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USFWS Log Number: 1-7-01-F-526
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September 6, 2001

David P. Boergers, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, DC 20426

Subject: FERC project 2496 - Leaburg-Walterville Project
Endangered Species Act Section 7 Consultation: Final Biological Opinion on the Federal Energy Regulatory Commission's relicensing of the Eugene Water and Electric Board's Leaburg-Walterville Project in the McKenzie River basin, Oregon.

Dear Mr. Boergers:

Enclosed is the final biological opinion, prepared jointly by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), (collectively the Services) on the Federal Energy Regulatory Commission's (FERC) proposed relicensing of the Eugene Water and Electric Board's (EWEB) Leaburg-Walterville hydroelectric project (FERC #2496). This document represents the Services' biological opinions on the effects of the proposed action on listed and proposed species and designated critical habitat in accordance with Section 7 of the Endangered Species Act of 1973 (ESA) as amended (16 USC 1531 *et seq.*). This biological opinion is also being provided to EWEB as FERC's designated non-Federal representative.

The operation of the Leaburg-Walterville Project, under the 1997 FERC license, as reinstated and amended by FERC on April 27, 2000; the conservation measures as proposed in the FERC 2001 Biological Assessment (BA); and the revised and updated license articles developed by NMFS, USFWS, EWEB, and FERC separated staff, constitute the "proposed action" by FERC. The term of this biological opinion is the duration of the new license, forty years, and is the period of time during which the project operates under the terms and conditions of that license. The precise beginning and end dates of the license will be clarified by FERC when it acts on EWEB's pending request regarding term of the license. Specifically, EWEB has requested that FERC clarify that the license term of forty years for the Leaburg-Walterville Project begins in April, 2000.

Informal consultation discussions with FERC and EWEB began in January, 1999 for the USFWS, and in August, 1999 for NMFS. By letters dated June 24, 1999, and October 8, 1999, EWEB was designated by FERC as a non-Federal representative for the purpose of preparing the BA to determine the potential effects of EWEB's McKenzie River hydroelectric projects on Federally listed, proposed and candidate species and their critical habitat. Federal species lists were consequently issued to EWEB on January 10, 2000, by USFWS and on December 6, 199 by NMFS. During the development of the BA, the Services were given the opportunity to provide assistance and input during monthly coordination meetings. Consequently, EWEB filed the draft BA with FERC on December 21, 2000, and FERC forwarded the BA, with no changes, to the Services who received the document on February 15, 2000.

During the development of the draft biological opinion, the Services, FERC, and EWEB simultaneously worked toward revising and updating certain license articles for the Leaburg-Walterville Project with the goal of forwarding those license articles, a settlement offer and an agreement, and the biological opinion to FERC as a complete package. The revised and updated license articles for the Leaburg-Walterville license and the Article 403-required construction schedule, prepared as part of the package, call for construction activities to begin in 2002. A meeting among the Services, FERC, and EWEB was held on June 15, 2001, to finalize the documents and review the current status of the biological opinion. At the meeting, based on information provided by the Department of Interior solicitor and FERC separated staff, the parties concluded that issuance of a biological opinion that included two additional EWEB hydroelectric projects, Carmen-Smith and Blue River, could delay FERC approval of the revised and updated license articles, the settlement offer and agreement, and the issuance of the biological opinion on the Leaburg-Walterville facilities. In order to avoid potential construction delays, it was agreed by the parties to pull the Carmen-Smith and Blue River components of the proposed action out of the biological opinion, instead issuing a biological opinion only on the proposed action at the Leaburg-Walterville Project. The biological opinions on the Carmen-Smith and Blue River projects will be issued to FERC at a later date.

In this biological opinion, the Services have concluded that the ongoing operation of the Leaburg-Walterville Project is not likely to jeopardize the continued existence of Upper

Willamette River chinook salmon or Columbia River bull trout. In addition, the USFWS concurs with FERC's "not likely to adversely affect" determination regarding effects from EWEB's proposed action on Canada lynx, Kincaid's lupine, Bradshaw's lomatium, Northern spotted owl and bald eagle. A complete administrative record of this consultation is on file at the Services' offices listed below.

This concludes formal consultation on the actions outlined in FERC's request. Reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: 1) new information reveals that the agency action may affect listed species or critical habitat in a manner or to an extent not considered in the opinion; 2) the agency action is subsequently modified in a manner that causes an effect to listed species or critical habitats that was not considered in this opinion; or, 3) a new species is listed or critical habitat designated (other than those addressed in this opinion) that may be affected by the identified action.

Comments or questions regarding this biological opinion can be directed to Lynne Krasnow (NMFS) and Chris Allen (USFWS) at the following addresses:

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Sincerely,

Donna Darm
Acting Regional Administrator
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Kemper M. McMaster
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cc:

Laurie Power, EWEB
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Endangered Species Act - Section 7
Consultation

BIOLOGICAL OPINION

on the Effects of the Relicensing of EWEB's Leaburg-Walterville Hydroelectric Project in the McKenzie Subbasin, Oregon, on:

Upper Willamette River Chinook Salmon
Columbia River Bull Trout
Canada Lynx
Bald Eagle
Northern Spotted Owl
Bradshaw's Lomatium
Kincaid's Lupine

Agency: Federal Energy Regulatory Commission

Consultation Conducted By: National Marine Fisheries Service, Northwest Region & U.S. Fish and Wildlife Service, Oregon Fish and Wildlife Office

Approved By:

Donna Darm
Acting Regional Administrator

Kemper M. McMaster
State Supervisor

Date Issued: September 6, 2001

USFWS Log Number: 1-7-01-F-526
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ACRONYMS

BA	Biological Assessment
BLM	Bureau of Land Management
CFS	Cubic feet per second
CR	Columbia River
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act of 1973
ESU	Evolutionarily Significant Unit
EWEB	Eugene Water & Electric Board
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
IFIM	Instream Flow Incremental Methodology
LW	Large wood
MIF	Minimum instream flow
MVP	Minimum Viable Population
MWC	McKenzie Watershed Council
NGVD	National Geodetic Vertical Datum
NMFS	National Marine Fisheries Service
OCWRU	Oregon Cooperative Wildlife Research Unit
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OWQI	Oregon Water Quality Index
PMFC	Pacific Marine Fisheries Commission
RM	River Mile
TU	Temperature Unit
USACE	United States Army Corps of Engineers
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UWR	Upper Willamette River
VSP	Viable Salmonid Population
WNF	Willamette National Forest

1. Objectives

The Federal Energy Regulatory Commission (FERC) licenses the Leaburg-Walterville Hydroelectric Project owned and operated by the Eugene Water & Electric Board (EWEB) in the McKenzie River subbasin, Oregon. Section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.) (ESA) requires Federal agencies to consult with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), as appropriate, to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat.

The Leaburg-Walterville Hydroelectric Project (FERC Project No. 2496) is located on the McKenzie River in Lane County approximately 20 miles east of the Eugene/Springfield metropolitan area. Figure 1-1 provides a map of the McKenzie River subbasin, showing the location of the Leaburg-Walterville Hydroelectric Project.

The operation of the Leaburg-Walterville Project, under the 1997 FERC license, as reinstated and amended by FERC on April 27, 2000; the conservation measures as proposed in the Biological Assessment (BA); and the revised and updated license articles developed by NMFS, USFWS, EWEB, and FERC separated staff, constitute the "proposed action" by FERC. This is the subject of this ESA Section 7 consultation.[1]

In the BA (FERC 2001), which was received by NMFS and USFWS (the Services) on February 26, 2001, FERC determined that the Leaburg-Walterville Project is likely to adversely affect two listed species (Upper Willamette River [UWR] chinook salmon and Columbia River [CR] bull trout) and the designated critical habitat of the UWR chinook salmon, thus triggering formal consultation and the requirement for the Services to respond with this biological opinion. Because both of the Services have listed aquatic species in the McKenzie River subbasin under their respective jurisdictions, the Services have written this opinion jointly.

The objective of this biological opinion is for the Services to determine whether FERC's proposed authorization of the operation of EWEB's Leaburg-Walterville Hydroelectric Project in the McKenzie River subbasin, as defined in Chapter 3, is likely to jeopardize the continued existence of ESA-listed species, or result in the destruction or adverse modification of designated critical habitat. The standards for determining jeopardy are set forth in Section 7(a)(2) of the ESA as defined by 50 CFR § 402 (the consultation regulations). Procedures for conducting consultation under Section 7 of the ESA are further described in the Services' Consultation Handbook (USFWS and NMFS 1998). The general steps for conducting a jeopardy analysis, which correspond with the organization of this biological opinion, are described below. Formal

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[1] The August 28, 2001, draft revised and updated license articles were used to define the related portions of the proposed action in this biological opinion.

consultation will be concluded with the final issuance of this opinion.

In order for the Services to determine whether the action is likely to jeopardize the listed species and/or destroy or adversely modify designated critical habitat, they must perform an analysis of effects that (1) defines the biological requirements and current status of the listed species (Chapter 4); (2) describes the effects of the environmental baseline within the action area (Chapter 5); (3) evaluates the effects of the proposed action on the listed species (Chapter 6); (4) considers the cumulative effects of the future state, Tribal, local, or private actions that are reasonably likely to certain to occur within the action area (Chapter 7); and, (5) determines if the proposed action, together with the environmental baseline and cumulative effects, is likely to jeopardize the continued existence of the listed species within an evolutionarily significant unit (ESU) or distinct population segment (DPS) or result in the destruction or adverse modification of its designated critical habitat (Chapter 8). If the effects of the proposed action, taken together with the cumulative effects and baseline, are found to jeopardize the listed species, or destroy or adversely modify critical habitat, then the Services must identify any reasonable and prudent alternatives to the proposed action that will avoid jeopardy or adverse modification of critical habitat.

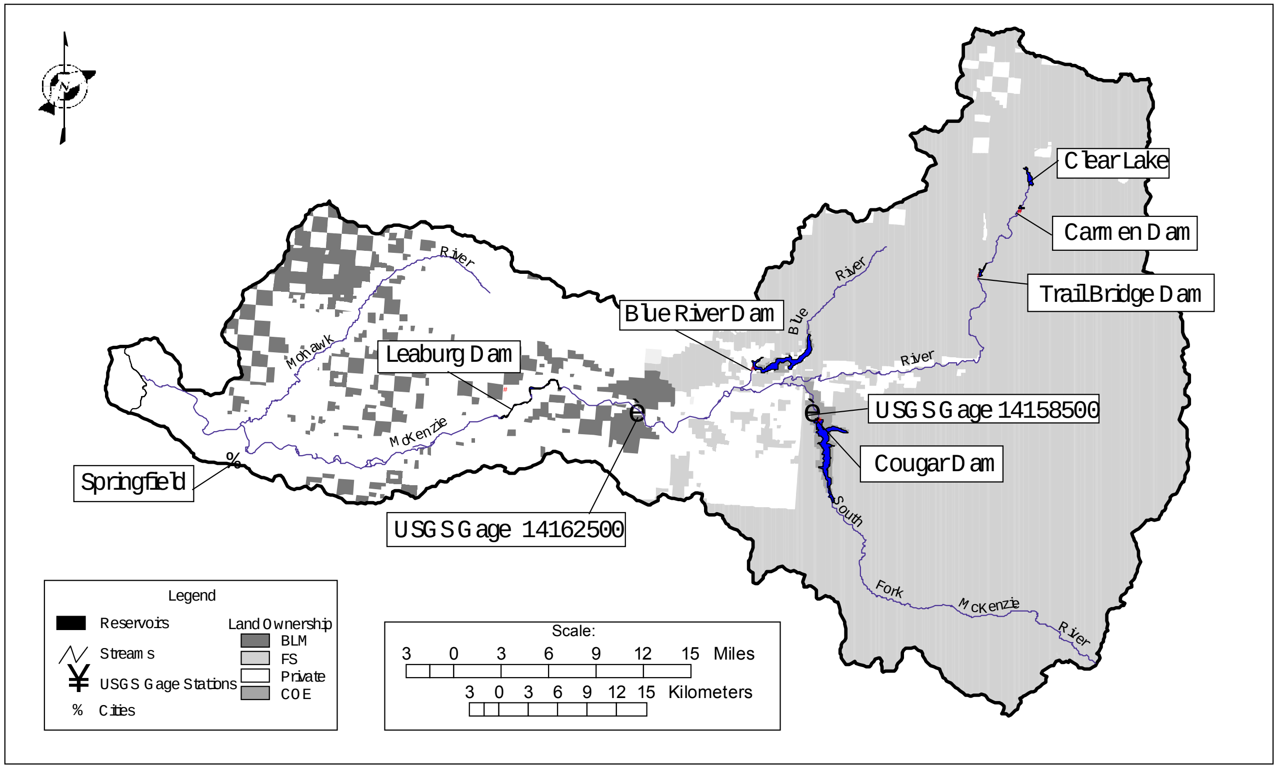

Figure 1-1. The McKenzie River subbasin, showing locations of EWEB and USACE projects.

1.1 General Approach for Jeopardy Analysis

As stated above, the Services must determine whether the action is likely to jeopardize the continued existence of the listed species, ESU, or DPS and/or whether the action is likely to destroy or adversely modify designated critical habitat. The Services define an action that is "likely to jeopardize the continued existence of ..." as one "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." The Services define "destruction or adverse modification" as "a direct or indirect alteration that appreciably diminishes the value of critical habitat for the survival and recovery of a listed species" (50 CFR §402.02). For salmonids, NMFS has interpreted the implementing regulations as requiring a high likelihood of survival and moderate to high likelihood of recovery when the proposed action is combined with mortality in other life stages (see Section 1.3.1.1 in NMFS 2000a).

The framework used to apply a jeopardy analysis in any given Section 7 consultation varies depending on the type of action analyzed and the availability of information regarding the effects of the action on listed species. Biological requirements may be expressed either in terms of survival rates and metrics indicating population viability or as habitat conditions necessary to ensure the continued existence of the species (NMFS 1999). The Services assert that these two approaches are equivalent based on studies that identify causal links between habitat modifications and population characteristics such as abundance, productivity, and diversity. This causal relationship can be quantified under certain specific conditions (e.g., Spence et al. 1996), although site-specific information is not available in the context of most Section 7 consultations. In these instances, the Services must rely on data that can reasonably be extrapolated to the action area and to the populations in question.

In the case of this biological opinion, elements of the environmental baseline, the proposed action, and/or cumulative effects affect both direct (passage) survival at the projects and the ability of the system to provide other biological requirements (food, shelter, flow regime, substrate, etc.) of listed species. That is, the abiotic habitat processes of disturbance, flow regime, sediment and large wood (LW) function, riparian vegetation and floodplain function, and water quality (section 2.3.3.1) support the fluvial (channel, riparian, and floodplain) ecosystem and, as such, create and maintain habitat for all fluvial species. The Services use a habitat-based framework to link effects on habitat processes with effects on the biological processes of listed species and thus their likelihood of survival and recovery. Where critical habitat has been designated (e.g., for UWR chinook salmon), NMFS also evaluates effects of the proposed action on its constituent elements. Cause and effect linkages between effects of the proposed action on the habitat processes and on the biological requirements of listed species for the processes of migration, spawning, and rearing, for adequate population level processes (e.g., life history diversity), and for adequate food web dynamics, are addressed in Chapter 6.

For UWR chinook salmon, NMFS has determined, for the purposes of this biological opinion, that there is enough information to quantitatively evaluate the likelihood of survival and recovery of the ESU. NMFS uses the techniques established by its Cumulative Risk Initiative to describe the status of the McKenzie River subbasin population under the environmental baseline and makes simple, determinative assumptions about the effect of the proposed action to estimate the effect on survival from one generation to the next. The purpose of this analysis is to determine whether mortality that can be attributed to the action is below a level that, when combined with mortality occurring in other life stages, results in a high likelihood of survival and a moderate to high likelihood of recovery.

In the application of this standard, NMFS relies on all the best available scientific information. However, NMFS recognizes that there is still substantial uncertainty in its projections of the likelihood of survival and recovery. As a result, NMFS relies on this analysis primarily to provide a standardized measure of risk against which to judge the significance of the action to the continued existence of the ESU. In the end, NMFS' determination of consistency with ESA Section 7(a)(2) is qualitative, informed to the extent possible by standardized quantitative analysis.

1.1.1 Metrics and Criteria Useful for Assessing Jeopardy Standards

This section describes metrics integral to NMFS' quantitative evaluation of the likelihood of survival and recovery for UWR chinook salmon.

1.1.1.1 Metrics Indicative of Survival

For the survival component of the jeopardy standard, a measurement of the risk of absolute extinction (no more than one fish returning over the number of years in a generation) within 100 years is relevant (McClure et al. 2000a). NMFS evaluates the status of the species relative to a standardized criterion of 5% probability of absolute extinction in assessing whether the species has a high likelihood of survival under the proposed action. A 100-year period captures both short- and long-term risk because a population that has a certain probability of extinction within a short time frame, such as 24 years, will have at least that probability of extinction in 100 years. NMFS also reviews a 24-year period for two reasons: 1) because the range of uncertainty around an estimate of the 100-year metric is quite large and 2) because there is potential to further modify the action in the near term through the adaptive management process (if monitoring and evaluation indicate a need for further action to avoid longer-term risks). Absolute extinction is used instead of a quasi-extinction level because of the unambiguous interpretation of this criterion, whereas quasi-extinction levels such as 20, 50, or 100 fish have different meanings for populations of different sizes and capacities in different river systems.

1.1.1.2 Metrics Indicative of Recovery

The recovery metric stated in the 1995 FCRPS Biological Opinion is a relevant measure of the status of the species relative to the recovery component of the jeopardy standard. This recovery metric is defined as the likelihood that the 8-year geometric mean abundance of natural spawners in a population will be equal to or greater than an identified recovery abundance level. Recovery abundance levels have not been finally determined for UWR chinook salmon. Until recovery levels are determined, NMFS will rely on a combination of the survival criterion and an alternate recovery criterion defined as the level of improvement needed in the productivity of the population to result in a median annual population growth rate (lambda) greater than 1.0 over 48 years. NMFS applies this alternative recovery metric because the recovery abundance level may not yet be specified, but it is certainly higher than the current abundance level. Therefore, at a minimum, a population must be increasing at least slightly to recover.

1.2 Spatial and Temporal Scales of the Jeopardy Analyses

In this biological opinion, the Services look at both short-term and long-term and small and large spatial-scale effects of the proposed action on direct survival at the projects and on habitat and related biological processes. Actions lasting for even a short period of time, or affecting only a small portion of the action area, can have some degree of adverse effect on habitat processes that support numbers, reproduction, and distribution. The Services must use their professional judgment to determine whether this type of adverse effect, when added to the current status of the species and its habitat in the action area (environmental baseline) and to the effects of other foreseeable non-Federal actions (cumulative effects), would be sufficiently significant to constitute jeopardy.

1.3 Application of the Basinwide Strategy in the Absence of Recovery Plans

This opinion is a formal consultation between the Services and FERC as required under Section 7 of the ESA. It is not a recovery plan for any of the species addressed in the opinion. Recovery planning to meet ESA requirements for listed species in the Willamette Basin is underway. Recovery plans for listed species call for quantified de-listing goals, measures necessary to meet those goals, and estimates of the time and cost required to carry out those measures.

In May 2000, NMFS convened a Technical Recovery Team (TRT) to develop de-listing goals for UWR chinook salmon, UWR steelhead, Lower CR steelhead, Lower CR chinook salmon, and CR chum salmon. The TRT expects to have draft products by late fall of 2001. The process of identifying measures needed in each stage of the anadromous salmonid life cycle for recovery of the ESUs will involve additional stakeholders, but a formal group to address that aspect of recovery has not yet been convened.

The USFWS initiated the recovery planning process for five DPSs of bull trout, which includes the CR bull trout DPS, in 1998. The Recovery Oversight Team, made up of state and Federal agency personnel, expects to have a draft recovery plan available by the fall of 2001.

Since 1995, the number of listed anadromous salmonid ESUs in the Columbia Basin has increased from three to 12, including listed UWR chinook salmon and UWR steelhead. The Services and the other seven Federal agencies comprising the Federal Caucus have developed guidelines for basin-level, multi-species recovery planning upon which individual, species-specific recovery plans can be founded. This foundational recovery planning analysis is contained in the document entitled "Conservation of Columbia Basin Fish: Final Basinwide Salmon Recovery Strategy" (hereafter, the "Basinwide Strategy;" Federal Caucus 2000). The Basinwide Strategy is also designed to complement the recovery plans for resident fish, such as bull trout and other aquatic species, and builds on actions already taking place to recover these species. Recovery plans for each individually listed species will provide the particular statutorily required elements of recovery goals, criteria, management actions, and time estimates that are not developed in the Basinwide Strategy.

Until the species-specific recovery plans are developed, the Basinwide Strategy provides the best guidance for judging the significance of an individual action relative to the species-level biological requirements. The concepts in the Basinwide Strategy are thus applied in this opinion. In the absence of full recovery planning for Willamette Basin species, the Services strive to ascribe the appropriate significance of actions to the extent available information allows, and will use the best available science to support measures prescribed to minimize the impact of incidental take of listed species.

1.4 Term of this Biological Opinion

The operation of the Leaburg-Walterville Project, under the 1997 FERC license, as reinstated and amended by FERC on April 27, 2000; the conservation measures as proposed in the BA; and the revised and updated license articles developed by NMFS, USFWS, EWEB, and FERC separated staff, constitute the "proposed action" by FERC. Therefore, the term of this biological opinion is the duration of the new license, 40 years, the period of time during which the project will operate under the terms and conditions of that license. The precise beginning and end dates of the license will be clarified by FERC in its decision on the Offer of Settlement submitted by NMFS, USFWS, and EWEB.

2. Background

This section identifies the ESA-listed species in the McKenzie River subbasin that are included in this opinion. The term "species" in this opinion refers to listable population units under the ESA; either species, subspecies, DPSs, or ESUs. Section 2.1.1 contains USFWS concurrences in response to FERC's "not likely to adversely affect" determinations (FERC 2001) for five of the seven listed species in this opinion, including bald eagle, Northern spotted owl and its designated critical habitat, Canada lynx, Kincaid's lupine, and Bradshaw's lomatium. Because the USFWS has provided concurrences for these five species, they are not further addressed in Chapters 4 through 9. However, any or all of these five species may be addressed in Chapter 10, Conservation Recommendations, which are discretionary measures proposed by the Services. A consultation history is also provided in this chapter, noting the development of the BA and significant meetings. Finally, the ecosystem context, used to evaluate effects of the action on abiotic habitat processes and related biological processes, is described, providing part of the framework for this multi-species consultation.

2.1 Listed Species

A total of seven species occurring in the McKenzie River subbasin are currently listed under the ESA by NMFS or USFWS and are included in this opinion (Table 2-1). The BA (FERC 2001) concluded that the proposed action is likely to adversely affect CR bull trout and UWR chinook salmon and its designated critical habitat, and thus requested formal consultation on these two listed species. The BA concluded that the other five listed species in the action, and the designated critical habitat for one of the species, are not likely to be adversely affected by the action, and requested USFWS concurrence.

Table 2-1. ESA-listed species occurring within the McKenzie River subbasin that are included in this opinion.

Species	ESA Jurisdiction	Listing Status and Federal Register Citation	Critical Habitat Status & Federal Register Citation
Upper Willamette River Chinook Salmon	NMFS	Listed as Threatened: March 24, 1999; 64 FR 14308	Designated February 16, 2000; 65 FR 7764
Bull Trout	USFWS	Listed as Threatened: Columbia River DPS June 10, 1998; 63 FR 31674. Coterminous U.S. November 1, 1999; 64 FR 58910.	None
Canada Lynx	USFWS	Listed as Threatened: March 24, 2000; 65 FR 16051	None
Bald Eagle	USFWS	Downlisted to Threatened: July 12, 1995; 60 FR 36010	None
Northern Spotted Owl	USFWS	Listed as Threatened: June 26, 1990; 55 FR 26194	Designated 50 CFR 17.95(b)
Bradshaw's Lomatium	USFWS	Listed as Endangered: September 30, 1988; 53 FR 38448	None
Kincaid's Lupine	USFWS	Listed as Threatened: January 25, 2000; 65 FR 3875	None

The listing of anadromous salmonids under the ESA is complicated by intraspecific diversity and historical hatchery practices. Populations that meet NMFS' interpretation of the ESA's criteria for a "DPS" are designated as ESUs (NMFS 1991). An ESU is often composed of a seasonal run of both native hatchery- and naturally-produced fish of a given species, located within a discrete geographic area below natural barriers; the Upper Willamette River (UWR) chinook salmon ESU includes hatchery- and naturally-produced spring chinook salmon above Willamette Falls and in the Clackamas River subbasin. However, only the naturally-spawned fish are listed under the ESA because of their small numbers. Most spring chinook that currently pass Willamette Falls are hatchery-produced and these adults are not listed even though they are part of the UWR chinook salmon ESU (64 FR 14308). Fall chinook salmon above Willamette Falls are not native (i.e., they did not occur there naturally before the first fishway was built in 1885). Thus, they are not part of the UWR chinook salmon ESU. In summary, in this opinion, the term "UWR chinook salmon" refers only to the naturally-spawned, spring-run component of the ESU.

2.1.1 Concurrences

2.1.1.1 Canada Lynx

Although several unconfirmed lynx sightings have occurred in the Willamette National Forest (WNF), lynx are considered to be rare to uncommon in this area. Further, the Leaburg-Walterville Project is located in low elevation agriculture and residential lands where lynx are not likely to be present. Information in section 5.4.1 in the BA (FERC 2001) and other available information suggest that the continued operation and maintenance of EWEB's Leaburg-Walterville Project is not likely to negatively impact lynx, and thus the USFWS concurs with FERCs' "not likely to adversely affect" determination for this species.

2.1.1.2 Bald Eagle

Although bald eagles are commonly seen along the McKenzie River, particularly in the winter months, there are no known active nests in proximity to EWEB's Leaburg-Walterville Project (FERC 2001).

In accordance with Article 427 of the Leaburg-Walterville license, EWEB is required to develop a plan, in consultation with the resource agencies, to manage snags created by the Leaburg Lake raise. The snag management plan is expected to have beneficial effects on potential bald eagle habitat in the lower McKenzie River subbasin. Additionally, as required in Article 431, EWEB will implement the bald eagle protection measures identified in the wildlife habitat enhancement and protection plans submitted as supplemental information in the license application, including monitoring the presence of bald eagles in and around the Leaburg-Walterville Project, snag management, and if needed, providing nesting platforms for bald eagles.

Based on the above descriptions, the USFWS concurs with FERC's determination of "not likely to adversely affect" bald eagles for the continued operation and maintenance of EWEB's Leaburg-Walterville Hydroelectric Project.

2.1.1.3 Northern Spotted Owl

No spotted owl nest, activity centers, suitable habitat or designated critical habitat is known to occur in the vicinity of the Leaburg-Walterville Project. The USFWS concurs with FERC's determination of "not likely to adversely affect" Northern spotted owl for the continued operation and maintenance of the Leaburg-Walterville Hydroelectric Project for the duration of the current license.

2.1.1.4 Bradshaw's Lomatium

According to information presented in section 4.6 of the BA, rigorous botanical surveys of the Leaburg-Walterville developments were conducted during the relicensing process in 1991 and no observations of Bradshaw's lomatium were made. Bradshaw's lomatium prefers wet prairie habitats. Because little or no wet prairie habitat exists within the action area of EWEB's Leaburg-Walterville Project, and because available data indicate that the plant does not exist within the action area, the USFWS concurs with FERC's determination that the proposed action is "not likely to adversely affect" Bradshaw's lomatium.

2.1.1.5 Kincaid's Lupine

Botanical surveys associated with the relicensing of the Leaburg-Walterville Project resulted in the detection of a single Kincaid's lupine found on private property less than one mile northwest of Walterville (section 4.7 of the BA). The Kincaid's lupine plant located near Walterville was directly beneath the project transmission line on land with an EWEB powerline easement and in an area that was categorized in the BA as being in the early stages of secondary succession to coniferous forest (FERC 2001). Kincaid's lupine prefer open habitats and thus the progression towards late successional coniferous forest represents a threat to its persistence. EWEB's transmission line vegetation maintenance program will help maintain this site in the early stages of secondary succession, thus providing some protection for this single plant. In addition, EWEB has proposed in the BA to resurvey the area in which the plant was last observed and if found, provide protection by providing maps and training for EWEB maintenance crews to protect the plant during maintenance activities. If new surveys indicate the presence of Kincaid's lupine, EWEB will work with the private property owner to encourage fencing the area around known plants.

Because of the lack of habitat and existing populations of Kincaid's lupine in the vicinity of EWEB's facilities, and because of EWEB's proposed conservation measures outlined above, the USFWS concurs with EWEB's "not likely to adversely affect" determination for Kincaid's lupine.

2.2 Consultation History

On May 7, 1999, EWEB and FERC met with USFWS and on June 28, 1999, EWEB and FERC met with the NMFS to develop an approach for initiating and completing Section 7 ESA consultation on the effects of FERC's licensing actions at EWEB's projects on CR bull trout (listed in 1998), UWR chinook salmon (listed in 1999), and other listed species occurring in the McKenzie subbasin. It was agreed that FERC's BA would address impacts from all three of EWEB's McKenzie River projects on all listed species within the action area, and that the Services would respond with a joint biological opinion. By letters dated June 24, 1999, and October 8, 1999, FERC designated EWEB as its non-Federal representative for conducting the ESA consultation, and as such, EWEB was responsible for developing the BA.

Over the next year, the BA was developed as EWEB provided drafts to the Services, and the Services responded with comments both in writing and in a series of meetings. After reviews of the BA by WNF and the Oregon Department of Fish and Wildlife (ODFW), EWEB approved and sent the document to FERC on December 15, 2000. FERC approved the BA without making any changes, and submitted the BA to the Services on February 14, 2001.

During the development of the biological opinion, the Services, FERC and EWEB simultaneously worked toward revising and updating certain license articles for the Leaburg-Walterville Project with the goal of forwarding those license articles, a settlement offer and an agreement, and the biological opinion on all three of EWEB's projects in the McKenzie subbasin to FERC as a complete package. The revised and updated license articles for the Leaburg-Walterville license and the Article 403-required construction schedule, prepared as part of the package, call for construction activities to begin in 2002. The Services, FERC, and EWEB met on June 15, 2001, to finalize the documents and review the current status of the biological opinion. At the meeting, based on information provided by the USFWS and FERC separated staff, the parties concluded that issuance of a biological opinion that included EWEB's Carmen-Smith and Blue River projects could delay FERC approval of the revised and updated license articles, the settlement offer and agreement and issuance of the biological opinion on the Leaburg-Walterville Project and in turn affect the schedule for construction of certain Leaburg-Walterville facilities. In order to avoid potential construction delays, it was agreed by the parties that the Services would withdraw the Carmen-Smith and Blue River components of the proposed action from the biological opinion, instead issuing a biological opinion on the proposed action at the Leaburg-Walterville Project. The biological opinion for the Carmen-Smith and Blue River projects would be issued at a later date.

The Services sent a draft biological opinion to EWEB and FERC separated staff on July 12, 2001. Following review of the document, FERC separated staff provided comments via e-mail on August 1, 2001, and EWEB provided comments via e-mail on August 2, 2001. These comments were reviewed by the Services and discussed in an August 14, 2001, conference call with EWEB and FERC separated staff.

2.3 Ecosystem Context for this Consultation

As noted in Table 2-1, this biological opinion addresses multiple aquatic and terrestrial species whose current ranges collectively encompass much of the McKenzie River subbasin. The purpose of this opinion is to determine if the proposed action is likely to jeopardize the continued existence of each species, and an ecosystem perspective provides the context for these species-specific analyses. Because dams not only affect passage survival but also alter the physical processes upon which aquatic ecosystems are based, their operation has complex ecosystem-wide effects. The future operation of EWEB's Leaburg-Walterville Project, under their new license, will alter natural habitat processes that, in turn, affect the numbers, distribution, and diversity of the listed species. NMFS commissioned a study, "An ecosystem approach to salmonid conservation" (Spence et al. 1996), to define ecosystem management for anadromous salmonids, which is the source of much of the following discussion.

2.3.1 The McKenzie Subbasin Ecosystem

For this consultation, the ecosystem is defined as the entire McKenzie River subbasin, with an emphasis on streams, riparian areas, and floodplains because the listed species most affected by the proposed action are aquatic. In this opinion, the U.S. Geological Survey's (USGS) hierarchical system of hydrologic unit codes (HUC) is used. This system classifies drainages of different sizes, the largest and 2nd largest of which are regions and subregions (e.g., Pacific Northwest and Columbia River drainage, respectively). Subregions are divided into the 3rd largest unit and called "basins", which are then divided into "4th field HUCs" called "subbasins". The subbasins are further divided into "5th field HUCs" and called "watersheds" and "6th field HUCs" called subwatersheds (UO 1998). USGS's hydrologic terminology considers the Willamette River drainage as a "basin", and 4th field HUCs such as the McKenzie River drainage are considered "subbasins". When this hydrologic terminology is applied to a stream instead of a subbasin or watershed, it refers to the largest stream in the subbasin or watershed (e.g., a "5th field HUC stream" is the largest stream in the 5th field HUC watershed).

Physical processes occur across a large range of temporal scales, such as millions or thousands of years (geological processes, major climate changes) to decades or years (disturbance, annual flow regimes of streams). In order to provide an ecosystem context for this consultation, it is necessary to differentiate between the longer-term (millions or thousands of years) physical processes that are independent of the proposed action, and the shorter-term (years to centuries) physical processes that are potentially influenced by the proposed action. The longer-term physical processes are termed "controls" because they constrain the shorter-term physical processes, as well as chemical and biological processes (Naiman et al. 1992).

2.3.2 Ecosystem Controls

The major physical features of the McKenzie subbasin ecosystem are the result of long-term (millions or thousands of years) geologic and climactic processes, particularly uplift, volcanism, glaciation, and catastrophic flooding. Uplift of the Coast Range and the Western Cascades (i.e., what are now the western foothills of the Cascade Mountains) originally formed the north-south trough of the Willamette Basin, followed by a period of intense volcanic eruptions in the Western Cascades about ten million years ago. As this ancient mountain chain became inactive and began to erode, the High Cascades built up immediately to the east during a period of volcanic activity that lasted from four million years ago to the present (Orr et al. 1992). The fault zone separating the Western and High Cascades is a prominent modern feature of the higher-elevation part of the McKenzie subbasin ecosystem as it forces the normally western-flowing streams into a north-south orientation (e.g., upper McKenzie and South Fork McKenzie rivers, Fig. 1-1).

Climactic changes occurring over thousands of years or longer are thought to be another type of control because the physical features they leave on the landscape constrain shorter-term processes. The most recent ice age in the McKenzie subbasin began about two million years ago, with the last cold, wet climactic interval ending 10,000 to 12,000 years ago. Ice age glaciation resulted in the Codilleran continental ice sheet advancing to northern Washington, with a 1,000-mile long ice lobe jutting from this massive ice sheet along the High Cascades to California. Glaciers hastened erosive processes in the higher elevation part of the McKenzie subbasin by carving and gouging stream valleys and canyons (Orr et al. 1992). As the glaciers periodically receded and advanced during the latter part of the last ice age, massive quantities of gravel, soil, and boulders formerly locked in ice were released and carried by the McKenzie and other rivers through the transfer zone of the Western Cascades. As a result, gravels were deposited on the eastern fringe of the upper Willamette Valley in layers up to 150-feet deep, pushing the upper mainstem of the Willamette River to the western side of the valley (Orr et al. 1992). The sediment production, transfer, and deposition rates of this period were probably much higher (e.g., estimated to be approximately 60 times higher in a Washington stream [Benda et al. 1992]) than during periods not affected by glaciation.

The entire Willamette Valley, including the lower elevations of the McKenzie subbasin, was also affected by periodic floods unleashed by the breaking of ice dams holding back immense lakes in western Montana. Between 15,500 and 13,000 years ago, this spectacular series of at least 40 floods grossly altered the landscape of eastern Washington and the Columbia River gorge through the force of 400 cubic miles of rushing water per flood. During each flood, water backed up into the Willamette Valley, creating a lake extending from Eugene to Portland (where the depth was 400 feet). As the floodwaters periodically filled the valley and drained away, deep layers of silt 50- to 100-feet thick were deposited between Eugene and Salem (Orr et al. 1992). After the glaciers receded for the last time about 10,000 years ago and the heavy sediment load was being dispersed, the climate continued to warm, culminating in a period of drought from about 6,000 to 5,000 years ago. About 4,000 years ago, the climate shifted to the cool, moist conditions that prevail today, resulting in the eventual development of late successional riparian communities along the streams of the McKenzie subbasin and neighboring ecosystems. This had a stabilizing effect and produced habitat conditions favorable to salmonids that endured until European arrival (UO 1998; Lichatowich 1999).

Geology and climate work together to form topographic features such as elevation and drainage network density (number of stream miles per unit area), which in turn exert great influence over shorter-term physical processes like flow regime in the McKenzie subbasin ecosystem. For example, elevation determines if a watershed is snow- or rain-dominated, and drainage network density determines the rate at which streamflow is delivered downstream per unit area because it reflects the porosity of the underlying rocks (i.e., less porous rocks result in more water flowing overland, creating a denser stream network). The importance of such topographic features to flow regime is demonstrated by differences between the High Cascades and Western Cascades: the former are higher elevation and snow-dominated with a low drainage network density, while the latter are lower elevation and rain-dominated with a much higher drainage network density. Consequently High Cascade streams have higher flows through the summer (due to snowmelt), but lower peak flows in the winter (due to greater infiltration into the more porous underlying rocks [Grant 1997]).

2.3.3 Ecosystem Processes

The ecosystem controls described above (geology, climate, and topography) are at the top of the McKenzie subbasin ecosystem hierarchy because they set the bounds within which the shorter term physical, chemical, and biological processes operate. The structure of the current McKenzie subbasin ecosystem - the physical habitats, the material and energy resources, and the associated biological communities - arises from complex interactions among these processes. Physical and chemical processes act in concert with vegetative characteristics to provide the physical and chemical context that regulates the exchange of material and energy within the ecosystem. Biological processes both influence the conversion of material and energy as well as govern the relationship of organisms to one another and to their environment. These physical, chemical, and biological processes interact in a complex manner, and together create the McKenzie subbasin ecosystem (Spence et al. 1996).

For the purposes of this biological opinion, physical and chemical processes are termed "habitat processes." The structure of the current McKenzie subbasin ecosystem is a product of a hierarchy of controls (longer-term geologic and climatic processes), habitat processes, and biological processes, represented in Fig. 2-1. While this is not a strict hierarchy (i.e., certain biological processes affect habitat processes, such as effects of living vegetation on stream channels), in general the habitat processes provide the template for biological processes. Because the habitat and biological processes are the basis of the McKenzie subbasin ecosystem over the temporal scale relevant to EWEB's projects, they are described in more detail below. These descriptions are based on Spence et al. (1996) unless otherwise indicated.

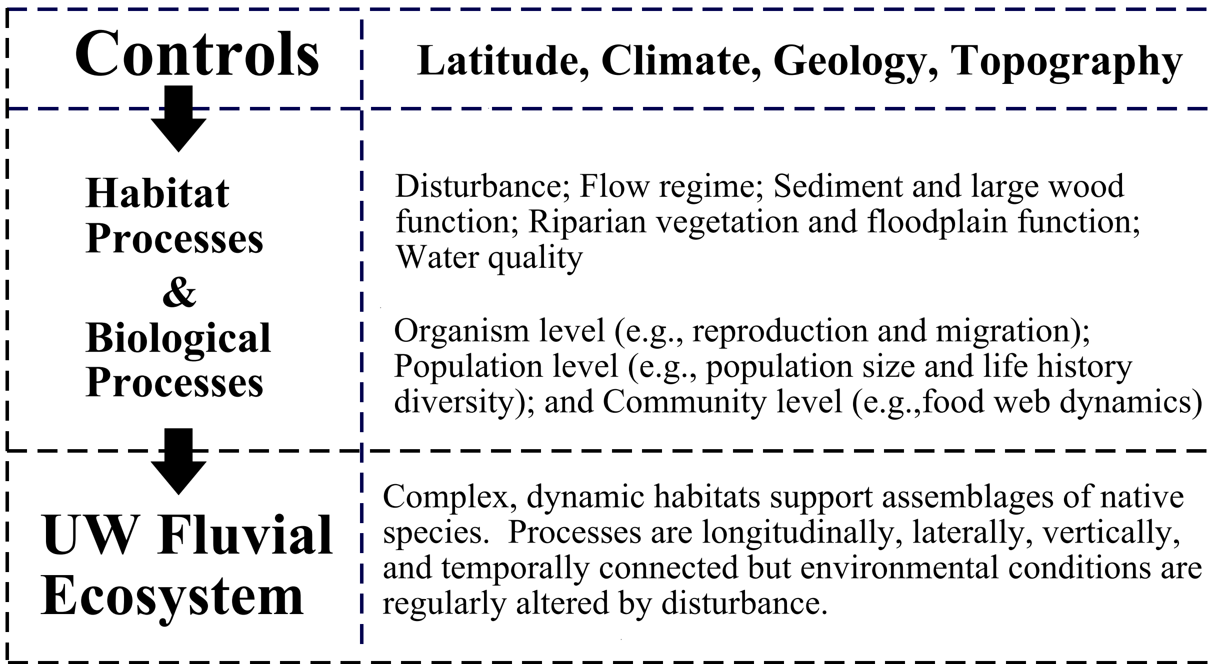

Figure 2-1. Hierarchy of controls and processes that collectively represent the McKenzie subbasin ecosystem on an annual to decadal timeframe.

2.3.3.1 Habitat Processes

Habitat processes on a decadal to annual temporal scale most relevant to the McKenzie subbasin ecosystem are disturbance (major floods, large landslides), flow regime, sediment and LW function, riparian vegetation and floodplain function, and water quality. These processes occur along longitudinal, lateral, and vertical gradients, driven by gravity and water flow (Fig. 2-2). The longitudinal gradient is unidirectional, and the physical and chemical variables (e.g., nutrients, substrate size) within a stream system are hypothesized to change in a predictable way as it flows from headwaters to the ocean (the River Continuum Concept; Vannote et al. 1980). Human impacts to fluvial ecosystems are typically arranged in a predictable way along the longitudinal gradient (Fig. 2-3). The lateral gradient represents the interchange between a stream and its riparian area and floodplain of water, sediment, and nutrients (Petts and Amoros 1996). The vertical gradient for most habitat processes is surface-subsurface, illustrating the connection of the stream and floodplain with the hyporheic zone (the area of subsurface flow) along which water and nutrients are exchanged (Stanford and Ward 1993). For water quality, the vertical gradient includes the air-surface interface due to the influence of solar radiation and convection. The five habitat processes are described below as they would occur in the absence of major human disruption of the McKenzie subbasin ecosystem.

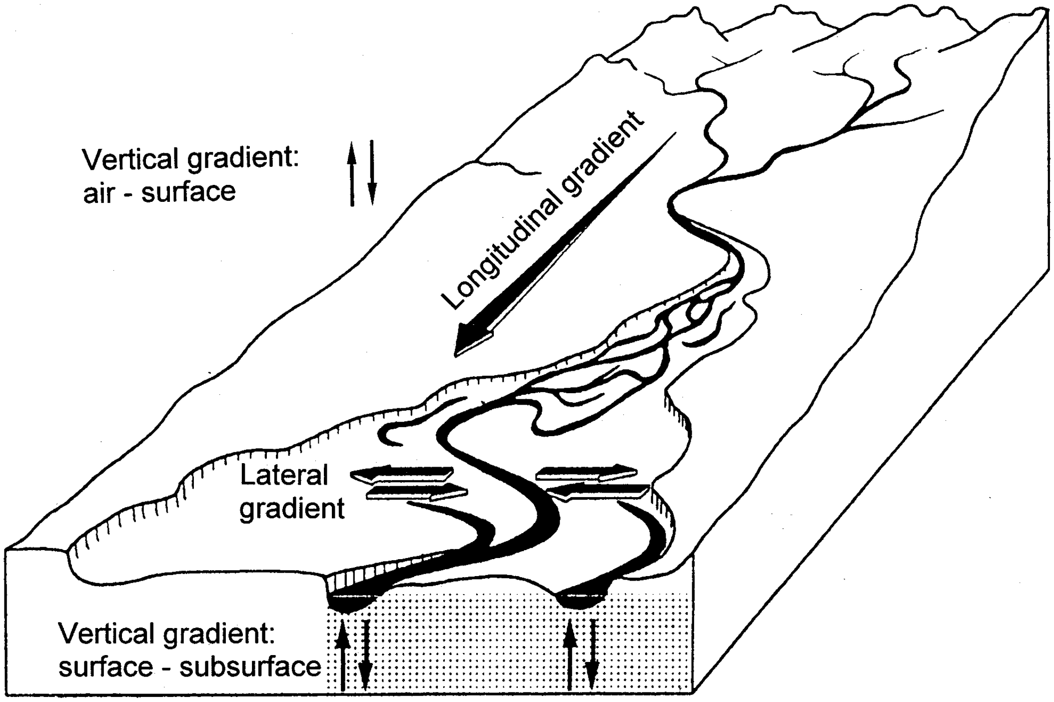

Figure 2-2. The longitudinal, lateral, and vertical gradients of habitat processes within the McKenzie subbasin ecosystem (after Petts and Amoros 1996).

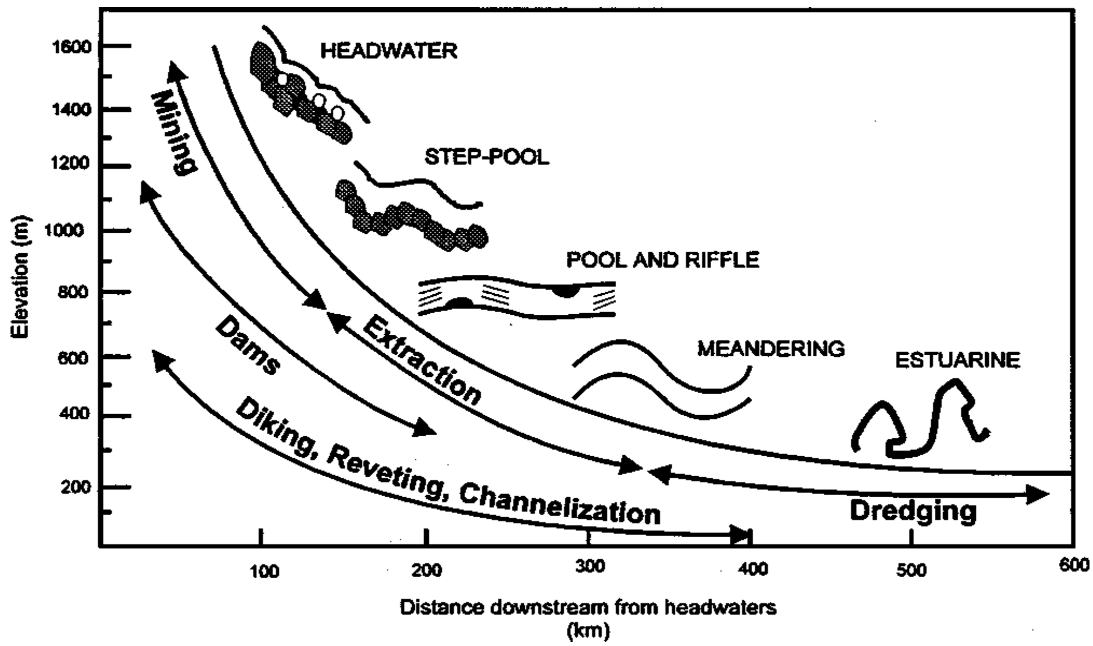

Figure 2-3. Schematic representation of human activities and river morphology along the longitudinal gradient (OWRRI 1995).

2.3.3.1.1 Disturbance

Disturbance is defined here as a natural disruption of 5th field HUC or larger stream channels (Reeves et al. 1995). The 5th field HUC was chosen as the scale of analysis for this opinion for the reason that most of the habitat altering dams that contribute to the effects of the current environmental baseline in the McKenzie River subbasin are located on 5th field stream channels. Stream channels and floodplains of the McKenzie subbasin ecosystem were historically subjected to periodic catastrophic disturbances, after which they moved through a series of recovery states over periods of decades to centuries (Reeves et al. 1995). Such disturbances include ten-year event or greater floods, which affect streams of all sizes; mass wasting (slumps and earthflows), which also affect streams of all sizes but usually have limited effects on larger streams and rivers due to wide floodplains; and vegetation die-offs (due to fire or insect outbreaks) and debris torrents, which primarily affect smaller streams but may have some effects on larger streams and rivers (Swanston 1991; Bisson et al. 1997). The frequency and magnitude of disturbance is thought to vary with stream size; the smaller the stream, the less frequent but more intense the disturbance (Naiman et al. 1992).

Disturbance supplies, transports, and deposits sediment and LW, thereby creating and maintaining stream channel and floodplain complexity over the long-term. The primary role of disturbance in the McKenzie subbasin ecosystem lies in the dynamic quality it provides; as different parts of the ecosystem are disturbed, a mosaic of conditions forms within the ecosystem as disturbed patches develop different conditions than undisturbed patches. The diversity of physical conditions within an ecosystem is positively correlated with ecosystem health, and disturbance is the source of such diversity (Resh et al. 1988; Reeves et al. 1995). While high flows and sediment movement caused by disturbance may cause short-term harm to aquatic organisms (e.g., redd scour), these dynamic processes are needed to perform essential functions for the long-term persistence and vitality of a fluvial ecosystem (Bisson et al. 1997). Thus, disturbance is the key natural process over decades, centuries, and longer for the survival of the McKenzie subbasin ecosystem.

2.3.3.1.2 Flow Regime

The flow regime of a stream is the annual pattern of timing and quantity of flow, and is primarily determined by seasonal precipitation patterns, as modified by soil infiltration, vegetation uptake, and rock porosity. Flow regimes determine the amount of water available for aquatic organisms, the types of habitats available, and the annual disruption patterns of aquatic communities. Peak flows, or flood pulses, drive sediment processes, recharge groundwater aquifers, disperse vegetation propagules, recruit LW into streams, and transport wood downstream. The vital functions provided to a fluvial ecosystem by peak flows are recognized as the Flood Pulse Concept (Junk et al. 1989). The two measures of flow regime used in this opinion are instantaneous peak flow and monthly average flow. Instantaneous peak flow is the highest water level in a single day and monthly average flow is the average flow over a month. In this opinion, the habitat process of flow regime includes instantaneous peak flows with recurrence intervals of less than ten years. Instantaneous peak flows with recurrence intervals of greater than ten years are considered a disturbance process, as described above.

In the McKenzie subbasin, there are two seasons of maximum monthly average flows: rain-induced maxima in the winter and snow-induced maxima in the spring, followed by slowly declining flows and long duration of base flows throughout the summer due to snowmelt. This contrasts with the 4th field HUCs in the lower-elevation Calapooia Mountains south of Eugene, such as the Coast Fork Willamette River, and the mainstem Willamette River, which exhibit a single rain-induced season of maximum monthly average flows in the winter, declining flows in the spring, and short duration of flows in the summer resulting in low base flows. Maximum annual instantaneous peak flows may occur in the winter or spring in either area.

2.3.3.1.3 Sediment and LW Function

Sediment and LW function refers to the process of entry, transport, deposition, and interaction of sediment and LW in a stream channel. On an ecosystem scale over a period of decades or longer, sediment is generally produced in the headwaters, transferred downstream through confined reaches of small to mid-sized streams, and stored in the channels and floodplains of rivers. As with other large rivers originating in the western Cascades, the McKenzie River is narrow and bedrock-confined in its upper reaches before flowing into a broad alluvial floodplain about 30 miles before joining the mainstem Willamette River just north of Eugene. The lowermost floodplain reach is a “wandering gravel-bed river,” characterized by a broad floodplain, multiple meandering channels, and abundant gravel bars and islands. Sediment is the material necessary to maintain the dynamic structure of such rivers, which in turn provides habitats for aquatic animals (e.g., spawning gravels for salmonids) and riparian vegetation (e.g., nutrient-rich silt for plants [Ligon et al. 1995]).

Large wood is provided to stream channels by the continual die-off and undercutting of riparian vegetation, and by the episodic transport of LW from outside the riparian zone by slumps and earthflows. Large wood provides critical structure in all streams of the McKenzie subbasin ecosystem, although its function varies with stream size. Large wood dominates hydraulic processes in smaller streams since trees span the channel, causing pool formation, coarse sediment retention, and streambank scour. In mid-sized streams, LW functions primarily to increase channel complexity and flow heterogeneity by anchoring the position of pools along the thalweg, creating backwater along the stream margins, causing lateral migration of the channel, and increasing depth variability (Abbe and Montgomery 1996). Large wood function in larger gravel bed rivers like the lower McKenzie River is similar, with a greater emphasis on LW-created channel and instream complexity due to the lack of other flow obstructions like boulders (Sedell and Froggatt 1984).

2.3.3.1.4 Riparian Vegetation and Floodplain Function

Riparian vegetation provides numerous physical functions in a fluvial system, including stream shading, stabilizing streambanks, interception of sediments and nutrients, and contributing LW to stream channels (Maser and Sedell 1994). Stream shading intercepts 75% to 90% of solar radiation in the warmer part of the year for mid-sized streams (more for smaller streams, less for larger streams and rivers [Naiman et al. 1992]), thereby moderating stream temperatures. Riparian vegetation stabilizes streambanks during high flows by binding soil with its roots, and the resulting undercut banks increase stream habitat complexity. Riparian vegetation can also intercept sediment from upland sources before it reaches the stream channel. Stems and branches slow the velocity of high flows, reducing erosion and causing deposition of fertile silt in the riparian area. On wide floodplains, vegetation outside of what is commonly thought of as the riparian zone contributes to this function because the floodwaters extend so widely. For example, an early U.S. Army Corps of Engineers' (USACE) report describing the mainstem Willamette floodplain between Eugene and Harrisburg noted the river flooded the dense riparian vegetation to a width of one to two miles and a depth of five to ten feet (USACE 1875, in Dykaar and Wingington 2000). The mouth of the McKenzie River is just upstream of Harrisburg, thus the floodplain along its lower reaches would have also been inundated during a flood of this magnitude.

A stream's floodplain includes the active channel and the riparian areas that are inundated during major floods. The floodplain includes the hyporheic zone (the area of subsurface flow) along which water and nutrients are exchanged. The floodplain is the ecological unit that collectively represents the function (or dysfunction) of disturbance, flow regime, sediment and LW, and riparian vegetation, thus floodplain function is a comprehensive concept that includes all four of these habitat processes. River-floodplain ecosystem integrity is maintained over time by these processes, which interact together to erode near-channel features, and then transport and deposit sediment and LW downstream. Riparian vegetation limits erosion by providing streambank stability and slowing flow velocity, while also providing the source of LW. Generally, greater complexity of flow patterns, stream channels, and riparian vegetation community structure indicates a higher degree of floodplain function. A floodplain with properly functioning habitat processes is dynamic as well as complex, and provides the foundation for all biological interactions within the floodplain ecosystem.

2.3.3.1.5 Water Quality

For the ecosystem context of this opinion, the Services focus on water quality as fluctuations of the following water quality parameters: heat (i.e., water temperature dynamics), dissolved oxygen (DO), hydrogen ions (which control buffering capacity through pH and alkalinity), turbidity, and nutrients (nitrogen, phosphorus, and carbon). These processes together constitute overall water quality, a fundamental component of the fluvial ecosystem that effectively integrates the physical and biological processes (Hem 1985, cited in Spence et al. 1996). The water quality parameters considered most important for the ecosystem context of this opinion are water temperature dynamics and nutrient cycling.

Because most aquatic organisms are poikilothermic (body temperature and metabolic demands determined by temperature of the environment), water temperature plays a fundamental role in the McKenzie subbasin ecosystem. Heat energy is transferred to and from streams by solar radiation, convective mixing with air, evaporation, conduction with the stream bed, and mixing with inflow from groundwater or tributary streams. Solar radiation, convection, and evaporation occur along the vertical air-surface gradient, stream bed conduction and groundwater inflow occur along the vertical surface-subsurface gradient, and tributary inflow occurs along the longitudinal gradient (Fig. 2-2). These processes occur in all streams, but the importance of each process on stream temperatures varies with stream size, season, and stream channel characteristics.

In the 5th field HUC and smaller streams of the McKenzie subbasin ecosystem, solar radiation and inflow from groundwater and tributaries are the dominant influences on stream temperatures, particularly during the summer. As stream size increases, convection, evaporation, and conduction become more important because their surfaces and banks are less insulated by riparian vegetation, but groundwater inflow during the summer moderates water temperature increases. In streams of all sizes, channel characteristics may also significantly affect water temperature dynamics. Wide, shallow streams are more affected by solar radiation, convection, and evaporation; consequently they heat and cool more rapidly than relatively deep, narrow streams.

Phosphorus, carbon, and nitrogen are primary nutrients required by plants and animals to make tissue. Given adequate levels of light, temperature, and water, these nutrients control the amount of primary production in an ecosystem, which in turn determines the productivity of invertebrates and vertebrates. Small streams in many forested watersheds of the McKenzie subbasin ecosystem typically have very low concentrations of nitrogen, thus it is more likely to be the limiting nutrient in these watersheds (Triska et al. 1984). Nitrogen exists in solution as both inorganic and organic forms, transformed from one form to another and back again largely through biotic processes that together make up the nitrogen cycle.

Anadromous salmonids are an important source of nitrogen to watersheds across their ranges, especially in nitrogen-poor volcanic geologies like the Cascade Mountains (Cederholm et al. 1999; Gresh et al. 2000). This marine-derived nitrogen is heavily used by terrestrial plants and animals as well as aquatic organisms (Bilby et al. 1996; Willson et al. 1998; Hilderbrand et al. 1999). The longitudinal gradient of a fluvial ecosystem (Fig. 2-2) strongly influences patterns of nutrient cycling, including nitrogen; a complete cycle of a nitrogen molecule depends on the distance it is carried in its dissolved or particulate form downstream by streamflow before being consumed and returned to the dissolved or particulate form through the nitrogen cycle. This unidirectional cycling of nutrients in streams has been termed the Nutrient Spiraling Concept (Newbold et al. 1982), and it illustrates how salmon carcasses in the upper reaches of watersheds provide an important source of nitrogen for downstream areas.

2.3.3.2 Biological Processes

The habitat processes described above form the template upon which the biological processes at all levels (organism, population, community) in the McKenzie subbasin ecosystem are organized. The spatial and temporal patterns of water flow, sediment, vegetation, water quality, and dissolved materials influence characteristics of individual organisms, populations, and communities: at the organism level, physiological and behavioral characteristics such as respiration, feeding, growth, reproduction, and migration; at the population level, the diversity of populations and life history types, and at the community level, competition, predation, disease, parasites, and the food web (Fig. 2-1). The major biological processes at each of these three levels are briefly described below, primarily from a fish perspective.

2.3.3.2.1 Organism Level

The survival of an individual organism depends on its ability to carry out the basic physiological and behavioral functions of respiration, feeding, growth, reproduction, and in the case of many animals, migration to suitable habitats for different life history stages. Respiration by aquatic animals is carried out in an environment containing an average of only 3% of the oxygen available in air, plus DO levels in water fluctuate an order of magnitude depending on temperature and mixing (unlike the stable oxygen levels in air), thus the physiology of an aquatic species allows efficient extraction of oxygen as well as habitat preferences that reflect oxygen demands. Feeding and growth rates of fish and other poikilotherms are strongly affected by temperature and DO, increasing up to a thermal optimum and DO saturation. Above the thermal optimum, feeding decreases and metabolic demands increase, combining to reduce growth rate. Energy reserves must be sufficient after growth and metabolic demands to allow for gamete production and breeding in order to successfully reproduce.

Some organisms in the McKenzie subbasin ecosystem have complex life histories requiring different types of habitat for each life history stage. As the organism matures from one stage to the next, it must undergo a migration to the required habitat. This is particularly true of anadromous salmonids, as they migrate from the subsurface interstitial spaces between gravels to the stream substrate (fry emergence), to stream margins and backwaters (freshwater rearing), to estuaries and the ocean (growth and maturation), back to the stream gravels (spawning). Such lengthy and continuous migrations require abundant energy to cover great distances, negotiate barriers, avoid predators, and undergo the physiological adaptations needed to move between freshwater and saltwater.

2.3.3.2.2 Population Level

Soulé (1987) defines a minimum viable population (MVP) (Shaffer 1981) as a population that is sufficiently abundant and well adapted to its environment that it will persist in the long term without significant artificial demographic or genetic manipulations. Meffe and Carroll (1994) define an MVP as "the smallest isolated population size that has a specified percent chance of remaining extant for a specified period of time in the face of foreseeable demographic, genetic, and environmental stochasticities, plus natural catastrophes." NMFS has developed a similar concept for viable salmonid populations (VSP) (McElhany et al. 2000). Though the VSP concept shares many features with the MVP concept, the two differ in several important ways. First, abundance has been the primary factor used in defining an MVP (Soulé 1987). NMFS defines VSP, on the other hand, by a variety of parameters, including population growth rate, population spatial structure, and diversity. Second, VSPs, unlike MVPs, include not just minimally viable populations, but more robust populations as well. Finally, the VSP concept is specifically tailored for use with Pacific salmonids and thus emphasizes parameters and criteria that are particularly relevant to this group of species.

Population abundance is an important determinant of risk, both by itself and in relationship to other factors. There are a variety of risks associated with the demographics of small populations, including both directional and random effects. Directional effects include two forms of population density-dependence: compensation and depensation. Random effects on population dynamics include demographic stochasticity, environmental stochasticity, and catastrophes (Gilpin 1987; Lande 1993). Small populations also lose adaptive variation and gain maladaptive variation at higher rates than large populations (Mills and Smouse 1994; Lande 1995; Schultz and Lynch 1997), both phenomena generate lower average fitness and a higher probability of extinction. Finally, if populations are declining due to deterministic effects (e.g., habitat degradation or overharvest), population abundance combined with measures of trends and productivity can be an indicator of how long it will take the population to reach a critically low abundance level (Caughley 1994). Given these considerations, it is clear that risk tends to vary inversely with abundance, if other factors are held constant.

In a spatially and temporally varying environment, there are three general reasons why diversity is important for species and population viability: diversity allows a species to use an array of environments and protects a species against short-term spatial and temporal changes in the environment, and genetic diversity provides the raw material for surviving long-term environmental changes (McElhany et al. 2000). Many species of plants and animals are made up of diverse populations, providing viability in response to changing environmental conditions over the short-term and the raw material for evolution over the long-term (Magurran 1999). In the McKenzie subbasin ecosystem, this is true of such keystone species as Douglas fir (Spies and Franklin 1991) and chinook salmon (Lichatowich 2000). Recognizing variation at different scales within a single species is essential to understanding ecological and evolutionary patterns and processes (Willson 1997). Variation between a species' populations (interpopulation variation, sometimes also called "among-population" or "geographic" variation [Thompson 1994]) and within individual populations (intrapopulation variation, sometimes also called "within-population" variation [Healey and Prince 1995]) is illustrated by the relatively well-studied Pacific anadromous salmonids. This is shown by the life history, physiological, and morphological examples of inter- and intrapopulation variation given below.

Wide-ranging species such as chinook salmon and bull trout can be divided into groups of populations termed by NMFS as "ESUs"[2] (NMFS 1991; Waples 1991), and "DPSs" by the USFWS. ESUs are usually defined by general location and timing of spawning; e.g., Sacramento River winter chinook salmon and Mid-Columbia River spring chinook salmon are separate ESUs within a single species. Each ESU is in turn made up of several populations that spawn in different drainages; e.g., Mid-Columbia River spring chinook salmon spawn in the Yakima, John Day, and other rivers. Each ESU and population is adapted to the conditions in its spawning drainages (Groot and Margolis 1991). Examples of such variation include unique physiological and morphological characteristics; spring chinook and summer steelhead ESUs that have evolved with the pathogen, *Ceratomyxa shasta*, are far more resistant to it than those that have not evolved with the pathogen. Likewise, ESUs of coho salmon show a range of adult adaptations depending on spawning migration conditions; ESUs with longer migrations have superior swimming duration, and those that migrate up higher velocity rivers have more streamlined bodies and larger fins. Such different adaptations between ESUs (and between populations within a single ESU) are examples of interpopulation variation.

Each population within an ESU is further divided into subpopulations characterized by slightly different life histories that take advantage of the range of conditions in a given drainage; e.g. Lichatowich et al. (1995) describes six life history types for Yakima spring chinook salmon (an example of intrapopulation variation). Intrapopulation variation in anadromous salmonids can also take the form of different sizes at maturity (Holtby and Healey 1986), mate selection strategies (Healey and Prince 1995), and probably other life history, physiological, and morphological traits. Intrapopulation variation in the life history of Yellowstone cutthroat, a nonanadromous salmonid species, has been demonstrated by Gresswell et al. (1994).

The USFWS considers three elements in a decision regarding the status of a possible DPS as endangered or threatened under the ESA (63 FR 31647). These are applied similarly for additions to the lists of endangered and threatened wildlife and plants, reclassification, and removal from the lists: (1) discreteness of the population segment in relation to the remainder of the species to which it belongs; (2) the significance of the population segment to the species to which it belongs; and, (3) the population segment's conservation status in relation to the ESAs standards for listing (i.e., is the population segment, when treated as if it were a species, endangered or threatened?).

The DPS policy, published on February 7, 1996 (61 FR 4722), is intended for cases where only a segment of a species' range needs the protections of the ESA, rather than the entire range of a species. Although the five listed threatened bull trout DPSs are disjunct and geographically isolated from one another with no genetic interchange between them due to natural and man-made barriers, collectively, they include the entire distribution of the bull trout in the

[2] The term "metapopulation" is not used in this document due to its ambiguity - see NMFS (2000a) for explanation of classic and contemporary usage.

coterminous United States. In accordance with the DPS policy, the USFWS authority to list DPSs is to be exercised sparingly. Thus a coterminous listing is appropriate in this case. In recognition of the scientific basis for the identification of these bull trout population segments as DPSs, and for the purposes of consultation and recovery planning, the USFWS will continue to refer to these populations as DPSs. These DPSs will serve as interim recovery units in the absence of an approved plan.

2.3.3.2.3 Community Level

According to current ecological theory, within biotic communities such as those in the McKenzie subbasin ecosystem, species and assemblages of species directly interact with one another in the form of predator-prey, competitor, and disease- or parasite- host relationships. In addition, many indirect interactions may occur among species. For example, predation of one species on another may enhance the ability of a third species to persist in the community by releasing it from predatory or competitive constraints. These interactions together make up the food web, and they continually change in response to shifting environmental and biotic conditions.

The food energy available to animals originates from either living plants (e.g., phytoplankton, macrophytes) or organic detritus (e.g., leaf litter, animal carcasses), which together form the basis of the food web in a biotic community. The invertebrates and other animals that consume the plants and detritus form the prey base for a host of predators, including fishes, birds, mammals, reptiles, and amphibians, which in turn provide detritus through excretion and their carcasses. The resulting food web is probably vastly more complex in the McKenzie subbasin ecosystem than this simplistic sketch, and it consists of many species representing several trophic levels. Food webs are constantly modified by the cyclic and episodic dynamics of the physical and chemical processes in the ecosystem. For example, seasonal changes in the flow and sediment regimes cause fluctuations in the quantity and quality of living plants and organic detritus, creating favorable or unfavorable conditions for individual invertebrate species at a given point in time.

2.3.4 Application of the Ecosystem Context in this Biological Opinion

The above description of the McKenzie subbasin ecosystem provides context for this opinion by demonstrating the importance of ecosystem controls and processes. Because ecosystem controls such as geology, climate, and topography are beyond the influence of the EWEB projects and biotic communities reflect the gradients of habitat processes (Figs. 2-2 and 2-3), the latter are the logical focal point of this opinion. The function of each of the five habitat processes, and their connectivity along the longitudinal, lateral, and vertical gradients thus form the basis for the organization of this opinion. Hence, conditions under the environmental baseline and the analysis of effects of the proposed action will first be considered in terms of habitat processes. This will provide an ecologically sound means of evaluating the baseline for, and the effects of the proposed action on, each of the individual species considered in this opinion.

The process-based approach used in the ecosystem context for this opinion is encouraged by the current leaders of applied aquatic science in the Pacific Northwest and elsewhere. For example, it is the basis of the watershed management and restoration strategy ("aquatic conservation strategy") of the Northwest Forest Plan (USDA and USDI 1994). Also, the Independent Science Group has published a process-based approach ("normative river concept") for Columbia River salmon management and restoration (ISG 1996, 1999). Stanford et al.'s (1996) "protocol for restoration of regulated rivers" provides similar guidance.

3. Proposed Action

The operation of the Leaburg-Walterville Project, under the 1997 FERC license, as reinstated and amended by FERC on April 27, 2000; the conservation measures as proposed in the BA; and the revised and updated license articles developed by NMFS, USFWS, EWEB, and FERC separated staff, constitute the "proposed action" by FERC. This is the subject of this ESA Section 7 consultation. The components of the proposed action are described below, following a brief project description. The proposed action no longer includes activities at EWEB's Carmen-Smith or Blue River projects for the reasons described in section 2.2, Consultation History. The action area is described in section 5.1.

3.1 Leaburg-Walterville Project

3.1.1 Project Description

The design and operation of the Leaburg-Walterville Hydroelectric Project, described in detail in the BA (FERC 2001) and hereby incorporated by reference, are briefly summarized below. The project consists of the Leaburg-Walterville developments, two separate hydroelectric facilities operated independently of one another. The Leaburg Dam and powerhouse are approximately 28 and 23 miles, respectively, east of the Eugene/Springfield metropolitan area. The Walterville Canal intake and powerhouse are approximately 17 and 13 miles, respectively, east of the metropolitan area.

The Leaburg development was completed in 1930 and consists of a dam, a 5-mile-long, 15-foot deep unlined canal (Leaburg Canal), forebay, penstocks, powerhouse, tailrace, and substation. Leaburg Dam is a reinforced concrete and steel structure approximately 400 feet long and 22 feet high. The dam is equipped with three 100-foot by 9-foot rollgates, a sluice way, and intake gates that divert water from the McKenzie River. The impounded area behind the Leaburg Dam (Leaburg Lake) extends about 1.5 miles upstream and covers an area of about 57 acres. Water diverted at the dam for power generation passes through a downstream migrant fish screen facility and enters the Leaburg Canal leading to the Leaburg forebay and powerhouse. The downstream migrant fish screen structure is located near the head end of the canal and consists of three steel V-shaped screen bays.

The Walterville development was completed in 1911, and consists of a headworks, a 4-mile-long, 14-foot deep unlined canal (Walterville Canal), a pumped storage pond, a forebay, a penstock, an automated powerhouse, a tailrace, and a substation. Water inflow to the canal is controlled by a headworks structure containing two 13-foot by 20-foot taintor gates. At most river flows, water from the McKenzie River is diverted by gravity without the use of a dam or river obstruction. The cut-and-fill unlined canal, widened and deepened in 1949 to its present dimensions, originates on the right bank (facing downstream) of the McKenzie River and flows westerly into the forebay. Water is returned from the powerhouse to the McKenzie River through a two-mile tailrace canal, part of which is an old meander channel of the river.

The Leaburg-Walterville Project is operated on a base load, run-of-the-river basis. River flows are partially controlled upstream by USACE facilities. Under normal operation, approximately 2,500 cfs is diverted into either project canal from the McKenzie River, with the balance of flow (in compliance with minimum flows imposed by FERC license conditions) continuing down the main river channel. As flows recede, diversion into the canals is reduced to maintain the licensed minimum in the river or minimum flows stipulated in an agreement reached voluntarily by EWEB with ODFW. The Leaburg-Walterville Project diverts water from two sections of the McKenzie River: (1) a 5.8-mile stretch of river between the Leaburg Dam and the point of confluence with the Leaburg tailrace, referred to as the Leaburg bypass reach; and (2) a 7.3-mile section between the Walterville intake and the point of confluence with the Walterville tailrace, referred to as the Walterville bypass reach.

The Leaburg development is equipped with a fish ladder and screen operated year-round to allow passage of fish both upstream and downstream around the dam. The ladder needs occasional cleaning, which usually can be accomplished with a one- or two-day shutdown. Routine maintenance is scheduled at times of lowest upstream fish migration. The Walterville development does not have a fish screen at the canal intake. Canal flow restrictions and/or complete intake closures are used to provide some protection to downstream migrating juvenile salmon.

3.1.2 Proposed Action at Leaburg-Walterville

The operation and maintenance of the Leaburg-Walterville Project is currently governed by the March 24, 1997, license, subsequent FERC Orders, and an agreement that has been reached between EWEB and ODFW. The Walterville development previously received a license on May 23, 1967, and the Leaburg development received a license on June 3, 1968. FERC issued the existing license for the combined developments on March 24, 1997. A subsequent Order on rehearing (November 26, 1997) resulted in a minor modification of the license terms. The final license was appealed to the Ninth Circuit Court of Appeals (American Rivers et al. vs. FERC). The Ninth Circuit vacated the new license and subsequent Order and remanded the case to FERC. On April 27, 2000, in response to the remand order, FERC issued an order reinstating the March 24, 1997, license, as revised by the Order on Remand, and amended the license by adding appendices containing the conditions submitted as fishway prescriptions by the USFWS and by NMFS during the licensing proceeding. As described in Section 2.2, Consultation History, NMFS, USFWS and EWEB have discussed and agreed upon revised draft license articles to replace Appendices A and B of the April 27, 2000, Order on Remand, as part of a settlement package submitted to FERC.
The operation of the Leaburg-Walterville Project, under the 1997 FERC license, as reinstated

and amended by FERC on April 27, 2000; the conservation measures as proposed in the BA; and the revised and updated license articles developed by NMFS, USFWS, EWEB, and FERC separated staff, constitute the "proposed action" by FERC. Whereas this proposed action includes construction activities, the effects of which are taken into account in this biological opinion, the details of that construction have not been developed in sufficient detail and will be the subject of further consultation with the USACE.

In issuing a license for a project under the Federal Power Act (FPA), FERC is to approve a project that is "best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of water-power development, for the adequate protection, mitigation, and enhancement of fish and wildlife (including related spawning grounds and habitat), and for other beneficial public uses, including irrigation, flood control, water supply, and recreational and other purposes referred to in section 797e of this title" (16 USC 803(a)(1)). The FPA also directs that FERC, in issuing a license for power and development purposes, shall give equal consideration to the purposes of energy conservation, the protection, mitigation of damage to, and enhancement of fish and wildlife (including related spawning grounds and habitat), the protection of recreational opportunities, and the preservation of other aspects of environmental quality (16 USC 797 (e)). In issuing the license for the Leaburg-Walterville Project, FERC determined that the purposes of the project were to: 1) address the regional need for cost-effective, nonpolluting, renewable energy, 2) address a need for fish protection and enhancement measures, 3) address the need for McKenzie River adequate minimum flows in the project bypass reaches to enhance fish, recreation and aesthetic values, 4) address the need to protect and to enhance recreation opportunities, 5) address the need to protect riparian wildlife habitat and to preserve other natural resources, and 6) conserve nonrenewable fossil fuels and reduce the emission of byproducts caused by the combustion of fossil fuels (FERC 1996). Regarding the minimum flow established in the license, FERC determined that the purposes of the project were to improve fish habitat across a broad spectrum of fish species and life stages, to optimize river recreation and to provide for power production (FERC 1996).

The 1997 license, as reinstated and including the proposed amended articles per the settlement agreement, reflects these purposes by authorizing EWEB to continue to operate and maintain the Leaburg-Walterville Project in accordance with a series of license articles, briefly summarized below:

- Article 401 - Requires that EWEB develop a plan to control erosion, to control slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities. The plan shall be implemented following Commission approval.

- Article 402 - Requires that EWEB obtain information to identify the location and designation of any geodetic control monuments that may be affected by the project within 120 days of license issuance.[3]

- Article 403 - Requires EWEB to develop and submit a construction plan for all inriver construction activities, which minimizes potential impact to aquatic resources in the McKenzie River, within one year of license issuance.[4] The plan shall be implemented following resource agency and Commission approval.

- Article 404 - Requires EWEB, within one year of license issuance, to submit a plan to protect Oregon State Highway 126 from encroachment caused by raising Leaburg Lake.

- Article 405 - Requires EWEB, within two years of license issuance, to develop and submit a final design plan for raising the water level of Leaburg Lake by 1.5 feet. The plan shall be implemented following Commission approval.

- Article 406 - Requires EWEB, within one year of license issuance, to develop and submit a plan to dispose of the Walterville tailrace excavation material in such way as to avoid impacts to wetlands, riparian vegetation, and accidental introduction of sediments to the Walterville Canal and McKenzie River. The plan shall be implemented following Commission approval.

- Article 407 - Requires that EWEB, within one year after raising Leaburg Lake, correct all adverse effects on adjoining private property. Corrections are to include, but not be limited to, reengineering shoreline bulkheads, restoring damaged landscape features, and relocating or replacing shoreline recreation facilities. EWEB may also compensate any affected landowners for the reasonable value of adverse effects.

- Article 408 - Requires EWEB, within one year of license issuance, to develop and submit a traffic management plan for construction at Leaburg Dam to minimize traffic congestion and inconvenience to local residents and state hatchery personnel.

- Article 409 - Requires EWEB to implement measures to restore any septic system around Leaburg Lake to proper working condition (or replace the system) within 6 months of

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[3]FERC has, in certain license articles, used the term 'license issuance' as the date from which to measure the period during which EWEB must perform certain activities (e.g., within 1 year or 18 months of license issuance). However, the date intended by 'license issuance' is presently uncertain. To resolve this uncertainty, for purposes of this biological opinion only, the term 'license issuance' shall mean the final date on which this biological opinion is signed by the Services. This is pertinent when analyzing the effects of the proposed action (in Chapter 6) and for setting the terms and conditions of incidental take (Chapter 9).

[4]Article 403 includes a construction schedule which is included in this biological opinion as Appendix A.

being notified that a problem exists with the system that was created by the rising groundwater levels associated with raising the lake.

- Article 410 - Walterville Diversion Dams: The licensee shall construct, operate and maintain rock drop water diversion structures associated with the Walterville Diversion as specified in the documents entitled "Volume 1 - Technical Specifications, Walterville Fish Screen Project, May, 2001" and "Volume 2 - Drawings, Walterville Fish Screen Project, August, 2000."

  The licensee shall submit a final design plan for the water diversion structures within 18 months of license issuance after consultation with the U.S. Department of Interior (Interior), U.S. Department of Commerce (Commerce) and Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the final design plan with the Commission. The licensee shall include with the final design plan documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed final design plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the final design plan. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall complete construction of the Walterville diversion structures by the date identified in the licensee's construction schedule (Appendix A), approved pursuant to Article 403.

  The licensee shall submit a plan for the monitoring and maintenance of the water diversion structures, such that these structures will continuously function according to the requirements of the final design plan, no less than 120 days prior to the scheduled completion date of the water diversion structures, consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with the U.S. Department of Interior (Interior), U.S. Department of Commerce (Commerce) and Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The monitoring and maintenance plan shall include monitoring of sediment accumulation at the rock drop diversion structures. It shall also allow Interior, Commerce and ODFW access for inspection after construction and throughout the term of the license, and provide for the licensee to make necessary adjustments to return the structures to proper function within a reasonable time after deficiencies are identified, consistent with the scope and nature of the deficiencies. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the monitoring and maintenance plan with the Commission. The licensee shall include with the monitoring and maintenance plan documentation of consultation with all agencies and approval by

Interior and Commerce, copies of comments and recommendations on the completed monitoring and maintenance plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the monitoring and maintenance plan. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall implement the monitoring and maintenance plan.

- Article 411 - Requires EWEB to maintain instantaneous minimum flows immediately downstream of Leaburg Dam and the Walterville intake at a continuous level of 1,000 cfs.

- Article 412 - Requires EWEB to develop and implement a gravel augmentation plan downstream of Leaburg Dam to enhance spawning habitat.

- Article 413 - Requires EWEB to develop and implement a fish habitat enhancement plan.

- Article 414 - Requires EWEB to operate the project to meet a seasonal set of project-caused ramping rate criteria in the river to prevent fish stranding.

- Article 415 - Requires EWEB to develop and implement a plan for monitoring compliance with the ramping rate criteria.

- Article 416 - Walterville Fish Screen Facility, Walterville Tailrace Barrier, Leaburg Fish Screen Cleaning System, Leaburg Bypass Modifications, Leaburg Left Bank Ladder Modifications, Leaburg Right Bank Fish Ladder, Leaburg Powerhouse Tailrace Barrier. To provide for safe and effective passage of anadromous fish past project features, the licensee shall complete the following facilities by the date identified in the licensee's construction schedule to be filed and approved pursuant to Article 403:

  % Construct, operate and maintain juvenile fish screens in the Walterville Canal, in accordance with the facilities plan contained in "Volume 1 - Technical Specifications, Walterville Fish Screen Project, May 2001" and "Volume 2 - Drawings, Walterville Fish Screen Project, August 2000." As an interim measure to reduce the potential for entrainment of juvenile salmonids into the Walterville Canal, the licensee shall continue implementing the operational provisions in "Intergovernmental Agreement for Certain Interim Fish Protection Measures" between the licensee and ODFW effective December 10, 1996, until the time the licenseee completes construction of juvenile fish screens.

  % Construct, operate and maintain an adult barrier at the terminus of Walterville Tailrace in accordance with the facilities plan contained in "Volume 1 - Technical

Specifications, Walterville Tailrace Barrier Project, May 2001" and "Volume 2 - Drawings, Walterville Project Tailrace Barrier, May 2001".

% Modify, operate and maintain the Leaburg fish screen cleaning system and/or modify system operations and maintenance in accordance with a facilities plan to provide clean, submerged screen area adequate to protect juvenile fish passing through this facility. The plan shall include modifications to clean the entire submerged screen area or other measures that provide equivalent or better protection of juvenile fish passing through the facility.

% Modify, operate and maintain the structure of the Leaburg fish return bypass conduit and/or the operations and maintenance for the Leaburg Canal in accordance with a facilities plan that meets the objectives of: 1) providing adequate inspection access to the bypass conduit at points where debris can accumulate; and 2) providing simple access for the purpose of debris removal, to reduce the potential for injury or mortality of fish subjected to debris accumulations currently undetectable under normal operations.

% Modify, operate and maintain the Leaburg left bank fish ladder in accordance with the facilities plan contained in "Volume 1 - Technical Specifications, Leaburg Dam - Right Bank Fish Ladder Reconstruction and Left Bank Fish Ladder Modifications, May 2001" and "Volume 2 - Drawings, Leaburg Dam - Right Bank Fish Ladder Reconstruction and Left Bank Fish Ladder Modifications, December 2000." The facilities plan for the modification, operation and maintenance of the upper ladder weirs shall be submitted in conjunction with the Leaburg lake raise design pursuant to Article 405 (as indicated in letter dated July 10, 2001 from licensee to Commerce and Interior) and shall meet the objective of maintaining ladder flow and hydraulic drop per pool consistent with conditions in existence before the lake raise.

% Construct, operate and maintain the Leaburg right bank fish ladder in accordance with the facilities plan contained in "Volume 1 - Technical Specifications, Leaburg Dam - Right Bank Fish Ladder Reconstruction and Left Bank Fish Ladder Modifications, May 2001" and "Volume 2 - Drawings, Leaburg Dam - Right Bank Fish Ladder Reconstruction and Left Bank Fish Ladder Modifications, December, 2000."

% Construct, operate and maintain an adult barrier at the terminus of Leaburg tailrace in accordance with a facilities plan referencing the concepts identified in the NMFS' Working Technical Paper entitled "The Use of Barriers to Prevent Adult Salmon Delay and Injury at Hydroelectric Powerhouses and Waterways," dated November 19, 1993. As an interim measure to reduce the potential for delay in the upstream migration of adult spring chinook salmon associated with the Leaburg tailrace, the licensee shall continue implementing periodic shutdowns of the flow into the Leaburg powerhouse until the time the licensee completes construction of the adult barrier. During the upstream migration of adult salmon in May to September, the licensee shall make a daily visual count of the number of adult salmon in the tailrace immediately below the Leaburg powerhouse where salmon can concentrate. If the licensee counts 50 or more adult salmon each day for 5 consecutive days, the licensee shall schedule a shutdown of flow into the powerhouse as soon as reasonably practicable. The licensee shall schedule the shutdown overnight from dawn to dusk to coincide with the period of greatest potential adult movement in the river unless another period of time would achieve grater adult movement. The shutdown shall consist of eliminating flow into the powerhouse and directing the flow into the siphon-hole outlet of the Leaburg Canal located upstream within a quarter-mile of the tailrace confluence. The licensee shall make a record of its daily visual counts and make that record available to Interior, Commerce, and the ODFW upon request. The licensee shall conduct operations to ensure that adult salmonids are not stranded below the siphon-hole outlet. The licensee shall coordinate the operations with the ODFW.

The licensee shall submit the facilities' plans within 18 months of license issuance after consultation with Interior, Commerce, and Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the facilities' plans with the Commission. The licensee shall include with the facilities' plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed facilities' plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the facilities' plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall complete construction of the facilities by the dates identified in the licensee's construction schedule approved pursuant to Article 403.

The licensee shall submit plans for the monitoring and maintenance of the facilities to ensure that they will continuously function according to the design objectives, no less than 120 days prior to the scheduled completion date of each facility, consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and ODFW and approval by Interior and Commerce. The monitoring and maintenance plans shall allow Interior, Commerce and ODFW access for inspection after construction and throughout the term of the license, and provide for the licensee to make necessary adjustments to return the facilities to effective performance within a reasonable time after deficiencies are identified, consistent with the scope and nature of the deficiencies. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the monitoring and maintenance plans with the Commission. The licensee shall include with the monitoring and maintenance plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed monitoring and maintenance plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the monitoring and maintenance plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall implement the monitoring and maintenance plans.

- Article 417 - Post-installation evaluations, modifications, operation and maintenance of tailrace barriers: Within one year after each facility is fully operational, consistent with the licensee's construction schedule approved pursuant to Article 403, or as otherwise specified in the evaluation plans and agreed to by the U.S. Department of Interior (Interior) and U.S. Department of Commerce (Commerce), the licensee shall conduct hydraulic and biological evaluations of the tailrace barriers at the Leaburg and Walterville tailraces. The licensee shall consult with Interior and Commerce with respect to any deficiencies identified as a result of the evaluations and undertake corrective actions in a time and manner appropriate to the scope and nature of the deficiencies.

  The licensee shall submit the evaluation plans at least 120 days before each facility is scheduled to be fully operational consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and the Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the evaluation plans with the Commission. The licensee shall include with the evaluation plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed evaluation plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the evaluation plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall complete evaluation of the facilities within one year of operation or as otherwise specified in the approved evaluation plans.

- Article 418 - Post-installation evaluations, modifications, operation and maintenance of fish screens and ladders: Within one year after each facility is fully operational, consistent with the licensee's construction schedule approved pursuant to Article 403, or as otherwise specified in the evaluation plans and agreed to by the U.S. Department of Interior (Interior) and U.S. Department of Commerce (Commerce), the licensee shall conduct hydraulic and biological evaluations of the juvenile fish screens and the adult fish ladders. The licensee shall consult with Interior and Commerce with respect to any deficiencies identified as a result of the evaluations and undertake corrective actions in a time and manner appropriate to the scope and nature of the deficiencies.

The licensee shall submit the evaluation plans at least 120 days before each facility is scheduled to be fully operational consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and the Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the evaluation plans with the Commission. The licensee shall include with the evaluation plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed evaluation plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the evaluation plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall complete evaluation of the facilities within one year of operation or as otherwise specified in the approved evaluation plans.

- Article 419 - Walterville Tailrace Return Channel**:** The licensee shall submit a plan to inspect, maintain, and operate the Walterville tailrace return channel at the Walterville tailrace barrier to ensure safe and effective adult fish passage, no less than 120 days prior to the scheduled date for completion of the Walterville tailrace barrier, consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with the U.S. Department of Interior (Interior), U.S. Department of Commerce (Commerce) and the Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The inspection, maintenance and operation plan shall specify a procedure for prompt removal of all obstructions or other impediments to fish passage. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the inspection, maintenance and operation plan with the Commission. The licensee shall include with the inspection, maintenance and operation plan documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed inspection, maintenance and operation plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the inspection, maintenance and operation plan. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the

Commission, the licensee shall implement the inspection, maintenance and operation plan by the time specified.

- Article 420 - Evaluate Fish Screen Impacts Created by Leaburg Lake Raise by a Maximum of 1.5 feet: Within one year after increasing the water surface elevation at Leaburg Lake, the licensee shall complete studies pursuant to a study plan to identify if, and to what extent, mortality and/or injury of juvenile salmonids, associated with the increased water surface elevation, occurs at the Leaburg Fish Screen Facility. The licensee shall, before the end of this one year period, consult with the U.S. Department of Interior (Interior), the U.S. Department of Commerce (Commerce), and the Oregon Department of Fish and Wildlife (ODFW) on the results of the studies and on any actions proposed by the Licensee to eliminate or mitigate for any source of increased injury and/or mortality associated with the increased water surface elevation. Licensee shall take corrective action to eliminate or mitigate for increased injury and/or mortality in a time and manner appropriate to the scope and nature of the problem.

  The licensee shall submit the study plan at least 120 days before increasing the water surface elevation, consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and ODFW and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the study plan with the Commission. The licensee shall include with the study plan documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed study plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the study plan. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall implement the study plan by the time specified.

- Article 421 - Evaluate Rollgate Mortality Impacts Created by Leaburg Lake Raise of a Maximum of 1.5 feet: Within one year after increasing the water surface elevation at Leaburg Lake, the licensee, in consultation with the U.S. Department of Interior (Interior), the U.S. Department of Commerce (Commerce) and the Oregon Department of Fish and Wildlife (ODFW), shall complete studies pursuant to a study plan to identify if, and to what extent, mortality and/or injury is induced through passage of juvenile salmonids through the rollgates at Leaburg Lake. The study must identify the impacts associated with passage at the current lake level, including the minimum gate opening, and at the maximum lake elevation proposed, also including minimum gate opening. The licensee shall, before the end of this one year period, consult with Interior, Commerce and ODFW on the results of the study and on any actions proposed by the Licensee to eliminate or mitigate any source of increased injury and/or mortality associated with the increased water surface elevation. The licensee shall take corrective action to eliminate or mitigate for increased injury and/or mortality in a time and manner appropriate to the scope and nature of the problem.

The licensee shall submit the study plan at least 120 days before increasing the water surface elevation, consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and ODFW and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the study plan with the Commission. The licensee shall include with the study plan documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed study plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the study plan. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall implement the study plan by the time specified.

- Article 422 - Requires EWEB to develop and implement a plan to salvage fish in the Walterville Canal. The plan must be developed at least 60 days prior to dewatering the canal for excavation and construction.

- Article 423 - Requires EWEB to develop and implement a plan to salvage or otherwise manage fish in the Leaburg and Walterville canals prior to dewatering the canals for routine inspection and maintenance.

- Article 424 - Requires EWEB to promptly notify (within 24 hours) the U.S. Department of Interior, the U.S. Department of Commerce, and ODFW of any emergency or unanticipated situations arising during project construction or operation that may be detrimental to fish and wildlife or their habitat.

- Article 425 - Requires EWEB to implement seven measures to protect fish and wildlife: (1) provide a yearly compliance report on fish and wildlife requirements, (2) properly maintain all physical features of fish and wildlife enhancement requirements, (3) permit representatives of the resource agencies to inspect all facilities and project records, (4) make available to the resource agencies records of diverted and bypass reach flow volumes and rates of change, (5) consult with the resource agencies during design of any proposed project facility modifications, (6) notify the resource agencies 90 days prior to project construction and upon completion of construction, and (7) consult with the resource agencies to site or route any new or modified project facilities.
- Article 426 - Requires EWEB to protect wetland resources by submitting a plan, within one year of license issuance, which quantifies the net change in wetland areas that will be

caused by project construction, operation, or enhancement opportunities and implementing the plan following Commission approval.

- Article 427 - Requires EWEB, within one year of license issuance, to submit a plan to manage snags that are created by the Leaburg Lake raise for raptor use.

- Article 428 - Requires EWEB, within six months of license issuance, to submit a plan to manage native vegetation and reduce exotic plant cover on Kaldor and Rodman islands.

- Article 429 - Requires EWEB to implement the vegetation management plans contained in the license application, at the project canals, at the Leaburg powerhouse, and at Walterville pond.

- Article 430 - Requires EWEB, within one year of license issuance, to implement a wood duck, osprey, purple martin, and northwestern pond turtle enhancement plan.

- Article 431 - Requires EWEB, within one year of license issuance, to implement bald eagle protection measures, including recording bald eagle use in the project area and providing nesting platforms.

- Article 432 - Requires EWEB, within one year of license issuance, to develop a recreation plan.

The operation of the Leaburg-Walterville Project, under the 1997 FERC license, as reinstated and amended by FERC on April 27, 2000; the conservation measures as proposed in the BA; and the revised and updated license articles developed by NMFS, USFWS, EWEB, and FERC separated staff, constitute the “proposed action” by FERC. In terms of on-the-ground actions, these articles can be grouped into the categories shown in Table 3-1. The BA included the year of completion of each action in Table 3-1 except the habitat enhancement measures, as shown in the table.

Table 3-1. Categories for construction and habitat enhancement activities at the Leaburg-Walterville Project, including pertinent license articles and the scheduled year of construction completion, from the BA.

Action Category	Pertinent License Articles	Schedule
Modify Leaburg fish screen cleaning and bypass systems	401, 403, 416	2003
Leaburg Lake Raise	401, 403, 405, 420, 421, 424, 425	2003
Leaburg Dam Left-Bank Fish Ladder	401, 403, 416, 418, 424, 425	2003
Modifications and Right-Bank Fish Ladder Construction	401, 403, 416, 418, 424, 425	2002
Leaburg Tailrace Barrier Construction	401, 403, 416, 417, 424, 425	2003
Walterville Water Diversion Structure	401,403, 410, 424, 425	2002
Walterville Fish Screen Construction	401, 403, 416, 424, 425	2002
Walterville Tailrace Excavation	401, 403, 406, 422, 424	2002
Walterville Tailrace Barrier Modification	401, 403, 416, 417, 419, 424, 425	2002
Habitat Enhancement Measures	411, 412, 413, 414, 415, conservation measures	not given

In addition to the above actions, EWEB proposed in the BA (FERC 2001) to voluntarily implement the following conservation measures at the Leaburg-Walterville Project: eliminate the use of the Walterville Pond for peaking purposes until effects on UWR chinook salmon of the pond use on fluctuating water levels in the river downstream of the Walterville tailrace outfall can be determined.

It is the intent of the Services for this biological opinion to address all potential effects associated with the implementation of FERC's proposed action for the Leaburg-Walterville Project, including potential incidental take from construction activities associated with the revised license articles (Table 3.1). Plans associated with new construction activities will require incorporation of construction related terms and conditions as outlined in section 9.3, and review and approval by the Services and ODFW. The purpose of the review and approval is to ensure that EWEB has taken all reasonable actions to limit construction related effects to listed species and their habitats.

The interim conservation measures outlined above, while proposed primarily for reducing impacts to UWR chinook, are expected to contribute to reducing impacts to CR bull trout, which are known to be seasonally present, though in low numbers, throughout the Leaburg-Walterville Project area.

4. Biological Information

Information on the distribution, status, and life history of the listed species addressed by this opinion are given in section 4.1 below. Information availability varies widely among species, thus the content and format of these sections varies by species. The status of critical habitat for each of the listed species is given in section 4.2, and the biological requirements of the species considered in this opinion are discussed in section 4.3.

4.1 Status of the Species and Life History

The status of each listed species included in this opinion is described below in terms of distribution and population trends. Life history is also described, including spawning, rearing, migration, and age at maturity.

4.1.1 Upper Willamette River Chinook Salmon

As described in section 2.1., the UWR chinook salmon ESU includes both hatchery- and naturally-produced spring chinook salmon above Willamette Falls (and in the Clackamas River), but only naturally-produced fish are listed under the ESA. Extensive biological information on this ESU is provided in the BA (FERC 2001) and is hereby incorporated by reference. Biological information is summarized below in terms of distribution, status, and life history of UWR chinook salmon.

4.1.1.1 Distribution

Historically, UWR chinook salmon were widely distributed throughout the Willamette Basin but approximately half of their spawning habitat was cut off by the construction of 13 USACE flood control dams in the 1950s and 1960s. The ESU originally had access to over 1,000 miles of stream habitat above Willamette Falls, with major subpopulations in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette subbasins (USACE 2000; FERC 2001). Most natural spawning of UWR chinook salmon now occurs within the McKenzie River subbasin, particularly above Leaburg Dam (Fig. 1-1). Significant natural production of this ESU also occurs in the North Santiam and Clackamas subbasins.

Historically, natural spawning areas in the McKenzie basin included the mainstem McKenzie River, Smith River, Lost Creek, Horse Creek, South Fork, Blue River, and Gate Creek (Mattson 1948; Parkhurst et al. 1950). ODF (1903) surveyed much of the M'Kenzie [sic] River to site a hatchery and collection rack. They state, "It has been generally reported by settlers and those living along the river that salmon can be seen spawning during the months of August and September all along the river, but principally from Leaburg post office up to its source." Currently, this is the only population above Willamette Falls with any level of sustained natural production. The McKenzie River Hatchery (RKm 52), which began egg taking operations in

1902, obtained a peak collection of 25,100,000 eggs in 1935 (Wallis 1961) from an estimated 7,844 females (@ 3,200 eggs per female). Mattson (1948) estimated that there were 4,780 adults returning to the McKenzie River, and that this constituted 40% of the entire run above the Willamette Falls. Parkhurst et al. (1950) estimated that there was suitable habitat for 80,000 fish in the entire basin.

The construction of the Cougar Mountain Dam (RKm 101) in 1963 eliminated 56 Km of spawning habitat on the South Fork McKenzie River. The South Fork was generally believed to be the best salmon-producing stream in the McKenzie drainage (USFWS 1948). The Blue River Dam (RKm 88) prevented access to an additional 32 Km of spawning habitat.

4.1.1.2 Population Trends

There are no direct estimates of the size of the chinook salmon runs in the Willamette River basin prior to the 1940s. McKernan and Mattson (1950) present anecdotal information that the Native American fishery at Willamette Falls may have yielded 908,000 kg of salmon (454,000 fish @ 9.08 kgs). Mattson (1948) estimated that the spring chinook salmon run in the 1920s may have been five times the existing run size of 55,000 fish (i.e., in 1947) or 275,000 fish, based on egg collections at salmon hatcheries. Wallis (1961) reported a peak collection of 25 million eggs at the hatchery rack at McKenzie RM 18 in 1935. These eggs were collected from an estimated 7,844 females (3,200 eggs per female) indicating a minimum run size of 15,700 adult UWR chinook salmon above the rack that year (assuming a 1:1 sex ratio). This estimate did not include fish that spawned downstream of the rack, in the lower mainstem McKenzie River and the Mohawk River watershed, for example. The Oregon State Game Commission (OSGC) estimated that the population of naturally and artificially produced UWR chinook salmon in the McKenzie subbasin was 14,500 in the mid-1960s (Thompson et al. 1966).

Estimates of naturally- and artificially-produced UWR chinook salmon returns to the McKenzie River since 1970 have comprised between 10.9 % (1984) and 25.5 % (1993) of the estimated total escapement over Willamette Falls and have remained relatively steady (Table 4-1). Estimated numbers of naturally- and artificially-produced returning adults averaged 5,861 fish (16.7 %) during the period 1970-1979; 6,183 fish (13.5 %) during 1980-1989; and 6,480 fish (16.5 %) during 1990-1999 (Table 4-1; USACE 2000).

An average of 2,599 fish escaped over Leaburg Dam and into natural production areas in the upper McKenzie River during the period 1970-1979, or 44 % of the estimated total spring chinook run returning to the McKenzie River. Escapement over Leaburg Dam averaged 2,493 fish during the period 1980-1989 and 2,846 fish during 1990-1999. However, the averages were influenced by the 1990, 1988, and 1991 runs, which were the first, second, and third largest, respectively, of the period of record since 1970. Again, these totals are for naturally and artificially produced adults combined. Only since 1994 has ODFW estimated the proportion of naturally produced ("wild") adults in the population passing Leaburg Dam (Table 4-1; USACE

2000).

Table 4-1. Estimated return of spring chinook to the McKenzie River and Leaburg Dam.

Run Year	Total Escapement to McKenzie River	% of Total Escapement Over Willamette Falls	Total Escapement Leaburg Dam	Estimated % of Naturally Produced Fish in Leaburg Dam Escapement
1970	4,787	14.0%	2,991	N/A
1971	6,323	14.2%	3,602	
1972	3,770	14.4%	1,547	
1973	7,938	18.9%	3,870	
1974	7,840	17.6%	3,717	
1975	3,392	17.8%	1,374	
1976	4,275	19.3%	1,899	
1977	9,127	22.8%	2,714	
1978	8,142	17.1%	3,058	
1979	3,018	11.3%	1,219	
Mean 1970-79	**5,861**	**16.7%**	**2,599**	------
1980	4,154	15.4%	1,980	N/A
1981	3,624	12.0%	1,078	
1982	5,413	11.7%	2,241	
1983	3,377	11.0%	1,561	
1984	4,739	10.9%	1,000	
1985	4,930	14.3%	825	
1986	5,567	14.2%	2,061	
1987	7,370	13.4%	3,455	
1988	12,637	17.9%	6,753	
1989	10,020	14.5%	3,976	
Mean 1980-89	**6,183**	**13.5%**	**2,493**	**-------**
1990	12,743	17.9%	7,115	
1991	11,553	22.0%	4,359	
1992	8,976	21.4%	3,816	
1993	8,148	25.5%	3,617	
1994	2,992	11.5%	1,526	54% (825)
1995	3,162	15.4%	1,622	57% (933)
1996	3,640	16.8%	1,445	76% (1,105)
1997	3,110	11.6%	1,176	84% (991)
1998	3,997	11.6%	1,874	77% (1,415)
1999	4,557	11.3%	1,909	72% (1,383)
Mean 1990-99	**6,289**	**16.5%**	**2,846**	**70% (1,109)**

Current levels of naturally produced adults spawning above Leaburg Dam (column 5 in Table 4-1) were estimated by ODFW based on the proportion of adipose fin-clipped fish among chinook counted passing the dam compared to the proportion among fish returning to the McKenzie Hatchery. Using this method, ODFW estimated that an average of 70 % (1,109 fish) of the adult chinook salmon passing above Leaburg Dam between 1994 and 1999 were naturally produced (Table 4-1).

For the ESU as a whole, NMFS estimates that the median population growth rate (lambda) over the base period[5] ranges from 1.01 to 0.63, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared to the effectiveness of fish of wild origin (Tables B-2a and B-2b in McClure et al. 2000a). NMFS has also estimated the risk of absolute extinction for the aggregate UWR chinook salmon population in the McKenzie River, above Leaburg Dam, using the same range of assumptions about the relative effectiveness of hatchery fish (Table 4-2). At the low end, assuming that hatchery fish spawning in the wild have not reproduced successfully (Hatch = 0) or that hatchery fish are 20% as effective as wild fish (Hatch = 0.2), the risk of absolute extinction within 24 or 48 years is 0.00. At the high end, assuming that the hatchery fish spawning in the wild have been as productive as wild-origin fish (hatchery effectiveness = 100%), the risk of absolute extinction within 100 years is 0.85.

Table 4-2. Risk of absolute extinction (one fish per generation) in 24, 48, and 100 years for UWR chinook salmon in the McKenzie River above Leaburg Dam over a range of hatchery effectiveness values.[1]

	Hatch = 0[2]	**Hatch = 0.2**	**Hatch = 0.8**	**Hatch = 1.0**
24 years	0.00	0.00	0.01	0.01
48 years	0.00	0.01	0.18	0.28
100 years	0.01	0.10	0.72	0.85

[1] Data for relative effectiveness of hatchery fish equal to 0%, 100%, 20%, and 80% from Tables B-5, B-6, B-11a, and B-11b, respectively, in McClure et al. 2000a). [2] Hatch = 0 means that hatchery fish do not reproduce successfully. Hatch = 1.0 means that hatchery fish produce the same number of spawners in the subsequent generation as wild-born fish.

In section 1.1.1, NMFS identified metrics that are indicative of the "high likelihood of survival" and the "moderate to high likelihood of recovery" species-level biological requirements. The *survival indicator criterion* is a risk of absolute extinction that is no greater than 5% over the next 100 years. The *recovery indicator criterion* is either: (1) a 50% or greater likelihood that recovery abundance levels (expressed as an eight-year geometric mean) will be achieved within 48 years; or (2) at least a 50% likelihood that the median population growth rate (lambda) over the next 48 years will be greater than 1.0. For UWR chinook salmon, recovery abundance levels have not yet been determined. Therefore, the recovery indicator criterion based on median population growth rate applies.

NMFS estimated the needed incremental change from base period survival for UWR chinook

[5]Estimates of median population growth rate and the risk of extinction are based on population trends observed during a base period beginning in 1980 and including 1998 adult returns. Population trends are projected under the assumption that all conditions will stay the same into the future.

salmon to meet the survival and recovery indicator criteria (Appendix A in NMFS 2000a). These estimates were based on the UWR chinook population in the McKenzie River above Leaburg Dam. This population must achieve an incremental increase in survival of 9 to 65% (depending on the relative effectiveness of hatchery fish) to reduce the risk of extinction within the next 100 years to 5% (Table 4-3). An incremental increase in survival of >4 to >59% must occur for the median population growth rate to increase to >1.0.

Table 4-3. Needed incremental change from base period survival to achieve a 5% risk of extinction in 100 years and median population growth rate (lambda) >1.0 over 48 years for UWR chinook salmon in the McKenzie River above Leaburg Dam over a range of hatchery effectiveness values (from Tables A-3 and A-6 in NMFS 2000a).

	Historical Effectiveness of Hatchery Spawners	
Needed Change in Survival to Achieve:	**Hatch = 0.2**	**Hatch = 0.8**
5% Risk of Extinction $_{(100\ yrs)}$	9.17	65.21
Lambda > 1.0 $_{(48\ yrs)}$	>4.55	>59.48

4.1.1.3 Life History

UWR chinook salmon have a life history pattern that includes traits from both ocean- and stream-type life histories. The majority of juveniles emigrate as young-of-the-year in late winter/early spring and as age-1 fish in the fall. A relatively small number presently emigrate through the second spring. The ocean distribution of fish from this ESU, most of which are caught off the coasts of British Columbia and Alaska, is consistent with an ocean-type life history. Freshwater entry begins in February, the earliest return timing of chinook stocks in the Columbia Basin (USACE 2000; FERC 2001). Life history is summarized below in terms of spawning, rearing, outmigration, ocean stage, and age at maturity.

4.1.1.3.1 Spawning

Adult UWR chinook salmon begin entering the Willamette River in February. The run peaks in April and entry continues, at lower levels, through June. Adults begin entering spawning tributaries like the McKenzie River as early as mid- to late April when water temperatures begin to reach 11.1 to 12.2° C. Spawning occurs from August to early November, peaking around the third week in September through the first week in October.

After spawning, UWR chinook salmon eggs remain buried in the gravel for one to four months, depending on stream temperatures. Chinook eggs require 882 to 991 temperature units (TUs) on average before hatching (1 TU = 1° C above freezing for 24 h). After hatching, the alevins, or yolk-sac fry, remain in the gravel for two to three weeks (depending on stream temperatures).

4.1.1.3.2 Rearing and Outmigration

Historical studies suggest that the majority of juvenile UWR chinook salmon historically reared to age one or older in the upper Willamette River basin before outmigrating to the estuary. In the 1940s, spring chinook juveniles were found to outmigrate in the Willamette Basin at different ages and at different times of the year near Lake Oswego on the lower river: (1) age 0+ fry (length 40-90 mm) in late winter/early spring; (2) age 1+ fingerlings (length 100-130 mm) in late fall/early winter; and (3) a second spring peak of age two smolts (length 100-140 mm; Mattson 1962). Less than half of a given age class emigrated as 0+, less than half as age 1+, and less than a third as age 2. This study was conducted after the Willamette River had already been subjected to water pollution for several decades. Thus, the author suggested that, historically, juvenile UWR chinook salmon may have continued migrating throughout the summer (Mattson 1962).

Currently, naturally produced juvenile UWR chinook salmon have two peak outmigration periods at Willamette Falls (5 miles upstream of Lake Oswego): (1) age 0+ fry in late winter/early spring; and (2) age 1+ fingerlings in late fall/early winter, a pattern similar to that observed by Mattson in the 1940s. The 0+ group may rear in the lower Willamette or lower Columbia rivers. The age at which each group enters the ocean is not known, nor is it known if survival is higher among one group or the other. Mattson (1963) found that only eight of 59 (13.5%) returning adults in the McKenzie in 1947 had entered the ocean as subyearlings, suggesting higher survival of juveniles that entered the ocean when they were older and larger. Juvenile UWR chinook appear to emigrate to mainstem areas of major subbasins, including sections of the Willamette River, in late winter and spring and to rear there until smoltification.

ODFW has collected some seine data in the upper mainstem Willamette River each year since 1991, mostly during the summer. Juveniles at various stages of development from fry to smolts have been collected from Peoria (RM 143) upstream to the mouth of the McKenzie River (RM 176). Of particular interest was the capture of numerous newly emergent chinook fry in April 1995 in the reach from Harrisburg (RM 162) to Marshall Island (RM 170). The authors concluded that these were naturally-produced fish because, at that time, hatcheries did not release fish of this size. It is likely that the fish originated from the lower McKenzie River because mainstem habitat below Peoria is less diverse with fewer islands, fewer backwater areas, and a more modified channel, characteristics that reduce its value as rearing habitat for spring chinook salmon (USACE 2000).

As described above, Mattson (1962) reported three distinct migration periods and ages of juvenile spring chinook in the lower Willamette River in the 1940s, and current patterns are similar to this in that the ages and timing of the first two groups are similar. There may have been greater changes in outmigration timing in the tributaries; based on sampling of juvenile

UWR chinook salmon in the McKenzie River from 1986-1992, juvenile migration timing appears to have changed over this time period; samples collected at various locations between 1948 and 1968 indicated that fry migration occurred primarily from March through June (USACE 2000).

In contrast, since 1980, fry have migrated past Leaburg Dam primarily during January through April, earlier than in previous years. Similarly, fingerling migration, which originally peaked during January through March now peaks during October and November. The change in juvenile migration timing may be due to the release of warm water from impoundments above spawning areas during the fall incubation period, accelerating fry emergence and movement (USACE 2000).

4.1.1.3.3 Ocean Stage and Age at Maturity

UWR chinook salmon are "Gulf of Alaska" migrants. They migrate to the north upon ocean entry and are subject to harvest in British Columbia and SE Alaska ocean fisheries. Unlike upriver Columbia spring chinook, UWR chinook appear to be highly vulnerable to ocean fisheries. Few adult Willamette spring chinook are caught in Oregon or California ocean fisheries. Commercial seasons are typically not open when the adults are off the coast of Oregon, in preparation for entering the Columbia River during January through May, and few to none, depending on the brood year, are taken off the California coast (USACE 2000).

Mattson (1962) analyzed scales taken from spring chinook salmon caught by sport fishermen in the lower Willamette River during 1946-1950, when most of the returning fish were naturally-produced and the run was comprised of a substantial number of returning adults that were five and six years old. In comparison, data from the lower Willamette River and Clackamas River fisheries in more recent years indicate that there has been a decrease in the presence of older age classes among returning adult spring chinook salmon since the late 1940s. There has been a steady decline in the proportion of older fish (i.e., age-5 and age-6) over the period 1946 to 1983. The age composition of spring chinook runs returning to the Clackamas and Willamette rivers is currently dominated by age-4 fish (USACE 2000).

4.1.1.4 Factors for Decline

4.1.1.4.1 Habitat and Hydrology

Human activities have had enormous effects on salmonid populations in the Willamette drainage. The Willamette River, once a highly braided river system, has been dramatically simplified through channelization, dredging, and other activities that have reduced rearing habitat (i.e., stream shoreline) by as much as 75%. In addition, the construction of 37 dams in the basin has blocked access to over 700 km of stream and river spawning habitat. Some of these dams also alter the temperature regime of the Willamette and its tributaries, affecting the timing of development of naturally spawned eggs and fry. Water quality is also affected by agricultural and urbanization on the valley floor, as well as timber harvesting in the Cascade and Coast ranges, which contribute to increased erosion and sediment load in Willamette basin streams and rivers. The disappearance in the 1920s and 1930s of the June run was associated with a dramatic decline in water quality in the lower Willamette River. The fall run in the Clackamas River was extirpated during this same time period.

4.1.1.4.2 Hatcheries

Hatchery production began in the basin during the late nineteenth century. Eggs were transported throughout the basin so that, in terms of genotype, current populations are relatively homogeneous (although still distinct from those of surrounding ESUs). Hatchery production continues in the Willamette, with an average of 8.4 million smolts and fingerlings released each year into the main river or its tributaries between 1975 and 1994. Hatcheries are currently responsible for most of the production (90% of escapement) in the basin.

The Clackamas River currently accounts for about 20% of the production potential in the Willamette River basin with fish originating from one hatchery plus natural production areas primarily above the North Fork Dam. The interim escapement goal for that area is 2,900 fish (ODFW 1998c). However, the Clackamas River system is so heavily influenced by hatchery production that it is difficult to distinguish spawners of natural stock from hatchery origin fish. Approximately 1,000 to 1,500 adults have been counted at the North Fork Dam in recent years.

4.1.1.4.3 Other Factors for Decline

Harvest on this ESU is high, both in the ocean and inriver. The total inriver harvest below Willamette Falls during 1991 through 1995 averaged 33% (and previously had been much higher in some years). Ocean harvest was estimated as 16% for 1982 through 1989. Total (marine and freshwater) harvest rates on UWR spring-run stocks were reduced considerably for the 1991 through 1993 brood years, to an average of 21% (ODFW 1998b).

4.1.2 Columbia River Bull Trout

Biological information is summarized below in terms of distribution, population trends, habitat, life history, and factors of decline for CR bull trout. Additional information on the biological processes of CR bull trout migration, spawning, rearing, and population size and life history diversity is provided in sections 5.3 and 6.2.

Bull trout (*Salvelinus confluentus*) are a native char found in the coastal and intermountain west of North America. Dolly Varden (*Salvelinus malma)* and bull trout were previously considered a single species and were thought to have coastal and interior forms. However, Cavender (1978) described morphometric, meristic, and osteological characteristics of the two forms, and provided evidence of specific distinctions between the two. In 1980, the American Fisheries Society formally recognized bull trout and Dolly Varden as separate species (Robins et al. 1980). Despite an overlap in the geographic range of bull trout and Dolly Varden in the Puget Sound area and along the British Columbia coast, there is little evidence of introgression (Hass and McPhail 1991).

The USFWS determined threatened status for the Columbia River and Klamath River DPSs of bull trout (*Salvelinus confluentus)* on June 10, 1998 (63 FR 31674). The Columbia River DPS includes bull trout in portions of Oregon, Washington, Idaho, and Montana, which encompasses the Willamette River and its tributaries. On November 1, 1999, the USFWS determined threatened status for all populations of bull trout within the coterminous United States (64 FR 58910). The approach to break the range of bull trout into DPSs was undertaken because the fish occurs in widespread, but fragmented habitats and has several life-history patterns.

Within the coterminous United States, the USFWS has designated five individual DPSs; the Columbia River and Klamath River, both mentioned above, as well as Coastal/Puget Sound in Washington State, Jarbidge River in Nevada and the St.Mary/Belly River in Montana. Populations of bull trout in the Willamette Basin are part of the Columbia River bull trout (CR bull trout) DPS. This DPS is represented by relatively widespread, geographically isolated subpopulations throughout the entire Columbia River basin within the United States and its tributaries. No critical habitat has been designated for bull trout and none is currently proposed.

4.1.2.1 Distribution

The historic distribution of bull trout spanned seven states (Alaska, Montana, Idaho, Washington, Oregon, Nevada, and California) and two Canadian Provinces (British Columbia and Alberta) along the Rocky Mountain and Cascade Mountain ranges (Cavender 1978). In the United States, bull trout occur in rivers and tributaries throughout the Columbia Basin in Montana, Idaho, Washington, Oregon, and Nevada, as well as the Klamath Basin in Oregon, and several cross-boundary drainages in extreme southeast Alaska. In California, bull trout were historically found only in the McCloud River, which represented the southern-most extension of the species' range. Bull trout numbers steadily declined after completion of McCloud and Shasta dams. The last confirmed report of a bull trout in the McCloud River was in 1975, and the original population is now considered to be extirpated (Rode 1990).

In Oregon, bull trout were historically found in the Willamette River and major tributaries on the west side of the Oregon Cascades, the Columbia and Snake rivers and major tributaries east of the Cascades, and in streams of the Klamath Basin (Goetz 1989). Currently, most bull trout populations are confined to headwater areas of tributaries to the Columbia, Snake, and Klamath rivers (Ratliff and Howell 1992). Major tributary basins containing bull trout populations include the Willamette, Hood, Deschutes, John Day, and Umatilla (Columbia River tributaries), and the Owyhee/Malheur, Burnt/Powder, and Grande Ronde/Imnaha basins (Snake River tributaries). Of these eight major basins, large fluvial migratory bull trout are potentially stable in only one, the Grande Ronde, and virtually eliminated from the remaining seven, including the majority of the mainstem Columbia River. The only known increasing population of bull trout is an adfluvial population located in Lake Billy Chinook, that spawns and rears in the Metolius River and tributaries in the Deschutes Basin.

Historically bull trout occupied a large portion of the Willamette Basin, including the McKenzie, Middle Fork, North and South Santiam and Clackamas rivers. Bull trout have been extirpated from all subbasins in the Willamette with the exception of the McKenzie River. Cougar Dam (1964 USACE project) on the South Fork McKenzie River, and Trail Bridge Dam (1963 EWEB project) on the upper mainstem, neither with fish passage, effectively fragmented the original fluvial McKenzie River bull trout population into three subpopulations.

4.1.2.2 Population Trends

Within the coterminous United States, bull trout distribution is highly fragmented and many sub-populations are geographically isolated. The best available information indicates that bull trout, although still wide-ranging, have suffered a significant reduction in range and abundance and are faced with varying degrees of ongoing threats. Resident bull trout presently exist as isolated remnant populations in the headwaters of rivers that once supported larger, more fecund migratory forms. These remnant populations have a low likelihood of persistence (Reiman and McIntyre 1993). Many populations and life history forms of bull trout have been extirpated entirely. Buchanan et al. (1997) reported that 81% of Oregon’s bull trout populations are considered to be at “moderate risk of extinction,” “high risk of extinction,” or “probably extinct.” The statewide status review also found only 16% of current bull trout distribution occurs within a protected area defined by Wilderness, Wild and Scenic River, or within a National Park. In recognition of the precarious status of Oregon bull trout populations, harvest of bull trout is prohibited in all state waters with the exception of Lake Billy Chinook and Lake Simtustus in the Deschutes River Basin.

Current population trends for bull trout in the McKenzie subbasin are based on redd counts, standard pool counts, juvenile trapping, radio tracking, and electronic fish counters. The total population of mature bull trout in the entire McKenzie River basin has been estimated at less than 300 individuals spawning annually, of which between 25 to 75 are found in the South Fork McKenzie River subbasin (USACE 2000). The mainstem McKenzie River subpopulation appears to be increasing, based on an increasing trend in redd counts in Anderson Creek (Buchanan et al. 1997; ODFW 1999a). The current population trends of the South Fork McKenzie and Trail Bridge subpopulations are unknown, but are considered to be at high risk of extinction due to isolation, low abundance, and limited spawning habitat (Buchanan et al. 1997).

4.1.2.3 Habitat

Rieman and McIntyre (1993) reported that bull trout have more specific habitat requirements than do other species of salmonids. They noted channel stability, substrate composition, cover, temperature, and migratory corridors as all influencing bull trout distribution and abundance. Dambacher and Jones (1997) listed seven habitat variables that were significant in determining presence of juvenile bull trout including high levels of shade, large woody debris, large woody debris pieces, undercut banks, gravel riffles, low levels of fines, and low levels of bank erosion.

Bull trout are strongly influenced by temperature. Rieman and McIntyre (1993) reported that water temperature in excess of about 15º C is thought to limit bull trout distribution. Additional research on the role of temperature and bull trout distribution and abundance was done by Buchanan and Gregory (1997). They found four temperature limiting periods for bull trout that include summer maximum temperatures (limiting juvenile and adult bull trout); fall spawning; fall, winter, and spring egg incubation; and spring fry growth.

Young-of-the-year bull trout are found primarily in side channel areas and along stream margins (Fraley and Shepard 1989). Juveniles (smaller than 100 mm in length) are primarily bottom dwellers and are found among coarse substrate (Fraley and Shepard 1989; Pratt 1992). Goetz (1989) stated that optimum water temperatures for rearing were about 7° to 8° C. Older, larger individuals are often found in deeper stream pools or in lakes in deep water with temperatures less than 15° C (Pratt 1992).

4.1.2.4 Life History

Bull trout possess several life history features that indicate adaptation to northern latitudes. These features include advanced age at maturity, alternate year spawning, extensive migrations, and separation of juvenile and adult segments of the populations (Thomas 1992). Bull trout in the Columbia Basin have evolved resident, fluvial and adfluvial life history patterns. Although anadromy is not found in Oregon, Bond (1992) believed that it was an important part of the life history and historical distribution pattern for bull trout, and may have acted as a mechanism for coastal distribution. In stream and lake resident populations, adults and juveniles generally occupy the same streams in which they spawn and rear. Fluvial bull trout populations migrate between smaller streams used for spawning and early juvenile rearing, and larger rivers used for adult rearing. Adfluvial populations generally migrate between smaller streams used for spawning and juvenile rearing and lakes or reservoirs used for adult rearing (Buchanan et al. 1997). Resident and migratory forms can be found together and it is suspected that bull trout give rise to offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993).

Bull trout typically spawn from August to November during periods of decreasing water temperatures. However, migratory bull trout frequently begin spawning migrations as early as April. Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater discharge (Goetz 1989; Pratt 1992; Rieman and McIntyre 1996). Spawning substrate generally consists of loose, clean gravel relatively free of fine sediments (Fraley and Shepard 1989). The size and age of bull trout at maturity depends upon life-history strategy. Growth of resident fish is generally slower than migratory fish and resident fish tend to be smaller at maturity and less fecund (Fraley and Shepard 1989; Goetz 1989). Bull trout normally reach sexual maturity in four to seven years and live as long as 12 years. Repeat spawning has been reported, although repeat spawning frequency and post-spawning mortality are not well known (Leathe and Graham 1982; Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1996).

Optimal incubation temperatures for embryo survival have been shown to lie between 2° and 4° C (McPhail and Murray 1979; Brown 1985; Carl 1985). Embryos incubate for approximately 100-145 days (sometimes as much as 200 days) and hatch in late winter or early spring. The alevins remain in the streambed, absorbing the yolk sac, for an additional 65-90 days, and emergence from the streambed occurs in late winter/early spring (Pratt 1992).

Juvenile bull trout are closely associated with the streambed and are found immediately above, on, or within the streambed (Griffith 1979; Oliver 1979; Pratt 1984, 1992). Juvenile migratory bull trout can spend from several months to several years in natal stream areas before emigrating into larger rivers or lakes (Scott and Crossman 1973). While Pratt (1992) found that juvenile bull trout migrate from natal areas during spring, summer, or fall, Shepard et al. (1984) found migration continued from early May through the middle of July on the Flathead River system in Montana.

Juvenile bull trout feed primarily on aquatic insects (Pratt 1992). Subadult bull trout rapidly convert to eating fish and adults are opportunistic and largely nondiscriminating fish predators. Historically, native sculpins (*Cottus spp*.), suckers (*Catostomus spp*.), juvenile salmonids (*Oncorhynchus spp*.), and mountain whitefish (*Prosopium williamsoni*) were probably the dominant prey across most of the bull trout range. Today, throughout most of the bull trout's remaining range, introduced species, particularly kokanee (*Oncorhynchus nerka*) and yellow perch (*Perca flavescens*), are often key food items (Pratt 1992).

4.1.2.5 Factors for Decline

Bull trout populations have declined range-wide from an array of land and water management practices. Dams, forest management practices, livestock grazing, agriculture and agricultural diversions, roads and mining have all been implicated in the decline of bull trout distribution and abundance (63 FR 31647). Buchanan et al. (1997) listed potential limiting factors as including loss of genetic diversity; over-harvest; passage barriers; predation, competition and hybridization with non-native species; habitat loss and degradation; and climatic changes.

Bull trout passage is prevented or inhibited at hydroelectric, flood-control, or irrigation dams in almost every major river in the Columbia River basin with the exception of the Salmon River in Idaho (63 FR 31647). Goetz (1994) proposed that the construction of dams was the primary factor in reducing bull trout abundance and distribution. In the Willamette Valley, dams have played a significant role in the decline of bull trout distribution and abundance. Dams can alter habitats, flow, sediment, temperature regimes, migration corridors and interspecific interactions, especially between bull trout and introduced species. Impassable dams prevent access of migratory fish to spawning and rearing areas in headwaters and preclude recolonization of areas where bull trout have been extirpated (Rieman and McIntyre 1993). Dams also isolate and fragment populations of bull trout causing a potential loss of genetic diversity and fitness which increases the risk of extinction for most species. Leary et al. (1993) and Spruell and Allendorf (1997) have reported that the persistence of many bull trout populations from throughout their range is necessary for the conservation of their genetic diversity.

Dunham and Rieman (1999) suggest that the extirpation of runs of anadromous salmon and steelhead above dams, and the importance of these species to the productivity of aquatic and terrestrial ecosystems (Willson and Halupka 1995), may have affected viability and productivity of bull trout populations directly through loss of a prey base of juvenile salmonids and indirectly through effects on associated species through loss or reduction in marine derived nutrients from decaying salmon and steelhead carcasses.

An additional factor possibly contributing to the decline of bull trout in the Willamette Basin is the historic use of rotenone to control undesirable, though typically native, fish species. These efforts, commonly referred to as "rough-fish control projects," were carried out primarily in the 1960's and generally targeted reservoirs and upstream tributaries (Willamette Basin Task Force 1969). The objectives of the control projects were to reduce competition and predation on stocked game fish, typically rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki clarki*), and kokanee (*Oncorhynchus nerka*). Species targeted for control included, but were not limited to, northern pikeminnow (squawfish) (*Ptychocheilus oregonensis)*, suckers (*Catostomus ssp*.) and redside shiners (*Richardsonius balteatus balteatus*), all of which were likely prey species of bull trout.

Although comprehensive information on historical use of rotenone in Willamette Basin streams is limited, treatment projects were recorded for the following reservoirs and tributaries: Hills Creek Reservoir and tributaries upstream, including Hills Creek and the mainstem Middle Fork Willamette River; Fall Creek Reservoir and tributaries upstream including Fall Creek; Cottage Grove Reservoir and tributaries upstream on the Coast Fork Willamette River; and Dorena Reservoir and tributaries upstream on the Row River (Willamette Basin Task Force 1969). The frequency and distribution of chemical treatment projects in the above listed subbasins suggests the possibility that similar rotenone projects occurred in other Willamette River subbasins. Although available information does not suggest that bull trout were targeted directly, rough fish control projects likely would have killed any bull trout present, and contributed to further reducing the distribution and abundance of bull trout populations already fragmented from dams and other impacts directly or indirectly targeted at bull trout.

Other fisheries management practices targeted bull trout more directly. Bond (1992) cited a number of works, including McAfee (1966), Dymond (1932), and Needham (1938), that mention the low regard in which bull trout were held by anglers and fishery managers because of reputed poor fighting qualities and their habit of eating other game fish. Brown (1971) and Simpson and Wallace (1978) mention that bull trout eradication efforts included bounty programs and commercial fishing with nets. The extent to which these practices were carried out in the Willamette Basin is largely unknown.

4.2 Critical Habitat

The status and extent of critical habitat for the two species addressed by this opinion is given below as related to the proposed action. Critical habitat for species below Willamette Falls is not described other than in the mainstem Willamette and Columbia rivers because the effects of the proposed action are limited to these areas.

4.2.1. Upper Willamette River Chinook Salmon

Designated critical habitat for UWR chinook salmon includes all accessible river reaches in the Clackamas and Willamette rivers and in tributaries above Willamette Falls (65 FR 7778). Areas above the following dams are excluded: Cottage Grove and Dorena (Coast Fork Willamette subbasin), Fern Ridge (Upper Mainstem), Blue River (McKenzie), Big Cliff (North Santiam), and Green Peter (South Santiam) (65 FR 7780, Table 9). Areas above naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years), such as Tamolitch Falls in the upper McKenzie River, are also excluded from designated critical habitat.

4.2.2. Columbia River Bull Trout

Critical habitat has not been designated for CR bull trout.

4.3. Biological Requirements

As described in Chapter 1 (Objectives), the first step in the method the Services use for applying the ESA standards of Section 7(a)(2) to listed species is to define the species' biological requirements. For the purposes of ESA consultation, the relevant biological requirements are those necessary for the listed ESU/DPS to survive and contribute to recovery to naturally-reproducing population levels at which protection under the ESA would become unnecessary. The biological requirements relevant to salmonid populations include adequate abundance, productivity (population growth rate), population spatial scale, and diversity (McElhany et al. 2000). These attributes are influenced by survival, behavior, and experiences throughout the entire life cycle. The action-area effects must be reviewed in the context of these species-level biological requirements to evaluate the potential for survival and recovery, relevant to the status of the species, given the full set of human activities and environmental conditions affecting the species.

For the ESU/DPS to survive and recover, adequate habitat and life-stage specific survival rates must occur within the action area. As described in NMFS (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. Therefore, the Services must describe biological requirements in terms of habitat conditions in order to infer the population's response to the effects of an action. To survive and recover, a wide-ranging salmonid ESU/DPS must have adequate habitat available for each population or subpopulation and each life history stage. In addition, each population or subpopulation must possess a minimum level of genetic fitness through adequate numbers and diversity.

The ecosystem context (section 2.3) and the biological information (section 4.1) above provide the foundation for understanding and describing habitat requirements of listed species by recognizing the dynamic, diverse nature of functional habitat (habitat processes), and illustrating the variety of freshwater habitats required for an individual to successfully incubate, rear, feed, migrate, and spawn (organism level biological processes). On an ESU/DPS scale, suitable habitat for each life history stage must be both available and adequately distributed for each population or subpopulation within the ESU/DPS to survive and recover.

5. Environmental Baseline

The "environmental baseline" is defined in the ESA Section 7 implementing regulations as:

> "the past and present impacts of all Federal, State, or private actions and other human activities in an action area, the anticipated impacts of all proposed Federal projects in an action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process" (50 CFR §402.02).

The Consultation Handbook (USFWS and NMFS 1998) further states that the environmental baseline is:

> "an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem within the action area. The environmental baseline is a 'snapshot' of a species' health at a specified point in time."

These definitions illustrate that the environmental baseline is more than the current condition of physical habitat within the action area. The environmental baseline is the progression of the physical, chemical, and biological conditions within the action area over time that has resulted in the current status of the listed species. This section therefore includes a discussion of the status of the habitat and biological processes within the action area under the environmental baseline, describing how pre-project conditions have been modified or transformed into current conditions.

5.1 Action Area

The "action area" for a consultation is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402.02). Because of the upstream (e.g., recycling of marine-derived nutrients) and downstream effects of the continued operation of the Leaburg-Walterville Project, the action area encompasses the entire McKenzie River subbasin (Fig. 1-1), excluding areas above EWEB's Trail Bridge Dam and USACE's Cougar and Blue River dams in the headwaters of the McKenzie, and extending down to the confluence with the Willamette River.

5.2 Status of Habitat Processes Under the Environmental Baseline

The proposed action affects the processes (described in section 2.3.3.1) that create and sustain habitat parameters required by listed species within the McKenzie River subbasin. The habitat processes relevant to this proposed action are disturbance, flow regime, sediment and LW function, riparian vegetation and floodplain function, and water quality. The status of these five habitat processes under the environmental baseline is described below. The status of habitat required to support each species-specific process (e.g., habitat for chinook salmon spawning, passage conditions for migration) is evaluated in the Biological Processes section, below, rather than in the Habitat Processes section.

The McKenzie River subbasin covers an area of approximately 1,300 square miles on the western slope of the Cascade Mountains, and the mainstem is approximately 90 miles long. The major tributaries are the South Fork McKenzie, Blue, and Mohawk rivers (Fig. 1-1). The McKenzie River originates high on the western slopes of the Cascade Range. Much of the McKenzie River subbasin is mountainous with steep ridges and a narrow band of level land in the valleys along the McKenzie and Mohawk rivers. Although the mainstems of the McKenzie River and the Mohawk River have relatively low gradients, most of the other tributaries have steep gradients in their upper reaches. The headwaters of the McKenzie River are characterized by a broad, gently sloping volcanic ridge that extends west from the steep peaks of the Three Sisters Mountains.

The profile of the upper river generally reflects the transition from resistant volcanic parent material through the more easily erodible tuffaceous sedimentary rock and glacial landforms. The channel slope decreases from 1.2% upstream of Belknap Springs to less than 0.4% through the glacial valley just upstream from the mouth of Blue River. Downstream of Blue River the channel slope remains between 0.2 to 0.4%, but the channel is tightly confined within a narrow canyon for approximately 20 miles. The slope flattens abruptly to less than 0.2% as the river enters the wide Willamette Valley.

The largest town in the subbasin is Springfield (population approximately 52,000; PSU 1998), which is also partially located in the upper Willamette and Middle Fork Willamette subbasins. There are several smaller towns and a large number of rural residents in the subbasin (Fig. 5-1). The largest dams are USACE's Cougar Dam on the South Fork McKenzie (RM 4.5; completed in 1963) and Blue River Dam on the Blue River (RM 1.8; completed in 1968). The other major dams in the subbasin are EWEB's Carmen and Trail Bridge dams on the upper McKenzie River, Smith Dam on the Smith River, and Leaburg Dam on the lower McKenzie River (Fig. 1-1). In addition, EWEB diverts a large proportion of the lower McKenzie River into the unscreened Walterville Canal. Other dams and diversions withdraw water from the lower McKenzie River and its tributaries in significant amounts during the summer and fall. The floodplains and channels of the lower McKenzie and its tributaries have been simplified by riprapping and filling for agriculture, urban development, highways, and other development (EA 1991a).

Approximately 70% of the McKenzie River subbasin is public land; most of the upper subbasin is managed by WNF and a much smaller proportion of the subbasin is managed by the Bureau of Land Management's Eugene District (BLME). The headwaters originate in the Three Sisters Wilderness area of WNF. Cougar and Blue River dams, and most of their reservoirs, are located within WNF (Fig. 1-1). Forest road construction and timber harvest have been extensive on both public and private land in the McKenzie River subbasin. The subbasin is used extensively for recreational purposes, and the McKenzie River is one of the most popular rivers for fishing and boating in Oregon. Much of the lower McKenzie River subbasin is described in watershed analysis reports by BLME (1995, 1996, 1998), EWEB (EA 1991a, 1991b), and Weyerhaeuser (Weyco 1994). Watersheds in the upper basin are described in watershed analysis reports by WNF (WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997). In addition, the McKenzie Watershed Council (MWC) has completed an assessment of water quality and habitat for the entire subbasin (MWC 1996).

5.2.1 Disturbance

Disturbance is defined in this biological opinion as a natural disruption of 5th field HUC or larger stream channels with a recurrence interval of 10 to 100 years. The main types of disturbance (using this definition) in the McKenzie subbasin are flooding, fire, and mass wasting. Floods that recur on an average interval of every ten years or longer are probably the most important type of disturbance for 5th field HUC or larger stream channels in the McKenzie River subbasin based on their effects and frequency, both historically and currently. Fire was historically of major importance but fire suppression during the 20th century has reduced its role. Mass wasting, on the other hand, has probably increased in frequency during this time due to construction of dense forest road systems and timber harvest (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997; Weyco 1994). Flood control operations at Cougar and Blue River dams have decreased the magnitude and frequency of peak flow events that historically recurred every ten to 100 years downstream of the dams. Prior to the construction of Cougar and Blue River dams, the highest flow recorded on the McKenzie River at the Vida gage was 64,400 cfs in December 1945 and flows greater than 40,000 cfs were not uncommon (USACE 2000).

Before the completion of Cougar and Blue River dams, the magnitude of floods recurring on an average interval of every 10 years (the 10-year flood) was approximately 50,000 cfs at Vida, 12 miles below the confluence of the South Fork (Fig. 5-1). Since the completion of the flood-control projects, the magnitude of the 100-year flood (i.e., a major flood) has been reduced to less than the pre-dam 10-year flood. Another way of looking at the data represented in the graph in Fig. 5-1 is to compare the pre- and post-dam magnitude of floods at a selected recurrence interval. For example, the ten-year flood has decreased from approximately 50,000 cfs at the Vida gage before the dams to approximately 26,000 cfs after the dams at the Vida gage (Fig. 5-1). On the South Fork below Cougar Dam, the magnitude of the ten-year flood has decreased from approximately 19,000 cfs to approximately 6,000 cfs at the gage just below the dam (Fig. 5-2). The construction of EWEB's Carmen, Smith, and Trail Bridge dams in the 1960s in the upper subbasin had minimal effects on flood magnitude due to much smaller storage capacities than Cougar and Blue River dams. An indirect effect of flood control by Cougar and Blue River dams has been the encroachment into the floodplain by agriculture and other development that would have been prevented by floods in the absence of the dams.

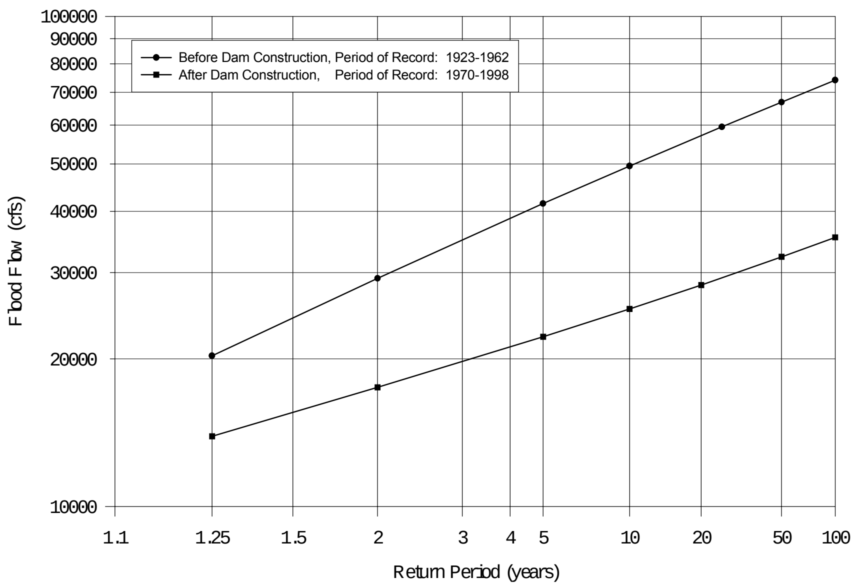


Figure 5-1. Flood frequencies at the Vida gage on the McKenzie River (USGS gage 14162500 at RM 47.7) before and after the construction of

Blue River, Cougar, Carmen, Smith, and Trail Bridge dams. The gage is located 12 miles downstream of the South Fork McKenzie River's confluence with the mainstem McKenzie (from Fig. F-22 in USACE 2000).

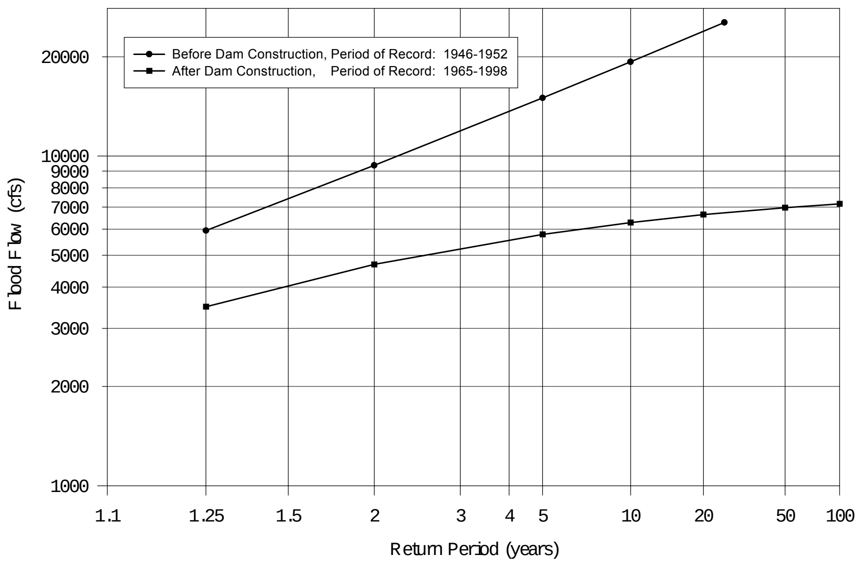


Figure 5-2. Flood frequencies at Rainbow on the South Fork McKenzie River (USGS gage 14159500 at RM 3.9) before and after the construction of Cougar Dam. The gage is one-half mile below the dam (from Fig. F-17 in USACE 2000).

Upstream of Cougar and Blue River dams and in other McKenzie River tributary watersheds, the environmental baseline with regard to disturbance is dominated by the effects of the three largest floods in the past 60 years, the 1945, 1964, and 1996 floods, combined with the effects of human activities. That is, these floods, especially the latter two, occurred after large stream channels had been considerably simplified through the results of road construction and LW removal, for example. The floods then scoured many of these stream channels and washed much of the existing substrate and LW downstream. The occurrence of these large floods in streams already altered by human activities has resulted in simplified, monotypic stream channels in much of the McKenzie subbasin above the dams and in tributary watersheds (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997).

In summary, USACE dams have reduced the frequency and size of floods in the largest stream channels from those observed historically. Fire suppression has reduced the frequency of fires and has increased fuel loads. Road construction, timber harvest, and other activities have increased mass wasting in some watersheds. The reduced frequencies and magnitude of these natural processes of disturbance, at the level of 5th field HUC stream channels, have resulted in relatively static and simplified aquatic habitat compared to the conditions under which the listed species evolved.

5.2.2 Flow regime

The McKenzie River drains an area of approximately 1,300 square miles. The highest monthly average flows typically occur from November through February, with a pronounced secondary peak in April and May due to snowmelt. Low flows occur in July through September. Vast areas of porous lava in the Cascade Range above the headwaters of the McKenzie River system retard surface runoff and act as a reservoir for large, relatively constant-flowing springs and abundant groundwater. This hydrologic feature maintains relatively high flows in the summer in the McKenzie River compared to other Willamette River basin tributaries such as the North and South Santiam rivers. However, peak flows and low flows have been changed from historical conditions as an indirect result of human activities such as timber harvest, road construction, and fire suppression. For example, an increase in peak flows in the unregulated watersheds of the lower basin has been caused by extensive forest road construction and timber harvest (Weyco 1994; BLME 1996). As shown in Figures 5-2 and 5-3, flows in regulated streams such as the mainstem McKenzie River have been strongly affected by dams, especially the high-head storage projects, Cougar and Blue River dams (USACE 2000).

In addition to reducing the magnitude of large instantaneous peak flow events, the management of Cougar and Blue River dams for flood control has reduced the magnitude of low and moderate instantaneous peak flow events (two- to five-year events). For example, before the completion of Cougar and Blue River dams, the magnitude of floods occurring on an average of every two years (two-year event) was approximately 30,000 cfs at the Vida gage on the McKenzie River, 12 miles below the confluence of the South Fork (Fig. 5-1). Since the completion of the dams, the magnitude of the two-year event has been reduced to approximately 18,000 cfs at this gage. Another way of looking at the data represented in Fig. 5-1 is that the pre-dam two-year event is now likely to happen only every 25 years or so. Comparisons between post-dam flows in the lower McKenzie River and flows over the same time period from an unregulated tributary (Gate Creek) show that two-year events have continued in this tributary while becoming much rarer in the mainstem McKenzie (BLME 1996).

Cougar Dam was completed in 1963 and Blue River Dam in 1968, and together they control flows from a total of 296 square miles (208 square miles and 88 square miles, respectively). The construction of these dams resulted in higher monthly average flows in the summer and fall (when reservoirs are emptied to create flood control storage) and lower flows in the spring (when reservoirs refill) below the dams. For example, prior to construction of the dams, the monthly average flow for September at the Vida gage (12 miles below South Fork confluence with the McKenzie River and ten miles below Blue River confluence) was approximately 1,800 cfs. Since construction of the dams, the monthly average flow for September at Vida has increased to approximately 2,700 cfs. Likewise, monthly average flows below the dams have decreased in the spring. For example, prior to construction of the dams, the monthly average flow for April at Vida was approximately 5,400 cfs. Since construction of the dams, the monthly average flow for April at Vida has decreased to approximately 4,000 cfs (Fig. 5-3).

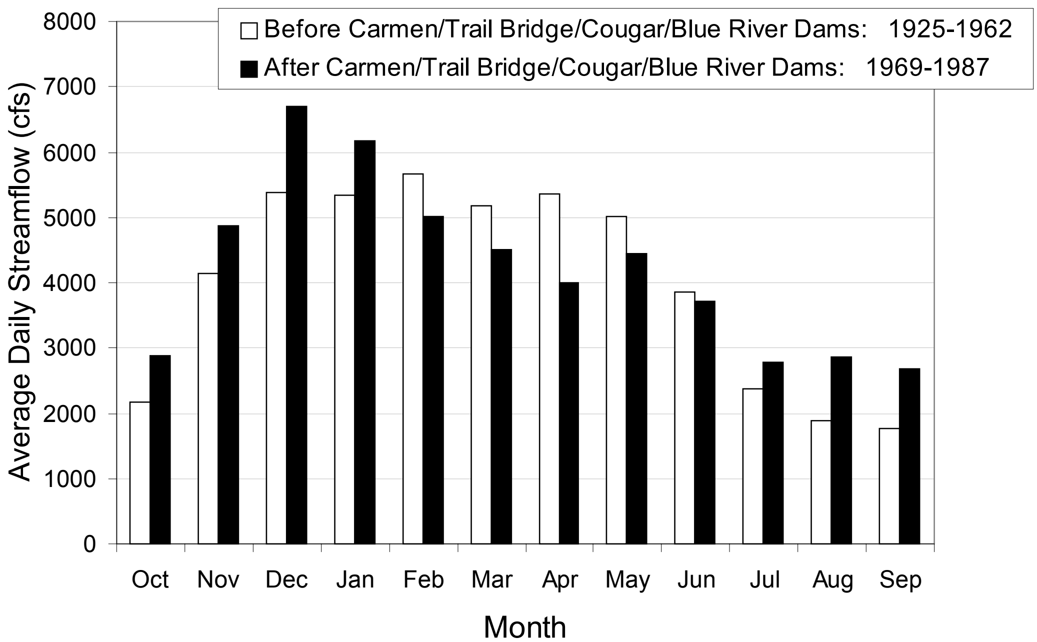


Figure 5-3. Monthly average flows at Vida on the McKenzie River (USGS gage 14162500 at RM 47.7) before and after the construction of Blue River, Cougar, and other dams. The gage is 12 miles downstream of the South Fork McKenzie River's confluence with the mainstem McKenzie (from Fig. F-58 in USACE 2000).

These changes in the flow regime below the dams are much greater on the South Fork McKenzie and Blue rivers downstream of the dams. For example, average September flows in the South Fork below the dam have approximately tripled since dam construction, and average April flows are only one-third of pre-project flows (Fig. 5-4). From November through January when the reservoir is kept at minimum flood control pool, flows below the dam are variable in order to maintain the reservoir at this elevation to provide flood control capacity. If there is a high flow event, the reservoir level will increase to hold back the floodwaters, and the flows below the dam in the South Fork may actually decrease to 100 cfs to reduce flooding downstream of its confluence with the mainstem. From February through May, the reservoir is filled and generally 300 cfs are released into the South Fork. This is less than one-fourth of the pre-dam flow during this period, which is dominated by spring snow melt. From late May until early September, near full pool is maintained for recreation and other purposes, and 200 cfs is released to maintain minimum flows in the South Fork, that is, during a period when pre-dam flows would have been slowly decreasing. The largest departure from pre-dam flow regimes occurs in September and October, when flows in the South Fork would naturally be at their lowest until the onset of rains. This is when the Corps' reservoir is drawn back down to minimum flood control pool, resulting in South Fork flows below the dam of 800-1,000 cfs - at least twice as high as pre-project flows at this time of the year (WNF BRRD 1994; USACE 1995).

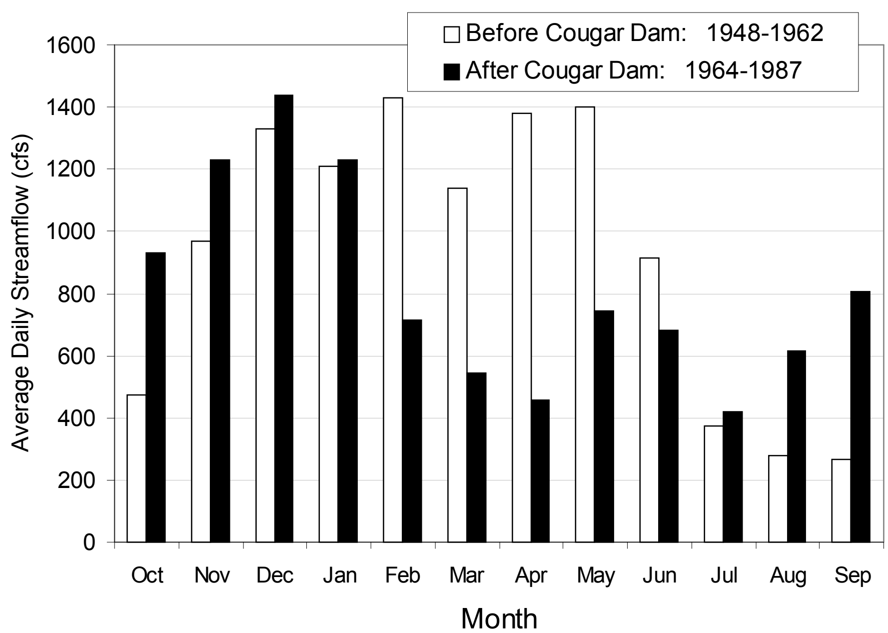


Figure 5-4. Monthly average flows at Rainbow on the South Fork McKenzie River (USGS gage 14159500 at RM 3.9) before and after the construction of Cougar Dam. The gage is one-half mile below the dam (from Fig. F-55 in USACE 2000).

After Cougar and Blue River dams, the dams that most affect the flow regime of the McKenzie River are EWEB's Carmen-Smith, Trail Bridge, and Leaburg dams on the Smith and McKenzie rivers. EWEB's unscreened Walterville Canal diverts water from the lower McKenzie without using a dam, but sometimes diverts over half of its flow (for nonconsumptive hydroelectric generation). In addition, EWEB has, on occasion, performed minor channel alterations near the Walterville intake to facilitate water withdrawal. These diversions have a smaller overall effect on flow because they have much smaller storage capacities than the USACE dams. Because the inflow into their forebays (or in the case of Walterville, canal headworks) equals their outflow from the powerhouse tailraces, these facilities are sometimes referred to as "run-of-river" projects. However, the Carmen-Smith, Leaburg, and Walterville projects divert water for several miles through canals or penstocks, depleting flows in the bypass reaches. The diverted flow amounts to a relatively large proportion of total flow during the low-flow season.

Besides EWEB's Carmen-Smith Project, the great majority of water withdrawals in the McKenzie subbasin occur downstream of Vida, both from the mainstem McKenzie as well as its tributaries. Withdrawals from the mainstem are partially compensated by storage and controlled release of water from Cougar and Blue River dams. Since storage is much less or nonexistent on tributaries of the lower mainstem McKenzie River, water withdrawals reduce flows by a larger proportion than on the mainstem. The largest withdrawals from the mainstem McKenzie River are from EWEB's Leaburg-Walterville Project. These projects both can divert over 2,400 cfs into canals several miles long for hydroelectric power generation before the water is returned to the river. Between Vida and Springfield, there are nearly 300 water rights for withdrawals from the mainstem McKenzie (124) and tributaries (170). Most withdrawals are for irrigation, but about 60 are for domestic water and the remainder are for fisheries, livestock watering, recreation, and hydroelectric power generation (BLME 1996).

In summary, USACE dams have altered the historical annual hydrograph in the largest streams by reducing peak flows in the winter and spring and by increasing low flows in the summer and fall. In streams not affected by the USACE dams, peak flows have increased due to road construction, timber harvest, and other activities, and low flows have decreased due to water withdrawals and the effects of various land-use practices.

5.2.3 Sediment and LW Function

The processes of sediment and LW function in various locations throughout the McKenzie subbasin have been characterized both by Federal agencies (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997) and others (EA 1991a, Minear 1994, Weyco 1994). The largest changes in sediment and LW function from historical conditions are evident in 6^{th} field HUC and larger stream channels in this and other Willamette subbasins. Generally, delivery of nonorganic sediment (rock and fine sediment) to stream channels upstream of dams has increased due to erosion caused by human activities, but the ability of these channels to retain sediment has decreased due to structural simplification of channels. Important agents in channel simplification have been the reduction in LW and isolation of channels from their floodplains, both caused by a variety of human activities. The current function of sediment and LW within stream channels reflects these changes, but the manner in which stream channels have responded to such changes depends on several factors such as channel type and gradient.

The relatively unconstrained, low gradient reaches of 5^{th} and 6^{th} field HUC streams historically were structurally complex and spatially diverse, having high densities of LW, side channels, islands, gravel bars, and pools. Upstream of the major dams in the McKenzie subbasin, these low gradient reaches have typically responded to increased sediment and decreased LW by channel widening and simplification. Constrained, high gradient reaches historically were less complex than the low gradient reaches, but LW provided sediment retention and structural complexity. With the reduction in LW, these high gradient reaches have typically responded by transporting sediment more efficiently (even when more sediment is available), resulting in widespread downcutting to bedrock or boulders/large cobbles (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997). Downstream of large dams, stream channels are deprived of all types of sediment (nonorganic and LW), thus they typically respond differently to human activities than unregulated streams.

In the mainstem McKenzie River (a 4th field HUC stream), channel bed material is generally armored and composed of cobble and larger material because the river has a large transport capacity relative to sediment availability and fine material is rapidly transported downstream. Leaburg Dam initially blocked the downstream transport of sediment in the lower McKenzie River when it was constructed in 1929, resulting in downcutting of 1-5 feet (Weyco 1994). However, Leaburg Lake has since filled in and passes gravel to spawning areas located downstream below Leaburg Dam. The five other major dams in the upper subbasin (Carmen, Smith, Trail Bridge, Blue River, and Cougar) alter the hydrology and trap sediment from over 35% of the watershed. The completion of Blue River and Cougar dams reduced the area supplying sediment to the mainstem McKenzie River by 23%. These dams act as sediment traps, with coarser material (gravel and larger rock) settling out at the head of the reservoir, and most of the finer sediment settling out within the reservoir. In addition, most woody material is prevented from going past the USACE dams and large log rafts may collect on the reservoirs after floods (USACE 2000).

In addition to trapping sediment from a large portion of the upper subbasin, the alteration in flow regime by Blue River and Cougar dams has reduced the river's ability to transport sediment produced by natural weathering processes in the upper subbasin. Prior to dam construction, peak flows with a five-year recurrence interval at the Vida gage were able to move sediments up to 150 mm in diameter, the estimated historical median particle size (Minear 1994). After dam construction, the peak flow corresponding to a five-year return interval was reduced from over 40,000 cfs to about 22,000 cfs; this flow is no longer able to mobilize the median substrate particle size (150 mm diameter). Aerial photos taken in 1945/1946 and in 1986 indicated that adjustments to these factors caused a 57% decrease in the area of exposed gravel bars and possible coarsening of mainstem substrates (Minear 1994). The sediment supply to most of the subbasin is still routed downstream through undammed reaches. Thus, the effects of armoring are localized compared to subbasins where dams entirely block the sediment supply to the mainstem.

The length of side channels in the unconfined reach downstream of the confluence with the South Fork McKenzie River (above Leaburg Dam) decreased from almost 6,000 feet in 1946 to just over 3,000 feet in 1986 (Minear 1994). The area of gravel bars also decreased during this same time period, from over 30 acres to three acres. These data suggest that the main channels in these reaches are downcutting and disconnecting from side channel habitats. The effects will probably continue until an armor layer develops; there are presently no data as to whether this has occurred (USACE 2000). The reach downstream of Leaburg Dam has been responding to a similar reduction in sediment supply for a longer time period. The area of islands and length of stream margin habitat decreased from approximately 540 acres and 117,000 linear feet respectively in 1930, to approximately 270 acres and 95,000 linear feet in 1990. The area of off-channel sloughs increased from approximately 39 acres in 1930 to 51 acres in 1990 (EA 1991a).

Large wood has been directly removed from stream channels of all sizes in the McKenzie subbasin during the 20th century. Large wood was directly removed from lower subbasin stream channels in the early 20th century as a result of splash damming (BLME 1995). More recently, the practice of "stream clean-out" from the 1950s to the 1970s directly reduced LW in many streams in the McKenzie subbasin. Logjams and other LW were removed from stream channels on both public and private land in a misdirected effort to improve fish passage, for timber salvage, and to reduce downstream damage during floods to bridges. Currently, LW is often removed by boaters from the mainstem McKenzie River channel to prevent navigation hazards. The subsequent simplification of stream channels allows sediment to be flushed downstream, thereby depriving the channel of material required for building streambanks and gravel bars (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997).

Construction of Cougar and Blue River dams disrupted the downstream transport of LW to downstream reaches. Wood and organic material trapped behind the dams would have eventually been transported to the McKenzie River. As evidence, the amount of LW in the McKenzie River between the confluence with the South Fork McKenzie and Leaburg Dam decreased from twelve large aggregations and three large single logs in 1930, to four aggregations and one large single log in 1991 (Minear 1994). Because Leaburg Dam is a run-of-river project, high flows pass over the spillway, allowing most LW to continue downstream rather than trapping it as occurs at Cougar and Blue River dams.

The degree to which dams disrupt the downstream transport of LW is presumed to be less severe, relative to other land use activities, in the McKenzie River subbasin, than in upper Willamette subbasins with mainstem dams. In the case of the McKenzie subbasin; the river still transports wood from unregulated tributaries. However, in the past, it was common practice for landowners and river guides to remove LW from the channel for flood control and navigation purposes or to sell pieces that were marketable (Minear 1994). Much of the in-channel LW in the mainstem near the confluence with the South Fork was removed during intensive logging of the riparian area in the 1950s. The relatively young, existing riparian stands and the disruption of downstream LW transport by Cougar and Blue River dams will continue to depress LW recruitment rates to the lower McKenzie River (Minear 1994).

In summary, both USACE dams and EWEB's Carmen-Smith Project have interrupted sediment transport in the largest stream channels, trapping it behind the dams and reducing sediment load, thus causing downcutting and substrate coarsening of these stream channels below the dams. In streams not affected by USACE or EWEB dams, road construction, agriculture, timber harvest, and other land use practices have increased sedimentation of stream channels. In nearly all 6th field HUC and larger stream channels, a combination of dams and land-management practices have reduced LW from historical levels, contributing to stream channel simplification.

5.2.4 Riparian Vegetation and Floodplain Function

The acreage covered and functional value of riparian vegetation of the McKenzie subbasin has been greatly reduced during the 20th century. Much riparian vegetation was removed for farmland, residences, timber harvest, and roads. In some cases, all woody vegetation on streambanks has been removed. For example, as of 1990, more than 11 miles of streambanks in the lower McKenzie River were protected by riprap or revetments built by USACE (USACE 2000). In the higher elevations of the subbasin, roads parallel stream channels and cut through riparian areas immediately adjacent to many streams. The construction of Highway 126 altered the McKenzie River's historical riparian character with the addition of roads, ditches, turnouts, and other road-related development. Secondary road construction and timber harvest activities in much of the subbasin have eliminated or greatly reduced riparian vegetation along most streams (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997). Cougar Reservoir inundated 1,280 acres, including 200 acres of riparian hardwoods and 1,600 acres of old-growth conifers (BPA 1985). Blue River reservoir inundated 975 acres of stream channels, riparian forest, and upland forest (USACE 2000).

The amount of riparian habitat adjacent to the lower McKenzie River is estimated to have been reduced from 1,607 acres in the 1930s to less than 930 acres in 1990 (EA 1991b). In the lower subbasin, riparian vegetation consists of narrow, sparse stands of shrubs or trees with poor to fair near-term LW recruitment potential, and poor long-term recruitment potential, assuming current land-use practices. Riparian vegetation and future LW recruitment potential improves along an upstream gradient (Weyco 1994). In much of the subbasin, three non-native invasive species dominate riparian areas: Himalayan blackberry, Scotch broom, and reed canary grass.

Downstream of the South Fork McKenzie River, vegetation has become established on gravel bars and other surfaces that were formerly regularly inundated, making them more resistant to erosion during flooding. This has resulted in dramatic changes in channel configuration and has reduced the area of exposed gravel bars in the wide, low gradient valley downstream of the South Fork McKenzie. A reduction in the total area of gravel bars was also noted in the canyon reach downstream of the confluence with Blue River, although the number of side channels increased (Minear 1994). As with reduction in peak flows and sediment supply, establishment of vegetation on formerly unstable bars has been an agent of channel change in the McKenzie system (USACE 2000).

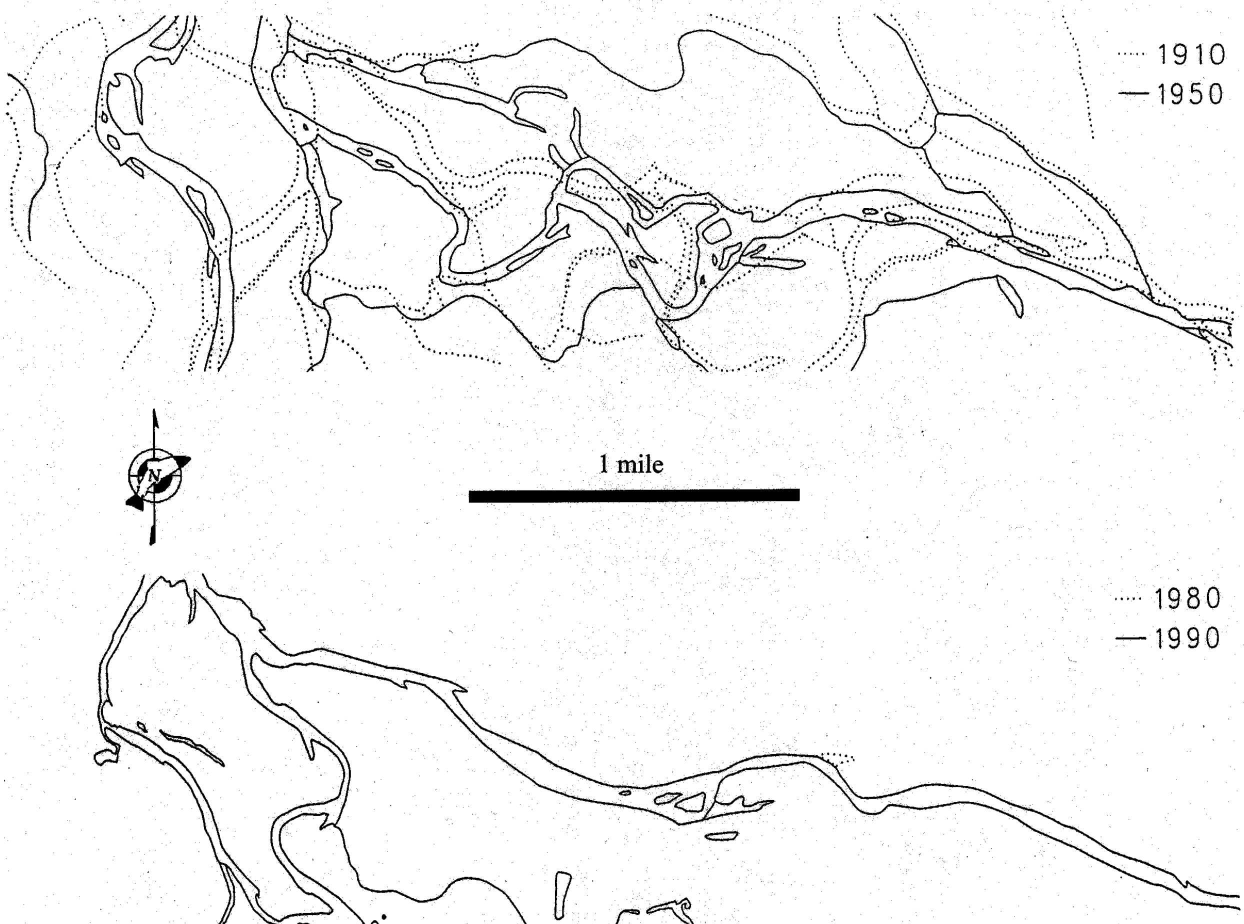
Historically, the lower, unconfined section of the McKenzie River downstream of Leaburg Dam contained frequent, mid-channel bars and islands, and multiple channels that periodically shifted from one side of the river to the other. Shear stress was high because the river gradient was still steep relative to discharge, and high flows were capable of transporting sediment larger than 256 mm in diameter. The river probably had an armored cobble bed within this reach, although there was substantial hydraulic roughness causing deposition of finer gravel and sand (EA 1991a). Over the entire reach of the McKenzie River below Leaburg Dam, the effects of altered flow regime and construction of flood control structures (levees and revetments) are believed to have had a greater influence on channel morphology than reduced sediment supply. Such effects and actions would serve to prevent flows capable of creating new bars and islands, constrict the channel and prevent bank erosion, and allow encroachment of perennial vegetation on formerly active bar surfaces (EA 1991a).

To provide protection from flooding, the USACE recommended in 1947 that nearly continuous levees with an average height of seven feet be constructed along the lower McKenzie River downstream of RM 22. As of 1990, more than 11 miles of streambanks in the lower McKenzie River were protected by riprap or revetments. These are located primarily along the outside of meander bends, and are concentrated in the heavily populated valley near the confluence of the McKenzie with the Willamette River. There are no levees or revetments constructed or maintained by the USACE in the vicinity of Blue River and the South Fork McKenzie River (USACE 2000). Riprap banks retard or prevent the formation of mid-channel bars and islands in the McKenzie River that are normally created and maintained by bank erosion and recruitment of sediment from streambanks. As a result, the channel form has been simplified and the bed has become comprised of an increasingly homogenous mixture of cobbles with few gravel deposits present. The dominant particle size is 152 mm and the D_{50} (average) is 119 mm, sizes approaching the maximum size used by spawning salmon and steelhead (EA 1991a).

In summary, the function of the McKenzie subbasin's floodplains has been impaired by peak flow reduction (due to dams), sediment supply reduction (due to trapping of gravel behind dams and streambank hardening by riprap and vegetation encroachment), loss of LW, and transformation of many floodplain areas to fields, roads, buildings, and other developments. The river is not only unable to create new floodplain complexity (e.g., gravel bars, side channels, LW aggregations) during peak flows, but cannot maintain existing structural complexity. As islands, side channels, and LW are lost without being replaced, the structure of the entire stream channel simplifies. An example of stream channel and floodplain simplification along the lower McKenzie River is shown in Figure 5-5.

Riparian vegetation has been reduced by road construction, agriculture, timber harvest, gravel mining, riprap, reservoir inundation, and urbanization. Downstream of USACE dams, riparian vegetation has encroached on surfaces that were regularly inundated before the dams were built, resulting in channel narrowing and gravel bar reduction. In the lower reaches of the largest streams, formerly wide floodplains and complex stream channels have been simplified by the removal of riparian vegetation, filling of secondary channels, and other backwaters, and hardening of streambanks with riprap. These simplified conditions are maintained by the reduction in floods, sediment, and LW by the USACE and EWEB dams, as well as the hardening of streambanks and ongoing development of the floodplain.

Figure 5-5. Channel simplification along the lower McKenzie River (flowing east to west through center of figures) from 1910 to 1990 at the confluence with the Willamette River (flowing south to north on left side of figures; EA 1991a).



5.2.5 Water Quality

Recently, nine reaches in the McKenzie subbasin were listed on ODEQ's 303(d) list for elevated summertime temperatures. The aquatic insect community in the McKenzie River basin is considered to be abundant and diverse, indicating relatively high water quality (USACE 2000). However, water temperature conditions in the summer and fall have been altered in Blue River, the South Fork, and the McKenzie River by the operation of Cougar and Blue River dams. These effects have been especially pronounced downstream of Cougar Dam in the South Fork, and have led to the current altered condition of the water temperature baseline. Cougar Dam is managed by the USACE primarily for flood control but also for secondary purposes such as recreation and instream flows. Thus, the reservoir is kept at its minimum flood control pool from November through January to provide room for potential floodwaters, then filled up nearly to full pool from February through May to provide recreation in the summer and stored water for instream flows and other purposes. The reservoir is drawn back down to minimum flood control pool in September and October to complete the cycle. Seasonal schedules for regulating reservoir elevations are commonly known as "rule curves" (USACE 1995).

Because water has been released from the bottom of Cougar Dam and water temperatures in the reservoir during the summer are strongly stratified, the water released in spring and summer is up to approximately 10EF colder (Fig. 5-6 below) than pre-project conditions in the South Fork. The water in the upper portion of the reservoir is heated throughout the summer, and as the deeper, colder water is released, the water temperature in the reservoir gradually increases and the different layers of water begin to mix. This results in water releases that warm throughout the fall when pre-project water temperatures would have been cooling, culminating in October releases to the South Fork that are up to approximately 10EF warmer than pre-project water temperatures. The resulting water temperature baseline is described in numerous reports in addition to the BA (USGS 1988; NMFS 1990; USFWS 1990, 1994; WNF BRRD 1994). USACE is planning to retrofit Cougar Dam with a water temperature control tower in 2002-2004, a proposed action for which the Services have completed formal ESA consultation (NMFS Log# OSB99-0311 and USFWS Log# 1-7-00-F-106, 2000).

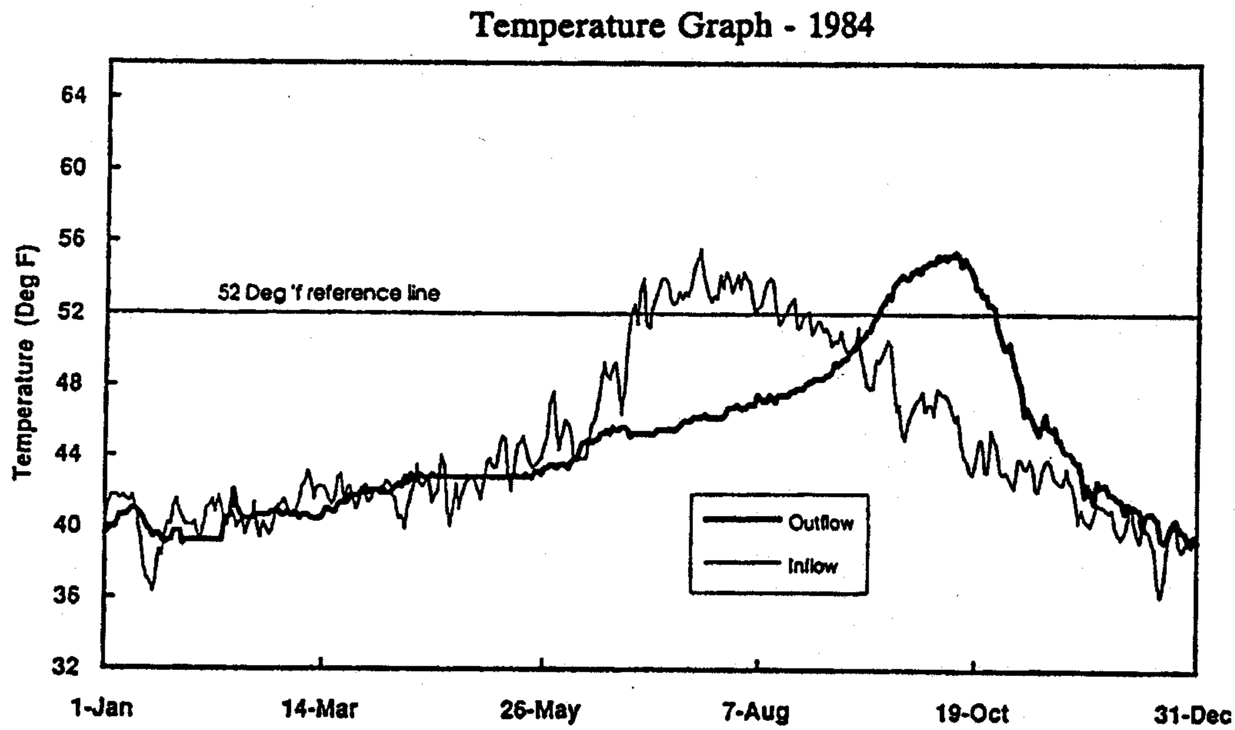


Figure 5-6. Water temperature changes in the South Fork McKenzie River caused by releases from Cougar Reservoir in 1984.

USGS (1988) studied the effects of Cougar and Blue River dams on water temperatures in the mainstem of the McKenzie River from the South Fork confluence (RM 59.7) to Vida (RM 47.7). Based on modeling for an "average" year, the study found that Cougar Dam alone resulted in a maximum water temperature decrease at Vida, compared to pre-project conditions during July through September, of 2.0EF, and a maximum increase, during October, of 2.4EF. The model showed that the average water temperature decrease due to Cougar Dam alone (compared to pre-project conditions) at Vida over 101 days in the summer and early fall was approximately 1.37EF, and the average water temperature increase over 57 days in the fall was approximately 1.75EF (Table 7; USGS 1988).

One of the Congressionally-authorized purposes of Cougar, Blue River, and the other USACE dams in the Willamette was to reduce water quality problems downstream due in part to nutrient loading (USACE 2000). Cougar and Blue River dams have contributed to the reduced nutrient loads in the lower McKenzie River and upper mainstem Willamette River by increasing summer flows and decreasing summer water temperatures. However, upstream of the dams, the blocking of salmon passage has probably had unanticipated effects on the nutrient cycles of the upper watersheds, particularly with respect to nitrogen. Unlike phosphorus, the volcanic geology of the Cascade Mountains is nitrogen-poor, thus anadromous salmonid carcasses are an important source of imported nitrogen (i.e., marine-derived) in this Cascade portion of the McKenzie subbasin ecosystem (Spence et al. 1996). For example, Triska et al. (1984) found low levels of nitrogen in all forms in a small watershed above Blue River Dam.

While the Blue River watershed above the dam supported a pre-dam annual population of less than 200 UWR chinook salmon spawners (USFWS 1965; WNF BRRD 1996), the South Fork McKenzie watershed above Cougar Dam historically supported an annual population of at least 4,000 UWR chinook spawners (USFWS 1959). Prior to 1958 (no beginning point indicated), an average of approximately 2,000 adult spring chinook salmon entered the South Fork annually to spawn. This average was more than doubled in 1958 when about 4,300 adult spring chinook salmon entered the South Fork. USFWS (1959) calculated that the spawning habitat available in the South Fork at the time would accommodate 5,360 adult spring chinook salmon. Prior to USFWS's study, the USACE estimated the South Fork could support a run of 6,000 adult spring chinook salmon, and a 1937-1938 survey by the Bureau of Commercial Fisheries (predecessor of NMFS) estimated spawning area available for "at least 13,000 salmon" (WNF BRRD 1994).

The spawner carcasses probably constituted an important source of nitrogen for the stream reaches above the Cougar damsite (and possibly above the Blue River damsite as well), thus the elimination of these carcasses by dam construction reduced nitrogen availability above the dams. This nitrogen limitation is in stark contrast to current nitrogen availability in the lower-elevation areas of the Willamette Basin, where human activities such as application of fertilizers for agriculture has resulted in an overabundance of nitrogen and other nutrients in aquatic environments (USGS 1995, 1996). This simultaneous nutrient impoverishment (highlands) and nutrient enrichment (lowlands) due to human activities is commonly observed at the subbasin and basin scales (Stockner et al. 2000).

In most streams, summertime water temperatures are higher than those observed historically due to the cumulative effects of human activities. In many of the lower elevation streams, eutrophication and contamination from agricultural practices and urbanization have degraded water quality. Downstream of USACE dams, stream temperatures have been substantially altered by management of the dams, resulting in cooler temperatures in the summer and much warmer temperatures in the fall. Upstream of USACE and EWEB dams, the elimination of salmon carcasses has reduced nutrient availability in streams.

5.3 Status of Biological Processes Under the Environmental Baseline

The proposed action affects the biological processes of UWR chinook and CR bull trout. The most relevant biological processes for both listed fish species in the McKenzie subbasin ecosystem covered by this opinion are migration, spawning, rearing, population level processes, and food web dynamics. The first four processes are species-specific (i.e., at the organism or population levels described in the Ecosystem Context in section 2.3.3.2) and are thus described by species, and these are followed by a section on food web dynamics relevant to all species.

In this opinion, the biological process of migration is defined as movement of an organism from one habitat to another, either for its next life history stage or in response to seasonal changes. Spawning is defined as breeding behavior and activity as well as incubation of eggs. Rearing is defined as the life history stage between emergence from incubation habitat to smoltification (for anadromous salmonids) or to development of the subadult form. Population level processes are defined as the number of reproductively mature adults within a given geographic area, survival rates of various life stages, and life history diversity (intra-population variation in the timing or location of one or more life history stages, such as the spawning of spring chinook salmon in different stream reaches and during different weeks or months within the same subbasin).

Food web dynamics is a very broad community level process that encompasses the interactions of species in the McKenzie subbasin ecosystem with one another, and includes predation, competition, and disease. The loss of historical habitats described above in section 5.3, the introduction of exotic species, and the creation of new habitats in reservoirs and revetments have caused shifts in food web dynamics in the McKenzie subbasin ecosystem. Exotic animal and plant species may compete with native species occupying similar ecological niches for food and habitat, compete with and prey upon native species, and/or modify, reduce, or eliminate the habitat for native species. Reservoirs, revetments, and other human-created structures provide extensive habitat for exotic and native predators of listed species.

A substantial portion of spawning and rearing habitat in the McKenzie subbasin for the listed species addressed by this opinion is on Federal land (Forest Service and Bureau of Land Management). Gradual improvements in habitat conditions for these species are expected on these Federal lands as a result of Northwest Forest Plan implementation, as guided by ESA consultation, and as a result of the Basinwide Salmon Recovery Strategy (Federal Caucus 2000). The status of habitat required to support each species-specific process (e.g., habitat for chinook salmon spawning, passage conditions for migration) and the status of each of the five biological processes are described below.

5.3.1 Upper Willamette River Chinook Salmon

The organism and population level processes of migration, spawning, rearing, and population size and life history diversity are described below for UWR chinook salmon in the McKenzie subbasin. General life history for this ESU is described in section 4.1.1.

5.3.1.1 Migration

Migration refers to the movement of adult UWR chinook salmon up the McKenzie River and its tributaries on their spawning run, and the movement of juvenile UWR chinook salmon from the redds to downstream rearing habitat. UWR chinook salmon historically migrated through much of the McKenzie subbasin to take advantage of abundant spawning and rearing habitat. The mainstem McKenzie River is free of natural migration barriers to adult salmonids up to Tamolich pool at approximately RM 81 (WNF MRD 1995), above which the river is subsurface for several miles. Adult chinook salmon historically migrated up to this point in the upper mainstem McKenzie River to spawn, as well as the upper reaches of all the major tributaries such as the Mohawk River, Blue River, the South Fork McKenzie River, Horse Creek, and many smaller streams. Spawning occurred throughout these streams where habitat was available, including the mainstem McKenzie River down to the confluence with the Willamette River. Juvenile chinook salmon migrated downstream to suitable rearing habitat in all these streams and the mainstem Willamette River, depending on their life history stage and the environmental conditions (USACE 2000).

Migration conditions for chinook salmon in the McKenzie subbasin were altered from historical conditions by at least one hatchery rack (weir) on the lower mainstem, numerous dams on the mainstem and many tributaries that created barriers, and flow regimes that were altered by the dams and other human activities. One of the earliest obstructions to fish migration was a hatchery rack on the lower McKenzie River at approximately RM 18. This rack, which intercepted the entire spring chinook salmon run, was operated from 1902 through 1957 to collect eggs for a state fish hatchery. Fish spawned from this rack were used for stocking the McKenzie River system, as well as other sites in Oregon and other states. Adult passage of a portion of the population was allowed upstream past the rack starting in 1954 after a major decline in the spring chinook runs was noted (USACE 2000).

Several EWEB hydroelectric projects have altered migration conditions for chinook salmon in the mainstem McKenzie River by creating barriers to migration. Shortly after the hatchery rack began operation on the lower mainstem McKenzie River, EWEB built the Walterville Project. EWEB began diverting water in 1911 from the mainstem McKenzie River at approximately RM 28 into a 4-mile long, 14-foot deep, unscreened canal that diverted water downstream to the Walterville Powerhouse. While the canal does not block the mainstem or prevent the upstream migration of adult chinook salmon, the return flow to the river attracts adults into the tailrace canal where there is the potential for delay in their spawning migration. At the Walterville Canal intake, over 70% of the river flow can be diverted during summer when adult spring chinook may still be moving upstream, potentially hindering migration through the bypassed reach. The diversion of so much flow into an unscreened canal also potentially affects a large proportion of juveniles migrating downstream. Juveniles that move downstream through the Walterville Canal become entrained in the powerhouse flow (FERC 2001). Currently, per an agreement with

ODFW, EWEB limits the entrainment mortality of chinook fry by reducing, on a seasonal basis, the amount of water diverted at the Walterville intake.

In 1930, EWEB also constructed the 22-foot high Leaburg Dam at RM 39 to divert water from the resulting 57-acre reservoir into a 5-mile long canal. The dam has two fish ladders, but only one ladder is operational. The Leaburg Canal is now fitted with juvenile fish screens and a bypass system returns juvenile fish to the McKenzie River just below the Leaburg Dam (USACE 2000). According to FERC (2001), current levels of mortality of downstream migrating fry and smolt chinook salmon passing through Leaburg Dam are low, although the results of field tests using smolts are described as inconclusive.

The construction and operation of weirs, diversions, and dams is the most obvious manner in which human activities have altered historical migration conditions for adult and juvenile chinook salmon in the McKenzie subbasin but there have been other human-induced changes. Adult chinook salmon enter the McKenzie River from late spring to early summer, then hold in deep pools until spawning in the fall. These holding pools are a critical component of migration habitat for adult chinook salmon. Sedell et al. (1992) found a 19% reduction in the number of large pools from 1937 to 1991 in the McKenzie River from RM 24 to RM 82, including an 85% reduction in the 15 RM downstream of Leaburg Dam. The important spawning tributaries of the South Fork McKenzie River and Horse Creek also had large pool reductions of 75% and 38%, respectively, during this time period. Loss of pool habitat is attributed to reductions of pool forming processes, including peak flow events and LW, and effects of forest management activities including road building and logging.

The USACE flood control dams (Cougar and Blue River) have altered the flow regime such that late winter and spring flows are lower (Fig. 5-3 and 5-4), and water temperatures such that summer temperatures are cooler and fall temperatures are warmer than those observed historically (Fig. 5-6). The management of Cougar Dam results in colder than natural stream temperatures in August and September below the dam in the South Fork and mainstem McKenzie rivers, followed by a sudden temperature increase as the summer pool is drained such that stream temperatures are warmer than natural in October. As adult UWR chinook salmon approach the South Fork on their spawning migration in the late summer, they delay entering the stream because of the cold temperatures or spawn elsewhere. Of those that do enter the South Fork, prespawning mortality is approximately five times as high as fish spawning in the mainstem above the mouth of the South Fork (USACE 1995; NMFS and USFWS 2000).

Because chinook salmon fry migrate in the late winter from the McKenzie subbasin, reduced flows at this time of the year could affect their migration. Less direct changes in juvenile chinook salmon migration conditions induced by human activities include water quality degradation, which prevents juvenile chinook salmon from using some historical rearing habitat in the lower subbasin (e.g., Mohawk River); and the introductions of warm-water species, which compete with or prey upon juvenile chinook salmon in the lower subbasin (e.g., sloughs off of the lower mainstem McKenzie near the Willamette confluence [USACE 2000]). Effects on the biological process of juvenile migration are also discussed under the "Rearing" and "Population Size and Life History Diversity" sections, below.

Current migration timing is as follows: returning adult UWR chinook salmon enter the McKenzie River as early as mid- to late-April, when water temperatures reach 11.1-12.2E C. Migration timing of spring chinook salmon adults in the Willamette basin has been shown to be very temperature dependent. The period of peak passage above Leaburg Dam (~RM 39) occurs in the first half of June on average, but can occur as early as the second half of May in warmer water years or as late as the first part of July in cooler water years. Therefore, the timing of upstream migration to the remaining spawning habitat is probably affected by changes in water temperature caused by the dams (i.e., cold water releases from the bottom strata of USACE reservoirs during summer may delay adults, as discussed in section 5.2.5). A smaller pulse of adults moves above the dam just prior to and during the spawning period in September. Juvenile UWR chinook salmon migrate downstream from spawning and incubation areas to the lower McKenzie River or to the Willamette River in the late winter or early spring as fry (age 0+). More than 90% of the naturally- produced juveniles captured at Leaburg Dam between 1980 and 1983 were fry (FERC 2001).

In summary, USACE dams block the upstream adult migration of UWR chinook salmon into large portions of their historical spawning habitat in the McKenzie River subbasin. In the case of Cougar Dam, a USACE project completely blocks access is to what was, historically, the most productive portion of the subbasin. The timing of upstream migration to remaining spawning habitat is probably affected by changes in water temperature downstream from the dams, caused by seasonal patterns of thermal stratification and mixing in the reservoirs. Two of the three dams comprising EWEB's Carmen-Smith Project, Trail Bridge and Smith dams, block access to historical spawning areas (Carmen Dam is above a natural barrier to migration). Neither the Leaburg or Walterville diversions totally blocks fish passage but the structures and related facilities cause mortality of juvenile chinook fry and smolts and probably some delay in a portion of the adult migration.

5.3.1.2 Spawning

Historically, UWR chinook salmon spawning occurred throughout the mainstem McKenzie River and in all the major tributaries such as the Mohawk River, the South Fork McKenzie River, Horse Creek, and many smaller tributaries (BLME 1995, 1996, 1998; WNF BRRD 1994, 1996, 1998; WNF MRD 1995, 1997; Weyco 1994). Spawning in the McKenzie River started in early to mid-August and lasted as late as the third week of October, but now largely takes place during September (USACE 2000; FERC 2001). Spawning may have been especially prolific in the lower reaches of the mainstem McKenzie River. For example, in 1946-1947, spring chinook spawning occurred primarily in the lower 20 miles, near the Hayden, Coburg, and Hendrick's bridges. Chinook spawners were also located in large numbers at Wilson's Bend near the mouth and the lower section of the Walterville Canal because of the presence of a rack placed in the river to collect fish for hatchery production (Mattson 1948). Changes in UWR chinook salmon spawning strategies during the 20th century are further discussed under "Population Level Processes," below.

Currently, the McKenzie subbasin supports the largest spawning aggregation of UWR chinook salmon. Above Leaburg Dam at RM 39, an estimated 70% of the spring chinook salmon spawners passing above the dam from 1994 to 1998 were naturally produced and therefore protected under the ESA. Downstream of Leaburg Dam, most chinook salmon spawners are hatchery produced and therefore not protected (USACE 2000). Based on aerial redd surveys, approximately 10-20% of the chinook salmon above Leaburg Dam spawn in the South Fork of the McKenzie below Cougar Dam, 30-40% spawn in the mainstem McKenzie River below the confluence with the South Fork, and 45-60% spawn in headwater areas above the confluence with the South Fork up to Trail Bridge Dam (USFWS 1994; ODFW 1999a). Because these redd surveys were done from the air, redds in side channels, tributaries, and near streambanks were obscured from view by vegetation and thus probably undercounted.

Minear (1994) observed that reduced sediment supply and flow alteration by dams on the mainstem McKenzie River, Blue River, and the South Fork McKenzie River in the 1960s altered the flow regime and cut off sediment supply from the upper half of the drainage area. Aerial photographs taken in 1945/1946 and in 1986 indicated that adjustments to these factors caused a 57% decrease in the area of exposed gravel bars and possible coarsening of mainstem substrates. Sedell et al. (1992) found that the substrate in the some reaches of the mainstem McKenzie River that are still accessible to chinook salmon has coarsened in the last 60 years, although the 15-mile reach between Hendricks Bridge and Leaburg Dam actually decreased in percent large rubble (from 49 to 35%) while increasing in percents medium rubble, small rubble, and fine sediment.

Ligon et al. (1995) observed that an average of 8.5 female chinook salmon were counted per redd in a reach of the McKenzie River above Leaburg Dam during the period 1970-1986. The authors state that it is likely that spawning-gravel limitations are resulting in redd superimposition. However, the female/redd estimate was derived from Leaburg Dam counts and aerial redd counts (assuming a 1:1 sex ratio) and aerial counts in the upper McKenzie River basin have been shown to significantly under-count the number of redds based on a comparison with ODFW ground surveys (Grimes et al. 1996; Lindsay et al. 1997). This is thought to be due to the narrowing of the channel, overhanging riparian vegetation, and the propensity for chinook to spawn along the margins which inhibit the view from the air. As a result, aerial counts in the upper McKenzie basin, which could overinflate estimates of females/redd, were discontinued after 1997 (pers.comm., Tim Downey, EWEB, August 17, 2001). Further, USACE (2000) reports that only 1% of the available spawning gravel is used by chinook salmon in the mainstem McKenzie River. Thus, evidence regarding whether spawning gravels of adequate quantity and quality are available to UWR chinook salmon under the environmental baseline is inconclusive at this time.

In the tributaries of the McKenzie River, spawning habitat that is still accessible to chinook salmon has been altered by a combination of human activities. In the upper subbasin, important undammed spawning tributaries such as Horse and Lost creeks still provide abundant spawning gravels and high water quality, although these conditions have become somewhat altered by recent road construction, LW removal, and timber harvest (WNF MRD 1995, 1997). In the lower subbasin, spawning habitat has been much more affected by human activities (splash damming, irrigation diversion, and channel simplification) that started during the early 20th century (BLME 1995, 1998). As a result, chinook salmon spawning habitat in these lower subbasin tributaries has been altered through sedimentation of spawning gravels and deterioration of water quality.

The McKenzie River Trust is an Oregon non-profit corporation established in 1989 and dedicated to protecting lands in the McKenzie River watershed. The Trust is developing a scientifically-based method for identifying, evaluating, and selecting specific high quality habitat property, using the combined inputs of EWEB, the MWC, ODFW, Oregon Trout, NMFS, and others. This method includes steps that consider the habitat needs of spring chinook salmon and bull trout. EWEB has granted $500,000 to the McKenzie River Trust and pledged up to $500,000 as an additional matching grant for contributions to purchase land and/or conservation easements in the McKenzie River watershed to further watershed health objectives. These objectives include maximizing protection of critical fish and wildlife habitat of the McKenzie River, minimizing the need for future public expenditures for habitat restoration, and promoting cooperative approaches to protection of fish and wildlife habitat. The land trust will provide both short- and long-term benefits for both species of fish (FERC 2001).

In summary, most natural spawning of UWR chinook salmon takes place in the McKenzie River subbasin. Substrate coarsening has been observed at various places in the McKenzie River basin but evidence regarding whether spawning gravels of adequate quantity and quality are available to UWR chinook salmon under the environmental baseline is inconclusive.

5.3.1.3 Rearing

Little information is available on historical rearing strategies of juvenile UWR chinook salmon in the McKenzie subbasin. Juveniles were observed moving downstream beginning in February and continuing throughout the year (Craig and Townsend 1946), and analysis of scales from adults returning to the McKenzie River in 1947 indicated that 13.5% (8/59) had entered the ocean as subyearlings (Mattson 1963). As described above, currently most UWR chinook salmon juveniles in the McKenzie subbasin migrate downstream soon after emergence as fry (age 0+), but some rear in the McKenzie River and then outmigrate as fingerlings (age 1+). Samples collected at various locations in the McKenzie River between 1948 and 1968 indicated that fry migrated from the system primarily during March through June. Fry migration past Leaburg Dam since 1980 has occurred primarily during January through April; thus, fry migration has occurred earlier than in previous years. Likewise, fingerling migration in the McKenzie River peaked in January through March during 1948 through 1968, and now peaks in October and November. This change in juvenile migration timing may be due to the release of warm water from the two USACE reservoirs above spawning areas during the fall incubation period, and the consequent acceleration of fry emergence (USACE 2000). The early emerging fry are now faced with a much longer period of unfavorable wintertime conditions (USACE 1995; NMFS and USFWS 2000).[6]

Rearing habitat is used by juvenile UWR chinook salmon for feeding and growth between emergence and entry into the estuary. Within the McKenzie subbasin, rearing habitat for juvenile UWR chinook salmon is provided by side channels and river margins along the mainstem and, to a lesser degree, tributaries such as the South Fork McKenzie River (WNF BRRD 1995; USACE 2000). The lower mainstem of the McKenzie River historically provided abundant UWR chinook salmon rearing habitat, especially in the lower, alluvial reaches where the river and floodplain were a complex mosaic of main channels, side channels, islands, sloughs, and wetlands (Fig. 5-5 above).

Much of the historical rearing habitat has been either lost or simplified during the 20th century as the function of the lower subbasin's floodplains has been impaired by peak flow reduction (due to dams), sediment supply reduction (due to trapping of gravel behind dams, streambank hardening by riprap and vegetation encroachment, and gravel mining), loss of LW, and transformation of many floodplain areas to fields, gravel mining quarries, roads, buildings, and other developments. The river is not only unable to create new floodplain complexity (e.g., gravel bars, side channels, LW aggregations) during peak flows, but cannot maintain existing structural complexity. As islands, side channels, and LW are lost without being replaced, the structure of the entire stream channel simplifies and rearing habitat is consequently lost. The remaining rearing habitat is in some cases affected by deteriorating water quality and the presence of introduced predator species.

In summary, the importance of the upper McKenzie subbasin to UWR chinook salmon spawning and rearing increased throughout the 20th century as production in the lower subbasin, and in the other five subbasins, dramatically declined. The abundance and quality of spawning and rearing habitat, albeit underseeded, have declined, primarily due to the construction and operation of

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[6]UWR chinook salmon eggs incubate in the gravel for one to four months, depending on water temperature. Chinook eggs require about 416 temperature units (TUs) to hatch (one TU = 1E C above freezing for one day), and an additional 472 TUs for fry to emerge from the gravel. However, the alteration of the water temperature regime in the McKenzie River, due to the existing operations of Cougar and Blue River dams, has accelerated the emergence timing of spring chinook fry by up to 85 days, most likely reducing fry survival (FERC 2001).

USACE's Blue River and Cougar dams. Winter flow releases from the dams are much smaller than historical flows at this time of the year due to flood control, and because reservoir filling for summertime recreation begins in February. Thus, side channels of the South Fork and the mainstem downstream of the South Fork confluence that historically provided rearing habitat for fry during the winter are not connected to the main channel (WNF BRRD1994). In the South Fork and the mainstem downstream of the South Fork confluence, the dams create warmer water temperatures during egg incubation in October and November, resulting in fry emergence as early as the first week in December into a longer period of unfavorable winter conditions.

5.3.1.4 Population Level Processes

NMFS estimates that the UWR chinook salmon population in the McKenzie River above Leaburg Dam must achieve an incremental increase in survival of 9 to 65% (depending on the relative effectiveness of hatchery fish spawning in the wild) to reduce the risk of extinction to an acceptable level (Table 4-3). An incremental increase in survival of >4 to >59% must occur for median population growth rate to increase to >1.0.

The threatened status of the population under the environmental baseline has been sensitive to adult conversion mortalities through sport fisheries in the lower Columbia and Willamette rivers (ODFW 2001). Average annual harvest rates on wild fish ranged from 27.3 to 41.1% (overall average = 32.8%) during 1980 through 1995 (total harvest - Clackamas River sport fishery from Table A-2 in ODFW 2001), a period that encompasses much of the baseline for NMFS' estimation of needed survival changes. However, fisheries can be directed at hatchery-origin fish if those fish can be differentiated externally from unmarked, natural-origin fish. As a term and condition of incidental take in NMFS' 2000 Biological Opinion on the Corps' and BPA's hatchery programs in the Upper Willamette basin (NMFS 2000c), the action agencies were directed to externally mark all hatchery-reared fish with an adipose fin clip. The expanded hatchery fish marking program was phased in beginning with the 1996 brood. As a result of this program, ODFW (2001) estimates that average annual adult harvest rates will be reduced from an average of 32.8% to less than 8%. This will result in an incremental increase in survival of 37%:

$$\frac{Surv_{selective\ fishery}}{Surv_{environ.\ baseline}} = \frac{(1-0.08)}{(1-0.328)} = 1.37 \ or \ 37\%$$

This estimate, 37%, is within the range needed to meet both NMFS' survival and recovery indicator criteria (Table 4-3). This means that, if hatchery-origin fish that spawned naturally during the base period were relatively unsuccessful compared to natural-origin spawners (hatch = 0.2), the McKenzie River population of UWR chinook is likely to at least stabilize over the next 48 years and is not likely to go extinct over the next 100 years. However, if hatchery-origin fish that spawned naturally during the base period were nearly as successful as natural-origin spawners (hatch = 0.8), it is unlikely that the population will survive or recover. As described in NMFS (2000), information regarding the effectiveness of hatchery-origin spawners is sparse and insufficient to distinguish among these alternative assumptions.

Life history diversity is also an important measure of the health of the McKenzie subbasin population of UWR chinook salmon. The existence of multiple life histories in a single population allows salmon and other organisms to cope with the problem of survival in variable and fluctuating environments - the more diverse the life history strategies within a population, the more likely that the biological requirements of some portion of the population will be met in a changing environment. Life history diversity may be expressed during the freshwater phases of the life cycle as staggered timing and extensive longitudinal distribution of spawning, or as outmigration of juveniles at different ages. For example, the adults of a subpopulation may migrate farther and higher into headwater areas and spawn earlier than other members of the same population within a watershed or subbasin. Likewise, juveniles produced by the different subpopulations of this population may rear to different ages at different locations within a watershed or subbasin, and then outmigrate to the estuary at different times of the year (Lichatowich 2000).

Historically, UWR chinook salmon spawning in the McKenzie River started in early to mid-August and lasted as late as the third week of October. The spawning period, which has been reduced to about one third to one half of its historical length, is now largely confined to September. This change is reflected in the timing of egg collection in the McKenzie subbasin (Fig. 5-7). As described in section 5.3, UWR chinook salmon spawning occurred more widely, historically, throughout the McKenzie subbasin than it does today. It is likely that spawning began during August in the upper subbasin and then gradually progressed downstream, concluding two to three months later in the lower reaches of the mainstem McKenzie River. However, there does not appear to be any historical information to substantiate this supposition (USACE 2000).

Mattson (1963) discusses the existence of a later-running spring chinook salmon that ascended the Willamette Falls in June at the end of the spawning migration. These fish were apparently much larger (25-30 lbs.; 11.4-13.6 kg) and older (presumably six year olds) than the earlier part of the run. Mattson (1963) speculated that this portion of the run “intermingled” with the earlier-run fish on the spawning ground and did not represent a distinct run. These large, later-running fish most likely spawned in the lower McKenzie River in considerable numbers. The disappearance of the June run in the upper Willamette Basin in the 1920s and 1930s was associated with the dramatic decline in water quality in the lower Willamette River.

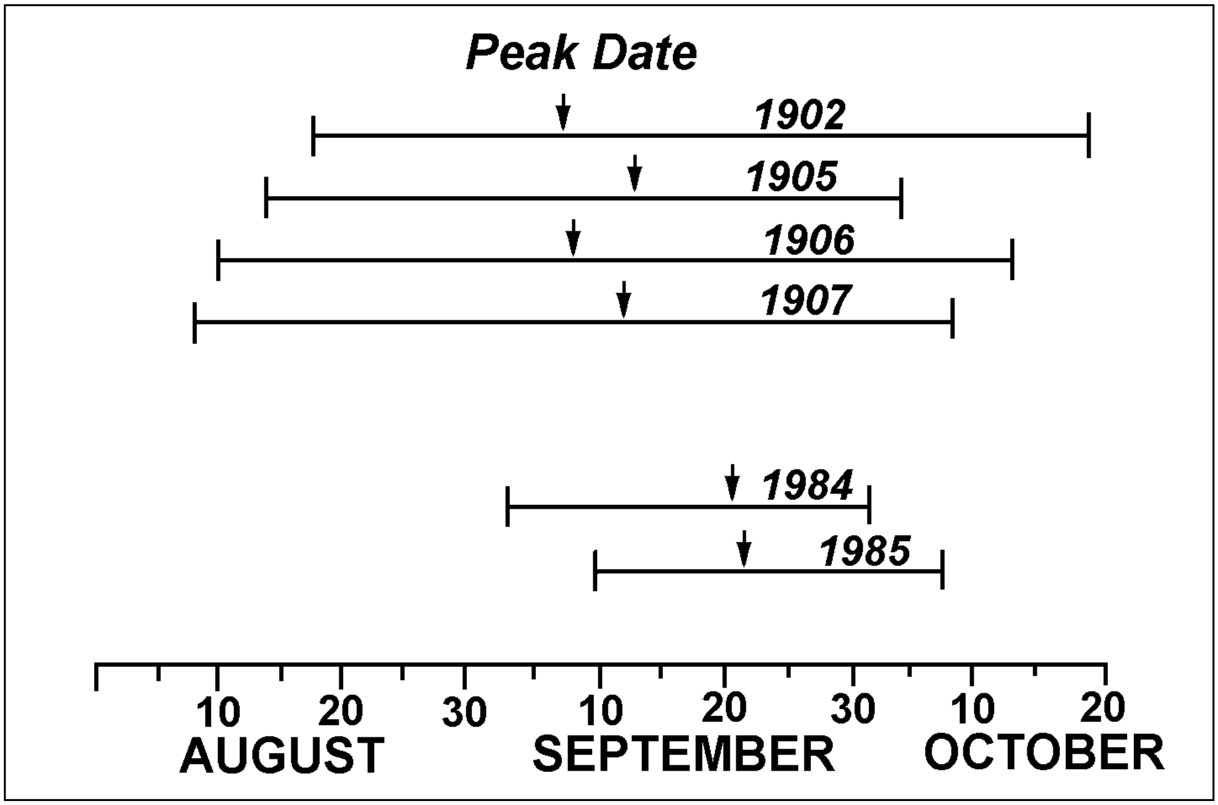

Figure 5-7. Comparison of historical and recent timing of egg takes from spring chinook in the McKenzie River (from Fig. 4-13 in USACE 2000).

Juvenile spring chinook salmon in relatively pristine systems demonstrate complex patterns of freshwater rearing and outmigration. Juveniles of the same population and age class may rear for different periods of time in different parts of the watershed/subbasin, and outmigrate at different ages. Spring chinook juveniles in the Willamette Basin generally followed this type of rearing and outmigration pattern, as shown by studies conducted in the l940s (Mattson 1962). Juvenile chinook salmon outmigrated through the lower Willamette River near Lake Oswego during three peak periods: (1) late winter/early spring (fry aged 0+, length 40-90 mm); (2) late fall/early winter (fingerlings age approximately 1, length 100-130 mm); and (3) a second spring peak (fingerlings 1+, length 100-140 mm; Mattson 1962). Less than half of a given age class emigrated at age 0+, less than half at age 1+, and less than a third at age 2. This study was conducted after the Willamette River had already been subjected to severe water pollution for several decades, thus the author suggested that juvenile UWR chinook salmon of various ages may have historically outmigrated down the Willamette River throughout the summer (Mattson 1962).

Little is known about the historical life history for juvenile UWR chinook salmon rearing in the McKenzie subbasin besides the sparse information mentioned above (section 5.3). Changes in the timing of juvenile UWR chinook salmon outmigration since the construction of the USACE reservoirs have been observed, also described above in the rearing section. Historically, UWR chinook salmon spawning occurred over a 2- to 3-month period (compared to the current one month) throughout a greater proportion of the McKenzie subbasin than current spawning, especially in the lower mainstem McKenzie River. This extended and widespread spawning most likely facilitated diverse rearing strategies because fry would have been emerging at different times in different places in the winter and early spring, and abundant rearing habitat was available for these juveniles throughout the lower McKenzie River and upper mainstem of the Willamette River (see Fig. 5-5). It is probable that juvenile UWR chinook salmon rearing duration and outmigration timing was historically more diverse than it is now in the McKenzie subbasin, but there apparently is no information available to corroborate this (USACE 2000).

In summary, the spawning period, which has been reduced to about one-third to one-half of its historical length, is now largely confined to September. Some variation in emergence timing appears to have been lost and it is probable that the duration of the rearing period and outmigration timing were also more diverse than at the present time, although no data are available to corroborate the latter point.

5.3.2 Columbia River Bull Trout

Migration, spawning, rearing, and population level processes are described below for CR bull trout in the McKenzie River subbasin. General life history for CR bull trout is described in section 4.1.3. Food web dynamics as related to both UWR chinook salmon and CR bull trout in the McKenzie River subbasin are described in section 5.3.

5.3.2.1 Migration

Migration refers to the movement of adult bull trout up the McKenzie River and its tributaries on their spawning run, and the movement of juvenile and adult bull trout from spawning areas downstream to rearing and overwintering habitat. Bull trout migration would also refer to the seasonal movement of adults and subadults to foraging areas throughout the McKenzie River subbasin. Historically, bull trout in the McKenzie River could migrate extensively throughout the basin with Tamolich Falls (RM 81) being the upper limit of distribution in the mainstem McKenzie River. Buchanan et al. (1997) reported that the McKenzie River probably had one or two fluvial populations distributed from the confluence with the Willamette River upstream to Tamolich Falls. Adults and sub-adults generally moved throughout the system for foraging, rearing and overwintering, while juveniles utilized natal rearing areas higher in the system. Bull trout are known to be wide ranging and migrations between individual subbasins in the Willamette Basin was likely. Migratory corridors link seasonally important habitats for all bull trout life history forms (Fraley and Shepard 1989). The ability to migrate, forming population networks or metapopulations, is particularly important to the persistence of local bull trout sub-populations (Rieman and McIntyre 1993).

Fish migrations in the McKenzie River, as in other subbasins in the Willamette Basin, have been delayed or blocked by dams built for hydroelectric power, flood control, irrigation and industrial use. Cougar Dam (1964 USACE project) on the South Fork McKenzie River and Trail Bridge Dam (1963 EWEB project) on the upper mainstem, neither with fish passage, effectively fragmented the original McKenzie River bull trout population into three groups. The resulting two sub-populations isolated above the two dams have since adopted an adfluvial life history strategy to utilize rearing and overwintering habitat in the reservoirs above the dams. The remaining fluvial subpopulation in the mainstem McKenzie River migrates between the confluence with the Willamette River and spawning areas in tributaries below Trail Bridge Dam in the upper McKenzie River. The extent to which individuals from the two subpopulations isolated above Cougar and Trail Bridge dams are currently moving downstream past the dams (through turbines or spillways) is largely unknown.

Additional major migration barriers in the McKenzie River subbasin include, but are not limited to, Blue River Dam (1969 USACE project) and Leaburg Dam (1930 EWEB project). Blue River Dam does not have any fish passage facilities. Although bull trout likely used Blue River for foraging prior to the construction of Blue River Dam, lack of cold water springs and streams with temperatures conducive to bull trout spawning, suggests the unlikelihood that this tributary of the McKenzie River was a significant spawning stream for bull trout (Amy Unthank, USFS, Willamette National Forest, personal communication, July 2000). Leaburg Dam, a much smaller project than the two USACE projects upstream, does have upstream and downstream fish passage facilities and bull trout have been monitored passing this project by ODFW in recent years. However, the right bank fish ladder has been inoperable for years, thereby contributing to potential migration delay. The extent to which Leaburg dam may slow or alter the migration of bull trout has not been examined, but some adverse effects to migration are expected to be occurring under the current baseline conditions.

Bull trout migrate into tributary streams for spawning, rearing and foraging. Bull trout in the mainstem McKenzie River subpopulation are thought to migrate into parts of the lower South Fork McKenzie below Cougar Dam, Blue River below the Blue River Dam, Horse Creek, Separation Creek, Deer Creek, Olallie Creek, and Anderson Creek. Spawning has been observed only in Olallie and Anderson creeks. The South Fork McKenzie subpopulation above Cougar Dam is known to spawn only in Roaring River but may utilize the upper South Fork above Roaring River and potentially French Pete Creek. The Trail Bridge Reservoir subpopulation is known to spawn and rear in Sweetwater Creek and the mainstem McKenzie River, both of which flow directly into Trail Bridge Reservoir. Several miles of habitat are also available in Smith River which also flows into Trail Bridge Reservoir, although no bull trout redds or spawning have been observed.

In addition to large impassable dams, smaller barriers, particularily culverts and push-up irrigation dams have also been implicated in reducing the distribution and abundance of bull trout. Several culvert replacement projects in the McKenzie subbasin during the last decade have opened up additional spawning habitat for the mainstem McKenzie River and Trail Bridge Reservoir subpopulations of bull trout. In 1992, an impassable culvert under Highway 126 was replaced, opening approximately 1.5 miles of habitat that was thought to be used by bull trout prior to the construction of the highway and Trail Bridge Reservoir (USFS, McKenzie Ranger District, 1992). From 1993 through 1998, over 5000 bull trout fry from Anderson Creek (McKenzie tributary below Trail Bridge Dam) were reintroduced to Sweetwater Creek. The re-establishment of access to Sweetwater Creek, along with the reintroduction of fry from Anderson Creek, is expected to provide major benefits to the small subpopulation of bull trout upstream of Trail Bridge Dam. Although five adult bull trout were observed ascending Sweetwater Creek in the fall of 1999, no redds were observed until fall of 2000, when two redds were counted (FERC 2001).

A second culvert replacement project occurred in 1995, on Olallie Creek, one of the few tributaries used for spawning by the mainstem McKenzie River subpopulation of bull trout. Surveys for bull trout in Olallie Creek during the early 1990's indicated that the culvert, constructed in 1959, acted as a velocity barrier to the upstream migration of fish. Replacement of the culvert and reestablishment of passage opened up an additional two miles of quality bull trout spawning and rearing habitat. The observation of three bull trout redds upstream of the new culvert in the fall following the project was indication that bull trout were immediately making use of the newly available habitat (WNF 1995).

McKenzie River bull trout generally migrate from overwintering areas beginning in June, although radio-tracking studies in 1998 noted upstream migration beginning as early as May (ODFW 1998). The peak of migration towards spawning areas occurs during the months of July and August for the mainstem McKenzie River subpopulation. Bull trout stage in large pools in the McKenzie River below Anderson and Olallie creeks before spawning (ODFW 1999b). The South Fork McKenzie subpopulation's peak migratory movement has been observed to occur in late June (Buchanan et al. 1997; Unthank 1998), but mature bull trout have been observed migrating upstream from Cougar Reservoir as early as April and May (ODFW 1998).

Although little data exists on the influence of water temperature on bull trout migration, they are known to be among the most temperature sensitive of all salmonids. Altered stream temperatures downstream of dams are likely to negatively influence bull trout migration patterns, locations and timing.

In the fall of 1999 and 2000, an electronic fish counter and weir were set up to collect data on the spawning migration of bull trout moving into Roaring River. Forty-one bull trout were detected passing the counter in 1999 with peak upstream migration occurring during the first two weeks of September. In 2000, 81 bull trout were detected passing the counter with peak migration very similar to that observed the previous year. An electronic fish counter was also installed in Anderson Creek on the mainstem McKenzie River during the fall of 1999 and 2000. Results in 1999 indicated as many as 249 adult bull trout migrating into Anderson Creek between August 28 and October 25 with a peak between September 10-17. In 2000, the electronic counter detected 138 bull trout migrating into Anderson Creek with a similar peak in run timing as seen the previous year. Similar to results from Roaring River, the majority of bull trout migrated past the counters during daylight hours (ODFW 1999b).

Post-spawning downstream migrations by bull trout in the McKenzie Basin appear to commence shortly after spawning. Information collected in the fall of 1999 on migration timing in Roaring River indicated that the majority of post-spawning bull trout migrated downstream in late September and early October. The time between peak upstream migration and peak downstream migration suggest approximately a week of spawning activity before bull trout return downstream to overwintering areas (ODFW 1999b). Several radio-tagged bull trout from the mainstem McKenzie River subpopulation returned to spawn in consecutive years in Anderson Creek and then returned quickly to the same overwintering area in the lower McKenzie River used the previous year (ODFW 1998).

Anderson Creek, which has averaged 80 redds per year for the years 1995-1999, is the most important spawning tributary for the mainstem McKenzie River subpopulation of bull trout. Juvenile bull trout studies in Anderson Creek began in 1994 and have provided data on reproductive success and juvenile outmigration patterns. Data collected from the operation of a rotary screw trap (downstream migrating fish trap) indicated that fry (0+) migration generally peaks in late March or early April and juvenile (age 1+ to 2+) migration peaks in late May (ODFW 1997). Data from the 1994-2000 juvenile trapping project indicate a strong upward trend in the number of outmigrating juvenile bull trout (Table 5-1).

Table 5-1. Number of bull trout fry and juveniles captured in the downstream migrant trap in Anderson Creek, 1994-2000 (ODFW 2000).

Date	Number of fry		Number ≥ age 1^{+}	
	Captured	Estimated migrants[a]	Captured	Estimated migrants[a]
Feb. 15-May 26, 1994	1,808	5,308	129	403
Feb. 15-May 31, 1995	1,877	5,995	261	785
Feb. 19-May 31, 1996	1,995	5,700	179	550
Feb. 11-May 31, 1997	6,540	21,592	64	215
Feb. 10-June 11, 1998	7,902	23,153	151	453
Feb. 23-June 03, 1999	7,406	21,693	100	263
Feb. 21-May 25, 2000	6,097	17,713	190	553

a Assumes trapping seven days per week and a 60% trap efficiency

5.3.2.2 Spawning

Bull trout spawning streams and potential spawning streams in the McKenzie River subbasin include: Horse Creek, Separation Creek, Anderson Creek and Olallie Creek in the upper McKenzie River below Trail Bridge Reservoir; McKenzie River and Sweetwater Creek above Trail Bridge Reservoir; and Roaring River, a tributary of the South Fork McKenzie River above Cougar Reservoir (Buchanan et al. 1997). The peak of spawning in the McKenzie River system usually occurs in early September to early October. Spawning is generally initiated as stream temperatures decline below 10ºC. Spawning occurs primarily in spring-fed tributaries (Anderson and Olallie creeks and Roaring River) or in areas with ground-water influence (the mainstem McKenzie above Trail Bridge Reservoir) with temperatures between 5° and 8° C (Pratt 1992; Buchanan et al. 1997; Unthank 1998; USACE 2000).

Mainstem McKenzie bull trout subpopulation

Spawning surveys for bull trout were first initiated in Anderson Creek, tributary of the upper mainstem McKenzie, in the fall of 1989 and have continued each fall to present. Results of these surveys through 2000 indicate a stable or increasing number of bull trout (Table 5-2.). ODFW surveys during the fall of 1999 indicated as many as 249 adult bull trout migrated into Anderson Creek, with as many as 77 redds observed (ODFW 1999b). In 2000, 83 redds were observed despite only 138 fish detected entering Anderson Creek by the electronic fish counter. Spawning surveys have also been conducted on Olallie Creek, a tributary of the upper Mainstem McKenzie just downstream of Anderson Creek. Initial spawning surveys in 1994 found only three redds below the Highway 126 culvert barrier. In 1995 the culvert was replaced, opening up an additional 2.0 miles of spawning and rearing habitat. Spawning surveys have been conducted above the new culvert beginning in the fall of 1995 and have averaged eight redds a year through 2000 (ODFW 2000).

The mainstem McKenzie bull trout subpopulation is the largest remaining in the Willamette Basin, and they are known to spawn in only Anderson Creek and Olallie Creek. Because the majority spawn in Anderson Creek, and because these two streams are only 1/4 mile apart, this subpopulation, though currently stable, is vulnerable to a catastrophic event such as a wildfire, flood, or landslide.

Table 5-2. Bull trout redd counts in Anderson and Olallie Creeks, 1989-2000 (ODFW 2000).

Year	Number of Redds Observed: Anderson, Index Area RK 1.3	Anderson, Total RK 2.6	Olallie	Total
1989	7			
1990	9			
1991	7			
1992	13			
1993	15			
1994	22	30		
1995	30	77	10	87
1996	26	82	8	90
1997	18	85	9	94
1998	29	79	7	86
1999	47	77	6	83
2000	44	83	9	92

Trail Bridge Reservoir bull trout subpopulation

Buchanan et al. (1997) reported that the bull trout subpopulation above Trail Bridge Dam is severely limited by lack of spawning habitat. Available spawning habitat is likely limited to Sweetwater Creek, which flows directly into Trail Bridge Reservoir, and several miles of the mainstem McKenzie upstream from the reservoir. Seven bull trout redds were observed in the mainstem McKenzie River above Trail Bridge Reservoir in 1996, and three bull trout redds were observed in the same reach in 1997 and 1998 (ODFW 1997; ODFW 1998). In recent years ODFW has been passing excess spring chinook above Trail Bridge Dam in order to provide both a forage base for bull trout and to reintroduce a source of nutrients for the stream system. The presence of chinook spawning above Trail Bridge Dam has made the detection of bull trout redds problematic due to the similarity of appearance between redds of both species. No positive identification of bull trout redds in the McKenzie above the reservoir were made in 1999 and 2000.

Sweetwater Creek, which was thought to be a historical spawning and rearing stream for bull trout, was inaccessible to bull trout from 1959 to 1992, due to an impassable culvert. Fish passage was restored in 1992 and starting the following year, and for three years following, fry from Anderson Creek were released in Sweetwater Creek in an attempt to establish a viable bull trout population. Spawning surveys began on Sweetwater Creek in 1997, but it was not until the fall of 2000, when two redds were observed, that spawning was first documented.

Bull trout were present upstream of Smith Reservoir in the years following the first filling of the reservoir, but no verified bull trout have been recorded in recent years. Because there does not appear to be suitable bull trout spawning habitat upstream of the reservoir, it is thought that bull trout utilized Smith River primarily for rearing and foraging (FERC 2001).

The Trail Bridge Reservoir bull trout subpopulation is likely negatively impacted by the presence of non-native brook trout in both the reservoir and upstream tributaries. Brook trout are frequently implicated in the decline of bull trout, impacting populations through introgressive hybridization, and possibly through interactive segregation (Rieman and McIntyre 1993; 63 FR 31647).

South Fork McKenzie bull trout subpopulation

Bull trout in the South Fork McKenzie River above Cougar Reservoir are thought to spawn only in Roaring River, a tributary of the South Fork McKenzie approximately 11.0 miles above the reservoir. Standard pool counts of bull trout staging in the South Fork McKenzie below the confluence of Roaring River have ranged from 9-17 since counts began in 1994 (ODFW 1999b). In 1999, 13 redds and nine adult bull trout were observed in Roaring River from its mouth upstream to a 1.5 m falls (ODFW 1999b). In 2000, 25 redds and eight bull trout were observed during three spawning surveys between the Road 19 crossing of Roaring River and a barrier 1.1 km upstream. No spawning has been documented upstream of Roaring River in the South Fork McKenzie or tributaries despite potential habitat in Elk Creek and in the upper South Fork McKenzie above the mouth of Elk Creek.

5.3.2.3 Rearing

Juvenile fluvial and adfluvial bull trout typically spend one to three years in natal streams before migrating downstream in spring, summer, or fall to larger habitats such as a lakes, reservoirs or rivers. After traveling downstream to a larger system from their natal streams, subadult bull trout (age three to six years) grow rapidly but do not reach sexual maturity for several years. Growth of resident fish is much slower, with smaller adult sizes and older age at maturity (USACE 2000).

Although reservoirs are generally acknowledged as important habitat for populations of bull trout in the McKenzie River subbasin, little information exists as to how bull trout use the reservoirs, how many are present, at what time of year, and the nature of their forage base.

Mainstem McKenzie bull trout subpopulation

Rearing habitat for the mainstem McKenzie bull trout subpopulation consist of side channels, river margins and tributaries. Adults and sub-adults utilize all habitats in the mainstem McKenzie River and tributaries while foraging and their temporal distribution is determined by concentrations and behavior of prey species (WNF MRD 1995). Adults are most often observed in deep pools utilizing available wood or undercut banks as cover. Little specific information exists about necessary biological and physical requirements for bull trout rearing in the McKenzie Basin. The extent to which habitat disturbance in the lower McKenzie River (and Willamette River) has restricted bull trout migration and rearing is unknown. The mainstem McKenzie River migratory corridor below Leaburg Dam is unobstructed in terms of physical barriers, however degradation of habitat beyond the specialized needs of bull trout may restrict use of their historical range downstream.

Snorkel surveys and radio tagging have confirmed that adult bull trout rear in large pools in the McKenzie River from below Leaburg Dam up to Trail Bridge Reservoir (Buchanan et al. 1997). Downstream migration monitoring in Anderson Creek indicates that a significant number of fry migrate downstream to the mainstem McKenzie in March and April, shortly after emerging from gravels. Margin habitats along the mainstem McKenzie are likely important rearing habitat for the fry, who at that age are quite vulnerable to predation by fish and birds. Foraging and rearing habitats essential to the mainstem McKenzie River bull trout subpopulation include the mainstem McKenzie River, Lost Creek, Lower Deer Creek, Anderson Creek and Olallie Creek. Additional rearing habitat exists in small, low gradient spring-fed seeps and streams along the east bank of the upper McKenzie River (WNF MRD 1995).

Trail Bridge Reservoir bull trout subpopulation

Rearing habitat for the Trail Bridge Reservoir subpopulation is limited but consists of: Trail Bridge Reservoir (73 acres); Sweetwater Creek (1.5 miles available habitat), the mainstem McKenzie River up to Tamolich Falls (approximately 2.0 miles available habitat); and lower Smith River below Smith River Dam (approximately 2.0 miles available habitat). Sub-adult and adult bull trout are thought to rear in Trail Bridge Reservoir, though no specific information exists on distribution and abundance within the reservoir, migration timing into and out of the reservoir, and forage base utilized in the reservoir.

South Fork McKenzie bull trout subpopulation

Rearing habitat in the South Fork McKenzie River above Cougar Dam likely occurs in the South Fork mainstem, as well as Roaring River and other South Fork McKenzie River tributaries. Sub-adult and adult bull trout are thought to rear in Cougar Reservoir, though little specific information exists on distribution and abundance within the reservoir, migration timing into and out of the reservoir, temporal and spacial use of the reservoir and forage base utilized in the reservoir. Habitat complexity is an important variable in sustaining bull trout. The main factors that are affecting bull trout rearing in the South Fork McKenzie above Cougar Dam (in terms of habitat complexity) are the loss of deep pool habitat and large woody debris, which provide cover and stream stability and maintain optimal stream temperatures (WNF BRRD 1994). Habitat complexity may also be reduced in Roaring River due to the location of Forest Road 19, forest salvage activities in the lower reach, and riparian degradation due to designated and dispersed camping areas next to Roaring River. The reduction in habitat complexity within the main South Fork has lowered the capability of the habitat to produce salmon, trout, and other aquatic species. The reduction in side channel habitat throughout the main South Fork also contributes to a loss in critical bull trout rearing habitat. South Fork McKenzie pool habitat has been reduced from 1937-1938 levels by approximately 60%-90% (WNF BRRD 1994).

5.3.2.4 Population Level Processes

Very limited information exists on the historical population size and life history diversity of bull trout in the Willamette Basin, and the McKenzie subbasin is no exception. At best, the early records simply denote presence and absence based on reports from anglers or the catch of bull trout at state hatchery racks placed in major subbasins of the Willamette River for the purpose of collecting salmon and steelhead for hatchery production. Until somewhat recently, anglers and fishery managers held bull trout in low esteem due to their reputed poor fighting qualities and piscivorous habits, particularily on wild spring chinook and steelhead juveniles. As a result, many Willamette Basin bull trout were likely killed at hatchery racks, poisoned by chemical treatment projects, or possibly captured by anglers as part of bounty programs.

In order to determine the long term viability of the current McKenzie River population of bull trout, it is useful to look at the entire Willamette Basin. The McKenzie population is considered part of the larger historical Willamette Basin population, and it once drew stability from wide geographical distribution and genetic interchange of migratory individuals among populations. Reduction to a single, isolated population (or three subpopulations in the case of the McKenzie subbasin) without benefit of immigration to replenish the gene pool, likely puts the McKenzie River bull trout population at an elevated risk of extinction (WNF MRD 1995). In addition, Rieman and McIntyre (1993) note that there are no criteria for determining the viability of an isolated bull trout population and little available research on the minimum number necessary to avert loss of genetic variability through inbreeding.

Current population estimates for bull trout in the McKenzie subbasin are approximations based on data collected from redd counts, standard pool counts, juvenile trapping, radio tracking and electronic fish counters. The total population of mature bull trout in the entire McKenzie River basin has been estimated at less than 300 individuals spawning annually, of which between 25 to

75 are found in the South Fork McKenzie River subbasin (USACE 2000). The mainstem McKenzie River subpopulation appears to be increasing, based on an increasing trend in redd counts in Anderson Creek (Buchanan et al. 1997, ODFW 1999b). The current population trends of the other two subpopulations are unknown, but are considered to be at high risk of extinction due to isolation, low abundance, and limited spawning habitat (Buchanan et al. 1997).

Recent redd counts, standard pool counts and juvenile abundance surveys of bull trout in the South Fork McKenzie River above Cougar Dam have provided little evidence that the population consists of more than 25 adult bull trout. However, in September and October of 1999, 13 redds and 41 fish were detected ascending Roaring River (ODFW 1999b) and in the fall of 2000, 25 redds were observed in Roaring River along with 81 bull trout detected by an electronic fish counter. Data collected by the electronic fish counter that is used to detect movement of fish into Roaring River should be viewed cautiously as the counter cannot identify species or whether individuals have moved passed the counter multiple times. However, data collected over the last two years suggests that the South Fork McKenzie bull trout subpopulation may be larger than previously assumed.

The subpopulation of bull trout in Trail Bridge Reservoir appears to very small based on spawning survey data from Sweetwater Creek and in the McKenzie River above Trail Bridge Dam. Bull trout fry from Anderson Creek (below Trail Bridge Reservoir) were introduced to Sweetwater Creek during the years 1993-1999, and it was expected that adults might begin spawning in the fall of 1999. Five adults were observed entering Sweetwater Creek in 1999, but spawning was not documented until the fall of 2000, when two redds were observed. Three redds were observed in the McKenzie River above Trail Bridge Reservoir in 1997 and 1998 but no bull trout redds were observed in 1999 and 2000. Spawning may be occurring in this area but spawning by excess hatchery chinook salmon planted above the dam has complicated redd identification beyond certain dates each fall (ODFW 1998).

5.3.3 Food Web Dynamics

Recent studies for the McKenzie River Watershed Council (Aquatic Biology Associates 2000) indicate good abundance and diversity within the action area for key aquatic insect families that serve as prey for chinook salmon and bull trout. However, the loss of historical habitats described above in section 5.3, the introduction of exotic species, and the creation of new habitats in reservoirs and revetments could have caused shifts in the abundance and diversity of fishes that prey on listed salmon and bull trout in the McKenzie subbasin. Reservoirs, revetments, and other human-created structures provide extensive habitat for exotic and native predators of listed species. As well as preying on exotic animal and plant species, exotic fishes often compete with native species occupying similar ecological niches for food and habitat and/or modify, reduce, or eliminate habitat used by native species.

The McKenzie subbasin has been less affected by warmwater exotic fish species than other upper Willamette subbasins because of its high water quality and the absence of large reservoirs on the mainstem. However, warmwater exotic fish species such as largemouth bass, bluegill, and crappie are found in many of the subbasin's ponds, sloughs, and tributaries to the lower mainstem. Coldwater exotic fish species such as brown trout, lake trout, and brook trout are found in many of the streams and/or lakes in the upper subbasin. Cumulatively, these exotic species are capable of changing the dynamics of predation and competition affecting native species. USACE's Blue River and Cougar reservoirs provide deepwater habitat for several native predatory fish species that allow them to grow larger than otherwise expected. Water temperatures in Blue River reservoir are warm enough to support populations of warmwater exotic fishes. In comparison, water temperatures are generally too cold in Cougar reservoir for significant populations of exotic species to develop (USACE 2000). EWEB's Trail Bridge Reservoir supports large populations of exotic brook trout which, in addition to the threat of hybridization, potentially affect CR bull trout through competition and predation.

Exotic species probably prey on juvenile salmonids during their downstream migration. The operation of the Blue River and Cougar reservoirs has increased the susceptibility of these juveniles to predation during their outmigration because of decreased springtime water velocities compared to before these dams were built (see Fig. 5-4 and 5-5). Outmigrating juveniles generally move at rates that are a function of the local current velocity and reduced water velocities increase the travel time of downstream migrating fish, thus increasing exposure time to predation.

The construction of fish passage facilities at Willamette Falls and summer streamflow augmentation by the USACE dams has allowed and facilitated easier passage of non-native fall chinook, summer steelhead, and coho salmon into the McKenzie subbasin. These species may interbreed or compete directly with native species such as spring chinook salmon and bull trout. Hatchery production of salmon and trout in the McKenzie subbasin as mitigation for lost habitat above the USACE dams has likely adversely affected listed native species because the hatchery fish likely compete with native species for resources, and may also interbreed with them (USACE 2000).

5.4 Completed Consultations in the McKenzie River Subbasin Affecting the Environmental Baseline

On November 15, 1999, the Service completed a joint biological opinion for FERC on the proposed licensing of the McKenzie Hydroelectric Project (FERC Project No. 11512), owned by Mr. John Bigelow. The Services concluded in the biological opinion that the proposed licensing was not likely to jeopardize the continued existence of listed Columbia River bull trout (CR bull trout) or Upper Willamette River chinook salmon (UWR chinook salmon). The issuance of a new license for the project will reduce adverse conditions for CR bull trout and UWR chinook salmon through installation of a protective screening and bypass system.

On March 8, 2000, the Services completed a joint biological opinion for USACE on the effects of the proposed water temperature control project at Cougar Dam (Cougar WTC) on the South Fork McKenzie River on listed UWR chinook salmon, CR bull trout, and the northern spotted owl. Cougar Dam is part of USACE's Willamette Project. The purpose of the Cougar WTC Project is to retrofit the dam with a control tower that will give the USACE better control over the temperature of water releases from Cougar Dam. The construction of the water temperature control tower is scheduled for 2002 through 2004 with preliminary work beginning in 2001. The project is expected to benefit the two listed fish species in the project area (UWR chinook salmon and CR bull trout) by reducing effects on water temperature downstream in the South Fork and mainstem McKenzie rivers.

On July 14, 2000, NMFS completed a biological opinion for USACE and Bonneville Power Administration (BPA) on the effects of collection, rearing, and release of salmonids associated with artificial propagation programs in the Willamette Basin on listed UWR chinook salmon and UWR steelhead (UWR steelhead do not occur in the McKenzie subbasin). USACE and BPA fund over 90% of the artificial propagation programs that potentially affect these two listed species as mitigation for loss of habitat for these species from the construction and operation of the Willamette Project. The hatcheries themselves are operated by the ODFW. The artificial propagation programs included in the July 14, 2000, biological opinion are located in the Clackamas, North Santiam, and McKenzie River subbasins. The biological opinion requires the USACE and BPA to implement measures to reduce interbreeding between hatchery-origin and natural-origin fish in areas where natural spawning occurs, to help develop more locally-adapted hatchery stocks, to reduce impacts to wild fish populations from hatchery broodstock collection, and to reduce harvest rates on natural-origin fish (by creating an opportunity for selective harvest through marking of all hatchery fish).

5.5 Summary of Effects of the Environmental Baseline

The current environmental baseline of the action area (the McKenzie subbasin ecosystem) is described above and summarized below in terms of habitat processes (disturbance, flow regime, sediment and LW function, riparian vegetation and floodplain function, and water quality) and biological processes (migration, spawning, rearing, population size and life history diversity, and food web dynamics) for the two listed species within the action area covered by this opinion.

5.5.1 Habitat Processes within the Action Area

The status of the habitat processes within the action area under the environmental baseline is summarized in Table 5-3 below.

Table 5-3. Summary of the status of habitat processes within action area under the environmental baseline.

Habitat Processes	McKenzie River Subbasin
Disturbance	USACE dams have reduced the frequency and size of floods in the largest stream channels from those observed historically. Fire suppression has reduced the frequency of fires and has increased fuel loads. Road construction, timber harvest, and other activities have increased mass wasting in some watersheds. The reduced frequencies and magnitude of these natural processes of disturbance has resulted in relatively static and simplified aquatic habitat compared to the conditions under which the listed species evolved.
Flow Regime	USACE dams have altered the historical annual hydrograph in the largest streams by reducing peak flows in the winter and spring and by increasing low flows in the summer and fall. In streams not affected by the USACE dams, peak flows have increased due to road construction, timber harvest, and other activities, and low flows have decreased due to water withdrawls and the effects of various land-use practices.
Sediment and Large Wood Function	Both USACE and EWEB dams have interrupted sediment transport in the largest stream channels, trapping material behind the dams and reducing sediment load, thus causing at least temporary downcutting and substrate coarsening of these stream channels below the dams. In streams not affected by USACE or EWEB dams, road construction, agriculture, timber harvest, and other land use practices have increased sedimentation of stream channels. In nearly all 6th-field HUC and larger stream channels, LW has been reduced from historical levels, contributing to stream channel simplification.
Riparian Vegetation and Floodplain Function	Riparian vegetation has been reduced by road construction, agriculture, timber harvest, gravel mining, riprap, reservoir inundation, and urbanization. Downstream of USACE dams, riparian vegetation has encroached on surfaces that were regularly inundated before the dams were built, resulting in channel narrowing and gravel bar reduction. In the lower reaches of the largest streams, formerly wide floodplains and complex stream channels have been simplified by the removal of riparian vegetation, filling of secondary channels, and other backwaters, and hardening of streambanks with riprap. These simplified conditions are maintained by the reduction in floods, sediment, and LW by the USACE and EWEB dams, as well as the hardening of streambanks and ongoing development of the floodplain.
Water Quality	In most streams, summertime water temperatures are higher than those observed historically due to the cumulative effects of human activities. In many of the lower elevation streams, eutrophication and contamination from agricultural practices and urbanization have degraded water quality. Downstream of USACE dams, stream temperatures have been substantially altered by management of the dams, resulting in cooler temperatures in the summer and much warmer temperatures in the fall. Upstream of USACE and EWEB dams (not including Leaburg Dam), the reduction or elimination of salmon carcasses has reduced nutrient availability in streams. The Cougar WTC Project is expected to reduce downstream effects on water temperature in the South Fork and mainstem McKenzie rivers.

5.5.2 Biological Processes within the Action Area

The status of biological processes within the McKenzie subbasin under the environmental baseline is summarized in the following tables (i.e., migration, spawning, rearing, and population level processes are addressed for UWR chinook salmon and CR bull trout, respectively, in Tables 5-4a and 5-4b, and food web dynamics for both species are addressed in Table 5-4c).

Table 5-4a. Summary of the status of biological processes within action area under the environmental baseline for UWR chinook salmon.	
Biological Processes	UWR Chinook Salmon in McKenzie River Subbasin
Migration	USACE dams block the upstream adult migration of UWR chinook salmon into large portions of their historical spawning habitat in the McKenzie River subbasin. In the case of Cougar Dam, a USACE project completely blocks access is to an area that was, historically, the most productive portion of the subbasin. The timing of upstream migration to remaining spawning habitat is probably affected by changes in water temperature downstream from the dams, caused by seasonal patterns of thermal stratification and mixing in the reservoirs. Two of the three dams comprising EWEB's Carmen-Smith Project, Trail Bridge and Smith dams, block access to historical spawning areas (Carmen Dam is above a natural barrier to migration). Neither the Leaburg or Walterville diversions block fish passage but the structure of both facilities causes some mortality of juvenile chinook fry and smolts and probably causes some delay in a portion of the adult migration.
Spawning	Both the abundance and quality of spawning habitat, albeit currently underseeded, have declined, primarily due to the construction and operation of USACE's Blue River and Cougar dams. Currently, most of the natural spawning in the UWR chinook salmon ESU takes place in the McKenzie River subbasin.
Rearing	Both the abundance and quality of rearing habitat have declined, primarily due to the construction and operation of USACE's Blue River and Cougar dams. Winter flow releases from the dams are much smaller than historical flows at this time of the year due to flood control and because reservoir filling for summertime recreation begins in February. Thus, side channels of the South Fork and the mainstem downstream of the South Fork confluence that historically provided rearing habitat for fry during the winter are not connected to the main channel (WNF BRRD1994). Also in the South Fork and in the mainstem downstream of the South Fork confluence, Blue River and Cougar dams create warmer water temperatures during egg incubation (October and November), resulting in fry emergence as early as the first week in December into a period of unfavorable winter conditions. The Cougar WTC Project is expected to reduce downstream effects on water temperature and the biological process rearing (emergence timing) in the South Fork and mainstem McKenzie rivers.
Population Level Processes	The spawning period, which has been reduced to about one-third to one-half of its historical length, is now largely confined to September. Some variation in emergence timing appears to have been lost and it is probable that the duration of the rearing period and outmigration timing were also more diverse than at the present time, although no data are available to corroborate the latter point. Under the Terms and Conditions of the Incidental Take Statement in NMFS' July 14, 2000, hatchery biological opinion, all hatchery fish are now marked (adipose fin-clipped), creating the opportunity for a selective fishery that will reduce harvest rates on wild-origin chinook salmon.

Table 5-4b. Summary of the environmental baseline of biological processes within action area for CR bull trout.

Biological Processes	CR Bull Trout in McKenzie River Subbasin
Migration	Cougar, Blue River, Trail Bridge and Smith dams block migration to portions of historical spawning and rearing habitat, and in part, isolate two subpopulations of bull trout (above USACE's Cougar Dam and EWEB's Trail Bridge Dam). Lack of safe downstream passage facilities prevent access for these two subpopulations to historical rearing, foraging and overwintering habitat downstream from these dams. Other dams and diversions in the subbasin may hinder bull trout migration such as EWEB's Leaburg-Walterville Project.
Spawning	The only known bull trout spawning in the Willamette Basin occurs in the McKenzie subbasin. Spawning habitat is limited in quantity and quality. Known spawning occurs in only three or four tributaries of the upper McKenzie and one tributary of the South Fork McKenzie River.
Rearing	Current rearing habitat limited above and below dams due to simplification of stream channels and floodplains, loss of pool habitat, reductions in anadromous juvenile salmonid prey base, and competition from non-native fishes.
Population Level Processes	Total population size in this subbasin is approximately 300- 400 individuals. Three subpopulations within this subbasin are isolated from each other with the status of two at high risk of extinction. Life history diversity is greatly reduced from historical due to fragmentation of habitat.

Table 5-4c. Summary of the environmental baseline of food web dynamics for listed species within the action area.

All Listed Species	Introduced species result in competitive and predatory pressures native species are not necessarily adapted for. The operation of USACE and EWEB dams increase the susceptibility of listed species to predation, competition and hybridization. Juvenile salmonids are particularly susceptible to predation during their outmigration because of the reduction of spring flows by the USACE dams. The widespread distribution of USACE riprap has simplified habitat and prevents new habitat from forming naturally during disturbance events, providing habitat conditions that favor introduced species, further disrupting food web dynamics. Degradation of water quality by numerous human activities also favor warm-water introduced species while harming native salmonids and other native species.

5.6 Biological Requirements of UWR Chinook Salmon in Action Area

To some degree, each of the species considered in this biological opinion reside in or migrate through the action area. For UWR chinook salmon, NMFS has determined that the species obtains its biological requirements during these life history stages through access to essential features of critical habitat. Essential features include adequate (1) substrate (especially spawning gravel), (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) migration conditions (65 FR 773). The sections below list the essential features of critical habitat for UWR chinook salmon for each of the relevant habitat types within the action area.

5.6.1 Relevant Critical Habitat Types for Chinook Salmon in Action Area

5.6.1.1 Juvenile Rearing Areas

Essential features of critical habitat for juvenile chinook salmon rearing areas include adequate water quality, water quantity, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions. The requirement for adequate substrate, although relevant to incubation of redds in the mainstem, is discussed under spawning areas, below.

5.6.1.2 Juvenile Migration Corridors

Essential features of critical habitat for juvenile chinook salmon migration corridors include adequate water quality, water quantity, water velocity, cover/shelter, food, riparian vegetation, space, and migration conditions.

5.6.1.3 Areas for Growth and Development to Adulthood

Essential features of critical habitat for juvenile chinook salmon areas for growth and development to adulthood include all the essential features of critical habitat for juvenile rearing areas (above).

5.6.1.4 Adult Migration Corridors

Essential features of critical habitat for adult chinook salmon migration corridors include all the essential features of critical habitat for juvenile migration corridors (above), except for adequate food.

5.6.1.5 Spawning Areas

Essential features of critical habitat for chinook salmon spawning areas include all the essential features of critical habitat for juvenile rearing areas (above), with the addition of adequate substrate and the exception of adequate food.

5.6.2 Adequacy of Habitat Conditions for UWR Chinook Salmon in Critical Habitat in Action Area

Regulations implementing Section 7(a)(2) of the ESA define "destruction or adverse modification" as "a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species." Adverse effects on a constituent element of critical habitat generally do not result in a determination of "adverse modification" unless that loss, when added to the environmental baseline, is likely to result in an appreciable decline in the value of the critical habitat for both the survival and the recovery of the listed species (50 CFR Section 402.02).

Quantitatively defining a level of adequacy through specific, measurable standards is difficult for many of these biological requirements. In many cases, the absolute relationship between the critical element and species survival is not clearly understood, thus limiting development of specific, measurable standards. Some parameters are generally well known in the fisheries literature (e.g., thermal tolerances). For other action-area biological requirements, the effects of any adverse impacts on essential features of critical habitat are considered in more qualitative terms.

5.7 Biological Requirements and the Current Baseline

Based on all the information above, not all of the habitat and biological requirements of UWR chinook and CR bull trout in the action area are being met under the environmental baseline. The status of these species are such that there must be a significant improvement in the habitat and biological conditions they experience, over those currently available under the environmental baseline, to meet their biological requirements for survival and recovery.

6. Analysis of Effects on Listed Species and Critical Habitat

The "effects of the action" is defined in the ESA Section 7 implementing regulations 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 that action, that will be added to the environmental baseline." (50 CFR §402.02).

The operation of the Leaburg-Walterville Project, under the 1997 FERC license, as reinstated and amended by FERC on April 27, 2000; the conservation measures as proposed in the BA; and the revised and updated license articles developed by NMFS, USFWS, EWEB, and FERC separated staff, constitute the "proposed action" by FERC. The Consultation Handbook (USFWS and NMFS 1998) provides the following direction for determining the effects of FERC relicensing actions and of other ongoing water projects (i.e., those existing before the ESA-listing of the species considered in a Section 7 consultation):

> "When analyzing these water projects, as well as water contract renewels for Bureau of Reclamation (Bureau) programs and ongoing discretionary operations of Bureau and Corps of Engineers water facilities, use the same approach as for other types of Section 7 analyses.
>
> - The total effects of all past activities, <u>including effects of the past operation of the project</u>, current non-Federal activities, and Federal projects with completed Section 7 consultations, form the environmental baseline;
>
> - To this baseline, future direct and indirect impacts of the operation over the new license or contract period, including effects of any interrelated and interdependent activities, and any reasonably certain future non-Federal activities (cumulative effects), are added to determine the total effect on listed species and their habitat."

Therefore, the effects of the action encompass the effects of the continued operation of the Leaburg-Walterville Project under the new license. The effects of the original construction and past operation of the Leaburg-Walterville Project is part of the environmental baseline; e.g., fish passage problems caused by the construction and operation of Leaburg Dam up to the present time are part of the environmental baseline. However, fish passage problems resulting from the continued operation of the dam into the future are considered effects of the action.

6.1 Effects of the Action on Habitat Processes

The proposed action affects the habitat processes (described in section 2.3.3.1) that create and sustain habitat for the listed species. The habitat processes relevant to the proposed action are disturbance, flow regime, sediment and LW function, riparian vegetation and floodplain function, and water quality. The status of each of these five habitat processes in the action area under the environmental baseline was described in section 5.3. The likely effects of the proposed action on each habitat process are described below.

6.1.1 Disturbance

Disturbance is defined in this biological opinion as a natural disruption of 5th field HUC or larger stream channels with a recurrence interval of ten to 100 years (section 2.3.3.1.1). As described in section 5.3.1, the main types of disturbance (using this definition) in the McKenzie subbasin are flooding, fire, and mass wasting. Floods that recur on an average of every ten years or longer are probably the most important type of disturbance due to the magnitude of their effects and frequency, both historically and currently. The proposed action is not likely to affect fire and mass wasting. As described in section 5.3.1 and shown in Figures 5-1 and 5-2, the USACE's Blue River and Cougar dams, which store a total of 222,800 acre-feet (USACE 2000), have reduced the magnitude of the 100-year flood to less than the pre-dam ten-year flood in downstream reaches of the South Fork and mainstem McKenzie rivers below the dams.

At any spatial scale within the McKenzie subbasin, the proposed action is not expected to significantly effect the habitat process of disturbance because EWEB's Leaburg-Walterville Project is operated in run-of-river mode such that inflow equals outflow. It is expected that the proposed action will have no effect, or at most, very small-scale effects on the process of disturbance in the McKenzie subbasin.

6.1.2. Flow Regime

Flow regime is defined in this biological opinion as the annual pattern of timing and quantity of flow (section 2.3.3.1.2). EWEB's Leaburg-Walterville Project is operated in run-of-river mode. None of these projects alter the flow regime by storing water during one part of the year and releasing it during another. However, the Leaburg-Walterville Project does alter the flow regime in the lower mainstem McKenzie River by diverting all but a minimum of 1,000 cfs from a total of 13.1 miles of bypass reach (i.e., past the 5.8-mile Leaburg bypass reach, plus the 7.3-mile Walterville bypass reach) for McKenzie River flows of less than approximately 3,600 cfs. Under the proposed action, the seasonal flow patterns would be similar in the bypass and non-bypass reaches, but the quantity of average daily flow would be reduced by approximately 30% in the winter and up to 70% in the summer (Fig. 6-1 and 6-2). The proposed action is expected to have localized biological effects due to these depleted flows (see "Effects of the Action on Biological Processes," section 6.2).

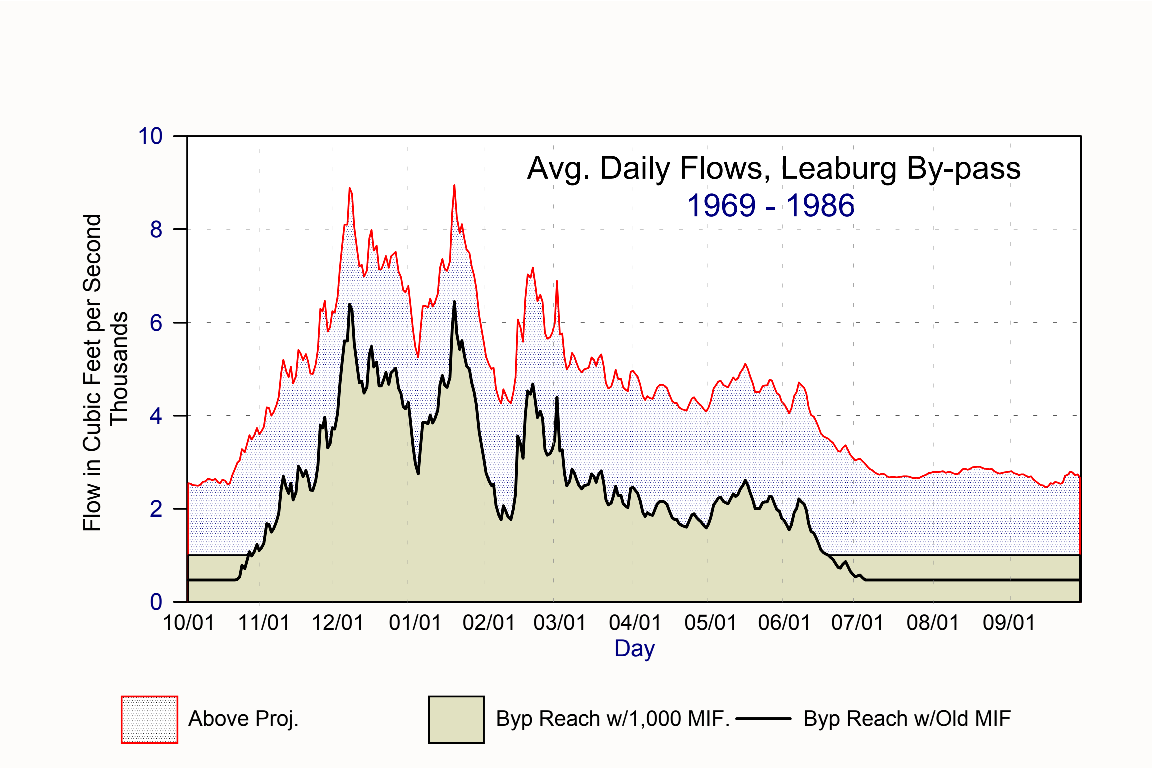

Figure 6-1 Comparison of above project and bypass reach flows in the Leaburg bypass reach. Diverted flow is the difference between total flow and bypass flow. The proposed action would result in a minimum instream flow (MIF) in this reach of 1,000 cfs, as shown in the figure (from Fig. 2-1 in FERC 2001).

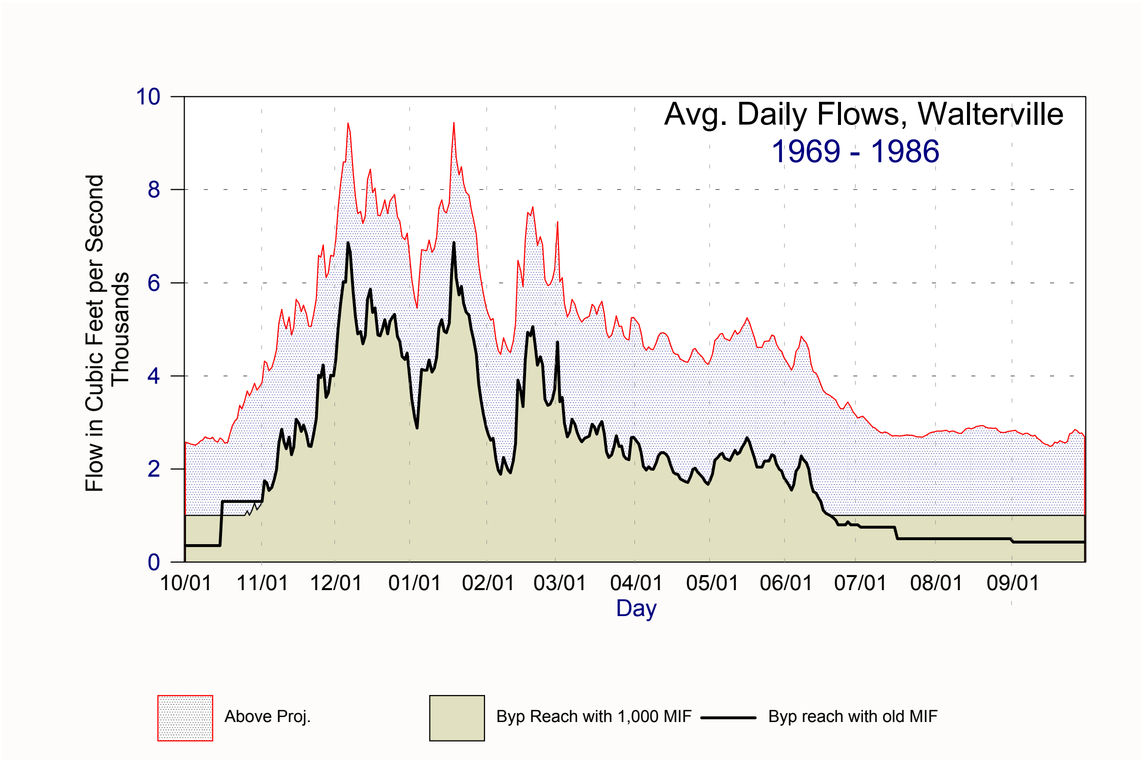

Figure 6-2 Comparison of above project and bypass reach flows in the Walterville bypass reach. Diverted flow is the difference between total flow and bypass flow. The proposed action would result in a minimum instream flow (MIF) in this reach of 1,000 cfs, as shown in the figure (from Fig. 2-2 in FERC 2001).

6.1.3 Sediment and LW Function

Sediment and LW function is defined in this biological opinion as the capacity of the system to deliver, transport and deposit sediment and LW in stream channels, as well as the in-situ effects of LW (i.e., creating channels and instream complexity in the absence of flow obstructions such as boulders; section 2.3.3.1.3). As described under the Environmental Baseline (section 5.2.3), construction and operation of the Leaburg-Walterville Project does not appear to have caused a reduction in the supply or transport of sediment or LW to downstream reaches. Nor do the Services expect any adverse effects on the habitat process of sediment and LW function under the proposed action.

6.1.4 Riparian Vegetation and Floodplain Function

The habitat process of riparian vegetation and floodplain function is defined in this biological opinion as the collective function of disturbance, flow regime, sediment and LW, and riparian vegetation (section 2.3.3.1.4). As described in section 5.2.4, in the McKenzie River below Leaburg Dam, riparian vegetation and floodplain function have been altered by the effects of the large USACE dams on flow regime and by the armoring effects of levees and revetments. The proposed action, including minimum flows in the bypass reaches, does not contain elements that will either improve or degrade riparian vegetation or floodplain function compared to conditions experienced under the environmental baseline.

6.1.5 Water Quality

Water quality is defined in this biological opinion as fluctuations of the following parameters: heat (i.e., water temperature dynamics), dissolved oxygen (DO), hydrogen ions (which control buffering capacity through pH and alkalinity), turbidity, and nutrients (nitrogen, phosphorus, carbon) (section 2.3.3.1.5). The water quality parameters considered most important for this opinion are water temperature dynamics and nutrient cycling.

As described in section 5.2.5, the water temperature model developed during the relicensing of the Leaburg-Walterville Project was used to predict peak temperatures in the bypass reaches above the Leaburg and Walterville powerhouses. The model showed that, under a worst-case, hot, dry climatological scenario, water temperatures can become elevated by 1.5° C and 2.0° C in the lower ends of the Leaburg and Walterville bypass reaches, respectively (EA 1994). Temperature elevations are reduced to less than 0.3° C in each mixing zone, where cooler water from each tailrace rejoins the mainstem McKenzie River. These effects would continue under the proposed action (see section 6.2.1.1.9 for magnitude of effect on biological processes).

The proposed action does not contain measures that are likely to adversely affect nutrient cycling.

6.2. Effects of the Action on Biological Processes

As described above in section 6.1, the proposed action affects each of the five habitat processes within the action area. These habitat processes provide the environmental conditions required for each biological process within the action area. The biological processes are defined in this opinion as migration, spawning, and rearing (organism level), population level processes (population level), and food web dynamics (community level) (section 2.3.3.2). The linkages between the habitat and biological processes are shown in Figure 6-3. The five habitat processes ultimately affect the population and community level biological processes due to their influence on the organism level biological processes.

Figure 6-3 expresses the linkages between habitat and biological processes, as defined in this opinion. In addition to altering habitat processes, the proposed action also effects biological processes more directly by harm and harassment associated with passage upstream or downstream through the Leaburg-Walterville Project (i.e., mortality, injury or stress from entrainment thru turbines or screening systems). While this biological opinion emphasizes the alteration of habitat processes and the resulting effects to biological processes from FERC's proposed action, direct effects at the Leaburg-Walterville Project are a integral component of the jeopardy analysis for UWR chinook salmon and CR bull trout.

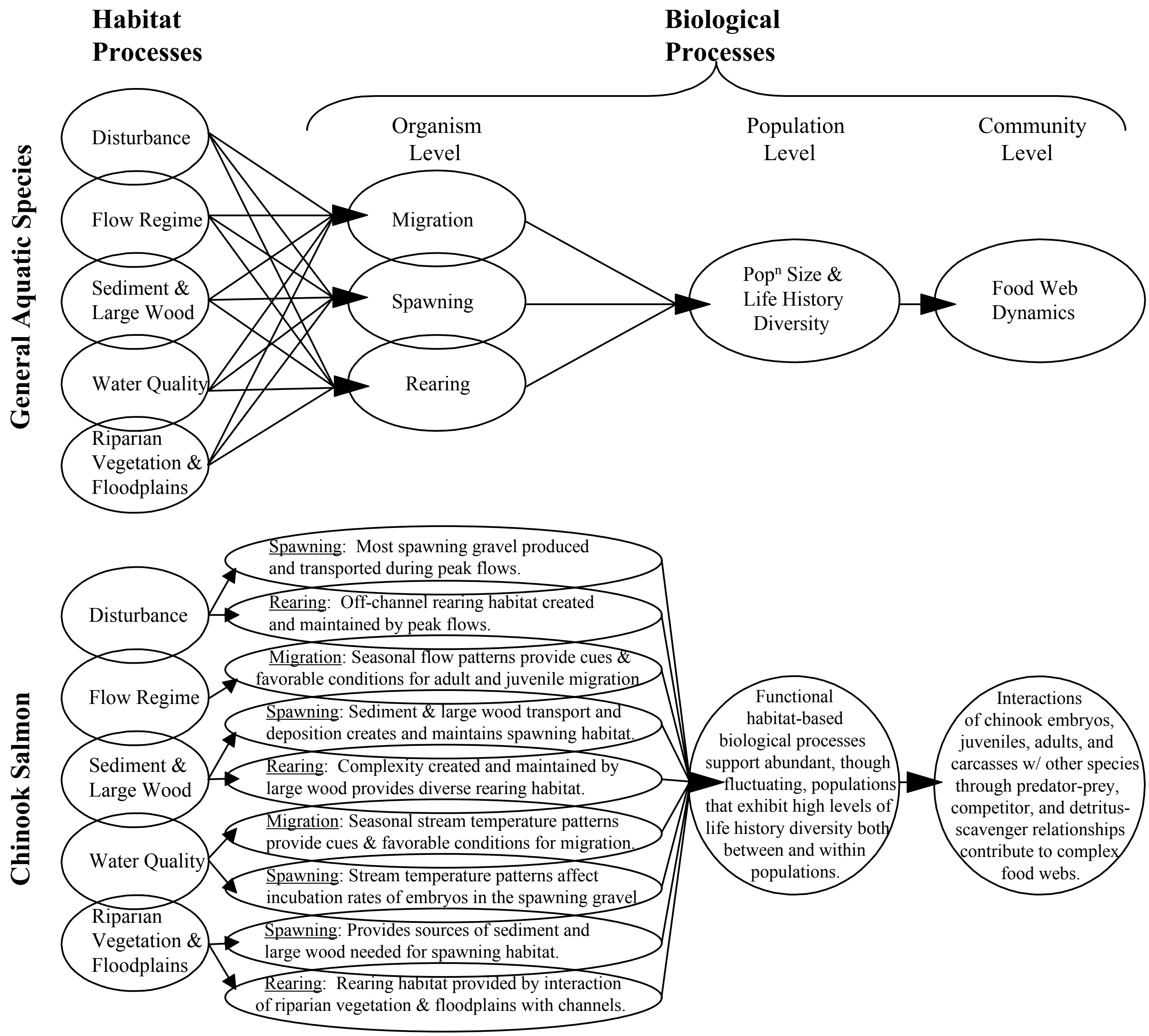

Figure 6-3. Framework of habitat and biological processes for aquatic species in the McKenzie subbasin (top panel) and for UWR chinook salmon (bottom panel).

The top panel of Figure 6-3 above shows the strongest causal links between each of the five habitat processes and organism-level biological processes for fish species, as indicated by the black arrows. The bottom panel uses UWR chinook salmon as an example of these causal links between the habitat and biological processes. The degree of influence of the habitat processes on organism level biological processes may depend on the species. Linkages between the habitat processes influences and the organism level biological processes are shown for each of the two listed fish species in the McKenzie subbasin in Table 6-1.

Habitat Processes → Biological Processes		Listed Fish Species	
		UW Chinook Salmon	CR Bull Trout
Disturbance	Spawning	Most spawning gravel produced and transported during peak flows.	Some spawning gravel produced and transported during peak flows.
	Rearing	Off-channel rearing habitat created and maintained by peak flows.	Off-channel rearing habitat created and maintained by peak flows.
Flow Regime	Migration	Seasonal flow patterns provide cues and favorable conditions for adult and juvenile migration.	Seasonal flow patterns likely provide cues and favorable conditions for bull trout migration
Sediment & LW Function	Spawning	Sediment & LW transport, deposition, and interaction creates and maintains spawning habitat.	Sediment & LW transport, deposition, and interaction Creates and maintains spawning habitat.
	Rearing	Complexity created and maintained by LW, which provides abundant and diverse rearing habitat.	Complexity created and maintained by LW, which provides abundant and diverse rearing habitat, esp. large pools
Riparian Vegetation & Floodplains	Spawning	Provides sources of sediment & LW needed for spawning habitat.	Provides sources of sediment and LW needed for spawning habitat.
	Rearing	Rearing habitat provided by interaction of riparian vegetation and floodplains with stream channels.	Rearing habitat provided by interaction of riparian vegetation and floodplains with stream channels.
Water Quality	Migration	Seasonal stream temperature patterns provide cues and favorable conditions for adult & juvenile migration.	Seasonal stream temperature patterns provide cues and favorable conditions for adult, sub-adult and juvenile migration
	Spawning	Fall and winter stream temperatures patterns affect incubation rates of embryos in the spawning gravel.	Fall and winter stream temperature patterns affect incubation Rates of embryos in the spawning gravel

Table 6-1. Linkages between habitat processes and organism level biological processes for listed fish species in the McKenzie subbasin.

Because habitat processes form the physical and chemical foundation upon which biological processes are built, human activities that affect habitat processes also affect biological processes. The way effects of the proposed action on habitat processes translate into effects on biological processes, and then into effects of the action on the two listed fish species, is described in the following section. The environmental baseline of the biological processes within the McKenzie subbasin is described in section 5.3, and the effects of the proposed action on the five habitat processes within this subbasin are described in section 6.1. The effects of the proposed action on the five biological processes of migration, spawning, rearing, population level processes, and food web dynamics are described below first for UWR chinook in section 6.2.1, and then for CR bull trout in section 6.2.2.

6.2.1 Upper Willamette River Chinook Salmon

The effects of the action on migration, spawning, rearing, and population level processes are described below for UWR chinook salmon within the action area (the McKenzie subbasin). Food web dynamics as related to UWR chinook salmon and CR bull trout in the McKenzie subbasin are described in sections 6.2.1.5 and 6.2.2.5 respectively.

6.2.1.1 Migration

Potential effects of the proposed action on the biological process of migration for UWR chinook salmon include: (1) direct effects to juvenile migration from physical structures and entrainment into canals and powerhouses; (2) direct effects to adult migration from physical barriers, false attraction at the Leaburg and Walterville tailraces, and/or impediments; and (3) indirect effects due to downstream alteration of habitat processes by EWEB dams.

As noted in Table 3-1, the proposed action includes the: (1) Leaburg Screen Cleaning and Bypass System Modifications; (2) Leaburg Lake Raise; (3) Leaburg Dam Left-Bank Fish Ladder Modifications and Right-Bank Fish Ladder Construction; (3) Leaburg Tailrace Barrier Construction; (5) Walterville Water Diversion Structure; (6) Walterville Fish Screen Construction; (7) Walterville Tailrace Excavation; (8) Walterville Tailrace Barrier and Return Channel Modification; and (9) Habitat Enhancement Measures. All of these activities could affect the biological processes of migration and fish passage for UWR chinook salmon. The expected effects of each component of the Leaburg-Walterville Project are described in section 6.2.1.1.

6.2.1.1.1 Leaburg Fish Screen Cleaning and Bypass System Modifications

There are two existing problems at the screen and bypass system: the cleaning system does not adequately clean the entire submerged screen surface and the design of the bypass system results in a high potential for debris accumulation (i.e., there is no operational mechanism for inspecting the submerged screen and removing debris that catches in the manifold of the bypass, which located under the power canal). Because the current screen cleaner does not clean the entire screen surface during normal operation, portions of the screen become clogged with debris reducing the screen area and increasing approach velocities. Data developed during 1993 tests (EWEB 1993; ODFW 1996) show that fry mortality ranged from:

- 4 to 13% with a bypass apex partially plugged with debris
- 8 to 9% with a single screen washer out of service
- 2 to 4% with clean screens
- 7 to 25% with debris on the screens

All of these evaluation results indicate that fry mortality can exceed the 1.5% reported in FERC (2001).

To ensure that juvenile chinook salmon passing through this facility will be adequately protected, the Article 416 requires EWEB to modify, operate, and maintain the Leaburg fish screen cleaning system and/or modify system operations and maintenance in accordance with a facilities plan to provide clean, submerged screen area adequate to protect juvenile fish passing through this facility, developed in consultation with and approved by the Services (section 3.1.2). The plan will include modifications to clean the entire submerged screen area or other measures that provide equivalent or better protection of juvenile fish passing through the facility. EWEB must also modify, operate, and maintain the Leaburg fish return bypass conduit and/or the operations and maintenance for the Leaburg Canal, in accordance with a facilities plan that meets the objectives of: (1) providing adequate inspection access to the bypass conduit at points where debris can accumulate; and (2) providing simple access for the purpose of debris removal, to reduce the potential for injury or mortality of fish subjected to debris accumulations currently undetectable under normal conditions. Therefore, the Services expect that, after screen and bypass modifications, survival at the juvenile fish screens and through the bypass conduit will be at least as high as under the environmental baseline (i.e., current operations), if not higher.

The license articles also direct EWEB to carry out the following measures to minimize the adverse effects on UWR chinook salmon of the construction and operation of the Leaburg fish screen cleaning and bypass systems: (1) EWEB must develop a plan to control erosion and slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities (Article 401) and (2) EWEB must plan in-water construction activities, including construction of the Leaburg fish screen cleaning and bypass systems, to avoid sensitive times of the year, such as migration periods (Article 403).

6.2.1.1.2 Leaburg Lake Raise

Article 405 allows EWEB to increase the elevation of Leaburg Lake by a maximum of 1.5 feet, which will affect hydraulic pressure (head) at the fish passage facilities (section 3.1.2). Under the proposed action, downstream migrating juvenile UWR chinook salmon will pass the Leaburg Dam facility through three possible routes: (1) the juvenile fish screen and bypass system at the head of the Leaburg power canal; (2) one of three spillway rollgates; or (3) the fish ladders (i.e., the functioning left-bank ladder or the non-functioning right-bank ladder, which will be rebuilt under the proposed action) and their respective attraction-flow enhancement facilities. The effects of the proposed Leaburg lake raise on injury or mortality of juvenile UWR chinook salmon using these routes are described below. Article 405 requires EWEB to develop and submit the final design plan for raising the water level of Leaburg Lake within two years of license issuance.

Juvenile chinook mortality through the fish screen and bypass system: The 5-mile long Leaburg Canal is screened with a vertical fixed plate screen and bypass facility that guide fish back to the McKenzie River just below Leaburg Dam. A decade of extensive testing, facility modifications, and re-testing at the existing fish screen bypass facility has resulted in mortality rates as low as 1.5% for fry and 1.0% for smolts (ODFW 1996, cited in FERC 2001). The smolt mortality estimate is based on tests conducted from 1985-1989, prior to baffle installation and other facility improvements that were designed to improve fry protection. However, the biological evaluations have usually been performed with clean screens and clean surfaces in the bypass conduit. Factors such as cleaning system failure, screen occlusion by debris, and debris trapped in the bypass conduit at Leaburg Dam probably increase injury and mortality rates (EWEB 1993; ODFW 1996). The increased lake elevation may result in increased mortality at the Leaburg fish screen above the levels described above. With the proposed lake raise, approach velocities across the screen will increase slightly, potentially increasing mortality of fry-sized UWR chinook salmon (i.e., less than 60 mm in length; FERC 2001).

The planned lake raise and subsequent increases in approach velocities to the Leaburg screen are complicated by the two existing problems at the screen and bypass system discussed in section 6.2 1.1.1: the cleaning system does not adequately clean the entire submerged screen surface and the design of the bypass system results in a high potential for undetectable debris accumulation. Because the current screen cleaner does not clean the entire screen surface during normal operation, portions of the screen become clogged with debris reducing the screen area and increasing approach velocities. Data developed during 1993 tests (EWEB 1993; ODFW 1996) show that fry mortality ranged from: (1) 4 to 13% percent with a bypass apex partially plugged with debris; (2) 8 to 9% with a single screen washer out of service; (3) 2 to 4% with clean screens; and (4) 7 to 25% with debris on the screens. All of these evaluation results indicate that fry mortality can exceed the 1.5% reported in FERC (2001).

To ensure that after the lake raise, survival at the juvenile fish screens and through the bypass conduit will be at least as high as under current operations, if not higher, Article 420 requires EWEB to complete studies pursuant to a study plan to identify if, and to what extent, mortality and/or injury of juvenile salmonids, associated with the increased water surface elevation, occurs at the Leaburg fish screen facility (section 3.1.2). Before the end of the one year period, EWEB must consult with the Services and with ODFW on the results of the studies and on any actions proposed to eliminate or mitigate for any source of increased injury and/or mortality associated with the increased water elevation. EWEB must take corrective action to eliminate or mitigate for any source of increased injury and/or mortality associated with the increased water surface elevation in a time and manner appropriate to the scope and nature of the problem.

Juvenile chinook mortality through the spillway rollgates: Juvenile salmon are known to pass under the rollgates, although test smolts released near the rollgate opening moved away from the rollgates. A study of rollgate mortality at the current lake level, conducted during project relicensing (EA 1990, cited in FERC 2001) indicated salmon fry mortality rates of less than 0.8% for flow releases of 200 and 600 cfs. Fry mortality was substantially higher in both the test and control fish at flow releases of 1,000 cfs (16.3 and 17.7%, respectively), indicating an effect due to handling rather than passage conditions. A smolt mortality of 5.1% was reported at 1,000 cfs with no smolt mortalities in the control release groups. A 1994 rollgate mortality study using pit-tag technology showed no significant difference between the recovery of fish released above and below the dam but was inconclusive because small sample sizes were used (EWEB 1994, cited in FERC 2001). Forty wild salmon smolts (including one mortality) were captured in an ODFW screw trap positioned below one rollgate during two weeks of river-run sampling (i.e., no control tests) at low flows during November 1992 (pers. comm., T. Downey, EWEB, cited in FERC 2001).

To ensure that juvenile chinook salmon will be adequately protected, Article 421 requires EWEB to complete studies, within one year of the Leaburg Lake raise, to identify if, and to what extent, mortality and/or injury of juvenile salmonids is induced by passage through the rollgates at Leaburg Lake (section 3.1.2). The study will identify effects at the current lake level and at the maximum lake elevation proposed. Both sets of tests will include the minimum gate opening. Before the end of the one-year period, EWEB must consult with the Services and with ODFW on the results of the study and on any measures proposed to eliminate or mitigate any source of injury and/or mortality associated with the increased water elevation. EWEB must take corrective action to eliminate or mitigate for increased injury and/or mortality in a time and manner appropriate to the scope and nature of the problem. Therefore, the Services expect that, after the lake raise, survival through the rollgates will be similar to that experienced under current operations (the environmental baseline).

Other effects of Leaburg lake raise on juvenile chinook migrants: Raising the lake level will also inundate about 200 feet of stream habitat at the upstream end of the current Leaburg Lake impoundment area. The lake raise will deepen the existing impoundment, and may slightly delay downstream migrating juvenile spring chinook salmon and slightly increase the likelihood of predation by fish-eating birds or other aquatic predators. However, data collected during the rollgate mortality study indicate that juvenile salmon pass through Leaburg Lake quickly (FERC 2001).

The license articles include the following actions that will further minimize adverse effects of the lake raise on UWR chinook salmon: (1) EWEB must develop a plan to control erosion and slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities (section 3.1.2; Article 401); (2) EWEB must plan in-water construction activities, including those associated with the lake raise, to avoid sensitive times of the year, such as migration periods (section 3.1.2; Article 403); (3) EWEB must notify rapidly (within 24 hours) appropriate state and Federal agencies of any unanticipated situations arising during the construction or operational activities associated with the lake raise that may be detrimental to aquatic resources (section 3.1.2; Article 424); and (4) EWEB must provide yearly compliance reports on the operation and maintenance of all physical structures, including those associated with the Leaburg lake raise (section 3.1.2; Article 425).

In summary, the proposed Leaburg Lake raise is not likely to adversely affect migration conditions for juvenile UWR chinook salmon compared to those experienced under the environmental baseline. EWEB must modify, operate, and maintain the fish screen cleaning system and the juvenile bypass canal in a manner that will improve passage conditions over those experienced by juvenile chinook salmon under the environmental baseline. If the lake raise is likely to result in increased approach velocities to the Leaburg Canal fish screen and through the spillway rollgates at a given discharge, any changes in injury and/or mortality rates due to the lake raise will be determined during testing. EWEB must take both immediate and long-term actions, as needed, to eliminate adverse effects.

6.2.1.1.3 Leaburg Dam Fish Ladder Modifications

Article 416 requires EWEB to modify the left-bank fish ladder and reconstruct the right-bank fish ladder at Leaburg Dam. The left-bank fish ladder is the only one currently operable, but, under the environmental baseline, its effectiveness has been limited by the following problems.

- The left-bank ladder entrance gate is not adjustable, resulting in head differentials at the fishway entrance that vary from nearly zero at high river flows to about four feet at low river flows
- The ladder lacks staff gages to allow accurate monitoring of the operation of the fish ladder entrance
- The lower part of the fish ladder can be overtopped by moderately high river flows
- The auxiliary water control gate is difficult to operate and can not be easily adjusted

Further, if the lake is raised and additional fishway pools are not provided, the fish ladder will draw excessive flow from the forebay, providing poor passage conditions.

Article 416 requires EWEB to modify, operate, and maintain the Leaburg left bank fish ladder in accordance with Technical Specifications and Drawings, developed in consultation with and approved by the Services, that will minimize adverse effects to fish (section 3.1.2). For example, the facilities plan for the modification, operation, and maintenance of the upper ladder weirs will meet the objective of maintaining ladder flow and hydraulic drop per pool consistent with conditions in existence before the lake raise. These measures are intended to protect adult salmon from injury, mortality, and/or delay.

A second fish ladder was built on the right-bank of Leaburg Dam during the original construction but has long since fallen into disuse. The absence of a fish ladder on one side of the dam may delay adult UWR chinook salmon moving upstream. To minimize delay, the license articles require EWEB to construct, operate, and maintain the Leaburg right-bank fish ladder in accordance with Technical Specifications and Drawings, developed in consultation with and approved by the Services.

Article 418 requires EWEB to conduct hydraulic and biological evaluations of the adult fish ladders within one year after each facility is fully operational (section 3.1.2). EWEB must consult with the Services regarding any deficiencies identified as a result of the evaluations and will undertake corrective actions in a time and manner appropriate to the scope and nature of the deficiencies. The license articles also includes the following measures to minimize the adverse effects on UWR chinook salmon of the construction and operation of the adult fish ladders: (1) EWEB must develop a plan to control erosion and slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities (Article 401); (2) EWEB must plan in-water construction activities, including construction and modification of the fish ladders, to avoid sensitive times of the year, such as migration periods (Article 403); (2) EWEB must notify rapidly (within 24 hours) appropriate state and Federal agencies of any unanticipated situations arising during the construction or operational activities associated with the fish ladders that may be detrimental to aquatic resources (Article 424); and (3) EWEB must provide yearly compliance reports on the operation and maintenance of all physical structures, including the Leaburg fish ladders (Article 425).

There does not appear to be any information regarding the downstream passage survival of juvenile UWR chinook salmon through the existing left-bank fish ladder. Because Article 416 calls for the reconstruction of the existing but currently inoperable right-bank ladder, the opportunity for juveniles to pass downstream through an adult ladder will increase under the proposed action. Downstream passage through adult fishways and potential interactions with adult anadromous salmonids and other fish species can be harmful to juvenile salmon. However, relatively small amounts of flow are diverted into the ladders (a total of 20 to 40 cfs) compared to an average daily river flow at Vida (above the Leaburg bypass reach) of 4,180 cfs or at Leaburg Dam of 2,745 cfs (USGS 2001a and 2001b). Therefore, the Services consider the likelihood that juvenile chinook salmon will become entrained into the adult fish ladders and then killed, injured, or otherwise reduced in condition (i.e., via disease transmission) to be very low. In summary, the Services expect that the net result of increasing the effectiveness of the left-bank fish ladder and redesigning and reconstructing the right-bank fish ladder to meet current design criteria will be to improve upstream migration conditions for adult UWR chinook salmon, without degrading migration conditions for juvenile chinook salmon.

6.2.1.1.4 Leaburg Tailrace Barrier Construction

A radio-tagging study conducted during relicensing demonstrated that adult chinook salmon were attracted into the tailrace of Leaburg Dam and can remain there for several days although more than 23% of the tagged salmon entered the bypass reach rather than the tailrace (EA 1991d). Migrating salmon that do enter the tailrace must actively swim (or be passively displaced) one-quarter mile downstream in order to continue their upstream migration. Further, when turbines are ramped up or down in response to low load or low flow conditions, adults that enter the tailrace can swim up into the turbine tubes and become injured or killed (pers. comm., B. Nordlund, NMFS, June 2001). To eliminate the possibility of injury or mortality and to reduce delay, Article 416 requires EWEB to construct, operate, and maintain an adult barrier at the terminus of Leaburg tailrace in accordance with Technical Specifications and Drawings, developed in consultation with and approved by the Services (section 3.1.2). For example, the facilities plan for construction, operations, and maintenance of the Leaburg tailrace barrier will minimize attraction into the tailrace, thereby allowing adult chinook salmon to remain safely in the river (i.e., the Leaburg bypass reach). The vertical bars at the velocity barrier will be spaced close enough together that fish nosing upstream cannot become gilled on the barrier rack. Velocity through the rack will be minimized such that attraction, which could encourage jumping, is also minimized.

During the interim period before the tailrace barrier is completed, Article 416 requires EWEB to continue implementing shutdowns of flow into the Leaburg powerhouse when 50 or more adult salmon are counted in the tailrace for five consecutive days. Over the past 13 years, EWEB and ODFW have developed the following counting method (pers. comm., T. Downey, EWEB, August 17, 2001): water clarity in the McKenzie River is generally very good and daily counts are made during mid-day when the sun is overhead, minimizing shadows. The configuration of the facility allows the counter to look directly down into the water below the turbine outlets where fish tend to congregate. Breaks in surface turbulence create lenses or “windows” in the water and, over a 15-minute period, a counter can make several replicate counts. The Services believe that, in the case of Leaburg tailrace, where the radio-telemetry data referenced above (EA 1991d) showed that 70% (9 fish) of the 13 fish entering the tailrace stayed 3 days or less and 6 of those stayed only 1 day, specifying that the powerhouse will be shutdown when 50 or more fish are counted for 5 consecutive days appears to provide a reasonable degree of protection against adult delay during the interim period. In addition, EWEB will ensure that adult salmonids are not stranded below the siphon-hole outlet.

The new Leaburg tailrace barrier is expected to greatly reduce migration delay, although to an unknown extent. Article 417 requires EWEB to conduct hydraulic and biological evaluations within one year after the tailrace barrier is fully operational to determine the effectiveness of the system in minimizing migration delay. Hydraulic tests will verify design objectives, such as the distribution of flow. Radio telemetry tests will be used to track fish behavior. Article 417 requires that EWEB consult with the Services if any deficiencies are identified in these evaluations and undertake corrective actions in a time and manner appropriate to the scope and nature of the deficiencies (section 3.1.2).

The license articles include the following measures to minimize the adverse effects on UWR chinook salmon of the construction and operation of the Leaburg tailrace barrier: (1) EWEB must develop a plan to control erosion and slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities (Article 401) (2) EWEB must plan in-water construction activities, including construction of the Leaburg tailrace barrier, to avoid sensitive times of the year, such as migration periods (Article 403); (3) EWEB must notify rapidly (within 24 hours) appropriate state and Federal agencies of any unanticipated situations arising during the construction or operational activities associated with the tailrace barrier that may be detrimental to aquatic resources (Article 424); and (4) EWEB must provide yearly compliance reports on the operation and maintenance of all physical structures, including the Leaburg tailrace barrier (Article 425).

In recent years, EWEB has periodically shut down the Leaburg powerhouse (usually overnight) to encourage adult UWR chinook salmon holding in the tailrace to move back into the river. The proposed action includes continuing this measure during the interim period until the Leaburg tailrace barrier is constructed and begins operation. This measure may slightly reduce migration delay during the interim period, compared to that experienced under the terms of the original FERC license. However, some level of migration delay is likely to continue during the interim period (section 6.2.1.1.3 and FERC 2001).

In summary, the Services expect that construction of the tailrace barrier will improve migration conditions for adult UWR chinook salmon at Leaburg Dam over those experienced under the environmental baseline. However, adult UWR chinook salmon will experience some ongoing migration delay during the interim period before the barrier is constructed and becomes operational.

6.2.1.1.5 Walterville Water Diversion Structure

In order to increase water surface elevation, allowing diversion of EWEB's water right into the canal, the revised license directs EWEB to build rock weirs at the upstream end of the Walterville bypass reach. Article 410 requires that EWEB construct, operate, and maintain rock drop water diversion structures in accordance with Technical Specifications and Drawings, developed in consultation with and approved by the Services, by the date identified in its construction schedule (section 3.1.2). The structures are designed to ensure safe and efficient upstream and downstream fish passage through the water diversion structures for a range of flow conditions. For example, the Technical Specifications require an upstream-downstream elevation differential of 1 foot or less and a minimum depth of 1 foot over the notch in the weir, design elements that will optimize fish passage.

No less than 120 days prior to the scheduled completion date of the water diversion structures, EWEB must submit a plan for monitoring and maintenance of the water diversion structures such that the structures continuously function according to the requirements of the final design plan. The plan will include monitoring of sediment accumulation at the rock drop diversion structures. It will allow the Services and ODFW access for inspection after construction and throughout the term of the license, and provide for EWEB to make necessary adjustments to return the structures to proper function within a reasonable time after deficiencies are identified, consistent with the scope and nature of the deficiencies.

The license articles also direct EWEB to carry out the following measures to minimize the adverse effects on UWR chinook salmon of the construction and operation of the Walterville water diversion structures: (1) EWEB must develop a plan to control erosion and slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities (Article 401); (2) EWEB must plan in-water construction activities, including construction of the Walterville water diversion structures, to avoid sensitive times of the year, such as migration periods (Article 403); (3) EWEB must notify rapidly (within 24 hours) appropriate state and Federal agencies of any unanticipated situations arising during the construction or operational activities associated with the water diversion structures that may be detrimental to aquatic resources (Article 424); and (4) EWEB must provide yearly compliance reports on the operation and maintenance of all physical structures, including the water diversion structures (Article 425).

6.2.1.1.6 Walterville Fish Screen Construction

EWEB's Walterville Diversion on the lower mainstem McKenzie River is currently unscreened and, during part of the year, diverts more than two-thirds of the river into the Walterville Canal and through the Walterville powerhouse. Most adult UWR chinook salmon spawn above this point in the McKenzie subbasin and thus a majority of the outmigrating juveniles are exposed to this unscreened diversion each year. Based on mortality data collected in 1958 using juvenile rainbow trout, and the water diversion rates that occurred during the 1981, 1982, 1987 and 1988 outmigration periods (i.e., 50 to 60% of total river flow), the estimated mortality rates of all outmigrating chinook fingerlings and fry were 3.5 and 4.0%, respectively (EA 1991c, cited in FERC 2001). However, the 1958 study on which these mortality estimates were based failed to account for 64% of the 991 test fish while 95% of 631 control fish were recovered. Unless all of the fish that were not recovered survived, mortality through the turbines may have been much higher than the reported estimates.

ODFW and EWEB performed a smolt mortality study during 1982 with two uniquely marked test groups, one released from the McKenzie Salmon Hatchery upstream of the Walterville intake and one directly into the Walterville Canal. Fish released upstream of the intake (above-Walterville intake group) traveled either through the bypass reach (flow = 1,300 cfs) or through the canal (2,300 cfs). A control group was released downstream of the mouth of the canal (Smith et al. 1982). The recovery rate of the Walterville Canal test group was 9.3% lower than that of the control group and 13.4% lower than that of the above-Walterville intake group. Because there was no detectable mortality of the above-Walterville intake group (i.e., recovery rate was higher than for the control group), the 1982, protection agreement between EWEB and ODFW implemented flows of 1,300 cfs in the bypass reach during March 16 through June 15 and October 16 through November 20 (FERC 2001).

In the mid-1990s, both EWEB and ODFW reviewed the results of the 1982 study and found that the size (i.e., body length) of the fish in the control group was significantly smaller than that of test group fish. Fewer of the smaller fish may have migrated downstream to the recapture site, Sullivan Plant at Willamette Falls. Also, the downstream gear used for recapture was probably less efficient at capturing the small fish, leading to underestimates of the recovery rate of the control group and therefore of the mortality of the test group. EWEB determined that the most statistically valid and defensible method of adjusting the data for the effect of body size was to eliminate all data derived from fish smaller than 130 mm (fork length) from the analysis. The adjusted results indicated a mortality rate of 8.8% (95% CI = 0 to 16%) for the above-Walterville intake group at bypass flows of 1,300 cfs and canal flows of 2,300 cfs. This result was statistically different from zero. The adjusted results indicated a mortality rate of 14.5% for the group released directly into the Walterville Canal.

ODFW assumes that the mortality rate of juvenile chinook entering the canal is approximately 14% and that the diversion rate of the fish is similar to the diversion rate of the flow (pers.

comm., J. Ziller, ODFW, June 8, 2001). That is, if 50% of the flow is diverted, 7% of the fish migrating down the river would be killed. Actual mortality rates may be lower as flow in the canal is adjusted to allow Walterville turbines to operate at peak efficiency (EA 1991c).

EWEB and ODFW developed, negotiated, and implemented a second agreement in 1996, which replaced the 1982 agreement. The new agreement was based on the best available science, including site-specific mortality data, turbine efficiency, and other information derived from the entrainment/mortality model (EA 1991c). EWEB agreed to operate the Walterville development, during October 1 through April 30 of each year, in accordance with two seasonally-adjusted, reduced flow levels (FERC 2001). The timing and duration of the two operating levels, which specified canal flows at various river flows, were selected based on fish migration data collected at the Leaburg Canal. The operating levels are assumed to reduce the entrainment of juvenile chinook salmon into the canal by reducing the proportion of flow diverted. Also, the operating levels allow the turbine to perform at the high end of its efficiency curve, which is assumed to reduce turbine mortality (FERC 2001). As stipulated in the agreement, EWEB closes the canal for a total of 18 nights, three blocks of 4 nights for releases of hatchery chinook salmon and one block of 6 nights for hatchery steelhead releases. Because these closures take place during the October through April time period, they provide additional protection to wild UWR chinook salmon. This agreement is referenced in the license articles and will continue until Walterville screens are in operation. Per the proposed action, the FERC license for the Walterville Project requires a year-round minimum flow in the bypass reach of 1,000 cfs. EWEB began to implement the 1,000 cfs minimum flow during 1993.

The license articles require EWEB to construct a fish screen at the Walterville Canal intake, about one-third mile downstream of the canal entrance. Article 416 requires EWEB to construct, operate, and maintain juvenile fish screens in the Walterville Canal in accordance with Technical Specifications and Drawings, developed in consultation with and approved by the Services, by the date identified in its construction schedule (section 3.1.2). The screens are designed to safely and quickly return juvenile chinook salmon to the river, preventing entrainment further down the canal or through the powerhouse. Turbine mortality will be eliminated and residual mortality (i.e., through the bypass system) is expected to be from zero to less than one percent for fry and from zero to less than 0.5% for juvenile salmonids exceeding 60 mm in length (Neitzel et al. 1985; Neitzel et al. 1990a; Neitzel et al. 1990b; Hosey and Associates Engineering Company and Fish Management Consultants 1990; Johnsen 1995). EWEB, as the licensee, has used NMFS' juvenile fish screen design screen criteria in the development of the Walterville screen and bypass system. Evaluation of the performance of juvenile fish screens constructed to NMFS' criteria has lead the Services to expect the following performance for screen installation:

For juvenile salmonids >60 mm in length:

- If biological evaluation indicates that mortality is 0.5% or greater and/or injury rates are 2% or greater, modified facility operations and/or structural changes to the facility will be considered and implemented in a manner described by revised Article 418.

For salmonid fry (<60 mm in length):

- If biological evaluation indicates that mortality is 1% or greater and/or injury rates are 4% or greater, modified facility operations and/or structural changes to the facility will be considered and implemented in a manner described by revised Article 418.

The license articles also include the following measures to minimize the adverse effects on UWR chinook salmon from the construction and operation of this fish screen: (1) EWEB must develop a plan to control erosion and slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities (Article 401); (2) EWEB must plan inwater construction activities, including construction of the Walterville fish screen system, to avoid sensitive times of the year, such as migration periods (Article 403); (3) EWEB must notify rapidly (within 24 hours) appropriate state and Federal agencies of any unanticipated situations arising during the construction or operational activities associated with the fish screen system that may be detrimental to aquatic resources (Article 424); and (4) EWEB must provide yearly compliance reports on the operation and maintenance of all physical structures, including the Walterville fish screen system (Article 425). Under Article 416, EWEB will continue to implement its 1996 Intergovernmental Agreement for Fish Protection Measures (with ODFW) which stipulates that EWEB will provide seasonally-adjusted flows into the unscreened Walterville Canal (Table 6-2) to reduce entrainment of outmigrating juvenile UWR chinook salmon until the new screens are constructed in 2002.

Table 6-2. Details of 1996 agreement between EWEB and ODFW determining amount of water to be diverted into Walterville Canal from McKenzie River to ensure certain minimum flows.

Operating Level	Time Periods	River Flows	Canal Flow Determination
Level 1	Oct 1 through Dec 31	< 2,600 cfs	Canal = river flow - 1,000 cfs
	Feb 15 through Mar 31	> 2,600 cfs	Canal = river flow x 0.05 + 1480.59 cfs
Level 2	Jan 1 through Feb 14	< 2,900 cfs	Canal = river flow - 1,000 cfs
	Apr 1 through Apr 30	> 2,900 cfs	Canal = river flow x 0.056 + 1737.48 cfs

In summary, the construction and operation of the Walterville screen is likely to reduce levels of entrainment and mortality of juvenile UWR chinook salmon at the Walterville powerhouse compared to migration conditions experienced under the environmental baseline. Juvenile chinook salmon will still be able to enter the upper one-third mile of the diversion canal, possibly causing some migration delay, but the new screen will safely direct outmigrants back to the McKenzie River, preventing these fish from moving down the entire length of the canal or from passing through the powerhouse.

6.2.1.1.7 Walterville Tailrace Excavation

Article 406 authorizes EWEB to lower the water surface elevation of the Walterville tailrace up to 1.5 feet at the powerhouse by excavating portions of the tailrace for about one mile downstream (section 3.1.2). The resulting increase in net head on the turbine will result in an estimated 1,971 MWh of additional energy produced annually and approximately 0.22 MW of additional dependable capacity (FERC 1996). Both the upstream and downstream ends of the Walterville Canal will be blocked off and any juveniles or adult chinook salmon migrants remaining within the canal will be salvaged before excavation begins (pers. comm., T. Downey, EWEB, July 10, 2001). Article 422 requires EWEB to develop and submit a fish salvage plan at least 60 days prior to dewatering the tailrace for excavation and construction. Article 406 requires EWEB to develop and submit a plan for disposal of the material excavated from the Walterville tailrace in a way that avoids impacts to wetlands, riparian vegetation, and accidental introduction of sediments to the Walterville Canal and the McKenzie River.

The license articles also include the following measures to minimize the adverse effects on UWR chinook salmon of the construction and operation of the tailrace excavation: (1) EWEB must develop a plan to control erosion and slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities (Article 401); (2) EWEB must plan inwater construction activities, including construction of the Walterville fish screen system, to avoid sensitive times of the year, such as migration periods (Article 403); and (3) EWEB must notify rapidly (within 24 hours) appropriate state and Federal agencies of any unanticipated situations arising during the construction or operational activities associated with the tailrace excavation that may be detrimental to aquatic resources (Article 424).

6.2.1.1.8 Walterville Tailrace Barrier and Return Channel Modification

The existing Walterville tailrace barrier, located approximately one-quarter mile up the tailrace from the river confluence, consists of a salmon rack fastened to a raised cement foundation that is oriented perpendicular to the water flow. The rack is in place from early April through September. To resume upstream migration, adults that enter the tailrace must either swim upstream through the adjacent one-quarter mile long return channel to the river or swim back down the tailrace to the river. Current migration conditions for UWR chinook salmon at the Walterville tailrace were assessed during a 1990 radio-tagging study (EA 1991e, cited in FERC 2001). The primary objectives of the study were to evaluate the effects of stream flow in the bypass reach and the likelihood of false attraction into the tailrace return channel and to estimate potential migration delays of fish entering the channel. During the study, total river flow ranged from 2,331 to 6,217 cfs and flows in the bypass reach ranged from 595 to 4,630 cfs. Of the fish that entered the Walterville tailrace, the mean time spent at the tailrace barrier was 9.5 days (median = 6 days) (FERC 2001). The total migration time through the Leaburg-Walterville reach of fish that entered the tailrace was significantly longer (19.8 days) than that of fish that did not (9.1 days). Fish that entered the tailrace did not compensate by migrating more quickly upstream after returning to the mainstem. The mean total natural holding duration (i.e., holding time in the mainstem) was not significantly different between these groups.

To increase the ability of adult chinook salmon to locate the return channel and to reduce the potential that fish that enter the channel will be delayed there, Article 416 requires EWEB to replace the existing fish rack barrier with a velocity barrier aligned at a 30 degree angle to the flow, designed to lead fish toward the left bank and the mouth of the return channel (section 3.1.2). Attraction flow from the return channel will be enhanced by the new entrance geometry. EWEB must construct, operate, and maintain an adult barrier at the terminus of Walterville tailrace in accordance with Technical Specifications and Drawings, developed in consultation with and approved by the Services. As described previously for the Leaburg Project, the facilities plans for construction, operations, and maintenance of the Walterville tailrace barrier and return channel will ensure that adult chinook salmon are safely and effectively returned to return to the river at the lower end of the Walterburg bypass reach.

Article 417 requires EWEB to conduct hydraulic and biological evaluations to determine the effectiveness of the tailrace barrier in minimizing the potential for migration delay within one year after the barrier is fully operational (section 3.1.2). Hydraulic tests will verify design objectives such as the distribution of flow over the velocity barrier. Radio-telemetry tests will be used to track fish behavior. EWEB must consult with the Services if any deficiencies are identified in the evaluations and will undertake corrective actions in a time and manner appropriate to the scope and nature of the deficiencies. Article 419 requires EWEB to submit a plan for inspection, maintenance, and operation of the Walterville tailrace return channel, no less than 120 days prior to the scheduled date for completion of the tailrace barrier, to ensure safe and effective adult fish passage.

The license articles also direct EWEB to carry out the following measures to minimize the adverse effects on UWR chinook salmon of the modification of the Walterville tailrace barrier: (1) EWEB must develop a plan to control erosion and slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities (Article 401); (2) EWEB must plan in-water construction activities, including modification of the Walterville tailrace barrier, to avoid sensitive times of the year, such as migration periods (Article 403); (3) EWEB must notify rapidly (within 24 hours) appropriate state and Federal agencies of any unanticipated situations arising during the construction or operational activities associated with modified tailrace barrier that may be detrimental to aquatic resources (Article 424); and (4) EWEB must provide yearly compliance reports on the operation and maintenance of all physical structures, including the tailrace barrier (Article 425).

In summary, modification of the Walterville tailrace barrier and return channel is expected to greatly reduce the likelihood and length of migration delay of adult UWR chinook salmon caused by the attraction of these fish into the tailrace.

6.2.1.1.9 Leaburg-Walterville Habitat Enhancement Measures

The license articles require EWEB to carry out several habitat enhancement measures for the Leaburg-Walterville Project. These measures, and their expected effects on the biological process of migration for UWR chinook salmon, are discussed below.

<u>Instantaneous minimum flows</u>: Article 411 requires EWEB to maintain instantaneous minimum flows immediately downstream of Leaburg Dam and the Walterville intake at a continuous level of 1,000 cfs to improve migration conditions for juvenile UWR chinook salmon (section 3.1.2).

The proposed diversion of water and minimum instream flows of 1,000 cfs at the Leaburg and Walterville bypass reaches are shown in Fig. 6-1 and 6-2 (historical post-USACE dam average daily flows compared with proposed minimum instream flows). An Instream Flow Incremental Methodology (IFIM) study conducted during the project relicensing, involving 39 cross-sectional transects, showed that critical riffle areas were passable to adult UWR chinook salmon at 1,000 cfs in both bypass reaches (EA 1991f, cited in FERC 2001). This particular result was corroborated by the radio-tagging study (EA 1991e, cited in FERC 2001), which did not reveal any indication that adult UWR chinook salmon were delayed in any portion of the two bypass reaches at flows of 1,000 cfs. Daily float surveys of both bypass reaches during the radio-tagging study showed no fish holding downstream of the critical riffles that had been identified in the IFIM study (FERC 2001).

As described in section 6.1.5, the diversion of all but 1,000 cfs of water from the Leaburg and Walterville bypass reaches is likely to result in water temperature increases during August of up to 1.5EC and 2.0EC in a hot, dry year like 1972 (EA 1994a as cited in FERC 2001). Because solar radiation causes the river to gain heat in a downstream direction below the diversion, maximum daily temperatures of 16.8° C [62.2° F] and 19.1° C [66.4° F] could occur in the lower ends of the Leaburg and Walterville reaches, respectively, during a hot, dry August (i.e., versus peak daily temperatures of 13.8° C [56.8° F] and 15.1° C [59.2° F] during a normal water year). EWEB (1995) considers EA's (1994) estimate of maximum daily average (peak) temperatures to be conservative because the model used the upper bound (95th percentile) of estimated source temperatures (i.e., mainstem McKenzie at Vida gage, above both the Leaburg and Walterville Canal diversions) as an input. EWEB also notes that the daily maximum is a transient value; daily maxima measured at the bottom of the Leaburg bypass reach during July, 1993, lasted less than 1½ hours (Figure 13 in EWEB 1995).

The Oregon Department of Environmental Quality (ODEQ) has established a water quality criterion for general salmonid use during warm summer months (i.e., the average daily maximum stream temperature for the seven warmest consecutive days during a year) of 17.8° C [64° F] (ODEQ 1997). The EWEB modeling study referenced above was completed prior to the development and implementation of the ODEQ criterion, and thus did not analyze data using the 7-day average daily maximum temperature metric. Additional analysis (EWEB 1995) compared the model results to the new criterion. According to this study, the projected 7-day average daily maximum temperature in the lower end of the Walterville bypass reach during a hot, dry year (i.e.,1997, average August temperatures within the warmest 10% of a 30-year period of record) reached this criterion for a short period of time during August, but did not exceed the criterion. Mark Wade (ODFW) reports that most wild chinook salmon move through these reaches before August (pers. comm., June 18, 2001). Further, McCullough (1999) states that migration blockages generally become important to chinook salmon when water temperatures exceed 21° C (69.8° C). Because the conservative estimate of a maximum, short-term temperature exceedence at the lower end of either reach is less than 21° C, and because most wild UWR chinook salmon move through these reaches before August, the biological process of migration is unlikely to be affected by maximum water temperatures in the bypass reaches.

<u>Ramping rates below the Walterville tailrace and downstream from the diversions</u>: To prevent juvenile fish stranding, Article 414 requires EWEB to operate the Leaburg-Walterville Project to meet a seasonal set of ramping rate criteria in the river below the Walterville tailrace and downstream from the Leaburg and Walterville diversions (Table 6-3):

Table 6-3. Ramping rate criteria, adapted from Hunter (1992).

Season	**Daylight Hours[1] (inches/hour)**	**Night Hours (inches/hour)**
December 15 - May 15	no ramping	1
May 16 - August 31	1	2
September 1 - December 14	2	2

[1] Daylight hours begin 1 hour before sunrise and end 1 hour after sunset

Assuming that Walterville pond will be used in the future for power peaking (i.e., after the effects of fluctuating river levels in the McKenzie River downstream of the Walterville tailrace outfall are determined), EWEB states that operation of the pond will be governed by the ramping rate criteria included in the above schedule. Article 415 requires EWEB to develop and implement a plan for monitoring compliance with the ramping rate criteria.

NMFS' best quantitative estimates of mortality for UWR chinook salmon following construction of new screens, bypasses, fish ladder, and tailrace barriers, as well as the Leaburg Lake raise are shown in Table 6-4.

Table 6-4. NMFS' best quantitative estimates of mortality for UWR chinook salmon following construction of new screens, bypasses, fish ladder, and tailrace barriers, as well as the Leaburg Lake raise.

Location	Mortality Estimate	
	Juveniles	**Adults**
Leaburg Project:		
Leaburg Lake	Unquantifiable (Low)	0%
Leaburg Fish Screen and Bypass	fry: 4%[1] smolts: 1%[1]	0%
Leaburg Spillway Rollgates	fry: 2%[2] smolts: 2%[2]	Not applicable
Leaburg Fish Ladder	Unquantifiable (Very Low)	0%
Leaburg Tailrace	Not applicable	0%
Leaburg Bypass Section	Unquantifiable	0%
Walterville Project		
Walterville Fish Screen and Bypass	Fry: 0% to 1%[3] Smolts: 0% to 0.5%[3]	0%
Walterville Tailrace	Not applicable	0%
Walterville Bypass Section	Unquantifiable	0%

[1]Based on maximum reported mortality of current screen under clean conditions (ODFW 1996, cited in FERC 2001). Screen mortality and injury is expected to decrease below these levels with additional improvements to screen debris management systems.
[2]Fry mortality based on 200-600 cfs flow results and lack of passage effect on mortality at 1,000 cfs (EA 1990, cited in FERC 2001); smolt mortality estimated based on studies performed at other spillways of similar design. Upon evaluation, if mortality exceeds these levels, operational adjustments may be required.
[3]Fry and smolt mortality following screen construction is based on performance of juvenile fish screens constructed to NMFS' criteria, as described in Section 6.2.1.1.6.

6.2.1.2 Spawning

Two elements of FERC's proposed action could affect the quantity or distribution of spawning gravels used by chinook salmon, the Leaburg Lake raise and the construction of rock drop weirs associated with the Walterville diversion. The lake raise will inundate approximately 200 feet of riffle habitat at the upstream end of the current Leaburg Lake impoundment area. The rock drop weirs at the Walterville diversion (constructed of large boulders, approximately 6 feet in diameter or larger) are expected to trap smaller materials (including gravel within the size range used by chinook salmon for spawning) until the crevices fill up (i.e., within two years). Although the area at the head of Leaburg Lake is currently riffle habitat, FERC (2001) states that there is no indication that it is used by spring chinook salmon for spawning. To ensure that spawning gravels are not adversely affected by the rock drop weirs, Article 410 requires EWEB to monitor sediment accumulation at the diversion structures. The Services and ODFW will review the data and will make recommendations to EWEB regarding measures that will return the structures to proper function, including the passage of sediment to spawning sites in the lower river, if the monitoring studies indicated that such actions are needed.

Articles 412 and 413 require EWEB to develop and implement a gravel augmentation plan downstream of Leaburg Dam to enhance spawning habitat and to develop and implement a fish habitat enhancement plan, respectively. The gravel augmentation plan must include a map showing the location(s) of proposed gravel placements, a description of the 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 will describe survey procedures and gravel replenishment techniques. The fish habitat enhancement plan must identify and quantify fish habitat enhancement objectives, provide a detailed map of stream areas to be affected by any fish habitat enhancement measures, provide costs of implementation (including construction, operation, and maintenance or replacement costs), provide a program of fish population and fish habitat monitoring to evaluate success of the enhancement plan, and provide a contingency plan of alternative actions that can be taken if the enhancement program does not achieve its objectives of maintaining or enhancing wild fish populations in the McKenzie River. EWEB plans to develop these gravel and habitat enhancement programs in a manner that implements the MWC's Conservation Strategy (currently under development) (pers. comm., L. Power, EWEB, June 15, 2001).

The Services expect that the proposed action, including monitoring and correction (if needed) of the effect of the rock drop water diversion structures at the Walterville Project and the gravel and habitat enhancement measures, will improve spawning conditions for chinook salmon over those experienced under the environmental baseline.

6.2.1.3 Rearing

Riprap, usually placed on the outside of meander beds where bank erosion is likely to occur, prevents the formation of midchannel bars and islands. The existing Leaburg Project includes less than 1,000 feet of riprap on the left bank of the Leaburg Dam tailrace at RM 38.8 (Appendix A in EA 1991). This riprap will remain in place under the proposed action. The proposed action also includes construction of new rock structures to armor the banks at several points within the footprint of the Walterville Project: the three rock drop structures and the armored point and new barb/breakwater (adjacent to the boat launch) associated with the Walterville diversion and the new juvenile bypass outfall associated with the Walterville juvenile fish screen facility. The Leaburg bypass reach lies entirely within a confined section of the river (i.e., passing through a steep, narrow valley), which contains a marked scarcity of side channels. In comparison, the Walterville bypass reach lies in an unconfined section where the valley progressively widens and side channels are more prevalent. Any potential adverse effects on biological requirements for rearing due to developing and maintaining rock structures would therefore be more significant in the Walterville reach.

Article 411 requires EWEB to provide continuous minimum flows in both the Leaburg and Walterville bypass reaches of 1,000 cfs (section 3.1.2). During the relicensing process, concerns were raised that the 1,000 cfs flow would not provide side-channel rearing habitat. EWEB evaluated this concern with respect to channel morphology and wetted width information from the IFIM report (EWEB 1996a). The instream flow study demonstrated that the wetted width at several transects in the Walterville bypass reach under 1,000 cfs was sufficient to provide side-channel habitat for rearing (FERC 2001). Review of cross sectional profiles and velocity distribution histograms for three side channel transects and for two transects at McNutt Island showed that flows near 1,000 cfs would provide adequate depth and velocity for all sections of the river channel (FERC 2001). Optimal amounts of preferred rearing habitat for chinook salmon would be provided. Further, with a minimum flow of 1,000 cfs, water temperatures in the Leaburg and Walterville bypass reaches would not exceed the thermal threshold for chinook salmon rearing, based on published data on thermal tolerances (EWEB 1995).

Article 413 requires EWEB to develop and implement a fish habitat enhancement plan (section 3.1.2). The fish habitat enhancement plan will identify and quantify fish habitat enhancement objectives, including those pertinent to spawning habitat, provide a detailed map of stream areas to be affected by any fish habitat enhancement measures, provide costs of implementation (including construction, operation, and maintenance or replacement costs), provide a program of fish population and fish habitat monitoring to evaluate the success of the enhancement plan, and provide a contingency plan of alternative actions that can be taken if the enhancement program does not achieve its objectives of maintaining or enhancing wild fish populations in the McKenzie River. EWEB plans to develop the habitat enhancement program in a manner that implements the MWC's Conservation Strategy (currently under development).

6.2.1.4 Population Level Processes

In section 4.1.1.2, NMFS described the incremental change in average survival over the base period (1980 through 1998) needed to reduce the risk of extinction of the UWR chinook salmon population in the McKenzie River to 5% and to increase the median population growth rate (lambda) to >1.0. Of the two criterion, that specified as the acceptable risk of extinction (5%) is more difficult to meet; the needed incremental change in survival ranges from 9 to 65% (Table 4-3). During much of the base period (i.e., through 1996, when EWEB instituted the interim flow agreement), smolts entrained into the Walterville Canal and powerhouse experienced mortality rates up to 14.5%. After EWEB screens Walterville Canal, NMFS expects the residual mortality to range from 0 to 0.5%. If all smolts passing through the Walterville reach entered the canal, using the more conservative assumption that mortality after screen installation would be 0.5%, the incremental change in survival would be approximately 16.4%:

$$\frac{Surv_{proposed\ action}}{Surv_{environ.\ baseline}} = \frac{(1-0.005)}{(1-0.145)} = 1.164 \ or\ 16.4\%$$

However, all of the smolts that passed through the Walterville reach were not entrained into the canal and powerhouse, even before the 1996 flow agreement. Making the conservative assumption that, during most of the base period, 50% of total flow was diverted into the canal during the smolt migration, NMFS' best estimate of the incremental increase in survival for the population is approximately 8.2%.

NMFS assumes that additional, unquantifiable, improvements in survival will accrue from the modifications to the Leaburg screen cleaning and juvenile bypass systems specified in Article 416. These improvements are more difficult to quantify because estimates of smolt mortality vary with the type and degree of screen or bypass occlusion at the Leaburg development (section 6.2.1.1.1) and there is no way to estimate the proportion of the outmigration that was exposed to a bypass partially plugged with debris, for example, during the 1980 through 1998 base period. Additional incremental improvements are also expected when EWEB constructs tailrace barriers at each project (Article 416), to reduce the attraction and delay of adult chinook salmon, from the reconstruction of the right bank fish ladder and modification of the left bank fish ladder at Leaburg Dam, and from the gravel and spawning and rearing habitat enhancement programs that EWEB will develop in a manner that implements the MWC's Conservation Strategy (section 6.2.1.1.9). Although these survival improvements cannot be quantified, NMFS expects that the total incremental improvement from the proposed action will be greater than 8% which, combined with an estimated 37% survival improvement from the selective harvest measure described in section 5.3.1.4, will provide a survival improvement within the range needed to meet NMFS' survival and recovery criteria.

Life history diversity is a population level process that the Services define, for the purposes of this biological opinion, as intra-population variation in the timing or location of one or more life history stages. For UWR chinook salmon, life history diversity is expressed through spawning in different stream reaches within a subbasin or during different weeks or months. Under the environmental baseline, life history diversity has been limited by the influence of hatchery fish, by physical barriers that prevent migration to historical spawning or rearing areas, and by water temperature barriers that influence the timing of emergence, juvenile growth rates, or the timing of upstream or downstream migration. The tailrace barriers that EWEB will construct at the Leaburg-Walterville Project are expected to reduce the delay of upstream migrants compared to conditions under the environmental baseline. Temperature conditions in the bypass reaches are not expected to exceed thermal tolerances for any chinook salmon life-history stage (EWEB 1995). The Services believe that EWEB's proposed action does not contain measures that are likely to adversely affect the life-history diversity of the ESU compared to conditions under the environmental baseline.

6.2.1.5 Food Web Dynamics

Recent studies for the McKenzie River Watershed Council (Aquatic Biology Associates 2000) indicate good abundance and diversity for key aquatic insect families in the action area. The proposed action, which includes development and implementation of the Watershed Council's Conservation Strategy, does not contain measures that are likely to adversely affect food web dynamics or the abundance and diversity of this key food resource.

The proposed action is not expected to adversely affect predation on UWR chinook salmon in the action area because: (1) the Leaburg-Walterville Project impounds very little water and therefore does not alter habitat such that the establishment of aquatic predators (i.e., native or exotic fishes) would be favored and (2) the project does not alter stream temperatures such that the establishment of aquatic predators would be favored.

6.2.2 Columbia River Bull Trout

The effects of the proposed action on migration, spawning, rearing, and population level processes are described below for CR bull trout in the McKenzie subbasin. General life history for CR bull trout is described in section 4.1.2 and the environmental baseline of CR bull trout biological processes is described in section 5.3. Food web dynamics as related to CR bull trout in the McKenzie subbasin are described in section 6.2.2.5.

6.2.2.1 Migration

The environmental baseline of migration for CR bull trout in the McKenzie subbasin is described in section 5.3. Migration is critically important to the persistence and interaction of local bull trout subpopulations within a larger population. Gene flow, refounding of locally extirpated populations, and support of locally weak populations require open migration corridors among populations (Rieman and McIntyre 1997; Dunham and Rieman 1999). This is particularly relevant in the case of fluvial and adfluvial bull trout which depend on a diverse array of habitats during different life history stages. Effects to CR bull trout migration from FERC's proposed action include: (1) direct effects resulting in harassment, injury or mortality from physical blockages and/or impediments due to inadequate fish passage facilities at Leaburg-Walterville; (2) direct effects resulting in migration delay, injury or mortality to bull trout entrained into diversion canals, turbine intakes or tailraces; and, (3) indirect effects to migration from the alteration of habitat processes such as reduced water quality and flow in the bypass reaches from the operation of the Leaburg-Walterville Project.

The Leaburg-Walterville Project, along with EWEB's Carmen-Smith Project and USACE's Cougar and Blue River facilities, have significantly reduced the ability of bull trout of all life stages to migrate freely and safely to critically important habitats within the McKenzie subbasin. FERC's proposed action at Leaburg-Walterville includes a number of construction activities that will address longstanding problems with fish migration within and past the project. It is expected that when these construction projects are complete, future adverse effects to migration will be reduced, though not eliminated. Although we expect the biological process of migration to improve under the proposed action, continued adverse effects are probable, especially in the interim before the Walterville screen and new tailrace barriers are constructed. Conservation measures included in the proposed action that are targeted for UWR chinook will also benefit CR bull trout migration. These conservation measures and their potential effects to bull trout, together with the components of the proposed action that effect bull trout migration, are summarized below.

As discussed in the environmental baseline (section 5.3 above) bull trout are relatively uncommon in the lower McKenzie below Leaburg Dam. The extent to which the Leaburg-Walterville Project has influenced bull trout distribution and abundance in this section of the McKenzie is largely unknown, though reduced flows in downstream bypass reaches, especially prior to the implementation of the 1,000 cfs minimum flow and the unscreened Walterville Diversion Canal, have likely had adverse effects.

Effects to bull trout from the proposed action at Leaburg-Walterville are similar to those discussed in section 5.2 of the BA (FERC 2001) and in section 6.2.1 above for UWR chinook. As noted in the BA, the primary difference between the two species is in the distribution and abundance at different life stages. Unlike chinook, bull trout are relatively uncommon downstream from Leaburg Dam and those that are present are typically sub-adults or adults. The proposed action at Leaburg-Walterville includes the Leaburg Lake raise, modifications to EWEB's Leaburg Dam fish ladders, the construction of the Leaburg tailrace barrier, construction of a fish screen at the Walterville Diversion, and a modification of the Walterville tailrace barrier. All of these actions will affect, and in most cases improve, migration conditions for bull trout. Although the BA (FERC 2001) did not suggest conservation measures specific for bull trout at the Leaburg-Walterville Project, the proposed measures for UWR chinook, along with the components of the proposed action described above, are expected to lessen adverse effects to bull trout migration. Components of the proposed action that will affect bull trout migration are summarized below and a discussion of effects follows.

Leaburg Lake Raise

The proposed action includes an increase in the elevation of Leaburg Lake by a maximum of 1.5 feet. Raising the lake level will require modifications to the dam and modifications to the adult fish ladder exit to ensure continued passage efficiency. As a result of the lake raise, water velocities under the rollgates will increase by about 5%, pressure changes under the rollgates will increase, approximately 200 feet of stream habitat at the upper end of Leaburg Lake will be inundated, and approach velocities at the Leaburg Canal fish screen will slightly increase.
The proposed action requires EWEB, in consultation with the resource agencies, to develop several study plans to evaluate juvenile fish mortality at the Leaburg fish screen associated with the lake raise and rollgate mortality for fish at current and new Leaburg Lake elevations.

Effects to bull trout from the lake raise described above will likely be negligible since most of the potential threats would be felt by fish of a smaller size (fry and age one chinook) than the sub-adult and adult bull trout that have been observed in this section of the McKenzie. Although bull trout are known to utilize Leaburg Lake for overwintering, there are not expected to be adverse affects from the 1.5 foot increase in the lake elevation. Sub-adult and adult bull trout should be able to exhibit a high level of avoidance of currents flowing beneath the rollgates in favor of migration downstream through the fishways or through the fish screen bypass system.

Leaburg Dam Fish Ladder Modification

The proposed action requires EWEB to modify the left-bank fish ladder and reconstruct the right-bank ladder at Leaburg Dam. The left-bank fish ladder is the only one currently operable, but, under the environmental baseline, its effectiveness has been limited by the following problems.

- The left-bank ladder entrance gate is not adjustable, resulting in head differentials at the fishway entrance that vary from nearly zero at high river flows to about four feet at low river flows
- The ladder lacks staff gages to allow accurate monitoring of the operation of the fish ladder entrance
- The lower part of the fish ladder can be overtopped by moderately high river flows
- The auxiliary water control gate is difficult to operate and cannot be easily adjusted

Further, if the lake is raised and additional fishway pools are not provided, the fish ladder will draw excessive flow from the forebay, providing poor passage conditions.

Article 416 requires EWEB to modify, operate, and maintain the Leaburg left bank fish ladder in accordance with Technical Specifications and Drawings, developed in consultation with and approved by the Services, that will minimize adverse effects to fish (section 3.1.2). For example, the facilities plan for the modification, operation, and maintenance of the upper ladder weirs will meet the objective of maintaining ladder flow and hydraulic drop per pool consistent with conditions in existence before the lake raise. These measures are expected to protect adult salmon and bull trout from injury, mortality, and/or delay.

The right-bank ladder has been inoperable for years and may contribute to a migration delay to bull trout attempting to migrate past the facility. The proposed action calls for the right-bank ladder to be redesigned and rebuilt according to criteria already agreed to during the relicensing between EWEB and the Services. The proposed action requires EWEB, in consultation with the resource agencies, to test the effectiveness of the new ladders during the initial period of operation. The modifications to the fish ladders at Leaburg Dam, when completed, are expected to reduce adverse effects to bull trout by improving migration conditions upstream and downstream past the facility. Although improved migration conditions are expected under the proposed action, adverse effects, in the form of migration delay, especially in the interim period before construction is complete, are probable for the length of the proposed action, since all dams pose adverse affects to the migration of fish.

<u>Leaburg Tailrace Barrier Construction</u>

The proposed action requires EWEB to construct a barrier at the downstream end of the Leaburg tailrace. The objective of the barrier is to deter adult chinook from entering the tailrace and thus delaying upstream migration. The facility is in the preliminary design phase and final design will be subject to approval by the Services. Radio-tagging studies and timing of bull trout passing Leaburg Dam indicate that adult CR bull trout are typically migrating upstream in the lower McKenzie at the same time as UWR chinook and thus it is expected that the operation of the weir from May through October would reduce migration delay for both species (FERC 2001). The proposed action includes measures to minimize the adverse effects to CR bull trout and UWR chinook from the construction and operation of the tailrace barrier (see 6.2.1.1.3 above). In summary, when completed, the tailrace barrier will lessen the probability of migration delay for CR bull trout. However, adverse effects to migration are still expected for the term of the proposed action, especially in the interim period prior to completion of the new tailrace barrier.

<u>Walterville Fish Screen Construction</u>

Much detail on the proposed Walterville fish screen construction is provided above in section 6.2.1.1.4 (UWR chinook) and will not be repeated below. The following summarizes that information and discusses potential effects to bull trout from the Walterville fish screen component of the proposed action.

The Walterville Diversion is unscreened and diverts up to two-thirds of the McKenzie River during part of the year into the Walterville Canal and through the Walterville Powerhouse. Although numbers of CR bull trout that inhabit the lower McKenzie are currently low, those that do are subject to entrainment into the Walterville Diversion Canal and potential death or injury from passing through the Walterville Powerhouse. The proposed action requires EWEB to construct a fish screen at the canal intake approximately one-third of a mile downstream from the canal entrance. In addition to the fish screen, the proposed action includes the construction of rock drop water diversion structures that will ensure efficient capture of river water and screen operation. The proposed action calls for the screen to be designed and built according to criteria already agreed to during the relicensing between EWEB and the Services. During the construction of the fish screen and the rock drop water diversion structures, EWEB will be required to implement a number of protective actions to reduce potential risk to UWR chinook and CR bull trout, as outlined in 6.2.1.1.4 above. Similarly, EWEB is required to test the hydraulic and biological effectiveness of the fish screen, with the evaluation plans developed in coordination with, and subject to, approval of the fisheries agencies.

The construction of the Walterville fish screen, when completed, is expected to significantly reduce adverse effects to CR bull trout from entrainment into the power canal. However, the construction and operation of the Walterville fish screen and rock drop water diversion structures may result in harassment, injury or mortality of CR bull trout due to contact with the screen or bypass system, or through construction related activity in the river channel. The protective measures built into the proposed action, and outlined above in 6.2.1.1.4, are expected to reduce potential adverse effects during construction in the short term and during the future operation of the Walterville screen. In the interim period prior to the construction of the fish screen, CR bull trout will continue to be at high risk of injury or mortality from passing through the Walterville Powerhouse, or be subject to harassment from migration delay caused by entrainment into the Walterville Canal.

Walterville Tailrace Barrier Modification

The proposed action requires EWEB to modify the existing tailrace barrier at the downstream end of the Walterville tailrace and to improve the entrance and attraction flows to the bypass channel that returns fish to the mainstem McKenzie. The objective of the tailrace barrier is to deter adult chinook and bull trout from entering the tailrace and thus prevent delay of upstream migration. The new tailrace barrier will be constructed of concrete (rather than the picket weir system currently in place) and will function as a velocity barrier. The proposed action includes measures to minimize the adverse effects to bull trout and UWR chinook from the construction and operation of the tailrace barrier (see 6.2.1.1.5 above). In summary, when completed, the tailrace barrier will lessen the probability of migration delay for CR bull trout. However, adverse effects to migration are still expected for the term of the proposed action, especially in the interim period prior to completion of the new tailrace barrier.

Leaburg-Walterville Habitat Enhancement Measures

The only habitat enhancement measure in the BA (FERC 2001) that is pertinent to bull trout is the provision to provide minimum flows of 1,000 cfs in both project bypass reaches. The BA states that the 1,000 cfs minimum bypass reach flows will protect bull trout habitat quantity and quality in the Leaburg-Walterville action area based on information collected from an IFIM study using rainbow trout simulations (FERC 2001, section 5.3.1.5). Although rainbow trout and bull trout are both native to the McKenzie subbasin, habitat preferences and biological requirements are species specific. As a result, calculating habitat quality and quantity for CR bull trout by utilizing rainbow trout habitat parameters is not a suitable method for determining the effects of the 1,000 cfs minimum flows in the Leaburg-Walterville bypass reaches on CR bull trout habitat.
We suspect that the decrease in available habitat due to the reduced flows in the bypass reaches, and the increase in water temperature in the bypass reaches during hot, dry summers, may negatively affect bull trout migration through the bypass reaches (see section 6.2.1.1.9 for additional discussion). However, there are currently a limited number of bull trout that seasonally inhabit the McKenzie River below Leaburg Dam, and information suggest most adult bull trout in the mainstem McKenzie River migrate to areas upstream of Leaburg Dam in spring and early summer. The resulting adverse effects are thus not expected to impact a large percentage of the mainstem McKenzie bull trout subpopulation.

The BA also proposed several conservation measures, one of which may reduce potential adverse effects to bull trout from migration delay. EWEB proposed to continue, until the Leaburg tailrace barrier is constructed, the interim measure of periodic shutdowns (usually overnight) of the Leaburg powerhouse to move UWR chinook, and thus any adult and sub-adult bull trout present, out of the tailrace and back to the river, hence avoiding prolonged migration delay.

6.2.2.2 Spawning

As discussed in the environmental baseline section 5.3, known bull trout spawning in the McKenzie subbasin occurs in only five streams: Roaring River above Cougar Dam in the South Fork McKenzie; Anderson Creek and Ollalie Creek in the upper McKenzie below Trail Bridge Dam; and Sweetwater Creek and the upper McKenzie above Trail Bridge Dam. EWEB's Leaburg-Walterville Project is not in the vicinity of bull trout spawning streams, nor do they directly effect bull trout spawning. Indirect effects to spawning from migration delay or entrainment at the Leaburg-Walterville Project were addressed in the migration section 6.2.2.1 above.

6.2.2.3 Rearing

The Leaburg-Walterville Project may adversely affect bull trout rearing by diverting all but 1,000 cfs out of a total of 13.1 miles of the lower mainstem McKenzie (Leaburg and Walterville bypass reaches). As discussed above in sections 6.2.2.1 and 6.2.1.3, the 1,000 cfs left in the bypass reaches may, in dry years, result in water temperature increases of up to 1.5 ºC and 2.0 ºC in the respective bypass reaches (EA 1994a, cited in FERC 2001). The flow studies discussed in section 5.3.1.5 of the BA (FERC 2001) determined that 1,000 cfs provided in the bypass reaches would maximize (98% optimal) trout habitat based on modeling for rainbow trout, a species with very different habitat preferences and requirements than bull trout. It is expected that the 1,000 cfs provided in the bypass reaches, exacerbated by increased water temperatures in dry years, may negatively effect bull trout rearing in the bypass reaches.

6.2.2.4 Population Level Processes

The McKenzie bull trout population represents the only viable population left in the Willamette Basin, and the only population remaining west of the Cascade Mountains in Oregon. Of the McKenzie's three subpopulations of bull trout, only the mainstem McKenzie River subpopulation is not considered at high risk of extinction (Buchanan et al. 1997). Redd surveys, juvenile studies and standard pool counts all indicate the mainstem McKenzie River subpopulation appears to be stable or slowly increasing (see Table 5-3 in section 5.3). By all indications, the two remaining subpopulations above Trail Bridge Reservoir and Cougar Reservoir on the South Fork McKenzie, remain depressed and are at risk of extirpation. Continued lack of upstream passage at Cougar Dam (USACE project) and Trail Bridge Dam will ensure that emigration through entrainment into the turbine works or regulating outlets depletes or may eventually deplete the existing bull trout subpopulations, thus affecting the overall population size and life history diversity of CR bull trout in the Willamette Basin.

The McKenzie subbasin population of bull trout was historically part of a larger metapopulation which most likely consisted of many local populations throughout the Willamette River Basin (refer to section 4.1.3.1). The extinctions of bull trout in subbasins throughout the rest of the Willamette Basin (North and South Santiam subbasins, Middle Fork Willamette subbasin, and the Clackamas subbasin) increases the risk of extinction for bull trout in the McKenzie. An isolated population has little chance of being refounded after a local extinction compared to a subpopulation close to other subpopulations (Rieman and McIntyre 1993, Rieman et al. 1997). This is particularly relevant to small populations isolated above man made migration barriers. As populations become isolated, local extinctions become permanent and the entire metapopulation moves incrementally toward extinction (Rieman and McIntyre 1993).

The Leaburg-Walterville Project has the potential to adversely affect population size and life history diversity by reducing rearing potential in the bypass reaches and by potentially delaying migration at tailrace barriers and fishways. In the interim time period until the Walterville fish screens are built, bull trout will continue to be at high risk of injury or death by entrainment into the Walterville Canal and turbine, thereby compromising the potential population size and life history diversity of CR bull trout in the McKenzie subbasin.

6.2.2.5 Food Web Dynamics

It is not expected that EWEB's Leaburg-Walterville Project significantly alters food web dynamics to the detriment of CR bull trout in the mainstem McKenzie because: (1) the projects impound very little water thus do not alter habitat in such a way that would favor the establishment of exotics; (2) the projects do not alter stream temperatures to the degree that would favor the establishment of exotics; and, (3) most CR bull trout migrating past the Leaburg dam and screening system, and the Walterville (unscreened) facilities, are adults or subadults and thus would not likely be subject to prey due to disorientation and stress.

6.3 Critical Habitat

Critical habitat for UWR chinook salmon was designated on February 16, 2000 (65 FR 7764). Within the McKenzie subbasin, critical habitat includes all accessible areas except those above Tamolitch Falls and Blue River Dam. The effects of the proposed action on the essential features of designated critical habitat are summarized below. Critical habitat has not been proposed or designated for CR bull trout, thus none is affected.

6.3.1 Upper Willamette River Chinook Salmon

The 10 essential features of UWR chinook salmon critical habitat are: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions. These essential features are related to the habitat and biological processes previously described in this biological opinion (Table 6-5). For example, the effects of the proposed action on the essential feature of substrate are described in sections on Disturbance, Flow regime, Sediment and LW function, and Riparian vegetation and floodplain function. Effects on essential features of spawning and rearing habitat are described in the effects on the biological processes of Spawning and Rearing. A summary of the effects of the proposed action on each essential feature of UWR chinook salmon and critical habitat is provided in section 6.5.3.

Table 6-5. Relationship of essential features of critical habitat (CH) for UWR chinook salmon to the habitat and biological processes described in sections 6.		
Essential Features of CH	Habitat Processes	Biological Processes
Substrate	Disturbance (6.1.1), Flow regime (6.1.2), Sediment and LW function (6.1.3), Riparian vegetation and floodplain function (6.1.4)	Spawning (6.2.1.2), Rearing (6.2.1.3)
Water quality	Water quality (6.1.5), Riparian vegetation and floodplain function (6.1.4)	Migration (6.2.1.1), Spawning (6.2.1.2), Rearing (6.2.1.3)
Water quantity	Disturbance (6.1.1), Flow regime (6.1.2)	Migration (6.2.1.1), Spawning (6.2.1.2), Rearing (6.2.1.3)
Water temperature	Water quality (6.1.5), Riparian vegetation and floodplain function (6.1.4)	Migration (6.2.1.1), Spawning (6.2.1.2), Rearing (6.2.1.3)
Water velocity	Disturbance (6.1.1), Flow regime (6.1.2)	Migration (6.2.1.1), Spawning (6.2.1.2), Rearing (6.2.1.3)
Cover/shelter	Sediment and LW function (6.1.3), Riparian vegetation and floodplain function (6.1.4)	Migration (6.2.1.1), Rearing (6.2.1.3)
Food	Sediment and LW function, (6.1.3) Riparian vegetation and floodplain function (6.1.4), Water quality (6.1.5)	Migration (6.2.1.1), Rearing (6.2.1.3), Food web dynamics (6.2.1.5)
Riparian vegetation	Riparian vegetation and floodplain function (6.1.4)	Migration (6.2.1.1), Rearing (6.2.1.3)
Space	Flow regime (6.1.2), Sediment and LW function (6.1.3), Riparian vegetation and floodplain function (6.1.4)	Migration (6.2.1.1), Spawning (6.2.1.2), Rearing (6.2.1.3)
Safe passage conditions	Flow regime (6.1.2)	Migration (6.2.1.1)

6.4 Effects of Interrelated and Interdependent Activities

Effects of the proposed action include the effects of other activities that are interrelated to, or interdependent with, that action. Interrelated and interdependent activities are those that would not be undertaken by the action agency but for the proposed action. The Services are not aware of any interrelated and interdependent activities associated with the proposed action.

6.5 Summary of the Effects of the Proposed Action

The effects of the proposed action are described above and summarized below in sections 6.5.1 and 6.5.2 in terms of habitat processes (disturbance, flow regime, sediment and LW function, riparian vegetation and floodplain function, and water quality) and biological processes (migration, spawning, rearing, population level processes, and food web dynamics) within the action area (the McKenzie subbasin). Section 6.5.3 summarizes the likely effects of the proposed action on UWR chinook salmon critical habitat.

6.5.1 Effects on Habitat Processes

The effects of the proposed action on habitat processes within the McKenzie subbasin is summarized in Table 6-6 below. Detailed descriptions of the effects of the proposed action on habitat processes are found in section 6.1 above.

Table 6-6. Summary of effects of the proposed action on the habitat processes considered in this opinion.

Habitat Processes	Summary of Effects
Disturbance	The Leaburg-Walterville Project is operated in run-of-river mode such that inflow equals outflow on a daily basis. It is expected that the proposed action will have no effect, or at most, very small-scale effects on the process of disturbance in the McKenzie subbasin.
Flow Regime	Effects are limited to reductions in flow quantity in a small proportion of stream miles in the subbasin, and annual patterns of flow timing are not affected. The seasonal flow patterns would be similar in the bypass and non-bypass reaches, but the quantity of average daily flow would be reduced by approximately 30% in the winter and up to 70% in the summer in the bypass reaches.
Sediment and Large Wood Function	The majority of LW and sediment is passed by Leaburg Dam and the proposed construction of the proposed rock drop diversion structure at Walterville is designed to also pass LW and sediment. As a result, the Services do not expect any adverse effects on the habitat process of sediment and LW function under the proposed action.
Riparian Vegetation and Floodplain Function	The proposed action does not contain elements such as levees and revetments that will degrade riparian vegetation or floodplain function compared to conditions experienced under the environmental baseline.
Water Quality	Potential elevated water temperature (up to 1.5 degrees C and 2 degrees C) in the lower ends of the Leaburg and Walterville bypass reaches respectively in August in a hot, dry year like 1972.

6.5.2 Effects on Biological Processes

The effects of the proposed action on biological processes within the McKenzie subbasin are summarized in Table 6-7 (UWR chinook salmon) and 6-8 (bull trout) below. Detailed descriptions of the effects of the proposed action on the biological processes are found in section 6.2 above.

Table 6-7. Summary of effects of the proposed action on biological processes for UWR chinook salmon considered in this opinion.	
Biological Processes	Summary of Effects
Migration	• Ongoing mortality of 4 to 25% for chinook salmon fry through the Leaburg fish screen facility when debris is on the screen or in the apex will be reduced to a consistent 2 to 4% by system modifications and revised maintenance procedures. • Ongoing mortality of up to 14.5% is expected for chinook salmon entrained into Walterville Canal and powerhouse (estimated from a 1982 study with 2,300 cfs, 64% of total flow, through the Walterville Canal before EWEB instituted the 1996 interim flow agreement, Table 6-2) until the diversion screen and bypass system are constructed and operational. Turbine mortality will be eliminated because the bypass system is designed to return all juveniles to the river. Residual mortality in the bypass system is expected to range from 0 to 1% for fry. • Delay of adult chinook salmon in the Leaburg and Walterville tailraces is expected to continue until the tailrace barriers are completed. Upon completion, the possibility of injury or mortality of adults attracted into turbine tubes will be eliminated and migration delay is expected to be greatly reduced.
Spawning	Potential adverse effects of the Leaburg Lake raise and/or the construction of rock drop weirs associated with the Walterville diversion on the quantity or distribution of spawning gravels used by chinook salmon are expected to be corrected by the proposed gravel augmentation and habitat enhancement programs.
Rearing	New rock structures will be constructed at several points within the footprint of the Walterville Project to anchor fish protection facilities to the banks and bed. Optimal amounts of chinook rearing habitat are expected to be available with minimum flows in the bypass reaches of 1,000 cfs and resulting water temperatures are not likely to exceed thermal tolerances for this life-history stage.
Population Level Processes	Any existing adverse effects on life history diversity due to delay of adults at the Leaburg and Walterville tailraces will be reduced by construction of the tailrace barriers and construction/modification of the Leaburg fish ladders. The proposed action does not contain measures that are likely to adversely affect life history diversity compared to conditions under the environmental baseline.
Food Web Dynamics	Recent studies for the McKenzie River Watershed Council indicate good abundance and diversity for key aquatic insect families in the action area. The proposed action, which includes development and implementation of the Watershed Council's Conservation Strategy, does not contain measures that are likely to adversely affect food web dynamics or the abundance and diversity of this key food resource. The proposed action is not expected to adversely affect predation on UWR chinook salmon in the action area.

Table 6-8. Summary of effects of the proposed action on biological processes for CR bull trout considered in this opinion.

Biological Processes	Summary of Effects
Migration	Minor adverse effects to adults at the Leaburg-Walterville Project from physical barriers and/or impediments to passage, and on juveniles from entrainment and impediments to passage. Effects at Leaburg-Walterville will be most pronounced in the interim period prior to the completion of proposed fish passage facilities, but will continue to a lesser degree after they are operational. Minor continuing adverse effects to adults and sub-adults during dry years due to water temperature warming and reduced flows in the Leaburg and Walterville bypass reaches.
Spawning	Minor continuing adverse effects at the Leaburg-Walterville Project from potential delay at dams and tailraces during spawning migrations. The Leaburg-Walterville Project is not in the vicinity of bull trout spawning streams, nor do they directly affect bull trout spawning.
Rearing	Minor continuing adverse effects to adults and sub-adults during dry years due to water temperature warming and reduced flows in the Leaburg and Walterville bypass reaches.
Population Size and Life History Diversity	Minor continuing adverse effects to population size from the combined adverse effects to migration, spawning and rearing. Insignificant effects to life history diversity.
Food Web Dynamics	Recent studies for the McKenzie River Watershed Council indicate good abundance and diversity for key aquatic insect families in the action area. The proposed action, which includes development and implementation of the Watershed Council's Conservation Strategy, does not contain measures that are likely to adversely affect food web dynamics or the abundance and diversity of key food resources.

6.5.3 Effects on UWR Chinook Salmon Critical Habitat

The effects of the proposed action on the essential features of critical habitat designated for UWR chinook salmon are summarized in Table 6-9.

Table 6-9. Summary of effects of the proposed action on essential features of UWR chinook salmon critical habitat.

CH Essential Features	Summary of effects
Substrate	No adverse effects on biological requirements for spawning gravel (size or distribution) are expected under the proposed action (section 6.1.3).
Water quality	The proposed action does not include measures that would be likely to adversely affect biological requirements for water quality or nutrient availability (section 6.1.5)
Water quantity	The proposed action does not include measures that will adversely affect biological requirements for water quantity (sections 6.1.1 and 6.1.2).
Water velocity	The proposed action does not include measures that will adversely affect biological requirements for water velocity (sections 6.1.1 and 6.1.2)
Cover/shelter	The proposed action does not include measures that will adversely affect biological requirements for cover or shelter (sections 6.1.3 and 6.1.4)
Food	The proposed action does not include measures that will adversely affect food web dynamics (section 6.2.1.5) or biological requirements for food.
Riparian vegetation	The proposed action does not include measures that will adversely affect riparian vegetation (section 6.1.4).
Space	The proposed action does not include measures that will adversely affect biological requirements for space (section 6.1.2)
Safe passage conditions	Injury and mortality of juvenile and adult migrants and delay of adults will be greatly reduced under the proposed action (section 6.2.1.1).

7. Cumulative Effects

Cumulative effects, as defined in 50 CFR Section 402.02, include the effects of future state, Tribal, local, or private actions, not involving Federal activities, that are reasonably certain to occur within the action area (described in Section 1). Future Federal actions requiring separate consultations pursuant to Section 7 of the ESA are not considered here.

State, Tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives. Government and private actions may include changes in land and water use patterns, including ownership and intensity, any of which could affect listed species or their habitat. Even actions that are already authorized are subject to political, legislative, and fiscal uncertainties. These realities, added to the geographic scope of the action area, which encompasses numerous government entities exercising various authorities and many private landholdings, make any analysis of cumulative effects difficult and even speculative. This section identifies representative actions that, based on currently available information, are reasonably certain to occur. It also identifies goals, objectives and proposed plans by state and Tribal governments, however, NMFS is unable to determine at this point in time whether such proposals will in fact result in specific actions.

7.1 State Actions

Most future actions by the state of Oregon are described in the Oregon Plan for Salmon and Watershed measures, which includes the following programs designed to benefit salmon and watershed health:

- Oregon Department of Agriculture water quality management plans
- Oregon Department of Environmental Quality development of total maximum daily loads (TMDLs) in targeted basins; implementation of water quality standards
- Oregon Watershed Enhancement Board funding programs for watershed enhancement programs, and land and water acquisitions
- ODFW and Oregon Water Resources Department (OWRD) programs to enhance flow restoration
- OWRD programs to diminish overappropriation of water sources
- ODFW and Oregon Department of Transportation programs to improve fish passage; culvert improvements/replacements

- Oregon Department of Forestry state forest habitat improvement policies and the Board of Forestry pending rules addressing forestry effects on water quality and riparian areas
- Oregon Division of State Lands and Oregon Parks Department programs to improve habitat health on state-owned lands
- Department of Geology and Mineral Industries program to reduce sediment runoff from mine sites

- State agencies funding local and private habitat initiatives; technical assistance for establishing riparian corridors; and TMDLs

If the foregoing programs are implemented, they may improve habitat features considered important for the listed species. In November 2000, however, Oregon voters approved a broad constitutional amendment requiring payment to private property owners for diminution in property values resulting from regulations. That measure essentially puts all Oregon regulatory initiatives into question. The Oregon Plan also identifies private and public cooperative programs for improving the environment for listed species. The success and effects of such programs will depend on the continued interest and cooperation of the parties. One such cooperative program, the Willamette Restoration Initiative (WRI), has been charged with developing the Willamette basin section of the Oregon Plan. The future of the WRI will be subject to discussion among the WRI board, the Oregon Governor's office, and the Oregon legislature in the 2001 legislative session.

In the past, Oregon's economy has depended on natural resources, with intense resource extraction. Changes in the state's economy have occurred in the last decade and are likely to continue, with less large-scale resource extraction, more targeted extraction, and significant growth in other economic sectors. Growth in new businesses, primarily in the technology sector, is creating urbanization pressures and increased demands for buildable land, electricity, water supplies, waste-disposal sites, and other infrastructure.

Economic diversification has contributed to population growth and movement in the Willamette Valley, a trend likely to continue for the next few decades. Such population trends will result in greater overall and localized demands for electricity, water, and buildable land in the action area; will affect water quality directly and indirectly; and will increase the need for transportation, communication, and other infrastructure. The impacts associated with these economic and population demands will probably affect habitat features such as water quality and quantity, which are important to the survival and recovery of the listed species. The overall effect will be negative, unless carefully planned for and mitigated.

Some of the state programs described above are designed to address these impacts. Oregon also has a statewide, land-use-planning program that sets goals for growth management and natural resource protection. If the programs continue, they may help lessen the potential for the adverse effects discussed above.

7.2 Local Actions

Local governments will be faced with similar and more direct pressures from population growth and movement. There will be demands for intensified development in rural areas, as well as increased demands for water, municipal infrastructure, and other resources. The reaction of local governments to growth and population pressure is difficult to assess without certainty in policy and funding. In the past, local governments in Oregon generally accommodated growth in ways that adversely affected listed fish habitat. Because there is little consistency among local governments regarding current ways of dealing with land use and environmental issues, both positive and negative effects on listed species and their habitat are probably scattered throughout the action area.

Local governments in Oregon are considering ordinances to address effects on aquatic and fish habitat from different land uses. The programs are part of state planning structures; however, local governments are likely to be cautious about implementing new programs, because of the passage of the constitutional amendment discussed above. Some local government programs, if submitted, may qualify for a limit under NMFS' 4(d) rule, which is designed to conserve listed species. Local governments may also participate in regional watershed health programs, although political will and funding will determine participation and, therefore, the effect of such actions on listed species. Overall, unless beneficial programs are comprehensive, cohesive, and sustained in their application, it is not likely that local actions will have measurable positive effects on listed species and their habitat and may even contribute to further degradation.

7.3 Tribal Actions

Tribal governments will participate in cooperative efforts involving watershed and basin planning designed to improve aquatic and fish habitat. The results of changes in Tribal forest and agricultural practices, in water resource allocation, and in land use are difficult to assess, for the reasons discussed in Sections 7.1 and 7.2. The earlier discussion of the effects of economic diversification and growth applies also to Tribal government actions. The Tribal governments have to apply and sustain comprehensive and beneficial natural resource programs such as the ones described below, to areas under their jurisdiction to have measurable positive effects on listed species and their habitat.

The Services know of no ongoing Tribal fisheries restoration project in the McKenzie River basin.

7.4 Private Actions

The effects of private actions are the most uncertain. Private landowners may convert their lands from current uses, or they may intensify or diminish those uses. Individual landowners may voluntarily initiate actions to improve environmental conditions, or they may abandon or resist any improvement efforts. Their actions may be compelled by new laws, or they may result from growth and economic pressures. Changes in ownership patterns will have unknown impacts. Whether any of these private actions will occur is highly unpredictable, and the effects are even more so.

7.5 Summary

Non-Federal actions are likely to continue affecting listed species. The cumulative effects in the action area are difficult to analyze, considering the broad geographic landscape covered by this opinion, the geographic and political variation in the action area, the uncertainties associated with government and private actions, and ongoing changes to the region's economy. Whether those effects will increase or decrease in the future is a matter of speculation; however, based on the population and growth trends identified in this section, cumulative effects are likely to increase. Although state, Tribal, and local governments have developed plans and initiatives to benefit listed fish, they must be applied and sustained in a comprehensive manner before the Services can consider them "reasonably foreseeable" in the analysis of cumulative effects.

8. Conclusions

In this opinion, the Services must determine whether the action is likely to jeopardize each listed species, as well as whether the action is likely to destroy or adversely modify critical habitat (CH) of species for which it has been designated. As indicated in Table 2-1, this opinion considers effects of the action on UWR chinook salmon and CR bull trout; critical habitat has been designated for the chinook salmon ESU. As noted in Chapter 1, the analyses of jeopardy/destruction or adverse modification of critical habitat leading to these conclusions involves the following steps: (1) define the biological requirements and current status of the listed species (Chapter 4); (2) describe the environmental baseline within the action area (Chapter 5); (3) evaluate the effects of the proposed action on the listed species (Chapter 6); and (4) consider the cumulative effects on the listed species (Chapter 7).

This opinion concludes that the effects of the proposed action, together with the environmental baseline and cumulative effects, is not likely to jeopardize the continued existence of UWR chinook salmon or result in the destruction or adverse modification of its designated critical habitat, and is not likely to jeopardize the continued existence of CR bull trout. The basis for these conclusions is described below for each species. For UWR chinook salmon, the available information includes quantitative estimates of the risk of extinction under the environmental baseline. However, for both species, the available information is largely qualitative, based on the
best available scientific and commercial data. Despite an increasing trend toward a more quantitative understanding of the critical life signs for these fish, critical uncertainties limit the Services' ability to project future conditions and effects. As a result, no hard and fast numerical indices are available for either of these stocks on which the Services can base determinations about jeopardy or the adverse modification of critical habitat (i.e., the Section 7(a)(2) standards). Therefore, for both UWR chinook salmon and CR bull trout, the Services' conclusions are qualitative judgements based on the best quantitative and qualitative information available for each species.

8.1 Upper Willamette River Chinook Salmon

As discussed in Section 4.1.1, historically, five major subbasins in the upper Willamette system produced spring chinook salmon: the Clackamas, North and South Santiam, Middle Fork Willamette, and McKenzie rivers. Between 1952 and 1968, dams were built on all of the major tributaries occupied by spring chinook salmon, blocking over half of the most productive spawning and rearing habitat. Water management operations have reduced the quality of the remaining spawning and rearing habitat in downstream areas. In particular, the release of relatively warm water during autumn leads to the early emergence of stream-type chinook salmon fry and relatively cold water released during summer may delay adult migrants. Mitigation hatcheries, built to offset the substantial habitat losses resulting from dam construction, maintained broodlines that are relatively free of genetic influences from outside the basin but may have homogenized within-basin stocks, simplifying the population structure of the ESU. The number of naturally spawning fish has increased gradually in recent years but the Services believe that many are first-generation hatchery fish.

At this time, chinook salmon in the McKenzie River above Leaburg Dam constitute the largest remaining spawning aggregation of wild fish in the Upper Willamette River ESU (approximately 40% of the ESU's production potential). Within the action area, the environmental baseline has limited productivity of the population in the following ways:

- Storage and release operations at the USACE's Cougar and Blue River dams have reduced the frequency and magnitude of natural disturbance in the form of 100-year floods, which has resulted in relatively static and simplified aquatic habitat compared to conditions under which the listed species evolved
- Storage and release operations at the USACE's Cougar and Blue River dams have altered the annual hydrograph, reducing peak flows in the winter and spring and by increasing low flows in the summer and fall
- Leaburg Dam, constructed in 1929, initially blocked the downstream transport of sediment in the lower McKenzie River, resulting in a 1- to 5-foot downcutting of the bed (i.e., until Leaburg Lake filled in and once again passed gravel to spawning areas downstream)
- Construction of the USACE's Cougar and Blue River dams trapped both sediment and LW in the upper subbasin, reducing transport to spawning habitat in the Leaburg and Walterville reaches
- Large wood was directly removed from stream channels of all sizes in a misdirected effort to improve fish passage, for timber salvage, to reduce downstream damage to bridges during floods, and to prevent navigation hazards
- Causing the injury, mortality, and potentially reduced condition of juvenile chinook salmon outmigrating through the Leaburg and Walterville Canals and the bypass reaches
- Much of the riparian vegetation was removed for farmland, residences, timber harvest, and roads, reducing the acreage covered and functional value of the riparian zone
- Altered flow regime and the construction of flood control structures (levees and revetments) affected channel morphology: the creation of new bars and islands, bank erosion, channel width and meandering, and the migration of channel bars
- Up to 14.5% passage mortality of chinook salmon smolts entrained into the Walterville Canal and powerhouse (estimated from the results of a 1982 study with 2,300 cfs, 64% of total flow, through the Walterville Canal before EWEB instituted the 1996 interim flow agreement, Table 6-2) and significant delay of adults at the Leaburg and Walterville tailraces and at the Leaburg fish ladder
- Diversion from the mainstem McKenzie River, leaving as low as 465 cfs in the 5.8 mile Leaburg reach and as low as 350 cfs during a portion of the year (fall-spring) in the 7.3 mile Walterville reach (bypass reaches) until 1991 affected rearing, in-stream temperature, and migration for juvenile and adult chinook salmon.

The net result of conditions under the environmental baseline is an extinction risk for the McKenzie River population above Leaburg Dam that currently varies from 0% within 24 or 100 years (assuming that hatchery fish have not reproduced in the wild or have been only 20% as productive as wild-origin fish) to >70% within 100 years (if hatchery fish have been 80% or 100% as productive as wild-origin fish; Table 4-2).

By implementing the proposed action, FERC will be ensuring that EWEB takes all available measures at the Leaburg-Walterville Project to reduce the effects of the projects on factors that currently limit the productivity of the ESU:

- Direct passage mortality of chinook salmon smolts entrained into the Walterville Canal and powerhouse will be reduced to less than 0.5%
- Mortality of chinook salmon fry through the Leaburg fish screen facility when debris is on the screen or in the apex will be reduced to a consistent 2 to 4% by system modifications and revised maintenance procedures
- Attraction and delay of adult chinook in the tailrace of each project will be reduced or eliminated by the construction of tailrace barriers and delay will further be reduced by modifying the left-bank fish ladder and redesigning and reconstructing the right-bank fish ladder at Leaburg Dam to meet current design criteria
- Actions, designed to increase the power generation capacity of the Leaburg and Walterville hydropower facilities (Leaburg lake raise and Walterville tailrace excavation), will be taken in a manner that does not increase direct or indirect effects on listed fish
- EWEB will maintain instantaneous minimum flows immediately downstream of Leaburg Dam and the Walterville intake at a continuous level of 1,000 cfs, maintaining current migration conditions for juvenile UWR chinook salmon
- Until the Walterville Canal is screened, EWEB will seasonally augment the minimum 1,000 cfs flow in the Walterville bypass reach to reduce the likelihood that migrating juvenile chinook salmon will be entrained into the Walterville Canal and powerhouse
- EWEB will operate the Leaburg-Walterville Project to meet a seasonal set of ramping rate criteria in the river below the Walterville tailrace and downstream from the Leaburg and Walterville diversions. Assuming that Walterville pond will be used in the future for power peaking (i.e., after the effects of fluctuating river levels in the McKenzie River downstream of the Walterville tailrace outfall are determined), EWEB operation of the pond will be governed by the ramping rate criteria included in the schedule
- EWEB will develop gravel and spawning and rearing habitat enhancement programs in a manner that implements the MWC's Conservation Strategy (currently under development).

The proposed action includes a prompt and reliable schedule for completing all of these construction activities (Appendix A). NMFS estimates that implementation of the proposed action will result in an incremental survival improvement for juvenile chinook salmon of at least 8.2% (section 6.2.1.4) which, combined with an estimated 37% survival improvement from the selective harvest measure described in section 5.3.1.4, will provide a survival improvement within the range needed to meet NMFS' survival and recovery criteria.

Until a species-specific recovery plan is developed, the Basinwide Strategy (see section 1. 3) provides the Services with guidance for judging the significance of FERC's proposed action relative to the species-level biological requirements of UWR chinook salmon. For tributary habitats on non-Federal lands, actions approved by FERC (along with actions undertaken by other Federal agencies that affect biological requirements in the action area) are expected to remove passage barriers, screen diversions, increase instream flow, and restore water quality, and to encourage settlements to improve habitat through the purchase of land or conservation easements. For tributary habitats on Federal lands, Federal agencies are expected to protect existing high quality habitat and to accelerate restoration activities. By issuing the revised license for the Leaburg-Walterville Project, requiring EWEB to implement the articles described in the proposed action (Chapter 3 of this biological opinion), FERC will meet its responsibilities with respect to the Leaburg-Walterville Project under the Basinwide Strategy. NMFS has determined that the incremental survival improvements expected from these measures, added to improvements expected from the selective fishery (sections 5.3.1.4 and 6.2.1.4), will avoid jeopardy by resulting in a population trajectory within the range needed for survival and recovery. Further, NMFS finds that the proposed action will not adversely modify or destroy designated critical habitat for UWR chinook salmon.

This consultation addresses projects that affect survival of UWR chinook salmon migrating to and from the remaining spawning and rearing habitat in the McKenzie River subbasin. Much of the historical spawning habitat in this important subbasin is currently blocked by other projects – EWEB's Carmen-Smith and the USACE's Cougar and Blue River dams. Subsequent consultations with FERC and with the USACE will address the need for access to this spawning habitat to achieve the distribution and diversity this ESU requires to survive and recover.

8.2 Columbia River Bull Trout

The implementing regulations for section 7 of the ESA (50 CFR 402) define "jeopardize the continued existence of" as "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, and distribution of that species." Although components of the proposed action are expected to adversely effect CR bull trout, especially in the short term prior to the completion of construction activity, the overall effects of the proposed action, added to the environmental baseline and cumulative effects, do not appreciably reduce the likelihood of survival and recovery through reductions in reproduction, numbers, and distribution. The proposed action is therefore not likely to jeopardize the continued existence of CR bull trout.

The USFWS' conclusions are based on the following:

- The proposed action includes the construction and operation of a fish screen at the top end of the Walterville Canal. The installation of the Walterville fish screen will address longstanding concerns over entrainment, and probably injury and death, of CR bull trout. While some adverse effects to CR bull trout may occur due to contact with the screen system, overall migration conditions past the Walterville project will be significantly improved over baseline conditions.

- The proposed action includes the modification of the Walterville tailrace barrier and the construction of a tailrace barrier below the Leaburg powerhouse. These components of the proposed action, while not eliminating the potential for migration delay, are expected to significantly improve migration over current conditions.

- In addition to modifications to the left bank fish ladder necessitated by the Leaburg Lake raise, the proposed action includes the construction and operation of a right bank fish ladder. The current right bank ladder has been inoperable for years and replacing it with a new ladder will greatly improve migration conditions for CR bull trout past Leaburg Dam over baseline conditions.

- While over the 40-year term of the proposed action, negative effects on the habitat processes discussed in this consultation will occur, these effects will not appreciably reduce reproduction, numbers, and distribution of CR bull trout since the Leaburg-Walterville project is run-of-the-river, impacts a relatively short stretch of the mainstem McKenzie, and does not prevent the downstream movement of LW and sediment.

- Interim measures in the proposed action will reduce the potential for delay in the upstream migration of CR bull trout associated with the Leaburg tailrace. EWEB will implement periodic shutdowns of the flow into the Leaburg powerhouse from May until September, during the time that UWR chinook and CR bull trout are expected to be migrating upstream. The periodic shutdowns will continue until the time EWEB completes the construction of the tailrace barrier.

- The proposed action includes license articles (401, 403, 406, 422, 425) that require EWEB to develop and submit, for resource agency and FERC approval, multiple plans to reduce adverse impacts of construction associated with the proposed action on UWR chinook and CR bull trout.

9. Incidental Take Statement

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by regulation as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of 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 to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

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

The measures described below are non-discretionary, and must be undertaken by FERC and EWEB and made binding conditions of any license or contract issued in the course of implementation of any component or part of the proposed action for the exemption in section 7(o)(2) to apply. The FERC has a continuing duty to regulate the activity covered by this incidental take statement. If the FERC: (1) fails to assume and implement the terms and conditions; or (2) fails to require EWEB to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the contracts, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FERC must report the progress of the action and its impact on the species to the Services as specified in the incidental take statement (50 CFR 402.14(i)(3)).

9.1 Amount or Extent of Incidental Take

9.1.1 UWR Chinook Salmon

The incidental take of UWR chinook salmon is expected to be in the form of harm, harassment, and mortality to individuals. The primary causes are associated with delay and injury associated with project passage, but habitat disruptions below the projects may also cause indirect effects.

It is difficult to quantify lethal take caused by passage through some sections of the Leaburg-Walterville Project, as well as to quantify non-lethal take associated with passage (e.g., delay) and habitat modifications downstream of the projects (Section 6.2.1). This is because, with the exception of passage survival studies specifically designed to estimate mortality through certain passage routes, it is difficult to find individuals that have been killed or otherwise taken by the project. Furthermore, even if dead or injured individuals are found in the project area, determining the cause of mortality or injury may be difficult. Therefore, even though NMFS expects some incidental take to occur due to the actions covered by this biological opinion, the best scientific and commercial data available are not sufficient to enable NMFS to estimate a specific amount of incidental take to UWR chinook salmon. In instances such as these, NMFS designates the expected level of take as "unquantifiable." Based on the information in the BA, NMFS anticipates that an unquantifiable amount of incidental take of UWR chinook salmon could occur as a result of the actions covered by this biological opinion.

For purposes of monitoring take and determining when the authorized take has been exceeded, NMFS defines the authorized incidental take as that associated with the operations and passage technology proposed in this opinion. The trigger for exceeding authorized incidental take is therefore failure to implement the license articles and conservation measures included in the proposed action. However, quantitative estimates of expected take for some aspects of the proposed action exist and were considered in the analysis of effects of the proposed action. Table 9-1 describes NMFS' best quantitative estimates of expected take while recognizing that these are not sufficiently reliable for setting triggers for exceedance of authorized take.

In the accompanying biological opinion, NMFS determined that the anticipated level of take is not likely to result in jeopardy to the species.

Table 9-1. NMFS' best quantitative estimates of mortality for UWR chinook salmon following construction of new screens, bypasses, fish ladder, and tailrace barriers, as well as the Leaburg Lake raise. Although not sufficiently reliable for setting triggers for exceedence of authorized incidental take, these estimates supplement the description of authorized incidental take, which is defined qualitatively for all passage routes and effects.

Location	Mortality Estimate	
	Juveniles	Adults
Leaburg Project:		
Leaburg Lake	Unquantifiable (Low)	0%
Leaburg Fish Screen and Bypass	fry: 4%[1] smolts: 1%[1]	0%
Leaburg Spillway Rollgates	fry: 2%[2] smolts: 2%[2]	Not applicable
Leaburg Fish Ladder	Unquantifiable (Very Low)	0%
Leaburg Tailrace	Not applicable	0%
Leaburg Bypass Section	Unquantifiable	0%
Walterville Project		
Walterville Fish Screen and Bypass	Fry: 0% to 1%[3] Smolts: 0% to 0.5%[3]	0%
Walterville Tailrace	Not applicable	0%
Walterville Bypass Section	Unquantifiable	0%

[1]Based on maximum reported mortality of current screen under clean conditions (ODFW 1996, cited in FERC 2001). Screen mortality and injury is expected to decrease below these levels with additional improvements to screen debris management systems.
[2]Fry mortality based on 200-600 cfs flow results and lack of passage effect on mortality at 1,000 cfs (EA 1990, cited in FERC 2001); smolt mortality estimated based on studies performed at other spillways of similar design. Upon evaluation, if mortality exceeds these levels, operational adjustments may be required.
[3]Fry and smolt mortality following screen construction is based on performance of juvenile fish screens constructed to NMFS' criteria, as described in Section 6.2.1.1.6.

9.1.2 Columbia River Bull Trout

The incidental take of CR bull trout is expected to be in the form of harm, harassment, and mortality to individuals. The primary causes are associated with delay and injury associated with project passage, but habitat disruptions below the projects may also cause indirect effects.

It is difficult to quantify lethal take caused by passage through some sections of the Leaburg-Walterville Project, as well as to quantify non-lethal take that results in harm or harassment associated with passage (e.g., delay) and habitat modifications downstream of the projects (Section 6.2.1). This is because, with the exception of passage survival studies specifically designed to estimate mortality through certain passage routes, it is difficult to find individuals that have been killed or otherwise taken by the project. Furthermore, even if dead or injured individuals are found in the project area, determining the cause of mortality or injury may be difficult. Therefore, even though the USFWS expects some incidental take to occur due to the actions covered by this biological opinion, the best scientific and commercial data available are not sufficient to enable the USFWS to estimate a specific amount of incidental take to CR bull trout. In instances such as these, the USFWS designates the expected level of take as "unquantifiable." Based on the information in the BA, the USFWS anticipates that an unquantifiable amount of incidental take of CR bull trout could occur as a result of the actions covered by this biological opinion. In the accompanying biological opinion, the USFWS determined that this level of anticipated take is not likely to result in jeopardy to the species.

9.2 Reasonable and Prudent Measures

The Services believe that the following reasonable and prudent measures are necessary and appropriate to minimize take of UWR chinook salmon and CR bull trout:

1. Reduce adverse impacts of the proposed Leaburg Dam lake raise on UWR chinook salmon and CR bull trout.

2. Reduce adverse impacts of the proposed fish passage facilities at Leaburg Dam on UWR chinook salmon and CR bull trout.

3. Reduce adverse impacts of the proposed Walterville rock drop water diversion structures on UWR chinook salmon and CR bull trout.

4. Reduce adverse impacts of the proposed fish passage facilities at the Walterville diversion on UWR chinook salmon and CR bull trout.

5. Determine, and if necessary, reduce adverse impacts of water diversion from the Leaburg and Walterville bypass reaches on water temperatures and sediment transport.

6. Reduce adverse impacts of construction associated with the proposed action on UWR chinook salmon and CR bull trout.

7. Reduce overall adverse effects of project construction and operation on UWR chinook salmon and CR bull trout by implementing habitat improvement measures.

8. Reduce adverse impacts of the proposed action through monitoring activities.

9.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, FERC and EWEB must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are part of the proposed action, but are also necessary for reducing incidental take. They are non-discretionary.

1. Terms and conditions to reduce adverse impacts of the proposed Leaburg Dam lake raise on UWR chinook salmon and CR bull trout.

1a. Implement Article 405, which requires the licensee, within two years of license issuance,[7] to develop and submit a final design plan for raising the water level of Leaburg Lake by 1.5 feet. The plan shall be implemented following Commission approval.

1.b. Implement Article 414, which requires the licensee to operate the project to meet a seasonal set of project-caused ramping rate criteria in the river to prevent fish stranding.

1.c. Implement Article 415, which requires the licensee to develop and implement a plan for monitoring compliance with the ramping rate criteria.

1.d. Implement Article 420, which requires the licensee to evaluate fish screen impacts created by the 1.5-ft Leaburg Lake raise. Within one year after increasing the water surface elevation at Leaburg Lake, the licensee shall complete studies pursuant to a study plan to identify if, and to what extent, mortality and/or injury of juvenile salmonids, associated with the increased water surface elevation, occurs at the Leaburg Fish Screen Facility. The licensee shall, before the end of this one year period, consult with the U.S. Department of Interior (Interior), the U.S. Department of Commerce (Commerce), and the Oregon Department of Fish and Wildlife (ODFW) on the results of the studies and on any actions proposed by the Licensee to eliminate or mitigate for any source of increased injury and/or mortality associated with the increased water surface elevation. Licensee shall take corrective action to eliminate or mitigate for increased injury and/or mortality in a time and manner appropriate to the scope and nature of the problem.

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[7] FERC has, in certain license articles, used the term 'license issuance' as the date from which to measure the period during which EWEB must perform certain activities (e.g., within 1 year or 18 months of license issuance). However, the date intended by 'license issuance' is presently uncertain. To resolve this uncertainty, for purposes of this biological opinion only, the term 'license issuance' shall mean the final date on which this biological opinion is signed by the Services. This is pertinent when analyzing the effects of the proposed action (in Chapter 6) and for setting the terms and conditions of incidental take (Chapter 9).

The licensee shall submit the study plan at least 120 days before increasing the water surface elevation, consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and ODFW and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the study plan with the Commission. The licensee shall include with the study plan documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed study plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the study plan. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall implement the study plan by the time specified.

1.e. Implement Article 421, which requires the licensee to evaluate rollgate mortality impacts created by the 1.5-ft Leaburg Lake raise. Within one year after increasing the water surface elevation at Leaburg Lake, the licensee, in consultation with the U.S. Department of Interior (Interior), the U.S. Department of Commerce (Commerce) and the Oregon Department of Fish and Wildlife (ODFW), shall complete studies pursuant to a study plan to identify if, and to what extent, mortality and/or injury is induced through passage of juvenile salmonids through the rollgates at Leaburg Lake. The study must identify the impacts associated with passage at the current lake level, including the minimum gate opening, and at the maximum lake elevation proposed, also including minimum gate opening. The licensee shall, before the end of this one year period, consult with Interior, Commerce and ODFW on the results of the study and on any actions proposed by the Licensee to eliminate or mitigate any source of increased injury and/or mortality associated with the increased water surface elevation. Licensee shall take corrective action to eliminate or mitigate for increased injury and/or mortality in a time and manner appropriate to the scope and nature of the problem.

The licensee shall submit the study plan at least 120 days before increasing the water surface elevation, consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and ODFW and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the study plan with the Commission. The licensee shall include with the study plan documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed study plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the study plan. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall implement the study plan by the time specified.

1.f. Implement Article 425, which requires the licensee to properly maintain all physical features of fish and wildlife enhancement requirements.

2. Terms and conditions to reduce adverse impacts of the proposed fish passage facilities at Leaburg Dam on UWR chinook salmon and CR bull trout.

2.a Implement elements of Article 416, which address proposed fish passage facilities at Leaburg Dam. To provide for safe and effective passage of anadromous fish past project features, the licensee shall complete the following facilities by the date identified in the licensee's construction schedule to be filed and approved pursuant to Article 403:

(1) Modify, operate and maintain the Leaburg fish screen cleaning system and/or modify system operations and maintenance in accordance with a facilities plan to provide clean, submerged screen area adequate to protect juvenile fish passing through this facility. The plan shall include modifications to clean the entire submerged screen area or other measures that provide equivalent or better protection of juvenile fish passing through the facility.

(2) Modify, operate and maintain the structure of the Leaburg fish return bypass conduit and/or the operations and maintenance for the Leaburg Canal in accordance with a facilities plan that meets the objectives of: 1) providing adequate inspection access to the bypass conduit at points where debris can accumulate; and 2) providing simple access for the purpose of debris removal, to reduce the potential for injury or mortality of fish subjected to debris accumulations currently undetectable under normal operations.

(3) Modify, operate and maintain the Leaburg left bank fish ladder in accordance with the facilities plan contained in "Volume 1 - Technical Specifications, Leaburg Dam - Right Bank Fish Ladder Reconstruction and Left Bank Fish Ladder Modifications, May 2001" and "Volume 2 - Drawings, Leaburg Dam - Right Bank Fish Ladder Reconstruction and Left Bank Fish Ladder Modifications, December 2000." The facilities plan for the modification, operation and maintenance of the upper ladder weirs shall be submitted in conjunction with the Leaburg lake raise design pursuant to Article 405 (as indicated in letter dated July 10, 2001, from licensee to Commerce and Interior) and shall meet the objective of maintaining ladder flow and hydraulic drop per pool consistent with conditions in existence before the lake raise.

(4) Construct, operate and maintain the Leaburg right bank fish ladder in accordance with the facilities plan contained in "Volume 1 - Technical Specifications, Leaburg Dam - Right Bank Fish Ladder Reconstruction and Left Bank Fish Ladder Modifications, May

2001" and "Volume 2 - Drawings, Leaburg Dam - Right Bank Fish Ladder Reconstruction and Left Bank Fish Ladder Modifications, December 2000."

(5) Construct, operate and maintain an adult barrier at the terminus of Leaburg tailrace in accordance with a facilities plan utilizing the concepts identified in the NMFS' Working Technical Paper entitled "The Use of Barriers to Prevent Adult Salmon Delay and Injury at Hydroelectric Powerhouses and Waterways," dated November 19, 1993.

(6) For terms 2.a.(1) through 2.a.(5), the licensee shall submit the facilities' plans within 18 months of license issuance after consultation with Interior, Commerce, and Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the facilities' plans with the Commission. The licensee shall include with the facilities' plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed facilities' plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the facilities' plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall complete construction of the facilities by the dates identified in the licensee's construction schedule approved pursuant to Article 403.

(7) For terms 2.a.(1) through 2.a.(5), the licensee shall submit plans for the monitoring and maintenance of the facilities to ensure that they will continuously function according to the design objectives, no less than 120 days prior to the scheduled completion date of each facility, consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and ODFW and approval by Interior and Commerce. The monitoring and maintenance plans shall allow Interior, Commerce and ODFW access for inspection after construction and throughout the term of the license, and provide for the licensee to make necessary adjustments to return the facilities to effective performance within a reasonable time after deficiencies are identified, consistent with the scope and nature of the deficiencies. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the monitoring and maintenance plans with the Commission. The licensee shall include with the monitoring and maintenance plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed monitoring and maintenance plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the monitoring and maintenance plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information.

Upon approval by the Commission, the licensee shall implement the monitoring and maintenance plans.

(8) As an interim measure to reduce the potential for delay in the upstream migration of adult spring chinook salmon associated with the Leaburg tailrace, the licensee shall continue implementing periodic shutdowns of the flow into the Leaburg powerhouse until the time the licensee completes construction of the adult barrier. During the upstream migration of adult salmon in May to September, the licensee shall make a daily visual count of the number of adult salmon in the tailrace immediately below the Leaburg powerhouse where salmon can concentrate. If the licensee counts 50 or more adult salmon each day for 5 consecutive days, the licensee shall schedule a shutdown of flow into the powerhouse as soon as reasonably practicable. The licensee shall schedule the shutdown overnight from dawn to dusk to coincide with the period of greatest potential adult movement in the river unless another period of time would achieve grater adult movement. The shutdown shall consist of eliminating flow into the powerhouse and directing the flow into the siphon-hole outlet of the Leaburg Canal located upstream within a quarter-mile of the tailrace confluence. The licensee shall make a record of its daily visual counts and make that record available to Interior, Commerce, and the ODFW upon request. The licensee shall conduct operations to ensure that adult salmonids are not stranded below the siphon-hole outlet. The licensee shall coordinate the operations with the ODFW.

2.b Implement elements of Article 417 related to post-installation evaluations, modifications, operation and maintenance of the tailrace barrier at Leaburg Dam. Within one year after the facility is fully operational, consistent with the licensee's construction schedule approved pursuant to Article 403, or as otherwise specified in the evaluation plans and agreed to by the U.S. Department of Interior (Interior) and U.S. Department of Commerce (Commerce), the licensee shall conduct hydraulic and biological evaluations of the tailrace barrier at the Leaburg tailrace. The licensee shall consult with Interior and Commerce with respect to any deficiencies identified as a result of the evaluations and undertake corrective actions in a time and manner appropriate to the scope and nature of the deficiencies.

The licensee shall submit the evaluation plans at least 120 days before the facility is scheduled to be fully operational consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and the Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the evaluation plans with the Commission. The licensee shall include with the evaluation plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed evaluation plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the evaluation plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall complete evaluation of the facilities within one year of operation or as otherwise specified in the approved evaluation plans.

2.c Implement elements of Article 418 related to post-installation evaluations, modifications, operation and maintenance of the Leaburg fish screens and ladders. Within one year after the facility is fully operational, consistent with the licensee's construction schedule approved pursuant to Article 403, or as otherwise specified in the evaluation plans and agreed to by the U.S. Department of Interior (Interior) and U.S. Department of Commerce (Commerce), the licensee shall conduct hydraulic and biological evaluations of the juvenile fish screens and the adult fish ladders. The licensee shall consult with Interior and Commerce with respect to any deficiencies identified as a result of the evaluations and undertake corrective actions in a time and manner appropriate to the scope and nature of the deficiencies.

The licensee shall submit the evaluation plans at least 120 days before the facility is scheduled to be fully operational consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and the Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the evaluation plans with the Commission. The licensee shall include with the evaluation plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed evaluation plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the evaluation plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall complete evaluation of the facilities within one year of operation or as otherwise specified in the approved evaluation plans.

2.d. Implement Article 423, which requires EWEB to develop and implement a plan to salvage or otherwise allow fish safe egress from the Leaburg Canal prior to dewatering the canal for routine inspection and maintenance.

2.e. Implement Article 425, which requires the licensee to properly maintain all physical features of fish and wildlife enhancement requirements.

3. Terms and conditions to reduce adverse impacts of the proposed Walterville rock drop water diversion structures on UWR chinook salmon and CR bull trout.

3.a. Implement Article 410, which addresses design, construction, and operation of the rock drop water diversion structures associated with the Walterville Diversion.

(1) The licensee shall construct, operate and maintain rock drop water diversion structures associated with the Walterville Diversion as specified in the documents entitled "Volume 1 - Technical Specifications, Walterville Fish Screen Project, May 2001" and "Volume 2 - Drawings, Walterville Fish Screen Project, August 2000."

(2) The licensee shall submit a final design plan for the water diversion structures within 18 months of license issuance after consultation with the U.S. Department of Interior (Interior), U.S. Department of Commerce (Commerce) and Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the final design plan with the Commission. The licensee shall include with the final design plan documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed final design plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the final design plan. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall complete construction of the Walterville diversion structures by the date identified in the licensee's construction schedule approved pursuant to Article 403.

(3) The licensee shall submit a plan for the monitoring and maintenance of the water diversion structures, such that these structures will continuously function according to the requirements of the final design plan, no less than 120 days prior to the scheduled completion date of the water diversion structures, consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with the U.S. Department of Interior (Interior), U.S. Department of Commerce (Commerce) and Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The monitoring and maintenance plan shall include monitoring of sediment accumulation at the rock drop diversion structures. It shall also allow Interior, Commerce and ODFW access for inspection after construction and throughout the term of the license, and provide for the licensee to make necessary adjustments to return the structures to proper function within a reasonable time after deficiencies are identified, consistent with the scope and nature of the deficiencies. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the monitoring and maintenance

plan with the Commission. The licensee shall include with the monitoring and maintenance plan documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed monitoring and maintenance plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the monitoring and maintenance plan. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall implement the monitoring and maintenance plan.

3.b. Implement Article 425, which requires the licensee to properly maintain all physical features of fish and wildlife enhancement requirements.

4. Terms and conditions to reduce adverse impacts of the proposed fish passage facilities at the Walterville diversion on UWR chinook salmon and CR bull trout.

4.a. Implement elements of Article 416, which address proposed fish passage facilities at the Walterville Diversion. To provide for safe and effective passage of anadromous fish past project features, the licensee shall complete the following facilities by the date identified in the licensee's construction schedule to be filed and approved pursuant to Article 403:

(1) Construct, operate and maintain juvenile fish screens in the Walterville Canal, in accordance with the facilities plan contained in "Volume 1 - Technical Specifications, Walterville Fish Screen Project, May 2001" and "Volume 2 - Drawings, Walterville Fish Screen Project, August 2000."

(2) Construct, operate and maintain an adult barrier at the terminus of Walterville Tailrace in accordance with the facilities plan contained in "Volume 1 - Technical Specifications, Walterville Tailrace Barrier Project, May 2001" and "Volume 2 - Drawings, Walterville Project Tailrace Barrier, May 2001."

(3) For terms 4.a.(1) and 4.a.(2), the licensee shall submit the facilities' plans within 18 months of license issuance after consultation with Interior, Commerce, and Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the facilities' plans with the Commission. The licensee shall include with the facilities' plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed facilities' plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the facilities' plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-

specific information. Upon approval by the Commission, the licensee shall complete construction of the facilities by the dates identified in the licensee's construction schedule approved pursuant to Article 403.

(4) For terms 4.a.(1) and 4.a.(2), the licensee shall submit plans for the monitoring and maintenance of the facilities to ensure that they will continuously function according to the design objectives, no less than 120 days prior to the scheduled completion date of each facility, consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and ODFW and approval by Interior and Commerce. The monitoring and maintenance plans shall allow Interior, Commerce and ODFW access for inspection after construction and throughout the term of the license, and provide for the licensee to make necessary adjustments to return the facilities to effective performance within a reasonable time after deficiencies are identified, consistent with the scope and nature of the deficiencies. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the monitoring and maintenance plans with the Commission. The licensee shall include with the monitoring and maintenance plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed monitoring and maintenance plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the monitoring and maintenance plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall implement the monitoring and maintenance plans.

(5) As is specified in Article 416, for the interim period until the Walterville screen is built, continue implementing measures established by the 1996 Intergovernmental Agreement for Fish Protection Measures between EWEB and ODFW (described in FERC 2001, Section 2.1 and Table 2-2) to reduce entrainment of juvenile UWR chinook salmon into the Walterville Canal.

4.b Implement elements of Article 417 related to post-installation evaluations, modifications, operation and maintenance of the tailrace barrier at the Walterville Diversion. Within one year after the facility is fully operational, consistent with the licensee's construction schedule approved pursuant to Article 403, or as otherwise specified in the evaluation plans and agreed to by the U.S. Department of Interior (Interior) and U.S. Department of Commerce (Commerce), the licensee shall conduct hydraulic and biological evaluations of the tailrace barrier at the Walterville Diversion. The licensee shall consult with Interior and Commerce with respect to any deficiencies identified as a result of the evaluations and undertake corrective actions in a time and manner appropriate to the scope and nature of the deficiencies.

The licensee shall submit the evaluation plans at least 120 days before the facility is scheduled to be fully operational consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and the Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the evaluation plans with the Commission. The licensee shall include with the evaluation plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed evaluation plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the evaluation plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall complete evaluation of the facilities within one year of operation or as otherwise specified in the approved evaluation plans.

4.c Implement elements of Article 418 related to post-installation evaluations, modifications, operation and maintenance of the Walterville fish screen. Within one year after the facility is fully operational, consistent with the licensee's construction schedule approved pursuant to Article 403, or as otherwise specified in the evaluation plans and agreed to by the U.S. Department of Interior (Interior) and U.S. Department of Commerce (Commerce), the licensee shall conduct hydraulic and biological evaluations of the juvenile fish screen. The licensee shall consult with Interior and Commerce with respect to any deficiencies identified as a result of the evaluations and undertake corrective actions in a time and manner appropriate to the scope and nature of the deficiencies.

The licensee shall submit the evaluation plans at least 120 days before the facility is scheduled to be fully operational consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with Interior, Commerce and the Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the evaluation plans with the Commission. The licensee shall include with the evaluation plans documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed evaluation plans after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the evaluation plans. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall complete evaluation of the facilities within one year of operation or as otherwise specified in the approved evaluation plans.

4.d. Implement Article 419, which requires the licensee to submit a plan to inspect, maintain, and operate the Walterville tailrace return channel at the Walterville tailrace barrier to ensure safe and effective adult fish passage, no less than 120 days prior to the scheduled date for completion of the Walterville tailrace barrier, consistent with the licensee's construction schedule approved pursuant to Article 403, after consultation with the U.S. Department of Interior (Interior), U.S. Department of Commerce (Commerce) and the Oregon Department of Fish and Wildlife (ODFW) and approval by Interior and Commerce. The inspection, maintenance and operation plan shall specify a procedure for prompt removal of all obstructions or other impediments to fish passage. The licensee shall allow a minimum of 30 days for Interior and Commerce to review and approve, and for ODFW to comment and make recommendations, prior to filing the inspection, maintenance and operation plan with the Commission. The licensee shall include with the inspection, maintenance and operation plan documentation of consultation with all agencies and approval by Interior and Commerce, copies of comments and recommendations on the completed inspection, maintenance and operation plan after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the inspection, maintenance and operation plan. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information. Upon approval by the Commission, the licensee shall implement the inspection, maintenance and operation plan by the time specified.

4.e. Implement Article 423, which requires EWEB to develop and implement a plan to salvage or otherwise allow fish safe egress from the Walterville Canal prior to dewatering the canal for routine inspection and maintenance.

4.f. Implement Article 425, which requires the licensee to properly maintain all physical features of fish and wildlife enhancement requirements.

5. Terms and conditions to determine, and if necessary, reduce adverse impacts of water diversion from the Leaburg and Walterville bypass reaches on water temperatures and sediment transport.

5.a. Implement Article 411, which requires the licensee to maintain instantaneous minimum flows immediately downstream of Leaburg Dam and the Walterville intake at a continuous level of 1,000 cfs.

5.b. Implement Article 425, which requires the licensee to properly maintain all physical features of fish and wildlife enhancement requirements.

6. Terms and conditions to reduce adverse impacts of construction associated with the proposed action on UWR chinook and CR bull trout.

6.a. Implement Article 401, which requires the licensee to develop a plan to control erosion, to control slope instability, to minimize the quantity of sediment, and to control spills of chemical or petroleum products resulting from construction and operation at least 90 days before starting any land-disturbing or land-clearing activities. The plan shall be implemented following Commission approval.

6.b. Implement Article 403, which requires the licensee to develop and submit a construction plan for all in-river construction activities, which minimizes potential impact to aquatic resources in the McKenzie River, within one year of license issuance. The plan shall be implemented following resource agency and Commission approval.

6.c. Implement Article 406, which requires the licensee, within one year of license issuance, to develop and submit a plan to dispose of the Walterville tailrace excavation material in such way as to avoid impacts to wetlands, riparian vegetation, and accidental introduction of sediments to the Walterville Canal and McKenzie River. The plan shall be implemented following approval by the Commission and by other agencies with regulatory jurisdiction over this activity.

6.d. Implement Article 422, which requires the licensee to develop and implement a plan to salvage fish in the Walterville Canal prior to construction activity. The plan must be developed at least 60 days prior to dewatering the canal for excavation and construction.

6.e. Implement Article 424, which requires the licensee to promptly notify (within 24 hours) the U.S. Department of Interior, the U.S. Department of Commerce, and ODFW of any emergency or unanticipated situations arising during project construction or operation that may be detrimental to fish and wildlife or their habitat.

6.f. Implement Article 425, which requires the licensee to perform the following tasks.

(1) Consult with the resource agencies during design of any proposed project facility modifications.

(2) Notify the resource agencies 90 days prior to project construction and upon completion of construction.

(3) Consult with the resource agencies to site or route any new or modified project facilities.

7. Terms and conditions to reduce overall adverse effects of project construction and operation by implementing habitat improvement measures.

7.a. Implement Article 412, which requires the licensee to develop and implement a gravel augmentation plan downstream of Leaburg Dam to enhance spawning habitat.

7.b. Implement Article 413, which requires the licensee to develop and implement a fish habitat enhancement plan.

8. Terms and conditions to reduce adverse impacts of the proposed action through monitoring activities.

8.a. Implement Article 425, which requires the licensee to perform the following tasks.

(1) Provide a yearly compliance report on fish and wildlife requirements.

(2) Permit representatives of the resource agencies to inspect all facilities and project records pertaining to the construction, operation, and maintenance thereof and any monitoring activities specified in the license articles.

(3) Make available to the resource agencies records of diverted and bypass reach flow volumes and rates of change.

10. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Services did not identify any conservation recommendations in this biological opinion.

11. Essential Fish Habitat

Public Law 104-267, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to establish new requirements for "Essential Fish Habitat" (EFH) descriptions in Federal fishery management plans and to require Federal agencies to consult with NMFS on activities that may adversely affect EFH. "Essential Fish Habitat" means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" Magnuson-Stevens Act §3. The Pacific Fisheries Management Council (PFMC) has designated EFH for Federally-managed groundfish and coastal pelagics fisheries. The Council has also recommended an EFH designation for the Pacific salmon fishery. EFH includes those waters and substrate necessary to ensure the production needed to support a long-term sustainable fishery (i.e., properly functioning habitat conditions necessary for the long-term survival of the species through the full range of environmental variation).

The Magnuson-Stevens Act requires consultation for all actions that may adversely affect EFH, and it does not distinguish between actions in EFH and actions outside EFH. Any reasonable attempt to encourage the conservation of EFH must take into account actions that occur outside EFH, such as upstream and upslope activities that may have an adverse effect on EFH. Therefore, EFH consultation with NMFS is required by Federal agencies undertaking, permitting or funding activities that may adversely affect EFH, regardless of its location.

The consultation requirements of section 305(b) of the Magnuson-Stevens Act (16 U.S.C. 1855(b)) provide that:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH;
- NMFS shall provide conservation recommendations for any Federal or State activity that may adversely affect EFH;
- Federal agencies shall within 30 days after receiving conservation recommendations from NMFS provide a detailed response in writing to NMFS regarding the conservation recommendations. The response shall 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 the conservation recommendations of NMFS, the Federal agency shall explain its reasons for not following the recommendations.

11.1 Identification of Essential Fish Habitat

The Columbia River estuary and the Pacific Ocean off the mouth of the Columbia River are designated as EFH for groundfish and coastal pelagic species. The marine extent of groundfish and coastal pelagic EFH includes those waters from the nearshore and tidal submerged environments within Washington, Oregon, and California state territorial waters out to the exclusive economic zone (370.4 km) offshore between the Canadian border to the north and the Mexican border to the south.

The proposed salmon EFH includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except above the impassable barriers identified by PFMC. Big Cliff, Cougar, Dexter, and Dorena dams are the listed manmade barriers that represent the upstream extent of the proposed chinook salmon EFH in the Willamette Basin. Habitat above Foster and Fall Creek dams is included in proposed chinook salmon EFH because they had fish passage at the time of EFH designation. Detroit, Green Peter, Blue River, Lookout Point, Hills Creek, Cottage Grove, and Fern Ridge dams do not appear on the list of dams marking the upstream extent of proposed chinook salmon EFH because these dams did not block this species at the time of proposed EFH designation due to being upstream of the its range. Proposed salmon EFH excludes areas upstream of longstanding naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). In the estuarine and marine areas, proposed salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (370.4 km) offshore of Washington, Oregon, and California north of Point Conception to the Canadian border.

11.2 Proposed Action

The operation of the Leaburg-Walterville Project, under the 1997 FERC license, as reinstated and amended by FERC on April 27, 2000; the conservation measures as proposed in the BA; and the revised and updated license articles developed by NMFS, USFWS, EWEB, and FERC separated staff, constitute the "proposed action" by FERC.

Estuarine and offshore marine waters are designated EFH for various life stages of 62 species of groundfish and five coastal pelagic species. A detailed description and identification of EFH for groundfish is found in the Final Environmental Assessment/Regulatory Impact Review for Amendment 11 to The Pacific Coast Groundfish Management Plan and the NMFS Essential Fish Habitat for West Coast Groundfish Appendix. A detailed description and identification of EFH for coastal pelagic species is found in Amendment 8 to the Coastal Pelagic Species Fishery Management Plan. The proposed action area also encompasses the Council-designated EFH for chinook (*Onchorhynchus tshawytscha*) and for coho (*Onchorhynchus kisutch*) salmon. A description and identification of EFH for salmon is found in Appendix A to Amendment 14 to the Pacific Coast Salmon Plan. Assessment of the impacts to these species' EFH from the above proposed FERC action is based on this information.

The objective of this EFH consultation is to determine whether the proposed action without further EFH consultation may adversely affect EFH for the species listed in Table 11-1 below and for the listed chinook salmon within the action area. Another objective of this EFH consultation is to recommend conservation measures to avoid, minimize, or otherwise offset potential adverse impacts to EFH resulting from the proposed action.

11.3 Effects of the Proposed Action

The effects of the proposed action on UWR chinook salmon and its habitat within the action area are described in section 6 above. The proposed action is not likely to affect EFH of any of the other species listed in Table 11-1.

11.4 Conclusion

NMFS believes that the proposed action may adversely affect designated EFH for listed UWR chinook salmon.

11.5 EFH Conservation Recommendations

The Incidental Take Statement in Chapter 9 provides non-discretionary Reasonable and Prudent Measures (RPMs) and Terms and Conditions that are applicable to designated EFH for UWR chinook salmon. Therefore, NMFS recommends that the RPMs and Terms and Conditions listed above be adopted. Should these EFH conservation recommendations be adopted, potential adverse impacts to EFH would be minimized from this proposed action.

11.6 Statutory Requirements

The Magnuson-Stevens Act and Federal regulations (50 CFR Section 600.920) to implement the EFH provisions require Federal action agencies to provide a written response to EFH Conservation Recommendations within 30 days of receipt. The final response must include a description of measures proposed to avoid, mitigate, or offset the adverse impacts of the activity. If the response is inconsistent with the EFH Conservation Recommendations, an explanation of the reasons for not implementing them must be included.

11.7 Consultation Renewal

FERC must reinitiate EFH consultation with NMFS if the proposed action is substantially revised or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 CFR Section 600.920).

Table 11-1. Species with designated EFH found in waters of the State of Oregon.

Ground Fish Species	Blue rockfish (*S. mystinus*)	Rougheye rockfish (*S. aleutianus*)	Flathead sole (*Hippoglossoides elassodon*)
Leopard shark (*Triakis semifasciata*)	Bocaccio (*S. paucispinis*)	Sharpchin rockfish (*S. zacentrus*)	Pacific sanddab (*Citharichthys sordidus*)
Soupfin shark (*Galeorhinus zyopterus*)	Brown rockfish (*S. auriculatus*)	Shortbelly rockfish (*S. jordani*)	Petrale sole (*Eopsetta jordani*)
Spiny dogfish (*Squalus acanthias*)	Canary rockfish (*S. pinniger*)	Shortraker rockfish (*S. borealis*)	Rex sole (*Glyptocephalus zachirus*)
Big skate (*Raja binoculata*)	Chilipepper (*S. goodei*)	Silvergray rockfish (*S. brevispinus*)	Rock sole (*Lepidopsetta bilineata*)
California skate (*R. inornata*)	China rockfish (*S. nebulosus*)	Speckled rockfish (*S. ovalis*)	Sand sole (*Psettichthys melanostictus*)
Longnose skate (*R. rhina*)	Copper rockfish (*S. caurinus*)	Splitnose rockfish (*S. diploproa*)	Starry flounder (*Platyichthys stellatus*)
Ratfish (*Hydrolagus colliei*)	Darkblotched rockfish (*S. crameri*)	Stripetail rockfish (*S. saxicola*)	
Pacific rattail (*Coryphaenoides acrolepsis*)	Grass rockfish (*S. rastrelliger*)	Tiger rockfish (*S. nigrocinctus*)	**Coastal Pelagic Species**
Lingcod (*Ophiodon elongatus*)	Greenspotted rockfish (*S. chlorostictus*)	Vermillion rockfish (*S. miniatus*)	Northern anchovy (*Engraulis mordax*)
Cabezon (*Scorpaenichthys marmoratus*)	Greenstriped rockfish (*S. elongatus*)	Widow Rockfish (*S. entomelas*)	Pacific sardine (*Sardinops sagax*)
Kelp greenling (*Hexagrammos decagrammus*)	Longspine thornyhead (*Sebastolobus altivelis*)	Yelloweye rockfish (*S. ruberrimus*)	Pacific mackerel (*Scomber japonicus*)
Pacific cod (*Gadus macrocephalus*)	Shortspine thornyhead (*Sebastolobus alascanus*)	Yellowmouth rockfish (*S. reedi*)	Jack mackerel (*Trachurus symmetricus*)
Pacific whiting (Hake) (*Merluccius productus*)	Pacific Ocean perch (*S. alutus*)	Yellowtail rockfish (*S. flavidus*)	Market squid (*Loligo opalescens*)
Sablefish (*Anoplopoma fimbria*)	Quillback rockfish (*S. maliger*)	Arrowtooth flounder (*Atheresthes stomias*)	
Aurora rockfish (*Sebastes aurora*)	Redbanded rockfish (*S. babcocki*)	Butter sole (*Isopsetta isolepsis*)	**Salmon**
Bank Rockfish (*S. rufus*)	Redstripe rockfish (*S. proriger*)	Curlfin sole (*Pleuronichthys decurrens*)	Coho salmon (*O. kisutch*)
Black rockfish (*S. melanops*)	Rosethorn rockfish (*S . helvomaculatus*)	Dover sole (*Microstomus pacificus*)	Chinook salmon (*O. tshawytscha*)
Blackgill rockfish (*S. melanostomus*)	Rosy rockfish (*S. rosaceus*)	English sole (*Parophrys vetulus*)	

12. Reinitiation of Consultation

This concludes formal consultation on the FERC action described in the BA (FERC 2001) at EWEB's Leaburg-Walterville Project. 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 specified in the incidental take statement is exceeded, or is expected to be 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 (50 CFR §402.16). In instances where the amount or extent of incidental take specified in the Incidental Take Statement is exceeded, FERC must notify the Services and reinitiate consultation immediately [(50 CFR §402.14(i)(4)].

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UNITED STATES OF AMERICA

Before the

FEDERAL ENERGY REGULATORY COMMISSION

Eugene Water & Electric Board	)	
	)	Project No. 2496-___
Leaburg-Walterville Hydroelectric Project	)	

LICENSE ARTICLE 403 CONSTRUCTION SCHEDULE

Pursuant to Article 403[8] of its license for the Leaburg-Walterville Hydroelectric Project, licensee Eugene Water & Electric Board ("EWEB") hereby submits its construction schedule to conduct all in-river construction during non-critical periods. EWEB has consulted with the U.S. Department of the Interior ("Interior"), the U.S. Department of Commerce ("Commerce"), and the Oregon Department of Fish and Wildlife ("ODFW") with respect to the schedule, and the three agencies have approved the schedule. Interior and Commerce have approved the Article 403 construction schedule by the terms of the "Agreement Among the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the Eugene Water & Electric Board To Resolve

[8]"Article 403. To minimize potential adverse effects to aquatic resources in the McKenzie River, the licensee shall, within one year of license issuance, develop a construction schedule to conduct all in-river construction during non-critical periods.

The licensee shall prepare the construction schedule after consultation with the U.S. Department of the Interior (Interior), the U.S. Department of Commerce (Commerce), and the Oregon Department of Fish and Wildlife. The licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations prior to filing the construction schedule with the Commission. The licensee shall include with the schedule documentation of consultation and copies of comments and recommendations on the completed schedule after it has been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the schedule. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on project-specific information.

The Commission reserves the right to require changes to the proposed schedule. Construction shall not begin until the licensee is notified by the Commission that the filing is approved. Upon Commission approval, the licensee shall implement the proposed schedule, including any changes required by the Commission."

Pending Request for Rehearing and Reconsideration and Petition for Rehearing" submitted to the Commission as part of the "Offer of Settlement" filed concurrently with this Article 403 schedule. EWEB has also obtained the formal written consent of ODFW to this schedule. The schedule is attached as Exhibit 1, and the documentation of consultation with ODFW is attached as Exhibit 2. Signing of the Agreement by Interior and Commerce in the concurrently filed "Offer of Settlement" documents their review and approval of the Article 403 schedule. No additional documentation for their approval is included here.

FEATURES OF THE CONSTRUCTION SCHEDULE

License Article 403 requires the submission of a "construction schedule to conduct all in-river construction during non-critical periods". In order to demonstrate its efforts to avoid critical periods in the river and to assure the Commission and the agencies of its commitment to expeditious construction of fish protection facilities, EWEB has included more than in-river construction in the attached schedule. In turn, this schedule is part of the much larger schedule that EWEB has prepared for the overall license implementation period.[9] (This explains why the task numbers on the left side of the schedule are not sequential. These tasks are a subset of the full schedule.)

In the development of the full schedule, it was necessary for EWEB to make some assumptions regarding actions by other entities that affect EWEB's ability to proceed. Chief among these is the assumption that the Commission will act to approve the offered settlement and incorporate the revised and updated license articles by late December 2001. The full

[9]The full license implementation schedule is also the basis for EWEB's concurrently filed "Motion for Extension Of Time To Comply With License Articles".

schedule also assumes that the Corps of Engineers and the Oregon Division of State Lands will issue appropriate permits for planned construction activities based at least in part on the final Biological Opinion, filed by Interior and Commerce concurrently with this schedule. Local construction permits are not assumed to be dependent on issuance of the final Biological Opinion. Should these assumptions not be realized, or other circumstances arise that force a material change in the construction schedule, EWEB will consult with Interior, Commerce and ODFW before submitting a revised schedule to the Commission for approval.

TIMELINESS OF FILING

License Article 403 requires the licensee to submit its schedule for in-river construction within one year of license issuance. However, the sequence of rehearing petitions, judicial review, Endangered Species Act consultation, remand, more rehearings, and settlement negotiations has led to substantial delays in implementation of license conditions for the Leaburg-Walterville Project.[10] The Commission's most recent formal action on license deadlines was its September 8, 2000 "Order Granting Extensions of Time", which established December 18, 2000 as the date for filing the Article 403 construction schedule. Since that order, EWEB has kept Commission staff well-informed of the progress of negotiations and the impact of delays on its ability to meet license deadlines. When the scheduling of fishway construction became an

[10]A complete discussion of the reasons for delays in filing various plans required by the license articles is contained in the concurrently-filed "Motion for Extension of Time" and "Offer of Settlement".

issue in the settlement negotiations, it became clear that EWEB's filing of its Article 403 construction schedule would have to await completion of negotiations. Thus, this schedule is being filed concurrently with the Offer of Settlement.

CONCLUSION

For the reasons set forth above, the Eugene Water & Electric Board, licensee for the Leaburg-Walterville Hydroelectric Project (FERC #2496) respectfully requests that the Commission approve the attached construction schedule and allow EWEB to proceed with implementation, including construction of fishways.

September __, 2001

Respectfully submitted,

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Gale Banry, Project Manager

Article 403 Construction Schedule

Project Name: Leaburg-Walt. Group   Filter: AAA- Construction for Article 403

#	Task Name	Start	Finish
754	PHYSICAL PLANT SCHEDULE	03/24/00	12/23/03
765	Walterville Outage Project SCREEN/DIVERSION	03/24/00	12/23/02
787	Construction Phase	02/13/02	12/23/02
788	EWEB Issue Notice to Proceed	02/13/02	02/13/02
789	Contractor Complete Outage Prepartions	02/14/02	04/30/02
790	EWEB Dewater/Fish Salvage	05/01/02	05/14/02
791	Contractor Outage Work	05/20/02	10/22/02
792	Contractor Complete In-River Work	07/01/02	08/30/02
793	Replace Cribbing w/Rock	07/01/02	08/30/02
794	Construct Rock Weirs	07/01/02	08/30/02
795	Construct Fish Return Outfall	07/01/02	08/30/02
796	Complete In-River Work	08/30/02	08/30/02
797	Outage Ends	10/22/02	10/22/02
798	Contractor Complete Remaining Post Outage Work	10/23/02	12/23/02
799	Startup & Testing	10/23/02	12/03/02
800	Screen Project Complete	12/23/02	12/23/02
801	Walterville Outage Project TAILRACE BARRIER	03/24/00	10/01/02
823	Construction Phase	01/28/02	10/01/02
824	EWEB Issue Notice to Proceed	01/28/02	01/28/02
825	Contractor Complete Outage Prepartions	01/29/02	04/30/02
826	EWEB Dewater/Fish Salvage	05/01/02	05/14/02
827	Contractor Outage Work	05/15/02	08/30/02
828	Contractor Complete In-River Work	05/15/02	08/30/02
829	Construct Coffer Dam	05/15/02	05/21/02
830	Remove Coffer Dam	08/26/02	08/30/02
831	In River Work Ends	08/30/02	08/30/02
832	Contract Finishes Work	09/02/02	10/01/02
833	Tailrace Barrier Project Complete	10/01/02	10/01/02
834	Walterville Outage Project TAILRACE EXCAVATION	03/24/00	11/21/02
856	Construction Phase	01/28/02	11/21/02
857	EWEB Issue Notice to Proceed	01/28/02	01/28/02
858	Contractor Outage Prepartions	01/29/02	04/29/02
859	EWEB Dewater/Fish Salvage	05/01/02	05/14/02
860	Contractor Construct Outage Work	05/15/02	10/22/02
861	Outage Ends	10/22/02	10/22/02
862	Contractor Complete Post Outage Work	10/23/02	11/21/02
863	Tailrace Excavation Project Complete	11/21/02	11/21/02
894	Leaburg Non-Outage Project RB FISH LADDER	03/24/00	11/13/02
916	Construction Phase	01/30/02	11/13/02
917	EWEB Issue Notice to Proceed	01/30/02	01/30/02
918	Contractor Complete Pre In-River Work	01/31/02	05/10/02

#	Task Name	Start	Finish
919	Contractor Mobilize & Complete Critical Submittals	01/31/02	03/08/02
920	Early Material Procurements	03/11/02	03/29/02
921	Construct Erosion Control	04/01/02	04/05/02
922	Construct Temp Riverside Access Road	04/08/02	04/26/02
923	Construct Temp Fish Return Pipe	04/29/02	05/10/02
924	In-River Work	05/13/02	06/11/02
925	Temp. Fish Return Pipe, Coffer Dam, DEW System, Boulder Removal	05/13/02	06/11/02
926	Ladder & Misc Concrete	06/12/02	09/25/02
927	Ladder Concrete	06/12/02	09/11/02
928	Fish Return Channel Mods	09/12/02	09/25/02
929	Mechanical/Electrical	09/26/02	10/30/02
930	Screen/Gate Mechanical	09/26/02	10/16/02
931	Electrical	10/17/02	10/30/02
932	Final Work	10/31/02	11/13/02
933	Remove Coffer Dam	10/31/02	11/06/02
934	Ladder Operation Flow Adjustments	11/07/02	11/13/02
935	Right Bank Fish Ladder Project Complete	11/13/02	11/13/02
936	**Leaburg Non-Outage Project LB FISH LADDER**	**03/24/00**	**10/29/03**
958	**Construction Phase**	**05/02/03**	**10/29/03**
959	EWEB Issue Notice to Proceed	05/02/03	05/02/03
960	Contractor Construct LB Fish Ladder Improvements	05/02/03	09/12/03
961	Contractor Mobilize & Complete Critical Submittals	05/02/03	06/03/03
962	Early Material Procurements	06/03/03	06/24/03
963	Construct Erosion Control	06/24/03	07/01/03
964	Ladder Out of Service	07/01/03	07/01/03
965	Concrete Construction	07/01/03	08/15/03
966	Mechanical	08/15/03	08/29/03
967	Electrical	08/29/03	09/12/03
968	Ladder Back in Service	09/12/03	09/12/03
969	Final Work	09/12/03	10/29/03
970	Finish Grade, Fencing, Recreation Improvements	09/12/03	10/29/03
971	Project Complete	10/29/03	10/29/03
972	**Leaburg Maintenance Projects - Non-Outage**	**03/24/00**	**09/17/03**
973	**LEABURG ROLLER GATE IMPROVEMENTS (Internal Reinf)**	**03/24/00**	**09/17/03**
1003	Construction Phase (2002 & 2003)	05/02/02	09/17/03
1004	2002 Roller Gate Work (No.1)	05/02/02	11/05/02
1005	EWEB Issue Notice to Proceed - 2002 Work	05/02/02	05/02/02
1006	Contractor Critical Submittals	05/03/02	05/30/02
1007	Contractor Procure Critical Materials	05/31/02	08/30/02
1008	Install Timber Isolation @ Gate No.1	09/02/02	09/13/02
1009	Modify Gate No.1 (Steel Reinforcing)	09/16/02	10/15/02
1010	Paint Gate No.1 & Return to Service	10/16/02	11/05/02
1011	2002-2003 Wet Weather Off Period	11/06/02	05/01/03
1012	No Work Period	11/06/02	05/01/03

#	Task Name	Start	Finish
1013	2003 Roller Gate Work (No.2 and No.3)	05/02/03	09/17/03
1014	2003 Install Timber Isolation @ Gate No.2	05/02/03	05/12/03
1015	Modify Roll Gate No.2 (Steel Reinforcing)	05/13/03	06/11/03
1016	Paint Roll Gate No.2 & Return to Service	06/12/03	07/02/03
1017	Remob for Gate No.3	07/03/03	07/09/03
1018	Install Timber Isolation @ Gate No.3	07/10/03	07/23/03
1019	Modify Roll Gate No.3	07/24/03	08/22/03
1020	Paint Roll Gate No.3 & Return to Service	08/25/03	09/12/03
1021	Roll Gate Work Complete	09/12/03	09/12/03
1022	Demobilize	09/15/03	09/17/03
1023	**Leaburg Non-Outage Project LAKE RAISE**	**09/28/01**	**10/22/03**
1046	**Construction Phase**	**04/21/03**	**10/22/03**
1047	EWEB Issue Notice to Proceed	04/21/03	04/21/03
1048	Construct Lake Raise Improvements	04/22/03	10/22/03
1049	Contractor Mobilize & Complete Critical Submittals	04/22/03	05/26/03
1050	Early Material Procurements	05/27/03	06/25/03
1051	Construct Erosion Control	06/26/03	07/02/03
1052	Construct Lake Raise Improvements- In and Out of River	07/03/03	10/22/03
1053	Out of River Work	07/03/03	10/22/03
1054	In River Work	07/03/03	08/29/03
1055	Lake Raise Improvements Complete	10/22/03	10/22/03
1056	**Leaburg Outage Project TAILRACE BARRIER**	**06/08/01**	**11/11/03**
1081	**Construction Phase**	**03/27/03**	**11/11/03**
1082	EWEB Issue Notice to Proceed	03/27/03	03/27/03
1083	Contractor Outage Prepartions	03/28/03	04/30/03
1084	EWEB Dewater/Fish Salvage	05/01/03	05/14/03
1085	Contractor Construct Outage Work	05/15/03	10/01/03
1086	In-River Work	04/11/03	10/15/03
1087	Prep for In-River Work	04/11/03	05/12/03
1088	Place Tailrace Coffer Dam	05/15/03	06/04/03
1089	Remove Coffer Dam	10/09/03	10/15/03
1090	Outage Ends	10/22/03	10/22/03
1091	Contractor Complete Post Outage Work	10/23/03	11/11/03
1092	Leaburg Tailrace Barried Project Complete	11/11/03	11/11/03
1093	**Leaburg Outage Project SCREEN**	**09/28/01**	**12/23/03**
1115	**Construction Phase**	**04/03/03**	**12/23/03**
1116	EWEB Issue Notice to Proceed	04/03/03	04/03/03
1117	Contractor Outage Prepartions	04/04/03	05/14/03
1118	EWEB Dewater/Fish Salvage	05/01/03	05/14/03
1119	Contractor Construct Outage Work	05/15/03	10/08/03
1120	Outage Ends	10/22/03	10/22/03
1121	Contract Complete Remaining Post Outage Work	10/23/03	12/23/03
1122	Startup & Testing	10/23/03	12/23/03
1123	Screen Project Complete	12/23/03	12/23/03