RECLAMATION
Managing Water in the West

Biological Assessment on the Future Operation and Maintenance of the Rogue River Basin Project

Talent Division

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Columbia-Cascades Area Office, Yakima, Washington
Pacific Northwest Regional Office, Boise, Idaho

October 2009

U.S. Department of the Interior

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities.

Mission of the Bureau of Reclamation

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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Acronyms and Abbreviations

BA	Biological Assessment
BiOp	Biological Opinion
BCWC	Bear Creek Watershed Council
BLM	Bureau of Land Management
BMP	Best management practices
BRT	West Coast Coho Salmon Biological Review Team
cfs	Cubic feet per second
CIG	Climate Impacts Group, University of Washington
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
DPS	Distinct population segment
EFH	Essential fish habitat
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FR	Federal Register
HUC	Hydrologic Unit Code
IFIM	Instream Flow Incremental Methodology
IPOD	Irrigation point of diversion
LWD	Large woody debris
MBI	Migratory Barrier Index
MID	Medford Irrigation District
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NCCSP	National Center for Conservation Science and Policy
NEPA	National Environmental Policy Act
NOAA Fisheries	National Oceanic and Atmospheric Administration, National Marine Fisheries Service (also known as NMFS)
NPDES	National Pollution Discharge Elimination System
O&M	operations and maintenance
ODEQ	Oregon Department of Environmental Quality

ODFW	Oregon Department of Fish and Wildlife
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
PCE	Primary constituent element
PHABSIM	Physical Habitat Simulation System
RBFATT	Rogue Basin Fish Access Technical Team
Reclamation	U.S. Bureau of Reclamation
RM	River mile
RRVID	Rogue River Valley Irrigation District
RPA	Reasonable and prudent alternative
RVCOG	Rogue Valley Council of Governments
SMU	Species management unit
SONCC	Southern Oregon/Northern California Coast Coho
TID	Talent Irrigation District
TMDL	Total Maximum Daily Load
TRT	Technical Review Team
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
VSP	viable salmonid population
WISE	Water for Irrigation, Streams, and the Economy
WUA	Weighted usable area

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Chapter 1 INTRODUCTION

1.1 Purpose

The Bureau of Reclamation (Reclamation) is submitting this Biological Assessment (BA) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) to the National Marine Fisheries Service (NOAA Fisheries). This BA describes and analyzes the effects of future operation and maintenance (O&M) of the Rogue River Basin Project, Talent Division (Project) on critical habitat and listed species. Additionally, this document includes the effects on essential fish habitat (EFH) as required under the Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (110 Stat. 3559, Public Law 104-297).

Each Federal agency has an obligation to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or destroy or adversely modify its critical habitat pursuant to the ESA (16 U.S.C Section 1536(a)(2); 50 CFR Section 402.03). Under relevant regulations (50 CFR Section 402.12[f]), the "contents of a biological assessment are at the discretion of the Federal agency and will depend on the nature of the Federal action." Reclamation followed 50 CFR Section 402.12(f) and the *Endangered Species Consultation Handbook: Procedures for Conducting Consultation and Conference Activities under Section 7 of the Endangered Species Act* (USFWS and NOAA Fisheries 1998) in developing the content of this BA

The Project is located in southwest Oregon near the city of Medford and encompasses Little Butte Creek, Bear Creek, Antelope Creek, and Dry Creek in the Rogue River basin and tributaries of Jenny Creek in the Klamath River basin (Figure 1-1). The Project covers approximately 35,000 acres of irrigated cropland in three irrigation districts: Talent Irrigation District (TID), Medford Irrigation District (MID), and Rogue River Valley Irrigation District (RRVID), collectively referred to as the "Districts."

Congress authorizes Reclamation to design and construct project facilities and operate and maintain them for a period of time. After that time, Reclamation enters into an agreement with the beneficial user (e.g., an irrigation district), transferring the O&M responsibilities to that user. These facilities are referred to as transferred works; however, these agreements do not transfer ownership of the facilities. Only Congress can authorize transfer of title of facilities out of Federal ownership. Occasionally, O&M responsibilities to certain facilities are not transferred to the beneficial user for specific reasons. These facilities are referred to as reserved works and are staffed, operated, and maintained by Reclamation. The only reserved works in the Project are the Green Springs Powerplant and its appurtenant facilities (Cascade Tunnel inlet, Cascade Tunnel, penstock/wasteway control valves, penstock).

Congress, by the Act of August 20, 1954 (68 Stat. 752, Public Law 83-606), authorized the Secretary of the Interior to construct the Rogue River Basin Project Talent Division, consisting of "two principal reservoirs at the Howard Prairie and Emigrant sites, together with other necessary works for the collection, impounding, diversion, and delivery of water, the generation and transmission of hydroelectric power and operations incidental thereto." The 1954 Act was amended by the Act of October 1, 1962 (76 Stat 677, Public Law 87-727) to authorize construction of Agate Dam and Reservoir, a diversion dam, feeder canals, and related facilities as a part of the Talent Division. Fish and wildlife facilities and minimum basic recreation facilities were also authorized. Under the provisions of the Rehabilitation and Betterment Act of October 7, 1949 (63 Stat. 724, Public Law 81-335), as amended, MID and RRVID are eligible to undertake the rehabilitation of some of their existing facilities.

Reclamation has repayment contracts with TID, MID, and RRVID for the Project. These contracts provide for the past rehabilitation, enlargement, and extension of existing facilities, the construction of new facilities, O&M, and the repayment of costs associated with the work. All Project construction and rehabilitation work has been completed.

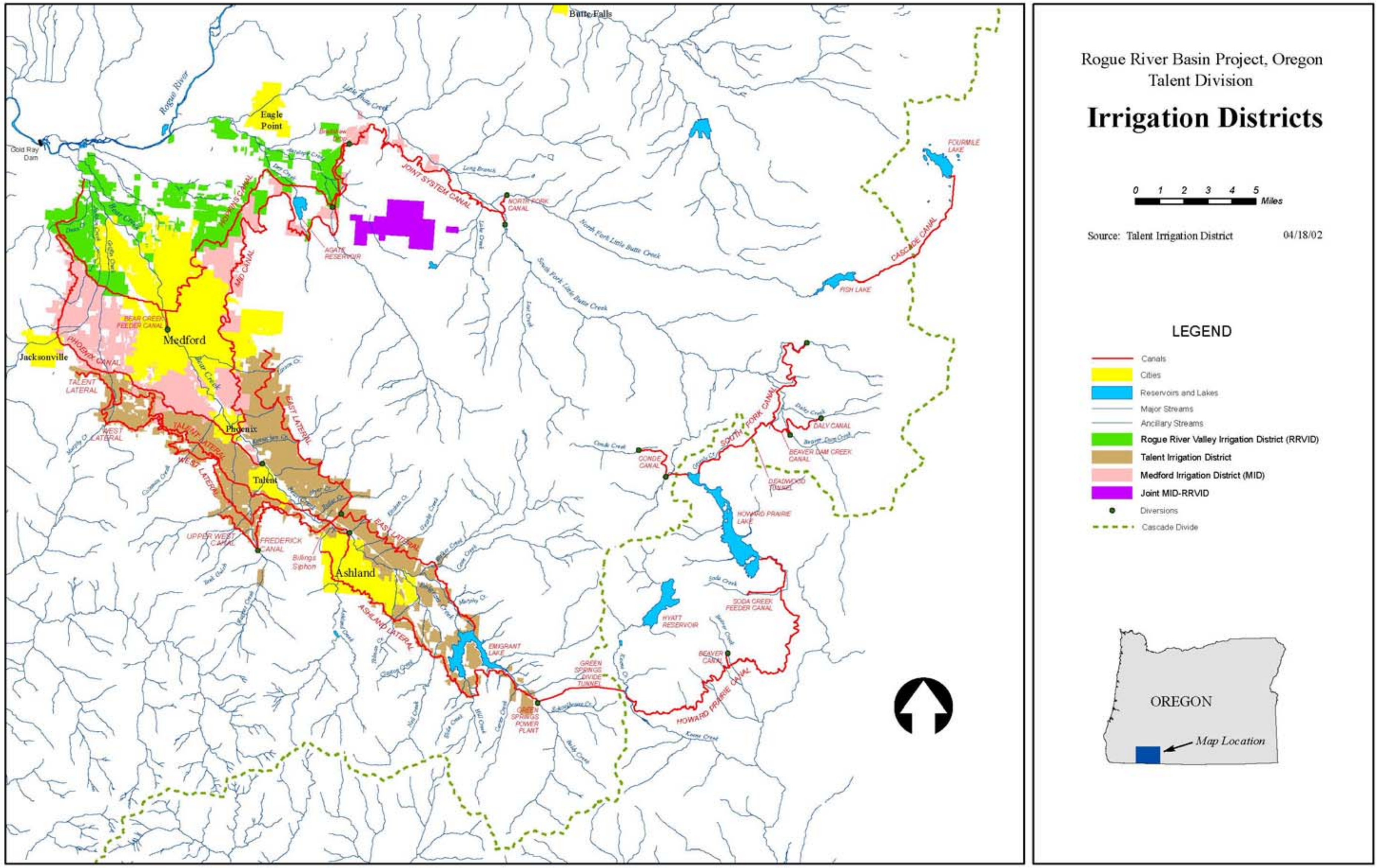


Figure 1-1. Rogue River Basin Project, Oregon

1.2 History of the Rogue Project Section 7 ESA Consultation

1.2.1 Previous Consultations

Reclamation has informally consulted with NOAA Fisheries since 2000 under Section 7 of the ESA on several projects and programs undertaken in the Rogue River Basin Project area. Reclamation evaluated these actions under the National Environmental Policy Act (NEPA) environmental compliance requirements using the respective NEPA documents to identify the effects of the action on ESA-proposed or listed species. Accordingly, the ESA effects analysis has been included in environmental assessment documents followed by Findings of No Significant Impacts (Table 1-1).

Table 1-1. Previous Reclamation ESA Section 7 consultations in the Rogue River basin project action area.

Project Name (NEPA Document)	Listed Species	Consultation Results	USFWS/NOAA Fisheries Determination
J. Herbert Stone Constructed Wetlands Demonstration Project, J. Herbert Stone Nursery, Oregon (FONSI/FEA July 1999)	SONCC coho salmon, peregrine falcon, bald eagle, northern spotted owl	No Effect	Concurrence by USFWS and NOAA Fisheries, 2000
Agate Reservoir Resource Management Plan, Oregon (FONSI/FEA September 2000)	SONCC coho salmon, vernal pool fairy shrimp, peregrine falcon, bald eagle, northern spotted owl	May Affect, Not Likely to Adversely Affect	Concurrence by USFWS and NOAA Fisheries, 2000
Continued Operation and Maintenance of the Rogue River Basin Project (BA August 2003)	Multiple including SONCC coho salmon and designated critical habitat	May Affect, Likely to Adversely Affect	No jeopardy from U.S. Fish and Wildlife Service; continuing consultation with NOAA Fisheries

1.2.2 Coordination in the Preparation of the Biological Assessment

Reclamation has continued communication and coordination with the Districts, USFWS, and NOAA Fisheries. The purpose of this open communication is to allow project stakeholders, in particular NOAA Fisheries, and the Districts to review the proposed action and make recommendations to minimize adverse effects to salmon as well as to improve benefits to other fish and wildlife species. The following list summarizes the informal consultations, site visits, face-to-face meetings, and conference calls that have been held to date which have led to the development of this BA.

October 30-31, 2003	Reclamation conducted an on-site tour with the Districts, consultants, USFWS, and NOAA Fisheries.
November 25, 2003	An interagency meeting was held in Portland, Oregon with Reclamation, the Districts and their attorneys, consultants, USFWS, and NOAA Fisheries.
December 2003	An interagency conference call was held to receive an update from the Consultant. Participants included Reclamation, the Districts, attorneys, USFWS, and NOAA Fisheries.
January 14, 2004	An interagency meeting was held in Portland, Oregon with Reclamation, the Districts and their attorneys, consultants, USFWS, and NOAA Fisheries.
February 12, 2004	An interagency meeting was held in Portland, Oregon with Reclamation, the Districts, attorneys, consultants, USFWS, and NOAA Fisheries.
March 15, 2004	An interagency meeting was held in Portland, Oregon with Reclamation, the Districts, attorneys, consultants, USFWS, and NOAA Fisheries.
March 29, 2004	A conference call was held between Reclamation and USFWS to clarify Reclamation's comments to USFWS.
June 2004	An interagency meeting was held in Portland, Oregon with Reclamation, the Districts, attorneys, consultants, and NOAA Fisheries.
August 2004	An interagency meeting was held in Portland, Oregon with Reclamation, the Districts, attorneys, consultants, and NOAA Fisheries.
February 2005	An interagency meeting was held in Portland, Oregon with Reclamation, the Districts, attorneys, consultants, and NOAA Fisheries.
November 2005	An interagency meeting was held in Portland, Oregon with Reclamation, the Districts, attorneys, consultants, and NOAA Fisheries.
March 27, 2006	Received 2006 Preliminary Draft Biological Opinion (BiOp) from NOAA Fisheries.

April 18-19, 2006	A meeting and site reconnaissance was held in Medford, Oregon with Reclamation, NOAA Fisheries, consultants, and various local organizations to solicit feedback on proposed instream flow study.
May 12, 2006	Rogue Physical Habitat Simulation System (PHABSIM) Project Workshop was held in Medford, Oregon with Reclamation, NOAA Fisheries, U.S. Forest Service (USFS), Oregon Department of Fish and Wildlife (ODFW), Bureau of Land Management (BLM), and consultants to discuss habitat suitability criteria for coho salmon.
September 2006	An interagency meeting was held in Portland, Oregon between Reclamation and NOAA Fisheries to discuss Reclamation's comments to NOAA Fisheries.
November 2006	An interagency meeting was held in Medford, Oregon with Reclamation, the Districts, attorneys, consultants, and NOAA Fisheries to discuss their 2006 Preliminary Draft BiOp.
March 7, 2007	An interagency meeting was held in Medford, Oregon with Reclamation, the Districts, attorneys, consultants, and NOAA Fisheries to discuss their 2006 Preliminary Draft BiOp.
March 8, 2007	Rogue PHABSIM Project Workshop was held in Medford, Oregon with Reclamation, USFWS, NOAA Fisheries, USFS, ODFW, Oregon Department of Water Resources (OWRD), BLM, and consultants to discuss habitat suitability criteria for coho salmon.
July 10, 2007	Reclamation and NOAA Fisheries met to discuss future format of consultation. Reclamation decided to complete a Supplemental BA.
June 16, 2008	An informal meeting was held in Roseburg, Oregon between Reclamation and NOAA Fisheries to discuss the progress of the BA.
January 29, 2009	Reclamation sent the Draft Supplemental BA to NOAA Fisheries and the Districts.
April 21, 2009	Reclamation and NOAA Fisheries met in Portland, Oregon to discuss the Draft Supplemental BA and consultation progress relative to pending litigation. Reclamation decided to proceed with a new BA and move consultation forward.

1.3 Proposed Action

The proposed action is for Reclamation, pursuant to contracts with TID, MID, and RRVID, to divert, store, and deliver water and operate and maintain Federal Project facilities in the future consistent with authorized purposes and routine O&M activities, while implementing the following:

- Modifications to improve fish passage and flow management
- Formalization of flow ramping protocol
- Implementation of minimum operational releases for Emigrant Creek based on total reservoir storage level.

The proposed action area contains (1) Upper South Fork Little Butte Creek and Bear Creek areas (includes Jenny Creek) and (2) Antelope Creek and Dry Creek, as more fully described in Section 1.4. Each section of this BA contains a description of the facilities and general operation procedures, broken down by water collection and storage facilities, and conveyance facilities (Table 1-2). A description of the facilities and O&M activities for the project is located in Chapter 2 with a detailed explanation provided in *Rogue River Basin Project Talent Division, Oregon Facilities and Operations* report (Vinsonhaler 2002).

Table 1-2. Rogue River basin project facilities, ownership, and storage rights.

Facility	Facility Ownership	Location (Basin)	Original Construction/ Reclamation Rehabilitation	Storage/ Water Right	O&M Responsibility
Agate Dam and Reservoir	Reclamation	Dry Creek (Rogue)	Reclamation constructed in 1966	RRVID	RRVID
Howard Prairie Dam and Lake	Reclamation	Jenny Creek (Klamath)	Reclamation constructed in 1958	Reclamation	TID
Hyatt Dam and Reservoir	Reclamation	Keene Creek (Klamath)	TID built in 1922, Reclamation rehabilitated in 1961	TID	TID
Keene Creek Dam and Reservoir	Reclamation	Keene Creek (Klamath)	Reclamation constructed in 1959	Reclamation & TID	TID

Facility	Facility Ownership	Location (Basin)	Original Construction/ Reclamation Rehabilitation	Storage/ Water Right	O&M Responsibility
Green Springs Powerplant	Reclamation	Emigrant Creek (Rogue)	Reclamation constructed in 1960	Reclamation & TID	Reclamation
Emigrant Dam and Lake	Reclamation	Emigrant Creek (Rogue)	TID built in 1924, Reclamation rebuilt in 1961	Reclamation & TID	TID
Upper South Fork Little Butte Creek Diversion Dam and Collection Canal	Reclamation	South Fork Little Butte Creek (Rogue)	Reclamation constructed in 1960	Reclamation	TID
Pole Bridge Creek Diversion Dam	Reclamation	Pole Bridge Creek (Rogue)	Reclamation constructed in 1960	TID assigned to Reclamation	TID
Daley Creek Diversion Dam and Collection Canal	Reclamation	Daley Creek (Rogue)	Reclamation constructed in 1960	TID assigned to Reclamation	TID
Beaver Dam Creek Diversion Dam	Reclamation	Beaver Dam Creek (Rogue)	Reclamation constructed in 1960	TID assigned to Reclamation	TID
Conde Creek Diversion Dam and Collection Canal	Reclamation	Conde Creek (Rogue)	Reclamation constructed in 1958	TID assigned to Reclamation	TID
Dead Indian Creek Diversion Dam	Reclamation	Dead Indian Creek (Rogue)	Reclamation constructed in 1958	TID assigned to Reclamation	TID
Soda Creek Diversion Dam and Feeder Canal	Reclamation	Soda Creek (Klamath)	Reclamation constructed in 1959	Reclamation	TID
Little Beaver Creek Diversion Dam and Delivery Canal	Reclamation	Little Beaver Creek (Klamath)	Reclamation constructed in 1959	Reclamation	TID

Facility	Facility Ownership	Location (Basin)	Original Construction/ Reclamation Rehabilitation	Storage/ Water Right	O&M Responsibility
Antelope Creek Diversion Dam and Feeder Canal	Reclamation	Antelope Creek (Rogue)	Reclamation constructed in 1966, fish screen & passage added in 1998	RRVID	RRVID
Agate Reservoir Feeder Canal	Reclamation	Dry Creek (Rogue)	Reclamation constructed in 1966	RRVID	RRVID
Ashland Canal Diversion Dam	Reclamation	Emigrant Creek (Rogue)	Reclamation relocated original works and rebuilt in 1959	TID & Reclamation	TID
Ashland Creek Diversion	Reclamation	Ashland Creek (Rogue)	TID constructed in 1924	TID	TID
Oak Street Diversion	Reclamation	Bear Creek (Rogue)	Reclamation constructed in 1961, fish screen & passage added in 1997	TID & Reclamation	TID
Phoenix Canal Diversion and Feeder Canal	Reclamation	Bear Creek (Rogue)	originally built about 1900, Reclamation rehabilitated in 1960, fish screens & passage added in 1998	MID	MID
Jackson Street Diversion and Feeder Canal	RRVID	Bear Creek (Rogue)	originally built about 1910, removed and replaced in an upstream location in 1998, fishscreen & passage added in 1999	RRVID	RRVID
Deadwood Tunnel	Reclamation	South Fork Little Butte Creek (Rogue)	Reclamation constructed 1956-1958	Combination	TID

Facility	Facility Ownership	Location (Basin)	Original Construction/ Reclamation Rehabilitation	Storage/ Water Right	O&M Responsibility
Howard Prairie Delivery Canal	Reclamation	Jenny Creek watershed (Klamath)	Reclamation constructed 1956-1959	Combination	TID
Cascade Divide Tunnel	Reclamation	(Cascade Divide)	Reclamation constructed 1958-1959	Combination	TID
Green Springs Tunnel	Reclamation	(Rogue)	Reclamation constructed 1957-1959	Combination	TID
Ashland Canal	Reclamation	Emigrant Creek (Rogue)	constructed in 1923	Combination	TID
East Canal	Reclamation	Emigrant Creek (Rogue)	constructed in 1925	Combination	TID
West Canal	Reclamation	Bear Creek (Rogue)	constructed in 1925	Combination	TID
Talent Canal	Reclamation	Bear Creek (Rogue)	constructed prior to 1925	Combination	TID
Phoenix Canal	MID	Bear Creek (Rogue)	constructed in 1960	MID	MID
Jackson Street Diversion Canal	RRVID	Bear Creek (Rogue)	constructed in 1906	RRVID	RRVID
Hopkins Canal	RRVID	(Rogue)	constructed prior to 1910	RRVID	RRVID

1.4 Action Area

Reclamation defines the “action area” as all areas to be affected directly or indirectly by the Federal proposed action which consists of future Project O&M activities that includes reservoirs and stream reaches primarily used by the Districts to divert, store, and deliver water as well as diversion dams and water conveyance canals. The Project is located in southern Oregon near the city of Medford and may effect Little Butte Creek, Bear Creek, Antelope Creek, and Dry Creek in the Rogue River basin and tributaries of Jenny Creek in the Klamath River basin (Figure 1-1) and covers approximately 35,000 acres of irrigated cropland in the Districts. Principal features of the Talent Division include Howard Prairie

Dam, Howard Prairie Delivery Canal, Keene Creek Dam, Green Springs Powerplant, Emigrant Dam and Lake, and Agate Dam and Reservoir. Direct or indirect effects may also occur in the Klamath River below Iron Gate Dam.

TID, MID, and RRVID are in the Rogue River basin in southern Oregon. MID and RRVID are located in the valley of lower Bear Creek, a tributary of the Rogue River, adjacent to the city of Medford, Oregon.

TID consists of approximately 15,500 irrigable acres. MID has a water supply for 11,500 acres, and RRVID has a water supply for 8,300 acres. TID also provides limited municipal and industrial water service. Supplemental water for MID and RRVID is diverted through the Project facilities. MID diverts its supplemental water at Phoenix Diversion Dam, and RRVID diverts its share from a reconstructed Jackson Street Diversion Dam in Medford, Oregon. Additionally, Reclamation provides electric power from the 16,000-kilowatt hydroelectric Green Springs Powerplant.

To supply water to lands in TID and supplemental water to MID and RRVID, a collection canal system was constructed to divert flows of the South Fork Little Butte Creek in the Rogue River basin through a tunnel beneath the Cascade Divide to Howard Prairie Lake in the Klamath River basin. Howard Prairie Dam stores collection canal diversions and Beaver Creek runoff. Howard Prairie delivery canal conveys the water from the storage reservoir to Keene Creek Regulating Reservoir, which also regulates releases from Hyatt Reservoir.

Water from Soda and Little Beaver Creeks is diverted into the delivery canal by the Soda Creek Diversion Dam and Little Beaver Creek Diversion Dam. From Keene Creek Reservoir, a tunnel and conduit carry the water back across the Cascade Divide and down to Green Springs Powerplant on Emigrant Creek. Emigrant Dam re-regulates powerplant discharges for irrigation. Storage in Agate Reservoir on Dry Creek is enhanced by diverting water from Antelope Creek and Little Butte Creek.

1.5 Listed Species in the Action Area

Southern Oregon/Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*) is the listed species that falls under the jurisdiction of NOAA Fisheries that occurs in the action area. Critical habitat for this species was designated in 1999 and is also present in the action area.

Chapter 2 ROGUE RIVER PROJECT FACILITIES

This chapter contains a description of the facilities and general operation procedures in the action area, broken down by water collection and storage facilities and conveyance facilities (Table 1-2 in Chapter 1). A more detailed explanation of the facilities, including privately-owned facilities, and O&M activities is provided in the *Rogue River Basin Project Talent Division, Oregon, Facilities and Operations* report which is incorporated here by reference (Vinsonhaler 2002).

2.1 Upper South Fork Little Butte Creek Area and Bear Creek Area

The Upper South Fork Little Butte Creek area and Bear Creek area include the following facilities:

- Water collection and storage facilities:
  - Water collection facilities on the headwaters of South Fork Little Butte Creek and its tributaries in the Rogue River basin which collect and move water from the Rogue River basin for storage in Klamath River basin
  - Water collection facilities on Jenny Creek tributaries in Klamath River basin
  - Water storage facilities on Jenny Creek tributaries in Klamath River basin
  - Water storage facilities on Emigrant Creek in Rogue River basin
- Water conveyance facilities:
  - Water conveyance facilities which move water from the Rogue River basin to the Klamath River basin
  - Water conveyance facilities which move water from the Klamath River basin to the Rogue River basin
  - Diversion dams on Bear Creek which divert water into canals
- Powerplant facilities:
  - Green Springs Powerplant

2.1.1 Water Collection and Storage Facilities

Water Collection Facilities

A portion of the South Fork Little Butte Creek streamflows in the Rogue River basin is diverted near its headwaters by the upper South Fork Diversion Dam into the South Fork Collection Canal. From there, the canal extends about 4 miles to a point where flows from Pole Bridge Creek are intercepted. At about canal mile 7.4, the South Fork Collection Canal is joined by the Daley Creek Collection Canal which collects runoff from Daley Creek and Beaver Dam Creek. At canal mile 8.6, the South Fork Collection Canal, with a capacity of 130 cubic feet per second (cfs), enters Deadwood Tunnel which conveys the collected runoff from the west side of Cascade Divide to east side. This water is then discharged into the natural channel of Grizzly Creek that flows into Howard Prairie Reservoir in the Klamath River basin.

Water from two other headwater tributaries of South Fork Little Butte Creek is also moved from the Rogue River basin to the Klamath River basin. The flow of Conde Creek is diverted at Conde Creek Diversion Dam into the Conde Creek Canal which terminates at Dead Indian Creek. The combined flow of Conde and Dead Indian creeks is then diverted into the 86-cfs-capacity Dead Indian Creek Canal which crosses Cascade Divide and discharges into Howard Prairie Reservoir in the Klamath River basin.

These water collection facilities are operated and maintained by TID. The facilities can operate year round, but most creek diversions usually occur during the winter and spring months until the needs of downstream senior natural flow rights in the Little Butte Creek drainage take precedent.

The average amount of water transferred for water years 1962 to 1999 was about 15,500 acre-feet. Table 2-1 provides an estimate of the volume and timing of average monthly diversions of the South Fork Little Butte Creek transbasin transfers.

Table 2-1. Average monthly South Fork Little Butte Creek[1] transbasin water transfer, Rogue River basin project (in acre-feet).

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
259	618	1,510	1,603	1,636	2,285	3,020	3,127	1,059	277	54	49

[1] Average of the sum of measured flow for water years 1962 to 1999. South Fork Little Butte Creek Collection Canal near Pinehurst (USGS:1433940) and Dead Indian Canal near Pinehurst (USGS:14340400).

Water Storage Facilities

The Project storage facilities include Howard Prairie Dam and Reservoir (Lake), Hyatt Dam and Reservoir, Keene Creek Dam and Reservoir, and Emigrant Dam and Reservoir (Lake). TID operates and maintains the water storage facilities. Contracts between Reclamation and TID, MID, and RRVID provide for these reservoirs to be operated as a pooled system with a total active capacity of 115,000 acre-feet. These contracts allocate the pooled storage as follows:

- 8,500 acre-feet (7.4 percent) is preferred capacity assigned to TID. The first annual inflow to the system is assigned to this preferred capacity.
- The residual capacity of 106,500 acre-feet (92.6 percent) is considered as new capacity and is assigned as follows:
    - 4,000 acre-feet (3.8 percent) to RRVID
    - 8,000 acre-feet (7.5 percent) to MID
    - 94,500 acre-feet (81.3 percent) to TID

Each irrigation district has the right to carry its stored water over from one year to the next year as long as the stored water does not exceed its assigned reservoir space. In addition to the irrigation storage, each reservoir has established surcharge space restrictions based on Reclamation requirements and Safety of Dam procedures. Surcharge space is the reservoir capacity provided for use in passing floods. This space can be used during emergency situations or extreme conditions on the reservoir or the river basin. For all of the Project reservoirs the surcharge space “floor” is the spillway crest.

Howard Prairie Dam and Lake

Howard Prairie Dam and Lake (total capacity 62,100 acre-feet; active capacity 60,600 acre-feet) are located on Jenny Creek. The priority for filling Howard Prairie Lake is to collect runoff from the Jenny Creek watershed, then supplement the runoff with transbasin transfers from the South Fork Little Butte Creek Collection System. The filling of Howard Prairie Lake can occur at any time and at any rate. There is no formalized flood control operation for the lake.

Howard Prairie Lake provides water for irrigation purposes in the Bear Creek drainage of Rogue River basin and for hydroelectric generation at Green Springs Powerplant. Releases from Howard Prairie Dam can be made at any time into the 18.7-mile-long Howard Prairie Delivery Canal which terminates at Keene Creek Reservoir. Storage releases are usually maintained at the maximum 53 to 55 cfs carrying capacity of Howard Prairie Delivery Canal throughout the year except as modified by downstream runoff intercepted by the canal en route to Keene Creek Reservoir. Flows from Soda and Little Beaver Creeks are diverted into Howard Prairie Delivery Canal.

Hyatt Dam and Reservoir

Located in the Klamath River basin, Hyatt Dam and Reservoir (total capacity 16,200 acre-feet; active capacity 16,200 acre-feet) store runoff from the Keene Creek watershed, a tributary of Jenny Creek. Hyatt Reservoir is operated by TID to supplement irrigation water and hydroelectric generation demands not met from Howard Prairie Lake. Hyatt Reservoir releases flow down Keene Creek a few miles to Keene Creek Reservoir.

Hyatt Reservoir can be filled at any time and at any rate. Although no formalized flood control operations exist, prudent efforts are made to maintain some flood control capability. The goal at Hyatt Reservoir is to operate in the top half (8,000 acre-feet) of the reservoir. This allows 8,000 acre-feet of stored water to be carried over to the next year and provides reasonable assurance that Hyatt Reservoir will refill.

Keene Creek Dam and Reservoir

Keene Creek Dam and Reservoir (total capacity 370 acre-feet; active capacity 260 acre-feet) receives water from Howard Prairie Lake via the Howard Prairie Delivery Canal and from Hyatt Reservoir releases into Keene Creek. The dam creates an impoundment used to regulate flows to the Green Springs Powerplant for various generating modes.

Emigrant Dam and Lake

Emigrant Dam and Lake (total capacity 40,500 acre-feet; active capacity 39,000 acre-feet) sits on Emigrant Creek. Emigrant Lake is the lowermost storage facility in this system and gets its water supply from several sources:

- Water is transferred by South Fork Little Butte Creek Collection System from the Rogue River basin to the Klamath River basin and released from Howard Prairie Lake
- Runoff from Keene Creek (a Jenny Creek tributary in the Klamath River basin) is impounded in and released from Hyatt Reservoir
- Runoff from various Jenny Creek tributaries in Klamath River basin is intercepted by Howard Prairie Delivery Canal en route to Keene Creek Reservoir.
- Emigrant Creek natural inflows.

Emigrant Dam and Reservoir are operated by TID to provide irrigation water in the Bear Creek drainage and for flood control. Releases are made into Emigrant Creek or directly into TID's East Canal.

Water can be impounded in the flood control reserved space only when inflow from Emigrant Creek is greater than 600 cfs or flow in Bear Creek at the Medford gage (Reclamation: MFDO; USGS: 14357500) is forecasted to be greater than 3,000 cfs. Any flood control reserved space filled under the foregoing conditions must be evacuated as soon as possible. Flood control of Emigrant Dam is described further in Section 3.2.1.

The lake reaches its highest level after April 1. It is drawn down during the irrigation season and reaches its lowest level in mid-October. The outlet gates at Emigrant Dam are normally completely shut at the end of the irrigation season after a ramp-down process, to accommodate refilling the lake. At the end of the irrigation season, releases from Emigrant Lake are made only if required by the flood control management plan. Tributaries, and for a time irrigation return flows, provide most of the flow in the mainstem unless flood control releases are made.

Project irrigation demands can often be met during the spring months with natural flow from tributaries downstream from Emigrant Dam and irrigation surface and subsurface return flows. When irrigation demands can no longer be fully met from these sources, storage water is released from Emigrant Lake to meet demands of the Districts. Stored water is called for by MID and RRVID from TID, who operates Emigrant Dam and Reservoir. The released stored water is assessed against the respective irrigation district's stored water supply.

Emigrant Creek flows about 4.5 miles downstream from Emigrant Dam to the confluence of Neil Creek at river mile (RM) 24.8 where Bear Creek begins. From this point Bear Creek, continues an additional 24.8 miles to its confluence with the Rogue River.

Water Conveyance Facilities

The water conveyance facilities which move water from the Klamath River basin through the Cascade Divide to the Rogue River basin consist of the Howard Prairie Delivery Canal, Keene Creek Reservoir, and Green Springs Powerplant and appurtenant works. These facilities transfer water (1) collected from the headwaters of South Fork Little Butte drainage and moved from the west side of Cascade Divide to the east side for storage in Howard Prairie Lake and (2) Jenny Creek tributary runoff impounded by Howard Prairie and Hyatt Dams as well as downstream runoff intercepted en route to Rogue River basin.

Howard Prairie Delivery Canal

The 18.7-mile-long Howard Prairie Delivery Canal extends from the outlet of Howard Prairie Dam to Keene Creek Reservoir. Operated by TID, the canal has the ability to convey 53 to 55 cfs, its maximum carrying capacity, to meet irrigation needs for stored water in Emigrant Lake and to facilitate hydroelectric generation at the Green Springs Powerplant.

The extent of releases from Howard Prairie Lake depends upon the flows of Soda Creek and Little Beaver Creek which are intercepted en route by the Howard Prairie Delivery Canal as well as discharges from Hyatt Reservoir. Hyatt Reservoir elevation and discharge, Soda Creek and Little Beaver Creek flows and Howard Prairie Lake storage are monitored through the Hydromet system. When the Howard Prairie Delivery Canal is close to capacity due to Soda Creek and Little Beaver Creek inflows, releases from Howard Prairie Lake are curtailed. Peak inflows are about 11 cfs from Soda Creek and about 24 cfs from Little Beaver Creek.

During water years 1961 to 2000, an annual average amount of about 24,000 acre-feet of runoff from the Jenny Creek drainage was moved from the east side to west side of the Cascade Divide through the Green Springs Powerplant and appurtenant works. Table 2-2 provides an estimate of the volume and timing of average monthly diversions of the Jenny Creek contributions.

Table 2-2. Average monthly Jenny Creek[1] transbasin water transfer, Rogue River Basin Project (in acre-feet).

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep
238	330	1,014	1,598	3,579	6,171	6,988	2,629	724	358	227	220

[1] Based on observed and estimated flow and reservoir content for water years 1961-2000 at Howard Prairie Lake, Hyatt Reservoir, Green Springs Powerplant, (USGS:14339499, South Fork Little Butte Creek Collection Canal Near Pinehurst), and Dead Indian Collection Canal near Pinehurst (USGS:14340400). See the Draft Technical Memorandum, Jenny Creek contributions to the Rogue basin, March 1, 2001, in Appendix B of Vinsonhaler 2002.

Green Springs Powerplant and Appurtenant Works

Water released from Keene Creek Reservoir flows through the Green Springs Powerplant and appurtenant works and is discharged into Emigrant Creek upstream of Emigrant Lake. The 18-megawatt powerplant and appurtenant works are operated by Reclamation. The power produced at the powerplant is provided to Bonneville Power Administration at the switchyard.

The Green Springs Powerplant normally operates daily during the irrigation season and on an abbreviated schedule during the non-irrigation season. If Keene Creek Reservoir receives higher than normal flows, then the Green Springs Powerplant is operated accordingly. When water bypasses the powerplant, it travels through a control structure to Schoolhouse Creek, Tyler Creek, and Emigrant Creek.

When total storage in Howard Prairie Lake is less than 20,000 acre-feet, the operation for higher power generation is modified. This is done by reducing the continuous flow into Keene Creek Reservoir to 30 cfs or the amount of available unregulated runoff, whichever is greater.

The average annual transbasin transfer through Green Springs Powerplant and appurtenant works for water years 1962 to 1999 amounted to 39,500 acre-feet. This was comprised of 15,500 acre-feet moved from the Rogue River basin via South Fork Little Butte Creek Collection Canal to Howard Prairie Lake (Table 2-1) plus 24,000 acre-feet of Jenny Creek drainage runoff (Table 2-2).

Major Rogue Diversion Dams and Conveyance Facilities

The major water diversion dams and conveyance facilities which carry water within the Rogue River basin and convey the water to points of use include:

- Ashland Canal Diversion Dam, on Emigrant Creek at 33.7 miles above the mouth of Bear Creek, about 100 feet downstream from the Green Springs Powerplant discharge; diverts up to 48 cfs into the Ashland Canal on the west side of the creek.
- The 132-cfs capacity East Canal receives water directly from Emigrant Dam at 29.3 miles above the mouth of Bear Creek, and the 39-cfs capacity West Canal bifurcates off the East Canal at canal mile 11.0.
- Oak Street Diversion Dam at RM 21.59 diverts up to 65 cfs into the Talent Canal which begins on the east side of Bear Creek.
- Phoenix Canal Diversion Dam at RM 16.8 delivers water into the Phoenix Canal with a maximum of 102 cfs on the west side of Bear Creek. The Phoenix Canal also receives up to 49 cfs from the Little Butte Creek drainage by siphon from the Medford Canal. The maximum capacity of the Phoenix Canal at the junction is 75 to 85 cfs.
- Jackson Street Diversion Dam, a non-Federal facility, at RM 9.5 diverts into a short canal on the west side that connects with the 50-cfs capacity Hopkins Canal (a non-Federal facility) before it crosses Bear Creek by siphon. The Hopkins Canal also carries water from the Little Butte Creek drainage.

Table 2-3 shows annual diversions in Bear Creek drainage by the Districts for water years 1990 through 1999. For these ten years, the average annual diversion during the irrigation season by the Districts was 70,000 acre-feet.

Table 2-3. Annual MID, TID, and RRVID diversions in Bear Creek subbasin for water years 1990-1999 (in acre-feet) (Vinsonhaler 2002).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Upstream from Emigrant Reservoir										
Ashland Canal	10,300	7,600	6,300	6,200	8,300	6,100	8,100	9,400	7,100	6,900
Directly from Emigrant Reservoir										
East Canal	36,700	29,500	26,200	28,700	32,700	29,300[1]	34,600	33,100	38,700	39,700
Downstream from Emigrant Reservoir Diverted From Bear Creek										
Talent Canal	8,300[2]	13,800	8,800	12,500	11,200	14,000	13,500	14,000	13,500	15,500
Phoenix Canal	13,000	14,900	4,800[3]	11,200	7,000	11,700	10,100	9,800	10,600[3]	14,500
Hopkins Canal	4,100	4,200	5,200	6,700	8,600	7,900	8,200	8,900	7,900	6,800
Total	72,600	70,000	50,900	65,500	67,800	69,000	74,500	76,700	72,200	80,900

[1] Partial data for June 1995 and significant missing data for July 1995 but data estimated.

[2] Missing data for May and June 1990.

[3] Partial data for June and July 1992 and missing data for May 1998.

2.2 Antelope Creek / Dry Creek Areas

The Antelope Creek/Dry Creek areas include the following facilities:

- Water Collection and Storage Facilities:
  - Water collection facility on Antelope Creek.
  - Storage regulating facility on Dry Creek.
- Water Conveyance Facilities:
  - Antelope Feeder Canal.
  - Agate Feeder Canal.

2.2.1 Water Collection and Storage Facilities

Water Collection Facilities

Antelope Creek Diversion Dam at RM 7.0 of Antelope Creek diverts up to 50 cfs into a connector canal extending about 0.1-mile to the Hopkins Canal. Flows in the connector canal are combined with the Hopkins Canal flows until they reach a bifurcation structure where the flows from Antelope Creek are diverted to Agate Reservoir. An estimated 1,400 acre-feet is diverted annually from Antelope Creek.

From November through March, a minimum flow of 1 cfs must pass downstream from Antelope Creek Diversion Dam for streamflow maintenance while Project diversions are being made. From April through October, 2 cfs or the natural streamflow, whichever is less, must be bypassed for streamflow maintenance and senior water rights. The stream is often dry at the diversion dam in the summer months and no diversions are made.

Water Storage Facility

Agate Dam and Reservoir, located on Dry Creek in the Rogue River basin, stores and re-regulates water from Antelope Creek, natural flows of Dry Creek, and water conveyed from the North and South Forks of Little Butte Creek. Agate Dam and Reservoir has a total capacity of 4,780 acre-feet and an active capacity of 4,670 acre-feet. The dam and reservoir are operated by RRVID as a storage and re-regulating facility.

Water can be stored in Agate Reservoir at any time and at any rate consistent with downstream rights. There is no flood control operation as the reservoir is kept as full as possible. Water released from Agate Dam into Dry Creek flows a short distance downstream where it is diverted into the Hopkins Canal for irrigation uses on RRVID lands on both the east and west sides of Bear Creek. Dry Creek flows into Antelope Creek below Agate Dam which flows into Little Butte Creek at RM 3.2, downstream from Eagle Point.

Releases from Agate Reservoir of 1 cfs for streamflow maintenance in Dry Creek are made when the inflow is equal to or greater than that amount. If inflow is less than 1 cfs, then the inflow amount is released for streamflow maintenance. These releases are made through a 6-inch bypass line in the outlet works.

2.3 Maintenance

With the exception of Green Springs Powerplant, the Districts have the responsibility for maintenance of all Project facilities.

2.3.1 Inspection

All project facilities are subject to on-going inspection programs. Dams identified as a high risk to downstream populations in the event of a failure are examined every three years and an underwater inspection by divers of the outlet works and spillway stilling basins is typically conducted every six years. Diversion and delivery facilities and dams characterized as low risk are examined at least every six years.

The Green Springs Powerplant penstock intake is periodically examined by divers. Flow through the penstock must be stopped to conduct this examination.

2.3.2 Routine Maintenance

The Districts maintain the transferred works of the Project. Routine maintenance is performed in accordance with state and Federal laws. To the extent possible, most maintenance is completed during the non-irrigation season. At times, it may be necessary to work within the stream channel, but an effort is made to minimize this work. Extraordinary maintenance is consulted on separately.

Fish screens and passage facilities are maintained according to the various Designer's Operating Criteria documents. Fish screens are removed every year by RRVID and the headgates closed as a precaution against damage from high runoff for their facilities since they are within the active stream channel. TID and MID do not remove their screens annually (unless they need maintenance) since their facilities are isolated from the creek channel by control gages which are closed in the off season.

The maintenance program may include, but is not limited to, the following activities:

- repair eroded concrete
- recoat or replace corroded metal work
- repair cavitation damage to control gates
- remove sediment, rock, and debris from intake and outlet works
- stabilize embankments
- reshape canals
- replace riprap
- remove trees and debris
- repair structures at creek crossings
- maintain access roads and right-of-way fencing
- control noxious and aquatic weeds

2.3.3 Green Springs Powerplant

Reclamation maintains the reserved works of the Green Springs powerplant and its appurtenant facilities including the Tyler Creek bypass channel. Routine maintenance is done in accordance with state and Federal laws. Maintenance items include, but are not limited to:

- turbine and transformer upkeep
- tailrace upkeep
- embankment stabilization

Chapter 3 ENVIRONMENTAL BASELINE

The environmental baseline describes the impacts of past and ongoing human and natural factors leading to the current status of the species and its critical habitat within the action area, providing a "snapshot" of the relevant species' present health and habitat. This includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 ESA consultation, and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR 402.2). The environmental baseline assists both the action agency and NOAA Fisheries in determining the effects of the proposed action on listed species and critical habitat and whether the proposed action will jeopardize the listed species or adversely modify or destroy its critical habitat.

3.1 Fisheries

3.1.1 Current Range-wide Status of the SONCC Coho Salmon

All actions and effects included in the environmental baseline have led to the current status of SONCC coho salmon in the Rogue River basin. SONCC coho salmon in this evolutionarily significant unit (ESU) experienced significant population declines through the Twentieth Century. Human-caused factors, in combination with natural variability in marine and freshwater environmental conditions, essentially impacted all phases of the fishes' life cycle in this ESU, diminishing its population numbers steadily over time. Historically, coho salmon abundance within this region was estimated from 150,000 to 400,000 native fish (62 FR 24588). In 1997, abundance was estimated to be less that 30,000 naturally reproducing coho salmon, and a vast majority of those (roughly 20,000) were considered to be non-native fish (62 FR 24588).

Overall, the Rogue River basin, its tributaries, and riparian areas are in relatively poor condition with respect to fish habitat conditions (USFS and BLM 1997). Stream habitat degradation from road building, logging, livestock grazing, mining, irrigation diversion, urbanization, wetlands removal, channelization projects, and point and non-point source water pollution impact coho salmon survival in freshwater. The May 6, 1997, Federal Register notice presented summary information on these factors that led to the current status of SONCC coho salmon ESU (62 FR 24588).

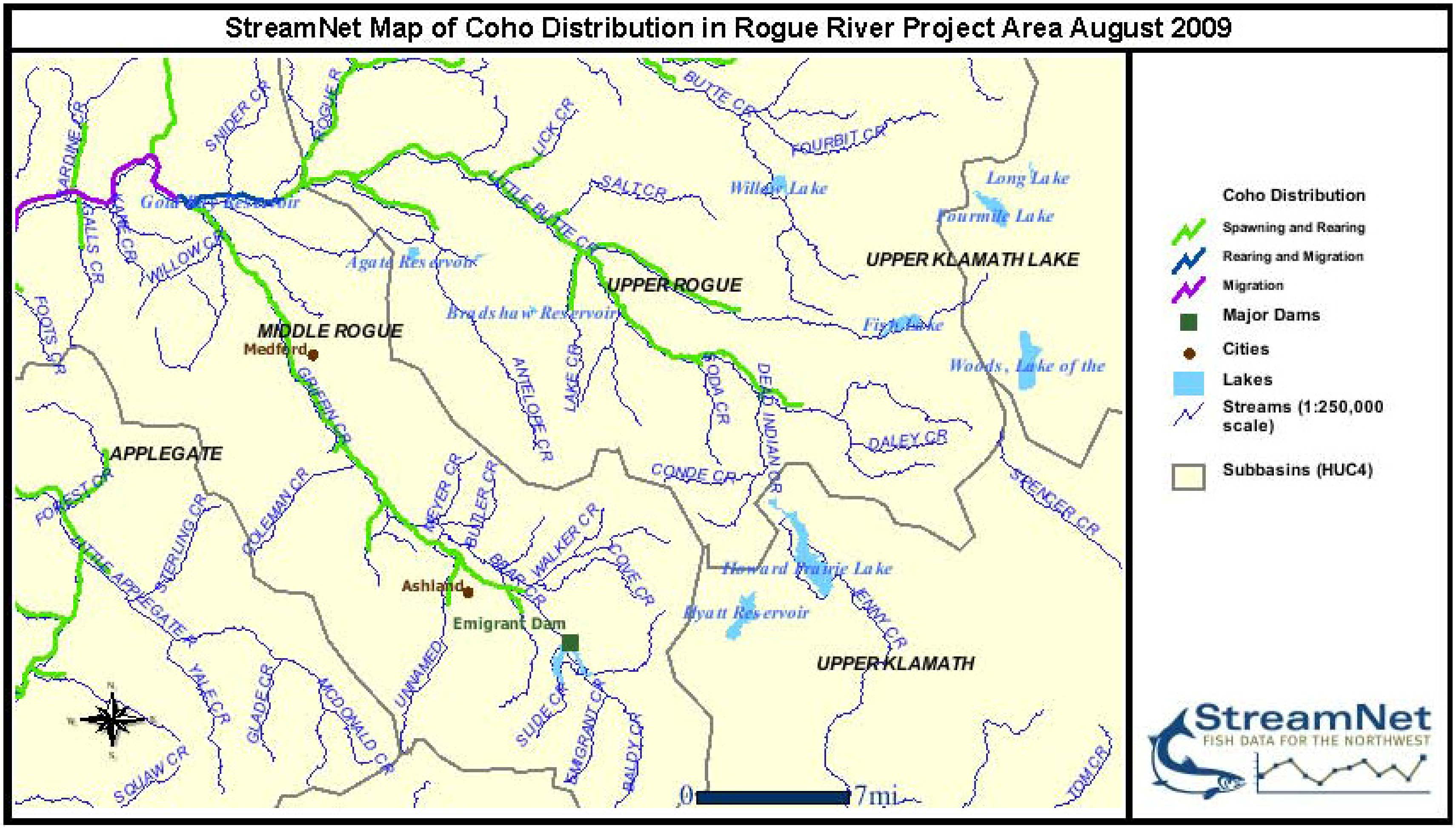
Hatchery and fishery management plus regulatory practices prior to the listing often worked against preservation of wild coho salmon populations. SONCC coho salmon, along with the region's other salmon and steelhead species, historically supported major commercial and sport fisheries. Overfishing of coho salmon was sanctioned from the mid-1970s to the mid-1990s during a time when poor ocean conditions resulted in poor salmon growth and survival; consequently, overharvesting contributed heavily to the decline in coho salmon populations.

Coho salmon fisheries during the mid-1970s to the mid-1990s consisted of a meager wild fish component mixed with a much more abundant, artificially-produced hatchery population of coho salmon. The greater numbers of hatchery fish within these fisheries could not be distinguished from fish produced in nature. This allowed for excessive harvest on declining wild fish stocks. In 1988, this problem was eliminated when Oregon hatcheries began clipping the adipose fin of all released juvenile coho salmon (Jacobs et al. 2000) and ODFW began restricting harvest of wild fish.

Fluctuating ocean conditions, in particular the Pacific Decadal Oscillation, produced alternating periods of good and poor ocean productivity and environmental conditions that affected the survival of anadromous salmonids. Ocean conditions and cold, nutrient-rich upwelling currents stimulate and enhance phytoplankton and zooplankton production which directly benefit prey animals that coho salmon feed upon. Numerous El Niño climate occurrences in recent decades have depressed upwelling currents, resulting in reduced coho salmon growth rates and survival. El Niño-Southern Oscillation events are superimposed over the longer-term Pacific Decadal Oscillation to affect ocean productivity. Droughts and flooding over time added to the adverse impacts to naturally occurring anadromous fish runs and caused most wild Pacific Coast coho salmon populations to be listed or considered for listing under the ESA.

Rogue River basin streams inhabited by SONCC coho salmon and influenced by Project operations include Little Butte Creek and Bear Creek watersheds (Figure 3-1).

Figure 3-1. Distribution of coho salmon in Little Butte Creek and Bear Creek watersheds (streamnet.org, August 7, 2009).



3.1.2 Current Status of Upper Rogue River Subbasin Independent Population

The Project lies within the upper Rogue River subbasin of the SONCC coho salmon ESU (Figure 3-2). The upper Rogue River subbasin population of the SONCC coho salmon has been identified as a functionally independent population (Williams et al. 2008). A functionally independent population has a high likelihood to persist over a 100-year time scale and "whose population dynamics or extinction risk over a 100-year time period is not substantially altered by exchanges of individuals with other populations" (Williams et al. 2006; McElhany et al. 2000).

Multiple reviews have been conducted to evaluate the status of the SONCC ESU coho salmon and specifically for the upper Rogue River coho salmon population. For the purposes of the environmental baseline, each relevant report is summarized below to identify the range of analysis that has been completed.

The West Coast Coho Salmon Biological Review Team (BRT) conducted an analysis of the SONCC coho salmon (BRT 2003) utilizing a risk-matrix method reflective of the four major criteria identified in the NOAA Fisheries Viable Salmonid Population (VSP) document (McElhany et al. 2007). The four criteria are abundance, growth rate/productivity, spatial structure, and diversity. The BRT concluded that positive upward trends in mean spawner abundance in the Rogue River reflect the effects of reduced harvest rather than improved freshwater conditions and productivity since trends in pre-harvest recruits are flat. The overall risk assessment by the BRT concluded the SONCC ESU coho salmon are likely to become endangered based on extinction risk determinations listed in Table 3-1.

Table 3-1. List of BRT (2003) SONCC ESU VSP analysis criterion and extinction risk determination.

Criterion	Extinction Risk Determination
Abundance	Moderate
Growth rate/productivity	Moderate
Spatial Structure and Connectivity	Low
Diversity	Low

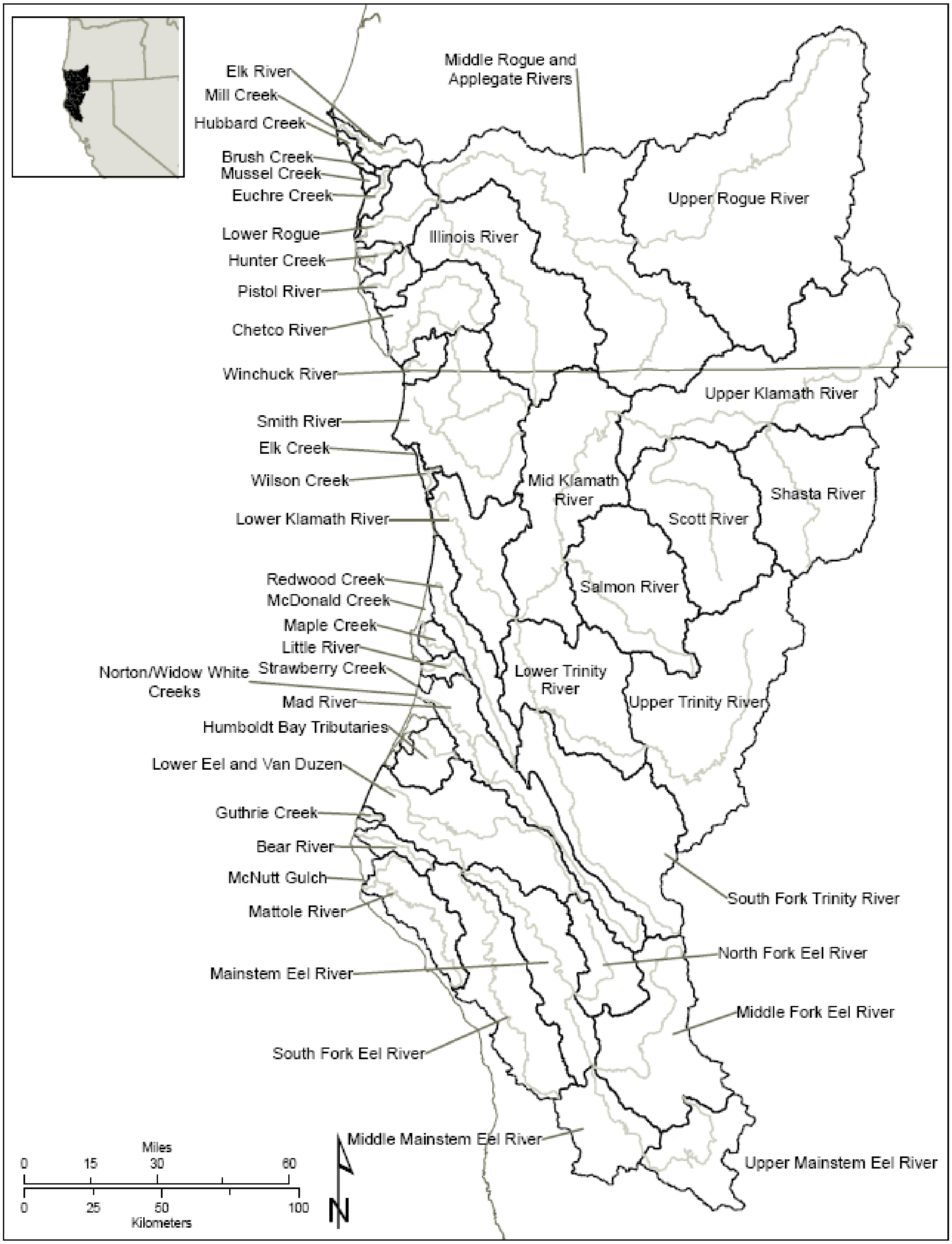


Figure 3-2. SONCC coho salmon ESU and historic population structure distribution (Williams et al. 2006).

Good et al. (2005) recognized that the Rogue River stock had an average increase in spawners over the last several years despite two low years (1998 and 1999), and that proposed hatchery reforms were expected to have a positive effect in the Rogue River basin. Yet, the BRT concluded that the new data does not contradict conclusions reached previously by the 2003 BRT VSP analysis that the SONCC ESU is likely to become endangered in the foreseeable future. The BRT also indicated that the recent data (1995 to the present) does not suggest any marked change, either positive or negative, in the abundance or distribution of coho salmon within the SONCC ESU (Good et al. 2005). Risk factors identified in previous status reviews that continue to be of concern to the BRT include severe declines from historical run sizes, the apparent frequency of local extinctions, long-term trends that are apparently moving downward, and degraded freshwater habitat and its associated reduction in carrying capacity.

In 2005, the Oregon Native Fish Status Report was conducted by ODFW. It concluded that the Rogue River coho salmon Species Management Unit (SMU) was not at risk, an area that includes the upper Rogue River population. ODFW did not use the VSP analysis framework established by NOAA Fisheries, but used criteria and data that consisted of:

- Existing Populations – annual seining surveys near Huntley Park near the mouth of the Rogue River, upstream of Gold Beach
- Habitat Use Distribution – percentage of accessible miles
- Abundance – Huntley Park seine mark-recapture estimates adjusted to account for harvest of hatchery and wild fish above the park since 1980
- Productivity - Huntley Park seine mark-recapture estimates less harvest of wild fish above the park since 1994
- Reproductive Independence – ratio of hatchery to naturally-produced spawners estimated during stratified random spawning surveys
- Hybridization – not an issue for Rogue coho salmon

In their report, ODFW considered all six interim criteria to be “Not at Risk” for the Rogue Coho salmon SMU (ODFW 2005).

A viability assessment of the SONCC coho salmon in the upper Rogue River population was recently completed by GeoEngineers on behalf of the Districts (GeoEngineers 2008a). It utilized the NOAA Fisheries Technical Review Team (TRT) framework and criteria to conduct the analysis for determination of the extinction risk (Williams et al. 2008). The report concluded that the upper Rogue River population is currently at a low risk of extinction based on the viability assessment as the population trends have significantly increased in abundance over the last four generations. The risk of extinction would remain at a low risk in the foreseeable future due to substantially reduced harvest levels which would remain low because of state and Federal regulations. Additionally, the report suggests that there is a strong indication of a resilient population that has the ability to recover from extended periods of lower abundance as related to poor ocean conditions based on the abundance trends for the past 65 years. The criteria and extinction risk determinations from the viability assessment are listed in Table 3-2.

Table 3-2. List of GeoEngineers (2008a) viability assessment of the upper Rogue River coho salmon population criteria and extinction risk determination.

Criterion	Extinction Risk Determination
Effective Population Size	Low
Population Size Per Generation	Low
Population Decline	Low
Catastrophe, rate and effect	Low
Spatial Structure and Diversity	Moderate
Hatchery Influence	Low

The most current framework utilized for assessing viability is the *Framework for Assessing Viability of Threatened Coho Salmon in the Southern Oregon/Northern California Coast Evolutionarily Significant Unit* (Williams et al. 2008). This report does not assess the viability for the SONCC coho salmon for each subbasin, but provides the framework and tools for practitioners such as GeoEngineers (2008a). The report provides an example for determining the extinction risk of the upper Rogue River population for each of the criteria and the overall extinction risk. Both reports utilized the same Gold Ray Dam data set for their analysis (Table 3-3). The extinction risk for the upper Rogue River population unit example is listed in Table 3-4 with the overall extinction risk identified as moderate since the framework and approach classify a population's overall risk factor based on the highest risk determination in any category (Williams et al. 2008).

The range of extinction risk determined for the upper Rogue River population of SONCC coho salmon is low to moderate. Reviews of the population would continue to be refined as new information and data become available.

Table 3-3. Number of wild, hatchery, and total coho salmon counted at Gold Ray Dam, 1942 to 2007 (compiled from GeoEngineer 2008a).

Year	Number of Wild Coho Salmon	Number of Hatchery Coho Salmon	Total Coho Salmon
1942	4,608	0	4,608
1943	3,290	0	3,290
1944	3,230	0	3,230
1945	1,907	0	1,907
1946	3,840	0	3,840
1947	5,340	0	5,340
1948	1,764	0	1,764
1949	9,440	0	9,440
1950	2,007	0	2,007
1951	2,738	0	2,738
1952	320	0	320
1953	1,453	0	1,453
1954	2,138	0	2,138
1955	480	0	480
1956	421	0	421
1957	1,075	0	1,075
1958	732	0	732
1959	371	0	371
1960	1,851	0	1,851
1961	232	0	232
1962	457	0	457
1963	3,831	0	3,831
1964	168	0	168
1965	482	0	482
1966	178	0	178
1967	89	0	89
1968	149	0	149
1969	530	0	530
1970	160	0	160
1971	181	0	181
1972	185	0	185
1973	193	0	193
1974	146	0	146
1975	154	0	154
1976	44	0	44
1977	52	464	516

Year	Number of Wild Coho Salmon	Number of Hatchery Coho Salmon	Total Coho Salmon
1978	240	511	751
1979	236	1,505	1,741
1980	1,608	3,919	5,527
1981	3,055	3,670	6,725
1982	591	79	670
1983	796	697	1,493
1984	2,203	1,033	3,236
1985	411	759	1,170
1986	591	3,481	4,072
1987	1,537	3,858	5,395
1988	3,545	3,337	6,882
1989	253	1,148	1,401
1990	331	366	697
1991	699	1,863	2,562
1992	1,770	2,236	4,006
1993	1,106	2,380	3,486
1994	3,244	7,455	10,699
1995	2,570	10,948	13,518
1996	2,572	11,027	13,599
1997	4,587	11,163	15,750
1998	1,325	4,717	6,042
1999	1,417	6,305	7,722
2000	15,460	13,331	28,791
2001	12,577	20,385	32,962
2002	11,335	22,819	34,154
2003	6,644	10,535	17,179
2004	11,918	9,784	21,702
2005	6,901	7,731	14,632
2006	4,866	6,502	11,368
2007	4,524	4,211	8,735

Table 3-4. Williams et al. (2008) report identified the extinction risk determination for the upper Rogue River population example.

Criterion	Extinction Risk Determination
Effective Population Size	Low
Population Size Per Generation	Low
Population Decline	Low
Catastrophe, rate and effect	Low
Spawner Density	Moderate
Hatchery Influence	Moderate

Current Status of Bear Creek Subpopulation

Coho salmon are considered almost extirpated from Bear Creek and its tributaries. The StreamNet map (Figure 3-1) illustrates that coho salmon are not present in Emigrant Creek. An occasional live coho salmon or adult carcass may be found although few data sets exist to evaluate abundance and distribution patterns of coho salmon in the Bear Creek watershed through time. For instance, only one juvenile coho salmon was captured in 1997 and 1998 during Reclamation's summer electrofishing surveys in six sections of mainstem Bear Creek and six tributary reaches (Broderick 2000). Some limited evidence of past coho salmon spawning is noted in Ashland, Neil, and Wagner creeks as indicated on the coho salmon distribution map in Figure 3-1. Summer steelhead and fall Chinook salmon are more abundant and spawning is regularly documented.

Each March since 2001, ODFW has temporarily installed a rotary screw trap in Bear Creek near its confluence with the Rogue River to collect salmon and steelhead smolts (Vogt 2001). This trap remains in place until June when flows become too low for effective operation. Trapping in Bear Creek resulted in coho salmon smolt production estimates of 100 in 2001, 2,194 in 2002, and 197 in 2003 (Doino 2006). No coho salmon smolts were captured in 2004 or 2005 in Bear Creek. In 2006, ODFW captured 212 coho salmon smolts in Bear Creek near Phoenix for an estimated outmigrant total of 1,843 (ODFW database). ODFW estimates that coho salmon production is approximately 3.7 coho salmon smolts per mile of habitat in the Bear Creek mainstem (Vogt 2004).

In a preliminary study conducted, the smolt production for the Bear Creek watershed is primarily located in the tributary streams of Bear Creek such as Neil and Ashland creeks and the upper reaches of the mainstem Bear Creek. Smolt production in this watershed is limited by summer habitat (Nickelson 2008).

With regard to the current use of the Bear Creek basin by coho salmon, it should be noted that just prior to initiation of the Rogue River Basin Project, the U.S. Fish and Wildlife Service (USFWS) conducted spawning surveys for anadromous fish in the Rogue River basin (USFWS circa 1955). These surveys included coho salmon spawning surveys in Bear Creek. Surveys in 1949-1950, 1951-1952, 1953-1954, and 1954-1955 did not identify any coho salmon redds in the stream reaches surveyed along Bear Creek. No survey results were reported for 1950-1951. Based on their spawning surveys, USFWS reported that Bear Creek did not support coho salmon and identified it as a steelhead-only system. Based on the survey reports, it does not appear that the surveys were conducted in a manner that would definitively demonstrate that there was absolutely no use of Bear Creek or its tributaries by coho salmon in those years. On the other hand, the surveys were conducted by trained observers who identified spawning coho salmon in many other stream reaches in the upper Rogue River basin and who appeared to be familiar with the basin. It seems unlikely that those conducting those spawning surveys simply missed large numbers of spawning coho salmon in Bear Creek. Rather it appears that prior to the advent of the Federal project, coho salmon were not using Bear Creek in large numbers. It seems most likely, based on the available data, that current use of the Bear Creek system is not substantially different than use in the early 1950s when the USFWS conducted the spawning surveys.

Current Status of Little Butte Creek Subpopulation

The Little Butte Creek watershed provides some of the best coho salmon production in the Rogue River basin. Approximately 50 to 75 percent of the coho salmon smolt production for the upper Rogue River coho salmon population occurs in the Little Butte Creek watershed (Vogt 2004; GeoEngineers 2008b). Several stream reaches within the Little Butte Creek watershed, similar to other Rogue River basin coho salmon streams, were sampled annually under the ODFW Coastal Salmonid Inventory Project to assess wild coho salmon spawning. Sampling occurred in the North Fork, South Fork, Soda Creek, Lake Creek, and Dead Indian Creek drainages of Little Butte Creek. Sampling surveys were done each year during the November to January spawning period (ODFW 2000c). The purpose of these surveys was to gather data to help estimate Rogue River basin-wide escapement and correlate the incidence of spawning with habitat conditions and smolt production. The Little Butte Creek watershed contains some of the better spawning returns in the entire Rogue River basin and, from 1996 to 2000, this stream averaged 15 coho salmon spawners per mile (ODFW 2001a). This represents the highest average density of coho salmon spawners of all Rogue River basin areas sampled.

The Little Butte Creek reaches surveyed each year were randomly selected so the full range of spawning habitat is represented (ODFW 2001b). Once started, surveys were repeated in the select reaches about every 10 days regardless of streamflow conditions. The primary objective was to count spawning coho salmon. Redds were also visually counted and spawned-out carcasses were tallied.

This survey approach does not yield a precise estimate of spawner escapement to the stream because only randomly selected stream reaches were inventoried and observations were dependent on water clarity and flow levels; however, over a period of years, the method provides a relative and valuable indication of coho salmon spawning. Spawning surveys completed by ODFW in the upper Rogue River tributaries indicate that coho salmon primarily enter tributaries in November, which is consistent with timing of most passage at Gold Ray Dam (Table 3-5). Forty five adult coho salmon were observed in Little Butte Creek during these surveys.

Table 3-5. First and last dates coho salmon observed during spawning surveys conducted by ODFW, 1996-2004. Data provided by Briana Sounheim, Corvallis Research Office, September 2007 to Rich Piaskowski, GeoEngineers, Inc.

Watershed	n	First Date	Last Date
Big Butte Creek	12	11/3	2/15
Evans Creek	75	11/14	2/2
Little Butte Creek	45	11/25	2/1
Mainstream Tributaries	44	11/26	2/15

A cooperative ODFW, BLM, and USFS coho salmon and steelhead smolt trapping project that began in March 1998 validates that Little Butte Creek is an important producer of wild coho salmon. Trapping has been conducted on six upper Rogue River basin streams, including Big Butte Creek, Little Butte Creek (action area stream), West Fork Evans Creek, Slate Creek, South Fork Big Butte Creek, and Little Applegate River. The objectives of this project are to:

- Estimate coho salmon and steelhead smolt production in the sampled streams
- Determine smolt migration timing
- Determine the size of migrating smolts (ODFW 2000a)

For the cooperative study, an irrigation diversion canal near Eagle Point fitted with a rotary fish screen, bypass pipe, and collection trap was used to capture downstream migrating smolts on Little Butte Creek. Rotary screw traps were also used at other stream trapping locations. The sampling period ran from March 1 to June 30 if streamflow permitted. The traps were checked daily and fish were identified as to species and life stage, enumerated, and measured. To estimate trapping efficiency, a subsample of coho salmon over 2.4 inches was marked with a caudal fin clip, transported back upstream, and released. Marked fish were recaptured to determine trapping efficiency which is used to estimate overall coho salmon smolt abundance in the stream. In 2004, coho salmon smolts abundance in Little Butte Creek was estimated to be 18,383 (Table 3-6). Aside from the 1998 trapping season, Little Butte Creek has consistently produced the highest number of coho salmon smolts per mile of habitat each year of this ODFW study (Figure 3-3).

Coho salmon smolt outmigration trap results that include Little Butte Creek are summarized in Figure 3-4 through Figure 3-6 for 1999, 2000, and 2004, respectively. Peak emigration in Little Butte Creek occurs in early May according to the figures.

Table 3-6. 2004 coho salmon smolt trap efficiencies and population estimates for each trip site. (Vogt 2004)

Stream	Dates Trapped	Number of Days Trapped	Number of Coho Captured	Number of Coho Marked	Number of Coho Recaptured	Trapping Efficiency	Population Estimate	95 Percent Confidence Interval
Little Butte	3/1 – 6/23	115	5,423	1,995	589	30 %	18,383	17,045 – 19,721
Bear Creek	3/1 – 6/16	106*	0	0	0	NA	NA	NA
West Evans	3/1 – 5/13	74	1,172	943	147	16 %	7,513	6,293 – 8,733
Elk Creek	3/1 – 6/12	103*	1,862	1,460	524	36 %	5,187	4,784 – 5,590
L Applegate	3/1 – 6/23	113*	0	0	0	NA	NA	NA
Slate	3/1 – 5/13	74	185	183	16	9 %	2,126	794 – 3,458

*Trap disabled one or more days by high flows/debris.

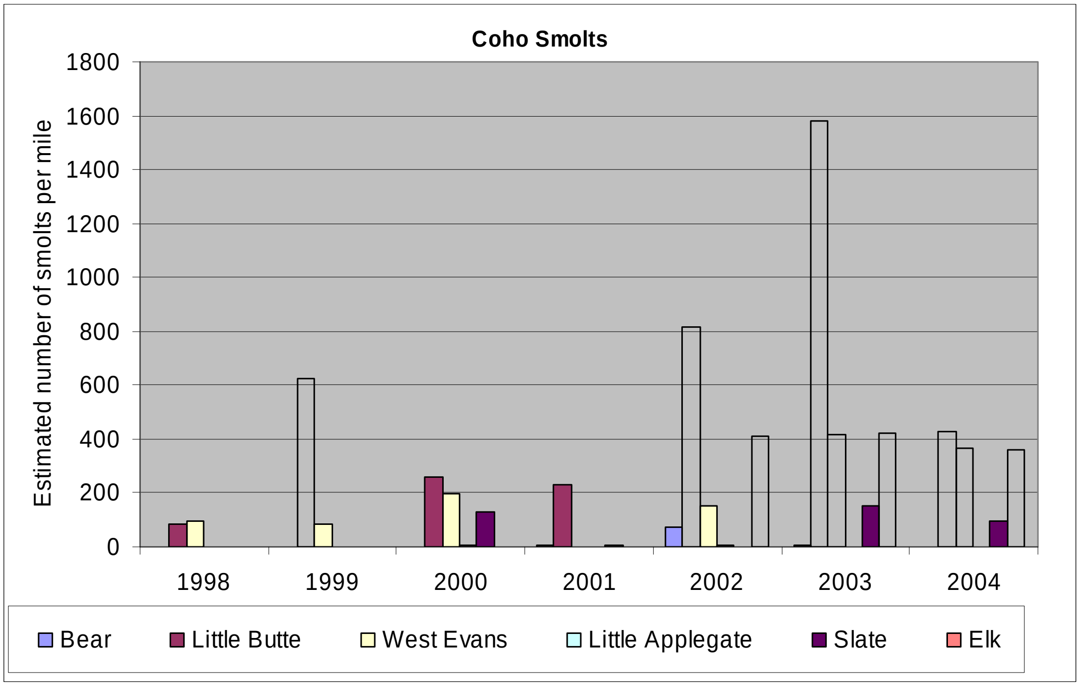


Figure 3-3. Annual estimated numbers of coho salmon smolt per mile from various creeks in the upper Rogue River basin, 1998-2004. (Vogt 2004)

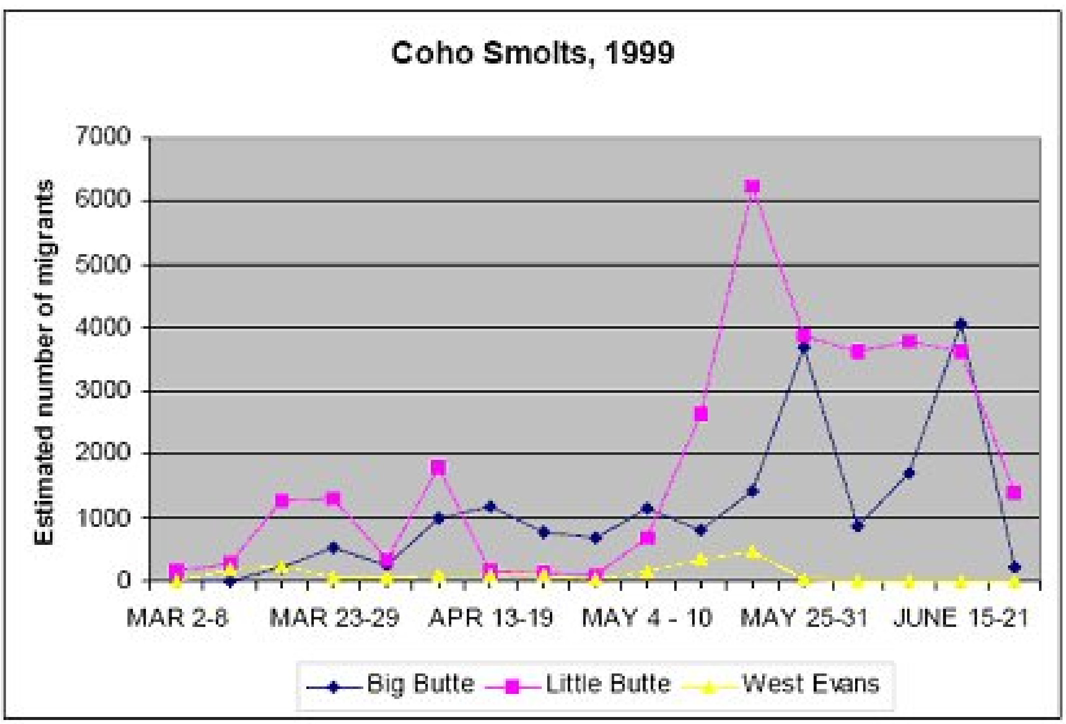


Figure 3-4. Estimated number of coho salmon smolts out-migrating weekly from various creeks in the upper Rogue River basin, 1999. (Vogt 1999).

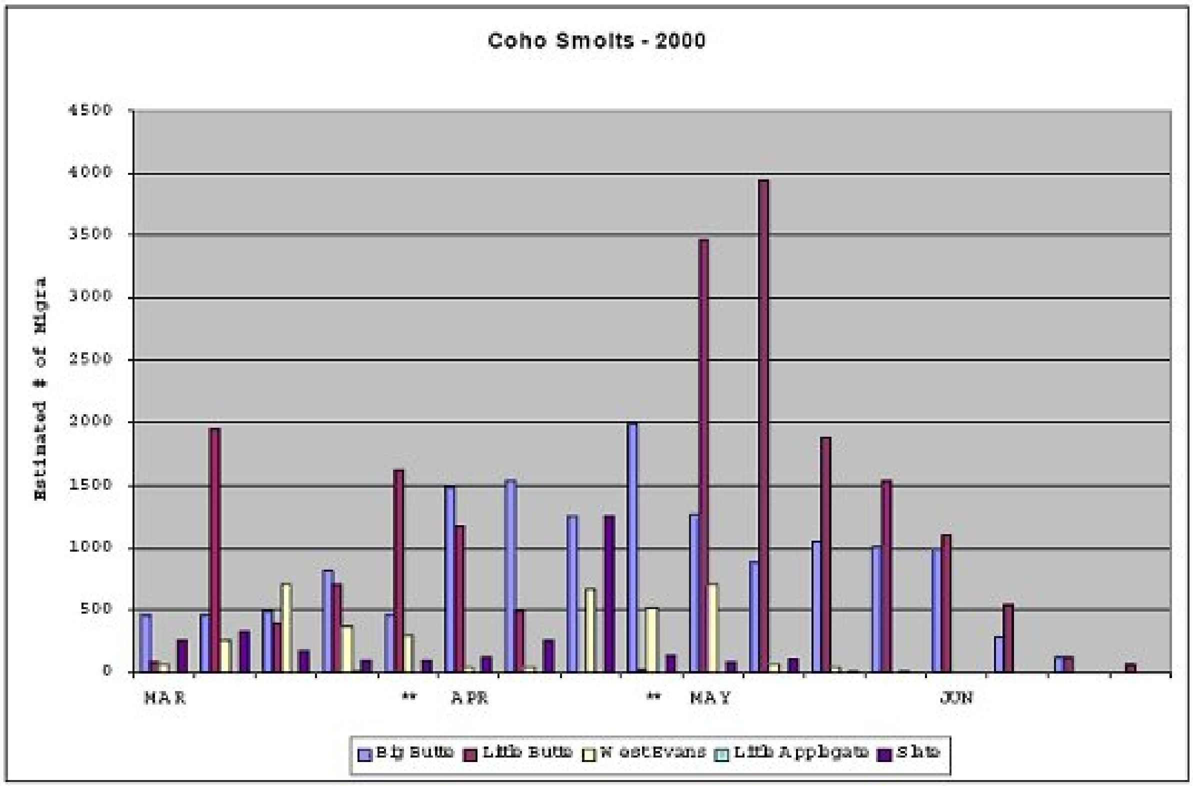


Figure 3-5. Estimated number of coho salmon smolts out-migrating weekly from various creeks in the upper Rogue River basin, 2000. (Vogt 2000)

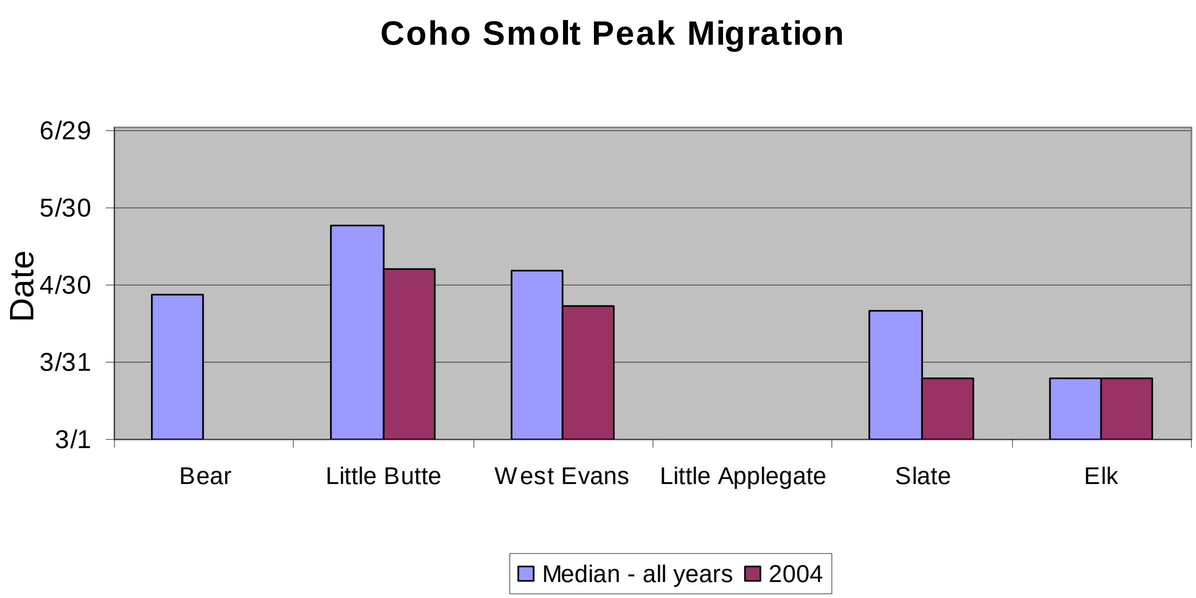


Figure 3-6. Estimated number of coho salmon smolts out-migrating weekly from various creeks in the upper Rogue River basin, 2004. (Vogt 2004)

Fish surveys were conducted by Reclamation during mid-to-late summer in 1997 and 1998 to supplement ODFW data on salmon and trout distribution and relative abundance in Bear Creek and Little Butte Creek drainages (Broderick 2000). During the survey, two coho salmon juveniles were captured in Little Butte Creek at the Brownsboro Bridge site. In 2006, Reclamation observed juvenile coho salmon in a pool located at the selected PHABSIM study site on South Fork Little Butte Creek where a coho salmon redd had been flagged during a January 2005 spawning survey (Sutton 2007a).

Current Status of Klamath Basin Subpopulation

Anadromous salmonids in the Klamath River are restricted to the mainstem Klamath River and tributaries below Iron Gate Dam. Jenny Creek is located upstream of Iron Gate Dam and is not accessible to coho salmon. No passage facilities exist at Iron Gate or Copco dams, which are owned and operated by PacifiCorp.

Coho salmon still occur in the Klamath River and its tributaries below Iron Gate Dam (CH2M Hill 1985; Hassler et al. 1991). Between Seiad Valley and Iron Gate Dam, coho salmon populations are believed to occur in Bogus Creek, Shasta River, Humbug Creek, Empire Creek, Beaver Creek, Horse Creek, and Scott River (NMFS 1999). Between Orleans and Seiad Valley, coho salmon populations are believed to occur in Seiad Creek, Grider Creek, Thompson Creek, Indian Creek, Elk Creek, Clear Creek, Dillon Creek (suspected), and Salmon River (NMFS 1999). Finally, between Orleans and Klamath (mouth of the river), coho salmon populations are believed to occur in Camp Creek, Red Cap Creek, Trinity River, Turwar Creek, Blue Creek, Tectah Creek, and Pine Creek (NMFS 1999). It is estimated that the Shasta River presently maintains approximately 38 miles of coho salmon habitat, which is below predevelopment levels (INSE 1999). Available data suggests that existing coho salmon habitat in the Scott River now constitutes approximately 88 miles of the river (INSE 1999).

Unscreened or ineffectively screened diversions are common in the Shasta and Scott Rivers, resulting in substantial entrainment and fish stranding. Downstream migrants are also trapped in pools or side channels when streamflows drop sharply during early summer and soon die from high temperatures, lack of food, or predation. Some portions of streams often become entirely dewatered due to diversions. Coho salmon juveniles are very susceptible to diversions because they need to spend at least one full summer in the stream.

Coho Salmon Abundance in the Klamath River Basin

Limited information exists regarding present coho salmon abundance in the Klamath River basin. Adult counts in a few Klamath River tributaries and juvenile trapping on the Klamath River mainstem and tributaries provide valuable information on the presence of coho salmon in specific areas during key time periods which gives an indication of the low abundance and the status of coho salmon populations in the Klamath River basin. However, they are less valuable for determining population status or trends (NMFS 2001).

Adult Data

Overall, recent adult coho salmon abundance information, summarized in Table 3-7 (NOAA Fisheries 2007), suggests that the Klamath River adult coho salmon population is depressed, but stable. In the Shasta and Scott Rivers, data suggest the 2004 adult returning brood year class was the strongest in recent years, while the 2005 and 2006 brood year class abundances were extremely depressed.

Table 3-7. Klamath River Basin adult coho salmon abundance information, 2002-2006 (NOAA Fisheries 2007).

Year	Yurok Tribal Harvest[1]	Trinity River Weir[2]	Scott River Live Fish or Redd Counts[1]	Shasta River Video Weir[1]	Bogus Creek Fish Counting Facility[1]	Iron Gate Hatchery Returns
2002	486	14,307	17[3]	86	n/a	1,193
2003	343	25,651	8[3]	187	n/a	1,317
2004	1,540	35,209	1,577[3]	373	414	1,495
2005	n/a	28,267	23[4]	69	114	1,384
2006		20,162	7[4]	45	35	332

[1] Annual effort not consistent between years (Yurok Tribal Fisheries Department).
[2] Estimated escapement abundance extrapolated from weir observations (CDFG).
[3] Live fish counts.
[4] Redd counts.

On average in the Trinity River, over 90 percent of coho salmon spawning between Willow Creek and Lewiston Dam are of hatchery origin (NOAA Fisheries 2007). Estimates of naturally-produced coho salmon are only available since the 1997 return year, after the hatcheries started marking 100 percent of the hatchery coho salmon. The results of counting for the 1997 to 1998, 1998 to 1999, and 1999 to 2000 seasons yielded an estimated 198, 1,001, and 491, respectively, naturally produced adult coho salmon (CDFG 2000b). Coho salmon were first observed at the Trinity River weir during the week of September 10 during the 1999 to 2000 trapping season (CDFG 2000b). Data from 1997 through 2005 indicate coho salmon runs have generally been higher than average during recent years, although wild fish continue to represent a very small portion of the overall run (NOAA Fisheries 2007).

Low numbers of adult coho salmon redds have been observed in the Iron Gate Dam to Indian Creek reach of the mainstem Klamath River (Table 3-8). These documented cases of mainstem coho salmon spawning indicate that the proportion of mainstem spawners may represent a small percentage of the annual adult coho salmon spawning population (NOAA Fisheries 2007).

Table 3-8. Mainstem Klamath River coho salmon redds observed during fall/winter surveys from Iron Gate Dam to Indian Creek. (Magneson and Gough 2006).

Year	Number of Redds
2001	21
2002	6
2003	7
2004	6
2005	6

Juvenile Data

Smolt data suggests that Klamath basin coho salmon recruitment is very low and abundance of out-migrating young-of-the-year (YOY) and smolt coho salmon is correlated to the abundance of their parent brood year class (NOAA Fisheries 2007). Juvenile traps, operated by USFWS on the Klamath River mainstem at Big Bar (RM 48), were used to estimate indices of smolt production. Based on counts from these traps between 1991 and 2000, the annual average number of wild coho salmon smolts was estimated at only 548 individuals (range 137 to 1,268) (USFWS 2000). For the same period, an average output of 2,975 wild coho salmon smolts (range 565 to 5,084) was estimated for the Trinity River at Willow Creek, within the Trinity subbasin (USFWS 2000). The incomplete trapping record provides limited information in terms of temporal trends, but it is still a useful indicator of the extremely small size of coho salmon populations in the Klamath basin.

The USFWS operates downstream juvenile migrant traps on the mainstem Klamath River at Big Bar (RM 48). The incomplete trapping record provides limited information in terms of abundance or trends, but indicates the presence of coho salmon at different life stages during certain times of the year (NMFS 2001). Indices of abundance are calculated from actual numbers trapped. In 2001, coho salmon smolts trapped at Big Bar between April 9 and July 22 resulted in an actual total count of 23 fish, 14 of which were considered wild (USFWS 2001). Trapping was discontinued after July 22 because of heavy algal loading in the traps.

A 1997 USFWS report and 2001 mainstem trap data (CDFG unpublished data) showed that YOY coho salmon were emerging from the Shasta and Scott rivers, where they were probably spawned, into the mainstem of the lower Klamath River between March and August. Considering the low numbers of coho salmon fry that have been reported from these sub-basins, it is unlikely that these fish were displaced downstream because of competitive interactions with other juveniles of their own species. Instead, the most likely explanation for their summer movement is that declining water quality and quantity in the lower-order tributaries force these young fish to seek refuge elsewhere. Thus, they ended up in the river's mainstem earlier than in other river systems. This exploratory behavior and movement in search for adequate nursery habitat has been well documented, especially before the onset of winter (Sandercock 1991). Recent thermal refugial studies on the mainstem Klamath River have documented the persistence of small numbers of coho salmon YOY near select tributary confluences during the summer (Sutton et al. 2004; Sutton et al. 2007; Sutton 2009).

Hatchery Programs

The Klamath and Trinity basin coho salmon runs are now composed largely of hatchery fish, although there may still be wild fish remaining in some tributaries. Because of the predominance of hatchery stocks in the Klamath River basin, stock transfers (use of spawn from coho salmon outside the Klamath River basin) in the Trinity and Iron Gate Hatcheries may have had a substantial impact on natural populations in the basin. Artificial propagation can substantially affect the genetic integrity of natural salmon populations in several ways. First, stock transfers that result in interbreeding of hatchery and natural fish can lead to loss of fitness (survivability) in local populations and loss of diversity among populations (Weitkamp et al. 1995). Second, the hatchery salmon may change the mortality profile of the populations, leading to genetic change relative to wild populations that is not beneficial to the naturally reproducing fish. Third, hatchery fish may interfere with natural spawning and production by competing with natural fish for territory or mates. The presence of large numbers of hatchery juveniles or adults may also alter the selective regime faced by natural fish.

Fish Harvest

Commercial fishing for salmon in the Klamath River had major impacts on populations as early as 1900. Commercial and recreational ocean troll fisheries, tribal subsistence fisheries, and in-river recreational fisheries have impacted salmon, including coho salmon, throughout the Twentieth Century. Over-fishing was considered one of the greatest threats facing the Klamath River coho salmon populations in the past; however, these harvest rates probably would not have been as serious if spawning and rearing habitat had not been reduced and degraded. Sport and commercial fishing restrictions ranging from severe curtailment to complete closure in recent years may be providing an increase in adult coho salmon survival.

The tribal harvest in the Klamath has been relatively small in the last five years and likely has not had a measurable effect on coho salmon populations (NMFS 2001).

3.1.3 Current Conservation Efforts

In the Rogue River basin, there have been numerous water conservation activities adopted by the local irrigation districts and various groups such as the Oregon Watershed Enhancement Board (OWEB), the Rogue Valley Council of Governments (RVCOG), and the Bear Creek Watershed Council (BCWC). The Project components have a long history of use and record of upgrades. As this infrastructure continues to age, additional upgrades are and will be needed to maintain proper function.

Conservation Grants

For the past several years, the Districts have applied for grants and expended their own funds to implement conservation actions such as lining and piping canals to minimize seepage and evaporation, utilizing technology such as ArcGIS to develop a comprehensive inventory of conservation activities, and conducting large-scale conservation projects such as the Larson Creek Pipeline and Fish Passage Project where Reclamation was the sponsor agency. A detailed listing of all the Districts' improvement projects was compiled and presented in GeoEngineers (2004). Additionally, a system optimization review grant (Water 2025 Grant) to identify the priority areas within the Project to improve water efficiencies have been awarded to TID and includes MID and RRVID. Through the water conservation process, the Districts address fish passage and fish screen issues when they are present in the location of conservation activity.

Table 3-9 lists potential conservation activities the Districts have suggested and the estimated water savings that may be accomplished through conservation grants received or instream leasing discussed in a following section.

Table 3-9. Potential water conservation activities with estimated annual water savings.

Project Description	Estimated Annual Water Savings (in acre-feet)
Temporarily lease idle lands that have been quit-claimed or land donated back to Districts.	600-1,674
Pump facility moving RRVID's supply from Rogue River with stored water in Lost Creek Reservoir in exchange for release of RRVID annual average Project yield down Bear Creek.	1,000
Exchange McDonald Creek (Little Applegate water) for Project water to be applied to TID lands.	3,000 - 4,000
Exchange water identified by Bear Creek Watershed Council's instream committee for instream lease with TID water delivered into Neil Creek or an added pressure line from Ashland Canal.	300 - 600
Exchange Reclamation/City of Talent Water in Howard Prairie with TID water released from Emigrant Reservoir.	600
Total	**5,500 - 7,874**

WISE Project

Released in February 2001, the *Bear Creek/Little Butte Creek Water Management Study Appraisal Report* documented the analysis that Reclamation conducted from 1997 through 2000 regarding water supply and water conservation opportunities in the Rogue River basin project area. The release of this report coincided with a local effort, called the Irrigation Point of Diversion (IPOD), which was focused on actions that could be taken to improve streamflows in Little Butte Creek. Reclamation began meeting with the IPOD group to explain the interconnectedness of the irrigation storage and distribution system among the Districts. These discussions led the IPOD group to expand its efforts to an analysis of water management/water conservation measures that could be implemented in the Bear Creek/Little Butte Creek basins. Eventually, the name of the study effort was changed to Water for Irrigation, Streams, and the Economy (WISE).

In 2003, Reclamation and 16 State and local entities signed a Memorandum of Understanding agreeing to work cooperatively on the WISE project. Reclamation continues to participate regularly in this effort. Significant contributions include technical assistance in developing alternatives and undertaking hydrologic modeling, assisting in the development of the Scope of Work that was issued as part of the Request for Proposal for consulting services to undertake the necessary technical studies, serving on the selection team for the consulting services, reviewing technical products developed by the consultant (HDR Associates), and collaborating with the consultant on the hydrologic modeling effort.

Reclamation received authority in 2008 to conduct a feasibility-level study to investigate alternative solutions for improving irrigation reliability, effectiveness, and efficiency for the Districts and streamflow conditions for salmon and steelhead (P.L. 110-229). Though no funding was included in the authorization, funds have been requested for the WISE Feasibility Study to be utilized for coordination with project partners, review of consultants' products, and initiation of the NEPA activities for fiscal year 2010.

In addition, the WISE project sponsors obtained funds from various sources to undertake specific project tasks. Federal grants from the Environmental Protection Agency and Bureau of Land Management and funds from the State of Oregon are being used for the preparation and implementation of a public outreach and marketing plan. These funds are also used to initiate the technical studies required for the feasibility study and environmental impact statement. The partners plan to obtain funds from other sources to complete the technical studies. Reclamation continues to participate in regular meetings and related activities.

Instream Leasing

The instream leasing program offered by OWRD provides a voluntary way for water users to aid the restoration and protection of streamflows. The purpose of instream leasing is to preserve water rights that may be forfeited from non-use and improve environmental conditions, such as flow for fish and wildlife, scenic value, and water quality (http://www.oregon.gov/OWRD/mgmt_leases.shtml).

The Districts participate in the instream leasing program. In recent years, the Districts have applied for and received approval from Reclamation to transfer a specified quantity, usually measured in acre-feet, of Project water for an instream lease during the irrigation season. The Districts have had instream leases in the action area since 1996. For example, TID requested the transfer of 242 acre-feet of Project water to Bear Creek for the 2008 irrigation season (April 1 through October 31) which translated to approximately 0.5 cfs of flow in Bear Creek during the irrigation season (information from Reclamation Categorical Exclusion Checklist dated June 30, 2008). In 2009, two instream leases were requested by TID.

Reclamation supports the lease of water rights for instream flows although the improvement from the leases has not been quantified and no such studies have been conducted. The term of the instream lease may range from 1 to 5 years. The applications from the Districts are typically restricted to one irrigation season with no long-term commitment. Typically, the leases from each irrigation season have provided increases in instream flow of 0.5 to 1.0 cfs. In 2009, leased water was protected to the mouth of the tributary from which the lease occurred, either Bear Creek or Little Butte Creek. Overall, Reclamation identifies the instream leases as a positive step to improve environmental conditions.

Other Conservation Efforts

Other activities in the area include routine water quality monitoring by RVCOG, comprehensive watershed assessments by OWEB and BCWC, and habitat improvement projects by BCWC (http://www.rvcog.org; http://www.bearcreek-watershed.org). These activities would continue in the Bear Creek and Little Butte Creek watersheds to help protect natural resources important on multiple levels. Reclamation plans to be an active participant.

The Districts are also quite active in a wide array of conservation and stream enhancement efforts in the action area. Appendix A presents a compilation of projects completed by the Districts as an example of the common stewardship objectives these Districts share.

3.2 Hydrology

There have been no major operational changes in the current hydrologic conditions. An overview of the Project operations is located in Chapter 2 with further details in the *Rogue River Basin Project Talent Division – Oregon, Facilities and Operations Report* (Vinsonhaler 2002).

The hydrology in the Project area is monitored through a series of gaging stations that provide real-time provisional data available through Reclamation's Hydromet system. The stations also provide an instrument platform for the collection of additional parameters, such as temperature. Data collection in the Project area is a valuable tool for the primary purpose of real-time management and operation of Reclamation's facilities. Table 3-10 and Table 3-11 provide the locations and descriptions for the monitoring sites and Figure 3-7 is a map of the locations.

Table 3-10. List of multi-parameter monitoring stations and location descriptions in the Project area identified in Figure 3-7.

Reclamation Maintained Hydromet Stations	
Station Identifier	**Location Description**
AGA	Agate Dam and Reservoir near Medford
ANTO	Antelope Creek and Diversion at Dam
BASO	Bear Creek below Ashland Creek at Ashland
BCSO	Beaver Creek and Beaver Siphon at Howard Prairie Delivery Canal
BCTO	Bear Creek below Phoenix Canal Diversion near Talent
CACO	Cascade Canal near Fish Lake
DICO	Dead Indian Collection Canal near Pinehurst
EGSO	Emigrant Creek above Green Springs Power Plant
EMI	Emigrant Dam and Lake near Ashland
GSPO	Green Springs Power Plant

Reclamation Maintained Hydromet Stations	
Station Identifier	**Location Description**
HPCO	Howard Prairie Delivery Canal at Keene Creek Dam
HPD	Howard Prairie Dam and Lake
HPWO	Howard Prairie Dam Weather Station
HYA	Hyatt Dam and Reservoir
MFDO	Bear Creek at Medford
SDCO	Soda Creek at Howard Prairie Delivery Canal
SLBO	South Fork Little Butte Creek Collection Canal
Local District or OWRD Maintained Stations (with Reclamation GOES data processing support)	
ACAO	Ashland Creek Mouth near Ashland
ASLO	Ashland Lateral near Ashland
BCAO	Bear Creek above Ashland
BCCO	Bear Creek Canal at Medford
BCMO	Bear Creek at Mouth near Central Point
BJBO	Bear Creek at Jackson St. Bridge, Medford
EPTO	Antelope Creek near Eagle Point
FIS	Fish Lake near Ashland
FOR	Fourmile Lake near Ashland
FSHO	North Fork Little Butte Creek below Fish Lake
GCCO	Griffin Creek near mouth
GILO	South Fork Little Butte Creek at Gilkey Ranch
JCCO	Jackson Creek mouth at Central Point
JCTO	Joint System Canal below Junction near Lakecreek
LBCO	Little Butte Creek at Lakecreek
LBEO	Little Butte Creek below Eagle Point
NCDO	Neil Creek mouth near Ashland at airport
NFBO	North Fork Little Butte Creek Canal near Pinehurst
NFLO	North Fork Little Butte Creek at Hwy 140
PHXO	Phoenix Canal Diversion at Talent
RRVO/MIDO	RRVID and MID Canals at Bradshaw Drop
SFBO	South Fork Little Butte Creek Canal near Pinehurst
SFLO	South Fork Little Butte Creek at Mouth
TALO	Talent Lateral at Oak St Diversion
WCTO	Wagner Creek mouth at Talent

Table 3-11. List of temperature monitoring stations and location descriptions identified in Figure 3–7 in the Project area.

Reclamation Temperature Monitoring Sites		
Site Reference Number	**Stream Name**	**Location Description**
1	Emigrant Creek	Below Green Springs Power Plant
2	Emigrant Creek	Above Confluence with Neil Creek
3	Bear Creek	Above Oak Street Diversion
4	Bear Creek	Between existing BJBO and BCMO Hydromet Stations, below Medford
5	East Canal	Southeast of Butler Creek Crossing
6	Gaerky Creek	Above confluence with Bear Creek
7	Butler Creek	Above confluence with Bear Creek
8	Jeffery Creek	Above confluence with Bear Creek
9	Anderson Creek	Above confluence with Bear Creek
10	Coleman Creek	Above confluence with Bear Creek
11	Willow Creek	Above confluence with Bear Creek
12	Little Butte Creek	Below confluence with Antelope Creek
13	South Fork Little Butte Creek	Above confluence with Little Butte Creek upstream to Natural Falls

The Hydromet stations at the various sites are independent in the respect one station does not rely on another station to generate data. In addition, each station has a margin of error associated with it primarily due to design criteria, channel composition, calibration frequency, and staging standard. For example, a station in a river channel is subject to conditions that will affect the measurements like a piece of woody debris located in the proximity or a sediment build-up both of which may affect the precision of data. There is maintenance and calibration on the Hydromet stations regularly that will identify issues affecting streamflow measurement such as the examples described.

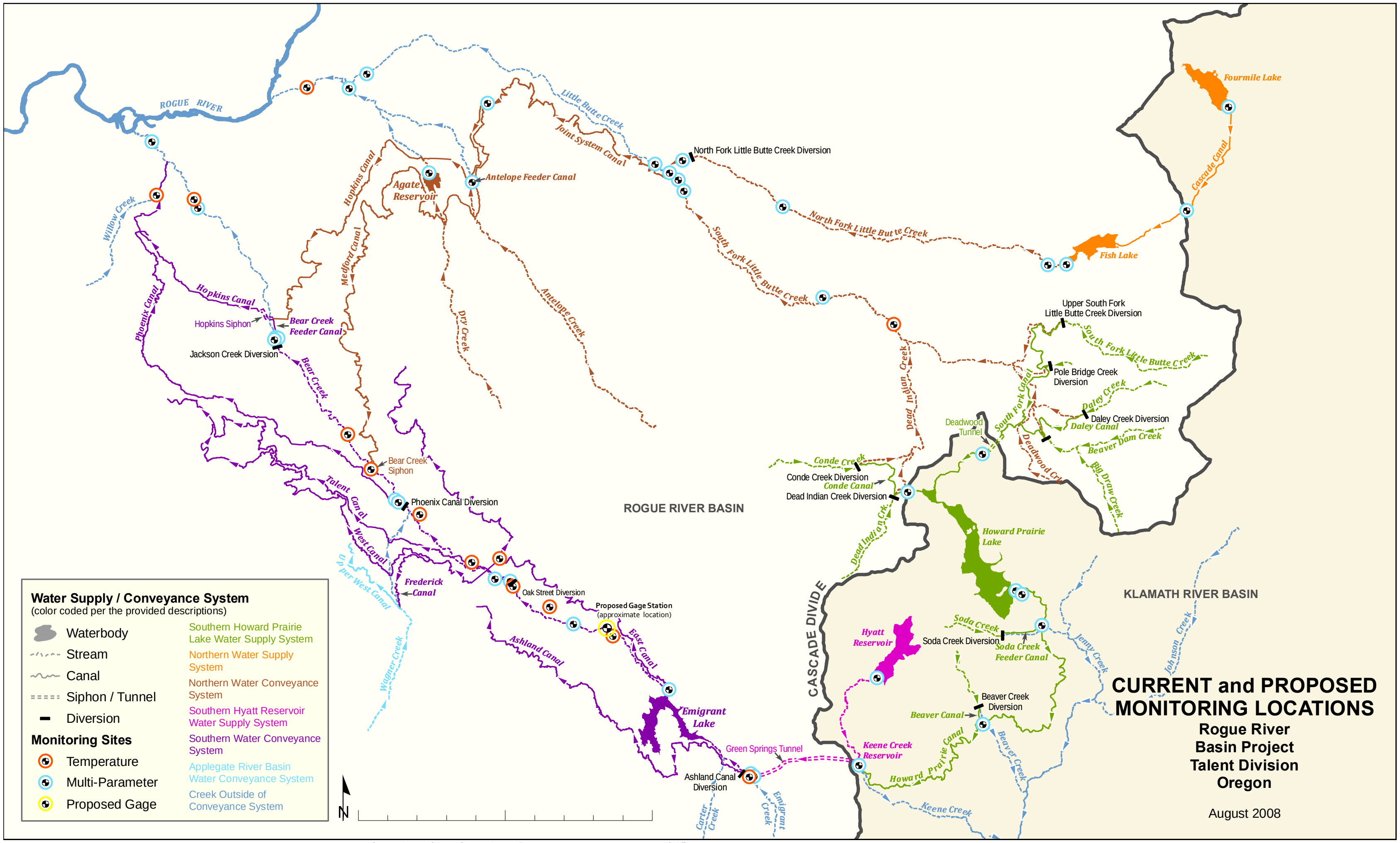


Figure 3-7. Rogue River Basin's Project current and proposed monitoring locations.

3.2.1 Bear Creek Watershed

Bear Creek is a large tributary of the Rogue River. The Bear Creek watershed encompasses approximately 253,440 acres, or 396 square miles, in the upper Rogue River subbasin of the Rogue River basin. The valley was formed by alluvial deposition from the surrounding areas. The headwaters of Bear Creek include such streams as Emigrant Creek, Tyler Creek, Soda Creek, and Schoolhouse Creek that occur above Emigrant Reservoir within the Emigrant Creek drainage. Approximately 950 linear stream miles create the Bear Creek watershed drainage; of that, 272 miles are within the agriculture zone of the watershed (RVCOG 2001).

The entire watershed lies within Jackson County which has a population of about 200,000 people (PSU 2008). Most of the county's population resides in the communities of Ashland, Talent, Phoenix, Medford, and Central Point. These communities border the banks of Bear Creek and are the most densely populated and intensely cultivated area in the Rogue River basin (ODEQ 2001).

Land use within the Bear Creek basin consists of private timber (31 percent), publicly-owned forest (20 percent), agriculture (39 percent), urban areas (7 percent), and mining and other uses (2 percent) (RVCOG 1995). Approximately 21 percent of the Bear Creek channel is considered confined, reducing floodplain connectivity to adjacent areas (RVCOG 2001). Bear Creek exceeds the Oregon Department of Environmental Quality (ODEQ) turbidity standards during high flow or storm events that occur several times per year (RVCOG 2001). Stream hydrology in the mainstem of Bear Creek is influenced by seasonal fluctuations in precipitation, irrigation withdrawals, and water releases from Emigrant Dam. In recent years, ODFW and the Districts have worked together to try to stabilize water levels during the summer.

Description of Facility Operations in Bear Creek Watershed

The Project is operated for irrigation water storage and delivery, flood control, and hydropower production in compliance with Congressional authorization and contracts between the Districts and Reclamation. Reclamation has limited operational flexibility on reservoir operations. For example, Emigrant Reservoir can only be drawn down to the flood control rule curve as set by the U.S. Army Corps of Engineers (Corps). Any reservoir releases in winter must be done within the flood rule curve limitations and irrigation storage objective. In wet years, water may be released more regularly than in dry years. Reservoir releases can also be made with the appropriate agreement in place to provide instream flows along with irrigation flows provided they are consistent with water rights and the contracts between the Districts and Reclamation as applicable.

Operational Overview

The primary purpose of the Districts, as well as the Project, is to deliver irrigation water to its patrons, within the limits of their water rights. To provide a general understanding of the water operations for this Project, a short summary is given in this section that covers a typical year.

Depending on the water right, irrigation season begins on average April 15 and ends October 15; however, most water rights held by the Districts allow the flexibility to extend the season to October 31 if weather conditions permit. As irrigation water needs decrease at the end of the irrigation season, the diversions to canals and discharges from the dams are reduced which requires a ramp-down process. With the end of irrigation season and full ramp-down period, the regulating gates of each reservoir are closed and the canal headgates are closed. During the winter, stream flows are diverted, collected and stored to refill the Project storage reservoirs. This involves diverting water from the South Fork Little Butte Creek systems and routing it into Howard Prairie Reservoir for storage and transport through the Howard Prairie Delivery Canal to operate the Green Springs Powerplant. Discharges from the Green Springs Powerplant are re-regulated and stored in Emigrant Reservoir for the future delivery during irrigation season. Stream flows from the Jenny Creek tributaries are also collected with some of the water going into storage in Hyatt Reservoir and some being routed through the Green Springs Powerplant to Emigrant Reservoir. Winter operations routinely involve reservoir adjustments and operations to meet flood control rule curves and surcharge space requirements as well meeting hydropower demands for the Green Springs Powerplant. While the reservoir regulating gates and canal headgates are shut, routine maintenance on the storage and conveyance system occurs.

When the Project reservoirs reach a certain level and irrigation season approaches, the diversions are managed in a manner to keep an even flow into the reservoirs, maintain the maximum pool possible for the delivery season, and allow adequate carry-over for future deliveries. In an average water year, flow releases from Emigrant Dam to Emigrant Creek are made starting in May. Prior to that, flows to the upper reaches of Emigrant and Bear creeks are supplemented by the operations of the East Main Canal and Ashland Canal. Prior to the release of storage water, users receive water from natural streamflow, as allowed by their water rights which are administered by the Districts, from various diversion structures throughout the basin. Typically these stream flow rights are actually the Districts' primary and senior rights and as they diminish, irrigation requirements are supplemented by the releases from the storage reservoirs. Once the water is released from Emigrant Dam, it travels downstream from Emigrant Creek to Bear Creek where it can be diverted at multiple locations.

At times there is variability in Bear Creek flows. This is due in part to the natural diurnal affects of the stream and compounded by both Project and non-Project water diversions and return flows and municipal influences (i.e., wastewater and stormwater discharges; municipal hydropower withdrawals). There are a large number of non-Project users in the Bear Creek basin whose water rights are senior to the Districts and the Project. The Bear Creek Watershed Assessment (RVCOG 2001) reports that there are over 1,200 recorded water rights in the Bear Creek watershed and that private irrigators hold rights to about 105 cfs of natural flow in Bear Creek and its tributaries. Non-Project water users are not required to notify the Districts or the Jackson County Watermaster about diversion schedules. As long as they do not exceed the terms of their water right, they can divert completely independently of the Districts. At times this can prove challenging for the District managers when non-Project diverters go on and off quickly, altering the amount of stream flow in Bear Creek.

Facility Operational Limitations

There are operational limitation issues to consider for the Emigrant Dam facility, primarily when releasing flows below 10 cfs. During the storage season, the guard gate behind the dam can be closed to fill the reservoir. When this gate is closed, the streamflow in Emigrant Creek is reduced to near zero or zero as has occurred in dry water years. The guard gate for Emigrant Dam was originally designed to be open or closed.

The guard gate must be open in order to provide water for minimum operational releases in Emigrant Creek which are less than 10 cfs or for flood control. This requires the regulating gates at the outlet works to be operated; however, the regulating gates for Emigrant Dam were not originally designed to provide fine adjustments for low operational releases. The regulating gates at the outlet works leak water when the guard gate is open and particularly when the reservoir is at high pool due to the increased pressure. As the regulating gates are closed or minimally opened to release water, cavitation may occur, causing damage to the gate surfaces over time. The East Canal regulating gate has the same issue. Water that is leaked into the East Canal from the regulating gate drains to the outlet chute, then into Emigrant Creek.

Similar to the guard gate, the 6-inch filler valve was designed to operate in the full open or completely closed position. Discharge from the 6-inch filler valve in a fully open position will depend on reservoir elevation with a minimum design flow of 3 cfs. The 6-inch filler valve can operate with the guard gate closed which aids in relieving pressure on the regulating gates for operational releases greater than 3 cfs. This filler valve may not operate properly with operational releases less than 3 cfs.

Though facility operational limitations are present, the proposed minimum operational releases can be provided, but will likely cause issues for future operations due to the potential excess wear on the regulating gates. A preliminary analysis was conducted in May 2009 by Reclamation staff to quantify the operational limitations. Since the analysis was conducted during irrigation season, additional analysis will need to be conducted when the guard gate and filler valve can be closed for two days after the 2009 irrigation season to collect the necessary data for accurate improvement designs. The preliminary report supports the flow capability described above through the filler valve as well as identifies the potential damage to the regulating gates. There are options that would address these issues, but they would require significant work and funds to accomplish. Design work on the gate modification is currently scheduled to begin in fiscal year 2012.

Flood Control

Section 7 of the Flood Control Act of 1944 gives the Corps flood control authority over Emigrant Dam. Flood control rule curves were developed by the Corps, with input from Reclamation, in a manner that balances flood protection with assuring a viable irrigation water supply. The flood control rule curve prescribes the amount of reservoir space needed to reduce the downstream flood potential during the October through April period. Rule curves are developed using historic runoff volumes, reservoir storage potential, and downstream flow restrictions.

The rule curve for Emigrant Reservoir requires 20,000 acre-feet of space to be reserved for flood regulation from October through December (Figure 3-8). This storage space is sufficient to control all floods of record including the historical floods of 1861 and 1890. After January 1, the reservoir can begin filling by 18,500 acre-feet on a gradual straight-line basis until April 1, when 1,500 acre-feet of space is required. This gradual reduction in flood control storage space coincides with the decrease in storm activity as the season progresses and balances the need to refill the project for irrigation supply. The final 1,500 acre-feet of space can be refilled on a straight-line basis during April.

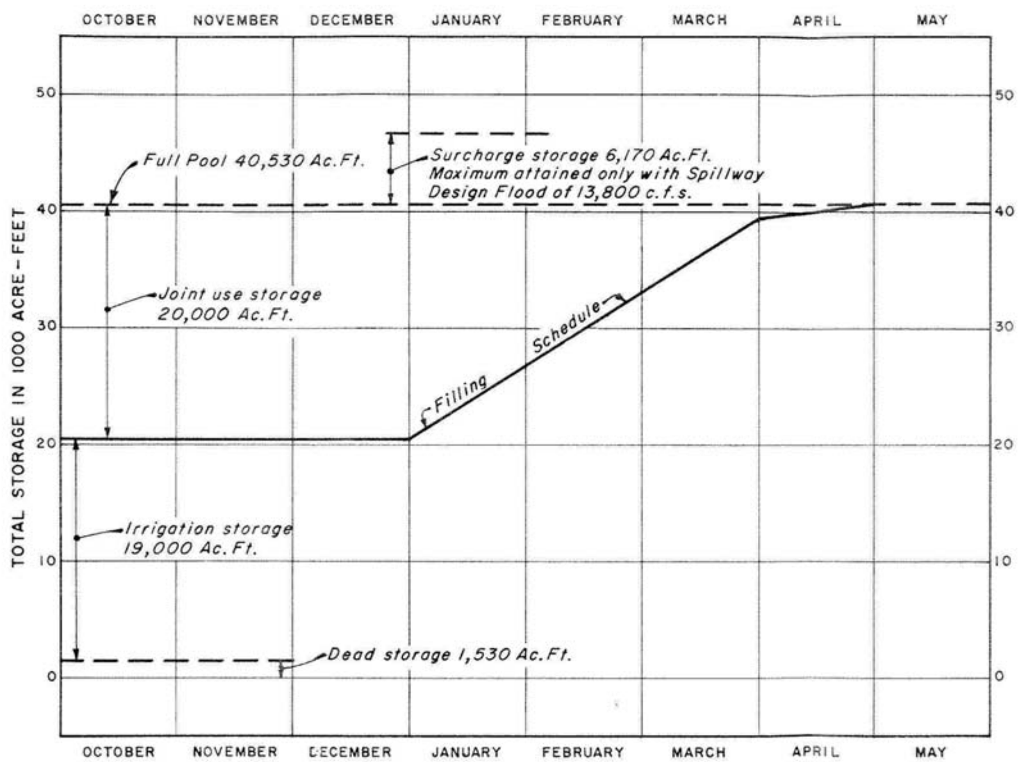


Figure 3-8. Flood control rule curve for Emigrant Dam (USACE 1965).

During the flood season, assuring sufficient flood control space for downstream protection takes precedence. Reservoir releases during the October through April period are guided by the rule curve space requirements. Releases are adjusted as needed to allow Emigrant Reservoir to fill to the space requirement dictated by the rule curve (i.e., “follow the curve”) and refill at a controlled rate. Inflows are sometimes too low to allow the reservoir to follow the curve, even with minimum discharges. During flood events, the reservoir stores flood water and fills above the rule curve requirements. Higher releases are made after the flood event to lower the reservoir down to the rule curve space requirements. Flood water can be evacuated rapidly or more gradually if flood space is not immediately needed. The rate of reservoir drawdown is coordinated between Reclamation and the Corps.

Bear Creek Watershed Hydrology

There are multiple gages in the Bear Creek watershed as shown in Figure 3-7 and Table 3-10 and Table 3-11. Data was collected from five Hydromet stations from Emigrant Creek to the mouth of Bear Creek for the period from March 31, 2001 to February 17, 2007, with the exception of BCMO that was extended through February 17, 2008, to provide a better depiction of the hydrology.

EGSO is the uppermost gage station that records inputs to Emigrant Reservoir in the Rogue River basin. EGSO measures inflow to the reservoir and provides a reference point to how the streams above the reservoir behave across the annual hydrograph (Figure 3-9). Figure 3-9 indicates the majority of the streamflow occurs during the winter and spring month while in the summer months, the unregulated flow is reduced to a point that the gage does not record flow suggesting a zero flow. The station begins recording streamflow again in late fall and winter months when precipitation in the region increases.

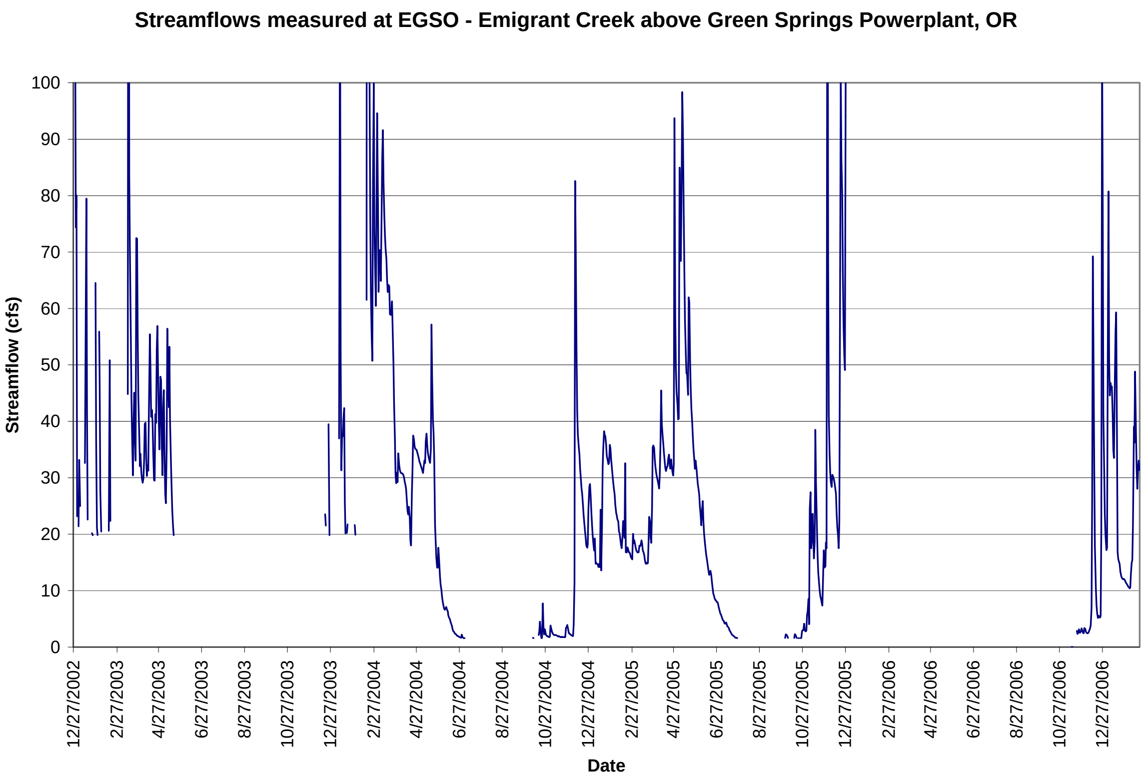


Figure 3-9. Hydrograph of measured streamflow at Hydromet station EGSO located at Emigrant Creek above Green Springs Powerplant.

A few hundred feet below Emigrant Dam, data is collected at the EMI station. Emigrant Creek inputs are primarily dependent upon releases from the dam. As shown in Figure 3-10, the stream flow pattern in Emigrant Creek shows the higher seasonal discharge for irrigation releases than the lower discharge while the reservoir is filling. Spikes in discharge during the winter or early spring are generally created by storm events in the area.

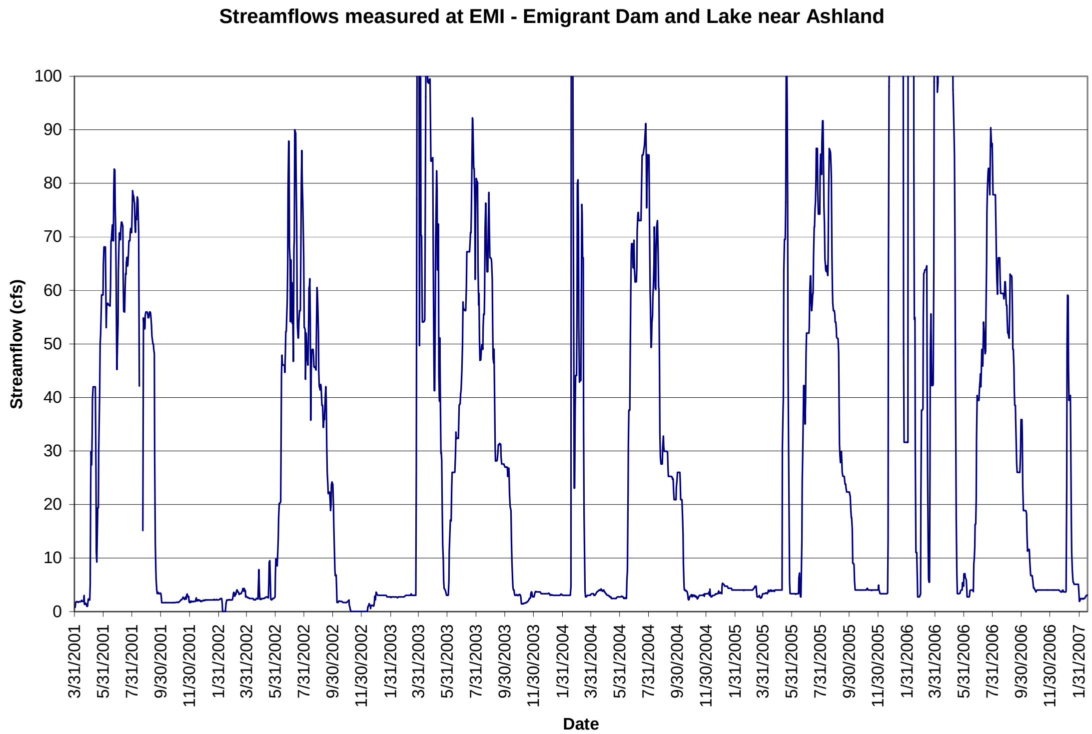


Figure 3-10. Hydrograph of measured streamflow at Hydromet station EMI located at Emigrant Dam and Lake near Ashland.

The gaging station BCAO is located above Ashland and began collecting data in July 2005. BCAO is below the confluence of Emigrant Creek and Bear Creek but above the Oak Street Diversion. There are also tributaries above BCAO whose flows are captured at this station. Troubles with the gage developed in early 2006 causing a data gap but were resolved in the spring (Figure 3-11). From the limited data, the hydrology reflects a pattern of higher flows in the summer with lower flows during the winter except when there is a storm event.

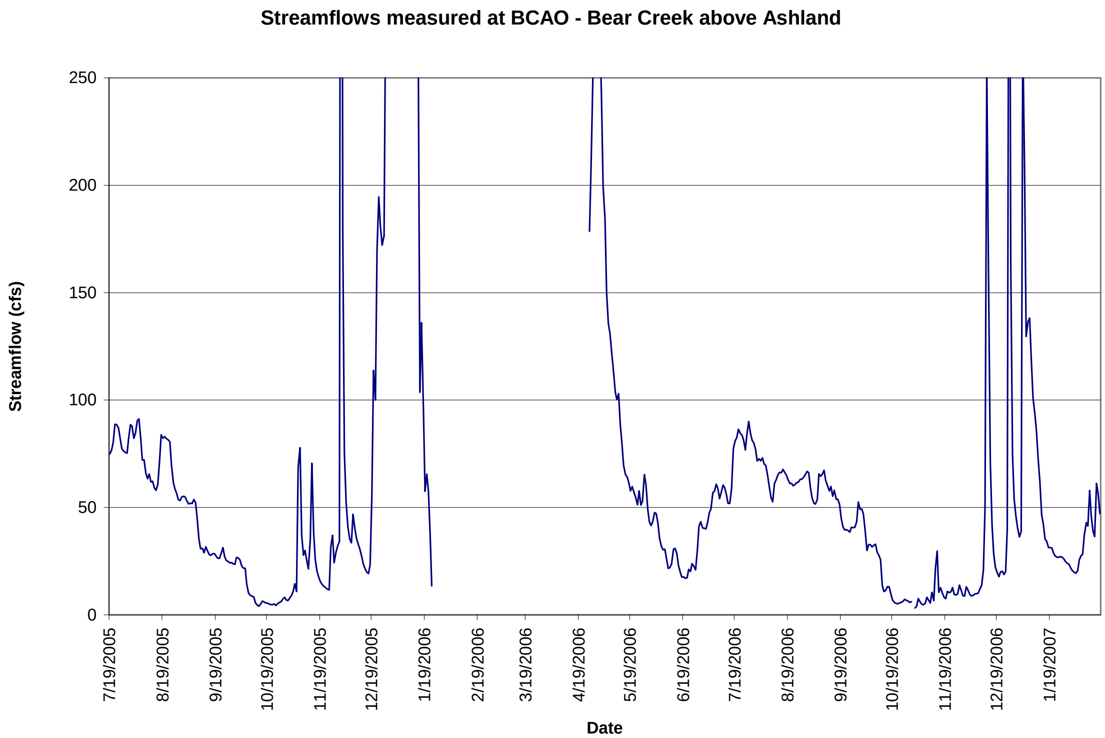


Figure 3-11. Hydrograph of measured streamflow at Hydromet station BCAO located at Bear Creek above Ashland.

Data was collected from BASO located on Bear Creek below Ashland Creek in Ashland and MFDO located on Bear Creek in Medford. These stations have been in operation for several years before March 2001 and provide good data. The hydrographs in Figure 3-12 and Figure 3-13 demonstrate low flows in the winter increasing to high flows, with spring run-off decreasing through the summer and fall. There are multiple spikes throughout a year which represent storm events in the winter and spring and operations by non-Project irrigation entities in the summer.

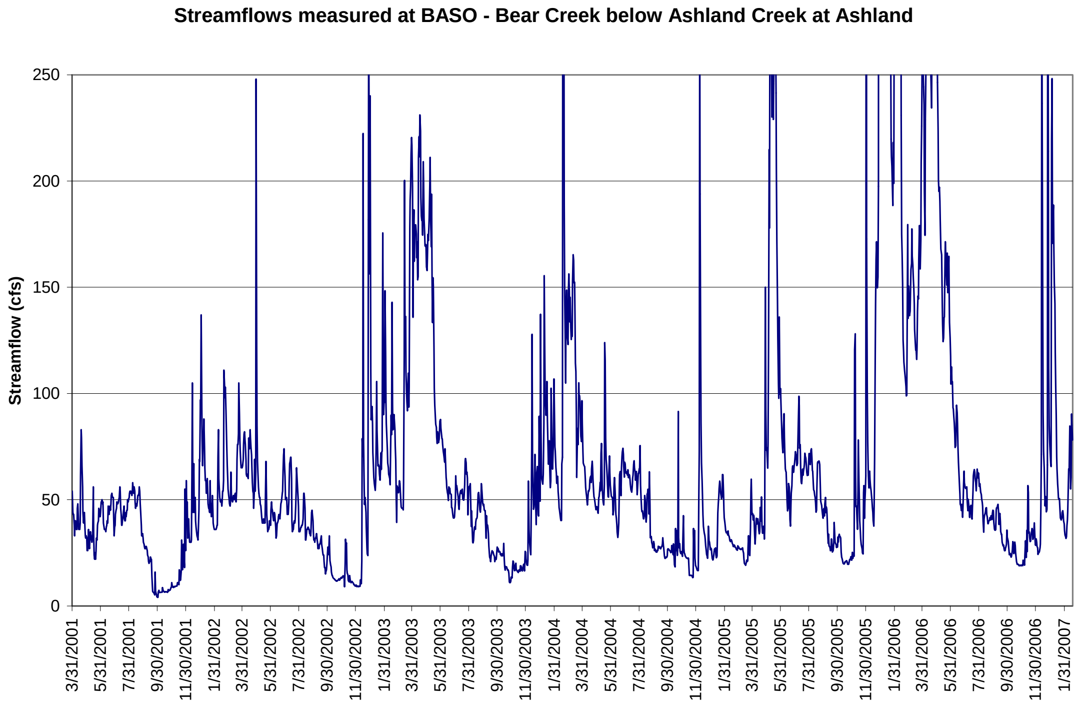


Figure 3-12. Hydrograph of measured streamflow at Hydromet station BASO located at Bear Creek below Ashland Creek at Ashland.

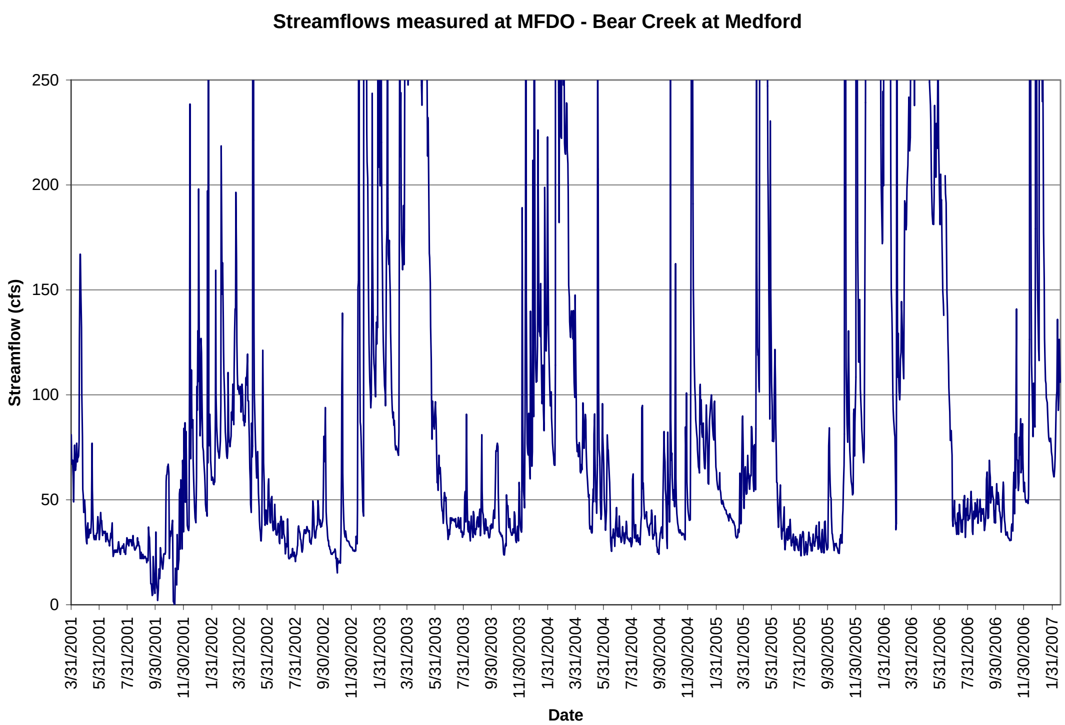


Figure 3-13. Hydrograph of measured streamflow at Hydromet station MFDO located at Bear Creek at Medford.

Data was collected from BCMO located on Bear Creek at the mouth. This station began operation in July 2005 but malfunctioned early 2006, causing a large data gap as shown in Figure 3-14. To provide a better depiction of the hydrology of this section of Bear Creek, the period of record was extended one year as mentioned previously. The streamflow seems to follow a similar pattern as described for BASO and MFDO: low in the winter, increasing in the spring, then decreasing in the summer and fall. There are other factors to those identified above for BASO and MFDO as potential causes for the spikes in streamflows including the non-Project water users that start and stop water diversions. Non-project water users are not required to provide communication with the Project managers about their use of water as long as it is within their right.

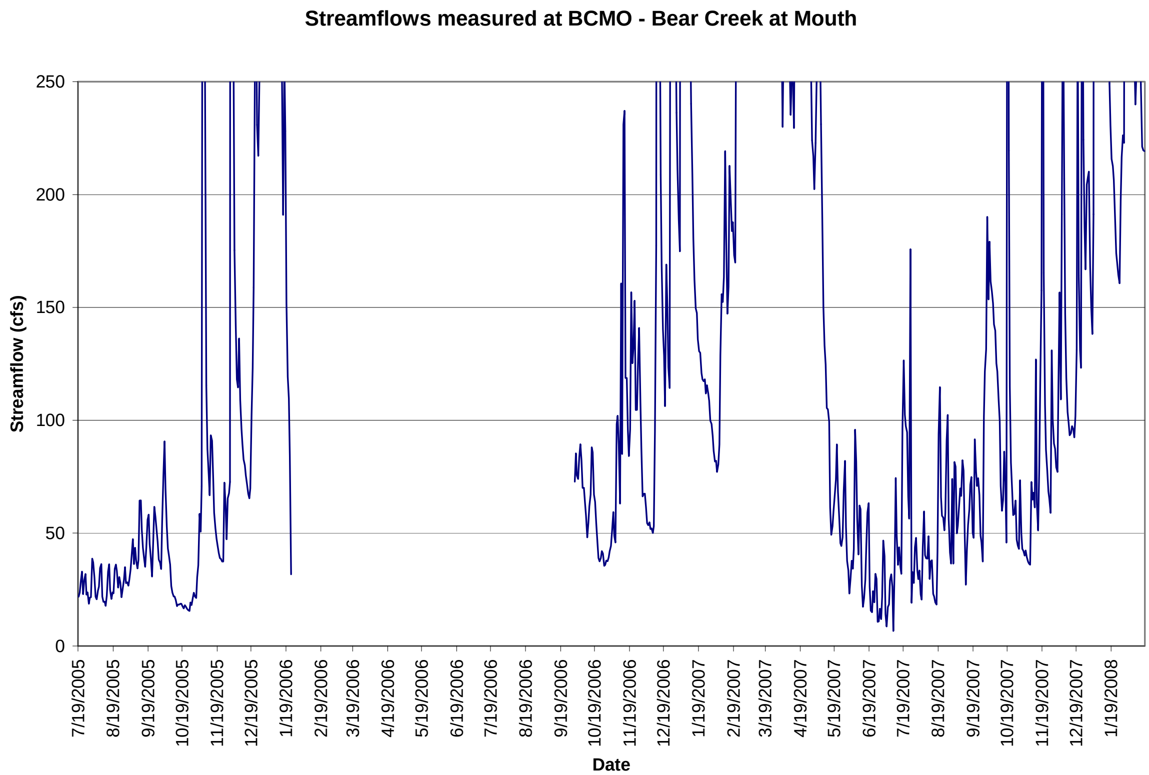


Figure 3-14. Hydrograph of measured streamflow at Hydromet station BCMO located at mouth of Bear Creek.

3.2.2 Little Butte Creek Watershed

The Little Butte Creek watershed covers approximately 238,598 acres. The BLM and USFS manage approximately 114,600 acres of Federal land in the watershed. The majority (50 percent) of the land is privately owned. Little Butte Creek watershed is comprised of the mainstem Little Butte Creek and the tributaries, North Fork Little Butte Creek, South Fork Little Butte Creek, Antelope Creek, Dry Creek, Lost Creek, Lake Creek, and Dead Indian Creek. Hydrographs for the Little Butte Creek watershed were compiled from available stream gage data using Reclamation's Hydromet system which collects data every 15 minutes and reports a daily average. The average daily flow values are represented on hydrographs in terms of cfs. The period of record for the data collection is March 31, 2001 to February 17, 2007, to remain consistent with the period of record used for the Bear Creek watershed.

On North Fork Little Butte Creek, there are two gages identified as FSHO and at Highway 140 identified as NFLO. Data was available from FSHO beginning in January 2001 which lies below Fish Lake Dam, a non-Project facility, and above any irrigation diversions. The pattern of streamflow in Figure 3-15 suggests seasonal discharge from the dam is clearly represented with low flows in winter and higher flows in summer. Data was available from NFLO beginning in July 2003 that also depicts higher flows in winter and lower flows in summer, with fluctuating irrigation demands in Figure 3-16. Although the graph indicates this location is occasionally dry, field observations by the Districts and others confirm water is flowing at all times and that gage function/accuracy at low flow may be poor.

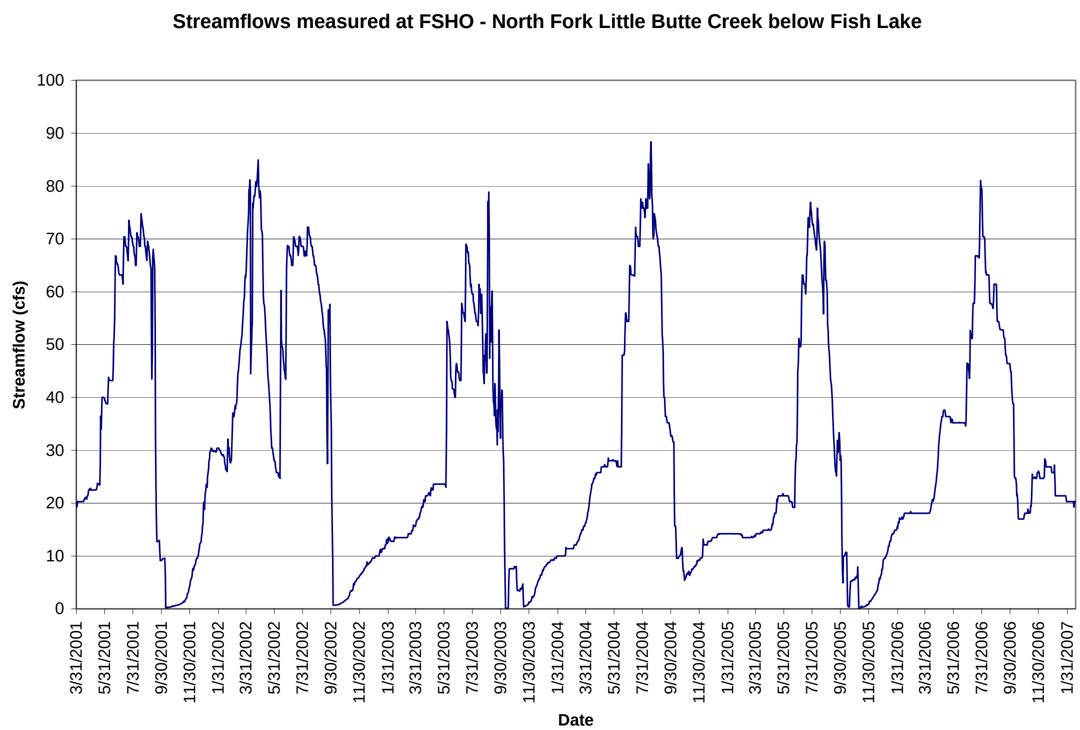


Figure 3-15. Hydrograph of measured streamflow at Hydromet station FSHO located on North Fork Little Butte Creek below Fish Lake.

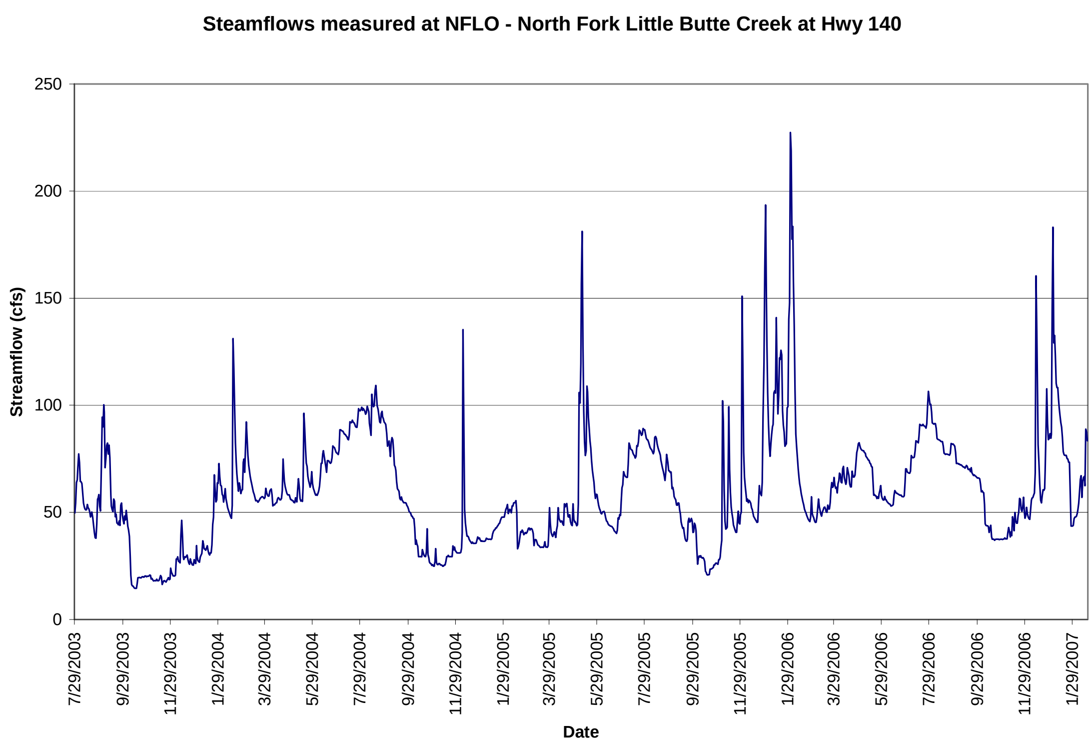


Figure 3-16. Hydrograph of measured streamflow at Hydromet station NFLO located on North Fork Little Butte Creek at Highway 140 Fish Lake.

The South Fork of Little Butte Creek has two gages: the South Fork Little Butte Creek at the Gilkey Ranch gage (GILO) and the South Fork Little Butte Creek at the mouth gage (SFLO). Data was available from GILO beginning in March 2005. It is located on the upper reach of the South Fork and there are many diversions upstream (Figure 3-17). The canal and irrigation system is complex in this area as water is diverted out of South Fork Little Butte Creek to Howard Prairie Lake. Project diversions occur during the winter and spring months while the reservoirs are storing water and discontinue during the irrigation season or summer months although non-project diversions above the gage continue. Data from SFLO was available beginning March 2005 with some data gaps between 2005 and 2007 due to poor measuring conditions and control problems (Figure 3-18). SFLO is located just above the confluence of the North and South Forks of Little Butte Creek, just below the Lower South Fork Little Butte Creek Diversion Dam, a non-Project facility.

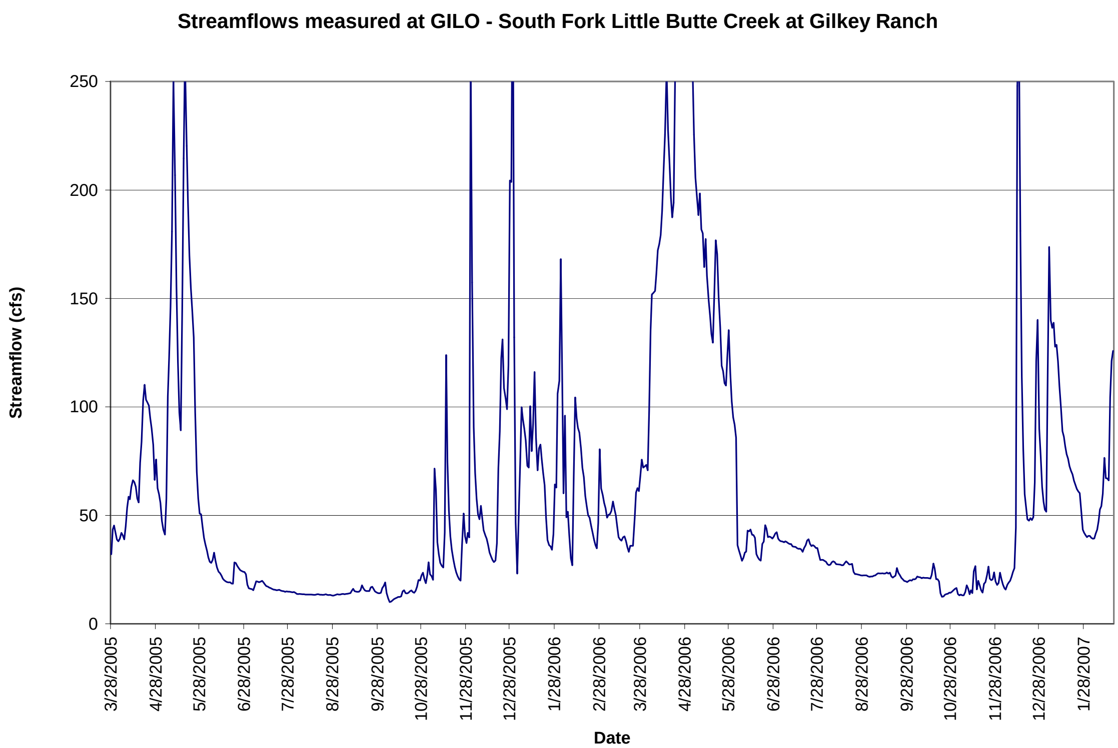


Figure 3-17. Hydrograph of measured streamflow at Hydromet station GILO located on South Fork Little Butte Creek at Gilkey Ranch.

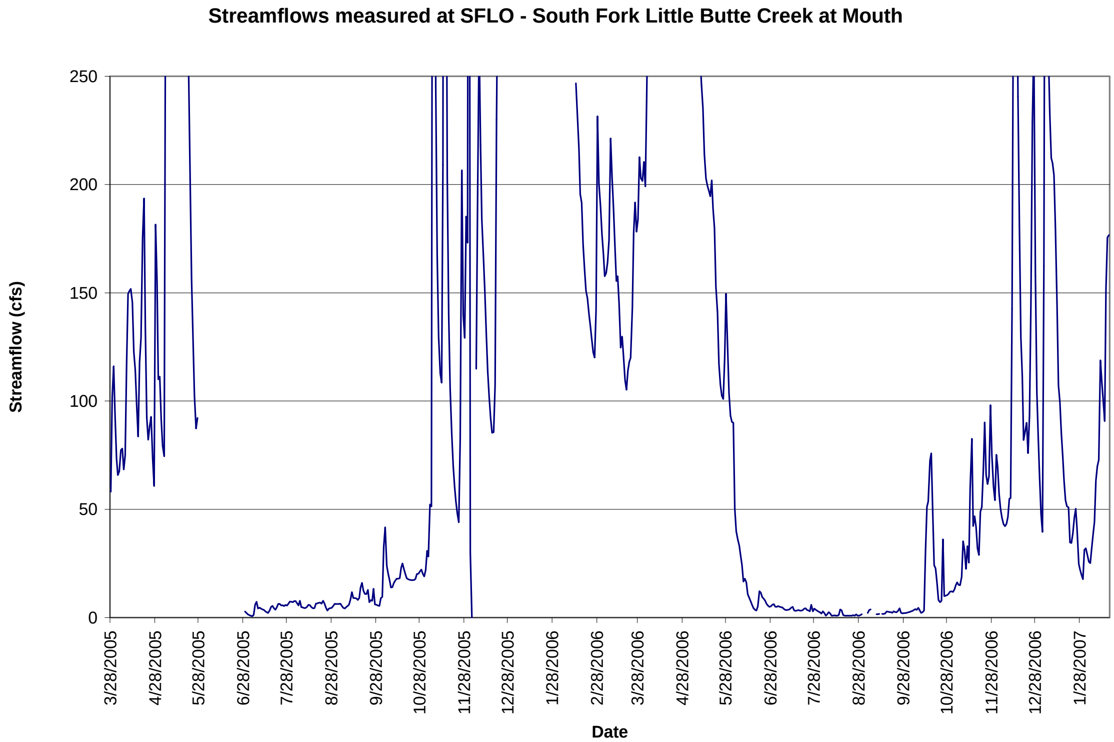


Figure 3-18. Hydrograph of measured streamflow at Hydromet station SFLO located on South Fork Little Butte Creek at mouth.

Little Butte Creek below the confluence of the North and South Forks of Little Butte Creek also has two gages which are located at Lakecreek identified as LBCO and the gage near Eagle Point identified as LBEO. Data was available from LBCO beginning in May 2002. Like SFLO, LBCO (Figure 3-19) is below the South Fork Little Butte Creek Diversion Dam which identifies a seasonal pattern of increased flows from late winter to early summer, reflecting spring runoff. Data was available from LBEO beginning in February 2006 is further downstream on Little Butte Creek above the confluence with Antelope Creek. The gage was not operating properly from May 2006 through November 2006 as shown in Figure 3-20.

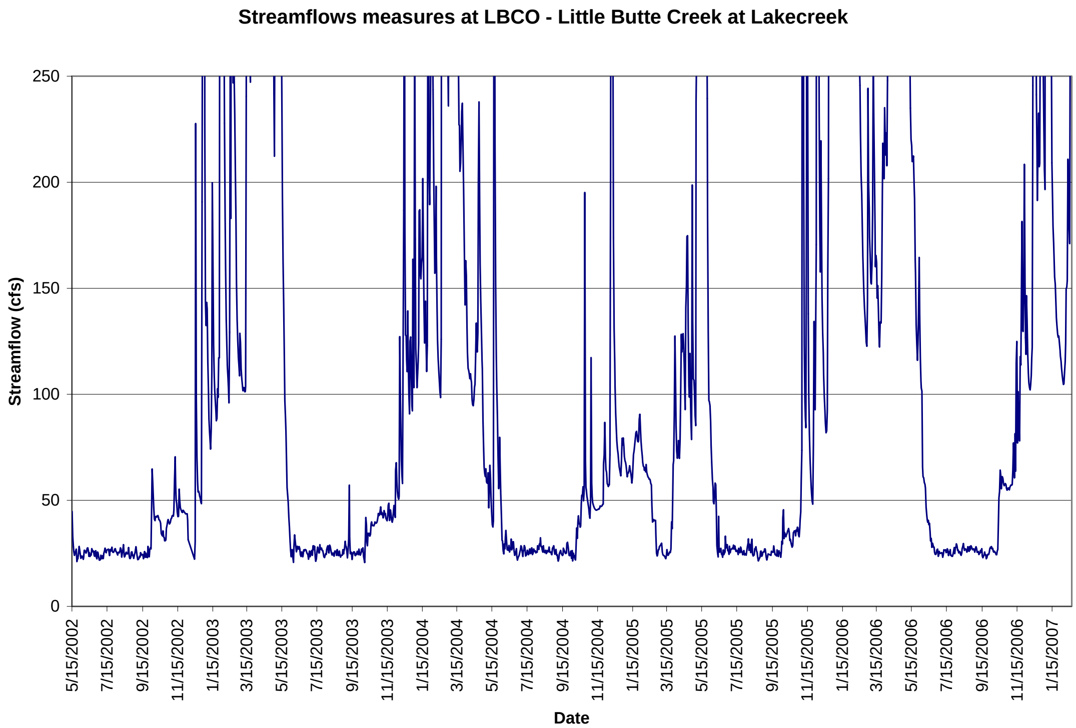


Figure 3-19. Hydrograph of measured streamflow at Hydromet station LBCO located on Little Butte Creek at Lakecreek.

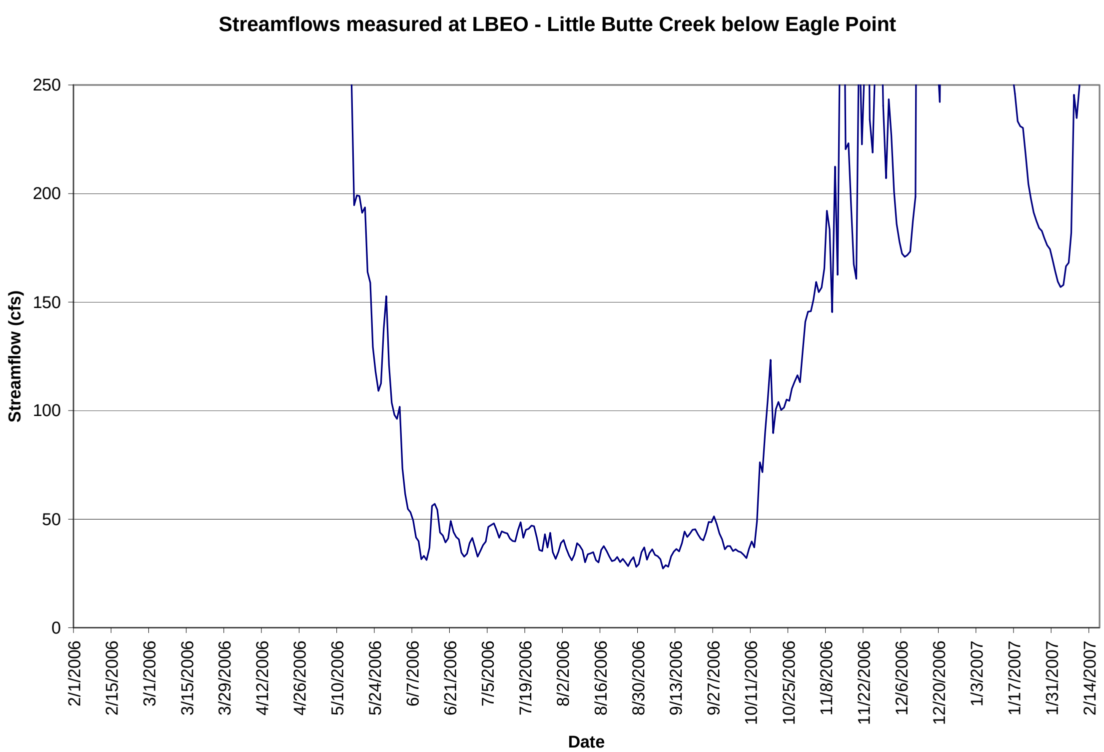


Figure 3-20. Hydrograph of measured streamflow at Hydromet station LBEO located on Little Butte Creek below Eagle Point.

Three gaging stations have been in operation on Antelope Creek during the last several years; however, the period of record for some of these stations is relatively short. Figure 3-21 shows data from the three stations since 2003. The data is provisional and subject to change. Currently, only the Antelope Creek station near Eagle Point (EPTO) is providing reliable streamflow measurements for Antelope Creek. Since EPTO is located below the confluence of Antelope Creek and Dry Creek which is below Agate Dam and diversions on Antelope Creek, the data collected reflects streamflow from the releases from Agate Dam, Antelope Creek, and any other local gains that occur. Stream flow measurements at the Antelope Creek Diversion Dam (ANTO) are not currently reliable, but past records show good correspondence with flows measured at ANTO and those recorded downstream at EPTO, with high flows in the winter and spring and low flows in the summer. Long periods of no streamflow are recorded at ANTO in the summer and, based on actual observations, these are accurate.

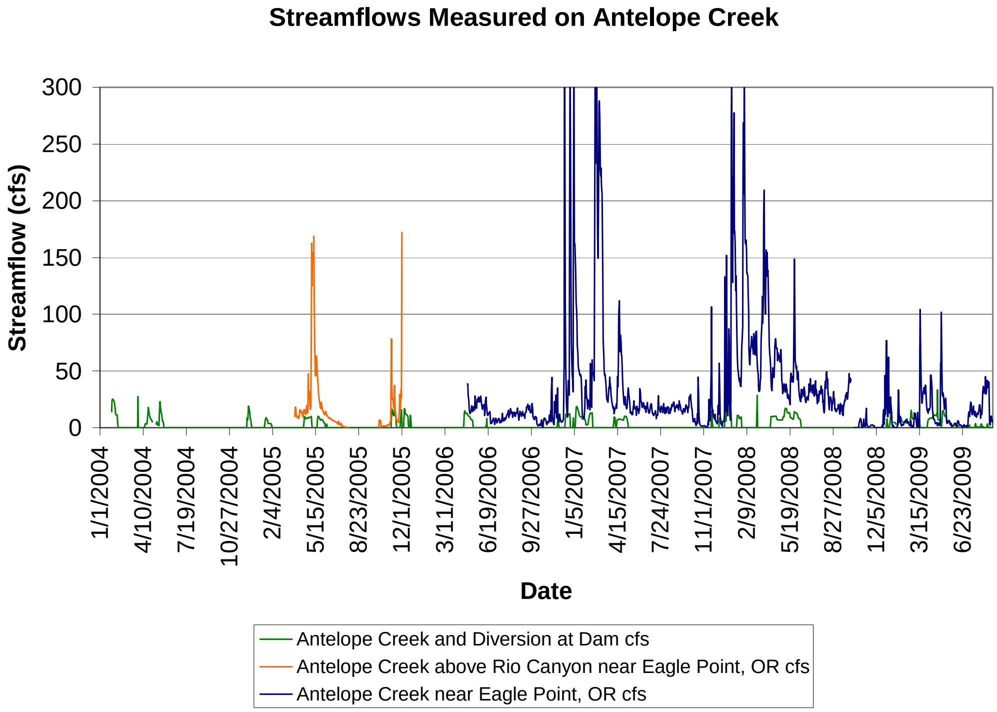


Figure 3-21. Hydrograph of measured streamflows at three stations located on Antelope Creek.

3.2.3 Klamath River Basin

The Klamath River basin covers approximately 12,100 square miles in southern Oregon and northern California. There are four creeks within the Project area which are affected by Project water management: Jenny Creek, Soda Creek, Keene Creek, and Little Beaver Creek. Of those four streams, Jenny Creek could be considered the main tributary in the reach as it receives water from Soda Creek, Keene Creek, Little Beaver Creek, and Johnson Creek. The hydrology of these creeks is primarily dependent on the release and diversion of water which is determined by the time of year.

As described in Chapter 2, water is transferred from the Rogue River basin to storage facilities in the Klamath River basin, and then transferred back to the Rogue River basin. Runoff in the Jenny Creek basin is also captured, stored, and routed to the Rogue River basin. There are approximately 24,000 acre-feet transferred from the Klamath River basin to the Rogue River basin. Although no hydrographs are shown for these creeks, the type of system is similar to most irrigation water management systems with low flows in the winter months and higher flows in the summer months. Additional information regarding the Klamath Basin hydrology can be found in the Klamath Project BA (Reclamation 2008).

3.3 Habitat Conditions

There are a total of 110 streams and approximately 1,000 miles in the entire Rogue River basin considered to be coho salmon habitat, but only 18 stream reaches totaling 170.9 miles within Rogue River basin were designated as coho salmon core areas in the Southwest Oregon Salmon Restoration Initiative report (Prevost et al. 1997). About 17 percent of Rogue River basin coho salmon streams are considered high value coho salmon core habitat.

3.3.1 Bear Creek Watershed

Aquatic habitat conditions in the environmental baseline are documented through habitat surveys, water quality sampling, and flow data collected within the Bear Creek watershed (Table 3-12). ODFW conducted habitat surveys in six reaches of the mainstem of Bear Creek in 1990. More recent habitat-typing was conducted by Reclamation (Sutton 2007b). In addition to these habitat surveys, temperature and other water quality surveys have been conducted (GeoEngineers 2004). Overall, Bear Creek provides relatively poor habitat for coho salmon (NOAA Fisheries 2007). Despite poor habitat conditions in the Bear Creek subbasin, some coho salmon spawning and rearing habitat occurs in approximately 30 miles of streams in this basin and accessible habitat in the basin has been designated as critical habitat for SONCC coho salmon (Vogt 2004). Beneficial actions have also occurred within the watershed and have included instream and riparian habitat enhancements, fish passage improvements, upland restoration, and road improvements.

Table 3-12. Summaries from ODFW, USFS Level II, and Reclamation stream habitat surveys.

Stream	Reach	Survey Date	Total pools (%)	Riffles (%)	Glides (%)	Other (%)	Avg Gradient (%)	Width/Depth Ratio	Substrate percent wetted area				
									Sand (%)	Grav (%)	Cob (%)	Boul (%)	Bed (%)
Reclamation stream segments (Sutton 2007)													
Bear Creek	Avg	2006-2007	17	37	47		1	27	21	31	17	4	14
Emigrant Creek	Mouth to Emigrant Dam	8/17/06	16	39	45			20	13	26	17	3	18
Little Butte Creek	Avg	8/17/06	25	29	46		0	39	7	36	23	1	18
S. Fk. Little Butte Creek	Mouth to natural falls	8/17/06	7	25	68	<1	1.7	19	5	28	62	3	0
Antelope Creek	Avg (mouth to diversion)	2006	32	35	33		1	31	12	37	21	9	11
Neil Creek	Mouth to Tolman Creek	6/13/06	19	40	41	<2	0.7	15	53	14	15	3	0
Oregon Dept Fish and Wildlife													
Bear Creek[a]	Avg (Reaches 1-6)	6/27/1990	29	6	63	3	0		22	33	25	4	17
Antelope Creek[b]	Avg (Reaches 1-6)	4/91	22	37	28	12	1	13	8	33	48	5	6
Little Butte Creek[b]	Avg (Reaches 1-3)	6/94	39	24	15	21	2	53	3	34	17	5	12
S Fk Little Butte Creek[b]	Avg (Reaches 1-11)	7&8/94	24	19	4	52	3	36	7	32	28	15	4
S Fk Little Butte Creek[c]		6/2/1969	86										
U.S. Forest Service Level II Surveys													
Neil Creek[d]	Avg (Reaches 1-6)	8/30/2002	30	66		6	3	17					
Neil Creek[c]	Avg (Reaches 1-3)	8/20/1990	4	86	7		14	5			SUB	DOM	
Neil Creek[c]		1969-1970	15				7						
S Fk Little Butte Creek[b]	Avg (Reaches 1-6)	8/1990	9	66	23	0	6	10					
	Avg (Reaches 1-6)	9/6/97	24	76		0	4	23					
S Fk Little Butte Creek[c]		1969-1970	10	86		14	4-5						

Sources:
[a] Dambacher et al. (1992)
[b] Talabere (1994)
[c] GeoEngineers, Inc. (2004)
[d] Siskiyou Research Group (2002)
DOM – Dominant Substrate Type
SUB – Sub Dominant Substrate Type

Examination of Table 3-12 shows some general similarities between habitat conditions of each Reclamation instream flow study site and stream habitat conditions at large. For example, the gradient in Bear Creek is between about 0 and 1 percent at each stream reach measured by Reclamation in 2006 and by ODFW in 1990. Also, there is general agreement of a higher percentage of glides than riffles or pools in Bear Creek; however, it should be noted that many of the differences in habitat parameters among various habitat surveys are the result of different objectives, methodologies, and flow conditions at the time of the surveys. For example, ODFW reports substrate types as a percentage of wetted area, while the USFS reports only dominant and subdominant substrate types. Reclamation's substrate results were summarized as percentages of each substrate type from cells among all transects at each site. Also, ODFW and USFS surveys include entire stream segments, including channelized areas, whereas Reclamation surveys focused on untreated habitat reaches. Finally, stream morphology in Bear Creek was likely affected by the flooding that occurred in December 2005; thus, habitat conditions recorded by Reclamation in the spring and summer of 2006 and fall of 2007 were likely different than before the flood.

Water Quality

Water quality impairment in the Bear Creek watershed has been recognized for many years. ODEQ has conducted water quality monitoring since the mid-1980s and determined the Bear Creek watershed is the most impacted watershed in the basin (ODEQ 2001). In 1992, Bear Creek was one of the first watersheds in the State of Oregon to have Total Maximum Daily Loads (TMDLs) developed for total phosphorus, ammonia, nitrogen, and biochemical oxygen demand. TMDLs determine the maximum allowable level of pollutants a water body can assimilate while supporting existing beneficial uses, allocate pollutant loads to different sources in the watershed, and set the stage for implementing corrective actions. The Districts are Designated Management Agencies (DMAs) for both the Bear Creek and Rogue River TMDL processes.

Poor water quality conditions in Bear Creek are the result of elevated point and non-point source pollutants related to urban development, intensive agriculture, and historical upper watershed resource management practices. Several water bodies in the Bear Creek watershed appear in the State of Oregon's 2004/2006 Integrated Report, also known as the Section 303(d) list. Section 303(d) listed waters are thought to be water-quality limited by one or more pollutants and a TMDL is required to restore impaired beneficial uses. Table 3-13 shows the Section 303(d)-listed water body segments in the Bear Creek watershed. Elevated water temperature and excess bacteria are the two primary pollutants of concern in the watershed.

Table 3-13. Bear Creek watershed 303(d) listed water body segments in Oregon's 2004/2006 Integrated Report.

Water Body	Listed Segment (RM)	Listed Pollutant
Ashland Creek	0 – 2.8	Fecal Coliform (year around)
Bear Creek	0 – 26.3	Temperature (summer) Fecal Coliform (year around) *E. coli* (year around)
Butler Creek	0 – 5.2	Temperature (summer) Fecal Coliform (fall/winter/spring)
Carter Creek	0 – 4.8	Temperature (summer)
Coleman Creek	0 – 6.9	Temperature (summer) Fecal Coliform (year around)
Crooked Creek	0 – 4.3	Fecal Coliform (year around)
Emigrant Creek	0 – 3.6, 5.6 – 15.4	Temperature (summer)
Gaerky Creek	0 – 4.6	Temperature (summer)
Griffin Creek	0 – 14.4	Fecal Coliform (year around)
Hobart Creek	0 – 1	Temperature (summer)
Jackson Creek	0 – 12.6	Temperature (10/1 – May 31) Temperature (summer) Fecal Coliform (year around)
Larson Creek	0 – 6.7	Temperature (summer) Fecal Coliform (year around)
Lazy Creek	0 – 4.5	Temperature (summer) Fecal Coliform (year around)
Lone Pine Creek	0 - 5	Temperature (summer)
Meyer Creek	0 – 5.3	Temperature (summer) Fecal Coliform (year around)
Neil Creek	0 – 4.8	Temperature (10/1 – May 31) Temperature (summer)
Payne Creek	0 – 2.1	Temperature (summer) Fecal Coliform (year around)
Tyler Creek	0 - 4	Temperature (summer)
Wagner Creek	0 – 7.4	Temperature (summer)
Walker Creek	0 – 6.7	Temperature (10/1 – May 31)

The RVCOG has collected water quality data from nearly 30 sites in the Bear Creek system since the early 1990s, gathering information and establishing trends for parameters such as dissolved oxygen (DO), phosphorus, ammonia, and bacteria. Water quality monitoring reports calculate each percent exceedence of the established standards for each parameter and shows where pollutants are found in Bear Creek and whether pollutant inputs have a growing cumulative impact as water moves from upstream to downstream. In Olson (2000) and successive RVCOG monitoring reports for 2002-2004, percent exceedences indicate that DO, phosphorus, ammonia, and bacteria do not appear to have a increasing cumulative trend downstream – the percent exceedence seems dependent largely on factors relating to each particular site. However, the data indicates that Bear Creek exceeds TMDL standards throughout its length, demonstrating that mitigating pollutant concerns at one particular point in Bear Creek will not necessarily impact or improve water quality downstream.

Temperature

High water temperatures along a significant portion of Bear Creek exclude use by juvenile coho salmon (Williams et al. 2006; Nickelson 2008; Reclamation in Appendix B). Natural or background sources of solar radiation are by far the largest heat source in the Bear Creek watershed (ODEQ 2006). Other, less prevalent sources of heat include point sources such as municipal and industrial wastewater treatment facilities and diffuse non-point sources such as forestry and agriculture. The Bear Creek temperature TMDL was finalized by ODEQ and approved by EPA on October 2, 2007. The National Pollutant Discharge Elimination System (NPDES)-permitted point sources impacting water temperatures include Associated Fruit, Bear Creek Corporation, Valley View Landfill, Boise Building Solutions Manufacturing, Rogue Aggregates, Rock and Ready Mix, Willow Creek Aggregates, and the City of Ashland. The TMDL separated the diffuse non-point sources into several categories, which included near-stream vegetation disturbance/removal, channel modification and widening, dams, diversion, and other hydrological modifications.

The biologically-based numeric temperature criteria for the Bear Creek watershed is a 7-day moving average of daily maximum water temperature not to exceed 18^{o} C (64.4^{o} F) and 13^{o} C (55.4^{o} F) during times when salmon and steelhead spawning, incubation, and emergence are occurring. Table 3-14 shows the temperature criteria sorted by month and the associated salmonid life stage expected to be occurring during that month. In months where there is life stage overlap, the most stringent criterion is applicable to protect the resource. While the temperature criteria are the same, it should be noted that the spawning and incubation periodicity shown in Table 3-14 is slightly different than the periodicity applied by ODEQ in their Salmon and Steelhead Spawning Use Designation map for the Rogue River basin. The periodicity modifications are based on discussions with the agency representatives and local experts involved in the Rogue PHABSIM workshops held May 12, 2006.

Table 3-14. Applicable temperature criteria in Bear Creek for coho salmon.

LIFE STAGE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Spawning	13°C	--	--	--	--	--	--	--	--	--	13°C	13°C
Incubation	13°C	13°C	13°C	13°C	13°C	--	--	--	--	--	13°C	13°C
Smolt Emigration/ Juvenile Rearing[1]	--	15th-28th 18°C	18°C	18°C	18°C	18°C	--	--	--	--	--	--
Juvenile Rearing	--	--	--	--	--	--	18°C	18°C	18°C	--	--	--
Adult Passage (Gold Ray/Rogue Mainstem)[2]	--	--	--	--	--	--	--	--	18°C	--	--	--
Adult Passage[3]	18°C	--	--	--	--	--	--	--	--	18°C	18°C	18°C

-- These months fall outside the critical period for this life stage
[1] Smolt trap data from ODFW and temperature data from Reclamation's Hydromet Stations
[2] Gold Ray Dam ODFW fish counts (Satterthwaite 2007) and temperature data from Reclamation's Hydromet Stations
[3] Gold Ray fish counts and periodicity charts (Doino 2006)

In summer, water releases from Emigrant Dam benefit salmon by supplementing summer flows in Bear Creek. Through most of the summer, these supplemental flows also benefit salmon by cooling Emigrant Creek and upper Bear Creek relative to ambient temperatures (Appendix B). As illustrated in Figure 3-22, though Bear Creek routinely exceeds the temperature criteria, particularly during the summer months (June through September) and more so in the lower portions of the system where the beneficial cooling effect of Emigrant Reservoir is diminished. Direct solar radiation on unshaded stream reaches and warm air temperatures can cause daytime water temperatures to exceed 26.7° C (80^{o} F) below Medford during the summer (Reclamation 2001). Although release of Project water cools Emigrant Creek and portions of upper Bear Creek, Reclamation found water flow does not relate to water temperature in the middle and lower reaches of Bear Creek (Appendix B) where the high temperatures result largely from solar loading (ODEQ 2007).

The elevated temperatures can hinder juvenile coho salmon and steelhead survival, but most anadromous fish depart the Bear Creek tributaries by July to enter the Rogue River system (RVCOG 2001). Young fall Chinook salmon generally are not affected by summer temperatures because they begin migrating to the ocean shortly after emergence from gravels in the spring.

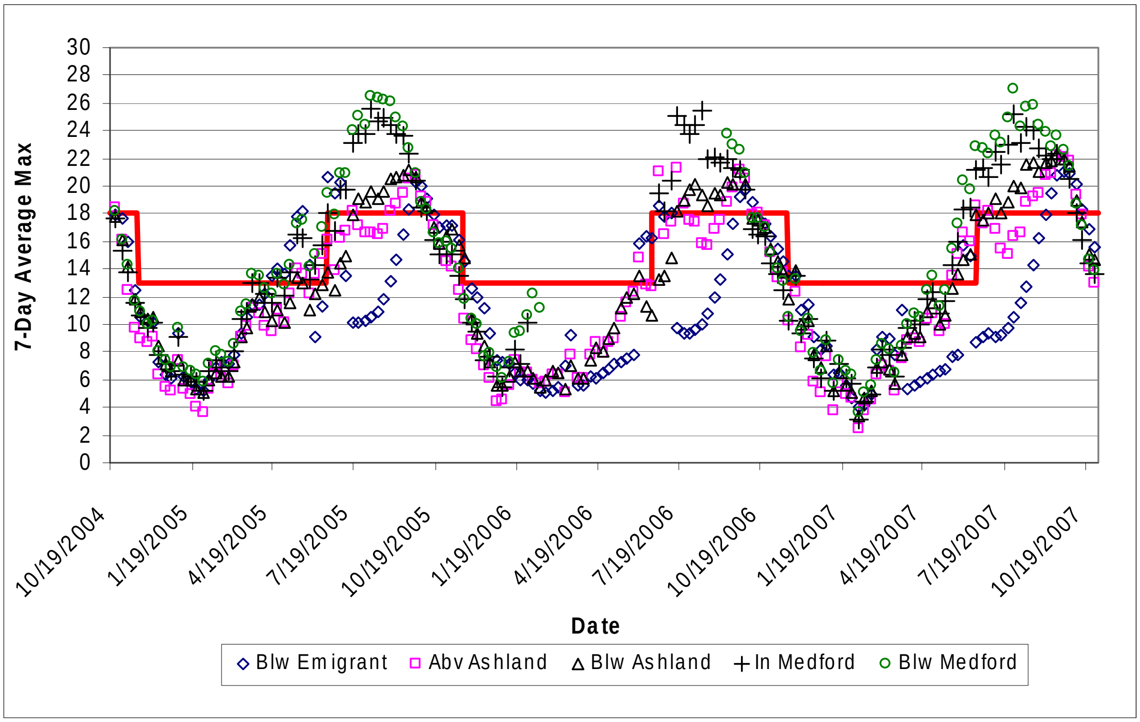


Figure 3-22. October 2004 – October 2007, 7-day average maximum water temperatures in Bear Creek and Emigrant Creek (gaps indicate missing data). The red line indicates the data from Table 3-14.

Reclamation (2001) collected water temperature data during the summer and fall of 1998 at 3 Bear Creek sites and at 15 tributary stream sites. Monitoring occurred from August 1 through the end of October to obtain hourly temperature data to monitor diurnal temperature swings and to determine exceedences of the water temperature criterion. Temperature recorders were installed upstream from irrigated lands on Wagner, Coleman, Griffin, and Jackson creeks, as well as at the confluence with Bear Creek, to evaluate the effects of return flows on water temperature. Monitoring results indicate high diurnal fluctuations in both Bear Creek and its tributaries.

Some tributaries with monitoring locations above and below irrigated lands (Wagner and Coleman Creeks) showed water temperature increases between the upper and lower sites. Griffin Creek showed increases during portions of the period of record, while Jackson Creek showed very little change in temperature from the upper to lower site.

In the Bear Creek water temperature modeling report prepared as part of the Bear Creek TMDL, ODEQ reported the maximum water temperature for several tributaries to Bear Creek (ODEQ 2006). Table 3-15 shows the current maximum water temperature reported for each tributary.

Table 3-15. Current maximum water temperature for tributaries to Bear Creek.

Tributary	Maximum water temperature
Neil Creek[††]	20°C (68°F)
Gaerkey Creek[†]	25.2°C (77.4°F)
Ashland Creek[††]	20.7°C (69.4°F)
Butler Creek[†]	20.6°C (69.1°F
Meyer Creek[†]	19.7°C (67.5°F)
Wagner Creek[†]	21.8°C (71.4°F)
Payne Creek[†]	21°C (69.8°F)
Larsen Creek	23.5°C (74.9°F)
Lazy Creek[†]	24°C (75.2°F)
Lone Pine Creek[†]	28.6°C (83.5°F)
Griffin Creek[†]	21.8°C (71.4°F)
Jackson Creek[†]	23.5°C (74.9°F)

[†]Ephemeral streams (dry above the canals in August)
[††]Perennial streams

The data shown in Table 3-15 suggest that maximum tributary temperatures have a varying effect on water temperature in Bear Creek, depending on where they enter the system. Some tributaries, particularly those in the upper portion of the watershed, likely warm Bear Creek temperatures during the hottest time of the year, especially since the cooler water from the reservoir reduces base stream temperatures. The cooling effect of the reservoir diminishes progressively moving downstream until equilibrium is reached in Bear Creek near Ashland (Appendix B). Those tributaries in the lower portion of the watershed likely have less of a warming effect because Bear Creek is already warm.

In 2007, Reclamation initiated a multi-year comprehensive water temperature study by placing temperature loggers at the mouth of major tributaries in the watershed (Appendix B). These data can be used to better define how the tributaries are affecting water temperature in Bear Creek.

In August of 2007, 13 coldwater springs, seeps, and tributaries were identified in an inventory conducted by Reclamation (Sutton 2007b). The data from this inventory suggest evidence of possible summer thermal refugia for juvenile coho salmon. Most potential thermal refugia were located in the upper half of Bear Creek watershed, with the majority of it being tributary inflows originating in the southwest portion of Bear Creek watershed.

Bacteria

About half of the Section 303(d) listed stream segments shown in Table 3-13 are listed due to excess bacteria (fecal coliform or *E. coli*). Elevated bacteria in the highly developed Bear Creek watershed are likely attributable to many sources, including cross connections between sanitary and storm sewer systems, certain permitted industrial sites, animal waste on ground surfaces (birds and livestock), illegal dumping into storm sewer systems, and general urban and rural runoff (ODEQ 2001). Elevated bacteria levels impact beneficial uses associated with aesthetic quality and water-contact recreation.

Bacteria loading in Bear Creek exhibits seasonal variation. During the fall, winter, and spring months when there is less recreational and agricultural activity in the watershed and the water is colder, bacteria counts are reduced. In the summer months when recreational and agricultural activity and water temperature increases, the bacteria counts increase as well. Figure 3-23, which is derived from the ODEQ bacteria assessment prepared as part of the Bear Creek TMDL (ODEQ 2006), shows the cumulative loading in Bear Creek at Medford sorted by month. The graph illustrates April and May as the highest loading months for bacteria. Agriculture practices are just beginning at this time in the Rogue River basin. RVCOG typically posts bacterial warning signs throughout the basin in August.

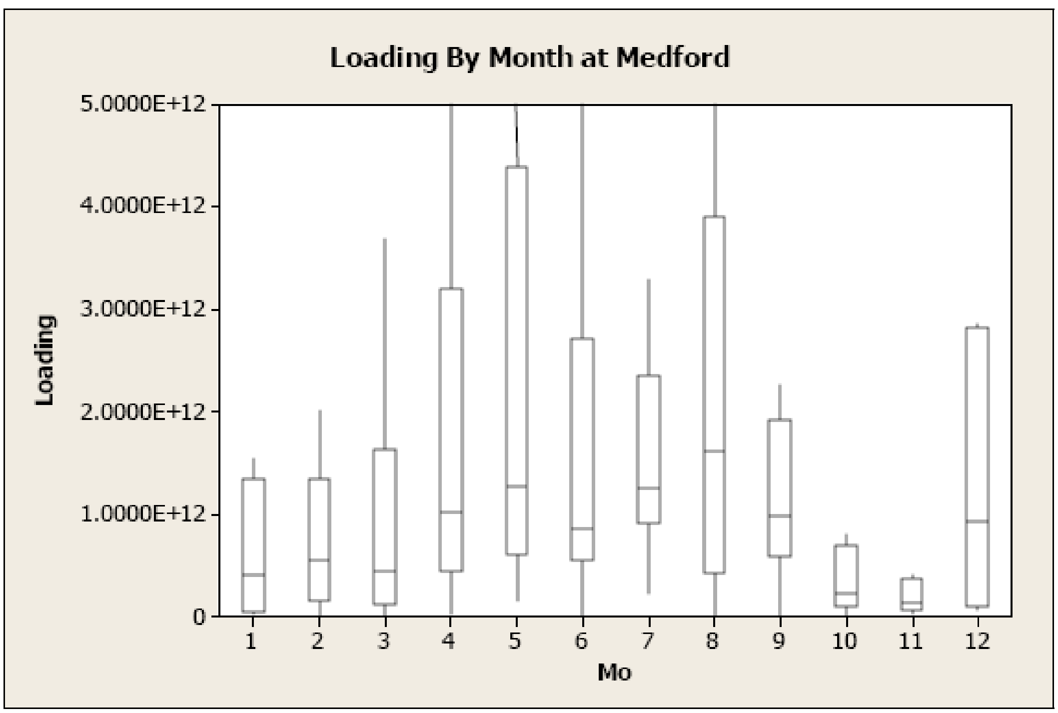


Figure 3-23. Monthly cumulative bacteria loading in Bear Creek at Medford.

In the Bear Creek bacteria assessment, ODEQ also reported the total bacteria loading from several tributaries to Bear Creek over the period from February 1995 through October 1998 (ODEQ 2006). Figure 3-24 shows the relative bacteria loading for each tributary converted to a percentage of the total load.

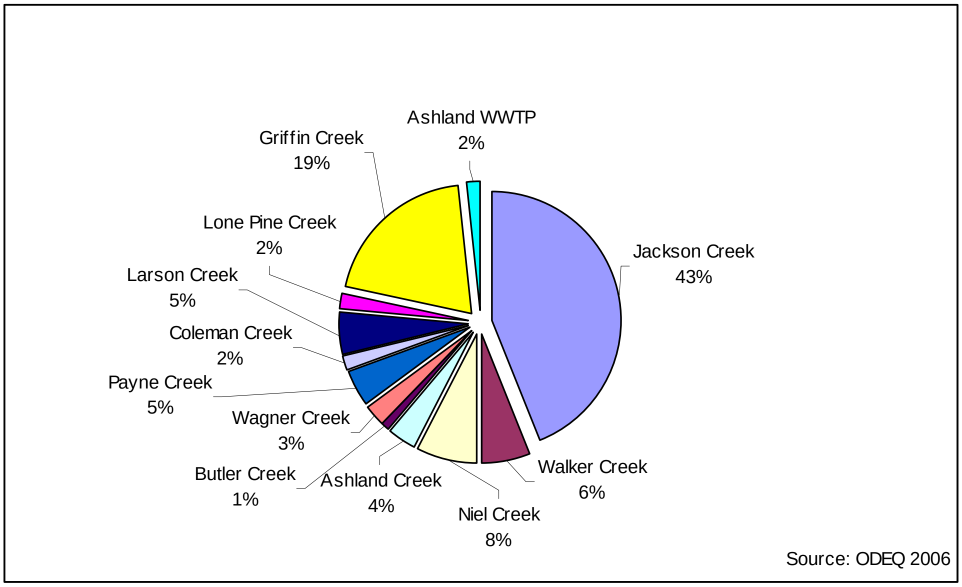


Figure 3-24. Relative percentage of bacteria loading from tributaries to Bear Creek.

Dissolved Oxygen

Since the mid-1970s, water quality in Bear Creek has been compromised by low dissolved oxygen (DO) levels (McKenzie and Wittenberg 1977; Wittenberg and McKenzie 1980). The amount of dissolved oxygen in a river is directly affected by river temperature, with higher DO levels in colder water and vice versa. Thus, DO levels fluctuate daily and seasonally, with higher levels generally at night and in the winter. The seasonal trend of higher DO levels during the winter (October through May) has been captured in the Bear Creek system (Olson 2000), but the need for multiple samples per day has limited observations of daily trends.

DO levels are also impacted by Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), reflecting oxygen consumption through biological processes and consumption of oxygen from chemical reactions within the water column. One of the major pollutants in the Bear Creek system is total phosphorus. Phosphorus is fed to the Bear Creek system through treated wastewater effluent, agriculture, and other sources (Reclamation 2001; RVCOG 2003; GeoEngineers 2004). This input can lead to massive algal growth during the summer (April to September) when flows are lower and water temperatures become warmer (RVCOG 2004). During the day, photosynthesis occurs, but at night, algae can consume DO, lowering those levels in the stream even as temperature improves (JSWCD 1992). Algal decomposition in the winter can also excessively use DO, lowering those higher winter DO levels (Olson 2000; RVCOG 2004).

The 1992 TMDL water quality standard for DO reflects the need for higher DO levels in the winter (11.0 milligrams per liter [mg/l]) for salmon spawning versus in the summer (8.0 mg/l). The phosphorus standard currently is 0.8 mg/l during both summer and winter.

The RVCOG has been monitoring approximately 27 sites since the early 1990s and Olson (2000) conducted a summary analysis of collected data, calculating percent exceedence of the established standards for multiple water quality parameters (including DO and phosphorus) as well as describing distributions of each parameter by site and by year from 1992 to 1999. Measurements were generally monthly (winter) or bi-monthly (summer), but still show some trends. The DO levels exceeded the standard over 50 percent of the time at almost all sampled sites during the winter season. In the summer, the majority of sites experienced over 15 percent exceedence with one site that was below the Ashland waste water treatment facility experiencing over 50 percent exceedence. The winter exceedence is higher most likely due to the change in the numerical DO standard from summer to winter (8.0 mg/l to 11.0 mg/l). In calculating winter exceedence at the summer standard, almost no standard violations were noted; consequently, the winter DO levels are consistently exceeding the standard, but not by much. When examining DO level distribution by site, only the site below the Ashland waste water treatment plant shows consistently lower DO levels in the summer. DO trends at all other sites are comparable to each other. This trend is also the same when looking at DO levels by year.

Phosphorus levels exceed the current standard over 50 percent of the time for both seasons in all sites, with multiple sites showing 100 percent exceedence of the 0.8 mg/l standard. In order to determine which sites have the highest phosphorus readings and hence the worst water quality conditions, Olson (2000) calculated the exceedence at 3 to 4 times the standard (0.24 mg/l or 0.32 mg/l). Many sites continue to show 20 to 60 percent exceedence even at these higher standards, indicating that phosphorus loading is a major pollutant of concern to the Bear Creek system. Previous studies have shown that the Ashland wastewater treatment plant is accountable for up to 80 percent of the nutrient loading in Bear Creek (Reclamation 2001; RVCOG 2004) which has direct and immediate consequences to the aquatic habitat quality.

RVCOG has continued water quality monitoring and calculating standard percent exceedences since Olson (2000), and trends have not changed significantly through 2004 (RVCOG 2004; RVCOG 2005). Efforts continue to reduce phosphorus loading to the Bear Creek system which may help improve overall DO levels.

Fish Passage

The Rogue Basin Fish Access Technical Team (RBFATT) of the Rogue Basin Coordinating Council identified a large number of physical fish passage barriers located throughout the Bear Creek watershed, nearly all of them non-federal structures. The RBFATT program prioritizes fish passage funding and improvement projects. Table 3-16 provides a general tally of fish passage barriers identified to date. The RBFATT (2007) inventory lists 212 fish passage barriers in tributaries entering Bear Creek downstream from Emigrant Dam. Road culverts and bridge crossings comprise 186 of these. ODFW judged most of these to be either total fish passage barriers under all flow conditions or to be a passage impediment under most flows. The remaining barriers are mostly non-Federal permanent concrete diversion structures.

The RBFATT list excludes streamside pump locations that have the potential to dewater the stream and entrain juvenile salmonids if not properly screened. The inventory of streamside pumps is outside of their designated purpose.

The inventory for the Rogue River basin is not necessarily complete and does not include all the fish passage barrier locations on Bear Creek tributaries (Ritchey 2001).

Table 3-16. RBFATT inventoried Bear Creek fish passage barriers downstream from Emigrant Dam (RBFATT 2007).

Barrier Type	Mainstem Bear Creek	Bear Creek Tributaries
Diversion dams	3 (Project permanent structures [Oak Street, Phoenix, and Jackson Street] all meet current NOAA Fisheries passage criteria)	18 (6 structures meet current NOAA Fisheries passage criteria); 1 Project structure on Ashland Creek
Pushup dams	none	2 (do not meet current NOAA Fisheries passage criteria)
Road culverts/bridges	none	186
Other fish barriers	none	6
Total RBFATT barriers identified	3	212

Sixteen tributaries that are considered to be fish-bearing streams for salmon and steelhead enter Bear Creek. These streams, plus a few of their respective smaller tributaries, are documented locations for anadromous fish migration, spawning, and rearing (Figure 3-1). Fish passage impediments related to road and highway crossings, urban and rural land uses, and water withdrawal systems are found within all these streams. Though there has been a continuous effort to identify fish barriers, many undocumented, non-Project locations likely exist where water is diverted from the 16 tributaries into ditches or through pump intake locations on private land. Fish passage protection at these locations may be lacking on many non-Project diversions could be upstream from fish migration blockages in lower reaches of the stream. Water users divert from these streams and share in fish passage problems.

Federal Project Facilities

Emigrant Dam, 29 miles upstream from the mouth of Bear Creek on Emigrant Creek, was first built in 1924 and enlarged as part of the authorized Project in 1960. The dam has no fish passage facilities. There are two Federal diversion dams on mainstem Bear Creek downstream from Emigrant Dam: Oak Street Diversion (RM 21.6) and Phoenix Canal Diversion (RM 16.8). Reclamation and the Districts were involved in funding, designing, and making extensive modifications to these diversions and their fish passage facilities from 1997 to 1999 under the Rogue River Basin Fish Passage Improvement Program. This work upgraded fish passage protection at the diversions to the latest NOAA Fisheries criteria for fish ladders, fish screens, and juvenile bypass systems. NOAA reviewed and approved the plans for these facilities prior to constriction.

New adult fish ladders were constructed at the dams and older fish screens in the canal were replaced with state-of-the-art rotary drum or self-cleaning vertical screens. Juvenile fish bypass systems were also included in the modifications. The Phoenix Canal Diversion fish passage structure is functioning properly since the improvements. The Oak Street Diversion, although designed and constructed to meet NOAA standards at the time, does not provide for efficient salmonid upstream passage and would benefit from design upgrades (see Chapter 4).

There is a recently identified Federal diversion on Ashland Creek less than one mile upstream of the confluence with Bear Creek. The structure does not have fish passage or fish screen components and is a complete blockage to juvenile fish upstream migration. As a Federally-owned structure, improvements to this facility are included in the proposed action in Chapter 4.

Non-Federal Facilities

Jackson Street Diversion (RM 9.6) is a non-Federal diversion dam on Bear Creek downstream from Emigrant Dam. Hopkins Canal Diversion Dam was dismantled and completely rebuilt one-quarter mile upstream from Jackson Street Diversion. Non-Federal facilities were improved under the Rogue River Basin Fish Passage Improvement Program as described above. Adult fish passage in Bear Creek has improved since the fish passage modifications were made (Ritchey 2001). Medford and Phoenix canals cross fish-bearing streams by using concrete dam structures with check boards that can be removed after the irrigation season and siphons at select locations constructed to promote fish passage. Some of the crossings can spill canal water into the natural stream course for conveyance to downslope water users. Creeks where irrigation districts retain natural flow rights can be diverted to the canal.

Bounds Dam, a private dam located about one-half mile downstream from Emigrant Dam on Emigrant Creek, is a blockage to upstream salmon migration. Mainstem Bear Creek may have a number of small private, pump diversions along the stream. It is unknown whether the pump intakes are screened. There are other fish passage barriers and an undocumented number of small irrigation water diversion structures or pumps on Bear Creek tributaries.

3.3.2 Little Butte Creek Watershed

South Fork Little Butte Creek is a designated “coho salmon core area” as identified in the Southwest Oregon Salmon Restoration Initiative (Prevost et al. 1997) and contains about 27 miles of high value stream habitat used by native coho salmon. Coho salmon core areas are streams capable of sustaining year-round coho salmon spawning and rearing. While there may be existing habitat limitations, the resource management intent is to protect and improve these core habitats to help stabilize the basin’s native coho salmon population at a genetically viable level.

The Little Butte Creek Watershed Analysis (USFS and BLM 1997) provided extensive information on ecosystem conditions in Little Butte Creek watershed and includes information on stream habitat elements that may affect anadromous fish production. The analysis also identified limiting factors for aquatic species including: (1) high summer stream temperatures; (2) sedimentation; (3) riparian degradation; (4) instream degradation; (5) fish passage; (6) fish carcass reduction; and (7) wetland and floodplain losses. Instream channel degradation includes channelization, instream wood removal, stream adjacent roads, logging in riparian and landslide prone areas, farming and grazing practices, and urbanization.

In 2003, the Little Butte Creek Watershed Council prepared a watershed assessment for Little Butte Creek (LBCWC 2003). Their findings were in general agreement with the early findings by the Forest Service and BLM. They concluded that water quantity, water quality, riparian habitat, fish habitat, channel structure, and sediment were significant issues with respect to the degraded health of the watershed.

Stream Habitat Conditions

Much of Little Butte Creek and its tributaries are mostly riffle-dominated single-channels and lack historic side-channel and small-meadow, wetland-type habitats preferred by coho salmon during juvenile rearing stages. Past management activities in the riparian zones have limited the amount of large wood recruitment (valuable for cover, pool maintenance, and fish rearing), thereby reducing stream shading and streambank stability. Streams lack quality pools, especially those with suitable depths and velocities. Reduced riparian vegetation causes streambanks to be less stable. Periodic large storm incidents have taken out streamside riparian vegetation; livestock grazing further impacts it (USFS and BLM 1997).

Water Quality

The Little Butte Creek watershed currently has water-quality limited stream segments in Oregon's 2004/2006 Integrated Report. These stream segments do not meet certain water quality criteria or support certain beneficial uses. In 2006, ODEQ identified impaired stream segments for the 303(d) list and EPA approved the list in February 2007. Table 3-17 shows stream segments in Little Butte Creek watershed that are included on the 303(d) list. The State of Oregon completed the Rogue River basin TMDLs in December 2008 which covered temperature and bacteria.

Table 3-17. Little Butte Creek watershed 303(d) listed waterbody segments in Oregon's 2004/2006 Integrated Report.

Water Body	Listed Segment (RM)	Listed Pollutant
Antelope Creek	0 – 19.7	Temperature (summer) *E. coli* (year around)
Burnt Canyon	0 – 3.2	Temperature (summer)
Conde Creek	0 – 4.4	Temperature (year around)
Dead Indian Creek	0 – 9.6	Temperature (year around)
Deer Creek	0 – 3.2	Sedimentation
Lake Creek	0 – 7.8	Temperature (summer) *E. coli* (year around) Sedimentation
Lick Creek	0 – 6.8	Dissolved Oxygen (summer) *E. coli* (summer)
Little Butte Creek	0 – 16.7	Dissolved Oxygen (year around) *E. coli* (year around) Sedimentation Temperature (summer)
North Fork Little Butte Creek	0 – 6.5	*E. coli* (fall, winter, spring) pH (summer), RM 0 – 17.8 Temperature (summer)
North Fork Little Butte Creek, Fish Lake	15.9 – 17.6	pH (summer)
South Fork Little Butte Creek	0 – 16.4	*E. coli* (summer) Sedimentation Temperature (summer)
Lost Creek	0 – 8.4	Sedimentation Temperature (summer)
Salt Creek	0 – 9.0	*E. coli* (year around)
Nichols Branch	0 – 5.0	*E. coli* (year around)
Soda Creek	0 – 5.6	Sedimentation Temperature (summer)

Temperatures

Water temperature data recorded in the Little Butte Creek watershed indicate that several of the segments on the 303(d) list do not meet the water temperature criteria for salmonid rearing during the summer period. The temperature criteria are intended to protect stream rearing cold-water salmonid fish species such as trout, salmon, and steelhead. More recent sampling confirms that the water temperature criterion continues to be unmet in many areas of the Little Butte Creek watershed. This is attributable in part to past practices that have (1) channelized stream segments following flooding events; (2) removed riparian vegetation, reducing shading of the streams during the summer; and (3) reduced flows during summer months.

Summer water temperatures in the Little Butte Creek watershed generally correlate with elevation, with cooler temperatures found at higher elevations. The coolest summer temperature conditions are in stream segments above and elevation of 4000 feet. These streams are primarily on Federal land in the Little Butte Creek watershed and account for 75 to 85 percent of the viable salmonid production during the summer months (USFS and BLM 1997). However, the amount of this habitat available for salmon and steelhead rearing in the watershed appears to be quite limited. Lower elevation stream sections influenced by cool water spring discharge may provide some localized refugia and good summer rearing temperatures.

Little Butte Creek and its tributaries have been designated by ODEQ as having core cold water habitat. Core cold water habitat waters are expected to maintain temperatures within the range generally considered optimal for salmon and steelhead rearing. The biologically based numeric temperature criteria for the Little Butte Creek watershed is a 7-day moving average of daily maximum water temperature not to exceed 16° C (60.8° F) and 13° C (55.4° F) during times when salmon and steelhead spawning, incubation, and emergence are occurring. Table 3-18 shows the temperature criteria sorted by month and the associated salmonid life stage expected to be occurring during that month. In months where there is life stage overlap, the most stringent criterion is applicable to protect the resource. While the temperature criteria are the same, it should be noted that the spawning and incubation periodicity shown in Table 3-18 is slightly different than the periodicity applied by ODEQ in their water Salmon and Steelhead Spawning Use Designation map for the Rogue River basin.

Table 3-18. Applicable temperature criteria in Little Butte Creek for coho salmon.

LIFE STAGE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Spawning	13°C	--	--	--	--	--	--	--	--	--	13°C	13°C
Incubation	13°C	13°C	13°C	13°C	13°C	--	--	--	--	--	13°C	13°C
Smolt Emigration/ Juvenile Rearing[1]	--	15th-28th 16°C	16°C	16°C	16°C	16°C	--	--	--	--	--	--
Juvenile Rearing	--	--	--	--	--	--	16°C	16°C	--	--	--	--
Adult Passage (Gold Ray/Rogue Mainstem)[2]	--	--	--	--	--	--	--	--	16°C	--	--	--
Adult Passage[3]	18°C	--	--	--	--	--	--	--	--	16°C	16°C	16°C

-- These months fall outside the critical period for this life stage
[1] Smolt trap data from ODFW and temperature data from Reclamation's Hydromet Stations
[2] Gold Ray Dam ODFW fish counts (Satterthwaite 2007) and temperature data from Reclamation's Hydromet Stations
[3] Gold Ray fish counts and periodicity charts (Doino 2006)

Figure 3-25 shows the temperature criteria overlaying the 7-day average maximum water temperatures in the South Fork Little Butte Creek at Gilkey. The data show that temperatures typically reach a maximum of around 21° C to 23° C (69.8° F to 73.4° F) during the summer months, which is well above the temperature criteria for those months. However, snorkeling by Reclamation biologists on August 17, 2006, identified the presence of juvenile SONCC coho salmon near Gilkey, indicating the fish are persisting during their most sensitive life stage. The observed fish did not appear to be limited by elevated water temperatures (i.e., they appeared healthy). The most likely explanation for the presence of the juveniles, despite generally elevated water temperatures, is the presence of colder water refugia. Juvenile coho salmon have been observed using thermal refugia in the warm mainstem Klamath River during the summer. Generally, most juveniles move into refugia when mainstem temperatures exceed about 22° C (71.6° F).

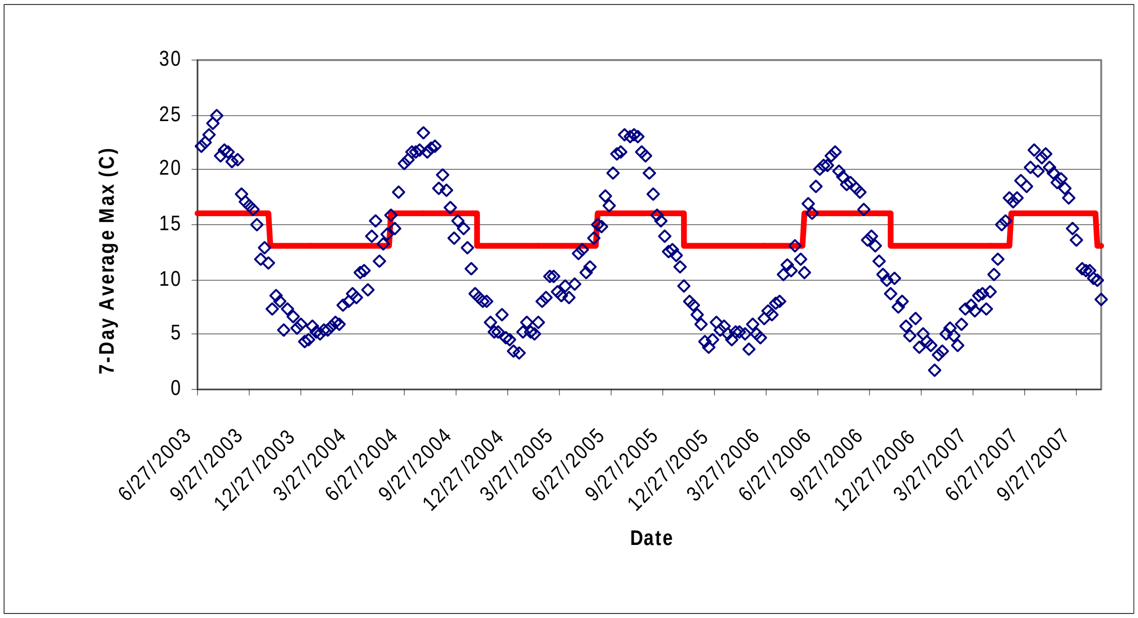


Figure 3-25. July 2003 – November 2007, 7-day average maximum water temperature in South Fork Little Butte Creek at Gilkey. The red line indicates data presented in Table 3-18.

Figure 3-26 compares the 7-day average maximum water temperatures at Gilkey and at the mouth. The comparison between the two locations shows a noticeable increase in water temperature during all times of year, with the increase being more pronounced during the hot summer months.

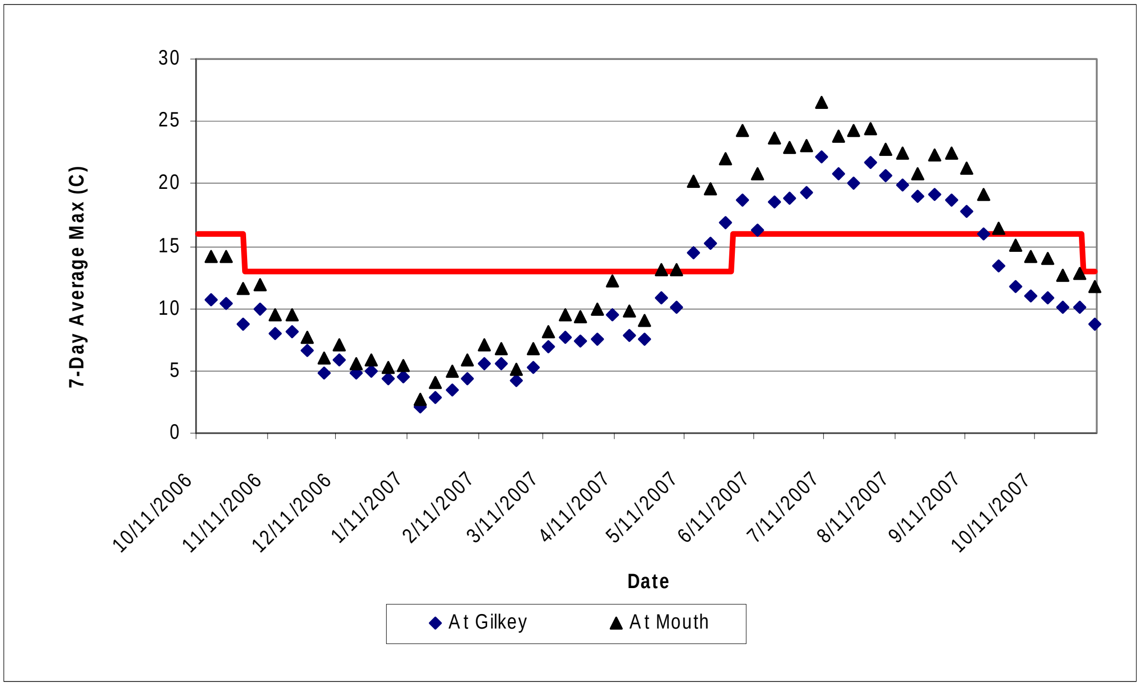


Figure 3-26. 7-day average maximum water temperature in South Fork Little Butte Creek at Gilkey and at the mouth. The red line indicates data presented in Table 3-18.

Water temperatures in Little Butte Creek at Lakecreek continue to exceed the criteria during the summer months. However, when compared to temperature data from the South Fork Little Butte Creek at the mouth for similar dates, the change is de minimis. This indicates that the North Fork Little Butte Creek is not significantly increasing water temperature in Little Butte Creek.

Figure 3-27 compares the 7-day average maximum water temperatures in Little Butte Creek at Lakecreek and below Eagle Point to the temperature criteria. As expected, the criteria continue to be exceeded during the summer months below Eagle Point. However, as illustrated in Figure 3-28, the measured change in temperature between the two locations shows distinct seasonal variability. During the summer irrigation season (April through September), the temperature change is significantly greater than during the non-irrigation season. During the non-irrigation season, the stream decreases in temperature between the two locations.

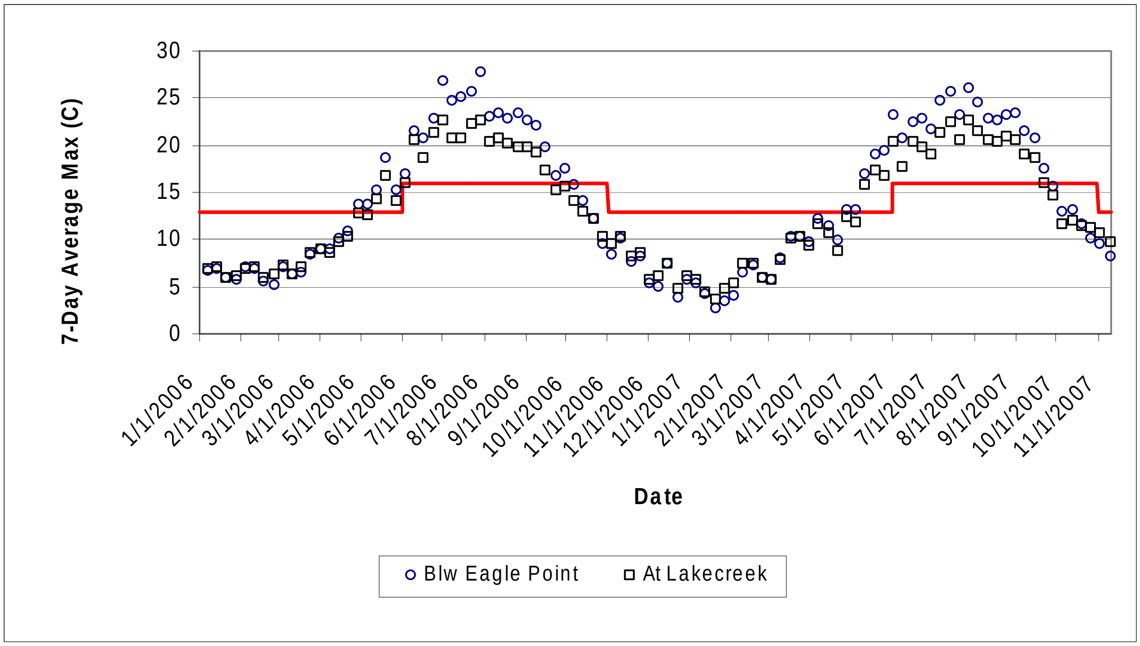


Figure 3-27. 7-day average maximum water temperatures in Little Butte Creek at Lakecreek and below Eagle Point. The red line indicates data presented in Table 3-18.

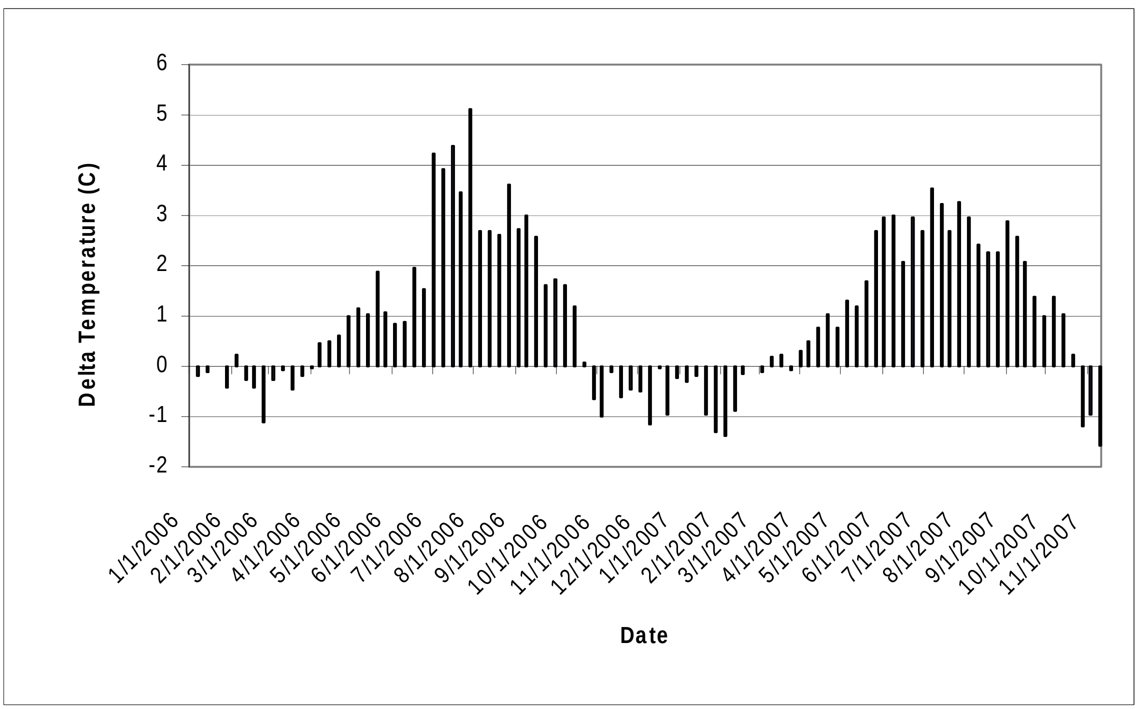


Figure 3-28. Change in Little Butte Creek water temperature between Lakecreek and below Eagle Point.

Reclamation also collected temperature below the confluence of Antelope Creek from August 18 through October 30, 2007 (Figure 3-29). Water temperatures exceed the criteria during the summer months, but when compared to temperature data from Eagle Point, there is very little difference. This indicates that Antelope Creek is not significantly increasing water temperature in Little Butte Creek.

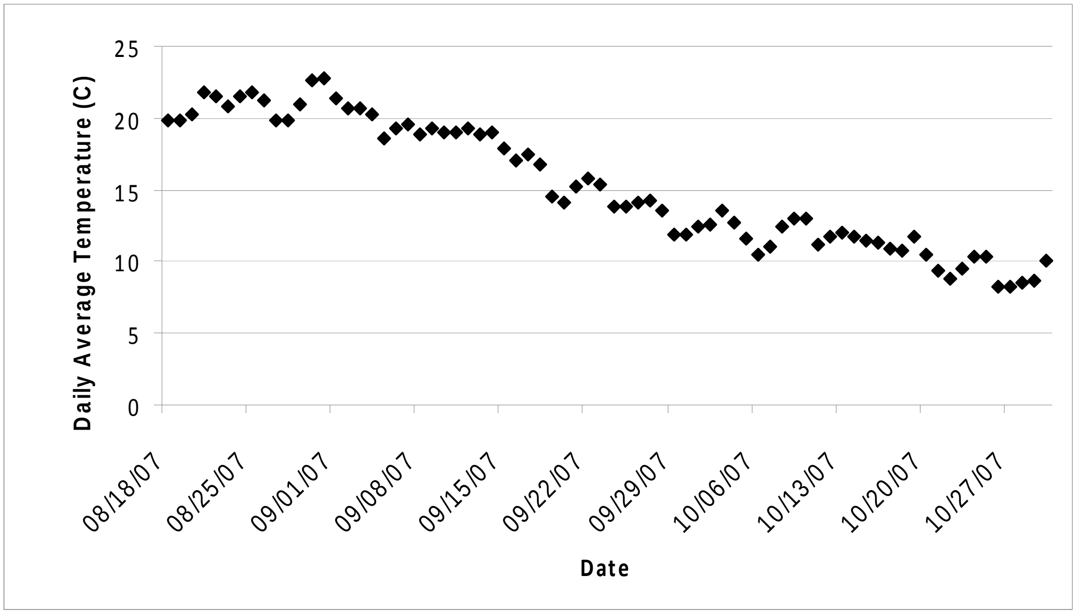


Figure 3-29. Daily average water temperature in Little Butte Creek below Antelope Creek.

For reference purposes, it should be noted that at most sites in the Little Butte Creek basin discussed previously, stream temperatures are at or below the identified criteria during those periods when Project diversions are being made in the headwaters.

Bacteria

Bacterial contamination in the Little Butte Creek watershed is likely attributable to many sources, including animal waste on ground surfaces (wildlife and livestock), failing residential septic systems, cross connections between sanitary and storm sewer systems, certain permitted industrial sites, and general urban and rural runoff. Elevated bacteria levels impact beneficial uses associated with aesthetic quality and water-contact recreation.

The contact recreation water quality standard for bacteria in Oregon is expressed as a 30-day log mean of 126 *E. coli* organisms per 100 milliliter (ml), based on a minimum of five samples, with no single sample exceeding 406 *E. coli* organisms per 100 ml. A water body is generally considered impaired by bacteria if greater than 10 percent of the samples exceed 406 *E. coli* organisms per 100 ml or the 30-day log mean is greater than 126 organisms per 100 ml.

Antelope, Lake, Lick, Salt, North Fork Little Butte, South Fork Little Butte, and Little Butte creeks are 303(d) listed for *E. coli* bacteria on the 2004/2006 Integrated Report. These waters are known to contain levels of bacteria in excess of the criterion. As a result, ODEQ is currently in the process of developing TMDLs for bacteria.

Sediment

Elevated levels of sediment adversely affect aquatic species, particularly salmonid spawning and rearing, by embedding stream gravel and cobble substrates and reducing the quality and quantity of prey-base (macroinvertebrate) habitat. Elevated sediment can also deposit fine material in pools that serve as important habitat for some life stages. Sediment deposition diminishes incubating salmonid egg survival by covering eggs and filling interstitial spaces with fine material.

Storm-triggered landslides, both natural and human-caused from older clear-cuts, and the high number of forest roads are a continuing source of sediment in Little Butte Creek. Major rain-on-snow storm flood events in 1955, 1964, 1974, 1997, and 2005 caused both natural and road/logging-related landslides and transported large amounts of sediment into the Little Butte Creek watershed. These storm events caused major stream channel erosion. As a result, an elevated amount of fine sediment evident in the watershed's lower gradient stream reaches is embedding spawning gravels and filling pools important for juvenile fish rearing.

The sedimentation standard in Oregon is narrative, meaning there is no single criteria that applies to all waters of the state. The narrative criteria says the "formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed."

Deer, Lake, Lost, Soda, South Fork Little Butte, and Little Butte creeks are 303(d) listed for sedimentation on the 2004/2006 Integrated Report. These waters are thought to exceed the narrative standard for sedimentation. As a result, ODEQ is currently in the process of developing TMDLs for sediment.

Dissolved Oxygen

Fish and other aquatic organisms require oxygen to live. When the amount of oxygen dissolved in the water column becomes low, aquatic life may find it difficult to transfer oxygen from the water to their blood stream.

The dissolved oxygen criteria applicable to the Little Butte Creek watershed is expressed as a 30-day mean minimum for the protection of salmon and steelhead spawning and cold-water aquatic life. The salmon and steelhead spawning criteria is not less than 11.0 mg/L or 95 percent of saturation. This criterion applies September 15 through June 15. The cold-water aquatic life criterion is not less than 8.0 mg/L or 90 percent of saturation. There is to be no measurable risk level for these communities.

Lick Creek and Little Butte Creek are 303(d) listed for dissolved oxygen on the 2004/2006 Integrated Report. These waters are thought to exceed the criteria for dissolved oxygen. As a result, ODEQ is currently in the process of developing TMDLs for dissolved oxygen.

Fish Passage

Federal Facilities

Antelope Creek Diversion Dam is a federally-owned facility operated and maintained by RRVID. Reclamation improved adult fish passage and fish screens at RRVID's Antelope Creek Diversion Dam in 1997 and 1998 with NOAA design review and input. The improved fish screen system gives ODFW the ability to trap, collect, and haul downstream migrant smolts when streamflow is too low to provide adequate bypass flow back to Antelope Creek. There have been concerns during low flow periods when the ladder is not accessible due to the water flowing under rocks as the base of the ladder (Casad 2008). This has been noted in the RBFATT inventory (RBFATT 2007).

Reclamation constructed six diversion dam structures in the headwater tributaries of South Fork Little Butte Creek watershed. These structures are located upstream from a natural waterfall which blocks fish passage (USFS and BLM 1997). The facilities are Upper South Fork Little Butte Creek Diversion Dam, Daley Creek Diversion Dam, Beaver Creek Diversion Dam, Dead Indian Diversion Dam, Pole Bridge Diversion Dam, and Conde Creek Diversion Dam. Reclamation constructed these facilities to collect water for conveyance across the Cascade Divide for storage in Howard Prairie Lake. TID operates and maintains these diversion facilities. These diversion dams do not block fish passage.

Non-Federal Facilities

MID and RRVID own, operate, and maintain North Fork and lower South Fork Little Butte Creek Diversion Dams. The diversion dams are each about one-half mile upstream from the confluence of the North Fork and South Fork Little Butte Creek. The South Fork Little Butte Creek was improved in 2003 when the current fish screen was installed and the fish ladder was replaced. The fish screen and ladder for the North Fork Little Butte Creek now meet the current standards following improvements made in 2003.

RRVID and MID canals traverse some anadromous fish-bearing streams in the Little Butte Creek watershed; however, all such crossings use flume or siphon structures and pose no fish passage impediments. No water is withdrawn from these streams to augment canal flow, except at Antelope Creek Diversion Dam.

3.3.3 Klamath River Basin

Coho salmon are restricted to the mainstem Klamath River and tributaries below Iron Gate Dam. No passage facilities exist at Iron Gate or Copco dams, which are owned and operated by PacifiCorp. Available recent information suggests adult populations are small to nonexistent in some years. Existing information also indicates that adult coho salmon are present in the Klamath River as early as September and juvenile coho salmon are present in the mainstem Klamath River year round. Reclamation addressed the environmental baseline in the Klamath basin in a 2008 BA written for the Klamath Project (Reclamation 2008). That analysis is incorporated here by reference.

Within the SONCC coho salmon ESU, dam construction has blocked access to coho salmon habitat in portions of the Eel River, Mad River, Trinity River, Rogue River, and the Klamath River basins. Within the Klamath River basin, an estimated 20 percent of historical coho salmon habitat is no longer available (62 FR 62741).

Past coho salmon harvests by ocean salmon fisheries have also contributed to the decline of SONCC coho salmon ESU. Currently, only incidental “hook-and-release” of natural-origin coho salmon continues in ocean salmon fisheries. For a certain percentage of the coho salmon caught in a “hook-and-release” fishery, the stress of being caught and released causes direct or delayed mortality. However, capture rates for coho salmon have been reduced from a high of 80 percent to a low of 5 percent in recent years in non-tribal fisheries now directed at Chinook salmon (NOAA Fisheries 2002). Poor and uncertain hatchery practices in the past also continue to have lingering adverse effects on natural-origin populations in the ESU. For example, stock transfers from outside of the Klamath River basin, which occurred in the past, might change the genetic bases or phenotypic expression of life-history characteristics in a natural population in such a way that the population might seem more or less distinctive than it was historically.

Timber harvest activities with its associated road construction, grazing, and mining activities have degraded adjacent aquatic habitat conditions. This was acknowledged in the Northwest Forest Plan (USDA and USDI 1994 as cited in NOAA Fisheries 2002) which guides present and future Federal land management activities in the Klamath River basin.

Water was diverted and pumped for use in sluicing and hydraulic mining operations have also contributed to the decline in coho salmon. Mining operations can result in dramatic increases in turbidity levels and physical alterations of the streambed, altering stream morphology. The negative impacts of stream sedimentation on fish abundance from mining were observed as early as the 1930s.

Water management throughout the Klamath River basin has altered the historical hydrology. The magnitude and timing of water flows has significantly changed in the Trinity, Shasta, and Scott rivers and in the main stem of the Klamath River. Agricultural activities, including return flows from irrigation, are also known to increase nutrient loading through runoff into adjacent streams. These activities have likely resulted in adverse effects to coho salmon as well as other fish species, including other salmonids.

Crop cultivation and livestock grazing in the upper Klamath River basin began in the mid-1850s. Since then, valleys have been cleared of brush and trees to provide more farm land. By the late 1800s, native perennial grasses were replaced by various species of annual grasses and forbs. This, combined with soil compaction, resulted in higher surface erosion and greater peak water flows in streams. Other annual and perennial crops cultivated included grains, alfalfa hay, potatoes, and corn.

Besides irrigation associated with the Klamath Project, other non-Klamath Project irrigators operate within the Klamath River basin. The Project supplies water annually to approximately 200,000 to 220,000 acres of the 240,000 acres within the Project boundaries. Current agricultural development in the Shasta River Valley consists of approximately 51,600 acres of irrigated land. Estimated consumptive use of irrigation water by the crops is approximately 100,000 acre-feet per year. In the Scott River valley, there are approximately 33,000 acres of irrigated land with an estimated crop consumptive use of approximately 71,000 acre-feet per year.

A series of diversion dams on the Trinity River, a tributary of the Klamath River, transfers water from the Klamath River basin to the Sacramento River basin. The difference in elevation between the Trinity River and the Sacramento River facilitates generation of hydroelectric power. Starting in 1964 and continuing until 1995, an average of 1.2 million acre-feet per year, or 88 percent of the Trinity River flow, was diverted into the Central Valley Project within the Sacramento River basin. This diversion contributed to the decline of coho salmon populations within the Klamath River basin.

Klamath River

Beginning in the late 1800s, construction and operation of the numerous non-Project facilities and, beginning in 1906, Klamath Project facilities have changed the natural hydrographs of the mainstem Klamath River (Reclamation 2001a). Major Project diversion facilities include the A-Canal, Link River Dam, Lost River Diversion Dam, and the Lost River Diversion Channel. Non-Project facilities include Copco Nos. 1 and 2 Dams, J.C. Boyle Hydroelectric Dam, Iron Gate Dam, and Keno Dam. Changes in the flow regime at Keno, Oregon, after the construction of the A-Canal, Link River Dam, and the Lost River Diversion Dam, can be seen in the 1930-to-present flow records. These changes have reduced average flows in summer months and altered the natural seasonal variation of flows to meet peak power and diversion demands (Hecht and Kamman 1996). Flows downstream from Iron Gate Dam affect the quantity and quality of aquatic habitat for coho salmon in the mainstem Klamath River in California.

Iron Gate Dam, located approximately at RM 190 on the mainstem Klamath River, was completed in 1962 and is owned and operated by PacifiCorp. Iron Gate Dam was constructed to re-regulate flow releases from the Copco facilities, but it did not restore the pre-project hydrograph. Minimum streamflows and ramping rate regimes were established in the Federal Energy Regulatory Commission license covering operation of Iron Gate Dam. A fish hatchery was constructed by PacifiCorp as a mitigation measure for the loss of fish habitat between Iron Gate and Copco No. 2 Dams.

Currently, the Klamath Project is operated in compliance with a reasonable and prudent alternative (RPA) identified in the 2002 Biological Opinion from NOAA Fisheries. That RPA included a set of minimum streamflows that are being used to govern Project operations. Those flows are identified in Table 3-19.

Table 3-19. The 2002 to 2012 NMFS Biological Opinion recommended long-term minimum flows Iron Gate Dam discharge by month, by water year type.

Month	Water Year Type (values in minimum daily cfs)				
	Dry	Below Average	Average	Above Average	Wet
October to February	1,300	1,300	1,300	1,300	1,300
March	1,450	1,725	2,750	2,525	2,300
April	1,500	1,575	2,850	2,700	2,050
May	1,500	1,400	3,025	3,025	2,600
June	1,400	1,525	1,500	3,000	2,900
July to September	1,000	1,000	1,000	1,000	1,000

Source: Table 9, p. 71, NOAA Fisheries 2002.

Water Quality

In addition to hydrologic changes caused by the activities discussed above, human activities have resulted in degraded water quality in the Klamath River basin. The main water quality problem for coho salmon is high water temperature. The Klamath River, from source to mouth, is listed as water quality impaired (by both Oregon and California) under Section 303(d) of the Federal Clean Water Act (CWA). In 1992, the California State Water Resources Control Board proposed that the Klamath River be listed under the CWA as impaired for both temperature and nutrients, requiring the development of TMDL limits and implementation plans. The EPA and the North Coast Regional Water Quality Control Board accepted this action in 1993. The basis for listing the Klamath River as impaired was aquatic habitat degradation due to excessively warm summer water temperatures and algae blooms associated with high nutrient loads, water impoundments, and agricultural water diversions (EPA 1993).

Temperatures periodically reach levels that are lethal to coho salmon within the Klamath River basin. High water temperatures during the late spring and summer months can be an important factor affecting the distribution, growth, and survival of juvenile coho salmon. Water temperatures above 60.8° F (16° C) can trigger movement of juvenile coho salmon during these months. Movement occurs as fish seek refuge from high temperatures. The National Academy of Science concluded that juvenile coho salmon living in the main stem of the Klamath River probably tolerate the temperature only by staying in pockets of cool water created by ground-water seepage or small tributary flows (NAS 2004).

Generally, during late spring and early summer, flows from Iron Gate Dam tend to be below equilibrium temperature on the order of 2º C to 4º C; however, the effect is diminished with increased distance from the dam. The cooler water temperature is attributed to the source of the water, the Iron Gate Reservoir. The warmest reach of the Klamath River at this time is between Scott River and Shasta River.

In late spring and continuing through the summer, temperatures exceed tolerable levels and coho salmon are relegated to thermal refugia throughout most of the mainstem or must migrate into non-natal tributaries. At these times, releases from Iron Gate Dam have little influence on temperatures downstream of the Shasta River.

Temperature modeling done for the Klamath and cited in the 2008 BA (Reclamation 2008) indicates that tributary inputs and meteorological conditions are the primary temperature drivers throughout the year downstream from the Scott River. Thus, the ability to control temperature in the lower Klamath River through flow management at Iron Gate Dam is limited because ambient temperatures and tributary flows downstream are much larger than those from Iron Gate Dam, depending on season and annual variability.

3.4 Critical Habitat for the SONCC Coho Salmon

NOAA Fisheries (62 FR 24588) listed SONCC coho salmon (*Oncorhynchus kisutch*) as threatened on May 6, 1997, under provisions of the ESA. This ESU of coho salmon inhabits coastal rivers and streams between Cape Blanco in southern Oregon to Punta Gorda in northern California. Most of the remaining natural production in this coho salmon ESU takes place in the Rogue, Klamath, Trinity, and Eel River basins (Figure 3-1). The Rogue River basin and Klamath River basin contain naturally reproducing populations of this coho salmon ESU.

NOAA Fisheries published a final rule designating critical habitat for SONCC coho salmon effective June 4, 1999, which encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River in Oregon inclusive. Accessible reaches are those within the historical range of the ESU that can still be occupied by any life stage of coho salmon (64 FR 24049). Inaccessible reaches are those above specific dams as identified in Table 6 of the Federal Register (Iron Gate Dam, Emigrant Dam and Agate Dam) or above longstanding naturally impassable barriers (natural waterfalls in existence for at least several hundred years) (64 FR 24049). Rogue River basin streams inhabited by SONCC coho salmon and influenced by Project operations include Little Butte Creek and Bear Creek watersheds, as previously described.

Klamath River tributaries downstream from Iron Gate Dam provide habitat critical for coho salmon. Jenny Creek is located upstream of Iron Gate Dam and is not accessible to coho salmon. Most coho salmon spawning occurs in the tributary streams rather than in the mainstem of Klamath River. The mainstem serves primarily as a migratory pathway. Coho salmon move into the tributaries with the onset of fall rains and increased flows. Suitable tributary flows are important to provide coho salmon access to spawning habitat during their upstream migrations. Many coho salmon attempt to migrate as far upstream as possible and then hold in deep pools near good spawning sites until they are ready to spawn a month or more after freshwater entry. Redds (spawning sites) must remain watered throughout the incubation period. After they emerge from the gravel in the spring, the young fish disperse into the available habitat. During the year that juvenile coho salmon spend in freshwater, they utilize pools with good cover and cool water, which are predominantly in the tributaries. Cool water is critical for survival during the warm summer period. Many coho salmon likely move downstream from the spawning location because coho salmon generally spawn near the upstream extent of good rearing habitat. It is unlikely that significant numbers of coho salmon enter the mainstem Klamath for summer rearing because tributary water temperatures are cooler. During winter when water temperature is below about 10° C (50° F) and high flows are more frequent, juvenile coho salmon seek denser cover and lower water velocity than used during the summer. These conditions are often found in off-channel areas of the tributaries.

Chapter 4 PROPOSED ACTION

4.1 Description

The proposed action is for Reclamation, pursuant to contracts with TID, MID, and RRVID, to divert, store, and deliver water and operate and maintain Federal Project facilities in the future consistent with authorized purposes and routine O&M activities, while implementing the following:

- Modifications to improve fish passage and flow management
- Formalization of flow ramping protocol
- Implementation of minimum operational releases for Emigrant Creek based on total reservoir storage level.

In the proposed action, the Project would be operated in the future largely as described by Vinsonhaler (2002) with some noted exceptions which are presented in this chapter. Reclamation would divert, store, and deliver water to the Districts and operate and maintain federal Project facilities in the future consistent with authorized purposes and routine O&M activities pursuant to contracts with TID, MID, and RRVID. Concurrently, Reclamation would implement modifications to improve fish passage and flow measurement and TID would operate Emigrant Dam under a formalized flow ramping protocol, with minimum operational releases from Emigrant Dam based on the total reservoir storage level.

Table 1-2 in Chapter 1 presented summary information on the dams and reservoirs, diversion dams and conveyance or feeder canals, and main conveyance canals within the Rogue River basin that are covered under this proposed action. A summary of the facilities and O&M activities is located in Chapter 2 of this BA. A detailed explanation of this information can be found in the *Rogue River Basin Project Talent Division – Oregon, Facilities and Operations* report which is incorporated here by reference (Vinsonhaler 2002).

Diversions would be made from the South Fork Little Butte Creek and its tributaries as described in Chapter 2 and Vinsonhaler (2002). While the volumes diverted and flow rates in the diversion canals and tunnels would vary from year to year, the future diversions would largely mimic the past diversions. Most diversions occurring in the winter and spring with little water diverted during the remainder of the year. The diverted flows would be routed and stored through the reservoir system, described in Chapter 2, on the Klamath side of the

Cascade divide. Eventually the stored water would be routed back under the Cascade divide, through the Green Springs powerplant, and into Emigrant Reservoir.

Flows would also be diverted from streams in the Jenny Creek basin in the future and routed through the existing facilities to Emigrant Reservoir. As in the South Fork of Little Butte Creek, the volumes diverted and timing of the diversions would vary from year to year, as they have in the past, but the bulk of the diversions would occur in the winter and spring, following the pattern of past operations. Future operations of the Project would not involve any changes from the current operations in either the South Fork Little Butte Creek basin or the Jenny Creek basin. No new facilities would be constructed in either of these basins under the proposed action. Finally, reservoir operations, with the exception of Emigrant Reservoir, would also not change to any large extent.

Operations in the Dry Creek basin, including diversions from Antelope Creek, would be similar to past operations under the future proposed operation of the Project. Winter and spring diversions would continue to be made from Antelope Creek and stored in Agate Reservoir. Releases would be made from Agate Reservoir during the irrigation season. As with the operations described above, diversions and releases would vary from year to year depending upon annual runoff, storage, and demand. They would occur as described in Vinsonhaler (2002).

Operations in the Bear Creek basin from Emigrant Dam downstream would be altered from previous operations under the proposed action primarily during the fall and winter. Operations during the irrigation season would be similar to those that have occurred in the past with respect to the diversion of water from Emigrant Reservoir, Emigrant Creek, and Bear Creek. During the fall and winter, however, operational changes would occur under the proposed action. In the fall, a new ramping rate protocol would go into effect when releases from the reservoir are terminated at the end of the irrigation season. The protocol would also be used during the winter to ramp flows down from flood control releases. Winter flows would also be modified as the result of implementation of minimum operational flow releases. The modifications associated with the implementation of the ramping rate protocol and the minimum operational flow releases are discussed in more detail in the following sections.

Facility modifications are also proposed in Bear Creek under the proposed action. The existing fish ladder at the Oak Street Diversion Dam would be modified under the proposed action to improve fish passage at this site. This would improve adult coho salmon access to Bear Creek and its tributaries above Oak Street Diversions Dam, including Emigrant Creek. A fish passage and protection for juvenile coho salmon would also be provided at the Ashland Creek Diversion Dam. A new gaging station would be constructed on Emigrant Creek below Emigrant Dam to monitor the minimum operation flow releases under the proposed action. These facilities are also discussed in more detail in the following sections.

4.1.1 Ramping Rates at Emigrant Dam

The purpose of ramping rates is to reduce the risks of fish stranding and displacement as flows are decreased below the dam. As shown in the memorandum from the District's consultant GeoEngineers (Appendix C), TID began operating under the ramping rate schedule listed in Table 4-1 below Emigrant Dam in 2001. The ramping rate schedule was modified slightly from the original guidelines developed by the ODFW table for days 7 to 10 to avoid damaging the outlet works at Emigrant Dam in 2004 (Table 4-2; Appendix C). The ODFW-approved ramping rate schedule suggests no more than a 50 percent decrease in daily streamflow to minimize impacts on aquatic habitat and reduce risk of stranding or displacing fish downstream from Emigrant Dam within the irrigation season during periods of declining flows (Appendix C).

Table 4-1. Ramping rate criteria used by TID from 2001 to 2004 for Emigrant Dam discharge during periods not governed by the flood control operating criteria (Appendix C).

Day	Percent Reduction	Flow (cfs)
0	0	25
1	50	12
2	50	6
3	20	5
4	20	4
5	0	4
6	25	3
7	0	3
8	33	2
9	50	1
10	100	0

Table 4-2. Ramping rate criteria used by TID since 2004 for Emigrant Dam discharge during periods not governed by the flood control operating criteria (Appendix C).

Day	Percent Reduction	Flow (cfs)
0	0	25
1	50	12
2	50	6
3	20	5
4	20	4
5	0	4
6	25	3
7	0	3
8	0	3
9	0	3
10	100	0

TID makes every attempt to follow the ramping rate schedule throughout the year to the extent possible, considering facility operational limitations and flood control requirements in effect between September 1 and March 31 (Appendix C).

There are operational limits of the existing facilities as described in Chapter 3. There is a minimum operational release of 3 cfs from Emigrant Dam due to the limitations of the 6-inch filler valve. The low flow releases become an issue in the spring when the reservoir is full. TID must be cautious with very low flow operational releases when reservoir water levels are high because it can cause extra wear on the gate surfaces resulting in damage to the outlet works. There are solutions such as structural upgrades to the outlet works or upgrades and use of the East Canal gate as an alternative point of outflow from Emigrant Reservoir downstream to Emigrant Creek to address these problems (Appendix D). Additionally, between September 1 and March 31, flood control regulations supersede ramping operations (see Section 3.2.1). It should also be noted that seasonal releases from Emigrant Reservoir are dependent on downstream “calls” for water from irrigators. During wet spring months (e.g., in 2006), water may be held in Emigrant Reservoir until late June because downstream irrigators do not need the additional water. These decisions are made on a daily basis.

The proposed action would implement the ramping protocol described in Appendix C.

4.1.2 Minimum Operational Releases for Emigrant Creek

In Emigrant Creek, low to zero streamflows occur during the non-irrigation months as the system reservoirs are storing water. Providing minimum operational releases for Emigrant Creek based on total reservoir storage levels would supply year-round streamflow and address the low winter flow issue of concern. Under the proposed action, Reclamation would implement minimum operational releases for Emigrant Creek of 6 cfs when total reservoir storage levels are high, 3 cfs when total reservoir storage levels are average, and 2 cfs when total reservoir storage levels are low based on storage level curves presented in Appendix D. The development of the minimum operational releases for Emigrant Creek and determination of total reservoir storage level are discussed below.

Identification of Streamflow Requirements

In order to assess streamflow needs to support relevant life history stages of the SONCC coho salmon, a study was conducted which investigated streamflow and habitat in the Bear Creek and Little Butte Creek watersheds within the Project area. That study was used to help craft the minimum operational release portion of the proposed future operations.

PHABSIM is a model developed to evaluate the varying amounts of habitat types available to a selected fish species/life stage based on habitat preference criteria linked to scientific studies of the selected species and varying flow regimes that increase or decrease physical aquatic habitat in a river system. Weighted Useable Area (WUA) is an index of the predicted habitat availability or quantity for the selected species/life stage at each simulated flow. Accuracy of the results for any PHABSIM study are directly linked to the number and location of transects studied in the field and the number of flow conditions measured at those transects. WUA is an also index of habitat quality which uses depth, velocity and substrate to estimate the quality of the habitat. It is measured either as square feet of usable habitat per 1,000 longitudinal feet of stream or as a percentage of maximum WUA.

The PHABSIM was used for this study because it is considered a scientifically-tested, appropriate methodology that is a generally-accepted technique for determining available aquatic habitat for a particular species under variable flow conditions. Meetings and workshops were held to receive input from local experts and to discuss items relevant to the analysis such as habitat suitability criteria and species use timing. The input resulted in the *Rogue River Basin Project Coho Salmon Instream Flow Assessment* or PHABSIM report (Sutton 2007a). The PHABSIM report documents the analysis completed regarding changes in relationships between instream flows and fish habitat, measured as WUA, for individual species and life stages. The report describes the analytical methods and models utilized with the extensive field data collected to determine the flows needed in the specific reaches for coho salmon. The report does not address macrohabitat conditions such as water temperatures or dissolved oxygen relative to habitat suitability. Chapter 3 in this BA provides further information on temperature and general water quality parameters in the Bear Creek watershed.

The critical periods for coho salmon life stages, as listed in Table 4-3, are specific to the study areas of Bear Creek and Little Butte Creek (Sutton 2007a). The twelve stream segments studied represented areas that share the following characteristics:

- Uniform gradient and flow regime within segment
- Known coho salmon use
- Potentially affected by Reclamation diversions
- Minimal anthropogenic channel disturbances (e.g., channelization, vegetation removal)
- Continual access permission to Reclamation from the landowner in at least a portion of the segment

Table 4-3. Critical periods of coho salmon use in the Bear Creek and Little Butte Creek watersheds (Sutton 2007a).

Coho Salmon Life Stage	Critical Period
Spawning[1]	November 1 – January 31
Incubation[2]	November 1 – May 31
Smolt emigration/juvenile rearing[3]	February 15 – June 30
Juvenile rearing[4]	July 1 – September 30
Adult passage[5]	October 1 – January 31

Backup sources:

[1] Oregon Department of Fish and Wildlife (ODFW) spawning survey data (1996-2004) provided to GeoEngineers, Inc. by Briana Sounhein, ODFW Corvallis Research Office, September 2007
[2] Egg incubation timing based on 700-800 temperature units (^{o}C) for coho salmon and temperature data from Reclamation's Hydromet Stations
[3] Smolt trap data from ODFW and temperature data from Reclamation's Hydromet Stations
[4] Oregon Department of Environmental Quality (ODEQ) water temperature standard and temperature data from Reclamation's Hydromet Stations
[5] Gold Ray Dam ODFW fish counts and periodicity charts (Doino 2006)

In the Bear Creek watershed, the Emigrant Creek reach (Emigrant Dam to the confluence of Bear Creek, approximately 4.6 miles) was identified as an important reach where flows are directly affected by current operations. The Project only has the ability to directly manage flows in a portion of Emigrant Creek down to Bounds Reservoir since there is minimal influence from non-Project water diversions in this reach.

Development of the Minimum Operational Releases

The development of the minimum operational releases for Emigrant Creek was initiated with the completion of the PHABSIM study and report described previously which provides the detailed analysis of how the flows were determined. The values in Table 4-4 for the Emigrant Creek reach between Emigrant Dam and the confluence of Bear Creek were used in the development of the minimum operational releases. Additional field reconnaissance surveys described in Appendix E were also utilized in the development of the minimum operational releases.

Table 4-4 from the PHABSIM report lists the inflection points or breakpoint flows. Inflection points are the intercept points of the WUA/discharge curves and the wetted surface area/discharge curves. The curves were created while quantifying habitat and wetted area gained or lost with incremental flow changes.

Table 4-4. Coho salmon habitat modeling summary for PHABSIM report (Sutton 2007a).

Stream segment/ life stage	Discharge (cfs) at maximum (100 percent) WUA	80 percent of maximum WUA (cfs)		Inflection point[1]
Emigrant Creek-between Bear Creek and Emigrant Dam				
Spawning/incubation	60	20,>80[2,3]	10,>80	13
Juvenile – summer	25	4,>80	1,>80	3
Juvenile - winter	50	7,>80	2,>80	6

[1] Discharge where fitted curve slope = 1.0 on ascending limb of habitat/discharge curve.
[2] Maximum habitat assumed to occur at maximum simulated discharge.
[3] First value on ascending limb of WUA curve and second value on descending limb.

The minimum operational release of 6 cfs for Emigrant Creek is the inflection point flow for the juvenile-winter life stage (Table 4-4). When the total reservoir storage level is at average levels, the minimum operational release will be 3 cfs, based on the juvenile-summer stage (Table 4-4).

Additional analysis was required to identify the suitability of 2 cfs minimum release at the low total reservoir storage level, as the PHABSIM report did not analyze flows in that range. A site assessment in early November 2008 in Emigrant Creek determined that 2 cfs was sufficient to allow up and downstream movements of juvenile coho salmon among habitats (Appendix E). Therefore, the minimum operational release for time periods of low total reservoir storage level is identified as 2 cfs.

Emigrant Creek flows have been reduced to near zero or zero in past winter periods while water is being stored for the next irrigation season. This flow condition is typical of dry years which occurred in 1992, 1994, and 2001. However, even in dry water years, a minimum flow level would be maintained under the proposed action to ensure Emigrant Creek is usable for coho salmon.

Determination of Total Reservoir Storage Level

The hydrologic state of the system or water year type can be determined using different methods. The use of snow pack and precipitation data is a common method to identify the water availability for the upcoming irrigation season based on the percentage of normal. For Emigrant Reservoir, the forecasted inflows to Hyatt Reservoir are commonly used for planning purposes. The forecasted inflows for Hyatt Reservoir for April through July are calculated on April 1 of the year.

As the minimum operational releases were developed, it became evident that forecast information would not be representative of the current hydrologic state of Emigrant Reservoir as precipitation in the basin occurs November through April with high variability from month to month (GeoEngineers 2008b). Therefore, it was concluded that the total reservoir storage level would be the most effective method to determine the minimum operational releases for Emigrant Creek.

The total reservoir storage level method is based on the sum of the daily storage values within Howard Prairie, Hyatt, and Emigrant reservoirs based on data obtained from Hydromet. This parameter reflects operational carryover storage during the year and serves as an indirect measure of precipitation and snowmelt. As mentioned, the proposed minimum operational releases would be based on whether the total reservoir level is high, average, or low. Figure 4-1, created by GeoEngineers (Appendix D), uses daily storage values recorded from water year 1992 through water year 2008 to determine the average level and a fixed 15,000 acre-feet deviation for the upper and lower limits. By referencing the storage curve on a periodic basis such as monthly, this would allow the minimum operational releases to Emigrant Creek to be adjusted to reflect the current hydrologic state of the system (see Appendix D for a more detailed explanation of this methodology).

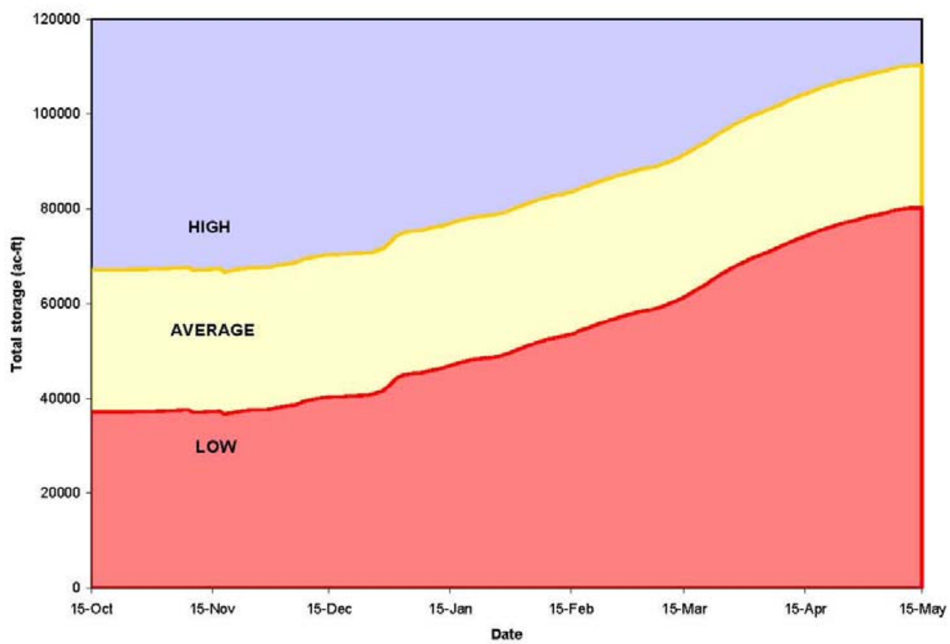


Figure 4-1. Plot of high, average, and low storage curves and resulting storage zones (Appendix D).

For example, if the total reservoir storage level on December 15 is 55,000 acre-feet, it would be considered average and the operational release would be 3 cfs. If one month later on January 15 the total reservoir storage level is recorded at 62,000 acre-feet, the operational release would remain at the average level or 3 cfs. The periodic monitoring of total reservoir storage and the associated adjustment of Emigrant Dam releases to Emigrant Creek would occur during the storage season (October 15 to May 15). Storage conditions (high, average or low) on May 15 of each year will set the minimum flow conditions for the subsequent irrigation season.

The application of the storage curve to determine the total reservoir storage level for the proposed minimum operational releases would represent the variation of storage conditions and provide the means to adjust operations as necessary especially during the non-irrigation seasons.

4.1.3 Gaging Station

The installation of a new Hydromet gage station in Emigrant Creek approximately 300 feet downstream of Emigrant Dam is a component of the proposed action to quantify low flows in Emigrant Creek. The existing gage, as originally designed, does not accurately measure flows less than approximately 10 cfs. Additionally, TID has indicated that seepage from Emigrant Dam contributes to the flows in Emigrant Creek and that this flow is potentially not detected by Hydromet station EMI at the outlet of Emigrant Dam due to the gage location.

Installing a new gaging station would allow operators of Emigrant Dam (TID) to better measure flows from Emigrant Dam meet the minimum operational releases. It would also allow TID to better quantify any seepage occurring from Emigrant Dam.

4.1.4 Fish Passage Improvement

Oak Street Diversion

The fishway on the Oak Street Diversion has been identified as potentially impeding upstream passage of adult SONCC coho salmon to the upper reaches of Bear Creek and its tributaries (Figure 4-2). The current fishway was modified in 1998 by Reclamation to meet the 1997 fish protection design criteria of State and Federal fishery agencies. Since the modification, the difficulties associated with fish passage include:

- Sediment buildup in and around the ladder exit
- Debris obstructing the orifice to the uppermost pool (Figure 4-3)
- High velocity jet in the fish passage orifice (Figure 4-4)
- Water surface elevation differences between the uppermost pool and ladder exit, further exacerbating passage between the trashracks
- Adjustments to attraction flows needed to improve passage conditions

Figure 4-2. Oak Street Diversion fish ladder downstream of Oak Street Bridge also showing gravel parking area on the left side of Bear Creek (Reclamation photograph by P. McGowan, 1998).

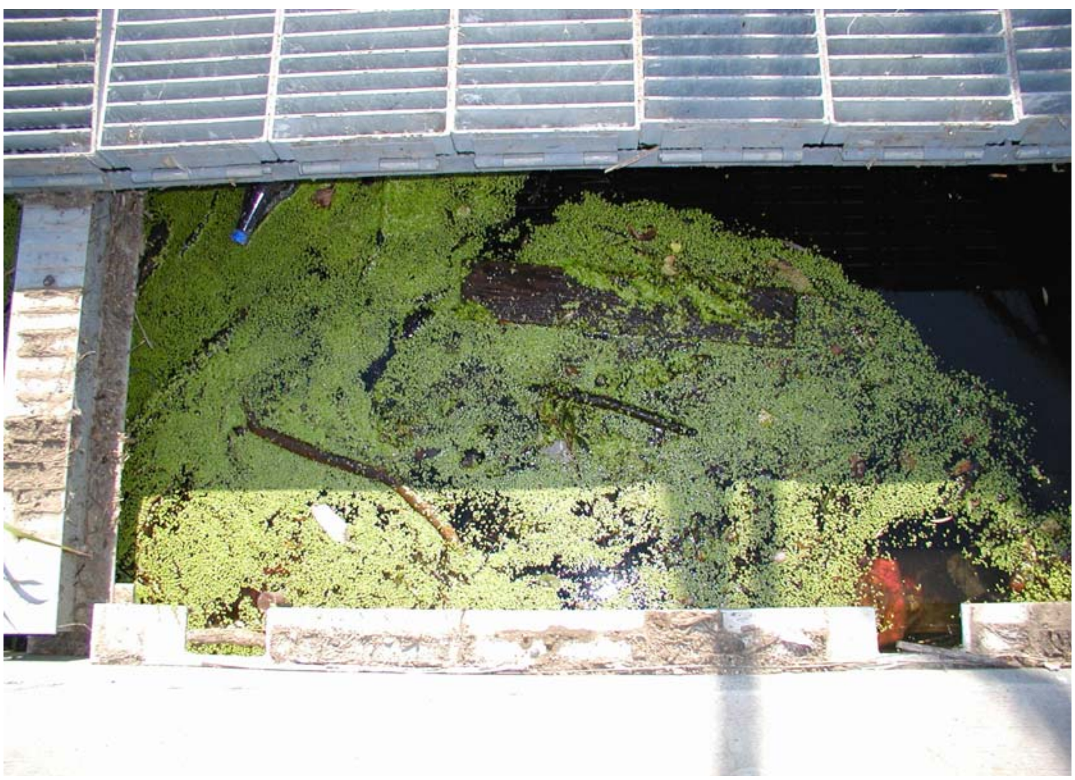


Figure 4-3. The fish passage orifice in the uppermost pool plugged by sediment and woody debris (Reclamation photograph by P. McGowan, 2007).

Figure 4-4. View looking inside the fish ladder pool after removal of the bar grating shows a high velocity jet shooting out of the orifice, making fish passage difficult (Reclamation photograph by P. McGowan, 2007).

The Oak Street Diversion was initially added to the RBFATT list in 2003, but it was moved to a lower priority later that same year because it was a Federally-owned site. The primary responsibility of RBFATT is to enhance fish passage at non-Federal sites. There were numerous meetings and communications with multiple local agencies and Federal agencies, including Reclamation, regarding the issues at Oak Street Diversion through the summer months of 2007. The meeting discussions involved feedback on various types of fish passage improvements to meet NOAA Fisheries current fish passage design criteria while addressing maintenance and aesthetic concerns.

Reclamation has been requested to continue working on the Oak Street Diversion project as the owner of the diversion dam. Therefore, it has been included in the proposed action to address improvements of the fish passage structure and to ensure implementation resolves the existing passage issues in accordance with current NOAA Fisheries fish passage criteria.

The fish passage improvement for the Oak Street Diversion would begin by compiling input previously received from meetings and communications described above to determine if further public involvement would be necessary. Additional research would be conducted to identify potential design modifications for the existing fish passage structure. Reclamation would consult with NOAA Fisheries fish passage experts through this process to ensure compliance with current criteria. There would be considerations for operations and maintenance to ensure it is compatible with the Districts' current schedule and cost structure.

Following other necessary compliance and permitting requirements, Reclamation would begin construction and other construction activities. Since designs for the site have not been completed the following discussion assumes that construction would be similar to other fish passage improvements in small streams (e.g., installation of the fish ladder and fish screen in the South Fork of Little Butte Creek in 2003 and the North Fork of Little Butte Creek fish ladder constructed in 2004).

When construction commences, a coffer dam would be constructed to isolate Bear Creek from the construction area in the vicinity of the existing fish ladder. This would allow removal of all or part of the original ladder and construction of the modified section of ladder or replacement with a new fishway to be completed "in the dry." This would prevent contamination of the creek from concrete, silt, welding slag, sandblasting abrasive, or other contaminants, and prevent physical harm to aquatic life. Upon completion of construction tasks, the coffer dam would be removed.

All construction work would be accomplished during the ODFW-established in-water work period of June 15 to September 15 for Bear Creek (ODFW 2008). Work is estimated to take from 3 to 4 weeks for modification to the existing ladder structure and between 5 to 7 weeks for replacement with a new fishway (McGowan 2008).

At this site a gravel parking area exists on the left side of the creek and a gravel O&M road exists on the right side of the creek, including a small area of riparian vegetation**.** Less than an acre of riparian habitat in the project area would be affected by construction-related activities.

Contingent on funding, Reclamation would provide adequate passage by the end of the fiscal year 2013.

Ashland Creek Diversion

The Ashland Creek Diversion is a Reclamation facility that diverts water for TID from Ashland Creek through an underground pipeline that connects to Bear Creek. The water is then diverted at the Oak Street Diversion to the TID Canal. This structure has been identified as an upstream passage impediment for juvenile fish passage to the upper reaches of Ashland Creek (Figure 4-5) by RBFATT (2007).

Figure 4-5. Ashland Creek Diversion looking upstream (Reclamation photograph by P. McGowan, 2008).

The existing headgate structure is absent any fish screen (Figure 4-6). ODFW recommended a fish screen to protect juveniles at this location as the 18-inch underground pipe is non-passable for juveniles and the exit of the pipeline can get plugged by debris. Additionally, juveniles that do travel through the headgate structure and pipeline can get stranded in the shoulder of the ditch along Oak Street (Figure 4-7).

Figure 4-6. Existing headgate structure for Ashland Creek Diversion (Reclamation photograph by P. McGowan, 2008).

Figure 4-7. Juvenile fish (red arrows) trapped on the shoulder of the ditch along Oak Street (Reclamation photograph by P. McGowan, 2008).

As with the Oak Street Diversion, RBFATT moved Ashland Creek Diversion to a low priority because it is a Federally-owned facility. It has been requested by local organizations and parties to address the fish barrier issues at Ashland Creek Diversion. This has been included in the proposed action to address potential improvements for fish passage and to ensure implementation, contingent on funding, resolves the existing issues in accordance with current NOAA Fisheries fish passage criteria.

The fish passage improvement for Ashland Creek Diversion would begin by obtaining input from various agencies, the Districts, and local organizations. Reclamation would consult with NOAA Fisheries fish passage experts through this process to ensure compliance with current criteria. Following other necessary compliance and permitting requirements, Reclamation would begin construction and other construction activities. Construction steps would be similar to those outlined for Oak Street; however, access to this site is more difficult so some additional disturbance to riparian habitat may be needed to gain access to the site.

Contingent on funding, Reclamation would provide adequate passage by the end of the fiscal year 2013.

4.2 Interrelated and Interdependent Actions

Effects from interrelated and interdependent actions are considered along with effects from the proposed action itself in making the overall determination of effects on ESA-listed species or critical habitat affected by the proposed action. An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. Interrelated or interdependent activities are measured against the proposed action.

The Hopkins Canal, Jackson Street Diversion Canal, Phoenix Canal, and Jackson Street Diversion Dam and Feeder Canal are privately-owned facilities and are considered interrelated and interdependent due to the co-mingling of water delivered under Federal and private water rights. While these facilities could operate without the proposed action, it would be difficult to partition the water for separate effects analyses.

Other private facilities within the Project including Cascade Canal, Fish Lake, and Fourmile Reservoir are not considered interrelated or interdependent because these facilities (1) do not depend on the proposed action for their justification and (2) have independent utility from the proposed action.

Chapter 5 Effects of the Action

Effects of the action refer to the direct and indirect effects of a proposed action on listed species or critical habitat, together with the effects of other activities that are interrelated to or interdependent with that action. In accordance with the provisions of the ESA implementing regulations and the USFWS Section 7 Handbook, Reclamation uses the following definitions to make its effects determinations for each listed species:

May Affect - Likely to adversely affect (MA/LAA): Any adverse effect to ESA-listed species or their critical habitat may occur as a direct or indirect result of the proposed actions or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial (see definition of is not likely to adversely affect). In the event the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action is likely to adversely affect the listed species. If incidental take is anticipated to occur as a result of the proposed action, a likely to adversely affect determination should be made.

May Affect - Not likely to adversely affect (MA/NLAA): Effects on ESA-listed species or their critical habitat are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

No effect (NE): When the action agency determines its proposed action will not affect listed species or critical habitat.

5.1 Effects to Hydrology

This section describes the effects of the proposed action to the hydrology in the Bear Creek watershed, Little Butte Creek watershed, and Klamath River basin.

5.1.1 Bear Creek Watershed

Minimum Operational Releases

Average daily flow data was obtained from the Hydromet station EMI located just downstream from Emigrant Dam which was plotted against the minimum operational releases for Emigrant Creek in the proposed action to determine the number of occurrences that the actual flows are less than the proposed minimum operational releases (Figure 5-1). The EMI gaging station would be utilized in flow management to ensure the minimum operational releases are being met until the new proposed gaging station is installed. This new station would be located near the existing EMI gage and provide accurate data to quantify low flows and any difference in the data collected from the EMI site as discussed in Chapter 4.

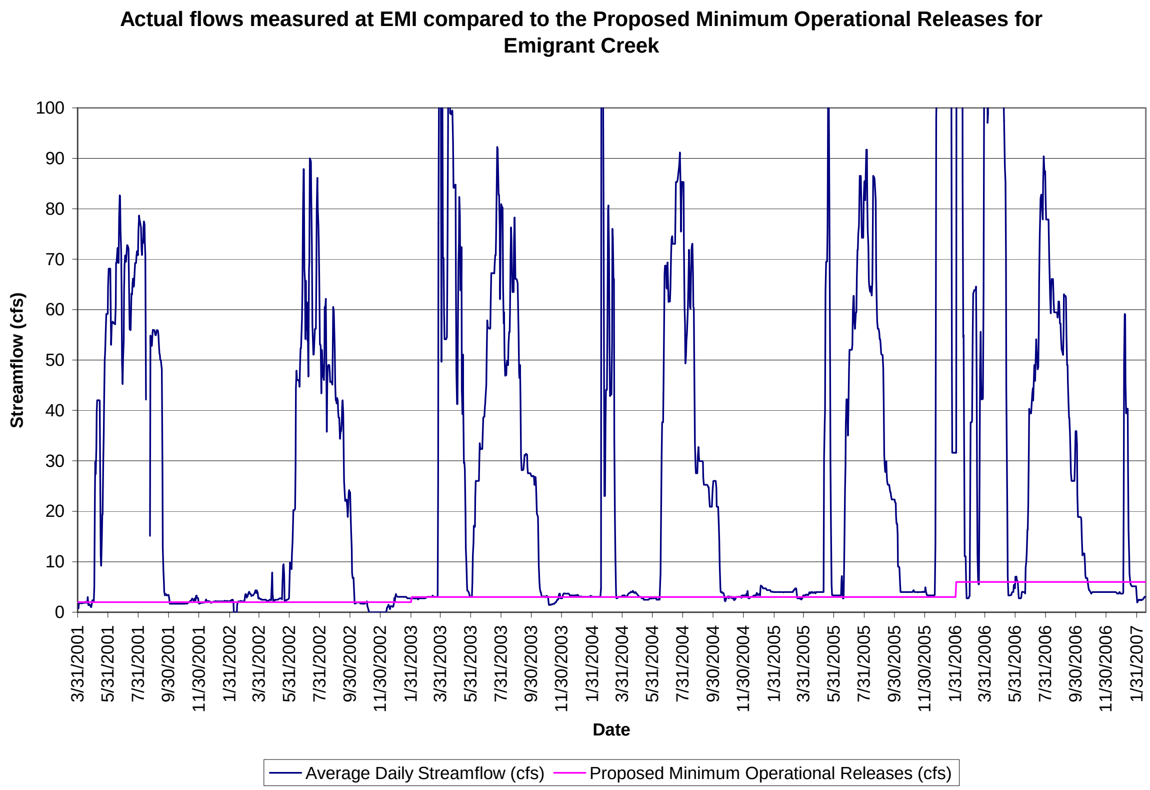


Figure 5-1. Comparison of actual flows in Emigrant Creek measured at EMI and the proposed minimum operational releases for the Emigrant Creek reach from March 31, 2001 to February 17, 2007.

Approximately 25 percent of the time the operational releases did not meet proposed releases in Emigrant Creek from March 31, 2001 to February 17, 2007. Twenty-one percent of the operational releases not met occur during the non-irrigation or storage periods. It has been identified that the daily mean flows in Emigrant Creek during the storage periods are typically less than 10 cfs and more reflective of the natural flow based on the data available (GeoEngineers 2008b). Precipitation also has an impact on streamflows in Emigrant Creek. The early storage months for the area tend to have lower precipitation quantities resulting in lower effects on streamflow while as the storage season progresses, the precipitation quantities have a greater impact on streamflows in Emigrant Creek (GeoEngineers 2008b).

The minimum operational releases for Emigrant Creek were used in the hydrology model described below. The purpose of using a model was to provide simulated output flow data for the habitat time series analysis discussed later in this chapter and to determine the impacts the flow regime would have on the reservoir capacity levels over time.

The Emigrant and Bear Creeks Daily Operations Model (Model) is a daily time step water budget simulation of Emigrant and Bear creeks, major diversions, and Howard Prairie, Hyatt, Keene Creek, and Emigrant reservoirs. The Model is constructed in MODSIM. The model was applied to two scenarios: current operations and proposed action (minimum operational releases). The current operation scenario is used to present observed reservoir levels and streamflows for the period of study and serves as a basis of comparison for the proposed action scenario.

The study period of the Model is limited by the availability of streamflow data (March 31, 2001 to February 17, 2007) and is considered a short length of time for statistical analysis. The assumption was made that this data set would be largely reflective of current conditions. In addition, the assumption was made that return flows (since they are not measured) do not contribute to instream flows in the modeled reach. Other reasonable assumptions were made for modeling purposes in an attempt to develop comparisons with as much accuracy as possible given limited data.

As discussed above, the minimum operational releases for the proposed action scenario were based on the storage curve determination. All three reservoir storage levels were represented in the Model. The simulated model results illustrated in Figure 5-2 identify the deviations of the proposed action scenario from the current condition scenario which occurs primarily during the non-irrigation season. This is consistent with the desire to address the low winter flows in Emigrant Creek. Based on the simulated modeled results, the impacts to reservoir storage of providing the proposed action minimum operational releases are minimal (Figure 5-3).

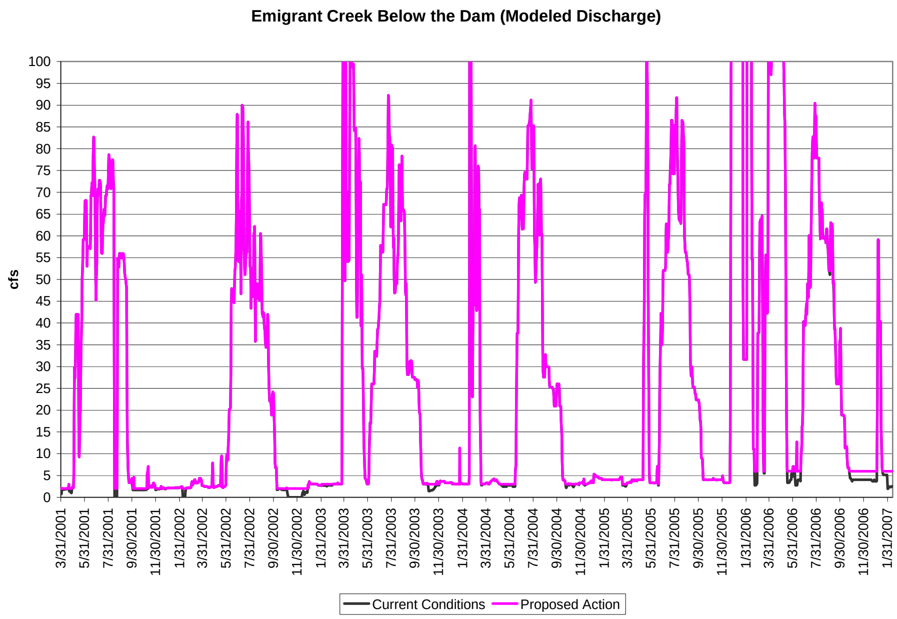


Figure 5-2. Comparison of current conditions in Emigrant Creek measured at EMI and the simulated proposed action minimum operational releases for the Emigrant Creek reach from March 31, 2001 to February 17, 2007.

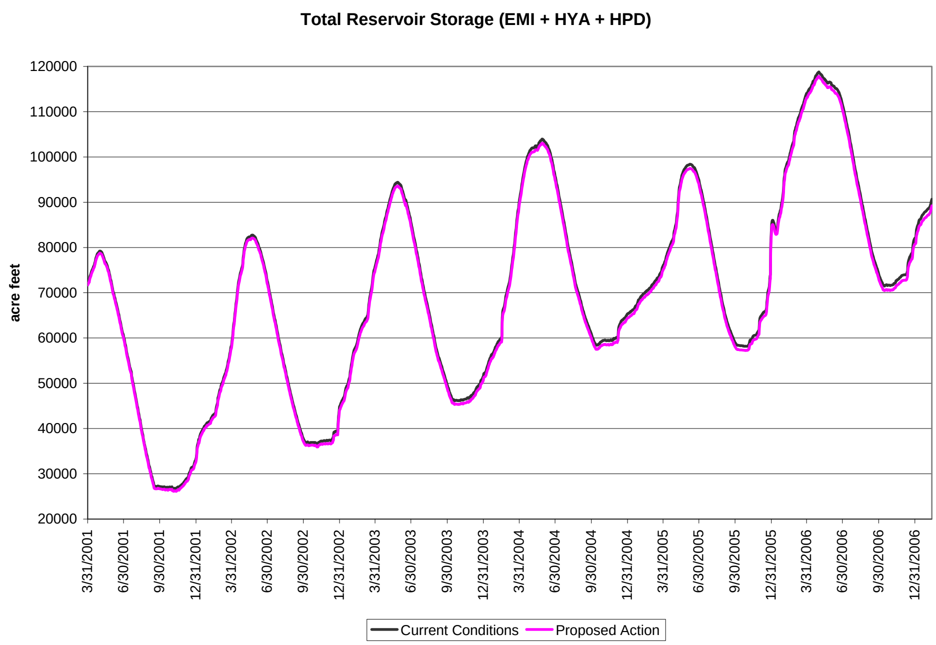


Figure 5-3. Comparison of total storage capacity from Emigrant Reservoir (EMI), Hyatt Reservoir (HYA), and Howard Prairie Reservoir (HPD) under current conditions to the simulated total storage capacity when the proposed action minimum operational releases are applied from March 31, 2001 to February 17, 2007.

Ramping Rates at Emigrant Dam

As part of the consultation process, TID provided Reclamation information regarding ramping rates for Emigrant Dam that would be expected to reduce fish stranding and displacement. The protocol and analysis of ramping rates at Emigrant Dam was completed in 2007 by GeoEngineers (memorandum provided in Appendix C). The proposed action is to implement the ramping rate laid out in the protocol as part of the standard Project operations.

In Appendix C, an analysis was conducted to compare the ramping rates schedule currently in operation by TID to natural streamflow variability. It was concluded that the level of protection to fish from changes in the reservoir releases are similar to what would occur naturally (Appendix C). TID has used the ramping rate schedule described above as shown in Table 5-1 at the end of each irrigation season and at other times during the year when necessary as indicated in the ramping rate memorandum based on data obtained from Hydromet station EMI.

Table 5-1. List of dates the ramping rate schedule was used as identified by data obtained from the Hydromet station EMI located at the outlet of Emigrant Dam.

Dates of Observed Ramping Rates (2001 - 2008)
9/16/2001 – 9/26/2001
10/1/2002 – 10/11/2002
5/19/2003 – 5/29/2003
10/11/2003 – 10/21/2003
10/10/2004 – 10/20/2004
5/22/2005 – 6/1/2005
10/3/2005 – 10/13/2005
2/16/2006 – 2/26/2006
3/13/2006 – 3/19/2006
5/12/2006 – 5/22/2006
10/3/2006 – 10/28/2006
1/12/2007 – 1/22/2007
5/7/2007 – 5/17/2007
9/28/2007 – 10/11/2007
6/8/2008 – 6/17/2008

Table 5-2 illustrates actual flows using or approximating the ramping rates schedule. October dates are for the end of an irrigation season; February dates are for the end of a flood pool evacuation period. For comparison purposes, data from October 1997 included to show typical operation with respect to shutting down operations at the end of the irrigation season before the ramping rate protocol was implemented

Table 5-2. Examples of ramping rate schedule effects: dates and flows (cfs) for three time periods to display conditions with and without the ramping rate schedule with data obtained from Hydromet station EMI.

	Without Ramping Rate Schedule		With Ramping Rate Schedule			
Day	Date	cfs	Date	cfs	Date	cfs
0	9/30/97	26	10/2/2005	21.64	2/16/2006	54.95
1	10/1/97	9.89	10/3/2005	19.02	2/17/2006	29.75
2	10/2/97	3.38	10/4/2005	17.56	2/18/2006	11.07
3	10/3/97	3.10	10/5/2005	17.56	2/19/2006	11.07
4	10/4/97	3.08	10/6/2005	15.39	2/20/2006	11.07
5	10/5/97	3.10	10/7/2005	9.03	2/21/2006	5.85
6	10/6/97	3.16	10/8/2005	9.03	2/22/2006	2.74
7	10/7/97	3.12	10/9/2005	8.95	2/23/2006	2.74
8	10/8/97	2.90	10/10/2005	8.77	2/24/2006	2.74
9	10/9/97	2.94	10/11/2005	5.74	2/25/2006	2.75
10	10/10/97	2.90	10/12/2005	4.02	2/26/2006	2.8

5.1.2 Little Butte Creek and Antelope Creek Watersheds

In the Little Butte Creek watershed, there are no proposed changes to the Project water diversions or operations including those that occur in the upper reaches of South Fork Little Butte Creek or Antelope Creek. Consequently, there would be no changes under the proposed action in the hydrology of those streams relative to the current conditions in the environmental baseline.

5.1.3 Klamath River Basin

The proposed action would not alter hydrology in the Klamath River basin relative to the current conditions in the environmental baseline.

5.2 Effects to SONCC Coho Salmon Critical Habitat

This section describes the effects of the proposed action on SONCC coho salmon critical habitat within the Project area of the Rogue River basin and the Klamath River basin.

The Endangered Species Act requires that the designation of critical habitat be based on the conditions which are found at the time of designation. An occupied area must contain one or more of the primary constituent elements (PCEs) to be eligible for designation as critical habitat and cannot be designated as critical habitat unless it contained physical or biological features essential to the conservation of the species at the time of designation (70 FR 52630). The ESA does not permit an area lacking such features to be designated as critical habitat in the hope that it may over time acquire such features (70 FR 52630). Since the designation was based on conditions which existed at the time the critical habitat was listed, this analysis looks at the effects of the proposed action, the future operation of the Rogue River Basin Project, on the existing critical habitat conditions. This is done to help inform the determination as to whether the proposed action would adversely modify or destroy those conditions.

In designating critical habitat for SONCC coho salmon, NOAA Fisheries focused on the known physical and biological features, referred to as PCEs, within the designated area that are essential to the conservation of the species and that may require special management considerations or protection. These essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation. The SONCC coho salmon life cycle can be separated into five essential habitat types: (1) juvenile salmon summer and winter rearing areas; (2) juvenile salmon migration corridors; (3) areas for growth and development to adulthood; (4) adult migration corridors; and (5) spawning areas. Within these areas, essential features of SONCC coho salmon critical habitat, the PCEs, include adequate: (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.

5.2.1 Bear Creek Watershed

Ramping Rates at Emigrant Dam

As outlined in the previous section, ramping rates at Emigrant Dam would change under the proposed action and more closely mimic naturally declining flow patterns. Utilizing the ramping rate protocol would reduce fish stranding and displacement of coho salmon in Emigrant Creek as releases from Emigrant Dam are decreased at the end of an irrigation season and following a non-irrigation season release. This should improve fall and winter rearing conditions by improving PCEs including water quantity, cover/shelter, and, in a fashion, safe passage conditions as juveniles move from one portion of the stream channel to the low flow channel as flows decline. Other PCEs, such as substrate, water quality, temperature, velocity and riparian vegetation, would not be affected by the ramping rate protocol. Overall, the implementation of the ramping rate protocol would improve conditions of the critical habitat in Emigrant Creek during those brief periods when the protocol is in effect and flows are being reduced.

Minimum Operational Releases for Emigrant Creek

The effects of the proposed minimum operational releases were evaluated using a habitat time series analysis to assess effects of this feature of the proposed action on coho salmon designated critical habitat in portions of Emigrant Creek and Bear Creek. Several of the PCEs would not be affected by this part of the proposed action. Water temperatures, water quality, riparian habitat, substrate, and food would not likely be affected by the release of 2 to 6 cfs during low flow periods in the winter. Water temperatures in Emigrant Creek and Bear Creek are consistently below the 13° C standard and generally suitable for coho salmon. This would not change with the minimum operational releases. There are no water quality issues currently associated with the water released from Emigrant Dam and the winter releases would not alter that. The winter releases would not affect riparian habitat as they occur during the non-growing season and are too low to scour existing vegetation. Also, winter operational flow releases should not affect the substrate as they are too low to scour or redistribute the existing substrate. Finally, since winter is not a biologically productive period for aquatic invertebrates, it should have little effect on food production.

Other PCEs, including water quantity, cover/shelter, water velocity, and space would be affected by the minimum storage releases. Water quantity would be increased as higher flows are released. These higher flows would create additional space for coho salmon by wetting more of the channel. Water velocity conditions may also be improved and the higher flows would allow coho salmon in the streams to make use of additional cover and shelter.

Habitat Time Series Analysis

The habitat time series analysis approach used to assess effects of the proposed minimum operational releases described in Chapter 4 for the coho salmon designated critical habitat was conducted by examining habitat availability for two life stages: juvenile salmon rearing and spawning/incubation. The daily flow data utilized for analysis were collected from March 31, 2001 to February 12, 2007 (also identified as water years 2001 through 2006). Existing conditions were based on daily Hydromet gage data. The proposed action simulated daily flows in Emigrant Creek downstream from Emigrant Reservoir and Bear Creek between Emigrant Creek and Jackson Street Diversion from 2001 to 2007 that were generated using the hydrologic model described previously. Two sets of daily habitat time series were constructed for the coho salmon life stages identified above for the proposed action and existing conditions.

The habitat time series approach involves the integration of the hydrologic time series with the habitat versus discharge relationship illustrated in Figure 5-4. The hydrologic time series is the daily flows or discharge for a stream reach over a consecutive period of time. The uppermost graph in Figure 5-4 is an example of a hydrologic time series. In this approach, habitat is identified by the weighted useable area (WUA) (see Chapter 4). WUA is an index of habitat which is measured either as square feet of usable habitat per 1,000 longitudinal feet of stream or as a percentage of maximum WUA. The habitat (WUA) versus discharge (cfs) graph example is the left graph of Figure 5-4. The bottom graph in Figure 5-4 is an example of the resulting habitat time series. With respect to the PCEs for coho salmon critical habitat, the improvement in WUA that comes about from the minimum operational release program likely reflects an improvement in water quantity, water velocity, and cover and shelter.

WUA accounts for fish habitat by looking at depth, velocity, and substrate criteria as well as the amount of habitat that is physically available. As such, the WUA values can be used as a rough index of to explore possible changes in space available and water velocity for the various life stages. For this analysis, changes in WUA for coho salmon with the proposed action is equated to a change in critical habitat conditions, with increases in WUA representing an improvement in the critical habitat conditions. The increase in WUA may come about by improving the existing habitat as the micro-habitat conditions move toward those more suitable for the coho salmon life stages evaluated or by simply increasing the physical amount of habitat available.

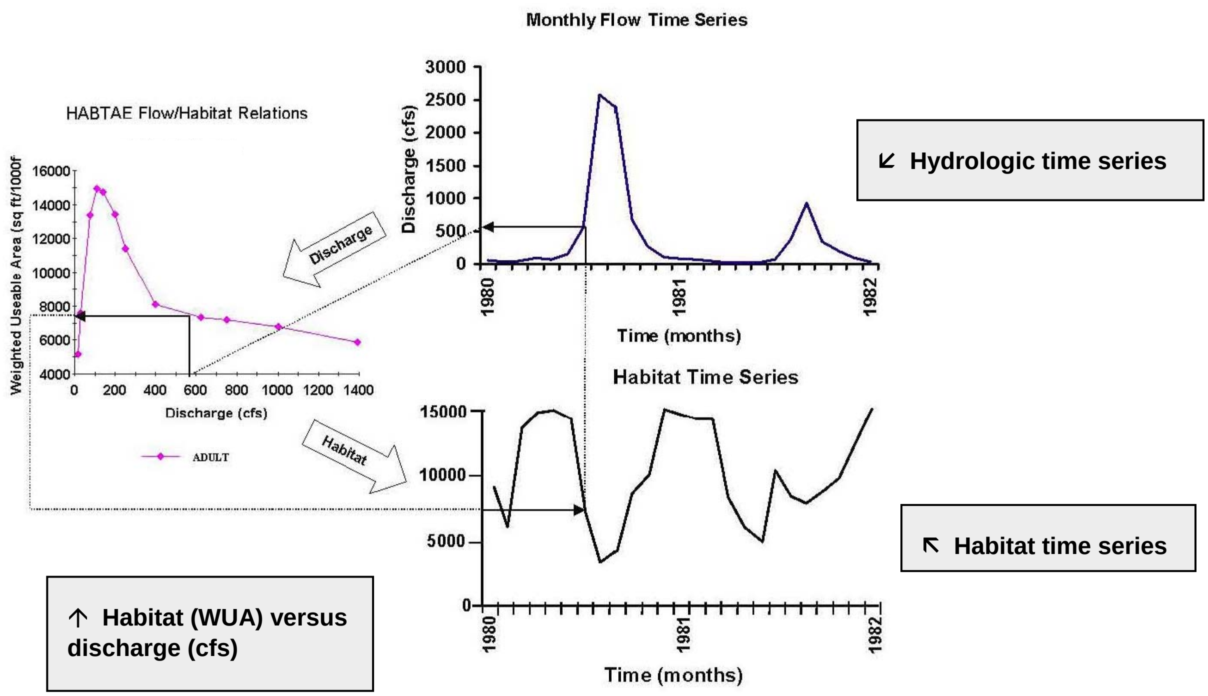


Figure 5-4. Illustration of a generic habitat time series.

The graphs of the daily habitat time series are presented for the Emigrant Creek reach (Figure 5-5 and Figure 5-6) and three Bear Creek stream reaches (Figure 5-11 through Figure 5-24). Gaps in the graphs indicate either times when a life stage was not present or where streamflows exceeded the predictive range for the habitat modeling simulation.

The relative impact assessment for coho salmon critical habitat was determined based on the percentage difference between the habitat values for the proposed action and existing conditions (Table 5-3). For purposes of this analysis, habitat effects due to the proposed action as a percentage of existing conditions were considered minor if less than or equal to 10 percent; moderate between 11 and 20 percent; and major more than 20 percent. The rationale for these percentages is similar to that used by NOAA Fisheries (2002). In their analysis, they assumed potential errors of 10 percent associated with stream gaging estimates and stream habitat modeling. Percent changes greater than 10 percent would more likely reflect actual habitat changes.

Table 5-3. Basis for determining effects of the proposed action relative to current conditions on coho salmon critical habitat.

Coho salmon critical habitat effect	Percentage range	Relative effect
Major gain	Greater than 20	+++
Moderate gain	11 to 20	++
Minor gain	1 to 10	+
No change	0	0
Minor loss	-1 to -10	-
Moderate loss	-11 to -20	--
Major loss	Greater than 20	---

Emigrant Creek

Emigrant Creek daily habitat time series (March 31, 2001 to February 12, 2007) with current critical habitat conditions and the proposed action for coho salmon juveniles and spawning/incubation life stages are shown in Figure 5-5 and Figure 5-6, respectively. Gaps in the graphs indicate either times when the life stage was not present or where streamflows exceeded the predictive range for the habitat modeling simulation. Examination of these figures shows that the proposed action increases WUA primarily during low flow periods, thereby reducing habitat bottlenecks. There are incremental gains in juvenile salmon and spawning/incubation salmon WUA with proposed minimum operational releases when compared to 0 cfs flows under existing conditions that occurred, for example, in February 2002 and November 2002.

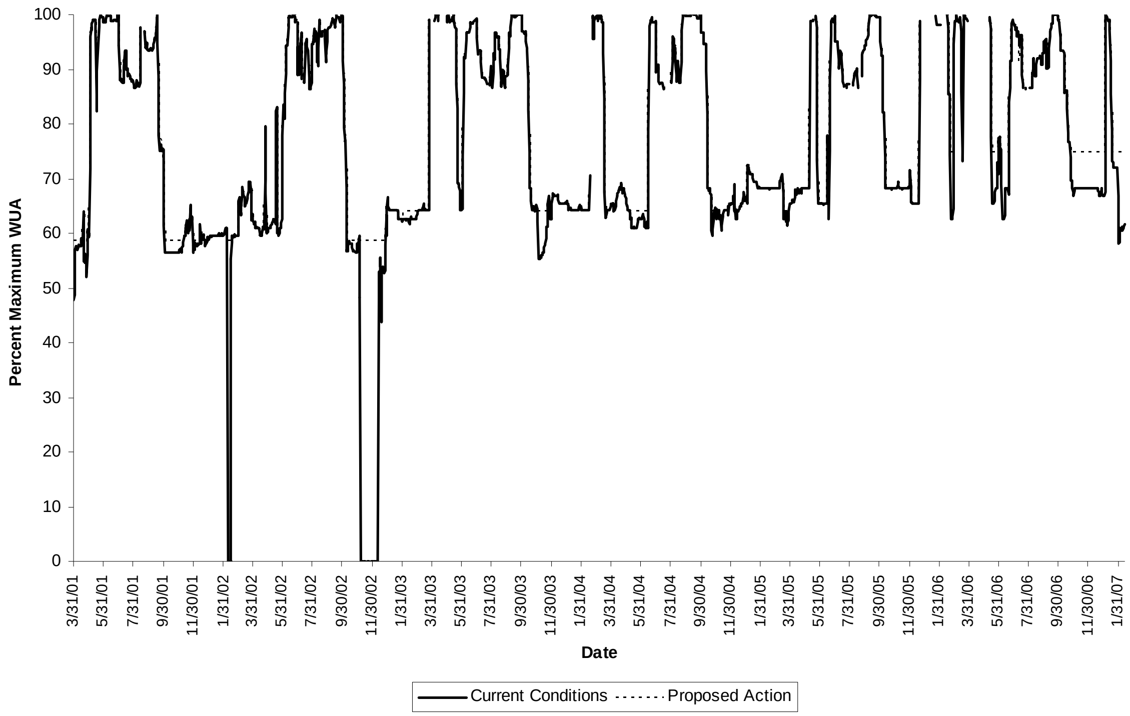


Figure 5-5. Daily habitat time series for juvenile coho salmon in Emigrant Creek. WUA units = percent of maximum WUA.

Figure 5-6. Daily habitat time series for spawning/incubation coho salmon in Emigrant Creek. WUA units = percent maximum WUA.

Table 5-4 and Table 5-7 summarize the tabular results of the effects of the proposed action on coho salmon critical habitat in Emigrant Creek. The stacked bar graphs in Figure 5-7 through Figure 5-10 are graphical representations of Table 5-4 through Table 5-7 and are intended to simplify the abundant amount of information shown in Figure 5-5 and Figure 5-6. Figure 5-7 and Figure 5-8 illustrate the effects of the proposed action minimum operational releases on coho salmon WUA by comparing numbers of daily gains and losses by water year. The proposed action would result in generally minor gains in both juvenile salmon and spawning/incubation coho salmon WUA for this stream reach or no change (Figure 5-7 and Figure 5-10). Most gains in WUA would occur in dry and average water years when there are periods of low flow to no flow with existing conditions. For example, more gains in WUA occur in 2002 (dry water year) and 2003 (average water year) than in 2006, a wet water year (Figure 5-5 and Figure 5-6).

Figure 5-9 and Figure 5-10 illustrate seasonal effects of the proposed action minimum operational releases by summarizing numbers of days with WUA gains for the water years. Only gains in WUA are graphed because they demonstrate the most common definitive effects compared to WUA losses for this stream reach. Juvenile salmon WUA gains would occur during the winter months with little to no effect during summer (July through September) in Emigrant Creek (Figure 5-9). A few days during April and May have salmon spawning/incubation WUA gains for water years 2001, 2004, and 2006, resulting from increased minimum flows with the proposed action when compared to existing conditions (e.g., on April 21, 2001, existing flow was 1 cfs compared to proposed action flow of 2 cfs). Many days in February 2002 (water year 2002) and November and December 2002 (water year 2003) show major juvenile salmon and salmon spawning/incubation WUA gains with proposed action flows compared to existing conditions, particularly when there was 0 cfs from February 8 through February 14, 2002, and November 6 through December 12, 2002. The most losses in WUA occur with eight days of minor juvenile salmon WUA losses during July through September of water year 2006 related to slightly higher proposed action flows than existing conditions during irrigation season.

Table 5-4. Proposed action minimum operational releases relative to current conditions for juvenile coho salmon critical habitat in Emigrant Creek. The values represent the number of times proposed action weighted usable area (WUA) units deviated from current conditions for all time steps (days) and each water year.

	Water Year					
Value [1]	2001	2002	2003	2004	2005	2006
+++	2	7	40	0	0	0
++	2	0	4	15	0	22
+	24	62	66	53	38	21
0	145	289	223	277	306	217
-	2	1	0	1	0	8
--	0	0	0	0	0	0
---	0	0	0	0	0	0

[1] Major gain (>20%) = +++; moderate gain (11to20%) = ++; minor gain (0 to10%) = +; no change (0%) = 0; minor loss (0 to-10%) = -; moderate loss (-11to-20%) = --; major loss (<-20%) = ---.

Table 5-5. Proposed action minimum operational releases relative to current conditions for spawning/incubation coho salmon critical habitat in Emigrant Creek. The values represent the number of times proposed action weighted usable area (WUA) units deviated from current conditions for all time steps (days) and each water year.

	Water Year					
Value [1]	2001	2002	2003	2004	2005	2006
+++	8	8	53	17	0	19
++	3	6	1	16	6	1
+	16	24	33	21	23	4
0	35	173	101	153	180	100
-	0	1	0	1	0	0
--	0	0	0	0	0	0
---	0	0	0	0	0	0

1 Major gain (>20%) = +++; moderate gain (11to20%) = ++; minor gain (0 to10%) = +; no change (0%) = 0; minor loss (0 to-10%) = -; moderate loss (-11to-20%) = --; major loss (<-20%) = ---.

Table 5-6. Number of days when juvenile coho salmon WUA gains occur as a result of the proposed action in Emigrant Creek.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Totals
2001	0	0	0	0	0	1	26	0	0	0	0	1	28
2002	31	12	16	0	10	0	0	0	0	0	0	0	69
2003	23	29	27	0	28	3	0	0	0	0	0	0	110
2004	1	24	1	0	0	4	0	24	14	0	0	0	68
2005	7	13	5	0	0	11	0	0	2	0	0	0	38
2006	0	0	0	0	8	2	0	14	16	0	1	2	43

Table 5-7. Number of days when spawning/incubation coho salmon WUA gains occur as a result of the proposed action in Emigrant Creek.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Totals
2001		0	0	0	0	1	26	0					27
2002		12	16	0	10	0	0	0					38
2003		29	27	0	28	3	0	0					87
2004		25	1	0	0	4	0	24					54
2005		13	5	0	0	11	0	0					29
2006		0	0	0	8	2	0	14					24

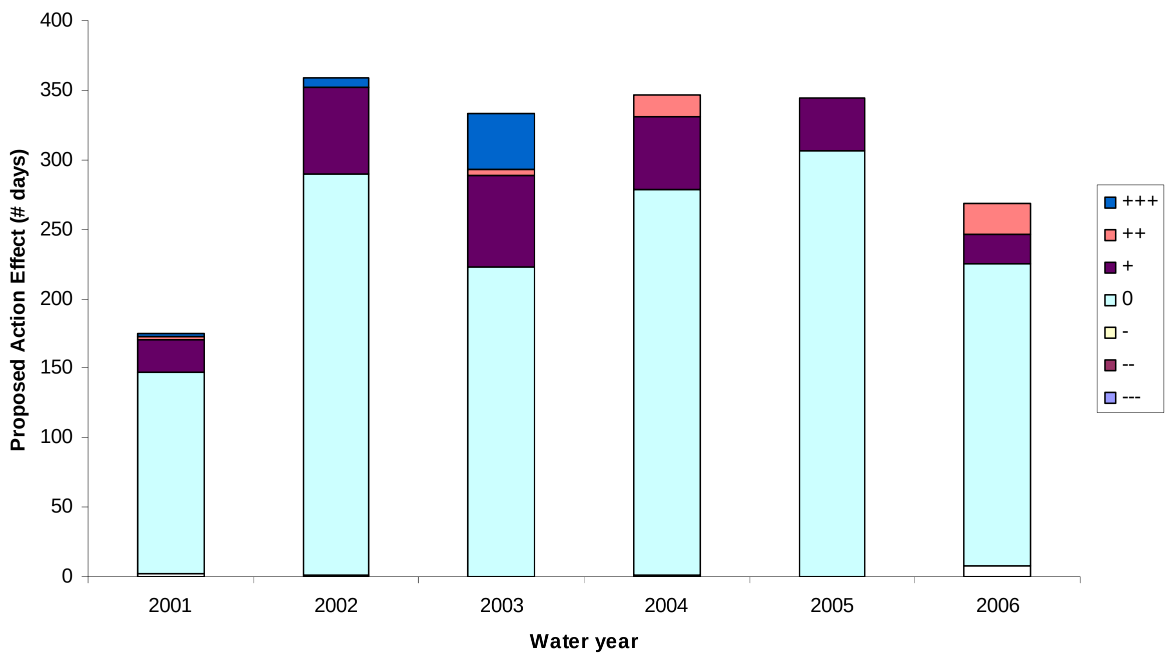


Figure 5-7. Number of days proposed action juvenile coho salmon habitat units (WUA) deviated from current conditions in Emigrant Creek.

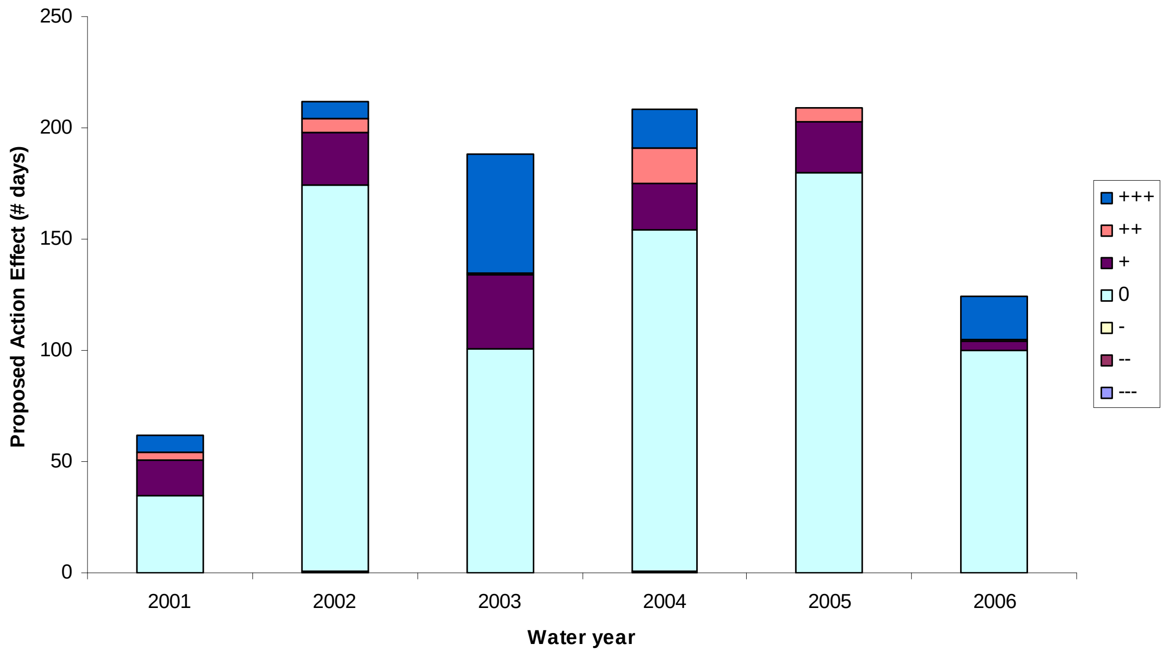


Figure 5-8. Number of days proposed action spawning/incubation coho salmon habitat units (WUA) deviated from current conditions in Emigrant Creek.

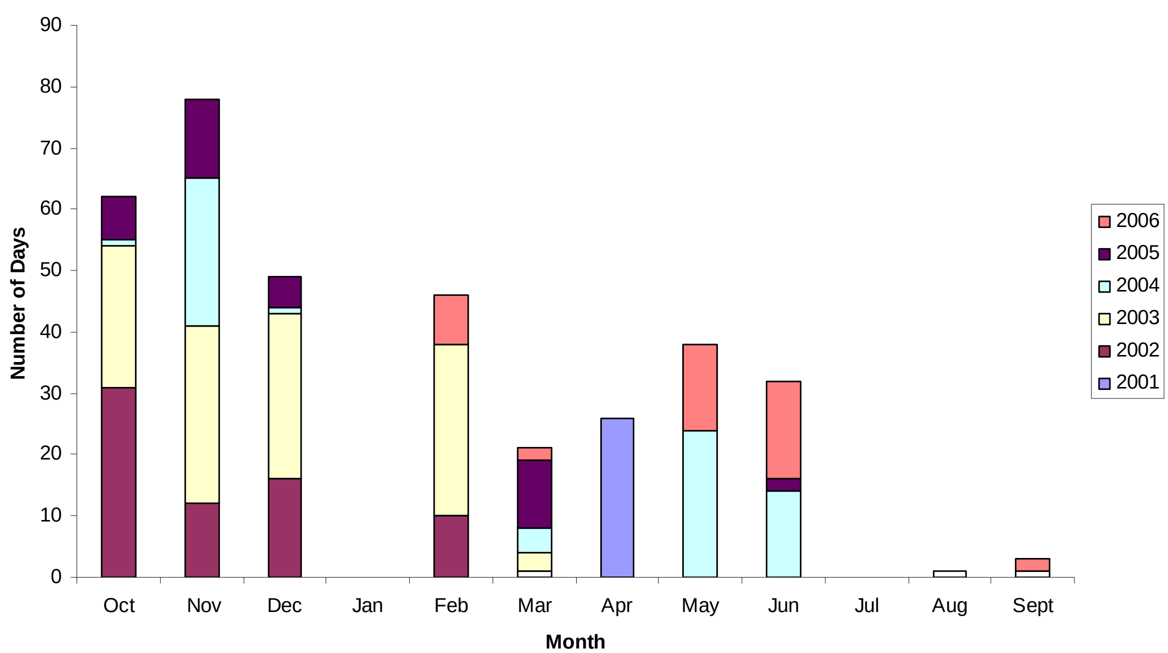


Figure 5-9. Number of days when juvenile coho salmon WUA gains occur as a result of the proposed action in Emigrant Creek.

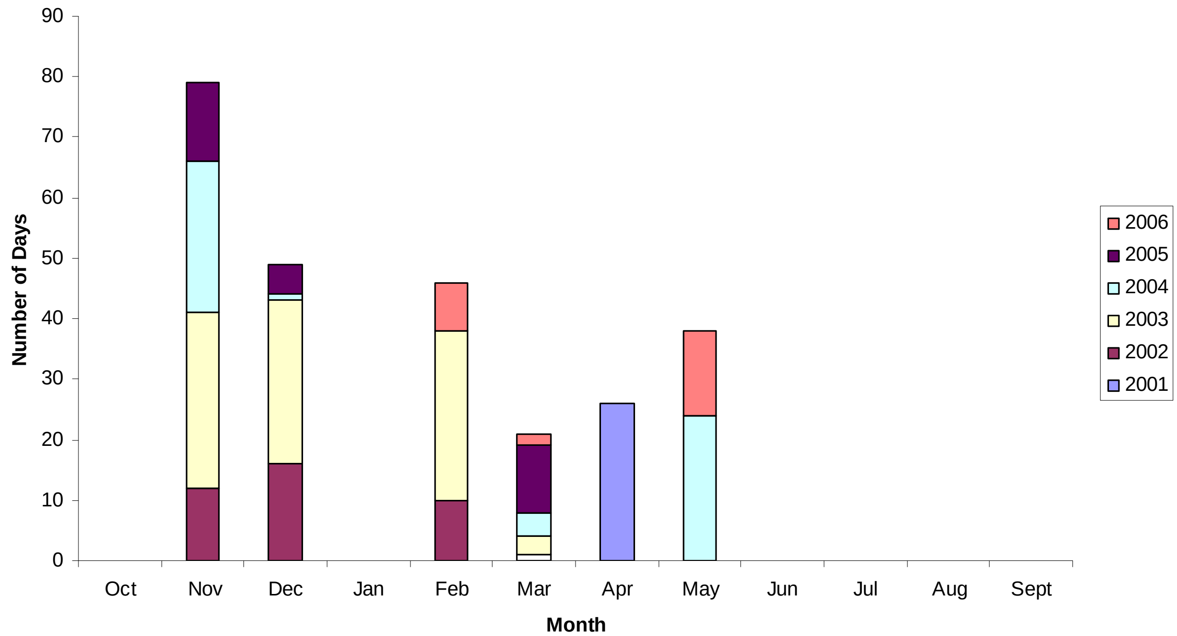


Figure 5-10. Number of days when spawning/incubation coho salmon WUA gains occur as a result of the proposed action in Emigrant Creek.

Bear Creek - Emigrant Creek to Oak Street Diversion

Daily habitat time series under current conditions and with the proposed action for coho salmon juveniles and spawning/incubation life stages in Bear Creek – Emigrant to Oak Street Diversion from March 31, 2001 to February 12, 2007 are shown in Figure 5-11 and Figure 5-12, respectively. Examination of these figures shows that the proposed action increases WUA primarily during low flow periods, thereby preventing habitat bottlenecks. There are incremental gains in juvenile salmon and salmon spawning/incubation WUA with proposed minimum operational releases compared to 0 cfs flows under conditions that occurred in February 2002 and November 2002.

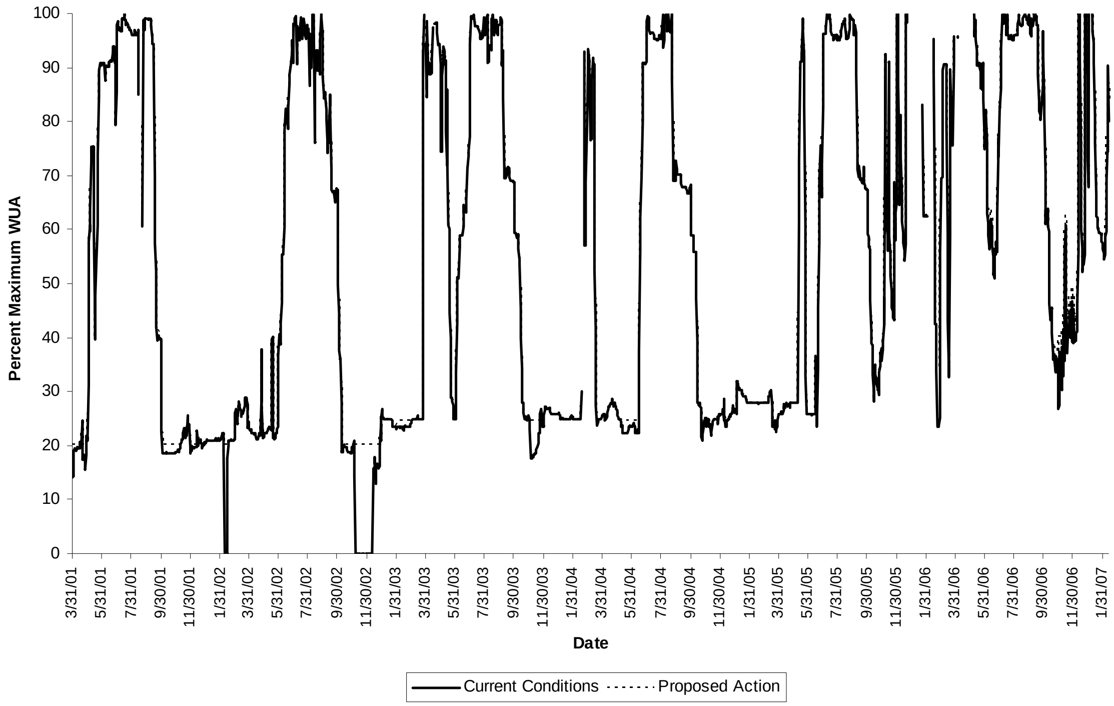


Figure 5-11. Daily habitat time series for juvenile coho salmon in Bear Creek between Emigrant Creek and the Oak Street Diversion. WUA units = percent maximum WUA.

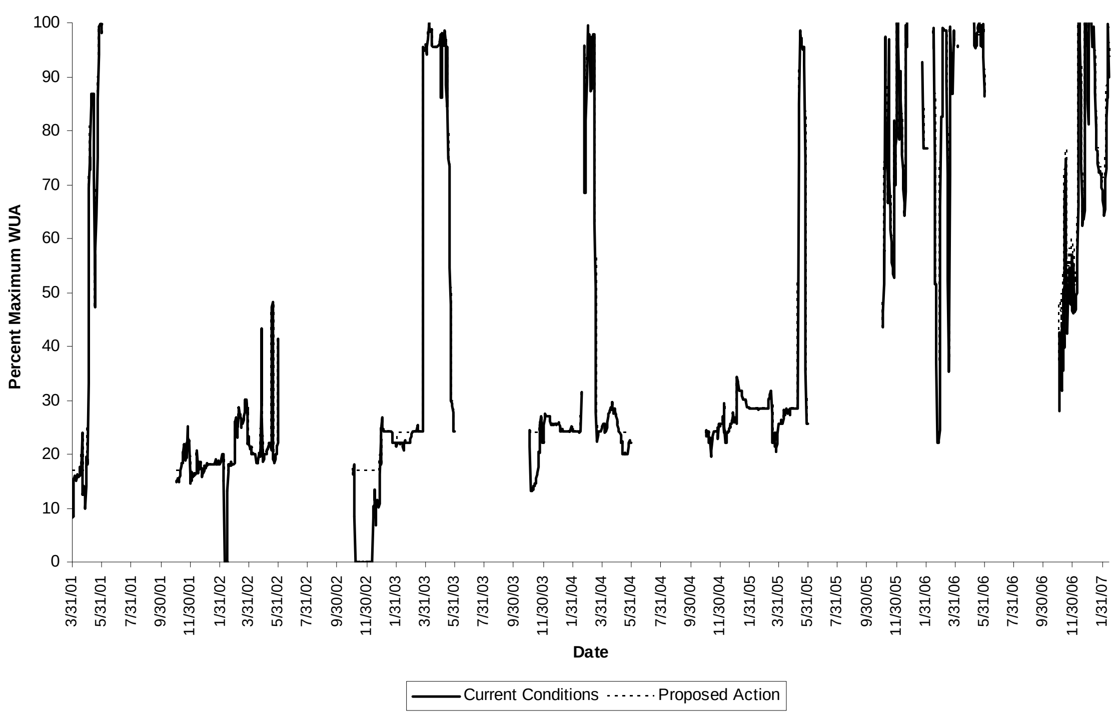


Figure 5-12. Daily habitat time series for spawning/incubation coho salmon in Bear Creek between Emigrant Creek and the Oak Street Diversion. WUA units = percent maximum WUA.

Table 5-8 through Table 5-11 summarize the tabular results of the effects of the proposed action on coho salmon WUA, and by extension, critical habitat in Bear Creek between Emigrant Creek and the Oak Street Diversion. The stacked bar graphs in Figure 5-13 through Figure 5-16 are graphical representations of Table 5-8 through Table 5-11. Figure 5-13 and Figure 5-16 illustrate the effects of the proposed action minimum operational releases on coho salmon WUA by comparing numbers of daily gains and losses by water year. The proposed action would result in generally minor gains in both juvenile salmon and spawning/incubation coho salmon WUA for this stream reach or no change (Figure 5-15 and Figure 5-16). Most gains in WUA would occur in dry and average water years when there are periods of low flow to no flow with current conditions. For example, more gains in WUA occur in 2002 (dry water year) and 2003 (average water year), than in 2006, a wet water year (Figure 5-11 and Figure 5-12).

Figure 5-15 and Figure 5-16 illustrate seasonal effects of the proposed action minimum operational releases by summarizing numbers of days with WUA gains for the water years. Only gains in WUA are graphed because they demonstrate the most common definitive effects compared to WUA losses for this stream reach. Juvenile salmon WUA gains would occur during the winter months with little to no effect during summer (July through September) in Bear Creek between Emigrant Creek and the Oak Street Diversion (Figure 5-18). A few days during April and May have major salmon spawning/incubation WUA gains for water years 2001, 2004, and 2006 resulting from increased minimum flows with the proposed action compared to current conditions (e.g., April 21, 2001 existing flow was 1 cfs compared to proposed action flow of 2 cfs). Many days in February 2002 (water year 2002), and November and December 2002 (water year 2003) show major juvenile salmon and salmon spawning/incubation WUA gains with proposed action flows compared to existing conditions, particularly when there was 0 cfs from February 8 through February 14, 2002, and November 6 through December 12, 2002. The most losses in WUA occur with 7 days of minor juvenile salmon WUA losses in July through September of water year 2006. This is the result of slightly higher flows with the proposed action as compared to the current conditions during irrigation season.

Table 5-8. Proposed action minimum operational releases relative to current conditions for juvenile coho salmon critical habitat in Bear Creek between Emigrant Creek and the Oak Street Diversion. The values represent the number of times proposed action weighted usable area (WUA) units deviated from current conditions for all time steps (days) and each water year.

	Water Year					
Value [1]	2001	2002	2003	2004	2005	2006
+++	4	7	52	16	0	7
++	5	1	1	18	5	0
+	19	61	57	35	33	37
0	147	295	249	292	327	240
-	2	1	0	1	0	7
--	0	0	0	0	0	0
---	0	0	0	0	0	0

[1] Major gain (>20%) = +++; moderate gain (11to20%) = ++; minor gain (0 to10%) = +; no change (0%) = 0; minor loss (0 to-10%) = -; moderate loss (-11to-20%) = --; major loss (<-20%) = ---.

Table 5-9. Proposed action minimum operational releases relative to current conditions for spawning/incubation coho salmon critical habitat in Bear Creek between Emigrant Creek and the Oak Street Diversion. The values represent the number of times proposed action weighted usable area (WUA) units deviated from current conditions for all time steps (days) and each water year.

	Water Year					
Value [1]	2001	2002	2003	2004	2005	2006
+++	9	8	53	17	1	7
++	5	9	2	16	5	0
+	13	21	32	21	23	11
0	35	173	119	154	183	114
-	0	1	0	1	0	6
--	0	0	0	0	0	0
---	0	0	0	0	0	0

1 Major gain (>20%) = +++; moderate gain (11to20%) = ++; minor gain (0 to10%) = +; no change (0%) = 0; minor loss (0 to-10%) = -; moderate loss (-11to-20%) = --; major loss (<-20%) = ---.

Table 5-10. Number of days when juvenile coho salmon WUA gains occur as a result of the proposed action in Bear Creek between Emigrant Creek and the Oak Street Diversion.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Totals
2001	0	0	0	0	0	1	26	0	0	0	0	1	28
2002	31	12	16	0	10	0	0	0	0	0	0	0	69
2003	23	29	27	0	28	3	0	0	0	0	0	0	110
2004	1	24	1	0	0	4	0	24	14	0	1	0	69
2005	7	13	5	0	0	11	0	0	2	0	0	0	38
2006	0	0	0	0	8	2	0	11	16	0	1	6	44

Table 5-11. Proposed action minimum operational releases relative to current conditions for juvenile coho salmon critical habitat in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion. The values represent the number of times proposed action weighted usable area (WUA) units deviated from current conditions for all time steps (days) and each water year.

	Water Year					
Value [1]	2001	2002	2003	2004	2005	2006
+++	0	0	0	0	0	0
++	0	0	0	0	0	0
+	17	48	98	59	31	27
0	147	293	196	275	304	184
-	20	22	5	11	7	9
--	0	0	0	0	0	0
---	0	0	0	0	0	0

[1] Major gain (>20%) = +++; moderate gain (11to20%) = ++; minor gain (0 to10%) = +; no change (0%) = 0; minor loss (0 to-10%) = -; moderate loss (-11to-20%) = --; major loss (<-20%) = ---.

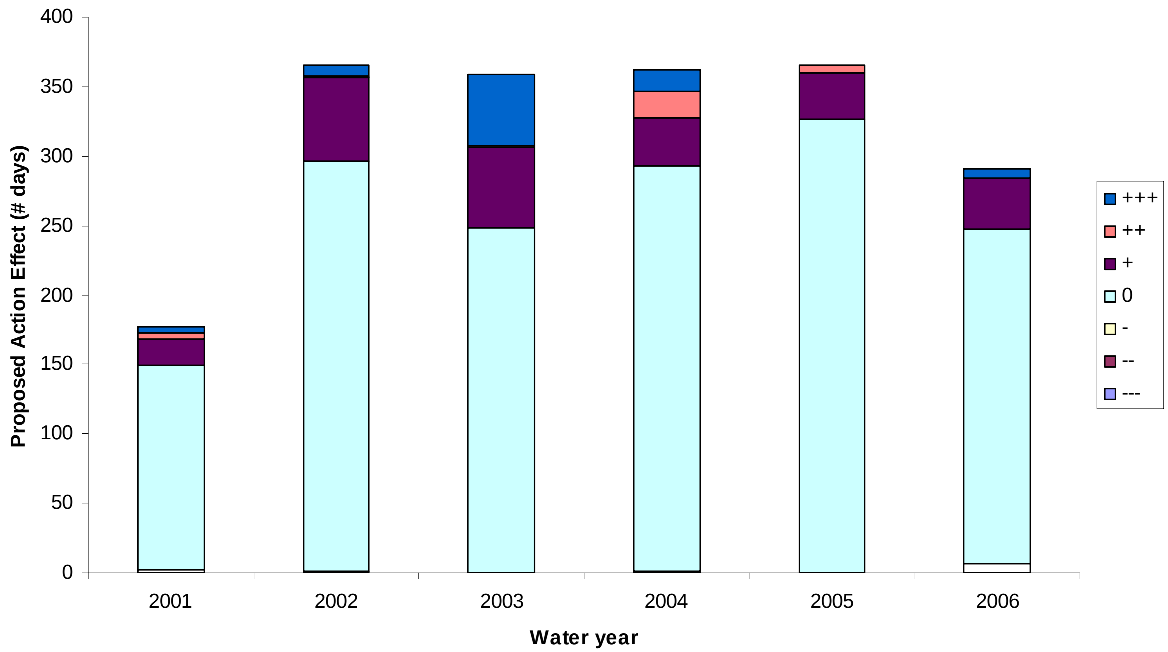


Figure 5-13. Number of days proposed action juvenile coho salmon habitat units (WUA) deviated from current conditions in Bear Creek between Emigrant Creek and the Oak Street Diversion.

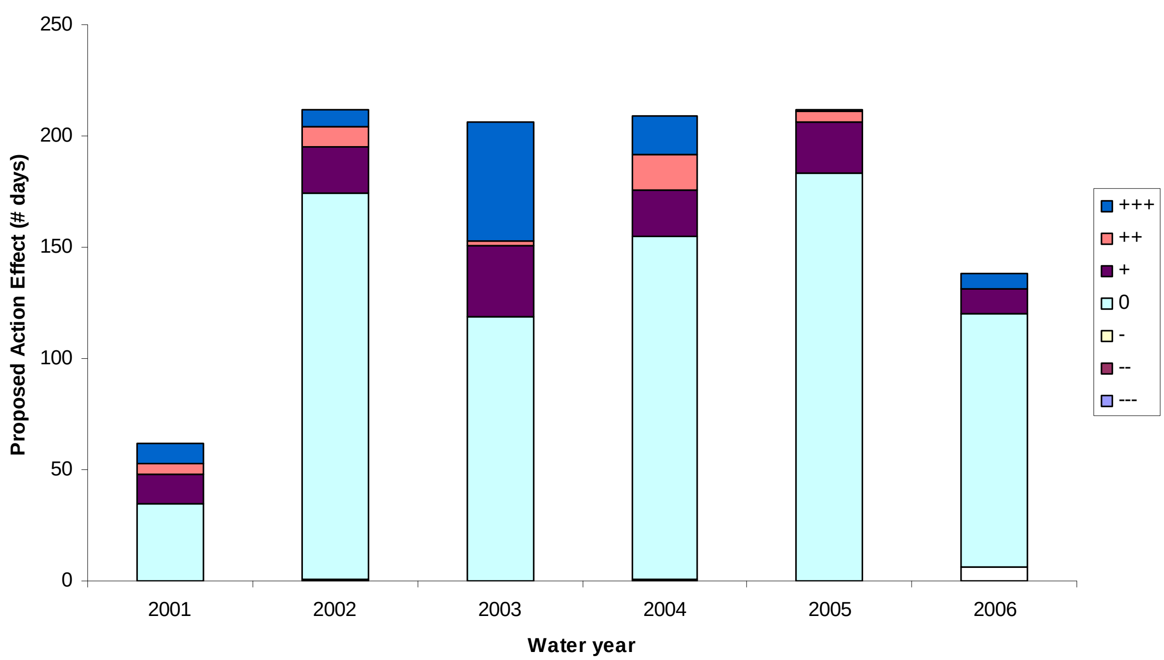


Figure 5-14. Number of days proposed action spawning/incubation coho salmon habitat units (WUA) deviated from current conditions in Bear Creek between Emigrant Creek and the Oak Street Diversion.

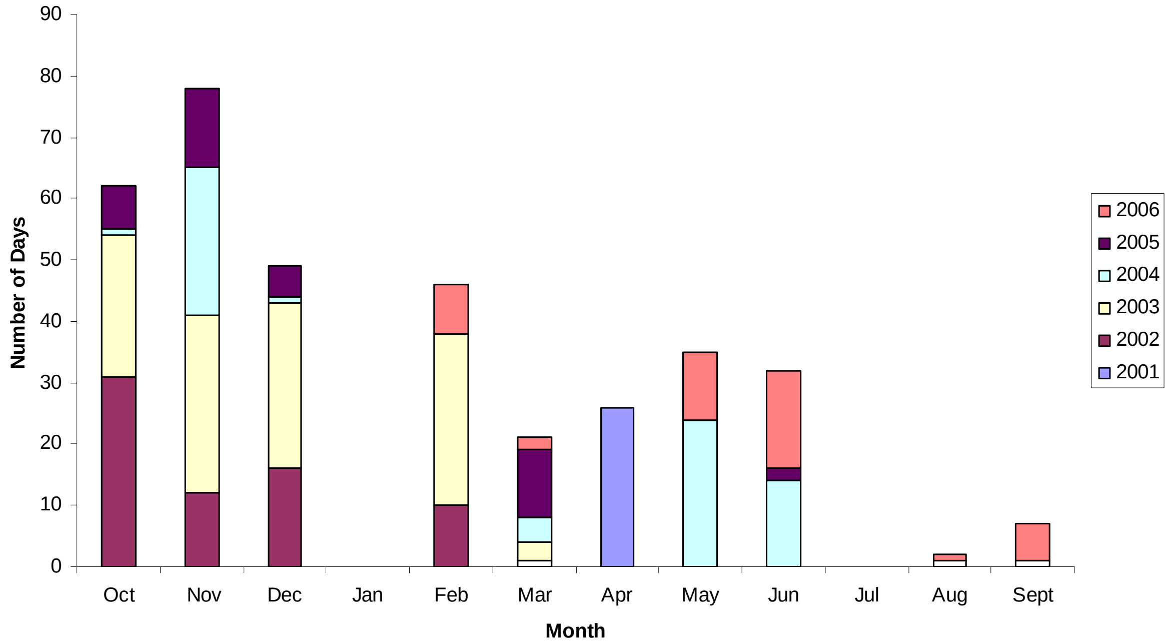


Figure 5-15. Number of days when juvenile coho salmon WUA gains occur as a result of the proposed action in Bear Creek between Emigrant Creek and the Oak Street Diversion.

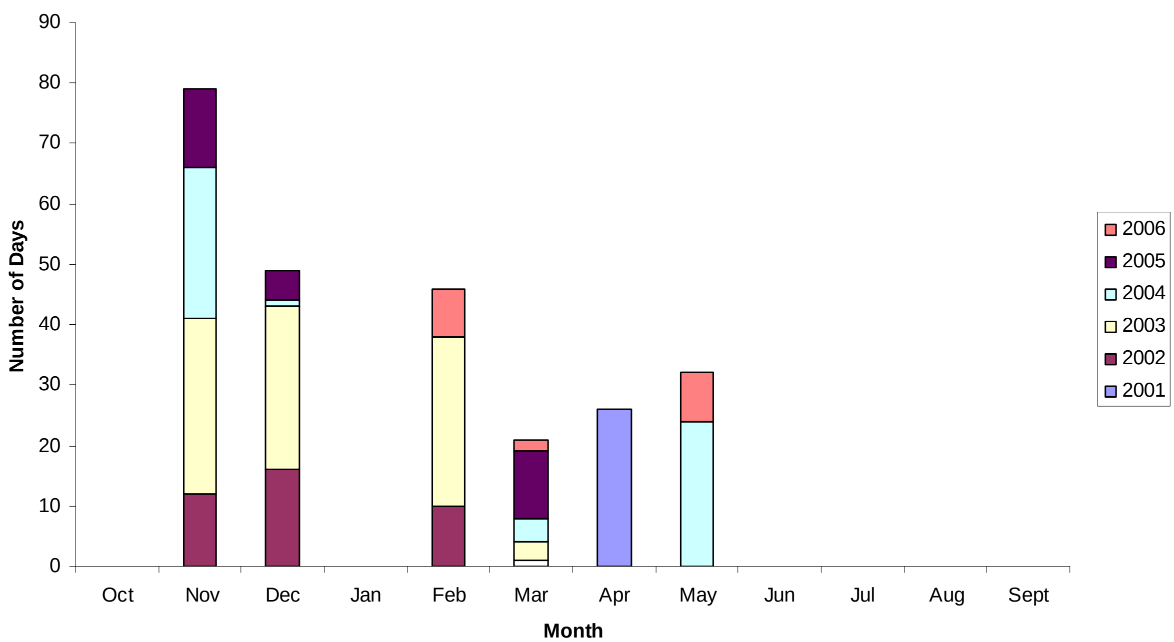


Figure 5-16. Number of days when spawning/incubation coho salmon WUA gains occur as a result of the proposed action in Bear Creek between Emigrant Creek and the Oak Street Diversion.

Bear Creek – Oak Street Diversion to Phoenix Canal Diversion

Daily habitat time series under current conditions and with the proposed action for coho salmon juveniles and spawning/incubation life stages in Bear Creek – Oak Street Diversion to Phoenix Canal Diversion from March 31, 2001 to February 12, 2007, are shown in Figure 5-17 and Figure 5-18, respectively. Examination of these figures shows that the proposed action has a minimal effect on critical habitat conditions.

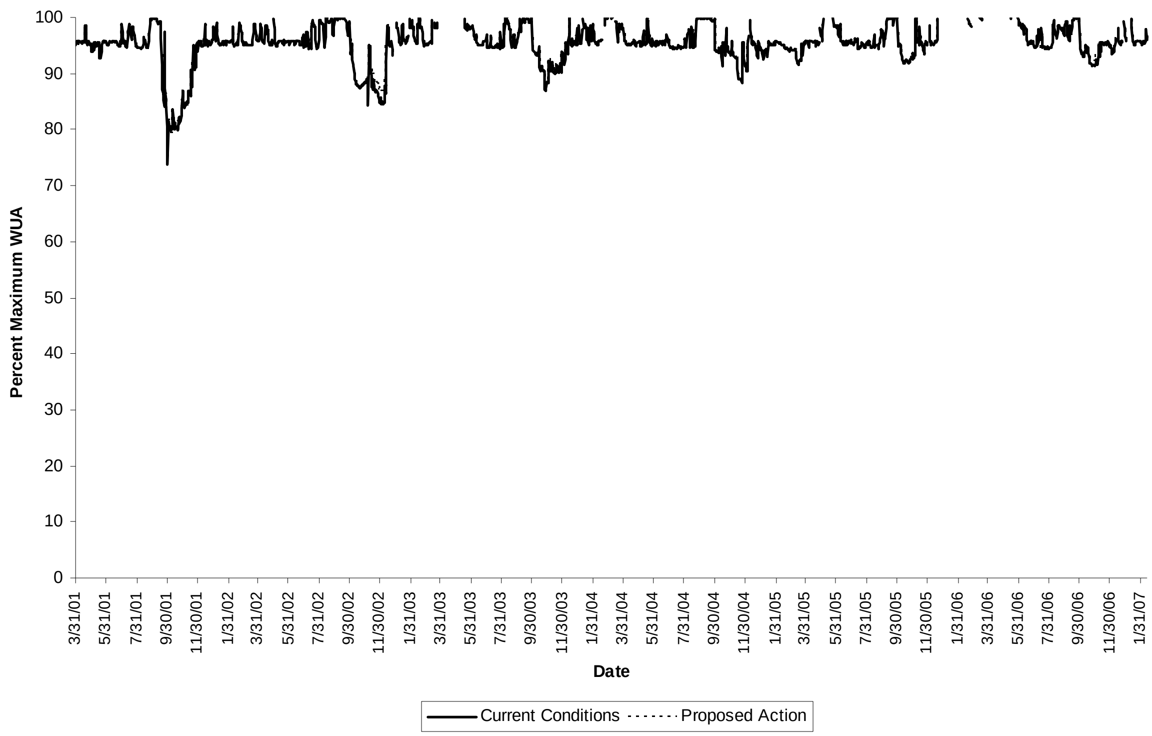


Figure 5-17. Daily habitat time series for juvenile coho salmon in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion. WUA units = percent maximum WUA.

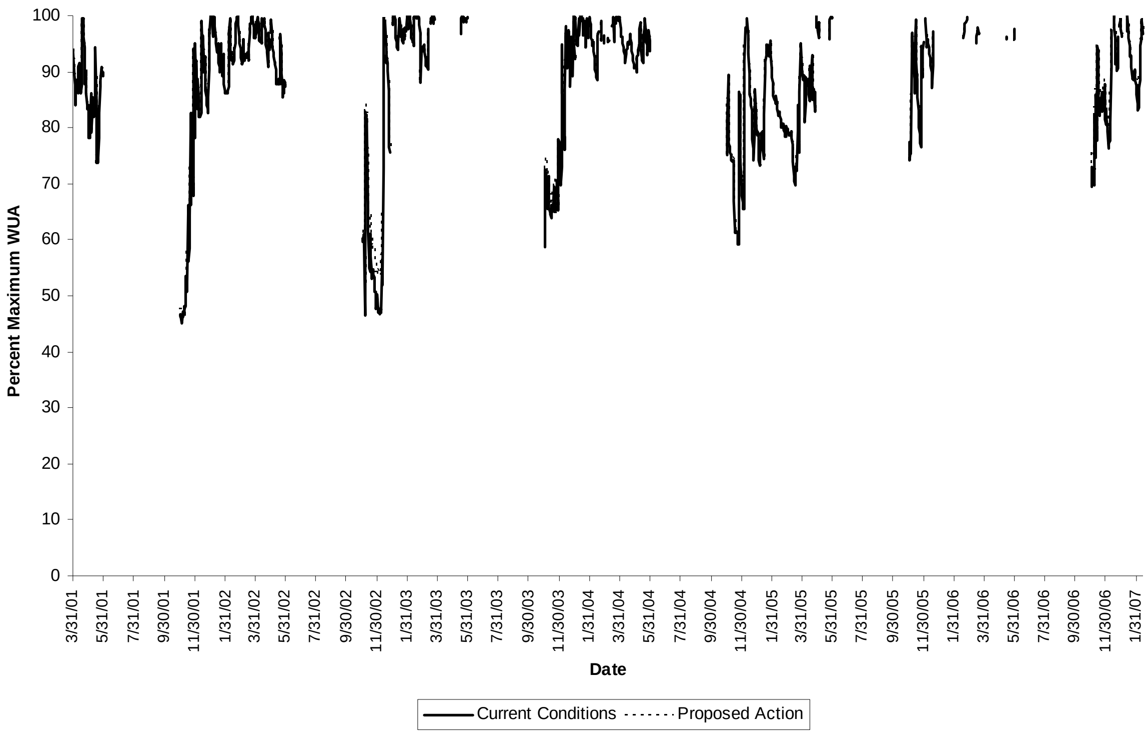


Figure 5-18. Daily habitat time series for spawning/incubation coho salmon in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion. WUA units = percent maximum WUA.

Table 5-12 through Table 5-15 summarize tabular results of the effects of the proposed action on coho salmon WUA in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion. For this analysis, gains in WUA are presumed to represent improvements in critical habitat conditions as conditions for PCEs including water quantity, water velocity, and cover and shelter improve with implementation of the minimum operational flows. The stacked bar graphs in Figure 5-19 through Figure 5-22 are graphical representations of Table 5-12 through Table 5-15. Figure 5-19 and Figure 5-20 illustrate the effects of the proposed action minimum operational releases on coho salmon WUA by comparing numbers of daily gains and losses by water year. The proposed action would result in generally minor gains in both juvenile salmon and spawning/incubation coho salmon WUA for this stream reach or no change (Figure 5-19 and Figure 5-20). No moderate or major juvenile salmon WUA gains or losses would occur. Most gains in WUA would occur in dry and average water years when there are periods of low flow with current conditions. For example, more gains in WUA occur in 2002 (dry water year) and 2003 (average water year), than in 2006, a wet water year (Figure 5-19 and Figure 5-20).

Figure 5-21 and Figure 5-22 illustrate seasonal effects of the proposed action minimum operational releases by summarizing numbers of days with WUA gains for the water years. Only gains in WUA are graphed because they demonstrate the most common definitive effects compared to WUA losses for this stream reach. Juvenile salmon WUA gains would occur during the winter months with little to no effect during summer (July through September) in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion (Figure 5-21). A few days during April and May have minor salmon spawning/incubation WUA gains for water years 2001 and 2004 resulting from slightly increased minimum flows with the proposed action compared to current conditions (e.g., April 21, 2001 existing flow was 66 cfs compared to proposed action flow of 67 cfs). More minor losses in juvenile salmon and salmon spawning/incubation WUA occur in this reach than upstream reaches as a result of higher proposed action flows on some days than under current conditions.

Table 5-12. Proposed action minimum operational releases relative to current conditions for juvenile coho salmon critical habitat in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion. The values represent the number of times proposed action weighted usable area (WUA) units deviated from current conditions for all time steps (days) and each water year.

	Water Year					
Value [1]	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
+++	0	0	0	0	0	0
++	0	0	0	0	0	0
+	17	48	98	59	31	27
0	147	293	196	275	304	184
-	20	22	5	11	7	9
--	0	0	0	0	0	0
---	0	0	0	0	0	0

[1] Major gain (>20%) = +++; moderate gain (11to20%) = ++; minor gain (0 to10%) = +; no change (0%) = 0; minor loss (0 to-10%) = -; moderate loss (-11to-20%) = --; major loss (<-20%) = ---.

Table 5-13. Proposed action minimum operational releases relative to current conditions for spawning/incubation coho salmon critical habitat in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion. The values represent the number of times proposed action weighted usable area (WUA) units deviated from current conditions for all time steps (days) and each water year.

	Water Year					
Value [1]	2001	2002	2003	2004	2005	2006
+++	0	0	0	0	0	0
++	0	0	15	0	0	0
+	26	33	60	50	22	0
0	35	171	66	137	160	58
-	1	6	8	5	7	9
--	0	0	0	0	0	0
---	0	0	0	0	0	0

1 Major gain (>20%) = +++; moderate gain (11to20%) = ++; minor gain (0 to10%) = +; no change (0%) = 0; minor loss (0 to-10%) = -; moderate loss (-11to-20%) = --; major loss (<-20%) = ---.

Table 5-14. Number of days when juvenile coho salmon WUA gains occur as a result of the proposed action in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Totals
2001	0	0	0	0	0	1	14	0	0	0	0	2	17
2002	23	8	13	0	4	0	0	0	0	0	0	0	48
2003	23	29	22	0	21	3	0	0	0	0	0	0	98
2004	1	23	1	1	0	3	0	21	8	0	1	0	59
2005	7	12	2	0	0	8	0	0	2	0	0	0	31
2006	0	0	0	0	6	2	0	1	14	0	1	3	27

Table 5-15. Number of days when spawning/incubation coho salmon WUA gains occur as a result of the proposed action in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Totals
2001		0	0	0	0	1	25	0					26
2002		8	16	0	9	0	0	0					33
2003		29	25	0	18	3	0	0					75
2004		23	1	1	0	3	0	22					50
2005		13	1	0	0	8	0	0					22
2006		0	0	0	0	0	0	0					0

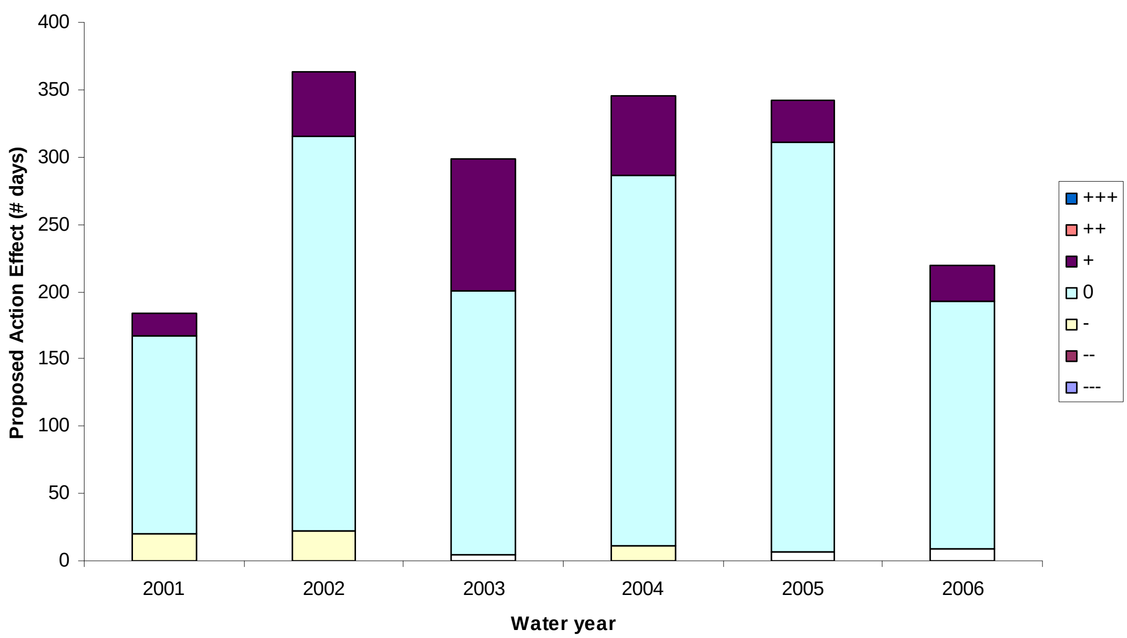


Figure 5-19. Number of days proposed action juvenile coho salmon habitat units (WUA) deviated from current conditions in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion.

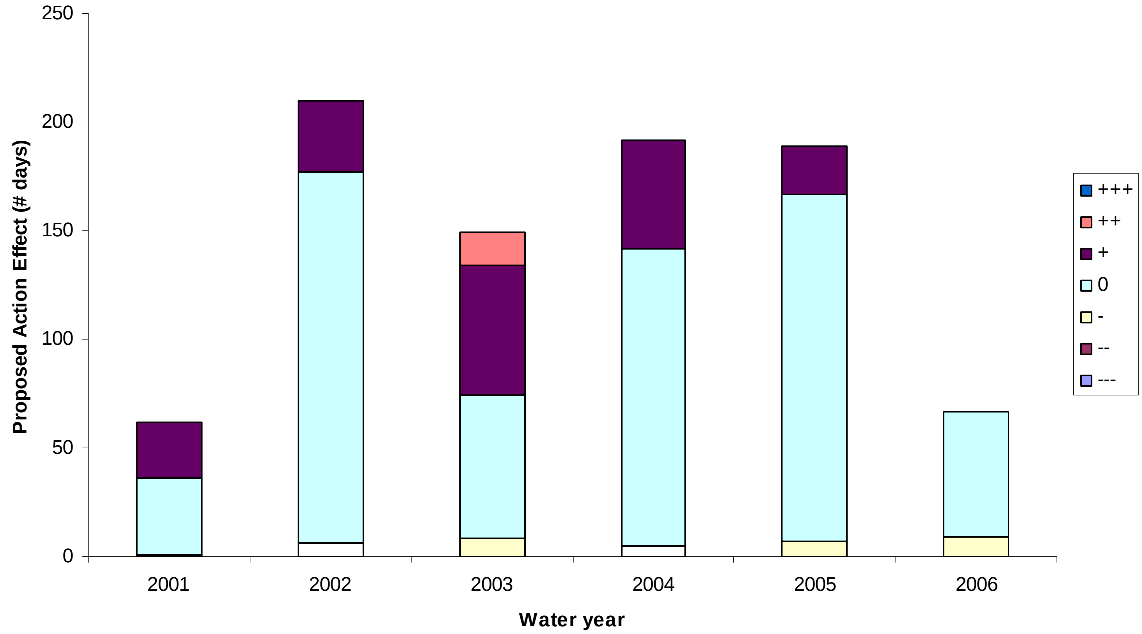


Figure 5-20. Number of days proposed action spawning/incubation coho salmon habitat units (WUA) deviated from current conditions in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion.

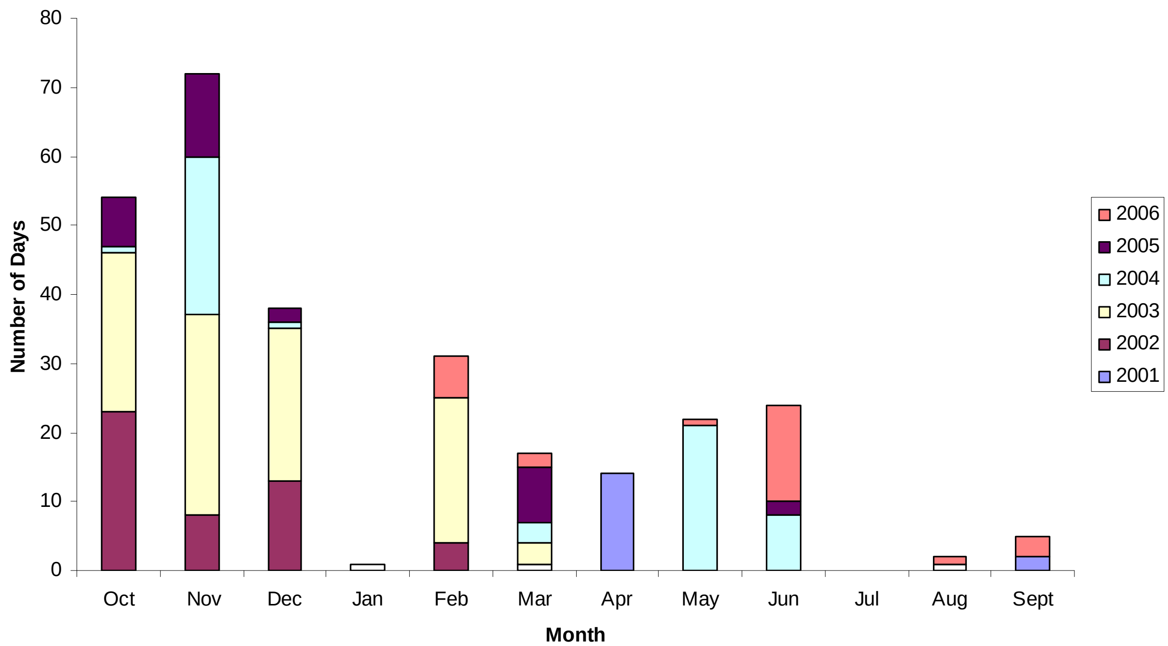


Figure 5-21. Number of days when juvenile coho salmon WUA gains occur as a result of the proposed action in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion.

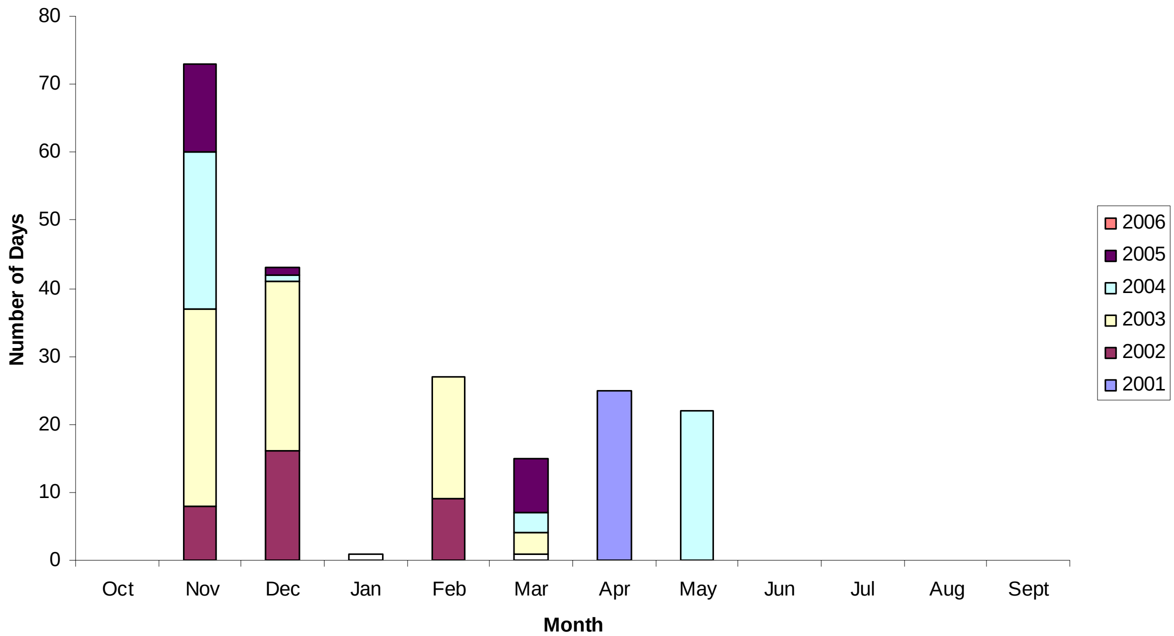


Figure 5-22. Number of days when spawning/incubation coho salmon WUA gains occur as a result of the proposed action in Bear Creek between Oak Street Diversion and Phoenix Canal Diversion.

Bear Creek - Phoenix Canal Diversion to Jackson Street Diversion

Daily habitat time series under current conditions and with the proposed action for coho salmon juveniles and spawning/incubation life stages in Bear Creek – Phoenix Canal Diversion to Jackson Street Diversion from March 31, 2001 to February 12, 2007, are shown in Figure 5-23 and Figure 5-24, respectively. Examination of these figures shows that the proposed action has minimal effect on critical habitat conditions.

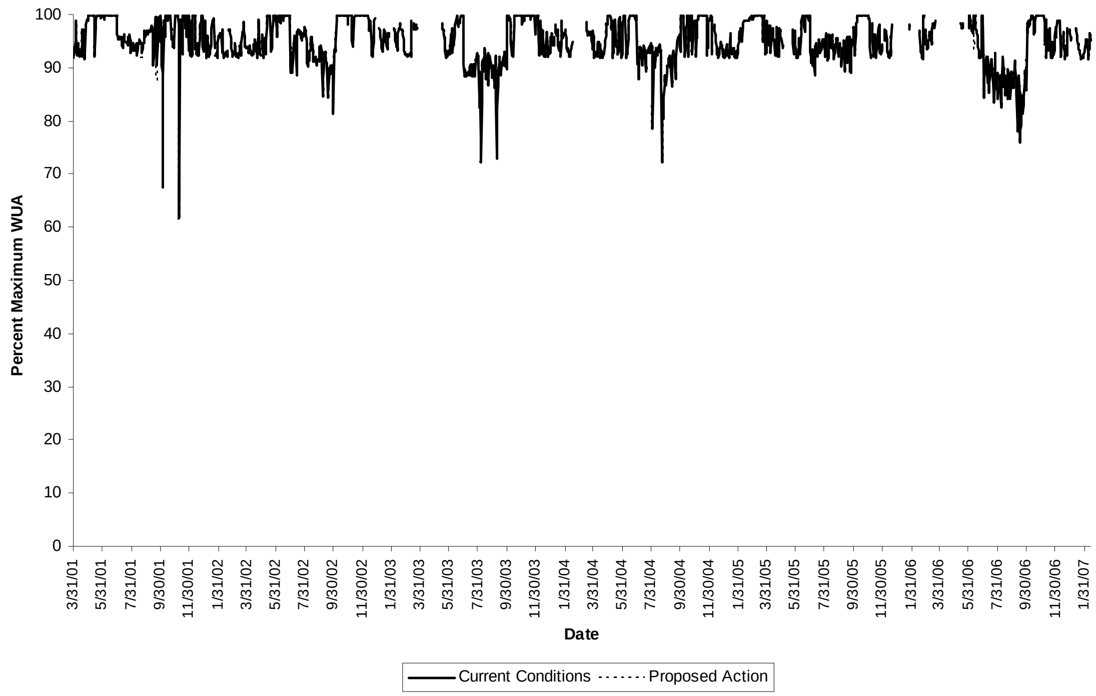


Figure 5-23. Daily habitat time series for juvenile coho salmon in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion. WUA units = percent maximum WUA.

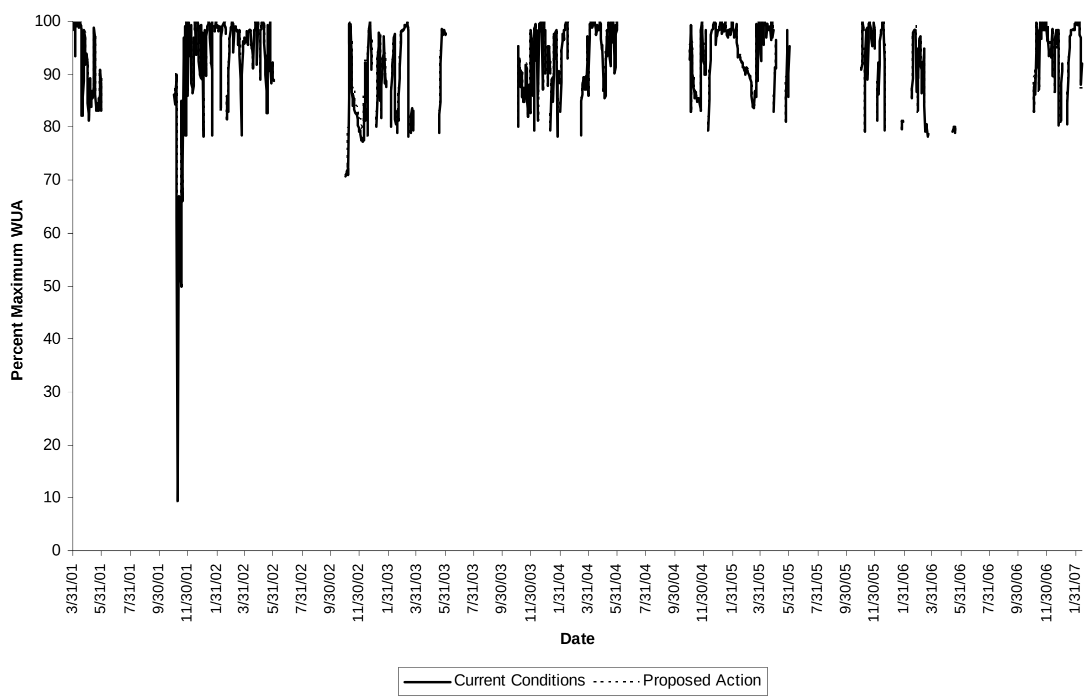


Figure 5-24. Daily habitat time series for spawning/incubation coho salmon in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion. WUA units = percent maximum WUA.

Table 5-16 through Table 5-19 summarize tabular results of the effects of the proposed action on coho salmon critical WUA and by extension critical habitat in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion. The stacked bar graphs in Figure 5-25 through Figure 5-28 are graphical representations of Table 5-16 through Table 5-19. Figure 5-25 and Figure 5-26 illustrate the effects of the proposed action minimum operational releases on coho salmon WUA by comparing numbers of daily gains and losses by water year. The proposed action would result in generally minor gains and losses in both juvenile salmon and spawning/incubation coho salmon WUA for this stream reach or no change (Figure 5-25 and Figure 5-26). No moderate or major juvenile salmon WUA gains or losses would occur. Most gains in WUA would occur in dry and average water years when there are periods of low flow with current conditions. For example, more gains in WUA occur in 2002 (dry water year) and 2003 (average water year) than in 2006, a wet water year (Figure 5-25 and Figure 5-26).

Figure 5-27 and Figure 5-28 illustrate seasonal effects of the proposed action minimum operational releases by summarizing the number of days with WUA gains for the water years. Only gains in WUA are graphed because they demonstrate the most common definitive effects compared to habitat losses for this stream reach. Juvenile salmon WUA gains would occur during the winter months with little to no effect during summer (July through September) in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion (Figure 5-27). A few days during April and May have minor salmon spawning/incubation WUA gains for water years 2001 and 2004, resulting from slightly increased minimum flows with the proposed action compared to current conditions (e.g., April 24, 2001 existing flow was 80 cfs compared to proposed action flow of 81 cfs). Minor losses in juvenile salmon and salmon spawning/incubation WUA occur in this reach as a result of higher proposed action flows on some days than under current conditions.

Table 5-16. Proposed action minimum operational releases relative to current conditions for juvenile coho salmon critical habitat in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion. The values represent the number of times proposed action weighted usable area (WUA) units deviated from current conditions for all time steps (days) and each water year.

	Water Year					
Value [1]	2001	2002	2003	2004	2005	2006
+++	0	0	0	0	0	0
++	0	0	0	0	0	0
+	7	36	74	29	18	24
0	147	289	187	264	304	202
-	30	32	4	39	17	12
--	0	0	0	0	0	0
---	0	0	0	0	0	0

[1] Major gain (>20%) = +++; moderate gain (11 to 20%) = ++; minor gain (0 to 10%) = +; no change (0%) = 0; minor loss (0 to -10%) = -; moderate loss (-11 to -20%) = --; major loss (<-20%) = ---.

Table 5-17. Proposed action minimum operational releases relative to current conditions for spawning/incubation coho salmon critical habitat in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion. The values represent the number of times proposed action weighted usable area (WUA) units deviated from current conditions for all time steps (days) and each water year.

	Water Year					
Value [1]	2001	2002	2003	2004	2005	2006
+++	0	1	0	0	0	0
++	0	0	0	0	0	0
+	15	24	46	40	21	6
0	35	167	57	127	160	78
-	12	12	35	13	6	6
--	0	0	0	0	0	0
---	0	0	0	0	0	0

1 Major gain (>20%) = +++; moderate gain (11 to 20%) = ++; minor gain (0 to 10%) = +; no change (0%) = 0; minor loss (0 to -10%) = -; moderate loss (-11 to -20%) = --; major loss (<-20%) = ---.

Table 5-18. Number of days when juvenile coho salmon WUA gains occur as a result of the proposed action in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Totals
2001	0	0	0	0	0	1	5	0	0	0	0	1	7
2002	15	8	9	0	4	0	0	0	0	0	0	0	36
2003	12	21	18	0	20	3	0	0	0	0	0	0	74
2004	0	16	0	1	0	4	0	5	2	0	1	0	29
2005	1	9	3	0	0	5	0	0	0	0	0	0	18
2006	0	0	0	0	4	2	0	3	12	0	0	3	24

Table 5-19. Number of days when spawning/incubation coho salmon WUA gains occur as a result of the proposed action in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion.

Water Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Totals
2001		0	0	0	0	1	14	0					15
2002		10	14	0	1	0	0	0					25
2003		27	18	0	1	0	0	0					46
2004		24	1	0	0	0	0	15					40
2005		13	0	0	0	8	0	0					21
2006		0	0	0	6	0	0	0					6

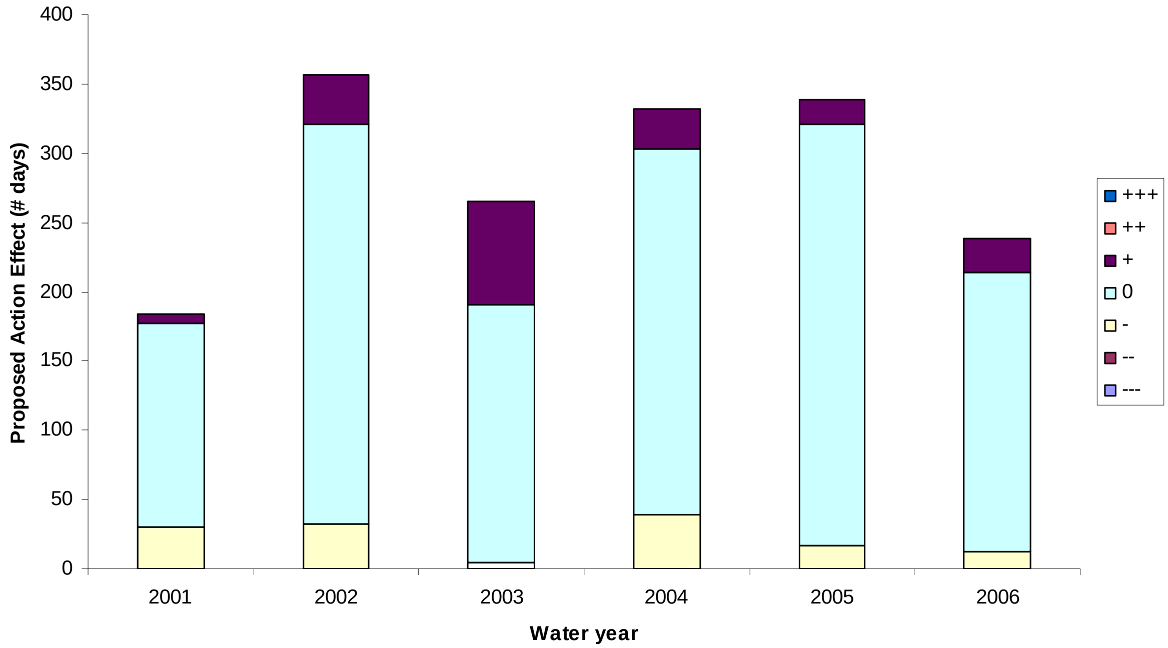


Figure 5-25. Number of days proposed action juvenile coho salmon habitat units (WUA) deviated from current conditions in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion.

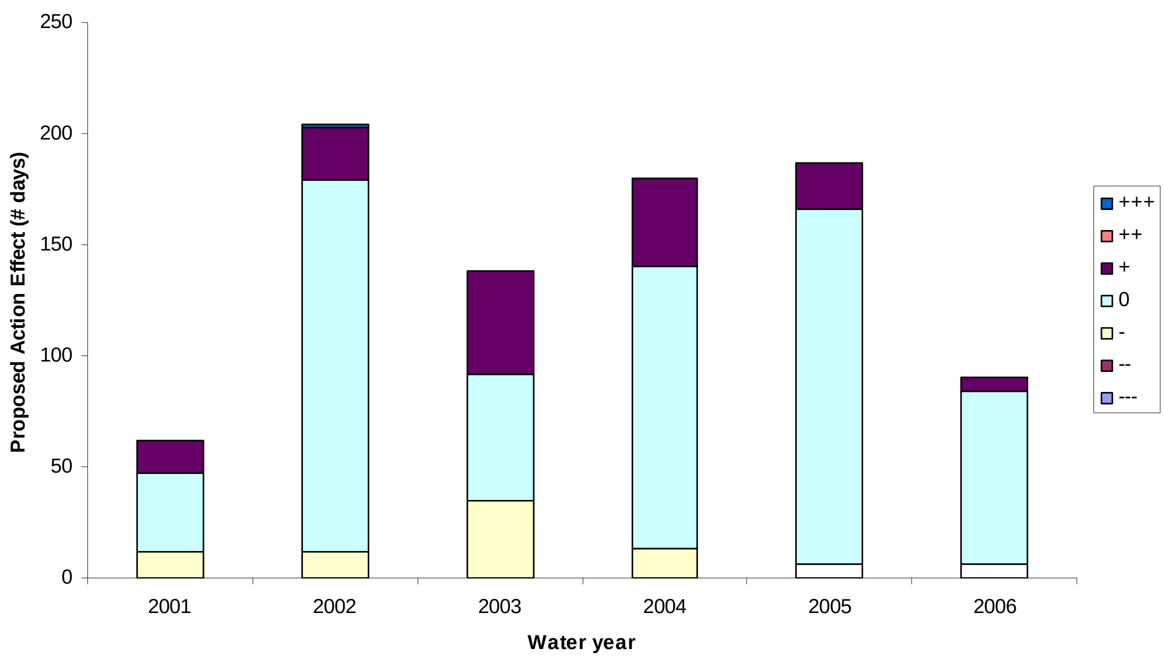


Figure 5-26. Number of days proposed action spawning/incubation coho salmon habitat units (WUA) deviated from current conditions in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion.

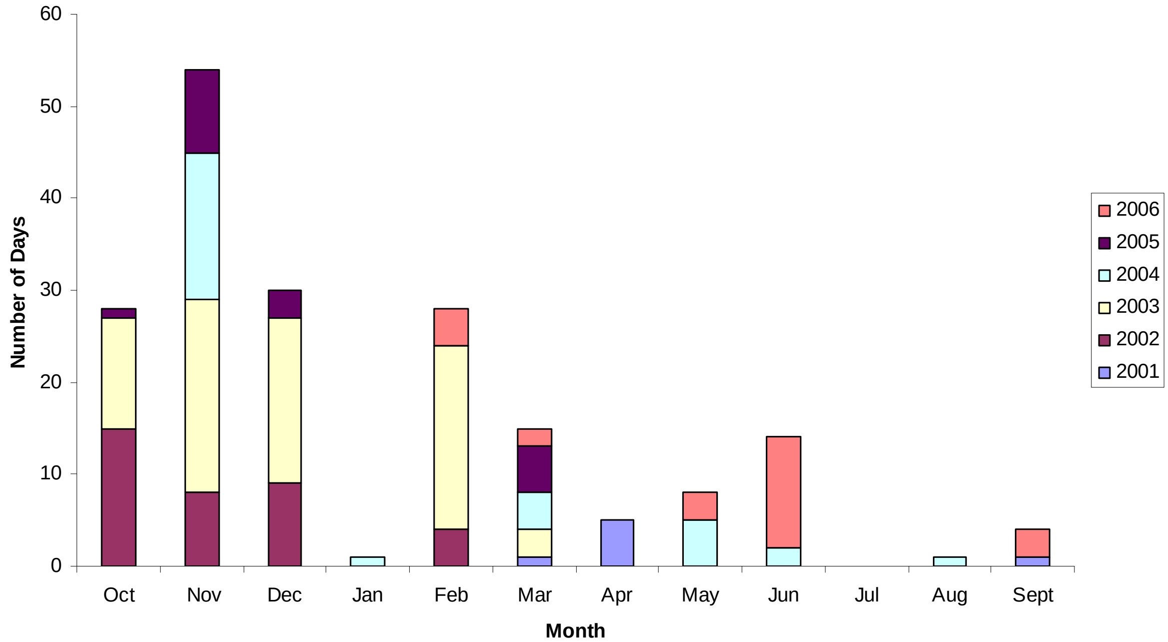


Figure 5-27. Number of days when juvenile coho salmon WUA gains occur as a result of the proposed action in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion.

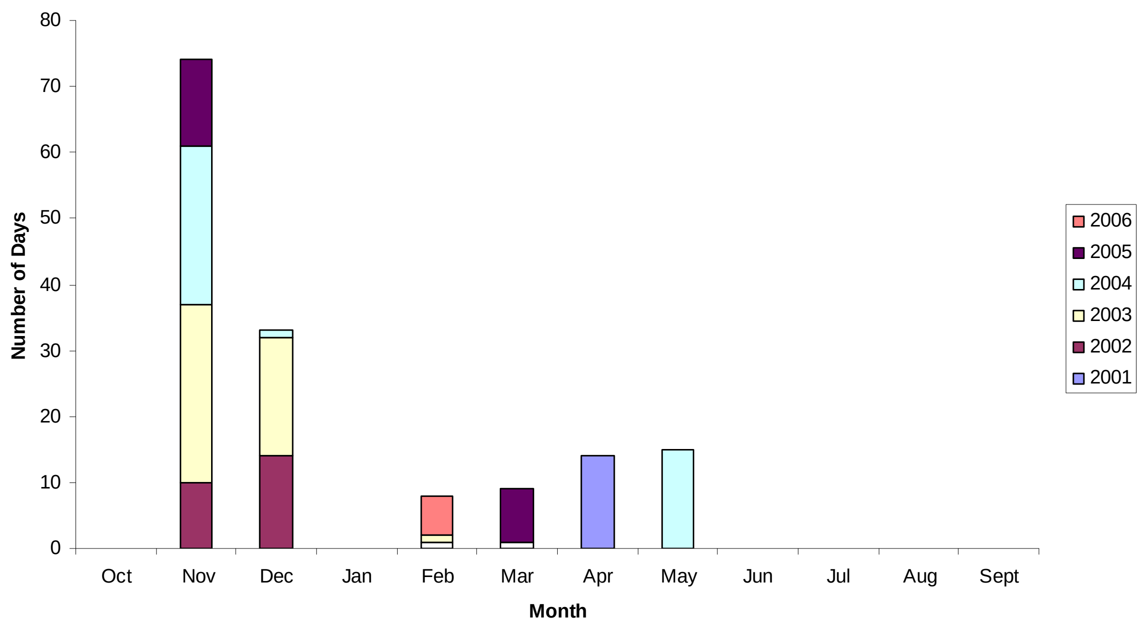


Figure 5-28. Number of days when spawning/incubation coho salmon WUA gains occur as a result of the proposed action in Bear Creek between Phoenix Canal Diversion and Jackson Street Diversion.

Gaging Station

The installation of a new gaging station below Emigrant Dam would result in minor short-term construction-related impacts. These are addressed in the Section 5.3. A small amount of riparian vegetation (less than 100 square meters) would be removed permanently to allow for the construction of the station and access road. This would be an adverse effect on the riparian vegetation PCE. Losses would be minimized to the extent practicable, but on this reach of the stream, the impacts are not expected to be significant.

Oak Street Diversion Fish Passage Improvement

The Oak Street Diversion on Bear Creek has been identified as creating an impediment to upstream passage for adult SONCC coho salmon. The proposed action would correct this situation by modifying the existing fish ladder so that it would no longer impede coho salmon passage at the Oak Street Diversion Dam. Construction-related effects on coho salmon from modifications to the existing ladder are outlined in section 5.3.2. Additional consultation on the construction-related effects may be necessary once designs are completed and construction plans are finalized.

With respect to critical habitat, the modifications to the ladder at the Oak Street Diversion Dam would improve safe passage conditions, an identified PCE, at the site. Access to Bear Creek and its tributaries above Oak Street, including Emigrant Creek, would be improved relative to the current condition. The improvement in passage conditions would be a beneficial effect on critical habitat for these areas.

Ashland Creek Diversion Fish Passage Improvement

The Ashland Creek Diversion on Ashland Creek has been identified as creating an impediment to upstream passage for juvenile SONCC coho salmon; in addition, there is no fish screen at the existing headgate structure. Both of these problems would be corrected as part of the proposed action. Construction-related effects on coho salmon from modifications at the diversion dam are outlined in Section 5.3.2. Additional consultation on the construction-related effects may be necessary once designs are completed and construction plans are finalized.

With respect to critical habitat, the modifications at the Ashland Creek Diversion Dam would improve safe passage conditions, an identified PCE, at the site. Access to Ashland Creek for juvenile coho salmon would be improved and protection of all life stages would increase with installation of a screen. The improvement in safe passage conditions would be a beneficial effect on critical habitat for this area.

5.2.2 Little Butte Creek Watershed

As discussed in Section 5.1, no changes in hydrology in this system are expected as a result of implementation of the proposed action. Diversions would occur in the upper South Fork Little Butte basin, including diversions at the Dead Indian Creek Diversion Dam and in Antelope Creek. The diversions would be made mostly during the winter and spring during periods of high runoff. Table 5-20 shows the historic distribution of diversions from the South Fork Little Butte Creek basin for the period from 1991 to 1999. Table 5-21 shows historic distribution of diversions from Antelope Creek for the period from 2005 to 2008. The periods of record differ as the Antelope Creek gage has not been in operation long. Both are representative of the typical diversions that are made. The diversions under the proposed future operation of the project would be essentially identical.

Table 5-20. Average Daily Diversion from the South Fork to Howard Prairie Reservoir (in cfs).

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
3	10	17	25	22	37	24	36	20	7	2	1

Period of record is 1991-1999 and represents diversions measured at the Dead Indian and Deadwood Tunnel gages.

Table 5-21. Average Daily Diversion from the Antelope Creek to Agate Reservoir (in cfs).

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
0	2	5	4	1	0	5	6	2	0	0	0

Period of record is 2005-2008 and represents diversions measured at the Antelope Creek gage.

No additional facilities would be constructed as part of the proposed action. The diversions would be made using the existing diversions, conveyance, and storage facilities.

With respect to the PCEs of critical habitat, those most directly related to flow levels would not be affected. These would seem to include water quantity and space. The diversions under the proposed action would be unchanged from those that were occurring when the critical habitat was designated in 1999 and would be no different from those that currently occur. As a result, the quantity of water in South Fork Little Butte Creek, Dead Indian Creek, Little Butte Creek, and Antelope Creek would be unchanged from the current condition.

Space and water velocity, which are functions of flow, would also be unchanged. Figure 5-29 through Figure 5-30 show existing current condition daily habitat time series using WUA to measure habitat for coho salmon juvenile and spawning/incubation, respectively, in

South Fork Little Butte Creek near the Gilkey Hydromet station, in Little Butte Creek at two locations, near Eagle Point and near Lake Creek and in Antelope Creek near Eagle Point. WUA takes into account habitat value by looking at depth, velocity, and substrate criteria as well as the amount of habitat that is physically available. As such the WUA values can be used as a rough index of to explore possible changes in space available and water velocity for the various life stages.

Under current conditions, WUA for juvenile salmon rearing reaches its highest point in the South Fork in the winter and spring when current diversions are relatively high. The low point with respect to juvenile salmon rearing WUA occurs in the summer when diversions are low. (It should be noted that the steep decline in juvenile salmon habitat each year on October 1 is an artifact of the modeling where summer juvenile salmon habitat preference curves give way to winter preference curves. Biologically, habitat would not decline at this time, but rather continue to plateau until fall rains cause flows to rise, at which time WUA would also increase until it reaches its peak in late winter and early spring.) Under the current conditions, spawning/incubation WUA is routinely high; for most winters, it is in the range of 75 to 80 percent of the maximum value or higher (Figure 5-30). The conditions for juvenile salmon rearing WUA and spawning/incubation WUA would remain unchanged under the proposed future operation so the space and water velocity PCEs would be unaffected.

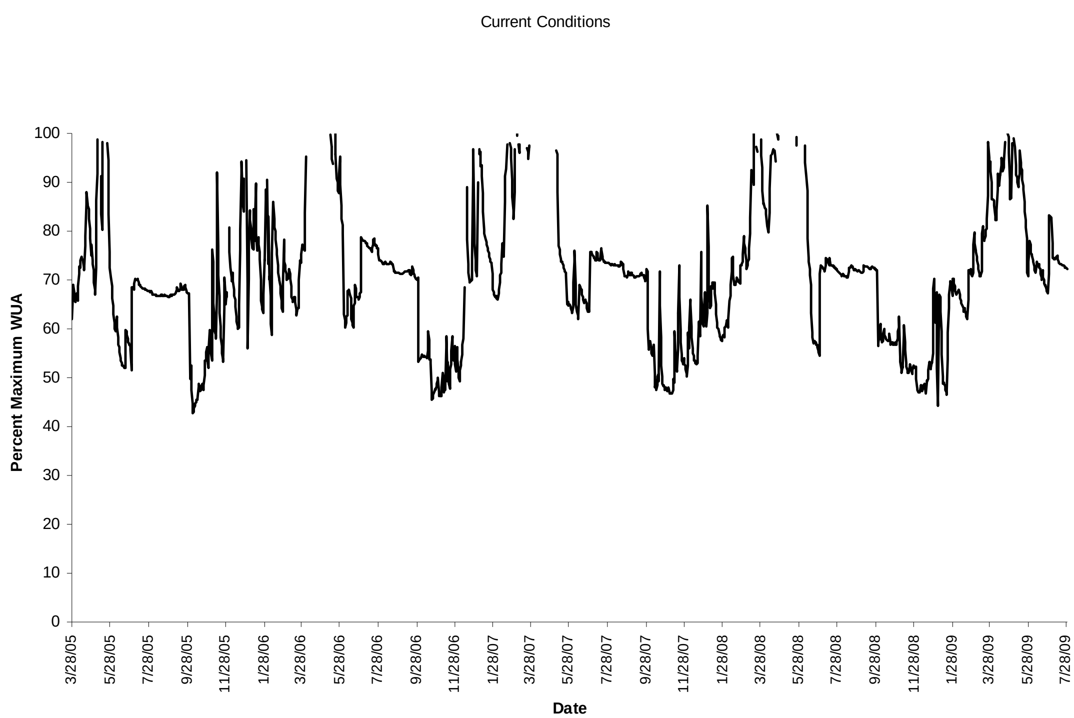


Figure 5-29. Daily habitat time series for juvenile coho salmon in South Fork Little Butte Creek near Gilkey. WUA units = percent maximum WUA.

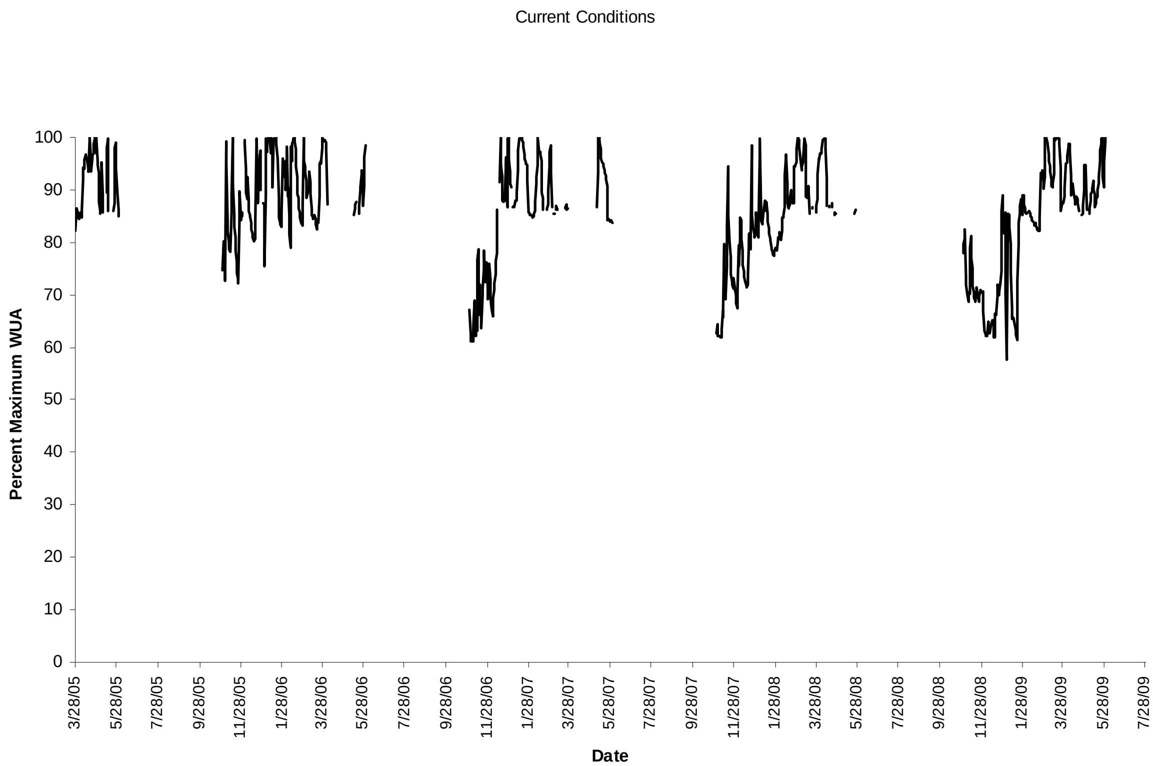


Figure 5-30. Daily habitat time series for spawning/incubation coho salmon in South Fork Little Butte Creek near Gilkey. WUA units = percent maximum WUA.

In Little Butte Creek near Eagle Point, juvenile salmon WUA is in the upper quartile; that is greater than 75 percent of maximum, WUA over 99 percent of the time within the range of simulated flows for the PHABSIM modeling (Figure 5-31). As on the South Fork, the low point occurs in the summer when Project diversions from the basin are very low or non-existent. During the winter when diversions are occurring, the juvenile salmon WUA is near the optimum. Spawning and incubation habitat at this site could not be routinely modeled as most flows exceeded the range that could be simulated (Figure 5-32). Modeling that could be done suggested that flows are generally good for spawning and incubation. WUA dropped off sharply for incubation in 2007 and 2009. This drop-off was due to an end of the spring runoff rather than Project operations. Similar patterns are seen in the modeling results for the Lake Creek site (Figure 5-33 and Figure 5-34). Juvenile salmon WUA reaches its low point in the summer when Project diversions are very low and spawning salmon WUA is near optimum throughout the spawning and incubation periods. The conditions for juvenile salmon rearing WUA and salmon spawning/incubation WUA would remain unchanged in Little Butte Creek under the proposed future operation so the space and water velocity PCEs would be unaffected.

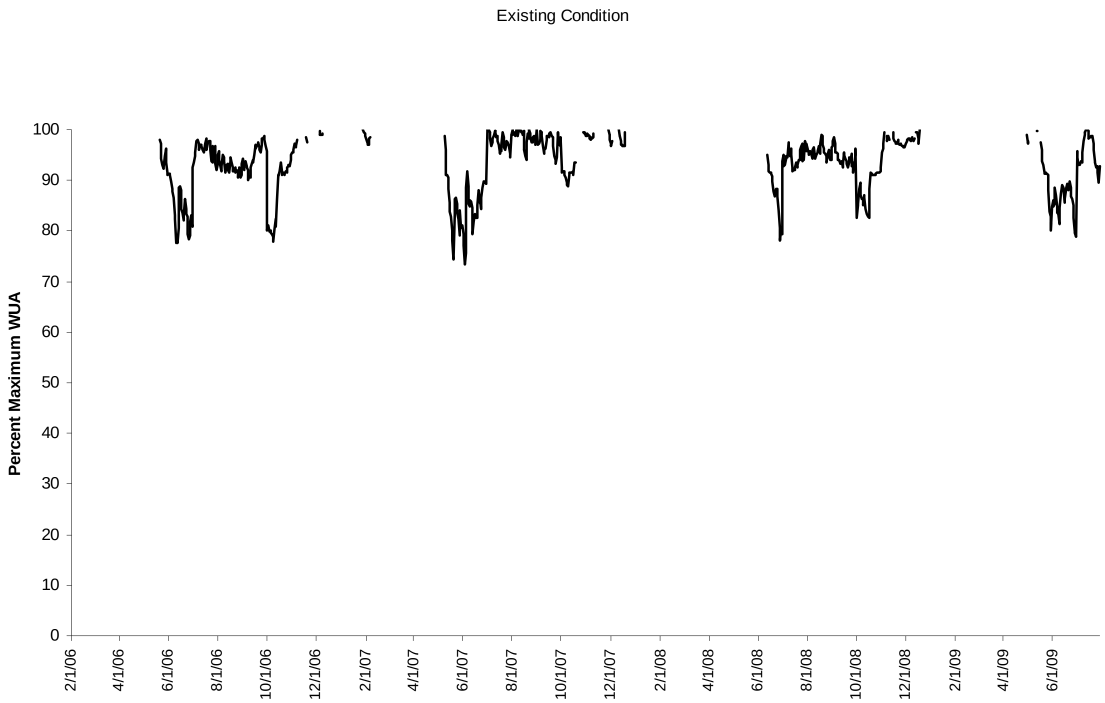


Figure 5-31. Daily habitat time series for juvenile coho salmon in Little Butte Creek near Eagle Point. WUA units = percent maximum WUA.

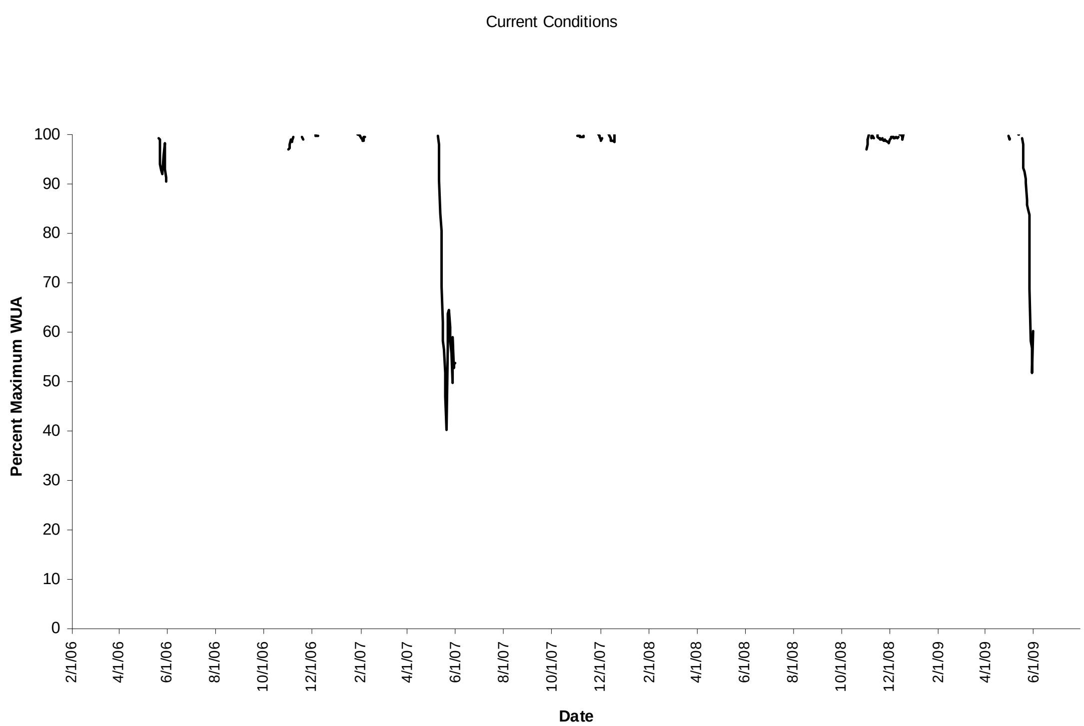


Figure 5-32. Daily habitat time series for spawning/incubation coho salmon in Little Butte Creek near Eagle Point. WUA units = percent maximum WUA.

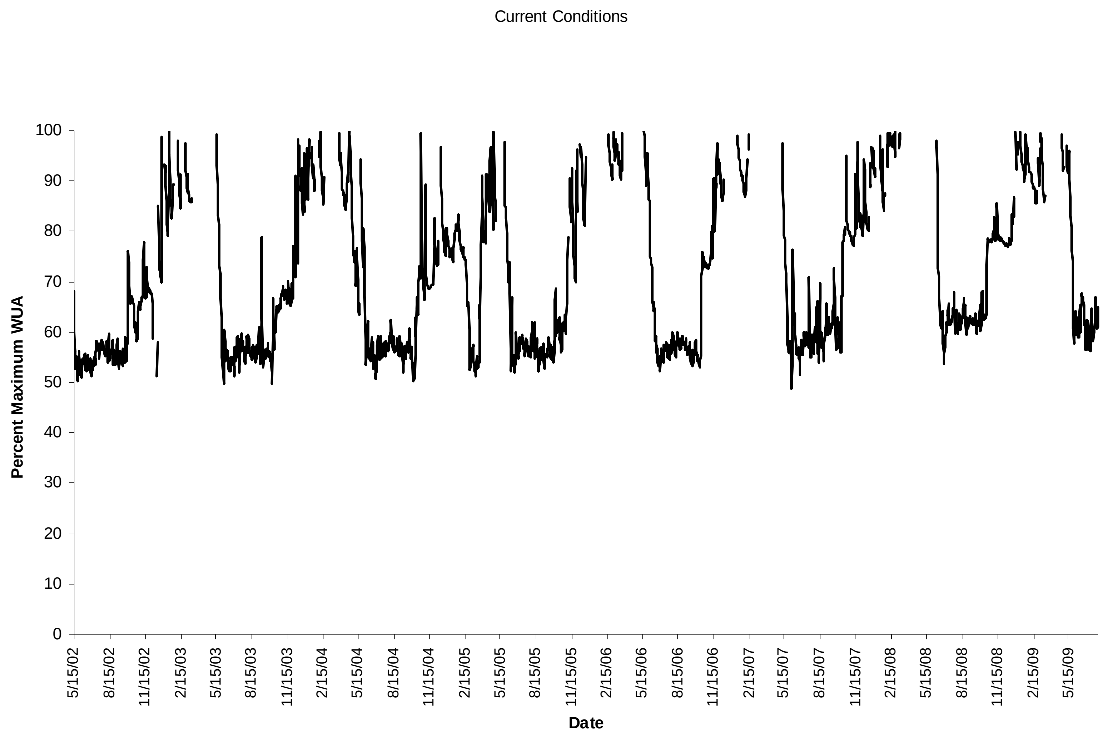


Figure 5-33. Daily habitat time series for juvenile coho salmon in Little Butte Creek near Lake Creek. WUA units = percent maximum WUA.

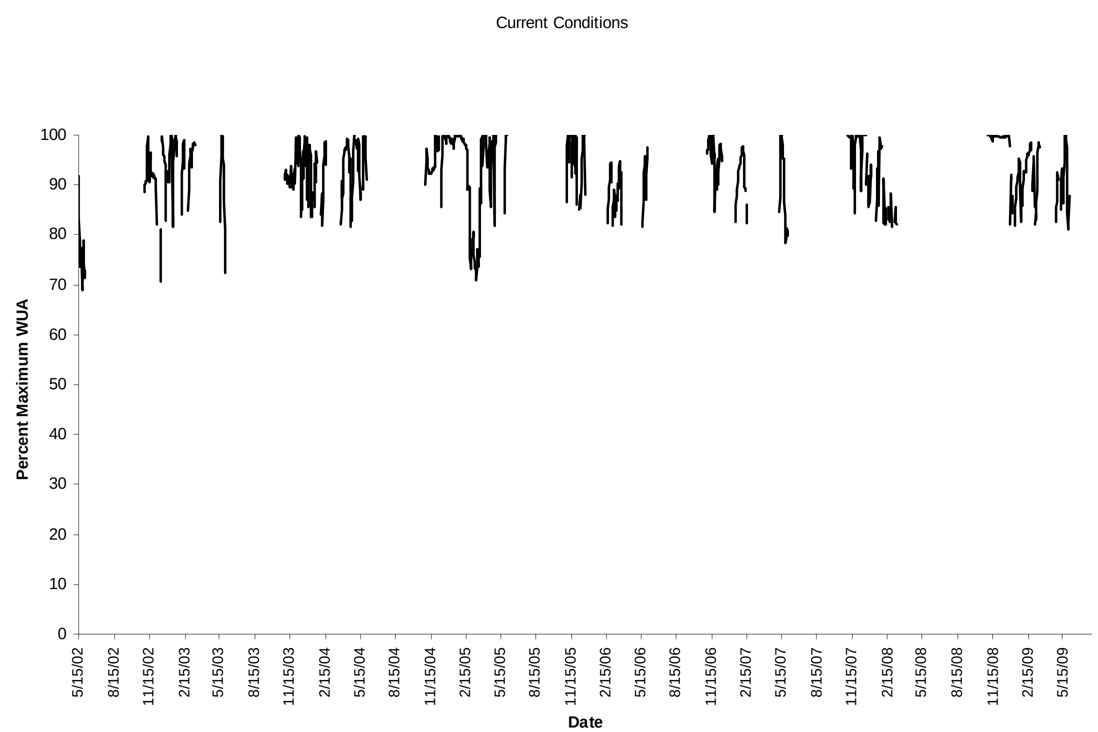


Figure 5-34. Figure 5-34. Daily habitat time series for spawning/incubation coho salmon in Little Butte Creek near Lake Creek. WUA units = percent maximum WUA.

On Antelope Creek, juvenile salmon WUA is routinely high throughout the year (Figure 5-35). Steep declines occurred when the stream was completely dry in November 2008 and March 2009. In November, no Project diversions were being made while in March, flows were being bypassed at the diversion dam to meet downstream requirements. Overall, it appears the current operations have little effect on juvenile salmon WUA. Salmon spawning/incubation WUA fluctuates considerably (Fig. 5-36). This is due to the flashy nature of the stream rather than Project operations. In 2007 and 2008, salmon spawning/incubation WUA tended to be high during the months of peak diversion in the spring while in 2009, salmon spawning/incubation WUA fluctuated widely irrespective of Project diversions. The conditions for juvenile salmon rearing WUA and salmon spawning/incubation WUA would remain unchanged in Antelope Creek under the proposed future operation. The space and water velocity PCEs would be unaffected.

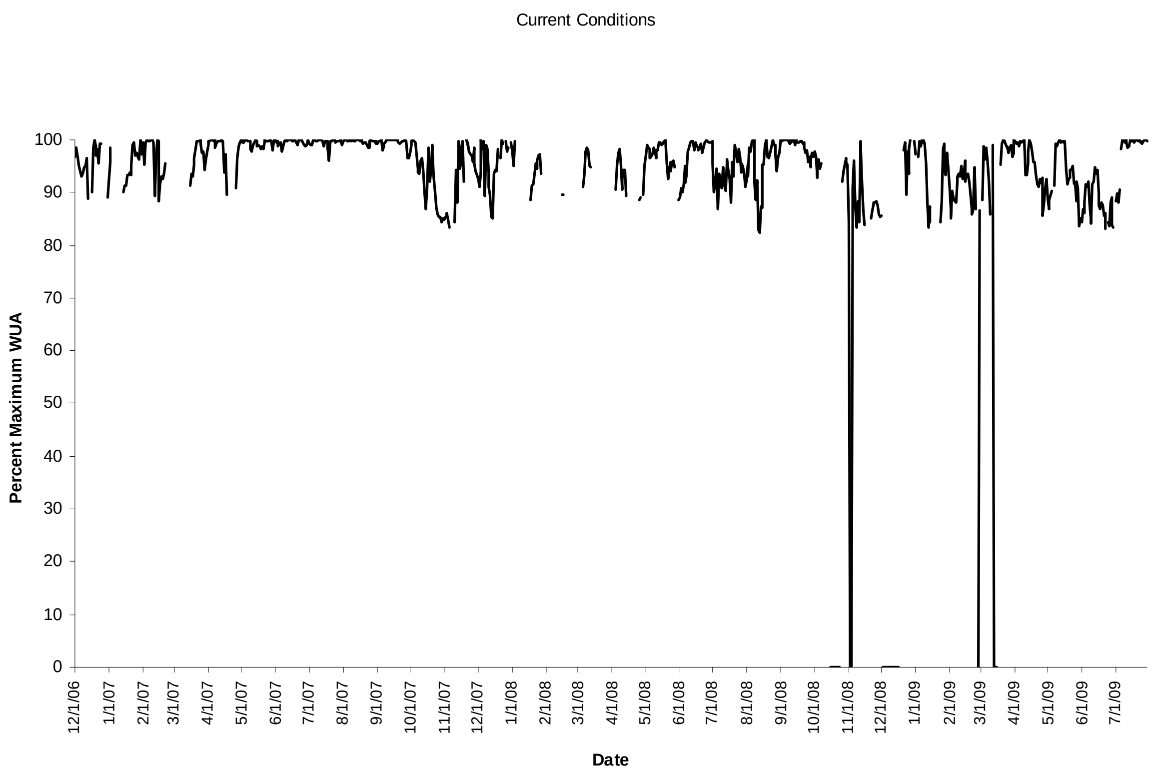


Figure 5-35. Daily habitat time series for juvenile coho salmon in Antelope Creek near Eagle Point. WUA units = percent maximum WUA.

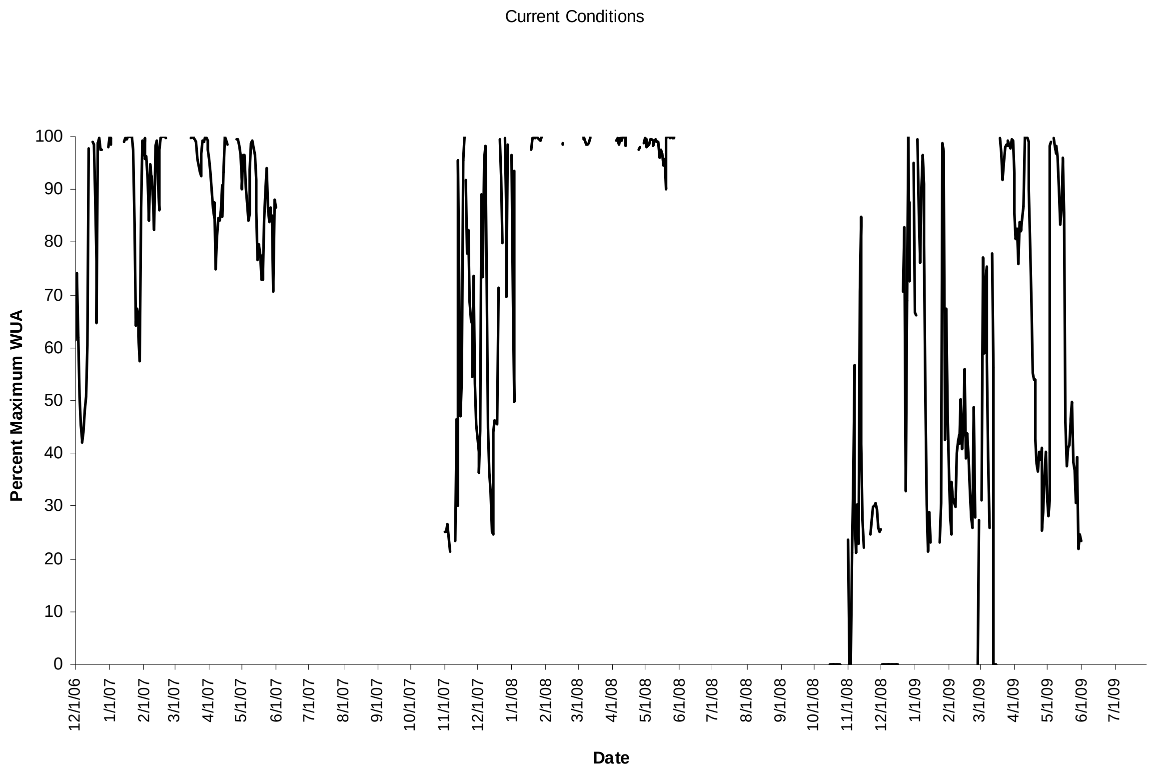


Figure 5-36. Daily habitat time series for spawning/incubation coho salmon in Antelope Creek near Eagle Point. WUA units = percent maximum WUA.

Other PCEs of concern in the Little Butte Creek basin that may possibly be affected by the proposed action include substrate, water quality, water temperature, cover/shelter, riparian vegetation, and safe passage conditions. The Little Butte Creek Watershed Assessment evaluated conditions in the Little Butte Creek watershed shortly after the critical habitat for SONCC coho salmon was designated (LBCWC 2003). Much of the data used in the assessment represented watershed conditions at the time the designation was being considered. It addressed several of the PCEs either directly or indirectly and identified factors which were thought to contribute to the current conditions for them.

While the substrate PCE was not addressed directly in the watershed assessment, the assessment did address the issue of sediment which can have significant impacts on the substrate in streams and the value of the substrate for fish, including coho salmon. The assessment concluded that the three main sources of sediment to streams are road runoff, road instability, and mass wasting. Forestry practices were also identified as being of concern with respect to the potential for sediment delivery to streams. None of these sources are related to the proposed action or influenced by the proposed action so it appears that diversions from the South Fork Little Butte Creek basin, Dead Indian Creek, and Antelope Creek would not affect the substrate PCE, at least as it relates to sedimentation. Streambank erosion was identified as being of moderate concern. The proposed action does not involve any construction activities which could affect stream banks and the diversion of flows during the high flow period, when stream bank erosion may occur, but would tend to lessen, rather than exacerbate, bank erosion.

Water quality was addressed in the watershed assessment directly. The assessment identified sediment, temperature, bacteria, dissolved oxygen, and nutrients as issues with respect to water quality. Sediment was addressed above relative to its potential effects to the substrate PCE. Suspended sediment can also affect fish both chronically at low levels and acutely when levels are high. None of the sources of sediment discussed above are related to the proposed action or influenced by the proposed action so it appears that diversions from the South Fork Little Butte Creek basin (i.e., Dead Indian Creek and Antelope Creek) would not affect the sediment as it relates to the water quality PCE. The same is true with regard to the water quality issues associated with bacteria and nutrients. Runoff from agricultural land is thought to contribute to the water quality issues associated with bacteria and nutrients. The diversions proposed as part of the proposed action would not result in any increased runoff from agricultural lands in the Little Butte Creek basin; therefore, these aspects of the water quality PCE would not be affected.

Water temperature is one most important water quality issues identified in the Little Butte Creek Watershed Assessment. It is also an identified PCE distinct from water quality. In the Little Butte Creek watershed, high temperatures in the summer are the issue of concern regarding water temperature and was an issue of concern at the time that critical habitat was designated in this area. The proposed action involves some diversions during the summer, but only at very low levels (Table 5-20 and Table 5-21) and so may contribute in a minor way to the current water temperature profile of the South Fork of Little Butte Creek, Dead Indian Creek, Little Butte Creek, and Antelope Creek. Diversions identified as part of the proposed action are not expected to cause any further deterioration over time in water temperatures in the South Fork of Little Butte Creek, Dead Indian Creek, Little Butte Creek, or Antelope Creek beyond the current conditions which are similar to the conditions present when the critical habitat was designated.

Riparian vegetation conditions in the Little Butte Creek basin are thought to be influenced significantly by logging and agricultural practices as well as other land use activities such as mining and rural development (LBCWC 2003). None of these activities or practices are influenced by or affected by the diversion of water from the South Fork of Little Butte Creek, Dead Indian Creek, or Antelope Creek. As such the proposed action would not have an effect on the riparian PCE.

The cover/shelter PCE was not directly addressed in the Little Butte Creek Watershed Assessment, but the assessment does look at the production of large woody debris (LWD) which can provide cover and shelter for coho salmon. While LWD is important because it provides cover for coho salmon, its role in creating pools is likely even more important. The assessment concluded that under the conditions at that time, which were not likely substantially different than conditions at the time of critical habitat designation, LWD and the pools they create were generally lacking and conditions with respect to both LWD and pools was undesirable. Factors contributing to the lack of LWD were not specifically identified, but appear to be related to the land use practices which have impacted riparian zones in general, as discussed above. The lack of large conifers in the riparian zones, which can become LWD, was attributed to past logging practices. It should be noted that where riparian zones exist, they are vegetated with other species, including cottonwood and alder, and generally provide good shading of the streams. This suggests that current flow levels are sufficient to sustain riparian zones where other factors do not prevent it; consequently, the diversions in the proposed action would not cause deterioration in the riparian zones that exist to the point where LWD is no longer produced. The proposed action also would not affect the production of conifers in the riparian zones. As a result, effects to the cover/shelter PCE, as measured by LWD production and presence are not expected.

The safe passage PCE also would not be affected by the proposed action in this area. The structures currently used to divert in the South Fork of Little Butte Creek, Dead Indian Creek, and Antelope Creek would not by altered in the proposed action. Only the diversion structure on Antelope Creek occurs in a stream and at a location where coho salmon have access. That structure currently provides safe passage for coho salmon. As a result, passage at these sites would be maintained as it currently exists.

Overall, it appears that the proposed action in the South Fork of Little Butte Creek, Dead Indian Creek, and Antelope Creek would not cause deterioration in current conditions of the designated critical habitat.

5.2.3 Klamath River Watershed

In 2002, Reclamation completed consultation with NOAA Fisheries on the impacts of operations of the Klamath Project on SONCC coho salmon and their critical habitat in the Klamath River below Iron Gate Dam which blocks the coho salmon upstream migration. The potential effects of the future operation of the Rogue River Basin Project on SONCC coho salmon in the Klamath River are confined to the same area since Jenny Creek, the basin from which Rogue River Basin Project diversions are in part made, empties into Iron Gate Reservoir above Iron Gate Dam.

The consultation on the Klamath Project resulted in the implementation of a RPA that does not adversely modify or destroy SONCC coho salmon critical habitat in the Klamath River below Iron Gate Dam. All of the effects from operation of the Klamath Project under the RPA are now part of the environmental baseline as provided for at 50 CFR 402.02.

The Klamath Project operation has been operating under the RPA since 2002 when the consultation was completed. During that same period, the Rogue River Basin Project has also been in operation. These operations included the diversions from the Klamath basin to the Rogue basin from Jenny Creek and its tributaries. This operation has not prevented the Klamath Project from operating under its 2002 RPA. The proposed future operation of the Rogue River Basin Project is identical to past operations, including those since 2002, with respect to diversions from the Klamath basin to the Rogue basin. Nothing about the proposed future operations of the Project would affect the ability of Reclamation to operate the Klamath Project in compliance with the RPA, the effects of which are in the environmental baseline for this consultation. As a result, flow and habitat conditions in the Klamath River below Iron Gate Dam would be unchanged from those that are currently occurring in the environmental baseline. Consequently, the proposed future operation of the Rogue River Basin Project would have no effect on critical habitat in the Klamath River.

5.2.4 Summary

The effects to SONCC coho salmon designated critical habitat from implementation of the proposed action would be almost entirely beneficial, particularly over the long term. Safe passage conditions in Bear Creek or Ashland Creek do not presently exist due to the condition of the Oak Street Diversion fish ladder and the Ashland Creek Diversion Dam, respectively. The proposed action would provide improved passage at both of those diversions, an important critical habitat element. Flow improvements would also occur in Emigrant Creek and Bear Creek as a result of implementing the minimum operational releases. This would improve critical habitat conditions for some of the PCEs in some reaches of Bear Creek and Emigrant Creek, particularly in low flow years. Implementation of a ramping rate protocol at Emigrant Dam would also improve critical habitat conditions in Emigrant Creek

In the South Fork of Little Butte Creek, Dead Indian Creek, Little Butte Creek, and Antelope Creek, no effects to critical habitat from the proposed action were identified. The proposed future operations involve diversions from those streams that are largely identical to past diversions. The analysis of conditions in the Little Butte Creek Watershed, done shortly after the critical habitat was designated, does not suggest that any of the PCEs would be degraded relative to their current status by the proposed action (LBCWC 2003).

5.3 Effects to SONCC Coho Salmon

Adult Migration

Bear Creek

Sutton (2007), as part of an instream flow study, made estimates of the flows needed to meet adult coho salmon passage needs. He located transects at his PHABSIM study sites at the shallowest points of the stream channel, points that are critical for passage, and collected necessary flow and cross-sectional data. A range of flows through the site was modeled for the transects to determine the flow at which at least 25 percent of the transect had a minimum depth of at least 0.6 feet with at least one continuous portion meeting that criteria equal to at least 10 percent of the total width. These criteria came from Thompson (1972). The Bear Creek median average monthly flows under the proposed action exceed the flows determined necessary to provide passage for coho salmon adults. During the month of October, median flows approach the minimal levels for passage; however, releases for irrigation early in the month augment background flow levels. In October, flows at the 90 percent exceedance level (very low flows that are exceeded 90 per cent of time) fall below the threshold for providing adult passage, but at these times irrigation releases raise flows to some extent, ameliorating the low flow conditions (Table 5-22).

Generally, flows on Emigrant Creek do not reach the threshold necessary for adult passage during the adult migration period under the proposed action. Flows during periods of flood control releases flows could possibly exceed the 31 cfs threshold estimated necessary for optimum adult passage; however, the minimum flows included in the proposed action, 2 to 6 cfs, are well below this flow volume (Sutton 2007). As a result, while flow conditions during the adult migration period would improve under the proposed action during low flow years when the minimum operational release is made, they would not reach the identified adult passage threshold as modeled in PHABSIM.

It should be noted on that the unregulated flows of Emigrant Creek above Emigrant Dam are usually well below the passage threshold of 31 cfs (Sutton 2007). This illustrates that unregulated flows in this system at this location do not provide the modeled flow identified to provide optimum adult fish passage. A gage above the reservoir has been in operation since 2003 and data collected since then shows that flows over 31 cfs occur only sporadically during the adult migration period, usually during or following storm events. In most years when flows over 31 cfs do occur, they occur late in the migration period, usually after mid-December. In some winters (i.e., 2007-2008; 2008-2009), flows over 31 cfs almost never occur in Emigrant Creek above the reservoir. This may explain in large part the lack of use of Emigrant Creek by adult coho as shown in Figure 3-1.

The improvement of passage at Oak Street Diversion Dam would provide for improved passage by coho salmon into some reaches of Bear Creek, but adult passage into Emigrant Creek would not be improved to any large extent.

Table 5-22. Bear Creek and Emigrant Creek flows during adult migration

Percent exceedance level	October	November	December	January
Emigrant (31 cfs)				
Minimum operational flow	2-6	2-6	2-6	2-6
Bear (E Cr-Oak Street)(15 cfs)				
10	29	132	674	405
50	19	27	67	98
90	9	12	19	21
Bear (Phoenix to Jackson St) (20 cfs)				
10	80	208	766	605
50	45	60	97	150
90	15	38	34	38

Little Butte Creek

For the site on the South Fork Little Butte Creek, the adult passage criteria were met at a flow of 30 cfs (Sutton 2007). During the adult migration period, the median flow equals or exceeds this value in all months except October when median flows were 18 cfs at the gage near Lake Creek (Table 5-23). At that time of the year, the Project diverts very little from the South Fork Little Butte Creek either in the environmental baseline or under the proposed action; therefore, the existing good passage conditions for adult coho salmon would be maintained in this stream with the proposed future operations.

Table 5-23. Little Butte Creek and South Fork Little Butte Creek flows during adult migration.

Percent exceedance level	October	November	December	January
10	45	112	339	357
50	18	51	99	137
90	14	25	24	32

A similar analysis was done for Little Butte Creek (Sutton 2007). At a site near the mouth of Little Butte Creek, the adult passage criteria were met at 16 cfs (Table 5-24). At a site near Brownsboro, the criteria were not met until flows reached 40 cfs. Median monthly flows in Little Butte Creek near Lake Creek, in both the environmental baseline and under the proposed action, exceed both of these values for the adult migration period from October through January. The lowest median monthly flow is 55 cfs which occurs in October when few Project diversions upstream on the South Fork Little Butte Creek are being made under the proposed action; therefore, the proposed action would not change adult migration in the Little Butte Creek drainage. Given that the Little Butte Creek drainage currently supports some of the best remaining coho salmon production in the basin under conditions found in the environmental baseline, this result was not unexpected.

Table 5-24. Little Butte Creek adult coho salmon passage analysis.

Percent exceedance level	October	November	December	January
10	83	198	504	462
50	55	114	236	230
90	37	77	123	110

For Antelope Creek, Sutton (2007) identified two passage flows, one above the mouth but below the confluence with Dry Creek and another between Dry Creek and the Antelope Creek Diversion Dam. The passage flow at the lower site was 40 cfs while at the upper site, it was 15 cfs. At the lower site, flows seldom reach the 40 cfs criteria until about mid- to late December. Similarly, flows at the diversion dam generally do not reach 15 cfs until about the same time. Diversions to Agate Reservoir occur very rarely during this period indicating that unregulated flows in this system cannot accommodate the modeled PHABSIM adult passage results. Normally flows are not diverted until later in the winter and spring with highest diversions usually occurring in April and May outside of the adult migration period. While flows in the environmental baseline and with the proposed action often do not meet the criteria identified by Sutton (2007) early in the adult migration period, this is largely due to factors unrelated to Project operations. As a result, the proposed action would have no effect on adult migration in Antelope Creek.

As described earlier, there is an adult passage facility at the Antelope Creek Diversion Dam that provides passage for adult coho salmon. While there are issues relative to passage conditions at very low flows, passage at the dam is not a concern when flows suitable for passage in the rest of the stream are present.

Klamath River

Under the proposed action, flow diversion from the Jenny Creek basin would occur throughout the year, but mostly in the late winter and early spring which is outside of the adult coho salmon migration period. During the adult migration period, diversions under the proposed action would be identical to those in the environmental baseline and generally less than 1 percent of the Klamath River flow at Iron Gate Dam, the upstream limit of fish passage. As noted in Section 5.2.3, the RPA for operations of the Klamath Project, which is currently being implemented, would continue. As a result, adult coho salmon passage would not be affected by the proposed future operations of the Project.

Factors Affecting Spawning and Incubation of Coho Salmon

Bear Creek

Conditions for spawning and incubation in the Bear Creek area may improve slightly with the proposed action. In most years at most sites, there would be an increase in the amount of spawning habitat in November and December, with possibly modest increases in other months. Given that the gains are expected to be quite small and, in most cases, conditions would be unchanged, no significant increases in the number of redds would be expected. Similarly, while incubation conditions may improve slightly, the expected changes with the proposed action are not likely to increase egg or alevin survival in any discernable way.

On Emigrant Creek, increases in WUA for spawning and incubation are also projected. As discussed in Section 5.2, the minimum operational releases for Emigrant Creek would result in minor increases in the amount of WUA available for spawning/incubation in the three reaches modeled. As with Bear Creek, these improvements are expected to be modest in most years and increases in the number of redds of egg and alevin survival in any discernable way is not expected. As noted in the previous section, flows in Emigrant Creek (even with the proposed increases) would not meet the safe adult passage criteria under most conditions. It appears that spawning coho salmon would experience difficulty accessing this reach even under improved conditions. The existing conditions for coho salmon spawning and incubation under the proposed action would be maintained in this stream and any effects that do occur should be positive.

Little Butte Creek

As outlined in Section 5.2, the proposed action would not result in changes to spawning or incubation habitat. The habitat that was available for spawning and incubation at the time critical habitat was evaluated and designated would be unchanged from those conditions. As shown in Figure 5-30, coho salmon spawning/incubation is generally in the range of 75 to 100 percent of optimum and often exceeds 80 percent of the optimum value in the environmental baseline and with the proposed action. It is generally at its lowest level early in the spawning period when little, if any, flow is being diverted from South Fork Little Butte Creek. Under the proposed action, few diversions for the Project, if any, would continue to occur early in the spawning period when WUA for salmon spawning/incubation is at least 80 percent of the optimum and often is in the range of 90 to 100 percent of optimum. Under the proposed action, the existing conditions for spawning and incubation in this area would be maintained.

The same is generally true in Little Butte Creek itself. Sutton (2007) evaluated spawning/incubation at two sites. WUA was consistently high throughout the winter and early spring (Figure 5-32 and Figure 5-34). Under flow conditions that occurred in 2007 and 2009, salmon incubation WUA dropped sharply in late May as flows declined by mid-month. The declining flows occurred as a result of the end of spring runoff, not as a result of Project operations. When runoff extended later into the spring in 2006 and 2008, WUA stayed high.

As noted in the discussion about salmon spawning WUA in Antelope Creek, it fluctuates considerably during the spawning period. This is due to the flashy nature of the stream rather than Project operations. Project diversions are very low during most of the spawning period in late fall and early winter so the diversions have little affect on spawning either under current conditions or with the proposed action.

Klamath River

Effects to coho salmon spawning and incubation in the Klamath River would be confined to the mainstem below Iron Gate Dam which blocks further upstream passage. Coho salmon spawning in the mainstem appears to be limited, but it is known to occur (Reclamation 2007). NMFS (2002) concluded that coho salmon are primarily tributary spawners in the Klamath basin and that mainstem spawning and rearing habitat is likely not limiting at the current population size.

Coho salmon spawning in the Klamath River basin typically occurs during December and January (60 FR 38011). During that time period, 20 to 40 cfs, or about 1 to 2 percent of the

Klamath River flows at Iron Gate Dam, are being diverted and stored from the Jenny Creek drainage. Under the proposed action, these flow conditions would not change. Reclamation (2007) has committed to maintaining the long-term minimum flows for releases from Iron Gate Dam during the October through February period as part of the RPA recommended by NOAA Fisheries in its 2002 Biological Opinion concerning the operations of the Klamath Project. The proposed action for the Rogue River Basin Project would not alter those flow releases; consequently, the proposed action would not affect the limited spawning that occurs in the mainstem of the Klamath River.

5.3.1 Factors Affecting Juvenile Coho Salmon

Juvenile Salmon Rearing

Bear Creek

Modifications to the ladder at Oak Street Diversion may impact juvenile rearing during construction of the proposed upgrades. As discussed in Chapter 4, construction of the cofferdam to isolate the work area from Bear Creek would create a small amount of turbidity that would be temporary and confined to the area close to the operation. The turbidity would be relative minor and last for only a short period as the cofferdams are installed and then removed. It is unlikely that SONCC coho salmon juvenile salmons would be present in the vicinity of the Oak Street Diversion during construction given the elevated stream temperatures present in this reach during the June 15 to September 15 in-water work period (Broderick 2000). It is also possible that coho salmon could become trapped in the isolated area behind the cofferdams. In the unlikely event that juveniles are trapped behind the berm, they would be salvaged immediately from the area and returned to the stream channel.

Similar impacts could occur if a fish passage facility and fish screen is constructed at the Ashland Creek Diversion dam. Cofferdams, above and below the diversion dam would likely be needed to construct a passage facility and fish bypass. These facilities would likely be built in the summer construction window and could possibly affect rearing coho salmon. Sediment from the installation and removal of the cofferdams could affect downstream habitat quality, but BMPs would be employed to minimize those effects. Some riparian habitat would possibly be removed to gain access to the site, some permanently due to the footprint of the new facilities. This area would likely not amount to more than 100 to 200 lineal feet of riparian habitat, most of which could be reestablished once construction is done. As at Oak Street, any fish trapped behind the cofferdams would be safely salvaged and returned to the stream.

The installation of a new gaging station below Emigrant Dam would result in minor short-term construction-related impacts to rearing coho salmon. Suitable conditions for rearing coho salmon occur on this stream so effects are likely. A small amount of turbidity would be created in the immediate area of the gaging station for a short period of time during the in-water work period. A small amount of riparian vegetation (less than 100 square meters) would be removed permanently to allow for the construction of the station and access road.

Additional consultation on construction-related impacts would take place before any of these construction projects proceeded.

As outlined in Section 5.2, rearing habitat for juvenile coho salmon would be improved on Bear Creek and Emigrant Creek under the minimum operational releases portion of the proposed action. WUA for rearing coho salmon would increase under the proposed action with the gains varying from minor to major, depending upon time of year and reach of stream. Most gains would occur in the fall and early winter and again in the spring. Little increase in WUA is expected in the summer when temperatures on Bear Creek would make any projected increase in habitat availability or suitability questionable.

The projected increases in WUA on Emigrant Creek would appear to potentially have the most value. In the past, flows near zero occurred as a result of Project operations. By providing minimum operation flow releases between 2 and 6 cfs, rearing habitat would be maintained on a year-round basis. This is significant because Emigrant Creek has suitable temperatures for rearing coho salmon year round and could support rearing coho salmon year round under the proposed action.

Benefits for rearing coho salmon would also occur in Bear Creek as a result of an increase in WUA for rearing juveniles. The benefits may be tempered by the fact that in the summer temperatures are too warm for the rearing coho salmon in most of the stream and they need to find thermal refugia in which to rear during the summer. These conditions in the summer, relative to the amount of juvenile salmon rearing habitat, would appear to limit the amount of coho salmon rearing in Bear Creek rather than the amount of habitat present in the fall and spring when bulk of the benefits would accrue from the minimum operational releases.

By adopting a formalized ramping rate for Emigrant Dam, discharges from the dam into Emigrant Creek would be decreased at a rate less than 50 percent. The gradual reduction of flows in the creek would decrease the occurrences of fish stranding that are common with sudden changes in releases. The ramping rate would increase the chances of survivability for juvenile coho salmon and have a positive effect on the population numbers. Even with the ramping rate protocol in place, the possibility that stranding of juveniles may occur cannot be totally eliminated. As a result, take may occur in Emigrant Creek when flows are reduced at the end of the irrigation season or following flood control releases. Given that Bear Creek appears to receive very limited used by coho salmon as based on smolt counts and snorkeling surveys discussed earlier, any stranding in Emigrant Creek would likely be minor, particularly with the ramping rate protocol in use.

Little Butte Creek

PHABSIM results discussed in Section 5.2 demonstrate that juvenile salmon rearing habitat in the South Fork of Little Butte Creek reaches its lowest level during the summer months when the stream is at its base flow. These conditions become a “bottleneck” through which rearing juveniles must pass if they rear year-round in the South Fork. During the summer periods in past years, Project diversions from the South Fork have been very low to non-existent and are expected to remain very low to non-existent in the future.

The same pattern generally holds for juvenile salmon habitat on Little Butte Creek near Lake Creek (Figure 5-33). Further down Little Butte Creek near Eagle Point, juvenile salmon WUA is generally high throughout the year with a small decline in the summer, but it generally remains at or above at least 80 percent of the optimum value (Figure 5-31). As a result, rearing habitat conditions in the South Fork, as well as downstream in Little Butte Creek, should be unchanged from current conditions under the proposed action.

Similar to Little Butte Creek, juvenile salmon rearing habitat in Antelope Creek reaches its lowest level in the summer months. In some reaches of the stream which go dry, it disappears entirely. During these periods, Project diversions from Antelope Creek are largely non-existent under current conditions and would remain so under the proposed action. Consequently, juvenile salmon rearing habitat conditions in Antelope Creek would not change with the proposed action.

Klamath River

Under past operations, only small amounts of water were diverted from the Jenny Creek basin to the Rogue River Basin Project. In the month June during the period of 1961 to 2001, the average diversion was 12 cfs. For the months of July, August, and September during the same time period, the average monthly diversions were 6 cfs, 4 cfs, and 4 cfs respectively (Reclamation 2003). In terms of the flows in the Klamath River at Iron Gate Dam, these diversions amount to a 0.1 percent or less reduction. Consequently, these diversions have not affected rearing conditions in the Klamath below Iron Gate Dam in any way that can be meaningfully evaluated. They would not have contributed to the warm temperatures issues on the Klamath River which reach lethal levels for coho salmon nor would have affected the physical availability of habitat (Reclamation 2007). Under the proposed action, the diversion amounts and patterns from the Jenny Creek basin would be unchanged. Under the proposed actions, no additional impacts to the environmental baseline would occur and there would be no effects to the current status of the species relative to juvenile salmon rearing in the Klamath River.

Juvenile salmon Migration

Bear Creek

The minimum operation flow releases at Emigrant Dam extend into the juvenile salmon outmigration period and would improve conditions slightly, especially in low water years. The minimum release of 2 to 6 cfs would occasionally result in flows higher by those same amounts in Emigrant Creek and downstream into Bear Creek. These flow increases would typically occur in March, April, or May when the additional 2 to 6 cfs would represent only a minor change in flow over a few days. Overall, then the proposed action would have little effect on juvenile salmon outmigration from this system.

Project diversion facilities occur in Bear Creek and Ashland Creek in reaches of those streams that are likely inhabited by listed coho salmon. These facilities include diversion structures, fish screens and bypasses, and fish ladders. With the exception of Ashland Creek, the structures in place were designed, built, and maintained to meet fish passage and protective criteria. Passage and protective facilities that would be built at Ashland Creek would meet the current criteria. Even though current and prospective facilities would meet the current passage and protection criteria, the possibility that take of outmigrants, in the form of harm, may occur when they encounter the diversion dams, fish screens and bypasses, and ladders cannot be discounted. This potential take at screen sites can involve injury due to encountering the screen and bypass structures, predation in screen forebays and at bypass outlets, and potential entrainment past the screens into the canal. While take is a possibility, it is expected that such take would be very limited. As NOAA Fisheries noted in the preamble to the final 4(d) rule governing take of 14 threatened salmon and steelhead ESUs, extensive biological evaluations have revealed little or no injury to fish if the screens are built and maintained to their criteria (65 FR 42422). Given that Bear Creek does not appear to harbor a large population of coho salmon and the screens in the basin have been built to meet required criteria, any take of outmigrating coho salmon would be very minor.

Little Butte Creek

PHABSIM results discussed in Section 5.2 demonstrate that juvenile salmon rearing habitat in South Fork Little Butte Creek reaches its lowest level during the summer months when the stream is at its base flow. These conditions become a “bottleneck” through which rearing juveniles must pass if they rear year-round in the South Fork Little Butte Creek. During the summer periods in past years, Project diversions from the South Fork Little Butte Creek have been very low to non-existent and are expected to remain very low to non-existent in the future. As a result, rearing habitat conditions in South Fork Little Butte Creek, as well as downstream in Little Butte Creek, should be unchanged from current conditions under the proposed action.

The proposed action would not alter current conditions for juvenile salmon outmigration in this area. The existing conditions and environmental baseline in this area are the same as they were when they were designated as critical habitat. These conditions would remain unchanged under the proposed action.

Diversions from the South Fork Little Butte system would continue, but flows would continue to exceed the OWRD instream flow rights at the mouth of the stream in March, April, and May. In June, when median flow diversion are approximately 6 cfs, the OWRD right cannot be met with or without the diversion as a result of the natural decline in the hydrograph at this time. While there is no empirical data concerning flow/survival relationships for this system, Little Butte Creek drainage currently supports some of the best remaining coho salmon production in the basin and these conditions appear conducive to their survival. Little Butte Creek flows at its mouth would remain unchanged from the current conditions under the proposed action.

Currently, diversions from Antelope Creek generally peak during the April and May period when flow in the stream is on a declining hydrograph. Diversions at the dam often cease when stream flows are low during this period. For the April-through-October period, 2 cfs or the natural stream flow must be by passed for stream flow maintenance and to meet downstream senior water rights. Those requirements would not change under the proposed action. Under the proposed future operation of the Project, conditions for juvenile salmon outmigration would not change.

As in Bear Creek, outmigrant salmon smolts would encounter the diversion and fish screen at the Antelope Creek diversion dam. Take is a possibility that cannot be discounted, but if it occurs, it would be expected to be minor since the screen was built to meet protective criteria.

Klamath River

Juvenile coho salmon outmigration occurs from March through June on the Klamath River (Reclamation 2007). Flow diversions from the Jenny Creek basin are at their peak in March and April. For the period from 1961 to 2001, March diversions average about 100 cfs and April diversions average about 120 cfs, with diversions in May averaging just over 40 cfs and about 12 cfs in June. These diversion levels are given in the environmental baseline and would remain unchanged in the proposed future operation of the Rogue River Basin Project. Klamath River flows are generally rising and at their peak during the March, April, and May time period. During these months, the diversions in the Jenny Creek basin would have minor effects on the Klamath River flows at Iron Gate Dam because they generally average less than 5 percent of the total discharge. Given that the past diversions from the Jenny Creek basin have been minor relative to the overall Klamath River flows in the during smolt migration, it is not likely that they would affect outmigrant survival on the Klamath River.

Since the proposed action would not alter these diversions, no additional effects to the current status of the species would occur.

5.4 Effects Determination

The coho salmon critical habitat in the South Fork Little Butte Creek and Little Butte Creek is in overall good condition based on the health of the coho salmon population in those basins. Less than 1 percent of the Klamath River flows would be diverted into the Rogue River Basin Project which would cause no effects on and no modifications of the existing critical habitat in the Klamath River basin. There would likely be no effects to the critical habitat in those basins.

Improvements to critical habitat would be made in Bear Creek and Emigrant Creek through modifying passage impediments and initiating minimum flows. The new fish passage facilities at the Oak Street and Ashland Creek diversion dams would open more habitat area that has not previously been available in Bear Creek, Ashland Creek, and Emigrant Creek. The minimum flow releases in Emigrant Creek would ensure that the creek is not dry in the winter and positively affect spawning and rearing habitat availability. The formalized ramping rates would also decrease the probability of stranding fish when releases from Emigrant Dam are curtailed. There would likely be short-term effects that would occur during construction of the new passage facilities and the installation of a new gaging station; however, these effects would be off-set by the long-term benefits gained from the proposed action.

Take of coho salmon may occur at the Project diversions on Bear Creek, Ashland Creek, and Antelope Creek. Site specific information about possible take is not available at the sites so case-by-case assessment cannot be done. Any take that may occur would be expected to be minor as the sites are or would be screened to meet criteria for fish protection. While the use of the ramping rate protocol to govern some operations of Emigrant Reservoir is expected to improve conditions for coho salmon, some minor take is possible as coho salmon may be stranded to some degree during reservoir shutdown.

Take is defined under the Endangered Species Act as an adverse affect. Consequently, Reclamation has determined that the proposed action may affect, and is likely to adversely affect (MA/LAA), the SONCC coho salmon. This is because the possibility of minor amounts of take at properly screened diversions cannot be ruled out completely. Potential stranding may occur associated with the fall shutdown of Emigrant Reservoir resulting in a potential take. Short-term construction effects may occur, but these would be temporary. The use of BMPs, potential conservation actions (Appendix F), methods, materials, and timing are all designed to reduce or eliminate adverse effects to anadromous fish and habitat.

Construction activities would be scheduled to occur during the ODFW-established in-water work period to avoid and minimize effects.

Reclamation has also determined that the proposed action may affect, but is not likely to adversely affect designated critical habitat for SONCC coho salmon. Modifications to operations in Emigrant/Bear Creek, including implementation of a ramping rate protocol and minimum operational releases, would result in the improvement of some PCEs without degrading others. The modification of the passage facility at Oak Street Diversion Dam and the provision of passage and protection at the Ashland Creek Diversion Dam would improve the safe passage PCE.

Chapter 6 CUMULATIVE EFFECTS

This chapter describes the cumulative effects for the SONCC coho salmon ESU and their designated habitat in the collective action area for the proposed action. ESA regulations define cumulative effects as "those effects of future Tribal, State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR 402.02). Listed below are a few activities that may be reasonably certain to occur as a result of Tribal, State or private actions within the Federal action area. Future Federal actions will be reviewed through separate section 7 consultation processes. Although effects resulting from some of these actions cannot be directly quantified, a qualitative description of the likely effects to listed species resulting from the actions is provided.

6.1 Water Conservation Efforts

As previously outlined in Section 3.1.2 and Appendix A, there are numerous ongoing conservation efforts in the Rogue River basin. These include many small projects being investigated by the Project and non-Project irrigation entities as well as larger efforts, such as the WISE Project, which involve multiple stakeholders. The identified projects are in various states of development, but the majority of them cannot yet be classified as reasonable certain to occur. Many are in the planning stage and most lack sufficient funds or have no funds for implementation. For example, the WISE project is in the feasibility study stage so the actual elements of a potential final project are unknown at this time; consequently, detailed analysis of the potential effects cannot be done.

The goal of many of these efforts is to make more efficient use of existing water supplies. From a cumulative impacts standpoint, these projects individually and collectively should improve stream flows in area streams and improving habitat conditions for coho salmon. The improvements in stream flows would likely be reach specific, occurring in the stream reaches affected by irrigation diversions and return flows. Based on the projects identified to date, this would include reaches of Bear Creek as well as some of its tributaries. The improvements would also generally occur during the irrigation season as demands and subsequent diversion requirements are reduced. Potential improvements may occur during the non-irrigation season to the extent the conservation efforts offset the need for stored water so that the need for off-season refill is reduced.

6.2 Fish Passage Improvements

Currently efforts are underway to improve fish passage in the basin. As discussed in Section 3.3, RBFATT has inventoried fish passage impediments and various parties have undertaken efforts to remove or provide passage at those impediments. This activity is expected to occur in the future as well. The purpose of these actions is to improve fish passage including passage for coho salmon. As such, these efforts would complement the proposed action which includes passage improvements at the Oak Street and Ashland Creek diversions.

While in most cases the final designs for these future improvements are not completed, most would likely involve some minor instream work. This would result in temporary impacts during the construction similar to the potential impacts discussed in Section 5.3.1 in reference to the improvements at the Oak Street and Ashland Creek diversions. These impacts would be of short duration during the project construction, but cumulatively they are not expected to be significant. The most significant impact from the activity would be an overall improvement in fish passage conditions in the basin.

6.3 Population Growth and Associated Development

Between the 2000 Census and July 1, 2007, the population of Jackson County, Oregon grew from 181,269 to 202,310, an 11.6 percent population growth (PSU 2008). Such growth will likely continue within the Bear Creek and Little Butte Creek watersheds. The demand for agricultural, commercial, and residential development will continue to grow in the area in the foreseeable future. The effects of new development resulting from this steady population growth are likely to continue to adversely affect water quality and quantity in the Bear Creek watershed and to adversely affect riparian habitat. Offsetting these pressures somewhat are ongoing programs funded by OWEB through the BCWC, as well as the RVCOG. These programs and other local government, land use planning, and development regulations are designed to manage the impacts of population growth; applying these in a balanced manner that protects coho salmon habitat while supporting economic growth and private property rights would require a strong commitment from local governments, landowners, and the public at large.

6.4 Climate Change

The Climate Impacts Group (CIG) at the University of Washington analyzed the effects of global climate change on the Pacific Northwest and on Washington in particular (Littell et al 2009). That evaluation used up to 20 different General Climate Models and two different emission scenarios to explore potential impacts at 3 different time periods extending out to near the end of the century. The global climate models generally agree that future conditions in the future in the Pacific Northwest will be warmer. The individual models, though, predict various amounts of increase with Mantua et al. (2009) reporting that "the range of projected changes from individual models can be as extreme as 15 to 200 percent of the multi-model average." There is consensus among the climate models that some amount of future warming is likely to occur in the Pacific Northwest region; however, the models are not as consistent regarding increases in mean annual precipitation, with about 75 percent of the models predicting increases in precipitation in the Northwest (Reclamation 2008). Recent studies have continued to identify the relative wide range of future projections of precipitation. Mote and Salathe (2009) report that models used in their study gave equivocal results relative to the projected future changes in precipitation. They report that individual models produce changes of a much as -10 percent or +20 percent by the 2080s. On a seasonal basis, they indicate that some models produce modest reductions in fall or winter precipitation while others predict very large increases (up to 42 percent).

A recently published study by Doppelt et al. (2008) investigated climate change impacts to the Rogue River basin. That study relied on three general climate models and a single emission scenario that was different than the scenarios used in the CIG study discussed previously. Because the Rogue River basin falls directly in the transition between two major global climate bands identified as the wet north and dry subtropics, the future forecast patterns for this area are uncertain. However, models used in a recent study forecast increased severity and variability of precipitation events in this region (Doppelt et al. 2008). As with other climate change estimates, however, there is a significant amount of uncertainty related to the estimates made.

The report suggests that the annual average temperatures are likely to increase from 1° F to 3° F in approximately 30 years. The total precipitation will likely remain similar to historic levels, but more rainfall will occur than snowfall. The wet and dry cycles will likely last longer and be more extreme, leading to both periods of deeper drought and extensive flooding (Doppelt et al. 2008). These components lead to broad issues to be addressed in the changing climate such as increased potential of wildfires, changes in the aquatic systems and species, and impacts on the human and economic systems in the Rogue River basin (Doppelt et al. 2008). The report concludes by offering recommendations for increasing the capability of ecosystems, species, and communities to withstand and adapt to the stressors related to climate change.

Brekke et al. (2009), in evaluating approaches to incorporating climate change into water resource management decisions, suggest that climate change information may be most useful in informing decisions with application horizons greater than roughly 20 years. Decisions made for actions that occur in less than 20 years involve time spans which are shorter than those required for detecting climate change (IPCC 2007). In the case of this consultation, the proposed action covers a 10-year time period; consequently, incorporating climate change is not appropriate in this situation.

6.5 Klamath Basin

The analysis for the proposed action in this BA did not identify any affects in the Klamath Basin. Since this action is not expected to have any effects in the Klamath Basin, it is unlikely that there would be any cumulative effects that need to be addressed relative to it. The 2007 BA completed for Klamath Project operations addressed cumulative effects potentially associated with that action and that discussion is incorporate here by reference (Reclamation 2007).

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