmental baseline, is likely to jeopardize the continued existence of the ESA-listed species or adversely modify critical habitat. If so, NOAA Fisheries must identify any reasonable and prudent alternatives (RPA) for the action that avoid jeopardy or adverse modification of critical habitat and meet the other regulatory requirements for RPAs (50 CFR §402.02). Additional information on the consultation process can be found in the Endangered Species Consultation Handbook (USFWS and NOAA Fisheries 1998).

Recovery planning will help identify measures to conserve listed salmonids and increase their survival at each life stage. NOAA Fisheries also intends recovery planning to identify the areas/stocks most critical to species conservation and recovery, and to thereby evaluate proposed actions on the basis of their effects on those factors.

NOAA Fisheries based its analysis in this Opinion on a review and synthesis of the best available scientific and commercial information. Specific sources are listed in the bibliography and cited throughout the body of the document. Sources of information included the Final Environmental Impact Statement (FERC 2001); the Order Approving Settlement and Issuing New License (FERC 2002); and the Draft Biological Assessment of the Cowlitz River Hydroelectric Project FERC No. 2016 (Tacoma Power 2000).

Figure 1. Cowlitz River Basin. Source: FERC 2001.



# 2. PROPOSED ACTION

## 2.1 The Cowlitz River Hydroelectric Project

The Project is located on the Cowlitz River, in southwestern Washington (Figure 1) near the community of Morton. The Project consists of two dams, Mayfield and Mossyrock; a salmon and a trout hatchery; and other non-fisheries related items, such as campgrounds, day-use sites, and wildlife lands (Figure 2).

Figure 2. Project Schematic.

The Mayfield Dam, located at river mile (RM) 52, was completed in 1963, impounding 13-mile-long Mayfield Lake. Mossyrock Dam, located at RM 65.5, was completed in 1968, forming 23.5-mile-long Riffe Lake. Although not part of this Project, Lewis County Public Utility District's (PUD) Cowlitz Falls project (FERC No. 2833), constructed in 1994, is the uppermost dam on the mainstem Cowlitz River. It is located just upstream from the headwaters of Riffe Lake and forms the 11-mile-long Lake Scanewa. The mainstem Cowlitz River flows unimpeded above Lake Scannewa (the lake formed by the Cowlitz Falls project) and below Mayfield Dam.

### 2.1.1 The Cowlitz Hatchery Complex

The Cowlitz Hatchery Complex includes both the Cowlitz Salmon Hatchery and the Cowlitz Trout Hatchery. The Cowlitz Salmon Hatchery is situated about 2.5 miles downstream of Mayfield Dam at RM 49.5. The Cowlitz Trout Hatchery is located about 7.5 miles downstream of the salmon hatchery. Construction, operation, and maintenance of the hatcheries is funded by Tacoma Power, while the actual operation is managed by the Washington Department of Fish and Wildlife (WDFW). These hatcheries are mitigation for impacts due to construction and operation of the Project. The Cowlitz Salmon Hatchery produces spring chinook salmon, fall chinook salmon, and coho salmon juveniles for release into the Cowlitz River. The Cowlitz Trout Hatchery produces winter and summer steelhead and cutthroat trout.

Barrier Dam, constructed in 1969, is used to direct migrating adult fish into the salmon hatchery sorting facilities, where they are sorted by species for release to onsite holding ponds or for transport offsite. There are right and left bank entrances to the fish ladder and an under-spillway transport channel connecting the two ladder entrances. Neither the transport channel nor left bank entrance are in use because of design problems with the attraction flow. There is also an electrical field at the Barrier Dam to aid in blocking fish. There are no barriers associated with the Cowlitz Trout Hatchery; fish used for broodstock volunteer into the hatchery or are collected at the Barrier Dam.

NOAA Fisheries consulted on the operations of all the artificial propagation activities at these facilities as part of a Columbia River basinwide hatchery biological opinion in 1999 (NOAA Fisheries 1999a). However, that biological opinion covered only those ESUs listed prior to 1998. Consultation was reinitiated to cover those salmon and steelhead species that were listed after March 1999. NOAA Fisheries and WDFW are consulting on the production of hatchery fish to mitigate for impacts from the hydrosystem in the Cowlitz River Basin and for reestablishment activities in the Upper Cowlitz River Basin.

### 2.1.2 Mayfield Dam

At the time of its construction in 1963, this 250-ft-high concrete dam was equipped with both adult and juvenile (louver system) fish passage facilities. The adult fish passage facilities were abandoned after the completion of Barrier Dam in 1969, after a decision was made to stop passage into the upper basin and to use hatcheries instead. However, many components of this facility still exist, including the Mayfield barrier dam structure, lower fish ladder, trap, tramway track, and transfer building. The 25-ft-high dam at the base of Mayfield directed fish into a collection channel in the lower level of the powerhouse and a fish ladder directed fish into a 1,500-gallon hopper, in which fish were hauled to the top of a tramway on a railed carriage and discharged into the reservoir through a pipe. The downstream fish passage facility consisted of a series of vertical louvers constructed in a V-formation within the intake and a bypass channel that directed the fish to a secondary separator, where they were guided through the dam to a holding/counting facility and emptied into the river below the powerhouse through a pipe and chute. Today, much of the abandoned adult facility remains in place in varying conditions of disrepair, while other portions of the facility have been removed (FERC 2001). The louver system for downstream passage is still functional and effective. It is used to sample fish populations stocked in Mayfield Lake and the Tilton River, and to collect downstream migrants originating in Mayfield drainages. In summary, there currently is downstream fish passage, but no upstream passage.

The reservoir is typically operated with outflow equal to the inflow from Riffe Lake and the main tributary streams, the Tilton River and Winston Creek. Inflow in excess of the capacity of the turbines is spilled, resulting in a very stable reservoir elevation, typically fluctuating less than 2 to 3 ft throughout the year, although the maximum allowable elevation fluctuation is 10 ft below the full pool elevation of 425 ft.

### 2.1.3 Mossyrock Dam

This 606-ft-high dam was constructed between 1964 and 1968 at RM 65.5. Due to its height, the dam is not equipped with either adult or juvenile fish passage facilities. Past attempts to develop juvenile fish passage facilities in the reservoir were unsuccessful due to a combination of factors, including reservoir size, water temperature, and the limitations of collection technology available at that time. Riffe Lake is operated within a rule curve to provide winter flood control and instream flow releases below Mayfield Dam to protect fish habitat.

### 2.1.4 Cowlitz Falls Dam[2]

The uppermost dam on the mainstem Cowlitz River, Cowlitz Falls Dam, is owned by Lewis County PUD. Located near RM 89, it was completed in the early 1990s, creating an additional barrier to migratory fish. Subsequently, in 1994, fish collection facilities were added to collect outmigrating juvenile fish (spring chinook salmon, coho salmon, and steelhead) that had reared in the upper basin after being outplanted from the hatchery. Currently, fish are collected and trucked downstream to holding ponds at the Cowlitz Salmon Hatchery, where they are released to continue their seaward migration.

[2]While not part of the Cowlitz River Hydroelectric Project that is the subject of this consultation, the Cowlitz Falls Dam is linked by its location and by one of the performance standards for the Project.

## 2.2 Description of the Proposed Action

The proposed action for this consultation is the continued operation of the Cowlitz River Hydroelectric Project, FERC Project No. 2016, operated under the new License with an effective date of July 18, 2003. The License is for a term of 35 years and expires July 18, 2038. The parts of the License relevant to this Opinion relate to fish passage, fish production, fish habitat, water quality, instream flows, and reserved authority to reopen the License generally, for conservation of fish resources, and specifically, for fish passage measures. In the license order, FERC approved the Settlement Agreement, and in the License itself, incorporated parts of the Settlement Agreement license articles. Thus the License and Settlement Agreement are closely interwoven. NOAA Fisheries considers the Settlement Agreement to be part of FERC's License. Therefore, references to the Settlement Agreement in this document include the License.

### 2.2.1 Action Area

The action area is from the upstream end of the Scanewa Reservoir (formed by the Cowlitz Falls project) to the mouth of the Cowlitz River. This area encompasses all direct and indirect effects to listed salmon. These effects include changes in large woody debris (LWD), sediment, and flows to areas downstream of the dams. Some of these effects, such as changes in LWD, may occur to the mouth of the Cowlitz River. The upstream boundary extends to the upstream of the Scanewa Reservoir because the fish passage survival performance standard, by definition, starts at this location (this definition is discussed in Section 2.2.2.3 of this Opinion). This is the upper extent of the area that Tacoma Power will be potentially assessing and modifying to meet downstream fish performance standards.

### 2.2.2 Proposed Action

The FERC license (including the new items required by WDOE through its Clean Water Act Section 401 process), Settlement Agreement, and a flood control rule curve developed by Tacoma Power in consultation with the U.S. Army Corps of Engineers (Corps) make up the proposed action. The comprehensive Settlement Agreement, filed with FERC on September 11, 2000, sets forth the environmental measures that Tacoma Power proposed to undertake during the term of a new FERC License for the Project. It emphasizes ecosystem integrity and recovery of wild, indigenous salmonid runs (including species listed under the ESA) to harvestable levels, but also addresses wildlife, recreation, and cultural resources. The FERC license incorporates parts of the Settlement Agreement, and article numbers in parentheses refer to the proposed license articles attached to the Settlement Agreement.

#### 2.2.2.1 Adaptive Management

An adaptive management[3] approach to carrying out the Settlement Agreement is central to the Settlement Agreement, with decisions on fish passage and hatchery operation and production tied to various measures of progress toward salmon recovery. This approach is appropriate when substantial uncertainty exists with regard to the specific activities that are necessary to achieve goals. It provides the opportunity to combine monitoring and decision making in a way that protects the environment. The License and Settlement Agreement both provide measures for post-licensing studies and monitoring. The information from this work will then be used by the parties to the Settlement Agreement, and NOAA Fisheries in particular, to make decisions regarding volitional fish passage and the long-term adequacy of Project operating criteria. The monitoring and studies information will also be used to determine if passage facilities are working effectively. If not, Tacoma will need to make modifications to ensure effective passage. Monitoring will be conducted in the areas of: fish habitat utilization, juvenile fish turbine passage mortality, fish passage facility effectiveness, fish stranding, side-channel habitat maintenance, and water quality. Most of these monitoring actions require that Tacoma develop monitoring plans in consultation with the resource agencies.

The parties to the Settlement Agreement created the Fisheries Technical Committee (FTC) and the Habitat Advisory Group (HAG) to participate in adaptive management.

- The FTC, consisting of one representative each from Tacoma Power, NOAA Fisheries, USFWS, WDFW, WDOE, and the Yakama Nation, and one representative each from the parties included in the conservation groups (Washington Council of Trout Unlimited and American Rivers), will make recommendations on actions to maximize the effectiveness of fisheries measures.

- The HAG, consisting of a representative from each Settlement Party that elects to participate, will be formed to advise Tacoma Power in the development and implementation of the Fisheries Habitat Fund.

The plans identified in the License via the Settlement Agreement will be prepared in collaboration with the FTC or the HAG. The final plan will include documentation of this collaboration and copies of comments and recommendations, and specific descriptions of how the plan accommodates all comments and recommendations. If the Licensee does not adopt a recommendation, the filing to FERC will include Tacoma Power's reasons, based on Project-specific information. The plans associated with upstream and downstream fish passage (Articles 1, 2, and 3) must be approved by NOAA Fisheries prior to filing with FERC. Further description

---

[3] Adaptive management is best described as considering management as a scientific process by setting objectives, defining management actions designed to achieve those objectives, implementing those actions, monitoring and evaluating the outcomes, and making changes in management actions in response to new information or objectives.

of NOAA Fisheries' understanding of how adaptive management will be implemented is located in the Analysis of Effects of the Proposed Action Section (Section 6) of this Opinion.

#### 2.2.2.2 Upstream Fish Passage: Barrier, Mayfield, and Mossyrock

- Tacoma Power will continue to provide and maintain effective upstream fish passage at the Barrier Dam, Mayfield Dam, and Mossyrock Dam through trap and haul facilities

  (Article 3) until they meet criteria, at which point Tacoma Power will construct volitional upstream passage systems. These criteria include:

  A. Development and implementation of a Disease Management Plan (Article 8) that defines an acceptable level of risk from *Ceratomyxa shasta (C. shasta)* and other diseases and allows adult fish to be upstream of Barrier Dam (protects the hatchery).

  B. Determination that adult fish in Mayfield Lake are able to choose their tributary of origin and survive Mayfield Lake transit at rates established by NOAA Fisheries and USFWS to be sufficient to achieve effective upstream passage through volitional facilities (Article 3).

  C. Documentation of self-sustaining levels of any salmonid species originating in the Tilton River Basin and self-sustaining levels of either spring chinook salmon or late winter steelhead above Mossyrock Dam (Article 3). These stocks would be considered self-sustaining when, in at least 3 of 5 consecutive brood years measured, and when a 5-year rolling average indicates:

     i. The number of pre-spawners[4] arriving at the Barrier Dam exceeds an abundance level that indicates natural recruitment above Mayfield Dam has achieved self-sustaining levels, as determined by NOAA Fisheries in consultation with the FTC.

     ii. The productivity level, as measured at Barrier Dam or other Cowlitz River fish counting facilities by the recruit[5]/pre-spawner ratio, exceeds 1.0.

---

[4]Pre-spawner means an adult salmonid that is progeny of hatchery or natural adult fish that spawned in the natural environment, returned from the ocean, and is collected at the Barrier Dam or hatchery trapping facilities.

[5]Recruit means an adult fish produced by a pre-spawner, measured one generation later and collected at the Barrier Dam or hatchery trapping facilities.

- Within 6 months of license issuance and on an annual basis thereafter, Tacoma Power will file a report that includes 1) estimates of age 3 recruits and survival equivalency relative to benchmark run year and survival rates for each species;[6] 2) estimates of the annual number of adult recruits originating from the Cowlitz River Basin upstream of the Toutle River, including steelhead, cutthroat trout, and all other indigenous stocks produced at the hatcheries, along with an index of each stock to its benchmark; and 3) a plan and schedule for studies to evaluate whether the criteria for volitional passage facilities have been met (Article 3).

- Within 12 years of license issuance, and when data indicate the passage criteria will be met within 3 years or less, Tacoma Power will prepare preliminary fish passage facility designs and schedules for the construction of volitional upstream passage systems for the Project (Article 3). Upstream passage systems will include:

  A. Barrier Dam — breaching Barrier Dam, unless NOAA Fisheries and USFWS determine in consultation with the FTC that a ladder is more appropriate than breaching for effective upstream passage, and disabling the electrical field.

  B. Mayfield Dam — a ladder with sorting facilities, unless NOAA Fisheries and USFWS determine that a tram with sorting facilities is more appropriate for effective upstream passage.

  C. Mossyrock Dam — an adult trap and haul facility to facilitate adult transit above Cowlitz Falls Dam, to be built before or concurrently with the upstream system at Mayfield Dam, unless NOAA Fisheries and USFWS determine that a comparably priced tram is more appropriate than a trap and haul facility. The appropriateness of a tram facility would be based on studies that show fish are able to migrate through Riffe Lake and it has been determined that adult passage facilities would be provided at Cowlitz Falls Dam.

  If volitional passage criteria have not been met by the end of Year 12 of the new License, but have been met or will likely be met by Year 15 of the new License, for any salmonid species originating in the Tilton River Basin, Tacoma Power will prepare preliminary Mayfield Dam volitional fish passage facility designs and construction schedules.

  Upon meeting the criteria for construction of the upstream volitional passage systems, Tacoma Power will complete design and construction of agency-

---

[6]These estimates will be provided by updating tables 3, 4, and 5 from *Contribution Rate Benchmarks for Future Runs of Spring Chinook, Fall Chinook, and Coho Produced at the Cowlitz Salmon Hatchery* by Cramer (June 28, 2000) and included as Attachment 7 to the Settlement Agreement that Tacoma Power filed with FERC on September 11, 2000.

approved upstream fish passage systems, with the systems made operational within 1 year of meeting the criteria or approval of the final design, whichever is later. Following construction, Tacoma Power will monitor the effectiveness of the facilities. As deemed necessary by NOAA Fisheries and USFWS, Tacoma Power will implement reasonable modifications necessary to improve passage effectiveness.

- Within 5 years of license issuance, Tacoma Power will establish an interest-bearing escrow account in the amount of $15 million to contribute to the total cost of constructing the volitional upstream fish passage facilities. If within 14 years of license issuance the criteria for volitional upstream passage systems has not been met, and it is determined by the FTC with concurrence from NOAA Fisheries and USFWS that additional measures are necessary for recovery of ESA-listed stocks, Tacoma Power will submit a plan to abandon volitional upstream passage and expend the funds in the escrow account for the purposes of protecting and recovering listed Cowlitz River stocks (Article 3).

#### 2.2.2.3 Downstream Fish Passage: Mossyrock

- Within 6 months of license issuance, Tacoma Power will submit a plan for improving downstream fish passage and collection at Riffe Lake and Cowlitz Falls (Article 1) that includes 1) a report on negotiations with Lewis County PUD and Bonneville Power Administration on funding of cooperative efforts to improve downstream passage and collection effectiveness at or near Cowlitz Falls, 2) proposed facilities and measures likely to achieve a target of 95% fish passage survival (FPS)[7] to be funded by Tacoma Power at or near Cowlitz Falls and/or constructed by Tacoma Power downstream of Cowlitz Falls Dam at the head of Riffe Lake, 3) plans to support continued operation and maintenance of these facilities and measures, 4) plans for monitoring and evaluation of effectiveness of these facilities and measures, and 5) a construction and implementation timeline not to exceed 12 months from plan approval by FERC.

- Within 18 months of completion of the new and/or modified downstream Riffe Lake/Cowlitz Falls downstream fish passage/collection facilities, Tacoma Power will file a report on the effectiveness of the facilities. If the target of 95% FPS has not been achieved, the report will contain plans for further improvements to fish passage facilities and measures likely to achieve a 95% FPS. Tacoma Power will continue to implement, or support implementation of, additional downstream passage facility improvements and file additional reports at 18-month intervals until the target 95% FPS has been achieved or the best available technology, determined in consultation with NOAA Fisheries and

[7]The Definition of FPS in the Settlement Agreement is the percentage of smolts entering the upstream end of Scanewa Reservoir (the reservoir created by the Cowlitz Falls project), and adjusted for natural mortality, that are collected at Cowlitz Falls Dam and Riffe Lake and Mossyrock Dam, that are transported downstream to the stress relief ponds, and subsequently leave the stress relief ponds at Barrier Dam as healthy migrants.

USFWS, has been employed and at least 75% FPS has been achieved for all species (Article 1).

#### 2.2.2.4 Downstream Fish Passage: Mayfield

- Within 6 months of license issuance, Tacoma Power will submit either a study plan or study results evaluating turbine mortality and effectiveness of the existing louver system at Mayfield Dam (Article 2). Within 3 years of license issuance, Tacoma Power will file a plan for improvements to downstream fish passage at Mayfield Dam. The plan will include 1) results of studies of turbine mortality and effectiveness of the existing louvers, 2) plans for debris handling modifications, 3) plans for changes to the bypass system, 4) a comparison of the proposed improvements with those identified in the 90% Fish Passage Report (Harza 1999c) and justification of any proposed improvements not included in the report, 5) a statement of how the improvements will achieve increased fish guidance efficiency (FGE) and survival at Mayfield Dam to a level of downstream fish passage survival rate of greater than or equal to 95% for anadromous stocks,[8] 6) a construction and implementation schedule not to exceed 1 year from date of plan approval, and 7) plans to evaluate the effectiveness of the passage facilities on survival. Within 18 months of completion of construction of the improvements, Tacoma Power will file a report on the effectiveness of the modifications in achieving the 95% downstream fish passage survival rate and plans to further improve the effectiveness of the facilities and measures, or substitute other measures if the 95% has not been achieved.

  Tacoma Power will carry on additional downstream passage facility modifications or measures and file reports at 18-month intervals until either: 1) 95% downstream fish passage survival rate is achieved, or 2) it is determined that passage effectiveness and survival are high enough to support self-sustaining populations of anadromous stocks and that protection of anadromous fish migrating downstream of Mayfield Dam has been maximized by all reasonable measures, and that adjustments to hatchery production and habitat measures will be required in lieu of further attempts to improve passage. Tacoma Power will monitor proper operation of the passage facilities and evaluate effects of changed conditions on FGE and downstream fish passage survival rate and report results annually to the FTC or agencies. Tacoma Power will consult with the FTC regarding improvements that may be required to maintain or obtain passage effectiveness and survival.

---

[8]Downstream fish passage survival rate as applied to Mayfield Dam means the percentage of smolts entering the Mayfield louver system that is guided through the juvenile fish guidance and bypass facilities and does not enter the turbines, plus those juveniles that pass through the Project turbines or over the spillway and also survive.

#### 2.2.2.5 Instream Flows

The proposed action includes a detailed minimum flow schedule to protect salmonid habitats in the lower Cowlitz River (downstream from Mayfield Dam), address water quality concerns, and improve downstream salmon migration. Table 1 summarizes the current operation of the Project (FERC 2001). Mayfield Lake elevations are not shown because of its limited fluctuation.

Table 1. Project operations summary for the Settlement Agreement.

<table>
<tr><th rowspan="2">Month</th><th colspan="4">Riffe Lake Elevation (ft)</th><th colspan="3">Mayfield Outflow (cfs)</th></tr>
<tr><th>Flood Control Curve</th><th>Median (50% exceedance)</th><th>Max</th><th>Min</th><th>Minimum Flows[1]</th><th>Median (50% exceedance)</th><th>Flood Control</th></tr>
<tr><td>Jan</td><td>745.5</td><td>740.5</td><td>769.9</td><td>695.0</td><td rowspan="2">5,000</td><td>6,316</td><td rowspan="8">Maintain flows at Castle Rock below 70,000 cfs</td></tr>
<tr><td>Feb</td><td rowspan="4">Fill</td><td>743.9</td><td>776.9</td><td>700.6</td><td>5,000</td></tr>
<tr><td>Mar</td><td>752.1</td><td>765.4</td><td>692.7</td><td rowspan="4">5,000<br>(Wkly 12-hr pulse of 8,000 or 120%)</td><td>5,000</td></tr>
<tr><td>Apr</td><td>756.2</td><td>768.5</td><td>692.5</td><td>5,000</td></tr>
<tr><td>May</td><td>768.7</td><td>776.9</td><td>705.1</td><td>5,000</td></tr>
<tr><td>Jun</td><td rowspan="3">778.5</td><td>777.6</td><td>777.9</td><td>712.5</td><td>6,000</td></tr>
<tr><td>Jul</td><td>777.9</td><td>777.9</td><td>717.5</td><td rowspan="2">2,000<br>—15th—<br>2,000-5,000</td><td>3,111</td></tr>
<tr><td>Aug</td><td>777.4</td><td>778.0</td><td>714.6</td><td>2,000</td></tr>
</table>

| **Month** | **Riffe Lake Elevation (ft)** | | | | **Mayfield Outflow (cfs)** | | |
|---|---|---|---|---|---|---|---|
| | **Flood Control Curve** | **Median (50% exceedance)** | **Max** | **Min** | **Minimum Flows[1]** | **Median (50% exceedance)** | **Flood Control** |
| Sep | Draw-down | 774.2 | 777.9 | 713.1 | | 2,000 | |
| Oct | | 766.1 | 777.5 | 696.9 | 3,500 or inundate redds up to 5,000 | 3,500 | |
| Nov | | 752.6 | 767.6 | 696.3 | | 7,820 | |
| Dec | 745.5 | 740.5 | 776.9 | 701.1 | 5,000 | 6,698 | |

Data source: Tacoma Power 1999, 2001 in FERC 2001
Note: This table presents an approximation of the instream flow schedule. The instream flow schedule contains numerous conditional constraints and requirements that change at times other than at the end of the month. For a comprehensive description of the instream flow schedule, please see the text below.

- Tacoma Power will provide the following minimum flows below Mayfield (Article 13):

  <u>March 1 – June 30</u>

  Minimum flow releases from Mayfield Dam shall be 5,000 cfs, unless the March 1 or later inflow forecasts indicate that this flow cannot be achieved and assure reservoir refill. A decision to reduce flows shall only be made after Tacoma Power has consulted with the FTC. Once per week from March through the end of June, or as otherwise agreed to with the FTC or agencies, Tacoma Power will conduct a 12-hour release at the lesser of 8,000 cfs or 120% of the preceding flows for juvenile fish transport flows. Natural flows (e.g., from the Tilton River) that provide the same magnitude of flow pulse may substitute for artificial flow pulsing.

  <u>July 1 - August 14</u>

  Minimum flow releases from Mayfield Dam shall be 2,000 cfs during this period.

  <u>August 15 - September 30</u>

  Minimum flow releases from Mayfield Dam shall be 2,000 cfs during this period. If Mayfield releases exceed 5,000 cfs for a consecutive 5-day period as measured by daily mean flows, then flows will not be decreased below 5,000 cfs until a spawning survey, documenting redd numbers and locations in key side-channel areas at RM 42.5 and RM 47[9], or two other representative sites as selected by the FTC, has been performed. If the survey shows that redds are present, the level of minimum flows necessary for the remainder of the period will be established after consultation with the FTC or agencies. The established minimum flows for incubation shall not exceed the lesser of: a) 8 inches of river stage height below the highest consecutive 5-day average flow as measured at U.S. Geologic Survey (USGS) Station No. 14238000, which is below Mayfield Dam, or b) 5,000 cfs.

  <u>October 1 - November 20</u>

  Minimum flow releases below Mayfield Dam shall be subject to the following requirements:

  1. At no time shall flows released from Mayfield Dam be less than 3,500 cfs.

---

[9]In the License, these river miles are listed as 42 and 47.5. The correct river miles as provided by Tacoma Power to the FTC via an October 2, 2003, letter are 42.5 and 47.

2. Flow releases from Mayfield Dam always must be at a quantity adequate enough to provide incubation protection to redds established during the period of August 15-November 20, as defined below (#3).
3. When releases during the August 15-November 20 period exceed 5,000 cfs for a consecutive 5-day period as measured by daily mean flows, minimum flows must be maintained at the lesser of: a) 5,000 cfs, or b) 8 inches of river stage height below the highest consecutive 5-day average flow during which active spawning occurred, as measured at USGS Station No. 14238000.

Flow releases less than those described above in #3 may be established upon agreement by the FTC, following its review of spawning survey data for the August 15-September 30 period.

Tacoma Power must make a good faith attempt to provide flows for the purpose of protecting spawning habitat (5,000 to 8,000 cfs) from November 1 until either November 20 or the completion of spawning, whichever comes first.

<u>November 21 – February 28</u>

Minimum flow releases from Mayfield Dam will be maintained at the lesser of: a) 8 inches of river stage height below the highest consecutive 5-day average flow during which active spawning occurred, as measured at the USGS Station No.14238000 below Mayfield Dam; b) 5,000 cfs; or c) a lower flow authorized by the FTC or agencies based upon the results of spawning surveys.

Instream flows will be monitored at the USGS Station No.14238000 below Mayfield Dam or via other approved means. These minimum release requirements may be reduced, in consultation with the FTC, when such reduction can be shown to not adversely affect downstream salmonid redds. Flows may be temporarily modified if required by operating emergencies beyond the control of Tacoma Power that threaten the safety and stability of Project facilities. In the event conditions beyond its control require Tacoma Power to deviate from this instream flow schedule, Tacoma Power will notify the WDOE as soon as practical, and not more than 10 days after such an incident. Tacoma Power may also deviate from this schedule for short periods upon prior agreement between Tacoma Power and the WDOE.

- Within 1 year of license issuance, Tacoma Power will submit a Fish Monitoring Plan to evaluate the effects of instream flows, including pulsing or channel maintenance flows, upon the fish in the Cowlitz River (Article 15).

- Within 2 years of license issuance, Tacoma Power will submit a report describing measures taken to ensure compliance with instream flows that includes a training manual for Tacoma Power's operations staff and any recommended modifications to operating procedures (Article 16). The training manual will provide tools, resources, and information to manage flows for flood control, recreation, power generation, and fish survival and health.

1. As part of its adaptive management program, Tacoma will undertake a detailed study of whether and how the IHA/RVA method, including other similar methods may supplement existing instream flow setting methods, consistent with the goal of restoring declining native anadromous salmonid runs to the Cowlitz River.

2. Both FERC and the WDOE will maintain the authority to require modification of the above instream flow schedule in the event that the fish monitoring plan shows those flows to be inadequate (SA Articles 15 and 16). This action may be taken on FERC's or WDOE's own motion or upon request of other state or federal agencies.

#### 2.2.2.6 Ramping

- At flows less than 6,000 cfs, Tacoma Power will follow the ramping rate restrictions shown in Table 2 (Article 14), but these may be modified based on further study.

Table 2. WDFW ramping rate guidelines for western Washington rivers.

| Season | Ramping Rate (inches of stage/hour) | |
|---|---|---|
| | Day* | Night** |
| Feb 16 - Jun 15 | No ramping*** | 2 |
| Jun 16 - Oct 31 | 1 | 1 |
| Nov 1 - Feb 15 | 2 | 2 |

* Day is defined as one hour before sunrise until one hour after sunset–for the protection of salmon fry.
**Night is defined as one hour after sunset to one hour before sunrise–for the protection of trout and steelhead fry.
***This means there will not be any ramping down during this critical period for fish.

- The above ramping rate restrictions may be modified based on further study and approval by the Fisheries Advisory Committee (SA Article 14).

#### 2.2.2.7 Flood Control

The Project will continue to be operated to provide flood control in the lower Cowlitz River Basin. Flood control operations are mandated by the FERC License as specified by the Corps. The goal of the flood control is to avoid flows at Castle Rock, Washington, in excess of 70,000 cfs, to the extent practical. Mossyrock Dam controls peak flows by managing storage in Riffe Lake. Riffe Lake is drawn down in the fall to provide storage for winter and spring flood flows. Mayfield Lake, a much smaller reservoir, is generally not drawn down and does not provide significant flood storage. When inflow to Mayfield Lake from the Tilton River and Winston Creek is high, generation at Mossyrock powerhouse may be shut down entirely to minimize flows in the lower river.

#### 2.2.2.8 Fish Production and Hatchery Management[10]

- Tacoma Power will fund the construction, operation, and maintenance of the Cowlitz Salmon Hatchery complex (Articles 5 and 7), consisting of a remodeled Cowlitz Salmon Hatchery, a remodeled Cowlitz Trout Hatchery, and 3 satellite rearing facilities for the duration of the License. Through 2004, Tacoma Power will provide funding for 50,000 lbs of trout production, with subsequent future trout production based upon the success or failure of the program and any impacts to listed stocks. Tacoma Power will fund the current production of spring chinook salmon, fall chinook salmon, coho salmon, late winter steelhead, early winter steelhead, and summer steelhead at levels not to exceed a total of 771,500 lbs of production. NOAA Fisheries is consulting with WDFW on these current levels of production.

- Within 9 months of license issuance, Tacoma Power will submit a Fisheries and Hatchery Management Plan (FHMP) (Article 6), which will be updated at 6-year intervals, that identifies a) quantity and size of fish to be produced at the complex; b) rearing and release strategies for each stock, including upward or downward production adjustments to accommodate recovery of indigenous stocks; c) credit mechanisms for production of high quality natural stocks; d) plans for funding ongoing monitoring and evaluation; and e) a fisheries management strategy consistent with the priority objective of maximizing natural production of wild indigenous fish stocks and species in the basin. The total level of production under the plan will not exceed 650,000 lbs for all stocks until and unless a decision is made under Article 3.

- Within 18 months of license issuance, Tacoma Power will submit a Hatchery Complex Remodeling and Phase-In Plan (Article 7) that includes: a) design drawings that include decreased rearing densities and innovative practices to replicate historical outmigration size and timing; b) a construction schedule; c) a provision for hatchery water supply that maximizes water from existing groundwater wells and, if necessary, treatment of up to 10 cfs of additional river water; and d) a plan for gradual transition to innovative rearing practices. The remodeled facilities will be designed to accommodate production levels up to 800,000 lbs; however, actual production levels will be established under the FHMP in Article 6.

---

[10]NOAA Fisheries, as a member of the FTC, will be involved in the development of the Fisheries and Hatcheries Management Plan (FHMP). All the activities proposed in the FHMP, the Facilities Remodel and Phase-In Plan, and the Disease Management Plan, will be part of a future ESA consultation(s) on these plans.

- Within 5 years of license issuance, Tacoma Power will submit a Fisheries Disease Management Plan (Article 8) that defines an acceptable level of risk from *C. shasta* and other diseases, and allows adult fish to be upstream of Barrier Dam. The plan will be designed to allow an appropriate level of pathogens, will include criteria for determining success or failure, will provide for a review every 5 years to see if criteria for success are being met, and will include a procedure and schedule for amending the plan if criteria are not met.

#### 2.2.2.9 Juvenile Tagging and Monitoring

- Tacoma Power will contribute up to $40,000 per year (adjusted for inflation) for a freshwater juvenile tagging and monitoring program (Article 4) to estimate: a) the number of juveniles arriving at transport facilities, b) their origin (natural or hatchery), c) the number of juveniles transported (by species), and d) the number of adults arriving and transported to the upper basin. Funding for the program will be continued until implementation of the FHMP. NOAA Fisheries expects these activities to continue as part of the FHMP.

#### 2.2.2.10 Fisheries Habitat Improvements

- Within 6 months of license issuance, Tacoma Power will establish a Fisheries Habitat Fund in the amount of $3 million (Article 11) that will be used for fisheries habitat protection, restoration, and enhancement through acquisition, easements, or restoration projects. Within 1 year of license issuance, Tacoma Power will submit a plan for uses of the fund that includes: a) a statement for priority of uses and criteria for disbursement of the funds, with first priority given to acquisition or conservation easements of riparian habitat along side channels below Barrier Dam; b) a description of the efforts Tacoma Power will make in concert with other entities to leverage the habitat fund as matching funds for other salmon recovery funding opportunities; c) plans to coordinate with Lewis County on purchases of land or easements; d) procedures for conservation groups and others to request Tacoma Power's participation in restoration projects, along with criteria for such participation; and e) a statement of what, if any, additional lands acquired through the habitat fund would be included in the Project boundary.

- Within 9 months of license issuance, Tacoma Power will submit a Gravel Augmentation Plan (Article 10) that will enhance salmon spawning gravel below Barrier Dam. The plan will include: a) a plan to monitor and evaluate the effectiveness of the program, including parameters that will be measured to determine the value of gravel placements to salmonid fish reproduction and the stability and life expectancy of such placements; and b) a plan for discontinuing gravel augmentation if Barrier Dam is breached, including measures to monitor the post-breach adequacy of gravel supplies between Mayfield Dam and Toutle River.

- Within 1 year of license issuance, Tacoma Power will submit a LWD Management Plan (Article 9) that will include: a) a description of the source(s) of debris to be made available; b) measures for transporting and delivering it within the Cowlitz River Basin; c) guidelines for its use and disbursement, with priority given to projects in the lower basin, then the upper basin, and then outside the basin; and d) provisions for storage of LWD and disposal of unused debris.

#### 2.2.2.11 Construction Activities

Tacoma Power will fund construction activities associated with the new hatchery facilities, fish passage facilities, and recreation facilities as identified in the License that references the Settlement Agreement.

## 3. CRITICAL HABITAT and EFH

This Opinion does not include a critical habitat analysis, because critical habitat designations for these ESUs were vacated by court order. On February 16, 2000, NOAA Fisheries designated critical habitat for 19 ESUs of chinook salmon, chum salmon, and sockeye salmon, as well as steelhead trout in Washington, Oregon, Idaho, and California.

On September 27, 2000, NOAA Fisheries approved Amendment 14 to the Pacific Coast Salmon Fishery Management Plan designating marine and freshwater essential fish habitat for Pacific salmon pursuant to the MSA. Shortly after these designations, the National Association of Homebuilders filed a lawsuit challenging the designations on a number of grounds. On April 30, 2002, the United States District Court for the District of Columbia adopted a consent decree resolving the claims in the lawsuit. Pursuant to that consent decree, the Court issued an order vacating the critical habitat designations, but retaining the MSA essential fish habitat designations. National Association of Homebuilders, et al. v. Evans, Civil Action No. 00-2799 (CKK)(D. D.C., April 30, 2002). NOAA Fisheries published a final rule removing critical habitat designations for 19 salmon and steelhead ESUs to comply with the court order. 68 FR 55900 (Sept 29, 2002). Thus the critical habitat designations for LCR chinook salmon, LCR steelhead, and CR chum salmon are no longer in effect. NOAA Fisheries intends to reissue critical habitat designations. Reinitiation of consultation will be required if the proposed action affects critical habitat designated after consultation has been completed. 50 CFR §402.16(d). In further EFH litigation, Idaho County v. Evans, Case No. CV02-80-C-EJL (D. Idaho) (Memorandum and Order of September, 30, 2003), the District Court remanded the Pacific Coast salmon EFH designation to NOAA Fisheries for a notice-and-comment rulemaking and codification in the Code of Federal Regulations.

## 4. BIOLOGICAL REQUIREMENTS

The first step NOAA Fisheries uses when applying the ESA Section 7(a)(2) to the listed ESUs considered in this Opinion is to define the species' biological requirements. Biological requirements within the action area are a subset of the rangewide biological requirements of the ESU. Identification of the rangewide biological requirements provides context for subsequent evaluation of action-area biological requirements.

Relevant biological requirements are those necessary for the listed ESUs to survive and recover to naturally reproducing population sizes at which protection under the ESA would become unnecessary. This will occur when populations are large enough to safeguard the genetic diversity of the listed ESUs, enhance their capacity to adapt to various environmental conditions, and allow them to become self-sustaining in the natural environment. McElhaney et al. (2000) describes the biological requirements of salmonid populations, which are the components of ESUs, as adequate abundance, productivity (population growth rate), spatial scale, and diversity. These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle.

In its draft, the Willamette/Lower Columbia Technical Recovery Team (WLCTRT) has determined that there were at least 31 historical, demographically independent populations within the LCR chinook salmon ESU. The WLCTRT identified 8 historical populations within the Cowlitz River Basin. The WLCTRT identified 23 populations of LCR steelhead, including 7 populations in the Cowlitz River Basin. Sixteen historical populations of CR chum salmon were identified in the ESU, including a Cowlitz River Basin population (WLCTRT 2002a).

The WLCTRT has not yet identified target abundance levels that are indicative of viable populations of LCR chinook salmon, LCR steelhead, or CR chum salmon in the Cowlitz River. The WLCTRT is currently in the process of defining a number of specific viability criteria for these populations, which will be useful for determining if population-level biological requirements are being met. WLCTRT (2002b) discusses a number of potential criteria in the areas of population adult growth rates and abundance criteria, juvenile outmigrant growth rate criteria, within-population spatial structure criteria, and within-population diversity criteria.

The WLCTRT has not determined the degree to which viability of the Cowlitz River Basin populations identified above are necessary for ESU viability. WLCTRT (2002b) identified three criteria for ESU viability:

1. Every stratum (life history and ecoregion combination) that historically existed should have two populations, or 50% of the historical populations, whichever is greater, that meet or exceed all the criteria for a viable population.

2. Within a stratum, populations should be selected to include "core" populations that were historically most productive, retain genetic diversity, and minimize susceptibility to catastrophic events.

3. All populations, even those which are not restored to fully viable status, should be maintained at least at the current population level, or an effective population size of 500 fish, whichever is greater.

For the purposes of this consultation, and until superceded by determinations of the WLCTRT, NOAA Fisheries assumes that the viability of the populations of the three listed ESUs in the action area is necessary for the viability and recovery of their respective ESUs. When there are gaps in information, NOAA Fisheries is expected to provide the benefit of the doubt to the species of concern (USFWS and NOAA Fisheries 1998). For the ESU to survive and recover, adequate habitat and life-stage specific survival rates must occur within the action area. As described in NOAA Fisheries (1999) "Habitat Approach," there is a strong causal link between habitat modification and the response of salmonid populations. Those links are often difficult to quantify. In many cases, NOAA Fisheries must describe biological requirements in terms of habitat conditions in order to infer the populations' response to the effects of the action. To survive and recover, a wide-ranging salmonid ESU must have adequate habitat available for each life history stage.

For this consultation, the relevant biological requirements are important habitat elements that function to support successful adult and juvenile migration, adult holding, spawning, incubation, rearing, and growth and development to the smolt stage. These important habitat elements for LCR chinook salmon, LCR steelhead, and CR chum salmon are: 1) substrate, 2) water quality, 3) water quantity, 4) water temperature, 5) water velocity, 6) cover/shelter, 7) food (juvenile only), 8) riparian vegetation, 9) space, and 10) safe passage conditions. Project activities are likely to affect each of these habitat elements. The majority of these habitat elements are included in an analysis framework titled "Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale" (hereinafter referred to as the "matrix") for making effects determinations at the watershed scale (NOAA Fisheries 1996). NOAA Fisheries uses the matrix to evaluate the environmental baseline condition and effects of the action on important habitat elements for affected LCR chinook salmon, LCR steelhead, and CR chum salmon.

## 4.1 Status of Species

NOAA Fisheries considers the current status of the listed species, taking into account population size, trends, distribution, and genetic diversity. To assess the current status of the listed species within the action area, NOAA Fisheries starts with the determinations made in its decision to list for ESA protection the ESUs considered in this Opinion and also considers any new data that is relevant to the determination. This section covers listing status, general life history, and population dynamics of species.

Six species of salmon and steelhead are found in the Cowlitz River Basin. Two of these six species are sockeye and pink salmon. Very little distribution or life history information is available for these species. Because they are not listed under the ESA, these two species will not be discussed further in this Opinion. Listed species in the action area include chinook (spring and fall) salmon, steelhead, and chum salmon. The specific status and ESU of each species and references are given in Table 3. Although LCR/SW coho salmon are neither listed nor proposed for listing, the effects of the action on this ESU are evaluated in this Opinion at the request of FERC. This will facilitate preparation of a subsequent Opinion should the status of this ESU change. Additionally, the effects analysis supports the analysis of effects of the proposed action on essential fish habitat in the MSA consultation that is included with this Opinion.

Table 3. ESA status of anadromous salmonids present in the Cowlitz River Basin.

| **Species** | **ESU** | **Status** | **Protective Regulations** |
|---|---|---|---|
| Chinook Salmon<br>*Oncorhynchus tshawytscha* (fall and spring) | Lower Columbia River | Threatened | 64 FR 143086<br>March 24, 1999<br>65 FR 42422<br>July 10, 2000 |
| Steelhead<br>*Oncorhynchus mykiss* | Lower Columbia River | Threatened | 63 FR 13347<br>March 19, 1998<br>65 FR 42422<br>July 10, 2000 |
| Chum Salmon<br>*Onchorynchus keta* | Columbia River | Threatened | 64 FR 14508<br>March 25, 1999 |
| Coho Salmon<br>*Oncorhynchus kisutch* | Lower Columbia River/Southwest Washington | Candidate | 60 FR 38011<br>July 25, 1995 |

### 4.1.1 Chinook Salmon

Chinook salmon are the largest of the Pacific salmon. The species' North American distribution historically ranged from the Ventura River in California to Point Hope, Alaska. In northeastern Asia, the species range from Hokkaido, Japan to the Anadyr River in Russia (Healey 1991). Additionally, chinook salmon have been reported in the Mackenzie River area of northern Canada (McPhail and Lindsey 1970). Of the Pacific salmon, chinook salmon exhibit the most diverse and complex life-history strategies. Healey (1986) described 16 age categories for chinook salmon, 7 total ages at maturity with 3 possible freshwater ages. Gilbert (1912) initially described 2 general freshwater life-history types: "stream-type" chinook salmon, which reside in freshwater for a year or more following emergence, and "ocean-type" chinook salmon, which migrate to the ocean within their first year. Healey (1983, 1991) has promoted the use of broader definitions for ocean-type and stream-type to describe two distinct races of chinook salmon. This racial approach incorporates life history traits, geographic distribution, and genetic differentiation, and provides a valuable frame of reference for comparisons of chinook salmon populations. The generalized life history of Pacific salmon includes phases of incubation, hatching, freshwater emergence, migration to the ocean, and subsequent initiation of maturation and return to freshwater for completion of maturation and spawning. Juvenile rearing in freshwater can be minimal or extended. Additionally, some male chinook salmon mature in freshwater, thereby foregoing emigration to the ocean. The timing and duration of each of these stages is related to varying degrees of genetic and environmental determinants and interactions thereof. Chinook salmon may spend 1 to 6 years in the ocean before returning to their natal streams to spawn.

Ocean distribution differs between ocean- and stream-type chinook salmon (Healey 1983, 1991). Ocean-type chinook salmon tend to migrate along the coast, and stream-type chinook salmon migrate far from the coast in the central North Pacific. Chinook salmon populations within the ESUs discussed here can be characterized by their time of freshwater entry as spring, summer, or fall runs. Spring-run chinook salmon tend to enter freshwater and migrate far upriver, where they hold and become sexually mature before spawning in the late summer and early autumn. Fall-run chinook salmon enter freshwater in a more advanced stage of sexual maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of their natal rivers, and spawn within a few days or weeks of freshwater entry (Fulton 1968, Healey 1991). Summer-run chinook salmon are intermediate between spring and fall runs, spawning in large- and medium-sized tributaries, and do not show the extensive delay in maturation exhibited by spring chinook salmon (Fulton 1968).

#### 4.1.1.1 LCR Chinook Salmon ESU

The LCR chinook salmon ESU is characterized by numerous short- and medium-length rivers that drain the coast ranges and the west slope of the Cascade Mountains. This ESU includes all native populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls. The former location of Celilo Falls (drowned by The Dalles Reservoir in approximately 1957) is the eastern boundary for this ESU. The Cowlitz, Kalama, Lewis, Washougal, and Wind Rivers constitute the major systems in Washington; the lower Willamette, Clackamas, Hood, and Sandy Rivers are the major systems in Oregon. The ESU does not include spring chinook salmon populations in the Clackamas River or the introduced Carson Hatchery spring chinook salmon stock. Tule fall chinook salmon in the Wind and White Salmon Rivers are included in this ESU, but not the introduced upriver bright fall chinook salmon populations in the Wind and White Salmon Rivers and those spawning naturally below Bonneville Dam (Myers et al. 1998). Of the 14 hatchery stocks included in the ESU, only the Cowlitz River spring chinook salmon was considered essential for recovery, but was not listed (64 FR 14308, March 24, 1999). WDF et al. (1993) identified 20 stocks within the ESU, but surveyed only Washington stocks, which did not include the Clackamas tule, Sandy spring or Sandy late fall bright spawning aggregations in Oregon.

There are three different runs of chinook salmon in the LCR ESU: spring run, late fall brights, and early fall tules. Spring-run chinook salmon in the lower Columbia River have a stream-type juvenile life history and enter freshwater as adults in March and April, well in advance of spawning in August and September. Historically, fish migrations were synchronized with periods of high rainfall or snowmelt to provide access to upper reaches of most tributaries where spring stocks would hold until spawning (Fulton 1968; Olsen et al. 1992; WDF et al. 1993). The tule and bright fall chinook salmon exhibit an ocean-type life history and northerly ocean migration patterns, with bright fish tending to travel father north than the tule stocks. Tule fall chinook salmon begin entering the Columbia River in August, rapidly moving into the lower Columbia River tributaries to begin spawning in September and October. Bright fall chinook salmon enter the Columbia River over a longer period of time beginning in August, and do not begin spawning until October with spawning observed into the following March in some locations. All lower Columbia River chinook salmon mature from 2 to 6 years of age, primarily returning as 3- and 4-year-old adults (Myers et al. 1998).

Long-term trends in fall-run escapement are mixed, with most larger stocks positive, while the spring-run trends are positive or stable. Short-term trends for both runs are more negative, some severely so (Myers et al. 1998). However, apart from the relatively large and apparently healthy fall-run population in the Lewis River, production in this ESU appears to be predominantly hatchery-driven with few identifiable native, naturally reproducing populations. About half of the populations comprising this ESU are very small, increasing the likelihood that risks due to genetic and demographic processes in small populations will be important.

Spring chinook salmon were present historically in the Sandy, Clackamas,[11] Cowlitz, Kalama, Hood, and Lewis Rivers. Spawning and juvenile rearing areas have been eliminated or greatly reduced by dam construction on all these rivers. The native Lewis River run became extinct soon after completion of Merwin Dam in 1932. The natural Hood River spring chinook salmon population was extirpated in the 1960s after a flood caused by the natural breaching of a glacial dam resulted in extensive habitat damage in the West Fork production areas. Currently non-listed hatchery spring chinook salmon from the Deschutes River are being released into the Hood River as part of a reintroduction program. The remaining spring chinook salmon stocks in the LCR ESU are found in the Sandy, Lewis, Cowlitz, and Kalama Rivers. Numbers of naturally spawning spring-run chinook salmon are very low, and have historically had or continue to have substantial contributions of hatchery fish. Recent escapements above Marmot Dam on the Sandy River average 2,800 and have been increasing (ODFW 1998). Hatchery-origin spring chinook salmon are no longer released above Marmot Dam; the proportion of first generation hatchery

[11] Clackamas River spring chinook salmon are considered part of the listed Upper Willamette River chinook salmon ESU.

fish in the escapement is relatively low, on the order of 10%-20% in recent years. Recent average escapement of naturally spawning spring chinook salmon adults in the Cowlitz, Kalama, and Lewis Rivers are 237, 198, and 364, respectively (LeFleur 2000, 2001). The amount of natural production resulting from these escapements is unknown, but is presumably small since the remaining habitat in the lower rivers is not the preferred habitat for spring chinook salmon (ODFW 1998). WDFW's hatchery escapement goals have been consistently met in the Cowlitz and Lewis Rivers. In the past, when necessary, broodstock from the Lewis was used to meet production goals in the Kalama. Although the status of hatchery stocks is not always a concern or priority from an ESA perspective, in situations where the historical spawning habitat is no longer accessible, the status of the hatchery stocks is pertinent.

Fall chinook salmon populations in the LCR are self sustaining, and escapements are generally stable (ODFW 1998). The tule component of the fall chinook salmon populations spawn in the Coweeman, East Fork Lewis, and Clackamas Rivers. Escapements for these populations have ranged from several hundred to thousands per year (WDFW 2003a). Some natural spawning of tule fall chinook salmon occurs in other areas, but is thought to result primarily from hatchery-origin strays. Tule fall chinook salmon are produced at the Elochoman, Cowlitz Salmon, Toutle, Kalama, Spring Creek, and Washougal hatcheries in Washington, and Big Creek Hatchery in Oregon. The bright component of LCR fall chinook salmon spawn in the North Fork Lewis, East Fork Lewis, and Sandy Rivers. LCR bright stocks are among the few healthy natural chinook salmon stocks in the Columbia River Basin. Escapement to the North Fork Lewis River has exceeded WDFW's escapement goal of 5,700 by a substantial margin every year since 1980, except 1999, with a recent five-year average escapement of 8,400. Escapements of the two smaller populations of brights in the Sandy and East Fork Lewis Rivers have been stable for the last 10-12 years and are largely unaffected by hatchery fish (NOAA Fisheries 2001; ODFW 1998).

Freshwater habitat is in poor condition in many basins, with problems related to forestry practices, urbanization, and agriculture. Dam construction on the Cowlitz, Lewis, White Salmon, and Sandy Rivers has eliminated access to a substantial portion of the spring-run spawning habitat, with a lesser impact on fall-run habitat (Myers et al. 1998).

The large numbers of hatchery fish in this ESU make it difficult to determine the proportion of naturally produced fish. In spite of the heavy impact of hatcheries, genetic and life-history characteristics of populations in this ESU still differ from those in other ESUs. However, the potential loss of fitness and diversity resulting from the introgression of hatchery fish within the ESU is an important concern. In response to concerns about straying into tributaries of the lower Columbia River (Myers et al. 1998), the release locations for non-ESU Rogue River bright fall-run fish in Youngs Bay were changed, and as a result, stray rates have declined markedly (Bishop, S., NOAA Fisheries, personal communication to R. Turner, NOAA Fisheries, February 19, 2002).

In 2002-2003, status reviews were conducted by the West Coast Salmon Biological Review Team (WCSBRT 2003). The WCSBRT, based on a synthesis of the updated information provided in its report, plus the information contained in previous LCR status reviews, tentatively identified the number of historical and currently viable populations (Table A.2.5.5 of the report). The summary indicated that the ESU is substantially modified from historical population structure. Most tule fall chinook salmon populations are potentially at risk of extinction and no populations of the spring run life-history type are currently considered self-sustaining. The Lewis River late fall bright population has the highest likelihood of being self-sustaining under current conditions. The WCSBRT concluded that the ESU remains "likely to become endangered in the foreseeable future" (WCSBRT 2003).

### 4.1.2 Steelhead

Steelhead in North America are distributed from northwestern Mexico to the Kuskokwim River in Alaska (Lichatowich 1999). Steelhead exhibit more complex life history traits than other Pacific salmonid species. Some forms of steelhead are anadromous, while others, called rainbow or redband trout, reside permanently in freshwater. Anadromous steelhead reside in freshwater for as long as 7 years before moving to the ocean, but steelhead typically reside in marine waters for 2 to 3 years before returning to their natal stream to spawn at 4 or 5 years of age. Some Oregon and California populations include "half-pounders" that migrate from the ocean to freshwater and return to the ocean without spawning (Busby et al. 1996).

Steelhead trout can be divided into two basic run types based on the level of sexual maturity at the time of river entry and the duration of the spawning migration (Burgner et al. 1992). The stream-maturing type (inland), or summer steelhead, enters freshwater in a sexually immature condition and requires several months in freshwater to mature and spawn. The ocean-maturing type (coastal), or winter steelhead, enters freshwater with well-developed gonads and spawns shortly after river entry (Barnhart 1986). Variations in migration timing exist between populations. Both summer and winter steelhead occur in British Columbia, Washington, and Oregon; Idaho has only summer steelhead; and California is thought to have only winter steelhead (Busby et al. 1996). In the Pacific Northwest, summer steelhead enter freshwater between May and October, and winter steelhead enter freshwater between November and April.

Steelhead are iteroparous, or capable of spawning more than once before death. Steelhead spawn in cool, clear streams with suitable gravel size, depth, and current velocity. Intermittent streams may also be used for spawning (Barnhart 1986; Everest 1973). Steelhead enter streams and arrive at spawning grounds weeks or even months before they spawn, and are vulnerable to disturbance and predation. Cover, in the form of overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water, turbulence, and turbidity (Geiger 1973) is required to reduce disturbance of and predation on spawning steelhead. Summer steelhead usually spawn further upstream than winter steelhead (Withler 1966; Behnke 1992). Juveniles typically rear in freshwater from 1 to 4 years before migrating to the ocean. Winter steelhead generally smolt after 2 years in freshwater (Busby et al. 1996).

Based on catch data, juvenile steelhead tend to migrate directly offshore during their first summer, rather than migrating nearer to the coast as do salmon. During fall and winter, juveniles move southward and eastward (Hartt and Dell 1986). Available fin-mark and coded-wire tag data suggests that winter steelhead tend to migrate farther offshore but not as far north into the Gulf of Alaska as summer steelhead (Burgner et al. 1992). Maturing Columbia River steelhead are found off the coast of northern British Columbia and west into the North Pacific Ocean (Busby et al. 1996). At the time adults are entering freshwater, tagging data indicate that immature Columbia River steelhead are out in the mid-north Pacific Ocean.

#### 4.1.2.1 LCR Steelhead ESU

The LCR steelhead ESU includes all naturally produced steelhead in tributaries to the Columbia River between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers in Oregon, excluding steelhead in the upper Willamette River above Willamette Falls (i.e., the Upper Willamette River ESU) (Busby et al. 1996). Steelhead in this ESU belong to the coastal genetic group (Schreck et al. 1986; Reisenbichler et al. 1992; Chapman et al. 1994) and include both winter steelhead (Cowlitz, Toutle, Coweeman, Kalama, Washougal, Sandy, Hood, Clackamas, and Wind Rivers) and summer steelhead (Kalama, Lewis, Hood, Wind, and Washougal Rivers). WDF et al. (1993) identified 19 stocks considered to be predominantly of natural production. Among hatchery stocks, late-run Cowlitz Trout Hatchery winter steelhead and the late-run Clackamas River hatchery winter steelhead are part of the ESU, but are not considered essential for recovery. Hatchery programs using endemic natural stocks of winter steelhead have been developed in the Sandy, Kalama, and Hood Rivers since the listing.

Life history attributes for steelhead within this ESU appear to be similar to those of other West Coast steelhead. Most LCR steelhead rear 2 years in freshwater and spend 1 or 2 years in the ocean prior to reentering freshwater, where they may remain up to a year prior to spawning (Howell et al. 1985). Summer-run stocks generally enter freshwater from May through October, while winter stocks generally enter freshwater from November to May (Busby et. al 1996). Peak entry generally occurs in July (B. Leland, WDFW, personal communication to S. Bishop, NOAA Fisheries, in July 1999).

No estimates of historical abundance (pre-1960s) specific to this ESU are available. A conservative estimate of current abundance puts the average run size at greater than 16,000. Abundance trends are mixed, and possibly affected by short-term climate conditions. At the time of NOAA Fisheries' status review in 1996, the majority of stocks for which data are available within this ESU were declining, although some had increased strongly. The strongest upward trends were those of either non-native stocks (lower Willamette River and Clackamas River summer steelhead) or stocks recovering from major habitat disruption and still at low abundance (mainstem and North Fork Toutle River) (Busby et al. 1996). Since 1996 when the status review was completed, listed LCR steelhead populations have generally increased, with some populations rebounding more quickly than others.

Recent adult return data for this ESU are summarized in NOAA Fisheries' biological opinion on the operation of the Federal Columbia River Power System (NOAA Fisheries 2000). For the larger runs, (Cowlitz, Kalama, and Sandy Rivers), current counts have been in the range of 1,000 to 2,000 fish. Historical counts for these runs, however, were more than 20,000 fish. In general, all the runs in the ESU have declined over the past 20 years, exhibiting sharp declines in the last 5 years. Escapement estimates for the steelhead fishery in the LCR ESU are based on in-river and estuary sport-fishing reports. There is also a limited ocean fishery on this ESU. Harvest rates range from 20% to 50% of the total run, but harvest rates on naturally produced fish have dropped to 0% to 4% in recent years (punchcard data from WDFW through 1994).

The major area of uncertainty in the status review is the degree of interaction between hatchery and natural stocks within the ESU. There is widespread production of hatchery steelhead within this ESU and several stocks for which there are hatchery composition estimates that average more than 50% hatchery fish in natural escapement. Concerns about hatchery influence are especially strong for summer steelhead and Oregon winter steelhead stocks, where there appears to be substantial overlap in spawning between hatchery and natural fish (Busby et al. 1996). Most of the hatchery stocks originate from stocks within the ESU, but many are not native to local river basins. WDFW's conclusion that there is little overlap in spawning between natural and hatchery stocks of winter steelhead throughout the ESU is generally supported by available evidence. However, with the exception of detailed studies of the Kalama River winter stock, it is based largely on models with assumed run times rather than empirical data. There is apparently strong overlap in spawning between hatchery and natural summer steelhead in tributaries on the Washington side of the lower Columbia River. NOAA Fisheries has no information regarding potential spawning separation between hatchery and natural fish in Oregon tributaries of the lower Columbia River (Busby et al. 1996).

In its 2002-2003 status reviews, the WCSBRT indicated some of the uncertainty about the ESU, with the WCSBRT unable to conclusively identify a single population that is naturally self-sustaining (WCSBRT 2003, especially see Table B.2.4.5 of the report). Over the period of the available time series, most of the populations have been in decline and are at relatively low abundance (no population has a recent mean greater than 750 spawners). In addition, many of the populations continue to have a substantial fraction of hatchery origin spawners and may not be naturally self-sustaining. The WCSBRT (2003) concluded that the ESU remains "likely to become endangered in the foreseeable future."

### 4.1.3 Chum Salmon

Chum salmon are semelparous, spawn primarily in freshwater, and apparently exhibit obligatory anadromy, as there are no recorded landlocked or naturalized freshwater populations (Randall et al. 1987). The species is known for the enormous canine-like fangs and striking body color (a calico pattern, with the anterior two-thirds of the flank marked by a bold, jagged, reddish line and the posterior third by a jagged black line) of spawning males. Females are less flamboyantly colored and lack the extreme dentition of the males.

The species has the widest natural geographic and spawning distribution of any Pacific salmonid, primarily because its range extends further along the shores of the Arctic Ocean than other salmonids. Chum salmon have been documented to spawn from Korea and the Japanese island of Honshu, east around the rim of the North Pacific Ocean, to Monterey Bay in California. Presently, major spawning populations are found only as far south as Tillamook Bay on the northern Oregon Coast. The species' range in the Arctic Ocean extends from the Laptev Sea in Russia to the Mackenzie River in Canada. Chum salmon may historically have been the most abundant of all salmonids: Neave (1961) estimated that prior to the 1940s, chum salmon contributed almost 50% of the total biomass of all salmonids in the Pacific Ocean. Chum salmon also grow to be among the largest of Pacific salmon, second only to chinook salmon in adult size, with individual chum salmon reported up to 43 inches (108.9cm) in length and 45 lbs (20.8kg) in weight (Pacific Fisherman 1928). Average size for the species is around 8 to 15 lbs (3.6 to 6.8kg) (Salo 1991).

Chum salmon spend more of their life history in marine waters than other Pacific salmonids. Chum salmon spend 2 to5 years in the northeast Pacific Ocean feeding areas prior to migrating southward during the summer months as maturing adults along the coasts of Alaska and British Columbia in returning to their natal streams (WDFW/PNPTT 2000). Most chum salmon mature as 4-year-old adults (Johnson et al. 1997). Chum salmon usually spawn in the lower reaches of rivers, with redds usually dug in the mainstem or in side channels of rivers from just above tidal influence to nearly 60 miles (100km) from the sea. Chum salmon, like pink salmon, usually spawn in coastal areas, and juveniles out migrate to seawater almost immediately after emerging from the gravel that covers their redds (Salo 1991). This ocean-type migratory behavior contrasts with the stream-type behavior of some other species in the genus *Oncorhynchus* (e.g., coastal cutthroat trout, steelhead, coho salmon, and most types of chinook salmon and sockeye salmon), which usually migrate to sea at a larger size, after months or years of freshwater rearing. This means survival and growth in juvenile chum salmon depends less on freshwater conditions than on favorable estuarine conditions. Another behavioral difference between chum salmon and species that rear extensively in freshwater is that chum salmon form schools, presumably to reduce predation (Pitcher 1986), especially if their movements are synchronized to swamp predators (Miller and Brannon 1982).

#### 4.1.3.1 CR Chum Salmon ESU

This ESU includes all naturally produced chum salmon populations that enter the Columbia River. Historically, chum salmon were abundant in the lower reaches of the Columbia River and may have spawned as far upstream as the Walla Walla River (Johnson et al. 1997). However, reductions in available habitat currently limit chum salmon in the Columbia River to tributaries below Bonneville Dam. Most of the historical runs disappeared by the 1950s (Rich 1942; Marr 1943; Fulton 1970). Historically, the CR chum salmon ESU supported a large commercial fishery, landing more than 500,000 fish per year. Commercial catches declined beginning in the mid-1950s. There are now no recreational or directed commercial fisheries for chum salmon in the Columbia River, although chum salmon are taken incidentally in the gill-net fisheries for coho salmon and fall chinook salmon and in recreational fisheries targeting other species.

Because of the well-known aversion of chum salmon to surmounting inriver obstacles to migration, the effects of the mainstem Columbia River hydropower system have probably been more severe for chum salmon than for other salmon species. Bonneville Dam presumably continues to impede the recovery of upriver populations. Substantial habitat loss in the Columbia River estuary and associated areas presumably was an important factor in the decline and also represents a continuing risk for this ESU.

The WLCTRT has identified 16 historical populations in the ESU. Currently, the WDFW regularly monitors two primary population centers where natural spawning populations still exist. The two population centers are in the Grays River and the Lower Gorge (below Bonneville Dam). In 1999, WDFW located another Columbia River mainstem spawning area for chum salmon near the I-205 bridge. Hatchery fish have had little influence on the naturally produced component of the CR chum salmon ESU. In the Grays River, the majority of the chum salmon spawning occurs in less than 1 mile of the river. Prior to its destruction in a 1998 flood, an artificial spawning channel created by WDFW in 1986 was the location of approximately 50% of the spawning in the Grays River chum salmon population. Data from the WCSBRT preliminary report (WCSBRT 2003) indicates both long-term and short-term negative trends in productivity and in growth for the population. Abundance estimates for 2002 suggest a substantial increase in the abundance over what was observed over the last 50 years. Survey crews handled over 7,000 chum salmon carcasses in the Grays River in 2002, but the total population size is in the neighborhood of 10,000 adults. However, a new chum salmon hatchery program in the Grays River started in 1999 confounds the abundance estimates. In 1999, 120,000 hatchery chum salmon were released into the Grays River and 60,000 hatchery chum salmon were released into the Chinook River. These fish returned as 3-year-olds in 2002 and are included in the 10,000 adult estimate. The hatchery fish were otolith marked, so it will be possible to determine the fraction of hatchery origin spawners once the otoliths are read, but that information is not available at this time. The Chinook River is a sub-population of the Grays River population that had essentially no chum salmon in recent years, prior to 2002 return of hatchery fish. In 2002, a preliminary estimate of 600 chum salmon returned to the Chinook River, suggesting a 1% return of 3-year-olds from the hatchery fish. Extrapolating this return rate to the Grays River, 1,200 of the estimated 10,000 returns would be of hatchery origin, suggesting that the large increase in the Grays River is not simply the result of the hatchery program (WCSBRT 2003).

The Lower Gorge population consists of a number of subpopulations immediately below Bonneville Dam. The sub-populations include Hardy Creek, Hamilton Creek, Ives Island, and the Multnomah area. Both the Ives Island and Multnomah area subpopulations spawn in the Columbia River mainstem. Long-term abundance estimates for the Hardy Creek and Hamilton Creek subpopulations are in the WDFW Fisheries Management Evaluation Plan (WDFW 2003a); Hamilton Creek estimates also include adults returning to the artificial spawning channel in Hamilton Creek. These abundance estimates may not be representative of the Lower Gorge population, because it does not include mainstem spawning areas. Chum salmon may alternate between the tributaries and the mainstem, depending on flow conditions, causing counts in only a subset of the population to be poor indicators of the total population abundance in a given year. Based on these data, the population has shown a downward trend since the 1950s and has been at relatively low abundance up until 2000. However, preliminary data indicated that the 2002 abundance has shown a substantial increase estimated at greater than 2,000 chum salmon in Hamilton and Hardy Creeks, plus another 8,000 or more in the mainstem (WCSBRT 2003).

The WDFW has started a chum salmon conservation program for the Lower Gorge group, collecting adults in the Ives Island area for broodstock. The broodstock is spawned and the juveniles reared at the Washougal Fish Hatchery. This hatchery program will supplement the Ives Island population and provide juveniles for release into Duncan Creek. Access to Duncan Creek for chum salmon was reestablished in 2001, when a dam at the outlet of a manmade lake was modified to allow passage. In addition, chum salmon spawning channels were developed in areas of historical upwelling adjacent to Duncan Creek. The improved access and the new spawning channels were immediately successful such that within 3 days after completion of work on the channels they were being used by spawning chum salmon. The hatchery program production goal is to release 100,000 chum salmon after a short rearing period (fish will be 500 fish to the pound).

A group of chum salmon was recently observed (since 1998-1999) to be spawning in the mainstem Columbia River on the Washington side, just upstream of the I-205 bridge (the "I-205 population"). These spawners are considered to be part of the WLCTRT's Washougal population of chum salmon, as this is the closest tributary mouth (WCSBRT 2003). It is not clear if this is a recently established population or only recently discovered by WDFW. In 2000, WDFW estimated 354 spawners at this location. As with the other Columbia River chum salmon spawning populations, preliminary data indicated a dramatic increase in 2002. Preliminary estimates put the abundance of this population in the range of several thousand spawners (WCSBRT 2003).

Chum salmon spawn on the Oregon side of the Lower Gorge population (Multnomah area), but appear to be essentially absent from other areas in the Oregon portion of this ESU. In 2000, ODFW conducted surveys to determine the abundance and distribution of chum salmon in the Columbia. Of the 30 sites surveyed, only 1 chum salmon was observed. With the exception of the Lower Gorge population, Columbia chum salmon are considered extirpated, or nearly so, in Oregon.

As a result of its 2002-2003 status reviews, the WCSBRT tentatively identified the number of historical and currently viable populations (Table E.2.2.5 in the WCSBRT 2003 report). At least 88% of the historical populations appear to have been extirpated, or nearly so. The extant populations have been at low abundance for the last 50 years in the range where stochastic processes could lead to extinction. Encouragingly, there has been a substantial increase in the abundance of these two populations and the new (or newly discovered) I-205 population. However, it is not known if this increase will continue, and the abundance is still substantially below the historical levels. The WCSBRT (2003) concluded that the ESU remains "likely to become endangered in the foreseeable future."

### 4.1.4 Coho Salmon

#### 4.1.4.1 LCR/SW Coho Salmon

The ESU includes all naturally spawned populations of coho salmon from Columbia River tributaries below the Klickitat River on the Washington side and below the Deschutes River on the Oregon side (including the Willamette River as far upriver as Willamette Falls), as well as coastal drainages in Southwest Washington between the Columbia River and Point Grenville. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 10,418 square miles in Oregon and Washington (Johnson et al. 1991).

Throughout their range, coho salmon spawn in streams along the coast and in small tributaries of larger rivers. Coho salmon migrate further upstream than pink and chum salmon, but usually not as far as sockeye and chinook salmon (Sandercock 1991). Typically, coho salmon spawn in gravelly transition areas between pool and riffle habitats. Preferred gravel is 0.5 to 4.0 inches (1.3 to10.2 cm) in diameter (pea to orange size). Preferred water depths range from 4 to 21 inches (10 to 53 cm) (Bjorn and Reiser 1991) and preferred velocities range from 1 to 3 ft/s (30 to 91 cm/s).

Hatchery production of coho salmon in the LCR/SW coho salmon ESU far exceeds that of any other area with respect to the number of hatcheries and quantities of fish produced; total annual production was just over 55 million fish between 1987 and 1991. Many hatcheries within this ESU released 1-3 million smolts annually, with the two largest hatcheries, Cowlitz and Lewis, releasing an average of 6-7 million smolts annually. Coho salmon production from Washington-side Columbia River hatcheries (29.4 million smolts per year) provides about 53% of the total annual production, with the remainder split between Oregon-side Columbia River (10.9 million smolts) and Southwest Washington coast (14.7 million fish) facilities (Johnson et al. 1991).

Extensive stock transfers have occurred within the LCR/SW coho salmon ESU. Most transfers of coho salmon have used stocks from within the ESU, although transfers from outside the ESU have also occurred, including those from the Oregon Coast, Olympic Peninsula, and Puget Sound/Strait of Georgia ESUs. Outplanting records show a similar pattern to transfers between hatcheries, with extensive use of within-ESU stocks, in addition to less frequent use of stocks from the same three ESUs. Most movement of coho salmon, either as hatchery transfers or off-station releases, has occurred within each of the three areas of this ESU (Oregon-side Columbia River, Washington-side Columbia River, and Southwest Washington coast), with little movement of fish among the three areas (Johnson et al. 1991).

Historical harvest rates on this ESU were in the range of 60%-90% from the 1960s to the 1980s. Modest harvest reductions were acheived in the late 1980s, but rates remained high until a crisis was perceived, with most directed coho salmon harvest prohibited in 1994 (WCSBRT 2003).

Prior to the 1900s, naturally produced coho salmon were widespread in the Columbia River Basin, with a historical center of abundance in the LCR. There were also large runs of coho salmon in the middle and upper reaches of the Columbia River and in the Snake River. All upper Columbia, middle Columbia, and Snake River runs were drastically reduced or destroyed by various factors prior to the 1950s, including overharvest and habitat destruction or blockage (Cramer et al. 1991 as cited in Johnson et al. 1991).

On July 25, 1995, NOAA Fisheries determined that listing was not warranted for this ESU (62 FR 38011). However, the ESU is designated as a candidate for listing due to concerns over specific risk factors. In the Columbia River Basin, all coho salmon stocks above Bonneville Dam (except Hood River) were classified by Nehlsen et al. (1991) as extinct. Hood River, Sandy River, and all other lower Columbia River tributary stocks were classified as at high risk of extinction, except the Clackamas River stock, which was classified as at moderate risk of extinction. This historical ESU also included portions of the Southwest Washington coast. Nehlsen et al. (1991) identified coho salmon stocks in Willapa Bay as at high risk of extinction. WDF et al. (1993) identified the Willapa Bay stocks as of unknown status, but of mixed origin and composite production. They identified all stocks in Grays Harbor tributaries as healthy, but of mixed origin and composite production.

# 5. ENVIRONMENTAL BASELINE

The environmental baseline includes "the past and present impacts of all Federal, State, or private actions and other human activities in the action area, including the anticipated impacts of all proposed Federal projects in the action area that have undergone Section 7 consultation and the impacts of State and private actions that are contemporaneous with the consultation in progress" (50 CFR §402.02). In step 2 of its analysis, NOAA Fisheries evaluates the relevance of the environmental baseline in the action area to the species current status. In describing the environmental baseline, NOAA Fisheries emphasizes important habitat indicators for the listed salmonid ESUs affected by the proposed action. The action area is described in Section 2.2.1 of this document. NOAA Fisheries does not expect any other areas to be directly or indirectly affected by the proposed action.

## 5.1 Status of Species within the Action Area

### 5.1.1 LCR Chinook Salmon

#### 5.1.1.1 Life History

Spring (stream-type) and fall (ocean-type) chinook salmon are native to the Cowlitz River Basin. The life history of spring chinook salmon in the Cowlitz River has been well documented. Adult time of return to the Cowlitz Salmon Hatchery ranges from March through September. Spawning occurs in September and October, and fry emergence occurs from December through February. Spring chinook salmon typically rear through the summer and migrate downstream in the spring one year after emergence (WDW 1990). Fall chinook salmon adults in the Cowlitz River begin upstream migration in late August, peaking in mid-September. Spawning occurs from September through November, fry emerge from January through March, and juvenile rearing lasts through mid-June. Juvenile emigration peaks in June through August and ends in December (WDW 1990).

#### 5.1.1.2 Distribution

Historically**,** spring chinook salmon were found in the Cispus, Tilton, Upper Cowlitz, and Toutle Rivers**.** In 1948, the Washington Department of Fisheries (WDF) and the Washington Game Commission estimated that the Upper Cowlitz River produced 63,612 adult fall chinook salmon and 32,490 adult spring chinook salmon annually (Tacoma Power 2000). The construction of Mayfield and Mossyrock Dams and the hatchery barrier dams from 1963-1968 restricted or prevented movement into the Cispus, Tilton, and Upper Cowlitz Rivers. The eruption of Mount St. Helens in 1980 extirpated spring chinook salmon from the Toutle River, although it has been recolonized through natural means and introductions from the Cowlitz Salmon Hatchery (Myers et al. 2003). A trap and haul program has been operating since 1994 that transports spring chinook salmon above the Mayfield and Cowlitz Falls Dams.

Historically, fall chinook salmon were observed spawning as far upstream as the lower reaches of the Tilton and Cispus Rivers (Bryant 1949 as cited in Myers et al. 2003). They were also present in the Toutle and Coweeman Rivers in large numbers. After the construction of the Mayfield and Mossyrock Dams and the hatchery Barrier Dam, upstream movement of fall chinook salmon was restricted. The eruption of Mount St. Helens in 1980 extirpated fall chinook salmon from the Toutle River, although it has been recolonized through natural means and introductions from the Cowlitz Salmon Hatchery (Myers et al. 2003). Fall chinook salmon are still found in the Coweeman River, the only run of fall chinook salmon in the basin that is unlikely to have been affected by hatchery releases (Myers et al. 2003).

#### 5.1.1.3 Population Dynamics

The WLCTRT has identified 8 historical populations of chinook salmon in the Cowlitz River Basin action area (Myers et al. 2003 and WCSBRT 2003):

1. Upper Cowlitz River fall run (extirpated)[*]
2. Lower Cowlitz River fall run
3. Coweeman River fall run
4. Toutle River fall run
5. Upper Cowlitz River spring run[*]
6. Cispus River spring run (extirpated)[*]
7. Tilton River spring Run (extirpated)[*]
8. Toutle River spring Run (extirpated)[*]

[*]Incorporated into Cowlitz Hatchery stock

Prior to the construction of the Project, the Cowlitz River Basin produced over 95,000 spring and fall chinook salmon annually (Harza 1999a). Today, there is very little natural production in the basin. The majority of the chinook salmon returning to the river are produced by the Cowlitz Salmon Hatchery (Tacoma Power 2000).

#### 5.1.1.4 Hatchery Chinook Salmon

***Spring chinook salmon***

Hatchery spring chinook were reared at a hatchery operating out of the Clear Fork of the Cowlitz River until 1950 when that hatchery ceased operation. The construction of Mayfield Dam in 1963 and Mossyrock Dam in 1967 eliminated the entire historical spawning habitat for spring chinook salmon in the Cowlitz River. The Cowlitz Salmon Hatchery was completed in 1967, with a mitigation goal of 17,300 adult spring chinook salmon. Natural spawning is now limited to a 12.8 km (7.7 miles) stretch in the mainstem Cowlitz River below the hatchery. Historically there were 3 demographically independent populations in the Tilton, Cispus, and Upper Cowlitz

River Basins. These populations were homogenized into a single hatchery stock, which is currently released into the lower Cowlitz River. Although the hatchery program has not achieved its mitigation goal, that hatchery has been able to maintain production using locally returning adults. The average natural escapement has been 232 (1990-1999), with the majority of these thought to be hatchery produced. There is a concern that these spring chinook salmon spawners are hybridizing with fall run adults. Currently 500,000 parr from the hatchery are released into the upper basin to reestablish natural production. Beginning in 1999, adult spring chinook salmon from the Cowlitz Salmon Hatchery have been released above Cowlitz Falls Dam. The biological resources of the 3 extirpated Upper Cowlitz stocks are present, albiet in a homogenized form, in the Cowlitz River Salmon Hatchery broodstocks. However, it is not known to what extent genetic variability has been lost or adaptive genetic complexes disrupted (Cleve Steward, Steward and Associates, personal communication to M. Day, NOAA Fisheries, November 12, 2003). The hatchery stock represents one of the few remaining spring chinook salmon populations in the LCR chinook salmon ESU, and is vital to the reestablishment efforts in the basin.

***Fall chinook salmon***

The fall chinook salmon have been reared at the Cowlitz Salmon Hatchery since 1967 but were reared at a hatchery operated out of the Clear Fork until 1950. The construction of Mayfield Dam in 1963 and Mossyrock Dam in 1967 eliminated 37% of the historical spawning habitat for fall chinook salmon in the Cowlitz River. The hatchery program was developed using the local stock of fall chinook salmon, and was operated to meet a mitigation goal of 8,300 adults. That hatchery has maintained production using locally returning fish and there have only been 4 introductions of non-local egg transfers since 1951. Natural spawning habitat conditions in the lower Cowlitz River may limit the successful reproduction of naturally spawning fall chinook salmon, but in recent years an estimated 80% of the naturally spawning fall chinook salmon were of unknown, presumably natural, origin fish. Because only a small percentage of the hatchery fall chinook salmon releases are marked, naturally produced fall chinook salmon can be incorporated into the broodstock. The hatchery population is considered part of the demographically independent population of fall chinook salmon in the lower Cowlitz River.

#### 5.1.1.5 Harvest

Through the 1980s, spring chinook salmon harvest rates have averaged 67%, 42%, and 30% for the Lewis, Kalama, and Cowlitz spring chinook salmon fisheries, respectively, during periods when hatchery fish were abundant. As these stocks declined in the 1990s, fisheries restrictions reduced harvest. The new selective fisheries for spring chinook salmon that were implemented in 2002 will reduce natural spring chinook salmon harvest rates to less than 10% and impacts will generally average closer to 5%.

#### 5.1.1.6 Status

The life history diversity value for chinook salmon in the basin is currently less than 50% of what it would be under pristine historical conditions (Harza 1999a). If this loss of habitat and continued reliance on hatchery production is left unchecked, both will likely continue to negatively affect the species and may pose a risk that the population would not be maintained over time (Tacoma Power 2000).

The lambda parameter describes the rate of increase of a population based on observations of past adult returns. A lambda value greater than 1.0 represents a growing population, a lambda value of 1.0 represents a constant population (no increase or decrease), and a lambda value of less than 1.0 indicates a stock in decline. For a lambda value of 0.68 after 20 years, a population would be 0.04% of its present size. Analysis of lower Cowlitz fall chinook salmon population (the only Cowlitz River Basin chinook salmon population for which sufficient data was available) dynamics yielded a lambda values of 0.68-1.00, depending on the spawning success of hatchery stocks. If hatchery stocks are relatively successful in spawning in the wild, lambda values are towards the lower end of the quoted range; if they are less successful, the lambda values are towards the higher end of the cited range.

### 5.1.2 LCR Steelhead

#### 5.1.2.1 Life History

The Cowlitz River Basin supports both winter and summer steelhead runs, although historically, winter steelhead were the dominant form. Adult winter steelhead enter the Cowlitz River from mid-November through June. Spawning occurs from mid-March through early June, and emergence occurs from April through July (WDW 1990). Natural juvenile rearing generally lasts for 2 to 3 years prior to spring ocean emigration (WDW 1990).

#### 5.1.2.2 Distribution

Prior to the completion of the Mayfield and Mossyrock Dams, the upper basin produced up to 22,000 winter steelhead annually. Winter steelhead were known to spawn in the mainstem Cowlitz River near Riffe, and in a reach of the mainstem Cowlitz River located between the mouth of the Muddy Fork and the mouth of the Clear Fork. Substantial spawning activity was also observed in the Tilton River, Cispus River, and in the lower Ohanapecosh River. No spawning steelhead were observed in the Clear Fork or Muddy Fork (Kray 1956 as cited in Tacoma Power 2000). The construction of Mayfield and Mossyrock Dams blocked access to approximately 50% of historical spawning habitat (Myers et al. 2003). Over 249 miles of historical anadromous fish habitat, including steelhead habitat in the mainstem Cowlitz River, Muddy Fork, and Clear Fork, and in the Tilton and lower Ohanapecosh Rivers, is blocked to volitional passage by the Project dams (Harza 1999a).

#### 5.1.2.3 Population Dynamics

The WLCTRT identified 7 provisional historical populations in the Cowlitz River Basin action area (Myers et al. 2003 and WCSBRT 2003):

1. Cispus River winter run (extirpated)*
2. Tilton River winter run (extirpated)*
3. Upper Cowlitz River winter run (extirpated)*
4. Lower Cowlitz River winter run
5. North Fork Toutle River winter run
6. South Fork Toutle River winter run
7. Coweeman River winter run

*Incorporated into the Cowlitz Trout Hatchery stock

Only 2% of the existing winter steelhead run is the product of naturally spawned fish (WDW 1990). In 2000, approximately 200 of the returning winter steelhead adults were from the upper basin reestablishment program. The loss of historical winter steelhead habitat in the upper basin and the shift to hatchery production has substantially reduced the capacity, productivity, and life-history diversity of winter steelhead in the Cowlitz River and the LCR ESU (Tacoma Power 2000).

#### 5.1.2.4 Hatchery

Historical Washington Department of Game hatchery records show that both winter and summer steelhead fry and smolts were planted into the Cowlitz River between 1936 and 1967, prior to the construction of the Cowlitz Trout Hatchery. Before 1957, steelhead plants were small and comprised of multiple stocks. From 1957 to 1967, less than 50,000 smolts were planted annually (WDG 1986). Between 1964 and 1966, an average of 67,511 juvenile steelhead were collected each year at the Mayfield fish passage facility (Thompson and Rothfus 1969).

***Late winter steelhead***
The Cowlitz River late winter steelhead stock was developed from naturally produced Cowlitz winter steelhead in the late 1960s. The broodstock specifically targeted April and May spawners to avoid incorporation of Chambers Creek stock winter steelhead (see description below). However, there was some potential for mixing the two stock because of an overlap in spawning time. The late winter steelhead are reared at the Cowlitz Trout Hatchery and released into Blue Creek, directly below the hatchery. The construction of Mayfield Dam in 1963 and Mossyrock Dam in 1968 eliminated about 50% of the historical spawning habitat for winter steelhead in the Cowlitz River. Historically late winter steelhead populations occurred in the Tilton, Cispus, Upper Cowlitz, Lower Cowlitz, North Fork Toutle, South Fork Toutle, and Coweeman Rivers. Currently natural production is limited to the Lower Cowlitz, North Fork Toutle, South Fork Toutle, and Coweeman Rivers; however, the South Fork Toutle production was severely impacted by the eruption of Mount St. Helens in 1980. There is concern that the hatchery late

winter steelhead stock has been altered from the naturally produced late winter steelhead due to incorporation of Chambers Creek fish and selection for April and May spawners. Even with these concerns, hatchery juveniles and adults are being used to reestablish natural production in the Upper Cowlitz and Tilton River Basins.

***Non-endemic population, early winter steelhead***
The early winter steelhead program at the Cowlitz Trout Hatchery started in 1967, when the hatchery was completed. The early winter steelhead program used Chambers Creek stock winter steelhead, that was started in 1945 at the Chambers Creek Hatchery (located in the Puget Sound near Tacoma, Washington). This early-timed winter steelhead stock was combined with Cowlitz River winter steelhead and released into the basin. The current program continues to use early winter steelhead returning to the Cowlitz Trout Hatchery for broodstock. To minimize impacts to listed late winter steelhead, production has been reduced and releases only occur at the hatchery. Recent studies have shown that Chambers Creek stock steelhead exhibit relatively low reproductive success in the wild. The early winter steelhead have been found to be genetically distinct from the late winter steelhead, but concern remains because there is still some spawn timing overlap between the two groups.

***Non-endemic population, summer steelhead***
Summer steelhead are released from the Cowlitz Trout Hatchery to support recreational fisheries. Summer steelhead are not native to the Cowlitz River, and broodstock for the summer steelhead was originally from the Skamania Hatchery (a mixture of Washougal and Klickitat River summer steelhead). Currently the summer steelhead releases use adults returning to the hatchery. The spawn timing of this hatchery stock has been advanced over 3 months since it was first developed in the 1950s. The early spawn timing decreases the potential for mixing between summer steelhead and late winter steelhead on the spawning grounds, and has also decreased successful natural production of the hatchery fish. Currently summer steelhead are released at the hatchery into Blue Creek to support recreational fisheries and to have the hatchery summer steelhead home to the hatchery. Hatchery summer steelhead from the Cowlitz Trout Hatchery are also reared and released from net pens operated by a local recreational fishing group.

#### 5.1.2.5 Harvest

The WDFW has implemented restrictive regulations permitting the retention of marked adult hatchery steelhead only and requiring the release of naturally produced adult steelhead (WDFW 2003a). All hatchery steelhead released in the action area are externally marked with an adipose fin-clip to allow for these selective fisheries. WDFW will manage the tributary harvest of summer and winter steelhead stocks in the action area not to exceed a maximum harvest rate of 10% of the natural spawning population, although the actual impacts are expected to be closer to 5% (WDFW 2003a).

#### 5.1.2.6 Status

The vast majority of steelhead production in the Cowlitz River is from hatchery fish and only approximately 8 accessible miles of spawning habitat remain in Cowlitz River. Under these conditions, the future survival of wild Cowlitz River steelhead populations is in grave doubt. Many of the adult winter steelhead which would have returned to the Cispus, Tilton, and Upper Cowlitz Rivers were collected to establish the Cowlitz Trout Hatchery late winter stock. Two out-of-basin stocks are also reared at the hatchery and some hybridization may have occurred between those stocks, although genetic studies indicate that Cowlitz Hatchery late winter stock are representative of winter steelhead historically found in the Cowlitz River Basin (Cleve Steward, Steward and Associates, personal communication to M. Day, NOAA Fisheries, November 12, 2003). Thus, as with Upper Cowlitz River Basin spring chinook salmon, the biological resources of the 3 extirpated Upper Cowlitz stocks are present, albiet in a homogenized form, in the Cowlitz River Trout Hatchery late winter broodstock. However, it is not known to what extent genetic variability has been lost, adaptive genetic complexes disrupted, or how domestication has altered the population (Cleve Steward, Steward and Associates, personal communication to M. Day, NOAA Fisheries, November 12, 2003).

### 5.1.3 CR Chum Salmon

#### 5.1.3.1 Life History

There is little available information on the life history of chum salmon in the Cowlitz River Basin. The WLCTRT estimates the historical abundance of the Cowlitz River Basin chum salmon population at 158,000 (Cleve Steward, Steward and Associates, personal communication to M. Day, NOAA Fisheries, November 12, 2003). Chum salmon enter the lower Columbia River mainly in October and November (WDF et al. 1993). Spawning occurs immediately after freshwater entry. The rate of chum salmon egg incubation and emergence depends to a large degree on water temperature. Typically, incubating eggs hatch in about 2 to 18 weeks (Wydoski and Whitney 1979; Johnson et al. 1997). Freshwater residence can range from a few hours to a few months. In Washington, chum salmon may reside in freshwater for as long as a month, migrating from late January through May (Johnson et al. 1997).

#### 5.1.3.2 Distribution

Within the Cowlitz River Basin, chum salmon spawned in the lower tributaries of the Cowlitz River: Coweeman River, Ostrander Creek, Arkansas Creek, Toutle River, Salmon Creek, Olequa Creek, and Lacamas Creek (WDF and USFWS 1951). Emigrating chum salmon fry were detected at the Mayfield Dam site in 1955 and 1956 (Stockley 1961) and chum salmon were observed spawning 15 miles upstream (Myers et al. 2003; Dammers et al. 2002). Chum salmon have been recently recovered in the mainstem Cowlitz River downstream of the Cowlitz Salmon Hatchery and in the hatchery trap (Myers et al. 2003).

### 5.1.3.3 Population Dynamics

The WLCTRT has identified 1 historical population of chum salmon in the Cowlitz River Basin (Myers et al. 2003).

1. Cowlitz River fall run/summer run

Estimates of annual chum salmon escapement to the Cowlitz River in 1951, when the populations were already in decline, was estimated at 1,000 fish (WDF and USFWS 1951). Between 1961 and 1966, only 58 chum salmon were counted at the Mayfield fish passage facility. Chum salmon are still captured in the Cowlitz hatchery trap. Records are incomplete, but typically less then 10 adults are captured per year (Dammers et al. 2002). The WLCTRT identifies a historical population of Cowlitz River fall run/summer run chum salmon; this population is considered to be extinct (63 FR 11774, March 10, 1998). Chum salmon that currently enter the Cowlitz River have been considered strays by NOAA Fisheries from other Columbia River populations. However, recent genetic studies (Small 2003) have identified collections from the Lewis and Cowlitz Rivers as a group genetically distinct from Coastal and Columbia River Gorge populations of chum salmon.

### 5.1.3.4 Hatchery

There are no hatchery programs in the Cowlitz River Basin currently rearing chum salmon.

### 5.1.3.5 Harvest

WDFW expects chum salmon harvest impacts to be less than 4% for all Washington tributary fisheries, because WDFW has eliminated the direct harvest of natural adult chum salmon in the fisheries through the use of selective fisheries that require anglers to release chum salmon, and through the use of time and area closures to establish sanctuaries, which are closed to fishing. WDFW estimates that the harvest rate impact will be limited to the incidental catch and release of chum salmon during tributary fisheries targeting other species. This is similar to the impacts on chum salmon expected by ODFW in the Oregon tributaries to the lower Columbia River (ODFW 2001). Currently, the incidental catch of chum salmon in the lower Columbia mainstem commercial and recreational fisheries is limited to a few tens of fish per year (NOAA Fisheries 2002). The harvest rate in the proposed mainstem fisheries is expected to be 1.6% of the total population abundances. The harvest rate in the ODFW proposed tributaries fisheries is expected to be 0.5% of the total population abundance (ODFW 2001).

### 5.1.3.6 Status

Chum salmon which currently occur in the Cowlitz River Basin are considered by NOAA Fisheries to be strays from 1 of the 3 extant chum salmon populations in the lower Columbia rather than remnants of the historical Cowlitz River population. However, recent information also indicates that together with the Lewis River chum salmon population, they may be part of a group that is genetically distinct from other Gorge and Coastal populations (Small 2003). Whether the Cowlitz chum salmon originate from out-of-basin populations, or with the Lewis River chum salmon and are part of a genetically distinct group, Cowlitz chum salmon are still part of the CR chum salmon ESU. In either case, Cowlitz chum salmon are important to the survival and recovery of the CR chum salmon ESU. If Cowlitz chum salmon are out-of-basin strays, they are important because recolonization of habitat formerly occupied by the 13 extirpated populations by chum salmon from the 3 remaining populations is important to the survival and recovery of the CR chum salmon ESU. If Cowlitz chum salmon, along with Lewis River chum salmon, represent a genetically distinct population, then they are an important source of genetic diversity for the CR chum salmon ESU.

### 5.1.4 LCR/SW Coho Salmon

#### 5.1.4.1 Life History

Historically, 2 separate runs of coho salmon were reported to enter the Cowlitz River. The early run (Type-S) entered the Cowlitz from late August and September, with a spawning peak in late October. The late run (Type-N) entered the Cowlitz from October through March, with a spawning peak in late November (WDF and WFC 1948 as cited in Dammers et al. 2002). Fry emergence occurs from January through April. Coho salmon fry spend the spring and summer within their natal streams, although larger, more dominant fish displace smaller fish downstream, especially during freshets (Sandercock 1991). Coho salmon smolts typically emigrate in the spring following emergence.

#### 5.1.4.2 Distribution

Prior to Project construction, coho salmon were reported to spawn in the mainstem and tributaries of the Coweeman, Toutle, Cispus, and Tilton Rivers, and in “most of the tributaries of the Cowlitz River wherever suitable conditions exist” (WDF and USFWS 1951 as cited in Tacoma Power 2000; Thompson and Rothfus 1969). After the construction of Mayfield and Mossyrock Dams, access was blocked to the Upper Cowlitz River Basin. Some coho salmon production has been reestablished in the Upper Cowlitz River Basin through trap and haul operations.

#### 5.1.4.3 Population Dynamics

Seven historical populations of coho salmon have been identified in the Cowlitz River Basin (WCSBRT 2003):

1. Cispus (extirpated)
2. Tilton (extirpated)

3. Upper Cowlitz (extirpated)
4. Lower Cowlitz
5. North Fork Toutle
6. South Fork Toutle
7. Coweeman

Coho salmon were historically the most abundant anadromous salmonid in the Cowlitz River Basin. In 1948, the WDF and Washington Game Commission (WGC) estimated that the Upper Cowlitz River had an annual production of 77,000 fish. Annual escapement above the Mayfield Dam site was estimated to be "not less than 24,000" fish (WDF and WGC 1948). Shortly thereafter, the WDF and USFWS (1951) estimated that the Cowlitz River Basin (including all tributaries) had a total annual escapement of about 32,500 adults. Following the construction of Mayfield Dam, between 1961 and 1966, an average of 24,579 adult and 349,127 juvenile coho salmon were collected at the Mayfield Dam fish passage facility (Tacoma Power 2000).

Since 1968, the Cowlitz Salmon Hatchery has maintained the coho salmon population in the Cowlitz River Basin. Natural production is limited, and most coho salmon that do spawn in the Cowlitz River are considered a mixed stock of hatchery origin (DeVore 1987; WDW 1990; WDF et al. 1993). Coho salmon broodstock is from the Cowlitz River via hatchery rack returns.

#### 5.1.4.4 Hatchery

***Late-Run (Type-N) coho salmon, non-listed endemic***

The late run (Type-N; north turning[12]) coho salmon are reared and released at the Cowlitz Salmon Hatchery. When it began, the broodstock for this program used naturally produced coho salmon from the Cowlitz River. Currently, broodstock collection occurs at the Cowlitz Salmon Hatchery and the management plan for the hatchery prevents any other stock of coho salmon to be used in the broodstock or released into the basin. No stock transfers into the basin have occurred since the program was started. The construction of Mayfield Dam in 1963 and Mossyrock Dam in 1968 eliminated about 50% of the historical spawning habitat for coho salmon in the Cowlitz River. Potential historical populations were distributed similar to late winter steelhead. Current hatchery production releases into the lower Cowlitz River have decreased to reduce potential impacts to natural spawning fall chinook salmon and chum salmon. Cowlitz Salmon Hatchery juvenile and adult coho salmon are being used as part of a reestablishment program in the Upper Cowlitz River Basin. There is some concern that the hatchery population may have diverged from the historical population with regards to returning timing, which has changed substantially since the beginning of the program. There is some evidence that this later return date is due to inriver harvest that targeted the earlier portion of the run. Type-S (south turning and early spawning) coho salmon are reared at the North Fork Toutle

[12] This is referring to the direction fish turn when they reach the ocean from freshwater as juveniles.

Hatchery and released into the Green River (a tributary to the North Fork Toutle River). No Type-S coho salmon are released into the mainstem Cowltiz River.

#### 5.1.4.5 Harvest

Cowlitz River Basin coho salmon are subject to in-basin sport harvest as well as out-of-basin commercial and sport harvest. All hatchery coho salmon released into the Cowlitz River are given an adipose fin-clip to identify these fish as being of hatchery origin. This mark allows for selective fisheries on hatchery fish while protecting unmarked naturally produced coho salmon. Naturally produced coho from above Cowlitz Falls Dam are collected there and released below the barrier dam without any identifying marks. Naturally produced coho from the Tilton are collected at Mayfield Dam and marked with a blank coded wire tag but not adipose fin-clipped to protect them from harvest impacts. This allows for the determination of the area of origin when adults return.

#### 5.1.4.6 Status

The blockage of the historical Upper Cowlitz River Basin, and the shift from wild to hatchery production, has likely limited the production and recovery potential of the coho salmon population in the Cowlitz River Basin and contributed to its status as a candidate for listing under the ESA.

## 5.2 Biological Factors Affecting Listed Species within the Action Area

### 5.2.1 Hatcheries

The majority of spring and fall chinook salmon and summer and winter steelhead produced in the Cowlitz River Basin are hatchery spawned and reared. Smolts released from the hatchery may negatively affect wild juveniles through predation and competition. The hatcheries have also been noted as potential sources of fish pathogens including bacterial kidney disease, *Ceratomyxa shasta*, and IHNV, although these are present in the natural spawning populations (Tacoma Power 2000). The potential genetic consequences to the remaining wild fish in the Cowlitz River Basin are mixed. Cowlitz hatchery stocks are all derived from populations native to the Cowlitz River Basin, and represent the most likely repository of the genetic legacy of stocks which were extirpated when the Mayfield and Mossyrock Dams were built. Introgression with listed wild populations seems highly likely to have occurred in the past and continues to be a risk into the future. Alhough Cowlitz hatchery stocks were derived from in-basin populations, there is still a risk to wild populations from genetic drift and introduction of negative traits associated with domestication into the wild population.

### 5.2.2 Predators in Reservoirs

There are high numbers of predators in Mayfield and Riffe Lake Reservoirs, such as northern pikeminnow and rainbow trout, as well as exotic predators, including tiger muskies, brown trout, large and smallmouth bass, bluegill, crappie, and yellow perch introduced for angling. This presents a risk to smolts migrating through the lake or juveniles rearing in the lakes.

## 5.3 Habitat Factors Affecting Listed Species within the Action Area

The Cowlitz River Basin drains a total of 2,480 square miles of mountainous terrain. The Cowlitz River originates on the slopes of Mount Rainer (elevation 14,410 ft) and flows southwest for about 133 miles to the Columbia River, near Longview, Washington. Tributary streams include the Tilton, Cispus, and Toutle Rivers, and Silver, Winston, Salmon, Lacamas, and Olequa creeks.

The eastern Cowlitz River Valley is within the Cascade physiographic province. The uplands to the north and south of the valley have rugged mountainous topography. The western portion of the Cowlitz River Valley is within the northern end of the Puget-Willamette Lowlands physiographic province. Streams are high to medium gradient. Soils are typically deep clay loams, silt loam, gravelly loam, and cobbly loam. The Cowlitz River Basin is located in a largely rural area. Primary land use includes 71%-82% commercial forest lands (range gives values above and below Mayfield Dam, respectively) and 2.7%-14.4% agricultural, with the remainder composed of National Park and built-up areas (WDW 1990). Annual precipitation in the Cowlitz River Basin ranges from 45 inches in the lower elevations to 108 inches at higher elevations (Paradise, Washington) with over 69% of the annual precipitation falling between October and March. Snow and freezing temperatures are uncommon in the Project area, but occur during the winter months at higher elevations in the watershed.

The environmental baseline encompasses the effects of both human and natural factors leading to the current status of the species, but does not incorporate impacts specific to the proposed action. Therefore, future impacts resulting from the future operation of the Project and other activities authorized pursuant to the proposed action are not part of the environmental baseline. Rather, the environmental baseline describes the current status of the species and the factors currently affecting the species within the action area. The resulting "snapshot" of the species' health within the action area provides the relevant context for evaluating the anticipated effects of the proposed actions on the ESU's likelihood of survival and recovery relative to its biological requirements.

Habitat-altering actions affect salmon population viability, frequently in a negative manner. However, it is often difficult to quantify the effects of a given habitat action in terms of its impact on biological requirements for individual salmon (whether in the action area or outside of it). Thus it follows that while it is often possible to draw an accurate picture of a species’ range-wide status—and in fact doing so is a critical consideration in any jeopardy analysis—it is difficult to determine how that status may be affected by a given habitat-altering action. Given the current state of the science, usually the best that can be done is to determine the effects an action has on a given habitat component and, since there is a direct relationship between habitat condition and population viability, extrapolate that to the impacts on the species as a whole. Thus by examining the effects a given action has on the habitat portion of a species' biological requirements, NOAA Fisheries has a gauge of how that action will affect the population variables that constitute the rest of a species' biological requirements and, ultimately, how the action will affect the species' current and future health.

Ideally, reliable scientific information on a species' biological requirements would exist at both the population and the ESU levels, and effects on habitat should be readily quantifiable in terms of population impacts. In the absence of such information, NOAA Fisheries' analyses must rely on generally applicable scientific research that one may reasonably extrapolate to the action area and to the population(s) in question. Therefore, for actions that affect freshwater habitat, NOAA Fisheries usually defines the biological requirements in terms of a concept called properly functioning condition (PFC). PFC is the sustained presence of natural habitat forming processes in a watershed (e.g., riparian community succession, bedload transport, precipitation runoff pattern, channel migration) that are necessary for the long-term survival of the species through the full range of environmental variation. PFC, then, constitutes the habitat component of a species' biological requirements. The indicators of PFC vary between different landscapes based on unique physiographic and geologic features. For example, aquatic habitats on timberlands in glacial mountain valleys are controlled by natural processes operating at different scales and rates than are habitats on low-elevation coastal rivers.

In the PFC framework, baseline environmental conditions are described as "properly functioning" (PFC), "at risk" (AR), or "not properly functioning" (NPF). If a proposed action would be likely to impair properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of impaired habitat toward PFC, it will usually be found likely to jeopardize the continued existence of the species or adversely modify its critical habitat or both, depending upon the specific considerations of the analysis. Such considerations may include for example, the species' status, the condition of the environmental baseline, the particular reasons for listing the species, any new threats that have arisen since listing, and the quality of the available information.

Since lotic habitats are inherently dynamic, PFC is defined by the persistence of natural processes that maintain habitat productivity at a level sufficient to ensure long-term survival. Although the indicators used to assess functioning condition may entail instantaneous measurements, they are chosen, using the best available science, to detect the health of underlying processes, not static characteristics. "Best available science" advances through time; this advance allows PFC indicators to be refined, new threats to be assessed, and species status and trends to be better understood. The PFC concept includes a recognition that natural patterns of habitat disturbance will continue to occur. For example, floods, landslides, wind damage, and wildfires result in spatial and temporal variability in habitat characteristics, as will anthropogenic perturbations.

The past operation and existence of the Project is a critical factor influencing survival in the action area. Up to 100% of the juveniles and adults of the Cowlitz populations of LCR chinook salmon, LCR steelhead, and CR chum salmon have been affected by the continuing effects of the human activities that contributed to the existing conditions in the system. Mortality and sublethal effects associated with lack of dam passage, flow diversions, and other aspects of the Project within the action area in recent years have contributed to the current status.

### 5.3.1 Water Quality: Contamination

NOAA Fisheries defines PFC as low levels of contamination with no 303(d)[13] designated reaches. The category "at risk" is defined as one 303(d) designated reach.

The WDOE includes two reaches in the Cowlitz River Basin on its 303(d) list, one for organics and one for pesticides (WDOE 1998).

**Conclusion**
Due to the multiple 303(d) reaches listed, this indicator receives a rating of NPF.

### 5.3.2 Water Quality: Water Temperature

NOAA Fisheries defines PFC for water temperature as water temperatures not exceeding 13.9E C. Water temperatures up to 15.6E C in spawning habitat and 17.8E C in rearing and migration habitat are considered to be at risk; temperatures exceeding 15.6E C in spawning habitat and 17.8E C in rearing and migration habitat are considered to be NPF (NOAA Fisheries 1996).

***Cowlitz River and Tributary Streams***
Water temperatures vary considerably at selected locations within the Cowlitz River. Temperatures above Riffe Lake were the most variable; ranging from as cold as 0E C in February 1998 up to 19E C in mid-August 1998. Water discharged from the Mossyrock powerhouse has a much more stable thermal regime through both the seasonal and daily cycles. Under normal Project operations, the Mossyrock tailrace temperatures are coldest (about 5E to

[13]Under Section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop total maximum daily loads (TMDLs) for these waters.

6E C) during February and early March, gradually increasing to a maximum of about 12E to 13E C in mid-November, followed by a rapid decrease back to the coldest temperatures of the year. Daily temperature fluctuations are usually less than 0.5E C throughout the entire year. During the spring and summer of 1997, Tacoma Power altered typical Mossyrock operations by spilling water at the dam to evaluate its effect on juvenile passage. Higher temperatures and larger daily fluctuations in tailrace temperatures coincided with these spill events. River temperatures below Mayfield Dam follow the same general trends as the Mossyrock powerhouse tailrace, but are somewhat warmer and have larger daily fluctuations due to warming in Mayfield Lake and inflow from the Tilton River and Winston Creek. Monthly temperature measurements for the Cowlitz River below Mayfield Dam and at the I-5 bridge indicate that temperatures increase about 1 to 2E C in the 21-mile-long reach during the months of April through September, but change little during the remainder of the year.

During relicensing studies, Tacoma Power used thermographs to continuously monitor water temperatures in 3 Cowlitz River tributaries. The sites monitored were the Tilton River at RM 7.1, Winston Creek at RM 1.2, and Rainey Creek at RM 6.0. Water temperatures measured in the 3 tributaries were similar to one another during much of the period monitored; however, Rainey Creek was considerably cooler than the Tilton River and Winston Creek during late spring and summer. Tilton River and Winston Creek temperatures ranged from close to 0E C to the mid-20s, and Rainey Creek temperatures ranged from 3E C to 15E C. Maximum temperatures of 25E C and 23E C were recorded in the Tilton River and Winston Creek, respectively, during July 1998. Historical water temperature data collected from Rainey Creek a short distance upstream of Riffe Lake range from 2E C to 20E C (Higgins and Hill 1973 in FERC 2001).

**Historical Project effects**

***Riffe and Mayfield Lakes***

Temperatures recorded near the dams in Riffe and Mayfield Lakes showed little vertical stratification during the winter and early spring. In summer, waters near the surface of both reservoirs warmed considerably. This warming extended to a deeper level in Riffe Lake than in Mayfield Lake. The thermocline in Riffe Lake near the dam moved from a depth of about 15 ft in June 1997 to around 50 ft in September 1997, whereas the thermocline near the dam in Mayfield Lake remained at 10 ft or less during the summer.

Surface temperatures recorded at the other Riffe Lake monitoring sites were similar to those near the dam during all months, although differences of 1 to 2E C occurred between sites during some months. The temperature at the extreme upper end of the reservoir is essentially the same from the surface to a depth of at least 25 ft during early summer. This trend continues down to near Landers Creek, but does not occur closer to the dam. In September 1997, all 4 of the Riffe Lake monitoring sites had temperatures that were nearly the same to depths of at least 30 ft.

Thermal stratification became obvious in Mayfield Lake near the dam in June of 1997 and May of 1998 and 1999. Thermal stratification began earlier in the Tilton arm of Mayfield Lake, but progressed at a slower rate from May to early July in all 3 years. No thermal stratification was measured in the Cowlitz River arm of Mayfield Lake until July of 1997. In contrast, a temperature difference of more than 7E C was recorded within the Cowlitz River arm water column during May 1998 and continued to become larger through July. These warmer surface conditions coincided with much lower flows in the Cowlitz River arm during the spring and early summer of 1998. Cowlitz River arm thermal conditions were intermediate during the spring and early summer of 1999.

***Swofford Pond***

Swofford Pond, adjacent to Riffe Lake, was built to address Project impacts. Its current use is largely wildlife and recreation. Water temperatures recorded in Swofford Pond ranged from 3E C in January to 25E C in August. Little thermal stratification occurs during most of the year, although temperatures typically range between 2E C and 4E C between the surface and the bottom during late spring and summer.

***Lower Cowlitz River***

The overall effect of the Project on lower Cowlitz River water temperatures is that of a heat sink. This effect is largely due to the size and depth of Riffe Lake and discharging water that is withdrawn from a very deep depth (approximately 60 meters at full pool). Discharging near surface water from Mayfield Lake also effects the thermal regime in the Cowlitz River below Mayfield Dam; however, these effects are small in comparison to the effects related to Riffe Lake and its operation. All of these factors result in a net cooling effect during the summer and a net warming effect during the winter.

By increasing winter water temperatures the project likely accelerated the development of incubating anadromous fish embryos. This likely caused alevins to hatch and fry to emerge earlier in the year than they did historically. By reducing summer water temperatures the project has likely had several beneficial effects on anadromous fish: reduced disease virulence in the lower river, a longer reach of river suitable for juvenile salmonid rearing, and a lower potential for thermal stress and mortality. However, decreasing summer temperatures also reduces aquatic plant growth and may thereby reduce total production. Although we consider each of these effects to have likely occurred in the lower river, it is very difficult to judge the significance of these changes because some effects would positively affect anadromous fish and others would negatively affect them and the body of available information is insufficient to draw a strong conclusion about the relative strength of each factor.

***Fish Hatcheries***

The temperature of water supplied to the Cowlitz Salmon Hatchery ranged from 4E to 13E C for river water, and from about 6E C to 9E C for the groundwater (Harza 1997a in FERC 2001). The water is coolest during January through March and warmest during June through October.

Water temperatures of the effluent from the hatchery are about the same as in the river (Harza 2000 in FERC 2001).
Water is supplied to the Cowlitz Trout Hatchery from the river and wells located on both sides of the river. The temperature of the river supply ranges from 4E C to 16E C, and only rarely exceeds 15E C, while water supplied from the wells has a more stable thermal regime that ranges from 8E to 12E C (Harza 1997a in FERC 2001). Water discharged from the hatchery into Blue Creek is a little warmer than the Cowlitz River during spring and summer.

**Conclusion**
A number of reaches within the Cowlitz River Basin were on the 1998 303(d) list for high temperature (none appear associated with historical Project effects), which leads NOAA Fisheries to give a NPF rating for this factor.

### 5.3.3 Water Quality: Dissolved Oxygen

NOAA Fisheries defines PFC as dissolved oxygen (DO) concentrations which meet the WDOE standards for fish bearing waters with dissolved oxygen exceeding 8.0 mg/l (Washington Administrative Code 173-201A).

The Cowlitz River and Project area tributaries (Tilton River, Winston Creek, and Rainey Creek) generally have DO concentrations in the range of 9 to 12 mg/L. The river and wells supply water to the Cowlitz Salmon Hatchery incubation and rearing facilities with DO levels of between 7 and 14 mg/L (Harza 1997a in FERC 2001). DO concentrations of water discharged from the Cowlitz Salmon Hatchery closely mimic those of the river (Harza 2000 in FERC 2001). In contrast, the Cowlitz Trout Hatchery gets much of its water from wells that have low DO concentrations that are increased to between about 8.5 and 11 mg/L by aerators before being supplied to incubation and rearing vessels (Harza 1997a in FERC 2001). Water in these facilities generally remains at or above 8 mg/L. The DO levels of the Cowlitz Trout Hatchery effluent, which flows into Blue Creek, are typically 1 to 2 mg/L lower than the Cowlitz River (Harza 2000 in FERC 2001).

**Historical Project effects**

Measurements of DO in Riffe and Mayfield Lakes were more variable than in streams in the Project area. DO concentrations throughout the water columns of both reservoirs are typically greater than 8 mg/L, although DO concentrations of less than 6 mg/L occur near the bottom a short distance up-reservoir of the dams prior to fall overturn (Harza 2000 in FERC 2001). DO concentrations drop to about 6 mg/L in the deep water of the Tilton River arm during mid-summer (Harza 2000 in FERC 2001).

**Conclusion**
No low DO events have been documented for the Cowlitz River Basin (with the exception of deep reservoir waters which are not generally considered as salmonid habitat) so NOAA Fisheries rates this factor as PFC.

### 5.3.4 Water Quality: Total Dissolved Gas

NOAA Fisheries defines PFC as total dissolved gas (TDG) concentrations which meet WDOE standards for fish bearing waters with TDG concentrations of less than 110% (Washington Administrative Code 173-201A).

***Cowlitz River***
TDG levels in Project area streams typically range from 95% to 105% of saturation. Of the 416 TDG measurements made in the Project area between December 1996 and April 1999, 25 were greater than 105% (Harza 2000 in FERC 2001); supersaturated DO conditions corresponded with nearly all of these measurements. Only 5 of the TDG values that exceeded 105% during the monitoring period between December 1996 and April 1999 were greater than the applicable criterion of 110%. The specifics of each of these measurements are listed in Table 4. Three high measurements were recorded in early January 1997 during a major precipitation/runoff event that resulted in water being spilled at the Cowlitz Falls Dam (operated by Lewis County PUD), Mossyrock Dam, and Mayfield Dam. A TDG level of 111% was measured at the upper end of Riffe Lake (Taidnapam Park boat launch, located 3.5 miles downstream of the Cowlitz Falls Dam) on January 3, 1997, when the upstream powerhouse was discharging approximately 10,000 cfs and the dam was spilling approximately 25,000 cfs. None of the other 10 sites monitored on January 3, 1997, had TDG levels of greater than 110%. However, measurements made at the Cowlitz Salmon and Trout Hatchery intakes a few days later were 112% and 111%, respectively. These measurements were made following turbine flows of 14,000 cfs at the Mossyrock and Mayfield powerhouses and spills of about 4,000 cfs at Mossyrock Dam and about 10,000 cfs at Mayfield Dam. Two TDG measurements of more than 110% were also recorded in Mayfield Lake on July 9, 1998. These high TDG levels occurred during highly productive and sunny conditions, and had corresponding super-saturated dissolved oxygen conditions.

Table 4. Data for TDG samples greater than the maximum limit of 110%.

| Site | Date | Time | DO saturation | TDG |
|---|---|---|---|---|
| Mayfield Lake; lower end | 7/9/98 | 13:15 | 111% | 114% |
| Cowlitz Salmon Hatchery | 1/8/97 | 9:45 | | 112% |
| Cowlitz Trout Hatchery | 1/9/97 | 12:10 | | 111% |
| Taidnapam Boat Launch | 1/3/97 | 9:20 | 112% | 111% |
| Mayfield Lake; Cowlitz arm | 7/9/98 | 10:10 | 116% | 111% |

**Conclusion**
Occasional observations of TDG exceedences lead NOAA Fisheries to rate this factor as AR.

### 5.3.5 Water Quality: Sediment/Turbidity

NOAA Fisheries defines low turbidity as PFC, not exceeding Washington State water quality standards. For this factor, turbidity must not exceed 5 nephelometric turbidity units (NTU) over background turbidity when the background turbidity is 50 NTUs or less, or have more than a 10% increase in turbidity when the background turbidity is more than 50 NTUs (Washington Administrative Code 173-201A-010).

Suspended sediment, which moves suspended in the water column, affects water turbidity (cloudiness) and settles in the more quiescent areas of the channel (i.e., large pools and channel margins). In the Cowlitz River, suspended sediment is primarily clay, silt, and fine sand-sized particles.

During storm runoff events that occur in the winter and spring, turbidity levels are sometimes elevated above 5 NTUs in the Cowlitz River, Tilton River, and Winston Creek. Levels typically remain below 10 NTUs at most locations under these conditions; however, values as high as 16 NTUs and 17 NTUs were measured in the Cowlitz River below the Mossyrock powerhouse and at the I-5 bridge, respectively.

**Historical Project Effects**

Turbidity is usually less than 5 NTUs in streams in the Project vicinity and Project reservoirs. Three exceptions to this generality occur: 1) throughout the basin during high runoff events, 2) in the Upper Cowlitz River during glacial melt, and 3) in Swofford Pond during late summer and early autumn.

Turbidities of more than 5 NTUs also occur in surface waters of Riffe and Mayfield Lakes, coinciding with periods of weak to no thermal stratification. The only times that this was reported for Riffe Lake coincided with a period when the reservoir was drawn lower than elevation 745 ft. The turbidity in Mayfield Lake elevates to a higher level (27 NTUs) and remains above 5 NTUs for a longer period than in Riffe Lake.

Glacial melt in the headwaters of the Cowlitz River elevates turbidity over 5 NTUs (up to 17 NTUs) in the river above Riffe Lake during the summer and early fall. Since inflow to Riffe Lake is cooler than the surface of the reservoir during this period, the glacial melt plunges to near bottom as it enters the reservoir, resulting in much lower turbidities near the surface of Riffe Lake, maintaining Secchi depths of 6 ft to about 25 ft. Water discharged from the reservoir also remains fairly clear during most of this period, although turbidity below the Mossyrock powerhouse and in the Cowlitz River arm of Mayfield Lake is sometimes elevated to about 17 NTUs following storm events during drawdown of Riffe Lake. These conditions lead to Secchi depths of less than 3 ft in Mayfield Lake in comparison to the typical condition of about 6 ft to 13 ft.

The relationship between anadromous fish survival and turbidity is complex. Highly turbid waters may interfere with salmonid respiration, social and behavioral cues, and at rates high enough to deposit fines into the channel substrates, could limit reproductive success by interfering with embryo respiration and the rate of intergravel flow. However, juvenile outmigration timing is correlated with freshets. In natural waters, freshets often provide the highest turbidities observed in a stream. Outmigrating during high flow/high turbidity events likely reduces the exposure of juvenile salmonids to predators. Thus, the significant seasonal reduction in turbidity provided by the project likely improves habitat conditions for most life stages of anadromous fish but likely indirectly reduces the survival of outmigrating juveniles by increasing their exposure to predators.

**Conclusion**
Turbidity does not exceed Washington State standards; NOAA Fisheries rates this indicator as PFC.

### 5.3.6 Habitat Access: Barriers

***Upstream passage***
NOAA Fisheries defines PFC as a lack of any barriers being present, allowing upstream and downstream passage at all flows without significant levels of mortality or delay.

Barriers on the Upper Cowlitz include the Cowlitz Falls Dam completed in 1994. Barriers on the lower Cowlitz include a sediment trapping dam on the Toutle River and small dams on tributaries. Impassable culverts are also present on some tributaries (Tacoma Power 2000).

**Historical Project Effects**

The most significant barriers in the Cowlitz River Basin are the Mayfield and Mossyrock Dams completed in 1963 and 1968, respectively, and the hatchery Barrier Dam, built below Mayfield Dam in 1969. The barriers to spawning and rearing habitat represented by these dams have been identified as a key limiting factor to samonid production in the Cowlitz River Basin (Dammers et al. 2002; Tacoma Power 2000). The amount of historical salmonid spawning and rearing habitat in the Cowlitz River and tributaries upstream from Mayfield Dam was surveyed by Kray (1957) and summarized by Stober (1986). Results of this study show that there was an estimated 249.8 miles of accessible salmonid spawning and rearing habitat in the Upper Cowlitz River Basin prior to the construction of Mayfield Dam. The mainstems of the Cowlitz River, Cispus River, and Tilton River comprise 82.0 miles, 33.5 miles, and 27.0 miles, respectively. The remainder is attributed to tributary habitat. The construction of these dams blocked access to this habitat, representing 80% of historical anadromous salmonid spawning and rearing habitat in the Cowlitz River Basin (Dammers et al. 2002). The dams prevented access to all of the spawning and rearing habitat of the following historical populations: Cispius River spring chinook salmon and winter steelhead, Tilton River fall chinook salmon and winter steelhead, and Upper Cowlitz River spring chinook salmon and winter steelhead. Some chum salmon also spawned upstream of Mayfield Dam. Various attempts have been made to establish fish passage above the Mayfield/Mossyrock Dam complex. The Mayfield Dam maintained upstream and downstream passage facilities until after the completion of the Cowlitz Salmon Hatchery in 1969 (WDW 1990). Trap and haul operations were conducted transporting some adult spring chinook salmon, coho salmon, and steelhead above Mayfield Dam and Mossyrock Dam. The objective of these transfers was to provide a limited sport fishery. The trap and haul program was terminated for all species other than coho salmon in 1981, due to concerns about introducing disease into the Cowlitz hatchery water supply (WDW 1990). In 1994, trap and haul operations were restarted with the objective of reestablishment of anadromous salmonids to the Upper Cowlitz subbasin. Currently, winter steelhead, spring and fall chinook salmon, and coho salmon are released above Cowlitz Falls into the Cispuis, Tilton, and Upper Cowlitz Rivers.

***Downstream passage***

Cowlitz Falls Dam presents a barrier which impedes or prevents downstream migration of smolts from the Upper Cowlitz. However, the dam includes a juvenile bypass system. The Cowlitz Falls fish facility attracts and collects downstream migrating juveniles at an estimated efficiency of 58%-65% for steelhead and 23%-24% for chinook salmon (Dammers et al. 2002).

**Historical Project Effects**

Mayfield and Mossyrock Dams and their reservoirs act as partial or total barriers to downstream migration. Migration was impeded by lack of passage facilities and impacts from predators.

**Conclusion**

Due to the impacts to passage in the basin, NOAA Fisheries rates this indicator as NPF.

### 5.3.7 Habitat Element: Substrate

NOAA Fisheries defines PFC as predominantly gravel and cobble substrate with clear interstitial spaces and <20% embeddedness. The supply and movement of sediment in a river system can affect aquatic habitat and water quality. Bedload sediment, which moves by rolling and hopping along the bed of a river, is important for shaping aquatic habitat and providing spawning and rearing areas for fish and invertebrates.

In the Cowlitz River, bedload is composed of coarse sediment (coarse sand, gravel, cobbles, and boulders). A study of the supply and transport of bedload-sized sediment was completed for the lower Cowlitz River (Harza 1999a). This study divided the lower river between Mayfield Dam and the Toutle River into 5 reaches based on characteristics of the river channel, and then calculated average bedload input and transport in each of the reaches.

Under current conditions, bedload transport capacity in the reach between Mayfield Dam and Barrier Dam far exceeds gravel input. As a result, much of the gravel and smaller sediment has been transported out of this reach and has not been replenished from upstream sources. The riverbed is lined with cobbles and there is little gravel-sized sediment in the channel. In the reach between Barrier Dam and the Cowlitz Trout Hatchery, transport capacity also exceeds gravel input. The majority of this reach also lacks gravel-sized sediment.

In the reach between the Cowlitz Trout Hatchery and the I-5 bridge, the Cowlitz River meanders across a wide, alluvial plain. In this reach, supply of sediment from riverbank cutting exceeds the current transport capacity. There is ample gravel in the channel, and sediment from this reach is also supplied to the two downstream reaches.

The eruption of Mount St. Helens in 1980 buried more than 26 miles of anadromous stream habitat in the Toutle River Basin (Dammers et al. 2002). Sediment effects from the eruption continued downstream when the channels were dredged to maintain flood capacity. Dredge spoils filled floodplain and wetland habitat in the lower Cowlitz River (Dammers et al. 2002).

**Historical Project effects**

Mayfield Dam traps sediment coming down the Tilton River and Winston Creek. Riffe Lake traps sediment from the Cowlitz River. The Cowlitz Falls project has a relatively small impoundment and is operated to pass sediment. Current operations include lowering the water level in Lake Scanewa and opening the low level sluice gates in the Cowlitz Falls Dam during high flows. These measures are effective at transporting the majority of sediment through the impoundment and into Riffe Lake.

An estimate of the amount of total sediment transported into Riffe Lake was made based on limited suspended sediment measurements collected for licensing of the Cowlitz Falls project (R.W. Beck and Associates 1981 in FERC 2001) and comparison with more extensive measurements in the nearby Nisqually and White Rivers (Nelson 1974 in FERC 2001; Nelson 1979 in FERC 2001; Dunne 1986 in FERC 2001). Based on the sediment rating curve prepared by R.W. Beck and Associates, and a 50-year record of stream flow at the gage just upstream from Riffe Lake, an average of 1 million cubic yards (cy) of sediment is transported into Riffe Lake from the Cowlitz River every year. Grain size data from the White and Nisqually Rivers suggests that 40% to 50% of this total is sand or larger-sized sediment; the rest is silt or clay.

While the average annual amount of sediment transported into Riffe Lake is estimated to be 1 million cy, the amount supplied to the lake in any one year is highly variable since it is dependent upon river flows and flood events. In addition, inputs of sediment from infrequent geologic events, such as a large mudflow from Mount Rainier or volcanic ash fall from Mount St. Helens, could supply much more than the average amount of sediment to the Cowlitz River system.

As the sediment is transported into Riffe Lake from the Cowlitz River, water velocities decrease rapidly, and the sand and larger sediment drops out, forming a delta at the upstream end of the lake. These deposits of mostly sand-sized sediment can be seen at the head of the lake at low pool levels. Comparison of pre-Project topographic maps and recent bathymetric maps in this area indicate 13 million cy have accumulated. Based on 30 years of accumulation, this is an average of 450,000 cy/year, consistent with the estimate of sand-sized particles based on the suspended sediment calculations. The remaining 550,000 cy of silt and clay are deposited over the bottom of Riffe Lake, forming a layer of fine-grained, unconsolidated sediment probably 1 to 2 ft thick in areas of the lake never exposed by drawdowns. Total storage volume in Riffe Lake is 2.7 billion cy, so less than 0.04% of the lake is filled with sediment each year.

Mayfield Lake accumulated the sediment coming down the Cowlitz River for 5 to 6 years before Riffe Lake was closed (about 5 to 6 million cy). Since that time, sediment has been added from the Tilton River and Winston Creek, at an estimated rate of 7,000 cy per year. Total storage is 215 million cy, so less than 0.003% of the lake is filled with sediment each year.

Downstream from the confluence with the Toutle River, the substrate in the Cowlitz River is predominately silt and sand (influenced by the Mount St. Helen's eruption). Upstream from the Toutle River, cobble and gravel, including high quality spawning gravel, are the dominant substrate types (Harza 1999a).

The interception of gravel by the reservoirs is believed to negatively affect the quality and diversity of steelhead spawning and rearing habitat in the 10-mile-long reach of the Cowlitz River located immediately below Mayfield Dam (Harza 1999b). Downstream of this reach, there is abundant spawning-sized gravel in the mainstem Cowlitz River (Harza 1999b). Conversely, the Project traps fine sediments, which maintains the quality of spawning habitat in the lower mainstem and side channels of the Cowlitz River.

**Conclusion**
Due to the loss of suitable spawning gravels in the Cowlitz River downstream from Mayfield Dam, NOAA Fisheries concludes that the substrate habitat element is NPF.

### 5.3.8 Habitat Element: Large Woody Debris

NOAA Fisheries defines PFC as >80 pieces of wood per mile which are >24 inches in diameter and > 50 ft. long.

Mossyrock and Mayfield Dams are a barrier to downstream transport of LWD. With the exception of the removal of sunken debris in front of the project intakes and trapped behind the cofferdam, LWD is passed downstream of the Cowlitz Falls Dam. Intensive logging in the Upper Cowlitz River Basin and current riparian conditions limit recruitment of LWD above the Project. The 1,000-ft-wide riparian zone along the Cowlitz River below the Barrier Dam is dominated by conifer, deciduous, mixed conifer and deciduous, meadow/grassland, and agriculture cover types. Together, these 5 cover types account for approximately 90% of the total riparian area below Barrier Dam (Harza 1999a). LWD densities in the Cowlitz River below Barrier Dam average 11 pieces per mile (FERC 2001). Lack of sufficient LWD for channel forming processes was noted as a limiting factor to salmonid production by the Washington Conservation Commission (2003) in its review of the Cowlitz River Basin.

**Historical Project effects**

Recruitment of LWD from upstream sources is limited by the presence of Mossyrock, and Mayfield Dams and Tacoma's management of LWD collected at the dams.

**Conclusion**
NOAA Fisheries conclduces that the LWD habitat element is NPF.

### 5.3.9 Habitat Element: Off-Channel Habitat

NOAA Fisheries defines PFC for off-channel habitat as backwaters with cover and low-energy, off-channel areas, including ponds and oxbows.

The lower Cowlitz River is characterized as a simple channel which has been subject to dredging and diking. Connectivity to off-channel habitat is generally absent or extremely limited.

**Historical Project effects**

Historical Project operations negatively affected the availability and function of off-channel habitat in downstream reaches due to restricted LWD and substrate transport and modified flows. For a more detailed discussion of off-channel habitat conditions, see Section 5.3.14.

**Conclusion**
Due to reduced connection of off-channel habitat areas to the Cowlitz River downstream from Mayfield Dam, NOAA Fisheries concludes that the off-channel habitat element is NPF.

### 5.3.10 Habitat Element: Pool Frequency/Quality

NOAA Fisheries defines PFC for pool frequency based on channel width; the standard for the lower portion of the action area is 18-23 pools/mile. Pool quality for PFC is defined as pools >1 m deep with cover, cool water, and low amounts of fine sediment.

Pool frequency is limited in nearly all reaches of the lower Cowlitz River Basin. This is believed to be related to insufficient LWD input, channel modifications, and increased sediment input (Dammers et al. 2002).

**Historical Project effects**

Historical Project operations had some negative effect on this element in downstream reaches due to restricted LWD and substrate transport, as well as modified flows.

**Conclusion**
Due to reduced frequency of pools in the Cowlitz River downstream from Mayfield Dam, NOAA Fisheries concludes that the pool frequency/quality habitat element is NPF.

#### 5.3.11 Habitat Element: Refugia

NOAA defines PFC for refugia as being buffered by riparin reserves and of sufficient size, number, and connectivity to maintain a viable population.

Because of dredging following the eruption of Mount. St. Helens, dredge spoils block access to off-channel habitat in the lower Cowlitz River. Channel alterations, combined with increase sediment inputs, have resulted in limited pool habitat cover and habitat diversity in the mainstem and lower reaches of most of the Upper Cowlitz River basin tributaries (Dammers et al. 2002).

**Historical Project effects**

Historical Project operations probably had some negative effect on this element in downstream reaches due to restricted LWD and substrate transport, as well as modified flows.

**Conclusion**
Due to reduced access to off-channel areas in the Cowlitz River downstream from Mayfield Dam, NOAA Fisheries concludes that the refugia habitat element is NPF.

#### 5.3.12 Channel Dynamics: Channel Morphology

Channel morphometry is the result of geologic conditions and processes combined with hydrologic conditions. Channel morphological conditions (e.g., point bars, meanders) and processes (e.g., avulsion, aggradation, degradation) broadly affect a stream's habitat characteristics for all inland life stages of anadromous fish (e.g., pools, riffles, runs, side-channels). In determining whether the channel conditions in the baseline are properly functioning, NOAA Fisheries considers main-channel morphology, streambank conditions, and floodplain connectivity. The nature and magnitude of human-caused changes as they relate to fish habitat and survival are considered in NOAA Fisheries' analysis. Channel conditions are also linked to other habitat indicators discussed elsewhere in this Opinion, including sediment supply and transport, LWD, and hydrology.

***Upper Watershed***
The condition of upper basin habitat is highly variable, depending on the stream location in the basin and its adjacent land use practices (Harza 1999a). Some relatively undisturbed streams in the upper basin include the Clear Fork, Ohanapecosh, and Cispus Rivers. These contain "good" to "excellent" salmonid spawning and rearing habitat. Other streams contain reaches that have been heavily impacted by timber harvest activities, road building, agriculture, and urban development (Harza 1999a; USFS 1997b in FERC 2001). Channel structure in portions of the Upper Cowlitz River Basin has been negatively effected by channel alterations and increased sediment inputs (Dammers et al. 2002).

Habitat conditions related to channel morphological conditions and processes range from properly functioning to not properly functioning in the upper watershed under the environmental baseline. Detailed analysis of the upper watershed is outside the scope of this Opinion. The Project has had no effect on baseline channel morphological conditions and processes upstream from the inundated areas of Mayfield Reservoir and Riffe Lake.

***Lower Watershed - Main Channel Morphology***
NOAA Fisheries defines PFC as main-channel morphological conditions conducive to all applicable life stages of listed salmonids and morphological processes sufficient to maintain those conditions through time.

The 50-mile-long reach of the Cowlitz River downstream from Barrier Dam has an average wetted width of between 237 ft and 307 ft, depending on the flow. Detailed bathymetry is not available, but data collected at USGS stations suggest that channel depths range from less than10 ft to over 30 ft. Channel gradient is generally moderate, ranging from 0.5% to 2.5% (WDW 1990 in Tacoma Power 2000). Aquatic habitat consists of a mixture of pools, riffles, glides, and rapids with occasional side channels and off-channel sloughs. Glides are the dominant habitat type (Harza 1999a). The Project has reduced peak flows (Table 5) and greatly reduced sediment and LWD loads and transport processes. Other human-caused impacts include agriculture, roads, levees, revetments, and urbanization. Under the baseline, main-channel morphological conditions were substantially altered, but large areas remained suitable for all inland life-stages of anadromous fish. The processes necessary to maintain these conditions were diminished, largely due to the Project. Given the degrading channel conditions downstream from Mayfield Dam and the interruption of morphological processes, NOAA Fisheries considers this indicator to be AR in the baseline between Mayfield Dam and the Toutle River confluence.

Downstream from its confluence with the Toutle River, the Cowlitz River has been heavily altered by sediment generated by the eruption of Mount St. Helens in 1980 and subsequent remediation efforts, principally dredging. This has resulted in a loss of spatial heterogeneity.

**Conclusion**
Given the loss of main-channel morphological function, this element is NPF in the baseline for this river reach.

### 5.3.13 Channel Dynamics: Streambank Condition

In this lower river setting, NOAA Fisheries defines PFC as streambank conditions that provide natural stream and floodplain function e.g. hyporheic connection, flood refugia, and river meandering.

Because of bank protection efforts to protect property, and as a result of channel clearing efforts downstream from the Toutle River confluence, streambanks are too stable in this section of the Cowlitz River in the baseline to support natural floodplain function, including juvenile anadromous fish habitat (WPCHB 2003). (See Floodplain Connectivity, below.)

**Conclusion**
Given the lack of natural stream and floodplain function, this element is NPF.

### 5.3.14 Channel Dynamics: Floodplain Connectivity

NOAA Fisheries defines PFC as well-connected, off-channel areas with overbank flows of sufficient frequency to maintain function.

Following the eruption of Mount St. Helens, dredge spoils were placed along the Cowlitz River to serve as levees to reduce the impacts of subsequent flood and mass-flow events. This practice greatly reduced side-channel connectivity in the river reach downstream from the Toutle River confluence. Historical Project operations likely also contributed to the loss of side-channel connectivity and likely dominated this effect upstream from the Toutle River confluence. Specifically, the Project clipped Cowlitz River peak flows from flood and near-flood events (Table 5). Although channel forming processes occur over a wide range of discharges, the characteristics of most alluvial channels are defined by the more frequent peak flows (Leopold et al. 1964). Thus, the 1.5- to 2-year return interval flood is often referred to as "the dominant discharge." As shown in Table 5, the more frequent peak-flow events were the most substantially reduced by flood control operations.

Table 5. Estimated changes in peak flow due to the Cowlitz River Project.

| Return Interval (years) | **Cowlitz River Discharge Downstream from Mayfield Dam (cfs)** | |
|---|---|---|
| | Estimated Peak Flow Prior to Project Development | Estimated Peak Flow with Project Under Baseline Operations |

| | | |
|---|---|---|
| 2 | 31,400 | 23,400 |
| 5 | 42,200 | 35,400 |
| 10 | 49,700 | 44,600 |
| 20 | 57,200 | 54,400 |
| 100 | 75,300 | 80,300 |

**Historical Project effects**

Historical Project operations negatively affected this element in downstream reaches due to greatly diminished deliveries and transport of sediment and LWD and substantial reductions in the dominant discharge.

Through a combination of factors, including flood control operations and the interruption of sediment and LWD transport, the Project has contributed to the loss of side-channel connectivity downstream from Mayfield Dam.

**Conclusion**
This element is NPF.

### 5.3.15 Flow/Hydrology: Altered Flows

NOAA Fisheries defines PFC for the watershed hydrograph as being similar in terms of peak flow, base flow, and timing characteristics of the pre-development condition in the action area or an undisturbed watershed of similar size, geography and geology. Pronounced changes to the hydrograph, as are exhibited here, are classified as “not properly functioning.”

***Flow Fluctuation/Ramping***
The effects of flow fluctuations on salmonids depends on the rate, frequency, and magnitude of fluctuations, channel and floodplain morphometry, and the timing of the fluctuations relative to salmonid life cycles. Flow fluctuations can result in stranding or entrapment of juvenile and adult salmon in dewatered or isolated areas as flows recede (during downramping). Rapid increases in discharge can cause fish to relocate or be conveyed out of preferred habitats.

Stranding occurs when fish are trapped in dewatered areas and die of asphyxiation or desiccation. Entrapment occurs when fish are isolated in potholes or side channels that become separated from the flowing channel. Entrapped fish may subsequently become stranded if flows continue to recede. They may also be subject to increased predation and physiological stress (caused by high temperatures and oxygen deficit). If flows increase and inundate the side channel or pothole, the entrapped fish may return to the main channel (R.W. Beck and Associates 1987). Stranding and entrapment of salmon have been documented on many rivers in the Pacific Northwest (Phinney 1974; Bauersfeld 1978; Becker et al. 1981; Woodin et al. 1984; R.W. Beck and Associates 1987). Although fish entrapment and stranding due to rapid flow fluctuations occur in nature, they can occur much more frequenly downstream from power-peaking hydroelectric projects and the frequency of such events may pose a significant drag on fish populations (Olson and Metzgar 1987).

Flow fluctuations may also affect juvenile salmonids by forcing emigration behavior (McPhee and Brusven 1976 in Hunter 1992) and by forcing changes in fish location as habitat conditions change. Whether such sublethal effects reduce the likelihood of juvenile survival and adult return is not well understood, but to the extent such survival linkages exist, the frequency of flow fluctuations likely plays a role in the severity of the effect (ISAB 2003). Flow fluctuations during spawning seasons can also result in redd dewatering and abandonment (WDFW 2003b).

**Historical Project Effects**

The Mossyrock development was a load-following, or power-peaking, operation. The Mayfield development was typically operated as a re-regulating facility with slight variations in reservoir storage due to variable inflows from the upstream Mossyrock development. Although the Mayfield development was not typically operated in an hourly load-following manner, the project was at times operated to store water and reduce power generation and outflow during weekends to take advantage of long periods of low electrical demand (Figure 3).

Tacoma Power has, in recent years, voluntarily operated the Project to comply with the ramping rate limits presented in Table 2 downstream from Mayfield Dam. These standards were based on review of research reports and were designed to minimize the potential for salmonid entrapment and stranding (Hunter 1992).

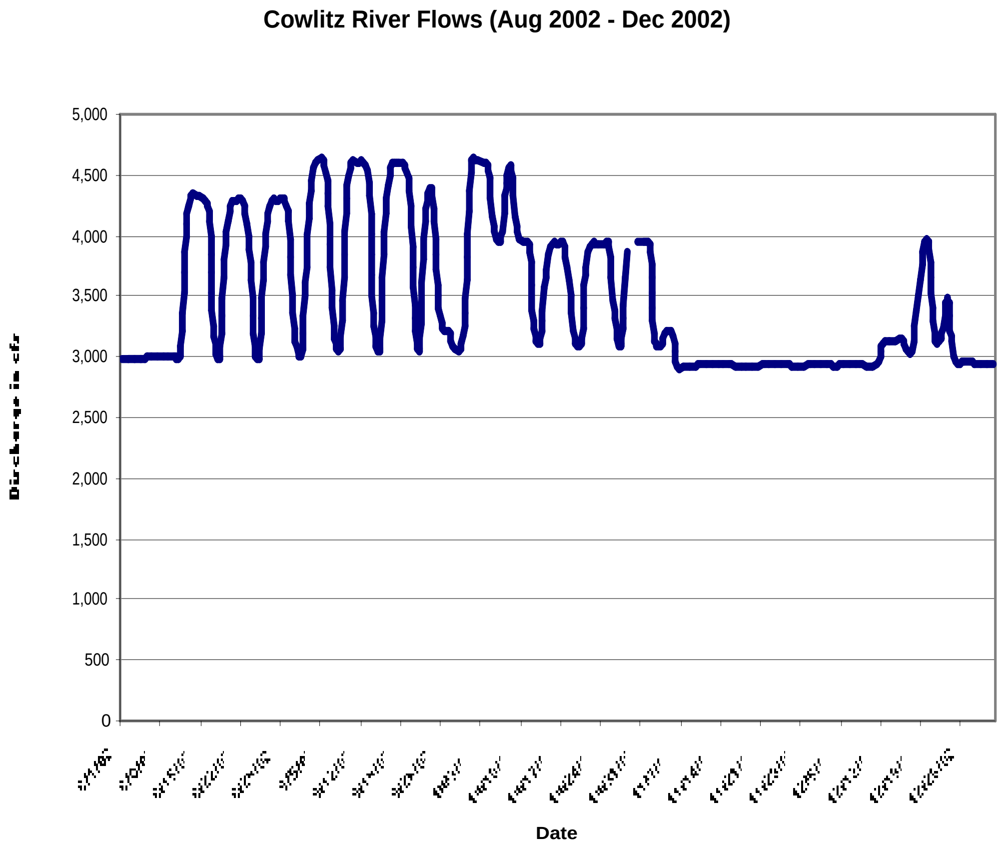



Figure 3. Instantaneous discharge of the Cowlitz River downstream from Mayfield Dam from August through December 2002. USGS Station No. 14238000.

In 2002, WDFW personnel observed the effects of redd dewatering and abandonment in the Cowlitz River at a gravel bar near RM 43, downstream from Mayfield Dam (WDFW 2003b). Following the completion of spawning, WDFW identified 18 suspected redds that were exposed by power-peaking operations. Of the 18, 7 contained dead eggs or egg fragments and 9 did not contain any identifiable eggs, suggesting that they were abandoned prior to completion of spawning or were misidentified by the researchers. This loss of redd viability via flow fluctuations suggest that Project operation, even with the agreed to ramping rates, reduced spawning success for LCR chinook salmon.

**Conclusion**
Due to unnaturally frequent flow fluctuations downstream from Mayfield Dam, NOAA Fisheries concludes that this habitat element is NPF.

### 5.3.16 Flow/Hydrology: Altered Flows-Seasonal and Minimum Flows

The ability to return to their streams of origin to spawn is among the most distinguishing characteristics of anadromous fish. This fealty to natal waters indicates a high degree of adaptation to the conditions in which they evolved, including adaptations to the prevailing hydrologic conditions of their natal streams. Run timing, spawning activity, emergence and outmigration timing are well adapted to the natural hydrology. Although the effects of altering the hydrologic regime are seldom precisely known, it is likely that alteration of the hydrologic environment has implications for native anadromous fish survival.

The areas of effect to this indicator are addressed in the historical project effects section below.

**Historical Project Effects**

Mean monthly flow at three gages on the mainstem Cowlitz River and two tributaries in the Project area (1969 through 1997) are shown in Figures 4 and 5.

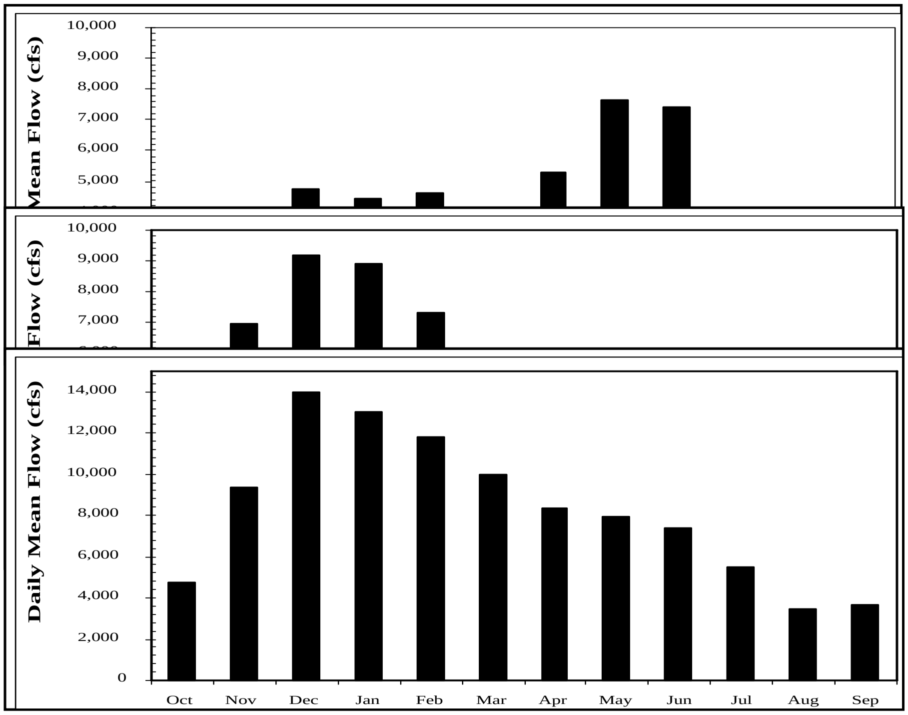
The gage at Kosmos represents flows in the Cowlitz River just upstream of the Project (Figure 4[a]). This gage is located at the Cowlitz Falls Dam. Mean monthly flows at this location are between 3,000 and 5,000 cfs through the winter (November to February), increasing to 7,000 to 8,000 cfs during spring snowmelt (May and June), and then decreasing to lows of 1,000 to 2,000 cfs during the late summer and early fall (August through October).

The Cowlitz River gage below Mayfield Dam (Figure 4[b]) shows the effects of Project storage and operation on upstream mainstem and tributary flows. Mean monthly flows are high during the winter months, 7,000 to 9,000 cfs between November and February, as the Project maintains storage for flood control. During spring, outflows are lower than inflows (5,000 to 6,000 cfs) as Riffe Lake is filled for summer recreation. Summer outflows (2,000 to 3,000 cfs) are held higher than inflow to provide more water for fish in the lower river.

The gage at Castle Rock provides an indication of flows in the river far downstream of the Project (Figure 4[c]). This gage is located downstream of the Toutle River, a major tributary draining Mount St. Helens. The timing of high and low flows at Castle Rock is similar to those below Mayfield Dam, but the magnitude is several thousand cfs higher.

Flows in the two major tributaries to the Project area are shown in Figure 5. Both flow into Mayfield Lake, the Tilton River entering from the north and Winston Creek entering from the south. The Tilton River Basin drains an area that is influenced both by winter rain and rain-on-snow events and early spring (lower elevation) snowmelt. The Tilton has consistently high mean monthly flows from November through April (800 to 1,000 cfs), tapering off to very low flows (less than 100 cfs) in the summer and early fall. Winston Creek also has high winter flows (160 to 200 cfs), but relatively lower snowmelt flows (120 cfs) and very low summer flows (less than 10 cfs).

Figure 4. Mean monthly flow in the Cowlitz River a) upstream of the Project; b) downstream of Mayfield Dam; and c) downstream from the Toutle River confluence with the Cowlitz River under existing conditions (1969-1997 data). Source: USGS waterdata website for Washington in FERC 2001.

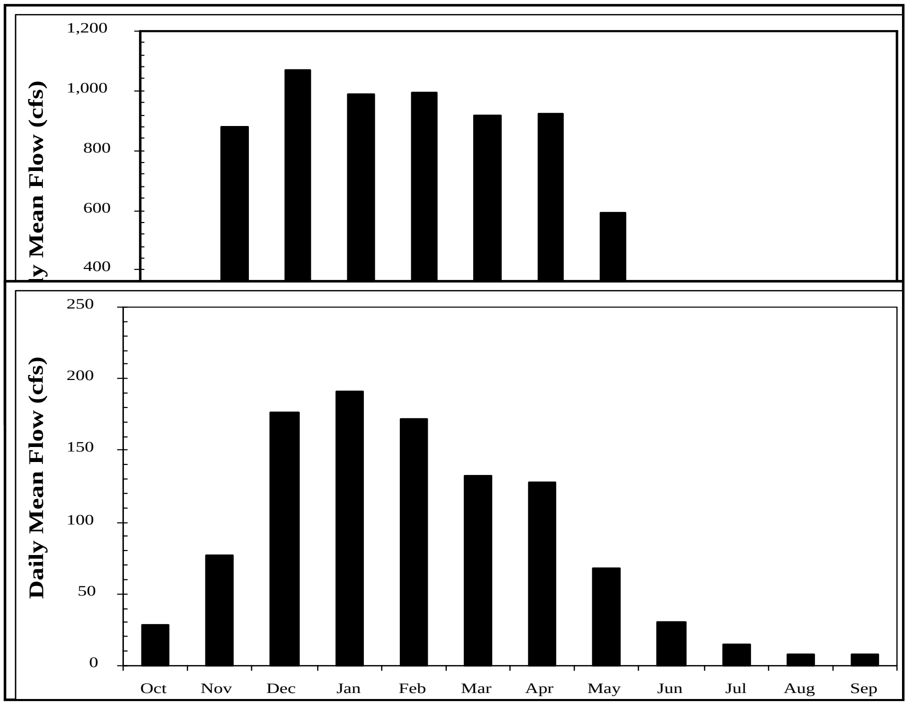



a) Cowlitz River near Kosmos, WA (USGS 14233500)

b) Cowlitz River below Mayfield Dam, WA (USGS 14238000)

c) Cowlitz River at Castle Rock, WA (USGS 14243000)

Figure 5. Mean monthly flow of major tributaries in the Project area: a) Tilton River under existing conditions (1969-1997) and b) Winston Creek (1949-1970). Source: FERC 2001.




a) Tilton River above Bear Canyon Creek near Cinebar, WA (USGS 14236200)

b) Winston Creek near Silver Lake, WA (USGS 14237500)

In November 1977, an agreement was reached between Tacoma Power and WDF and WDG to manage release rates at Mayfield Dam to protect salmon and steelhead resources in the lower Cowlitz River.[14] Minimum flow releases from Mayfield Dam were as follows:

<u>March 1 – July 15</u>
Minimum flow releases from Mayfield Dam were 5,000 cfs unless the March 1 or later forecasts indicate that flow cannot be achieved and meet Riffe Lake refill requirements. If the forecasts indicated that 5,000 cfs could not be achieved, every concerted effort was made to maintain as high and as constant a release as possible. Date of commencement to be March 1, dependent upon observations or predictions of the emergence of salmonid fry made by the WDFW.

<u>July 16 – September 15</u>
Minimum flow releases from Mayfield Dam were 2,000 cfs during this period. The 2,000 cfs was to be a constant flow. If circumstances beyond the control of Tacoma Power required the release of greater amounts of water, then reductions in rate of flow should have been equal to or less than the rate of change of natural flow into Mayfield Reservoir.

<u>September 16 – November 20</u>
Every effort was made to maintain a flow regime between 2,500 and 4,000 cfs at Mayfield Dam. If circumstances beyond Tacoma Power's control made it necessary to exceed the 4,000 cfs flow level, then, if possible, subsequent discharges were provided to adequately cover existing salmon redds. Spawning flows applied through November 20 or until completion of spawning, whichever came first. The WDFW conducted spawning surveys each season and notified Tacoma Power upon completion of spawning.

<u>November 21 – February 28</u>
Minimum flow releases from Mayfield Dam were maintained at a level that would inundate existing redds, except when conditions were beyond the Licensee's control.

These flows were to be met unless circumstances occurred that were beyond Tacoma Power’s control. Tacoma Power committed to consult with WDFW prior to reducing the flows enumerated in the 1977 agreement.

Historical project operations, including those following the 1977 flow management agreement, greatly modified the flow regime downstream from Mayfield Dam. The substantial decrease in spring flows during the reservoir refill period has likely reduced the survival of juvenile anadromous fish that emigrated during the spring by increasing travel time and decreasing turbidity. This reduction has also had channel morphometry effects discussed elsewhere in this

[14] The Settlement Agreement and FERC License (the proposed action) superseded these flows.

Opinion. Increasing summer flows in the lower Cowlitz River increased available habitat area and reduced water temperature in the Cowlitz River. It also increased flow velocity, reducing the travel time for late outmigrants (e.g., fall chinook). The slight increase in fall flows provided more spawning habitat than would otherwise have been available but weekly flow fluctuations that also occurred during this period reduced the effectiveness of this benefit.

Tributary inflow downstream of the Project can, and does, exceed 70,000 cfs. The Project has no means to reduce or control these flows.

The Project has been operated according to an instream flow schedule designed to protect important anadromous fish habitat since 1977.

**Conclusion**
Because certain aspects of historical Project operation have had adverse effects on anadromous fish, NOAA Fisheries concludes that this element is at risk.

### 5.3.17 Flow/Hydrology: Altered Flows - High Flows

**Historical Project Effects**

As described above, the Cowlitz River Project was operated to provide flood control in the lower Cowlitz River Basin (Table 6). Flood control operations were mandated by the FERC License and coordinated with the Corps as part of their flood control efforts in the Columbia River Basin. The goal of the flood control effort was to avoid flows at Castle Rock in excess of 70,000 cfs, to the extent practical. Mossyrock Dam controlled peak flows by managing storage in Riffe Lake. Riffe Lake was drawn down in the fall to provide storage for winter and spring flood flows. Mayfield Lake, a much smaller reservoir, was generally not drawn down and did not provide significant flood storage. When inflow to Mayfield Lake from the Tilton River and Winston Creek was high, generation at Mossyrock powerhouse may have been shut down entirely to minimize flows in the lower river. The effectiveness of the flood protection is shown in Table 5.

Table 6. Previous Project operations summary.

<table>
<tr><th rowspan="2">Month</th><th colspan="4">Riffe Lake Elevation (ft)</th><th colspan="3">Mayfield Outflow (cfs)</th></tr>
<tr><th>Flood Control Curve</th><th>Median (50% exceedance)</th><th>Max</th><th>Min</th><th>Minimum Flows</th><th>Median (50% exceedance)</th><th>Flood Control</th></tr>
<tr><td>Jan</td><td>745.5</td><td>741</td><td>767</td><td>721</td><td rowspan="2">inundate redds</td><td>6,420</td><td rowspan="10">Maintain flows at Castle Rock below 70,000 cfs</td></tr>
<tr><td>Feb</td><td rowspan="4">Fill</td><td>744</td><td>776</td><td>708</td><td>5,000</td></tr>
<tr><td>Mar</td><td>752</td><td>766</td><td>701</td><td rowspan="4">5,000</td><td>5,000</td></tr>
<tr><td>Apr</td><td>758</td><td>769</td><td>701</td><td>5,000</td></tr>
<tr><td>May</td><td>770</td><td>777</td><td>714</td><td>5,000</td></tr>
<tr><td>Jun</td><td rowspan="3">778.5 (767 minimum)</td><td>778</td><td>778</td><td>723</td><td>6,334</td></tr>
<tr><td>Jul</td><td>776</td><td>778</td><td>719</td><td rowspan="4">—15th—<br>2,000<br>—15th—<br>2,500-<br>4,000</td><td>5,000</td></tr>
<tr><td>Aug</td><td>776</td><td>778</td><td>715</td><td>2,000</td></tr>
<tr><td>Sep</td><td rowspan="2">Draw-down</td><td>773</td><td>778</td><td>707</td><td>2,500</td></tr>
<tr><td>Oct</td><td>765</td><td>778</td><td>696</td><td>2,500</td></tr>
</table>

| **Month** | **Riffe Lake Elevation (ft)** | | | | **Mayfield Outflow (cfs)** | | |
|---|---|---|---|---|---|---|---|
| | **Flood Control Curve** | **Median (50% exceedance)** | **Max** | **Min** | **Minimum Flows** | **Median (50% exceedance)** | **Flood Control** |
| Nov | | 753 | 777 | 696 | | 7,848 | |
| Dec | 745.5 | 741 | 777 | 709 | inundate redds | 7,035 | |
| Source: Tacoma 1999 from FERC 2001. | | | | | | | |

The analysis period for the baseline period is from 1969 to 1997. This 29-year period includes the flood of 1996. The occurrence of such a large flood in the relatively short analysis period may result in predictions of higher 50- and 100-year flood flows than if a longer period of record was analyzed.

Under past conditions, the effects of the Cowlitz River Project on flood flows can be seen by comparing the Kosmos gage (upstream of the Project) with the gage below Mayfield Dam (Table 7). Peak flows at Castle Rock show that the flood control effects of the Project are diluted by inflow from the Toutle River and smaller tributaries in the lower Cowlitz River Basin.

Table 7. Computed Cowlitz River flood flows under past Project operations (peak flows in cfs, 1969-1997 period). Source: FERC 2001.

| Return Period (years) | Cowlitz River near Kosmos (cfs) | Cowlitz River below Mayfield Dam (cfs) | Cowlitz River near Castle Rock (cfs) |
|---|---|---|---|
| 2 | 32,700 | 23,400 | 50,000 |
| 5 | 53,600 | 35,400 | 78,300 |
| 10 | 70,200 | 44,600 | 97,500 |
| 20 | 88,200 | 54,400 | 116,000 |
| 50 | 115,000 | 68,600 | 140,000 |
| 100 | 137,000 | 80,300 | 158,000 |

The Project's effects on peak flows are also illustrated by looking at pre-Project peak flows (Table 8). As part of the Ecosystem Diagnosis and Treatment (EDT) analysis, Tacoma Power completed a review of annual peak flows for 7 gages in the basin based on water years. The peak flow record was divided into three periods chosen for the EDT analysis as pre-major basin development (prior to 1955), during major basin development (1955-1968), and post-Project (1969-1996). Tacoma Power used the HEC-FFA computer program to generate flood flow frequency curves. Table 7 compares flood flows based on peak flows under current conditions near Kosmos, below Mayfield Dam, and near Castle Rock. Table 8 illustrates flood flows based on peak flows at these gages prior to 1955 and during Project development (1955-1968). Comparing the results in these two tables illustrates that the Project is effective at lowering flood peaks. However, these data sets also reflect the effects of both small data sets and the inclusion of specific large floods. Flows following Project construction show higher large magnitude (i.e., 20 to 100+ year) floods than the pre-1955 or 1955-1968 period. In part, this is due to the large floods in water year 1996, which included the largest flood of record for the Cispus River, Tilton River, Cowlitz River near Randle, and Cowlitz River below Mayfield Dam gages. The water year 1934 flood is the largest on record for the Cowlitz River at Packwood and Castle Rock gages; the other gages analyzed were not in operation at that time, so the pre-1955 record does not include this large flood.

Table 8. Computed historic Cowlitz River flood flows (peak flows in cfs, pre-1955, and 1955-1968 periods). Source: Harza 1999a.

| **Return Period (years)** | **Cowlitz River near Kosmos (cfs)** | | **Cowlitz River below Mayfield Dam (cfs)** | | **Cowlitz River near Castle Rock (cfs)** | |
|---|---|---|---|---|---|---|
| | Pre-1955 (n=6) | 1955-1968 (n=14) | Pre-1955 (n=21) | 1955-1968 (n=14) | Pre-1955 (n=28) | 1955-1968 (n=14) |
| 2 | 25,100 | 26,600 | 31,400 | 36,100 | 50,800 | 54,500 |
| 5 | 29,900 | 34,900 | 42,200 | 47,600 | 69,600 | 69,900 |
| 10 | 32,900 | 40,900 | 49,700 | 55,700 | 82,700 | 76,400 |
| 20 | 35,500 | 47,000 | 57,200 | 63,700 | 95,800 | 88,100 |
| 100 | 41,200 | 62,100 | 75,300 | 83,500 | 127,000 | 107,000 |

Historical Project operations reduced peak flows by 28%, 34%, 36%, 38%, 40%, and 41% for the 2-, 5-, 10-, 20-, 50-, and 100-year floods, respectively. Reductions in peak flows likely had both positive and negative effects on anadromous fish. High flows can scour redds and displace or kill juvenile fish and temporarily reduce benthic biomass. By reducing peak flows, the Project reduced these effects. These short-term benefits were offset by reductions in the habitat creating effects of floods (e.g., channel avulsion, recruitment of LWD, recruitment of spawning-sized sediments, and the liberation of embedded sediments). These effects were small but exacerbated the more significant adverse effects of the reservoirs in reducing the flows of LWD and spawning sized sediments to the river downstream from Mayfield Dam.

**Conclusion**
NOAA Fisheries concludes that due to substantial reduction in the magnitude of low return-interval floods, the peak flow maintenance habitat element is not properly functioning.

### 5.3.18 Watershed Condition: Increase in Drainage Network

NOAA Fisheries defines PFC as zero to medium increases in drainage network due to roads. That is, construction of roads and their companion drainage systems has not increased the total number of drainage routes to the river (potentially increasing input of sediment and contaminants).

Extensive networks of logging roads are present in upper basin, many subject to erosion or failure (Dammers et al. 2002; Washington Conservation Commission 2003).

**Conclusion**
NOAA Fisheries rates this indicator as NPF because of the extensive network of road throughout the basin.

### 5.3.19 Watershed Condition: Road Density and Location

NOAA Fisheries defines PFC as <2 miles of road per square mile with no valley bottom roads.

Extensive networks of logging roads are present in upper basin, many subject to erosion or failure (Dammers et al. 2002, Washington Conservation Commission 2003). The lower basin has large networks of roads associated with agricultural, urban, and industrial development.

**Conclusion**
NOAA Fisheries rates this indicator as NPF due to the high road density throughout the basin.

### 5.3.20 Watershed Condition: Disturbance History

The surrounding watershed profoundly influences the physical and biological processes that occur in a stream. Disturbances in the watershed associated with logging or development can lead to increased sediment input, increased water temperatures and other habitat degradation which directly effect listed salmonids. PFC is defined as having <15% Equivalent- clear cut area (ECA) (entire watershed) disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except adaptive management areas), 15% retention of late successional old growth timber (LSOG) in watershed.

Historically, fire was the strongest natural disturbance influencing vegetation structure and composition within these different plant communities (USFS 1997a as cited in WCC 2000). However, the eruption of Mount St. Helens has shown the potential influence that volcanism can also exert on vegetation composition and structure within the watershed. Logging, and in areas grazing, have also had substantial impacts on vegetation structure and composition and riparian areas throughout The Cowlitz Basin (WDW 1990 as cited in WCC 2000). The Washington Department of Natural Resources derived vegetation cover for 26 Water Resource Inventory Areas (WRIA) in Western Washington, including the Cowlitz basin (WRIA 26), using 1988 Landsat 5 TM data (PMR 1993 as cited in WCC 2000) and updated with 1991 and 1993 TM data. Forest cover was broadly categorized into four classes based on forest type and age class. The non-forest land cover and most surface water features were then overlaid on the forest-cover classification to discriminate non-forest lands, such as agriculture and urban areas from forest lands (PMR 1993 as cited in WCC 2000). Table x contains the both the number of acres in each land cover category and the percentage of the total area in each category. Late seral stage vegetation still covers a fairly large percentage of the Cowlitz River basin. The Washington Conservation Comission (WCC 2000) estimates that 28% of the vegetation cover in the upper Cowlitz River watershed and 19% in the middle Cowlitz watershed is in "large tree" (similar characteristics to late seral stage).

**Table x:** Cowlitz River Basin Land Cover Data (WCC 2000)

| | Late Seral | Mid Seral | Early Seral | Other Lands | Water | Non Forest |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Acres | 336,112 | 289,972 | 108,750 | 688,856 | 23,260 | 147,489 |
| Percent | 21 | 18 | 7 | 43 | 2 | 9 |

In the Lower Cowlitz River, most of the historic off-channel and floodplain habitat has been disconnected from the river by diking and hardening the channels and due to the 1980 eruption of Mount St. Helens. Loss of these off-channel habitats limits rearing and over-wintering habitat for juvenile salmonids within most subbasins (WCC 2000).

**Conclusion**
NOAA Fisheries classifies this factor as NPF.

#### 5.3.21 Watershed Condition: Riparian Reserves

NOAA Fisheries defines PFC as a riparian reserve system which provides adequate shade, LWD recruitment, habitat protection, and connectivity to all subwatersheds. This reserve must be >80% intact and the vegetation must be >50% similar to the potential natural community composition.

The USFS (1997) estimated that 28% of the vegetative cover in the Upper Cowlitz River watershed and 19% in the middle Cowlitz River watershed is in the “large tree” (late seral stage) category (Dammers et al. 2002). Historically, the Cowlitz River Basin has been subject to extensive industrial logging, and riparian reserves in the Toutle basin were damaged by the eruption of Mount St. Helens in 1980 (Dammers et al. 2002; Washington Conservation Commission 2003).

**Conclusion**
NOAA Fisheries rates this factor as AR because of depletion of riparian reserves by high levels of logging and other disturbances in the Cowlitz River Basin.

### 5.4 Summary of Environmental Baseline

The habitat biological requirements of the Cowlitz spring- and fall-run chinook salmon populations of the LCR chinook salmon ESU, the Cowlitz chum salmon populations of the CR chum salmon ESU, and the Cowlitz winter-run steelhead population of the LCR steelhead ESU are not being met under the environmental baseline. Environmental baseline conditions in the action area would have to improve to meet those biological requirements not presently met. Any further degradation or delay in improving these conditions might increase the amount of risk the listed ESUs presently face under the environmental baseline. Table 9 displays a summary of the relevant factors discussed in this section, based on the Matrix of Pathways and Indicators described in NOAA Fisheries (1996).

Habitat conditions directly affect the survival and fecundity of individual salmon, which in turn affects the viability of a particular population of salmonids. The habitat method was developed to describe and analyze habitat changes from a properly functioning condition (most beneficial for salmonids) and by inference, the effects of these changes on salmonid populations.

Table 9. Matrix of Pathways and Indicators for the environmental baseline. Unless otherwise noted, the descriptions apply to the habitat biological requirements of the populations of all three listed ESU's found in the action area. Note that continuing project effects are not part of the environmental baseline because they are the subject of the proposed action Function codes; PFC: properly functioning condition, NPF: not properly functioning, and AR: at risk.

| **Pathway** | **Indicator** | **Function** | **Description** | **Source** |
|---|---|---|---|---|
| Water Quality | Contamination | NPF | 2 reaches on WDOE 303d list for organics and pesticides respectively. | Agriculture, industry, urban development |
| | Temperature | NPF | Numerous reaches on WDOE 303d list for exceeding water temperature standards. | Poor riparian conditions |
| | Dissolved Substances | PFC | Dissolved oxygen | |
| | | AR | Total dissolved gas levels occasionally exceed standard during spill events. | Spill at Mayfield dam |
| | Sediment/ Turbidity | PFC | Large amounts of sediment in river downstream from Toutle River confluence. | Mt. St. Helens eruption |
| Habitat Elements | Barriers | NPF | Access to about 250 miles of historical spawning and rearing habitat blocked or significantly impeded. Downstream migration impeded. | Historical effects of Mayfield and Mossyrock and current effects of Cowlitz Falls Dam and associated reservoirs. |
| | Substrate | NPF | Substrate transport from upper basin blocked. Large amounts of fine sediment below Toutle River | Historical effects of Mayfield and Mosstrock and current effects of |

| **Pathway** | **Indicator** | **Function** | **Description** | **Source** |
|---|---|---|---|---|
| Habitat Elements | Large Woody Debris | NPF | LWD transport from upper basin blocked, low levels of LWD in upper basin. | Historical effects of Mayfield and Mosstrock and current effects of Cowlitz Falls Dam and associated reservoirs, poor recruitment due to riparian conditions. |
| | Off-Channel Habitat | NPF | Poor connectivity to off channel habitat in lower river. | Dredging following Mt. St. Helens eruption. Diking to support agricultural, urban, and industrial development. |
| | Pool Frequency/ Quality | NPF | Pool frequency low throughout system. | Logging and road building low LWD recruitment and transport high sediment input from roads and Mt. St. Helens eruption. |
| | Refugia | NPF | Little Structure or cover available in upper Cowlitz tributaries. Poor connectivity to off channel habitat in | Logging and road building low LWD recruitment and transport high sediment |
| Channel Dynamics | Channel Morphology | NPF | Lower Cowlitz channelized and diked. | Flood control, post Mt. St. Helens eruption recovery measures, and industrial and agricultural development. |
| | Streambank Condition | NPF | Streambanks do not support natural Floodplain Function in the lower river. | Dredging following Mt. St. Helens eruption and bank protection. |
| | Flood Plain Connectivity | NPF | Lower river inundated with dredge spoils. | Dredging following Mt. St. Helens eruption. |

| Pathway | Indicator | Function | Description | Source |
|---|---|---|---|---|
| Channel Dynamics | Altered Flows | NPF | Lower Cowlitz River hydrology affected by seasonal reservoir drafting and refilling, flood control operations, and power peaking operations. | Historical effects of Mayfield and Mossyrock and current effects of Cowlitz Falls Dam and associated reservoirs. |
| | Seasonal and Minimal | AR | Changes to flow regime in lower river. | Historical effects of Mayfield and Mossyrock. |
| | High Flows | NPF | Substantial reduction in magnitude of low return-interval floods. | Historical effects of Mayfield and Mossyrock |
| Watershed Conditions | Increase in Draining Network | NPF | Large network of logging roads in upper basin. Road network in lower basin associated with urban, agricultural, and industrial development. | Logging, agricultural, industrial and urban development. |
| | Road Denisty and Location | NPF | Large network of logging roads in upper basin. Road network in lower basin associated with urban, agricultural, and industrial development. | Logging, agricultural, industrial and urban development. |
| | Disturbance History | NPF | Intensive industrial logging, fires, and volcanic eruption. | Logging and Mt. St. Helens eruption. |
| | Riparian Reserves | NPF | 19-28%of standing vegetation in late Seral stage. | Logging and clearing land for agricultural, industrial, and urban development. |

The relationship of the habitat effects to effects on salmonids and salmonid populations is described in Table 10. The effect on populations is described in terms of the viable salmonid population (VSP) criteria from McElhaney et al. (2000). The VSP criteria encompass abundance, population productivity trends, spatial distribution, and diversity. In the absence of minimum viable population size estimates, and often accurate data on actual population sizes, these metrics are used to assess the effects of the factors under consideration on the viability of a salmonid population.

Table 10. How baseline conditions affect listed species in the Cowlitz River Basin.

| **Factor** | **Listed Species affected** | **Life stage** | **Effect** | **Population viability factors** |
|---|---|---|---|---|
| Barriers-Dams | Spring Chinook salmon | Adult egg, juvenile, smolt | limits or blocks access to 80 to 100% of historical spawning and rearing habitat | Productivity<br>Diversity<br>Distribution<br>Abundance |
| | Fall Chinook salmon | Adult, egg, juvenile, smolt | limits or blocks access to approximately 37% of historical spawning and rearing habitat | Productivity<br>Diversity<br>Distribution<br>Abundance |
| | Winter Steelhead | Adult, egg, juvenile, smolt | limits or blocks access to approximately 50% of historical spawning and rearing habitat | Productivity<br>Diversity<br>Distribution<br>Abundance |
| | Chum Salmon | Adult, egg, juvenile, smolt | limits or blocks access to an unknown proportion (probably small) of historical spawning and rearing habitat | Productivity<br>Diversity<br>Distribution<br>Abundance |
| Water Temperature exceedences | All | Juvenile | Degrades spawning and rearing habitat, reduced juvenile survival | Productivity<br>Abundance |

| | | | | |
|---|---|---|---|---|
| Habitat Elements, Channel Dynamics, Watershed condition | All | Egg, juvenile, smolt | Degrades spawning and rearing habitat, reduced juvenile survival | Productivity Abundance |
| Hatcheries | All | Juveniles, smolts, | Possible competition and predation on wild juveniles by hatchery smolts. | Productivity Abundance |
| | All except Chum | genetic effects | Introgression with wild stocks presents risks of genetic drift and introduction of traits associated with domestication | Diversity |
| Upper Basin-Predators in reservoir | All | Juveniles and smolts | Decreased survival of juveniles and smolts rearing or migrating through reservoirs | Productivity Abundance |
| Lower basin-channelization, dredging | Chum | Adult, egg, juvenile | Degrades or eliminates likely primary spawning habitat for chum in Cowlitz basin | Productivity Diversity Distribution |
| | All listed species present | Adult, smolt | Limits available holding habitat for migrating salmonids | Productivity Abundance |

# 6. ANALYSIS OF EFFECTS OF THE PROPOSED ACTION

## 6.1 Effects of Proposed Action

Effects of the action are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR §402.02). Direct effects occur at the Project site and may extend upstream or downstream based on the potential for impairing important habitat elements. Indirect effects are defined in 50 CFR §402.02 as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." They include the effects on listed species of future activities that are induced by the proposed action and that occur after the action is completed. "Interrelated actions are those that are part of a larger action and depend on the larger action for their justification" (50 CFR §403.02). "Interdependent actions are those that have no independent utility apart from the action under consideration" (50 CFR §402.02).

## 6.2 Methods of Analysis

In step 3 of its jeopardy analysis, NOAA Fisheries evaluates the effects of proposed actions on listed salmon and steelhead in the context of their biological requirements, as described in Sections 4 and 5 and below.

NOAA Fisheries may use either or both of two independent techniques in determining whether the proposed action jeopardizes a species continued existence. First, NOAA Fisheries may consider the impact in terms of how many listed salmon will be killed or injured during a particular life stage and then gauge the effects of that take on population size and viability. Alternatively, NOAA Fisheries may consider the effect on the species freshwater habitat requirements, such as water temperature, streamflow, etc. The habitat analysis is based on the well-documented cause and effect relationships between habitat quality and population viability. While the habitat approach to the jeopardy analysis does not quantify the number of fish adversely affected by habitat alteration, it considers this connection between habitat and fish populations by evaluating existing habitat condition in light of habitat conditions and functions known to be conducive to salmon conservation (Spence et al. 1996). In other words, it analyzes the effect of the action on habitat functions that are important to meet salmonid life cycle needs. The habitat approach then links any failure to provide habitat function to an effect on the population and to the ESU as a whole. For this consultation, NOAA Fisheries utilizes the habitat approach in considering the biological requirements best described by important habitat characteristics. The effects are summarized with respect to whether they impair properly functioning habitat, appreciably reduce the functioning of already impaired habitat, or retard the long-term progress of the impaired habitat toward properly functioning conditions (NOAA Fisheries 1999b).

## 6.3 Direct Effects of the Project

Direct effects are the direct or immediate effects of the Project on the species or its habitat. Direct effects result from agency action, including the effects of interrelated actions and interdependent actions. Future Federal actions that are not a direct effect of the action under consideration (and not included in the environmental baseline or treated as indirect effects) are not considered in this Opinion.

The primary limiting factors to salmonid populations associated with past Project operations (as summarized in Table 10 of the Environmental Baseline description) include:

1. Barriers to upstream and downstream migration of salmonids resulting in the loss of spawning and rearing habitat.
2. Reservoir inundation and passage blockage.
3. Modified flow regimes in the Cowlitz River below the Project.
4. Blocked downstream movement of substrate and LWD.

Unless identified herein, effects from past Project operations which were defined in the Environmental Baseline section of this Opinion are expected to continue. In other words, we expect past impacts to continue into the future if they are not explicitly modified by the new license.

The License sets specific performance targets. By examining existing data, NOAA Fisheries will assess the likelihood of attaining those targets. NOAA Fisheries will analyze if Project operations with the described measures in place will jeopardize the continued existence of listed salmonids within the Cowlitz River Basin. Note: If targets are not attained in the future at this Project, then it is likely to change the results of this analysis and potentially the conclusion concerning whether or not Project operations jeopardize the continued existence of listed salmonids within the Cowlitz River Basin.

### 6.3.1 Restoration of Upstream and Downstream Fish Passage

The License proposes to refine existing efforts to reestablish listed salmonids above the Mayfield, Mossyrock, and Cowlitz Falls Dams. The goal of these efforts is to reestablish indigenous stocks of chinook salmon, steelhead, coho salmon, and sea-run cutthroat trout upstream of the dams. As stated in the May 8, 2000, Agreement in Principle for the Cowlitz Settlement Agreement, “The emphasis of this agreement in principle is ecosystem integrity and the recovery of wild, harvestable salmonid runs.” Indigenous hatchery stocks will be used for at least a portion of the restoration efforts. Adults and juveniles are transported and released above the dams with the adults spawning there and the juveniles rearing in this upstream area before smolting and moving downstream. Mortalities are expected among downstream migrating smolts (and potential adult fallbacks) as they move through the projects via turbine and reservoir migration. Passage survival performance standards (e.g., FPS) have been set at levels that are expected to allow for a sustainable population above the dams.

The goal is to reestablish a viable population of spring chinook and a contributing population of steelhead (a contributing population is one whose status needs to improve but not to the level of viability) above the Cowlitz River projects. Adaptive management will occur to ensure this is met. Adaptive management is best described as setting objectives, defining management actions designed to achieve those objectives, implementing those actions, monitoring and evaluating the outcomes, and making changes in management actions in response to new information.

Historically, the Tilton River has been used as a release site for surplus hatchery adults returning to the Cowlitz River. Adult releases were used to provide sport harvest opportunities for local communities, and to secondarily increase natural production in the basin.

Fish management in this basin is changing from one focused on harvest to reestablishment of native fish communities in the basin. In recent years, juvenile salmonids migrating from the Tilton have been captured at Mayfield Dam and uniquely marked so that they could be identified upon their return as adults and transported to the Tilton River. The License calls for the basin to be managed in a similar manner in the future, i.e., focused on fish restoration.

#### 6.3.1.1 Upstream Fish Passage

The License (and Settlement Agreement) require the Licensee to provide and maintain effective upstream passage at the Barrier Dam, Mayfield Dam, and Mossyrock Dam (Settlement Agreement License Article 3.). Trap and haul operations to transport adult fish to the upper basin will continue, shifting to volitional passage at Mayfield Dam and a trap and haul facility at Mossyrock Dam within certain timelines when recovery criteria are reached.

***Trap and Haul Operations***

Currently fish passage upstream of Mayfield and Mossyrock Dams is achieved by a trap and haul operation. Chinook salmon, steelhead, and coho salmon are captured at the Cowlitz Salmon Hatchery trap and trucked to release sites above the dam (Table 11). Although a few chum salmon enter the hatchery trap, none are transported above the dams (it is believed that Upper Cowlitz chum salmon spawning habitat was inundated by Mayfield Lake). These numbers remain relatively small, especially when compared to historic run sizes averaging 10,921 spring chinook salmon during the operation of the Mayfield Dam fish passage facility.

Table 11. Adult spawners transported to the Upper Cowlitz River Basin, 1998-2002.

| Year | Spring Chinook | Fall Chinook | Steelhead | Coho |
|---|---|---|---|---|
| 1998-1999 | 91 | - | 129 | 8628 |
| 1999-2000 | 204 | - | 322 | 27010 |
| 2000-2001 | 149 | 2170 | 645 | 32619 |
| 2001-2002 | 1737 | 5539 | 2792 | 39862 |

The trap and haul program has reestablished some anadromous salmonid production in the Upper Cowlitz River Basin. It has been most successful with coho salmon. Outplants of juvenile coho salmon ceased in 1999 and all smolts since 2001 have been the result of natural production. Spring chinook salmon and steelhead transported to the upper basin have also spawned successfully and produced smolts, although outplanting of hatchery juvenile of both species continues in the upper basin (Dammers et al. 2002). Transportation of adult fall chinook salmon to the Tilton Basin and the Upper Cowlitz River Basin began again in 2001 (prior to that there had been only a small number of jacks passed upstream since 1980 due to hatchery spawning needs).

***Efficacy of Trap and Haul***

To determine the efficacy of trap and haul operations one must know trap efficiency, handling and transport associated mortality, and fallback rate of transported fish. While NOAA Fisheries does not have these data for the Cowlitz River, data is available for adult passage efficiency and timing at other facilities. Provided that the fishways associated with the Barrier Dam meet established NMFS criteria, we should expect that the collection/passage efficiency (number of fish detected in the tailrace and proportion of those fish that pass the ladder) to be similar to Bonneville Dam. Based upon six years (1996-2002) of radio tag data at Bonneville Dam, passage efficiency was approximately 98% for spring chinook, 97.5% for steelhead, and 94% for fall chinook (Data provide by Christopher Peery to Ed Meyer, 27 Feb 2004). (Note: the same information collected at site on the mainstem Columbia and Snake Rivers (Bonneville, The Dalles, John Day, McNary, and Ice Harbor Dams), yields average passage efficiency of approximately 96% for spring chinook, 97% for steelhead and 93% for fall chinook). Based upon the same radio tagging studies, we can expect that approximately 75% of the spring chinook, steelhead and fall chinook that enter the tailrace will enter the ladder within approximately 30 hours, 15 hours and 16 hours respectively.

Also, since NOAA Fisheries does not have the specific data for the Project, review of the relationship between numbers of fish transported to numbers of smolts and prespawners counted can indicate the effectiveness although these numbers are confounded by releases of hatchery juveniles in the Upper Cowlitz. The potential effects of trap and haul operations include delay, handling stress, potential injury, etc.

Preliminary data from the first 4 years of anadromous salmonid reestablishment efforts into the Upper Cowlitz River Basin indicate that trap and haul methodology has been successful at re-establishing some level of anadromous salmonid production in the Tilton River and in the Upper Cowlitz River, especially for coho salmon (Dammers, et al. 2002).

***New ladder at Mayfield Dam***

Volitional passage ( i.e., ladder, including sorting facilities) is technically possible around Mayfield Dam. A ladder will be built if certain criteria in the License are met. There was an adult fish passage facility in place on Mayfield Dam which functioned from 1962 to 1968 (Table 12). Planned sorting facilities at the head of the ladder would allow fisheries managers to separate wild from hatchery fish. The plans for the ladder also include a trap and haul facility to allow for continued fish migration in the event that the ladder would have to be taken out of service. The effects of the ladder, if constructed properly, would be to allow all three ESUs access to tributaries of Mayfield Lake, particularly the Tilton River, with less handling (and presumably less stress and injury), than with the trap and haul operations although there may need to be some type of sorting facility to separate wild from hatchery stocks.

Table 12. Adult (including jacks) upstream migrants and juvenile downstream migrants, chinook salmon, coho salmon, and steelhead collected at the Mayfield fish passage facilities, 1962 through 1966.

| Year | **Chinook salmon** | | | **Steelhead** | | **Coho** | |
|---|---|---|---|---|---|---|---|
| | Spring Adults | Fall Adults | Juveniles[1] | Adults | Juveniles | Adults | Juveniles |
| 1962 | 3,738 | 2,798 | no data | 10,693 | no data | 22,701 | no data |
| 1963 | 4,799 | 5,171 | no data | 8,821 | no data | 22,083 | no data |
| 1964 | 13,617 | 10,335 | 241,448 | 11,497 | 59,064 | 25,546 | 271,387 |
| 1965 | 20,761 | 10,706 | 231,081 | 13,155 | 63,093 | 22,774 | 359,774 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1966 | 11,691 | 10,265 | 719,510 | 11,240 | 80,377 | 31,001 | 416,221 |
| avg. | 10,921 | 7,535 | 397,346 | 11,081 | 67,511 | 24,579 | 349,127 |

Source: Birchet 1962 as cited in Tacoma Power 2000; Thompson and Rothfus 1969.
[1] Includes both spring and fall chinook salmon juveniles.

Potential adverse effects of a fish ladder include the length of the ladder and the number of resting pools required (the time required to pass the ladder could be significant) and the effort required to salvage fish out of the ladder when the ladder has to be taken out of service. However, there is an existing ladder on the Clackamas River in Oregon at a dam with characteristics similar to the Mayfield Dam. Total head at Mayfield Dam is approximately 188 ft. The highest fish ladder currently in operation is approximately 190 ft high on the Clackamas River, Oregon. Most of the large fish ladders on the Columbia and Snake Rivers are between 70 and 100 ft. Since the Mayfield Dam forebay fluctuation is limited to approximately 10 ft, the upstream flow control section of ladder can be designed to accommodate this variation. Fish ladders constructed and operating on the Columbia and Snake Rivers have similar forebay fluctuations.

Another potential adverse effect is elevated temperature of the water in the ladder caused by solar radiation; however, if this proves to be a problem, the ladder could be shaded. Water temperature in the ladder should match the water temperature of the tailrace (not counting solar heating in the ladder), since both the powerhouse and ladder withdraw water from the surface of Mayfield Reservoir. This should reduce the likelihood of fish rejecting the ladder.

***Trap and Tram and Trap and Haul at the Mossyrock Dam***

Trap and haul or trap and tram fish passage at Mossyrock Dam would require similar trap facilities and have similar effects on fish. The difference between the two fish passage methods lies in the transport method, either a tram system to lift fish over the dam or transfer to a fish hauling truck to be driven around the dam for upstream release. Fish would enter a short section of ladder leading to a holding pool where they remain until transport. Transportation would be conducted a minimum of once per day, more often during the peak of the migration. Transport frequency will be specified in the operation guidelines or fish management plans for the facility.

Delay could occur as a result of either truck or tram transportation and, at this time, it is not possible to determine which method would be most effective. Using trucks to transport the adults above Mossyrock Dam may take slightly longer depending on the route and the release point. Multiple trucks or trailers can be used to rapidly move fish out of the trap (potentially reducing the overall holding time). Delays in migration from a tram system would be determined by the cycle time of the tram, as well as the operation time of the trap. A system to acclimate fish to the warmer water surface temperature in Riffe Lake will be required for a tram.

Additionally, the tram will have to be designed to be operational under the full range of forebay fluctuations in Riffe Lake. Upstream passage facilities would also be required at Cowlitz Falls Dam (operated by Lewis County PUD) which blocks passage from Riffe Lake to the Upper Cowlitz River Basin.

#### 6.3.1.2 Downstream Fish Passage

Smolts from the Tilton Basin need only pass through Mayfield Lake and its reservoir. Smolts originating in the Upper Cowlitz River Basin may pass through up to 3 dams and the respective reservoirs before reaching the lower Cowlitz River. Smolts from the Upper Cowlitz River are either collected at Cowlitz Falls and transported to the lower river or they pass through Cowlitz Falls, Mossyrock, and Mayfield Dams and the associated reservoirs. The largest barrier to downstream passage is Mossyrock Dam and its reservoir, Riffe Lake. Current downstream fish passage efforts are focused on a bypass system at Mayfield Dam and collection of smolts at Cowlitz Falls Dam for release below Mayfield Dam.

***Tilton River Fish -Mayfield Dam***
Article 2 of the Settlement Agreement requires Tacoma Power to submit within 3 years of license issuance, a study plan for improvements to downstream fish passage at Mayfield Dam. The plan will be developed in consultation with the FTC, subject to approval by NOAA Fisheries and USFWS, and will include the results of turbine mortality studies and effectiveness estimates of the existing louver system. The plan will describe the proposed facilities and measures needed to achieve the goal of 95% juvenile fish passage survival for anadromous stocks.

Tacoma Power will implement the proposed facility changes and improvements within one year of plan approval. Within 18 months of facility construction, the Licensee will submit a report detailing the effectiveness of the new facility in regards to meeting the 95% downstream fish passage survival rate criterion. If the criterion is not met, the Licensee will consult with the FTC, and NOAA Fisheries and USFWS, to develop further improvements to the facility until:

1. NOAA Fisheries and USFWS agree that FPS is high enough to support self-sustaining run(s) of anadromous fish, and/or

2. That protection of anadromous fish migrating downstream at Mayfield Dam has been maximized by all reasonable measures, and that hatchery production or habitat measures will be required in lieu of further attempts to improve juvenile collection.

The terms and conditions established in the Settlement Agreement and established in the License, along with retention of Section 18 authority to prescribe fishway prescriptions, give NOAA Fisheries authority to select mitigation measures that best meet the fisheries goals identified for the basin. The effect of achieving the 95% downstream fish passage survival rate criterion on Tilton River fish is discussed below.

***Effect of Increased Downstream Fish Passage Survival Rate on Tilton River Fish***

The number of juveniles captured, system FGE, and estimated number of fish passing through the Mayfield louver system is presented in Table 13. Note that estimates of the number of juveniles passing the Project through spillways are unavailable at this time, but this data would be collected as part of future monitoring efforts for the basin.

The data in Table 13 indicate that based on estimated FGE, 66.4% of the coho salmon, 81.4% of the spring chinook salmon, and 73.6% of the steelhead, currently arriving at Mayfield Dam enter the juvenile bypass (louver) system (Thompson and Paulik 1967). Those not guided pass through the two Project turbines.

While these FGE values are currently the best available, there is a need for a new study of FGE at Mayfield Dam. The original study, in 1964, to determine fish guidance efficiency of the downstream migrants at Mayfield Dam was conducted by Thompson and Paulik (1967). However, when this study was conducted, the Mayfield Powerhouse only had three vertical Francis turbines and average discharge through the powerhouse (and thus the louver system) was approximately 9,000 cfs during the 1964 tests. A forth vertical Francis turbine was installed in 1979 and the total plant discharge at rated conditions was increase to approximately 13,300 cfs (Harza 1996). This increase in flow through the louver system could seriously affect the fish guidance efficiency.

Table 13. Mayfield Dam downstream fish passage. Migrants captured with estimated FGE and turbine survival applied to estimate passage survival (PS) and total passage.

Table 13. Mayfield Dam downstream fish passage. Migrants captured with estimated FGE and turbine survival applied to estimate passage survival (PS) and total passage. PS% = (FGE x bypass survival) + ((1-FGE) x turbine survival)

| Year | Coho | | | | | Chinook | | | | | Steelhead | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Captured | FGE % | Est. Total Run | PS % | Est. Total Passage | Captured | FGE % | Est. Total Run | PS % | Est. Total Passage | Captured | FGE % | Est. Total Run | PS % | Est. Total Passage |
| 1995 | 374 | 66.4 | 563 | 95.3 | 537 | 317 | 81.4 | 389 | 96.5 | 376 | 2560 | 73.6 | 3478 | 95.9 | 3335 |
| 1996 | 1773 | 66.4 | 2670 | 95.3 | 2545 | 64 | 81.4 | 79 | 96.5 | 76 | 3318 | 73.6 | 4508 | 95.9 | 4323 |
| 1997 | 895 | 66.4 | 1348 | 95.3 | 1285 | 4456 | 81.4 | 5474 | 96.5 | 5283 | 329 | 73.6 | 447 | 95.9 | 429 |
| 1998 | 16747 | 66.4 | 25221 | 95.3 | 24039 | 2153 | 81.4 | 2645 | 96.5 | 2553 | 6476 | 73.6 | 8799 | 95.9 | 8437 |
| 1999 | 8006 | 66.4 | 12057 | 95.3 | 11492 | 86 | 81.4 | 106 | 96.5 | 102 | 2893 | 73.6 | 3931 | 95.9 | 3769 |
| 2000 | 23535 | 66.4 | 35444 | 95.3 | 33783 | 62 | 81.4 | 76 | 96.5 | 74 | 3528 | 73.6 | 4793 | 95.9 | 4596 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | 82215 | 66.4 | 123818 | 95.3 | 118013 | 618 | 81.4 | 759 | 96.5 | 733 | 7447 | 73.6 | 10118 | 95.9 | 9702 |
| 2002 | 11675 | 66.4 | 17583 | 95.3 | 16759 | 19282 | 81.4 | 23688 | 96.5 | 22862 | 2050 | 73.6 | 2785 | 95.9 | 2671 |
| 2003 | 38892 | 66.4 | 58572 | 95.3 | 55826 | 10825 | 81.4 | 13299 | 96.5 | 12835 | 4790 | 73.6 | 6508 | 95.9 | 6241 |
| Mean | 20457 | 66.4 | 28732 | 95.3 | 27385 | 4207 | 81.4 | 1361 | 96.5 | 1314 | 3710 | 73.6 | 5154 | 95.9 | 4942 |
| *Assumes 90% turbine survival, 98% bypass survival, no spillway passage | | | | | | | | | | | | | | | |

The juvenile marking program at Mayfield Dam was just recently implemented and data on adult returns is sparse. Because data on the number of fish passing the spillway, their survival rate, and the survival rate of fish entering and passing through the juvenile collection system is currently unknown, the overall increase in fish production resulting from improvements to this system cannot be estimated with precision. The specific effects to juveniles due to reservoir migration is unknown, but could include loss and/or migration delay. It is expected that the improvements to fish passage at Mayfield Dam and the adaptive management associated with the proposed action will result in conditions which will support the reestablishment of listed fish above the Project.

***Upper Cowlitz River Fish - Cowlitz Falls/Riffe Lake/Mossyrock Dam***
Article 1 of the Settlement Agreement requires Tacoma Power to submit within 6 months of license issuance, a plan for downstream fish passage and collection facilities at Riffe Lake and Cowlitz Falls Dam. The Licensee is required to prepare this plan in collaboration with, and subject to approval by, NOAA Fisheries and USFWS. The plan will describe the proposed facilities and measures most likely to achieve the goal of 95% FPS.

FPS is defined in the Settlement Agreement as follows: "Fish Passage Survival (FPS) as used in proposed License Article 1 and applied to Cowlitz Falls Dam, Riffe Lake, and Mossyrock Dam, means the percentage of smolts entering the upstream end of Scanewa reservoir, and adjusted for natural mortality, that are collected at Cowlitz Falls Dam and Riffe Lake and Mossyrock Dam, that are transported downstream to the stress relief ponds, and subsequently leave the stress relief ponds at Barrier Dam as healthy migrants."

If the FPS criterion is not met within 18 months of construction of the new facilities, Tacoma Power is required to file an amended plan describing the new measures or facilities proposed by NOAA Fisheries and USFWS to meet the 95% standard. These new facilities would be constructed upon approval of the designs by NOAA Fisheries and USFWS. This process would continue until the Licensee has employed the best available technology and achieved at least a 75% FPS for all species.

***Effect of Increased FPS on Upper Cowlitz River Fish***
Anadromous fish reestablishment efforts in the Upper Cowlitz River started in the mid-1990s and continue through the present. The program uses both hatchery origin adults and juveniles to seed the upper basin. Currently, juvenile salmonids emigrating from the Upper Cowlitz River Basin are collected at Cowlitz Falls Dam and transported by truck to stress relief ponds. At the stress relief ponds, fish are held for 24 hours with the screen in place, and then for 24 hours with the screen removed and the water lowered about eight inches allowing fish to volitionally move out. After that the remaining boards are removed and the water level is lowered. The fish that are still present are then flushed into the channel and released into the Cowlitz River below Barrier Dam. Fish not collected at Cowlitz Falls Dam pass through Project spillways and turbines and enter Riffe Lake. Due to observed difficulties of smolts migrating the long reservoir, high predator densities, and the 200 ft depth of the Mossyrock Dam intake, these

smolts have generally been considered lost. However, studies conducted during relicensing showed that few juveniles were able to migrate successfully through the 23.5-mile reservoir,[15] but recently there were a number of juvenile chinook salmon at Mayfield whose origin was believed to be above Cowlitz Falls.[16]

Survival of fish not collected at Cowlitz Falls is unknown (but believed to be extremely low). Juveniles not collected at Cowlitz Falls Dam that do survive are assumed lost to anadromy. While some may become landlocked, this is still considered lost as these fish are not able to contribute to the reproductive cycle. Because of this assumption, the fish collection efficiency (FCE) of the juvenile collector at this dam can be used as a surrogate for FPS.[17] The number of juveniles captured, system FCE, and estimated number of fish arriving at Cowlitz Falls Dam since 1997 is presented in Table 14.

---

Tacoma Power 2000. 1999 Technical Study Reports. Cowlitz River Hydroelectric Project FERC No. 2016. Riffe Lake Smolt Behavior Study.

16 Those fish traveled through the Cowlitz Falls project, through Riffe Lake and the Mossyrock development, and through Mayfield Reservoir.

17 This assumption is conservative - meaning that there may actually be a higher survival if some fish that are not collected make it through the system.

Table 14. Annual number of juveniles collected, fish collection efficiencies (FCE), and estimated number of steelhead, coho salmon, and chinook salmon arriving at Cowlitz Falls Dam (1997-2002). Source: Serl and Morrill 2002.

| | Steelhead | | | Coho | | | Spring Chinook | | |
|---|---|---|---|---|---|---|---|---|---|
| | Captured | FCE | Total | Captured | FCE | Total | Captured | FCE | Total |
| **1997** | 18,435 | **45%** | 40,967 | 3,673 | **21%** | 17,490 | 22,815 | **17%** | 134,205 |
| **1998** | 41,634 | **19%*** | 219,126 | 109,974 | **32%** | 343,669 | 14,917 | **18%** | 82,872 |
| **1999** | 20,815 | **41%** | 50,768 | 15,120 | **17%** | 88,941 | 8,878 | **24%** | 36,992 |
| **2000** | 33,516 | **65%** | 51,563 | 106,880 | **45%** | 237,511 | 32,704 | **24%** | 136,267 |
| **2001** | 56,199 | **58%** | 96,895 | 334,718 | **42%** | 796,948 | 36,475 | **23%** | 158,587 |
| **2002** | 28,955 | **56%** | 51,705 | 55,028 | **33%** | 166,752 | 26,328 | **22%** | 119,673 |
| | | | | | | | | | |
| Mean | 33,259 | **47%** | 85,171 | 104,232 | **32%** | 275,219 | 23,686 | **21%** | 111,433 |

* There was poor retention of PanJet marks this year and the actual FCE value is believed to be higher.

The Settlement Agreement requires the Licensee to achieve a system that meets the FPS from a minimum of 75% to a maximum of 95%. The estimated effect on adult returns of achieving these FPS is illustrated in Table 15.

***Likelihood of achieving target FPS values***

The data in Table 14 indicate that, based on estimated FCE, only 47% of steelhead, 32% of coho salmon, and 21% of spring chinook salmon currently arriving at Cowlitz Falls Dam are captured and transported to the lower Cowltiz River. The percentage change in the number of juveniles collected and transported under the minimum 75% FPS performance standard scenario ranges from 60% (steelhead) to 258% (spring chinook salmon). Achieving the 95% FPS performance standard results in an increase of 102% to 353%, for these same species.

There appears to be an improving trend in FPS and studies continue. Studies by the USGS-Columbia River Research Lab using radio-tagged fish in 2003 suggest that further improvement is possible. Preliminary data indicates that the proportion of radio-tagged fish attracted to, but not necessarily entering, the bypass system (approaching within a few meters) were 81% for steelhead and 56% for chinook salmon age 0+ smolts (Perry, R., USGS, Columbia River Research Laboratory, personal communication to B. Bellerud, NOAA Fisheries, on December 16, 2003). Values for coho salmon are believed to be similar for those observed by steelhead. It should be noted that NOAA Fisheries has retained Section 18 authority to prescribe changes to fish passage structures at the Project.

Table 15. Observed and estimated number of adult returns from 1999-2002 under the 75% and 95% performance standards for fish passage survival (assumed to be equal to collection efficiency at Cowlitz Falls Facility).

| FPS | Steelhead | Coho | Spring Chinook |
|---|---|---|---|
| Observed | 413 | 2,956 | 229 |
| 75% FPS | 659 | 6,927 | 819 |
| 95% FPS | 834 | 8,775 | 1,037 |

### 6.3.2 Hatchery

Current levels of hatchery production in the Cowlitz River Basin are undergoing ESA consultations between NOAA Fisheries and WDFW. Artificial propagation activities in this new License that will be proposed as part of the FHMP, the Remodeling and Phase-In Plan and the Disease Management Plan,[18] will undergo a separate ESA consultation as these are not at a far enough stage to give a full picture of the proposed action on which to consult. Any future hatchery consultation will be in the overall context or to meet the goal of reestablishing self-sustaining population levels consistent with a viable ESU scenario. In other words, a viable population of spring chinook and a contributing population of steelhead would need to be established above the Cowlitz River projects. When the plan is updated, NOAA Fisheries will be consulted to determine if reintitiation of the consultation is warranted, pursuant to which NOAA Fisheries will consider the potential for both beneficial and adverse effects to listed species. This section generally considers the direct and indirect effects to listed species that may result from hatchery mitigation actions.

Scientific knowledge regarding the benefits and risks of artificial propagation is incomplete, but improving. Artificial propagation techniques and strategies have proven effective in many cases at alleviating near-term extinction risks, yet the potential long-term benefits of artificial propagation as a recovery tool for depleted salmon populations are unclear. The same issues apply to programs supporting the reestablishment of salmon and steelhead into historical habitat. Hatchery-based artificial propagation techniques may provide benefits to fish populations, both ESA-listed and unlisted, by several mechanisms, including: reducing the risk that a population on the verge of extirpation will be lost by expeditiously boosting the number of emigrating juveniles in a given brood year, preserving or increasing the abundance of salmonid populations while other factors causing decreased abundances are addressed, accelerating the recovery of populations by increasing abundances in a shorter time frame than may be achievable through natural production, increasing the "nutrient captial" in the freshwater ecosystem supporting natural salmonid populations by increasing the numbers of decomposing salmonid carcassess in a watershed, establishing a reserve population for use if the natural population suffers a catastrophic loss, seeding vacant habitat by reintroducing populations to streams where indigenous populations

18 Timelines for Tacoma Power to submit these plans: FMHP within 9 months of license issuance, the Remodeling and Phase-In Plan within 18 months, and Disease Management Plan within 5 years.

have been extirpated while the causes of extirpation are being addressed, and collecting and providing new scientific information regarding the use of supplementation in conserving natural populations.

Potential negative effects of artificial propagation on naturally produced populations include effects on the genetic and ecological health of natural populations, effects of fisheries management, and the potential to mask the status of naturally producing stocks which affects public policy and decision making. Existing and ongoing ESA Section 7 consultations concerning artificial propagation evaluate the risk of 11 generic effects on listed species, which are: 1) operation of hatchery facilities, 2) broodstock collection, 3) genetics, 4) diseases, 5) competition/density dependent effects, 6) predation, 7) residualism, 8) fisheries, 9) masking, 10) nutrient cycling, and 11) monitoring and evaluation.

### 6.3.3 Minimum Flows

Under the proposed action, Project operations provide several improvements in flow regulation downstream from Mayfield Dam. These modifications and the effects on the ESUs downstream from the Project are discussed based upon seasonal fish species and life stage use below.

<u>December through June</u>
This season includes much of the incubation, emergence, and early fry life stages of LCR chinook salmon (both fall- and spring-run fish) and spring-run emigration; the principal period for LCR steelhead spawning, incubation, and emergence; and the principal season of CR chum salmon juvenile emigration. Both chinook salmon and steelhead juveniles would be rearing during this period. Chum salmon, which spawn in November and December and have an ocean-type life history and remain inland for only a few weeks to a few months post-emergence, would be near the end of their spawning season in December and would incubate, emerge, and emigrate during this period. LCR/SW coho salmon display a broad range of life-history strategies. This period would typically include most of the coho salmon incubation and emergence life stages. Peak spawning activity for late run coho salmon (Type-N) also typically occurs during this period. This is also the season of peak juvenile coho salmon emigration.

The proposed action provides a specified minimum flow throughout this season of 5,000 cfs with weekly 12-hour pulses of 8,000 cfs from February through May (Table 1). The environmental baseline instream flow schedule specified the provision of flows sufficient to cover established redds, a difficult to quantify amount, in January and February, and 5,000 cfs from March through May (Table 6). The proposed action will reduce the impairment of habitat conditions for all affected life stages of listed ESUs caused by historical storage patterns of the Project and will be particularly helpful for outmigrating spring-run chinook salmon, coho salmon, and chum salmon juveniles. Juvenile salmon appear to key on several environmental variables for the timing of smoltification and outmigration, including accumulated temperature units (i.e., degree days) and flow (Groot and Margolis 1991). The 8,000 cfs pulses are intended to stimulate the outmigration response in these juvenile fish.

July through September
This is the principal season for spring-run LCR chinook salmon spawning and adult immigration and early spawning of fall-run LCR chinook salmon. During this season, LCR chinook salmon, LCR steelhead, and LCR/SW coho salmon juveniles would be rearing. Fall chinook salmon juvenile emigration, which occurs over a broad period from June through December, tends to peak during this season. Early run coho salmon (Type-S) enter the river during this period and may initiate spawning.

The proposed action provides a minimum discharge of 2,000 cfs through August 14 and flows between 2,000 and 5,000 cfs depending on antecedent flow conditions and fish spawning activity (Table 1). This minimum flow regime is intended to mimic natural low summer flow conditions to protect juvenile rearing and spawning LCR chinook salmon and LCR/SW coho salmon. An important aspect of this flow regime is an effort to avoid higher discharge rates of a sufficient duration to encourage chinook salmon spawning in channel areas that would be difficult to keep watered throughout incubation and emergence. In the event that spawning does occur during higher flows in areas that would be subsequently dewatered by reducing discharge, Tacoma Power would operate the Project to maintain redd coverage through emergence.

October through November
This is the primary season for LCR fall-run chinook salmon, CR chum salmon, and early run LCR/SW coho salmon spawning. LCR spring-run chinook salmon also spawn through October. Thus the proposed flow management for this season focuses on the provision of flows necessary to provide adequate spawning opportunity and to prevent subsequent dewatering of established redds.

A minimum flow of 3,500 cfs will be supplied to provide adequate spawning habitat from October 1 through November 20. In the event that the highest 5-day average flow between August 15 and September 30 equalled or exceeded 5,000 cfs, Tacoma Power would provide flows that provide no more than 8 inches less stage than was provided by that average flow or 5,000 cfs, whichever is less. From November 21 through 30, the maximum 5-day average test and 8-inch stage reduction limit would apply for all redds established during active spawning, or 5,000 cfs, or a lesser amount as may be authorized by the FTC.

This fairly complex set of rules would provide 1,000 cfs more flow at the lowest level (3,500 cfs under the proposed action as compared to 2,500 cfs caused by historical Project storage in the environmental baseline). It also provides greater surety that established redds would be protected throughout incubation.

### 6.3.4 Flow Fluctuations

The Mossyrock development will continue to be operated in a load-following or power- peaking mode. The Mayfield development will typically be operated at a constant pool elevation so flow fluctuations caused by the Mossyrock development are passed downstream. By managing Project operations to avoid changes in river stage downstream from Mayfield Dam in excess of those specified in Table 2, the proposed action will limit the potential for entrapment and stranding of juvenile salmon. For example, no ramping down will occur during daylight hours from February 16 - June 15. The potential for stranding tends to be greatest shortly after emergence, when young-of-year fish inhabit and are reluctant to leave shallow areas near channel margins. This period extends from around April through July in the Cowlitz River.

The Project will continue to result in unnaturally frequent flow fluctuations downstream from Mayfield Dam due to load-following operations. Such flow fluctuations have been shown to cause chinook salmon redd abandonment and egg death in the lower Cowlitz River under the environmental baseline. There is no evidence that Project operation in compliance with the ramping rate limits included in the proposed action would avoid or minimize this Project impact. The proposed action addresses this issue through the fish monitoring plan and adaptive management program.

### 6.3.5 Fish Monitoring Plan

The proposed action includes the development of a fish monitoring plan to evaluate the effects of the instream flow requirements, including: minimum flows, pulsing or channel maintenance flows, and ramping rates on the fish in the Cowlitz River. This will be an integral part of the adaptive management program for ensuring the adequacy of Project operations as licensed and for defining any needed modifications in Project operations. In the event that the fish monitoring plan indicates that operating the Project as licensed is inadequate to protect Cowlitz River fish, FERC and WDOE separately reserve the right to require modifications to the flow regime, either on their own motion, or upon the request of State or Federal resource agencies. NOAA Fisheries believes that this adaptive management approach is an excellent way to deal with issues of this nature and expects that timely response by FERC to requests for modifying operating criteria would reduce any adverse effect of operating the Project as proposed in the amended license order.

### 6.3.6 Flood Control and Peak Flow Reduction

Project operation for flood control is unchanged by the proposed action and the effect remains as described in Section 5 of this Opinion. The effects of flood control will continue throughout the life of the new License. These effects are both beneficial and detrimental to anadromous fish. By reducing peak flows, flood control reduces the potential for redd scour and LWD and gravel flushing. This would also benefit anadromous fish by increasing the life of gravel and LWD augmentation measures. However, by reducing the potential for channel avulsion and gravel transport, flood control may adversely affect anadromous fish by reducing the rate and extent of habitat formation and rejuvenation. Reducing the magnitude of non-damaging, short-return-interval peak flows will also continue to diminish side-channel formation. Side channels are important juvenile salmonid habitats, and loss of these habitats would continue to affect this life stage throughout the life of the License.

The Clean Water Act Section 401 certification issued by WDOE for this Project includes a requirement for Tacoma Power to monitor an array of side channels to determine if the flow regime is adequate to maintain side-channel habitat. In the event that side-channel habitat is not adequately maintained by the proposed action, WDOE would modify the flow requirements of the 401 certificate as appropriate.

NOAA Fisheries concludes that continued flood control operation of the Project, particularly the substantial reduction in peak flows from lesser return-interval floods (e.g., 2- and 5-year floods) may reduce the availability of side-channel habitat.

#### 6.3.7 Sediment and Spawning Gravel Augmentation

The Project reservoirs will continue to be a major sink for incoming sediments, capturing an average of 1,000,000 cy annually. The loss of sediment, particularly gravel- and cobble-sized particles, will continue to reduce spawning opportunity downstream from Mayfield Dam. However, the reduction in sand and finer particles will also reduce the rate that existing gravel lenses become embedded with fines, a factor that has been shown to be detrimental to salmonid reproduction by reducing interstitial flow.
The proposed action includes the development of a plan to augment spawning gravel downstream from the Barrier Dam located approximately 2 miles downstream from Mayfield Dam. The effectiveness of gravel augmentation efforts tends to be highly variable. Even at the relatively low discharges expected under the proposed action, sufficient tractive force to initiate and maintain particle movement would likely occur in much of the channel. It is likely that gravel placed in the stream downstream from the Barrier Dam will be redistributed and may be transported out of the reach by hydraulic conditions that vary throughout the stream reach. Gravel will likely need to be replenished frequently, particularly after high flow events. Nonetheless, scattered areas of suitable spawning gravel deposition would be likely persist for a sufficient length of time to facilitate spawning activity. This measure will likely substantially enhance spawning opportunity in the stream reach between the Barrier Dam and the Cowlitz Trout Hatchery where geomorphic conditions change and access to suitable gravel is less limiting. This measure will likely reduce the impairment of downstream habitat for LCR chinook salmon, LCR steelhead, and CR chum salmon populations that has historically resulted from the presence of the Project. Tacoma Power would monitor the effectiveness of its gravel augmentation efforts throughout the life of the License.

NOAA Fisheries concludes that the spawning gravel augmentation program would provide an adequate the loss of sediment supply from upstream areas and that spawning substrate would likely be properly functioning under the proposed action.

#### 6.3.8 Large Woody Debris

The reservoirs will also continue to intercept virtually all LWD generated in upstream areas. The loss of LWD will continue to reduce the formation of isolated, low-velocity, pool-type microhabitats that have been shown to be very important for rearing juvenile stream-type anadromous fish (e.g., LCR spring-run chinook salmon, steelhead, and coho salmon).

By providing a life-of-license LWD augmentation program to supplement LWD in the lower Cowlitz River, the proposed action will enhance both juvenile rearing habitat and adult resting habitat and will enhance habitat-forming processes throughout the life of the License. This measure is expected to enhance juvenile survival, benefitting LCR chinook salmon (particularly the spring-run population), steelhead, and coho salmon populations that spawn downstream from Barrier Dam. NOAA Fisheries concludes that the LWD habitat element will be improved under the proposed action.

#### 6.3.9 Adaptive Management

The License proposes to refine existing efforts to reestablish listed salmonids above the Mayfield, Mossyrock, and Cowlitz Falls Dams. The goal of these efforts is to reestablish indigenous stocks of chinook salmon, steelhead, coho salmon, and sea-run cutthroat trout upstream of the dams. As stated in the May 8, 2000, Agreement in Principle for the Cowlitz Settlement Agreement, "The emphasis of this agreement in principle is ecosystem integrity and the recovery of wild, harvestable salmonid runs."

The Willamette and Lower Columbia Basin Domain Technical Recovery Team developed recommendations that address the question of how many and which populations need to be restored to various levels of health for the ESU to be considered recovered. In applying those recommendations, the Lower Columbia Fish Recovery Board has determined that to meet the WLCTRT's guideline, viable populations of spring chinook and a contributing population of steelhead need to be above the Cowlitz River Projects (a contributing population is one whose status needs to improve but not to the level of viability). Reestablishment of anadromous salmonids to the Upper Cowlitz basin and Tilton River is critical to the viability of Cowlitz River anadromous salmonids, and the recovery of the Lower Columbia River chinook and Lower Columbia River steelhead. Therefore, to avoid jeopardy, reestablishment with sufficient protection to achieve the goal, i.e., effective passage, must occur.

Indigenous hatchery stocks will be used for at least a portion of the restoration efforts. Adults and juveniles will continue to be transported and released above the dams with the adults spawning there and the juveniles rearing in this upstream area before smolting and moving downstream. Mortalities are expected among downstream migrating smolts (and potential adult fallbacks) as they move through the projects via turbine and reservoir migration. Passage survival performance standards (e.g., FPS) have been set at levels that are expected to allow for a sustainable population above the dams. Other protective measures have also been set (e.g., a flow regime in the lower river).

Uncertainties and unrealized passage performance targets will remain for many years. Continued monitoring and possible modification of procedures, methodology, and facilities or construction of new facilities are required to ensure the success of the reestablishment efforts. In the assessment of the effects of the proposed action, NOAA Fisheries assumes adaptive management will occur because it is in the Settlement Agreement and license articles. Since portions of the adaptive management do not provide many details in the Settlement Agreement, NOAA Fisheries is providing further elaboration based on our understanding of how it will be incorporated in this proposed action.

Adaptive management must occur to ensure the overall goal of "reestablishing viable populations of spring chinook and a contributing population of steelhead" is met within the bounds of the Project effects. Adaptive management is best described as setting objectives, defining management actions designed to achieve those objectives, implementing those actions, monitoring and evaluating the outcomes, and making changes in management actions in response to new information. The WLCTRT recommended that population status be monitored and evaluated based on the following population parameters: 1) adult productivity and abundance, 2) juvenile outmigrant growth rate, 3) within-population diversity, 4) habitat, and 5) within-population spatial structure (WLCTRT 2003). The final recovery plan will include population specific goals for each of these parameters.

Adaptive management will occur to ensure viable populations of spring chinook and a contributing population of steelhead are established above the Cowlitz River Projects. To guide and inform this process, an overall plan must be developed by Tacoma Power in cooperation with or involvement of the FTC and submitted to NOAA Fisheries for final approval. Among other factors, the plan will consist of annual and periodic monitoring and reporting of factors critical to the success of reestablishment. Results of the monitoring will allow us to modify any piece of the equation in the future to meet our population goals. Some examples include: the FPS criteria may need to be modified in the future or the decision whether or not to construct a ladder at Mayfield.

Tacoma Power will prepare and submit to the FTC, including NOAA Fisheries, an annual report throughout the life of the license, including all of the metrics identified in the overall plan, no later than July 18. The report must include a summary of all available factors or metrics to facilitate the evaluation.

Reviews of reestablishment success will be conducted annually, with major reviews at three and five years following issuance of this Opinion and every five years after that, for the duration of the license. NOAA Fisheries and the FTC will conduct an annual review of reestablishment success or progress to date with more in depth reviews occurring at years 3 and 5, and every 5 thereafter. Upon identification of a significant shortfall in expected performance (as specified in this Opinion, in further adaptive management, or that necessary to obtain the overall goal), corrective actions must occur. One option to resolution of a significant shortfall may be that the FTC has reviewed and proposed a response that meets NOAA Fisheries' approval. Another course of action may be that Tacoma Power will be notified by a deficiency letter from NOAA Fisheries to submit a corrective action plan and implementation schedule subject to NOAA Fisheries review and approval.

If the FTC through adaptive management does not resolve issues/problems and if NOAA Fisheries and the licensee are not able to come to an agreement regarding the appropriate corrective actions required to meet the performance levels established in this Opinion, then FERC will reinitiate consultation.

For illustrative and guidance purposes, potential factors or metrics that may be monitored are shown in Table 17. These focus on passage standards. Expansion to other areas of project related impacts is expected. Adult upstream passage metrics and kelt passage metrics would be evaluated over several years to capture the range of environmental conditions and would be completed before the 5-year evaluation. Juvenile salmonid downstream passage factors would be measured over several years to capture the range of environmental conditions and would be completed before the 3-year evaluation.

All study and evaluation plans will include FTC involvement and should be reviewed and approved by NOAA Fisheries before implementation. Past study reports will be reviewed by NOAA Fisheries before being accepted for use in passage evaluation. We expect that the FTC will review the reports and assess whether or not monitoring components should be removed, added, or changed in frequency e.g., some monitoring currently identified as annual may be discontinued if shown not to be necessary, with NOAA Fisheries approval. All studies must be conducted in a statistically valid manner. Where appropriate, some evaluations may consist of indices. Factors must be re-evaluated if significant modifications are made to facilities, operations, or procedures.

Table 17. Factors to be Monitored.

| Factor | Specific Metric | Minimum Interval | Locations |
|---|---|---|---|
| **Adult upstream passage** | | | |
| **Adults transported** | transport count by species, life history, date of transport, transport destination | Annual | All trap sites |
| **Trapping effectiveness** | trap efficiency (% of total potential upstream migrants captured) | 3 years | All trap sites |
| | Trap and hauling capacity | Once[1] | All trap sites |
| **Handling survival** | Trap survival | Annual | All trap sites |

| | | | |
|---|---|---|---|
| | Hauling survival | Annual | All trap sites |
| | Release survival | Annual | Tilton and Upper Cowlitz basins |
| **Spawning success of transported fish** | Fallback rate of transported fish | Annual | Tilton and Upper Cowlitz basins |
| | pre-spawning mortality | Annual | Tilton and Upper Cowlitz basins |
| | Number of fish hauled vs redd counts | Annual | Tilton and Upper Cowlitz basins |
| **Spawning rate** | Redd counts | Annual | Tilton and Upper Cowlitz basins |
| **Juvenile Salmonids downstream passage** | | | |
| **Reservoir Survival** | Reservoir mortality upstream of collection site | 3 years (repeated if predator index indicates significant change) | Mayfeild, Cowlitz Falls and Mossyrock reservoirs |
| | Predator Index | 3 years and every 5 years after that | Mayfeild, Cowlitz Falls and Mossyrock reservoirs |
| **Trap effectiveness** | Collection efficiency (estimate of percent of migrants entering the trap) | 3 years | All juvenile trap sites |
| | Trap and handling survival | Annual | All juvenile trap sites |
| **Dam passage survival** | Turbine passage survival | Once[1] Various species/sizes. Direct and indirect components | Mayfield, Mossyrock Dams |
| | FGE and Bypass efficiency | 3 years Various species /sizes. Range of powerhouse/reservoir operation | Mayfield Dam |
| | Spill survival | Once[1] Various species/sizes. Direct and indirect components | Mayfield Dam, Mossyrock Dam |

| | | | |
|---|---|---|---|
| **Smolt Production** | Smolt production by species, life history, location, origin (hatchery or wild) | Annual | Tilton, Upper Cowlitz |
| **Steelhead kelts downstream passage** | | | |
| **Reservoir survival** | Reservoir mortality upstream of collection site | 3 years | Mayfeild, Cowlitz falls and Mossyrock reservoirs |
| **Trap effectiveness** | collection efficiency (estimate of percent of migrants entering the trap) | 3 years | All downstream trap sites |
| | trap and handling survival | Annual | All downstream trap sites |
| **Dam Passage survival** | turbine survival | Once[1] | Mayfield, Mossyrock Dams |
| | FGE and Bypass efficiency | 3 Years (Direct and indirect components) | Mayfield Dam |
| | spill survival | Once[1] (Direct and indirect components) | Mayfield Dam, Mossyrock Dam |
| **Kelt rate** | Number of Kelts by basin | Annual Enumeration | Upper Cowlitz, Tilton |
| **Fish Passage Facility Operations** | | | |
| **Operations and maintenance of all fish passage facilities** | Proper operation of facilities within established criteria | Annual. Inspection/compliance reports every 2 weeks during the fish passage season | All fish passage facilities |

[1]Modification of facility or procedures requires a new study

### 6.3.10 Construction Activities

Future construction activities (e.g., juvenile collectors, etc.) may cause impacts including, but not limited to, disruption to the waterway and introduction of sediment and other materials. NOAA Fisheries expects that construction activities will follow best management practices for the protection of fish including conducting in-water work during seasons that will minimize impacts to fish, maintaining fish passage during construction, minimizing impacts to riparian areas, and preventing or controlling erosion and pollution input to streams.

### 6.3.11 Fisheries Habitat Fund

The Fisheries Habitat Fund ($3 million) will be used for fisheries habitat protection, restoration, and enhancement through acquisition, easements, or restoration projects. Because no specific activities are proposed, it is impossible to evaluate the effects of habitat protection and enhancement. To the extent that these activities may affect listed salmon and steelhead in a manner not considered in this Opinion or their critical habitat, subsequent consultation wil be necessary before the project action can proceed. Although specific effects of this activity are unknown, it is likely that the habitat program will cumulatively result in protection of currently productive habitat (i.e., no change from baseline conditions) or improvement of currently impaired habitat (i.e., an improvement over baseline conditions). The highest priority of this fund is given to acquisition or conservation easements of riparian habitat along side channels below Barrier Dam.

## 6.4 Indirect Effects

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action. If they are reasonably certain to occur, indirect effects may include other Federal actions that have not undergone Section 7 consultation, but will result from the action under consideration. No indirect effects have been identified from the proposed action.

## 6.5 Summary of Project Effects Analysis (Table 16)

In the PFC framework, baseline environmental conditions are described as “properly functioning,” “at risk,” or “not properly functioning.” If a proposed action would be likely to impair properly functioning habitat (Impair), appreciably reduce the functioning of already impaired habitat (Reduce), or retard the long-term progress of impaired habitat toward PFC (Retard), it will usually be found likely to jeopardize the continued existence of the species or adversely modify its critical habitat or both, depending on the specific consideration of the analysis. Such considerations may include for example the species’ status, the condition of the environmental baseline, the particular reasons for listing the species, any new threats that have arisen since listing, and the quality of available information. Actions which do not compromise a species' biological requirements to the degree that appreciably reduces the species' viability and chances of survival in the action area are considered not to reduce or retard (NR).

As described in Section 5, the project has historically represented a partial or complete barrier or juvenile and adult passage and some populations above the Project have been extirpated. Passage improvements and reintroductions proposed in the License, if successful, would result in properly functioning passage and partially mitigate for extirpation of upstream populations. Reestablishment of anadromous salmonids above the Project is dependent on the success of upstream and downstream passage measures described in the License. Upstream fish passage above the Cowliz Falls project remains dependent on trap and haul operations for at least the next 5-15 years. These measures have established some level of natural production in the Upper Cowlitz River Basin, most successfully for coho salmon. Spring chinook salmon and steelhead production above the Project is supplemented by outplants of hatchery juveniles. Reestablishment of fall chinook salmon has started recently and there are no plans for transporting chum salmon. Construction of volitional fish passage facilities is dependent on trap and haul operations establishing self-sustaining populations.

Successful reestablishment of salmonids to the Upper Cowlitz River Basin is also dependent on the Licensee achieving passage performance standards described in the License. This is most critical for populations in the Upper Cowlitz River where low FPS may inhibit the establishment of self-sustaining populations. Current levels of FPS seem likely to retard the reestablishment of listed salmonids in the upper basin (Retard). The only species to approach self-supporting levels in the Upper Cowlitz River is coho salmon, for which the number of adults transported to the upper basin exceeded other species (Table 12). Passage at Mayfield Dam affects primarily reestablishment efforts in the Tilton River. Current estimates of passage survival at Mayfield Dam seem unlikely to limit reestablishment of anadromous salmonids in the Tilton River and the downstream fish passage survival standards that the License requires of the Licensee lend further support to this analysis. However, some critical uncertainties, such as bypass survival, remain, although fish passage measures proposed in the License at Mayfield Dam appear to be unlikely to reduce or retard the reestablishment of listed salmonids above the dam (NR).

This analysis assumes that current FPS will continue for up to 3 years, then reach the 75%-95% FPS specified in the Settlement Agreement. Present FPS levels, especially for chinook salmon, appear too low for establishing self-supporting populations in the Cowlitz River above Cowlitz Falls Dam. Continuation of the current levels of FPS for listed salmonids above Mossyrock Dam is likely to retard restoration of self-supporting populations above the dam (Retard). If the FPS standard of 75%-95% described in the License is acheived downstream fish passage past Mossyrock Dam is unlikely to retard restoration of self-supporting populations above the dam (NR).

Reestablishment of anadromous salmonids in the Upper Cowlitz River Basin would reduce the negative effects on listed salmonids caused by the Project blocking access to the upper basin. The viability of salmonid populations in the Cowlitz basin would be improved through increased distribution and production. These efforts are dependent on the efficacy of upstream and downstream passage efforts described in the License. NOAA Fisheries' analysis suggests that reestablishment efforts may be limited by the efficiency of trap and haul operations and current passage survival levels (and the time required to reach passage survival targets specified in the License) for fish in the Upper Cowlitz River.

Water management to maximize power production and control floods will continue to negatively affect fish and fish habitat downstream from Mayfield Dam through unnatural streamflow conditions (e.g., seasonal flow reductions and increases and rapid flow fluctuations). Through measures taken to improve flow-related habitat functions (e.g., minimum flows and ramping rates), those effects will be less than they were under the historical project operations. Available information suggests that those improvements would also be adequate to avoid reducing the functioning of impaired habitat or retarding return to properly functioning condition. This conclusion is based in part on the adaptive management program, which would help identify any inadequacy and define appropriate remedial actions. Through these actions and other efforts to enhance aquatic habitat downstream from Mayfield Dam, notably the LWD program and physical improvements in side-channel habitats, the negative effects of hydrologic alteration appear to be insufficient to significantly retard the return of important downstream habitats to properly functioning conditions (NR).

Gravel supplementation and LWD transport program are unlikely to totally mitigate the effects of the Project blocking transport of substrate and LWD and the resulting effects on channel morphology and substrate composition. However, it is unlikely that the function of already impaired habitat below the Project will be reduced. If the programs are successful, some improvement in habitat condition downstream of Mayfield Dam will be achieved, improving the chances of the habitat returning to properly functioning condition (NR).

Avoiding negative effects of construction and fish habitat improvement projects both depend on those projects following protocols which limit or eliminate those impacts. The extent of potential positive effects of these actions is not possible to analyze at this time because the actions are not fully described, but the overall outcome will be beneficial.

Table 16. Analysis of Project effects. Summary of effects of proposed action on Cowlitz River listed salmonids. IMPAIR = impair properly functioning habitat; REDUCE = appreciably reduce the functioning of already impaired habitat; RETARD = retard the long-term progress of impaired habitat towards properly functioning condition; NR = not reduce, retard, or impair/ NPF = baseline not properly functioning; AR = baseline at risk; PFC = baseline properly functioning conditioning.

| Project Feature | Effects | ESU | Life Stage | Effect Pathway/ Indicator | Baseline Status with Historical Project Effects | Summary Effect |
|---|---|---|---|---|---|---|
| Mayfield Dam | Partial upstream and downstream barrier | All | Adult, smolt | Barrier | NPF | NR |
| Mossyrock Dam | Partial downstream barrier, near term (next 3 years) | All except CR chum | Adult, smolt | Barrier | NPF | RETARD |
| Mossyrock Dam | Downstream barrier, future (after 3 years) | All except CR chum | Adult, smolt | Barrier | NPF | NR |
| Mossyrock Dam | Upstream barrier | All except CR chum | Adult, smolt | Barrier | NPF | NR |
| Mayfield and Mossyrock Dams | Large Woody Debris and Substrate transport inhibition (Partially mitigated by LWD and substrate enhancement) | All | All | Large Woody Debris, Substrate | NPF | NR |
| Mayfield and Mossyrock Dams | Ramping | All | Juvenile egg | Altered Flows | NPF | NR |
| Mayfield and Mossyrock Dams | Minimum flows | All | Juvenile,egg | Altered Flows | AR | NR |
| Mayfield and Mossyrock Dams | Seasonal Flows | All | Smolt, juvenile, egg | Altered Flows | AR | NR |
| | | | | | | |
| Mayfield and Mossyrock Dams | Construction effects dams-fish passage facility construction | All | All | Sediment, contamin-ants | | NR |
| Fish Habitat Restoration Fund | Restore degraded fish habitat | All | All | Habitat Condition | NPF | NR |

## 7. CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR §402.02 as "those effects of future State, tribal, local or private actions, not involving Federal activities, that are reasonably certain to occur in the action area and considered in this biological opinion." Future Federal actions, including the ongoing operation of hatcheries, fisheries, and land management activities, are not considered within the category of cumulative effects for ESA purposes because they require separate consultations pursuant to Section 7 of the ESA after which they are considered part of the environmental baseline. The Final Environmental Impact Statement (FERC 2001) only focused on the reestablishment/restoration efforts of anadromous fish runs above Cowlitz Falls in the cumulative effects section (section 6.2). As this is part of the proposed action, it is not considered part of the cumulative effects under this consultation.

The Endangered Species Consultation Handbook (USFWS and NOAA Fisheries 1998) describes this standard as follows:

> "Indicators of actions 'reasonably certain to occur' may include, but are not limited to: approval of the action by State, tribal or local agencies or governments (e.g., permits, grants); indications by State, tribal or local agencies or governments that granting authority for the action is imminent; project sponsors' assurance the action will proceed; obligation of venture capital; or initiation of contracts. The more State, tribal, or local administrative discretion remaining to be exercised before a proposed non-Federal action can proceed, the less there is a reasonable certainty the project will be authorized."

There are numerous non-Federal activities that have occurred in the action area in the past, which have contributed to both the adverse and positive effects of the environmental baseline. This step of the analysis for application of the ESA Section 7(a)(2) standards requires the consideration of which of those past activities are "reasonably certain to occur" in the future within the action area.

First, any of these actions that involve Federal approval, funding, or other involvement are not considered "cumulative effects" for this analysis (see ESA definition, above). This Federal involvement will trigger ESA Section 7(a)(2) consultation in the future. Once the consultation on those actions is completed, the effects may be considered part of the environmental baseline, consistent with the ESA regulatory definition of "effects of the action" (50 CFR §402.02). Thus, for example, State efforts to improve water quality in compliance with the Federal Clean Water Act would not be considered because of the involvement of the Environmental Protection Agency, until separate ESA consultations are completed. Other examples include irrigation water withdrawals involving the USFS (right-of-way permits for irrigation canals) or agricultural practices that receive Federal funding through the U.S. Department of Agriculture.

Next, actions that do not involve Federal activities must meet the "reasonably certain to occur" test for NOAA Fisheries to consider their effects in this Opinion. After review, NOAA Fisheries has not identified any actions that can be deemed reasonably likely to occur based on its ESA implementing regulations.

## 8. CONCLUSIONS

This section presents NOAA Fisheries' biological opinion regarding whether the aggregate effects of the factors analyzed under the environmental baseline (Section 5), effects of the proposed action (Section 6), and the cumulative effects (Section 7) in the action area, when viewed against the current rangewide status of the species (Section 4), are likely to jeopardize the continued existence of CR chum salmon, LCR steelhead, or LCR chinook salmon. To "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (CFR §402.02). The conclusions are based on the proposed actions described in Section 6 occurring as specified in the License, including in a timely manner.

After reviewing the current status of CR chum salmon, LCR chinook salmon, and LCR steelhead, the environmental baseline for the action area, the effects of the proposed action, and cumulative effects, it is NOAA Fisheries' biological opinion that the proposed action is not likely to jeopardize the continued existence of these species.

In reaching its conclusion, NOAA Fisheries finds that there will be continuing adverse impacts to species considered under this Opinion. These impacts are described in Section 6 and include: continuation of the Project as a partial barrier to migration for each ESU; loss of some spawning and rearing habitat for each ESU caused by creation of reservoirs; the potential for delay or injury associated with moving LCR chinook salmon and LCR steelhead past these partial barriers; the potential for injury or death of some juveniles as a result of potential stranding under License ramping rates; and effects on downstream spawning and rearing habitat (and egg survival and juvenile growth and survival within those habitats) caused by modified flow regimes and partially blocked transport of sediment and woody debris. Adaptive management is a cornerstone of how measures will be developed to minimize adverse impacts to the species.

Although some level of adverse effects will continue, in Section 6.5 NOAA Fisheries determined that these effects are reduced to levels that are not likely to reduce the functioning of already impaired habitat or retard the progress of impaired habitat towards properly functioning conditions. In particular:

- establishment of, or improvements to, both juvenile and adult passage at each project are to be implemented on a strict schedule and 75-95% survival performance standards associated with safe passage are expected to be met;

- provision of safe passage is expected to contribute to reestablishment of populations of LCR chinook and LCR steelhead upstream of the Project[19];

---

19 The Willamette and Lower Columbia Basin Domain Technical Recovery Team developed recommendations that address the question of how many and which populations need to be restored to various levels of health for the ESU to be considered recovered. In applying those recommendations, the Lower Columbia Fish Recovery Board has determined that to meet the TRT's guideline, a viable population of spring chinook and a contributing population of steelhead would need to be established above the Cowlitz River Projects (a contributing population is one whose status needs to improve but not to the level of viability).

X the amount of CR chum salmon spawning habitat that will remain lost as a result of inundation by Mayfield Lake is unknown, but believed to be small relative to the remaining available chum salmon spawning habitat downstream of the project;

X the amount of LCR chinook and LCR steelhead habitat that will remain lost as a result of Project inundation is unknown, but appears to be small relative to available habitat above and below the project;

X implementation of WDFW prescribed ramping rates should result in only a small potential for stranding and mortality as a result of flow fluctuations;

X proposed minimum flows, coupled with a monitoring program and WDOE's ability to modify those flows if necessary, should be adequate to protect listed fish;

X a gravel and large wood debris supplementation program, coupled with proposed flows and projects implemented through the Fisheries Habitat Fund, should result in a low likelihood of the project reducing the functioning of downstream spawning and rearing habitat.

# 9. INCIDENTAL TAKE STATEMENT

Sections 4(d) and 9 of the ESA prohibit any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct) of listed species without a specific permit or exemption. Harm is further defined in 50 CFR §222.102 as "an act that may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering." Harass is defined as actions that create the likelihood of injuring listed species to such an extent as to significantly alter normal behavior patterns which include, but are not limited to, breeding, feeding, and sheltering. Incidental take is take of listed species that results from, but is not the purpose of, the Federal agency or the Applicant carrying out an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to, and not intended as part of, the agency action is not considered prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

An incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures (RPM) that are necessary to minimize impacts and sets forth terms and conditions with which the action agency must comply in order to implement the RPMs.

## 9.1 Amount and Extent of Anticipated Take

NOAA Fisheries anticipates that the proposed action will cause more than a negligible amount of incidental take of LCR chinook salmon, LCR steelhead, and CR chum salmon within the action area for the term of the License for the reasons presented in this Opinion. Take examples may include adult harm caused by handling of fish for trap and haul operations, and delay or injury during adult and juvenile passage at Project dams. Despite the use of the best scientific and commercial data available, NOAA Fisheries cannot quantify a specific amount of incidental take of individual fish or incubating eggs for this action, with one exception: fish passage survival from the Upper Cowlitz River through the Project is expected to continue at current levels for the next 3 years, then reach 75%-95% as required by the License via the Settlement Agreement. For all other take by this Project, the extent of take is anticipated to be that associated with the operation of the Project in accordance with the measures of the License issued by FERC and in accordance with the measures in the terms and conditions section of this Opinion.

## 9.2 Effect of Anticipated Take

As analyzed in this Opinion, NOAA Fisheries has determined that this extent of anticipated take is not likely to jeopardize the continued existence of LCR chinook salmon, LCR steelhead, and CR chum salmon.

## 9.3 Reasonable and Prudent Measures

RPMs are non-discretionary measures to minimize take that are not already part of the description of the proposed action. They must be implemented as binding conditions for the exemption in Section 7(a)(2) to apply. FERC has the continuing duty to regulate the activities covered in this incidental take statement. If FERC fails to require the Licensee to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are in the license, or fails to retain the oversight to ensure compliance with these Terms and Conditions, the protective coverage of Section 7(o)(2) may lapse. Activities carried out in a manner consistent with these RPMs, except those otherwise identified, will not necessitate further site-specific consultation. Activities that do not comply with all relevant RPMs will require further consultation.

The following RPMs are necessary and appropriate to minimize the effect of anticipated incidental take of LCR chinook salmon, LCR steelhead, and CR chum salmon. FERC must require Tacoma Power to:

1. Minimize the likelihood of incidental take from the operation of the Project by requiring that Tacoma Power follow all of the items in the Settlement Agreement relating to anadromous fish.

2. Settlement Agreement (License Order Appendix A) Articles 15 and 16 reserve FERC's and WDOE's authority to require modifications to the flow regime, either on their own motion or upon request of State and Federal resource agencies. This reservation is appropriate to each agency's responsibilities and NOAA Fisheries supports it. Although substantial effort was made to ensure that Project operations, as specified in the Settlement Agreement and the license order, would be highly protective of anadromous fish, it is not possible to fully define the outcome of the proposed water management regime until the Project is operated as licensed and the effects monitored and evaluated. Opportunity for future modification is a hallmark of adaptive management. However, the license order does not define the amount of time that would be allowed between the identified need for a flow modification and the initiation of changed operations, the duration of such changes, or describe how FERC would manage its responsibility under the ESA in the event the flow regime is changed.

   Under the license order, the Project could continue to be operated such that discharge rates would fluctuate dramatically from day to day. Such frequent flow fluctuations can and have adversely affected fish in the Cowlitz River. Information recently provided by WDFW (2003b) demonstrates that flow-fluctuating operations in 2002 caused a loss of LCR chinook salmon spawning success. Although the license order increases the minimum allowable discharge during the period of interest and sets a rate of permissible discharge change designed to minimize stranding, it remains possible for the Project, operated as licensed, to fluctuate discharge in a manner that harasses spawning fish and dewaters established redds.

3. Minimize the likelihood of incidental take from handling of anadromous fish during any trap and haul operation by development of a plan that addresses such issues. NOAA Fisheries must approve the plan.

4. Ensure that the reestablishment is occurring at a level needed to avoid jeopardy and that sources of mortality to listed fish are reasonably considered and improved to meet the overall objective of a viable population of spring chinook and a contributing population of steelhead by incorporating a strong adaptive management component.

5. Minimize the likelihood of incidental take from construction activities in or near watercourses by restricting instream work to recommended time periods, implementing pollution and erosion control measures, and avoiding or replacing lost riparian and in-stream functions.

### 9.3.1 Terms and Conditions

In order to be exempt from the take prohibitions of Section 9 of the ESA and regulations issued pursuant to Section 4(d) of the ESA, FERC must include in the License and Tacoma Power must implement the following Terms and Conditions, which implement the RPMs listed above. These terms and conditions are non-discretionary. Terms and Conditions 2, 3, 4, 5, 6, and parts of Term and Condition 1 are not included in the existing new license. FERC must reopen the License and amend it to include these new conditions. These Terms and Conditions all constitute no more than a minor change in the proposed action because they provide details on more general license and/or Settlement Agreement conditions.

1. All License articles (and the associated Settlement Agreement) for this Project must be followed by Tacoma Power and enforced by FERC. This applies to those articles in the License and Settlement Agreement that relate to salmon, their habitat, and implementation of those measures, including adaptive management measures. Some key provisions include, but are not limited to:

   a. Passage performance standards.

      i. Downstream at Mossyrock - 95% survival or at least 75% with the best available technology within 3 years[20] of the issuance of this Opinion. This will include facilities where necessary to meet the goal which could ultimately mean building a collector at Mossyrock in addition to the other efforts at or near Cowlitz Falls.

         Interim measures, e.g. additional trapping, during the 3 year period to improve collection efficiencies are expected.

      ii. Downstream at Mayfield - 95% survival
         Note: The adaptive management identified in the License is a component of this, i.e., that studies/evaluations will be conducted and improvements will be made to address identified shortfalls.

   b. Tacoma Power will provide the following minimum flows below Mayfield (Article 13):

      <u>March 1 – June 30</u>
      Minimum flow releases from Mayfield Dam must be 5,000 cfs, unless the March 1 or later inflow forecasts indicate that this flow cannot be achieved and assure reservoir refill. A decision to reduce flows must only be made after Tacoma

20 This is an additional measure and FERC must modify the License to incorporate it.

Power has consulted with the FTC. Once per week from March through the end of June, or as otherwise agreed to with the FTC or agencies, Tacoma Power will conduct a 12-hour release at the lesser of 8,000 cfs or 120% of the preceding flows for juvenile fish transport flows. Natural flows

(e.g., from the Tilton River) that provide the same magnitude of flow pulse may substitute for artificial flow pulsing.

<u>July 1 - August 14</u>
Minimum flow releases from Mayfield Dam must be 2,000 cfs during this period.

<u>August 15 - September 30</u>
Minimum flow releases from Mayfield Dam must be 2,000 cfs during this period. If Mayfield releases exceed 5,000 cfs for a consecutive 5-day period as measured by daily mean flows, then flows will not be decreased below 5,000 cfs until a spawning survey, documenting redd numbers and locations in key side-channel areas at RM 42.5 and RM 47,[21] or two other representative sites as selected by the FTC, has been performed. If the survey shows that redds are present, the level of minimum flows necessary for the remainder of the period will be established after consultation with the FTC or agencies. The established minimum flows for incubation must not exceed the lesser of: a) 8 inches of river stage height below the highest consecutive 5-day average flow as measured at USGS Station No. 14238000, which is below Mayfield Dam, or b) 5,000 cfs.

<u>October 1 - November 20</u>
Minimum flow releases below Mayfield Dam must be subject to the following requirements:

1) At no time should flows released from Mayfield Dam be less than 3,500 cfs.
2) Flow releases from Mayfield Dam always must be at a quantity adequate enough to provide incubation protection to redds established during the period of August 15-November 20, as defined in #3 below;
3) When releases during the August 15-November 20 period exceed 5,000 cfs for a consecutive five-day period as measured by daily mean flows, minimum flows must be maintained at the lesser of: a) 5,000 cfs, or b) 8 inches of river stage height below the highest consecutive 5-day average flow during which active spawning occurred, as measured at USGS Station No. 14238000.

Flow releases less than those described in #3 above may be established upon agreement by the FTC, following its review of spawning survey data for the August 15-September 30 period.

---

21 In the License, these river miles are listed as 42 and 47.5. The correct RMs as provided by Tacoma Power to the FTC via an October 2, 2003, letter are 42.5 and 47.

Tacoma Power must make a good faith attempt to provide flows for the purpose of protecting spawning habitat (5,000 to 8,000 cfs) from November 1 until either November 20 or the completion of spawning, whichever comes first.

<u>November 21 – February 28</u>
Minimum flow releases from Mayfield Dam will be maintained at the lesser of: 1) 8 inches of river stage height below the highest consecutive 5-day average flow during which active spawning occurred, as measured at the USGS Station No.14238000, which is below Mayfield Dam, 2) 5,000 cfs, or 3) a lower flow authorized by the FTC or agencies based upon the results of spawning surveys.

Instream flows will be monitored at the USGS Station No. 14238000 below Mayfield Dam or via other means approved by NOAA Fisheries. These minimum release requirements may be reduced, in consultation with the FTC and written approval of NOAA Fisheries, when such reduction can be shown to not adversely affect downstream salmonid redds. Flows may be temporarily modified if required by operating emergencies beyond the control of Tacoma Power that threaten the safety and stability of Project facilities. In the event conditions beyond its control require Tacoma Power to deviate from this instream flow schedule, Tacoma Power will notify the WDOE and NOAA Fisheries as soon as practical, and not more than 10 days after such an incident. Tacoma Power may also deviate from this schedule for short periods upon prior agreement between Tacoma Power, the WDOE, and NOAA Fisheries.

c. At flows less than 6,000 cfs, Tacoma Power will follow the ramping rate restrictions shown in Table 2 (Article 14), unless modified with NOAA Fisheries' approval based on further study.

d. Within 1 year of license issuance, Tacoma Power will submit a Fish Monitoring Plan to evaluate the effects of instream flows and ramping rates, including pulsing or channel maintenance flows, upon the fish in the Cowlitz River (Article 15). This plan shall include a plan to thoroughly investigate the effects of project operation on anadromous fish redd abandonment and dewatering and entrapment and stranding of juvenile and adult fish.

e. Within 2 years of license issuance, Tacoma Power will submit a report describing measures taken to ensure compliance with instream flows that includes a training manual for Tacoma Power's operations' staff and any recommended modifications to operating procedures (Article 16). The training manual will provide tools, resources, and information to manage flows for flood control, recreation, power generation, and fish survival and health.

f. Within 1 year of license issuance Tacoma Power shall, in consultation with the WDOE, WDFW, NOAA Fisheries, and the USFWS (the FTC agencies) develop a plan to monitor the maintenance and use of side channel habitat in the Cowlitz River downstream from Mayfield Dam. In the event flow management under the constraints contained in the new license is insufficient to maintain the availability and anadromous fish habitat function of side channels, NOAA Fisheries and WDOE retain the authority to modify the flow constraints or require other measures to preserve side channel habitat availability and function.

g. Within 6 months of issuance of this Opinion, Tacoma Power shall provide a water quality monitoring plan for the lower Cowlitz River. The plan shall be developed in consultation with NOAA Fisheries and WDOE. The plan will include monitoring of water temperature, dissolved oxygen concentration and percent saturation, total dissolved gas concentration and percent saturation, total nitrogen and ammonia concentrations, and total and ortho-phosphorus concentrations. The draft plan shall be provided to the agencies and Tribes for a 30-day review and comment period. Tacoma Power shall include with the final plan documentation of consultation and copies of comments and recommendations, and specific descriptions of the final plan accommodates all comments and recommendations.

h. Within 9 months of license issuance, Tacoma Power will submit a FHMP (Article 6), which will be updated at 6-year intervals, that identifies a) quantity and size of fish to be produced at the complex; b) rearing and release strategies for each stock, including upward or downward production adjustments to accommodate recovery of indigenous stocks; c) credit mechanisms for production of high quality natural stocks; d) plans for funding ongoing monitoring and evaluation; and e) a fisheries management strategy consistent with the priority objective of maximizing natural production of wild indigenous fish stocks and species in the basin hatchery plan, etc. This should include a chum salmon analysis.

2. As afforded by license article 408, FERC must modify Appendix A, Articles 15 and 16, to specify that if requested by the WDOE or FERC, Tacoma Power must modify Project operations to provide agency-specified stream flows downstream from Mayfield Dam within the time frame specified by WDOE or FERC, not to be less than 48 hours from the time of WDOE or FERC request, and that such flow modification would remain in effect until superceded by subsequent WDOE or FERC action.

   Because any such modification of the instream flow schedule may affect ESA-listed species, FERC must notify NOAA Fisheries following initiation of a flow change action. Such notification should not be cause to delay implementation of any flow change identified as needed by the FERC or WDOE.

3. Trap and Haul

   a. Tacoma Power must develop a plan, in consultation with the FTC, including NOAA Fisheries', and with NOAA Fisheries' approval that addresses and minimizes harm to anadromous fish during any trap and haul operation. This plan must be completed and implemented within 1 year of the completion of this Opinion. The plan should adhere to the most updated criteria at the time of plan finalization regarding trapping and hauling of anadromous fish as outlined in the document "Draft Anadromous Salmonid Passage Facility Guidlines and Criteria" available at http://www.nwr.noaa.gov/1hydrop/hydroweb/docs/release_draft.pdf. The guidelines will be updated shortly.

b. As the number of adult fish returning to the applicable traps increase, Tacoma Power must increase the trap and haul capabilities before existing capabilities are exceeded.

4. a. Adaptive Management will be implemented as described in the Analysis of Effects of the Proposed Action Section (Section 6) of this Opinion.

   b. The applicant will create a Fish Passage Plan (FPP) and update it annually subject to NOAA Fisheries review and approval. The FPP shall include, but is not limited to, plans for the operation and maintenance of all fish passage facilities, emergency operation of said facilities, protocols for emergencies, schedule for inspection of facilities (to insure operation within established criteria), reporting procedures of inspection results, anticipated special operation of the facilities for research, etc.

5. In all proposed actions involving construction in or near waterways, FERC must require Tacoma Power to follow the construction practices described below to control sediment, disturbance, and other potential detrimental effects to listed salmonids.

   a. Minimum area. Construction impacts will be confined to the minimum area necessary to complete the project

   b. Alteration or disturbance of the streambanks and existing riparian vegetation will be minimized to the greatest extent possible.

   c. No herbicide application should occur as part of this action. Mechanical removal of undesired vegetation and root nodes is permitted.

   d. All existing vegetation within 150 ft of the edge of bank should be retained to the greatest extent possible.

   e. Timing of inwater work. Work below the bankfull elevation will be completed during the State of Washington’s or the Corps’ preferred inwater work period as appropriate for the Project area, unless otherwise approved in writing by NOAA Fisheries.

   f. Cessation of work. Project operations will cease under high flow conditions that may result in inundation of the Project area, except for efforts to avoid or minimize resource damage. All materials, equipment, and fuel must be removed if flooding of the area is expected to occur within 24 hours.

   g. Fish screens. All water intakes used for a project, including pumps used to isolate an inwater work area, will have a fish screen installed, operated, and maintained according to NOAA Fisheries' fish screen criteria.

   h. Fish passage. Provide passage for any adult or juvenile salmonid species present in the Project area during construction, unless otherwise approved in writing by NOAA Fisheries, and maintained after construction for the life of the Project.

Passage will be designed in accordance with NOAA Fisheries' "Anadromous Salmonid Passage Facility Guidelines and Criteria" (2003). Upstream passage is required during construction if it previously existed.

i. Construction activities associated with habitat enhancement and erosion control measures must meet or exceed best management practices and other performance standards contained in the applicable State and Federal permits.

j. Pollution and Erosion Control Plan. Prepare, in consultation with NOAA Fisheries, and carry out a Pollution and Erosion Control Plan to prevent pollution caused by survey, construction, operation, and maintenance activities. The Plan will be available for inspection upon request by FERC or NOAA Fisheries.

   i. Plan Contents. The Pollution and Erosion Control Plan will contain the pertinent elements listed below, and meet requirements of all applicable laws and regulations.

      1) The name and address of the party(s) responsible for accomplishment of the Pollution and Erosion Control Plan.
      2) Practices to prevent erosion and sedimentation associated with access roads, decommissioned roads, stream crossings, drilling sites, construction sites, borrow pit operations, haul roads, equipment and material storage sites, fueling operations, and staging areas.
      3) Practices to confine, remove, and dispose of excess concrete, cement and other mortars or bonding agents, including measures for washout facilities.
      4) A description of any regulated or hazardous products or materials that will be used for the project, including procedures for inventory, storage, handling, and monitoring.
      5) A spill containment and control plan with notification procedures, specific cleanup and disposal instructions for different products, quick response containment, and cleanup measures that will be available on the site; proposed methods for disposal of spilled materials; and employee training for spill containment.
      6) Practices to prevent construction debris from dropping into any stream or water body, and to remove any material that does drop with a minimum disturbance to the streambed and water quality.
      7) Erosion control materials (e.g., silt fence, straw bales, aggregate) in excess of those installed must be available on site for immediate use during emergency erosion control needs.
      8) Temporary erosion and sediment controls will be used on all exposed slopes during any hiatus in work exceeding 7 days.

   ii. Inspection of erosion controls. During construction, the operator must monitor instream turbidity and inspect all erosion controls daily during the rainy season and weekly during the dry season, or more often if necessary, to ensure they are working adequately.

1) If monitoring or inspection shows that the erosion controls are ineffective, mobilize work crews immediately to make repairs, install replacements, or install additional controls as necessary.
2) Remove sediment from erosion controls once it has reached one-third of the exposed height of the control.

k. Construction discharge water. Treat all discharge water created by construction (e.g., concrete washout, pumping for work area isolation, vehicle wash water, drilling fluids) as follows:

i. Water quality. Design, build, and maintain facilities to collect and treat all construction discharge water using the best available technology applicable to site conditions. Provide treatment to remove debris, nutrients, sediment, petroleum hydrocarbons, metals, and other pollutants likely to be present.
ii. Discharge velocity. If construction discharge water is released using an outfall or diffuser port, velocities will not exceed 4 ft per second, and the maximum size of any aperture will not exceed 4 ft per second.
iii. Spawning areas, submerged estuarine vegetation. Do not release construction discharge water within 300 ft upstream of spawning areas or areas with submerged estuarine vegetation.
iv. Pollutants. Do not allow pollutants, including green concrete, contaminated water, silt, welding slag, or sandblasting abrasive to contact any wetland or the 2-year floodplain, except cement or grout when abandoning a drill boring or installing instrumentation in the boring.

l. During completion of habitat enhancement activities, no pollutants of any kind (sewage, waste spoils, petroleum products, etc.) should come in contact with the water body or wetlands nor their substrate below the mean high-high water elevation or 10-year flood elevation, whichever is greater.

m. Treated wood.

i. Projects using treated wood that may contact flowing water or that will be placed over water where it will be exposed to mechanical abrasion or where leachate may enter flowing water will not be used, except for pilings installed following NOAA Fisheries' guidelines.
ii. Projects that require removal of treated wood will use the following precautions:
   1) Treated wood debris. Use the containment necessary to prevent treated wood debris from falling into the water. If treated wood debris does fall into the water, remove it immediately.
   2) Disposal of treated wood debris. Dispose of all treated wood debris removed during a project, including treated wood pilings, at an upland facility approved for hazardous materials of this classification. Do not leave treated wood pilings in the water or stacked on the streambank.

n. Preconstruction activity. Complete the following actions before significant alteration of the Project area:

  i. Marking. Flag the boundaries of clearing limits associated with site access and construction to prevent ground disturbance of critical riparian vegetation, wetlands, and other sensitive sites beyond the flagged boundary. Construction activity or movement of equipment into existing vegetated areas must not begin until clearing limits are marked.
  ii. Emergency erosion controls. Ensure that the following materials for emergency erosion control are onsite: A supply of sediment control materials (e.g., silt fence, straw bales), and an oil-absorbing, floating boom whenever surface water is present.
  iii. Temporary erosion controls. All temporary erosion controls will be in place and appropriately installed downslope of project activity within the riparian buffer area until site rehabilitation is complete.

o. Temporary access roads.

  i. Steep slopes. Do not build temporary roads mid-slope or on slopes steeper than 30%.
  ii. Minimizing soil disturbance and compaction. Low-impact, tracked drills will be walked to a survey site without the need for an access road. Minimize soil disturbance and compaction for other types of access whenever a new temporary road is necessary within 150 ft of a stream, water body, or wetland by clearing vegetation to ground level and placing clean gravel over geotextile fabric, unless otherwise approved in writing by NOAA Fisheries.
  iii. Temporary stream crossings.
    1) Do not allow equipment in the flowing water portion of the stream channel where equipment activity could release sediment downstream, except at designated stream crossings.
    2) Minimize the number of temporary stream crossings.
    3) Design new temporary stream crossings as follows:
      a) Survey and map any potential spawning habitat within 300 ft downstream of a proposed crossing.
      b) Do not place stream crossings at known or suspected spawning areas, or within 300 ft upstream of such areas if spawning areas may be affected.
      c) Design the crossing to provide for foreseeable risks (e.g., flooding and associated bedload and debris) to prevent the diversion of streamflow out of the channel and down the road if the crossing fails.
      d) Vehicles and machinery will cross riparian buffer areas and streams at right angles to the main channel wherever possible.
    4) Obliteration. When the Project is completed, obliterate all temporary access roads, stabilize the soil, and revegetate the site.

Abandon and restore temporary roads in wet or flooded areas by the end of the inwater work period.

p. Vehicles.
   i. Choice of equipment. When heavy equipment will be used, the equipment selected will have the least adverse effects on the environment (e.g., minimally sized, low ground pressure equipment).
   ii. Vehicle staging. Fuel, operate, maintain, and store vehicles as follows:
      1) Complete vehicle staging, cleaning, maintenance, refueling, and fuel storage, except for that needed to service boats, in a vehicle staging area placed 150 ft or more from any stream, water body, or wetland, unless otherwise approved in writing by NOAA Fisheries.
      2) Inspect all vehicles operated within 150 ft of any stream, water body, or wetland daily for fluid leaks before leaving the vehicle staging area. Repair any leaks detected in the vehicle staging area before the vehicle resumes operation. Document inspections in a record that is available for review on request by FERC or NOAA Fisheries.
      3) Before operations begin and as often as necessary during operation, steam clean all equipment that will be used below the bankfull elevation until all visible external oil, grease, mud, and other visible contaminates are removed. Any washing of equipment must be conducted in a location that will not contribute untreated wastewater to any flowing stream or drainage area.
      4) Diaper all stationary power equipment (e.g., generators, cranes, stationary drilling equipment) operated within 150 ft of any stream, waterbody, or wetland to prevent leaks, unless suitable containment is provided to prevent potential spills from entering any stream or waterbody.
      5) At the end of each work shift, vehicles must not be stored within or over the waterway.

q. Site preparation. Conserve native materials for site rehabilitation.
   i. If possible, leave native materials where they are found.
   ii. If materials are moved, damaged, or destroyed, replace them with a functional equivalent during site rehabilitation.
   iii. Stockpile any large wood, native vegetation, weed-free topsoil, and native channel material displaced by construction for use during site rehabilitation.

r. Isolation of inwater work area. If adult or juvenile fish are reasonably certain to be present, or if the work area is less than 300 ft upstream of spawning habitats, completely isolate the work area from the active flowing stream using inflatable bags, sandbags, sheet pilings, or similar materials, unless otherwise approved in writing by NOAA Fisheries.

s. Capture and release. Before and intermittently during pumping to isolate an inwater work area, attempt to capture and release fish from the isolated area using trapping, seining, electrofishing, or other methods as are prudent to minimize risk of injury.

i. The entire capture and release operation will be conducted or supervised by a fishery biologist experienced with work area isolation and competent to ensure the safe handling of all ESA-listed fish.

ii. If electrofishing equipment is used to capture fish, comply with NOAA Fisheries' electrofishing guidelines, listed below.

1) Do not electrofish near adult salmon in spawning condition or near redds containing eggs.
2) Keep equipment in good working condition. Complete manufacturers' preseason checks, follow all provisions, and record major maintenance work in a log.
3) Train the crew by a crew leader with at least 100 hours of electrofishing experience in the field using similar equipment. Document the crew leader's experience in a logbook. Complete training in waters that do not contain listed fish before an inexperienced crew begins any electrofishing.
4) Measure conductivity and set voltage as follows:

| Conductivity (umhos/cm) | Voltage |
|---|---|
| Less than 100 | 900 to 1100 |
| 100 to 300 | 500 to 800 |
| Greater than 300 | 150 to 400 |

5) Use direct current (DC) at all times.
6) Begin each session with pulse width and rate set to the minimum needed to capture fish. These settings should be gradually increased only to the point where fish are immobilized and captured. Start with pulse width of 500us and do not exceed 5 milliseconds. Pulse rate should start at 30Hz and work carefully upwards. In general, pulse rate should not exceed 40 Hz, to avoid unnecessary injury to the fish.
7) The zone of potential fish injury is 0.5 meters from the anode. Care should be taken in shallow waters, undercut banks, or where fish can be concentrated, because in such areas the fish are more likely to come into close contact with the anode.
8) Work the monitoring area systematically, moving the anode continuously in a herringbone pattern through the water. Do not electrofish one area for an extended period.
9) Have crew members carefully observe the condition of the sampled fish. Dark bands on the body and longer recovery times are signs of injury or handling stress. When such signs are noted, the settings for the electrofishing unit may need adjusting. End sampling if injuries occur or abnormally long recovery times persist.
10) Whenever possible, place a block net below the area being sampled to capture stunned fish that may drift downstream.
11) Record the electrofishing settings in a logbook along with conductivity, temperature, and other variables affecting efficiency. These notes, with observations on fish condition, will improve technique and form the basis for training new operators.

iii. Do not use seining or electrofishing if water temperatures exceed 18EC.

iv. Handle ESA-listed fish with extreme care, keeping fish in water to the maximum extent possible during seining and transfer procedures, to prevent the added stress of out-of-water handling.

v. Transport fish in aerated buckets or tanks. Release fish into a safe release site as quickly as possible, and as near as possible to capture sites.

vi. If a listed fish is injured or killed at any point during the salvage operation, the NOAA Fisheries Law Enforcement Office will be contacted (360-418-4248).

vii. Do not transfer ESA-listed fish to anyone except NOAA Fisheries or USFWS personnel, unless otherwise approved in writing by them.

viii. Obtain all other Federal, State, and local permits necessary to conduct the capture and release activity.

ix. Allow NOAA Fisheries or USFWS or its designated representative to accompany the capture team during the capture and release activity, and to inspect the team's capture and release records and facilities.

t. Earthwork. Complete earthwork (including drilling, excavation, dredging, filling, and compacting) as quickly as possible.

i. Excavation. Material removed during excavation will only be placed in locations where it cannot enter sensitive aquatic resources. Whenever topsoil is removed, it must be stored and reused onsite to the greatest extent possible. If culvert inlet/outlet protecting riprap is used, it will be class 350 metric or larger, and topsoil will be placed over the rock and planted with native woody vegetation.

ii. Drilling and sampling. If drilling, boring, or jacking is used, the following conditions apply.

1) Isolate drilling operations in wetted stream channels using a steel pile, sleeve, or other appropriate isolation method to prevent drilling fluids from contacting water.

2) If it is necessary to drill through a bridge deck, use containment measures to prevent drilling debris from entering the channel.

3) If directional drilling is used, the drill, bore, or jack hole will span the channel migration zone and any associated wetland.

4) Sampling and directional drill recovery/recycling pits, and any associated waste or spoils, will be completely isolated from surface waters, off-channel habitats, and wetlands. All drilling fluids and waste will be recovered and recycled or disposed to prevent entry into flowing water.

5) If a drill boring conductor breaks and drilling fluid or waste is visible in water or a wetland, all drilling activity will cease, pending written approval from NOAA Fisheries to resume drilling.

iii. Site stabilization. Stabilize all disturbed areas, including obliteration of temporary roads, following any break in work, unless construction will resume within four days.

iv. Source of materials. Obtain boulders, rock, woody materials, and other natural construction materials used for the Project outside the riparian buffer area.

u. For LWD and gravel placement, Tacoma will develop Best Management Plans, in consultation with NOAA Fisheries, that will minimize the impacts to listed fish during the implementation of the projects. NOAA Fisheries approval must be given prior to the activity occurring.

v. Implementation monitoring. For projects undertaken by or funded by Tacoma Power, Tacoma Power will submit a monitoring report to FERC and NOAA Fisheries within 120 days of Project completion describing the success in meeting the RPMs, and associated Terms and Conditions of the Opinion.
    - i. Project identification.
        - 1) Project implementor name, project name, detailed description of the project.
        - 2) Project location by 5th or 6th field HUC and by latitude and longitude as determined from the appropriate USGS 7-minute quadrangle map.
        - 3) Starting and ending dates for the work completed.
    - ii. Photo documentation. Photo documentation of habitat conditions at the project site before, during, and after project completion.
        - 1) Include general views and close-ups showing details of the project and project area, including pre- and post-construction.
        - 2) Label each photo with date, time, project name, photographer's name, and documentation of the subject activity.
    - iii. Other data. Additional project-specific data, as appropriate, for individual projects.
        - 1) Work cessation. Dates work ceased because of high flows, if any.
        - 2) Fish screen. Compliance with NOAA Fisheries' fish screen criteria.
        - 3) Pollution and Erosion Control Plan. A summary of pollution and erosion control inspections, including any erosion control failures, contaminant releases, and correction efforts.
        - 4) Description of site preparation.
        - 5) Isolation of in-water work area, capture, and release.
            - a) Supervisory fish biologist's name and address.
            - b) Methods of work area isolation and take minimization.
            - c) Stream conditions before, during, and within one week after completion of work area isolation.
            - d) Means of fish capture.
            - e) Number of fish captured by species.
            - f) Location and condition of all fish released.
            - g) Any incidence of observed injury or mortality of listed species.
        - 6) Streambank protection.
            - a) Type and amount of materials used.
            - b) Project size - one bank or two, width, and linear feet.
        - 7) Site rehabilitation. Photo or other documentation that site rehabilitation performance standards were met.

NOAA Fisheries will be reviewing the detailed construction plans submitted to advise FERC regarding whether or not those plans are likely to meet the “best management practices” articulated in this incidental take statement terms and conditions, or such additional best management practices that NOAA Fisheries deems appropriate.

## 10. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary measures suggested to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, or to develop additional information. NOAA Fisheries has no conservation recommendations to make at this time.

## 11. REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed action. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded, 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion, 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion, or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation, unless such action is not expected to constitute an irreversible or irretrievable commitment of resources that has the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative measures that would not violate 16 USC §1536(a)(2).

# 12. MAGNUSON-STEVENS FISHERY CONSERVATION & MANAGEMENT ACT

## 12.1 Background

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) for those species regulated under a Federal fisheries management plan. Pursuant to the MSA:

1. Federal agencies must consult with NOAA Fisheries on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (§305(b)(2)).

2. NOAA Fisheries must provide EFH conservation recommendations for any Federal or State action that would adversely affect EFH (§305(b)(4)(A)).

3. Federal agencies must provide a detailed response in writing to NOAA Fisheries within 30 days after receiving EFH conservation recommendations. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NOAA Fisheries' EFH conservation recommendations, the Federal agency must explain its reasons for not following the recommendations (§305(b)(4)(B)).

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (§3). For the purpose of interpreting this definition of EFH, waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities; necessary means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR §600.10). Adverse effect means any impact which reduces quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), site-specific, or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR §600.810).

EFH consultation with NOAA Fisheries is required regarding any Federal agency action that may adversely affect EFH, including actions that occur outside EFH, such as certain upstream and upslope activities.

The objective of this EFH consultation is to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse effects to EFH, if the action would adversely affect EFH.

### 12.2 Identification of EFH

Pursuant to the MSA, the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Federally-managed Pacific salmon: chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 1999). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable manmade barriers (PFMC 1999), and longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). In this case, EFH extends above the projects on the Cowlitz River. Detailed descriptions and identifications of EFH for salmon are found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan (PFMC 1999). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

### 12.3 Proposed Action

The proposed action is detailed in Section 2 of this Opinion.

### 12.4 Effects of Proposed Action

As described in detail in Section 6 of this Opinion, the proposed action may result in short- and long-term adverse effects to a variety of habitat parameters. These adverse effects are identified in Section 6.1 of this Opinion.

### 12.5 Conclusion

NOAA Fisheries concludes that the proposed action will adversely affect designated EFH for chinook salmon and coho salmon.

### 12.6 EFH Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NOAA Fisheries is required to provide EFH conservation recommendations to Federal agencies regarding actions which adversely affect EFH. The proposed action includes a number of measures for fish protection and enhancements. Because these measures are part of the proposed action, NOAA Fisheries does not need to include them as EFH recommendations. However, these measures are necessary for conservation and protection of EFH and would have been included as EFH conservation recommendations if they were not already part of the proposed action. While NOAA Fisheries understands that these measures described in the License will be implemented by Tacoma Power and enforced by FERC, it does not believe that these measures are sufficient (although they will help) to address the adverse impacts to EFH described above. However, the Terms and Conditions in the Incidental Take Statement (Section 9 of this Opinion) are applicable to designated EFH for chinook salmon and coho salmon and minimize these

adverse effects. Consequently, NOAA Fisheries adopted all the terms and conditions in its Incidental Take Statement (Section 9 of this Opinion) as its EFH recommendations.

### 12.7 Statutory Response Requirement

Pursuant to the MSA (§305(b)(4)(B)) and 50 CFR §600.920(j), Federal agencies are required to provide a detailed written response to NOAA Fisheries' EFH conservation recommendations within 30 days of receipt of these recommendations. The response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity on EFH. In the case of a response that is inconsistent with the EFH conservation recommendations, the response must explain the reasons for not following the recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

### 12.8 Supplemental Consultation

FERC must reinitiate EFH consultation with NOAA Fisheries if the proposed action is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects the basis for NOAA Fisheries' EFH conservation recommendations (50 CFR §600.920(k)).

## 13. LITERATURE CITED

Barnhart, R. A. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest) - steelhead. U.S. Fish Wildl. Serv. Biol. Rep. 82 (11.60), 21p.

Bauersfeld, K. 1978. Stranding of juvenile salmon by flow reductions at Mayfield Dam on the Cowlitz River, 1976. Technical Report 36. Washington State Department of Fisheries, Olympia, Washington.

Becker, C. D., D. H. Fickeisen, and J. C. Montgomery. 1981. Assessment of impacts from water level fluctuations on fish in the Hanford Reach, Columbia River. Report No. PNL-3813, UC-97e, Contract No. DE-AC06-76RLO 1830. Prepared by Pacific Northwest Laboratory, Richland, Washington, for U. S. Department of Energy.

Behnke, R.J. 1992. Native trout of western North America. Am. Fish. Soc. Monog. 6, 275 p. American Fisheries Society, Bethesda, Maryland.

Bjorn, T.C. and D.W. Reiser. 1991. Habitat Requirements of Salmonids in Streams. American Fisheries Society Special Publication 19: 83-138.

Burgner, R.L., J.T. Light, L. Margolis, T. Okazaki, A. Tautz, and S. Ito. 1992. Distribution and origins of steelhead trout (Oncorhynchus mykiss) in offshore waters of the North Pacific Ocean. Int. North Pac. Fish. Comm. Bull. 51. 92p.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-27, 261p.

Chapman, D., A. Giorgi, T. Hillman, D. Deppert, M. Erho, S. Hays, C. Peven, B. Suzumoto, and R. Klinge. 1994. Status of summer/fall chinook salmon in the mid-Columbia region.Report for Chelan, Douglas, and Grant County PUDs. 412 p. + app. (Available from Don Chapman Consultants, 3653 Rickenbacker, Ste. 200, Boise, ID 83705.)

Dammers, W., P.A. Foster, M.Kohn, C. Morrill, J. Serl, G. Wade. 2002. Draft Cowlitz River Subbasin summary, prepared for the Northwest Power Planning Council. Columbia Basin Fish and Wildlife Authority, Portland, Oregon.

DeVore, J. 1987. Cowlitz River Salmon Investigation Program: Analysis of the 1983-85 Cowlitz River Runs of Fall Chinook and Coho Salmon. Washington Department of Fisheries, Progress Report No. 254.

Everest, F. H. 1973. Ecology and management of summer steelhead in the Rogue River. Oregon State Game Comm., Fishery Research Report 7. Corvallis, 48p.

FERC (Federal Energy Regulatory Commission). 2001. Final Environmental Impact Statement Cowlitz River Hydroelectric Project Washington (FERC Project No. 2016). FERC/FEIS - 133. November 2001. Division of Public Information, Federal Energy Regulatory Commission, 888 First Street, NE, Washington, DC 20426.

FERC. 2002. Order Approving Settlement and Issuing New License. Project No. 2016-044. Issued March 13, 2002.

Fulton, L. A. 1968. Spawning areas and abundance of chinook salmon (*Oncorhynchus tshawytscha*) in the Columbia River--past and present. Special Scientific Report--Fisheries No. 571. U. S. Department of Commerce, Washington, D. C.

Fulton, L.A. 1970. Spawning areas and abundance of steelhead trout and coho, sockeye, and chum salmon in the Columbia River basin—past and present. Special Scientific Report—Fisheries 618.

Geiger, R.D. 1973. Streamflow requirements for salmonids. OR Wildl. Comm., Job. Final Rep. Proj. AFS 62-1, Portland, Oregon. 117p.

Gilbert, C.H. 1912. Age at maturity of Pacific coast salmon of the genus *Oncorhynchus*. Bull. U.S. Fish Comm. 32:57-70.

Groot, C. and L. Margolis, Eds. 1991. Pacific Salmon Life Histories. UBC Press, Vancouver, British Columbia.

Hartt, A.C., and M.B. Dell. 1986. Early oceanic migrations and growth of juvenile Pacific salmon and steelhead trout. International North Pacific Fisheries Commission Bulletin 46:1-105. *In* Nickelson *et al*. (1992a).

Harza. 1996. Initial Consultation Package, Cowlitz Hydroelectric Project Mossyrock Facility and Mayfield Facility, FERC No. 2016. Prepared for Tacoma City Light. May 3, 1996.

Harza. 1999a. *Cowlitz River Hydroelectric Project, FERC No. 2016. Draft Environmental Assessment.* Prepared for Tacoma Power. December 1999.

Harza. 1999b. Cowlitz River Hydroelectric Project, FERC No. 2016. 1996 through 1999 Annual Reports. Prepared for Tacoma Power.

Harza. 1999c. 90% Fish Passage Report. Cowlitz River Hydroelectric Project, FERC No. 2016. Prepared for Tacoma Power. June 1999.

Healey, M.C. 1983. Coastwide distribution and ocean migration patterns of stream- and ocean-type chinook salmon, *Oncorhynchus tshawytscha*. Can. Field-Nat. 97:427-433.

Healey, M. C. 1986. Optimum size and age at maturity in Pacific salmon and effects of size-selective fisheries. Can. Spec. Publ. Fish. Aquat. Sci. 89:39-52.

Healey, M.C. 1991. Life history of chinook salmon (Oncorhynchus tshawytscha). Pages 311-

393 in C. Groot and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press, Vancouver, British Columbia.

Howell, P., K. Jones, D. Scarnecchia, L. LaVoy, W. Kendra, and D. Ortmann. 1985. Stock assessment of Columbia River anadromous salmonids Volume II: Steelhead stock summaries stock transfer guidelines - information needs. Final Report to Bonneville Power Administration, Contract DE-AI79-84BP12737, Project 83-335. 1032p.

Hunter, M.A. 1992. Hydropower Flow Fluctuations and Salmonids: A Review of the Biological Effects, Mechanical Causes, and Options for Mitigation. State of Washington Department of Fisheries. Technical Report No. 119.

ISAB (Independent Scientific Advisory Board). 2003. Review of Flow Augmentation: Update and Clarification. ISAB 2003-1. 851 SW 6th Avenue, Suite 1100, Portland, Oregon 97204.

Johnson O. W., T. A. Flagg, D. J. Maynard, G. B. Milner, and F. W. Waknitz. 1991. Status Review for Lower Columbia River Coho Salmon. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS F/NWC-202.

Johnson, O.W., W.S. Grant, R.G. Kope, K.Neely, F.W. Waknitz, and R.S. Waples. 1997. Status review of chum salmon from Washington, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-32. 280p.

Kray, A. 1957. *A Survey of Resident and Anadromous Game Fish Populations of the Cowlitz River Above Mayfield.* Washington Department of Game, Seattle, WA.

LeFleur, C.M. 2000. "Data request". *Leflecml@dfw.wa.gov*. Email from C. LeFleur, WDFW, to S. Bishop, NOAA Fisheries (April 10, 2000).

LeFleur, C. M. 2001. "Data request". *Leflecml@dfw.wa.gov*. Email from C. LeFleur, WDFW, to S. Bishop, NOAA Fisheries (April 4, 2001).

Leopold, L.B., M.G. Wolman, and J.P. Miller. 1964. Fluvial Processes in Geomorphology. Dover Pub. Copyright 1964, printed 1992.

Lichatowich, J.A. 1999. *Salmon without Rivers*. Island Press: Washington, D.C.

Marr, J.C. 1943. Age, length, and weight studies of three species of Columbia River salmon (*Oncorhynchus keta, O. gorbuscha* and *O. kisutch*). Stanford Ichthyological Bulletin 2:157-197.

McElhaney, P., M.H. Ruckleshaus, M.J. Ford, T.C. Wainwright, E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. Commerce, NOAA Tech, Memo. NMFS-NWFSC-42. 443 p.

McPhail, J.D., and C.C. Lindsey. 1970. Freshwater fishes of Northwestern Canada and Alaska. Bull. Fish. Res. Board Can. 173:381.

Miller, R.J., and E.L. Brannon. 1982. The origin and development of life history patterns in Pacific salmonids. Pp. 296-309 in E.L. Brannon and E.O. Salo, eds. Proceedings of the Salmon and Trout Migratory Behavior Symposium. University of Washington, School of Fisheries. Seattle, Washington.

Myers, J.M., and 10 co-authors. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-NWFSC-35. 443p.

Myers, J., C. Busack, D. Rawding, A. Marshall. 2003. Historical population structure of Willamette and Lower Columbia Basin Pacific Salmonids. National Marine Fisheries Service, Seattle, Washington. Willamette and Lower Columbia Technical Recovery Team. Draft report.

Neave, F. 1961. Pacific salmon: Ocean stocks and fishery developments. Proc. 9th Pac. Sci. Congr. 1957(10):59-62.

Nehlsen, W., J. E. Williams, and J. A. Lichatowich. 1991. Pacific salmon at the crossroads: stocks at risk from California, Oregon, Idaho, and Washington. Fisheries 16: 4-21.

NOAA Fisheries (National Marine Fisheries Service). 1996. Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale. Habitat Conservation Division, Portland, Oregon.

NOAA Fisheries. 1999a. Endangered Species Act - Section 7 Consultation Biological Opinion on Artificial Propagation in the Columbia River Basin - Incidental Take of Listed Salmon and Steelhead from Federal and Non-Federal Hatchery Programs that Collect, Rear and Release Unlisted Fish Species. Issued March 29, 1999. National Marine Fisheries Service, Northwest Region.

NOAA Fisheries. 1999b. The habitat approach: implementation of Section 7 of the Endangered Species Act for actions affecting the habitat of Pacific anadromous salmonids. Northwest Region, Portland, Oregon.

NOAA Fisheries. 2000. Endangered Species Act - Section 7 consultation biological opinion - reinitiation of consultation on operation of the Federal Columbia River Power System (FCRPS), including the juvenile fish transportation program, and 19 Bureau of Reclamation projects in the Columbia Basin. Issued December 21, 2000. National Marine Fisheries Service, Northwest Region. Seattle, Washington.

NOAA Fisheries. 2001. Endangered Species Act - Reinitiated Section 7 Consultation - Biological Opinion and Incidental Take Statement. Effects of the Pacific Coast Salmon Plan and U.S. Fraser Panel Fisheries on Upper Willamette River chinook, Lower Columbia River chinook, and Lower Columbia River chum. April 25, 2001. 55p.

NOAA Fisheries. 2002. Endangered Species Act Section 7 consultation. Biological opinion on impacts of treaty Indian and non-Indian fall season fisheries in the Columbia River basin in year 2002 on salmon and steelhead listed under the Endangered Species Act. August

15, 2002.

ODFW (Oregon Department of Fish and Wildlife). 1998. Briefing Paper - Lower Columbia River Chinook ESU. October 13, 1998. 7p.

ODFW. 2001. Fisheries Management and Evaluation Plan. Lower Columbia River Chum Salmon in Oregon Freshwater Fisheries of the Lower Columbia River Mainstem and Tributaries Between the Pacific Ocean and Bonneville Dam. August 13, 2001. Submitted to NMFS. Portland, OR.

Olsen, E., P. Pierce, M. McLean, and K. Hatch. 1992. Stock Summery Reports for Columbia River Anadromous Salmonids Volume I: Oregon. U.S. Dep. Energy., Bonneville Power Administration. Project No. 88-108.

Olson, F.W., and R.G. Metzgar. 1987. Downramping to Minimize Stranding of Salmonid Fry. Vol. 1 Proceeding of the International Conference on Hydropower - Portland, Oregon 1987. Am. Sec. of Civil Engineers Vol. 1 p 691-701.

Pacific Fisherman. 1928. Record chum caught off Quadra. Pac. Fisherman 1928 (Oct.):13.

Pitcher, T.J. 1986. Functions of shoaling in teleosts. *In* T.J. Fisher (ed.). The Behavior of Teleost Fishes. Johns Hopkins University Press, Baltimore, Maryland, pp. 294-337.

PFMC (Pacific Fishery Management Council). 1999. Amendment 14 to the Pacific Coast Salmon Plan. Appendix A: Description and Identification of Essential Fish Habitat, Adverse Impacts and Recommended Conservation Measures for Salmon. Portland, Oregon.

Phinney, L. A. 1974. Further observations on juvenile salmon stranding in the Skagit River, March 1973. Progress Report 26. Washington State Department of Fisheries, Olympia.

R. W. Beck and Associates. 1987. Skagit River salmon and steelhead fry stranding studies. Document 2133C. Prepared for Seattle City Light, Environmental Affairs Division, Seattle, Washington.

Randall, R.G., M.C. Healey, and J.B. Dempson. 1987. Variability in length of freshwater residence of salmon, trout, and char. *In* M. J. Dodswell *et al*., editors. Common strategies of anadromous and catadromous fishes. American Fisheries Society Symposium 1:27-41.

Reisenbichler, R.R., J.D. McIntyre, M.F. Solazzi, and S.W. Landino. 1992. Genetic variation in steelhead of Oregon and northern California. Trans. Am Fish. Soc. 121:158-169.

Rich, W.H. 1942. The salmon runs of the Columbia River in 1938. Fisheries Bulletin 50:103-47.

Salo, E.O. 1991. Life history of chum salmon, *Oncorhynchus keta*. *In* C. Groot and L. Margolis (editors), Pacific salmon life histories, p. 231-309. Univ. B.C. Press, Vancouver, B.C.

Sandercock, F. K. 1991. Life history of coho salmon (Oncorhynchus kisutch). In C. Groot and L.

Margolis (editors), Pacific salmon life histories, p. 396-445. Univ. British Columbia Press, Vancouver.

Schreck, C.B., H.W. Li, R.C. Hjort, and C.S. Sharpe. 1986. Stock identification of Columbia River chinook salmon and steelhead trout. Final Report to Bonneville Power Administration, Contract DE-A179-83BP13499, Project 83-451. 184p.

Serl, J. and C. Morril. 2002. Draft 2002 Annual Report for the Cowlitz Falls Project. Prepared for Bonneville Power Administration, Contract number 96BI92557. 50p.

Small, M.P. 2003. Lower Columbia River chum salmon (Oncorhynchus keta) population genetic structure inferred from microsatellite DNA. Washington Department of Fish and Wildlife, Olympia, Washington.

Spence, B.C., G.A. Lomnicky, R. M. Hughes, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. Report No. TR-4501-96-6057. ManTech Environmental Research Services Corporation, Corvallis, Oregon.

Stober, Q.J. 1986. *Reintroduction of Anadromous Fish Runs to the Tilton and Upper Cowlitz Rivers.* Washington State Department of Fisheries and Department of Game. 103p.

Stockley, C.E. 1961. *The Migration of Juvenile Salmon Past the Mayfield Dam Site, Cowlitz River, 1955 and 1956.* State of Washington Department of Fisheries.

Tacoma Power. 2000. Draft Biological Assessment of the Cowlitz River Hydroelectric Project FERC No. 2016, Tacoma, Washington. Prepared for FERC.

Thompson, J.S., and G.J. Paulik. 1967. An Evaluation of Louvers and Bypass Facilities for Guiding Seaward Migrant Salmonids Past Mayfield Dam in Western Washington. State of Washington Department of Fisheries, Research Division. September 1967. 133p.

Thompson, J.S., and Lloyd Rothfus. 1969. Biological Observations of Salmonids Passing Mayfield Dam. State of Washington Department of Fisheries, Research Division.

USFS (U.S. Forest Service). 1997. Upper Cowlitz River Watershed Assessment. Gifford Pinchot National Forest, Packwood and Randle Ranger Districts.

USFWS (U.S. Fish and Wildlife Service ) and NOAA Fisheries. 1998. Endangered Species Consultation Handbook, Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act.

Washington Conservation Commission. 2000. Salmon and Steelhead Habitat Limiting Factors, Water Resource Inventory Area 26, Cowlitz River Basin. Washington Conservation Comission. Olympia, Washington.

Washington Conservation Commission. 2003. Habitat Limiting Factors Executive Summary, Water Resource Inventory Area 26 Cowlitz River System. Washington Conservation Comission. Olympia, Washington.

WCSBRT (West Coast Salmon Biological Review Team). 2003. Preliminary conclusions regarding the updated status of listed ESUs of West Coast salmon and steelhead. West Coast Biological Review Team. Co-manager review draft. Northwest Fisheries Science Center, Seattle, Washington.

WDF (Washington Department of Fisheries) and USFWS. 1951. Lower Columbia River Fisheries Development Program, Cowlitz Area, Washington.

WDF, Washington Department of Wildlife, and Western Washington Treaty Indian Tribes. 1993. 1992 Washington State salmon and steelhead stock inventory (SASSI). Wash. Dep. Fish Wildl., Olympia, 212p. + 5 regional volumes.

WDFW (Washington Department of Fish and Wildlife). 2003a. Fisheries Management and Evaluation Plan. Lower Columbia River. Submitted to NMFS. Portland, Oregon.

WDFW. 2003b. A November 20, 2003, e-mail from Wolf Dammers, WDFW to Michelle Day, NOAA Fisheries which included an attached report by Dan Harmon, WDFW.

WDFW and PNPTT (Point No Point Treaty Tribes). 2000. Summer chum salmon conservation initiative. An implementation plan to recover summer chum salmon in the Hood Canal and Strait of Juan de Fuca region. 384p. + appendices (available at: *www.wa.gov/wdfw*).

WDG (Washington Department of Game). 1986. Memo to Brian Hauger, Habitat Management from Jim Gearheard, Fisheries Management. April 25, 1986. Subject: Cowlitz River fish stocks.

WDOE (Washington Department of Ecology). 1998. 303d list for 1998. Washington Department of Ecology, Lacey, Washington.

WDW (Washington Department of Wildlife). 1990. Cowlitz River Subbasin: Salmon and Steelhead Production Plan. Washington Department of Wildlife, Northwest Power Planning Council, and the Agencies and Indian Tribes of the Columbia Basin Fish and Wildlife Authority

WLCTRT (Willamette/Lower Columbia River Technical Recovery Team). 2002a. Identifying historical populations of chinook and chum salmon and steelhead within the lower Columbia River and upper Willamette River evolutionarily significant units. Draft.

WLCTRT. 2002b. Willamette/Lower Columbia Pacific salmonid viability criteria. Draft.

WLCTRT. 2003. Interim Report on Viability Criteria for Willamette and Lower Columbia Basin Pacific Salmonids. March 31, 2003.

WPCHB (Washington Pollution Control Hearings Board). 2003. Modified Findings of Fact, Conclusions of Law and Order. PCHB No. 02-022.

Withler, I.L. 1966. Variability in life history characteristics of steelhead trout (*Salmo gairdneri*) along the Pacific coast of North America. J. Fish. Res. Board Can. 23(3):365-393.

Woodin, R. M., S. C. Crumley, Q. J. Stober, and G. Engman. 1984. Skagit River interim agreement studies. Volume II. Salmon and steelhead studies. Final Report March 1980 to February 1983, FRI-UW-8406. Prepared by Washington State Department of Fisheries, Fisheries Research Institute, University of Washington, Seattle, and Washington State Department of Game for City of Seattle, Department of Lighting.

Wydoski, R.S., and R.R. Whitney. 1979. Inland Fishes of Washington. University of Washington Press, Seattle, Washington. 220 pp.